150 YEARS OF CELEBRATING THE MAHATMA

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Emerging Trends in Public Architecture

September 2019

केन्द्रीय लोक निर्माण विभाग
CPWD



CENTRAL PUBLIC WORKS DEPARTMENT, New Delhi



Proceedings of Seminar on

EMERGING TRENDS
IN
PUBLIC ARCHITECTURE

September 18, 2019

(The views expressed are purely of the authors and not of the editor or their organizations)



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MESSAGE

I am happy to know that Central Public Works Department is organizing one day seminar on "**Emerging Trend in Public Architecture**" on September 18, 2019 in Vigyan Bhawan, New Delhi as a part of Nationwide Awareness Campaign during ongoing '**Construction Technology Year**' announced by the Hon'ble Prime Minister.

Construction Technologies are changing fast and new building forms based on modern materials and Technologies are emerging on regular basis. CPWD has already adopted over 30 new and innovative technologies in its work to ensure, speedy and flawless construction.

I am sure the proceedings of this Seminar will help the department in achieving greater heights and bigger milestones in the field of building Construction.

(Prabhakar Singh)

Place: New Delhi
Dated: September 2019

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MESSAGE

Ever since the human settlement has taken place the evolution of architecture came into existence. Architecture is reminiscent of it's time and tells about the science, technology, social and economical state of affairs.

CPWD being the Government of India's pioneering construction organization has contributed immensely in the public utilitarian structures like Housing, Offices, Hospitals, Universities, Schools & Colleges, Samadhis, Parks etc.

In this context, today's seminar on "**Emerging Trends in Public Architecture**" has been organized to bring on a single platform experts from different fields to impart knowledge for the latest trends and development.

The proceedings of this seminar shall prove to be a milestone in knowledge sharing and capacity building to bring in new ideas under the observance of Construction Technology Year 2019-20.

I wish the seminar a great success.

Navneet

NAVNEET KUMAR

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SMART HERITAGE IN SMART CITY

Navin Piplani[1]

Abstract

"Preserving the historic core" is an idea that recognizes the value of heritage and strives to safeguard the authenticity and integrity of a place. However, the pace and pattern of urbanisation and modernisation tends to ignore this aspect, and suggests a standard approach to 'development' that threatens the existing fabric, character and experience of the place. It may also impact the quality of life of the people of the city at social, cultural and economic level. The conservation of historic buildings and redevelopment of historic areas plays a critical role in the emerging directions for architecture and planning. The current and most popular scheme launched by the Government of India is 'Smart City'. It is a driver of mega scale infrastructure development in several cities across the country, and many of them have evolved over several centuries. They are witness to the rich and diverse history, culture and traditions that the inhabitants of these cities represent, practice and carry. The paper will illustrate a unique concept that integrates cultural heritage in the planning for 'smart cities' in India. It suggests solutions that will ensure a pivotal role of heritage for development and promotion of a 'smart city', and demonstrate 'smart solutions' for city's heritage.

"..Throughout history, the common strategy for intervention in the existing city has been to transform the inner city with different ideas of urban improvement. Today, the question of preserving the old city has become key."

~ Prof. Dr. Juan Luis de las Rivas

(ICCROM Best Practices Manual in Cultural Heritage Management)

"Preserving the historic core" is an idea that recognises the value of heritage and strives to safeguard the authenticity of a place. However, the pace and pattern of urbanisation and modernisation ignores this idea and suggests a standard approach to 'development' that erodes the existing fabric, character and experience of the place. This impacts the quality of life of the people of the city at social, cultural and economic level.

The current and most popular scheme launched by the Government of India - 'Smart City', is a driver of mega scale infrastructure development in ninety cities across the country. The Smart City Mission Statement outlines: ' The purpose of the Smart Cities Mission is to drive economic growth and improve the quality of life of people by enabling local area development and harnessing technology, especially technology that leads to Smart outcomes. Area-based development will transform existing areas (retrofit and redevelop), including slums, into better planned ones, thereby improving liveability of the whole City. New areas (greenfield) will be developed around cities in order to accommodate the expanding population in urban areas.

[1]*Navin Piplani, Principal Director, INTACH Heritage Academy, pd.iha@intach.org*

Application of Smart Solutions will enable cities to use technology, information and data to improve infrastructure and services. Comprehensive development in this way will improve quality of life, create employment and enhance incomes for all, especially the poor and the disadvantaged, leading to inclusive Cities.' (National Institute of Urban Affairs)

This does not acknowledge the existence of a historic layer(s) in a city. As a result the heritage of a city remains isolated from the elements of change, and is forced to remain frozen in time.

The evolving concept of cultural heritage renders it dynamic, which means it includes not only ancient monuments and sites but also historic buildings, social spaces, cultural traditions, local narratives and community lifestyles. People of a city and their cultural heritage are inextricably linked to the present and future of the city. Hence, if a city is on the path to becoming 'Smart', why should its heritage remain static and frozen?

In 2014, at the International Biennial of Art and Heritage Management (AR&PA) in Valladolid, Spain on the theme of 'India-Spain Co-operation in the field of Heritage Conservation and Management', a roundtable was organised on the future of heritage in the context of Smart City. It was here, the concern for addressing the challenges of heritage management in Smart City was expressed. The author of this paper had suggested to initiate a programme wherein heritage experts would meet and discuss the issues and problems faced by heritage in the wake of changing global scenarios, particularly in relation to 'Smart Cities'. The term 'Smart Heritage' was coined at this meeting in order to facilitate a thematic direction under which these discussions would take place.

This paper is developed with an aim to initiate a critical discussion on this theme and develop the concept of 'Smart Heritage' within the context of 'Smart City'.

The key objectives behind this initiative are:

a) to ensure a pivotal role of heritage for development and promotion of a 'smart city', and

b) to explore if the 'smart city' project can incorporate 'smart solutions' for city's heritage.

WHAT IS A SMART CITY?

The website of Ministry of Urban Development mentions: '... there is no universally accepted definition of a smart city. It means different things to different people. The conceptualisation of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city residents. A smart city would have a different connotation in India than, say, Europe. Even in India, there is no one way of defining a smart city.'

However, in a wider international context the understanding of Smart City idea is not so

disappointing. There are a few agencies that have shared useful views on the concept of 'Smart City'. One such organization is the International Data Corporation (IDC) which states that 'Smart City is a concept that integrates information and communication technology (ICT) and internet technology (IT) with sustainable development and community engagement, and works to increase the economy of the city by promoting new businesses, talents and investments.' (http://ec.europa.eu/eurostat/documents/3217494/7596823/ks-01-16-691-EN-N.pdf/0abf140c-ccc7-4a7f-b236-682effcde10f

Smart City solutions are expected to use ICT to deliver high-quality services more efficiently, achieve operational cost savings and bring about a change in the behaviour and lifestyle patterns of the users and the community.

As per the Urban Europe: Statistics on Cities, Towns and Suburbs (2016 edition), the European Union defines a smart city as 'a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses'. Designed and developed upon the cutting-edge technology and innovation, Smart Cities are designed to create more inclusive, sustainable and connected environment.

The report continues to state that, 'smart cities have the potential to improve the quality of life, while ensuring he needs of present and future generations with respect to economic, social and environmental challenges'. Here again, the aspect of 'culture' is completely ignored. The quality of life is embedded in social interactions and cultural traditions which are key to shaping the built environment in a city. Any effort towards changing the quality of life of inhabitants of a city will need to consider the cultural needs of the community along with their economic and social aspirations.

An interesting perspective on Smart Cities is shared by the UK Department for Business, Innovation and Skills (BIS). It considers Smart Cities 'a process rather than a static outcome, in which increased citizen engagement, hard infrastructure, social capital and digital technologies make cities more liveable, resilient and better able to respond to challenges'. (Centre for Cities website - http://www.centreforcities.org/reader/smart-cities/what-is-a-smart-city/) The British Standards Institute (BSI) defines Smart City as 'the effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens'. (Centre for Cities website - http://www.centreforcities.org/reader/smart-cities/what-is-a-smart-city/)

Broadly speaking, a 'Smart City' plan works toward promoting cities that provide:

- core infrastructural strength
- a high quality living

- a sustainable and inclusive environment

In India, the 'Smart City' focus has been on addressing the above aspects as well as on sustainable and inclusive development which can be replicated by other cities.

However, there has been a considerable oversight where heritage is an integral part of a city's cultural infrastructure, economic prosperity and social well-being. When cities are aspiring to become 'smart', it is imperative for the heritage of the city to also move in the same direction. Why should the heritage of a city remain frozen in time? How does heritage become 'smart'? What are the parameters of dealing with heritage in the context of smart city?

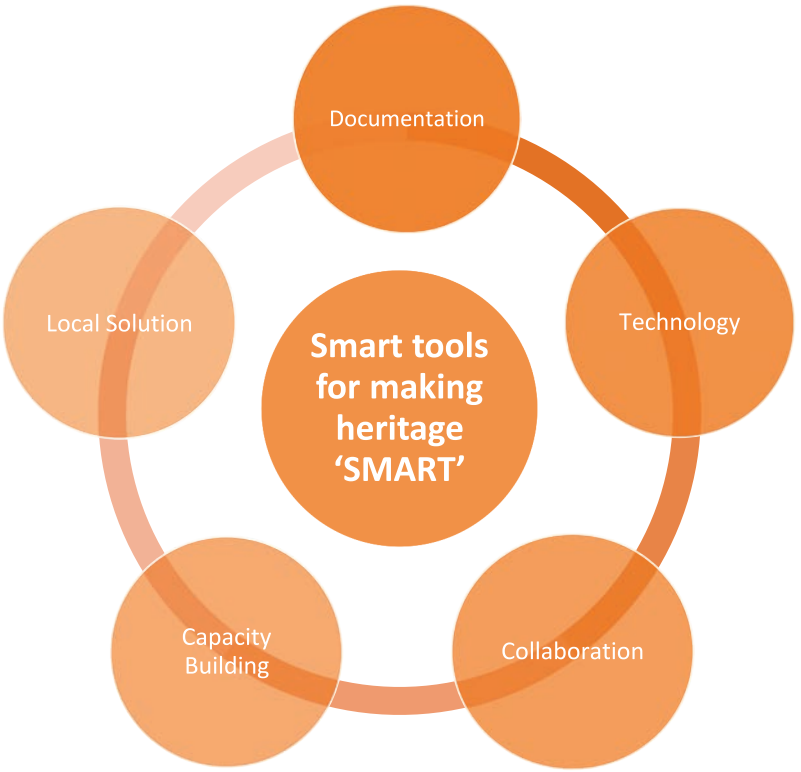
These are a few questions that need urgent and full attention of the decision-makers, policy-makers, city planners, smart city consultants, heritage professionals and concerned stakeholders.

To answer these questions, it is essential to develop a broad framework for the understanding of the concept of 'Smart Heritage'. In the context of heritage, this concept shall include aspects of management, conservation, archaeology, interpretation and experience related to all heritages that are in or around a 'Smart City'.

The basic premise behind this idea is that a 'smart city' approach, whether in a green field or brown field area, cannot ignore the history and culture of a place.

The key aspects that need to be considered whilst making heritage 'smart' are:

- Management
    - The stakeholders responsible for this aspect include the urban local bodies, Centre or State level government organisations, public and private enterprises and local communities
- Conservation
    - the stakeholders responsible for this aspect include Archaeological Survey of India, State Department of Archaeology (SDA), INTACH, Aga Khan Trust for Culture, UNESCO heritage experts, art and architectural historians and so forth
- Archaeology
    - the stakeholders responsible for this aspect include the Archaeological Survey of India, State Departments of Archeology, universities and research institutions
- Interpretation
    - the stakeholders responsible for this aspect include museums, interpretation centres and visitor management and guide services
- Experience
    - the stakeholders responsible for this aspect include visitors to heritage places.



What is most essential is to develop local smart heritage strategies that would integrate with the local smart city plans. It is here that INTACH Heritage Academy proposes to develop 'Smart Heritage Strategic Plan' for every Smart City. This document will provide a detailed background on the heritage of a city, assess the cultural significance of this heritage, outline conservation and management approaches and suggest 'smart solutions' for heritage management, and identify 'smart tools for making the heritage assets smart.

Conclusion

The key aspect of any Smart Heritage approach will be to establish cultural heritage conservation and promotion as a unique component among smart city plans. This will inevitably require a different line of thinking and will serve different goals than smart city plans. The solutions will engage with information and communication technology for conservation, management, archaeology, interpretation and experience of heritage(s). The historical and cultural context of the city will help position its heritage in the wider context of technology led urban development and a specific role that it can play towards local urban, social and economic development.

The Smart Heritage strategies will have conceptual, management and operational implications for the integration of cultural heritage within smart cities. Each city will call for different course of action depending on the case. This indeed will result in unique, yet diverse, solutions for 'smart heritage' in different 'smart cities' in India.

HERITAGE CONSERVATION AND RESTORATION

Usha Batra[1], Dr K M Soni[2]

Abstract

India has an extraordinarily rich, vast and diverse cultural past that has left a huge corpus of built heritage across the country. Besides this, as of 2018, India has 38 world heritage sites, the sixth most of any country. Architecture in Indian heritage buildings varies from place to place, particularly depending upon the old rulers of that area like British, Portuguese, French, Mughal or Indian.

Conservation of heritage structures, being multi-disciplinary and scientific enterprise, demands regular training and creation of professional expertise for archaeologists, conservation architects, engineers, historians, scientists, horticulturists, planner and surveyors, etc. To maintain the architectural, artisanary, aesthetics, and historical character of the heritage building, architect plays the most important role. To safeguard the built and natural heritage, central government and state governments have set up heritage committees to conserve and protect heritage of the country. For making the process of conservation more viable, commercial use is permitted without marring the heritage value of the building in some cases.

The paper discusses the special heritage architectural features of "Indian Institute of Advanced Studies, Shimla" and the case study of restoration of "Gorton castle - heritage building at Shimla" in which upper two floors were destroyed in fire in 2014.

Paper also discusses the case study of additional construction in Western Court - heritage building at Janpath, New Delhi in respect of architectural features.

Introduction

"Heritage building" means and includes any building of one or more premises or any part thereof and/or structure, artefact which requires conservation and/or preservation for historical, architectural, artisanary, aesthetic, cultural, environmental, ecological purpose and includes such portion of land adjoining such building or part thereof as may be required for fencing or covering or in any manner preserving the historical and/or architectural, aesthetic, cultural value of such building.

Government of India and the states have declared some structures as heritage sites / structures. Such structures including precincts are to be preserved, maintained and used according to the prescribed guidelines to conserve their heritage value and to avoid any harm by any means to the protected structure/area/precinct. Any proposals of restoration, modifications, additions, alterations, and demolition of such structures require prior approval from appropriate authorities. Heritage committees have also been formed at state and central level for examining the

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proposals for accord of approvals.

Besides, there are Heritage sites at global level as well. A World Heritage Site is a landmark or area which is selected by the United Nations Educational, Scientific and Cultural Organization as having cultural, historical, scientific or other form of significance, and is legally protected by international treaties.

India has 38 sites inscribed on the World Heritage List. Apart from this, there is a list of 43 tentative sites for recognition which has been submitted to the UNESCO Committee for evaluation and acceptance. This procedure of prelisting is a prerequisite for the nominations for the World Heritage List to be accepted.

The world heritage sites are selected by the World Heritage Committee which is the governing body of protected sites. It selects the sites to be listed as UNESCO World Heritage Sites, maintains list of World Heritage in danger, monitors the state of conservation of the World Heritage properties, defines the use of the World Heritage fund and allocates financial assistance upon requests from the countries. Countries can also apply for long-term loans and in special cases, non-repayable grants for maintenance of world heritage sites. The responsibility of protecting world heritage sites is thus at international level.

As per recent report published in HINDU dated 9.7.2017, Ahmadabad has been declared India's first World Heritage City having 2600 heritage sites and over two dozen ASI protected monuments. At present, India has 38 world heritage sites. Archaeological Survey of India (ASI), government of India, and state governments declare the sites, monuments and heritage structures as per their byelaws classifying them as protected monuments or heritage sites/buildings.

As per recent report published in the Times of India dated 2.5.2018, Tajmahal, built in Agra between 1631 and 1648 and seventh wonder of the world, is turning brownish and greenish due to rising pollution levels in spite of best efforts to remove these effects by ASI. Court has restrained authorities from cutting any tree in Taj Trapezium Zone- a 10,400 sq km area, being the world heritage site. The apex court suggested that the Centre take the assistance of experts from India and abroad to first assess the damage and then take steps to restore the historic monument.

New world heritage site of mumbai

'Victorian Gothic and Art Deco Ensembles of Mumbai', the new Mumbai precinct was added to the global list of heritage sites in July 2018 at the 42nd session of the Unesco World Heritage Committee, propelling the precinct to global fame, attracting more tourists, ensuring additional funding from international agencies and grants for upkeep of the structures and ensuring strict control over external changes to all structures on the site.





Victorian Gothic and Art Deco Ensembles of Mumbai'

The ensembles include the structures that line the city's Oval Maidan — a row of 19th-century Victorian buildings characterised by Gothic spires and gargoyles on one side, and the 20th-century Art Deco structures on the other. This includes historic landmarks like the Bombay High Court, Rajabai Clock Tower, Eros Cinema, University of Mumbai, David Sassoon Library and Maharashtra Police Headquarters buildings.

Classification of heritage buildings

Buildings and sites are classified as Grade I, II and III in descending order of importance.Grade-I comprises buildings and precincts of national or historic importance, embodying excellence in architectural style, designand/or aesthetics, technology and material usage. They richly deserve careful preservation. No intervention is permitted either on exterior or interior of the heritage building or natural features unless it is necessary in the interest of strengthening and prolonging the life of the buildings/ precincts or any part or features thereof.Heritage Grade-II (A and B) comprises of buildings and precincts of regional or local importance possessing special architectural or aesthetic merit or cultural or historical significance though of a lower scale than Heritage Grade-I. They deserve intelligent conservation. Internal changes and adaptive re-use may by and large be allowed but subject to strict scrutiny by Heritage Conservation Committee. Care would be taken to ensure the conservation of all special aspects for which it is included in Heritage Grade-II.Heritage Grade-III comprises building and precincts of importance for townscape that evoke architectural, aesthetic, or sociological interest though not as much as in heritage Grade-II. They deserve intelligent conservation but lesser than Grade II.

Heritage buildings differ from modern buildings in the sense that they are anticipated to last permanently. Heritage buildings are seriously threatened by environmental agencies such as moisture, intense solar radiation and prevailing winds which change their physical attributes. The major effects of these environmental agencies include discoloration, abrasion, cracks, stains and fungal growth. Apart from exposure to weather, biochemical agencies also hasten the deterioration of heritage buildings tremendously.

Objectives of conservation

Retain visual identity

Visual identity must be retained to enhance the visual character of the architectural heritage and site. Additions of street furniture, pavement material, lighting, signage, etc. can add to the experience and appreciation of the heritage. The objectives of conservation can mediate even new buildings or neighbourhoods by making reference to the old by using some elements, methods and devices characterising the architectural heritage of the area so that the new is linked with the old.

Adaptive reuse

The re-use of historic buildings and neighbourhoods is an effective strategy to conserve architectural heritage. Such re-use distinguishes between preservation as an ideal on the one hand and, on the other, the goal to prolong the useful life of architectural heritage. Priority must be accorded to retaining the continuity of original functions. Any new use must be introduced only after studying its effect on the local context, and must conform to the carrying capacity and vulnerability of the architectural heritage. All changes to the original fabric should be preceded and followed by comprehensive documentation. Additions and alterations must respect the coherence of the whole, and must, to the extent possible, engage traditional materials, skills and knowledge in the process. When it becomes necessary to modernise and comprehensively alter the original internal functional characteristics of the building or site, its external image must be retained.

Conservation, restoration and reconstruction

Conservation means preservation to prevent decay/deterioration to prolong the life and maintain the authenticity and integrity of the building/structure, including internal spaces, sculpture and artefacts, furnishings and architectural decoration according to their original appearance. Conservation provides insight of past history, tradition and culture.

Restoration is a process that attempts to return the heritage object/structure to some previous state that the restorer imagines was the "original". Restoration becomes essential due to aging of structures, disasters and some additions/alterations/modifications carried out during life of a heritage structure.

Sometimes, reconstruction becomes essential. Reconstruction means altering a heritage object/feature by introduction of new or old materials to produce a work which respects the original. Reconstruction in heritage may be undertaken for such monuments/ buildings when such an intervention is the only way and without which its survival is impossible. Reconstruction should be attempted only in extreme cases, such as damage or destruction due to the impact of a disaster (natural or human induced) or structural failure, and should be undertaken only on basis

of evidence and not conjecture.

Conservation, restoration and reconstruction measures are interconnected. Therefore according to the circumstances, they may be carried out one after the other or simultaneously. When these works are carried out by incorrect or inappropriate methods, they cause great deal of unintentional aesthetical and technical damage. On the other hand well designed modern forms and materials carefully chosen to respect their old/existing environment/building can be rewarding in aesthetical and technical terms. Identification of original material is of great importance. Lack of knowledge can inadvertently damage the original features destroying the original character of the building. Preservation of information of restoration work for future reference in written as well as through photographs can prove to be very useful.

Employment generation

Conservation strategy must focus on the potential for employing local raj mistris, labour and materials because this will prolong the economic viability of traditional ways of building. In conditions of resource scarcity, the use of architectural heritage can provide an alternate and more economic strategy to meet contemporary needs as well.

Local material and traditional technology

The use of local materials and traditional technologies must invariably be preferred. Their choice must be based on the availability of traditional knowledge systems. Modern substitutes should be considered only after their use is proven efficient and judicious, and must not compromise the integrity and continuity of local building traditions. Use of certain traditional building materials may be inadvisable on account of their climatic region.

Sustainability

The objective of conservation should be to sustain the building and/or the traditional skill and knowledge system of building. In this context, continuity must be seen as evolving over time.

Funding for maintenance and repairs

It is the duty of the owners/occupiers of heritage buildings/sites to carry out regular repair and maintenance at their own cost. In case of private ownership of properties such as Havelis or residences that lack government or institutional funding, Heritage conservation committee(HCC) proposes funds via local bodies as an incentive to maintain them. To make the process of conservation more viable, HCC recommends the following;

- Grade I to be allowed restricted commercial use.
- Grade II could be put to commercial use but facade would be retained and open spaces would be used without marring the heritage value.

- Grade III buildings could be remodeled.

One of the many activities undertaken by companies as corporate social responsibility includes protection of national heritage, art and culture.

To preserve the heritage assets, listing of heritage assets/ buildings is essential.

Benefits of listing of heritage assets/ buildings

There are essentially four benefits of heritage listing;

Preservation and conservation

Heritage lists highlight the relative importance, need and more detailed follow-up on preservation and conservation efforts. In many cases, preservation and conservation management plans are developed using preliminary data from listings.

Tourism

Heritage lists help in developing tourism plans for localities e.g. setting up heritage walks by converting assets such as houses or shops into mini museums. Through tourism sector; listings eventually help in contribution to the local economy.

Heritage research

Heritage listing helps in research activities such as excavation, evaluating historical significance, determining impacts of building projects, architectural valuation etc. Listings also help in highlighting assets that are not well-known but yet are important to determine historical continuity. Thus listings help research in providing a broader picture of the heritage of communities and cities.

Community pride and sense of place



Fig 1

One of the most critical benefits of listing is the acknowledgement of the historical value of the building to the surrounding residents and communities where it is located. It increases the pride of residents in their community and helps to build a "sense of place"

Identifying and listing are the first steps in protecting and managing the heritage buildings. It provides a legal framework for managing major development changes so that heritage significance is retained and not diminished.



Fig 1A Some Heritage buildings of Mumbai

All the buildings are not listed as heritage buildings the moment they are completed. The process takes many years. In many buildings, it is observed that changes are carried out which don't match the heritage character of the existing building , which could be due to two reasons i.e. either at the time of making changes, it was not listed as heritage building or the owner could not appreciate the importance of Heritage character of the building and made changes as per his will without bothering for obtaining approval as shown in Fig 1 & 1A. The changes once made are not reversed as no specific norms are in place.Due to addition and alteration like adding toilets with modern fixtures, grills, chhaja/projection, ACs, drainage pipes and change in flooring, dilution of heritage character has been observed in heritage buildings.

Now the governments, municipal corporations, users of the buildings and public, all the stakeholder have larger responsibility to conserve the heritage of Mumbai. To retain the heritage character which is pride of the city, some of the important steps required to be implemented are;

i. No addition /alteration be carried out without approval and if carried out they must be restored to original conditions. Converting office space into toilets should be avoided as they require water supply and sewer line connections which are taken by damaging the structure as well as aesthetics.

ii. No canopy/porch should be added just to take car at the entrance to the building. Building heritage needs to be respected.

iii. No temporary structure should be added in front of heritage buildings and if available should be removed at the earliest to restore the glory of the heritage buildings.

iv. The pipes should be used which are compatible to original ones.

v. Trees and shrubs should be planted as per the heritage character of the building and in a way that they do not hide the aesthetics of the heritage buildings.

vi. Footpaths, kerb stones, bus stops, footpaths, roads, railings, toe walls, boundary walls etc should be compatible to heritage precinct and as such need to be designed.

vii. In the precincts, all structures like toilet facilities, bus counters, water storage tanks, gates etc should be designed compatible to heritage character.

viii. Electric and fire installations including cable laying, fixture installation and air-conditioners should be designed and placed considering heritage character.

ix. Timely maintenance, repair and restoration and housekeeping should be given top priority in such buildings and precincts.

x. Parking should not be in close vicinity of heritage structures as they damage the structures due to pollution.

There are large numbers of buildings in the country having heritage value. Architectural features of IIAS Shimla, Gorton Castle Building, Shimla, and recently completed Western court annexe, New Delhi are discussed below;

Case Study I: Indian Institute of Advanced Studies (IIAS): Some architectural features

The building that houses the institute was originally built as a home for Lord Dufferin, Viceroy of India from 1884–1888 and was called the Viceregal Lodge. It housed all the subsequent viceroys and governors general of India. It occupied Observatory Hill, the second highest point in Shimla. The hill was levelled and flattened for the construction to be started. Light blue limestone and grey sandstone were used and all of it was transported to the hill by mules.

Many historic decisions have been taken in the building during the Indian independence movement. The Simla Conference was held here in 1945. The decision to carve out Pakistan and East Pakistan from India was also taken here in 1947. The building is designed in Indo-Gothic style by Henry Irwin of the then Public Works Department, now considered as CPWD. The building was provided with electricity and sophisticated fire fighting mechanism through wax-tipped water ducts which is functional even today. The British got some of their latest technology to Shimla while building it. Some of the important architectural features demarcating the heritage character of the building (shown in Fig 2)are;



Fig 2.Important architectural features demarcating the heritage character

1. Switches in brass
2. Fire fighting mechanism through wax-tipped water ducts.
3. Well lit corridor at entrance with glass roof, beautifully carved balustrades, arches and paneling.
4. Prisms in ceiling with one row fixed and one hanging. This system transfers maximum light inside falling from any angle.
5. The heritage clock needs winding once in 2 days. Displays correct time and actual position of moon.
6. Use of technology for drying clothes. Hot air comes up through perforated floor having hot water pipes running below and dries clothes spread in the room.
7. Rectangular rain water pipes in grey colour are in harmony with shape and colour of stone used in external wall. One pipe damaged was got fabricated from Jallandhar for replacement to maintain the heritage character. The other two pipes also are matched with colour; retain the beauty near entrance due to no leakage problems even today. Stone jambs add to the strong/grandeur heritage character of the building.
8. The fire place with decorative wooden paneling all around, brass work in front and ethnic tables on both sides.
9. Rich wooden paneling, false ceiling, brass lights and chandelier.
10. Interior of the library with decorative ceiling work and merging arched wall with finely detailed wooden railing.

11. The main entrance with terrazzo flooring. The heritage lights in ceiling at entrance and hanging down in corridor.

CASE STUDY II: GORTON CASTLE BUILDING, SHIMLA

The building was commenced during November 1901 and completed during May 1904 .The original design of this building was conceptualized by Sir Swinton Jacob with expenditure of Rs. 13,42,901. Presently, the Castle houses the office of Pr. Accountant General of Himachal Pradesh. It has many special features as shown in Fig. 3which resemble the Neo-gothic and Rajasthani style, some of which are described asunder:



Fig 3.Some special architectural features of existing building

The building has high pitched roof with Nainital pattern iron sheets, ornamental dormers, gutters, valleys, ridges,facias, cornice, wooden ornamental brackets and eve boards along external projection of roof, wall and chimney flashing etc. adding to the aesthetics. Special features of flag post add beauty to the artistic roof line. Balconies having ornamental stone work in Rajasthani style with stone railing having stone jalis, stone balusters and handrails on ornamental stone brackets, ornamental copings/arches/Mehrabs at number of locations enhance the aesthetics of the structure.

Tall canopieshaving steep sloped conical shape up to 75-80 degree slope and height up to 9m add to the aesthetics of the building improving overall sky line of the location.Glass roof over complete area of the central staircase over wooden ornamental trusses avoids any lighting during day time. Central staircase having ornamental cast iron railing with wooden treads and risers and ornamental hand rail further enhance the aesthetics of the interior of the building.Two number big central courtyards take care of passages of number of services like rain water drainage and fire hydrant lines etc. in addition to providing natural sunlight to the rooms.

Major fire broke out on 27-28 January, 2014 causing massive damage to the building. Top two

- Doors/windows frames and shutters, jams, cills, soffits, staircase roofing and railing, balconies, Jharokhas, eve boards, jalis, cornices and arches to be used matching the existing ones.
- All toilets with modern fixtures and tiles.
- Energy efficient lighting and central heating system to be redesigned and used.
- Fire place to be restored, but not to be used. Architectural character to be retained.
- Open court yards to be maintained. But all around chhajjas added in court yard to be redesigned to merge with the building features.
- Chimney's feature to be retained for aesthetics but vent pipes to be sealed.
- All external walls to have exposed stone finish as existing.
- No lift was provided in the existing building. Capsule type lifts without machine room with features matching to building features to be provided.
- Provisions to be made for barrier free, rain water harvesting.
- All services may be redesigned keeping visual aesthetics in mind. A well documented comprehensive scheme to be developed for entire building.
- All unauthorized constructions are to be removed. Original building external envelope to be reclaimed. A clear 6 m. wide access all round the building for fire tender should be provided.
- Appropriate seismic retrofit measures to be provided as per recommendation of CBRI, Roorkee.
- Additional fire protection measures to be adopted during restoration of the building as per prevailing present norms.

In addition to above, there is requirement to cover the open courtyards and also to cover the open corridors on top floor / terrace level. It is very challenging as the top floor has many floor levels and many attic floors. Providing roofing to take care of rain and snow disposal by covering the entire building having flooring at various levels, especially when no roof can go beyond the existing maximum roof level, is a herculean task. The courtyards which were previously used for rain and snow disposal are also to be covered. It has been decided to prepare a study model with roofing in transparent material to see all the floor levels below and also to study the rain and snow disposal. It has also been decided by the heritage cell to remove all shabby looking chhajjas, grills and glasses (provided earlier for protection from rain) after covering the courtyard. The existing toilets of the building are being re-planned and reconstructed at the same location.

CASE STUDY III: WESTERN COURT, NEW DELHI

Western Court at Janpath, New Delhi was built pre-independence as a hostel for legislative

floors including roof had been totally gutted in fire in addition to causing severe damages including structural damages to most of the components of the building in overall. All iron trusses, roof sheets, iron girders, steel tables and furniture and various other steel items were totally melted and distorted. The table glass and other glass items also melted. Stone masonry walls expanded and disintegrated. Stones got fragmented and were getting chipped off easily. All wooden items such as wooden trusses, wooden boarding under roof sheets, wooden plank floors and false ceiling got totally gutted in fire.

Re-establishing the office functioning from the left out portion of the building was the main concern. The temporary electric supply was provided to the ground floor first after taking necessary safety precautions. 80% of the left out portion was made re-operational within next 3 months. In order to make ground and first floor re-operational, repairs to doors, windows, painting, distempering, removing hazardous materials, making re-functional of water supply, sewerage lines and many other connected activities were carried out including temporary roofing (Fig 4) on the entire structure so as to make it safe against any further damage.



Fig 4.Temporary roofing and some other ongoing works.

This building is listed as one of the heritage buildings by Himachal Pradesh Government and Ministry of Housing and Urban Affairs (MoHUA), Government of India, New Delhi. To take care of all such heritage buildings falling under ambit of MoHUA, a dedicated heritage cell is functioningunder MoHUA. After inspection of the building, considering retrofitting measures suggested by CBRI Roorkee and original drawings of the British architects prepared during original construction, to retain the heritage character of the existingbuilding, Heritage cell recommended the followings;

- Walls to be reconstructed using matching stones with lime/cement mortar.
- Similar type of floor finishes as already existing i.e. mosaic/cement concrete flooring to be used.
- Minimum amount of false ceiling to be used. Items for false ceiling proposed are calcium silicate/aluminum perforated/aluminum strips.
- All doors to be built as per original design and specifications.

councillors of Imperial Delhi. It is a Grade II heritage building. As per bye-laws, scope of changes in Grade II-Ais limited to internal changes by and large subject to strict scrutiny. In Grade II-B, in addition to above, extension or additional building in the same plot or compound could in certain circumstances be allowed provided that extension or additional building is in harmony with the existing heritage building(s) or precincts especially in terms of height and facade.

Accordingly, design of new constructed 4-storied Annexe building reflects the built form of the existing building in terms of linear planning, symmetry, no. of storeys , classical character of the building and green ambience.Within height of 3 floors of existing building, new construction has been done for 4 floors.Two basements are provided to cater to parking requirements of existing and new constructed building with some surface parking as well. Other features are as given below;

- Plot area : 31,408.45 Sqm.
- Permissible ground coverage : 9422.53 Sqm. (30%)
- Total ground coverage : 5891.51 Sqm (18.75%)(Existing + proposed)
- Total built up area / FAR : 19036.41Sqm (60.6%)(Existing + proposed)
- Permissible FAR : 120
- Parking required@2 ECS/100 Sqm. : 381 ECS
- Parking provided: 381 ECS (Open: 195, Basement: 186)

Main character of the existing building has been retained to a wider extent in new constructed building as shown in Fig 5 in which the architectural elements of the existing building are shown in top and the corresponding elements used in the new constructed building in bottom.

Due to ground area used for construction of new building, two basements are provided in the new building to cater the parking requirement of the existing as well as the new building. The entrance porch missing in existing has been provided in the new building using the architectural features of the existing building.Hard area at entrance of existing buildinghas been compensated by beautiful landscaped garden enhancing the beauty of the area.



Arched opening with keystone has been retained but proportions of rectangular openings have been changed, also horizontal member has been added reducing the grandeur character in the new building. Balustrades have been replaced with modern glass reducing the ornamental heritage character. Although there is change in joints between column & slab and column & beam but the architectural character is not altered. Change in door detail does not change the exterior character of the building. Although detailing of projection at roof level differs from the original existing detail and probablywould have looked much better if followed in new building still itdoes not bring down the architectural character of the building.

CASE STUDY IV: BATESHWAR TEMPLES

Bateshwar temples, the largest Shiva temple built between the 8th and the 10th-century are a group of nearly 200 sandstone temples in north MP about 35 kilometres (22 mi) north of Gwalior in post-Gupta, early Gurjar-Pratihara style of North Indian temple architecture . The temples as they now appear are in many cases reconstructed from the fallen stones in a project begun by the ASI in 2005.

ASI declared it as protected site in 1920 and steps for its conservation were initiated. Not much could be done for many years to come as the region was ill famous for terror of dacoits and was considered unsafe.

In 2004, it appeared as a huge pile of rubble absorbed by the jungle with only 10-12 temples intact and rest all broken down. It was then decided by ASI to start the seemingly impossible project of piecing together the ruins and bring back the original grandeur of temples . ASI convinced the famous dacoit that it was his ancestors of Gurjara-Pratihara dynasty who built the complex and these temples needed to be restored and shown to the whole world and his gang gave much-needed help and support for the restoration work . Almost 60 out of 200 temples were restored between 2004-2008.Once again temple complex which stood safe for decades under the shadow of dacoits suffered tremendously at the hand of mining mafias . Due to ongoing blasting in nearby areas the temple ruins again began to crumble .





Ruins at Bateshwar

The surrounding area was encroached by the mafias and stone mining went around relentlessly . ASI approached several government officials to save the site from the hands of mafias. Finally, government took action to curb the menace of illegal mining and also created a buffer zone of 750



Restored and Stacked ruins

meters around the site instead of the usual 200 meters prohibiting all form of construction activities. It is amazing to see the spectacular result of reassembling.

Conclusions

- Location of heritage building increases the historical value of the area/place and brings pride to the residents of the community and provides historicalambience.
- Conservation, restoration and reconstruction measures are interconnected and according to the circumstances, need to be carried out one after the other or simultaneously, preserving the architectural features, style and character of the building.
- Written and photographic records of restoration work must be preserved as they can prove to be very useful for future working and reference.
- Permission for change in use of building for better maintenance proves to be helpful but many times calls for additions/alterations which need to be carried out on advice of conservation architect.
- Old proven technology used in heritage buildings can be used in modern buildings also like prisms and exposed rectangular pipesused in IIAS Shimla without leakage even after more than 100 years of use.
- Before taking up restoration and maintenance, existing architectural features, materials, and colours used in the heritage building Vis a Vis new selected materials and their effect must be studied carefully and appropriately so that essence of heritage character is not lost.
- Buffer zone around heritage/protected areas, buildings, structures and precincts helps in conserving their heritage value and aftercare .

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UNIVERSAL ACCESSIBILITY IN BUILDINGS AND THEIR SETTINGS

Kamal Preet Singh[1]

Abstract

The term "Universal Design" was coined by the Architect Ronald Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life. It is the aim to deliver equity of access to opportunity for all community members., starting to think inclusively of both our older adults and people with varying needs and capacities. We're all getting older everyday- the buildings and spaces around should be inclusive of elderly persons' opportunities for their healthy participation:

More or less in our country approximately 16 % of our society has a physical disability permanent and temporary.

Barrier-free designs create the opportunity for more citizens to participate in the economy. Workplace Inclusivity, diversity and equality that triple bottom line results are driven by a corporate social responsibility (CSR) platform that includes a barrier-free workplace. Persons with disabilities represent a qualified, hard-working, and loyal talent pool. A Certified Accessible platform is informed by Universal Design standards which promotes design for all and addresses the unique relationship between spatial layout and the spirit for social inclusion. At a bare minimum, we can start building age-friendly communities by assessing our spaces and places for accessibility which includes easy way finding, functional washrooms and the ability for someone to access, exit, and pass independently through a building.

Goals and Benefits of Universal Design-means planning to build physical, learning and work environment so that they are usable by a wide range of people regardless of age size and disability status while universal design promotes access for individuals with disability, it also benefits others.

Introduction

The Barrier Free Environment and now **The Universal Accessibility**- in Architecture- is an all-encompassing term in context of design and execution to create such an environment which is for all the members of the society for all ages irrespective of their physical state and physical ability i.e may be a child, young or the old. Prior to the space standards the Persons with disability and Elderly Persons Act in 1995 it was not being taken seriously many a times or was done to meet someone's personal requirements and was optional -thus was treated as a special provision for persons with disability.

With this Act of 1995 it has become mandatory to make all the provisions in the buildings and its

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spaces around in settings which will take care of a major section of society to join with a great sense of self-respect and confidence -the main stream of active and productive life also turns out to be useful to their fellow beings. These structures like public buildings and offices which were made accessible by making the necessary intervention and modifications for necessary provisions.

Primary disabilities

1 Non Ambulatory

2 Semi Ambulatory

3 Sight-Total Blindness or impairment or impairment affecting sight to the extent of individuals functioning in public area

4. Deafness of hearing handicaps that can make an individual insecure in public areas because one is unable to communicate or hear warning signals

With lot of attention given to the needs of the persons with physical disability and elderly persons and the Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act 1995 was introduced in 1996 to Architects as many of us may know buildings are being designed and constructed accordingly now a days .

The term Universal Access is in the context of design and execution of buildings and their settings including roads, footpaths pathways and elements of landscape in the layout. All possible provisions are made for all the users of these buildings and environment and make these fully accessible by way of designing and constructing ramps with specified gradient up to plinth 1:15 and 1:12 the wheelchair on this ramp can be taken with assistance-the gradient being more comparatively. With specially designed handrails at the main entrance or at other important locations for easy independent movement of the wheel chair as one of the main features and all other possible elements to take care of other physical disabilities.



8 Goals of universal design were also developed

Body Fit, Comfort, Awareness, Understanding, Wellness, Social Integration, Personalization and Cultural Appropriateness The first four goals are oriented to human performance: anthropometry, biomechanics, perception, cognition. Wellness bridges human performance and social participation. The last three goals address social participation outcomes. The definition and the goals are expanded upon in the textbook "Universal Design: Creating Inclusive Environments."

The 7 Principles of Universal Design were developed in 1997 by a working group of architects, product designers, engineers and environmental design researchers, led by the late Ronald Mace in the North Carolina State University.The purpose of the Principles is to guide the design of environments, products and communications. According to the Center for Universal Design in NCSU, the Principles "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments."

Principle 1: Equitable Use

Principle 2: Flexibility in Use

Principle 3: Simple and Intuitive Use

Principle 4: Perceptible Information

Principle 5: Tolerance for Error

Principle 6: Low Physical Effort

Principle 7: Size and Space for Approach and Use

Examples

- Smooth, ground level entrances without stairs
- Surface textures that require low force to traverse on level, Surfaces that are stable, firm, and slip resistant .
- Wide interior doors (3'0"), hallways, and alcoves with 60" × 60" turning space at doors and dead-ends
- Functional clearances for approach and use of elements and components
- Lever handles for opening doors rather than twisting knobs
- Single-hand operation with closed fist for operatable components including fire alarm pull stations
- Components that do not require tight grasping, pinching or twisting of the wrist

- Components that require less than 5 pounds of force to operate
- Light switches with large flat panels rather than small toggle switches
- Buttons and other controls that can be distinguished by touch
- Bright and appropriate lighting, particularly task lighting
- Auditory output redundant with information on visual displays
- Visual output redundant with information in auditory output
- Contrast controls on visual output
- Use of meaningful icons with text labels
- Clear lines of sight to reduce dependence on sound
- Volume controls on auditory output
- Speed controls on auditory output
- Choice of language on speech output
- Ramp access in swimming pools
- Closed captioning on television networks
- Signs with light-on-dark visual contrast
- Web pages that provide alternative text to describe images
- Instruction that presents material both orally and visually
- Labels in large print on equipment control button
- A museum that allows visitors to choose to listen to or read description
- Disability ergonomics should be taught to designers, engineers, non-profits executives to further the understanding of what makes environment wholly tenable and functional for individuals with disabilities. In the building so that wheel chair movement is free and is not hindered at any level differences. Universal Access is to create equal access to all members whether children aged or persons with disabilities to opportunity for all by reducing the barriers towards use of a place or space by way of easily accessing and are able to move around with ease and to do their work whether in offices, Public buildings or at home and delivers social and economic impacts in these Age-friendly designs.

Outdoor spaces and buildings, transportation and housing create inclusive atmosphere. We do believe in design for all and hope first of all as Architects to join in creating a barrier-free community with engineers and all other professionals

As life expectancy rises and modern medicine increases the survival rate of those with significant injuries, illnesses, and birth defects, there is a growing interest in universal design. There are many industries in which universal design is having strong market penetration but there are many others in which it has not yet been adopted to any great extent. Universal design is also being applied to the design of technology, instruction, services, and other products and environments.

Curb cuts or sidewalk ramps, essential for people in wheel chairs but also used by all, are a common example. Color-contrast dishware with steep sides that assists those with visual or dexterity problems are another.

There are also cabinets with pull-out shelves, kitchen counters at several heights to accommodate different tasks and postures and amidst many of the world's public transit systems, low-floor buses that "kneel" (bring their front end to ground level to eliminate gap) and/or are equipped with ramps rather than on-board lifts



From Road to Pathways and maintaining a green

With this Act of 1995 it has become mandatory to make all the provisions in the buildings and its spaces around as settings which will take care of a major section of society to join with a great sense



Barrier free junctions with the pavement and common open spaces



Providing for pathways as well as maintaining green



Cement Concrete Paving with grating, and bricks on edge for road crossing
in place of zebra crossing adds to the barrier free environment

of self-respect and confidence -the main stream of active and productive life also in terms of to be useful to their fellow beings. These structures like public buildings and offices which were made accessible by making the need for necessary provisions.

The need for sensitizing the professionals like Architects, Engineers, the Clients and the technically skilled work force for which the intent of design must be explained at length on plans and other drawings by the Architect so that this is followed up throughout the process of execution without doubts and If there are any these are to be sorted by the Architect in due course of time so that the end products are as per space standards and specifications, useful for the users. National Building Code, Guidelines for Barrier Free Environment prepared by the Ministry of Urban Development with design consciousness for the purpose.

In the absence which we all of us must have come across many such efforts and material are not being utilized properly by the needy Divyangjan and all others.. Just a few examples to quote but these are many more.

CGO Complex, Ghaziabad entry by ramp locked by chain can not be used Harish Chandra Public Library, Jaipur and many other places where in ramp travelling to the plinth has been blocked at the mid landing with a big cement planter and cannot be used any person on the wheel chair.

All the levels should be the same for free movement accept for reaching upper level like plinth the

ramp must follow a min slope of 1:12 (will go to1:15 in case the wheel chair is self-driven without assistant.



Ramp from ground going up to plinth-its handrail is not continuous is just a formality and not as per guidelines in Shop cum office complex at Vasant Vihar

In the historical precincts the ramps integrated with existing steps will be an apt solution as universal. In places of tourist interest (Living Heritage spaces) also either only ramps can be provided to a slope for pedestrian of 1:15 or 1800mm (1:12mm ramp for moving with) wide of double width ramp can be provided. Whereas single width ramp wherever provided can be 900mm width. condition in all such cases is that addition to these ramps being functional they have to gel well with the settings structure and aesthetics of existing buildings. There have been instances that at very responsible positions when historical buildings or precincts were required to be made accessible, so much was thought about and touchy about the existing buildings that aesthetics of the buildings could not be put to risk and could not be spoiled where as these issues can be resolved with conscious and efficient design process and these very element like ramps can add to the aesthetics of these buildings. Even the existing steps can be very well merged with the ramps and can make look furthermore beautiful.

Provision of Barrier free Environment in the residential spaces is also very important and useful.

Lifts should be provided of the specified size for all the upper floors ensuring its access even on the first floor if the building is two storied thus to make all floors of the building accessible and usable for all. It will have braille indications on the lobby side on the floor for the lifts and the directions to various spaces as well as within the lift car and auditory signals for floor information in the lift.

Components of Kitchen, Toilet , Bath, Staircases and Ramps are also to be designed and got executed as per the guidelines and precise standards specified in the Manual published by Ministry of UD with a furthermore urge to look for such solutions which are equally comfortable for people in general also. It is a really challenge for the Architects to visualize and finalize the designs.

Staircases connecting all floors shall have handrails on both the sides of the flight to ensure proper support for going up as well as coming down by the people on crutches.

Tactile tiles Grey or Yellow colored textured tiles shall be provided on the floor lobbies and corridors for guiding the persons with no or poor visibility. All the lobbies and corridors shall have handrails fixed on the on wall and projecting in such a manner that once gripped the hand movement goes uninterrupted .The flooring shall be finished with nonskid tiles or other finishes which are easily maintainable also.

Minimum side and size of the toilets and size shall be clearly earmarked as barrier free toilets with opening out or with sliding doors on all floors shall be as per the specified space norms., Mirror fixed on the wall inclined at an angle to enable the person to see their face . Space planning and design shall be designed for ease of use of all. All the fixtures like wash basin and urinals and the water closets shall be provided with guard rails of chromium plated steel pipes as per the details specified in the manual.

However it does leave a scope for design of universal accessible toilets with effective design ensure comfortable use.

Double handrails steel/wood/aluminum handrails shall be provided in the line of movement in semi open and open spaces in to the landscaped areas.

Any ramps provided composed with 3-4inches long strips of granite, kota stone or stone-fixing these on an inclination in the name of non-skid surface is not an ideal solution as while use of wheelchair on it will make it uncomfortable and with jerks.

Universal access to education encourages a variety of pedagogical approaches to accomplish the dissemination of knowledge across the diversity of social, cultural, economic, national and biological backgrounds. Initially developed with the theme of equal opportunity access and inclusion of students with learning or physical and mental disabilities, the themes governing universal access to education have now expanded across all forms of ability and diversity. However, as the definition of diversity is within itself is a broad amalgamation, teachers exercising universal access will continually face challenges and incorporate adjustments in their lesson plan to foster themes of equal opportunity of education.

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Conclusions

The guidelines derived from barrier free environment should be well assimilated and followed in spirit taking it to a level further whereas per these space standards culminate into a much strong and satisfying end result for us all in the society. Here the role of Architects becomes more important who can work with the process and development of design successfully.

Acknowledgements

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2. All the faculty members of Training programs organized and attended at CPWD Training Institute, Ghaziabad
3. Initial trainings and workshop on Barrier Free Environment with special emphasis on Sensitization of professional Architects by Council of Architecture

Results of main findings of study:

At many a places the attempts for Barrier Free Environment are being done as a mere formality primarily because of no proper sensitization of various professionals. Without imagining the plight of the disabled or the elderly people it is difficult to achieve good solutions.

Another reason for halfhearted or in fructuous work is that at the outset that many of the decisions for doable things guided by budget for the projects or curbing the extent of necessary rectifications which are required to be done to implement the scheme especially in the existing buildings or environs. Now in order to achieve Universal Access in our buildings, These provisions are required to be kept in mind along with their purpose right from the initial stages of planning and design in new buildings/projects. Even in the existing buildings/projects the extent of intervention should be decided in a way to affect existing structure the least which can be achieved by effective designing and minimizing constraints.

EMERGING TRENDS IN PUBLIC ARCHITECTURE

R K Kakar[1]

Introduction

Architecture of an era is widely acknowledged as a measure of the state of evolution of the people of that time, the culture of people, the makeup of the society and the technological advancement of that era. We know of the highly evolved knowledge of our ancient culture by the architectural marvels of that era and even surmise the State of Art, existing at that time by the architectural remains. The ravages of time alas lay waste the domestic buildings leaving the buildings for public use as standing testimony of that time because these were built more durably. Excavated ruins of Indus Valley Civilization or other civilizations in various regions of the world are a perfect example of this where we deduce, how evolved the ancient civilization was by reading the foot prints. Similar is the case for our ancient heritage spread all over the country which tells us how advanced were the Mughal, Chola or Pallava.

Public Architecture

Now, what distinguishes Public Architecture from the Architecture?

Responsibility! That is the key word. Public Architecture carries within it, a greater responsibility as public money is spent in raising it. What constitutes responsibility, of course, has been changing from time to time. If it was frugality at one time, soon after the country became independent because of tight resources in the hands of Government of that time, it is sensitivity towards the environment in present time. If it was Exploitation of natural resources at one time around the industrial revolution in 19th and early part of 20th century, it became conservation of resources in the later part of 20th and 21st century. Now the key word is **'Sustainability'**.

Public Architecture being environmentally responsible, should also act as standard bearer for the industry to follow. Most great modern marvels fall within the realm of public architecture and that shapes the image of the city, neighbourhood. Academic, Institutional, Cultural buildings make up the most of spectrum of public architecture. Humanity faced with rapid urban growth leading to rising demand for public infrastructure, currently faces urgent and difficult challenges, like the perpetual decay of our natural resources, climate change and degradation of environment. But we also have more opportunity than ever to create a better world through sensitivity towards environment and use of technology.

Sustainability

In order to be sustainable, the human Habitat will need to become more space savvy i.e. planning in more efficient way that will be able to cope with the increased population.

Sustainable architecture holds the key to an environmentally positive future. Often repeated

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cliché that – **"Mother Earth has ample resources to meet the needs of all but not the greed of even few"** has always held good and will continue to do so. Only by living more economically and sustainably within our resources, can we hope to protect our environment and climate. The philosophy behind sustainable architecture is all about reducing Waste. This not only means physical waste but also minimising consumption of water and energy. By keeping the energy we consume within our habitat as low as possible, we need less supply in the first place. Using less energy to keep us comfortable means that we become resource efficient and environmentally responsible which is vital to reducing the adverse effects of climate change. Sustainable design in fact is a continuous process requiring a change in the architects'/engineers' attitude towards the design paradigms, oriented towards concern for ecology. The concept of sustainable development needs to run through the entire design process so as to be able to make full use of all effective resources and to obtain maximum economic benefit under the premise of sustainable development. Sustainable architecture is founded on the principle of architects/engineers turning environmentalists moving from a linear approach to a closed one where the building is treated not as a "place of processing natural resources into waste" as had been existing, for example, energy "converted" into heat loss, clean water into sewage, fresh air into used air, materials and consumer goods into waste as we have known but a closed plan which incorporates recycling of resources in which a building may change from a voracious consumer of energy and other resources, into a self-sufficient unit using much less energy for heating in winter, and cooling and ventilation in the summer and the water is saved and re-used. The transition from linear plan to a closed one is evolutionary.

Design Methodology

There are three overriding concerns when designing buildings with consideration towards ecological impact. First is the materials used for construction. Second is the energy efficiency of the building and the Third and last, the location of the building itself. The building might be energy efficient and use low impact construction technologies but this would not mean anything if the ecosystem suffers as a result of the building. A holistic approach to all of these design concerns is becoming more prevalent in today's mainstream architecture. The first step in this design approach was passive, low energy buildings. The next step was buildings — friendly to the people and also the environment. We are talking about low energy use buildings to almost zero energy buildings and progressing to Net Zero autonomous buildings. There are numerous examples of such buildings worldwide. CPWD took the lead by demonstrating its capability and sensitivity towards natural environment by planning and building in public sector, country's first Net zero building –'Paryavaran Bhawan' in the capital for the building industry to emulate. There are also examples of sustainable settlements or cities. One such an example is the city of Masdar in the Abu Dhabi Emirate, together with the Masdar Institute of Science and Technology, which is autonomous in terms of energy. It also

meets all other criteria of sustainable development like low carbon footprint.

Technology

Concern for natural environment has been accompanied by enormous progress in the field of digital technology. All put together, the derivative is a new term: Architectural IQ. For since several years now, buildings are being treated as a living organism like the human beings, breathing, exhaling, consuming and excreting. Level of intelligence is coming to be assigned to them. Hitherto in practice, BMS –Building Management System has progressed to assigning intelligence to the buildings.

BIM

Architects and Engineers in practice today began their education and professional careers under the influence of modernism which was the in thing till the end of the previous century, significantly impacting the approach to architecture and public architecture in specific. The difference in the level of knowledge prevailing in that period and the knowledge necessary to understand and implement the principles of intelligent buildings and sustainable development, is enormous and needs to be bridged through re-education. Having woken to the need, the Public agencies responsible for public infrastructure have taken up learning programmes. One of the best new trends is The Building Information Model abbreviated as BIM. Though in use for long now, considerable innovation has gone into this technology in recent times. BIM is a design software for integrated design, to meet the different design requirements in the integrated design process. It is growing fast, and is already the mainstream tool to design buildings. BIM combines various geometric information and related functional requirements to bring together all the information in one construction project to form a comprehensive information management system.

Virtual Reality & Immersive Architecture

BIM though a versatile technology, is already evolving into Virtual Reality. Every design will soon be made using virtual reality, enabling the user to fully immerse him in a 1:1 scale, 3D (BIM) model which can be manipulated and will provide an incredibly accurate sense of presence in a space that is yet to be built. Imagine an artificial world that you can observe, walk through, reach out to touch objects and see everything around you respond in real time. It is essentially an intelligent technology that takes a project from conception to completion. Virtual Reality technology has seen rapid developments in recent years and this is most apparent in the architectural, engineering and construction industry. This not only enables 3D and 4D (time) programming, but also 5D, 6D, 7D and 8D, or cost, as-built operation, sustainability and safety. It is essentially an intelligent technology that takes a project from conception to completion. This is immersive virtual reality.

In immersive technology, the Spaces are created using a combination of Computer Graphics, Wireless Tracking Technology, Headsets, HD projectors, Polarised glass and more, all working together to create interactive and real-life experiences. The world of 3D virtual design and engineering is a fast growing field and seriously forward thinking is happening in these fields. We can hope to see more and more of it in coming years in the architectural, engineering and construction industry. Every design will soon be made using virtual reality; enabling the user to fully immerse him in a 1:1-scale, 3D (BIM) model which can be manipulated and provides an incredibly accurate sense of presence in a space that's yet to be built.

Cloud & Mobile Technology

Today, virtually all mobile devices are capable of leveraging cloud technology, with the ability to use and operate cloud-based software from anywhere, and at any time. The sky is the limit for cloud devices as essentially limitless amounts of data can be stored and shared instantly with the touch of a button, and at about one tenth of the cost of old sharing technologies. It is accessible from anywhere that is connected online. This technology will go from being preferred in the construction industry to becoming mandatory in order to remain competitive in the market.

Construction Management Programmes

The use of construction management programmes through remote sensors and monitors are also making their entry in the field of construction in some form or another. These programmes help manage all operations that are just as important as the construction itself, including job costing, project scheduling, budgeting, and payments. Various supplements are used to feed the information required for the purpose.

Drones

Drones are proving very useful at construction sites, as an entire site can be surveyed in a matter of minutes, rather than days and weeks while also saving a great deal in labour costs. This is a rapidly developing technology in terms of accuracy and precision of their readings besides involving less human involvement.

Robotics

Finally, likely to be a commanding force in the construction industry in the time to come, these will come handy in hazardous operations. They may be able to lay bricks, plaster and tie rebar, maybe replace some of the current man-operated activities in the future. It may not be long before the construction professionals are assisting in a construction process that involves assembly robots. Assisted robotics, in which a human and robot work together to direct the

construction process, is also on the horizon.

3d Printers

"Robotic construction and 3D printing are the future". We've seen 3D printing of consumer items. It is predicted that the buildings of future will be built nee printed using not drawings but algorithms which will also be capable of value engineering of a project, while resolving the structural analysis/resilience and material use. In architecture, we will see parametric design tools assisting in creating amazing structures. The use of large-scale 3D printers will help push the materiality of those structures. 3D-printed construction will greatly expand the limits of construction technologies.

Project Procurement - Engineering Procurement and Construction

Engineering, Procurement and Construction Contracts are getting to be the more and more accepted form of contract within the construction industry. This contract typically covers the design of the project along with the procurement from the bidding to handing over stage within the given period of time. Under the EPC contract, EPC contractor will be the single point responsibility for all the contract work to the client. Commonly the EPC contractor will subcontract the part works to other contractors, however the EPC contractor only will be the single point responsibility to the client for the work of sub-contractors. The EPC contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Works. By signing the Contract, the Contractor accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works. One direct benefit of EPC contracts is that It minimizes the risk to the employer and proponents of the project, leaving the complete risk at the Contractor side. As the system is new to the industry, there remain some apprehensions in its adoption, in particular, pertaining to the architectural and engineering design. These are the same as in most Design & Build projects where the contractor is responsible for the design too and thus in position to influence the parameters of the project i.e. the design and specifications. Since the mode has come to stay and we will see more and more in coming times in respect of public projects, there are certain safe-guards which need to be built in. Prime of these safeguard is assuring the integrity of the designers. One way is for the employer to have a say in selection and engagement of Architects & Engineers team on the terms which are already prescribed in the bidding document as a condition. The terms could provide for an Architectural Design Competition for this purpose. As is usually done for all the architectural design competition, there would need to be developed a Design Brief in advance of bidding.

Public Financing

Another recent innovation in the field of public Architecture is financing of public projects, at least

in the developing countries which are hard pressed to allocate its revenue collection for developmental outlay away from the pressing social outlay heads. Under the circumstances, the concept of Public Private Partnership (PPP) emerged as a viable option for infrastructure development especially in the context of developing country like ours. PPP broadly refers to long-term, contractual partnerships between the public and private sector agency identified through a transparent and open procurement system, designing, implementing, and operating/maintaining facilities, sometimes including financing too. In Indian context however, the Government/Public Works body continues to carry responsibility of oversight and accountability for quality, price and value for money in the partnership. In practice for long in purely physical infrastructure projects it is only recently that it has been experimented with in Public Architectural projects. Typically, the PPP is not privatization as there is no change in the ownership in whole or part, from Government to Private sector. Recent increase in number of PPPs has been attributed to improvement in performance of the public sector by employing innovative operation and maintenance methods and bringing in the efficiencies of private sector. There are several variations of PPP in adoption but the most common being where the State meaning the public body pitches in with the land as its equity participation without parting with the ownership of the land.

EMERGING TRENDS IN ARCHITECTURE-EDUCATION AND PRACTICE

Ar. Vijay Garg[1]

Abstract

The past year has been eventful, and a large number of opportunities have emerged for architects. I would like to draw your attention to the key projects.

1. Trilateral Highway. A connection between India - Myanmar - Thailand;
2. Sagarmala Project for development of ports;
3. Chabahar Port in Iran;
4. Rural Development Project;
5. Urban Renewal Projects happening across the country especially the NorthEast.

The merits and demerits of the projects may be debated among our fraternity and also judged but such projects offer an enormous opportunities for Architects. For example, the Chabahar Port in Iran is located in an under developed town and in times to come, this port city would become populated and new buildings/projects would start appearing within the next few years. Similarly the Trilateral highway passes through undeveloped parts of our country, Rural Development & Urban Renewal is happening across the country. With the Sagarmala project the New Ports and through it newer materials will soon starting appearing across the country and not be just limited in large cities.

To enable our Emerging Architects, i.e: our architect students to benefit from such projects, our curriculum and our pedagogy needs an adjustment. This paper puts forth the author's thoughts based on the following quote by Albert Einstein that says, the author quotes **"If you can't explain it simply, you don't understand it well".**

Various units of COA, IIA and Architecture Schools have held events in the past, that were focussed on addressing the "Challenges after completion of College Education". The challenges an architect has to face after completing the Architectural education.

Similarly, Administrative Decisions and Curriculum Changes that have happened in the past have had an impact on Architectural Education. A study of the proceedings of these events forms a good platform to build upon.

This paper addresses the issues related to:

1. Previous Discussions & Required Changes to Architectural Education Experience;
2. Enabling an understanding of Economic Environment in which the Emerging Architects have

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to thrive and perform;

3. Enabling the Professional Network for an Emerging Architect to build up the practice;

4. Enabling the Emerging Architect to handle the transition from “College to Profession”.

The Required Changes to Architectural Education Experience – Journey since then...

The earliest document referenced in this paper is from 1922. **“The Training of Architects in Ancient India”** by Sh. Prasanna Kumar Acharya. This paper discussed the attributes of architects , the skillsets they were supposed to possess and the subjects they had to master. The mythological treatise from the 4 heavenly architects (Visvakarman, Maya, Tvashtar, and Manu) to the progenitors of the 4 terrestrial architects (Sthapati, Sutra-grahin, Vardhaki, and Takshaka) were cited in this document. Its important to note that these 4 progenitors formed the guild of architects, each an expert in his own department, consisting of the chief architect, the designer, the painter, and the carpenter. Slhapati was in the rank of director-general and the consulting architect, Sutra-grahin was the guide (guru) of the other two, and Vardhaki was the instructor of Takshaka.

It is important to note that “Timeless Buildings” were created by Architects who were formally trained in such skills and only the people who displayed the capability were imparted such skillsets by people who had the skills required of an instructor.

Over the years, the past workshops have discussed diverse aspects to enhance the architectural education experience. The attributes required of students, their educators and administrators have been detailed along with the curriculum.

However two questions that have remained relevant over the past 100's of years are “What is the Purpose of Architecture Education?” & “How to impart Professional Education, should it be School Based or Guild Based”?

The answers to these two questions have changed over the period of time. This is evident by analysing the proceedings of past events.

1959 : Architectural Education—An Approach at the National Policy Level. This was organized by Lalit Kala Academy and was edited by ArAchyutKanvinde in March 1959. The inaugural address was made by our First Prime Minister Shri Jawaharlal Nehru and Welcome address was by Ar. Humayun Kabir. Summarizing and evaluating the PM's thoughts after half a century does allow an alternate thought in judging the current GOI projects. Sh Nehru observed that the Great Indian Experiment called Chandigarh was in progress and there was both a praise & criticism of it. He said that it was immaterial whether anybody liked it or disliked it. It was very welcome to the decision makers and visionaries of those times because “it was the biggest job of its kind in India”. He said that he used the word biggest because “it hit you in your head and made you think”. being hit would maybe make you squirm but it would force you to think and imbibe new

ideas and the one think it was causing was what India needed in those early days, a thinking minds in all disciplines needed by man and so important for making a new india. He looked at Chandigarh with such importance and was not concerned about it succeeding or failing. He wanted the static nature of our Country's mind to change. He believed that the Static Nature of our minds caused the British to come in and rule us for centuries. He expressed his belief that “A society which ceases to change, ceases to go ahead, necessarily becomes weak and it is an extraordinary thing how that weakness comes out in all forms of creative activity”. The urban renewal mission, the rural development mission and all the infrastructure projects happening in India are a reflection of such similar situation. Our architectural education needs to be geared up to provide the skillsets needed to enable and facilitate the next level of India.

In this seminar, interesting papers were published included:

Architectural Education in India by Ar SJ Narwekar. He discussed Ancient, Medieval & Modern Architectural Education. He suggested uniformity in Architectural Education and suggested Educational tour based learning as a suggestion. He was concerned about Discipline among students and laid emphasis on Teaching Staff having practical experience. He laid importance on teacher having a burning desire to teach. He cited Prof Batley responding to a suggestion made to him, that called for giving up Teaching so that his practice does not suffer. To which Prof Batley said “I would give up practice rather than giving up teaching in the school”.

Theory of Architecture as a Basis for Architectural Education and Practice by Prof GK Paknikar. In this he suggested importance of Theory in clarifying the confusion of ideas. He argued that Practice always implies theory and Good practice depends on the correct understanding of theory. He expressed concerns that, Even though the number of schools of architecture in India was gradually increasing, no serious thought was accorded to formulating a sound policy or philosophy—of architectural education in India. He opined that the objectives of architectural education and practice are to be decided by the architects themselves. He felt an urgent need for public education for the realization of those objectives that could clear confusions in mind of Public who would be recipients of good architecture.

Architectural Education in India by Prof SH Parelkar. His paper was focussed on salient features of Academic System of Training in Architecture. He evaluated the events & results of last 50 years to deal with problems connected with architectural education. He attempted to find an answer to a question whether training should be in Colleges or Part Time Courses and how to organize it. His paper documented the problems that plagued Architectural education in India. A few important one that merit highlighting were

- Architect profession has become complex than what it used to be 50 years back. The architect is required to be conversant with Town Planning, Law, landscape, science and economics;

- Lack of full time appointment of a Qualified Architect as Principal or as Other Head Decision Makers in colleges;
- Lack of qualified and trained teachers;
- Allowing teaching staff/principals to setup practice;
- Lack of Infrastructure, Books, Extra Curricular Activities etc;
- Lack of sufficient Practical Training Avenues;
- Inadequate focus on practical side of subjects;
- Lack of adequate consideration while admitting students in architectural courses. He was concerned about lack of the basic knowledge & language skills in students;
- Lack of Love towards Architecture in students and introduction of architecture as an elective in schools;

He suggested detailed solutions to these challenges.

Architectural Education - An Approach at the National Policy Level by Prof GM Mandalla. He outlined the various basic approaches, and needed changes at school level, cooperation from the profession to help build a sound educational system and a clear cut Government policy at national level for fundamental recognition of architects and their profession. Interestingly he suggested that Only architects should be eligible to practise architecture. He suggested that this could be done through legislation and compulsory registration. Any other person desiring to practise architecture should pass the National Diploma as external candidate or be admitted to I.I.A. as associate. A civil engineer should not ordinarily be permitted to practise architecture as he has a much greater field to practise engineering. However, if he desires to practise, three courses could be kept open to him: (i) admission at 4th year level in architecture; (ii) passing National Diploma as external candidate; and (iii) associationship of I.I.A.

He also suggested that, Government Architect/ Planner should be independent of PWD Chief Engineer. He proposed a separate cadre of Architects in Government.

1986[1]: Training Architects : India by Ar. Balkrishna Doshi. His findings were that the curriculum in the 20 odd schools of architecture that existed then had a curriculum that was not current and it did not lay emphasis on the excellence required of a technical graduate nor did it encourage the social commitment by the professional. His conclusion was to place students (engineering, technology, architecture and planning) under a common technical program and make them undergo a common curriculum till 3rd year. Beyond that they could choose an allied discipline and seek practical training for it. CEPT at Ahmedabad was set up on the basis of such an approach.

1992: Admission-Eligibility and Selection Procedure by Ar. Shireesh Deshpande, in Workshop on Architectural Education, March 6-7, 1992, held at School of Planning and Architecture. New Delhi, 1992. He relied on the learnings from the previous workshops to define the admission criteria for students who could seek formal Architectural Education. He discussed the proposals & suggestions in:

- The Baroda Workshop;
- The Hyderabad Workshop;
- The Bombay Workshop;
- The Delhi Workshop.

In each of these workshops, the participants had tried to decide the prerequisites for taking the aptitude exam; duration of architectural studies; were discussed. However the equating of architectural education with technical education started appearing with no resistance from architects was visible. Also "freedom of format" or "independence to decide the focus of studies" was being accorded to school which had gained academic maturity.

1999 : Status and Future of Architectural Education in India - Need for radical change. in IIA, Nagpur Centre[2]. During these years, a significant changes happened. The mandatory requirement of Science (PCM) background was removed. The students without elementary education in science started undergoing architectural education in the large number of Self Financing Institutions of Architectural Education that started appearing all across the country. The curriculum was changed from "what the profession required" to "what suits the students & their background". During these years, another concept was introduced formally by the name of "Visiting Faculty". Another interesting concept was discussed, under which a proposal was made to delink an "institution's capacity to provide quality education from the ownership of infrastructure facilities in the form of large built-up areas". It was said the Quality is more a function of type of expertise available with an institution though a powerful human resource base rather than an infrastructure. It was believed that a drastic reduction in capital investment needed to start a new school could in future attract a larger number of the "academically inclined" category of people rather than "commercially inclined" category. Almost 2 decades since this event, the results are evident and the adverse impact on the profession is visible as an direct evidence to present status of architectural education in India. The national workshops that were driven by such thoughts happened in 1998 to 1999 in IIA chapters of Northern Chapter, West Bengal Chapter, Gujarat Chapter, Karnataka Chapter, Maharashtra Chapter & Nagpur Centre.

The follow up symposium in Delhi was titled "Symposium on New Directions in Architectural Education: Proceedings of Working Group Sessions in April 1999", was endorsed the views of the Nagpur Centre.

2004 : Regulating Architectural Education in India, an Approach Paper by Ar. Prem Chandavarkar, in New Delhi. This approach paper discussed the concept of Regulating Architectural Education. He wanted to shift the focus from "who will regulate" to "why regulation is needed and how should it be regulated". To enable such discussion, he proposed a series of ideas for discussion. The reason why i have included his thoughts in this paper is because our Government/ Decision Makers have taken up a new approach towards Professional Education and our architectural education is also impacted by it.

a. He argued that the concept of "Colleges competing for ranking under which a system would allow excellent to rise to the top and bad colleges to cease to exist was a bad idea. The reason cited was that financial muscle power would allow colleges to create a image inconsistent with capabilities.

b. He discussed the concept of "Purpose of Architecture College - Vocational or Philosophical". He argued that colleges should be "Sites of Learning rather than be places that create graduates who are employable architects". He correctly summarised that Any discipline (read profession) in order to ensure its own vitality must continuously seek renewal. His other contention was that Profession cannot be content with the current state and must always seek re-evaluation &reconstruction of its boundaries. This was followed by defining the attributes of establishing "Sites of Learnings".

c. The last idea was a suggestion on system of regulation. A system that would recognizes that "Architectural Education would be a self driven process rather than a regulated process imposed from outside". He said "A learning process can be justifiably controlled from outside only if the controlling source is unquestionably more enlightened and learned than the institution that is controlled". Such a regulator was termed as "The Enlightened Regulator". He proposed a regulator that would not be focussed and concerned with Control & Power Structures but rather be focussed on "enhancement of learning".

d. As a solution, he proposed that a college must produce a document that presents its vision – its case as to how the college becomes a site for learning, and how it will strive for excellence. He suggested an auditing system of the college to be centred on the goals that the college has set for itself. These concepts were detailed out in his approach Paper.

2013 : Letter to Joint Secretary, University Grants Commission by Ar. Pushkar Kanvinde. This was one of the early interventions while the COA amendment was being discussed in Parliament. The UGC had invited comments on Draft regulations for control and approval of Technical and Professional Colleges 2013 . He correctly objected that Architectural Education is not an Technical Education and it should be removed from the definition of Technical Education. He observed that such an inclusion leads to duplicity of authority and leads to conclusion and the results would not be healthy for the profession.

2014 : Turmoil- Opportunities - Future Course - Seminar in Architectural Education by IIA Northern Chapter, Haryana Chapter, UP &Uttranchal Chapter & SPA Alumni. The seminar discussed the Turmoil & Dilemma along with the Challenges and Opportunities and the Road Ahead. The role of Practicing Architects along with Academia was suggested as a way forward to improvement in Architectural Education. This seminar paved the way of inclusion of IIA Members/ Practicing Architects as support to Academia in imparting Architectural Education.

Required Changes

To find the required changes in Architectural Education, the purpose of Architectural Education must be understood. An understanding is needed on the Historical Concept on why was Architectural Studies kept distinctly different from Technical Education. Why was a separate identity needed? And why was the Architecture Education requires a longer duration of study.

All the challenges that persist in our education system today are not new and should not be treated as a major cause of worry. The Council is working with Professionals and the Other Decision Makers & Colleges to regulate and weed out the ineffective teaching shops that give precedence to Architectural Institutes as Commercials Entities.

The Council in its wiseness has already created a framework in the form of Minimum Standards of Architectural Education. It covers 75% of required study to gain education to become an architect. It gives freedom to the colleges to orient the course as per their own philosophy by choosing the subjects in the balance 25% course. The first stage covers 2880 contact periods, out of which 570 periods are left to the discretion of the institute. SO further regulation will not lead to the betterment or renewal of the Profession.

As indicated in the 2004 approach paper by Ar Prem Chandavarkar , a vision document by the Architectural Institute would be a good way forward for any Architectural Institute. Such vision documents would allow the teachers to equip themselves and prepare students who would be geared up to meet the expectations of becoming Problem Solvers.

Any such vision paper is not expected to be a static document that remains on institutes websites but should be reflective of the problems the society or the country faces. Every few years based on prevailing conditions it should be changed. For example the focus of the country is “Housing for All”. Immense opportunities exist today and Challenges of achieving the vision lies in working out a solution that would allow Quick and Standardized Construction at the lowest possible cost. If an institute creates such a vision document and uses the 25% of its freedom to create contact hours that can allow architects geared to take up the challenge, then I feel the objective of formal education would be met.

Another example to illustrate and reinforce the concept would be the a vision document that the Academic Council of Institute could create would be on Infrastructure or Port Development or

Rural Development or Urban Infrastructure.

The other required changes that are required is to reduce the Gestation Period in Learning. This can be achieved by integrating the Academia into Profession. This can be understood in the following scenario. by Every practicing architect has limited or non existent time devoted to research. As a result, very frequently, an architect only offers to his/her client a solution that has been adopted earlier. This leads to stagnation in idea and profession does not evolve over time. In such scenario, whenever a foreign architect brings a fresh new idea, he is seen as a solution providers by Indian Client. Although the Council is working towards regulating the practice of architecture by foreign architects but it is a reality and need that Indian Architects create their own identity and devote time to research to cater to such need. This is where the Academia can step in and offer its expertise to the profession.

Till date a standardized architectural contract remains undefined. All the contracts are made by Clients Legal & Finance Teams. They are designed to take care of client needs. Institutes can research the needs of the profession and create framework documents. Such integration of profession and academia will allow the profession renew itself and redraw its boundary with every step.

In the age of internet, the disruptions will happen in all spheres of the profession and society. There is an abundance of information available at every instant. The ability to analyze and process this information is a skillset that needs to be cultured in every institute. To ensure that the architect remains consistent with the prevailing environment, the institutes need to impart education that teaches the emerging Architects, the Mechanisms to Learn. The mechanism to convert Information into knowledge. The mechanism to convert technology & research into tangible services that can be offered as expertise. The mechanism to sift through the overload of information and reach the right source of to begin their learning.

The course needs to be structured so that the disruptions in professions can be accommodated within it.

Last but not the least the institutes must ensure that the emerging architects understand that Software are just tools and not the end in itself.

Understanding the Economic Environment to Thrive in –

In every decade, political changes happen and sometimes such changes bring with it a new economic environment. Architectural Institutes that do not recognize such changing environment do not remain relevant and they stagnate and this becomes visible in the skillsets in the Architects they create.

The architectural education that should enable the emerging architects to understand such Economic Environment so that they can thrive and perform like problem solvers.

An understanding of the PM inaugural Address of 1959 also indicated such expectations from the professions and academia. Those thoughts even after 50 years remain relevant. Just like Chandigarh was the experiment in the 1950s, similarly the Smart Cities Mission, Housing For All remains the experiment for this decade. Such massive experiments have caused a major disruption in all fields of professionals and technologist. They are expected to generate solutions that could be adopted for the benefit of the society.

The profession is relying heavily on the academicians to create the next generation of architects who would be able to take up the challenges in working out a solution that could solve the challenges of urbanization in our country.

Importance of Professional Networking to Thrive

Very rarely have the colleges recognized the need of teaching the importance of Professional Networking to the Emerging Architects. The lack of this knowledge often creates disillusionment among the emerging architects. The economic benefits of pursuing a profession remains elusive and causes a different set of challenges. The inability to set up independent practice is major source of concern for us in the Council.

The council is attempting to regulate the profession by amending the Architects Act but the academia is expected to instill the importance of professional networking.

A networking that would allow an emerging architects to create an identity with the potential clients or create an identity for themselves as problem solvers. This would allow them to be employment creators rather than become employment seekers. The economic gains they will get will enrich the profession at large.

The networking with professionals from other discipline and decision makers via seminars and conferences and trade events would enable the emerging professional.

Such networking would include, the architectural institutes approaching the local councillors/ urban local bodies / rural development bodies and offering their services to document their problems, challenges and offering research.

Handling the Transition

The Architectural Education has to enable the Emerging Architect with skills needed to handle the transition from “College to Profession” or “Life after Studies”.

There is and always remain a gap between the College and Professional Life. The time required to bridge this gap is sometimes significant part of one's youth. The second part of architectural education should contain few contact periods that would allow this transition to be set in motion before graduation. The experts in the academia are the best people to tackle this need.

There are ongoing debates within the council to address this need and hopefully with adequate

inputs the council may be able to formalize this change as part of mandatory minimum standards.

Conclusions

It is the mandate of Council of Architecture to be an enabler and it relies on the Academia and Professionals to give its inputs to frame the Minimum Formal Education required to educate a Student to gain qualifications adequate enough to become an Architect.

This means that its task is not to coerce Architectural Colleges into following a central thought but it encourages them to become centres of excellence and expects the profession to renew itself with the needs of the society. The problems that plague the profession should not cause us to divert majority of the energy, but the enrgies should be focussed in availing the opportunities that present itself.

With such an approach our institutes will find the right places for each sort of students; place where they will really flourish.

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TOD AS URBAN PLANNING FOR SUSTAINABLE CITY

P K Singh[1]

Introduction

In this century, cities have become unprecedented centres of human settlement, with the majority of this urban growth occurring in developing nations including India. Resulting environmental problems including greenhouse gas (GHG) emissions generated from population increase, rapid urbanization, high private motor vehicle dependency in cities have placed serious concerns for the future of our wellbeing, and even our existence in the long run that must be addressed in order to create a sustainable future.

Faced with such pressing problems, this paper focuses on a particular strategy known as Transit-Oriented Development, or TOD as one of the solutions for cities to become more sustainable in its planned development.

Challenges in Urban Planning

In context of TOD as solution to City's unsustainable urban growth, some of the challenges are:

Urban Sprawl

Urban sprawl can be defined as low density residential and commercial development on undeveloped land. Cities had traditionally grown around urban centres and around transit rich suburban neighbourhoods reached by buses or rail. However, with mass production of the car, this urban form was disrupted by the massive increase in automobile use which pushed population out of the city.

Some other factors that have contributed to this type of urbanization include: lowered cost of land and houses in the outer suburbs of the cities; increased spending on certain types of infrastructure (such as roads for private cars) as opposed to other types (such as mass public transportation); rise in the standard of living, which has caused many people with higher incomes to demand bigger housing units and lower tax rates in suburban areas.

These new cities do not always have the jobs and economic opportunities needed to support potential residents where mono-use housing developments are located so far away from jobs that people have ended up abandoning poorly-located houses. Though sprawl began in the US, this model of unsustainable development spread throughout the world, and has become prominent in developing countries DDA/ slum development

Rapid Motorization

Another problem that cities face today is rapid motorization.

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Increased automobile use caused urban expansion; in turn, urban sprawl forced increased motorization, as cities became too spread out to be easily accessible. This is especially true of cities located in the developing world, where the automobile has more recently become widely available and affordable to residents.

Such rapid rates of motorization have major consequences for cities, including increased road traffic fatalities, congestion. As road transport is one of the main causes of greenhouse gas (GHG) emissions, motorization is also a major contributor to long-term global climate change, with the immediate effects of increased pollution and associated health problems for citizens.

Energy Consumption and Density

Directly related to urban sprawl is a city's overall energy consumption; the amount of energy used by a city is linked to whether the urban form of that city is compact or sprawled. Studies have shown that energy consumption of a city is negatively correlated with the density of that city. As this graph illustrates, cities with high urban density, like Hong Kong, consume less energy per capita per year than cities with low urban density, like Houston. Cities with a greater amount of urban sprawl are more reliant on the automobile, and, therefore, typically consume more energy.

Urban Footprint

Directly related to problems of urban sprawl and motorization are cities' greenhouse gas emissions. A city's urban form has considerable and measurable impacts on its overall carbon footprint, findings indicate that areas with higher urban density will typically have a smaller carbon footprint than more sprawling areas. In order to decrease emissions and create more sustainable cities, density is the preferred urban form.

Additional Costs of Urban Sprawl

Rising rates of motorization have led to increased levels of traffic congestion in many cities. Traffic congestion leads to lost time and economic opportunities for residents of developing countries. For example, in 2011, 35% of respondents to a survey conducted in the developing city of Nairobi, Kenya, estimated that they spent 3 or more hours a day stuck in traffic.

Urban sprawl has additional economic costs due to the high cost of the provision of infrastructure such as sewage and water systems. As a study conducted in the US in 2003 concluded, the cost per capita of the provision of public services declines with density and increases with sprawl.

Urban sprawl and automobile-dependency can also have great consequences for the overall health of a city's population. As an immediate effect of traffic congestion, pollution can cause life-threatening respiratory illnesses in a city's residents.

Sprawl's Harm on the Urban Poor

when auto-dependent cities invest in automobile infrastructure, the urban poor are unlikely to benefit. Instead, they suffer when public transit, bicycle, and pedestrian infrastructure improvements are ignored, as they are more likely to utilize these more cost-effective modes of transit. In many developing nations, the urban poor, unable to afford to live in the city centre, are forced to live on the outskirts of sprawling cities; in some developing cities, this can create concentrations of urban poverty focused in informal settlements located at the periphery of a city

Transit Oriented Development:

Historically, urbanization has typically materialized around predominant modes of transportation, with urban development occurring along such transit routes as water passageways, trade routes, and railway networks. With limited mobility, cities grew organically to meet the needs of residents within the confines of their travel ability, often resulting in dense, mixed-use, and walkable areas—exactly the aims of TOD.

TOD can be defined as a planning strategy used to achieve well-designed, high-density mixed-use, mixed-income, pedestrian and bike-friendly urban development, organized around mass transit stations.

Key Elements of TOD:

TOD neighbourhoods should be designed to contain the same elements that make life in a city attractive. TOD communities should include commercial and residential development, including development for a variety of income levels, diversity in building structure and design, vibrant public spaces, access to high quality public transit, design of safe walking and biking corridors, and access to a wide range of amenities, public services, and recreational activities.

Ideally, TOD should include the following design elements:

Access to Opportunities: TOD should offer a variety of services, amenities, and job opportunities to residents of a community. If TOD developments offer a variety of opportunities for residents, residents will have less need to leave their communities; this is a strategy by which automobile dependency can be reduced.

Mass Transit Access: Key to the success of TOD is its location near a mass transit station. TOD must be located near a high-quality transit station so that residents have access to fast and reliable transportation. This access will prevent residents from relying on their cars for transportation.

Mixed-Used Development: TOD should be mixed-used, that is, TOD should be designed to

include different types of development such as residences, retails, offices and leisure amenities. This can help to increase economic and social activities within a community.

High-density Development: Another important element of TOD is high-density planning. In order to increase transit ridership and decrease automobile-dependency, TOD should be designed to be high density, providing more housing and job units near transit stations.

Mixed-Income Development: TOD should be designed to be inclusive, and should include mixed-income residential units affordable to members of lower socio-economic classes, at least at a corridor level.

Walkability and bike-ability: A primary element of TOD is walkability; TOD should be designed to be walkable, with developments planned to be both pedestrian and bicycle friendly. With proper integration of access for non-motorized modes of transport, automobile-dependency can be reduced.

The Case for TOD - Sustainable City:

Connection between TOD and sustainable cities TOD stems from fact that it can enhance urban competitiveness by concentrating jobs in areas with high level of transit accessibility providing economic opportunities for many.

TOD can help to increase ridership for mass transit by providing customers that live, work, and play in high-density developments located in close proximity to transit stations.

TOD has been associated with positive health benefits related to cleaner air, decreased congestion, and increased physical activity by decreasing automobile-dependency. By providing pedestrian-friendly conditions, bicycling infrastructure, and high-quality public transportation, TOD can also help to decrease the number of traffic fatalities on roads and build safer neighbourhoods.

TOD provides the opportunity for municipalities to develop non-traditional schemes for financing through such strategies as land value capture mechanisms, tax increment financing, and private public partnerships. Successful TOD projects have the potential of improving a municipality's fiscal situation by increasing property tax revenues in the long run. The economic activity generated from TOD can also lead to increased sales tax revenues.

TOD can help cities reduce their carbon footprints. Because TOD proposes high density development, TOD can help reduce automobile-dependency and encourage public transit use, which, in turn, reduces energy consumption and greenhouse gas emissions. TOD can also help curb issues of sprawl and conserve a city's open public spaces by directing new development to brownfields and existing urban areas.

Cities can use TOD as a way to create more inclusive, mixed-income neighbourhoods. Promoting mixed use development with increased height and density zoning can create opportunities for developers to build mixed-income housing. An inclusive TOD approach proposes that true TOD should be beneficial for the entire community, independent of income level.

Case of Hongkong

In the high-density city of Hong Kong, 43% of residents live within 500m of a transit station, while 57% of jobs are located within 500m of a transit stop; such distributions have occurred due in part to both organic and planned TOD. As a result, Hong Kong's high-quality transit system is one of the most successful transit networks in the world: in 2000, it was estimated that roughly 90% of all motorized trips taken in Hong Kong were made by public transit, a huge majority market share. When TOD is implemented successfully, transit ridership is increased, and residents have access to a variety of housing and employment opportunities through transit networks. Hong Kong's transport-related energy consumption per capita per year is one of the lowest among major cities in the world.

Scales of TOD

During its planning stages, TOD planning should occur at the regional or city, corridor, and district or station levels. Planning with a cohesive, long-term TOD vision in mind at each level can ensure successful TOD.

Corridor-level TOD is more specific: at this scale, TOD planning occurs around a single transit corridor. Corridor-level TOD planning includes developing strategic plans for TOD around each station area along a transit corridor. In corridor-level planning, a station area can be defined as the area located within an 800 metre radius, what is considered to be walking distance, of a transit station in that corridor.

Corridor level planning involves thinking about travel patterns, distribution of work, and transportation demand; it also involves planning where housing and service areas will be located within a corridor, and thinking about how to connect the planned corridor with other existing corridors in a city.

For many cities, it can be difficult to coordinate TOD planning at different scales. However, in order to achieve successful TOD, community participation planning must be integrated at all levels to ensure proper implementation. Different levels of planning and implementation might involve various level of governmental authorities: from metropolitan agencies, to city and neighbourhood level agencies. All the planning scales should be coordinated.

Limited transit networks diminish TOD appeal. TOD project attractiveness depends on the number and variety of destinations that are reachable by transit beyond an individual TOD neighbourhood. A limited transit network limits the appeal of TOD. Building multiple commercial, employment, and entertainment centres near transit stops provides an opportunity to increase the number and quality of destinations reachable by the transit network.

Conclusion:

The challenges that cities face are complex, and may, at times, seem overwhelming. However, with the strategies available through TOD, cities can begin to address many of these problems, moving towards sustainability. TOD is a long-term strategy often initiated by the public sector. It can be achieved over a long time period through a series of investments.

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REDEVELOPMENT AS A DEVELOPMENT STRATEGY
A CRITICAL ANALYSIS - CASE STUDY VINOD NAGAR, DELHI

Sulabh Goel[1]

Abstract

Delhi has a significant history and housing has been a critical aspect that has defined the city form through time. Housing of the masses is now among the foremost issues that city has been grappling. The rapid pace of evolution of this typology of housing suggests a favorable demand trend of this kind of housing. This housing texture of this housing type is synonymous with a characters of built environment like 'organic growth' ,high density, narrow lanes, small plots, high ground coverage and structures of about 3-4 floors height, mixed land use and a general deficiency of infrastructure. Often outside the ambit of the planned and perceived as chaotic, these locations are then categorized as the “informal, unregulated and unplanned “which are deficient in services and unfit for habitation. The city administration and growth regulators from time to time attempted to find formal solutions like redevelopment for such reorganizing these housing chunks. The Delhi Master Plan 2021 encourages redevelopment as a developmental policy and details an entire chapter on the possible clauses that could be adopted for a redevelopment exercise.

Our investigations into the nature of these settlements reveal existence of evolved and established social and economic networks and an equilibrium between life styles and aspirations of the people. We through our paper wish to critically evaluate the suitability of redevelopment as a process in such a scenario. The essential question that we intend to pose is – Is redevelopment the right solution for organic Delhi? Our paper would attempt to understand redevelopment through study of Vinod Nagar (a combination of unauthorized, unauthorized regularized and an urban village) located in East Delhi.

Some of the questions that we wish to explore are:

- Understanding the context of Vinod Nagar (social and economic profile) and Its connection to the city.
- Understanding of the policy of redevelopment in context of Delhi.
- Imagining redevelopment against the context of Vinod Nagar and critical analysis of the outcome.

Keywords: Redevelopment, urban village, unauthorized colonies

Understanding aspects of Vinod Nagar

The spread of unauthorized construction in our cities has assumed significant proportions. It is

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estimated that in Delhi, the population resident in unauthorized colonies(a type of unauthorized construction) is over 4 million. The government, of the National Capital Territory of Delhi under the 2021 master plan guidelines has issued 'provisional regularization' certificates to 1,639 unauthorized colonies to start the process of redevelopment/renewal/regularization of the colonies. The objective of this is to bring them into the urban mainstream. However, the morphology and urban structure of these colonies is different from the 'greenfield' planned development guided by the Delhi Master Plan. . To represent a case, and to understand the context of these colonies, the paper has taken up the study of Vinod Nagar, an unauthorized development in East Delhi.

1.1. Location and legal status

Initially Vinod Nagar was a small village of Mandawali that lay across Yamuna in East Delhi. During the process of expansion of boundaries of Delhi, urban villages were absorbed and the agricultural lands were acquired by the DDA. Unplanned/unauthorized/Regularized colonies are typologies that emerged when the acquired agricultural lands were illegally cut into parcels and offered to people for development.

Figure :Location of Vinod Nagar(Source : Images done by author in City level projects, west vinod nagar and mandawali, DUAC report)

A few years back a part of Vinod Nagar was regularized .Regularization is about recognition of ownership rights of residents in the area. Regularization also legally makes a colony a legal part of city development process. However larger parts of Vinod Nagar are still unauthorized. The area thus is an apt example to represent the unauthorized colonies in the city.



Figure 1: Location of Vinod Nagar(Source : Images done by author in City level projects, west vinod nagar and mandawali, DUAC report)

Despite being an unauthorized colony, the area is witnessing development, which is often a violation of Delhi master plan. The image below briefly narrates the process of expansion of Vinod Nagar from the small village Mandawali to the present state of Vinod Nagar.

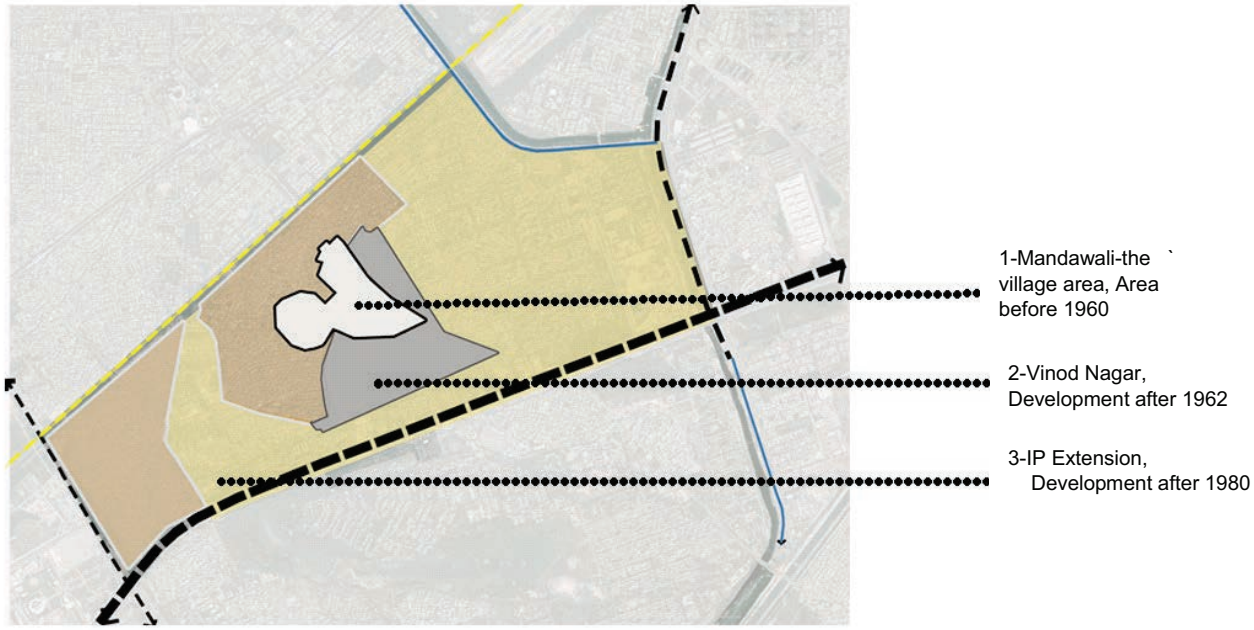
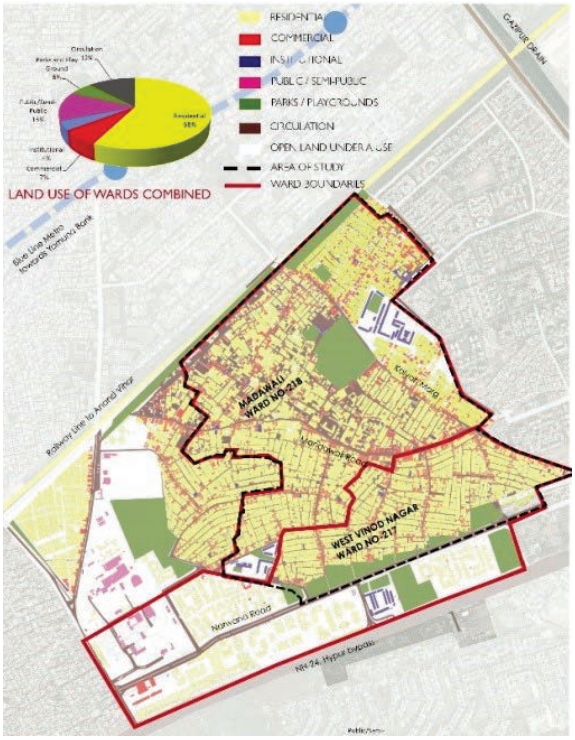
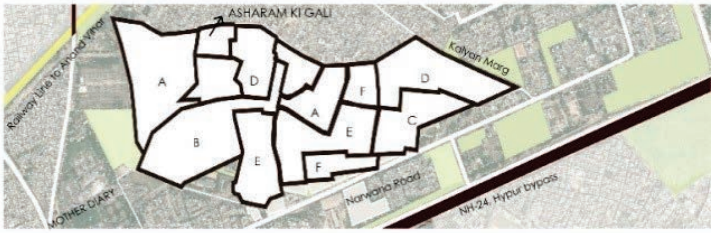


Figure 2: Phases of growth of Vinod Nagar ,Source: Images done by author in City level projects, west vinod nagar and mandawali, DUAC report

Growth and expansion





BLOCK D	BLOCK C	BLOCK F	BLOCK B	BLOCK A	BLOCK E
LEGAL STATUS					
Unauthorized Regularized	Unauthorized	Unauthorized Regularized	Unauthorized	Unauthorized Regularized	Unauthorized
DENSITY PPha - BY ELECTORAL COUNT					
983	**618**	1186	**1475**	1351	1101
AREA					
7.2	4.0	**1.8**	3.4	**11.01**	10.50
DENSITY Du/ha (ASSUMED NO OF FLOORS : g+2) BY GIS MAP					
NO. OF DUS 1770	NO. OF DUS 243	**NO. OF DUS 534**	NO. OF DUS 664	**NO. OF DUS 3720**	NO. OF DUS 2890
245 DU /ha	**609 DU /ha**	296 DU /ha	370 DU /ha	338DU /ha	275 DU /ha

Figure 3: Landuse distribution of Vinod Nagar,
Figure 4: Range of densities existing across various colonies in Vinod Nagar,
Source: Images done by author in City level projects, west vinod nagar and mandawali, DUAC report

Due to locational advantages like proximity to NH-24 and the planned areas of Patpargunj and IP Extension, Vinod Nagar is becoming a favorable residential destination. The area has witnessed a consistent increase in density in terms of PPHA with a single plot being divided into a number of dwelling units. The following image demonstrates the densification of Vinod Nagar between 1980 and 2013.



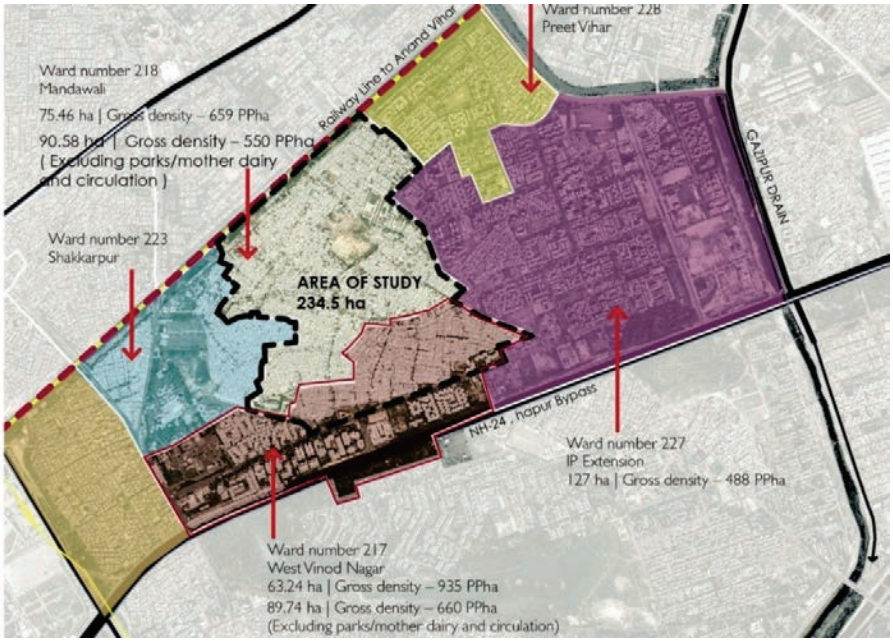
Figure 5: Growth of built form in a colony in Vinod Nagar,Figure 6a,6b,6c : Photos of Vinod Nagar,
Source : Images done by author in City level projects, west vinod nagar and mandawali, DUAC report

The area has grown in terms of density in various ways. Reduction of plot sizes, Subdivision of bigger plots into smaller ones, encroachment on roads and open spaces are ways used by residents to increase built-up areas.The densities of Vinod Nagar colonies range between 600 people /ha to 1400 ppha.When the existing land use was compared to that suggested by masterplan, the following was the analysis:

1. 56% land was under residential use.
2. The area of convenience shopping existing on site exceeded master plan numbers by six times.

3. The area of study had 65% shortage in neighborhood greens but an excess of 11.4% of community parks.
4. The area under study had sufficient schools in comparison to standards prescribed by MPD but lacked in primary schools (with a deficit of 82%)
5. The area of study has no bedded hospitals and lacks in facilities like Dispensary with almost 71.6 % deficit.

To sum up, the area fell short in healthcare and education facilities, while the commercial and residential components exceed the limits prescribed by the master plan. With growing population the area will increasingly fall short in terms of health and education facilities.



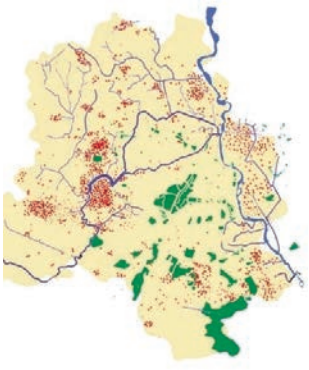


Figure 7: the ward boundaries within Vinod Nagar, Figure 8: Location of unauthorized sett lements in Delhi, Source : Images done by author in City level projects, west vinod nagar and mandawali, DUAC report

Mandawali is an urban village with a defined legal boundary. Vinod Nagar consists of colonies which are a combination of Unauthorized, Unauthorized Regularized and slum. “Unauthorized colonies in Delhi have been in existence right from the time the planned development of Delhi started with the setting-up of DDA in 1957, Since DDA was unable to construct enough low cost housing and there was large scale migration from neighboring states. It is estimated that about 7.00 lakh families are residing in these unauthorized colonies. (Source, DDA website). Because of their unplanned and spontaneous nature they could not be covered under the ambit of masterplan legality and therefore couldn't be assigned any legal status. All these areas face common issues like absolute shortage of open spaces within the colony, lack of healthcare facilities, chaotic and unorganized mobility, inefficient storm water management and lack of water conservation, growing mixed use in the area and higher densities than anticipated and smaller plot sizes.

REDEVELOPMENT: UNDERSTNDING GOVERNMENT INITITATIVES

Redevelopment as a policy in Delhi Master Plan: an analysis

DDA through the Zonal and master plan proposes redevelopment as an alternative for creation of a healthy environment for various areas in Delhi. The paper shall attempt to understand the policy of redevelopment as a solution. Redevelopment proposes optimum utilization of existing urban land in planned and unplanned areas by encouraging possible incentives and modalities, pooling of properties, provision of social infrastructure though TDR, enhanced FAR etc. Following are the clauses for redevelopment as stated in the Master Plan:

30% of area should be used as common green/ soft parking besides circulation area. To incentivize the redevelopment a maximum overall far of 50 % over and above existing permissible far on individual plots subject to a maximum of 400 shall be permissible. Maximum ground coverage is 33.3%. Ground coverage up to 40 % may be allowed to achieve low-rise high density housing without lifts.

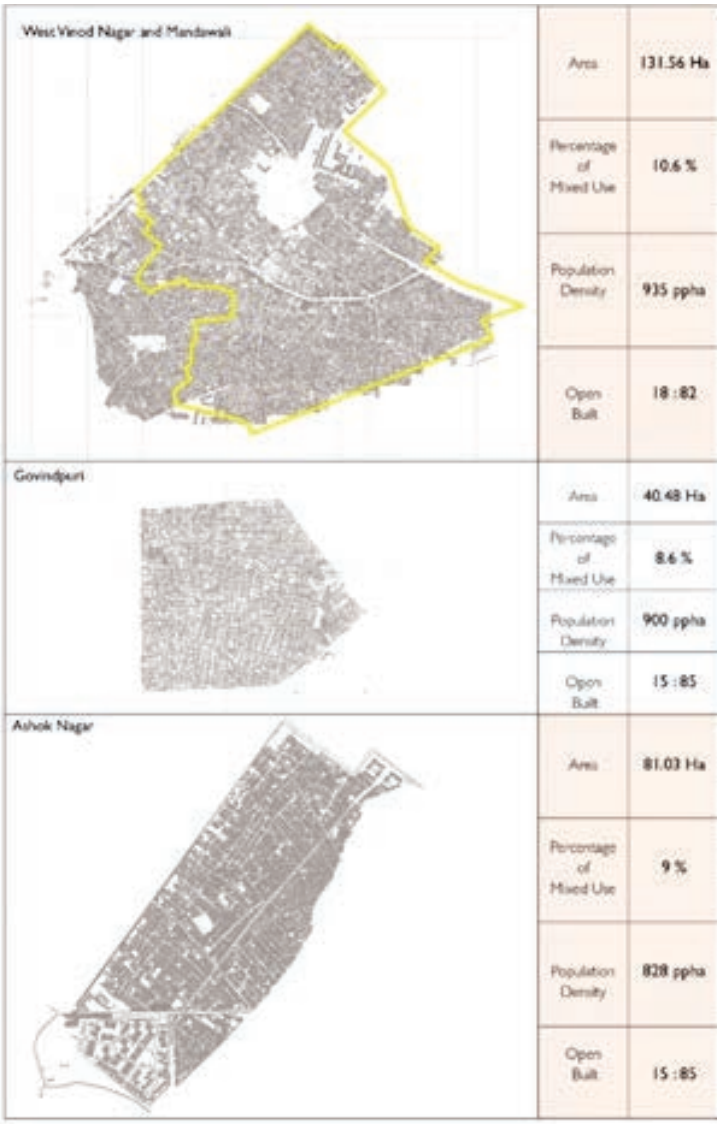


Figure 9: Comparison of density across unauthorized colony
Source : Images done by author in City level projects, west vinod nagar and mandawali, DUAC report

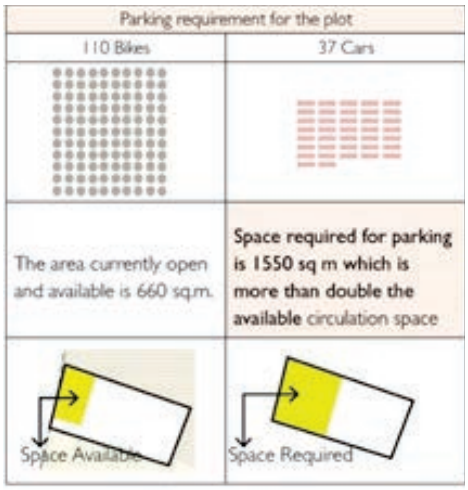
The density for different units is as follows: Category I (upto 40sq.m) - 500 du / ha , Category ii (40-80 sq.m) - 250 du / ha, Category iii (up to 80 sq.m) - 175 du / ha.

The minimum size of amalgamated plot proposed where the development can happen is 3000 sq.

Site demonstration

Scenario I: Proposed development of cluster on external periphery of Vinod nagar as per M.P.D

We have demonstrated the clause of redevelopment on two sites within the site of study to understand the implications on the urban form



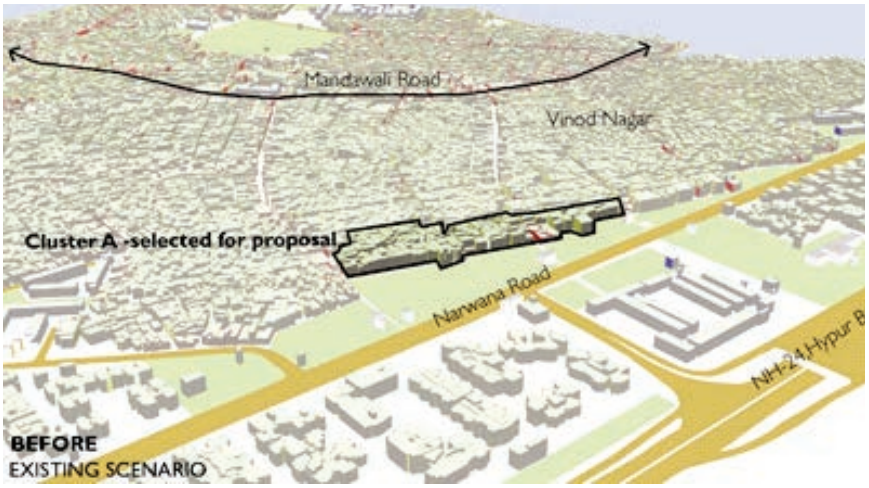
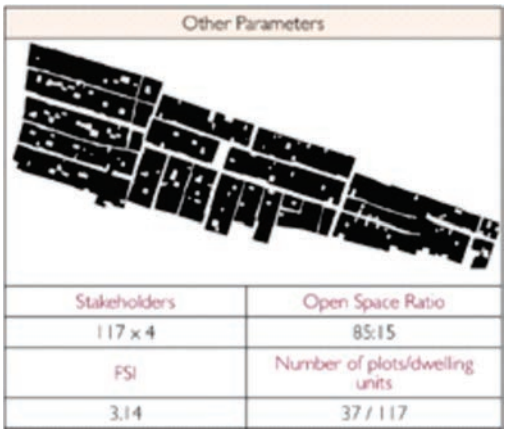


Figure 10: The area requirements as prescribed by master plan, Figure 11: Existing built up of the proposed site: Images done by author in City level projects, west vinod nagar and mandawali, DUAC report



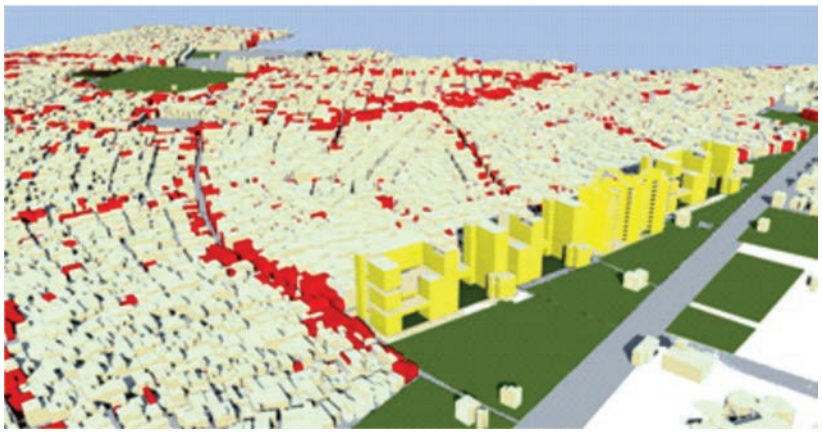


Figure 12: The characterstics of site, Image 13: The proposed intervention: Images done by author in City level projects, west vinod nagar and mandawali, DUAC report



Figure 14: The proposed intervention and area statement: Images done by author in City level projects, west vinod nagar and mandawali, DUAC report,Image 15: next page, plan of the proposed intervention



By MPD standards maximum ground coverage is 33.3% Ground coverage up to 40 % may be allowed to achieve low-rise high density housing without elevators.

SCENARIO II:Proposed Development of 3000 sq.m cluster within Vinod Nagar

Total Site Area	4600 sq.m
% of Open	65.56 %
F.A.R	3
Gross Built Up	13800
No. of Dus	280
Parking required @ 2 E.C.S per 100 sq. m: 215 . Parking provision : 317	

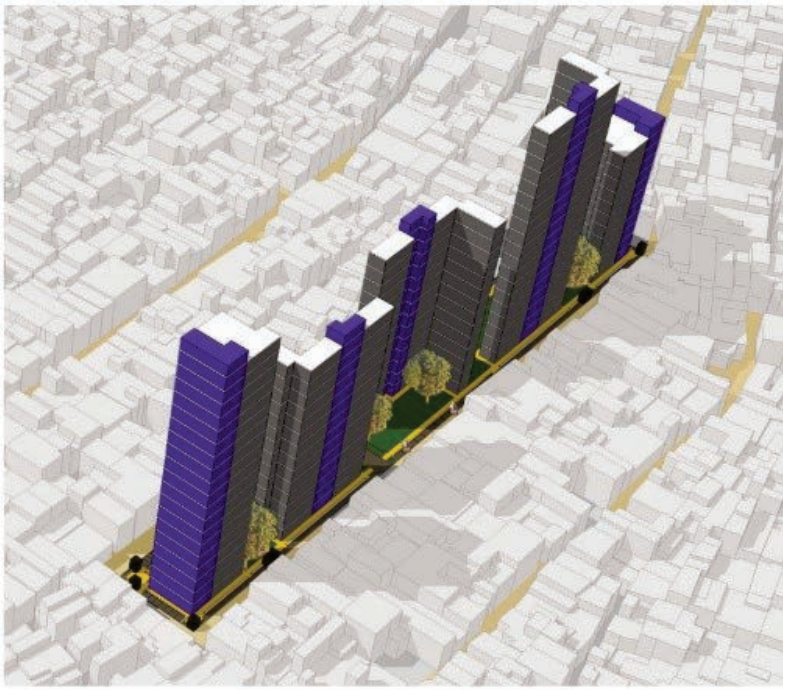


Figure 16: area calculation for ooption 2.Figure 17: the proposed intervention

ANALYSIS

A process of this kind has advantages like optimal utilization of land, provision for facilities/amenities, ordered traffic movement and parking spaces .However there are some critical questions: Unauthorized colonies like Vinod Nagar have small plots and many owners. Its

only an assumption that the people residing in this area are low income. As stated earlier, these locations because of their proximity to amenities are now sought after residential locality. The development of Vinod Nagar (typical of most such colonies) reflects an equilibrium attained w.r.t. life styles and aspirations of the people. Would redevelopment justify negating the investment the residents have made in the present development? A plot amalgamation exercise would require active participation of all owners and residents. In this situation approx. 1800 owners of MIG would be involved. **Who, then would be entrusted withthe ownership of implementation of development on this scale? Who would finance it and why?**



Figure 18:Existing Site context for Scenario 2,Figure 19: Proposed intervention for Scenario 2 Images done by author in City level projects, west vinod nagar and mandawali, DUAC report:

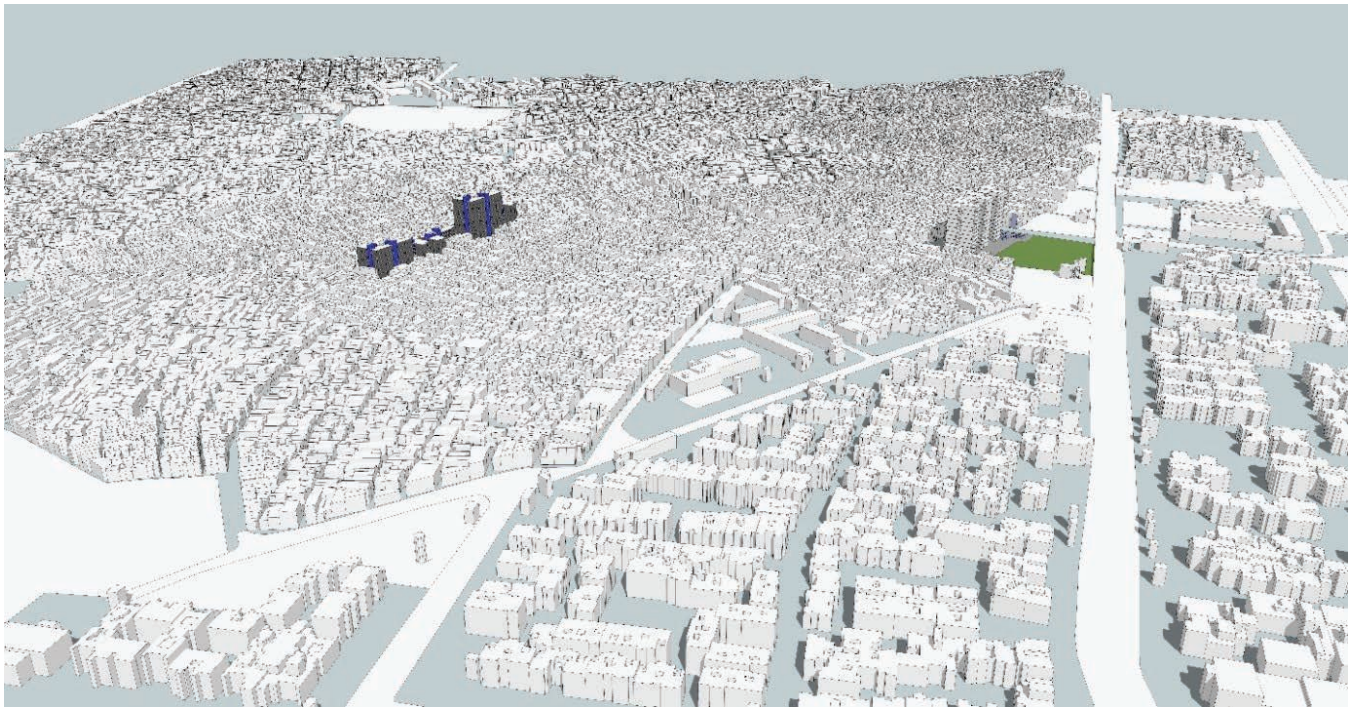
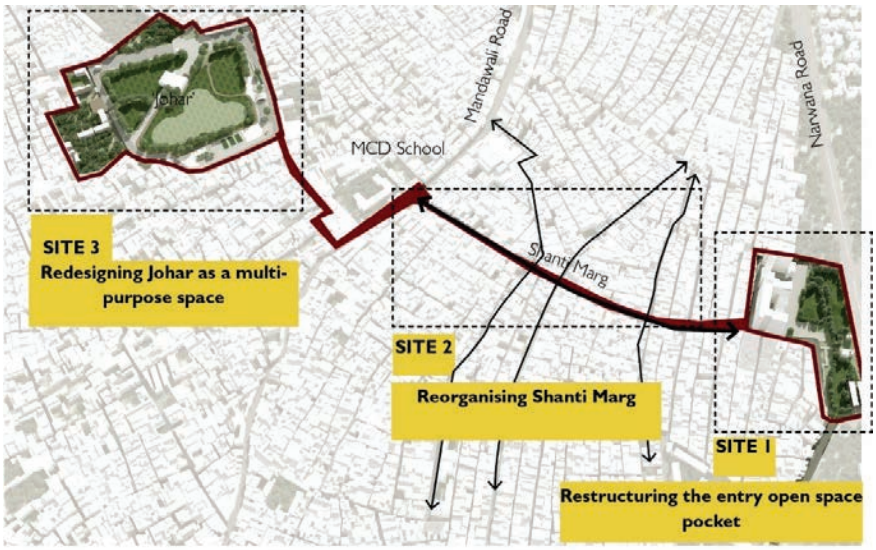


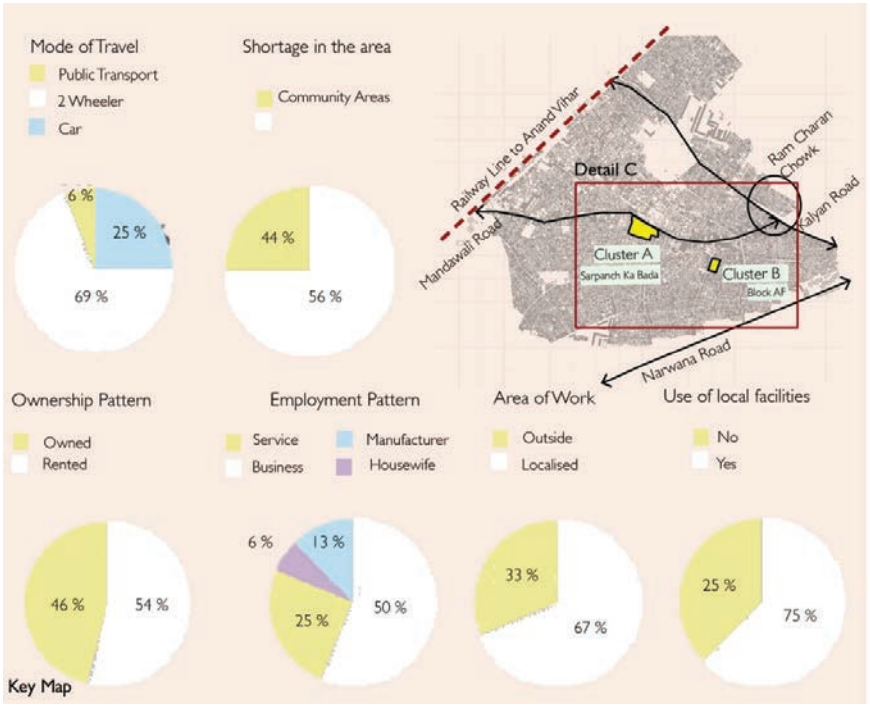
Figure 18:Existing Site context for Scenario 2,Figure 19: Proposed intervention for Scenario 2 Images done by author in City level projects, west vinod nagar and mandawali, DUAC report:

Apart from the complexities in decision of an ideal model, our experience with people's participation suggests that people prefer provision of facilities and amenities than the condition of

the housing. Due to their location and access to facilities these spaces are preferred rental destinations.

The policy of regularization is thus still a very unclear. We suggest an immediate focus on small but effective schemes should be placed on small yet effective schemes that would help in overall up gradation of the area





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OPTIMIZING THE THIRD SKIN - ADDRESSING ENERGY EFFICIENCY AND THERMAL COMFORT IN AFFORDABLE HOUSING

Rajneesh Sareen[1], Mitashi Singh[2]

Abstract

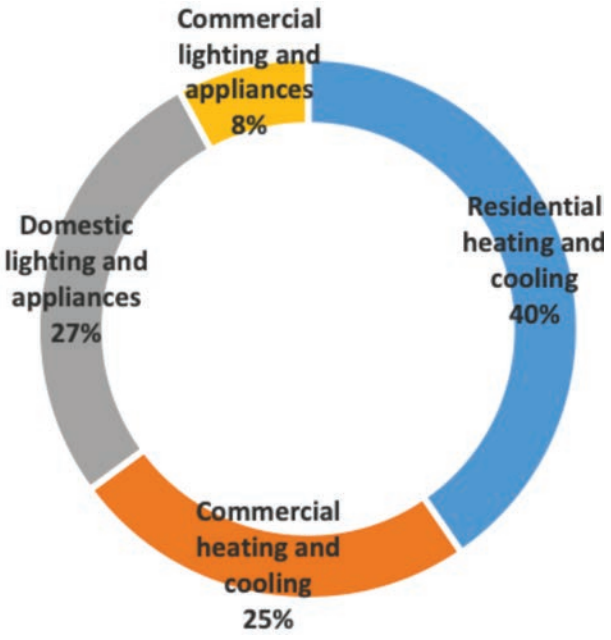
Under the current flagship programme for affordable housing in urban and rural areas — Pradhan Mantri Awas Yojana (PMAY), 48 million dwelling units are targeted to be built by 2022. Recently launched National Cooling Action Plan 2019 suggests to enable thermal comfort for all climate by using appropriate and energy efficient building design for construction of houses under EWS and LIG segments. Currently, there is no explicit focus on combining energy efficiency and environmental sustainability of materials with thermal comfort and quality of life in the affordable housing sector. This paper brings forth a methodology to understand the interplay between building design and material choice in order to inform state governments and their housing strategies for wider proliferation of thermal comfort and energy efficiency.

Keywords: Pradhan Mantri Awaas Yojana, Affordable Housing, Energy Efficiency, Thermal Comfort, Energy Conservation Building Code – Residential, Alternative materials and walling assembly.

Research domain

Pradhan Mantri Awaas Yojana (PMAY) was launched in 2015 to meet the mammoth requirement of 18.78 million urban and 29.5 million rural dwelling units in the country (Ministry of Housing and Urban Poverty Alleviation, 2015; Ministry of Rural Development, 2016). This translates into India adding 360 million sqm of building footprint by 2022. The impact of this new construction on material and other resources will be huge.

As of 2016, buildings consumed 30 per cent of the total electricity demand in India, of which residential buildings constitute 22 per cent (Ministry of Statistics and Programme Implementation, 2018). Gross electricity consumption by residential buildings was around 55TWh in 1996 and 260 TWh in 2015, i.e. a fourfold increase in 20 years (Central Electricity Authority, 2017). The annual electricity use per household is predicted to increase from 650 kWh in 2012 to 2750 kWh by 2050 (Rawal and Shukla, 2014). Clearly, a lot of new energy demand will be driven by the space cooling needs (NITI



Graph 1: Distribution of components in buildings sector contributing to energy demand

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Aayog, 2017) (see Graph 1).

While the policy goals of resource and energy savings is well understood, combining these efficiency goals with the target of delivering thermal comfort and quality of life for all, especially the urban poor, has still not received adequate attention.

The National Cooling Action Plan, 2019, just released by the Ministry of Environment and Forests and Climate Change (MoEF&CC) estimates that by 2038, a significant percentage of Indian households will be residing in buildings that would not be able to provide thermally comfortable indoors due to poor architectural design and warming of urban environment (MoEF&CC, 2019). If energy efficiency and thermal comfort goals are not combined, households will make early crossover and resort to active means of cooling (room air-conditioners, etc) to keep indoors comfortable. This will have a financial implication for the lower income rung as well, which constitutes nearly 95 per cent of the housing deficit.

The National Cooling Action Plan therefore states that wider proliferation of thermally efficient built spaces, that have reduced heat load with the help of walling assembly that addresses material and insulation, in addition to which, shading, and enhanced natural ventilation, will become important to reduce requirement of active-cooling. This allows thermal comfort to be available for all to minimize energy footprint in an increasingly climate-risked world.

Research methodology

The Bureau of Energy Efficiency (BEE) acknowledges that energy demand in buildings can be cut down by up to 40 per cent by designing an efficient envelope. Eco-Niwas Samhita 2018 (Energy Conservation Building Code for Residential Buildings or ECBC-R) is the latest code which sets energy performance standards for building envelope through Residential Envelope Transmittance Value (RETV), Openable Window-to-floor area ratio, Visible Light Transmittance (VLT). The code takes majority of the affordable housing sector in its ambit (Bureau of Energy Efficiency, 2018). RETV in ECBC-R factors in the thermal transmittance property of the material or walling assembly used. Building Material and Technology Promotion Council (BMTPC) under the Ministry of Housing and Urban Affairs (MHUA) promotes 24 alternative materials and construction technologies as part of the Technology Sub-mission (BMTPC, 2018).

These two interventions have led to the policy convergence of two big ideas – planning and designing for energy efficiency as well as for thermal comfort. In order to understand this convergence in the current affordable housing regime and the interplay between design and material choice, this pilot study takes up a sample project located in Composite climate. The project as designed along with the materials used is evaluated for:

i) Performance as per ECBC-R

ii) Annual thermal comfort using whole buildings energy & thermal simulation

iii) Day lighting as per the National Building Code 2016.

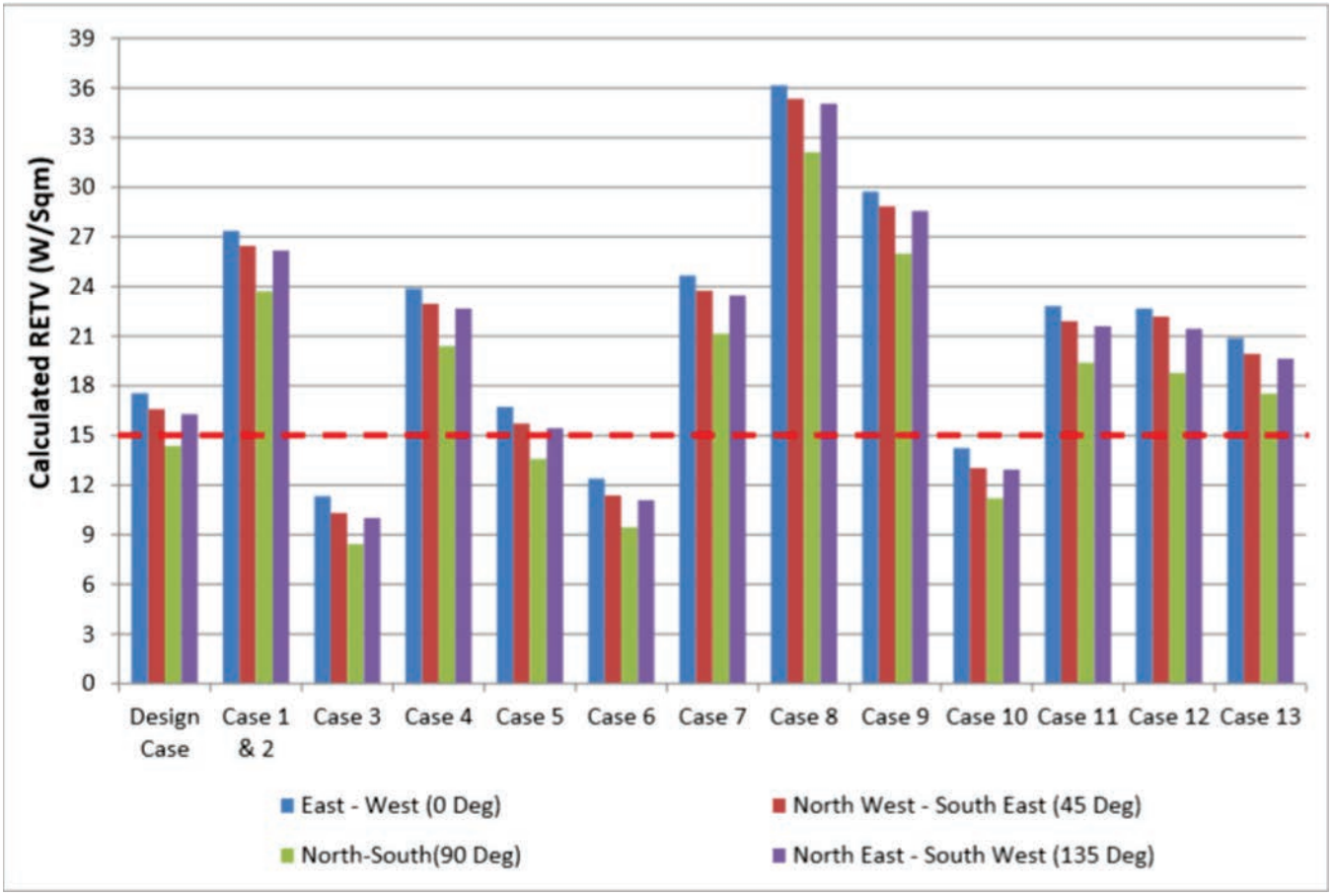
iv) Performance of alternative materials according to ECBC-R. To check the impact of alternative materials, RETV is re-evaluated for 13 of the 24 walling assemblies promoted by BMTPC by replacing the thermal transmittance value (U-value) in the RETV equation.

Results and discussion

The four evaluations are discussed with their results below:

ECBC-R compliance for the project as designed: The sample case performs as per the VLT requirement stated in ECBC-R but demonstrates opportunity to work further when it comes to openable window-to-floor area ratio, U value of the roof and residential envelope transmittance value. The analysis reveals that North-south orientation delivers lowest RETV at 14.3 W/sqm followed by North East-South West, North West-South East and is worst for East-West orientation at 17.3 W/sqm.

RETV analysis with alternative materials: The study further simulates the sample project with alternative materials compiled by BMTPC and the conventional burnt clay brick to understand their compliance to ECBC-R, if used. On being used in exterior walling and when oriented in four different directions, how the materials (or cases) perform or what RETV is received is



Graph 2: RETV analysis results of alternative materials promoted by BMTPC

The scenario establishes two aspects, firstly, that the building orientation interplays with material to deliver different RETV. Secondly, there is great opportunity to work on the interplay between design and materials to arrive at mass housing stock that is thermally comfortable and hence uses less energy.

Thermal Comfort Analysis: An analysis using a whole building energy & thermal simulation approach is conducted to calculate Energy Performance Index (EPI) for a typical building. It also estimates indoor comfort conditions achieved in dwelling units facing different directions. Different orientations are tested by rotating the design by 45 deg, 90 Deg& 135 Deg. The layout is simulated using various software and data inputs include building parameters like construction materials, operation & occupancy schedules, internal lighting & equipment loads, natural ventilation logic etc. and indoor thermal comfort in dwelling units is calculated.

Important assumptions used behind the simulation are taken as follows:

Interior Lighting Load: 5 W/sqm

Interior Equipment Load: 10W/Sqm

No. of Occupants per Dwelling Unit: 4 Nos

Thermal Comfort System: Natural Ventilation with Ceiling Fans Only

Thermal Comfort Range: 18 Deg C - 32 Deg C

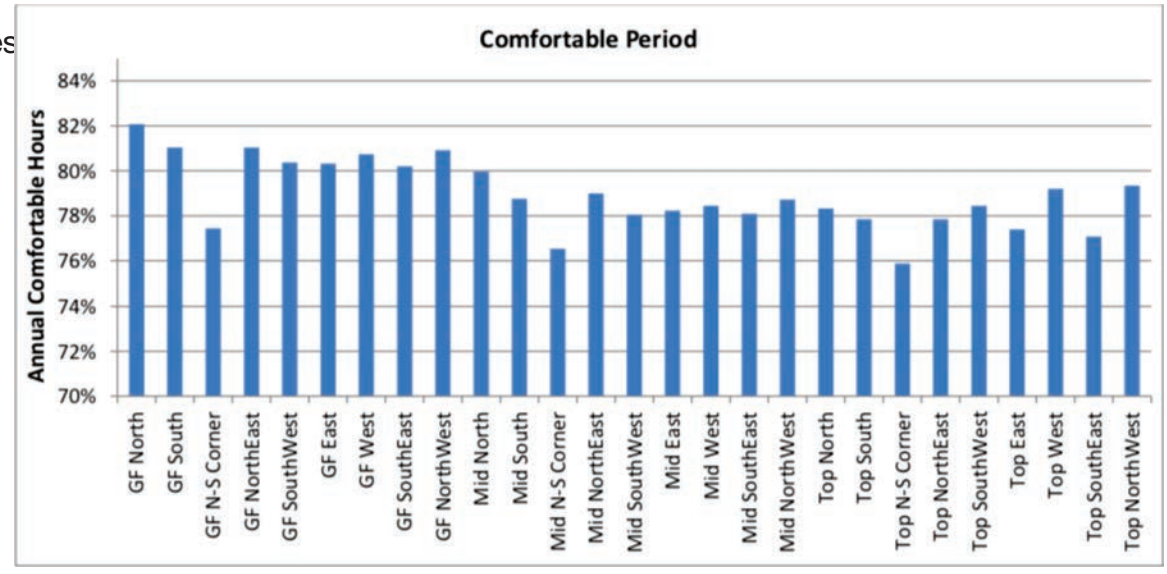
Logic used for natural ventilation: Windows are open when:

a. Outside temperature is between 18 DegC - 36 Deg C

b. Indoor Temperature is higher than outdoor temperature

c. Night Time During Summers

The res

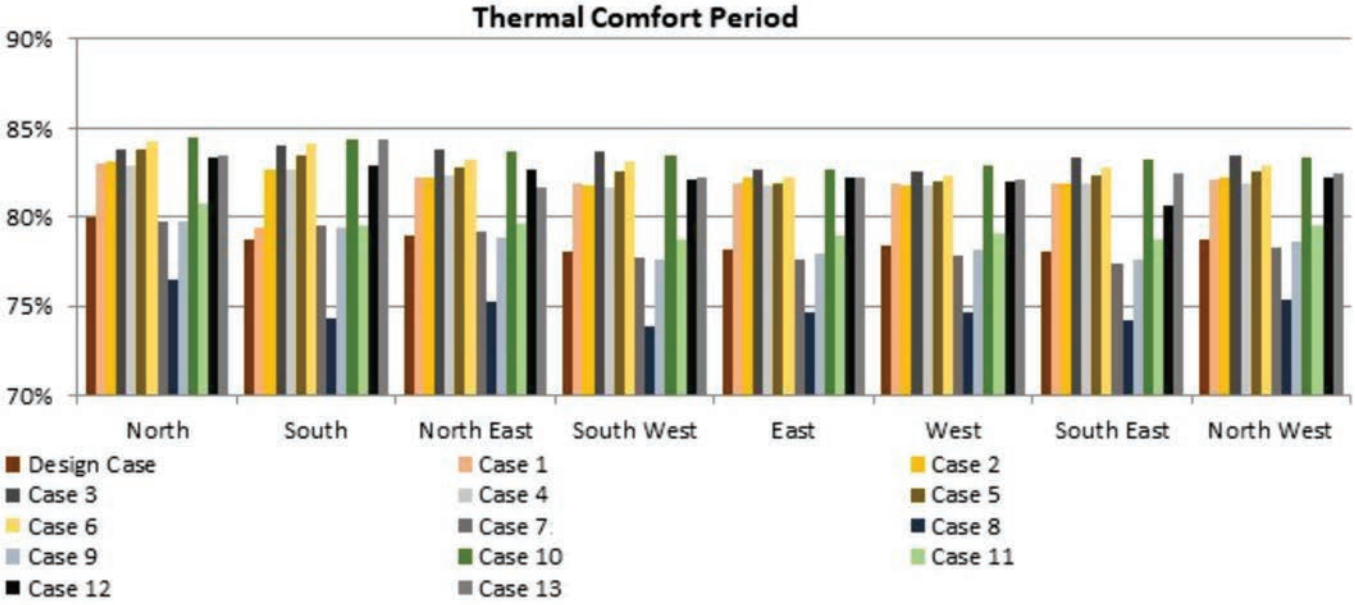


Graph 3: Results of thermal comfort analysis

The existing design will achieve thermal comfort for minimum 75 per cent period of the year to maximum 82 per cent period of the year. The simulated results also show that maximum thermal comfort will be achieved in units facing North-South direction. These results are consistent with calculated RETV where North-South oriented building delivers lowest RETV.

Further, the project is simulated with variation in alternative materials and construction technologies suggested by BMTPC for comparison. The results are compared & presented only for the central dwelling unit on an intermediate floor in all 8 cardinal directions for each technology. A total of unique 13 cases is simulated and compared with the sample case.

The simulation results are represented below in as annual percentage of thermally comfortable



Graph 4: Results of thermal comfort analysis by changing materials

Comparison of the two analysis – RETV and thermal comfort – conducted for alternative materials reveals that a few materials, which perform average in terms of RETV value are still able to achieve good results in terms of thermal comfort. The reason can be attributed to their respective thermal mass.

This comparison can be inferred as for a non-air conditioned building typology such as affordable housing, thermal mass plays an important role in achieving thermal comfort. The RETV calculation in ECBC-R does not factor in the role played by thermal mass, hence a provision for incorporating the role of thermal mass of a material should be made.

Day lighting analysis: The analysis is carried out as per daylight factor requirement under the National Building Code 2016. The daylight simulation considers two scenarios:

Case 1 - Building is not shaded by any other building in its proximity

Case 2 - Self-shading of buildings due to close proximity as per the project layout

Ecotect is used to build daylight model and Radiance to simulate it. Only first floor is modelled for simulation as it forms the worst-case scenario. The simulation reveals the day-lit area is 47 per cent of the total living area in the project when the building is non-shaded by any other building. Wherever the buildings are mutually shading each other, day-lit area is only 15 per cent. However, the design delivers good VLT as per the ECBC-R.

Conclusions

a. National Cooling Action Plan 2019 has mooted the idea of thermal comfort standards to ensure thermal comfort for all. Since, PMAY has triggered frenetic construction across the country, affordable housing sector becomes an important climate change adaptation area. Governments need to extend support towards targeted programmes to enable thermal comfort for economically weaker section (EWS) and low income groups (LIG). Government support for affordable housing should include strategies such as enforcing efficient building envelope guidelines from ECBC-R.

b. India has five climate zones. In order to mainstream climate appropriate housing, there is enormous scope and need for research. Firstly to prioritise and exhaust energy conservation potential from passive architecture and delay crossover to air-conditioned or mechanically-cooled buildings. Government needs to formulate national guidelines with respect to different climate zones and typologies to enable this address. These guidelines can then be integrated with existing regulatory tools such as Environment Impact Assessment provisions, state housing policies, building byelaws, etc.

c. The pilot study – set in composite climate zone – reveals layout and orientation need to be carefully planned in affordable housing as they have an ample contribution to thermal comfort, day lighting and energy performance. For instance, North-South orientation suggested by passive design principles, is able to perform well on the ECBC-R standards, whereas the East-West orientation results a 2.5 W/sqm worse RETV.

d. RETV analysis with alternative walling materials and assemblies has shown a vast variation in their performance i.e. ranging from 9 W/sqm to 35 W/sqm. Since, there is a limitation to layout buildings in the preferable North-South orientation, appropriate material can essentially compensate the thermal performance losses due to the undesirable East-West orientation. In order to do so, adequate research on alterative materials and their (thermal) properties needs to be prioritised by the government.

e. The pilot study revealed that a few materials, which perform average in terms of RETV are still able to achieve good results when simulated for thermal comfort due to their high thermal mass.Current energy conservation regulatory tools do not acknowledge the role played by

mass of materials in thermal comfort. Since there is a great number of low-rise housing typologies also being constructed in the country under PMAY, government can prioritise materials with high thermal massing to achieve thermal comfort in those typologies.

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ADDRESSING BUILDING ENERGY PERFORMANCE & RETROFIT CHALLENGES IN INDIA

Pardeep Chauhan[1], Lalitya Reddy[2]

Abstract

This study includes the energy consumption analysis of existing commercial buildings (Hotels, Offices and Hospitals) in four different climatic zones of India (Hot and Dry, Warm and Humid, Composite, Moderate). Study was focused on analyzing the energy consumption patterns of buildings and finding out the energy saving potential. Majorly HVAC, lighting and Electrical equipment were monitored in every building. Building usage pattern was also analyzed to see its impact on energy performance index (EPI). Study was based on both primary and secondary data collection.

Collecting accurate data is key to find out the energy saving potential in any building. For implanting energy conservation measures unavailability of funds is the major barrier. However various business models are available in the market but still this ESCO model has not uptake to the level to tap the energy saving potential available in the country.

Considering the growth rate of building sector, it has now become imperative to reduce the energy demand of buildings by using energy efficient measures.

Keywords: Energy Efficiency, Commercial Buildings, Retrofit, Sustainable Development, Building Energy Performance, Energy Conservation Measures

Background

India is facing formidable challenges in meeting its energy needs. Domestic and commercial building sectors account for approximately one-third of total electricity consumption and these sectors are likely to consume around 37% of electricity in 2020-21. The commercial buildings sector which comprises office buildings, hotels, hospitals, educational institutes, retails malls, etc., consumes 9% of total electricity consumption in India. This sector has experienced

electricity consumption growth rate of 12-14% in recent years which is attributed to the increasing electricity

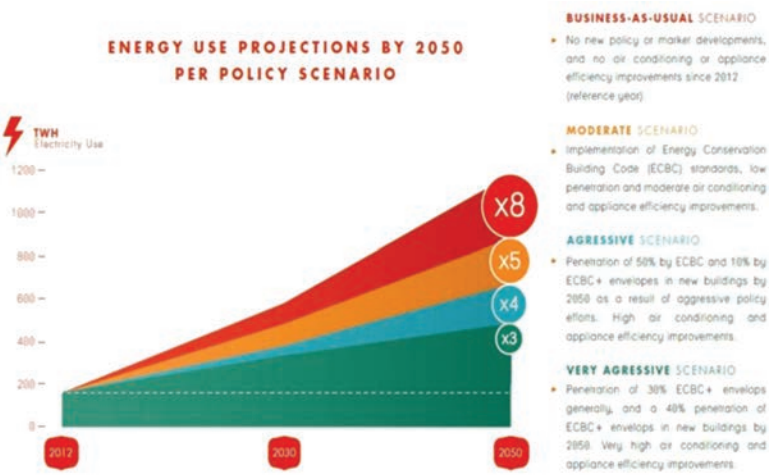


Figure 1. Energy Use Projections by 2050 (Rawal, R., 2014)

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consumption in the existing buildings as well as increasing energy intensity of newly constructed commercial buildings. Further, building construction is taking place at a rapid pace. India is yet to build nearly two-third of its 2030 building stock, according to a report by McKinsey & Company. There is a huge opportunity to conserve energy in this sphere.

The above projection scenarios indicate that electricity consumption is predicted to rise by more than eight times under the business-as-usual scenario. Using focused policy and market efforts, moderate, aggressive and very aggressive strategies can limit the consumption increases to five times, four times and three times the current energy usage, respectively.

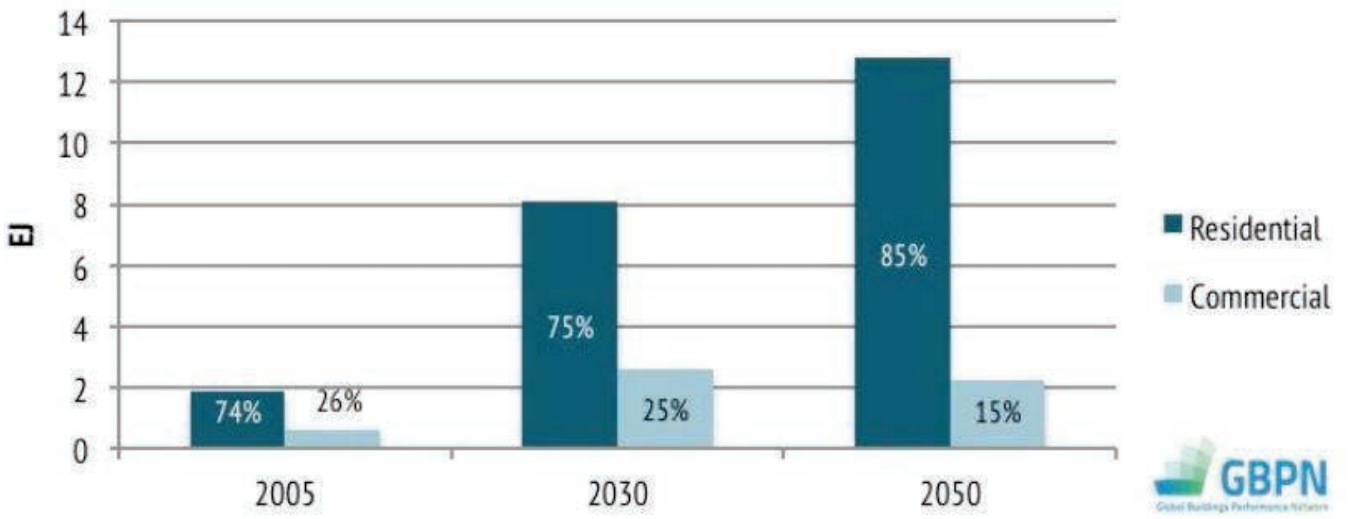


Figure 2.India's moderate efficiency scenario projected energy consumption of India's buildings in 2030 and 2050; percentages represent the ratio of residential and commercial buildings. (Rawal, R., 2014)

Although the residential sector consumes major part of electricity, commercial buildings have greater opportunity to conserve energy as they are more energy intensive and are usually dominated by internal loads. The main focus of this study is on commercial buildings consisting of hospitals, hotels and offices.

In order to reduce the ever increasing gap between energy supply and demand, energy efficiency in existing buildings is of prime importance. The opportunities for improvements in energy performance are not readily recognized by public in general.

Approach

What gets measured gets managed is the underlying principle of this study. Data collection helps manage buildings effectively. Data collection facilitates energy accounting. It assists in identifying opportunities for improvement. It can also help quantify/verify energy savings. Data collected primarily helps to identify energy conservation measures (ECMs) for low performing buildings.

Emphasis is placed on the rigor of the field data collection process and data requirements to perform energy analysis and maintain high quality of energy audits. The purpose of the energy audit process is to collect accurate data about the building which can later be used to make informed decisions about the feasibility of retrofit upgrades.

The data collected from the client during the audit consists of electricity bills (for three years period), lighting inventory, AHU inventory, HVAC design data, chiller, LT panel, and transformer logbook data. State of the art technology instruments are used for data collection during the energy audit of the buildings. The building facilities depend majorly on meters installed on electrical panels and readings from chiller panels to obtain needful information. They do not utilize any special equipment for energy data collection. The instrumentation used by our team for measurement of data on site include one phase and three phase power analyzer, lux meter, ultrasonic flow meter, anemometer, thermo hygrometer and thermal imager etc.

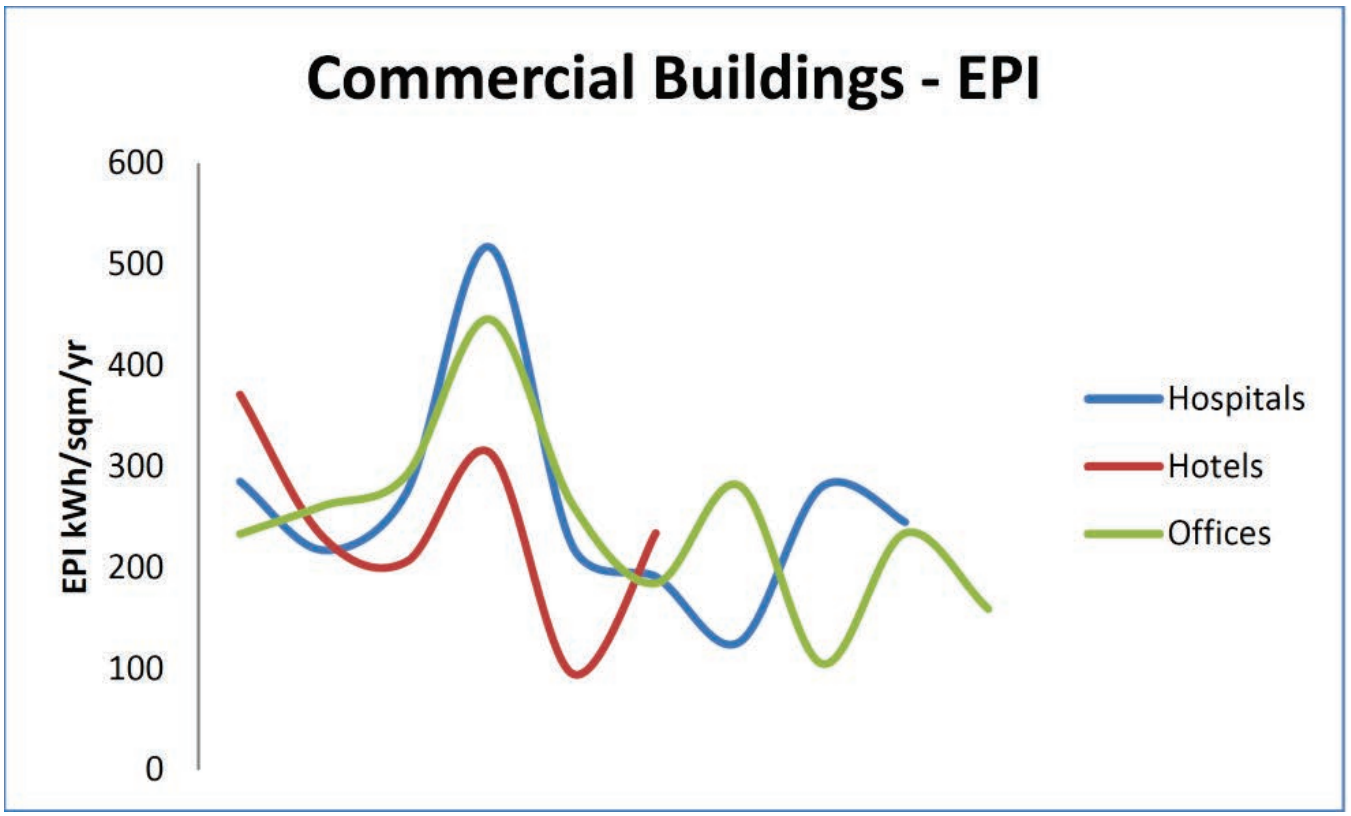


Figure 3. Represents the Energy performance index (EPI) of the three types of audited buildings.

The energy consumed by buildings under the three typologies varies in each case, with the EPI of hospital buildings in the range of 126-517 kWh/m2/yr, EPI of hotels is 95-371 kWh/m2/yr and office buildings in the range of 105-446 kWh/m2/yr. The average EPI calculated for hospital buildings is 262 kWh/m2/yr, while the average EPI for hotel and office buildings is 242 kWh/m2/yr and 246 kWh/m2/yr, respectively.

Identification of ECMs

Appropriate Energy Conservation Measures (ECMs) have been identified for each building audited with an aim to reduce the consumption of energy. ECMs suggested include variable operation of secondary chilled water pump, installation of chiller plant optimizer, replacement of standard efficiency motors, retrofitting existing single loop constant pump, replacing existing chillers, replacement of existing unitary ACs, packaged ACs with variable refrigeration volume systems, installation of adiabatic cooling pads in existing air cooled chillers, replacement of existing lighting fixtures with LED fixtures and replacement of chilled water pumps and condenser water pumps etc. The ECMs are applied based on feasibility and profitability of the scheme for each building. A simple payback period analysis was carried out for the ECMs applied in each building. By assessing direct energy and cost savings from the energy efficient technologies or measures the payback periods were in a promising range of 0.6-5years.

Challenges in Implementation of ECMs

After energy conservation measures have been appraised the next challenge lies in implementation of these measures in the building. Some of the major challenges are as follows:

- The entire focus should be shifted from the level of the facility manager to the board room where the decision making takes place. The first challenge lies in enabling the smooth communication between the board room and the facility manager level.
- A lack of a comprehensive view in implementation of the energy saving measures. A holistic approach is needed to achieve the deemed savings.

The electricity tariffs are continuously increasing and hence there is an undeniable need to improve energy efficiencies of building systems.

Financing methods

Several methods of financing energy efficiency measures exist including internal funding, debt funding, lease, energy performance contracts (ESCOs), utility incentives, equipment rebates etc. Internal funds are direct allocations from an organization's own internal capital or operating budget for ECM implementation. Debt financing is using capital borrowed directly by organization from private lenders and include multiple bonds. Lease purchase agreement is funding through an operating or financial lease of 5- 10 years with no up-front cost. Under energy performance contract, ESCOs provide a service package that includes design and engineering, financing, installation and maintenance of retrofit measures to improve energy efficiency. Utility incentives are rebates, grants, or other financial assistance offered by an energy utility for the design and purchase of certain energy-efficient systems and equipment usually as a result of the

implementation of a policy to promote energy efficiency. Equipment rebates involve rebates on the initial purchase price of selected energy-efficient equipment (UNIDO, 2009). Thus, several methods of ECM implementation and some with the inclusion of policy are possible.

Conclusion

Enhancing the energy efficiency of the building stock is an important part of achieving cost reductions at the building owner-tenant level and also of any national level energy or climate policy. This requires a thorough understanding of building energy consumption patterns. A reliable and robust energy data framework to quantify energy consumption and production benefits the government tremendously. A robust program that has technical and statistical rigor, collects parameters relevant to energy use in commercial buildings and produces results in an effective manner is needed. This will enable enhancing of energy efficiency and evidence based effective building energy efficiency policy making in India. The study will be carried forward with these goals in mind. We hope that this study helps in taking the implementation of ECMs to the next level and makes the change we want to see. Thus, it helps ratify the active involvement of the board room while highlighting these measures.

The recommendations offered following energy audits are often not implemented due to the reason that electricity bills are a small area in the context of an organization. However, we need to look at the big picture and consider the fact that electricity prices are not stagnant and are recurring. We must manage what is measured before the problem gets out of bounds at an early stage itself. Organizations that implement these changes are at an advantage and perform well in the future.

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MAINTENANCE ASPECTS IN ARCHITECTURAL PLANNING

Dr K M Soni[1], Usha Batra[2]

Abstract

Maintenance is the process of ensuring that buildings and other assets retain a good appearance and operate at optimum efficiency. Inadequate maintenance can result in decay, degradation and reduced performance and can affect health and threaten the safety of users, occupants and others in the vicinity therefore, maintenance is very essential for the users as well as for the durability of the assets.

Based on the design, function and location, quality of materials and workmanship, buildings deteriorate at different rates and require different levels of attention. A well designed building incorporating the requirements of easy and minimum maintenance proves to be durable and economical during its life cycle. Though, no building will ever be maintenance-free, but the quality of the design and workmanship can minimise the level of maintenance required.

In the present paper, few suggestions are made which are to be considered during design of the building to make the building easily maintainable.

Introduction

Building maintenance is defined as " work undertaken in order to keep, restore or improve every part of a building, its services and surrounds, to a currently accepted standard, and to sustain the utility and value of the building " or to retain a building during its service life in a state in which it can perform its required functions.

Maintenance plays a crucial role in the creation and endurance of architecture during the life cycle of the building. All buildings need to be maintained to live their expected life, and architecture no matter what its form, be for the aesthetics, functionality and durability, cannot escape from such realities. A good building can't be defined only by its aesthetical appearance but needs to fulfil the functional requirement along with due care to the maintenance aspects in terms of spatial planning, materials and interrelation of civil and electrical services with respect to use of building including approachability for maintenance of services. Leakage and seepage, water stagnation, cracks, improper ventilation and inadequate comfort level in a building leads to faster deterioration of the building in addition to affecting its aesthetical appearance.

Services to be considered during planning and designing

Shafts for Services

Shaft in any building is required for taking the service pipes and accordingly designed. Services may include water supply pipes, sanitary pipes, rain water pipes and even AC pipes and smoke

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exhaust due to fire requirements.

Three important factors need to be kept in mind while deciding the size of shaft are i.e. Space requirements for taking out the pipes/services in case of damage or replacement, intermixing of discharge due to breakage of the pipes especially in case of breakage of sanitary pipe and accessibility to the maintenance staff for repair or replacement.

It has been observed that many a times shaft size is designed only to accommodate total number of pipes or is provided very small and pipes are laid one over the other and sometimes the space between two pipes is so tight that it is not feasible to open the joints of pipes by the maintenance staff. It is also very common scene that pipes are placed in front of window, making it unoperational. In one of the case, it was observed that doors/ eye of the sewage pipes were broken and sewage started accumulating over potable water supply lines which were laid closely due to space constraints and then due to leakage at one place in the water supply lines, it was getting mixed while water supply was stopped.

In many multi-storeyed flats, proper entry is not provided and size of the shaft is kept very tight and sometimes even one person can't enter into it. In a design of T-V flats, the entry to the shaft was provided through door from the toilet attached to the bed room and the maintenance staff was not allowed to enter the bed room by the allottee resulting in problems to the occupants of the flat below it and deterioration of the structure. Also, sometimes allottees try to convert such door into small window and even close it. It is therefore important to provide the approach from outside only and size should be sufficient to provide space for working/ operation, as well as segregation of sanitary and water pipes. In another case, entry to the shaft was through a small window and due to no ventilation, maintenance staff was feeling suffocated in the shaft. Opening of shaft from toilets is not desirable due to difficulties mentioned above. Otherwise also, maintenance staff is not allowed to work timely in such cases which leads to damage of the structure. Therefore, shaft needs to be well ventilated along with arrangement of illumination, proper entry and staging platform for repairing the services.





Sometimes platforms for maintaining the services are either not designed or designed without any protection from rain water and due to continuous flow of water on such platforms, corrosion starts in the reinforcement and such platforms become dangerous from safety point of view. It is therefore desirable to provide platforms of sufficient width, properly approachable and covered from rains so that maintenance staff can work properly with safety. It must be understood that sometimes two persons may be required to maintain the services at a time and use such staging platforms. Detailing of shafts must be worked out w.r.t. pipe layout, easily approachable working platform at every floor and sufficient work space for maintenance.

Flat Rooftop with waterproofing

Flat rooftop is very common in the country. Flat roof means RCC work is carried out through uniform thickness of slab, over which slope is prepared by various methods, most commonly by laying brickbat coba treatment or plain cement concrete. Waterproofing is then laid over the same as slope cannot be prepared in water proofing. In case, material used in preparation of slope treatment is not laid properly, seepage starts and even after various layers of waterproofing, seepage still continues due to failure of base slope treatment.

Slope can be prepared in roof slab itself in two ways, one by casting slab into slope from bottom and other by providing flat slab from bottom and giving slope in slab from top. In first case, architecturally, slab will be visible as sloping in case false ceiling is not provided but the cost variation will be insignificant compared to normal flat slab. In second case, thickness of RCC will increase and cost will also go up. In both the cases, advantage is that slope will be in same material and thus waterproofing can directly be laid over the slab and chances of leakage will be minimised. Advantage will be that in future, only upper layer of water proofing treatment would be required to be changed. In such a case, membrane water proofing of small thickness would be sufficient.

Service Pipes through Floor

Service pipes like rain water, sewage and water supply pipes are taken normally from the shaft which is located on outer face of the buildings and is the best way of taking out pipes. In some of the buildings, shafts are provided inside the building and the pipes are horizontally brought out through floor. Such a system sometimes can create considerable maintenance problems. In one of the office building, such arrangement was provided and the rains started at night. In the morning, it was found that water has entered on ground and first floors of the buildings and damaged furniture and the files which were lying on floor or even entered in the almirahs. Actually, horizontal pipes got blocked somewhere between the shaft inside the building and outside manhole. Once the pipes were blocked, rain water got blocked which resulted into water rising up. It was also difficult to desilt such pipes.

Another issue with such arrangement is that such pipes are taken out at the level below plinth beams. Due to slope required, such pipes are then taken out much below level than floor level and thus outer level of the manholes becomes deep. In case, there is only marginal level difference between main drain and connecting drain, in case of water stagnation or heavy rains, water flow gets stopped.

Drainage in Balconies - Open or Covered

In India, balconies are used for many purposes whatever may be the design consideration. Many a times water proofing is not provided in the balconies and sometimes even spout is not provided. If spout is provided, water falls on the ground floor or in the balconies of other allottees due to wind. Sometimes allottees use balconies for keeping the washing machines and discharge waste water through spout of the balconies. Therefore, there is need to provide water proofing and proper pipes to take out water to the manhole chambers provided on the ground floor.

Catwalk in Auditoriums

Auditorium also needs maintenance like any other structures during their operation and as such catwalks must be integral part of the buildings. Sometimes, catwalks are not considered due to either not considering initially in the design or due to negligence. Catwalks should be designed in a proper way so that all the services are easily approachable for maintenance which may include internal lights, fire alarms, false ceiling, audio visual system etc.

Low Plinth Level

Low plinth level is a major problem which leads to backflow of rain water during rains from the adjoining areas which go on rising due to road level rising every time due to re-carpeting and even backflow in the toilets due to rain water entering into sewer manholes. Minimum plinth level should be adopted now as 600mm in place of 450mm. Also, sometimes cutting and filling is resorted to economise the cost and plinth level is then decided based on cut level which then further reduces the plinth level with respect to raised level. Further, plinth level should be considered 600mm above ground level and also with respect to road level whichever is higher.

Plinth Protection in Black Cotton Soil Areas

Plinth protection is normally provided as 900mm to 1200mm wide with concrete prepared with brick bats or lean concrete. In the areas where black cotton soil exists, such plinth protection fails due to joint formation at the junction of the building and plinth protection and swelling pressure of the soil. Therefore, in the areas of black cotton soils, plinth protection should be 2000- 3000mm as per the space availability and of RCC below which lime concrete should be used in place of cement concrete. It is also recommended that either horizontal plinth protection should be connected through RCC plinth beams for monolithic construction to avoid joint at the junction of

horizontal plinth protection and the structure or vertical plinth should be provided covering the joint through stone cladding provided in addition to RCC horizontal plinth protection.

Tree Plantation and Grassing in Black Cotton Soil Areas

Trees and grass are normally planted near the buildings but in case trees are too close to the foundation, they are likely to damage the foundation due to water required by the plants. In case of black cotton soil areas, such plantation is very damaging to the structure as the soil expands due to expansive characteristics and damage the structure hence no plantation or grass is recommended near the foundation. In case of courtyards, RCC floor should be provided over which good soil can be filled up if grassing is required.

Stone Window Frames or Linings

At few places now granite is provided in the window openings and thereafter aluminium or PVC windows are provided to have pleasant look and also true vertical and horizontal faces. As the walls are casted with bricks/blocks, there is likely to be small gap if mortar is not filled up and even small crack as the coefficient of linear expansion of granite and brick/block work has large difference. During rains, if rain is likely to come on the surface, there is likelihood of rain water getting inside. Rain water is also likely to enter if no gasket is provided between granite and window frame and granite slab and masonry work. The problem is very severe and common in Mumbai due to heavy rains with high speed of wind. Therefore window frame must be provided with rubber gasket and joint between granite stone and wall must be sealed properly.

Location of Electric Points

Electric points are generally not planned properly, particularly with reference to furniture proposed and conceptualised in the architectural design. This leads to placement of electric points provided by the electrical engineer as per his judgement and when furniture is placed; it creates inconvenience and does not fulfil the requirement of the user. Therefore, electric points and furniture layout should be the part of the architectural designs issued by the architect. Number of fans and air-conditioning requirement with fan should be worked out properly for energy efficiency and required comfort level as many a times, single fan is provided in bigger rooms which makes it necessary to install AC even when another fan can serve the purpose.

Ventilation

Fresh air inside the office buildings and even in residential buildings is not being considered though conditions inside the building are altered. In many buildings, openable windows are changed with fixed windows and window/split ACs provided in which there is no provision of fresh air. Also due to new materials, there is hardly any place for air entry and as such windows play a major role in circulation.

In Nirman Bhawan, recently doors have been provided in corridors for compartmentation but there is no provision of fresh air in the corridors. Therefore, ventilation should be considered during original construction as well as maintenance period.

Different Flooring Thickness at Same Floor

Now, different types of floorings are provided in the corridors, office rooms and conference halls. The thickness of such flooring may be varying. Suppose, granite is provided in the corridor, its thickness may be 18-20mm and if tiles are provided in rooms, thickness may be 12mm. It may lead to difference in level making rooms lower than corridor or compensated by extra mortar to maintain same level. Therefore, either this is to be taken care during casting of slab or flooring material must be selected carefully. During maintenance, may a times new flooring is laid over existing flooring leading to increase in load and creating different levels and as such these should be avoided and new flooring should be laid only after removal of original one. Such construction also leads to accessible unfriendly.

Air-conditioning Ducts not Anticipated

Air-conditioning is sometimes not designed during initial phase when the building is conceptualised and the beam sizes and duct sizes sometimes becomes so huge that headroom available becomes a major problem. Hence, air conditioning must be designed simultaneously. Advantage of Post Tensioned slab should be taken in such cases.

Exposed RCC Members

Sometimes RCC members are provided outside the building for making continuous frame and remain exposed to rains. Due to continuous drying and wetting, corrosion starts in such members. Similar is the case in beams of water tanks on staging. It is recommended that such beams should be treated with materials restraining water to ingress to avoid corrosion like tile cladding or special kind of reinforcement be provided which doesn't corrode easily.





Position of External Door Shutters of Adjoining Flats

In multi-storeyed flats, external doors of adjoining flats at 90 degree to each other are sometimes a problem when safety door or wire gauge shutter is later provided. As the single doors open inside, there appears to be no problem. After sometime, allottee insists for wire gauge shutters or safety doors and then these doors clash due to openings outside hence, future requirements should be considered in advance while planning.

Trenches for Services

Providing trenches for integrated services in campus makes operation and maintenance workable and easy, simultaneously cutting down cost of maintenance. It also saves deconstruction and reconstruction time as easy access is available in the form of trenches with openings.



Disaster Resilient Coastal Cities

In cyclones, major hurdles are uprooted trees, overhead power lines, hoardings, poles and similar structures which are not being designed for wind pressure. If power lines are overhead, they get wrapped around them. It takes almost 2-3 weeks and considerable cost for bringing the power situation to normal. It is the high time that all services are properly designed before installation. Underground cables, wind directional hoardings, tree plantings that will not get uprooted are also some probable solutions.



Timely Replacement of Services and Renewal of Maintenance Contract

Normally services are not compatible to the life of the building whether water supply, lifts or electric cables. These have to be replaces as a part of preventive maintenance. Lifts, escalators etc are some of the most important services for life safety also. Timely renewal of Maintenance contracts of such services is therefore very important. Recently maintenance contract for elevator at Bhau daji Lad museum had expired a month back only and it crashed, killing a doctor.





Poor quality of construction and maintenance

Access for Maintenance

Areas that require a higher level of maintenance such as cleaning should remain clear and immediately accessible with enough space to carry out the work. Similarly for occasional maintenance, all drawings with layout of services must be available for easy access and repair and should be displayed in every building along with fire safety/evacuation plans.

Passive Design Solutions

To develop passive design solutions, architects must consider the impact of features such as orientation, glazing (or windows), thermal mass, insulation, materials, greening, natural ventilation and zoning in order to achieve the optimal efficiency in terms of materials and comfort

in the building as they don't require mechanical parts to function, meaning very little maintenance-related costs in the future.

Toilets

It is observed that even the best building fails to get appreciation in case toilets are not well maintained. Many a times, minimum sizes are provided which become difficult to use. Shift from Indian to European WC requires larger size due to convenience of door operation and use of WC. Also comfortable size of toilet gives feeling of lavishness. It is therefore very important that reasonably good sizes must be used for WCs and toilets. Minimum functional clearance must be respected for fixing WC or wash basin for comfortable usage. Size of tap w.r.t. design of wash basin is a very important aspect in use of wash basin. Absence of hooks and counters in toilets makes them practically non functional for use by all. A very small minute detailing of not matching of joints of flooring and dado becomes an eye sore and must be taken care. Well designed, spacious and easy to maintain toilets enhance the functional as well as aesthetical value of the building.

Staircases

Comfortable risers and landing spaces for staircases enhance the functional as well as aesthetical value of the building. It has been observed that least priority is given to this criterion to increase the efficiency of the building. We must remember that any building designed will be used for at least 50 years, will be used by thousands of persons. To make these thousands people more comfortable, we must plan comfortable staircases.

During maintenance period, it must be ensured that riser is not altered during renovation as it may cause accidents.

O & M Manual

O & M Manual is essential for safety and proper maintenance as it contains the information required for the operation, maintenance, decommissioning and demolition of a building. The building owner is required to be provided the information about the building services to help them operate the building properly and efficiently.

Conclusions

We must learn from our mistakes. Recognition of an institute is valued by the experience and expertise available in the institute. In case attention is paid to very small points observed while using the built environment, it must be made mandatory to improve upon such details in order to increase credibility, enhance the life and reduce maintenance of built environment. No building will ever be maintenance-free, but the quality of the design, detailing, appropriate learning from past experience and workmanship can minimise the level of maintenance required and increase customer satisfaction level.

DR. AMBEDKAR NATIONAL MEMORIAL
A CASE STUDY ON DESIGN OF MEMORIAL

Vimal Kumar[1], Tarkeshwar Tiwary[2]

Abstract

Dr. B.R. Ambedkar popularly known as an Architect of the Indian Constitution, breathed his last at 26, Alipur Road and attained Mahaparinirvaan on 6th December, 1956. This place was declared as a Memorial by the then Hon'ble PM Shri Atal Bihari Vajpayee in 2003. A high level committee for planning the development of Dr. B.R. Ambedkar Memorial at 26, Alipur Road, Delhi was formed by the M/o Social Justice & Empowerment (MoSJ&E), Govt. of India on 29.11.2011. The committee submitted its report on 14.06.2012 and MoSJ&E assigned the construction work of Dr. B.R. Ambedkar Memorial to CPWD in the year 2013. Architectural planning of the building was entrusted to Consultant. A/A & E/S amounting to Rs. 99.64 Crore was issued on 02.07.2015 with completion period of 30 months. Hon'ble Prime Minister Sh. Narendra Modi laid the foundation stone of the Memorial on 21.03.2016. The work actually started at site on 21.04.2016 and the work completed in March, 2018.

The case studies on design of Dr. Ambedkar National Memorial covers the architectural concept design & layout of Memorial building. Facilities created, green building compliance, static and dynamic display and use of high technology in creating the museum.

Keywords: Architecture, Memorial, Landscape, Dynamic Museum, Exhibit Display

Introduction

The iconic open book shape building (representing Constitution of India) of Dr. Ambedkar National Memorial, constructed by CPWD was dedicated to Nation by Hon'ble Prime Minister on 13th April, 2018. The open book shape signifies the immense contribution of Dr. Ambedkar to the framing of the Constitution of India. The befitting Memorial building is having three basements and ground floor with a built up area of 6758 sq.m. at 26, Alipur Road, Delhi.

Baba Saheb Dr. B.R. Ambedkar, after his resignation from Union Counsel of Minister as Minister of Law, vacated his official residence at 1, Harding Avenue, New Delhi and shifted to a bungalow at 26, Alipur Road, Delhi on 1st November 1951 and lived there till he breathed his last on 6th December, 1956. Hence, it is considered as a sacred place as Mahaparinirvaan Sthal. Ground floor and first basement of the building have been used for the various exhibits display of the museum. Basement two and basement three have been used for the vehicle parking and for other services. The Memorial building is an amalgamation of modern and Buddhist architecture. Designed to look like Constitution Book, the Memorial has been built at a cost of Rs. 99.64 Crore and is spread over nearly 2 acre.

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Memorial Building Design: Photograph – I (Main Building front)

Building aesthetics of the Memorial provides psychological comfort in the living environment like pleasing architecture, visual interest, art on the walls and beautifully landscaped external area with musical fountain and other cultural symbols. The Memorial is an excellent example of architectural design, as it is the first open book shaped building in India. The shape of the building symbolizes the Constitution of India and empowerment through education & knowledge. Open book shape façade has been created with stainless steel fins in curvature and precise positioning and the hollow space between the two successive fins is filled up with DGU glass unit for effective air conditioning and saving in electricity. The main entrance gate to Memorial building is grand and inspired from historical Ajanta gate in the shape of Chaitya Door. The heavy main door is constructed with hammered copper sheet cladding on teak wood joint frame resting on pivot support. The overall ambience of the Memorial is a perfect blend of modern science and traditional Buddhist architecture.

Building functionality has been given due consideration enabling smooth operations of various functional activities both inside and outside the Memorial building. Thermal comfort inside the building, which is a key to the satisfaction of visitors has been given due importance at the design stage itself. Acoustic comfort has been achieved by controlling sources of noise from interior and exterior to building. Musical fountain, dynamic display on facade, a replica of Ashoka pillar at Sarnath,12 feet high bronze statue of Dr. Ambedkar and Toran Dwars are some of the highlights

of the complex.

Building Parameters of Memorial

Green building: The common objective of green building to reduce the overall impact of the built environment on human health and the natural environment has been achieved by virtue of

Efficiently using energy, water and other resources: Energy consumption by ventilation, lighting and air conditioning is reduced by way of using VFD control in ventilation fan operation system, lighting inside & outside the museum are of LED only and central air conditioning with efficient VRV system without use of water. Waste water recycling has been done through installation and commissioning a sewerage treatment plant (MBBR) of 25 KLD and the treated water is being utilized for horticulture purposes inside the campus. Adequate number of rain water harvesting pits have also been created to harness roof top rain water. HVAC system adopted is of VRV (Variable Refrigerant Volume) – 346 HP and is 100% Zero ODP insulating and HCFC and CFC free. Solar power unit of 50 KW capacity have been installed on the roof of main building and connected to the grid.

Protecting occupant health by creating healthy building: Healthy building refers to physical, psychological and social wealth and well being of people in building and the built environment. In the Memorial, good arrangements have been made for the visitors for the access to potable water, healthy dining options in cafeteria and to enjoy the various static and dynamic displays and other art works in the Memorial. Indoor air quality is maintained and adequate number of signages have been put inside and outside the building for the prohibition of smoking.

Reducing waste, pollution and environmental degradation: A large number of trees were saved earlier during the preconstruction / construction stage by way of fixing the orientation of the building and by way of fixing the position of external unit of VRV, sub-station equipments, UG sump and pump room etc. The open area above sump room was also developed green and sitting space was provided in steps for open gathering. It is being widely used by visiting school children and others for organizing events/activities. Additional trees were planted to create more green space around the Memorial and particularly on the front side which checks noise & dust.

Layout of the space: Architectural design of the building was finalized based on competition and open book shape design, portraying a message of learning was adopted. The Memorial building is placed diagonally at site to enhance its visibility appeal. The core idea of the design conception is to create a serene space with plenty of open areas. The only visible architecture above the ground is the iconic book shape building & the stupa dome of meditation hall. External area has been beautifully landscaped with greens, linear musical fountains and open theatre. Interior architectural design fits into the requirement of the static and dynamic display of exhibits in the museum.

Ground Floor ceiling height varies from 9 m to 11 m and with open metal (aluminium) false ceiling of cell size 50mm x 50mm covered on top with Rockinsul Acoustic Thermal Insulation Board, Audio Visual display in the museum enhances its appeal. Between the main gate of the Memorial and the building, there is an Ashoka Pillar with the sculpture similar to four Asiatic lions standing back to back on an elaborate base that includes other animals placed a top of Ashoka Pillar. Its presence in the Memorial shows Dr. Ambedkar's commitment of working round the clock to protect the unity of India from all sides.



Photograph - II (ASHOKA PILLAR)

Comfort: Architectural design of building complies to the differently abled friendly guidelines like provision of ramps, railings, lifts, reception counter and signage etc. Wheel chairs are also made available at the entry point to cater the requirement in emergency. To avoid any risk and any possibility of slip on the floor / path only flamed granites have been used on floors, passage, staircase and external area for the safe & smooth movements of visitors.

A reception area has been designated at the entry of the main building to provide help / guide to the visitors. Twenty-one number exhibits spread in five zones have been conceived based on the script on the life of Dr. Ambedkar approved by Ministry of Social Justice & Empowerment. The exhibits have been placed in chronological order in the form of static and dynamic display to avoid monotony. Various facets of Dr. Ambedkar have been displayed in the museum by way of back lit & front lit display, hologram, A.V. display, artwork & mannequins etc. It provides immense physiological comfort to visitors. Thermal comfort in the museum is maintained by providing VRV AC system.

Efficiency of work: Two number lifts and three sets of staircases have been provided with suitable signage for the visitors. The flow of visitors is channelized so that exhibits are available in chronological order. Signage marking have been done on the floors, starting from reception table to the end of the exhibits. There is centralized monitoring of the museum and the campus from control room through twenty-two numbers CCTV cameras fixed at suitable locations both inside & outside the museum. There exist the facilities of announcement system to inform and guide the visitors in emergency.

Security and structure: Security of the building is done by round the clock private security guards and sufficient number of persons inside the museum to cater the functional requirement of the museum and recording of events through CCTV camera including PTZ installed inside the building and outside premises of the campus at all suitable locations. The occupancy certificate,

CEA and fire NOC have been issued by the authorities as per norms and preventive maintenance of building systems are being adopted.

Building Management: Building management system of Honeywell has been installed to monitor air conditioning, ventilation, substation, fire alarm system, equipment for their healthy ness and location of any fault. Sensor operated pumps have been installed in basements for dewatering of waste water accumulated during washing / rain etc. pneumatic control pumps are installed for drinking water, flushing and auto control pumps for STP system.

Healthy building: The group of elements include drinking water and washing systems, drainage, toilet, parking, smell, cleaning, waste management and filtration in linear fountain. Adequate arrangement has been made to provide drinking water at suitable locations using water coolers. External drainage has been maintained through gravity while that of basement and toilets are handled with the help of sensor operated pumps installed at suitable locations. Basement parking has been well ventilated using ventilation system and water filtration installed at extreme end of linear fountain.

Broad parameters of Museum

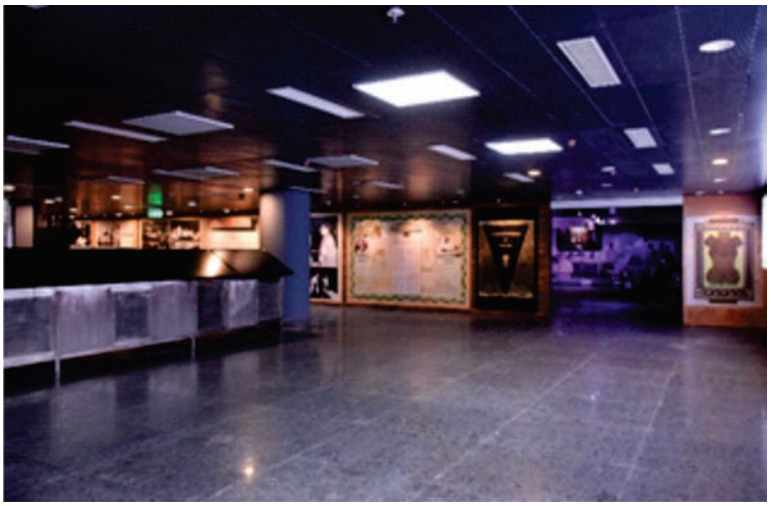
Cultural elements:

It includes culture based interior design, interior decorating, exterior landscape and views, which are considered as a soft side of smart / intelligent building. In the Memorial, the interior design and decorations provide a glimpse of the life, vision & ideology of Dr. Ambedkar and his innumerable contribution to humanity. The exhibits in the form of static display, dynamic display, animatronics and interactive table with constitutional quizzes etc. have been placed suitably to serve the intended purpose. The ancient Buddhist architecture in the form of Stupa, Canopy, Toran Dwars, Meditation hall, Bodhi Tree etc. have been positioned excellently. The architecture building and the entire area surrounding the building is in sync with the life & thoughts of Dr. Ambedkar. The first floor houses high quality displays related to Baba Saheb's life. At basement-1 level there is one exhibition gallery, where days spent by Ambedkar on the premises have been illustrated. His last day and journey have also been captured vividly. Apart from the digital experience the exhibits give rare inside into Dr. Ambedkar life.



Photograph - III (STUDY ROOM SET)

There are virtual reality displays of Baba Saheb giving finishing touches to the Constitution of India. And the unique interactive table is a delight for Constitution lovers. It is full of information on Baba Saheb and the Indian Constitution. It allows to visitors to explore original manuscript of the world's largest written constitution digitally.



Photograph - IV (INTERACTIVE TABLE)



Photograph - V (MEDITATION HALL)

Dr. Ambedkar revived the Buddha Dhamma, which is humanistic in nature and seeks social reconstruction based on the principle of liberty, equality and fraternity. Meditation hall with Lord Buddhas statue in single piece marble (Vietnamese) convey the true message “the suffering & spiring people to come out of their bondage and attain real peace, harmony & happiness.”

Dr. Ambedkar bust in bronze placed in a Buddhist canopy with excellent stone carvings in external area is a place to remember and offer flower or garland. Around the bust green has been developed and number of trees have been planted.



Photograph - VI (AMBEDKAR BUST)

Bodhi Vriksha planted on the northeast corner of Memorial maintains the sanctity of the place and around it there is meditation area surrounded by flowers and ground covers depicting peace, purity and tranquility. The garden developed along the walk way to the right of Memorial building enhances the beauty of whole premises. Toran Dwars erected alongside linear musical fountain are replicas of the eastern gate of Sanchi Stupa.



Photograph-VII (BODHI TREE)

High Technology: Content production with integration and programming: It was intended to create an immersive experience of Dr. Ambedkar and his contribution through extensive use of dynamic media with AV content and multimedia technologies. The content creation involved a high degree of research both factual and historical and the approved content document formed the basis of all the content creation for the museum static, dynamic and AV content. It was aimed to provide a lively recreation of major facets of the life and activities of Dr. Ambedkar and it was achieved by deploying high end audio visual technology comprising direct view LED video walls, high end projectors, mannequins & holograms.



Photograph - VIII (VIDEO WALL)



Photograph-IX (ANNIMANTRONICS)

Animatronics: It is a robotic device. Hyper realistic animatronics of Dr. Ambedkar was created and actions were programmed pneumatically to provide the realism like blinking eye lids, hand movement, mouth movement while speaking, eye balls movement etc. Speech and expression sink and is operated through proximity sensors. Much to the visitor's delight, the robotic device narrates one of the speeches delivered by Dr. Ambedkar is widely appreciated by the visitors and provides lot of entertainment to them.

Interactive table: Sixteen numbers work stations with 55 inch touch panels with embedded IR or capacitative touch have been used for interactive panel with programming to accommodate various aspects of Constitution of India, speech on Dr. Ambedkar and quizzes etc. This gallery has got a lot of information on Constitution and making of Constitution. Handing over of constitution book by Dr. Ambedkar. A set created with hyper realistic mannequins of great leaders.



Photograph-X (HYPER REALISTIC MANNEQUINS)

Dynamic control LED facade lighting: Direct illumination with strip of LED nodes put in the tracks fixed to SS fins and LED nodes programmed to display on the facade. These luminaries work on Ethernet based network using VSM (Video System Manager) controller. Varieties of colorful display could be organized through software.



Photograph - XI (MUSICAL FOUNTAIN & FAÇADE LIGHT)

Plumbing less musical fountain:100 m length of linear musical fountain along the theme garden has been created through proper programming. The fountain is modern, digitally controlled with the advantage of plumbing less technology and DMX control system.

Projection: Translucent pepper-scrim have been used to enhance the impact of content. Medialon technology is used for combination of 7 projectors in the rear wall of the exhibition hall to cover area in huge wing shape.



Photograph - XII (PAPER SCRIM)



Photograph - XIII (VIDEO WALL)

A.V. Systems: Christie coolux work station serve as the heart of video system deployed and is the location where all the contents reside. Christie projectors and Delta LED video wall comprising 4mm pixel pitch tiles have been used. Audio is handled by Behringer 8 channel USB sound card which provides processing and distribution of sound. Individual channels are selectable and configurable with an output power of 125w per channel at 70v.

For dynamic museum to run with designed museum lights, Medialon pro has been used to control all the peripherals over IP. It is an all in one show controller with all necessary show protocol interfaces and control & synchronize dimmers, lighting desks, video projectors, video sensors and sound processors etc.

Results: Dr. Ambedkar National Memorial is the integration of marvelous architectural design with high end technology display to meet the objective of creating a befitting museum.

Conclusion: The Memorial exhibits display on the life and times of the Dr. Baba Sahab Ambedkar and also displays his struggle and relent less search for ensuring social equality and justice in the Country. There are exhaustive collection of works of Bharat Ratna and recapture his life with many interesting and memorable skills. High display screens at first floor tell the life story of Baba Saheb. The National Memorial is magnificent and a perfect blend of marvelous architectural design & high end display through modern means to achieve the objective. The building aesthetic and dynamic façade lighting / musical fountain have been well appreciated by the visitors and the dignitaries. On an average 500 visitors visit the museum daily and the numbers increases to more than 15000 every year on 14th April. The Memorial is getting popularity with the passage of time and it has become one of the iconic building conceived & constructed by CPWD."

References: Report of High level committee for planning the development of Dr. Ambedkar National Memorial at 26, Alipur Road, Delhi.

BIPV-A FAST FORWARD DRIVE TOWARDS SUSTAINABILITY

C.K.Varma[1]

Abstract:

BIPV is the latest innovation available to building sector in its approach towards sustainability. A built environment when fulfils its entire energy needs through non renewable energy sources then its energy footprints as well as carbon emissions are zero. Ideally such buildings are said to be Net Zero buildings. But this feat cannot be achieved through solar roof tops alone which consume almost entire roof space or prime roof space without giving the required power output.

The latest solution in this direction is BIPV which helps in harnessing solar power from entire building envelope as it fits into the building envelope and not merely sits on it. This paper aims to discuss this technological intervention which is the latest in offering in the quest for sustainability.

Introduction:

BIPV stands for Building Integrated Photovoltaics. It is one of the most promising renewable Technologies available as of now. A BIPV System amounts to integrating photovoltaic modules into the building envelope like roof, wall, window or façade. So BIPV can serve both as building material as well as energy producer. It can thus reap dual benefits by being a part of the building envelope. The extra amount on account of special building material called BIPV can be offset by the extra advantage it offers in terms of producing electricity during the entire lifecycle of the building besides giving the glassy look to the building thus enhancing its aesthetics.

Historical Perspective

Photo Voltaic applications for the building sector began in the 70s of the 19th century. The journey began with the Aluminium framed photovoltaic modules mounted on buildings that were remote or had no access to electricity grid. In other words, these were standalone systems with or without battery backup. Subsequently a decade later, these systems began to be mounted on buildings having access to the electricity grid. These systems thereafter began more viable with the support of electricity grid and were called as grid interactive systems where through inverter/ Power conditioning device, the output of the electricity produced by a group of PV modules better known as Arrays were connected to the Grid. This arrangement provided the required boost to solar generating system as the generating schedule of the PV system which is dependent on clear sun position in the sky as well as time of the day became more meaningful in providing constant power flow without battery backup which is a costly proposition. But now with the advent of BIPV technology solar cells are embedded into various building materials used in the roof, wall, fenestration, facade etc. so that entire building envelope is in the pursuit of generating solar power whenever solar radiations are falling on it. So the coming decade really belongs to BIPV when this technology rolling out of laboratories has started becoming

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commercially viable.

PV Technologies

Presently, two commercially established PV technologies are available:

Thick Crystal

Includes solar cells made from crystalline silicon either as single or poly-crystalline wafers and deliver about 10-12 watts per ft^2 of PV array (under full sun) which is improving with the development of new materials and processes.

Thin-film

It incorporates very thin layers of photovoltaic material placed on a glass superstrate or a metal substrate using vacuum-deposition manufacturing techniques. These are similar to those employed in the coating of architectural glass. Presently, commercial thin-film materials deliver about 4-5 watts per ft^2 of PV array area (under full sun) but is also being improved with the innovations being brought in the material and process technologies.

Thin film technology is presently the preferred technology used in BIPV applications owing to the advantages it has over thick crystal technology. Further, with more and more advancements in this technology the advantages claimed outnumber the drawbacks. Therefore thin film technology provides the required flexibility to the PV panel to be molded into any desirable shape besides being cheaper option.

Different BIPV Options& Their Applicability

Depending upon the application in the building envelope, various options of PV Modules are available. A few of these are:

Transparent Solar Modules

Transparent solar modules offer very attractive BIPV solutions as window glazing in normal windows, sun spaces and integration with roofs. Different transparency Modules can be employed which consist of transparent crystalline cells(modules with transparent back side and with standard crystalline cells). Such solutions can be used in heritage buildings with possibility of different shapes or patterns within modules.

Facade Glazing

Different types of transparent modules are used as glazing, most common crystalline as single glazing or double (low U-value) insulation glass. Transparent modules can also be used in sunspaces and atriums.Another solution is thin film transparent amorphous modules which are more a part of shading devices either movable or fixed. Such systems better known as shadow-

voltaic systems can also be part of energy efficient glazing, where instead of usual glass these are used. With back side coloured with different colours or in multi combination, vibrant visual effects can be created thus giving a phenomenal aesthetic impression.

Roof Integrated Glazing

As roof-integrated transparent modules, usually glass-glass laminates without frame are used. For Special roof types like curved roof, plastic laminates are used. Crystalline cells are most common solution - transparency rate is defined by distance between solar cells (as larger the distance as larger the transparency rate of transparent modules). For roof integrated glazing, use of laminated safety insulating glass modules is obligatory due safety issues.

Transparent Modules as Shading Devices

Transparent modules are often part of shading devices. Shading devices, like overhangs for example, can be fixed or movable. Manual tracking-combined with shadowing system, or automatic tracking systems can be realized. Very often they are realized as venetian blinds or classic awnings. Vertical and horizontal shading devices are used in practice. If transparent modules are integrated into transparent roof or sunspace glazing, additional shading devices are usually not necessary because they themselves provide shading.



Different BIPV Components in a Built Environment

Design Philosophy of Building Integrated Photovoltaics (BIPV) System

Design plays a key role in achieving the key objectives of any project. Therefore, BIPV systems should be approached in those buildings where energy efficient design strategies have already been employed as well as Energy efficient equipment and systems have been properly selected and specified.

Again, BIPV systems should be viewed in terms of life-cycle cost only, and not just on the basis of

initial/first-cost. Because the reduction in the overall cost will be significant by the avoided costs of the building materials including traditional replaced labor cost. Design considerations for BIPV systems must therefore include the building's use, its location and orientation, the appropriate building and safety codes, and the relevant utility issues and costs and above all electricity load which it has to cater for.

Design Steps:

First consider the energy-efficiency measures/energy conscious design practices to reduce the energy requirements of the building–Electrical load of any building is estimated first on the basis of building area or space function method as defined in the ECBC 2017. Then energy saving worked out on account of energy efficiency measures and equipments taken in the design sheet is subtracted to find out the net electrical requirement of the building. Based on this, the capacity of BIPV System is conceived /worked out.

Provision of Batteries to cater to Peak Demand: Next step is to assess the peak or maximum demand. Based on this, inclusion of batteries to offset the most expensive power demand periods can be considered in addition to being grid interactive system. This will give the system the independence from import of power from the grid during the peak period. The batteries can get charged either from the grid or the system when power demand is not at its peak. The system therefore can also act as an uninterruptible power system (UPS) and additional expenditure of providing UPS systems can be avoided.

Provision of Adequate Ventilation: Ventilation is one important aspect from the system efficacy as well as system degradation point of view. Hence adequate measures should be employed to take care of this aspect.

All solar options should be evaluated: There are different solar options available to a designer. Depending upon the availability of solar insolation, requirement of hot water and the available space, solar PV or a mix of solar PV and solar thermal system can be considered to tap the solar energy optimally. Besides, if a heat exchanger can be planned to tap the heating energy of the modules extracted out of the conversion, this will enhance the system efficacy substantially, particularly in cold climates for pre-heating the ventilation make-up air.

Integration of Day lighting & Photovoltaic Collection: The BIPV System itself provides different ways of integration of day lighting into the building envelope. This can be achieved uniquely by either semi-transparent thin-film modules or crystalline modules with custom-spaced cells between two layers of glass in facade, roofing, or skylight PV systems. Thus BIPV elements themselves help in providing inimitable daylighting features in the building envelope and can also simultaneously help to reduce unwanted cooling load and glare associated with aesthetic expression through glazing.

PV Modules as Shading Devices: PV arrays conceived as overhang of a building can also act as passive solar shading besides providing power generation. This may have a cumulative effect when considered as part of an integrated design approach such that thermal load of the building and so chiller capacity can be smaller. Besides, cooling distribution in the periphery can be either reduced or totally eliminated.

Design for Local Climate & Environment: Design should also take into account Local Climatic conditions and Climate zone in which the building is located. For instance, there will be more power produced if the weather remains cold and clear for most of the period during the year while opposite will be the case in hot and cloudy days.

Ensure shadow free areas: This is a very important aspect of any PV System and has a direct bearing on the power produced.

Proper Orientation: Different orientations of PV System have a significant impact on the annual energy output of a system. Tilted arrays generate 50%–70% more electricity depending upon the angle of tilt matching with the solar orientation of the place than a vertical facade.

Employ peak load reduction strategies: Minimize the loads experienced by the BIPV system. Employ daylighting, energy-efficient motors, and other peak reduction strategies whenever possible.

Employing Professionals Only: It is always a good practice to employ only certified professionals to ensure that the design, installation, and maintenance requirements of the project are properly carried out to achieve the desired results.

Blending with Traditional Buildings: In addition, BIPV systems can also be designed to integrate with conventional building materials and designs, or can be used to create a future-oriented appearance. This gives the system the desired flexibility to be employed with old as well as modern structures.

Benefits of BIPV

- Noise protection (up to 25 db sound dumping is possible) due to the inherent characteristics of the BIPV Material. Besides, it also provides thermal (heating as well as cooling) insulation.
- Visual cover/ refraction (one-way mirroring visual cover)
- Electromagnetic shielding
- Aesthetic quality (integration in buildings as a design element)
- Safety (safety glass function is possible)
- Weatherproof (waterproof and windproof façade or roof of a building)

- Sun protection/ shadowing
- Improving the efficiency of cells by cooling through rear ventilation

Barriers

1. As the technology is new and upcoming, Cost of procurement is high. But with the proper designing this can give best results thus offsetting the high initial cost.
2. The design and installation of a BIPV system is more complex than roof mounted systems as it involves careful planning to maximise power generation while optimising other functions of building envelope.
3. Ventilation of the PV systems also needs to be taken into account to avoid excess heating of the modules, which could increase system degradation and resultant reduction in the lifespan of the installation thereby increasing its lifecycle cost .
4. Incorporating and ensuring all Safety Features may be complex as entire building envelope is generating electricity and is prone to electric shock and short circuit.

A Few BIPV Projects Worldwide



Photovoltaic wall near Barcelona, Spain



**PV Solar parking canopy,
Autonomous University of Madrid, Spain**



CIS Tower in Manchester, England



**Solar Roof in headquarters
of Apple Inc, California**

Other Possibilities

Other possibilities in this area can be VIPV i.e. Vehicle Integrated Photovoltaic where solar cells embedded panels merge into the hood , trunk, wall , roof of any vehicle whether car , Bus , Truck, Rolling Stock, Metro Rails etc. and can bring revolutionary changes into the energy security of the country. It looks as if the conventional power plants may have to be shut down during the sunny period of the day.

Further pole mounted PV panels can also be integrated within the trunk of the pole thus ensuring better power generation on account of greater area available for harnessing the solar energy.

Conclusion

1. BIPV Systems are the backbone of Net Zero and Net PlusEnergy Buildings. With the further improvement of BIPV, day is not far ahead when there will be energy trading amongst various building owners.
2. Building Sector professionals are now heading towards a new kind of architecture which may appropriately be called as active solar architecture. In this architecture, besides providing passive solar strategies, emphasis is now on actively taking up the green power generation through and over the building envelope.

Recommendations

1. CPWD being the Principal Technical Advisor to the Government of India and a Premier Construction Agency of the Government should be the front runner in using this technology in one of its built environments.
2. BIPV should be adopted very frequently in all building designs. CPWD being the Premier construction arm of the Government of India should take a lead in this direction and adopt BIPV systems in its building code essentially as a green architecture policy.
3. In addition, Roof mounted low speed Wind Mills having Photo voltaic blades can also be tried to provide multi options green power generation for attaining the objective of constructing more and more Net energy plus buildings in New India.

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TRANSPLANTATION OF 'HOWRAH HAAT'
A CASE STUDY

Sumeru Roy Chaudhury[1]

History

'Howrah Haat' is a wholesale market place near Howrah station. The popular name of the place is 'Mongla Haat'. The word 'Mongla' comes from 'Mangal-bar' and 'Haat' means market place. It is the largest organised wholesale garment market and governs the entire garment trade in eastern India. The 'Haat' was originally held on Tuesdays. Its origin dates back to late 19th century.

Those days, major communication routes; i.e. roads and railways that led to India's Capital city of Kolkata, from western and northern side terminated on the western bank of river Hoogly, at Howrah. It was, therefore, a natural place for setting up of a major market centre for trade and commerce. The 'Mongla Haat' grew around the Howrah railway station terminus and on Grand Trunk Road which starts from Howrah.

Growth

Bengal is known for textile, garments, small scale industrial products and jewellery. Over the century, producers, whole sale and retail merchants in these products from adjoining south Bengal districts came here every Monday evening to sell their product on Tuesdays. Buyers from all over south Bengal and even from the north and adjoining States throng the roads along GT Road, the CBD of Howrah. With the gradual improvement of road and rail connections, 4 bridges connecting Kolkata and 2 additional railway terminals in Howrah, business grew rapidly. The 'Haat' grew to 2 days' business in the last decade and presently functioning for 2 & ½ days; Sunday afternoon to Tuesday evening. There are good chances of the business growing to more than 3 days.



Image 1: Location of 'Mongla Haat'

Location and size

These 'Haats' are located on 7 non-contiguous private plots on GT Road and on roads leading from GT Road. Some are in single storeyed sheds while many are in multi-storeyed buildings. There are almost 8,000 stalls in these buildings of varying sizes but mostly of 5'x5', measuring a total of about 4 lac sft. The wholesale market has customarily given rise to retail stalls along the road sides. They number 3,000.

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These stalls attract tremendous human traffic on a mile-long strip on GT Road every Sunday evening to Tuesday evening. Before this time, on Sunday mornings and Tuesday late evenings, mini lorries, taxis, rickshaw vans, coolies throng this area for loading and unloading the goods.

For those 3 days, this area houses an addition of 12,000 people being the stall owners or shop-keepers @ 1.5 persons/stall. About 2.5 lac buyers arrive each day and throng the area for 12 hours @ over 20,000 persons/hour in that small stretch of one mile. The area, the CBD of Howrah city, gets completely choked. GT Road is narrowed to a single lane width and vehicular traffic comes to a standstill. It is terrifying for Howrah citizens, motorists, to cross the area or enter the CBD from Sunday evening to Tuesday.

These stalls are located mostly in shabby buildings, in unhygienic condition and have scant regard to building regulations and fire-fighting arrangements. But as is the nature of humans, people adopted themselves to these conditions and is carrying out their weekly businesses. Pedestrians and commuters passing this area are daily compromising with traffic snarls, jams, pollution and environmental hazards. Things would have continued this way for many more years we do not know, had not the 'Metro' project come up for Howrah to connect with Kolkata.

Future of Howrah 'Haat'

The 'East-West Metro' line, now under construction, connects Salt Lake area of Kolkata to Howrah passing underground through Kolkata's CBD. It is the first underwater river metro tunnel in India as it crosses the river Hoogly through a 600m long tunnel having its roof at (-) 30m. The terminus at the Howrah end is strategically placed a bit away from Howrah station and on GT Road, directly where the 'Haat' functions.

The Metro will bring in another 48,000 passengers/hr at its peak time @300 persons /coach x 8 coaches @ 3min interval. During peak hours and on 'Haat' days with a total pedestrian load of 68,000/hour, people will find no place to walk on the road. There would be a total collapse of vehicular transport in Howrah city. The chaos is unimaginable and uncontrollable.

Solution

In view of such an eventuality the Government in consultation with all the stake holders decided to give back the 60'-80' wide GT Road to vehicular traffic and pedestrians. To implement this the only alternative was to vacate the buildings of the 'Haat' which will also help in making the roads free of retail stalls that come up on 'Haat' days. This will remove 12,000 stall owners and 2.5 lac buyers from the area.

The removal obviously cannot go without rehabilitation. Therefore, the Municipal Corporation tasked itself to find out a suitable place where 'Mongla Haat' could be transplanted. Most of the 'Haat' owners, shop & stall occupiers agreed to shift to a suitable new place for their better lively hood.

Rehabilitation

A Textile Park is to come up at a place called Unsani which is 7km west of Howrah station. The owner/s of the land offered 25% of their land, approx. 5 acres, for rehabilitation of 'Mongla Haat'. To some extent the 'Haat' would supplement the Textile Park.

The site is 800m from Santragachi railway station, 600m from the new ISBT, 200m from 6-lane NH 117 and 2km from NH junction connecting Mumbai, Chennai and Delhi. The location was found to be a natural setting for the wholesale market. It fulfilled the criteria set for relocation. The plot required proper development of the infrastructure and widening of the available 40' approach road. These developments, in any case, were required for commissioning of the Textile Park.

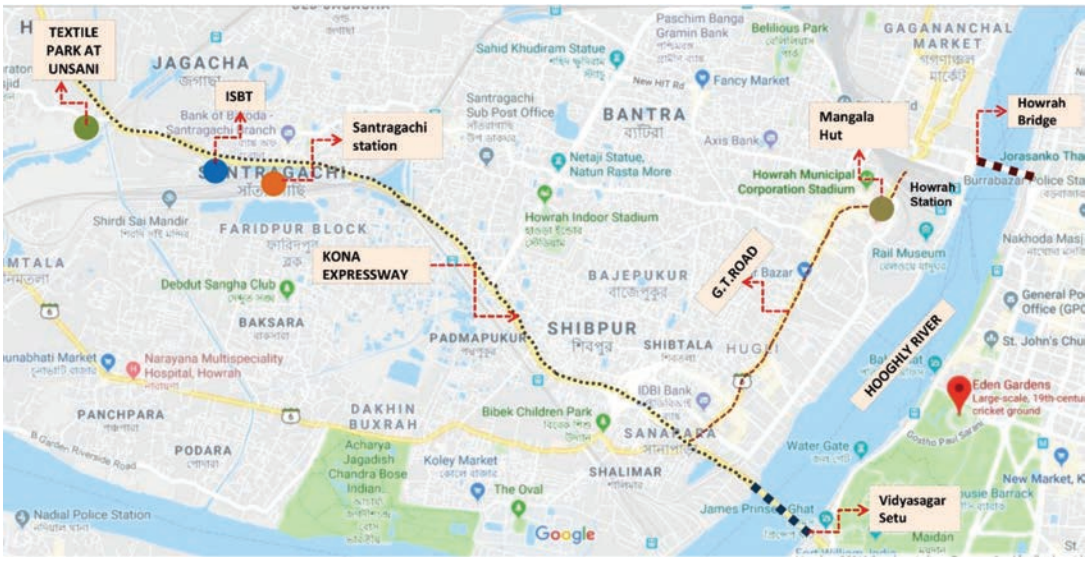


Image 2: Location of Textile Park and present 'Mongla Haat'

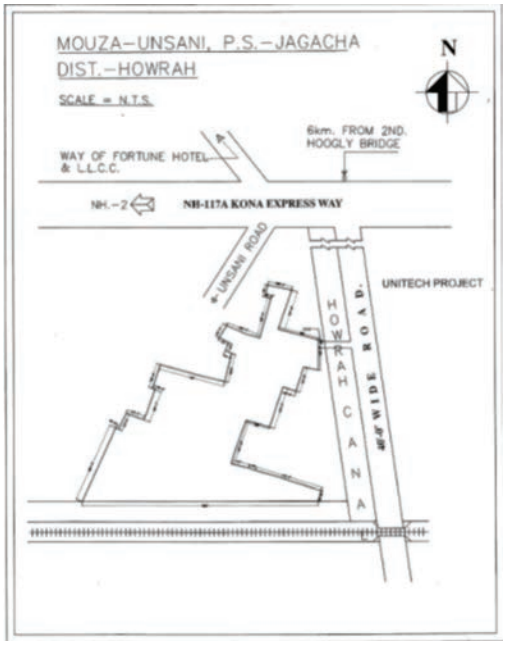


Image 3: Site Plan of Textile Park plot

The Textile Park

The proposed Textile Park is to have all the operational units required under the Government Scheme for Integrated Textile Park (SITP): Dyeing and Bleaching, Knitting/ stitching, Fabric painting, Embroidery, Compacting and calendaring, Shops and offices for selling to whole sellers, Common Facility Building. The relocated 'Mongla Haat', Hawkers Zones, Godowns, Residential and Parking Spaces.

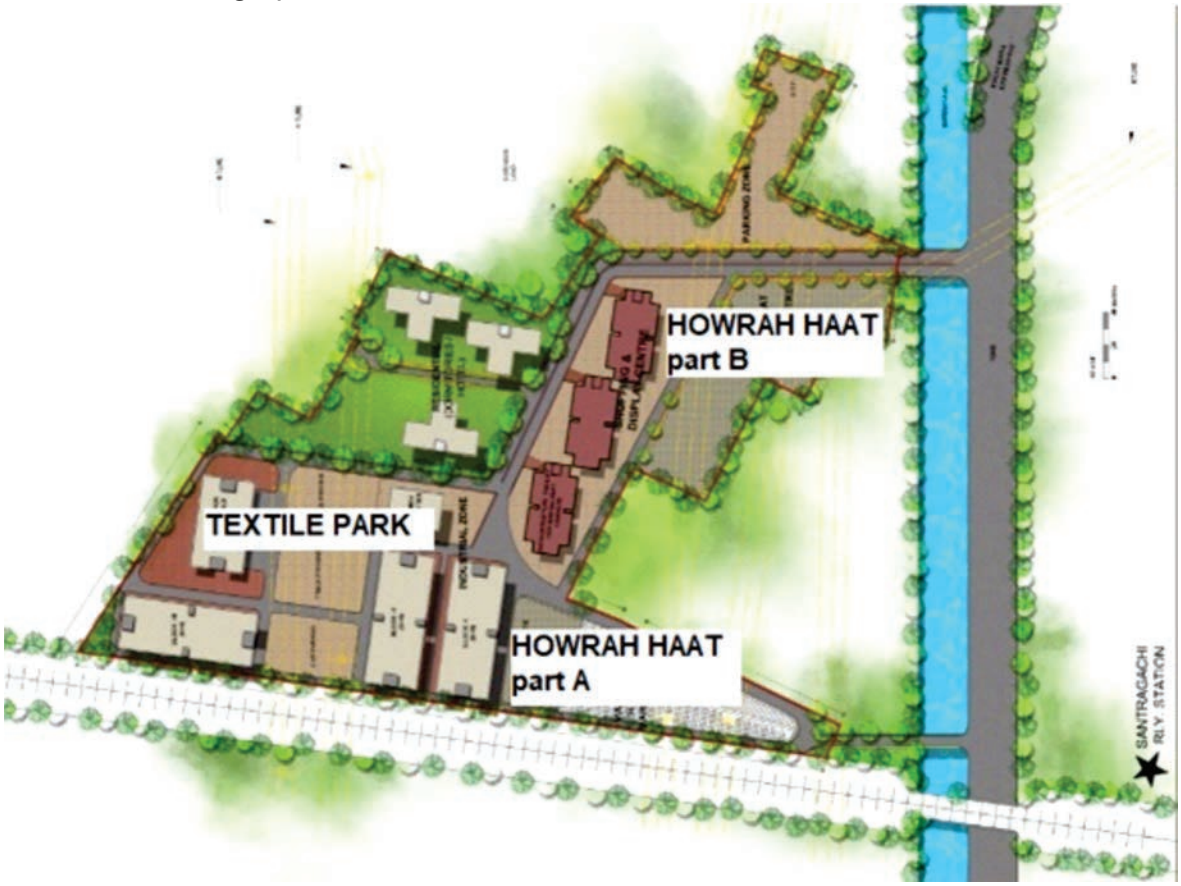


Image 4: Layout Plan of Integrated Textile Park and Howrah Haat

The 5 acre land allocated to 'Mongla Haat' shall yield a floor are of 40,000 sqm considering 50% ground coverage and 2.0 as F.A.R. This will allow 8% growth of the stalls in future.

The 'Haat' area will be provided with an 'Auction' area, Warehouse, Dormitories for the vendors. The stalls will be located in both multi-storeyed and single storied buildings to retain the characteristics of the 'Haat'.

Transplantation

The Government has decided that Howrah Municipal Corporation shall develop the infrastructure facility for the proposed new 'Mongla Haat'. It shall construct the 'Haat' Complex and will give operational benefit to set up the Textile Park. HMC will rehabilitate the existing shop and stall occupiers of the 'Mongla Haat' to this new place free of cost or without charging any

premium and charge only a nominal amount on rental basis. Space so vacated by shop and stall occupiers on GT Road and its surroundings will be occupied by HMC and pay rent to the private land owners. With the commissioning of the Metro railway to Howrah there will be a tremendous demand of office space in the CBD area. Thus, space vacated by 'Haat' occupiers can be rented out to Government departments and private offices.

Socio economic benefits

Boosting of the industry: The integrated Textile Park and the 'Haat' with close proximity to rail head, road and port is envisaged to boost the industry

All in one place: The Park aims to bring different stake holders of the value chain in one place. Manufacturers, suppliers, traders and buyers will be able to interact and work together and create a vibrant market place.

Employment generation: The proposed Park is estimated to generate approximately 30,000 direct and indirect employment to local people.

Development of skill and livelihood of the local people.

Encouraging entrepreneurs: The integrated Park will provide the required infrastructure to attract entrepreneurs.

Decongesting the city: The Park by moving trading away from prime city location to an equally convenient off-city location will help in decongesting Howrah and have a sobering effect on rising real estate prices.

Rehabilitation: The Park will be a rehabilitation centre for thousands of hawkers from the unorganised 'Howrah Haat'.

Healthier environment: 'Mongla Haat' hawkers will get a healthier environment with all basic infrastructure to work in which will reflect on their health.

Residential accommodation: Hostel accommodation for the workers of the Textile Park and Dormitories for 'Mongla Haat'

In a nut shell, the Hub; integrated Textile Park with “Mongla Haat', should become a vibrant market place that will have a positive effect on the economy and help bettering the image of the State.

(1465 words other than the Title)

SITE PLANNING - CAMPUS PLANNING

Rajat Rashmi [1]

Abstract

Site planning is the art and science of arranging the structures on the land and shaping the spaces between. Site planning generally begins by assessing a potential site for development through site analysis. The design process culminates with detailed planning within the scope of a master plan. The scope of site planning also includes setting out the landscape with visual features, coordinating the services to give a functionally sound campus and most importantly setting out the environmental sustainability goals. The final synthesis is done considering the objectives, set in the framework of the aim. The end objective relates to the efficient establishment of the proposed development while being sensitive to the environmental characteristics of the site and its surroundings. This paper examines various components of site planning for sustainable campuses.

Key Words: Site plan, Campus Plan, Zoning, Land-Use, Environment, Sustainability, Design

Introduction

The process of planning for a development project is organising the spaces according to land use zoning, access, circulation, privacy, security, shelter, services, land drainage, and other factors. Site planning generally begins by assessing a potential site for development through site analysis. By identifying areas that are best suited for development, the planner or architect can assess the optimal location and design a structure. After the site analysis, conceptual zoning is done.

Design Process

The process of organizing land is done by integrating physical features such as climate, vegetation, gradation or landform, hydrology, wildlife if any, and other notable features with architectural requirements such as access and circulation pattern, zoning as per regulation, open spaces, integration of colour and texture of materials, views and use of other physical features, etc.

Thus, the design process shall include:

a) Site Analysis.

b) Conceptual Zoning

c) Organizing vehicular and pedestrian circulation

d) Forming land use plans and setting out of services

e) Designing visual form and material concepts

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f) Environmental Sustainability

Site Analysis: Broadly, the site analysis will include

Topography and Slopes –Topographic information is gathered through survey plans and those available with Survey of India. Visually, as well as functionally, the form of the landscape, its slopes and patterns are one of the most important factors to consider for the proposed land use. Grading on the site involves cutting and filling which needs to be balanced. Maximum benefit is taken of flat areas so that minimum cutting and filling is involved. Maintenance of natural slopes is desired so as not to disturb the natural flow of water. It is desirable that features such as rock outcrops, mature trees, water bodies, etc are preserved.

Geology and Soils – General information is available from Geological Survey of India. More explicit information may be required from core drillings and specific soil testing. Soil analysis also helps in deciding the landscape. Thus, soils are important in terms of stability, suitability for structural foundations, erosion susceptibility, surface drainage, and soil fertility to support plant growth.

Hydrology: Hydrology helps in deciding the plantation and natural infiltration. Generally, it is advisable to avoid disturbing natural subsurface drainage patterns. A high-water table may limit or restrict development such as basements, etc. Where possible, the design should maintain and enhance natural drainage patterns especially the gullies and riverine systems.

Vegetation – The existing vegetation patterns and types can be obtained from maps and visual survey. A site with extensive mature vegetation would be less suitable for high-density development from the standpoint of environmental sustainability. The visual character and spatial definition of a site is impacted by the amount and category of vegetation – from ground cover to canopy, from new growth to mature stands of trees, etc. Vegetation can modify the microclimate of the site by providing shade, protecting potential development from harsh summer winds or by channeling breezes. On large sites, it is desired that local flora and fauna be maintained and enhanced to get natural settings.

Conceptual Zoning

After a detailed site analysis and marking landforms suitable for development, conceptual zoning is done. This exercise is first done as “ideal” or non-site related diagrams to establish the best abstract relationships among the various components of the project. This is essentially a diagrammatic exploration in which the planner may move through a series of alternative arrangements until he/she achieves a solution which maximizes the positive relationships and minimizes the number of conflicts. The availability of essential utilities – water, sanitary sewer, storm sewer, gas, electric, telephone, etc., municipal regulations – are crucial to the potential for site development from both an economic and environmental standpoint.

Organizing Vehicular and Pedestrian Circulation

The process of zoning is further carried on with the setting of access points on the site and the main circulation pattern determined.

Access: it is imperative that the access to the site be decided to keep in mind various aspects such as approach from the main road, distance from crossroads, access to the mass transit system, location of buildings vis-à-vis roads, ease of accessibility.

Spine or main circulation system: The main vehicular circulation is planned so that there is universal access to all buildings and zones so that movement is smooth and non-conflicting.

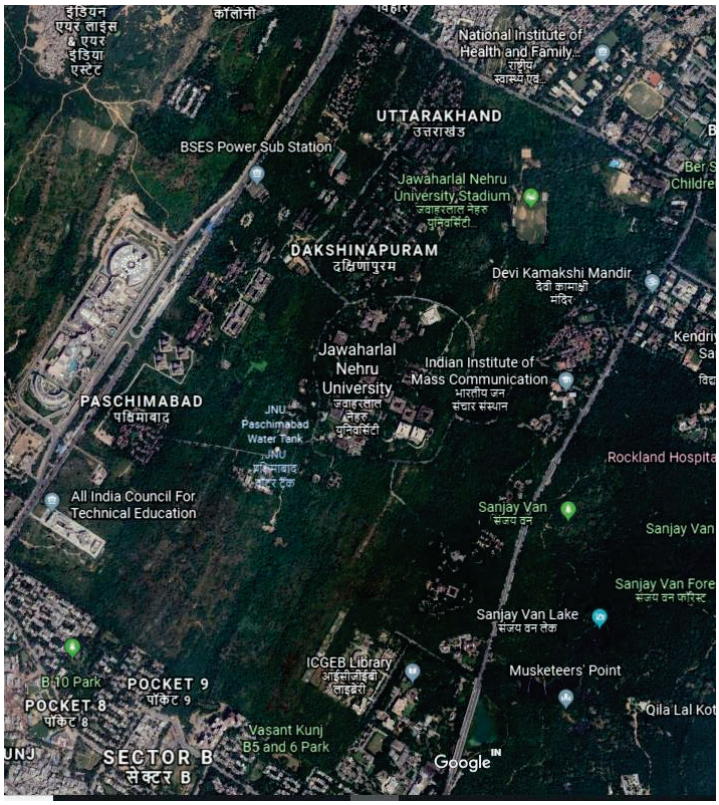


Figure 1. Main circulation pattern in the JNU campus shown in yellow

Cycle routes: On large campuses, especially educational campuses, efforts should be made to provide dedicated bicycle tracks for student's convenience. Not only is bicycle environmentally friendly, but it is also a great way to exercise.

Pedestrian movement: Large population of the campuses moves by foot for daily needs. It is desirable that shaded pedestrian ways be provided with interesting visual spaces widening into plazas and courtyard. Usually, the pedestrian routes are routes that are most direct as those tend to be used easily.

Forming Land Use Plans and Services

With the conceptual zoning in hand and the main circulation pattern, land uses are decided.

Retaining natural features and incorporating landscapes play a key role in enhancing the visual experience and environmental sensitivity. The basic aim is to accommodate the function for which the site is delegated for enhancing its image and identity with strong connections and ease of access within and surrounding areas creating a model of planning, design and environmental stewardship.

In large campuses, such as educational hub Iconic Structures can be planned that represent the core values and become orientation points of such campuses. These become central focal points around which other structures may come up. In Jawaharlal Nehru University, Library building, and Ganga hostel became such focal points which the community could identify with. Similarly, in Oxford University, the Christ Church, Bodleian library, Bridge of Sighs and many more form the iconic structures and meeting points.

Natural scenescapes: Some sites are endowed with natural scenes such as water bodies, hills, rocky outcrops, which may be integrated into the design process to enhance site experiences. Because of its visual prominence, environmental sensitivity and habitat for natural wildlife, natural open space should remain undeveloped. Visual analysis is the most practical means of determining positive and negative on-site views. In IIT, Gandhinagar, the effort was made to integrate the Sabarmati river and the ravines into the planning process.



Figure 2. Satellite image showing detailed site planning with preservation of natural features such as ravines and forest near the river to have an environmentally sensitive campus.

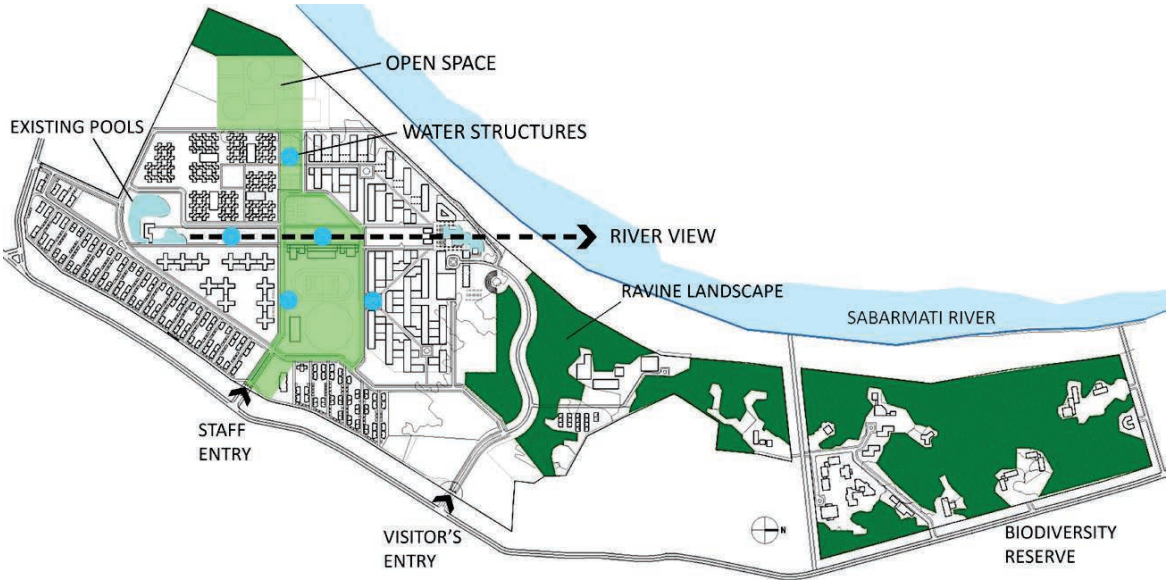


Figure 3. Master Plan of IIT Gandhinagar

Courtyards and Plazas are important places for intellectual exchanges and informal interaction amongst students and faculty as well as places for quiet contemplation. Large lawns/ plazas form the gathering spaces and places to hold activity/ winter fairs. Smaller courtyards and nooks and niches form smaller interactive spaces and meeting points.

Auditorium/ open-air theatre, students centre, sports centre forms the recreational centres in educational campuses while commercial area/ centre may act as a focal point in other campuses.

Services such as water and sewer pipelines, stormwater drains, electricity, health and shopping centers, parking facilities, fire safety, signages, and other features are incorporated in the design.

Designing Visual Form and Material Concepts

Material plays an important role in the cohesion of the campus as it forms the identification of the area. In JNU, machine cut bricks were used to define the campus. With the material, the scale comes into prominence as a definition of material helps in setting the scale too.



Figure 4. Central library, JNU



Figure 5. The convention center, JNU

Central Library, JNU constructed with machine cut bricks and administrative block, JNU with rough-hewn bricks later.

In IIT, Gandhinagar, the prominent material used is grit finish with exposed concrete which defines its characteristics.



Figure 6. The central Plaza, IIT Gandhinagar



Figure 7. Shaded pathways connecting Academic blocks, IIT Gandhinagar

Interesting massing and streetscapes form the basis of the campus which is at its nascent stage and will develop further to give it its identity.

Environmental Sustainability

The government and CPWD are committed to the protection of the environment and energy efficient campuses. Planning of net-zero campuses should be the aim and there should be a perceptible movement towards that initiative. The following initiatives can be taken to enhance the environment in the campus:

Green building design the concept of green building is that it should consume less energy in construction as well as in operation compared to conventional buildings, by optimum use of active elements such as building orientation, flow of natural ventilation and light, usage of green material and technology, explicit use in terms of minimum life cycle costs.

Clean energy is symbiotic to the use of renewable energy and lessens the dependence on non-renewable energy. It can be generated on-site in the form of wind and solar energy or purchased from the local grid with clean energy supply.

Recycling and waste management: Methods for recycling waste can be studied and encouraged to reduce waste generation. The unhealthy waste generation should be banned as is done on JNU campus where the use of plastic bags is banned and fined, if found violated, to increase compliance. The biodegradable solid waste generated can be categorized for manure generation.

Sustainable transport practices: Clean transport can be encouraged such as the use of bicycles for within campus movement with dedicated tracks for its use, use of electric and CNG vehicles for movement and other practices such as rideshare and other programs.

Sustainable site planning issues: Sustainability measures include site selection, minimum site disturbance, stormwater management, use of local and appropriate materials, minimizing vehicle use and many other measures. Water efficiency and water harvesting should be encouraged to reduce water dependency on outside sources. Efforts need to be made to plant vegetation which will help in water retention and help in greening the campus.

Conclusion

Site/ campus planning is an extensive exercise with major outlines defined here. Stakeholders and consultants help in developing a comprehensive plan which shapes up and takes definite form. A core team comprising stakeholders and consultants provide a rich and diverse group for design development and enhancement. Once the selection of a planner is done, a master plan is developed which sets the tone of development. The master plan takes care of all the above factors. Individual planning zones in an educational campus, for example, such as hostel blocks, Academic blocks, sports arena, residential area, etc may be individually worked out by teams decided/ selected by the core group who follow the basic design strategy set by the master planner in the master plan. An aesthetically pleasing and functionally sound campus is the aim of

the planner. If he/she can achieve this aim, cent percent of satisfaction is achieved.

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TRANSIT COMPLEX FOR IIT-PALAKKAD

Manjula Inian[1]

Abstract:

This article is about the Case study of Transit Complex, IIT Palakkad at Kanjikode, Palakkad district, Keralathat involved the principles of site and campus planning. It talks about the general design concept that was evolved for the whole campus and the individual buildings. It is about the details of individual buildings and how they are integrated to each other and to overall campus.In this, the sustainable environmental planning details with green building and barrier-free norms for the campus are briefed out. And it is about how an objective of designing a functionally satisfying and aesthetically pleasing campus was achieved in spite of various constraints like tough terrain, hostile climatic condition,etc.

Introduction:

Kerala is a state with a unique culture and tradition expressed by its strong Architectural identity evolved out of its physical, climatic and social characteristics. Hence designing a Transit Complex of the State's first IIT Institution was exciting experience. IIT-Palakkad currently functioning in a temporary complexwas in urgent need of additional spaces - classrooms, labs for its forthcoming batches of students. The task was to build a Transit facility which will cater the present need of the institution and later to be converted as a convention hall which will function independently and also as a part of the main campus. CPWD was entrusted with preparation of layout plan and architectural plans in a time- bound manner. The complex is to housean academic complex, an auditorium, a workshop complex, three bedded boys hostel, three bedded girls hostel and two bedded boys hostel. Situated at the northern part of Kerala, the place has tropical hot and humid climate with monsoon rainfalls. The site is predominantly rocky with steep contours which had influenced to create a building environment that flows along the site.

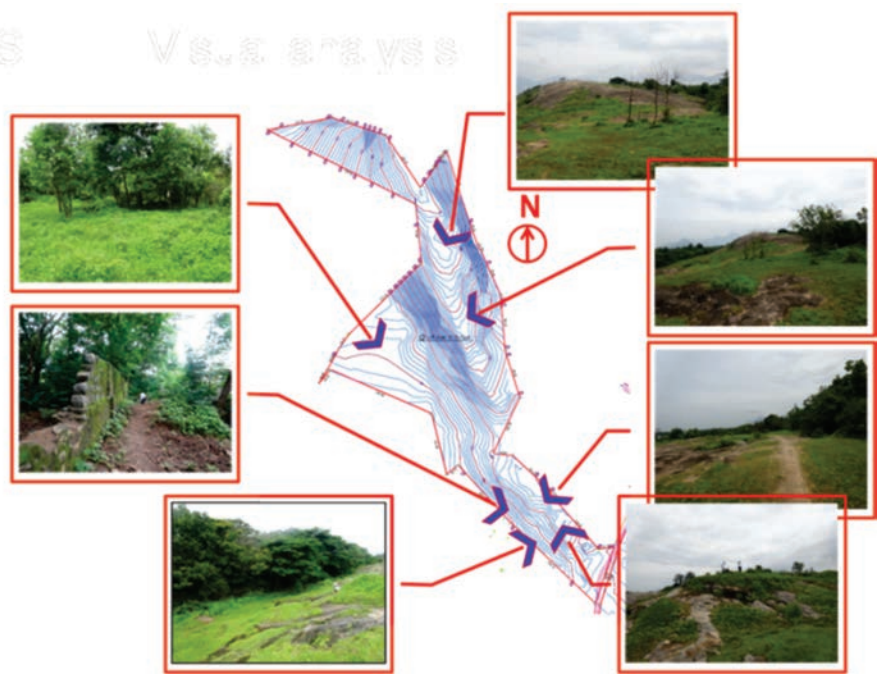


Fig.1 Site scape

[1]*Manjula Inian, Architect, CPWD*

Design Philosophy:

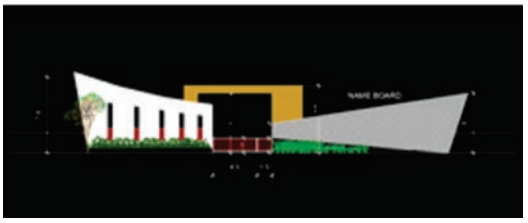
Transit complex:



Fig.2. Conceptual layout plan

Transit Complex for IIT-Palakkad is proposed in an area of approximately 28 acres opposite to the site of Permanent Complex. The front portion of the site is relatively linear with an average width of 75 m. The site is hard rocky strip with steep contours with combination of plane areas at western corner of middle portion of the site and high lands towards north.It is surrounded by green neighborhood. It has dramatic slopes, beautiful panoramic views of valley and distant hills which had influenced the project to be an interesting and challenging one, in terms of its spatial, environmental, structural and service planning. It was proposed to restrict the design to the areas that fall within the ease of accessible reach – by pedestrian as well as vehicles with institutional spaces in the front and residential spaces at the rear and green buffer in the center. A pocket of thick green forest is left undisturbed to save the only green patch in the site.The total built-up area is 15,000 Sqm approximately.

Entrance Plaza:


Fig.3. Proposed Gateway

The entrance forms an imagibility of any campus, a well-conceived entrance plaza is proposed for this transit facility as this will be Convention Center in future where the delegates from across the country and the world will come. The concept was the culmination of artistic lateral thinking and technical linear thinking. The site profile at the entry is taken to advantage for this purpose.

Academic Block:

The design concept of academic block was derived from Kerala vernacular architecture of 'Mutram- courtyard' with access from 'Veedhi- street' ,the concept that tackles local climatic conditions such as hot , humid and frequent rainfall effectively. The specific design has features that are characterized to this style of architecture such as sloping roofs, deep sunshades,and transitional spaces like verandahs to avoid heat gain. Adequate openings, courtyard, covered corridors on both side of classrooms to avoid direct sun rays and cluster planning for cross ventilation & lighting are provided while designing this building. The functional spaces are designed around the courtyard in three levels. The natural slope of the central courtyard is effectively converted as Students' Plaza which will cater to the outdoor student activities. The

incidental spaces evolved due to steep contours are effectively utilized into usable space. The general colour scheme of the entire campus is perceived as white serene with terracotta highlighters in the form of Mangalore tile roofing, brick wall cladding,etc.



Fig.4. Level 1.Plan



Fig.5.Level 2 Plan



Fig.6. Elevations



Fig.4. Level 1.Plan



Fig.5.Level 2 Plan



Fig.6. Elevations

Workshop complex:

The Workshop is designed around a central courtyard in two levels to accommodate eight huge labs with one as double storeyed space. Four labs are designed to have direct vehicular access to mount huge machineries. This building is designed as PEB structure to speed up the time of construction. All the features of Kerala vernacular architecture are worked on Pre-Engineered Building structures to integrate this building with the conventional buildings.



Fig.10. Level 1 plan



Fig.11. Level 2 Plan

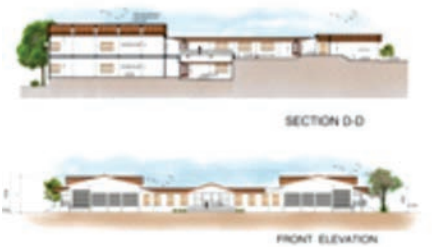


Fig.12.Elevation & Section



Fig.13. Front view

Auditorium complex:

Auditorium complex is designed to cater around 500 students at present, also to serve as a multipurpose hall with shuttle courts for an year-around effective use of the building and to serve as convention hall in future. Colonnades are created in front of the auditorium for informal gatherings of the students and a link has been established between the academic complex and auditorium on the undulating landscape.

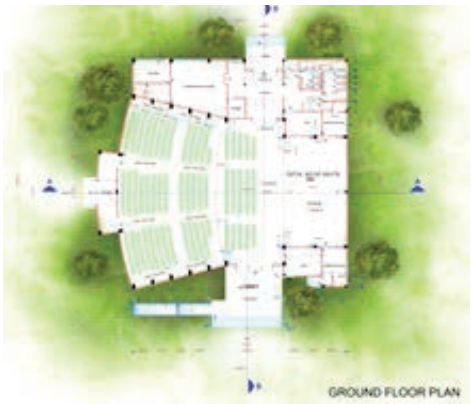


Fig.14. Auditorium floor plan

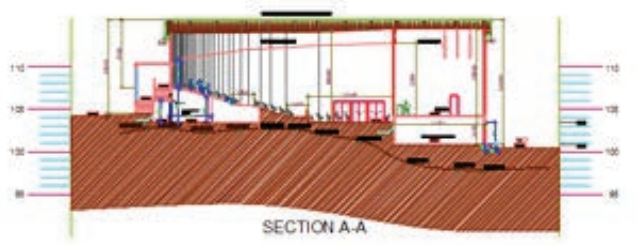


Fig.15.Cross Section



Fig.16.Front Elevation

Three bedded Girls' Hostel:

It is designed as standalone building to house 15 rooms with attached toilets for girls students and independent dining facility. As this building will be converted as VIP Guest house at later stage, it was designed as iconic building and is set on high rocks to have command on site as well as to have beautiful panoramic views of the site. The individual rooms of three seater capacity are designed around a central courtyard which is at two different levels.



Fig.17. Floor Plans

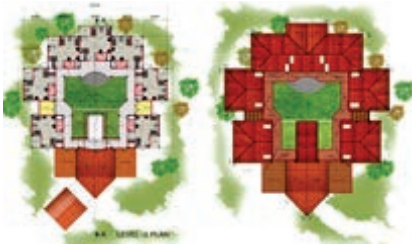




Fig.18.Elevation & Section



Fig.19. Section across 2 bedded boys hostel and 3 bedded girls hostel

Three bedded Boys' Hostel:

This building is designed as two staggered blocks connected by a central double storeyed lobby which will be capturing the adjacent lush forest green. The front side of the building faces the steep rock with will be intermittently landscaped with flowery patches. The rear balconies of the building face the forest. This building is also constructed as Pre-Engineered Building structure. This building had its unique foundation planning that was essential to be placed directly on rocks. This building will serve as married students' hostel.



Fig.20. Floor Plans



Fig.21.Elevation & Sections



Fig.22. Front view

Two bedded Boys Hostel:

This building has two blocks connected by a dining hall in the center. The site is so undulating that the blocks are designed in levels to navigate the steep contours in both directions. This building is designed to cater as guest house in future. The blocks are designed around the courtyards with

deep sunshades to prevent from scorching heat that will get reflected from adjoining rocks. The character of the building synchronizes with the other buildings of this complex by its features.



Fig.23. Floor Plans



Fig.24. Elevation & Sections



Fig.25.Front view

Integration and landscaping of the campus:

The academic buildings are connected the hostels with covered green walkways which will enable the users to navigate the campus at ease during rough climatic conditions, be it flashing rains or scorching sun. Ancillary buildings like Amenity center, Service buildings like substation, AC plant room are placed at strategic points in the campus. An extensive landscape plan has been evolved and is under execution. The local plant species are identified and they are extensively used to create various hues of landscaping. Sustainability was one of the main criteria while designing the landscape.



Fig.26. Campus view

Barrier-free and Green campus:

The entire campus is barrier-free with adequate ramps, tactile paths, barrier-free toilets and other essential barrier-free building features. The design of campus is in compliance with GRIHA norms and green building parameters. The existing site features like a patch of forest, the hillocks,and the natural rain water path are retained. Collection pond of rain water is built at the lowest point of the campus for ground water replenishment.Local materials are used. Soft landscape is planned for better surface imperviousness. The existing climatic conditions were considered to create better internal thermal comfort. Solar energy is tapped in as alternative energy resource. Use of water is minimized by recycling of water. Best construction management practices are being adopted at site. Low environmental impact building materials are used extensively. Overall, an effort has been made, to maximum extent, to have a 'Green' campus.



Fig.27. Campus view – Landscape under execution

Conclusion:

A site with very difficult terrains has evolved into a wonderful campus due to effective planning of buildings with a strong architectural character and a wonderful blending of the site with built environment.The transit complex is designed to createbuildings of international education ambiance with an expression of Vernacular Architecture, embedded in latest construction technology.

STORMWATER MANAGEMENT THROUGH GREEN INFRASTRUCTURE FOR A PUNE CITY'S WARD

Nikita Paliwal[1]

Abstract

Pune has been considered famous for its natural water resources, due to its topographical context. And the increasing urbanization, leading to increased run-off volumes, and in turn polluting the natural waterways, by carrying all the pollutants through its way, ultimately putting the natural resources of Pune city into danger, which needs to be taken care of.

In today's urbanization scenario, the rain which pours down, and reaches the earth surface become stormwater, in other word, it becomes polluted, and thus treated as an effluent. The conventional urban stormwater management, mainly, focuses on the collection of storm runoff, through underground pipes or engineered overland flow drains, which collect the contaminants from roads, parking lots and other surfaces, and eventually becomes a part of lakes and rivers.

Stormwater has to be considered as a resource and not as an affluent, which needs to be drained off. A different outlook towards stormwater management program is required which will make, urban stormwater, visible, and speak itself about its inherent values and becomes an educational as well as a recreational source, altogether.

A ward of Pune City has been selected as a pilot project to formulate Green Infrastructure strategies for managing stormwater.

Key Words: stormwater, green infrastructure[2]

Introduction: Proposal

Green infrastructure is a fresh approach to manage stormwater aiming to overcome the shortcomings of the conventional approaches by mimicking the natural drainage of a site before development.

Green infrastructure strategies aim towards maintaining or restoring a more natural hydrological regime, such that the impact of urbanization on downstream flooding and water quality is minimized. The idea behind green infrastructure is to try to replicate natural systems that use cost-effective solutions with low environmental impact to drain away dirty and surface water run-off through the collection, storage, and cleaning before allowing it to be released slowly back into the environment, such as into watercourses.

It will get complemented by grey infrastructure (concrete pipes), where green infrastructure does not have sufficient capacity to treat all of the run-offs.

Aim: To develop green infrastructure strategies to manage stormwater, in compliance with

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[2]*Green Infrastructure - Green infrastructure is an approach to water management that protects, restores, or mimics the natural water cycle. (American Rivers.org)*

existing stormwater infrastructure, for different built typologies, existing within a ward of Pune City.

Scope

To do a detailed study of the ward selected through certain criteria, in terms of its existing natural conditions as well as man-made stormwater infrastructure, and, identification of issues for same, and, come up with the identification of green infrastructure component suitable in particular, and their strategic locations for the same.

Limitations

The study and strategies for stormwater management are ward specific. The study is open-ended for further hydraulic design of the identified Green Infrastructure components.

Process of Analysis

Step 01 - Selection of Basin

Pune city has been divided into, twenty-three number of basins based on the natural parameter, by Pune Municipal Corporation (PMC). Among these basins, Kothrud basin is selected through two criteria. First, the upstream catchment basin (Figure 1). Second, the density of urbanization (Figure 2).

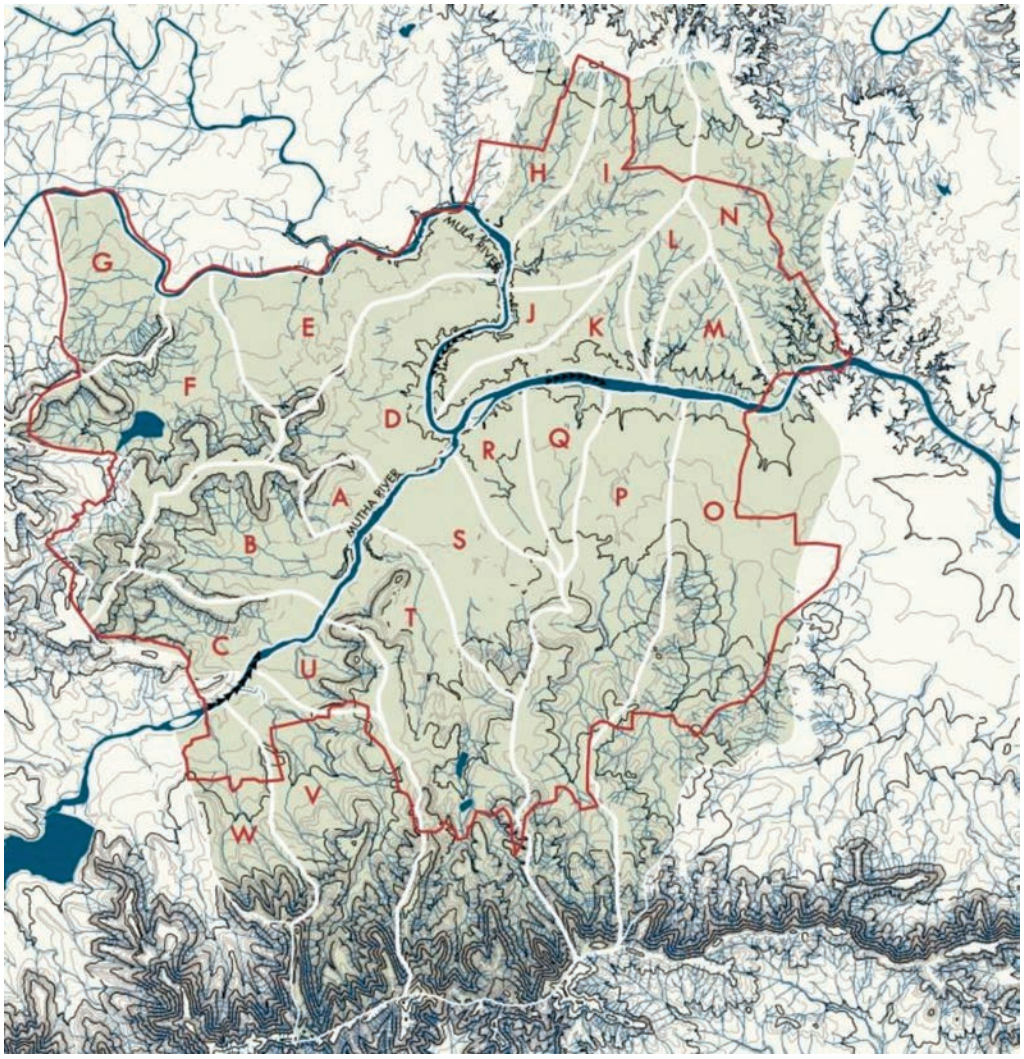


Figure 1. Watersheds Basins of Pune City. Kothrud Basin 'B' is selected as being the upstream basin.

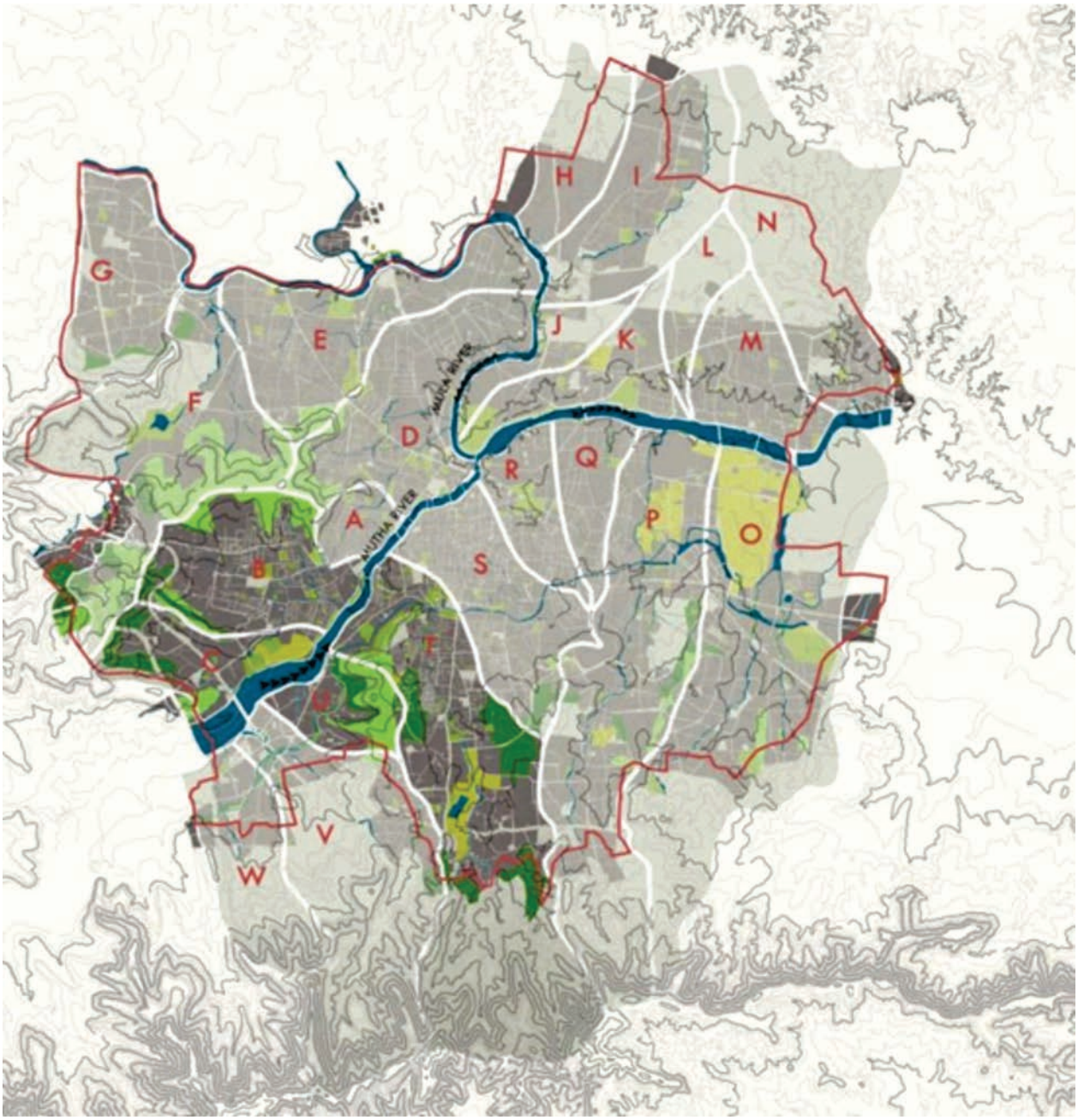


Figure 2. Built Densities for Basins of Pune City. Kothrud Basin selected as it has the highest percentage of built density.

Step 02 - Selection of Ward within the basin

Pune city has been divided into a number of wards, by an administrative boundary set by PMC. One ward is selected, through two criteria. First, Building Typology (Figure 3). Second, Built Density (Figure 4).

Ideal Colony ward (Figure 5) in Kothrud Basin is selected as it has four different types of built typologies i.e. Residential, Commercial, Institutional and Industrial. (Figure 3).And, further, this particular ward has more percentage of open spaces and will offer more opportunities to incorporate Green Infrastructure (Figure 4).



Figure 3. Depiction of Different Typologies present in the wards in Kothrud Basin.



Figure 4. Depiction of Built Density and Open Spaces in Kothrud Basin.



Figure 5. Ideal Colony Ward (selected) in Kothrud Basin.

Step 03 - Identification of Built Typologies, within Ward

Total 7 number of built typologies are identified in particular for the selected ward (Figure 6), through Field study and Base Map study.

- Typology A

Commercial high street with pathways on both the sides - with mixed frontage, some having paved surfaces available before adjoining to the pathway.

- Typology B

Residential Street with adequate width, with pathways on both sides of the street, and a median.

- Typology C

Residential Street with limited width and no pathways, and compound wall of private properties directly abutting the street.

- pTypology D

Street having with mixed frontage, commercial activities (at ground floor) and residential (at the upper floor), street abutting the paved surfaces with no compound walls.

- Typology E

Residential street having an open space available in between the two-way road and no pathways along.

- Typology F

Residential street, with limited width and compound walls directly abutting the street, and a central public open space available.

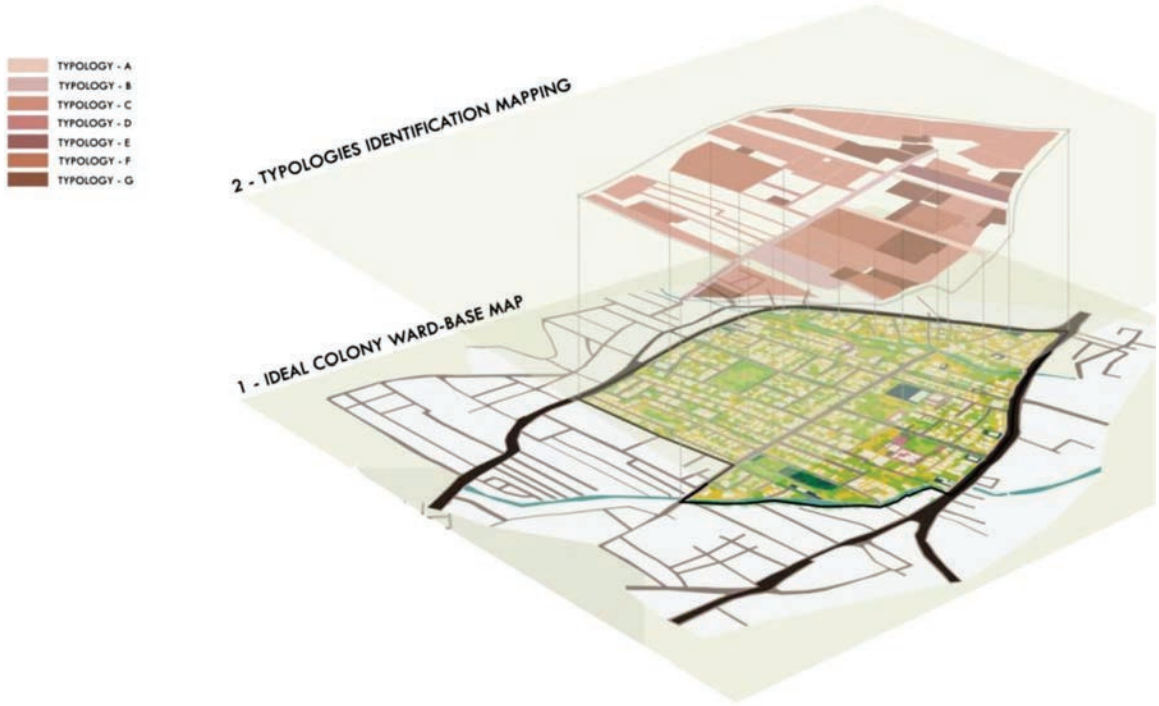


Figure 6. Depiction of built typologies identification within Ideal Colony Ward

Step 04 - Stormwater Management Train for Selected Ward

Existing typologies are overlaid with the concept of Stormwater Management Train, and, identify the applicable stage of Management Train for each identified Typology within the ward.

Stormwater Management/ Treatment Train Concept

A stormwater management train approach, assures that run-off quantity and quality are addressed. There are three objectives (Table 1) of the treatment which provide an integrated and balanced approach to help mitigate the changes in stormwater runoff flows.

OBJECTIVES	FUNCTION	COMPONENTS
Source Control	conveyance and infiltration of run-off.	Infiltration Trench, Permeable Paving, soakaway, Bio-retention, Filter Trench, Filter Strips, Swales, Green Roofs, Green Walls
Site Control	reduction in volume and rate of surface runoff.	Detention Basin, Retention Basin
Regional/ Ward Control	Interception of run -off downstream of all source and on -site controls to provide follow -up flow management and water quality treatment.	Stormwater Wetland

Table 1. Objectives of Management Train and their function &components

Step 05 - Existing conditions analysis are analyzed for each typology.

Existing conditions analysis is done through below-mentioned layers

- Surface types generating stormwater run-off
- Existing stormwater management infrastructure (grey)
- Activity pattern at identified open space

Step 06 - Developing Green Infrastructure Strategies for Stormwater Management, for each typology.

Green Infrastructure component is selected through a three-step selection criteria

- Site surface characteristics
- Physical feasibility criteria
- Benefits achieved

Selected component is strategically placed, within the typology, forming a network of components, and ultimately connecting to a natural water system or existing stormwater infrastructure.

Result: Stormwater Management Strategies through Green Infrastructure for Typology 'A'

As a pilot study for this paper, strategies are framed for Typology 'A' (2.3).

Existing Conditions Analysis

Commercial High street with pathways on both sides - with mixed frontage, some adjoining directly to the pathway, some having paved surfaces, available before adjoining to pavement (Figure 8)

Road width - 14m.

Road length - 0.37km.

Slope along the road - 0.9%

Width of pathway - Ranges from 2.3m to 4.0m



Figure 8. Typology 'A' Base map with existing conditions and site photographs.

Existing Stormwater Management Infrastructure

Existing infrastructure is laid by PMC, capturing stormwater through catch basins at nodes, along with the pollutants from road and pathways and ultimately draining into the river.

Existing Open spaces with stakeholders

Pathways along the road ranging from 2.3m wide to 4.0m wide, on both sides, are contributing the major areas as open space. As this space is owned by PMC, incorporation of Green Infrastructure components will be much easier.

Few open spaces are available directly abutting the pathway, which has eventually become the part of the pathway itself, but as they are owned by private bodies, the intervention will be a challenge.

Activities at open spaces

Parking is the major activity, which occupies the sides of roads, but it is done on either side of the road alternatively as a rule by PMC, further provides an opportunity.

Proposed strategies

The strategy for this typology is to catch stormwater run-off close to its source as much as possible, reduce the rate of run-off, and improve the quality before it enters into the existing infrastructure, ultimately leading to the channelized river.

To achieve this, a green infrastructure component is selected through a three-step selection criteria (mentioned in the process) which resulted into the selection of Bio-retention planters, as it suits the basic requirement of this typology.

These planters between street and sidewalks, calms traffic and makes the pedestrian feel safe and enhance amenity.

Strategic location of Bio-retention Planter

Planters are proposed in the alternate parking offset on both sides of the street. This alternative location of planters does not reduce the parking number, in turn, provided a marked and organized parking space, and also does not reduce the effective carriageway.

Planters are proposed to be placed in a way, that they incorporate existing trees and provide a breatheing space to them.

Flow of Stormwater run-off

The run-off from street and pathway, enters into the bio-retention planter, through kerb cut-outs, offset on both sides of the street, and carried away through perforated pipes and under laid, and ultimately connects with the existing infrastructure.



Figure 9. Typology 'A' – Conceptual Map for the Stormwater Management through Green Infrastructure.

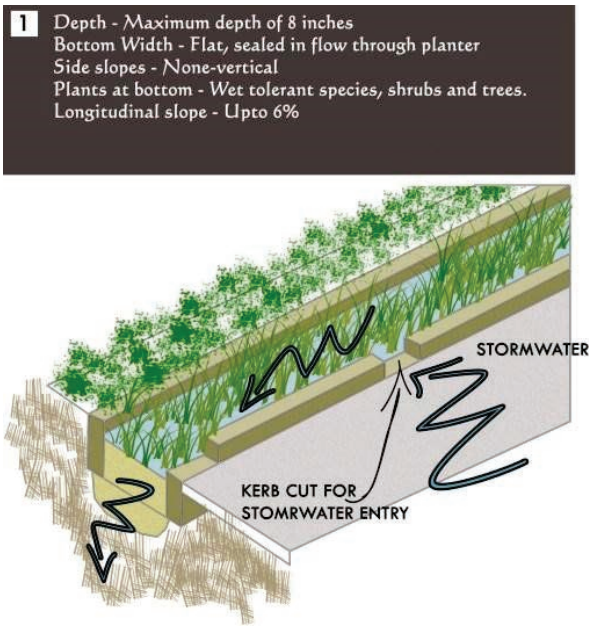


Figure 10. Typology 'A' – Legend for different componenets utilized.

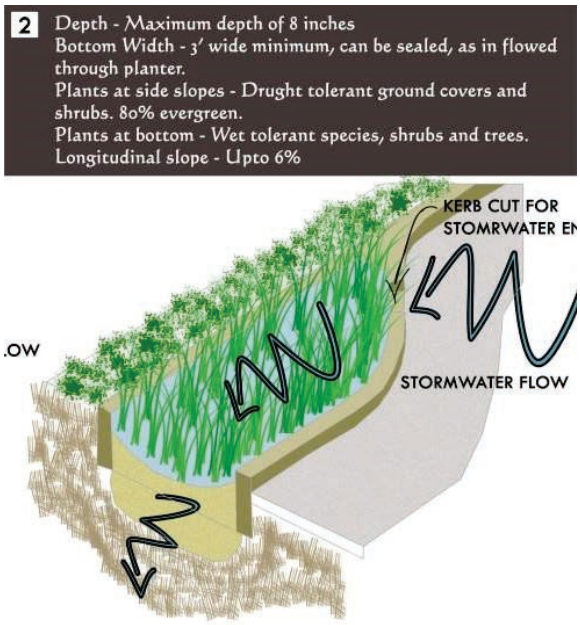


Figure 11. Typology 'A' – Legend for different componenets utilized.

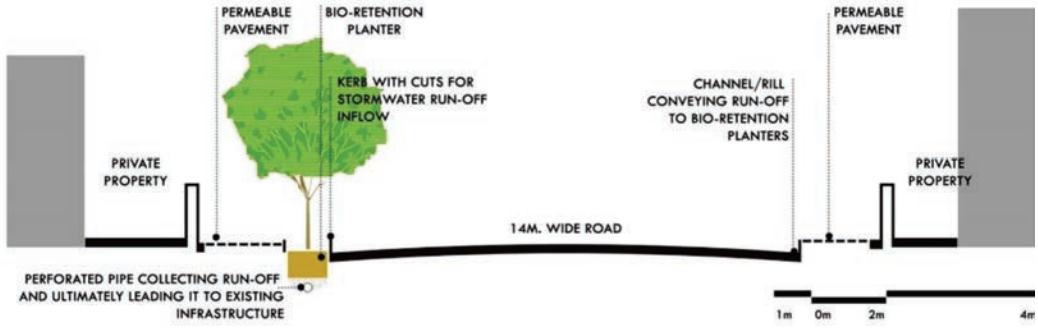


Figure 12. Typology 'A' Typical Section through street.



Figure 13. Typology 'A' – Street Perspective.

Conclusion

This pilot study of framing strategies of stromwater management for a particular ward of Pune city, is a representative of the entire city as whole. These strategies will counter the effects of conventional drainge systems that allow for flooding, pollution of the environment – with the resultant harm to wildlife and contamination of groundwater sources. These sustainable solutions would be easy to manage, requiring little or no energy input, resilient to use an dbeing environmentally as well as aesthetically attractive.

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SIGNIFICANCE OF PUBLIC ART

Namita Nitesh[1]

Abstract

Any Art form or a creative element put up in a Public Space is a Public Art. The Public space also includes a building, which is accessible to all. Every public Art speaks for itself and has a message to convey to our society. There can be various forms of Public Art which includes sculptures, statues, murals, installations, wall paintings, folk and tribal art, made of any material with any texture. The paper is based on the importance of Public Art and its role in today's Scenario.

Introduction

The Indian Art consists of various art forms which can be expressed as paintings, sculptures, pottery and textile arts. During the pre-historic settlements, the Indian Art was in the form of Rock Art (carvings/paintings) in the caves. These paintings depicted the human life along with their activities.

Many excavations have revealed that the Art forms had great influence of cultural and religious aspect on them. The famous “Ashokan Pillar” in Iron without rusting till date, is one of the finest example of technological advancement of that period and its inscriptions reveal about the society existing, at that time. It became a part of culture. Thus, the Art work installed in public places add meaning to it, thereby reflecting the inner vision of that time.

The term Public Art basically denotes “Community Art” which is accessible to all. It is an art in any medium that is installed with an intention to attract attention of Public to convey a message. It forms a landmark and becomes a part of collective memory. History of Public is as old as the history of mankind. The Memorials are supposed to be the oldest form of Public Art.

Purpose of Public Art

Looking at the Indian Context of the Public Art, it is an initiative, for the beautification of a place. With the beautification, the Art work also serves the purpose of conveying a strong message to or about the society in terms of the tradition and culture. Thus, the Public Art is the voice of the public space.

Some of the case studies where the public art conveys a unique message are listed below :

Mumbai International Airport

The Mumbai Airport houses one of the largest indoor public art, which depicts our country's rich and diverse culture with ancient and modern traditions. The Art work is a part of Art Programme, titled –“Jaya He” derived from the National Anthem describing the Glory of the Nation.

The Public Art is in the form of 3.2 kms., multi-storeyed Art wall illuminated with skylights. It

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houses 5000 pieces of artwork and artefacts from all over the nation. It is kind of Museum with different sections displaying multi-layered culture of India. It gives an impression of true beauty of our country.



Fig.1, 2 and 3 Showing Various Art Forms at T2, International Airport Mumbai.
(Source:www.csia.in/atcsia/jayahe)

Kala Ghoda, Mumbai

Kala Ghoda is a famous area located in South Mumbai near Jahangir Art Gallery. It is named after the statue of King Edward VII, the then Prince of Wales sitting on a horse. The Statue is made of Black Stone, from where the name Kala Ghoda has been derived meaning Black Horse. It was the symbol of Imperial Power. It also serves as the Landmark of this area.



Fig.4 : Plan showing the Kala Ghoda Statue and its surrounding heritage area.
(Source :www.kalaghodaassociation.com)

In 1965, the Govt. decided to remove the statues of British Rulers, hence the original statue was replaced by a Statue of “Horse”, which is black in colour. The area around this statue comprises of many listed heritage buildings and is popularly known as Kala Ghoda Area which houses museums, art galleries, libraries, cafes etc. It also hosts the Kala Ghoda Art Festival every year in the month of February and the statue of Kala Ghoda has become the life of this area.



Fig. 5 :Kalaghoda - With King Edward VII (Prince of Wales), during British Rule, Mumbai (Source: http://memumbai.com/kalaghoda)



Fig.7 : New Kala Ghoda Horse Statue, installed in 2017. (Source: http://memumbai.com/kalaghoda)

Walkeshwar Wall Painting, Mumbai

Walkeshwar wall is the external boundary wall of the Governor's Bungalow- “Raj Bhawan” in Mumbai, which is approximately 1092 feet long from Gate no. 1 to Gate no. 2. It has total 69 panels which displays Warli paintings with human figures, trees and animals. Each panel depicts a landmark of Mumbai. There are 60 themes based on the all major landmarks of Mumbai which covers the city from Chhatrapati Shivaji Maharaj Terminus, South Mumbai to Suburbs, Navi Mumbai. These landmarks include Gateway of India, Elephanta Caves, Sea link Suspension Bridge, National Parks and so-on.

This Art work plays an important role in beautification of the place. It reflects the culture, creativity, evolution and history of the city or a nation on larger platform. It is an artistic legacy that is left behind for the generations to come.



Fig. 8 : Warli Painting at Walkeshwar Wall, Mumbai.



Fig. 9 : Warli Painting depicting Gate Way of India, Mumbai. (Source:www.asianage.com/metros/Mumbai)

Guidelines for public art

The Delhi Urban Art Commission (DUAC), Govt. of India, has prepared Guidelines on Public Art , to promote and encourage the Public Art. It is important to identify places where, the thought provoking Public art can be displayed, so that they need not be confined to the Museums only.

The guidelines of DUAC clearly mentions about the typology of the Public Art, (but not limited to it) which is as under :

i. Public Art based on Medium.
   - Two Dimensional Public art
   - Three dimensional Public Art
   - Digital and Interactive Public Art
   - Performing Art
   - Landscape/Horticulture

ii. Public Art based on Time span
   - Temporary
   - Short Term
   - Long Term
   - Permanent

The Guidelines also states that the following conditions should be followed while placing the Art Work.

- Light and Ventilation should not be obstructed due to Public Art.
- The Artwork should not compete with the scale of the site or adjacent architecture.
- The Artwork should not mar the aesthetic beauty of the surroundings.
- The Artwork when located in natural surroundings should not conflict with the natural vegetation and habitat.
- The Artwork should not interfere with the movement of traffic and supporting facilities.
- The Artwork should not obstruct any pedestrian movement, fire escape, door or window, opening used as a means for fire-fighting purposes.

These are the basic guidelines which need to be taken into account while planning an Art work. The Public Art helps in enriching the civic spaces. They tend to present different meaning based on their settings.

The maintenance and the life of the Public Art also plays an important role, which has to be addressed appropriately.

Conclusion

Public Art plays a vital role in depicting the local theme of that area. The building becomes lively and interactive, if public art is included in the building premises/façade. It introduces a component of social idea and leaves people to visualise and form their opinions.

The department CPWD, handles a wide range of projects dealing with Residential, Offices, Hospitals, Airports, Bridges, Flyovers and so on. All these projects have wide scope of the Public Art work.

One of the greatest Public Art constructed by the CPWD is “The National Salt Satyagraha Memorial at Dandi, Gujarat”. This beautiful Memorial is planned in an area of 15 acres near the sea coast at Dandi, Navsari, Gujarat. It depicts the famous Salt movement and the March, against the Colonial Government. The life – size sculptures of 80 Salt Marchers are installed with Mahatma Gandhi's Statue in lead. A crystal made of glass has been installed on canopy which symbolises the importance of salt. This whole set up the Art work conveys the message of the strength of the movement and the vision of Mahatma Gandhi.

Thus, the Memorial has made the history alive by speaking for itself.



Fig.10 : The National Salt Satyagraha Memorial at Dandi, Gujarat. (Source:thebetterindia.com)

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EVOLUTION OF ARCHITECTURAL PERCEPTION IN URBAN INDIA

Shibashis Chaudhuri[1]

Abstract

A true architect is a visionary who can foreseethe needs of the future and design built environmentsand lives ages ahead of them. India following to its different planning commissions and the knowledge exchanges with other Nations around the globe is ever changing in its way of Planning and Architecture. The Architects occupied privately or publicly are creating and giving shape to a new dynasty of Architectural realm in India. The Smart Cities Vision plans by MoUD, along with planning and designing guidelines from TCPO, COA and local authorities in different state and city level are contributing to the recent developments. A continuous endeavour is also being taken to modify the guidelines according to the need to be at per with global level. The new technologies like GIS, 3D modelling, digital analysis of climate responsive designs are becoming essential for shaping the future. The Architects of the nation are now even thinking of constructing in the moon.

Key Words: Vision, Planning, Architecture, City, Built-environment.

Introduction:

The footprint of the progressive changes in trend of Architecture in Urban India has created an impact in spherical reshaping of earth. This transition has put the entire nation in a win-win situation in the scenario of global warming, conservation of earth and water and sustainable development of mankind.

Public and private spaces come together

As more and more people gather in urban areas, cities today are largely facing a space crunch. Long traffic jams have called for a change in the way cities organise their space.As a result, Combination of public and private spaces has become a trend. Earlier, cities had fixed designated areas marked as residential, commercial, and industrial.This makes the need for transport minimal, thereby keeping residents happier.The inversely proportional math amid land and population growth is a red flag for architect's fascination towards horizontality. The scenario of day beckons the growth on Z-axis We need to look into reducing the horizontal footprint, by expanding towards the sky. With the emerging ideas like vertical farming and active revolution in vertical transportation systems the concept seems to be soon barging into the mainstream. Bombay is a classical case study to realize the assurgent need to adapt to the notion of getting a vertical growth (Fig. 1) . Negation of same is only a step towards annihilation.

Multi-utility feature

The problem of providing shelter and creating more room out of given space still rules the

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architectural designs, but the difference is that the designs of today are not only minimalistic, they support the multi-utility feature also (Fig: 2). The malls, shopping complexes, commercial establishments and cinema halls have gone a makeover in sync with the emerging global tastes. The previous notion of procuring the material as well as expertise from within the close vicinity has transformed into going for cross-border solutions and picking global trends and integrating as per Indian conditions.

The paradigm Shift in Design Sensibilities

The growing economy and population has led to enormous housing needs, driving the extent of architectural work and creating massive opportunities in the country. It is also one of the reasons why the number of foreign architectural firms working in India has increased. In the aftermath of cities burdened by the lack of infrastructure, the opportunity to design and make a difference in India has become immense. This has also led to the increasing number of Indian architects, who, after receiving their architectural education overseas, have returned to India to practice and be a part of the shift the country is going through.An influence from the West, glass and designer-shaped buildings (Fig:3) began as design statements some years back, but are now shunned by responsible architects for their out-of-context implementation. Indian architecture is seeing many explorations. Though globalisation is widely influencing the architecture being built in India today, the need and anxiety to localize is also fiercely felt by many.

Increased emphasis on outdoor living

With the evolution of living room and dining rooms into common areas with an open space layout,(FIG.4) there has been a gradual disappearance of formal spaces in urban homes. As homes are progressively de-formalised, we will see an increase in emphasis on outdoor living.

Eco-friendliness will reach a new level

Due to introduction of different government policies & also due to public awareness Green buildings, Green terrace, (Fig: 5a) eco-friendly material, green walls, green bridges, are becoming very important trend nowadays.There is a wave of creating eco-friendliness in every industry.It is architecture that has created new trends.Green roofs (Fig: 5b) and green walls have become very popular in 2018.In addition, we can also expect to see more of green inside the buildings. Indoor parks are expected to be the next big thing along with micro-climates.

Neo-Organic Architecture

The last decade has witnessed a shift in a new approach in architecture, which this paper coins as Neo-Organic Architecture. This approach has been dominating the architectural practices, and many architects have changed their strategies in architecture to follow it. It tracks the principles of organic architecture, satisfies the criteria of sustainable architecture and, to the great surprise is an offspring of De-constructivists architecture. The seemingly opposing trends are uniting to

produce the aesthetical architecture that could be recognized as iconic. Architects marked as De-constructivists are changing their output architecture. Suddenly smooth lines, fluid curvilinear forms and aesthetic values could be monitored in their work. Interest in eco-friendly solutions in their buildings is accentuated. Even their concepts explanations are modified and for the first time it seems that architecture is getting its concepts from science and nature instead of philosophy. Organic flavour is beginning to dominate their designs with its attachment to its surroundings instead of being in complete diversity with it (Fig.6). Their buildings are turning into icons that mark its places and its designers. New architectural practices are also adopting this trend competing and producing the most fantastic collection of Iconic Neo-organic buildings. The unbelievable technological progress with its impact on drawing and visualization, manufacturing (CAD/CAM), structure and materials, are all shifting architectural ideas and helping in opening the doors widely in front of creativity and innovation. This paper identifies this new trend and tries to comprehend it. It tests its prevalence, looks into the factors that led to it, analyses its main features and studies how it is different and dependent on deconstruction architecture and organic architecture. It also looks into the sustainable features in it. The paper sees if this approach is up to being established as the recent architectural style for contemporary years and the years to come.

New building materials of traditional or modern look

Traditional concrete and iron houses are being replaced with newly found materials. In addition to wood, dirt mixture is constantly being tested and experimented with.(Fig: 7) These changing technologies are surely going to re-image some conventional building types and have a huge impact on the kind of materials used by architecture. Glass, steel and aluminium might remain as 'fashionable' materials, but there has been a shift in sensibilities with the revival of Indian crafts and the use of natural and alternative materials such as brick, mud, clay, bamboo, wood, stone, etc.

Starchitecture – The newest trend

Over last few years, we have seen a growing trend of architecture called starchitecture (FIG. 8a, FIG. 8b) where architects have come up with some marvellous eye-catching new urban forms which stands out very well in the existing urban-scape.

Conclusion

From the beginnings of history as we know it, architecture has been one of the defining forces of humanity. Architects and town planners have left timeless echoes through our past; echoes that found their essence in culture, art, and formed the very fabric of civilizations. As both an art and a science, architecture has played a very important role in mankind's story. Each era has brought with it different ways of design thinking ; ways to build community, preserve political boundaries, and design built environments that are timeless and so beautiful that they take your breath away!

Looking into the past, we can glean wisdom from the lessons that we have learnt and forge new tools to take us into the future. What will the next few years hold in store for architects all over the world? We study some of the emerging trends in architecture, to help us get some clues about how our future cities will look.The past decade has already seen the initialization of these trends, with path-breaking changes that have laid the foundation for a future where traditional concepts are shattered. Today's projects are already answering the needs of the future, with innovative designs seeking to represent the architecture of tomorrow. In the words of one of the greatest architects the world has ever seen, Frank Gehry “Architecture should speak of its time and place, but yearn for timelessness.”

Figures



Figure 1: Infinity building complex in Mumbai, The Hotel Building Twists Along Its Axis With Open Breaks Between Sets of Rooms To Allow Views Towards the sea. The Residential Apartments In Two Wings Are Planned With The Service Cores On The Southern Face, Cross Ventilated Apartments Angled With Varying Views Of The Sea And Naturally Ventilated Circulation Space



Figure 2: The Biswa Bangla Gate in New Town, Rajarhat,
Kolkata houses a number of utilities for business and amusements.



Figure 3: The Hi-tech Infosys Building in Hinjewadi, Pune has a unique 'egg-shape' design making it look ike a descending UFO. This uniquely designed building is green and environment friendly.



Figure 4: Combining Indoor and outdoor spaces

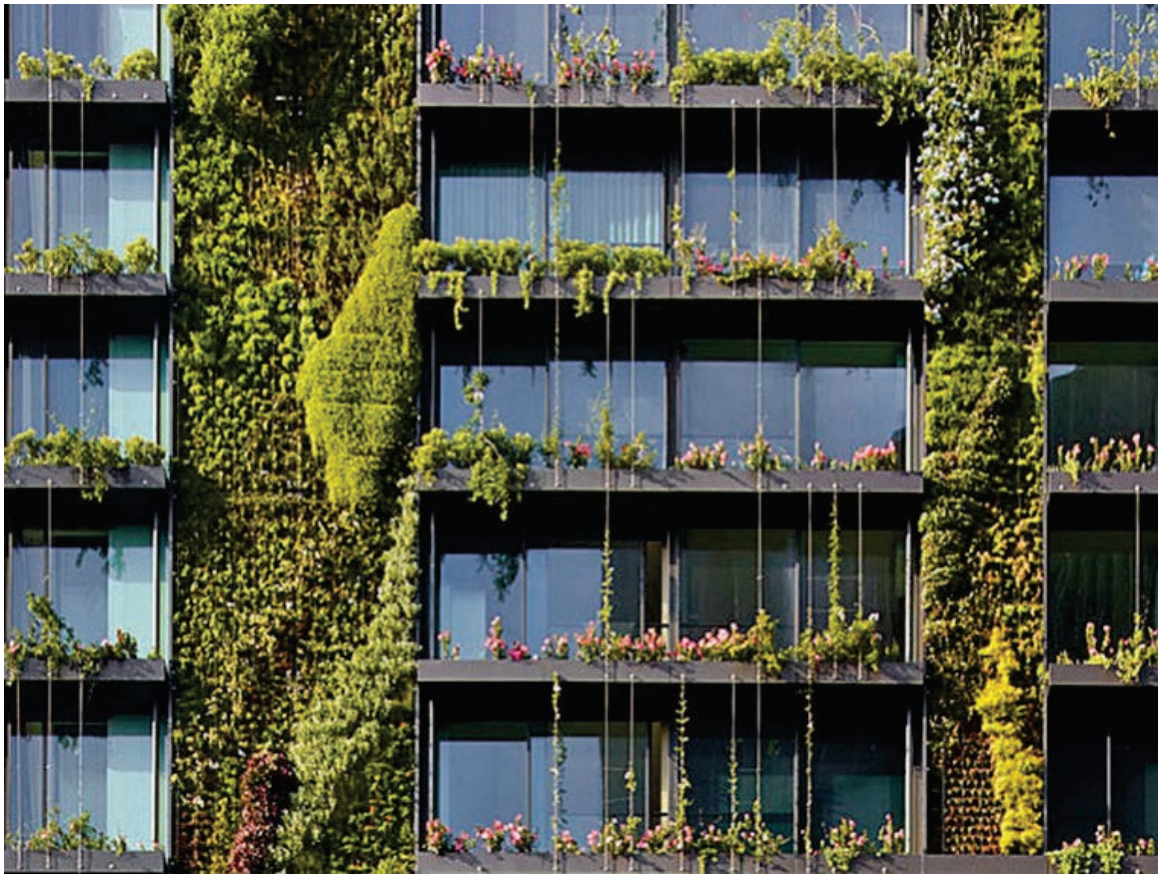


Figure 5a: Green Wall



Figure 5a: Green Terrace



Figure 6: International Management Institute at Kolkata example of combination of tradition with modern



Figure 7: AEC Blocks of different shapes and colours, experimental in new building materials



Figure 8a: The Bahai Temple, New Delhi, creating a landmark and example of starchitecture



Figure 8b: Matri Mandir, Auroville, Puducherry example of Starchitecture

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URBAN WATER FOR SUSTAINABLE DEVELOPMENT

Debarati Chakraborty[1]

Abstract

Rapid growth in megacities is putting pressure on water and sanitation. World Health Organisation in 1966 prepared the first Asian master plan for water supply, sewerage and drainage with a phased programme. The metropolitan areas were divided into five service districts and suggested construction of treatment plants, primary and secondary grids, booster station etc. A vision for water 2025 was prepared with new standard for per capita water supply. Kolkata Metropolitan Development Authority took up the implementation procedure accordingly for sustainable development. Measures were taken to prevent pollution of the river Ganga, & ground water, control water wastage, use surface water, recycle of waste water etc. Water supply was planned through ground and surface water but different municipalities lacked coordination, and resulted in dissatisfied groups of stake holders. The paradox led a group of Architects, Engineers and academicians at a non-profit professional society in Kolkata to take initiative and challenge the situation of huge amount of urban water getting wasted every day in our city.

Keywords: growth, wetlands, aqua-agriculture, urban water, sustainable development.

Introduction

A settlement receives resources but produces waste whose usual disposal methods are expensive both financially and environmentally. One of the objectives of sustainable development is to reduce the gap between resource input and waste output where recycling helps in bringing ecological balance. About 85 – 90% of the water consumed in Kolkata city becomes waste water, sometimes mixed with sewage and its disposal has become a problem. Most of Kolkata's sewage, is treated naturally in wetlands that is now a Ramsar site. In the conventional water management, recycling of wastewater has not been given adequate attention though reuse of waste water has been in practice in many countries. An extensive study was carried out. In Kolkata, sewage fed wastewater is taken into the East Kolkata Wetlands (EKW) where shallow ponds with sunlight produce phytoplankton through a process of photosynthesis. This provides fish food, generates oxygen and produces fish for sale. Waste water, sludge and natural compost produce good quality of vegetables. A biotic environment is thus created. Rainwater harvesting is another ancient system in Asia. Its revival has great potentiality. In addition to the decentralised waste water recycling projects rain water harvesting project for impoverished communities has been taken up as a part of the voluntary activities of the group.

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METHODOLOGIES:

a. URBAN WASTE WATER RECYCLING (generation of wealth through waste) : Process and application

In south west Kolkata. At the end of 1961, a group of fishermen formed a cooperative society, in the name of Mudiali fishermen cooperative society Ltd (MFCS) (Fig.1) and took lease of a derelict and marshy land of 70 ha from Kolkata Port Trust. The effluent waste water is 70% from industry and 30% from domestic sources. There are 9 ponds including a nursery pond (Fig.2). The first ponds are used for settlement and lime is used to remove oil and grease, water hyacinth is used to remove dirt and metal particles (Fig.3). Water then flows to subsequent tanks through a narrow passage where quality of water is improved. The primary ponds are aerobic tank. The water flows into the secondary tanks which are breeding tanks. And finally the water flows through a drain towards the river far away. The method is indigenous. MFCS has made a community sustainable by treating waste water as wealth with the main business of selling out the fish produced, peripheral business, & welfare activities of and for members. As a result of developing this waste water treatment area as a nature park, the MFCS has received many awards while newspaper articles and video films have been made on it. School children are often around for gaining scientific knowledge about environment. It can be deduced that MFCS can be a model for other areas using eco-hydrology as an effective tool in the betterment of environment while generating socio-economic opportunities (Graph.1).

The Mudiali Fishermen's Cooperative Society (MFCS) model had been studied in detail and a way forward was suggested in the city & city's fringe areas performing as waste recycling and food producing districts. Similar such communities in and around Kolkata are being identified, as potential for such an exercise where waste-polluted ground water is to converted to an aqua culture zone as a model for waste water recycling, generation of livelihood and contribution to food production(Table. 1). Additionally, the treated water is proposed to be used as potable after primary treatment. USAID guidelines have been included for site selection criteria. Urban agri-aquaculture will be an important element in the urban strategy for West Bengal & for this new land use town planning regulations are to be changed and near guidelines are to be provided. The possibility of introducing a natural waste water recycling system in such areas is now being proposed and investigated as part of an academic project. The process follows the Ramsar guidelines of stakeholder involvement as well as clauses from the National Water Policy of India and is in tune with India's Swachh Bharat Mission and the Millennium Development Goals. Accordingly, one community in rural West Bengal, has been identified in a College level National Service Scheme (NSS) venture as a potential for such as an exercise where waste-polluted ground water will be converted to an aqua culture zone as a model for waste water recycling, generation of livelihood and contribution to food production. The community near Uluberia, Howrah has been surveyed and interviewed and the characteristics are found to be:

- Area : 80,000sq.mt. (20 acres approx)
- Total population : 1700 (approx.) people living in 400 families
- Economic condition : 90% of the families living below poverty level with an average monthly income level of Rs.1000 – 3000
- Source of income : the villagers are mostly occupied in (a) buying and selling animals (b) providing labor in construction (c) carpentry (d) jari (embroidery) work
- Source of potable water: out of 400 families, 15 have their own submersible pump, others use 5 nos. of deep tubewells.
- Condition of Sanitation : only 10-15 families use their private toilets . No presence of sewerage and drainage system in the whole area. Effluent from all these houses go straight to the water bodies adjacent to them. Open defecation is still prevalent.

It is found to be economically weak and dependent on poor ground water resources while being ignorant of sanitation standards. Importantly, the community is socially cohesive and after several rounds of counseling and convincing has become very receptive to idea of waste water recycling. To put in place an effective aqua culture system, USAID guidelines have been followed for site selection criteria. Land use of the area has been studied for location of different parts of the project and a design sequence has been laid out in phases.

Rainwater Harvesting (Bhoroshar Borosha) : Process and Application

With the help of a small grant from Japan Water Forum, a rain water harvesting project was done in Anandapalli, in northeast Kolkata named as 'Bhoroshar Borosha' (The promising rain). With acceptability of people the project was taken up after a series of campaign. The roof over the detached toilet block in the school was selected for placement of storage tank. Rain Water from the 60 sqm. terrace would yield 75000 litres water. annually (Kolkata's average annual rainfall is 1.5m and roof run off coefficient 0.85) which during the monsoon period would give 500-625 litres of water every day. This would meet substantial demand of both drinking water and sanitation. Water from terrace (eliminating dirt with first flush) is carried in 75 mm dia(Fig.4, Fig.5) . pipes to first tank which is to be used for drinking water. A very simple silver cartridge was used to filter the remnants of the debris collected from roof in order to make it drinkable. Overflow from this tank could fill up the next and the rest of interconnected tanks. The project is simple with cost effective system and replicability setting up an example of participatory sustainable development.

Conclusion or Way Forward

The metropolitan area is an agglomeration of several municipalities and water governance is a problem. The Master plan and water infrastructure implementation is slow and in some cases partial. Abundance of water does not guarantee access to water resource and adequate

sanitation. There are pockets of scarcity due to population boom, sporadic urbanization, receding aquifer level, water wastage and a lack of synergies between water, land use and environmental planning. An integrated holistic plan is required for sustainable development which is to include also (a) Recycling of wastewater (b) conservation of water bodies (c) Aquifer recharge, (d) rain water harvesting (e) pollution control (f) water management in the context of environment. Besides urban planning regulation, zoning for protection of water bodies and building regulations are to incorporate rainwater harvesting, recycling of water and other devices. The task of ensuring sustainability through proper use of urban water will be through stakeholder involvement participation and monitoring at all levels. Accordingly, educational and recreational opportunities have been explored in addition to steps envisaged for integrating the decentralized waste water treatment system and the rain water harvesting system in the urban planning process. Replication of the systems in adjacent communities remains the consistent aim of this endeavour.

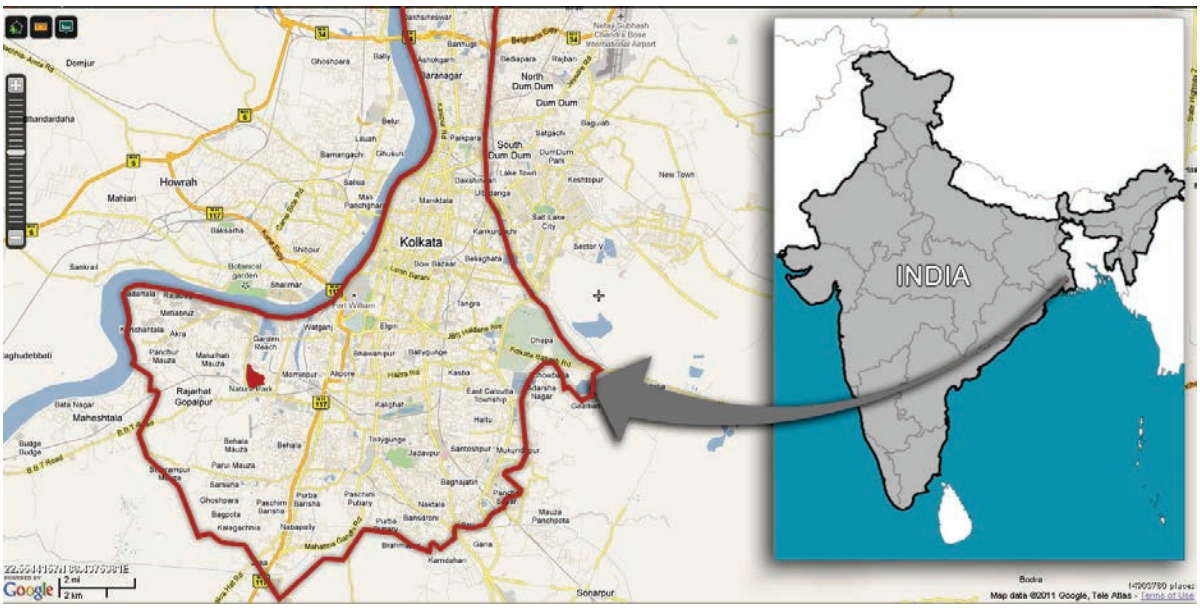


FIGURE 1: Location of Kolkata in India and the MFCS Area with Kolkata

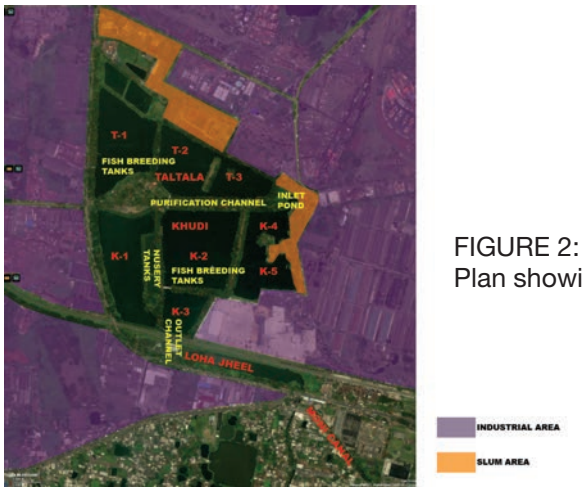


FIGURE 2:
Plan showing Landuse pattern at Mudiali

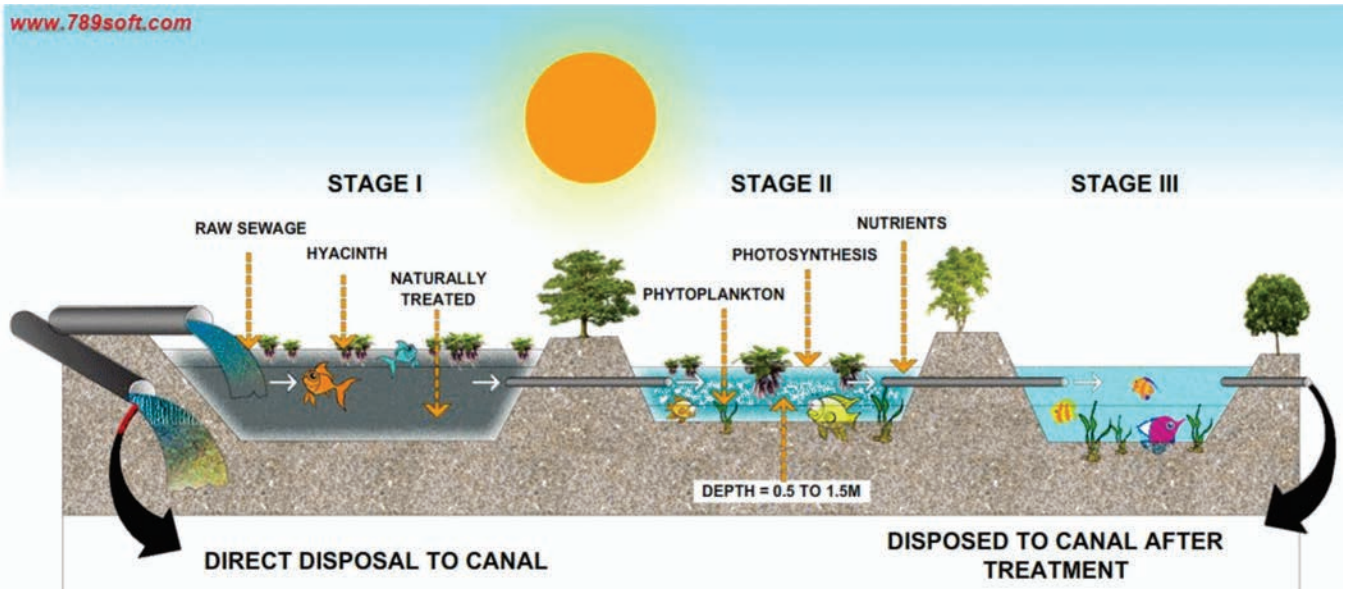
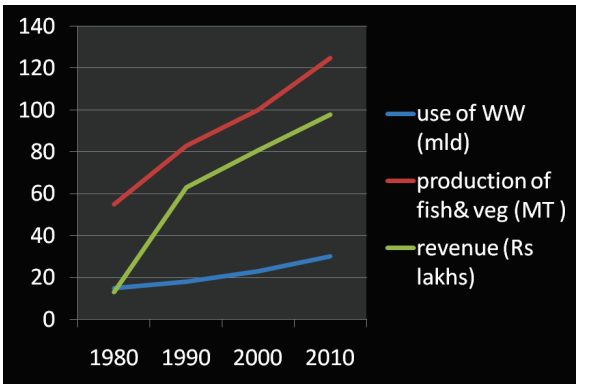


FIGURE 3: Indigenous Process of treating waste water through natural pond system (From Inlet to outlet)

PARAMETERS	INFLUENT	EFF-LUENT
ph	7.83	7.64
TEMPERATURE	27.9°c	27.4°c
BOD	3.5	2.0
COD	21	19
Fe	2.1	0.8
Cu	0.05	0.O4
Cd	0.044	0.042
HARDNESS	168	218
ALKALINITY	60	47
F. COLIFORM	46000	0.91

TABLE 1: Test results of water (Source: MFCS report, 2005) ALL EXCEPT ph AND TEMP IN mg/l



GRAPH 1: Use of waste water, production of food and generation of revenue over time (Source: MFCS report, 2005

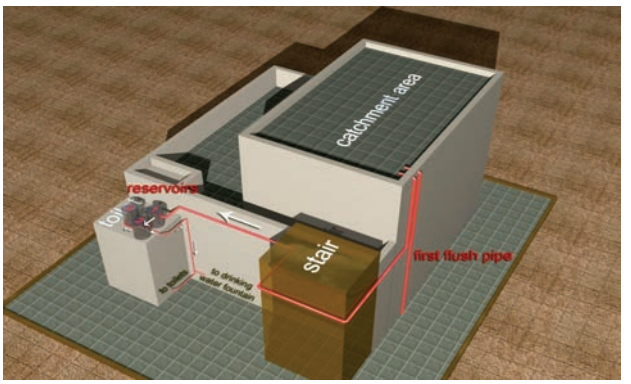


FIGURE 4: Santimoynagar Prathomik Vidyalaya Model Rain Water Harvesting Project

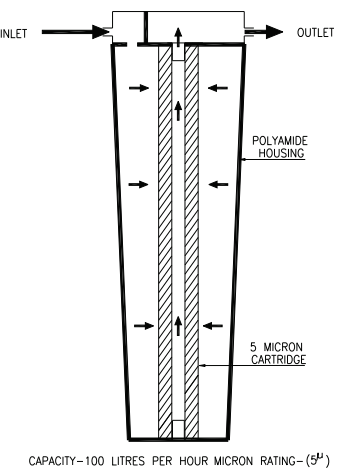


FIGURE 5: Filtration System for Drinking Water

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BUILDING INFORMATION MODELING

Ar. Shailja U Sakharkar[1]

Introduction

There was a time when pencil, paper and complex drawings would be the base of a construction planning. It would be a tiring process with lots of loopholes in it. But things have changed, it is now all about BIM.

It has been part of the construction industry.

BIM= Building Information Modeling

Also known as Virtual Building or Building Simulation.

What is BIM or Building Information Modeling?

BIM is an intelligent, model-based process for planning, designing building, managing buildings and infrastructure.

It connects AEC professional in more efficiently design.

BIM is an umbrella term for the way in which architects now design buildings. The benefits are relevant and useful to all those involved in the design process, from the designers themselves through to clients.

BIM", is a process that can help architecture, engineering and construction firms to increase sustainability in the construction industry. It can allow architects and engineers to integrate and analyse environmental issues in their design over the life cycle of the building.



Figure 1. The façade of the Shanghai Tower necessitated the use of BIM.

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* Building Information Modeling (BIM)) is the process of generating and managing building data during its life cycle. BIM uses three-dimensional, real-time, dynamic building modelling software to increase productivity in building design and construction.

* To create a BIM, a modeler uses intelligent objects (Families) to build the model.

BIM is an acronym for Building Information Modeling. It is a highly collaborative process that allows multiple stakeholders and AEC (architecture, engineering, construction) professionals to collaborate on the planning, design, and construction of a building within one 3D model. It can also span into the operation and management of buildings using data that owners have access to. This data allows owners and stakeholders to make decisions based on pertinent information derived from the model— even after the building is constructed.

The BIM Concept

Drawings, building views, visualizations, calculations and quantity take-offs are automatically derived from the 3D model.

Working Concept BIM

- Single file concept: The complete building model and all of its representations are included in the BIM file
- Real architectural elements used for modeling
- Changes of the model affect all related drawings (and vice versa)
- Automatic generation and updating of documentation
- Architectural content (libraries)
- Building information data attached to the elements
- Additional materials (rendering, animation, quantity take-offs, schedules)



Figure 2. Before construction, Gensler and the Shanghai Tower team used BIM to model the structure to perform analyses and to preview the final product.

Objectives of Building Information Modeling (BIM)

BIM is not just for architects.

"BIM is for everyone."

It can be used for just about anything in the built environment, including:

- Architecture and building design
- Civil and structural engineering
- Energy and utilities
- Highway and road engineering
- Landscape and land surveying
- Offshore and marine architecture
- Rail and metro transportation engineering
- Tunnelling and subway architecture
- Urban master-planning and smart city design

How can BIM help?

BIM brings together all the information about every component of a building, in one place. BIM makes it possible for anyone to access that information for any purpose, e.g. to integrate different aspects of the design more effectively. In this way, the risk of mistakes or discrepancies is reduced, and abortive costs minimized.

BIM prevents errors creeping in at the various stages of development/construction.

Benefits of BIM

*** Compared to 2D and 3D CAD :**

- Elements have architectural meaning.
- Changes on one drawing have influence on all others.
- Rich visualization content (animation, sun studies, rendering etc.)
- Automatic quantity take-offs, schedules.
- Connection to structural, energy calculation, collision detection etc. software.

*** Drawing representation**

- Floor plan, section and elevation views

- Adjustable contours, fills, backgrounds
- Scale sensitivity

*** Model representation**

- 3D shapes connected to drawing elements
- Surface color and texture
- Non-graphical information
- Quantities, volumes
- Cost
- Values specific to certain elements
  (e.g. lux values of lights, fire resistance of doors)

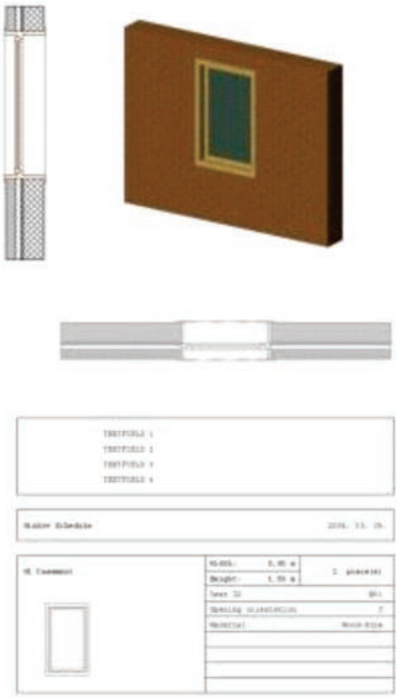


Figure 3. Material descriptions

Relevance and importance of building information modeling skills in the present-day profession

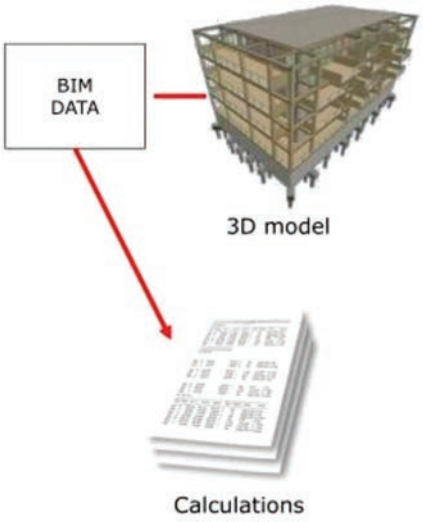
Estimation-BIM

*** Additional information attached to the model**

- Quantity
- Materials
- Descriptions: Product details, Construction details, Safety details
- Cost

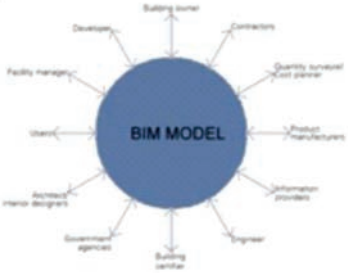
*** Instant Calculation**

- Quantity take-offs
- Room Inventories
- Door-Window Schedules



The BIM data can be shared with the project stakeholders via :

* IFC (Industry Foundation Classes)
* DXF-DWG (Autocad Drawing)
* PDF (Portable Document Format)
* XML (Extensible Markup Languag
* Other native CAD file formats.



igure 4.External Collaboration – BIM

Analysis, coordination-BIM

Further processing the BIM data allows a wide range of analytical activities :

* Code checking (collision detection)

* Energy efficiency analysis

* Structural analysis

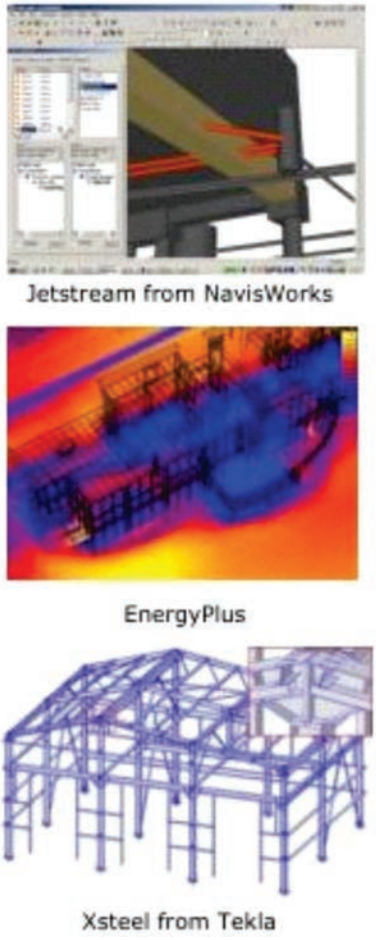


Figure 6. BIM analysis

TRENDS: Construction Coordination

Construction industry is moving towards automated solutions. Adding time and cost information to the 3D model results the virtual construction model.

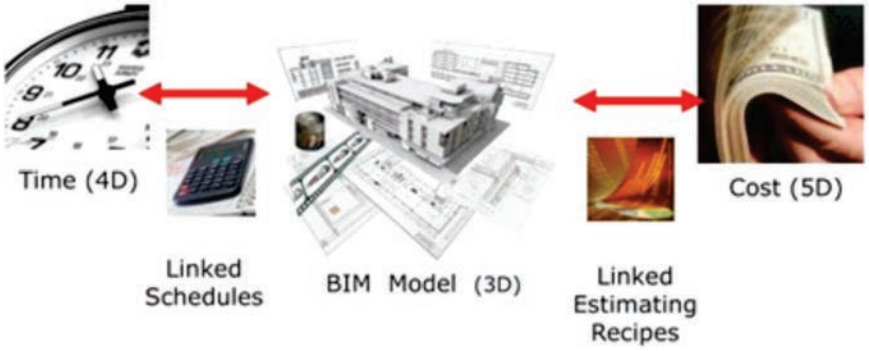


Figure 7. BIM TRENDS : Construction Coordination

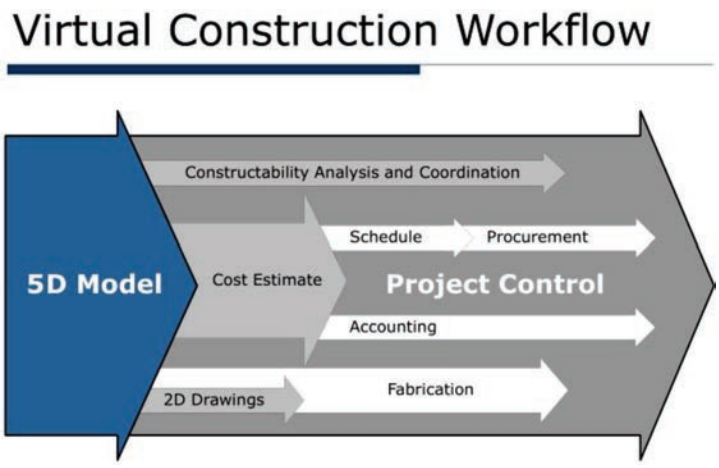


Figure 8. BIM VirtualConstruction Workflow

Softwares : According to the NBS National BIM Report 2017, the most popular drawing tools are:

- Autodesk Revit (Architecture/Structure/MEP)
- Graphisoft ArchiCAD

- Autodesk AutoCAD
- Autodesk AutoCAD LT
- NemetscheckVectorworks
- Other
- Bentley Microstation
- Trimble Sketchup (formerly Google Sketchup)
- Bentley AECOsim Building Designer
- Nemetscheckallplan

BIM - Benefits for architects

- **Speed**

From silk to tracing paper to computers, the process of designing and delivering buildings has become more advanced, and much faster. BIM has given architects the capacity to deliver projects in massively reduced timescales.



Figure 9. BIM Speed

In 2D, when you draw a line in plan, you draw a line in plan. In BIM, when you draw a line in plan, you also draw a 3D element such as a wall, which automatically creates part of your section, part of your elevation, and a basis for construction details.

- **Retention of the design**

BIM has ability to review a 3D model reduces this time down significantly and gives the Concept Architect reassurance that the design is being interpreted correctly.



Figure 10. BIM Retention of the Design

- **Communicating the design**

BIM software offers several new ways to communicate the design. It can be as technical or as interactive as you need it to be



Figure 11. BIM Communicating the Design

Therefore, to have different presentation options available within the software helps to speed up client understanding of the design and give much more reassurance

A fully co-ordinated design



Figure 12. BIM Co-ordinated Design

BIM is a great way to work collaboratively with the entire design team. It allows to check that the design is fully co-ordinated in a way that traditional methods could never have allowed for. This

reduces error, which makes the process run much more smoothly as well as protecting the initial concept.

Reduction of error

If there are 8,000 doors within a design, traditionally we would have to check that each door is covered on the schedule.

With BIM, if on the plan, we need not check that it is on the schedule.



Figure 13. BIM reduction of error



Figure 14. BIM - spatial awareness

Providing spatial awareness

BIM can quickly and easily provide an in-depth understanding of the space being designed.

The detail

Details in BIM are created in 2D, which is like the traditional methods. However, BIM works with a 3D model, allowing 3D to produce the detailing, making the process very efficient. BIM allows for great collaboration and protection of the design in detailing.

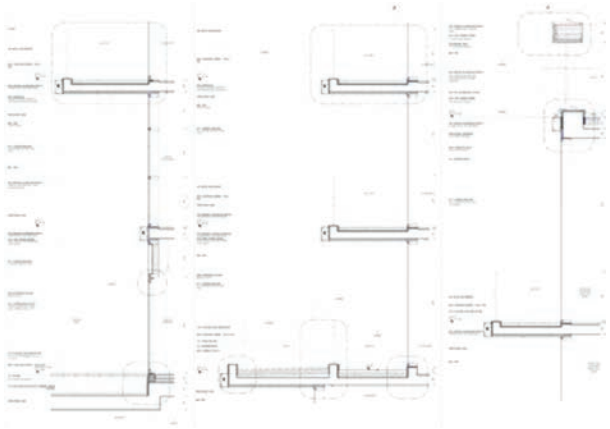


Figure 15. BIM - Detail

Results :

* Improved quality of the construction drawings.

* Reduced time to prepare the initial drawings and final construction drawings.

* Quantities and shared properties of materials are easily extracted for cost estimating.

* BIM software helps to deliver projects with improved quality and efficiency.

Conclusion

Current BIM software is used by individuals, businesses and government agencies who plan, design, construct, operate and maintain diverse physical infrastructures, such as water, refuse, electricity, gas, communication utilities, roads, railways, bridges, ports and tunnels.

BIM can help with the design process in being able to provide a much more considered design, from aesthetics, material selection, to access and maintenance and construction phasing.

BIM will allow projects to be produced with increased efficiency, which for owners, will increase feasibility

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ANALYSIS OF EXTERNAL SHADING DEVICES IN OFFICE BUILDING AT CONCEPTUAL DESIGN STAGE

Abhishek Gwaskoti[1]

Abstract

World is in demand of energy efficient office buildings. Passive solar architecture utilizes building elements to shade building envelope which plays a significant role in optimizing energy needs of a building. Building Information Modeling (BIM) Tool and energy simulation tools have facilitated visualization, interaction and documentation of a buildings performance. In this study, case of office building proposed in Gwalior, Madhya Pradesh at conceptual design stage is taken, different variation of external shading devices are modeled with Autodesk Revit, solar analysis is simulated using Autodesk Insight. The result obtained shows although louvers, fins and egg crate perform well in reducing solar gain, their judicious use is required to control building cost.

Keywords: Passive Solar Architecture, External Shading Devices, BIM, Conceptual Building Design, Solar Analysis, Energy efficiency.

Introduction

With every passing day, the need for energy efficient buildings is increasing as they requires 40 to 60% less amount of energy than conventionally designed buildings . Mutual shading on building envelope and elements like external shading devices play vital role in lowering the solar radiation, thus reduces heat gains in building interiors (Freewan, 2011; Saboor, 2016) and ultimately lowers the energy requirements by HVAC systems . The advent of Building Information Modeling (BIM) and energy simulation tools has facilitated in decision making to improve energy performance of a building with better accuracy (Azhar, 2011; Pathan, 2019).

Since 1990's building energy simulation has been incorporated in professional practices (Hong, 2000) while introduction of energy conservation guidelines & national rating system for green buildings in 2000's gave boost to simulation practices in India. Study on existing designs to compare effect of variation in building forms has been done previously (Daniel, 2010; Freewan, 2011; Esquivias, 2016). The objective of this paper is to utilize BIM and simulation tool to find relative effectiveness of external shading devices in an office building at early stage of design.

Passive Shading Techniques

Passive shading technique includes mutual shading by building forms or neighboring buildings, vegetation features and external shading devices. To shade a buildings envelope there are three basic types of external shading devices (Figure 1.1):

a) Horizontal devices

b) Vertical devices

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c) Egg-crate devices

Horizontal devices are like canopies, generally known as louvers & are usually project out at lintel levels. Vertical devices consist of projecting fins in a vertical position. “Low depth & close spaced” fins may give same shadow effect as provided by “Deep & wide spaced” fins. Egg-crate devices are combinations of horizontal and vertical.

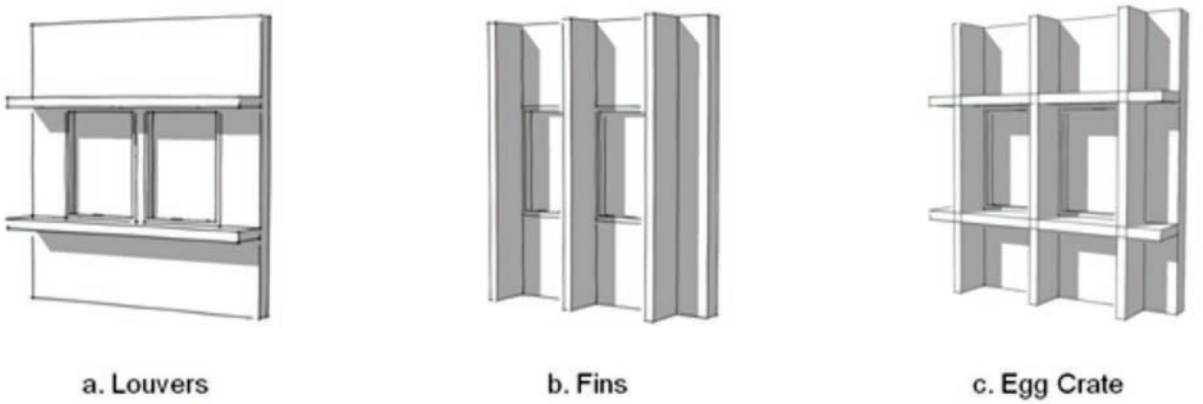


Figure1: Different type of External Shading Devices (Koenigsberger, 1974)

BIM Solution: Autodesk Revit

Revit is a Building Information Modeling Tool which has capability of detailed 3D modeling & specifying characteristics of building elements like walls, roofs, windows, floor, building location etc. It also supports conceptual massing feature which facilitates modeling and analyzing different variation of a building during conceptual design stage. With integration of Structural design and MEP design along with Architectural design in a single tool, it allows efficient modeling for energy simulation and therefore is very popular in AEC industry.

Autodesk Insight

Autodesk Insight is a tool for enhancing the environmental performance and energy requirement of a building by facilitating visualization, interaction and documentation of building performance. On specifying a date, time, and range, it helps one to understand how much solar radiation will strike a given surface. The simulation results are provided in terms of solar radiation accumulated on a surface (kWh/sqm) which are validated with NREL provided test values.

It is to be noted that incident solar radiation is not dependent upon characteristics of the material as it measures only the amount of sun striking the surface under consideration. In addition, the above calculation done by software does not take building reflected radiation into account, due to absence of spectral information about external surface of the building.

Methodology

In order to study the effect of external shading devices, the following three-level research framework was executed (Figure 2.1):

Level 1: 3 D Modeling - Based on data collected from project documents, client and design team correspondences etc. a conceptual BIM 3D model is produced using Autodesk Revit. Different variations of shading devices shall be modeled as per literature study.

Level 2: Solar energy analysis – Orientation of building as per site, specification of study time and surface for simulation are provided to solar analysis tool of Autodesk Insight which is a plug-in to Autodesk Revit.

Level 3: Last step involves documenting and comparing result provided by simulation to access the effectiveness of external shading devices.



Figure 2.1:Research Framework for Study of External Shading Devices

Case Study: Office Design

For carrying out the developed framework in conceptual design, case of office building for EPFO at Gwalior, Madhya Pradesh, India was taken. Gwalior receives around 4-4.5 kWh/m2 of solar radiation (Figure 2.2) and goes through intense heating in summers as seen in Table 2.1. Thus providing external shading feature becomes an excellent way to prevent unwanted solar gain into the building.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temperature (°C)	15.4	18.2	24.4	30.3	35.1	35.3	30.2	28.6	28.4	25.7	20.1	16.1
Min. Temperature (°C)	7.6	10	16	22.2	27.8	30	26.5	25.3	24.3	18.2	10.8	7.4
Max. Temperature (°C)	23.2	26.5	32.9	38.4	42.4	40.7	34	31.9	32.5	33.2	29.5	24.8

Table 2.1 Temperature Data of Gwalior (Climate Gwalior, 2019)

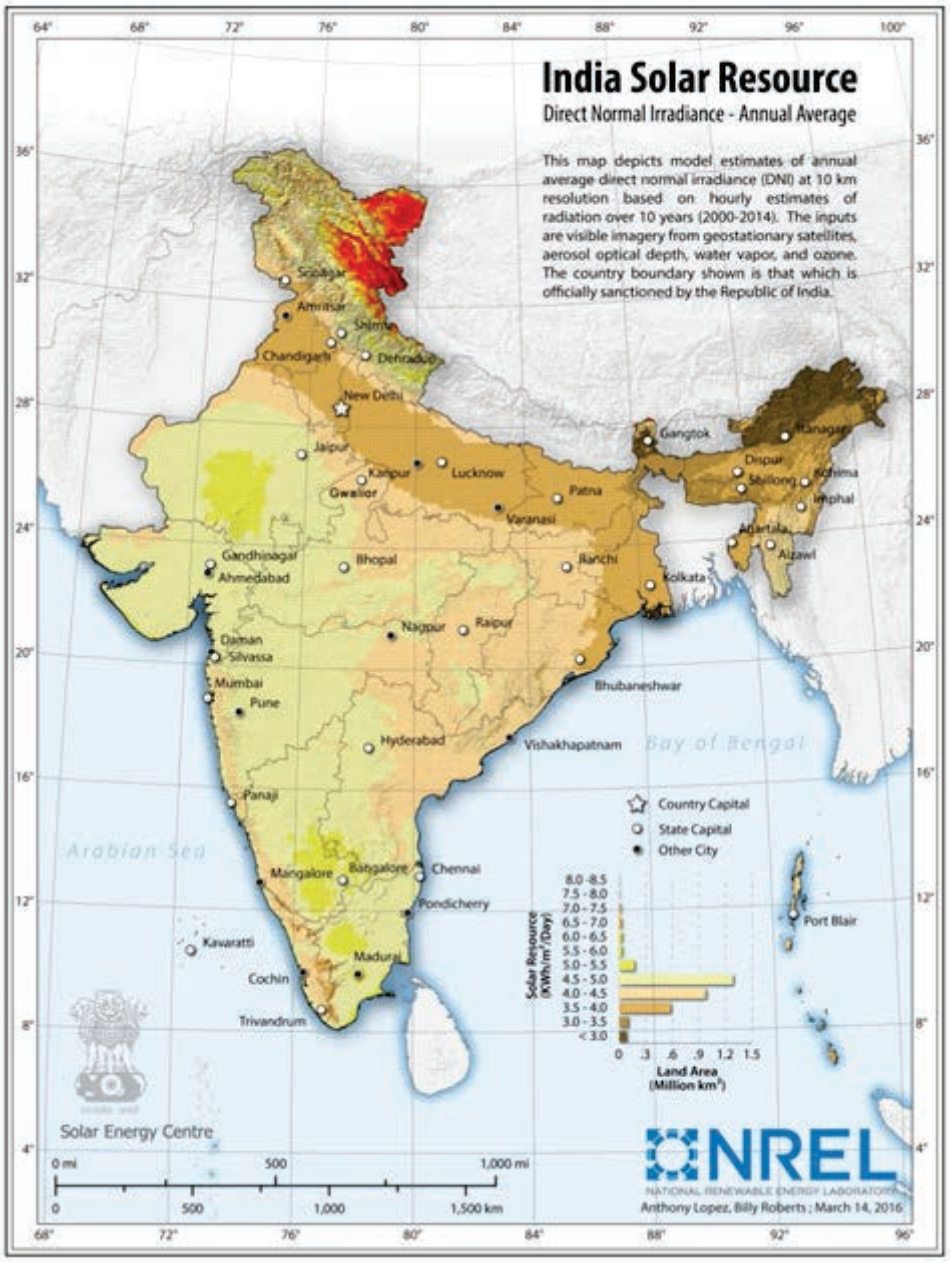


Figure2.2: Solar Resource Map of India (NREL, 2018)

The envelope design of the building was constrained by the following factors:

a) The back portion of site was to be kept reserved for residential quarters and thus building couldn't be elongated much towards back side.

b) Specific room allocation on specific floors as per client requirement restricted vertical play of floor space.

c) Slim shape of plot made underground parking unfeasible. Thus combination of stilt parking with open parking was only solution left.

d) Mandatory marginal open spaces further reduced buildable area on plot.

Under the above constraints a building envelope was developed in Autodesk REVIT 2016, as shown in Figure 2.3.

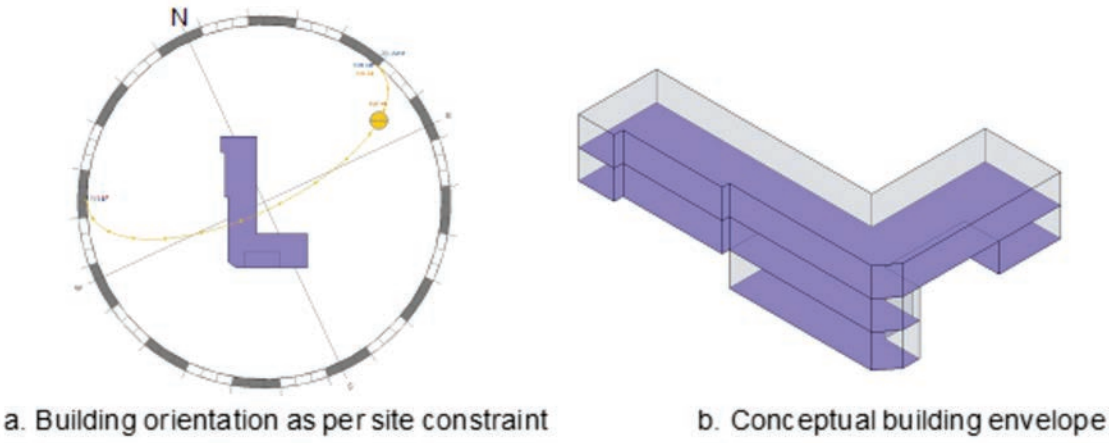


Figure2.3: Conceptual Design of Office Building for EPFO at Gwalior, MP

Simulation Models

Although a number of combinations of vertical and horizontal projections are possible, in this study following five variations (Figure 2.4) were made to for simulating solar radiation:

1. Baseline: This model without any projections is used as a reference model for all other model variations having projections.
2. Louvers: To arrive at a louver depth, 5 previous projects executed by CPWD in same city was studied and use of 600 mm deep louvers was recorded. Following the same pattern, this study takes the case of 600 mm wide horizontal blades projected at each Lintel level and Floor level around the building envelope. Both of these levels were selected considering concrete casting activity during project execution. The effect of louver depth in positive and negative increments in size shall be studied in future works.
3. Fins: In this model 600 mm wide vertical blades are projected out and spaced at approximately at 1200 mm (taking into consideration commonly used 1200 wide window size recommended for AC/Cooler around the building envelope.
4. Egg Crate: In this model, both the features explained in 2 & 3 are used. 600 mm wide horizontal blades are projected at each Floor level and Lintel level along with 600 mm wide vertical blades projected out and spaced at approximately at 1200 mm around the building envelope.
5. Boxing: In this model, a variation in model 4 above was experimented. Set of Louvers are enclosed from outside and alternate fins are enclosed from outside, thus creating a recessed feature in envelope.

Simulation Settings

Each model was then simulated in Autodesk Insight, with following parameters:

a. Surface: All Mass Faces.

b. Sun Settings: Sunrise to Sunset of Summer Solstice (21st June, 2019), since this day has maximum number of sun hours available.

c. Location: Gwalior, Madhya Pradesh, India.

d. Solar Study: Cumulative Insolation.

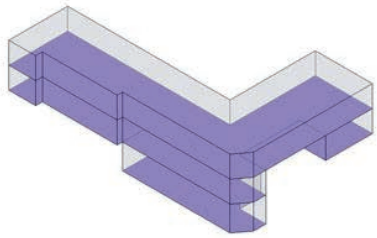
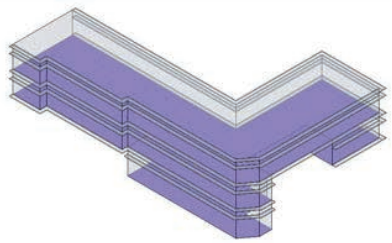
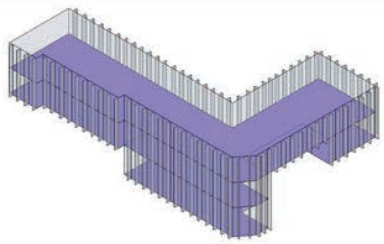
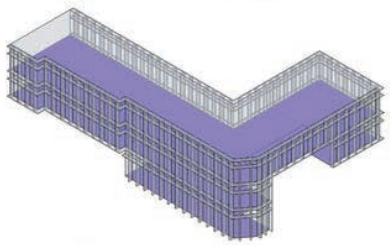
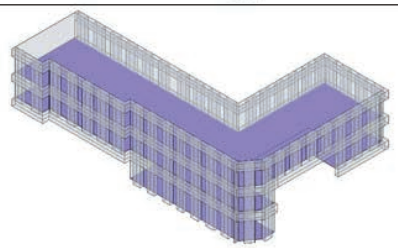
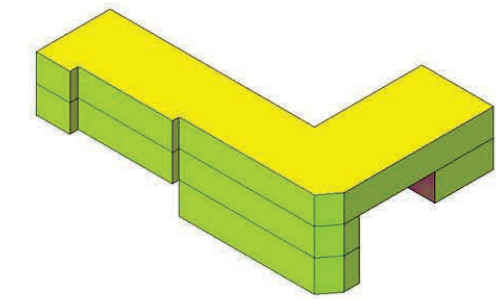
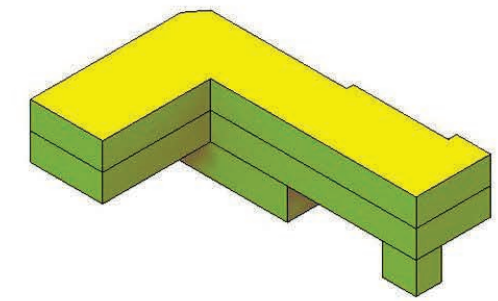
No.	3D View	External Feature	Description
1.		Baseline	This model stands as reference model for all other model variations having no horizontal or vertical projects from building envelope.
2.		Louvers	This variation consist of 600 mm wide horizontal projections at each Floor level and Lintel level.
3.		Fins	This variation consist of 600 mm wide vertical projections at spaced approximately at 1200 mm along the building envelope.
4.		Egg Crate	This variation is a combination of both models described in No. 2 & 3 above.
5.		Boxing	This variation is modified version of model no. 4 above. Louvers are enclosed from outside and alternate fins are enclosed from outside.

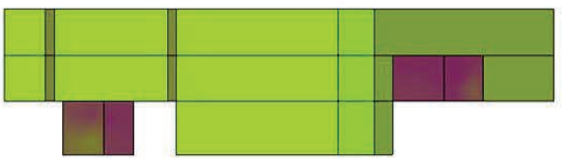
Figure 2.4 Models with Different External Features



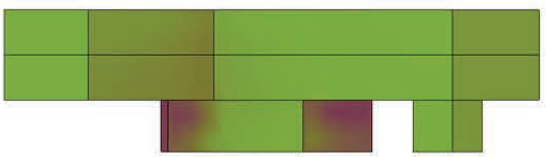
South West View (Front)



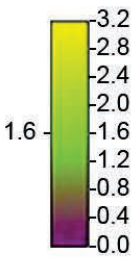
North East View (Back)



South West Elevation (Front)



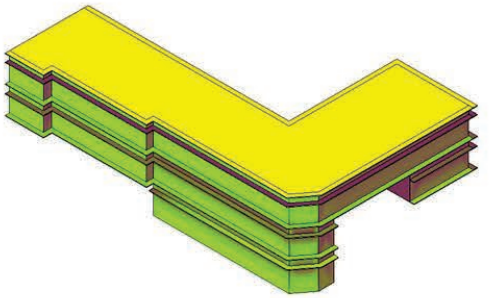
North East Elevation (Back)



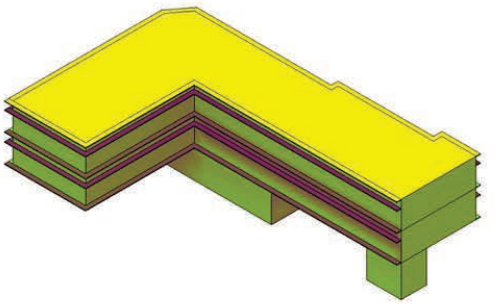
Cumulative Insolation (kWh/m²)

Project location : 474001, India
Sun study start date time: 21-Jun-19 5:26:00 AM
Sun study end date time: 21-Jun-19 7:11:00 PM

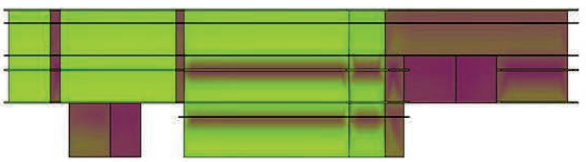
Figure 2.5 Solar Analysis of Baseline Model



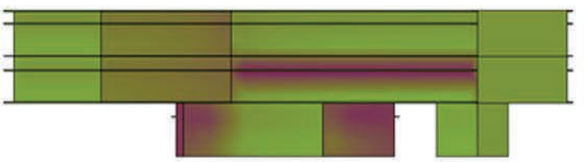
South West View (Front)



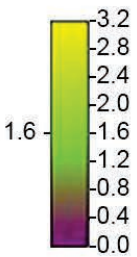
North East View (Back)



South West Elevation (Front)



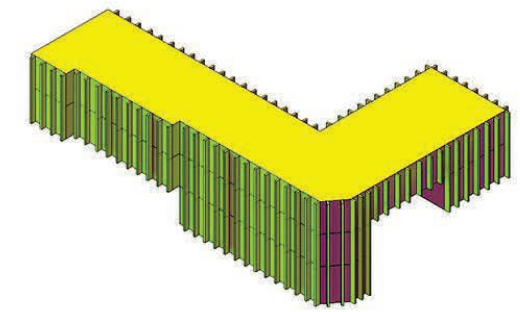
North East Elevation (Back)



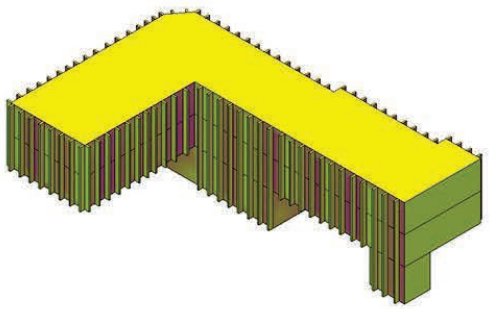
Cumulative Insolation (kWh/m²)

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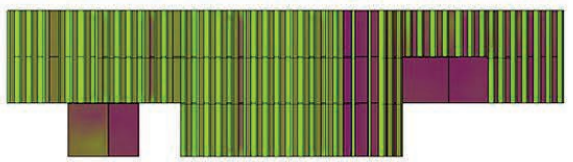
Figure 2.6 Solar Analysis of Model with Louvers



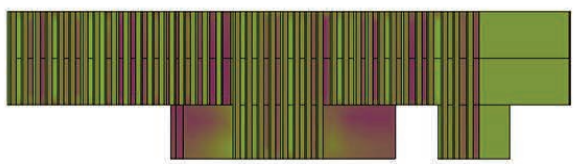
South West View (Front)



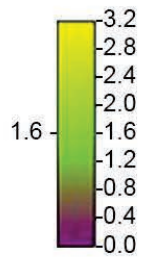
North East View (Back)



South West Elevation (Front)



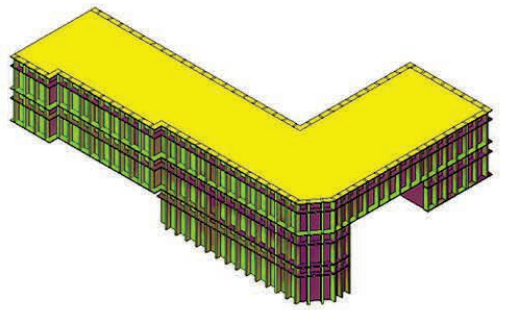
North East Elevation (Back)



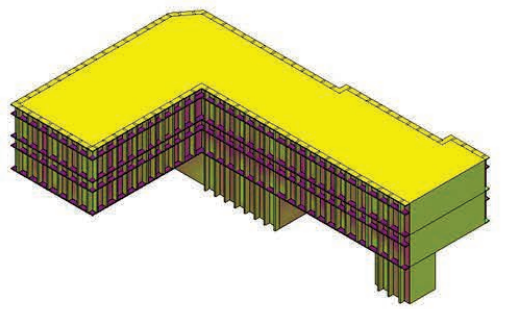
Cumulative Insolation (kWh/m^2)

Project location : 474001, India
Sun study start date time: 21-Jun-19 5:26:00 AM
Sun study end date time: 21-Jun-19 7:11:00 PM

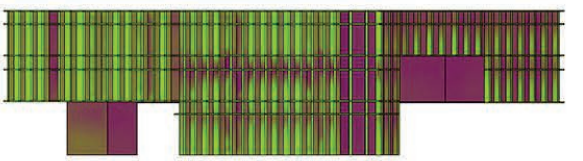
Figure 2.7 Solar Analysis of Model with Fins



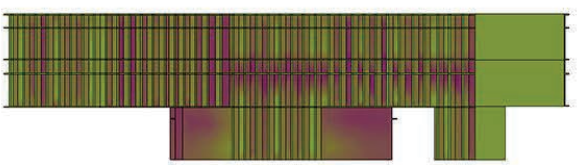
South West View (Front)



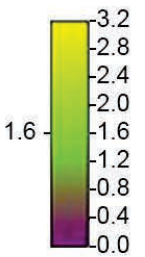
North East View (Back)



South West Elevation (Front)



North East Elevation (Back)



Cumulative Insolation (kWh/m^2)

Project location : 474001, India
Sun study start date time: 21-Jun-19 5:26:00 AM
Sun study end date time: 21-Jun-19 7:11:00 PM

Figure 2.8 Solar Analysis of Model with Egg Crate

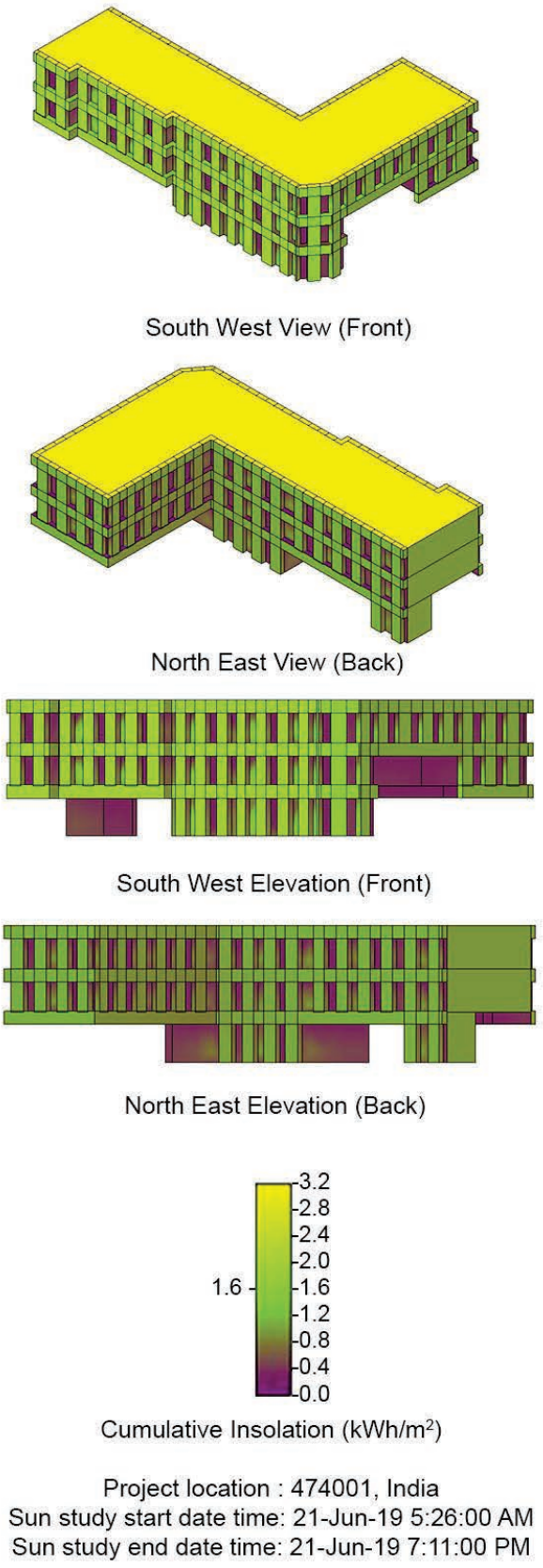


Figure 2.9 Solar Analysis of Model with Boxing

Results & Discussion

Simulated images of South-West and North-East face of all 5 models are shown in Figure 2.5 – Figure 2.9. The simulation data is compiled and shown in Table 3.1. The average insolation value decreases drastically when external shading devices were applied. Among the four projections, Boxing performed best in reducing the average insolation value followed by Egg Crate, Fins and then Louvers.

While providing each type of projection, the surface area of envelope also increased. Figure 3.1 compares percentage change in average insolation value and percentage change in surface area of envelope in reference to baseline model. Studying the graph reveals that the surface area increased & isolation value reduced by 35.17 % & 28.3 % in case of Louvers; 52.52 % & 32.49 % in case of Fins; 87.69 % & 38 % in case of Egg Crate; while 120.05 % & 39.34 % in case of Boxing. Since, increase in surface area means increase in cost of building; this comparison establishes the need of using the external shading devices judiciously. For example, Boxing feature can be adopted for façade which is seen from entrance/road (South-West) while other façade shall be limited to louvers for providing shade yet limit building cost.

No.	External Device Feature	Insolation Study Type	Study Average Insolation Value (kWh/m^2)	Total Study Surface Area (m^2)	Total Study Insolation Value (kWh/m^2)	Study Date Range	Study Time Range	Longitude	Latitude
1	Baseline	Cumulative	1.4	2412.61	3388.66	21-Jun-19,21-Jun-19	Sunrise,Sunset	78.1642	26.1735
2	Louvers	Cumulative	1.01	3261.16	3284.43	21-Jun-19,21-Jun-19	Sunrise,Sunset	78.1642	26.1735
3	Fins	Cumulative	0.95	3679.64	3489.12	21-Jun-19,21-Jun-19	Sunrise,Sunset	78.1642	26.1735
4	Egg Crate	Cumulative	0.87	4528.19	3943.08	21-Jun-19,21-Jun-19	Sunrise,Sunset	78.1642	26.1735
5	Boxing	Cumulative	0.85	5308.93	4523.24	21-Jun-19,21-Jun-19	Sunrise,Sunset	78.1642	26.1735

Table 3.1 Details of Solar Analysis of Different External Features

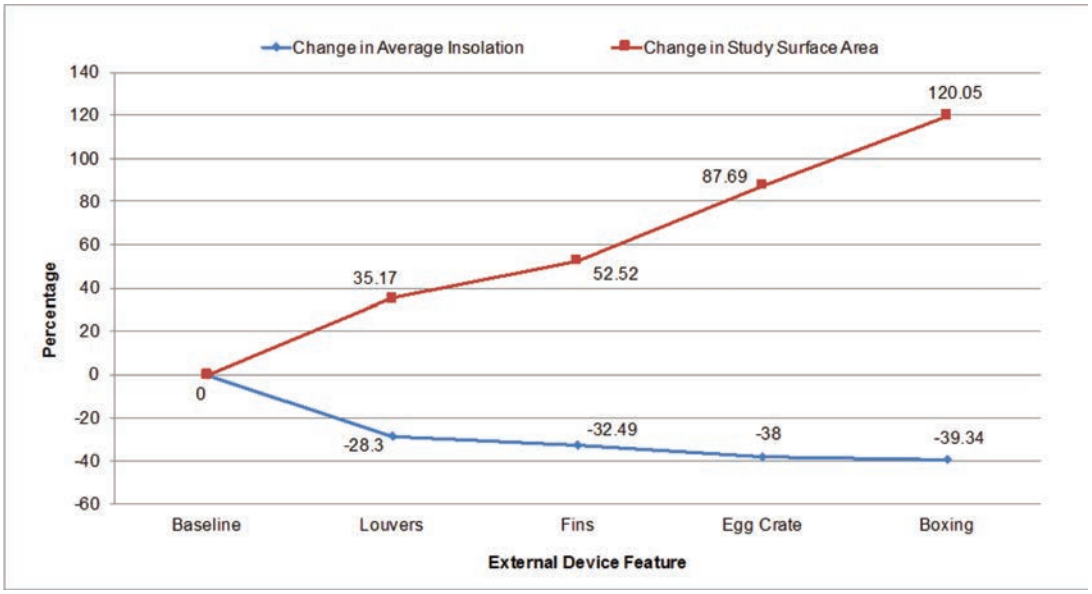


Table 3.1 Comparison of Different External Features w.r.t. to Area and Insolation values

Conclusions

In this work, a study of passive solar design achieved with external shading elements using BIM tools (Autodesk Revit & Autodesk Insight) was done successfully. The tools provided insight upon effects of different shading devices on building envelope which were helpful in decision making at conceptual design stage.

On the basis of achieved results, the proposed methodology can be concluded to be promising for saving time and aiding in conceptual design. However the trade-off between different elements lies with the designer based on aesthetic, structural, bye-laws, site conditions and other relevant factors depending upon the project. Further studies can be done by increasing/decreasing sizes of shading elements and by incorporating HVAC and lighting details, the operational cost of building can be calculated.

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EFFECT OF VEGETATED FACADES ON THE THERMAL BEHAVIOUR OF BUILDINGS

Irfan Haider Khan[1]

Abstract

Greening of spaces help bring down the ambient temperature is a known practice, however the quantification of this effect is a relatively new research interest. Research suggests that greening of facades and roofs help in mitigating the urban heat island effect. It also acts as a tool to enhance the thermal performance of the building envelope, and improve the energy efficiency of buildings. This paper is based on literature review of works by various authors, which quantify the effect of vegetated facades in different climatic contexts. The paper is intended to draw inferences from the existing literature that can be used to conduct similar studies in the Indian context. The theoretical model based study for Mumbai is taken up to build a case to adopt green facades in buildings to improve their performance. The study suggests that there is a huge scope for the application of vegetated facades in the Indian context, as it can help bring down the cooling load and increase energy efficiency in buildings.

Keywords: Vegetated Facades; Thermal Performance; Green Walls; Energy Efficiency

Introduction

Vegetated facades cover a broader area that deals with the greening of vertical surfaces in the buildings. They are known by different names: Green facades, Living walls, Vertical gardens, etc., differentiated mainly on the basis of the growth media (planted on horizontal surfaces or planted directly on walls) or the structural support of the vegetation (supported by walls directly or an external support systems). The research shows that there is a significant reduction in the surface and air temperature around the green facades, particularly in hot climates. The reduced indoor temperatures help in reducing the cooling loads and energy consumptions of conditioned buildings specifically. India however has seen very limited acceptance to the concept of vegetated facades; green walls are used either as 'feature' walls in inhabited spaces of buildings or they are used in small scale projects for aesthetic purposes.

The literature reviewed for this paper suggest that the reduction in temperatures and air velocities near vegetated surfaces is a function of a number of factors – solar radiation, orientation, species of vegetation and density of vegetation among several others (Alexandri & Jones, 2008). The prediction of the thermal behaviour of green facades therefore becomes rather challenging, as the contributing factors listed above further complicate the task. Since each climatic zone has a unique characteristics of vegetation and the micro-climate of different areas further affect these characteristics, therefore, the thermal performance of vegetated facades cannot be generalized for all the climate types, and each case has to be looked separately. Indian cities have witnessed

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the construction of buildings that are not relevant to the climate type, and hence end up consuming a lot more energy than required. India is the fourth largest energy consumer in the world (Berardi, 2015), out of which 35% energy is consumed by buildings alone (Yu, et al., 2014), with its variety of climate types and zonal characteristics, therefore, makes a very interesting case to study the impact of greening the vertical surfaces on the energy consumptions and the occupants' comfort. As per the Koppen climate classification, India has six different climatic zones (Wikipedia, 2015)], and therefore the effect of performance of vegetated facades on the indoor environment would exhibit a large variation. The recent researches on urban climate (UHI) has brought the positive impact of vegetated roofs and walls in focus, and the need of studying their impact on the urban environment has thus become more crucial.

Thermal Impact of Vegetated Facades

Vegetated facades act as thermal buffer and shading tool, which in turn affect the thermal performance of the building envelope. The main characteristic of the vegetated façade is its insulation properties that blocks the passage of heat through the surfaces and bring down the temperatures. The reflective and absorptive properties of the vegetation are the major contributing factors; the plants use the sunlight for evapotranspiration and with an increased rate, it brings down the temperatures significantly. Moreover, studies also suggest through experiments and simulations conducted for buildings in temperate and Mediterranean regions that the air trapped within the vegetation (stagnant air) serves as an additional insulation layer. The stagnant air layer combined with the insulating properties of vegetated walls help in retarding the heat transfer rate between the internal and external surfaces. The insulating properties of vegetated surfaces can be increased by covering a larger portion of vertical surface with vegetation, which helps in preventing summer heat to enter inside the building and by preventing heat loss from inside during the cold winters (Ottelé, et al., 2011). Another study suggest that the reduction in surface temperatures is more in double skin facades as compared to direct green walls. This may be due to the air gap, which acts as an additional insulation (Cameron, et al., 2014).

Effect of Aspect

Data from various sources suggest that the thermal performance of vegetated facades is a function of the wall aspect (orientation). The work by Susorova, based on experimental studies relate the thermal impact of vegetated facades with the building aspect (orientation), and suggests that the reduction in air and surface temperatures is a function of the amount of solar radiation any surface receives, depending upon the orientation of these surfaces. In case of conditioned buildings in cold climate of Chicago, the most significant results in surface temperature reduction were observed on the East and West facades. This is attributed to the higher intensity of solar radiation and lower angle of sun in early morning and late evening hours. The average reduction of 10% in heat flux was measured in the studies. However, the south wall

showed a negative impact, indicating the increase in heat flux (I. Susorova, 2014). Another research carried out in humid continental climate of Beijing suggests that vegetating the West façade with thick ivy results in an approximate reduction of 28% in the peak cooling load of the building (Di & Wang, 1999). The studies reflect that the surface that receives the maximum solar radiation behaves more efficiently and the temperature reduction in these cases is more significant.

Effect of Vegetation Characteristics

The cooling capacity of a green wall is also dependent on the plant species, along with the type of growth media. The cooling potential of a vegetated wall is not a function of plant species alone, but for each species, it will also vary with the type of system employed (Cameron, et al., 2014). Leaf Area Index (LAI) is defined as the area of the leaf surface per unit ground surface area. For vegetated facades, LAI gives the amount of surface area covered by the vegetation, which in turn, will determine the thermal capacity of the green facades. Various studies have suggested that the thermal properties of the vegetation itself viz. growing media, plant species, planting depth, height, density of vegetation and leaf area index (LAI) influence the performance of green facades in altering the energy consumptions. The study also suggested that the cooling capacity vary as per the plants selection, and moreover different species cool down the surfaces with different mechanisms, which is again a function of leaf area, LAI, moisture content and evapotranspiration capacity (Haggag, et al., 2014). The study done by Stav and Lawson reflect that an average savings of 25% cooling energy can be achieved using the green facades. LAI determines the amount of surface covered by vegetation; the higher the LAI, the more will be the savings. However, an interesting outcome of the study was that LAI<2 resulted in increased energy consumption rather than savings (Stav & Lawson, 2012). A study done at Illinois Institute of Technology, Chicago suggested that with an increase in LAI, there is a significant reduction in the transmissivity (Fig. 1) and heat flux (Fig. 2), while the thermal resistance (Fig. 2) increases linearly. (Susorova, 2011)

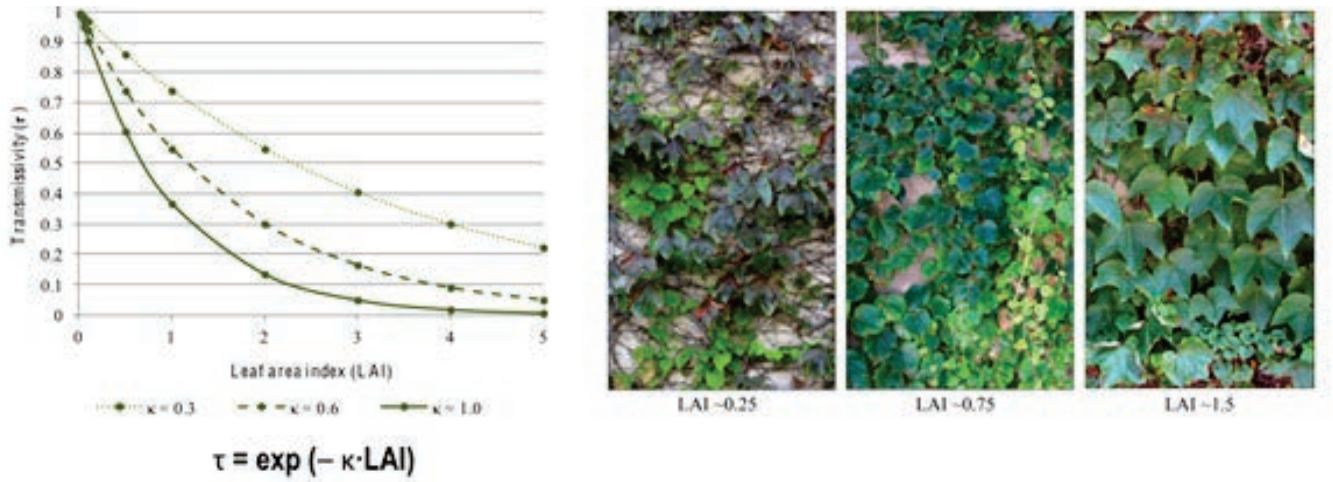


Fig. 1: Variation of transmissivity with LAI
(Source: http://built-envi.com/wp-content/uploads/2013/06/vegwall_lai.png)

Thermal Behaviour of Vegetated Facades

A study conducted in Mediterranean climate, showed temperature reduction of up to 10.8 ˚C, attributed to vegetated walls (Eumorfopoulou & Kontoleon, 2009). Another study by Alexandri and Jones reported air temperature reduction of 4.5 ˚C in Mediterranean climates. The same study showed temperature reductions of up to 2.6 ˚C for temperate regions. The simulation based studies suggest that cities in humid climates benefit the most from vegetated surfaces, and temperature reductions can be as high as 12 ˚C (Riyadh) and can result in energy savings of up to 100% in certain cases. Moreover it was reported that the impact of vegetated surfaces is even more pronounced when the surfaces receive higher solar radiation. This is attributed to the fact that the impact of green facades is more dependent on the characteristics of the vegetation itself, rather than the physical parameters (Alexandri & Jones, 2008). Another research suggested that vegetated facades have the potential to cool down the external wall surface temperature by up to 21˚C and internal wall temperature by up to 8˚C, in warm humid climates.

The studies mainly rely on the surface temperatures of external and internal walls, in comparison with non-vegetated wall surfaces to quantify the cooling capacity of green facades. All the studies conducted to study the impact of vegetated facades, necessarily study this reduction in temperatures, which is often seen as the determinant of the thermal performance of these green surfaces.

Vegetated Facades – Indian Context

The building industry in India has seen a rapid growth over the last few decades; however, there is still a reluctance to adopt the vertical greening measures by the Indian market, despite its enhanced environmental benefits. This may be due to the lack of verifiable data to establish the relevance of vegetated facades in the Indian context. Very limited work has been done by Indian authors, and there are very few documents that talk about the impact of vegetated facades in the Indian context. Only one of the works reviewed for this paper documented the thermal performance of green facades in Mumbai, India (Alexandri, 2005). However, since it is a simulation based theoretical study, and is not validated by real-time experiments, the exact behaviour of these vegetated facades is yet unknown.

The studies conducted for the climate of Mumbai, India shows that the application of green facades in buildings of Mumbai help in reducing the temperatures by about 2.7 – 4.4 °C. The study also suggested that if the roofs and walls are both vegetated, there can be up to 72% of cooling energy savings, while in case of the applications of green walls alone, the reduction can be up to 35%. Fig. 3 shows the air temperature decrease (%) inside the canyon for the green-all and green-walls cases, for the different canyon geometries examined for Mumbai. Fig. 4 shows a comparison of air temperature decrease (%) 1m above the roof (Tf[gr a]) for green-roofs and green-all cases with the air temperature decrease inside the canyon for the green-walls and

green-all cases, for the H5W10 canyon, Mumbai. Fig. 5 shows the average cooling load decrease (%), with a 23 ˚C indoors temperature, for the green-walls and the green-all cases for Mumbai as examined (Alexandri, 2005).

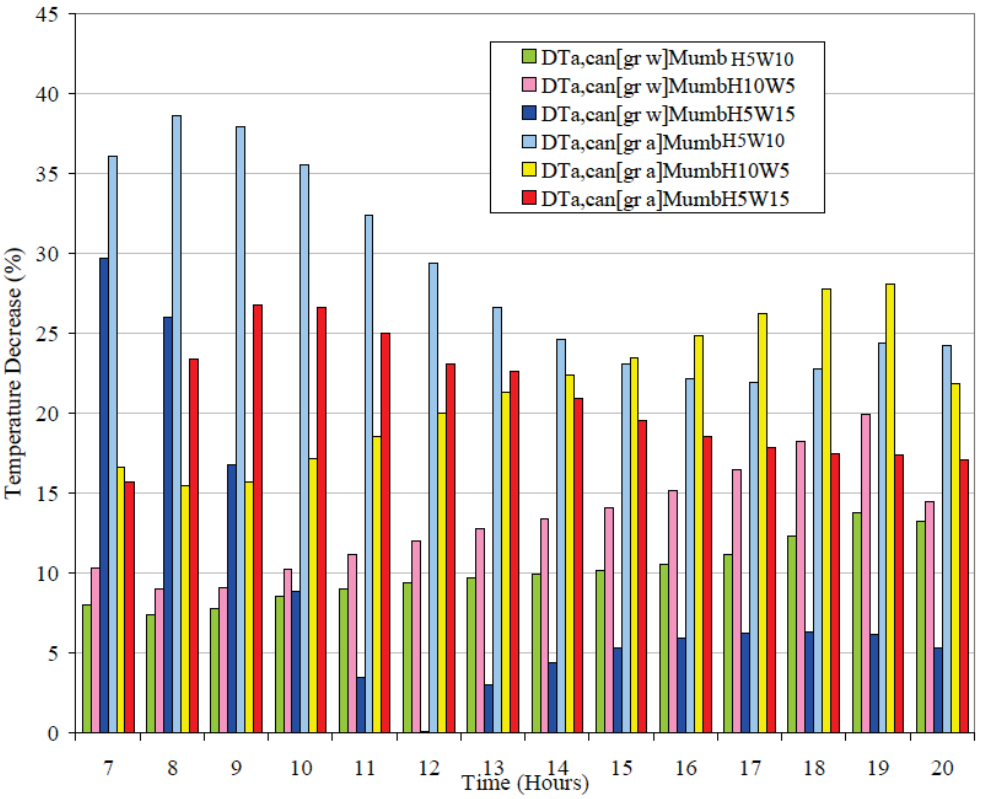


Fig. 3: Air temperature decrease (%) inside the canyon for the green-all and green-walls cases, for the different canyon geometries examined for Mumbai

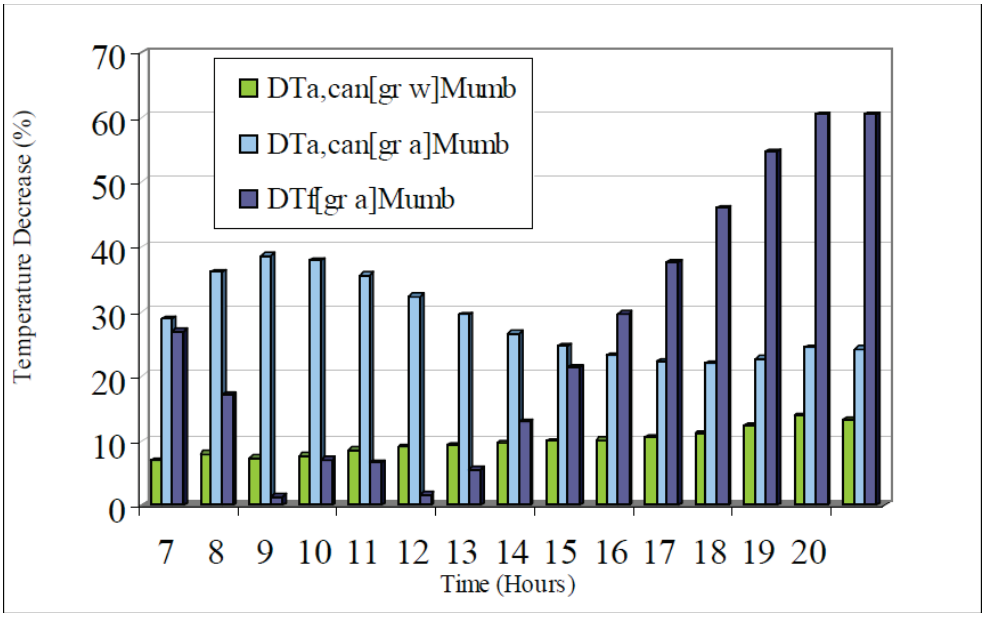


Fig. 4: Comparison of air temperature decrease (%) 1m above the roof (Tf[gr a]) for green-roofs and green-all cases with the air temperature decrease inside the canyon for the green-walls and green-all cases, for the H5W10 canyon, Mumbai

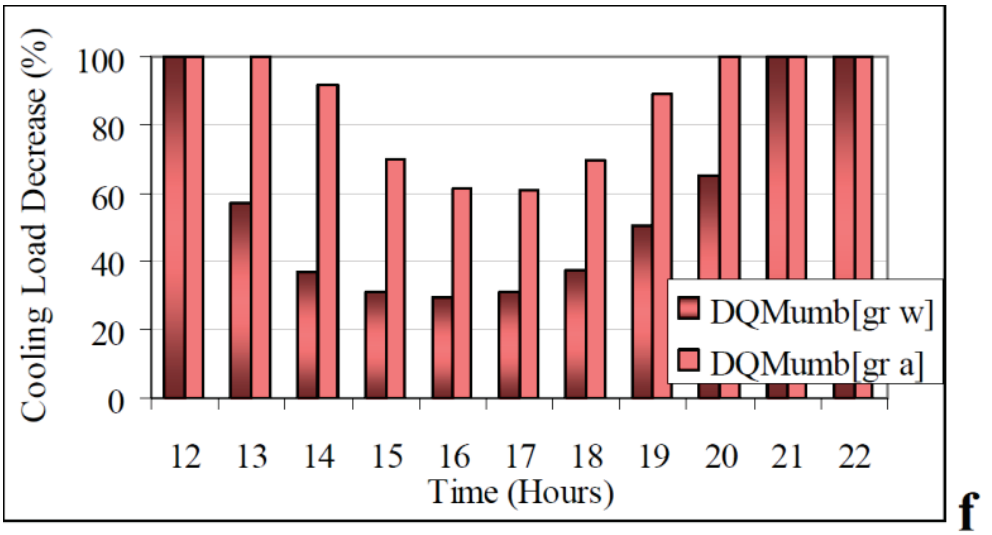


Fig. 5: Average cooling load decreases (%), with a 23 ˚C indoors temperature, for the green-walls and the green-all cases for Mumbai

If the data collected, as shown in Fig. 4 and Fig. 5, is to be quantified to measure the energy savings, it can be a useful information to progress in the field of vegetated facades. On an average, an office building in temperate region of India (Mumbai) consume 18.55 kWh/ft2/yr. (Source: Bureau of Energy efficiency), while a residential building consumes about 15-30 kWh/ft2/yr. Since office and residential buildings eat up the maximum energy, the impact of vegetated facades on these buildings will be an interesting case to see. As per the research, green walls can save up to 35% of energy for buildings in Mumbai. This means that the energy consumption by office and residential buildings (based on typical consumption) can be brought down to 12 kWh/ft2/yr. and 9.75 – 19.5 kWh/ft2/yr., respectively. That means per square feet of area, an energy reduction of about 6.55 kWh for offices, and 5.25 – 10.5 kWh for residences annually can be achieved..

	Average annual energy consumption in normal case (kWh/ft^2)	**Annual energy consumption in case of green walls (kWh/ft^2)**	**Annual energy savings (kWh/ft^2)**
Office Buildings	18.55	12	6.55
Residences	15-30	9.75 – 19.5	5.25 – 10.5

TABLE 1: Energy savings for a typical office and residential building (Based on data from BEE)

Conclusion

The literature reviewed for the purpose of this paper shows that vegetated facades significantly enhance the thermal performance of the building envelope, and can be used to reduce the energy consumption by conditioned buildings. The theoretical model used to quantify the energy savings by the employment of vegetated facades in the buildings for the region of Mumbai suggest that there can be an energy savings of up to 30% annually, which can bring down the working costs significantly. The reluctance in the Indian market to employ green facades is however primarily due to the limited body of work in the design and development field of vegetated facades, which presents a serious challenge, as there are very few works that rely on site measurements and real-time experiments. Moreover, the existing studies based on simulations or experiments lack the ability to be replicated as they consider only selected number of parameters to study the thermal behaviour of green facades, and often overlook the ecological characteristics of vegetation itself. There is an urgent need to integrate the experimental studies with simulation based studies, to achieve more realistic results. In combination with simulating standalone vegetated facades, it is advisable to include other parameters of building such as the various thermal zones, anthropogenic heat generation, internal heat gains (function of the occupants), etc. Another important issue at present is the need to incorporate the horticulture, soil sciences, botany and geological sciences along with the building sciences to better understand the behaviour of these green facades. The existing studies have given sufficient evidences to support the hypothesis that the use of vegetated facades help in improving the building performance. The application of these facades however, should not be seen as mere a corrective measure to enhance the performance in a poor design. The more appropriate approach would be to treat vegetated facades as a design element, and must be integrated within the building planning and design.

Acknowledgements

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URBAN PLANNING OF INDIAN CITIES WITH FLOOD RESILIENCE APPROACH

Kamal Prasad Singh[1]

Abstract

India is a vast country with a land mass area of 3.28 million square km with the total length of the coastline 7,516.6 km. The country is prone to many natural as well manmade disasters. According to the statistics, 12% of India's land is prone to floods alone. It is reported that in year 2017 about 15.6 million people are affected by flood causing huge displacement of population settlements, large numbers of deaths and epidemics. About 34% of Indian population lives in urban area. When proposing urban redevelopment and renewal schemes, the responsibility of city planner have to ensure citizens are not placed at risk, an emergency management focus is particularly necessary when urban renewal and redevelopment is being considered in flood prone cities. Considering the above scenario, this paper proposes incorporation of integrated flood defences system in Urban Planning for renewal and redevelopment of present cities as well as newly developing Smart City in the line of "Tokyo Metropolitan Area Outer Underground Discharge Channel". Adopting this flood defences system in cities in Tokyo line, the normal life and working of the people can be maintained without flooding or water-lodgings hindrances.

Keywords: cities, people, floods, urban planning, redevelopment, Tokyo.

Introduction

Annually good amount of money is spending on the preparedness of monsoon flood protection and mitigation work. For want of jobs and better opportunity there is migration of good numbers of people from rural area to urban area which is resulting in overcrowding of cities. The flood protection infrastructures of city were designed to support number of people based on old data and prediction, as a result the the flood drainage structure is not able to support the present population of the city due to change in the land use and ecosystem for supporting the settlements of increasing population in the city without any scientific approach. In year 2005 Mumbai received a rainfall of 944 mm (a 100-year high), in a span of 24 hours as a result at least 1,000 people lost their lives and 14,000 homes were destroyed, the city had to bear a direct loss of about 5.5 billion. In year 2015, Chennai flood more than 188 people reported dead more than 200,000 people displaced. It has been reported that the main cause of such flood are reduction in carrying capacity of the water bodies, illegal construction and encroachment, illegal dumping of waste in drainage, etc.

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Urban Planning

Urban planning is a technical and political process concerned with the development and design of land use and the built environment, including air, water, and the infrastructure passing into and out of urban areas, such as transportation, communications, and distribution networks.

Key Factors in Urban Planning

- Planners must pay attention to the area's environment.
- City planners need to consider city residents.
- Plans should be forward-thinking.
- Areas in need of renewal need special consideration.
- Urban planners need the right tools at their disposal to do their jobs.

Planners must pay attention to the area's environment: While adding a new space to an urban area, paying attention to the region's environment is necessary. This consists of three essential categories: Physical environment, Social environment & Economic environment.

City planners need to consider city residents: This field takes into account the goals of a particular region. When urban spaces began flourishing in the 19th and early 20th centuries, architects and city officials were more concerned about the aesthetic design of the city then the people it affected. Later on, many cities opted to build highways/ expressways etc. in place of historic buildings, which were often demolished or displaced despite public outcry.

Plans should be forward thinking: An urban planning official monitors population trends to determine the space needed for future constructions. If the population is going up and a developer wants to build apartment buildings, they may need to build high rises rather than smaller two-story buildings to accommodate future growth. Similarly, increases in tourism would call for additional hotels and events venues. Planners know that the population might increase, it could be in five years or 20 years.

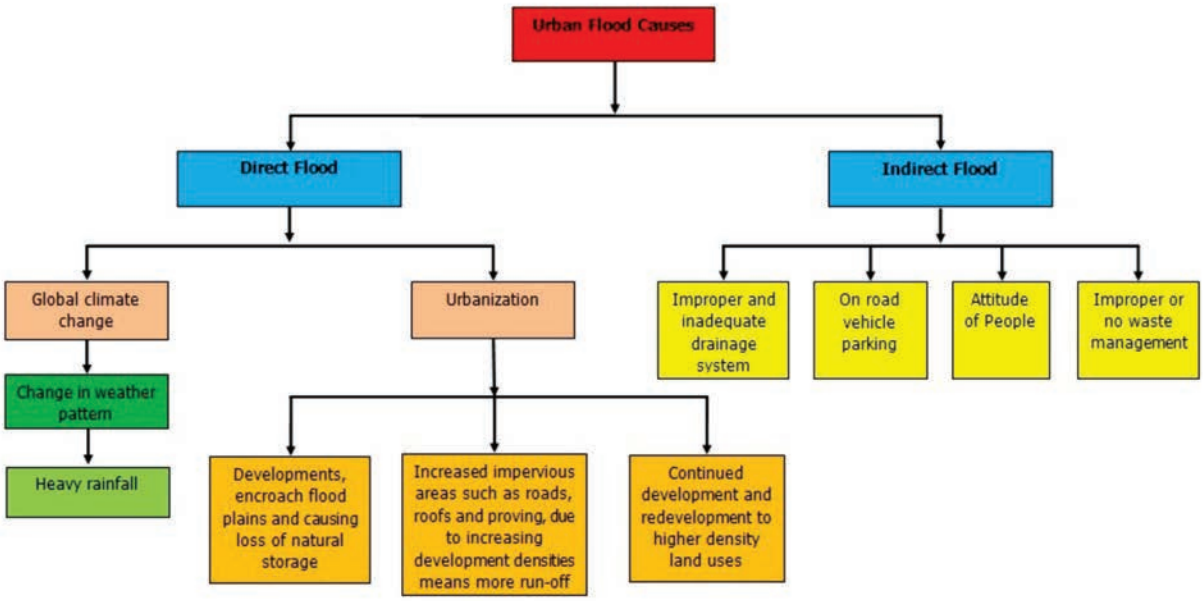
Areas in need of renewal need special consideration: This can involve either renovating existing structuring or demolishing them to make way for new buildings. Urban planners especially need to keep in mind the history of the area's buildings. Although a building may be in disrepair, it could be a historic site or landmark. City residents may want to preserve the area in favor of building a new strip mall etc. In the event of a natural disaster, urban planning professionals may play a role in recovery and mitigation efforts. These include

rebuilding roads, updating building codes, etc.

Urban planners need the right tools at their disposal to do their jobs: Planners and other officials often employ a number of GIS solutions that include high-resolution aerial imagery for planning and mapping. High-resolution oblique aerial imagery enables users to view, analyze, and measure objects seen in imagery. Three-dimensional models use the most up-to-date imagery and can be delivered in a variety of 3D file formats.

Causes of Urban Flooding

Important direct and indirect factors responsible for Urban are shown in Figure - 1.



Proposed Flood Resilience Approach

Many large cities of India like Mumbai, Kolkata, Chennai, New Delhi, Patna, etc. are heavily flooded every year during rainy season and normal life of the people are badly affected. Though these cities have taken many measures in past like construction of flood protection works along the river/channels, construction of drains lifting out flood water with heavy pumps, etc. but in spite of all these efforts we are not able to manage the flooding in the cities. As experiences from past our present tools of flood management within the cities are not effective and results in very poor response time towards relief and recovery of affected areas. Many original rivers passing through these cities are lost due to developments and are not effective in routing out the flood water out of the city, lifting out of flood water with heavy pump will not work if proper flood protection considering back water flow is not done. To cope with the present situation some integrated, adoptable and experienced Flood Resilience Approach is needed. Hence Flood Resilience Approach in the line of Tokyo flood resilience Approach i.e. **Tokyo Metropolitan Area Outer Underground**

Discharge Channel can be best adopted as it is already protecting Tokyo from heavy flood from many years.

Tokyo flood resilience Approach has considered the following Comprehensive Flood Control Measures aspects:

- Measures planned along the rivers
  - The embankment will be improved
  - Discharge channels will be constructed
  - Drainage pump station will be constructed
- Measures planned for the drainage basins
  - Unnecessary earth filling will be avoided
  - Measures will be developed to have rainwater soak into the ground
  - Facilities for storing rainwater will be built
- Other software-based measures
  - Evacuation places will be located and you will be informed
  - Your cooperation with flood prevention and other activities will be requested
  - Pump operation method will be determined
  - Construction of buildings resistant to flood damage will be promoted

Tokyo Metropolitan Area Outer Underground Discharge Channel

A world-class underground discharge channel has been constructed on the outskirts of Tokyo, the capital of Japan. The tunnel, dug about 50 meters below ground, extends 6.3 km in total. The underground construction, comprising vertical shafts to store floodwater – which look more like gigantic tanks supported by towering pillars weighing 500 tons each. It was planned as an anti-flood scheme for local residents and completed in 2006. The underground discharge channel, having employed a variety of new technologies, is the very best of state-of-the-art civil engineering technology. The features of Metropolitan Area Outer Underground Discharge Channel are discussed below:

Gigantic Underground Shaft

The discharge channel is a mechanism to drain water from flooded residential areas into five gigantic vertical shafts built below ground and then discharge it into rivers through an underground tunnel connecting the shafts as shown in Figure – 2(a), 2(b) & 2(c). The cylindrical shafts are about 70 meters tall. The large shafts measure about 30 meters in

diameter, spacious enough to park a space shuttle. The connecting tunnel 50 meters below ground measures about 10 meters in diameter. The tunnel stretches for 6.3 km, including a sharp curved line with a minimum radius of 250 meters.

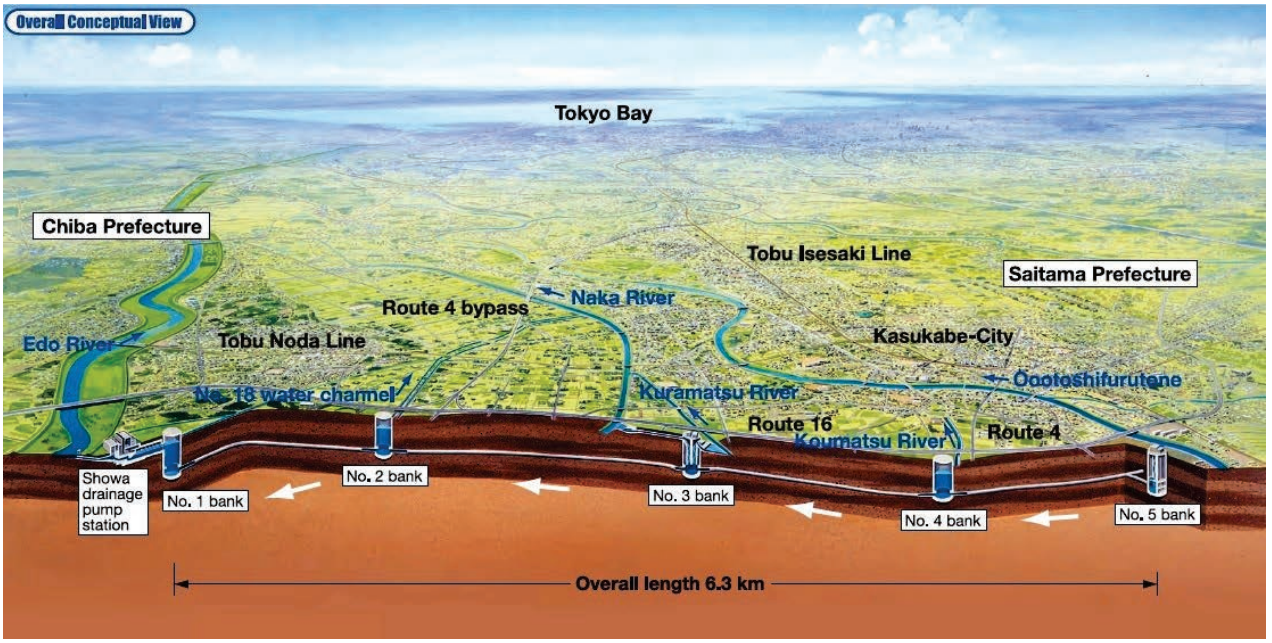


Figure – 2(a): Tokyo Metropolitan Area Outer Underground Discharge Channel

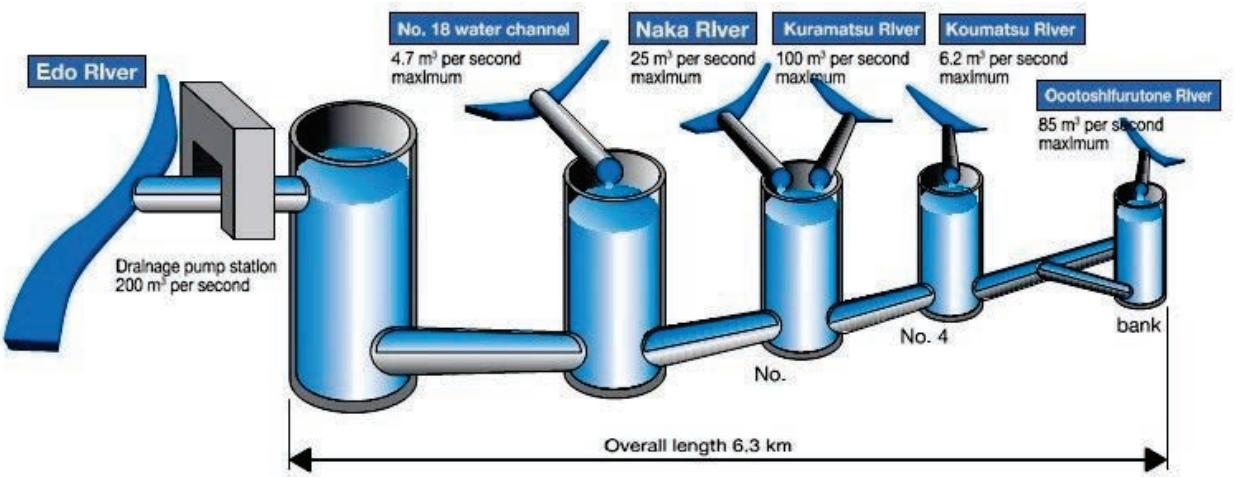


Figure – 2(b): Tokyo Metropolitan Area Outer Underground Discharge Channel

Before being discharged into rivers, the drained water is stored in a huge pressure-controlled tank. The tank is designed to perform multiple functions, including abating the force of running water and adjusting water pressure that could change sharply if a water pump breaks down. Measuring 177 meters long and 78 meters wide, and lying about 22 meters below ground, the water tank is larger than a soccer pitch. The ceiling of the water tank is supported by 59 pillars which are 18 meters tall and weigh 500 tons each as shown in Figure – 2© & 2(d). An inside look at the tank structure conjures up the image of a “temple” below ground

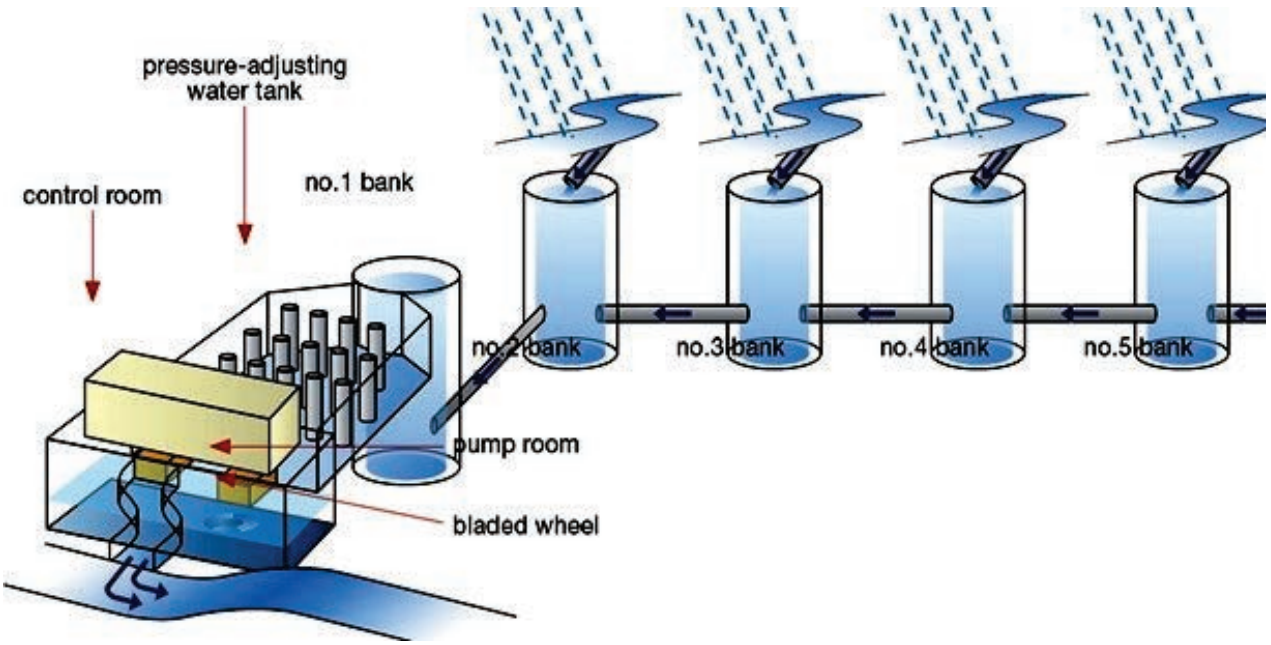


Figure – 2(c): Tokyo Metropolitan Area Outer Underground Discharge Channel



Figure – 2(d): Tokyo Metropolitan Area Outer Underground Discharge Channel - Huge Pressure-Controlled Tank

Developing New Construction Method

The underground tunnel for drainage, dug with a gigantic shield tunnelling machine, employed an improved segment technology. Segments, which are concrete plates, used to be bolted together to form the outer wall of a tunnel. In constructing the underground channel, segments were joined together with a wedge method developed on the principle of wedging instead of bolting. Unlike bolted walls with an uneven surface, joined walls have a smooth surface and are instrumental in greatly reducing construction time.

Rapid & Massive Water Discharge

Flood water stored in the channel can be discharged into rivers at a maximum rate of 200 cubic meters per second. In other words, a 25-meter swimming pool full of water is drained in a second. Under this mechanism, each drainage pump has a high-speed impeller that gives flowing energy to water, discharging it rapidly.

After the underground discharge channel was completed, a torrential rain hit the area in August 2008. The facility was able to discharge into rivers about 12 million cubic meters of water, a record high, or the equivalent of 25,000 25-meter swimming pools.

Conclusion

The urban flooding is attributed to many factors like Global Climatic Change, Improper Planning of Cities, rapid urbanizations, Developments, encroachment in flood plains, improper drainage, attitudes of people, lack of coordination's between Government agencies etc. Many large cities of India are heavily flooded every year during rainy season and normal lives of the people are badly affected. Though these cities have taken many measures in past but in spite of all these efforts we are not able to manage the flooding in the cities. As experiences from past our present tools of flood management within the cities are not effective and results in very poor response time towards relief and recovery. Due to over capacity of the urban areas of the country without any future planning are more prone to the flooding/ water lodgings as can be remember from flood of Mumbai July 2005, Chennai December 2015 etc. It is demand to have some integrated, adoptable and experienced Flood Resilience. In view of above we may adopt Flood Resilience Approach for Indian cities in the line of Tokyo flood resilience Approach i.e. Tokyo Metropolitan Area Outer Underground Discharge Channel which it is already protecting Tokyo from heavy flood from many years.

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HERITAGE CONSERVATION AS A TOOL FOR SUSTAINABLE DEVELOPMENT A CASE STUDY OF DELHI AND RAJNAGAR, INDIA

Nancy[1]

Introduction

The 21st century is the time when the world is undergoing urbanization. Most of the cities in the world as a consequence are facing the pressure of new development and rapid urbanization. India, a developing country is not left aloof.

India is a country with many historic layers and as many historic sites and cities. A city is not a static entity; it is dynamic and ever changing. In the last few decades there has been rapid development, modernization and various redevelopments in our cities due to rapid socio-economic developments. Most of the cities and towns of the country have one or more historic districts. Unconscious and insensitive developments have occurred in these historic precincts. This unplanned and improper urban growth has happened due to zeal of people to have a better and improved urban life but in turn it has tampered the social, cultural and environmental fabric of the cities.

In the last decade the new concept of “sustainability” was coined which has influenced architects, planners, policy makers and other related professionals to think on the same line of “sustainability”. They have started thinking on how to create a balance between development and heritage conservation in the present and upcoming time.

In the discussion we have left behind a very important element untouched: the community and the people. The local community has a sense of inheritance and pride for their built heritage and ancestral inheritance. But they also have the right to incorporate the new developments in their lives and the incorporation of these new developments (in form of infrastructure like electricity, telephone line, A.C. etc.) which tears down the old fabric and historic character of the cities and towns. These urban development's not only affect the historic urban fabric but also destroy the vernacular built environment, cultural values and collective memory of the habitants. Thus, there is need to create a balanced situation were urban development and heritage conservation go hand in hand bringing about sustainable development.

This paper aims to study the theoretical and practical aspects of Heritage conservation and sustain urban regeneration and their roles for sustainable development. The paper is divided into two parts. The first part explains the theoretical aspects of Heritage Conservation and Sustains Urban Regeneration and their relationship with sustainable development. The second part explains the practical aspects of Heritage conservation and sustain urban regeneration and how it can be done to achieved sustainable development. Selecting a case of an Indian city and

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analyzing it on the parameters of heritage conservation, urban regeneration and sustainable development.

Heritage

Heritage refers to something inherited from the past, which can be both tangible or intangible and natural or cultural property such as historical sites, buildings, and the unspoilt natural environment, specific societal tradition and norms.

Natural Heritage, an inheritance of fauna and flora, geology, landscape and landforms and other natural resources.

Cultural Heritage, the legacy of physical artifacts, monument, historic sites and intangible attributes of a group or society: man-made heritage.[1]

World Heritage Convention classifies heritage into two categories:

Cultural heritage: a monument, group of buildings or site of historical, aesthetic, archaeological, scientific, ethnological or anthropological value.

Natural heritage: includes outstanding physical, biological, and geographical features, different kind of plants or animals species and areas with significant scientific or aesthetic value those could be best for conservation (UNESCO, 1972[2]

Heritage Conservation is the process which includes both arts and science through which the tangible and intangible element of heritage can be maintained, protected and preserved for the future as it is an entity which is non-renewable and displays its various values as a major property of culture of the society.

Heritage creates a bridge and link between different generations with their ancestors. Hence heritage is a source of social attachment and sense of belonging.

Sustainable heritage conservation is "an approach to conservation that preserves the best of the heritage but does so without imposing insupportable costs and which affects a rational balance between conservation and change" (Delafons, 1997)[3].

The basic concept of conserving a building is to protect the built and cultural heritage. The built heritage generates economic resources and maintains social capital.

Sustainable Urban Regeneration

Urban regeneration involves measures to revive the decline in urban areas. The decline can be in form of physical, social or economic factors that define the urban fabric. Thus the main aim of regeneration process is revitalization of the urban space and fabric. Over time the need of involvement of concept of sustainability was felt in Urban Regeneration.

[1]http://en.wikipedia.org/wiki/Heritage | [2]http://whc.unesco.org/en/conventiontext/
[3]Delafons, J. (1997) 'Sustainable conservation', Built Environment vol. 23 no. 2 pp. 111-120.
Critical commentary on UK system and PPG 15 developing into concept of sustainable conservation.

Thus, Sustainable Urban Regeneration is a comprehensive action or process which revives and rejuvenates the urban spaces making it suitable for future generations and resolving the problems related to economic, physical, social and economic conditions of the area.

Comprehensive policies and effective guidelines help to revive the dilapidated urban fabric. A conscious effort and integrated approach of revival of spaces and existing fabric and heritage conservation will help achieve consistent sustainable urban regeneration.

Heritage Conservation, Urban Regeneration in the context of Sustainable Development

World Commission on Environment and Development (WCED) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).This emphasis for a balance and integrated urban growth by utilizing minimum resources for dynamic results of sustainable development[4].

During the preparatory meetings for the URBAN-21 Conference (Berlin, July 2000) the following definition was developed to define sustainable urban development: "Improving the quality of life in a city, including ecological, cultural, political, institutional, social and economic components without leaving a burden on the future generations. A burden which is the result of a reduced natural capital and an excessive local debt. Our aim is that the flow principle that is based on equilibrium of material and energy and also financial input/output plays a crucial role in all future decisions upon the development of urban areas[5]."

Heritage conservation helps us understand the historic, political, social, cultural and associational characteristic of an historic urban area. It helps us better understand the evolution and context of overtime changes in urban fabric. Urban regeneration enhances about spatial, environmental, social, community-based, and economical entity or capital of an urban space.

Sustainability is concerned with people, their environment and changes. Today the scope of study about heritage is not only concern with past but it is about understanding today and future. Heritage management is an ongoing and dynamic process balancing conservation and changes.

A comprehensive approach and policies involving heritage conservation and community as a participatory body for urban renewal and regeneration leads a way forward to sustainable development.

Case study: Historic city of Delhi

The Historic city of Delhi is a kaleidoscope of various culture and vibrant color. It is an "ancient living city". The story of the city of Delhi has a phoenix like characteristic and phenomenal magnetism. Buffeted by monarchic and dynastic changes, the city of Delhi still preserves glimpses of the past memories. The principal cities, whose some of the traces co-exist in the city today, are:-

[4]*World Commission on Environment and Development. 1987. From One Earth to One World: An Overview. Oxford: Oxford University Press.*
[5]*During the preparatory meetings for the URBAN21 Conference (Berlin, July 2000) the following definition was developed to define sustainable urban development.*
[6]*Blake P Stephen, Shahjahanabad: The Sovereign City in Mughal India, 1639-1739,Cambridge University Press.;*

- Indraprastha
- Lal Kot
- Quila Rai Pithora
- Siri
- Tughlakabad
- Firozabad
- Purana Quila
- Shahjahanabad

The ruins in the city tell a tale of the evolution of architectural styles overtime and the synthesis of various cultures and influences.

Although Delhi had been a thriving city for several centuries, the ' first city ' of Delhi dates back to 10th century, gets its recognition due to the availability of recorded historical facts. King Tomar Rajput, Anangpal, created the first city called Lal Kot - which Prithviraj took over and extended for his city Qila Rai Pithora.

Qila Rai Pithora was created by Prithviraj Chauhan, famous for his quest against Muslim invaders. Next city was developed by the Khilji ruler, Allaudin Khilji , the third city of Delhi, Siri.

In the 1320s Ghiasuddin Tughlaq, a Turk governor invaded Delhi. He created the city of Tughlaqabad. He created a fort here, whose splendid ruins still remain. One of the Tughlaq rulers, Firoz Shah Tughlaq created the next city of Delhi , Firozabad next to the river Yamuna. This was a large enclosure of high walls, containing palaces, pillared halls, mosques, a pigeon tower and a water tank.

What is known as the Purana Qila today, was Shergarh, the creation of Sher Shah .The second Mughal king, Humayun also built his capital called Dinpanah.

In the early 17th century, Mughal Emperors, Shah-Jahan, created the fortified city of Shahjahanabad, at the Bank of river Yamuna the seventh city of Delhi-in the area which is now known as Old Delhi. Initially the cities fortification, Red fort and the mosques; (Fatehpuri mosque, Akradabi mosque and Jama Masjid) were built. Latter nobles and elite people started settling down around the Red Fort in the city. They built large Havelies, orchards, gardens and water bodies. Along the major spine of the city, the Chandini Chowk the bazaars and residences of trades came up. Localities around the religious structure started developing next. The city is formed of intricate lanes, kuchaa and katras. Over-time these havelies subdivided to form smaller Havelis, kuchas and katras.The city also face a lot of changes due to colonisation. The study is

done on one such Kucha “Kucha Pati Ram.”

The Kucha Pati Ram was a residential area near the Sita Ram Bazaar. Sita Ram Bazaar has been a thriving market and was earlier called Hyder Quili Khan Street. After the Mutiny of 1857, most of the Muslim residents of the city left the city and sold off their properties to Hindu Merchants. In the latter time the street has also inherited various colonial influences, which is evident in form of some of the havelis which have Indo- Sarsenic character.

After the independence other parts of the city (New Delhi area) developed and the most of the people started moving out. One major change occurred when in 1962 master plan it was identified as a Slum. The Elites in the city felt defamed in living in a slum so moved out and rented out the havelis. Also the incorporation of modern amenities and maintenance of these havelies became difficult. Due to the Rent Control act the rents in the region was very low. Neither the owner nor the tenant was interested in maintenance of the structure and the hevelis further deteriorated. Most of the havelis are now rented in the street[7].

In the present time as other part of the old city, this area has also undergone a lot of commercialization, leading to mixed use. According to master plan 2021, it comes under special area, under zone A, subzone – 13. As a special area it has special guidelines and byelaw for construction and redevelopment and conservation policies. The master plan allows mixed use in the street.

The street has yet a few lavish and old havelies that have yet retained their architectural character. The havelies have central courtyard, stone façade with intricate carvings, decorative balcony, beautiful arches and arched doors and beautiful windows with jharokhaks. Most of the buildings are structurally intact but the elevations have been hampered by intervention of shops and new services like pipe A.C. /cooler, latter addition of floors and modern doors and windows.

The importance of the street is just not on architectural level but also on cultural level. We can understand the spirit of “Purani Dilli” only if we view the kucha by the eyes of the proud residents of the kucha. Their proud descriptions of their possessions indicate the level of pride they have for their properties but in present time where technology has greatly intervened in life of people, it is difficult to be susceptive too these modern amenities.

The deteriorating condition of the city is not only to because of the transformation and negligence of the residents but also due to the stringent and restrictive bye-laws and unavailability of proper guidelines. Another issue is the financial constrains of the people in the street, the repair cost of the old havelis is very high due to expensive labour and building material. The inhabitants also face a lot of problem in getting permission for any repair work from the authority if it is a listed structure so at times they prefer not going for repairs.

Apart from architectural importance the social framework and sense of good neighborhood is a

[7] *Gazetteers of Delhi (1912).*
Delhi Master Plan 1962, Delhi Development Authority.
Master Plan of Delhi 2001, Delhi Development Authority.
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major character of the street which may die in a few years if the commercialization of the street continues.

The regeneration of the city needs a broader outlook of the city. The revival process has to start on a larger scale rather than going on in bits and pieces. The whole Shahjahanbad has to be looked into as one and not as Red fort, Chandini Chowk, Gates and various Kuchaa and Katras.

Sustainability occurs on three main parameters: environmental sustainability, social sustainability and economical sustainability. We should look into the city in three stages Shahjahanabad level, street level and building level and considering all the three parameters of sustainability (environmental, social and economical). So first the environmental aspects have to be catered in the city on a larger scale looking on to the ecological aspects, considering the context of the River Yamuna and Shahjahanabad as riverside settlement. Development and conservation guideline for the whole Shahjahanabad in a comprehensive form should be figured out respecting the form and structure of the settlement.

Then going down to the settlement level and street level measures and interventions. On settlement level and street level various guidelines like control on land use, restriction on height, proper addition and alteration; maintenance of built-open space ratio and intricacy, control on façade treatment etc. has to be given. Guidelines for structural conservation and facelift measures for the structures should also be given. Proper documents for reference of professional for interventions and for common people for reference should be provided. An easy access to officials and professionals of the field should be availed for the community.

Apart from the architectural conservation measures awareness and economy generation ways should also be developed. The revival of haveli and provision of reuse as social infrastructure like schools and public buildings like art and craft workshops and museums can also help in economy generation of the area. Obviously work on the rent control act and other taxes and funding measures are also needed to be worked out for better economy generation.

The social awareness, sense of ownership and cultural attachment of people is there in the Old Delhi but a little most ease in living in the area by provision of comfortable, livable conditions and can change the face of this once thriving city of Delhi “The ShahJahanbad”.

Delhi is a living city and a much talked entity of a country but we have many small towns urban centres which have beautiful historic entities and cultural senses but left to fade and loose its character overtime. Rajnagar is one such a town.

Case study: Rajnagar

Rajnagar is situated in Chattarpur district of Madhya Pradesh State and in the historic Bundelkand region. It is a small town, five kilometers from the religious centre of Khajuraho which

has eminent temples of Chandella Dynastry. The Chandella kingdom had three capitals, Mahoba, the administrative capital, Kalinjar, the military capital and Khajuraho, the religious capital. Initially at the time of Chandella rule Rajnagar was a small settlement at the foothill of Bamnikhera Mountains. It slowly developed as nobles and rulers started pausing at the site while travelling from Mahoba to Kalinjar[8].

In the 18th century the town developed when Chattarpur Dynasty took over the Bundelkhand region. Latter Raja Sone Shah developed Rajnagar as his administrative centre and built a fort in the town. Along the fort the commercial spine of the town developed. It has old bazaar in its settlement and the traditional work done in the place is of making Silver jewelry. This is yet present there but is in a dying situation as first the cost of silver is rising rapidly and second the fashion of silver jewelry is dying.

The town is surrounded by two natural water bodies Jalsena and Thenera, around which there are historic gardens. These are scattered all around Rajnagar and the water bodies. These gardens are of nobles and local ruler with temple, pavilions and interesting water systems for irrigation in them. The water tanks not only fulfill the water requirement of the town but are also helpful in economy generation as the town has a large number of fishing community. There some very interesting temples of Chattarpur time in the settlement with interesting elevations and wall paintings. During Colonial time also it acted as administrative centre. But overtime it lost its importance and historic values.

The settlement is situated in catchment area of small hillocks; Bamnikera and Bhulera but the abrupt development has disturbed the catchment area. Thus, the two water bodies Jalsena and Thenera are in bad conditions. Important buildings in the town, the Fort, locally called Garih and other temples are in dilapidated conditions. The jewellary craftsmen are in bad circumstance. The historic gardens have also lost their glory for the people. There are traces of interesting architectural knowledge system of construction in vernacular residential building yet present in the settlement. But the residents want to move to pucca house not only for better services but as it is also a symbol of better status in society. All tradition systems would die and detoriate due to the upcoming influence of urbanization and bad effect of tourism at the adjoining WHS site of Khajuraho. The town today is just functioning as a satellites town to cater the requirements of the WHS site of Kajuraho and is losing its characters.

Rajnagar can also be revived if it becomes self sustained. First ecological sustenance can be attained by maintenance of terrain and catchment area and revival of water bodies. The town is a part of a larger regional watershed area whose revival will surely help in betterment of the ecology of the region. This will also lead to revival of the gardens, a very important element of the cultural landscape of the town. These gardens can be revived and developed as tourist spots thus help in economy generation and provision of employment to the locals. Abrupt and insensitive

[8]*Madhya Pradesh District Gazetteers – Chhatarpur, Guru S.D. Published by Directorate of Gazetteers, Bhopal.*
Conservation and Sustainable Development Strategy for the Khajuraho Heritage Region, INTACH Report 1998.

urbanization should be stopped. The vernacular houses should be provided with better architectural solutions and guidelines. The conservation of Garih and better reuse of the structure is to be provided. But most important in this town is to develop awareness and pride for the local people for their own heritage as the people so much influenced by the new developments that they incorporate it without understanding the damage they cause to the ethnic fabric.

Conclusion

Heritage and sustainability are strongly interrelated and interdependent. Sustainable development is associated with the protection of natural environment and built heritage both.

Sustainability has to be attended in all the three main spheres environmental, social and economical. Heritage Conservation looks into effective implementation of all the three parameters. Thus, forms a very important tool to attain sustainable development.

Be it a large city or small town respect for the historic fabric is very important. Strategic measures involving revival of the traditional knowledge, respect for site topography and context before development and sensitive urbanization are the prime measures to have sustainable architectural conservation.

Our historic city and towns are in immediate need of a comprehensive and elaborate policies and legal framework for revival and regeneration of these cities which should encompass all the measure of architectural conservation and sustainable development with people centric approach, thus following a Sustainable Architectural Conservation Approach.

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