MANTECH Publications

Journal of Water Resource Engineering & Pollution Studies

Volume 7, Issue 2, May-August, 2022

State of the Art Energy Saving Techniques & Implementation Module for a Green Residential Building

Ashutosh Virkhare[1], Prof. H. P. Nistane[2]

P.G. Student[1], Professor[2]

Department of Civil Engineering

Prof. Ram Meghe Institute of technology and Research, Badnera SGB Amravati University, India

Corresponding Author's Email: - *ashutoshv2702@gmail.com*

Abstract

The objective of this study is to achieve economy while delivering the best performance in order to maintain green building status. However, these discussions of green Building quality have not included many specific recommendations or criteria for building design, construction, or operation. Building projects described as green building demonstration softens make reference to indoor air quality, solar power & Rainwater harvesting but these references are often general and qualitative. In addition, Features that have been developed to assess the "greenness" of a building are based largely on design features and are not particularly specific with respect to indoor air quality & Water conservation Electricity. This Project studies the features of indoor air quality that are considered in green building discussions, demonstration projects. These green building features are discussed in terms of their completeness and specificity, and are compared to other guidance on building design, construction, and operation for good indoor air quality and other green building specific options. A case study of indoor air quality performance in a green building is presented. This study includes a various measure that can be implemented in a building which will help a building to receive the Green Building status.

Keywords*: Solar Energy, Rain Water Harvesting, Indoor Air Quality, Thermal Comfort)*

INTRODUCTION TO THE CORE GREEN BUILDING CONCEPT

Yuming Liu et.al. (2013) In order to initiate economic evaluation of green buildings and foster their development, this article conducts the cost–benefit evaluation of energy efficiency technology application on green buildings in China and can be considered for the other countries as well . Based on the economic evaluation theory of construction project , the authors first establishes the theoretical framework system of cost–benefit evaluation of the on green buildings and then develops the analysis methods of incremental costs and quantitative calculation formula of incremental benefits of the on green buildings. Using these theories and methods, this article takes the City project in China as a study case, conducts the cost–benefit empirical analysis of the on green buildings, and draws the following important conclusions: (1) the incremental costs of the account for a large proportion of total incremental costs of green buildings, which are more than 50% in this case; (2) the on green buildings can bring incremental economic benefits, as well as environmental benefits; (3) if only

consider the incremental economic benefits of the on green buildings, the financial evaluation indexes show green buildings do not have market investment potential; (4) among all the factors influencing the financial evaluation results of the on green buildings, power price is the most sensitive factor, followed by the unit incremental costs, and the lifetime has the smallest influence.

Delia D'Agostino et.el.(2017) Reducing energy consumption in buildings and increasing renewable production are key goals of global policies to achieve a sustainable and competitive low-carbon economy by 2020 and beyond. Residential & Non-residential buildings constitute a heterogeneity sector characterized by high energy consumption and various building types, sizes and energy characteristics over Europe. This paper presents the overall results of the data collected by the Green Building Programme (GBP), launched in 2006 to promote and improve energy efficiency in new and existing European non-residential buildings. The GPB involved building owners willing to adopt energy efficiency measures to decrease energy consumption of their buildings by of at least 25%. Based on voluntary participation, hundreds of partners joined the project, which collected data from more than a thousand buildings of different age, size, use and type (such as houses offices, hotels, and industry.

Features & Economy of the Green Building

Li, Yujie Lu et.el.(2019) Fulfilling the green building objectives will provide understanding of the cost effectiveness of green buildings and help to make insightful decisions on green building investment, resource allocation, and value- added asset operation for achieving optimal economic returns. Lessons from this national-level empirical study would also enable policymakers to strategically examine the validity of the green building certification system and even re-design their respective green building initiatives, incentives and programs .

Charles J. Kibert et.el.(2016) A robust high performance buildings movement to rethink built environment is rapidly emerging and affecting the d construction, and operation of new buildings; changing renovation process for existing buildings; and reshaping cit communities. The terminology used here to describe the ne of facilities resulting from this rethinking is high performance buildings. As is the case in many countries around the wor movement in the U.S. is growing at an explosive rate and emery on the radar screens of a wide range of actors, from de politicians, from designers to builders, from manufacture academics. This paper will provide some background on buildings and a historical perspective on the international building movement in general and the U.S. movement m specifically as is the case with any other truly serious efforts roots of its existence are important to appreciate its evolution current status.

ROLE OF RWH (RAIN WATER HARVESTING) AS AN INDEPENDENT ASPECT IN GREEN BUILDING

Boers & Asher (1981) addressed the design aspects of MCWH befitting the size of collecting area and layout to the contributing area owing to kinematic wave equation and dynamic equation with picturing the rainfall inducement and collection. The advantage of MCWH over RFWH is that threshold retention is much greater than RFWH and has high specific runoff yield than other small catchments whereas RFWH is limited to just farming and agro based needs. The factors determining the various features of MCWH and RFWH are determined for model development IB and SR.

Goel & Kumar (2004) proposed a generalization to find the best suitable economic analysis of watershed in rain water harvesting. The purpose was to increase the agricultural productivity and minimize soil erosion I the mountainous

region of India. With an estimated life of water retaining structures of different sizes ageing 25 to 40 years, the ratios were found out to be 0.41 to 1.33. The PVANR i.e. valuation of construction and maintenance for present value was $215/ ha. Made on the basis of sizes and the value decreased with the increase in the size of the structure. It was projected that the overall expenditure projected was around 15.15-2.20 m US$ and the net income from the proposed catchment plan would be around 1.18-3.86 m. hence it underlined that projected cost will be recovered in 13.17 years if the minimum life span of structure is 25 years.

Gupta & Sisodia (2019) showed that how the rain water can be used for different purposes and how its utilization can decrease load on the underground aquifers. The area of design was in a university in a semi-arid region of Rajasthan which receives rainfall less than 669 mm annually. The study was conducted over three surfaces concrete roof, hard pavement and garden respectively and was found that the overall system was efficient 70% for the concrete roof, 60% for the hard pavements for total rainfall. To predict the exact amount of water collected and its efficiency adequate runoff coefficients according to the surface and its material are selected. In the analysis, the system improved 10% of the daily inefficiency per student in the summer for around 4 months.

Helmreich & Horn (2008) gave general model of the RWH in semi-arid region n of sub Saharan Africa where discrete water flow components are used for the rainfall partitioning. The soil evaporation accounts for 30 50% of the losses and 10 to 25% is surface runoff whereas the surface runoff is subsequently increased when the surface is hard and paved. It was then combined with the statistical data depicting the demand satisfied with the tank size and was found that the graph tends to get linear with the increase in the size of the tank.

NEED OF WATER CONSERVATION

Jasrotia et al. (2009) proposed a method for a water balance approach of rain water harvesting using GIS techniques and remote sensing techniques. Judicial of the depleting and limited fresh water resources the study was conducted in Devak rui watershed in J&K where the remote sensing and GIS approach was taken to resurface information about watershed boundary drainage and network boundary by the integration of land use map a defined map was laid out to redefine

RWHS by mapping the soil texture, runoff potential and slope and contours of the region. The Thornthwaite and Mather's model was used to determine runoff and actual evapotranspiration. The overall data was then presented as monthly variation of precipitation, potential evapotranspiration, actual evapotranspiration and runoff

Jothiprakash & Sathe (2009) determined the number of structures and the suitable RWH method by the application of analytical processes such as analytical hierarchy process determining volume of water to be stored using mass balance method ripple diagram method, analytical method and sequent peak algorithm method. The research is also elaborated by considering economy in action if the site is considered with the site size and all the other parameters the recharging of groundwater will be the best suitable option. The area of study is a large automobile factory in Nasik Maharashtra India which has a large area of catchment. It was identified by the process the identical volume was 55000m3 resulting in four RCC cubical tanks of 4m height as an appropriate choice for the catchment.

Kadam et al (2012) identified the RWH sites in part of Deccan volcanic province, India using SCSCN method which showed the high runoff potential from water body agricultural land followed by settlement open forest areas. Physical parameters were also considered for identification of structures. The study area described the hydrological soil group with physical features specific to site such as slope and runoff. It resulted in average accuracy of SCSCN 86.25% considering various structures accuracy.

WATER MANAGEMENT & PLANNING

Kumar et al. (2006) considered the critical issues for basin planning and research for rain water harvesting identifying them as water supply potential in water scarce regions, complexities in assessment due to deficiency of inflow runoff data evaluation of RWH, maximizing the hydrological benefits and cost benefits trading hydrology, optimizing upper and lower water basins, improvement in locally harvested water and reduction in the utilization of augmented water integrating the surface- ground water. The paper shadows the dark regions where economic evaluation of the water harvesting system poses several complexities on the basis of economic studies where problem is in quantity of hydrological benefits and directed to view of action where water harvesting can be

made efficacious by developing better catchment hydrology, improving wet saving and enhancing green water for harvesting.

Mishra & Tembhurkar (2018) discussed the application of filters such as sand and foam filter in combination for rooftop RWHS in buildings such that the water shortage and scarcity can be minimized with sustainable approach in storing and collection of water for the needs of future. The area selected was a girl's hostel building in VNIT Nagpur campus covering 4980m2. The per capita consumption of water in a day was calculated in litre /day for all activities washing, cleaning and flushing. According to the experiments, it was found that the dual media filter combination is acceptable for treating rainwater with addition of little disinfectant like chlorine during its utilization. From experiments it was found that in this dual media filter single layer of foam works better than double layers.

Patel et al (2014) defined the process of collecting and storing the rainwater and use it for domestic use in the S.P.S.V. campus and analyzed the problems with current distribution system and water use at campus. The average monthly rainfall data was stipulated in tabular form to generate the data for hydrological analysis, volume of runoff per year, rainfall potential & catchment area of building. It was found that the RWH project on the campus can fight water scarcity and can reap benefits from financial point of view.

Rahman et al (2010) examined the sustainability of rainwater collection by harvesting in multi storey apartments taking a hypothetical approach to create various scenarios related to site area and floor arrangement. The water demand was assumed that it would be only used for flushing laundry and irrigation. The life cycle costing was developed assuming material cost, maintenance and operation cost. The operation cost was estimated following pump running time and pump operating cost. It was possible to achieve "payback" under most favorable financial condition and the benefit to cost ratio is smaller with the BASIX approach than non BASIX approach.

Shrivastava et al (2019) purposed design of the rooftop harvesting system in a sea coast high rainfall zone of south Gujarat, due to nearness to the sea the area suffers ingress water supply and overexploitation of the groundwater. The study is a four year extensive and the water studied is stored for more than 2 years for physical

chemical and micro bacterial quality assurance. The roof water was collected from 6 rooftops of the campus measuring around 3085m2 in total. In the first year of study it was concluded that the water's physically had peculiar rotten smell and black residue carbon from atmosphere. The chemical quality of harvested water using RBD methods showed that the quality of water in terms of TDS is far better than ground water i.e. 1440tds. The micro bacterial quality of the water in terms of MPN of faucal coli form/100ml was observed to be less than municipal water supply however it increased with the first year of storage and then decreased extensively due to enclosed conditions of the tanks. The efficiency of different bacterial removal methods was also studied with an achievement where E. coli bacteria was not found out in any treatment.

This article takes the City household as a study case, conducts the cost–benefit empirical analysis of the on green buildings, and draws the following important conclusions: (1) the incremental costs of the account for a large proportion of total incremental costs of green buildings, which are more than 50% in this case; (2) the on green buildings can bring incremental economic benefits, as well as environmental benefits; (3) if only consider the incremental economic benefits of the on green buildings, the financial evaluation indexes show green buildings do not have market investment potential; (4) among all the factors influencing the financial evaluation results of the on green buildings, power price is the most sensitive factor, followed by the unit incremental costs, and the lifetime has the smallest influence.

CONCLUSION

Implementation of the green building concept can lead to a reduction of carbon emission by thirty five percent, water usage by forty percent, solid waste reduction by seventy percent and reduction in energy consumption by fifty percent. Green Building concept also emphasizes on the fact that an area with high biodiversity should be avoided as a site for the construction of a building.

ACKNOWLEDGMENT

The authors are very much thankful to Principal Dr. A. P. Bodkhe and Dr. P. S. Pajgade, Head, Department of Civil Engineering, PRMIT&R, Badnera, Amravati for their fullest cooperation. The authors are also thankful to Prof. H. P. Nistane for timely guidance. Lastly thanks to our college librarian for permitting us to

collect the Research papers online as well as from journals.

REFERENCES

1. Charles J. Kibert ,2004‘Green Buildings: An Overview Of Progress ’Journal of land use & Environmental Law,Vol 19,pp491-502

2. DeliaD’Agostino, Barbara Cuniberti,2017‘Energy Consumption and efficiency technology mesures in Europian Non Residential Building’ Journal of Environmental Management ,Vol 2.pp341-349

3. Jian Zuo a, Zhen-Yu Zhao,2013‘Green Building Research–Current Status And Future Agenda’, Journal of Environmental Management, Vol 30,pp271-281

4. AndreaChegut,PietEichholtz,,2011, ‘The Value of Green Buildings’, New Evidence from United Kigdom,pp01-43

5. Ezanee M. Eliasa, ChongKhaiLinb,2015 ‘The Empirical Study Of Green Buildings (Residential) Implementation: Perspective Of House Developers, Procedia Environmental Sciences, Vol 28,pp708-716

6. Norm G. Miller, Dave Pogue, Quiana D. Gough, and Susan 6Davis,2020‘Green Buildings & Productivity’, Journal of sustainable Real Estate,Vol-1-2009

7. Judith Heerwagen,2010‘Green Buildings, Organizational Success And Occupant Productivity ‘Building Research Information, Vol-28,pp353-367

8. YumingLiua, XiaGuo, Feeling Hu,2014‘Energy And Buildings-Cost-Benefit Analysis On Green Building Energy Efficiency Technology Application ‘Energy & Building, Vol82,pp37- 46

9. Shingling Li, Yujie Lu, Harm Wei Kua, Ruidong Chang2020‘The Economy Of Green Buildings: A Life Cycle Cost Analysis Of Non-Residential Buildings In Tropic Climates ’Journal of Cleaner Production,vol252,

10. Andrea Chegut, Piet Eichholtz and Nils 'Supply, 2014'Supply, Demand and the Value of Green Buildings. 'Journal of Urban Studies,Vol1,pp22-43

11. Robert Ries and Melissa M. Bilec & Nuri Mehmet Gokhan and Kim LA Scola Needy,2007'The Economic Benefits Of Green Buildings: A Comprehensive Case Study' Journal of Engineering Economist,Vol-3,pp259-295

12. Li ZHANG, JingWU, Hongyu LIU,2017'Turning Green Into Gold : A Review On The Economics Of Green Buildings 'Journal of cleaner Production,vol3,pp01-42

13. Oidial Das, Priyanka Bera, Sanjib Moulick,2015'Water Conservation Aspects Of Green Buildings', International Journal of Research & Technology, Vol 4,pp7579

14. Dr.Suman Panigrahi, 2017'Roof-Top Rainwater harvesting system for Official / Residential Building' Dr. Suman Panigrahi. Int. Journal of Engineering Research and Application, Vol- 7,pp111-115

15. J.S. Muna, M.Y. Han,2012 'Design and operational parameters of a rooftop rainwater harvesting system :Definition, sensitivity and Verification' Journal of Environmental Management,Vol-93,pp147-153

16. Chao-Hsien Liaw and Yao-Lung Tsai,2004'Optimum Storage Volume Of Rooftop Rain Water Harvesting Systems For Domestic Use'Journal of water resource association,

17. Ding Ma, Yi-bing Xue,2013'Solar Energy and residential Building Integration Technology and Application' International Journal of Clean Coal and Energy,Vol-2,pp08-12

18. 'Dagnachew Adugna, Marina Bergen Jensen, Brook Lemma and GeremewSahiluGebrie'2018,Vol-2,pp408-412

19. 'Assessing the Potential for Rooftop Rainwater Harvesting from Large Public Institutions' International Journal of Research &Public Health,vol,pp03-11

20. Utsav R. Patel, Vikrant A. Patel, Manjurali I. Balya, Harshad M. Rajgor‘2014’Rooftop Rainwater Harvesting (Rrwh) At Spsv Campus, Visnagar :Gujarat - A Case Study.’ Chandigarh’ International Research Journal of Engineering & Technlogy,Vol-3,pp821-825

21. Paramjeet Singh Pannu, Nitish Kumar Sharma,2020 ‘A Review On Rainwater Harvesting In Chandigarh’ International Research Journal of Engineering & Technlogy,Vol7,pp2320-2323.