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Application of Water Abstraction Well to Reduce Water Level

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Abstract: This study presents a structured and environmentally sustainable methodology to investigate the effects of Water Abstraction well to reduce water level. Aimed to resolve the water table issue which become hindrance & safety hazard in excavation and construction activities, the methodology integrates controlled water abstraction from ground for faster & safe excavation, for carrying out construction activities and to protect nearby structures.

As continuous seepage of water is filling the excavation area and Manual or existing pumping is insufficient to maintain a dry working condition, resulted to soil Instability. This is because of Saturated soil becomes loose & prone to collapse and Excavated slopes & trench walls are at risk of caving in, posing safety hazards. This leads to work Disruption, which delays in excavation and foundation laying due to the need for constant dewatering and equipment & labour efficiency significantly reduced under wet & unstable conditions. In Wet conditions make it difficult to maintain dry, compacted base layers for concrete placement and also risk of poor curing and long-term durability issues in concrete foundations. It Increased Project Costs as well.

To overcome this issue, Series of water abstraction wells are connected to a header pipe for water abstraction from ground. After review of all the possible methods for lowering the ground water level, We had applied water abstraction well, As it is Cost effective, Time saving, and reliable method. It also provides Enhanced Safety, Improved Excavation Stability, Faster Progress, Equipment Efficiency & Protects Nearby Structures. Properly managed wells have a lower ecological footprint than large-scale surface water interventions like dams, which can disrupt ecosystems & displace communities and controlled dewatering prevents hydraulic uplift or ground movement, which can damage adjacent foundations or utilities.

Keywords: - Soil Instability, Saturated soil constant dewatering, Cofferdams, Hazards, Pumping Systems, Controlled Dewatering, Hydraulic Uplift, Seepage.

I. INTRODUCTION

Groundwater is a huge problem during excavation at construction sites. When digging deep, a lot of water needs to be removed using pumps, and water from nearby areas can keep flowing in. This can make nearby buildings weak and even cause them to fall. Too much water can also wash away the soil and make the sides of the hole fall in. Sometimes, water pushes up from the bottom and makes the ground under the hole weak.

To stop these problems, it's important to know about the type of soil , the amount of water underground, and how water moves through the soil. By doing this, we can make the construction work safer and economical.

Taking water from rivers or underground (called water abstraction) is done for farming,drinking, or even to stop floods. After cleaning, this water can be used for drinking. But iftoo much water is taken, it can dry up rivers and lower underground water levels. Toavoid these problems, scientists study the land and water to find out how much water canbe safely used. Dams are also built to store water and produce electricity.

Experts say that many areas in India are using more groundwater than can be naturallyrefilled. This is a serious problem in northern, western, and southern parts of the country. Pollution and changing weather, like irregular rain, are also puttingmore pressure on water sources. In rural areas, eighty five percent of the water used inhomes coming from ground water. In cities, it's 45%, and over 60% of farmland depends onit. Using too much water can affect jobs, farming, migration, and city growth. It alsomakes it harder to fight poverty in the long run. So, managing water properly is veryimportant for the future.

II. METHODS

To address the issues given by a high water table, specialised methodologies andprocedures are required to maintain the excavation's integrity and the long-term stabilityof the building foundation. Some typical strategies include:

1) Dewatering Techniques:- The most immediate concern when excavating in locations with a high water table isremoving excess water. Various dewatering strategy can be used, depending on themagnitude of the water table's impact:

2) Open Sump Method: One of the simplest forms of dewatering, sumppumps are placed installed in trenches or pits to remove water from theexcavation site. While this approach is inexpensive, it may not besufficient for large-scale commercial applications requiring considerablewater infiltration.
This is the most popular technique for dewatering groundwater. It isappropriate for the majority of rock and soil types, and the costs ofinstallation and upkeep are relatively low.This technique essentially entails installing a sump at one or more comersor sides that is below the overall level of the excavations. Theexcavation's bottom is surrounded by a shallow ditch that slopes in thedirection of the sump. The design of these drainage ditches needs to becarefully considered for large excavations that need to stay open for a longtime. In order to prevent erosion and limit the flow of ground water, theditches should be sufficiently wide. Check weirs, stone or concretepavement, and the construction of jointed pipes encircled by stone gradedor graded filter equipment are additional erosion control strategies. Thepumping sump should be situated near the base of the permeable stratum ifexcavation is to be done beneath clay and pore water is available in aupper layer covering the clay stratum. Garland drain is the name given tothis type of drain.
3) Well Point System: For major projects, a wellpoint system may berequired. Wellpoints are small-diameter wells placed around theexcavation site. These wells are linked to a pump, which draws water fromthe ground on a constant basis, keeping the water level low and promotingdry conditions.
4) Systems:- It is common practice to add well points in "ring" or "progressive"systems. When digging trenches, the "Progressive system" is used. Asmore well points are drilled and connected ahead of the section wherewater is being pumped out, the pipes are placed along the sides of theexcavation. The pumping process continues in one area as the well pointsare added and the space is filled back in once it's completed. Figures 4 shows an example of this setup.

The "Ring System" is perfect for rectangular excavations like basements orpiers because it uses a header main that completely encloses theexcavation. Figure 5 shows an example of one of these systems. A secondor succeeding set of well points must be positioned if a deeper excavationof more than 5 to 5.5 meters below standing water is necessary.

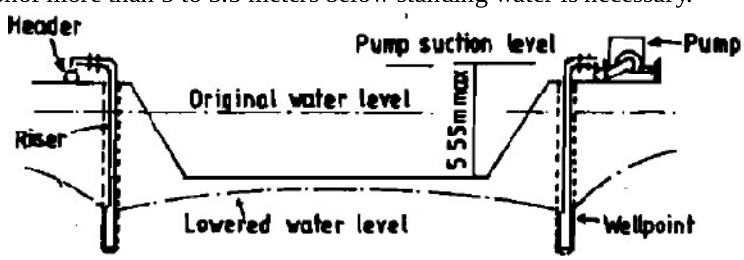


Figure 4-Wellpoint on both sides of Wide Excavation

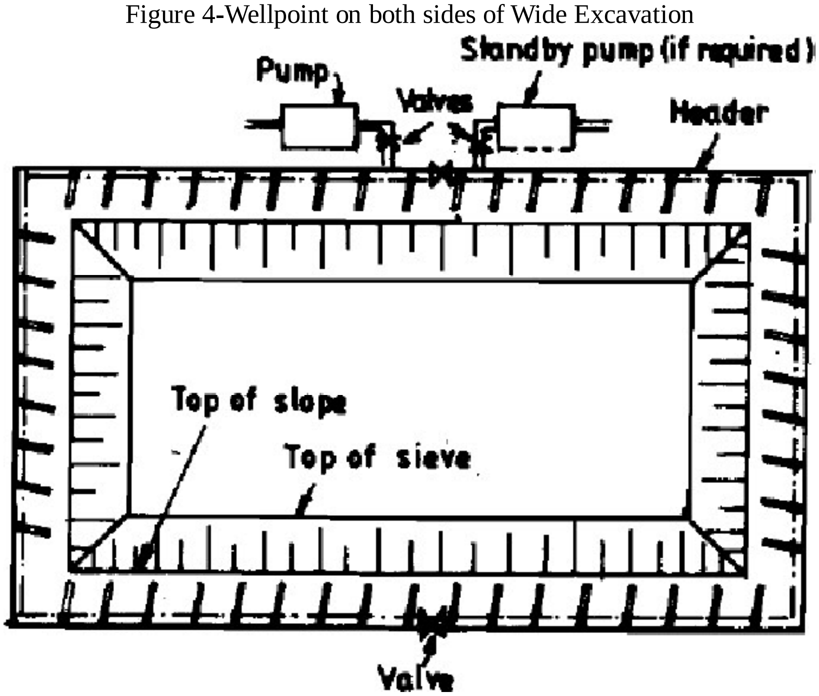


Figure 5-Single stage Well point setting up through the Loop Scheme

5) Bored Well System:- In this method, water is removed using surfacepumps that are connected to bore wells through suction pipes. Thesepumps pull water out from underground, but they can only lower the waterlevel by about 8 meters.
6) This is called the drawdown limit. This system is mainly used when weneed to remove a large amount of water from the ground. Because deepwell systems cost a lot of money, they are usually used only for big andlong-term projects. For example, they are used in places like dry docks(where ships are repaired) or tunnels that go under rivers or the sea. Thesekinds of projects take a long time to build, so it's worth using strong anddeep pumping systems to keep the area dry.
7) Dewatering the Ground Using Electro-Osmosis:- This method mentioned insections 3.1.1, 3.1.2, 3.1.3, and 3.1.4 are mostly employed for gravel and sandysoils, which are very permeable. When the soil has very fine particles like silt orclay, another method called electro-osmosis can help. In this system, electriccurrent is used to move water through the soil. Metal rods are placed in theground to send the current, and the water, which has a positive charge, movesthrough the tiny spaces in the soil toward special wells.
8) Ground Water Flow Reduction By Grouting:- Well pointing or boredwells on very permeable soils may require extremely high pumpingcapacity to be effective, making them pricey. In such cases, alternativeground water management techniques are required. By adding tiny fluidsor suspensions to the porespaces, holes, or fissures present in rock or soil,one technique is to reduce soil permeability. Grouting is the term for sucha process. Three forms of grouting will be discussed: chemical, clay, andcement grouting.
9) Cement Grouting:- Cement grouting is appropriate for circumstancesreinforcement is needed not only to make the soil or rock stronger but alsoto reduce how easily water can pass through it. This helps improvestability and prevents water from leaking through weak spots.Cementgrouting is more effective when the soil is very coarsely graded. Thisgrouting is often ineffectual in sands, with the exception of theconsolidation or tightening efforts: obtained by introdcuing at endintervals. In course rock and material, the excavations is encircled by a"grout-curtain" made up of 2 row of primary injection holes spaced twopoint five meter to five meter apart in all directions,with other holesscattered between them.
10) Clay Grouting: - Bituminous emulsion, clay, or bentoniteslurries are injected when the gravels don't need reinforcement.Sometimes, chemicals are added to help mix and spread grouting materialsbetter. This is often done to block water from passing through loose soillayers under dams or around construction sites where there's a lot ofunderground water. One common method uses bentonite clay mixed withchemicals to create a strong, water-proof barrier in the ground. Thefundamental idea is to use different amounts of bentonite clay, cement,soluble silicates, and other chemicals to create a grout that can satisfyground requirements. First, clay cement grout is used to cover the largergaps, and used the clay-chemical grout to fill the vacant pores between thefiner components.
11) Chemical Grouting: Except for the finest grades, chemicalgrouting works well with all types of sand and sandy gravels. Thecommonly use the sodium silicates for most commonly which forms asilica gel that is rather hard and insoluble when mixed with othersubstances.
12) Soil Stabilization:- Waterlogged soil is unstable, therefore soilstabilisation is essential when excavating in places with a high water table.Soil compaction, chemical grouting, and the installation of geotextilefabrics can all aid to strengthen and stabilise the soil for excavation andfoundation placement.
13) Compaction Grouting: This entails injecting grout into the soil toremove water and compact loose, water-saturated soils. The end result is amore dense and sturdy excavation base.
14) Chemical Grouting: This technique involves injecting chemicalsolutions into the soil to bind loose particles together, resulting in a morecohesive soil structure that is less likely to collapse or disintegrate underthe pressure of water penetration.

III. DESIGN MODIFICATIONS

The foundation design may need to beadjusted to account for high water table conditions. For example, floatingor mat foundations can spread the building weight over a broader area,thus lowering the danger of settlement in damp soil.

1) Floating Foundation: A floating foundation works by balancingthe weight of the building against the weight of the excavated soil, whichincludes water. It is a difficult procedure used by architects to create astable environment with a high water table.
2) Pile Foundations (or Caisson Foundations): For commercialconstructions that require deeper foundations, piles can be driven into theearth to transfer the building load to more stable soil or bedrock beneaththe water table. This approach helps to avoid soggy layers, but it comes ata high expense.
3) Diaphragm Wall Construction:-A more sophisticated kind of continuous (touching) bored pile constructionis diaphragm walls.Contiguous bored pile walls are made up of piles that are cast in such away that they contact and form a continuous wall.

There are fewer verticalseams between two subsequent panels when using diaphragm wallconstruction, nevertheless, because each diaphragm panel can only be atleast 3.5 meters long.

In India, diaphragm walls have been used extensively. Here are a fewof the most typical uses:

- basement of buildings with multiple stories.
- the dam cut-off wall.
- For subterranean constructions, such as foundations for atomic reactors
- or pump houses, etc.
- For marine constructions like wet basins
- and jetties.
- railroad project, particularly in Calcutta.
- Various uses, including filling up spaces between neighbouringmonoliths, load-bearing walls as piles, and bridge foundations.

4) Detailed breakdown of the processes:

Identifying Groundwater Potential:

- Geological Surveys:- Geological surveys has conducted to identify the presence and characteristics of aquifers (underground layers of rock and soil that hold groundwater).
- Water Table Assessment:-The depth of the water table (the level at which groundwater is found) is assessed to determine the feasibility of well construction.
- Aquifer Characteristics:-The permeability and storage capacity of the aquifer are evaluated to estimate the potential for groundwater extraction.

5) Well Construction:-

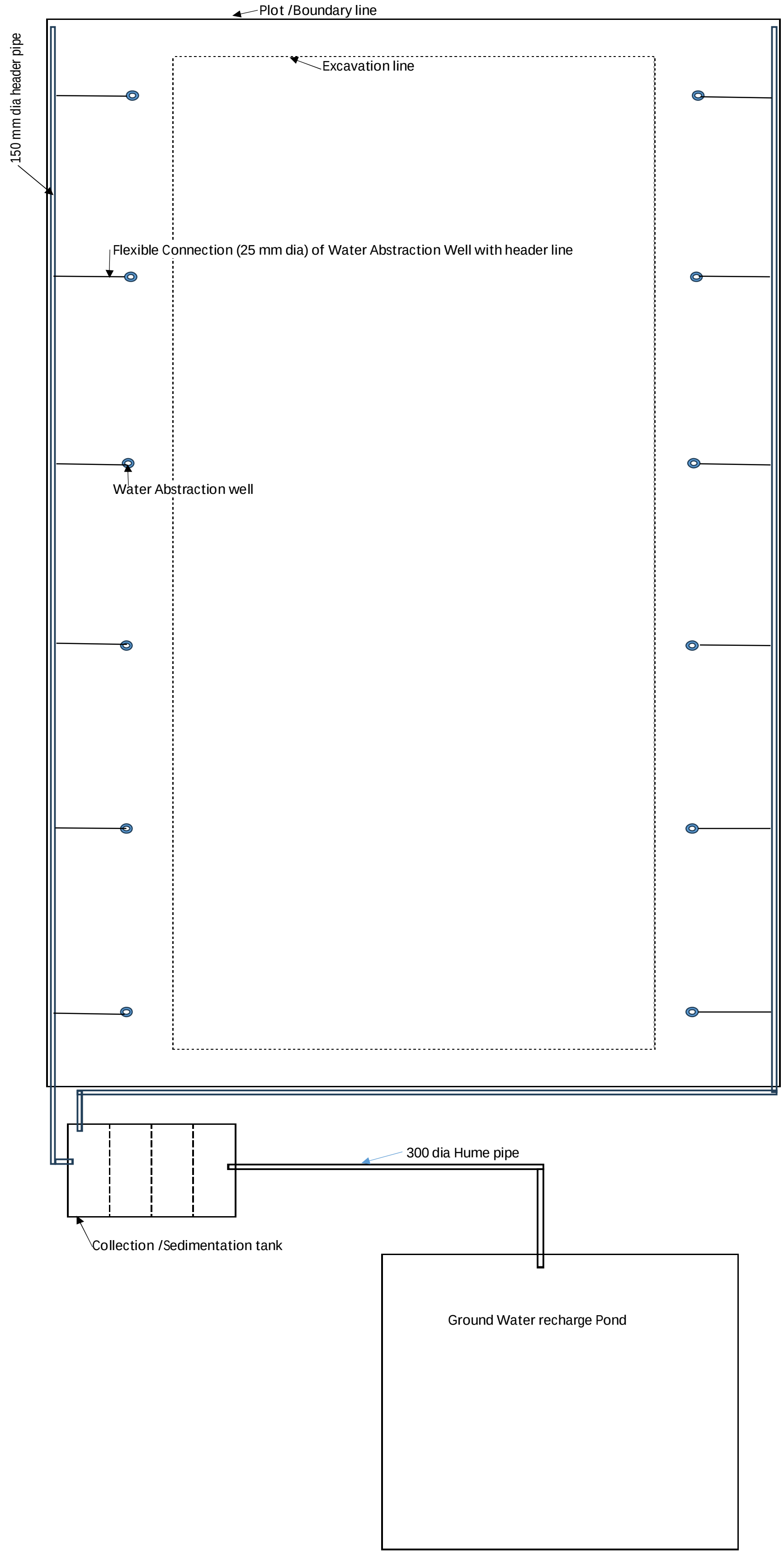
- Drilling:Wells constructed by drill in the ground until the water-bearing layer (aquifer) is reached for 200 mm dia PVC pipe by reverse circulation method using rig cutter machine.
- Well Casing:200 mm dia PVC pipe lowered in well as casings to prevent the collapse of the well walls and to ensure clean water extraction.
- 150 mm dia PVC Slotted pipe installed in bore well and bail plug has been fixed at the bottom to prevent suction of gravel.
- For filter media, Pea Gravels around the casing pipe of bore well has placed.
- Gravels are free from dust, dirt or vegetable manure.

6) Water Extraction:-

- Pumping Systems:-Pumps are used to extract water from the well, with various types of pumps available depending on the depth and flow rate requirements.
- Submergible Pump has been installed in Hydro Abstraction Well with GI Pipe, fittings, Control Panel, wire, Cable and starter complete in all respect

Telemetry piezometer has been installed at same level @ 50 m distance for self recording with reading display and 4G modem for online monitoring.

S no	Location Name	Drilling Depth (m)	Discharge (liter per hr)	Remarks
1	Hydro Abstraction well-1	20-25	7000-8000	Recommended
2	Hydro Abstraction well-2	25-30	8000-9000	Recommended
3	Hydro Abstraction well-3	30-35	9000-10000	Recommended
4	Hydro Abstraction well-4	25-30	8000-9000	Recommended
5	Hydro Abstraction well-5	30-35	8000-9000	Recommended
6	Hydro Abstraction well-6	35-40	9000-10000	Recommended
7	Hydro Abstraction well-7	25-30	8000-9000	Recommended
8	Hydro Abstraction well-8	20-35	7000-8000	Recommended
9	Hydro Abstraction well-9	20-25	7000-8000	Recommended
10	Hydro Abstraction well-10	25-30	8000-9000	Recommended
11	Hydro Abstraction well-11	30-35	7000-8000	Recommended
12	Hydro Abstraction well-12	20-25	8000-9000	Recommended
13	Hydro Abstraction well-13	30-35	8000-9000	Recommended
14	Hydro Abstraction well-14	20-25	7000-8000	Recommended
15	Hydro Abstraction well-15	20-25	8000-9000	Recommended
16	Hydro Abstraction well-16	30-35	7000-8000	Recommended
17	Hydro Abstraction well-17	25-30	7000-8000	Recommended
18	Hydro Abstraction well-18	20-25	8000-9000	Recommended



Layout of Water Abstraction well

IV. RESULTS & ANALYSIS

1) Budget and Timeline Considerations:-The existence of a high water table brings a number of additional variables that can affect both the budget and timing of an excavation operation. Here are some instances.
2) Increased Labor and Equipment Costs:- Dewatering systems, soil stabilization procedures, and specialized foundation designs all necessitate more labour, materials, and equipment. The cost of the well vary on the severity of the water level issue, but in most circumstances, they can significantly increase the entire project price.
3) Longer Project Timelines:- Managing a high water table also increases the time required for excavation and foundation construction. The additional steps of dewatering, soil stabilization, and maybe changing the foundation design might add weeks or even months to the project schedule. These delays must be accounted for in the overall construction timeline to avoid unanticipated overruns.
4) Ongoing Monitoring and Maintenance:-Long-term monitoring of groundwater levels may be required for projects where the water table is a persistent issue. To avoid future concerns, dewatering systems or foundations erected in high water table areas may need to be maintained on an ongoing basis.

A. *Key factors affecting the water table level:-*

- Proximity to Rivers and Lakes: Because of the quantity of surface water, areas near large rivers like the Ganga, Yamuna, and Rapti frequently have higher water tables. The same applies to regions surrounding lakes, such as Udaipur Lake.
- Seasonal Fluctuations: The water table rises during the wet season, which normally occurs in winter and early spring when rainfall and snowmelt fill the ground. In contrast, the water table frequently falls during the dry summer months due to evaporation and less precipitation.
- Topography: Lower elevation valleys, such as the Rogue Valley, tend to have higher water tables than hilly or mountainous locations, such as the Cascade Range, where the earth is porous and water drains more quickly.
- Soil and Geology: The type of soil and underlying geology influence water retention and table levels. For example, clay-heavy soils may store more water and have higher water tables, but sandy or rocky soils often have a lower water table due to improved drainage.

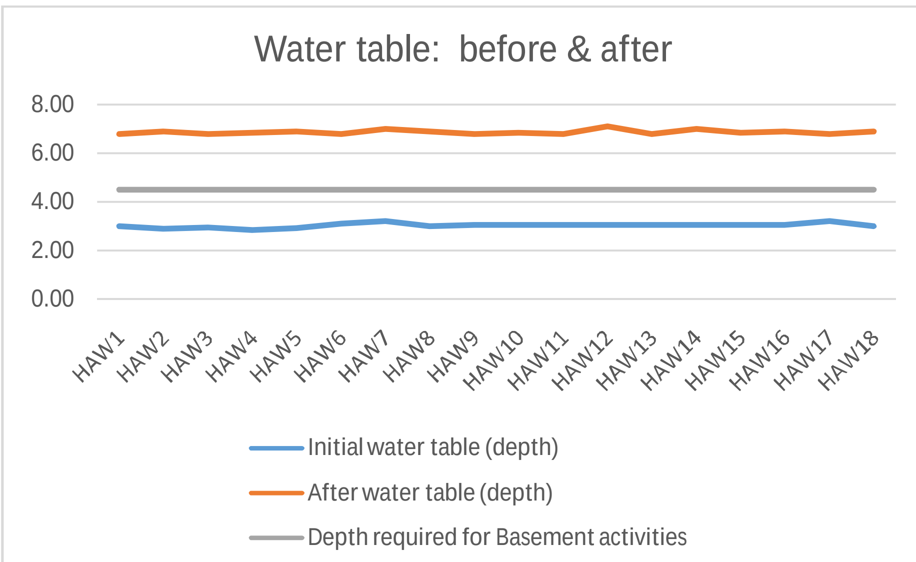
B. *Effects of over extraction:-*

- Intrusion of saltwater:-Saltwater intrusion happens when salty ocean water moves into places that usually have fresh groundwater. This can make the water salty and unsafe for drinking or farming. It usually happens in areas near the sea, where the fresh water underground is connected to ocean water.
- Groundwater Contamination:-Groundwater gets polluted in many places because we need a lot of water for farming, drinking, and supporting living things. It's important to keep this water clean, but sometimes harmful chemicals like arsenic and salt get mixed in. People can cause this pollution by taking out too much water from underground.
- Land Subsidence:- When enormous amounts of groundwater are removed from aquifers underground, it affects nearby places. When a substantial volume of water is withdrawn from the aquifer, the sediment, or specific rock types, separates due to the absence of water required to keep the sediment closely together. When people take out too much groundwater, it can cause the land above to sink. This happens because the empty spaces underground that used to hold water collapse. As a result, the ground surface suddenly drops, which can damage buildings, roads, and pipes.
- Reduced water table:-If water is removed faster than it is restored, the water table may drop, resulting in well failure and water scarcity.
- River drying:-Over abstraction can also cause rivers to dry up, as they rely on groundwater replenishment.

C. *Rules for Using Water:*

- Taking Permit- Maximum countries required for the permit to allow the water monitoring.
- Abstraction Limits:- In many places, people need to get permission from the government before they take water from rivers, lakes, or underground.
- Limiting Water Use:- There are limits on how much water a person or company can take, so that water sources don't dry up.
- Saving and Reusing Water:-People and businesses are encouraged to use water wisely and reuse it whenever possible, so that we don't need to take too much from nature.

Well no	Initial water table (depth)	After water table	Depth required for Basement activities
HAW1	3.00	6.8	4.5
HAW2	2.90	6.9	4.5
HAW3	2.95	6.8	4.5
HAW4	2.85	6.85	4.5
HAW5	2.92	6.9	4.5
HAW6	3.10	6.8	4.5
HAW7	3.20	7	4.5
HAW8	3.00	6.9	4.5
HAW9	3.05	6.8	4.5
HAW10	3.05	6.85	4.5
HAW11	3.05	6.8	4.5
HAW12	3.05	7.1	4.5
HAW13	3.05	6.8	4.5
HAW14	3.05	7	4.5
HAW15	3.05	6.85	4.5
HAW16	3.05	6.9	4.5
HAW17	3.20	6.8	4.5
HAW18	3.00	6.9	4.5

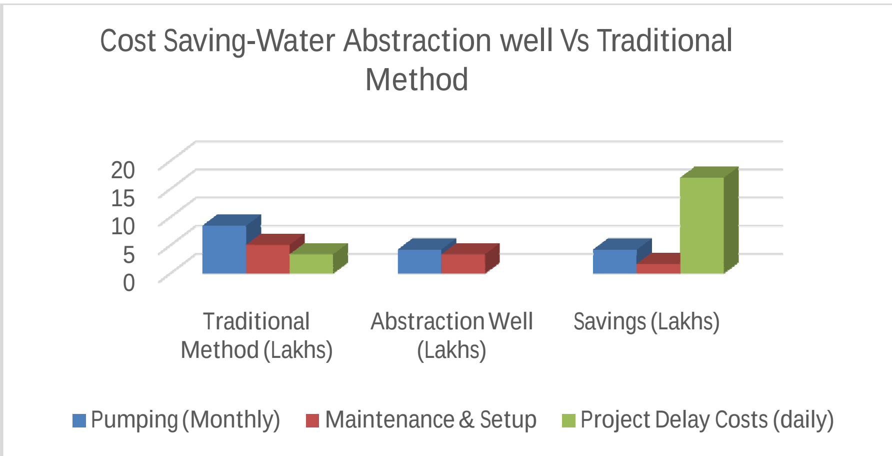


D. Cost Saving: -

- *Reduced Dewatering Costs*-
  - Conventional methods like wellpoint systems or sump pumping can be expensive due to continuous pumping and power consumption.
  - Abstraction wells tap directly into aquifers and often require fewer pumps, reducing energy and operational costs.
- *Smaller Pumping Systems*
  - Abstraction wells can yield higher flow rates with fewer wells, which means less equipment, fewer maintenance hours, and reduced installation time.
- *Faster Excavation Timeline*
  - Efficient water control allows for quicker soil stabilization and uninterrupted excavation, saving on labor costs and project delays.
- *Minimized Structural Risks*
  - Less water ingress reduces the need for additional support systems or remedial works, which can be costly if water pressure is not managed.
- *Reuse of Water*

- Abstracted water can be treated and reused for dust suppression, concrete mixing, or other construction needs, lowering freshwater usage costs.

Cost Factor	Traditional Method	Abstraction Well	Savings
Pumping (Monthly)	850000	425000	425000
Maintenance & Setup	510000	340000	170000
Project Delay Costs (daily)	340000		17 Lakhs + 5 days Saving in a month



E. Time Saving Benefits of Water Abstraction Wells in Excavation:-

- *Faster Excavation Progress:-*
- Removing excess groundwater makes soil drier and more stable, allowing machinery and workers to proceed without delays due to waterlogged conditions.
- *Reduced Delays from Equipment Stuck in Mud*
- Keeps the work area firm and accessible, avoiding stoppages caused by bogged-down equipment or unstable ground.
- *Fewer Slope Failures or Collapses*
- Stable excavation sides mean fewer interruptions from collapsed trenches or the need for extra shoring.
- *Speedier Installation of Utilities or Foundations*
- Dry ground improves the speed and accuracy of laying pipes, cables, or foundations.
- *Less Cleanup and Pumping During Work*
- Continuous groundwater control means less time spent removing water manually from pits or dealing with silty messes.
- *Improved Safety- Fewer Downtime Incidents*
- A dry, stable environment reduces accidents and injuries, which could cause project delays.

Method	Site Preparation	Excavation	Foundation works
Without well	30	90	190
With well	10	30	90
Time saving	20	60	100

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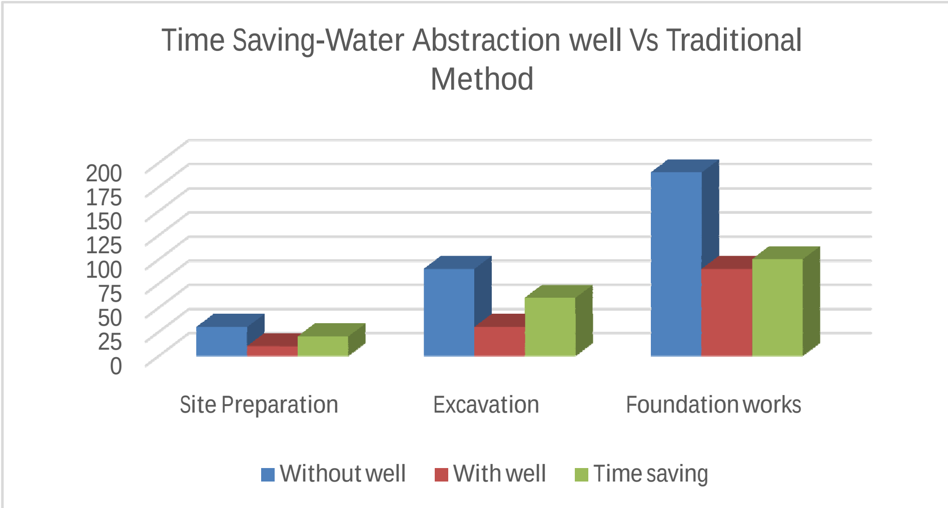


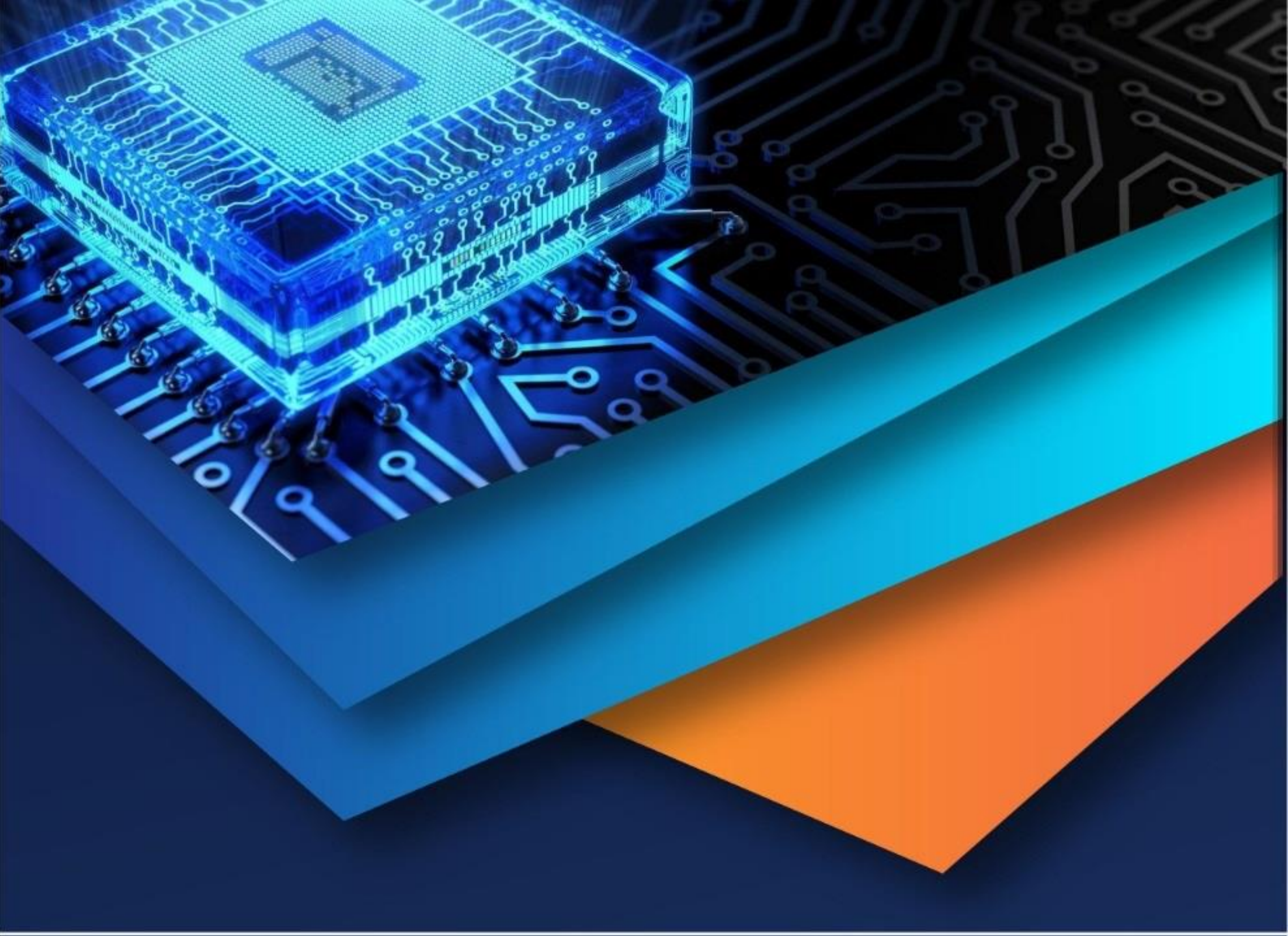
Total possible time Saving is 6 months after utilization of Water Abstraction well against traditional method

V. CONCLUSION

1) Achieved dry condition by dewatering through water abstraction well for construction of Basement activities like Base Plain Cement Concrete, Raft /Foundation- reinforced cement concrete etc.
2) Possible time saving is 6 months across the project phases
3) Provides a safe and stable environment for both workers and equipment.
4) Faster project completion and significant cost savings of 4-5% of total project cost.
5) Water Abstraction: Taking water from natural sources is important for drinking, farming, factories, and making electricity. But if not done carefully, it can harm nature. We need to use water wisely to make sure there's enough for future generations.
6) Protecting Nature: Taking water from rivers and lakes can affect the flow and health of the environment. That's why we need plans to measure how much water is available, how much is needed in the future, and what could happen during dry seasons. This helps us manage water better.

REFERENCES:

[1] Chaddha, D.K. (2006)- Development and management of ground water resources of India: an Overview. In Groundwater Modelling and Management, edited by N.C. Ghosh and K.D.Sharma, Capital Publishing Company, New Delhi.
[2] CPCB (1999) -Water Quality Status and Statistics 1996 & 1997. Central Pollution Control Board, New Delhi, 403 pp.
[3] National Water Policy (2002)- Ministry of Water Resources, Government of India, New Delhi.
[4] Central Ground Water Authority Ministry of Water Resources, Guidelines /Criteria for evaluation of proposals /requests for ground water abstraction (With effect from 16.11.2015)
[5] IS 3764 : 1992- Excavation work- Code of Safety
[6] IS 1904:1986- Code of practice for Design and Construction of Foundations in Soil: General Requirements.
[7] Book: Ground Water Abstraction Structures (Springer Briefs in Water Science and Technology) by Divya A.S. (Author), Joji V.S. (Author)
[8] Water abstraction works- By Prof. Konstantinos Mattas & Dr. Christos Mattas (January 2018)



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