Focusing on Induced Virtual Water

Ankit Pahade, Pranay Khare

Abstract- **The earth's surface is filled nearly 70% of water but only 3% of this water can be used as potable water. In present days with rapid urbanization and rapid increase in population water conservation has become a major issue. Now days, reduced water consumption is one of the most important objectives of many towns and cities as part of the trend towards more sustainable strategies. As around we see when construction of buildings takes place, there is lot of wastage of water occurs on site, this can be reduced to great extent by using new materials and various innovative techniques. This paper gives various materials and new techniques to reduce consumption and wastage of water on construction site.**

Index Terms-**building, construction, consumption, material wastage, water.**

I. INTRODUCTION

Water is scarce. Yet, we take it for granted, we waste it. It is the foundation of life, a basic human need. Yet today, all around India far too many people spend their entire day searching for it. It is important to appreciate the fact that only 3 per cent of the world's water is fresh and roughly one-third of it is inaccessible. The rest is very unevenly distributed and the available supplies are increasingly contaminated with wastes and pollution from industry, agriculture and households. Central India is more water-deficient. The Maharashtra state has experienced serious drought. The region of Marathwada has been worst-hit, with a drought-like condition declared in every single village.

Construction industry is regarded as one of the largest users of water along with energy and material resources. However, amount of water consumed by the construction activity is unknown. There is requirement of identifying the process and activities that consume more water, quantity of water required and also best practices for reducing water consumption during the construction. What we see around us is huge wastage of water at all the constructions site's around, weather we go out for a site visit or we just pass by a construction site, unrestricted use and wastage of water is what is been observed.

The construction industry is very water dependent, directly via material and processes such as water for concrete, water for dust suppression, water for cutting, water for mortars etc. and, indirectly, with embedded water in all construction products. Life cycle water demand of building can be classified in three stages i.e. stage 1 inherent virtual water (embedded water), stage 2 induced virtual water (on site during construction) and stage 3 operational water use. In all these 3 stages most of the studies focus on operational use of water, i.e. when person lives in building then how to reduce water use. Till now very less study was done on stage 2 i.e. water use during construction on site. Hence there is need of research in this part. With the use of new materials and innovative techniques we can reduce excessive use of water on construction site.

Ankit Pahade, Department of Civil Engineering, DYPSOET Lohegaon, Savitribai Phule Pune University, Pune, Maharashtra
(e-mail: pahade.ankit1@gmail.com)
Pranay Khare, Assistant Professor in Department of Civil Engineering, DYPSOET Lohegaon, Savitribai Phule Pune University, Pune, Maharashtra
(e-mail: pranay.khare@dypic.in)

II. ANALYSIS TO REDUCE WASTAGE AND CONSUMPTION

There are various methods, products to reduce the water quantity on site. Now days, admixtures are rightly considered as the fifth ingredient of concrete. The admixtures can change the properties of concrete. Commonly used admixtures are Plasticizers, Superplasticizers, Air entraining agents, Water proofing admixtures. It helps us in increasing the workability of concrete without addition of water. Water proofing chemicals have double action of blocking capillary pores and reducing the size of capillaries that may act as conduits for water. Most waterproofing agents have plasticizing effect and help to reduce water/cement ratio. These admixtures help to lower the water /cement ratio hence reduces permeability of concrete. It also reduces bleeding in concrete. The use of AAC blocks & gypsum plaster combination over Burnt red clay bricks & sand-cement plaster is very efficient as there is saving in use of water in both production and curing stage. As gypsum plaster does not require curing and sand cement plaster require a lot water curing. The brickwork also requires curing and AAC blockwork does not require any type of curing after construction. Hence these types of new materials should be use in future to reduce wastage and consumption of water.

Type of curing method adopted also plays an important role in the water requirement. Various methods of curing includes water curing, membrane curing, steam curing. Curing process done with the help of water is one of the most commonly and widely used as it satisfies all the requirement of curing which are promotion of hydration process, elimination of shrinkage and absorption of heat of hydration. In some cases of membrane curing method is adopted is found out to be desirable that up to some extent water curing is done before the concrete is covered with membranes.

Spraying of water on bricks

Curing of vertical member bricks

In some cases wet coverings such as gunny bags hessian cloth jute matting straw etc., are used to wrap around the concrete surface to keep them wet and moist. Fogging or spraying with water is excellent methods of curing when the ambient temperature is well above freezing and humidity is low. Wet coverings of earth, sand, and sawdust are effectively used for curing purpose. Wet hay or straw can be used to cure flat surface if used it shall be placed in layer of at least 150mm and is held down in its place with the help of wire meshes so that the possibility of it been blown away by the wind is taken care of.

Curing of concrete slab using gunny bags

Left in place forms usually provide satisfactory protection against moisture loss for formed concrete surfaces. The forms are usually left in place as long as the construction schedule allows. If the forms are made of wood, they should be kept moist, especially during hot, dry weather.

Curing using chemicals sprayed on concrete

Sometime concreting is carried in such places where there is acute shortage of water where lavish use of water curing is not possible for the reasons of economy also when concrete is placed in areas which are not properly accessible to the labors and they usually tend to neglect the curing of this area in such cases membrane curing is adopted rather than leaving the responsibility of curing to the labors.

Curing of vertical member using gunny bags

The basic concept of membrane curing is that the water used to mix the concrete is not allowed to go out from the body of concrete; obviously this water helps in uninterrupted and progressive hydration. When waterproofing paper or polyethylene film are used as membrane, care must be taken to see that these are not punctured anywhere and also see whether adequate lapping is given at the junction and this lap is effectively sealed. In today's world where we see increased volume of construction, shortage of water, need for conservation water increase in the cost of labors, the availability of effective curing compounds have encouraged the use of curing compounds in concrete construction.

Curing of concrete slab with covering plastic

Construction of a structure requires use of various construction equipments right from a trowel, spatula to a concrete mixer or a RMC truck. Most of these equipment need to be cleaned at a regular interval as in these equipment can be maintained in good working condition. The amount of

water required for cleaning of these equipments is generally not measured or can be said to be ignored as water isn't considered that important in concern of its cost. But a substantial amount of water is been used without any concern regarding the wastage of water. This unaccounted usage of water for cleaning and maintenance of these equipments if considered will bring to light the substantial amount of water required in these processes. Hence it is important to take in account this amount and also take some steps to reduce the amount of water which is being used in these activities to a certain extent.

Water meter at construction site

A suitable arrangement for runoff of water in monsoon and the runoff due to the surplus water used in the concreting process and in the curing process at a construction site is an important factor. In usual case this factor is mostly neglected even after being important, as it requires a subsequent amount of investment into it. If a suitable runoff arrangement is present at a particular site it helps in reuse of water which is obtained by surplus water from water which is used for various construction activities which is generally considered as wastage.

Collection of water (Each & every drop to be utilized)

As we come in the Indian sub-continent our country receives a sufficient rainfall for a period of about 4 months a year. This water generally flows away as runoffs through nallas and other water bodies into the Arabian sea and the Indian ocean without being sufficiently utilized. If this water is utilized properly right from the instance it falls on the ground it can lead to great water revolution. To be specific in regards of a site if a proper runoff and storage arrangement is done for the rain water it would help in reducing the amount of water which needs to be bought to the site though various other means.

Following the initial auditing program, it became clear that the one area where all sites could make improvements to water efficiency was domestic and welfare water consumption. This water requirement is unique at construction sites, in that it is present at each site for (generally) the full project duration. As such, it seems to account for a significant portion of a site's water consumption, and represents an excellent (and relatively simple) opportunity for improving water efficiency in the construction sector.

Another area where the majority of sites could improve was monitoring and targeting of water consumption. Where a site is unaware of how much water they are consuming (this was particularly prevalent at sites which did not pay for their water consumption on a variable basis), they are less likely to make improvements in this area. As such, ensuring each site is aware of exactly how much they are using (at a minimum) is likely to help promote a more water efficiency culture.

Leakage should be repaired immediately

Leaks were observed (or suspected) at multiple sites, some of which accounted for a significant portion of a site's water consumption. In addition, unrepaired leaks can act to detract from a water efficient culture, and may lead to additional water efficiencies elsewhere on site. As such, site management should ensure that a formal system is in place for checking/reporting/repairing leaks, on a regular basis.

There are 4 key areas which construction companies should consider. In typical order of priority, these are:

Ensure all areas of site water consumption are quantified, Record site water consumption on a regular basis, Create Key Performance Indicators (KPIs) to assist tracking of water efficiency, Utilize consumption or KPI data to set improvement targets.

In recent years there has been a growing realization that the increasing demands for water throughout India are not sustainable. As a result of increased understanding of the problem there has been a move away from the traditional approach of just increasing supply, through developing new resources and transfer schemes, to demand management. Demand management focuses on the more efficient use of water, reducing losses, less wasteful use of water, more efficient appliances and water recycling. In many cases it is cheaper and more effective to improve water use efficiency than it is to increase water supplies.

III. Conclusion

Life cycle water analysis of buildings is important topic of research in construction sector. Most of the studies focus on operational stage water use. There is need to focus on water usage during construction phase of building. We can save many litres of water during construction activity. Though today people consider water as cheap commodity in near future it will cost us more, we have to leave 'Don't Pay- Don't Care' attitude towards use of water. Thus there is tremendous scope of using new materials and innovative techniques in reduction of consumption and wastage of water.

Acknowledgment

I express my profound gratitude to our project guide Prof. Pranay Khare and Prof Milind Darade for their inspiring guidance due to which our difficulties and questions were shaped into the development of this paper and complete support, co-operation and valuable suggestions.

I would like to thank Principal Dr. Ashok Kasnale and H.O.D Dr. Sanjay Kulkarni, who were the source of inspiration throughout the making of this project and helped us to accomplish our goals in a much easier and healthy way. I would also like to thank my friends who gave me complete support for site work.

References

1. Cement.org/tech/pdfs/pl972.pdf, Portland cement association
2. *Jerzy Z. Zemajtis*, "*Role of Concrete Curing*"
3. Livemint, 6 charts that explain India's water crisis
4. Michael McCormack and Robert Crawford, "*Modelling direct and indirect water requirements of construction*"
5. Nirav R Kholia, Prof. Binita A Vyas and Prof. T. G. Tank, "*Effect on concrete by different curing method and efficiency of curing compounds- A review*", published in International Journal of Advanced Engineering Technology.
6. Saeed Ahmad, Attaullah Shah and Karamet Ali, "*Effect of water reducing concrete admixtures on the properties of concrete*"
7. S. Bardhan, "*Assessment of water resource consumption in building construction in India*", Dept. of Architecture, Jadavpur University, India
8. Suchandra Bardhan and Indraneel Roy Choudhuri, "*Studies on Virtual Water Content of Urban Buildings in India*", published in Indian Journal of Science and Technology.
9. theconstructor.org/practical-guide/quantity-of-cement-sand-calculation-in-mortar
10. Usha P. Raghupathi, "*Urban water scarcity: Challenges and Actions*", Water Forum, 7th GRIHA Summit, TERI
11. Waidyasekara K.G.A.S and De Silva M.L.D, "*Value of Sustainable use of water in construction industry*", Department of Building Economics, University of Moratuwa, Sri Lanka
12. WWW.cement.org/for-concrete-books-learning/concrete technology/concrete-construction/curing-in-construction