TOWARDS RETHINKING THE WATER CONSERVATION TECHNIQUES IN ORDER TO

Deal With Climate Resilience Design for Drought Area, A CASE OF JHANSI

A DISSERTATION PROJECT

Submitted To Babu Banarasi Das University, School Of Architecture And Planning

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE

Of

Masters in Architecture

Submitted By - MEGHA TARSOLIA

Roll Number #1210109002

Under the Guidance of

Ar. SAURABH SAXSENA

(Assistant professor)

BABU BANARSI DAS UNIVERSITY

LUCKNOW

CERTIFICATE

This is to certify that the “RESEARCH” report on the topic “Towards Rethinking The Water Conservation Techniques In Order To Deal With Climate Resilience Design For Drought Area” is submitted by Megha Tarsolia as a M.ARCH.3rd Year student at Babu Banarasi Das University is a record of original work carried out by her under professional guidance. All sources have been duly acknowledged from which the ideas and extracts have been taken.

The content included in this report has not been submitted to any other University or Institute for award of any other degree or diploma programmed.

Ar. SAURABH SAXSENA
(Dissertation Guide)

Prof. MOHIT AGARWAL
(Dean)

DECLARATION

I hereby certify that the Dissertation Project entitled “Towards Rethinking The Water Conservation Techniques In Order To Deal With Climate Resilience Design For Drought Area” which is being submitted in partial fulfillment of the requirement for the award of Master in Architecture, is a record of my own work carried out under the supervision and guidance of Ar. SAURABH SAXSENA (Assistant professor). .

The matter presented in this Dissertation has not been submitted elsewhere for the award of any other degree.

Signature

Date: June -2024

Place: Lucknow (Megha Tarsolia)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge and belief.

Forwarded by	**Forwarded by**	**Approved by**
Signature	Signature	Signature
Prof. Mohit Agarwal	Prof. Sangeeta Sharma	Ar. Saurabh Saxsena
(Dean)	(HOD)	(Dissertation Co-ordinator)
SAP, BBDU	SAP, BBDU	SAP, BBDU

Guided by

Signature

Ar. Saurabh Saxsena

(Assistant Professor)

SAP, BBDU

BABU BANARASI DAS UNIVERSITY, LUCKNOW CERTIFICATE OF THESIS

SUBMISSION FOR EVALUATION

(Submit in Duplicate)

1. Name: Megha Tarsoila
2. Enrolment No.:
3. Thesis title: Towards rethinking the water conservation techniques in order to deal with climate resilience design for drought area, a case of Jhansi.
4. Degree for which the thesis is submitted: M.Arch.
5. Faculty of the University to which the thesis is submitted – Ar. Saurabh Saxena
6. Thesis Preparation Guide was referred to for preparing the thesis. Yes☐No☐
7. Specifications regarding thesis format have been closely followed. Yes☐No☐
8. The contents of the thesis have been organized based on the guidelines Yes☐No☐
9. The thesis has been prepared without resorting to plagiarism. Yes☐No☐
10. All sources used have been cited appropriately. Yes☐No☐
11. The thesis has not been submitted elsewhere for a degree. Yes☐No☐
12. Submitted 2 spiral bound copies plus one CD. Yes☐No☐

BABU BANARASI DAS UNIVERSITY, LUCKNOW CERTIFICATE OF THESIS SUBMISSION FOR EVALUATION
(Submit in Duplicate)

13. Name: Megha Tarsolia
14. Enrolment No.:
15. Thesis title: Towards rethinking the water conservation techniques in order to deal with climate resilience design for drought area, a case of Jhansi.
16. Degree for which the thesis is submitted: M.Arch
17. Faculty of the University to which the thesis is submitted – Ar. Megha Tarsolia
18. Thesis Preparation Guide was referred to for preparing the thesis. Yes ☐ No ☐
19. Specifications regarding thesis format have been closely followed. Yes ☐ No ☐
20. The contents of the thesis have been organized based on the guidelines. Yes ☐ No ☐
21. The thesis has been prepared without resorting to plagiarism. Yes ☐ No ☐
22. All sources used have been cited appropriately. Yes ☐ No ☐
23. The thesis has not been submitted elsewhere for a degree. Yes ☐ No ☐
24. Submitted 2 spiral bound copies plus one CD. Yes ☐ No ☐

LIST OF CONTENT

CHAPTER 4 - INFOSYS LIMITED, MYSORE

CHAPTER 5

CHAPTER 6 - WATER SUPPLY SYSTEM IN JHANSI

CHAPTER – 7

CHAPTER – 8

ACKNOWLEDGEMENT

The work presented in this thesis would not have been possible without my close association with many peoples who were always there when I needed them the most.
I take this opportunity to acknowledge them and extend my sincere gratitude for helping me make this thesis possibility.

First and foremost, I would like to thanks the almighty GOD for always being with me and shoeing me the right path.

At this moment of accomplishment, I embrace the opportunity to express my deep sense of gratitude to my guide **Ar. Satyam Srivastava** and **Ar. Saurabh Saxena** , for his constant guidance, valuable suggestions and kind encouragement during my project. I would also like to express my sincere and whole hearted gratitude to **Dr. Mohit Kumar Agarwal sir** , **Prof. Keshav Kumar sir** for their guidance , encouragement and valuable suggestion.

I am also deeply indebted to my other faculty members who encouraged me to do the research.

Finally ,I would like to express my deep gratitude to my mother-in-law for her unconditional trust and being by my side. Special thank to my daughter for her love and support. Without support of my family and friends this project would not have been possible.

I am grateful to everyone who has supported me throughout this process. Without your help and guidance, this thesis would not have been possible.

ABSTRACT

India has 16% of the world's population and only 4%of the world's water resources, which are depleting rapidly. The demand for water is expected to grow from 40 billion cubic meters currently to around 220 in 2025. Water is one of the most important inputs essential for crops. Both its shortage and excess affects the growth and development of the plants, yields and quality of produce. There are numerous methods to reduce such losses and to improve soil moisture. The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitudes and habits; this includes each one of us.
Droughts are considered natural hazards which also have the significant impact on the sustainable management of water and sanitation for all. Droughts can lead to water scarcity and reduce access to clean drinking water. Drought is a natural hazard, known primarily in terms of scarcity or supply deficit of water due to failure of rainfall, deficiency of reservoirs and water resources, resultant failure of crops, and consequently a level of serious socio-economic distress. The study will reduce the climatic risk of drought in the region and will also reduce the risks of lives. Climatic resilience will encourage people towards environmental consciousness.

Keywords: *Water, conservation, technology, Rainwater-harvesting.*

SYNOPSIS

Need of Study-

Droughts are considered natural hazards which also have the significant impact on the sustainable management of water and sanitation for all. Droughts can lead to water scarcity and reduce access to clean drinking water. Drought is a natural hazard, known primarily in terms of scarcity or supply deficit of water due to failure of rainfall, deficiency of reservoirs and water resources, resultant failure of crops, and consequently a level of serious socio-economic distress.

Aim of The Study-

Identifying design techniques and intervention at building level to achieve water conservation.

Objective-

- Understanding the needs and reasons for water conservation.
- To study methods /techniques /interventions at city, neighborhoodand building level.
- Modern technologies in water conservations

Scope-

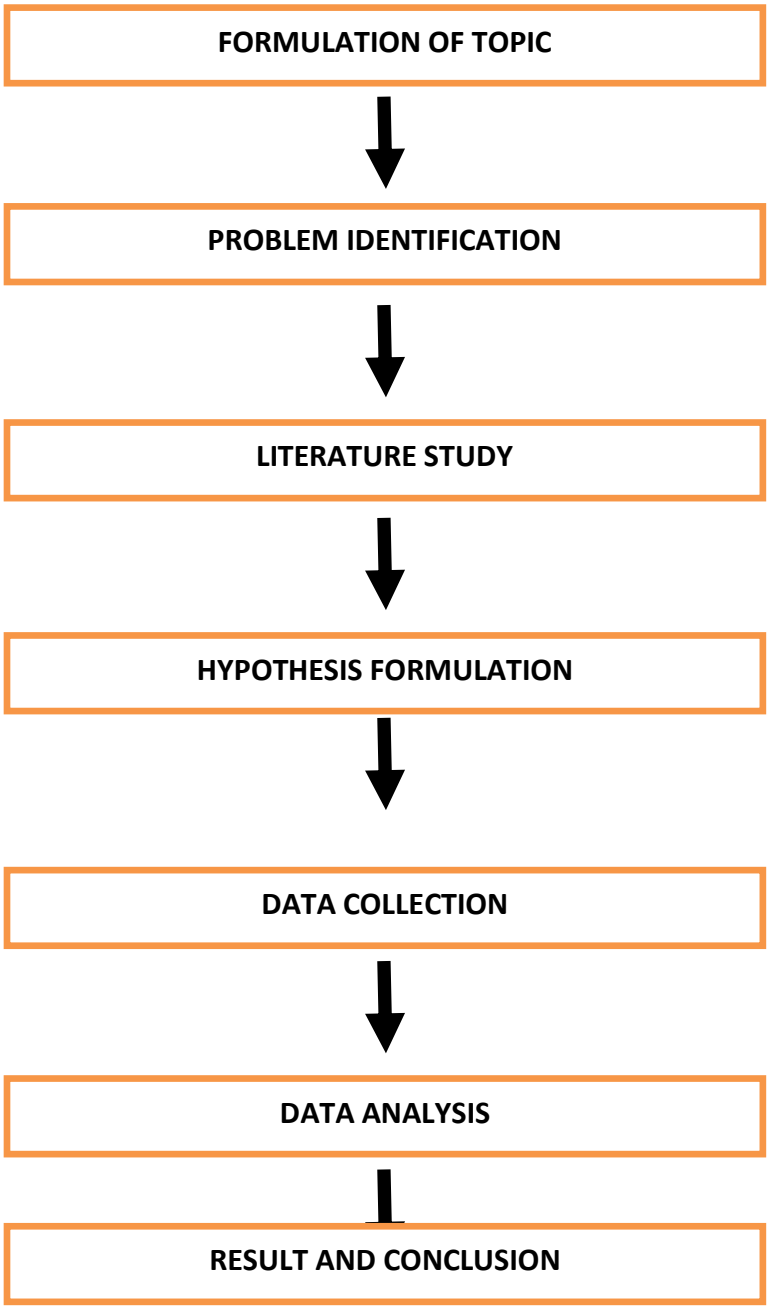
The study will reduce the climatic risk of drought in the region and will also reduce the risks of lives. Climatic resilience will encourage people towards environmental consciousness.

Limitations-

The study area in the region will be Jhansi.

The study will deal with the past and present secondary data available.

METHODOLOGY



CHAPTER-1:

INTRODUCTION

Jhansi is a prominent city of Bundelkhand region of Uttar Pradesh state. Jhansi grew in popularity during the reign of the Marathas because of the heroics of its valiant queen, Rani Lakshmi Bai.

She had valiantly fought against the Britishers during the 1857 revolt. Jhansi fort was built in 1613 and today has a wonderful collection of sculptures that depicts the history of Bundelkhand.

There are many sculptures of the 9th to 12th centuries found in the Rani Mahal too.

The museum of Jhansi houses regional antiques like sculptures, manuscripts, paintings, arms and silver, gold and copper coins.

Jhansi has a major and Key Road and Rail junction.

The National Highway Development Project, initiated by the government of Atal Behari Vajpayee, has sparked Jhansi's development.

The North-South Corridor connecting Kashmir to Kanyakumari passes through Jhansi. The East-West corridor also goes through this city, so there has been a sudden rush to infrastructure and real estate development in the city.

Jhansi city is situated between the rivers Pahunj and Betwa between North longitudes 24°11´ and 25°57´and East latitudes 78°10´and 79°25´.

It has an average elevation of 284 meters (935 feet)

In addition, the city is well connected to all other major towns in Uttar Pradesh by road and railway networks.

It is about 415 km from Delhi and 292 km from Lucknow, and the gateway to Bundelkhand.

Three national highways NH-3, NH-25 and NH-76 pass through the city.

As Jhansi is on a rocky plateau, the temperatures here are extreme. Temperatures reach as low as 1 degree Celsius in winter; it also reaches a maximum of 48 degrees Celsius in summer.

Jhansi has lots of monsoon rains that are used for irrigation purposes. The average temperature in the rainy season lies around 36 degrees Celsius while the average rainfall is about 35 inches a year.

DEMOGRAPHY

As per the 2011 Census, the total population of Jhansi was estimated at 507293.

PRESENT SCENARIO

Industrialization has been sporadic and this in turn has led to low levels of urbanization. Living conditions are harsh especially for the rural poor who depend mainly on agricultural incomes for sustenance, and are therefore highly vulnerable to drought and failure in cropping systems and loss of employment and incomes. the level of poverty in rural areas has increased since a large number of farmers depend on rain fed agriculture (Planning Commission, 2009 & CSO, 2010). According to the inter-ministerial central team report (Samra, 2008), , the water supply is not adequate.

The failure of the monsoon has severely affected the available water in river systems. The resulting diminishing water available in surface water sources as well as depletion of groundwater tables has not only decreased the availability of drinking water for people and domestic animals, but also impacted the natural vegetation and growing grasses (crucial as fodder). Most tribal population inhabiting forests areas adjacent to rivers have

no choice but to continue to exploit forests for survival and cause further over exploitation of resources. The repetitive crop failures and depletion of natural resources has led to widespread and increasing trends of migration to urban areas. With the collapse of monsoons and arrival of successive dry years, the inhabitants of city is now facing scarcity of water in almost every season. Urban areas are no better off than rural areas. The expense of securing water has been raised and the resource is treated as a commodity.

Drought is the combined effect of meteorological (reduced rainfall) and hydrological (reduced available water supply) factors. In the UP part of Bundelkhand, drought became evident in 2004-05 with a 25% short fall in monsoon rains. The rainfall deficit increased further to 43% in 2006-07 and 56% in 2007-08, leading to severe (metrological) drought conditions in Mahoba, Jhansi and Chitrakut districts. Except Tikamgarh and Datia districts, drought in the Bundelkhand region of MP commenced from 2006- 07.

CHAPTER-2

CLIMATE RESILIANCE STUDY

VISIONSTATEMENT

By 2050 we all live in a warmer world where all regions, countries, cities, businesses communities and individuals

THRIVE in the face of multiple risks, uncertainty and threats posed by climate change This vision of climate resilience is to be achieved through three interdependent outcomes:

Resilient people and livelihoods When we live in a world where people most vulnerable to climate risks, especially those living in least developed countries and small island developing States, are resilient, prosper and thrive. Actions are taken so all benefit from early warning systems; decent, secure and green jobs; resilient value chains; social protection; and getting finance to where it matters: local communities. This helps achieve climate justice and a just transition for all with noon left behind.

Resilient Businesses and Economies Where all climate risks are fully understood by all businesses ,investors and society. Actions are taken to manage these risks across and within sectors, with particular focus on cities, infrastructure, services(including energy, transport and industry),agriculture and food, water and natural ecosystems, and ocean and coastal systems. This includes delivering access to climate risk insurance for small, medium and large enterprises, and helping ensure trillions of US dollars in future investments are climate risk-informed and deliver social, environmental and economic impacts.

Resilient Environmental Systems Where nature, with its mosaic ofter restrial and marine ecosystems, is the first line of defense against climate risks of extreme events and disasters as well as long-term changes in climate. This means biodiversity and the natural ecosystems are protected to ensure the world has nutritious food, clean

air, fresh water, fertile soils and pollination services. This is paramount if we are to secure resilient and sustainable development for human and planetary health and wealth and learn lessons from the COVID-19 pandemic.

This vision puts a focus on people as agents of change to act now and tomorrow to transform systems for an equitable, low-carbon, resilient and sustainable future. This will involve everyone, especially women, youth, indigenous peoples and those living with disabilities. It means helping shape COVID-19 recovery investments to build a low-carbon and resilient future.

This vision recognizes that building climate resilience requires mitigation and adaptation actions that must be combined to tackle the current and future impacts of climate change.

Steps to build climate resilience

Building climate resilience involves all actors (governments, communities and businesses) having the capacity to anticipate climate risks and hazards, absorb shocks and stresses, and reshape and transform development pathways in the longer term. We propose six steps that sectors and actors need to take in developing climate resilience:

1. Awareness-raising and advocacy – Be clear that the future will not resemble the past; base this on science and examine different scenarios (e.g. 1.5-degrees and higher) and their impacts.
2. Carry out climate risk assessments at national, local (city/region), sectoral or organizational level and use a systems approach.
3. Develop and implement appropriate actions and interventions.
4. Mobilize resources – Build capacity and scale up actions.
5. Monitor and track progress.
6. Share knowledge, experiences and solutions.

TYPES OF INTERVENTIONS TO BUILD CLIMATE RESILIENCE

We have combined disaster risk reduction and management (including emergency preparedness and response) and climate change adaptation approaches to develop a suite of interventions to address climate risks and impacts across and within sectors. This suite of climate risk management interventions or measures essential to drive climate resilience efforts and investments by all act or includes:

- ✓ Climate risk and vulnerability assessments, disclosure and monitoring
- ✓ Early warning systems and early action
- ✓ Preparedness: contingency plans/emergency response
- ✓ Climate risk governance and capacity-building
- ✓ Nature-based solutions used to reduce risks across sectors
- ✓ Climate-proofing infrastructure and services
- ✓ Risk transfer: insurance and social protection
- ✓ Sharing of knowledge and best practices on climate risk management
- ✓ Volume, quality and access of public and private finance

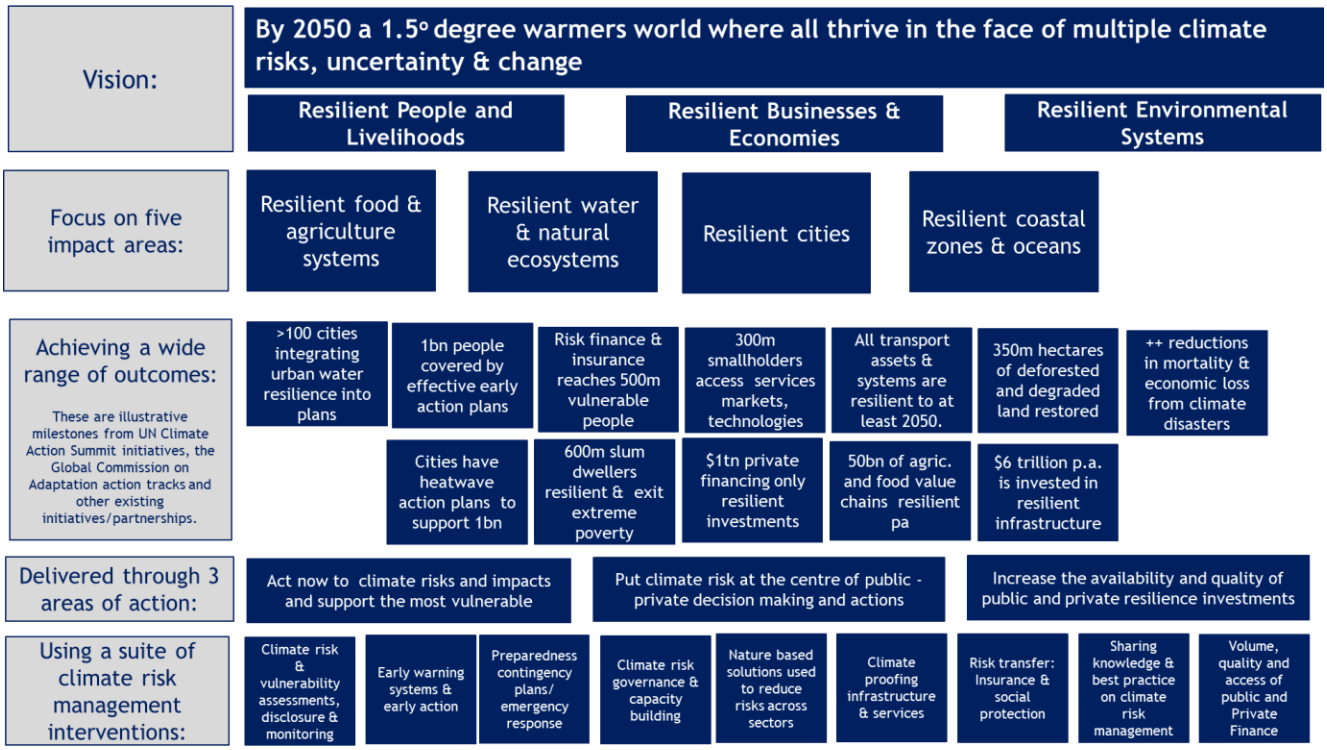
FACTS&FIGURES

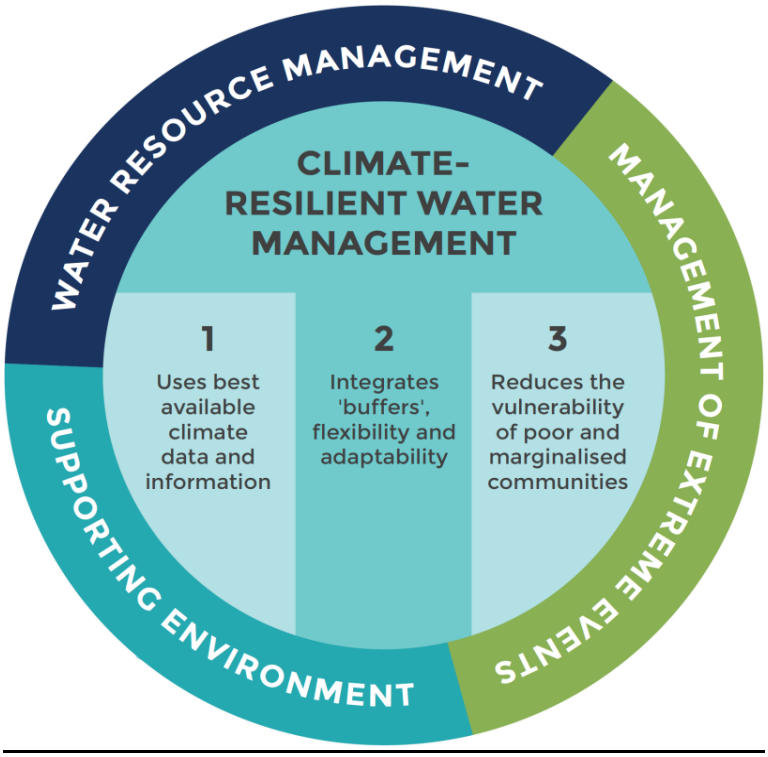
The world's climate is changing. The 2017 Atlantic hurricane season was the most devastating and cost lie stone record. In 2018, unprecedented cyclone eshit Mozambique. In2019,Chilestormsflooded the Atacama, Hurricane Dorian wreaked havoc in the Bahamas, European heat waves were hottest on record with 1,500 deaths in France, and in India, 9 million people in Chennai faced severe water shortages from drought.Inearly2020,temperaturesofmorethan20degreeCelsiuswererecordedfor the first time in the Antarctic, and the Arctic summer ended with very little sea ice. Wildfires inCaliforniawerethewor stonrecord.Severehurricanesandcyclonescontinuedtohitmanycou ntriesfromBangladesh(CycloneAmphan)andPhilippines(TyphoonGoni)toHurricaneEtaint heCaribbean. These facts, and the compelling scientific evidence of the growing

impacts from climate change across all sectors, mean that business-as-usual is no longer an option for any country, city, community, individual, business or financial institution.

STRUCTUREOFCLIMATERESILIENCEPATHWAYACTIONTABLE

The Climate Resilience Pathway is structured around delivering the overall vision and through threeoutcomes:resilientpeopleandlivelihoods;resilientbusinessesandeconomies;and resilientenvironmental systems. Under this, five main impact areas have been identified that require immediate action to put climate risk at the heart of decision-making with increased availability and quality of finance invested in a range of interventions. This framework is shown below.



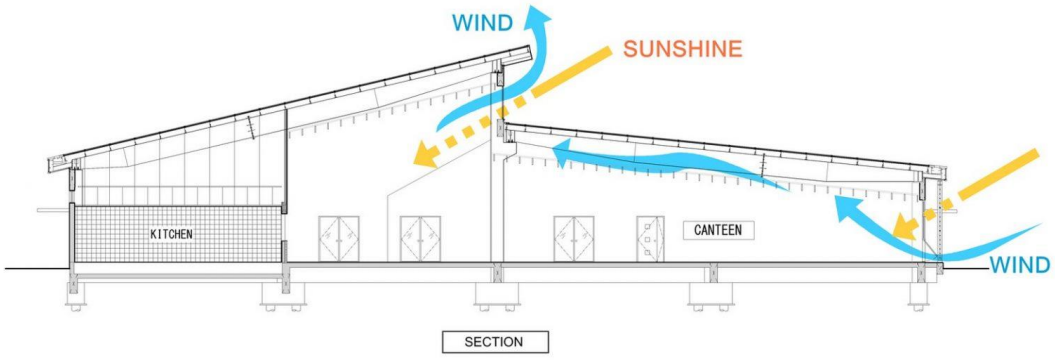


DESIGN PARAMETERS FOR CLIMATE RESILIENCE

Resilient design stands for the design of buildings, landscapes, regions, and communities responding to manmade and natural disasters as well as the long-term effects of climate change. Climate-resilient design ought to be an integral part of the planning process in the context of the project's function, purpose, asset type, and site location, and then conclude the suitable design strategies. Climate change is already affecting every corner of Earth. The changes will become more significant and increase with additional warming, thus threatening to impede capital investments and undermine critical services if the climate-resilient design is not enforced.

BUILDING SITE AND ORIENTATION

The building's site and orientation are crucial principles of climate-resilient design to mitigate overheating and adapt to increasing temperatures. A building's performance can be markedly impacted by where it is placed on a site. In particular, trees, buildings, or any other existing or planned elements can contribute to shading or adversely block the sun when it is necessary. Accordingly, designers must consider existing elements and the site's relationship to the equator to optimize the building's orientation. In this regard, the building's longest axis should be oriented in an East-West direction, which maximizes light and allows more heat gain control. For passive solar design, openings and spaces should be oriented to achieve maximum daylight with minimized or maximized heat gain, depending on the building's location and season.

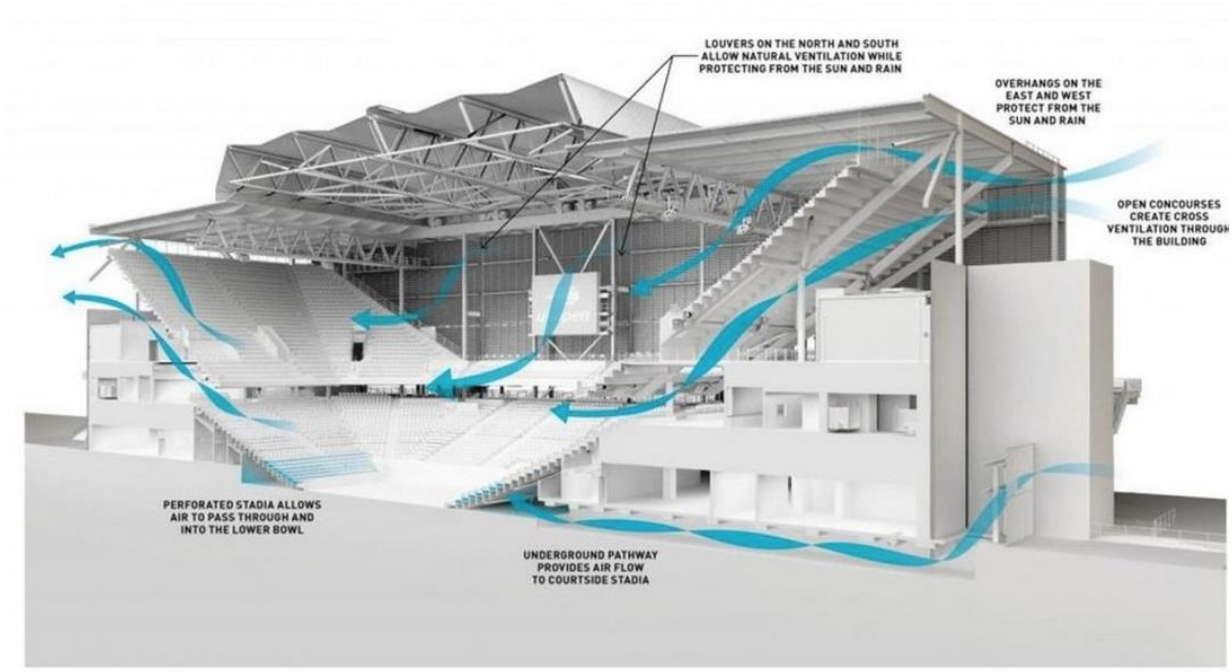


BUILDING CONFIGURATION AND LAYOUT

The building's configuration and layout are other aspects of climate-resilient design. Therefore, to capture solar gain to the greatest extent in cold climates, main rooms should face south in the northern hemisphere or north in the southern hemisphere. Henceforth, the opposite can be done in a hot climate to lessen the heat gained from the sun throughout the day. Besides, rooms that have few windows- namely bathrooms, storage, or utility rooms- can serve as "buffer areas" on the building's east and west sides, which helps to retain heat out of the main living areas.

NATURAL VENTILATION

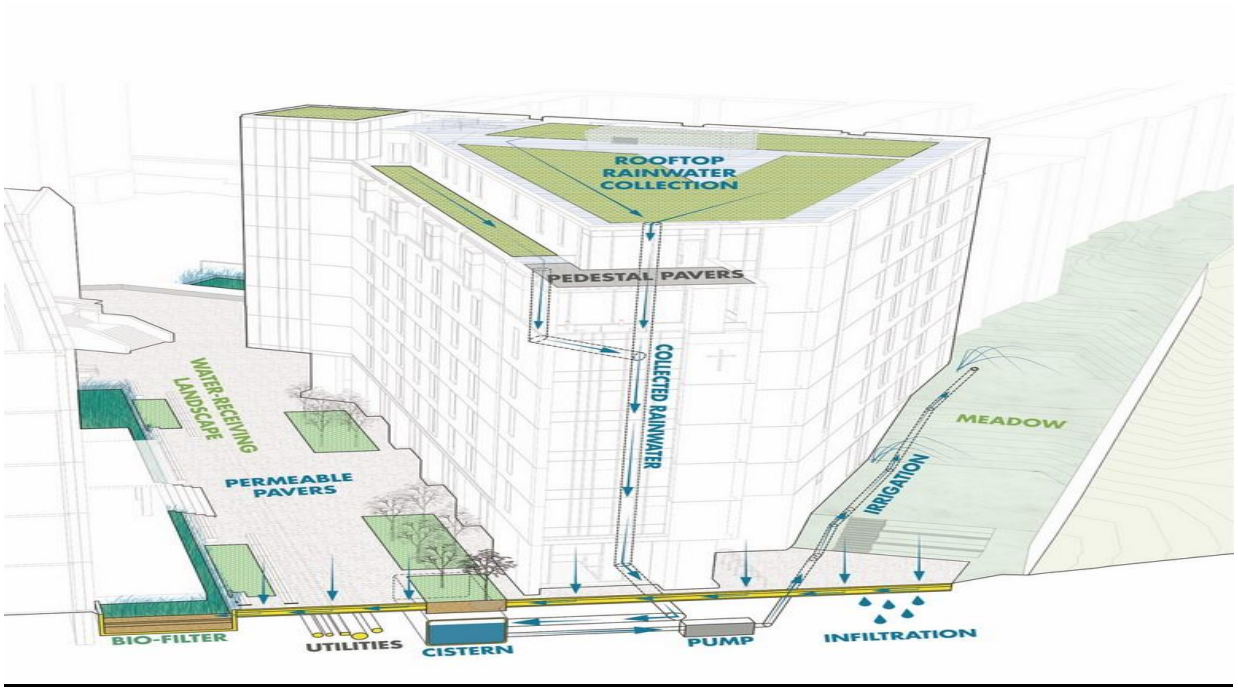
Climate-resilient design has to take advantage of cooling breezes. In such a manner, the building's orientation on the site should be determined to achieve the optimal positioning of windows and ideal natural ventilation. Furthermore, the prevailing wind direction should be taken into account for a climate-aware design. It is one of the best ways to attain relative coolness in habitable spaces. Forms with shorter depths facilitate cross-ventilation all over the building. Other on-site strategies to direct the wind include tactical placement of wing walls and dense vegetative cover. The airflow can be increased through the building through the strategic creation of positive and negative pressure zones to provide a cooling effect.



EAST-WEST SECTION AIRFLOW DIAGRAM

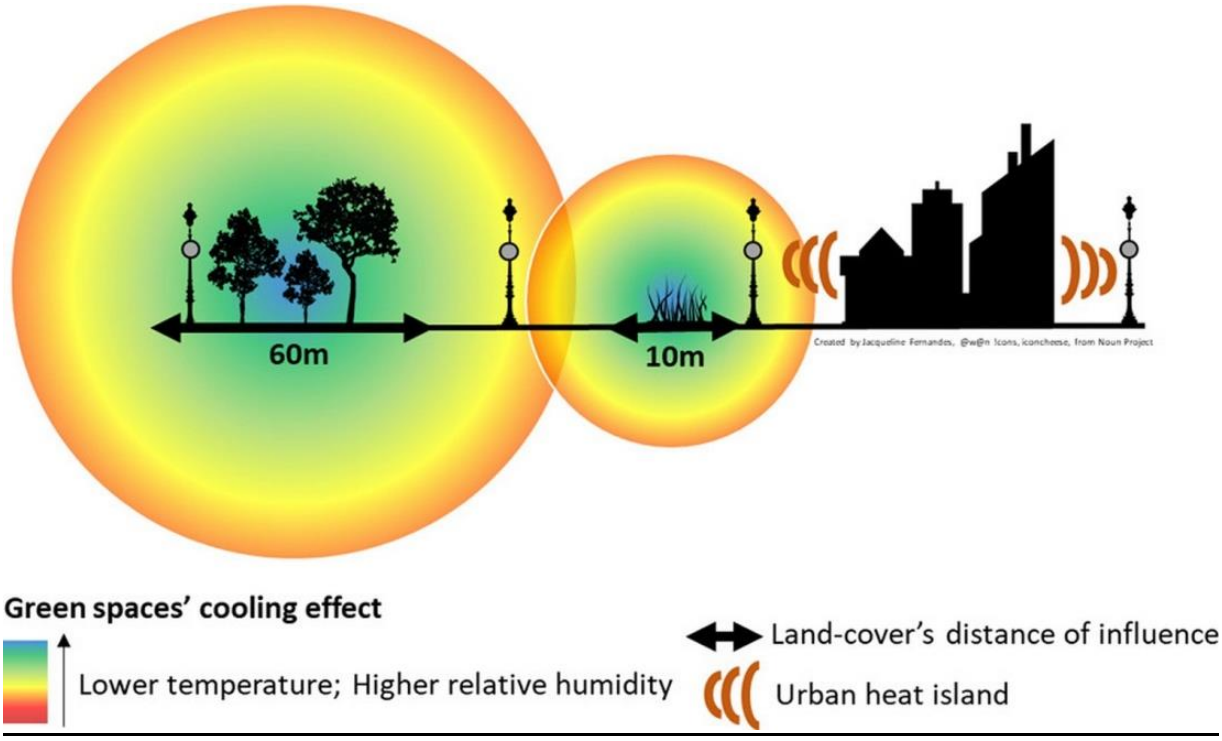
ADAPTING TO STRONGER STORMS AND FLOODING

Climate-resilient design can address flooding in several ways, among them keeping away from flood-prone areas. When that is unfeasible, then raising buildings above the flood level is pivotal. In many instances, buildings can be designed to float on the water. This is referred to as amphibious design, which is an alternative flood mitigation strategy that allows a structure to float on the surface of rising water instead of giving way to inundation. Over and above, there are solutions to improve local areas through nature-based strategies such as stabilizing riverbanks, better drainage, and using permeable paving materials to enable stormwater to flow through the gaps.



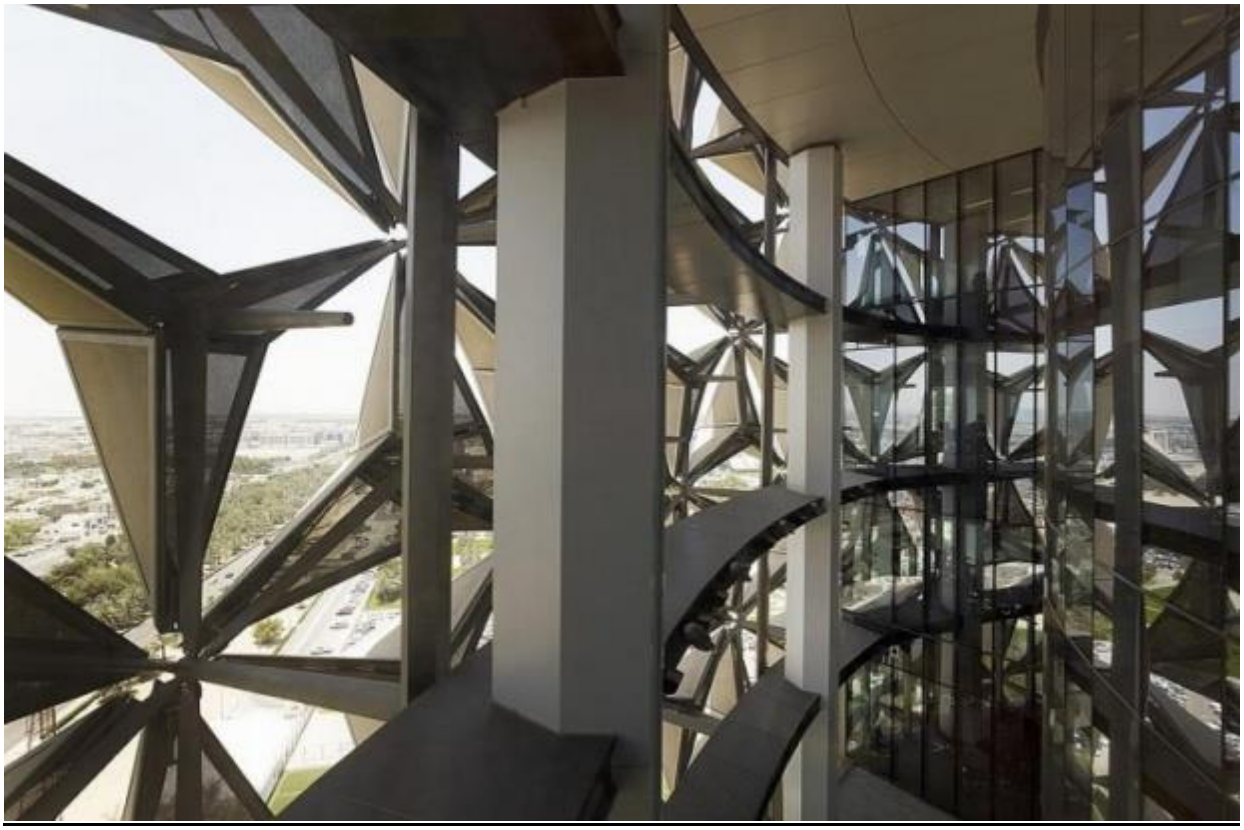
REDUCE URBAN HEAT-ISLAND EFFECT

In the built environment, materials absorb heat from the sun during the day and re-radiate it back into the atmosphere, thus increasing localized temperatures and demands on cooling systems. To address this issue, climate-resilient design can decrease the Urban Heat Island effect and minimize heat pollution. Using a lighter, reflective surface can help reduce heat loading, internal building temperatures, and Urban Heat Island effect. Correspondingly, energy costs are lowered and the lifespan of HVAC equipment, rooftops, roads, and other paved surfaces is extended. Moreover, a building's contribution to ambient temperatures can be brought down by utilizing light-coloured membranes, coatings, and pavement materials. On a related note, vegetative species can help keep buildings cool and dispense energy savings and lower temperatures.



DESIGN HEAT RESILIENT FACILITIES

Climate-resilient design can be applied to adjust and adapt vulnerable heat components of buildings. Suggested strategies include the use of green roofs, vegetated structures, planted permeable surfaces, and shade structures. When possible, permeable pavement surfaces are favoured. It is also advisable to use light-coloured pavement materials, coatings, and sealants. Solar panels can be arranged to provide shading and generate energy. Alternative occupant thermal safety strategies should be incorporated if mechanical cooling is impractical. Some examples are passive ventilation, increased insulation, and high-performance windows and façades.



MATERIAL SELECTION

In the context of climate-resilient design, it is generally preferable to choose building materials from among those available locally. This significantly reduces both embodied energy and transportation energy. Sustainably produced materials should be prioritized whenever possible and appropriate. Elsa Olivetti, the associate director of the MIT Climate and Sustainability Consortium, asserts that material selection plays a crucial role in all facets of the new technologies required to achieve sustainability goals and address climate change. Be that as it may, there are numerous material choices, construction implementation approaches, and construction techniques that allow designers and city planners to meet the climate goals set for 2050 and be ready for the future.

CHAPTER-3

METHODS TO REDUCE WATER USAGES IN BUILDINGS

Water is one of the most essential resources on this planet. It plays a key role in sustaining the environment, production of food resources and maintaining human health. With the ever-growing population, we are constantly reminded of how critical and limited water resources are. Most countries in the world are on the brink of running out of water.

Around 40% of India's water resources come from groundwater. A recent report from NITI Aayog has stated that 21 major cities in India are expected to run out of groundwater by 2020. The 'Composite Water Management Index' is India's first extensive collection of data on water throughout the nation. The CWMI report has stated that the demand for water will exceed its supply by 2050.

There is an urgent need to preserve and use water wisely. Water preservation is the need of the hour.

There has already been an implementation towards creating innovative ways to preserve water. Here are a few methods that can reduce the usage of water inside buildings

RAINWATER HARVESTING

Rainwater Harvesting is a method that can be quite easily implemented. In times of such water scarcity, it is a very effective method. The method is simple; rainfall is collected and stored so that it can be used in the future. Rainwater harvesting can aid in the replenishing of groundwater resources which also affects the climatic conditions in areas with water scarcity. Most importantly, it makes water available in such regions. Rainwater Harvesting has been in practice for a very long time in most parts of rural India. This method of water conservation can be implemented almost anywhere in buildings, individual houses, apartments, parks, etc.

WATER METERING

Water metering is the process of measuring the amount of water that is being used in residential and commercial buildings. The volume of water that is used is calculated and charged for according to the price of water. The water is supplied from a public water supply system

WATER-EFFICIENT TAPS

Water-efficient taps are of two kinds.

- Taps that have low water flow rate are usually designed that way to support minimum wastage of water.
- Taps with infrared sensors can sense a presence and automatically turn on or off based on its usage.

These taps are largely seen in most public places including malls, theatres, airports, etc.

PRESSURE REDUCING VALVES

A pressure reducing valve can control the amount of pressure in a hydraulic system and save a lot of water from being wasted. These valves ensure a pre-set level of water that is to be used. In this way, downstream components used in the water system last longer and water consumption is also reduced. This is a very fitting solution for industrial, residential, commercial and institutional buildings.

CHAPTER-4

Traditional methods of water resource management of Bundi

citythewatercrisisthatstaresusinthefacetodayisourcreation.India'sclimateisnotdry,nordowelackriversandgroundwater.Butwhatwedolackismanagement.Withunclearlaws,government corruption, and industrial and human waste rendering our vast supply almostuseless, the water supply crunch is real and rising. Historically water was viewed as anunlimited resource. Thus, no conventions were laid down to provide it as a basic human right.Theexistenceoflifeismainlydependentonwater.TheavailabilityofgroundwaterinRajasthanis decreasing steadily. The main reason being decrease in average annual rainfall, excessiveexploitation of groundwater and overuse of water in almost every sphere of life. Changingconsumerhabits,increasingdemand ofwaterforagricultureandindustries, increasingnumberofnuclearfamilieshaveallcontributedtothedeterioratingwateravailability.SinceIndependence, India's primary goals have been economic growth and food security, with acomplete disregard towards water conservation. As Indian law has virtually no legislation ongroundwater so anyone can freely extract water as long as the water lies beneath his patch of land. The owners of wells do not have to pay for extracting water, so there is no incentive to conserve or recycle it. The relentless, rapid pumping of groundwater and the ensuing depletion of aquifers are inevitable. Modernizationisalsoresponsibleforthecrises as washingmachines,flushed toilets, automobile washing, home gardensneed much water.

OBJECTIVES:

- Tostudytheimportanceofancientmethodsofwaterharvestinginbundiforsustainabledevelopment ofwaterresources ofthecity.
- Tostudythepresentsituationarisingduetopopulationgrowthand industrialization.
- Toprovideconcretestepstomeet futurewatersupply

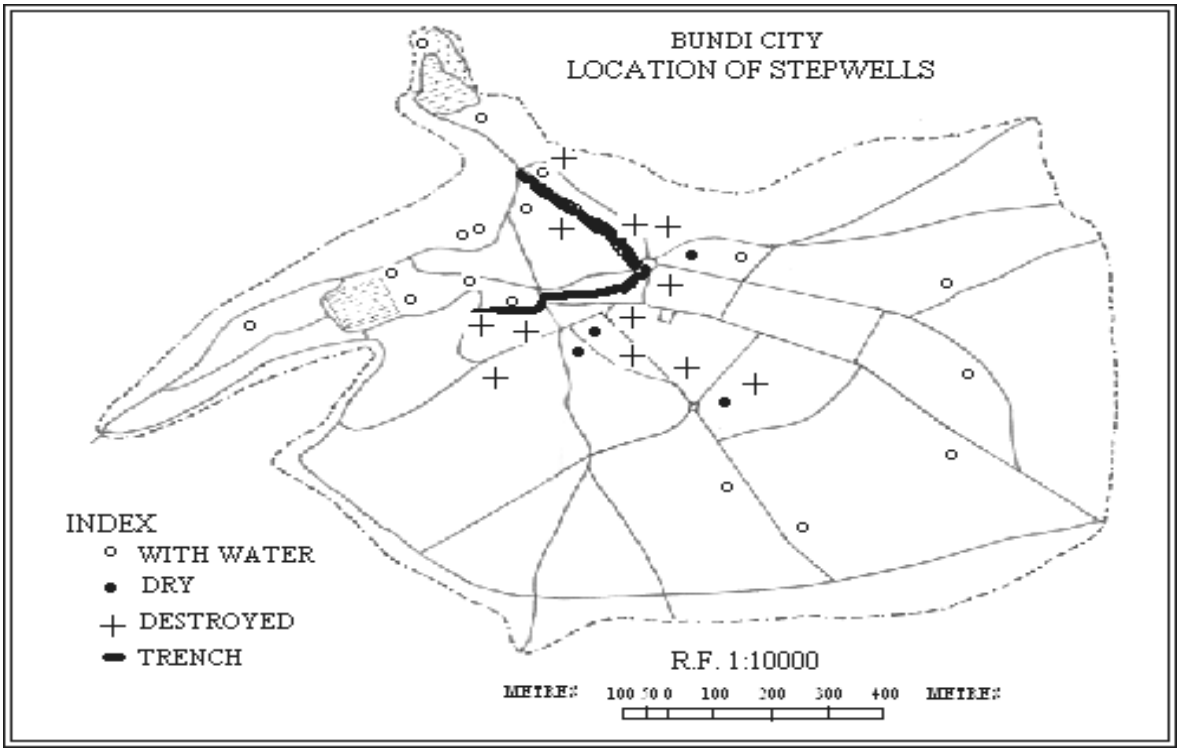
METHODOLOGY:

Use of primaryand secondarydata,field survey, use of toposheets and variousstatistical methods.

Hadauti region of Rajasthan, which experiences high rainfall is also not untouched bywater shortage. Bundi- an old city of Hadautiis also facing this problem. The geologicalstructureofBundiistypicalasitstandsontheconfluenceofAravallisandVindhyans. Aravallis

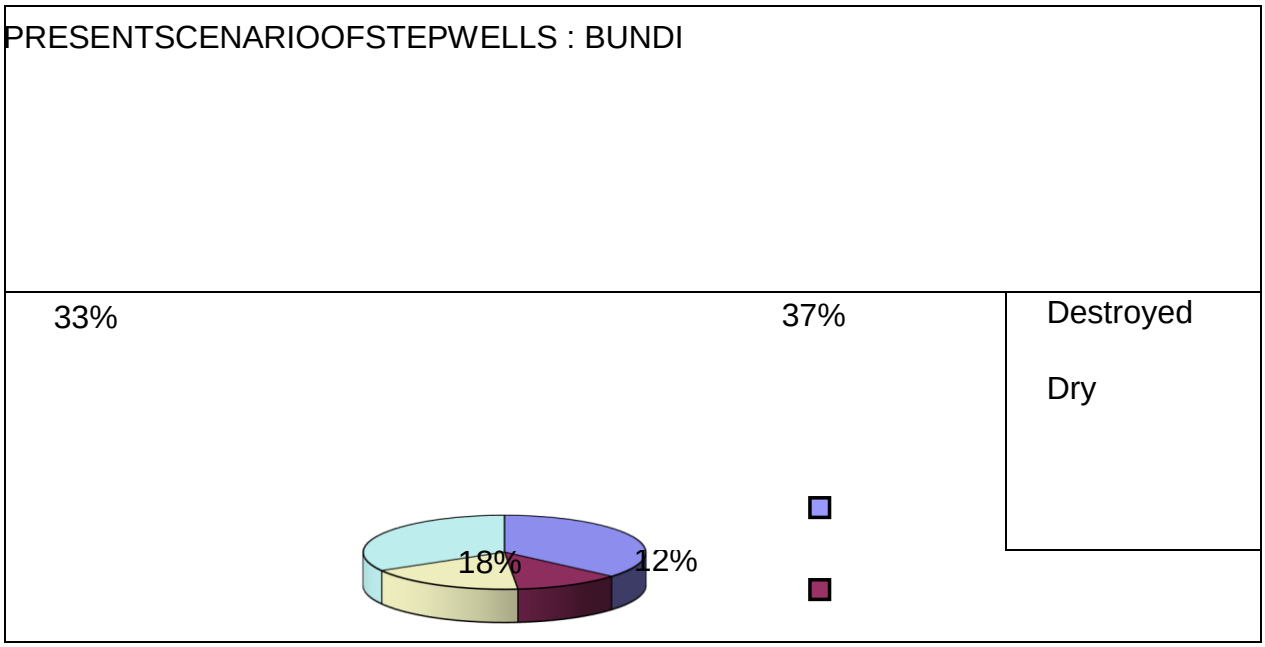
HereconsistofmarbleschistswhileVindhyanshaveferulligenouslimestone.Theundergroun d layers are a mixed combination of porous and non-porous rocky layers whichrestricts the recharging process.

With steep slopeyand plateau ground having black clay soil and hard undergroundstrata; Bundi since its formation has seen stepwells as a source of water availability. In theprincely state of Bundi, stepwells were mainly constructed by the royal family or by the rich'seths'. Water recharging in these stepwells occurred in twoways- Firstly, the rain watercollected in these stepwells directly as surface runoff and secondly, the walled city had a 40feet wide and 30 feet deep trench surrounding its walled section. The trench had a 10 feet



highsafetywallontsonesidetostopthewastefrombeingdumpedinside.Thiswaterinthetrench recharged the stepwells of Bundicity.Till1956,stepwellswere the only source of water in the city. There were 33 stepwells and 9 tanks to fulfill theneeds of a population of 25,000. In 1959, waterworks department introduced tap connectionschemeinthecityfromstepwellsatacostofrupeessevenlakhs.Thusstartedtheneg lectionofthe stepwells. After independence, rapid urbanization, break up of joint family system and toomuch dependence on the waterworks department led to the neglection of the stepwells thusputting them on the verge of destruction.

Till 1975, 2000 gallons of water per hour was pumped out of these stepwells.Fast increase in population saw the emergence of tubewells in Bundi but due to filling of thetrench by the erstwhile district administration, these tubewells soon turned dry, resulting inwater supply to the city from riverMangli. 24 hour water supply in Bundi till 1982 wasrestricted to 4 hours per day and from 1998 onwards this came down to an hour per day. 2004saw water supply in three days. At present, there is water supply for 30 minutes per day andin some parts of the city it is of 30 minutes per 48 hours.

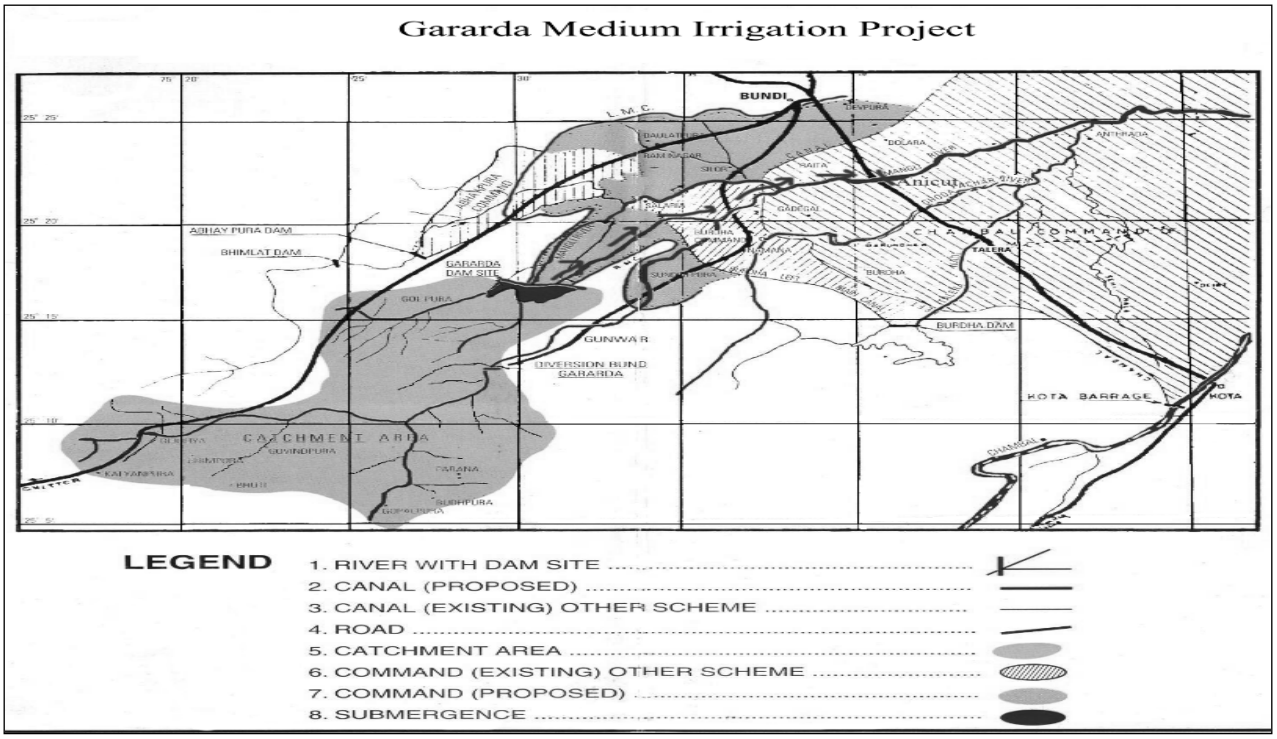


Today, many stepwells of Bundi have become waste disposal pits. 12 stepwellshave being filled up with garbage. At present, of the 21 remaining, 4 have gone dry and of the17 only 6 have potable water.

CAUSES FOR THE BAD CONDITION OF STEPWELLS:

- ✓ Increasingpopulationsawunplannedexpansionofthetownandthusthenaturalchannel sofwaterrechargetothestepwells wereblocked.
- ✓ The roadsweremadebycementconcretewhichalsostoppedorminimizedthegrou ndwaterseepage.
- ✓ In1982,thedistrictadministrationgotthetrenchfilleduptocreateamarket,whichledtoth eextinction ofthedistinctiverecharging techniqueofstepwells.
- ✓ Decreaseinaverageannualrainfallalsosawthe decreaseofwaterinthestepwells.
- ✓ The princely town of Bundi was surrounded by dense vegetative cover over the hillswhichhavenowchangedintorockybarrenhillsleadingtodeclineinannualrainfallan dalsomoresurfacerunoff.

Due to decreasing water supply, voices are raised for connecting Bundi withChambal.Thoughthedemandseemstobeviablebutitisgoingtobeanexpensiveaffairasth eheightofKotabarrageis250metersabovesealevelwhilethatofBundiis266meters.



By the national parameters of 100 litres of water per person per day (PHED takes only70 litres of water per person per day) ,Bundi requires 10 mcft. water per month. Just 18

kms.awayfromBundi,Garardadamisunderconstruction(almostcomplete)whichhasaprovisionof170 mcft. Ofwater reserved for drinking purposes. Looking at this it has enough water tomeet Bundi's demands. The dam is 280 metres above sea level and is built on river Mangli (Itis the present source of meeting Bundi's demands. 8 kms. away from Bundi, there is a anicutwhich receives rainwater from July to September and seepage from Chambal canals fromNovembertoFebruary).Theanicutis260metresabovesealevel,thusthereisaslopegradientof .009. Releasing water from the dam into the river will raise the water in the anicut and willalso help in ground water recharge. Rising water pipe line and treatment plant is alreadyfunctional from Mangli. Small storages are much more appropriate and effective for groundwater recharge. This is particularly importantwhen such large proportion of agriculturalproduction comes from the groundwater irrigatedareas.

CONCLUSIONS:

Efficientuseofwaterresourcesisnecessaryfordevelopingwatermanagementstrategies in which priorities must be fixed for optimum use of surface and groundwaterresources. We needa change of attitude.

- ✓ Afewpertinentwaterlegislations,strictwaterconservationpractices,efficiencyin water use and water recycling can offer viable redressal options. Makingrainwaterharvestingcompulsoryisyetanotheroptionthathastobelinkedwithhousetaxincentives toproductively tapthehugequantities ofmonsoon rain.
- ✓ Wecansaythatstepwellsatthattimewereanexcellentexampleofsustainability. To make the dream of sustainable development true, there is anurgentneedtorevive the traditionalmethodsof water harvestinglikethestepwells. On average, 30 per cent to 50 per cent of daily urban water supply iswasted. Leaking pipes and theft are the main culprits. Meanwhile, wastage ischronicbecause people arenot paying peruse.
- ✓ Leturbanlocalbodiesmanagewaterdistributionincities.Manyoftheproblems in urban water supply could be solved if local governance were incharge, rather than the faraway state governments. Even the 74th (PanchayatiRaj) amendment to the Constitution, when it laid down the framework for theidealmunicipalcorporation,recommendedthatwaterbe acivicsubject.

- ✓ The Centre must make water meters compulsory in all homes in all states, justaselectricitymetersarenow.Andcreateincrementalslabs,sothoseconsumingmore of this precious resource pay accordingly. As wastage dips, and resource management improves, cities might even find they have enough water for the whole year supply. Instead of bringing water from further and further away at considerable cost and high inefficiency; cities must be directed to depend on local sources. The government need stop protect our catchment areas. This is still not enough.
- ✓ We have to use much less water in every household, every industry and every institution. Every time we use the flush, as much as 10-12 liters of water goesdownthedrain.Thegovernmentmustinsistonwater-efficientappliances,labeland tax appliances that use more water, and make us 'you and me' pay for the water we use. Most ofourcitiesreallyhaveenoughwatertobeginwith.It'sjustthemanagementofthisresource that is lacking.

CHAPTER-4

INFOSYSLIMITED,MYSORE

- ARCHITECT AR. HAFEEZ CONTRACTOR
- SITE AREA -350 ACRES
- BUILT UP AREA- 12 MILION SQ FT

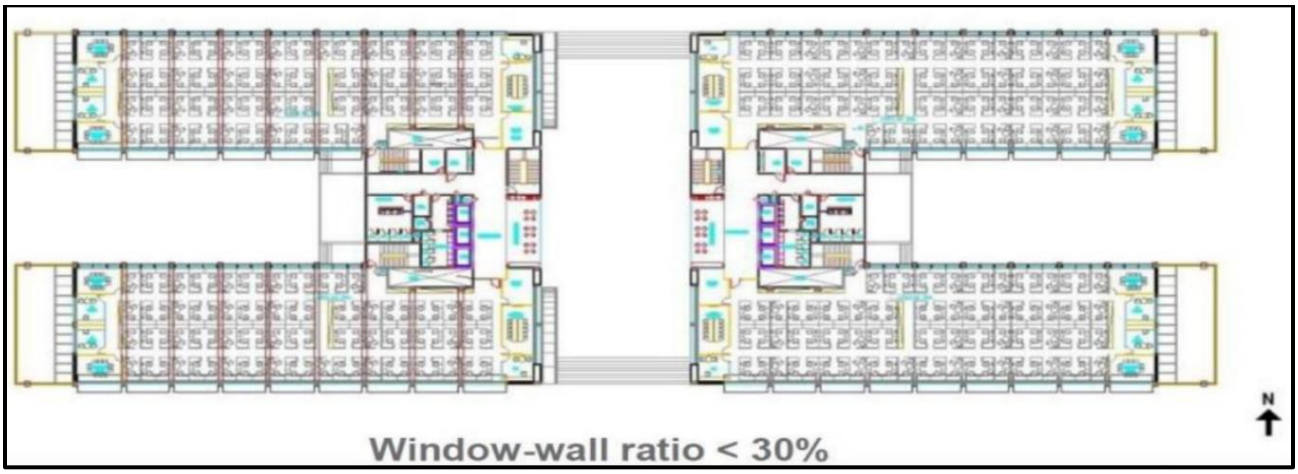
LOCATION- MYSURU

CLIMATE TROPICAL MONSOON

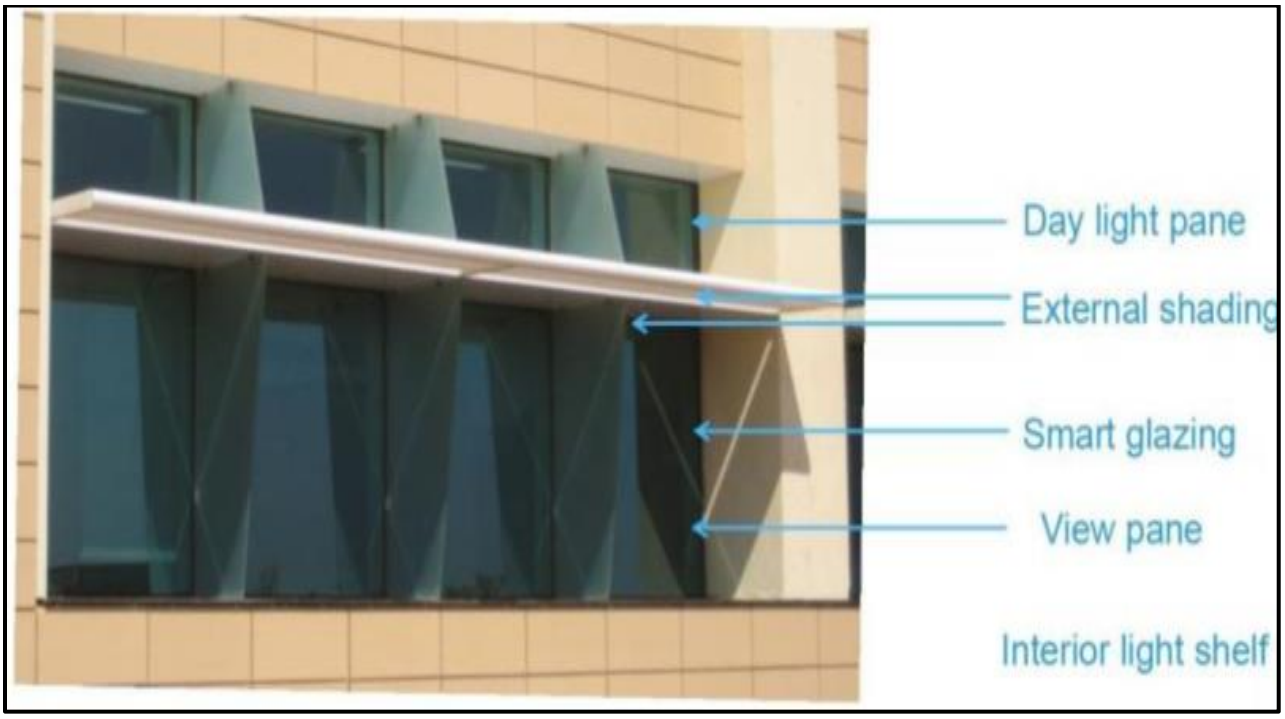
- HOT AND MOIST SUMMERS AND
- COOL AND DRY WINTERS

DESIGN ASPECT

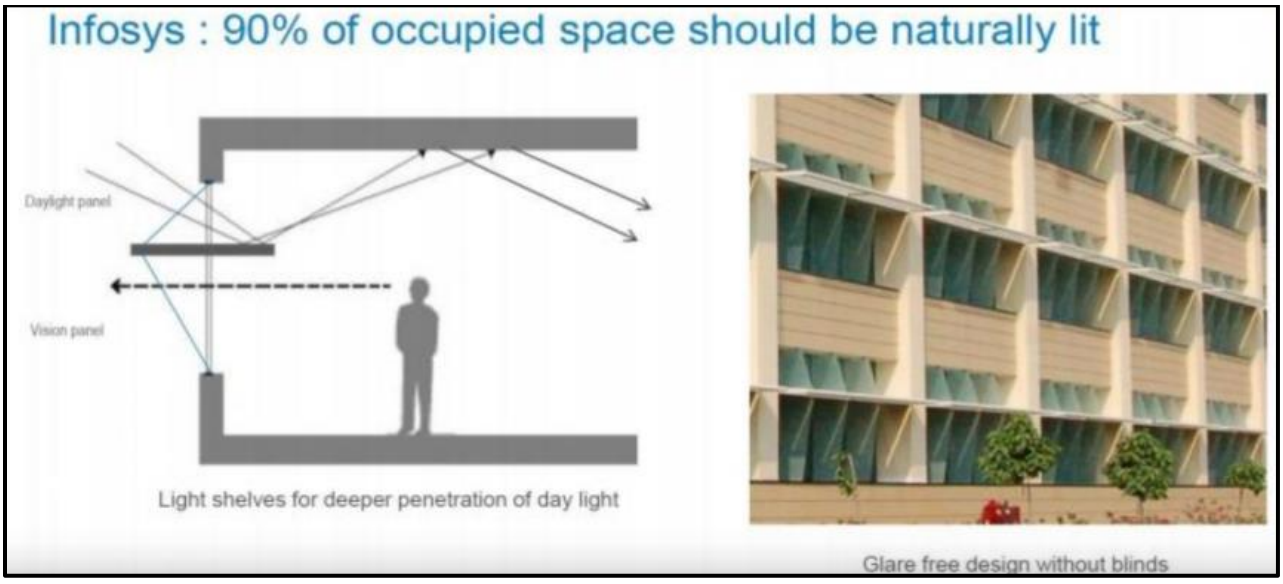
- BUILDING ENVELOPE EFFICIENCY
- BUILDING SHAPE AND ORIENTATION



- Daylight panels and vision panels for windows
- Light shelves to improve nature light in the working spaces
- Day lighting and Glare control – glass and shading



1. The window is split into two types of glass.
2. The upper glass is called the day light panel it gives nature light with less amount of glare.
3. The lower glass is called as vision panel and it has low visible transmittance.
4. This type of windows conserve energy as the allow less heat in the building and allow ample of day light.



DAY LIGHTING – SHADING STRATEGY IMPLEMENTATION

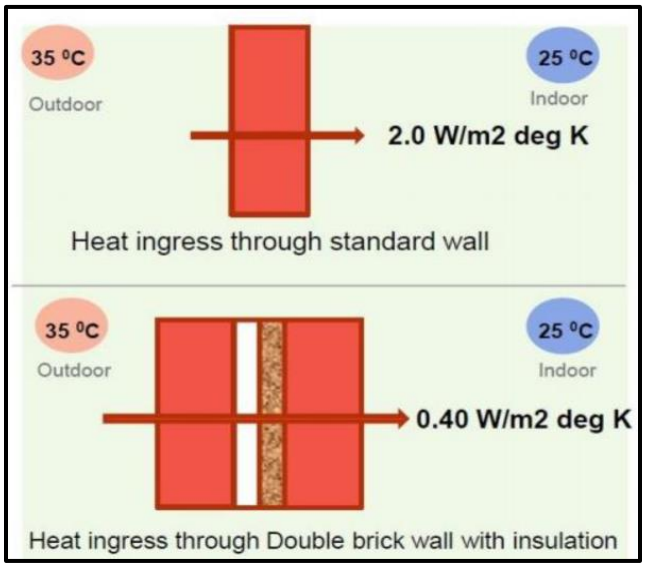
SDB-06, INFOSYS MYSORE CAMPUS

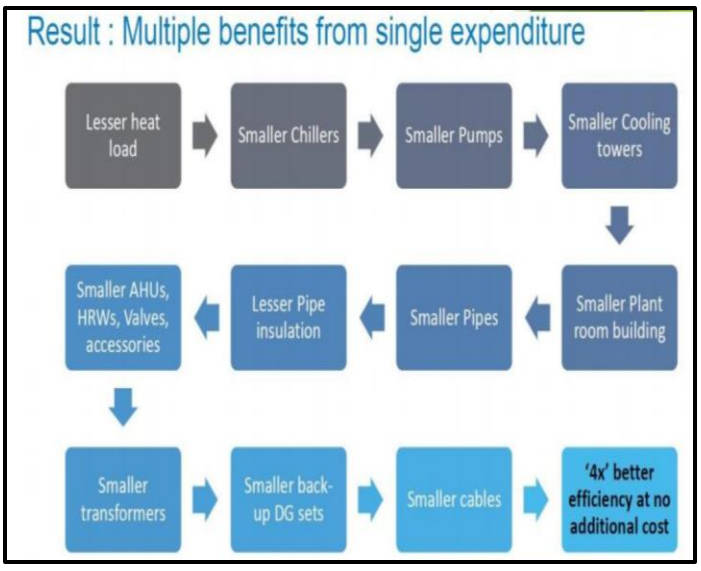
PARKING

- 392 Kwp car port solar PV on top of parking building

CONSTRUCTION ASPECT

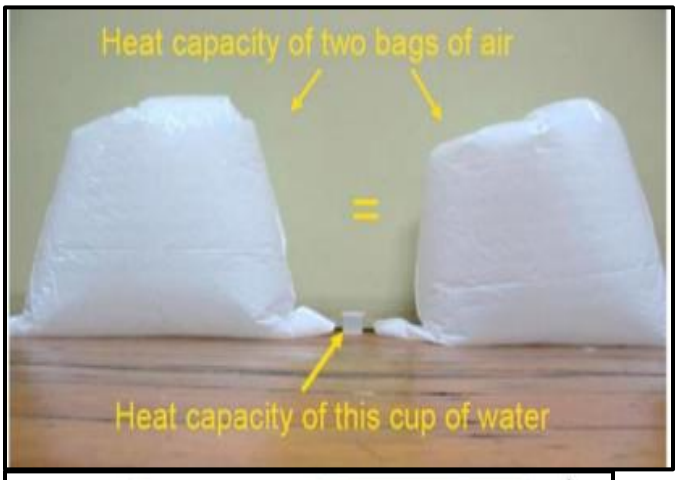
- MATERIAL & TECHNIQUE

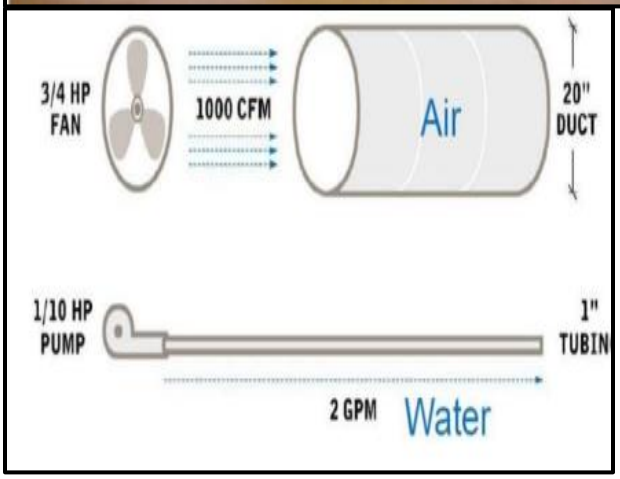




EFFICIENT HEAT TRANSFER MODE AND MEDIUM

Pumping Air Vs. Water for same cooling capacity



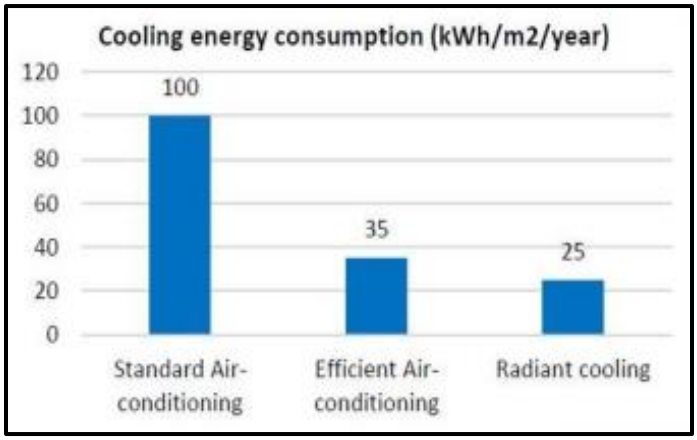


Water has 3400 times higher heat carrying capacity Pumping cost is 7 times lower with water as the medium of heat transfer

RADIANT COOLING TECHNIQUE

- 75% more efficient than standard air conditioning system
- Requires 80% less air compared to conventional system
- Higher thermal comfort on account of better mean radiant temperature
- Highest indoor air quality. Requires less space compared to conventional system

2.6 million sqft area covered with white roof About 5% reduction in HVAC energy Reduces building heat gain and urban heat island effect



DATA DRIVEN BUILDING OPERATIONS

- ✓ Energy saving algorithms optimize operation
- ✓ Continuous measurement and verification
- ✓ Improves indoor air quality, employee comfort and productivity
- ✓ 15% reduction in energy as compared to standard buildings
- ✓ Central command centre.

Command center at Infosys Bangalore to monitor, manage and optimize resources usage

SMART ENERGY METERING AND BENCHMARKING

- ✓ All building use smart energy meters and sub metering
- ✓ Smart meters communication on internet and out data continuously
- ✓ Capability to communication allows them to be compared on common platform
- ✓ Collected data from building in a city can be used benchmark building's
- ✓ EPI against standards. E.g. Office building EPI in Delhi not to exceed 100 kWh / m2/ Year
- ✓ Sub – metering to monitor consumption of sub system. E.g Air conditioning systems, lighting computers, etc.

SERVICES

Water positive strategies

- ✓ 100% water sequestration
- ✓ Zero discharge campus
- ✓ Low flow fixtures
- ✓ Gravity based system
- ✓ 100% recycling
- ✓ Flushing
- ✓ Air conditioning
- ✓ Gardening

Goal: 50% reduction in per capita water consumption

Low flow fixtures

- ✓ Dual flush system
- ✓ Waterless urinals
- ✓ Flow restrictors and aerators
- ✓ Pressure reducing valves at building entry
- ✓ Replacement of laws with low water consuming native plantation
- ✓ Root zone irrigation

DUAL FLUSH SYSTEM

Per capita fresh water requirement for commercial building not to exceed per day

100% of the Water to be Recycled and Reused

PRACTICE ZERO LIQUID DISCHARGE POLICY

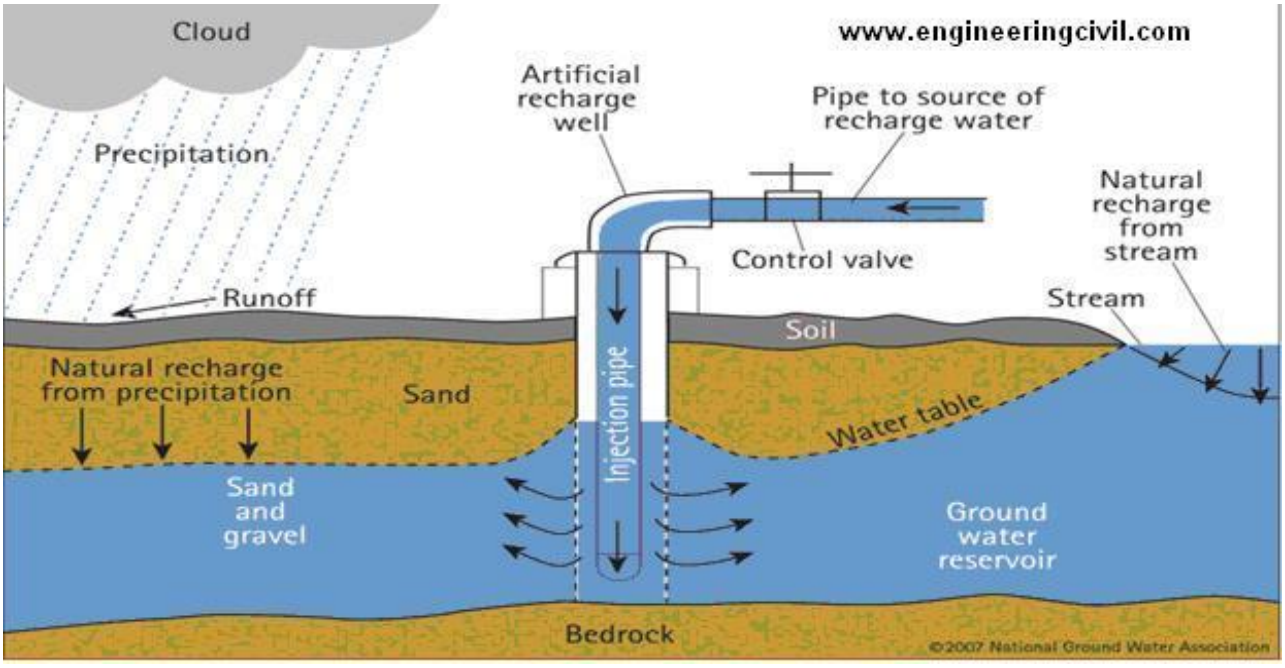
- ✓ 100% of waste water is recycled through in campus steps with ultrafiltration /membrane bio reactor (MBR) treatments.
- ✓ Recycled water is used for irrigation, flushing and air- conditioning systems.
- ✓ All buildings have dual piping system for fresh water and recycled water.

Sewage Treatment Plant with MBR Technology

ZERO DISCHARGE CAMPUS FOR RAIN WATER

- ✓ Roof top water is collected locally and sent to water treatment plants or sequesteredin the ground via bore wells
- ✓ Groundwater is collected in ponds
- ✓ Goal is to sequester more fresh water than we consume

Roof top Rain Artificial Rain Water Harvesting pondWater Harvesting



Ground Water Recharge

SMART WATER METERING AND BENCHMARKING

- ✓ All types of building and homes to use smart water meters
- ✓ Smart water meters can communicate on internet and send out data continuously Automated water balance to identify unaccounted water(leakage theft, measurement error) Collected data for buildings in a city is used to benchmark building waterperformance index WP against standard E.g 9OFFICE BUILDING WPI in Delhinot to exceed 25 liters / person / day) Provide all water consumption data on the cloud and allow user to compare their Consumption with others and with benchmark numbers Sub metering to allow comparison of sub system E . g water for domestic use recycle the water , water for air conditioning systems.

CHAPTER-5

A CASE STUDY ON BARAV (STEP WELL) AT MHALUNG

Maharashtra is a state which includes many historical monuments such as caves, forts, WADA/ Havelis, etc also they play an important role by providing information in terms of showing their different traditional styles and culture to the society. A case study was conducted on Step Well which is situated in Mhalung village, Maharashtra. To study its current scenario and the water conservation work that is being carried out on the step well. To make rehabilitation work for historic structure based on various established methods to preserve the particular structure, it carries through some maintenance and restoration work to know about the long and prestigious history of India and their culture in various monuments present in various states various in numbers, needs to be conserved this monument includes ancient caves, water tanks, forts, Wadas, etc. In this site, where we carried out one survey work here observed a step well with its all components like stone steps, stone carvings, small temple etc. are the major plus point of this site. For sustainable development of this site i.e., step well requires rehabilitation of this ancient structure here explain water system in this step well under contemporary technology incorporated in the construction. The main objective of this paper is to make a checklist that will be required for the preservation of this step well structure and other monuments near to it.

Introduction

Conservation of water is the important thing is now a days for carrying this water conservation so many different methods have been introduced and practiced. Conservation of water by rainwater harvesting is one of the most popular very efficient methods which helps to store of this rainwater and used various purposes as per required. If water conservation is correctly done under appropriate methods adopted then it reduces supply load which generate due to water demand to some extent. The importance of this water conservation as well as rainwater harvesting was used considered from ancient times in India. For the conservation of water during the summer season stepwells is specially constructed. Stepwells contains a special combination of technology and architectural view. This case study will help the ancient but existing water

conservation example by studying historical monument called stepwells this step well stepwells present in the Mhalung village near Velapur, Malshiras, some portion of this well comes under degradation and decay so proper maintenance work is the only way that can ensure to improve the life span of this structure i.e., step well the research aim to save this step well.

Study Area

BARAV(Stepwell), Mhalung Village, Maharashtra, IndiaStepwell present at Mhalung village near to Malshiras is an ancient water conservation system based on rainwater harvesting The most interesting thing to checks this stepwell used ancient water conservation and management system where the rainwater store to huge underground tanks water tanks in form of stepwell which provide water for various purposes to a different category of people at the same time.

This water demand distribution shows how water management is possible in those days. Another use of this stepwell water present on it for the animals to drink from during summer months. The efficiency of the water management system obtained here there can be studied by understanding the way of collecting storing runoff. We can learn that the Intelligence work is in conservation, so that due to this our future generations can continue to enjoy the blissful feeling and touch of water. Mhalung village present 20km away from sub-district headquarter Malshiras and 110 km away from district headquarter Solapur. Pandharpur is the nearest town to it. The population of Mhalung village is 20,833 also total geographical area 3465 hector. There are about 4,589 houses in Mhalung village. As per 2019 stats.This information is important to make population forecasting for water distribution and future planning. To understand the recent situation of this stepwell may consider the following information.

- ✓ Ownership: Archaeological Survey of India (ASI)
- ✓ Past use: Water source, Water Storage, Water conservations
- ✓ Present use: Water present in stepwell as source for various day to day activity purposes.

- ✓ Basic Description: It is a water reservoir made from stone using lime mortar.
- ✓ Constructed maybe 16th century. Presently the stepwell is under the protection of ASI and because of its sacred importance it's in function and protected by the residing, worshipping, and water for animals.

ASPECT	TRADITIONAL BUILDINGS	CONTEMPORARY BUILDINGS
Architectural Design	-Inward looking with courtyard -Square or rectangular plan -One or two floors -Covered terraces -A body of water and fountain -Clerestory windows -Flat, domed and vaulted roofs	-Outward looking -Free plan form -Multi-storey blocks -Small balconies -Vast glazed windows -Flat or pitched roofs
Constructional materials and methods	-Local materials found on the site of the building or brought from a nearby area -Simple constructions -Load-bearing walls	-Materials are mostly imported or locally made with poor qualities -Frame structures -Simple constructions -No insulation -Non-load bearing walls
Occupancy patterns	-Changed in residential buildings. The ground floor is used in summer days and the	-Unchanged in residential buildings because of the design restrictions of

CHAPTER- 6
WATER SUPPLYSYSTEM IN JHANSI

SOURCES OF WATER

TABLE: WATER SUPPLY SOURCES

ListofSurfacewatersources:	ListofGroundwatersources:
1. **Matateeladam** 2. **Pahujdam**	(1) Tubewell-14 (2) Openwell-15 Total-29

Source: Jhansi Division, Jal Sansthan, UP& Nagar Nigam Jhansi, 2011

Almost 66% of the city population gets the piped water supply. The main sources of water are river Betwa and local underground water.Jal Sansthan Jhansi is responsible for water supply and Water Production.

Table: 1

POPULATION AND WATER DEMAND

Year	Population	%Growth	Waterdemand (LacLiters/day)
1961	26478	16.66	18.53
1971	34492	30.28	24.14
1981	48027	39.24	33.62
1991	65047	35.44	45.53
2001	88871	36.63	62.20
2011Est.	101252	13.93	70.88

Table: 2

YEARWISE RAINFALL

Year	Rainfall(mm)	Year	Rainfall(mm)
1994	810	2001	824
1995	558	2002	307
1996	1370	2003	543
1997	665	2004	641
1998	475	2005	543
1999	642	2006	777
2000	621	2007	680

TABLE 3:**WATER PRODUCTION CAPACITY**

WaterProduction	Installed Capacity of TreatmentPlants (MLD)	Volumeofwaterproduced (MLD)
SurfaceWaterSources	12	10
GroundWaterSources	3	3
OtherSources		58.76
Total	15	71.76

Source:NagarNigamJhansi,2011

Transmission,DistributionandStorageCapacities

Most of the pipelines network is in satisfactory condition but pipelines leakage /wastages occur because of illegal tapings and connections.

TABLE 4:WATERSUPPLYNETWORK

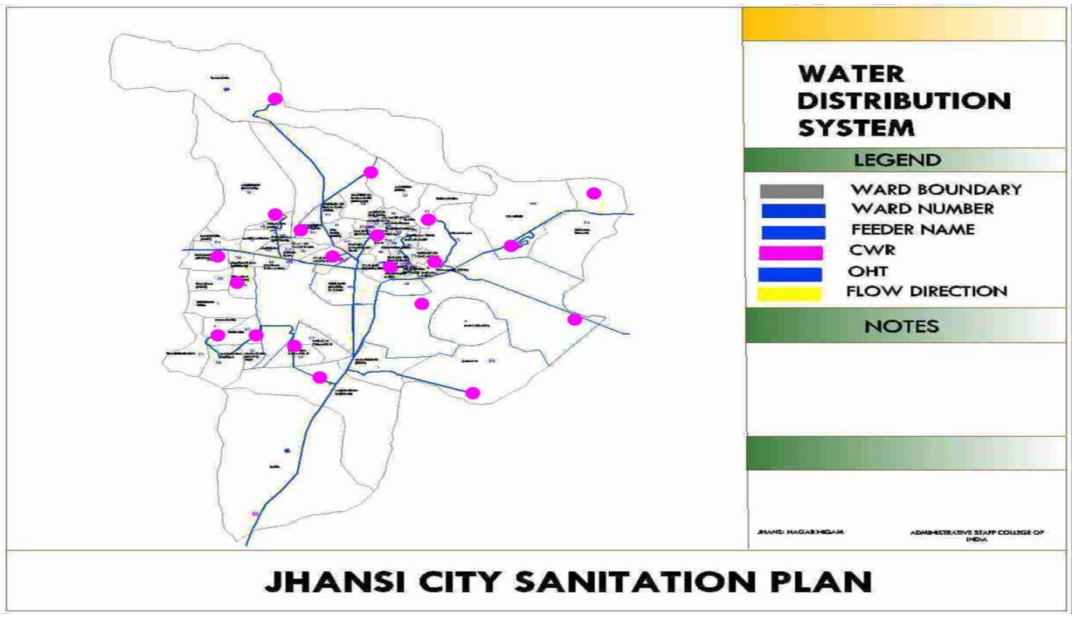
Data	Total	Working	Notworking/disconnected
No.OfPowerBores	2563	2493	70
No.Of Bore wells	14	12	2

TABLE 5:

No.OfStorageReservoirs	12CWR+15OHT=27Nos.
LengthofDistributionNetwork	287km.
NumberofPSPs(PublicStandPosts)	578nos.
No.Of water tankers	32nos.
TotalwaterSupplieddaily	71.18MLD

Source: JhansiDivision, JalSansthan, UP&NagarNigamJhansi,2010

MAP: WATERDISTRIBUTIONSYSTEM



DRAINS IN CITY

There are 63drainsinthecityofwhich36bigand27smalldrains.Ithasbeenobservedthatthelocalresidents dumptheirdomestics oilways inthenearbydrains.Thereisnoregulararrangementof cleaningofthedrains.Drainsannualcleaningstartsfrom1st April veryyearbeforethestartof monsoonseason.

The storm water drains within the city are constructed of natural stones while those towards the outskirts are made of earth (kuchha drains). A list of primary and secondary drains is given in Annexure.

WaterloggingisprevalentinsomeoftheareasduringtherainyseasonlikeSangamViharatMinor Canal,GadiyaGaonetc.

Figure5:WaterLoggingatGadiyagaon

Source:ASCISurvey,2011-12

SITUATIONAL ANALYSIS OF WATER BODIES

Therearea numberof water bodies aroundtheJhansicitybutthreearequite prominentandneed definite attention for maintaining the ecological balance. These are LaxmiTalab, HatiyaTala bandPani Ki Dharansala.

ThesewaterbodiescomeunderthejurisdictionofNagarNigamJhansi.Asurveywas conducted of these water bodies and found that the condition of these water bodies is quite poor because mostofcitynallas/drainsaredischarginginthesewaterbodies.Itisalsonoticedparticularlyinca seof Aathiya Talab that most of the nearby residents throw their solid waste in them. It is also seen that people are open defecating around these water bodies. Moreover, it has been ascertained that there is no formal arrangementoftheirregularupkeepandmaintenance.Overtheperiodoftimethe condition these prominent water bodies have become worst and thus becoming the major source of water pollution in the heartofcity.

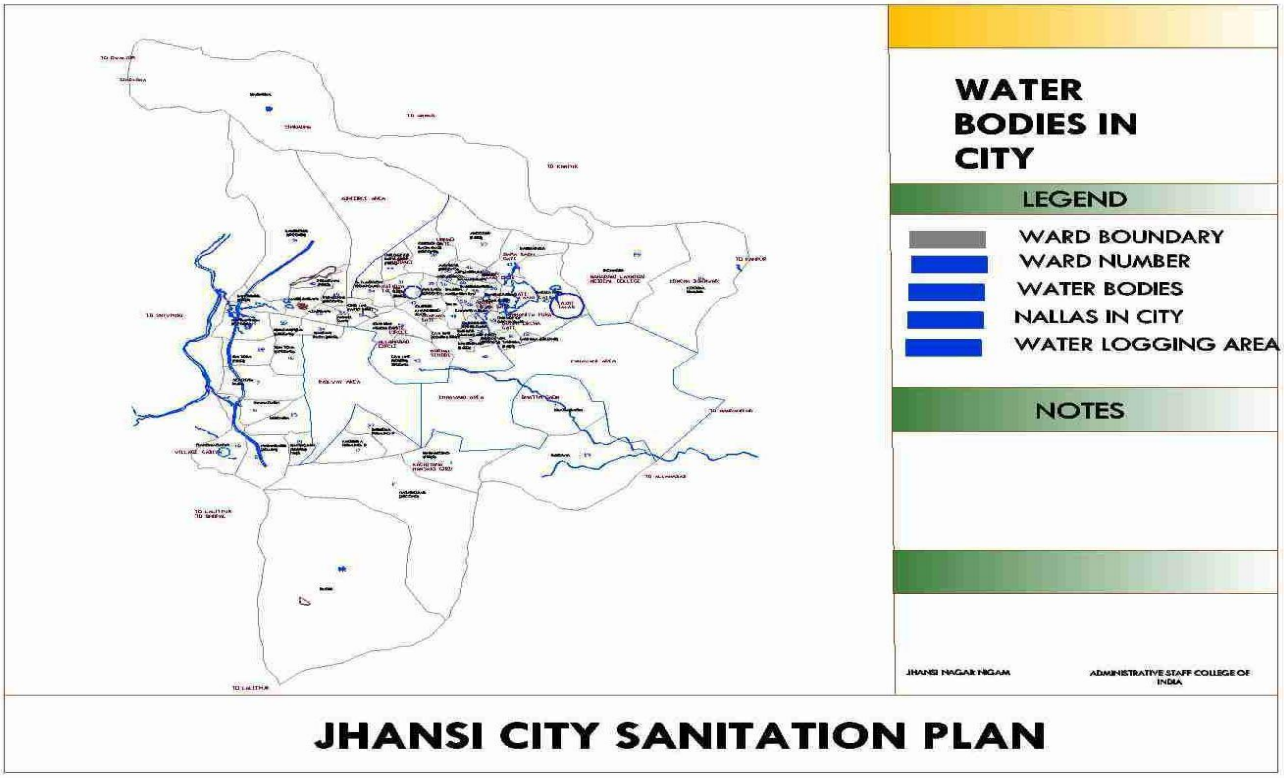
Figure13:LaxmiTalab

Figure14:AthiyaTalab

BeforeRenovationNov2010 AfterRenovationSept2012

Source:ASCISurvey,2011-12

Initiatives of Nagar Nigam for restoration of water bodies in the city is going on, in this attempt old filthy Athiya Tall is being renovated in beautiful public place, this can be seen from figure above. Same need to bereplicatedforotherwaterbodiesinthecity.



Map6:WaterBodies

SWOT ANALYSIS

WATER BODIES

TherearethreeprominentwaterbodiesinJhansicitybutthereisnosysteminplacetoensurethei r proper upkeep and maintenance.

Most of the nallas/drains ofthe city are discharging their wastewater in these water bodies whichiscompletelyunhygienicandhazardous for the city.

Thereishigh risk ofwaterbornediseasesbecauseofaccumulationofsludgeandwastewaterin the water bodies.

The stagnated water and filth in the water bodies causing the foul smell and acute air pollution inthesurroundingareas.

SWOT ANALYSIS

TheimportanceofSWOTanalysislies instability tohelpclarifyandsummariesthekeyissuesand opportunitiesfacingasector.Valueliesinconsideringtheimplicationsofthethingsidentifiedandditcan thereforeplayakeyroleinhelpingasectortosetobjectivesanddevelopnewstrategies.Theideal outcome would be to maximize strengths and minimize weaknesses in order to take advantage of external opportunities and overcome the threats. The biggest advantages of SWOT analysis is that it is simple and onlycoststimetodoItcanhelpgeneratenew wide as tohowas sectorcanuseaparticularstrengthto defendagainstthreatsintheperformance.Ifasectorisawareofthepotentialthreatsthenitcanhave responsesandplansreadytocounteractthemwhentheyhappen.SWOTAnalysisisthefoundationfor evaluatingtheinternalpotentialandlimitationsandthelikelyopportunitiesandthreatsfromtheexternal environment. It views all positive and negative factors inside and outside the sector that affect the success.
Aconsistentstudyoftheenvironmentinwhichthesectoroperateshelpsinforecasting/predicting the changing trends and also helps in including them in the decision-making process of the particular sector in thecontextofJhansi.

WaterSupply	
Strengths **Satisfactorycoverage** **Betwariverflowingnearbythecity**	Weaknesses Lackofmeteredconnections Leakages Usingprivateelectricpumpstosuckwater Illegalconnections Unwillingness to use water at the consumer endduetocontaminationinthesupplyline. Water borne diseases due to poor quality of water supplied
Opportunities **Improving water quality and reducing water bornediseases** **Rehabilitationoftheexistinglines** **Constantvigilancetocontrolillegal connections** **Tobringforthe changeinthemindsetto goforIndividualmeteredconnections**	Threats Poorserviceinsomeareas Contaminationduetohousehold&commercialwaste directly lead to open drainsandnallas

Sewerage&StormWaterDrainage

Strengths **Extensivenallasanddrainnetwork** **Naturalslopefacilitatestheflowof wastewater in storm waterdrains and nallas**	Weaknesses No sewerage network and sewerage treatment plant „STP" Blackandgraywaternottreated Householdandcommercialwastedirectl y leadtoopendrainsandnallas
Opportunities **PlanseweragenetworkandSTPs** **IEC campaign against throwing garbage in stormwaterdrains**	Threats All nallas /drains discharging in water bodies Stagnated water bodies are major source of pollution and health hazard

WATER SUPPLY

Pipewatersupplynetworkistherebutwithoutanymetering.Thisleadstomaximumwastageofw ater particularly at public stand posts in the slum/LIGareas. Thus there is ample cope for public awareness,as most people don't seem to bother about the optimum utilization of water. To overcome the shortage of water,JhansiDivision,JalSansthan,UPhasinstalledabout1000handpumpsintheslum/LIGar eas. Besides this almost 20,000 households have made their own private arrangement of hand pumps. Illegal connections and resultant leakages in the pipeline are very common resulting in mismanagement&supplyingofcontaminatedwatertotheconsumers.Insuchascenarioitisnot unusualthatpeopleof Jhansi city prefer the hand pump water to the supplied water for domestic purpose.

CHAPTER - 7

- ✓ Design Premises
- ✓ The proposals shall be based on the following parameters
- ✓ The Population Densities
- ✓ Development Pattern of the City Present &Future Land-Use
- ✓ Opportunities of means of livelihood
- ✓ Existing Institutional Capacities
- ✓ Existing Financial Capacities
- ✓ Existing Situation vis-à-vis the Key Issues at Ward Level
- ✓ Design Considerations

Thevariousboundaryconditionsthatinfluencethedesignofthecommunitytoiletsandenhance the acceptability levels amongst the community and also promote sustainability of the developed assets and the overall sanitation system a represented below -

- ✓ Location
- ✓ Proximitytosettlements–preferably100-200m
- ✓ Visibility
- ✓ Safety aspect
- ✓ Near sewage lines
- ✓ Co-location–compatible use
- ✓ Signage
- ✓ Directional and Labeling
- ✓ Gender Sensitive Design
- ✓ Women and children specific
- ✓ Disability Access
- ✓ Elderly User Access
- ✓ Well-lit/ventilated
- ✓ Environmentally Sustainable
- ✓ Energy Considerations
- ✓ High degree of natural lighting
- ✓ Low energy light fittings

- ✓ Use of solar power
- ✓ Passive ventilation
- ✓ Recycled, recyclable, renewable and locally sourced source materials
- ✓ Water Considerations
- ✓ Greywater Flushing
- ✓ Low-flow/waterless urinals
- ✓ Recycling of storm water for flushing

CONCLUSION

The presented study has a more unified scientific way for water resilience strategy. The given methods of gathering datasets will have an impact on understanding the issues and sources of chemical and biological pollutants issues which are posing a threat to water quality. The article stresses the spatial evaluation of water with trans-boundary policy approach for its better quality and quantity management. In developing countries, the issues are mostly among the governing body.

We have learned how climate resilience architecture is playing an important role in modification of buildings according to the climate of that region.

We have studied techniques to understand better of the climate resilience architecture.

Elements of climate resilience architecture have very important role in designing the shape, size &orientation of the buildings.

If we use climate resilience architecture then our building can sustain for long time & with less maintenance.

BIBLIO GRAPHY: -

http://bundelkhandinfo.org |

http://www.bundelkhand.in |

www.wikipedia.com

World Water Vision: Making Water Everybody's Business