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A Review of Water footprint in Building Construction

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ABSTRACT
The construction of any building consumes so many resources, among them one of the valuable resources is water. During building construction and manufacturing of different materials water is highly used and there is no proper data for usage of water. The previous research papers investigates water consumption of a particular buildings by visiting site and did the dcomparative study on data. The use of water is unavoidable but it should be conserved as we know the importance of fresh water in our life. The exhaustive use of water results in waste so to mitigate this problem, this paper shows some ways to conserve water during construction.

Keywords:-*water consumption, water footprint, building construction*

INTRODUCTION

The water issue in India currently tops everyone's list of worries. According to the Water Stress Index published by a London-based risk research company, 11 out of the 20 Indian cities are at "severe risk" of a water catastrophe, and seven of those are at "high risk."

Additionally, it emphasizes how vulnerable Chennai and Delhi are as well as Surat and Bangalore, the two cities with the highest water demand [6]. According to a 2018 NITI Aayog assessment on groundwater levels, 21 Indian cities might run out of groundwater by 2020. These include metropolitan areas like Chennai, Hyderabad, Bangalore, and Delhi.

Construction sector and water Crisis

By 2025, the real estate industry in India is projected to contribute 13% of the nation's GDP, citing the IBEF research. However, according to the most recent NITI Aayog assessment, the water problem will cost the economy 6% of its GDP by 2050. This suggests that it is past time for realtors to recognize the need of effective water management at construction sites (Solanki & Paul, 2022)

According to a study conducted by Jadavpur University in 2016, the average water consumption in Indian urban buildings is around 27 kiloliters per square meter of the total built-up area. While the actual construction used two kl/sq m of water, the embodied water of significant building materials was in the range of 25.6 kl/sq m. The study emphasized the need for increased water awareness and prudence at the material production stage, whether it be during the production of bricks, steel, or other construction materials.[2]

AIM AND OBJECTIVES

The aim of the study is to perform a comparative study on reduction of water footpint strategies in buildings. Following are the objectives to achieve the aim:

1) To obtain and analyze water footprint data for construction.
2) To find management strategy to reduce water footprint.

3) To explore different ways to reduce water consumptions.

LITERATURE STUDY

Impact of water consumption by buildings

Buildings are one of our basic need of food, cloth and shelter hence it is unavoidable also. Water consumption during manufacture of these material as well as duing the construction is increasing day by day. The ddemand for the vaious buildings is also highly increasing. Due to these increased demand of water, many alternative material and methods are evolved to reduce the water demand.

Many issues related to water are arousing these days. Acoording to studies from World Buisness Council for Sustainable Development (WBCSD) by 2030 there will be additional water stress load of 500 billion people in the BRIC (Brrazil-Russia-India-China) countries. In India, the National Action Plan for Climate Change (NAPCC) and its constituent National Water Mission have set a goal of 20% greater water use efficiency to address the issue. The Indian government's National Water Policy has suggested water zoning as a way to coordinate economic activities like agriculture, industry, and urban development with the availability of this resource that sustains life . In terms of urban growth, the building sector is widely known for being a significant consumer of water resources, which are frequently bore-well-extracted groundwater supplies [2,3].

Need to reduce water footprints of constuction

Indians have always faced a scarcity of water. Less than 1,700 cubic metres of water per person are deemed to be under stress, while India now has 1,545 cubic metres per person available. The Ministry of Water Resources anticipates that by 2025, there may only be 1,341 cubic metres of water available, and by 2050, there may only be 1,140 [5] . The country has occasionally experienced severe drought conditions that have a negative impact on livestock, agriculture, and other sectors. This time, a major water crisis has affected Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, and Telangana, 5 states in South India . Knowing all these, this issue has being even more serious and proved us that we need to save water resource as it is one of the major lifeline for us [2]

Techniques / ways to conserve water in construction

Flyash as an altenative in concrete

Fly ash has siliceous and aluminous properties and can partially or significantly replace cement in concrete mixes. Due to its Low Embodied Energy (LEE), which indicates that significantly less energy is needed for its overall processing, using fly ash proves to be a cost-effective solution that is also acknowledged as being environmentally benign. Less water is needed and improved workability is provided by concrete mixes including fly ash at the same water content.[1]

Adopt Alternate Methods of Curing

The most encouraging outcomes come from drip cure, a new method built on the idea of drip irrigation. Practically speaking, on-site drip curing provides the highest level of compressive strength while also utilising water resources most effectively. Water is applied straight to the desired site or region while drip curing, minimising transportation losses. In addition, wet canvas can be used to cover the concrete surface to improve the effectiveness of curing. Membrane curing is occasionally favoured because wet curing typically uses less water because the membrane helps to maintain a comfortable and ideal temperature, eliminating needless evaporation water loss.[2]

Use of Water Reducing Admix

By using these admixtures, you can minimise the amount of water needed while still getting the best possible consistency and workability, i.e., you can get a given workability at a lower water-to-cement ratio, which also leads to improved strength and durability. Additionally, it lessens permeability and concrete porosity, which further reduces water loss.

Admixtures that lower the amount of water actually neutralise surface charges and improve dispersion, which reduces cement particle flocculation and increases slump. Seveal addmixtures and chemical compounds are availavle now a days which can reduce waterfootprint by 10-12% and increase its durability and strength also.[1]

Dry mortar to reduce water consumption

The preparation of the mortar and the curing process typically utilise the most water. Using dry mortar instead of wet mortar effectively minimises the amount of water needed. Additionally, using dry mortar fully eliminates the requirement for curing. This facilitates significant water conservation during the planning stage of a project.[2]

Proper Management of Resources during construction

In order to conserve water during construction, proper management is required. Recycled or saved water from harvesting can definitely be used for things like cleaning working areas and cleaning equipment, among other things. On the off chance that saving water is central issue, while cleaning site and gear a nonstop water course through pipes should be stayed away from and application in little bundles like containers may be utilized.[1]

Methods to calculate inherent and during construction water consumption

For studying of the water consumption by a particular building, casestudies were conducted to calculate its consumption in two stages, first is the inherent water of major materials, for this vaious factuories is contacted for the related information also case studies were conducted to know the induced water of vaious materials and second is the water required during construction of a builing, taking the working hour of electric pumps and its capacity per day and since the working hours slightly differs on the regular basis, hence it is taken as uniform for the entire duration of project and calculated the demand of the building during its construction. Some of the results of these studies are; [1]

Table 1:*-Assessment of embodied water in the materials of the case study. [4]*

Sl.	Materials	Quantity used	Unit	EW Coefficient	Total Embodied water in material	Embodied water per unit floor area
				Kl/unit	Kl	Kl/Sq m
1	Cement	154,858	Ton	1	154,858	0.5
2	Bricks	42849.37	Cum	0.71	30423	0.1
3	Steel	38906	Ton	200-250	7781200	25
4	Aluminium	15143	Kg	0.088	1332.584	0.004
	Total embodied water of the major materials					25.604

Table 2:-*Water consumption for 68 months during construction [4]*

A	B	C= A/B	D	DxC/1000
Energy consumed in 21 months	Capacity of Water Pumps	Duration of operation	Yield of bore well	Total water consumed
KWh	kW	Hours	Litres per Hour (lph)	Kl
972319.44	5.595 (7.5 H.P) &7.46 (10.0 H.P.)	24826.23	18,000 & 24,000	
	Average: 6.5275			
	For 6 pumps: 39.165 kW		21000	521350.83

Also it has been analysed in studies data that by using water reducers and curing compound, a large amount of poratable water can be reduced. Taking these steps will reduce water demand and have a very good impacts on our one of the major issue of water scarcity facing by the whole world [2,3].

In addition, 'Evaluating Water Footprint of Building Construction in India' research paper is taken as reference to compare water consumption of a building which is traditionally built to the building in which several alternate methods and materials are used to reduce water consumption [10].

To compute reduction in water consumption by materials are categorize into two, first which cuts the use of water directly and other which reduce the water footprint during its construction phase. Its comparison using more research paper and case studies of material should be done as it is vey important to combat water scarcity and reduce the waste of our pecious source of life.

CONCLUSION

It the present study it can be concluded that the induced water demand is much more than the water footprint during construction phase. Hence we can conclude that more focus should be given to save and recycle water during manufacturing stage of materials only so that large amout of water can be saved. Also a good poject management is needed fo efficient use of material and reducing the waterfootprint of the building by using altenate methods.

The present water footprint study shows the issues and focuses on some major material only. Therefore more material should be lookout with less embodied water content and suggest this materials as an alternative especially of those who have higher embodied water content. Also other types of structures should be studied and suggest or present comparative data of water footprint required for all the structures [7].

It has also been concluded that the average water footprint of medium-rise residential buildings with shallow foundations is estimated to be 11 kl/m2 of floor area, while that of medium-rise residential buildings with deep foundations is 18 kl/m2 of floor area. High-rise residential buildings, which by definition have deep foundations, are estimated to have an average water footprint of 26 kl/m2 of floor area.

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