

# Implementation of sponge city phenomenon in Katraj Area

**Pushpak Patil<sup>1</sup>, Abhishek Kale<sup>2</sup>, Sudarshan Kale<sup>3</sup>, Gajanan Waghmare<sup>4</sup>, Prof. Smita Daterao<sup>5</sup>**

Student, Civil, Trinity Academy of Engineering, Pune, India<sup>1-4</sup>

Assistant Professor, Department of Civil Engineering, KJEL's Trinity Academy of Engineering<sup>5</sup>

**Abstract:** Most cities in our country are facing severe water security risks, how to change urban water safety management idea, sponge city theory provides a new solution in this area. This paper introduces the geneses of the urban water security, sponge city related theory in urban design, and how to use the sponge the content of the urban design idea, etc. From the perspective of urban designers, System of urban drainage, rainwater drainage and sponge urban construction the top policy design, and provide some useful Suggestions for the construction of the city. Points out that only in the unity of the competent department of city construction, the urban design of various professional collaboration, division of labor cooperation, to the smooth implementation of the sponge construction of city. Today India the urban growth is unprecedented. However followed by more and more cities in India have to confront frequent floods and urban ecological environment has become increasingly worse. However, followed by a growing number of cities in India at all levels suffer recurrent flooding rain and urban ecological environment is deteriorating. Proportion of urban impervious surface area expanding rapidly. With the transportation needs of the development and expansion of the urban population People are getting more and more obsessed with the hardening of the cities. It is considered that the original bare surface in concrete closed once and for all solve the problem of traffic water, health, etc. However, in this way, we put the original land to breath freely on a closed mask. From now on the rainwater can smoothly seep into the ground water. Once the storm struck forms a massive storm runs while shorten the rat pack arrival time then will cause waterlogging.

**Keywords:** Urban water security, sponge city, Urban population , Waterlogging.

## I. INTRODUCTION

A Sponge City is a city that has the capacity to mainstream urban water management into the urban planning policies and designs. It should have the appropriate planning and legal frameworks and tools in place to implement, maintain and adapt the infrastructure systems to collect, store and treat (excess) rainwater. In addition, a “sponge city” will not only be able to deal with “too much water”, but also reuse rain water to help to mitigate the impacts of “too little” and “too dirty” water. Primarily as a response to the increasing flood impacts, the Chinese Central Government called for widespread uptake of the Sponge City approach across China in 2013 and provided financial support to foster implementation of this approach in a selection of pilot cities. At present, the Sponge City approach is gaining ground and becoming more and more accepted by city governments. The first ‘best practices’ of Chinese cities are being shared and international exchange activities between research institutions and cities are providing guidance to the design and implementation of new concepts and technologies. However, there are still many challenges ahead which hamper uptake by the selected pilot cities and up-scaling to the remainder 600plus cities in China. City government at all institutional levels have to support the implementation of the Sponge City approach in new built-up areas of city districts, industrial parks and development zones. In existing urban areas retrofitting of neighborhoods, refurbishment of existing buildings and infrastructure and rebuilding activities of old city areas should comply with the Sponge City approach. This Special Issue brings together emerging approaches, challenges and opportunities related to Sponge Cities with the ultimate aim to foster up scaling and widespread uptake. While the sponge-city concept is new, the approaches involved in it, and therefore challenges and opportunities as well, have been tried out in many different parts of the globe under the guise of terminologies such as water sensitive cities, sustainable drainage systems, low-impact development, ABC waters, etc. This issue draws from worldwide experience to draw lessons relevant to the sponge-city concept. A sponge city is a new urban construction model for flood management, strengthening ecological infrastructure and drainage systems. It can alleviate the city's waterlogging, water resources shortage, and urban heat island effect and improve the ecological environment and biodiversity by absorb and capture rain water and utilize it to reduce floods. Rain water harvested can be repurposed for irrigation and for home use. It is a form of a sustainable drainage system on an urban scale. China has been noted for its effort in adopting the Sponge City initiative. In 2015, China was reported to have initiated a pilot initiative in 16 districts. This initiative presents an alternative to solve Asia's flood problems. China seeks to curb its flood with the initiative. The country plans for 80 percent of its urban cities to harvest and reuse 70 percent of rainwater. Building sponge cities requires huge investments, but has a lot of benefits. Funding sponge cities has been a challenge.

**II. LITERATURE REVIEW**

- 1. Analysis of Sponge City:- BY: - Huiqing Hu Publishing Year: - 28 May 2019, Logistics University of PAP. The purpose of Sponge City construction is to reduce urban water logging, reduce losses, increase the storage capacity of rainwater and flood resources, alleviate the shortage of water resources, and promote the healthy development of cities. This paper mainly studies the definition, construction idea, purpose, concrete measures and development trend of sponge city, and expounds the related problems of Sponge City in a systematic and comprehensive way.
- 2. A Systematic Literature Mining of Sponge City: Trends, Foci and Challenges Standing Ahead BY: - Zongmin Li, Shuyan Xu and Liming Yao. Publishing Year: - 14 April 2018, Sichuan University. Sponge City research has been attracting extensive attention both in practical and theoretical research field, as the increased threat of flood risk and environmental safety due to urbanization. Varies names of Sponge City prevalent in different countries, which leads to disconnection of literature in the same field of Sponge City. In this paper, a systematic literature mining of Sponge City is presented. A literature analysis system is created, which includes literature export from Web of Sciences and systematic analysis via Note Express and Cite Space.
- 3. Comparison Studying of Concentrated and Traditional Infiltration of Rainfall Runoff in Sponge Cities:- BY: - Chao Guo Publishing Year: - 2020, Institute of Land Engineering and Technology Many studies have been conducted on the volume reduction and pollutants purification effect of low impact development. However, the comparison between the concentrated infiltration and traditional infiltration of rainfall runoff has been rarely explored. In this study, the difference between concentrated and traditional infiltration mode in sponge cities is analyzed from water infiltration and pollutant purification. Then the infiltration mechanism and the pollutant adsorption, microbial degradation, plant absorption or accumulation processes are compared thoroughly. At last the future development direction of sponge city is also prospected. The conclusion of this study could provide scientific basis and theoretical support for the rational allocation and popularization of rainfall runoff infiltration measures, and promote the healthy development of sponge cities in China.
- 4. Case Studies of Sponge City Program in China:- BY: - Xiaoning Li, Junqi Li, Xing Fang Publishing Year: - 10 October 2017, Beijing University of Civil Engineering and Architecture Various problems such as urban flood inundation and water shortage occurred in China during the rapid urbanization in the last several decades. An urban water management program called Sponge City (SPC) is put forward in China in 2014 in order to relieve the flood inundation and water shortage situation. The SPC program implements not only the concept and practices of low impact development but also various comprehensive urban water management strategies. The SPC development promotes water security, water environmental protection, and water ecological restoration. The background information and general principles of the SPC program are introduced in this paper as well as the experience and achievement obtained in developing SPC so far.
- 5. Design and Performance Simulation of Road Bioretention Media for Sponge Cities:- BY: - Lei Zhang, Qing Lu, Yongfu Ding, Pan Peng, and Yu Yao Publishing Year: - 2018, Transportation Infrastructure Design and Research Institute Road bio retention is one of the promising low impact development (LID) best management practices (BMPs) for the construction of sponge cities. Design of the media used in the soil layer of a bio retention facility is critical to its performance regarding infiltration, filtration, and storage of a high volume of runoff from impervious areas. In this study, a coarse aggregate void filling (CAVF) method was adopted for the design of bio retention soil media. The key hydrological parameter of the bio retention media, the average matrix suction at its wetting front, was estimated through finite-element simulation of the rainfall infiltration process. Using the obtained parameter, a bio retention structure was designed, then modeled in the Storm Water Management Model (SWMM) software to analyze its potential hydrologic benefits in terms of reduction in both peak flow and total volume of surface runoff into storm drains in a rainfall event. It was found that the permeability of bio retention soil media is the key factor that affects outflow reduction ratio, peak flow reduction rate, and peak time of the system. The bio retention media composition design method adopted in this study seems promising for use in the material and structural design of road bio retention facilities for sponge cities.
- 6. Green Infrastructure and Sponge City Research:- BY: - Haifeng Jia, Shaw L. Yu, Allen P. Davis Publishing Year: - 2018, University of Virginia A sustainable rainwater utilization and water circulation model for green campus design is described using the Tianjin University campus as a case study. Considering green and sustainable concepts while planning, designing, constructing, and operating its new campus, Tianjin University built a green campus with a sustainable rainwater utilization and water circulation system. In the process of campus planning, Tianjin University set up a multilevel rainwater collection, usage, and discharge system with flood water as the first and rainwater the second priority of resource use. In the process of designing and building the campus drainage area, Tianjin University constructed a grassed swale and a depressed green belt to form an integrated ecosystem of rainwater collection in order to reduce flood peaks and mitigate surface runoff pollution. Based on the concept of system optimization and sustainable development, the campus water environment system incorporated rainwater as a major water supplement while incorporating measures for pollution control, self-purification, and water circulation to construct a sustainable green campus water circulation model. Through reclaimed water and rainwater supplements to the artificial water body, circulation is achieved among artificial wetlands, a central lake, the waterfront area, and an overflow lake.

- 7. The Construction Idea of Sponge City:- BY: - Feng Ping Publishing Year: - November 2017, South China University of Technology In recent years, affected by the socio-economic development, resulting in China's serious environmental problems, affecting the development of the city. At present, many cities are beginning to explore the construction of sponge city, and developed the relevant measures. In order to promote the comprehensive development of the sea city, we must analyze the concept of sponge city construction, analyze the problem from a comprehensive point of view, and promote the construction of sponge city.
- 8. Sponge City Construction and Management Strategies:- BY: - Linus Tielin Zhang, Wen-qiang ZHAO Publishing Year: - December 2017, Peking University, Beijing Sponge city construction can improve cities' ability to adapt to the environment change and to cope with floods, it can also prompt cities' development to be healthier and sustainable. However, this process may also have impact on the environment, especially in builtup areas.
- 9. Research on Rainwater Management from the Perspective of Sponge City:- BY: - Weike Chen, Shuang Gao Publishing Year: - 2018, Tianjin University of Technology School of Management In order to solve the problem of urban shackles and exploring rainwater management, China advocates the construction of sponge cities. This paper discusses the concept and connotation of sponge city and low impact development, and introduces foreign sponges. According to the actual situation of China, the suggestions and countermeasures for building sponge cities in China are put forward in order to provide reference for rainwater management in China.
- 10. Sponge City Theory and its Application in Landscape:- BY: - ZHANG Yu-shu Publishing Year: - March 2017, Urban and Rural Planning and Design Research Institute, Zhengzhou Currently, many sponge garden engineering are actual to input to construction in China economic rapid development and urbanization process constantly speeding up of situation Xia, but construction completed garden landscape in input using. In the future many performance are cannot meet people of requirements, it is found these fundamental reasons, this phenomenon are garden design is largely associated, so, how effective to processing sponge garden landscape design in the insufficient of at became has social from all walks of life concern of focus. Based on this, this paper will focus on the analysis of sponge city theory and its application in landscape planning, hoping for future practical work plays a certain role.
- 11. Study on the Construction of "Sponge City" in Shenyang:- BY: - Qiufei Wang, Bingjie Tang, and Dan Shi Publishing Year: - 2017, Shenyang Jianzhu University, Shenyang Sponge is a flexible material and its elasticity is manifested in some water characteristics like absorbing water, holding water and releasing water as well as mechanical property characteristics such as compression, rebound and recovery. Constructing sponge city is to build a sponge-like city which absorbs, stores, seeps, purifies water during rainfall and releases then uses water when needed. By this way, the city can flexibly adapt to environmental changes and cope with natural disasters brought by heavy rain. Sponge city follows the principle of ecology priority, pursuing low-impact development. It breaks the traditional concept of "drainage first" (Zeng 2015) in urban rainwater management and infuses in the concept of natural accumulation, natural infiltration and natural purification. Relying on construction, green space, squares, roads, water and other green infrastructure, sponge city builds a "Low Impact Development" rainwater management system, in order to solve a series of problems about urban infrastructure operation safety and urban water security.
- 12. The Impact of the Construction of Sponge Cities on the Surface Runoff in Watersheds:- BY: - Guoqiang Dong, Baisha Weng, Tianling Qin Publishing Year: - 20 March 2018, Institute of Water Resources and Hydropower Research, Beijing. Rapid urbanization has become a critical issue in the 21st century. In developing countries, like China, urbanization has been considered as an index of development. Urbanization is one kind of the important land use and thus land cover changes on runoff and floods within watersheds are the main research topics in past few decades. In China, the urbanization rate (the percentage of urban population) has increased from 12.5% to 50% from 1952 to 2011. The rapid expansion of built-up area has become the major feature of land-use changes in China, which has led to a built-up area vacancy and inefficient land uses. Statistical data showed that the urban population of China increased from 172.45 million to 777.82 million from 1978 to 2012, coupling with an increase of the urbanization level from 17.92% to 52.57%. What is more, the number of cities increased from 193 to 660 during this period. Due to the growth of urban areas, rural land cover types (e.g., soil, water, and vegetation) have been replaced by urban materials including asphalt, concrete, and metal. These replacements have profound environmental impacts, such as forest degradation, agricultural lands loss, air, soil and water contamination, increased water use and runoff, and reduced biodiversity.
- 13. A Critical Review of Water Adaptability in Urban Green Space under the Conception of Sponge City:- BY: - Yu Zhang, Yunwei Zhou, Fucun Cao, Leichang Huang and Yan Zhu Publishing Year: - 2019, Dalian Polytechnic University Adaptive design is an urgent need for contemporary urban development and environmental change. The water adaptability of urban green space is a new functional requirement for urban green space under the background of the construction of sponge city. It is an important carrier for the effective utilization of urban water resources and improvement of water ecological protection. Based on the conception and analysis of adaptability, hackles the concept of water adaptability to the construction of urban green space in the context of the construction of the sponge city, then explores its latest research situation in urban water problems and urban green space. The paper proposes adaptive targets, adaptive subjects, and ideas for water adaptability in urban green space, providing perspectives and references for more in-depth development of urban green space adaptation.

- 14. Sustainable Recycled Plastic Road: - It is fully circular infrastructure that use recycled plastic as a base material. At the end after the damaged base material can be again recycled for new plastic road. The cavities just below the road surface can be used for water storage and to accommodate sensors and other measuring equipments. Every meter sq. of plastic road uses 25.7 kg of recycled plastic house waste

### **III. MATERIALS AND METHODOLOGY**

During the process of urbanization, the design, implementation, and maintenance of the underground infrastructure, such as the drainage system, of built-up areas could not keep pace with the aboveground urban development processes and were not part of an integrated planning strategy. The design of these urban drainage systems is often based on a single design storm and thereby does not consider a range of plausible ways in which flood risk may shift in the future due to, for instance, land-use change.

- To counter the flood situation in particular flood plain.
- Rapid development of city.
- reducing carbon footprint of the city.
- To increase ground water table.
- To harvest the rain water so that we can use in summer when the water requirement is high and water supply is scarce, to fulfil the water demand of the city.
- To rehabilitation the bio diversity of the city which was destroy by urbanization and industrialization.

#### **Methodology (including a summary of the project):**

- Data Collection
- Location Finalization
- Feasibility Check
- Designing
- Estimation

#### **Hardware & Software to be used:**

Auto-Cad, Revit, GPS, Google Earth.

### **IV. CONCLUSION**

The report conclude that the sponge city project is an effective major to counter the flood in flood plains.

### **REFERENCES**

1. County, P. G. s. (1999). "Low-impact dev0velopment design strategies: an integrated design approach." Department of Environmental Resources, Programs and Planning Division, Prince George's County, Maryland.
2. Dai, M., Li, T., and Zhang, W. (2013). "Pollution source apportionment of combined sewer overflow using chemical mass balance method." Environmental Science (in Chinese) (11), 4226-4230.
3. Fletcher, T. D., Andrieu, H., and Hamel, P. (2013). "Understanding, management and modelling of urban hydrology and its consequences for receiving waters: A state of the art." Advances in Water Resources, 51(0), 261-279.
4. Ge, R. (2007). "Study about application of storm water management measures based on Low Impact Development." M. S. Thesis (in Chinese), Beijing University of Civil Engineering and Architecture, Beijing.
5. Fletcher T.D, Shuster W, Hunt W.F, et al. SUDS, LID, BMPs, WSUD and more â the evolution and application of terminology surrounding urban drainage [J]. Urban Water Journal, 2016, 12(7), pp.525-542.
6. Jia Z., Tang S., Luo W., et al. Small scale green infrastructure design to meet different urban hydrological criteria [J]. Journal of Environmental Management, 2016, pp.117:92- 100.
7. Li B.H. Investigation and risk evaluation of heavy metal in the soil of sunken green space [D]. Beijing: Beijing Construction University, 2016.
8. Li B.H. Investigation and risk evaluation of heavy metal in the soil of sunken green space [D]. Beijing: Beijing Construction University, 2016.
9. Rain Gardens: Sustainable Rainwater Management for the Garden and Designed Landscape[M].China Architecture & Building Press,2013