JOURNAL OF THE INDIAN INSTITUTE OF ARCHITECTS

REFEREED JOURNAL OF IIA | ISSN-0019-4913 2021 JAN-FEB | VOLUME 86 | ISSUE 01 | ₹ 100




happiness through architecture

SketchUp
Authorized Training

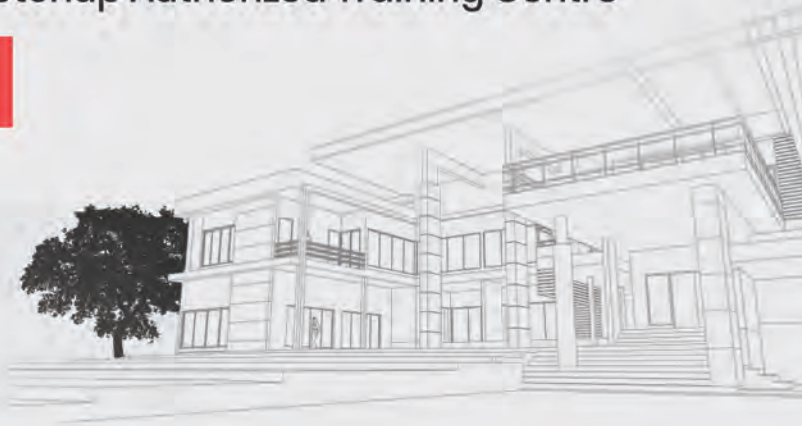
Trimble

Upskill Yourself!

Join the Sketchup Authorized Training Centre

Offline/Online Course Available

Get authenticated Trimble certificate after course completion



Courses Available

- **Sketchup Foundation Course**
- **Industry Specific Courses**
  - Urban Designers
  - Landscape Designers
  - Interior Designer
  - Architects
  - Kitchen Designers

Get in touch with your local ATC Centres

Goa
KAMAT EDUTEK LLP, Margao | Ph: 9860654979.

Karnataka
ADEBEO SOLUTIONS PVT LTD, Banglore | Ph: 9686730617.

Kerala
INTERCAD SYSTEMS PVT LTD, Kochi | Ph: 9061111040.

Maharashtra
AURA SOFTWARE PVT LTD, Pune | Ph: 8975003350.
D23 DESIGN LOUNGE, Mumbai | Ph: 9820093163
XS CAD INDIA PVT LTD, GREY EDGE, Mumbai | Ph: 8451964445.

Tamil Nadu
C CUBE TECHNOLOGIES, Erode | Ph: 9843520101
USAM CADSOFT INDIA PVT LTD, Coimbatore | Ph: 9382249445

Telangana
BIM & GRAFX INTEGRATED STUDIO PVT LTD, Hyderabad | +91-40-23744185
HAMSTECH INDIA PVT LTD, Hyderabad | +91-40-66684994 / 5

SW SYSTEMS

SketchUp Distributor
Learning Support Partner

Contents

JIIA IS REFEREED JOURNAL
ISSN-0019-4913

REGISTERED UNDER SOCIETIES REGISTRATION ACT, XXI OF 1860
JOURNAL OF THE INDIAN INSTITUTE OF ARCHITECTS
VOL-86/ISSUE01-02 JAN-FEB 2021

Printed & Published by **Ar Anand Palaye** on behalf of **The Indian Institute of Architects** and printed by **Krishna Graphics,** A-511, Royal Sands, A-Wing, 5th Floor, Behind Citi Mall, Shastri Nagar, Andheri (W), Mumbai-400 053 and Published at The Indian Institute of Architects, Prospect Chambers Annexe, 5th Floor, Dr D N Road, Fort, Mumbai – 400 001.
Tel.: +91.22.22046972/22818491/22884805 **Fax**: +91.22.22832516
Email: iiapublication@gmail.com / iiaho1214@gmail.com
Website: www.indianinstituteofarchitects.com

Editor: Ar Divya Kush **R.N.I. No.9469/57**
Email : divyakush@yahoo.co.in
Printer's Email : krish.graph@gmail.com

Ar Divya Kush

Dear Fellow Architects,

Warm Greetings.

My best wishes for a Happy, Healthy Prosperous and a very eventful year 2021.

Friends, the spread of COVID-19 in the year 2020, quickly turned into a pandemic which took the entire mankind by shock and surprise and brought unprecedented misery and hardship to all sections of the society cutting across national boundaries, race, religion, age group, economic strata and name what you have! To overcome this crisis our collective sense of resilience and spirit of survival was manifest at its best. However, this partly natural and partly manmade crisis has irreversibly changed our lives in many ways. It is also a wake-up call for the future. We are still struggling to reconcile and adapt ourselves to the new normal.

In the meantime, apart from dealing with the immediate fallout of the pandemic, our scientists have been able to develop effective Vaccines to protect ourselves from COVID-19 in times to come in record time. India has emerged as a leading torch bearer in this endeavour and earned universal recognition compliments.

Here, at IIA, I am immensely pleased and happy that we have successfully concluded the long overdue IIA elections. I take this opportunity to extend my heartfelt congratulations to the newly elected President Ar C R Raju along with his Office Bearers, Council Members, Chapter Chairpersons and their executive Committee members across the country.

I am sure, the more than 100 year old rich legacy of IIA is not only safe under the overall leadership of President Ar C R Raju, but will also scale new heights and achievements. I also take this opportunity to convey my thanks and gratitude to not just my elected colleagues but to all the members of the Institute for having reposed their trust in giving me opportunity after opportunity to serve the Institute for well over 25 years in various capacities at all levels and finally elect me as the President of the Institute.

It has been both an enriching and humbling experience all these years.

There is a lot to say and share but I conclude by saying a big "THANKS TO YOU ALL".

Divyakush

Ar. Divya Kush,
Immediate Past-President, IIA.

PRESIDENT'S MESSAGE

Ar C R Raju

Dear Fellow Architects,
Warm Greetings!

The Indian Institute of Architects has a long and rich legacy of contribution to the growth of the Profession, throughout our country. This was possible by the sustained work of the Past Presidents, Office Bearers and Members both at the National, Chapter, Centre & Sub-Centre level in the service to the Institute. Let me take this opportunity to appreciate Imm. Past President Ar. Divya Kush and the team of the previous term for their contribution.

It is heartening that the recently conducted elections have been concluded successfully and glad to see the enthusiasm of all the elected representatives exude a positive energy to serve the members and the Institute.

The awareness of Architecture has increased amongst the Society, thanks to the passion and hard work of the pioneers & stalwarts, with their outstanding works, who have been an inspiration for others, especially the younger generation of Architects, many of whose works are well appreciated.

Every Architect is a good will ambassador and we have to unleash this potential for a positive approach towards issues concerning our profession & academics and policies that influence the built environment & the community.

We have to revitalize our efforts and a number of initiatives are being planned to enhance the membership experience of IIA.

One such effort is the revitalization of the Journal of the Indian Institute of Architects from the March issue. The New Team under the able leadership of Ar. Lalichan Zacharias, the Editor and Chairman of the Publication Board is working on reformatting the Journal with different sections, enhanced content with varied features encompassing the Profession and academics for the readership of our members.

A renewed effort has been made to have a correspondent of JIIA from every chapter who can identify works of Architectural value, research papers and news that can be sent to the Team for Publication in the Journal.

We request members to actively document their works and coordinate with the correspondent of JIIA for Publication of their outstanding works.

Let us all look forward to good times ahead with renewed vision and vitality and wish you all a Happy Year 2021.

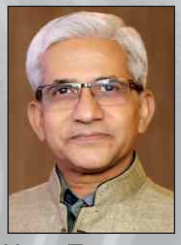
Ar. C R Raju
President,
The Indian Institute of Architects

IIA OFFICE BEARERS 2015-17/20

President
Ar. Divya Kush

Vice President
Ar. Vilas Avachat

Jr. Vice President
Ar. Amogh Kumar Gupta



Hon. Treasurer
Ar. Sunil Degwekar

Jt. Hon. Secretary
Ar. C R Raju

Jt. Hon. Secretary
Ar. Lalichan Zacharias

Imm. Past President
Ar. Prakash Deshmukh

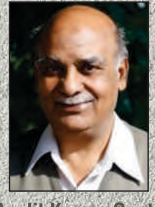
IIA COUNCIL MEMBERS 2015-17/20

Ar. Ashutosh Kumar Agarwal

Ar. Kamla Kant Asthana

Ar. Sandeep Manohar Bawdekar

Ar. Akshaya Kumar Beuria



Ar. Jit Kumar Gupta

Ar. Muralidhar Reddy Koppula

Ar. Jitendra Shantilal Mehta

Ar. Anand Padmanabha Palaye

Ar. Debatosh Sahu

Ar. Sarosh Hoshang Wadia

Ar. Alok Ranjan

Ar. Jatinder Saigal

IIA CHAPTER CHAIRPERSONS 2015-17/20

Andhra Pradesh Chapter
Ar. Vivekanand Swamy Ghanta

Assam Chapter
Ar. Ramendra Nath Baishya

Bihar Chapter
Ar. Vishnu Kumar Choudhary

Chandigarh Chapter
Ar. Manmohan Khanna

Chhattisgarh Chapter
Ar. Navin Sharma

Goa Chapter
Ar. Manguesh Raghunath Prabhugaonker

Gujrat Chapter
Ar. Mihir Chandravadan Parikh

Haryana Chapter
Ar. Punit Sethi

Himachal Pradesh Chapter
Ar.Nanda Kishore Negi

Jharkhand Chapter
Ar. Sandeep Kumar Jha

Karnataka Chapter
Ar. Leena Kumar

Kerala Chapter
Ar. Ajit Rajam Bhaskaran

Madhya Pradesh Chapter
Ar. Amogh Kumar Gupta

Maharashtra Chapter
Ar. Satish Madhav Mane

Northern Chapter
Ar. Shamit Manchanda

Odisha Chapter
Ar. Sagarendra Mohapatra

Punjab Chapter
Ar. Sanjay Goel

Rajasthan Chapter
Ar. Gyanendra Singh Shekhawat

Tamil Nadu Chapter
Ar. Senthil Kumar Karunakaran

Telangana Chapter
Ar. Gururaj Manepalli

Uttar Pradesh Chapter
Ar. Virendra Kumar Agarwal

Uttarakhand Chapter
Ar. Shashi Mohan Srivastava

West Bengal Chapter
Ar. Gita Balakrishnan

IIA TRUSTEES 2015-17/18

Ar. Dilip Chatterjee

Ar. Dulal Mukherjee

Ar. Neelam Parelkar

IIA REPRESENTATIVES IN COA 2015-18

Eastern Region
Ar. Amitava Roy

Western Region
Ar. Prakash Deshmukh

Northern Region
Ar. Jatinder Saigal

Southern Region
Ar. J. Manoharan

Central Region
Ar. Alok Ranjan

IIA OFFICE BEARERS 2020-22

President
Ar. C R Raju

Vice President
Ar. Vilas Avachat

Jr. Vice President
Ar. Jitendra Mehta

Hon. Treasurer
Ar. Gyanendra Shekhawat

Jt. Hon. Secretary
Ar. Leena Kumar

Jt. Hon. Secretary
Ar. Satish Mane

Jt. Hon. Secretary
Ar. Ashutosh Kr. Agarwal

Imm. Past President
Ar. Divya Kush

IIA COUNCIL MEMBERS 2020-22

Ar. Deepak Deshpande

Ar. Debatosh Sahu

Ar. Agarwal Virendra Kumar

Ar. Azmi Sarosh Wadia

Ar. Akshay Kumar Beuria

Ar. Brijesh Shaijal P K

Ar. Manguesh Prabhugaonker

Ar. Ranee M L Vedamuthu

Ar. Koppula Muralidhar Reddy

Ar. Rajeev Taishete

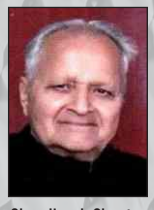
Chairman - Publication Board & Editor - JIIA
Ar. Lalichan Zacharias

IIA CHAPTER CHAIRPERSONS 2020-22

Andhra Pradesh Chapter
Ar. M Kranti Kumar

Assam Chapter
Ar. Hiranya Kumar Rajkhowa

Bihar Chapter
Ar. Amit Ranjan



Chandigarh Chapter
Ar. Shiv Dev Singh

Chhattisgarh Chapter
Ar. Raj Kumar Prajapati

Goa Chapter
Ar. Amit Mangesh Sukhthankar

Gujrat Chapter
Ar. Anand Jayaram Tatu

Haryana Chapter
Ar. Punit Sethi

Himachal Pradesh Chapter
Ar. Nandlal Chandel

Jharkhand Chapter
Ar. Sandeep Kumar Jha

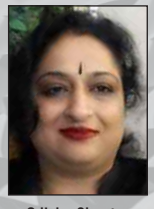
Karnataka Chapter
Ar. B R Mohan

Kerala Chapter
Ar. Gopakumar L

Madhya Pradesh Chapter
Ar. Jitendra Mehta

Maharashtra Chapter
Ar. Bawdekar Sandeep M

Northern Chapter
Ar. Ashish Gupta



Odisha Chapter
Ar. Rajkunwar Nayak

Punjab Chapter
Ar. Sanjay Goel

Rajasthan Chapter
Ar. Tushar Sogani

Tamil Nadu Chapter
Ar. Loganathan T

Telangana Chapter
Ar. Udaya Shankar Doni

Uttar Pradesh Chapter
Ar. Kamla Kant Asthana

Uttarakhand Chapter
Ar. Shashi Mohan Srivastava

West Bengal Chapter
Ar. Malay Kumar Ghosh

IIA TRUSTEES 2018-22

Ar. Dilip Chatterjee

Ar. H.C. Thimmaiah

Ar. Ramesh Bhambhani

IIA REPRESENTATIVES IN COA 2020-23

Eastern Region
Ar. Amitava Roy

Western Region
Ar. Abhijit Shirodkar

Northern Region
Ar. Punit Sethi

Southern Region
Ar. Lalichan Zacharias

Central Region
Ar. Navin Sharma

WARM WELCOME TO INCUMBENT PRESIDENT 2020-22 AT IIA HEAD OFFICE

Imm. Past President, Ar. Divya Kush, IIA, adorning the coveted CHAIN OF OFFICE on newly Elect President, Ar. C R Raju of IIA for the period 2020-22 as Vice-President Ar. Vilas Avachat, IIA and Joint, Hon. Secretary, Ar. Satish Mane, IIA are also seen welcoming him at the IIA Head Office at Mumbai. .

MEETING OF GREAT MINDS

Sitting L to R: - Ar Vilas Avachat, Vice-President, IIA, Ar Ashutosh Kumar Agarwal, Jt Hon Secretary, IIA; Ar C R Raju, President, IIA; Ar Leena Kumar, Jt Hon Secretary, IIA; Ar Divya Kush, Imm Past-President, IIA; Ar Gyanendra Shekhawat, Hon Treasurer, IIA and Ar Satish Mane, Jt Hon Secretary, IIA.

Standing L to R: Ar Rajeev Taishete, Ar Lalichan Zacharias, Chairman-Publication Board-IIA & Editor-JIIA; Ar Virendra Kumar Agarwal, Ar Debatosh Sahu; Ar Axmi Wadia; Ar Ranee Vedamuthu, Ar K Muralidhar Reddy & Ar K K Asthana-Chairman-Uttar Pradesh Chapter.(Pl NOTE: Except Ar Lalichan Zacharias and Ar. K K Asthana, rest all are Council Members, IIA)

2ND COUNCIL MEETING HELD ON 27TH FEBRUARY AT ITC GRAND CHOLA, CHENNAI

DEDICATED TEAM IN THE SERVICE OF INDIA'S ARCHITECTURAL FRATERNITY

Braving the odds of the constant threat of COVID-19, the newly elected team of Committee Members, representatives of various Chapters and Centres along with the dynamic team of IIA Committee Members led by Ar C R Raju met in Chennai on Feb 27 & 28 to chart out the path Indian Institute of Architects will be taking to best serve the large fraternity of Architects it serves in the years to come. Seen in this group are Ar Vilas Avachat, Vice-President, IIA, Ar Ashutosh Kumar Agarwal, Jt Hon Secretary, IIA; Ar C R Raju, President, IIA; Ar Leena Kumar, Jt Hon Secretary, IIA; Ar Divya Kush, Imm Past-President, IIA; Ar Gyanendra Shekhawat, Hon Treasurer, IIA and Ar Satish Mane, Jt Hon Secretary, IIA, Ar Lalichan Zacharias, Chairman Publication Board-IIA and Editor-JIIA and Ar. K K Asthana along with Council Members Ar Rajeev Taishete, Ar Lalichan Zacharias, Chairman-Publication Board-IIA & Editor-JIIA; Ar Virendra Kumar Agarwal, Ar Debatosh Sahu; Ar Axmi Wadia; Ar Ranee Vedamuthu, Ar K Muralidhar Reddy & Ar K K Asthana-Chairman-Uttar Pradesh Chapter.

Advent of Eco-Iconic and Sustainable High Rise:

Study of Environment Friendly and Energy Conserving Skyscrapers

- Ar Baljeet Singh Madan, *Architect and Interior Designer, Director, Acme Designtech Pvt. Ltd.*

Born and raised in the family of Architects, the expanse of this discipline has been my passion since the very beginning of high school, during university training and more than a decade long professional career as an Architect, Interior designer and an Exhibition designer. Under the umbrella of my responsibilities as an academician and on-site professional, I have been fortunate to gain multi-faceted experience nationally and internationally. My persevering passion towards teaching and research has helped me with well-placed opportunities at renowned universities in India since 2009, after graduating as an Architect in 2007 from Apeejay School of Architecture and Planning, Greater Noida, India; followed by the Master's degree in Project Management from Sheffield, United Kingdom. My passion to study further and learn more, motivated me towards another master's degree (M.Arch) in 2017 from Sharda University, Greater Noida, and thereafter, enrollment as a Ph.D. scholar. I have been privileged to work on several prestigious projects in India and abroad for Government of India, International Companies and Foreign Embassies which helped me gain versatile experience and diverse profile.

01balpreetmadan@gmail.com | balpreet@vssgroup.in

ABSTRACT

Skyscrapers are often associated with an illusion of having adverse impact on the environment. Most of the towers of the world conjure an image of major energy consumers leading to over exploitation of resources. Innovation and advanced technology encouraged construction of more skyscrapers which resulted in higher energy requirements and rapid use of resources. Consequently, Architects were more focused on designing green and environment-friendly high-rise buildings which later led to emergence of eco-iconic skyscrapers which can also contribute to conservation and generation of energy. There has been a constant race to design and develop taller buildings globally with which arisen a myth that 'taller the building, higher is energy consumption' with more adverse impact on environment. This scenario has shifted the focus towards designing of towers based on sustainable design principles having outstanding appearance and iconic outlook, through innovative materials and modern technologies. This paper reviews some of the iconic towers and technologically advanced buildings of the world integrating sustainable design principles, climate responsive facades, utilizing renewable sources of energy to generate their own possible energy requirements.

Key words- Architectural Innovations, Climate responsive, Energy conservation, Sustainable high-rise, Innovation, Technological advancements

1. OVERVIEW

High-rise buildings have been in-trend for past few decades due to over-expansion of cities in order to accommodate rapidly increasing population. Increasing requirement for housing units globally, would require larger count of tall buildings. Technological advancements have further encouraged construction of several such towers, which resulted in increased consumption of resources to meet the energy requirements. Some of these skyscrapers are built to symbolize the cities or countries, as an iconic feature to achieve global attention for showcasing supremacy, without realizing their impact on our environment. This emerging trend of high-rise construction has affected environmental conditions greatly. Conventional skyscrapers are considered to be the most energy consuming building typologies due to excessive amount of resources and material required for their development and subsistence. Rapid increase in the number of skyscrapers has led to over-utilization and exploitation of resources which necessitates their conservation by reducing energy loads. The concept of sustainable high-rise came into existence as a possible solution for energy conservation which resulted in a new generation of high-rise buildings that has initiated by incorporating green strategies and sustainable design principles. These towers are designed and developed on the principles of green architecture and eco-friendly considerations for healthier living conditions and reduced energy consumption (Rachel, 2005). Conservation of energy has become a vital aspect of Architectural design that outlines the overall form, appearance, planning, façade treatment and aesthetics. Therefore, the design and development of these towers require special concern.

1.1 Rationalization and Validation

Building sector itself accounts for 40 percent of total energy consumption every year and rapidly increasing number of tall buildings will further increase the energy requirements (Hocaoglu et.al, 2009). In an attempt to stand out, every skyscraper is designed with distinct outlook, challenging form and usually higher than the earlier one to surpass them. In a race to build more attractive and taller buildings, most of such towers have been created as highly attractive glass boxes. Enormous glass facades have transformed these buildings into heat boxes without realizing their harmful effects on health and environment. Sustainable high-rise require lesser energy for their operations and are often capable of generating energy for themselves, mainly through renewable sources of energy (Foster, 2001), which makes it significant to study and explore more such possibilities and techniques to design environment-friendly and energy efficient skyscrapers. The on-going trend and demand for skyscrapers will further escalate in the future with the increasing population, making the research inevitable.

1.2 Data and Research Methodology

The paper showcases the idea of sustainable high-rise buildings by studying some of these skyscrapers from different regions of the world with varying climatic conditions. Since, these skyscrapers are located outside India; the data has been collected through online articles, journals and other internet sources. The main objective is to study the influence of height, climate, innovation and technology on sustainability of a high-rise building. The study provides an insight of advancements in the building industry which include vertical landscaping, harnessing wind and solar energy for power generation and climate responsive façades. The paper analyses these innovative techniques and their capability to conserve energy.

1.3 Limitations of study

Some of the buildings under study are nearing completion or just been completed and the performance cannot be evaluated precisely, but the features and techniques are useful for research on the subject.

1.4 Research Questions

The buildings under study are located in different climatic regions of the world with varying heights. These towers have been designed with various integrated sustainable strategies and can save a substantial amount of energy, some of them are capable of generating energy. The study of these buildings will provide an understanding of the most commonly used strategies and leads to some research questions.

(a) Is renewable energy the future of skyscrapers?
(b) How do climatic conditions influence components of a green skyscraper?
(c) What is the impact of building height on its level of energy saving?

1. SUSTAINABILITY AND SKYSCRAPERS

The core objective of sustainable building design is to maintain ecological balance. Eco-friendly buildings are energy conserving, responsive towards environmental conditions and rely mainly on renewable energy (Newman, 2001). The level of sustainability of a building is dependent on various aspects which include location, surroundings and climatic conditions. Sustainable and green architecture are globally embraced concepts that focus on the principles of energy conservation. It can be achieved through various ways which include, incorporating nature and renewable sources of energy into the design, which are ultimately dependent on climate. This trend has brought up several buildings round the globe which conserve energy with minimal impact on environment. Availability of technology, combined with sustainable design has further encouraged the erection of environment-friendly high-rise in different parts of the world with varied climatic conditions such as Hot and Arid, Tropical, Sub-tropical, Moderate, Cold etc. Sustainable and high-performance skyscrapers have transformed the process of Architectural design with astounding technological inputs and innovative materials encouraging the formation of eco-iconic high-rise buildings which can also generate energy for themselves..

In the era of skyscrapers, there have been various definitions for sustainable high-rise. Some buildings are defined taller based on their base dimension to height ratio which is usually 3:14. As per Emporis Standanrds, an architectural height between 35 to 100 meters or a structure having 12 to 39 floors is defined as a high-rise building (Emporis, 2000). Council of Tall Buildings and Urban Habitat (CTBUH, 2000) states that if a building showcases some of the tall features in terms of height with respect to context, proportion or building technologies; it may be defined as a high-rise building. The concept of sustainable buildings majorly emphasizes on conservation of energy with minimal utilization of new resources and favourable response towards the climatic and environmental conditions. Such principles, when incorporated in a building design, can contribute to cleaner environment, healthier living conditions and reduced exploitation of non-renewable resources. A sustainable and environment-friendly skyscraper will rely majorly on the renewable sources of energy for its functioning and subsistence with reduced impact on the environment. Such towers are sensitive towards utilization of resources and fulfil the criteria economically and responsibly. Some of these buildings also benefit the environment by cleansing the air (Begeç, 2013).

3. ENVIRONMENT-FRIENDLY BUILDING TECHNIQUES

Energy efficiency in a high-rise building design can be achieved by incorporating green and sustainable design principles as an integral part of the building design. Such strategies can be either passive or active, depending upon various aspects such as, climatic and environmental conditions, functional requirements, availability of technology, structure etc., which, at times, become the prime factor outlining the overall built form. Harnessing energy from renewable sources enables the building to generate their own energy. Renewable energy is extracted from the sources that are likely to get recovered soon and are available in abundance or endless in comparison to the need of the mankind. These sources include wind energy, solar energy, water energy, tidal energy and geo-thermal (Ellaban, 2014). Realizing the necessity and following the trend, many such towers are being designed globally with intent to benefit the environment in various ways such as, by purifying the air, saving substantial amount of energy and even by generating energy through renewable sources.

3.1 Sun shading and Responsive facades

Facades are responsible components of a building which act as a shield against harsh climatic conditions while providing a distinctive appearance. Some of the iconic skyscrapers of the Middle East have incorporated their traditional feature, Mashrabiya, as a protective screen for prevention from harsh

desert sun. This Arabic heritage feature acts as climate responsive façade system when combined with advanced construction techniques and sustainable design principles.

3.1.1 Al Bahr towers, Abu Dhabi, UAE

The towers were erected with a major consideration to extreme climatic conditions of Abu Dhabi, where the temperature goes to extremes with high humidity (Attia 2016). The unique facade prevents excessive penetration of solar radiation without obstructing the outside view. The towers are enveloped with the weather tight glass curtain

Figure 5: Al Bahr Towers, UAE

wall, comprising of highly unitized panels covering an entire floor height. The curtain wall is separated from the shading system through moving joints, which comprise of innovative triangulated umbrella like panels which unfold at different angles to block direct sunlight. According to Paulo (2016), these components are semi-transparent and contribute substantially in reduction of energy consumption. Controlled by sun-tracking software, these shading devices are driven by actuators. The estimated reduction in the solar heat gain ranges from 20 to 50 percent along with reduced cooling loads upto 25 percent. The exclusive dynamic umbrella like facade imparts a distinctive appearance to the towers and makes them energy efficient with an overall saving of 40 percent of carbon emissions (Karanoah & Kerber 2015).

3.1.2 Doha Tower, Doha, Qatar

The 238 meters high Doha tower, also known as Burj Doha, is located at the water front of the city and is famous for its unique facade which also a reminiscent of Mashrabiya. The dia-grid structure of the tower is placed inwards which ensures continuous facade without compromising on the structural stability. The perforated facade screen covers entire height of the tower, forming a full-span dome at the top which makes it stand out against all other buildings. Pattern of perforations consists of single geometric motif spreading across entire façade at different scales which brings down the indoor temperature by shading the building from harsh desert sun. The density of pattern, which is made of Aluminium, varies in accordance with the solar conditions on all the directions. The screen is denser on the sides that are more exposed to direct sunlight without blocking the outside view.

The eastern and western faces account for 60 percent of

Figure 2 Doha Tower, Qatar

opacity, while, 25 percent and 40 percent opacity has been maintained on the north and south side respectively (Park & Reem, 2017) which reduces cooling loads by 20 percent. The Council of Tall Buildings and Urban Habitat (CTBUH) awarded the building with 'CTBUH skyscraper award' for its excellence, in 2012. Integrated programmable lighting system further enhances the geometric pattern even at night time (Doha Tower, 2020).

3.1.3 0-14, Dubai, UAE

The unique concrete exoskeleton façade of 22-storey tower acts as the main structural component providing column-free spaces inside, with reduced core area. The perforated shell of O-14 acts as a dia-grid structure against the lateral forces and follows a geometrical pattern which is repeated at different scales and prevents excessive exposure to solar radiation which reduces heat gain. The size of openings varies in accordance with structural requirement, exposure to sun, required daylight and views.

The peripheral structure is separated, yet connected at required points, by floor slabs with one meter gap throughout the height of tower. This passive solar technique results in 30 percent reduction in energy consumption (Reiser et. Al, 2010).

3.2 Facades with vertical vegetation

The awareness of preserving trees to combat pollution has encouraged Architects to incorporate plants, shrubs and trees into buildings, thus, creating towers wrapped with green envelope. They act as tall smog-eating towers that remove pollutants from air and purify it naturally. Integration of plants can also improve the micro and macro climate to create an ecological balance by reducing the heat island

Source:Author

Figure 3 World Trade Center, Bahrain

Table 1: Selection of Temple Precinct

effect which is mainly due to over-urbanization, especially in big cities.

2.1.1 The EDITT Tower, Singapore

EDITT was designed by T R Hamzah and Yeang, with intent to revitalize local eco-system and enhance local bio-diversity. Its design demonstrates a remarkable ecological approach in its organic composition by incorporating vegetation in its façade which reduces energy consumption. The continuous landscaped ramp and garden terraces surrounding the building contribute to ambient cooling through evapo-transpiration. According to Yeang (2007), the vegetation covers almost 50 percent of the gross area of the tower.

Passive design strategies provide substantial environmental comfort and reduced energy demand and cooling loads with integrated sun-shading to window glazing, green cover, rain water catchment provision and photovoltaic panels covering

Figure 4 EDITT, Singapore

855 sq.M. to provide an estimated energy self-sufficiency of more than 20 percent. The EDITT is also self-sufficient in terms of water supply which accounts for 31 percent. It also recycles 8000 to 9000 cu.m. of sewage (Yoneda, 2008).

3.2.2 Agora Garden, Taiwan

Taiwan's twisted Agora Garden tower, also known as Tao Zhu Yin Yuan, follows the form of double helix DNA structure. It is designed to combat air pollution in Taipei by absorbing smog through a large number of trees and shrubs incorporated in the building envelope. These trees and shrubs absorb a large amount of carbon dioxide and release oxygen. The green cover also provides shade to the occupants and maintains a convenient inside temperature by blocking the glare of direct sunlight. It prevents extreme heat load inside the building by filtering solar radiation which ultimately reduces energy consumption. Frearson (2013) suggests that these towers are, usually, self-sustainable as they utilize the filtered waste water for maintenance of the thick green cover. Other features of the building include a bed of photovoltaic panels on the roof for generation of electricity along with rain water harvesting (Agora Tower, Taipei 2020).

3.2.3 Commerzbank, Germany

Commerzbank is the first eco-friendly tall building of the world to be constructed which relies on natural systems of ventilation and lighting, with the provision of operable windows. The 259 meters high tower does not completely depend on mechanical ventilation which brings down its energy consumption to nearly 50 percent which was earlier estimated to be 35 percent. The full height central atrium connected to large garden terraces at different levels brings in natural light and fresh air that circulates through the atrium throughout the height of the tower (Campi, 2000). These gardens offer break-out spaces for social interaction and allow visual connection with the surroundings. The tower orientation responds to sun movement and prevailing winds ensuring daylight and ventilation naturally.

According to Foster & Partners (2014), the passive design strategy makes it naturally ventilated for more than half of the year. The tower is equipped with operable windows which shut off the mechanical ventilation, heating and cooling systems automatically, once the windows are open,

Figure 5 Agora Garden, Taiwan

resulting in an estimated saving of 20 percent more (Chan, 1997). The three layered façade system alongwith improved thermal properties of the windows results in substantial energy saving. Natural stack ventilation is gained through a black painted thermal chimney which gets heated up by the solar radiation and heats up the air inside to rise up and escape which then gets replaced by the fresh cooler air from the bottom causing cooling and ventilation (Afonzo & Oliveira, 2000).

3.2.4 One Central Park, Sydney

One Central Park was developed as first phase of a site redevelopment project in Sydney as a response to the

Figure 6 Commerzbank, Germany

environmental conditions and to accommodate residential units for growing population. The largest façades face north and south and provide sufficient self-shading which reduces overall heat gain. A 40 meters cantilevered sky garden projecting out of west face of the taller tower prevents heat gain by shading the upper façade which is exposed to direct west sun. The design emphasizes on daylight by breaking down the longer façade on north and south side into two towers, longer and shorter, allowing unobstructed light from north and south side, however, the 5-storey deep podium remained lightless which was a challenge. To overcome this, the roof of shorter tower is equipped with 40 heliostats to redirect sunlight to 320 reflectors installed at the bottom of cantilever which reflect light into the atrium below (Nouvel & Beissel, 2014).

The complex consists of a 30 MW Central Thermal Plant, black water treatment plant that contributes to sustainability. Nouvel & Beissel (2014) state that 20 percent of the solar gain is prevented by the 5 kilometers long system of edge slab planters which act as horizontal shading devices and absorb carbon dioxide. Additional reduction in heat gain is achieved through the vegetation itself. These plants are drip-irrigated through the recycled black water of the site which is also used for flushing, washing etc. One Central Park achieves about 26 percent of reduction in its energy consumption and a rating of 5 on the Australian Green Star Standards through its sustainable design and eco-friendly techniques and features.

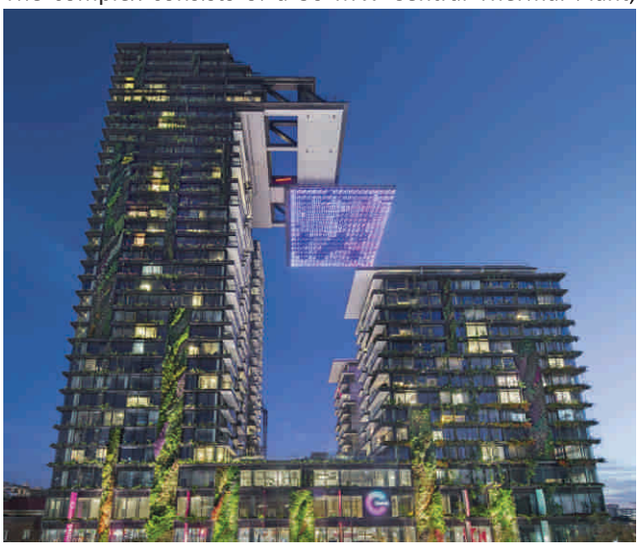


Figure 7 One Central Park, Sydney

3.3 Aerodynamic Built Form

Incorporation of massive wind turbines can generate tremendous amount of energy and can transform a conventional skyscraper into an energy generating tower while performing all the functions of a building. These skyscrapers require specialized structural system to withstand high wind forces which makes them cost-intensive. Their height attracts high velocity winds which run wind turbines to generate energy, especially in the areas with strong winds.

3.3.1 World Trade Centre, Bahrain

The twin tapering towers of Bahrain World Trade Center (BWTC) are located in Manama, capital city of Bahrain. The 240 meters high sail-shaped towers, having 50 floors, were designed by Atkins International. BWTC showcase Bahrain's dedication to sustainability and energy efficiency through its prominent features of energy conservation based on concept of wind-catching towers of the Arab region.

BWTC towers are the first skyscrapers to have integrated wind turbines for generation of energy. Aerodynamic form channelizes the off shore wind towards the 29 meters diameter turbines, each capable of generating 225 kW of energy. These turbines, attached to the sky bridges connecting towers, are designed to produce 1100 MW of electricity annually (Zhigulina & Ponomarenko, 2018). The innovative fluidic form, orientation and opening between the elliptically planned towers creates a wind-tunnel effect to attract high speed winds that run the turbine to generate upto 15 percent of energy requirement of the facility (Bahrain World Trade Center, 2020). It is landmark project of Bahrain which was awarded for the Best Use of Technology in

Figure 8 World Trade Center, Bahrain

the year 2006 and was renamed as the 'Best Tall Building' of the Middle East by the Council of Tall Buildings and Urban Habitat (CTBUH). Some of the features that contribute to the reduction of energy consumption include operable windows for ventilation, heat recovery system, grey water recycling, solar photovoltaic (PV) operated façade lighting and shading on the glass façade to minimize the heat gain.

3.3.2 Pearl River Tower, Guangzhou, China

The 300 meter high tower, having 71 floors, is located in the city of Guangzhou, China. CTBUH has enlisted Pearl tower as one of the sustainable tall building of the world. Integrated wind turbines at different levels enable generation of energy equivalent to its own requirement and consumption. The fluidic form has been conceived to attract high velocity winds to run integrated wind turbines (Webber, 2008). The orientation of the tower is such that the broader side faces the prevailing winds. The pair of openings accommodates wind turbines and also provides relief to the structure. Curvilinear form near the openings ensures the un-obstructed free flow of wind. Radiant cooling, high efficiency chiller system and lighting add to the sustainability of Pearl tower. Integrated photo-voltaics produce 200 MW of power per year. Additional energy saving is achieved through integrated sun shading devices. The tower also accounts for 30 percent of energy saving (Tomlinson et. al, 2014).

3.3.3 Pertamina Energy Tower, Indonesia

The iconic Pertamina Energy Tower is believed to be the tallest skyscraper of Indonesia. The 530 meters high tower has integrated innovative solutions for energy efficiency. The buiding design is famous for its unique form dominated by the principles of sustainability and energy efficiency. The tapered top end of the building has been designed to create a wind funnel at the top which will harness prevailing winds to upper floors for generation of energy. The campus includes a covered walkway throughout, covered with PV panels capable of generating energy while providing shade.

Owano (2013) stated that the project estimates substantial reduction in demand of water with about 26 percent of reduction in carbon emissions. The estimated energy generation from renewable sources is about 25 percent of total requirement. The campus targets zero water wastage through its green cover which accounts for 55 percent of total site area. According to Designbuild, the project was also nominated for Platinum grade Green certification by Green Building Certificate Institute (GBCI).

Figure 9 Pearl Tower, China

3.3.4 Swiss Re, London, United Kingdom

The spiral dia-grid structure made of steel makes Swiss Re, a landmark due to unique aerodynamic form. Constructed by Foster and Partners in 2004, it is the first eco-friendly tall building in London, mainly designed for commercial use.

The tower claims to utilize only half of the energy that a similar conventional building would use, due to its energy saving design strategy. It relies majorly on natural systems of ventilation, achieved through six shafts right behind the glass façade which create a chimney effect and allows unobstructed air flow within the building across the floors. The shafts maintain convenient temperature inside and insulate the office spaces. The warm air gets pulled out through these shafts during summers and in winters, warms up the building through passive solar heating and reduces energy loads. These shafts allow penetration of the daylight through these shafts into the internal spaces which results in further reduction of lighting loads and maintains a convenient and pleasing work environment.

Figure 10 Pertamina Tower, Jakarta

3.4 Photo-voltaic Facades (BIPV)

The photovoltaic (PV) panels planned as an integral part of the building design generate energy directly from solar radiations. It is a clean and abundant source of energy

Figure 11 Swiss Re, (The Gherkin), United Kingdom

without any adverse effect on the environment, especially, for high-rise buildings as their façade can receive unobstructed sunlight. Integrated PV transforms a skyscraper into a major source of energy due to the availability of large surface area of the facade, which otherwise is cost-intensive. Building Integrated Photo-voltaic (BIPV) also offers good thermal and sound insulation along with high aesthetics (Strong, 2016).

3.4.1 C.I.S. Tower, Manchester, United Kingdom

The Cooperative Insurance Society (CIS) tower, located in Manchester, is one of the old and tall buildings of United Kingdom. The original facade consisted of mosaic tiles which were replaced with the photovoltaic panels covering entire facade on three sides i.e. East, West and South, as the northern side would hardly receive direct sun. The tower is capable of producing 180 megawatt-hours of electricity per year through its photovoltaic facade having over 7000 solar panels. Additionally, it produces 10 percent of its energy requirement through wind turbines installed at the top of the building. CIS towers became the largest commercial solar facade of Europe with the integration of photovoltaic panels (Imeche, 2020).

3.4.2 The Solaire, New York City, US

The 27-story high rise, designed by Cesar Pelli and Associates, is the first residential tower in the U.S. to have integrated sustainable design features (Carey, 2006). The residential units of the tower have acquired LEED platinum rating. Photovoltaic panels incorporated into the façade along with a garden on roof top contribute to the higher level of sustainability by cooling down the internal spaces and enables the tower to generate energy.

The main objectives, according to Carey (2006), include conservation and purification of water through black water treatment system, enhanced quality of air, energy efficiency and recycled construction waste upto 93 percent (Horsley, no date). Horsley (no date) suggests that the tower consumes 35 percent lesser energy than a similar conventional one. The integrated PV contributes to 5 percent of building's energy requirement. The Solaire also reduces the requirement of portable water by 50 percent lesser than a conventional tower.

3.4.3 Conde Nast Building, New York City, USA

Figure 12 CIS Tower, Manchester, United Kingdom

The 48 story tower is located in New York City was designed by Fox and Fowle Partners. Some of the features of the building set the standards for commercial and office towers.
The building is energy efficient in terms of saving as well as generating energy. Photovoltaic panels have been mainly incorporated on the upper floors in spandrel areas, facing

Figure 13 The Solaire, New York City

The 48 story tower is located in New York City was designed by Fox and Fowle Partners. Some of the features of the building set the standards for commercial and office towers.

he building is energy efficient in terms of saving as well as generating energy. Photovoltaic panels have been mainly incorporated on the upper floors in spandrel areas, facing eastern and southern facades. Low E-value glass coating has been incorporated on the larger glass curtain surfaces which minimizes heat gain and loss and prevent penetration of unwanted UV radiation. Larger surface of glass curtain allows daylight to the internal spaces which reduces the lighting load. Other features include recycling systems, use of sustainable materials and enhanced indoor environment by allowing filtered fresh into the office spaces through specialized mechanical system.

Figure 14 Conde Nast, New York City

3.4.4 Lighthouse Tower, Dubai, UAE (Concept)

The Lighthouse Tower was planned to be the first low carbon footprint skyscraper of UAE. However, the project got cancelled in the year 2009 due to economic slowdown. According to Killa (2008), the features include three integrated wind turbines, photovoltaic southern facade and passive cooling techniques. The 300 meters high tower was designed to consume 50 to 60 percent lesser energy and 40 percent lesser consumption of water making it an example of highly efficient high-rise building design of the UAE.

3.4.5 Buj-Al-Taqa, Dubai, UAE (Concept)

Burj-Al-Taqa, also named as 'The Energy Tower', was designed to meet all its energy requirements through renewable sources. It is another iconic design which was not constructed but a useful concept for study. The 333 meters high tower was designed to reduce energy requirement by 40 percent from the integrated wind turbine and photovoltaic facade (McKeegen, 2008). A wind turbine was incorporated at the top along with integrated photovoltaic facade which could generate tremendous amount of energy.

4. RESEARCH OUTCOMES

The paper described some of the renowned tall buildings from different geographical locations with varying heights and specialized features to conserve energy. Various environment friendly techniques and green design strategies such as BIPV, vegetation facades, integrated wind turbines etc., have been incorporated to reduce energy consumption. It is observed that most of these buildings have incorporated natural components into their building designs and fulfil their energy requirement majorly through the renewable

Figure 15 Burj Al Arab, UAE & Figure 12 Burj-Al-Khalifa, UAE

sources of energy. PV panels have been widely incorporated on building facades combined with other natural or mechanical sustainable features for additional energy conservation. Some of the skyscrapers like Bahrain WTC, Pearl tower, CIS tower have appropriately utilized their height to incorporate the combination of photovoltaic and wind turbines. 15 to 30 percent of energy is conserved by fulfilling the energy requirement through renewable sources, which can be increased with further advancement of technology in the future. Some buildings like Lighthouse tower and Burj-Al-Taqa could save up to 40 to 50 percent of energy as envisaged at the design stage. The analysis (Table II) reveals that the higher range of percentage energy saving of 45 percent and 50 percent has been attained by Commerzbank tower and Gherkin majorly by ventilating the buildings naturally. BWTC, on the contrary, accounts for only 15 percent, however, it produces 1100 MW of power per year through solar and wind energy, which is the highest among all the buildings under study. Availability of renewable energy sources beyond limits and their incorporation in building design has altered entire phenomenon of skyscrapers which can further transform the entire high-rise building typology in the future, if incorporated and utilized appropriately.

Some of the towers utilize the climatic conditions and respond well to them by having incorporated energy conserving design components in accordance with the environmental conditions. Foster & Partners (2014), claim that Commerzbank tower runs on natural ventilation for

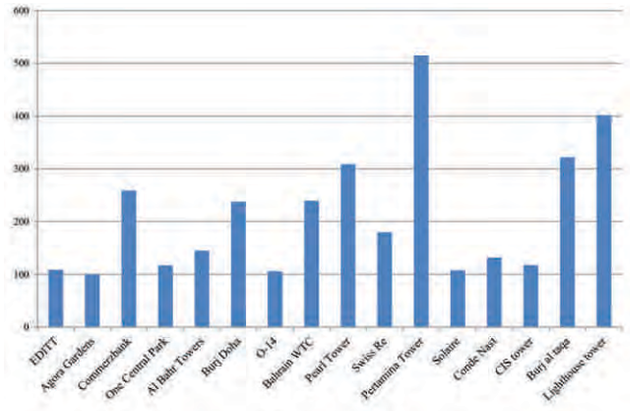


Table: Height Of Towers Under Study

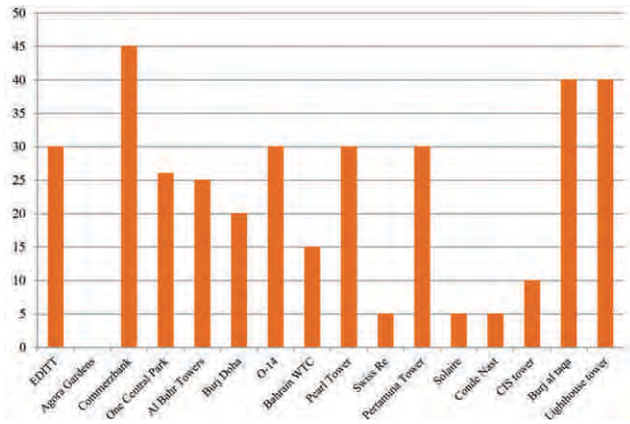


Table: Energy Saving By The Buildings Under Study

nearly three-forth of the year. Commerzbank, Germany lies in moderate to cold climate zone allowing the buildings to rely conveniently on natural ventilation for a longer time. On the contrary, towers of the Middle East such as Bahrain WTC, O-14, Burj Doha and Al Bahr, experience Hot and Arid climate and are constrained to incorporate terrace gardens in the building designs due to harsh desert sun which increases their dependency on mechanical ventilation (Attia 2016). Nevertheless, the high-speed prevailing winds favour the production of substantial amount of energy through wind turbines of Bahrain WTC. Increasing wind velocity with the height enables the towers to generate tremendous amount of energy, which can also be seen in the case of Pearl Tower. Subtropical and tropical regions favour vegetation which allows vertical landscaping in the buildings One Central Park,

TABLE I ENERGY EFFICIENT FEATURES AND TECHNIQUES OF BUILDINGS UNDER STUDY

	CLIMATE	PROMINENT SUSTAINABLE STRATEGY	ENERGY SAVING	ENERGY GENERATION	OTHER FEATURE(S)
AL BAHR TOWERS, ABU DHABI, UAE	Hot and Arid	Climate responsive facade screen for sun shading	25 %	N/A	Kinetic shading system, Weather-tight glass curtain wall, Reminiscent of Arab heritage
BURJ DOHA, QATAR	Hot and Arid	Climate responsive perforated façade screen for sun shading	20 %	N/A	Central Atrium, Structural system independent of façade, Reminiscent of Arab heritage
O-14, DUBAI, UAE	Hot and Arid	Structural perforated façade for sun shading	30 %	N/A	Air gap between facade and structure for chimney Effect to cool down window glazing
EDITT, SINGAPORE	Tropical	Vertical Landscape and Photovoltaic facade	30%	Yes, value not defined	self-sufficient in terms of water supply upto 31 % Sewage recycling
AGORA GARDEN, TAIWAN	Tropical/ Sub-tropical	Vertical Landscape and Photovoltaic roof	Not defined yet	130 MW per year, estimated (Photovoltaic)	Air Purification (absorbs 130 tons of Co2 per year), 6000 sqM of plantation, Rain Water Harvesting 1000 sqM PV
COMMERZBANK, FRANKFURT, GERMANY	Moderate to Cold	Vertical Landscape Triple layer Glazing, Central Atrium	45 %	N/A	Natural Ventilation for most of the year, Daylight, Stack effect
ONE CENTRAL PARK, SYDNEY	Humid Sub-tropical	Vertical Landscape	26 %	N/A	40 Meters cantilever with 320 reflectors at the bottom to redirect sunlight, Water treatment plant, Central Thermal Plant
BAHRAIN WTC, MANAMA	Hot and Arid	Wind Turbines, Photovoltaics	15 %	1100 MW per year (wind turbines)	Aerodynamic form
PEARL TOWER, CHINA	Humid Sub-tropical	Wind Turbines, Photovoltaic	30 %	200 MW per year	Radiant cooling, Daylight reflectors, High-efficiency lighting High – eff. Chiller system
PERTAMINA TOWER	Tropical/ Sub-tropical	Wind turbines	N/A	25 %	Aerodynamic form, Funnel shape design attracts winds
SWISS RE (GERKIN), LONDON	Moderate to Cold	Aerodunamic form, Natural Ventilation	50 %	N/A	Open shafts for ventiliation, heating and colling of the building naturally
CIS TOWER, MANCHESTER	Temperate	Photovoltaic facade	10 %	180 MW per year (Photovoltaic)	Wind Turbines, 10 % additional power production through wind turbines
SOLAIRE, NEW YORK CITY	Humid Sub-tropical	Photovoltaic Facade	35 %	5 %	50 % reduction in requirement of portable water
CONDE NAST, NEWYORK CITY	Humid Sub-tropical	Photovoltaic Facade	Yes, value not defined	Yes, value not defined	Low E-value glass coating
LIGHTHOUSE , UAE	Hot and Arid	Photovoltaic facade	40 %	Yes, Value Not defined	Wind Turbine
BURJ-AL-TAQA, UAE	Hot and Arid	Photovoltaic facade	50 %	Yes, Value Not defined	Wind Turbine

EDDIT and Agora Gardens. A large number of plants, shrubs and trees purify the air and improve its quality by removing harmful particulate and contribute to major energy savings.

The towers under study vary dramatically in terms of their heights ranging from 100 Meters to more than 500 Meters and all of them contribute to energy conservation. Increased height and surface area, when combined appropriately with local climatic conditions and sustainable design principles, can further contribute to tremendous amount of energy conservation while generating substantial energy. It is observed that the height of a skyscraper is not an independent determinant for energy conservation. Commerzbank tower and Gherkin tower, which are almost half of Pertamina tower in terms of height, save nearly double the amount of energy than that is estimated in the case of Pertamina tower, majorly through natural ventilation.

CONCLUSION

Energy conservation has brought up a pursuit to design and build green and sustainable skyscrapers with majority of them relying on renewable sources, mainly by harnessing solar and wind energy, to meet their energy requirement with a special consideration towards their iconicity which commenced a new generation of high-rise development. Modern technology, innovative construction techniques and energy efficient design strategies have completely transformed the concept of tall buildings into highly sustainable skyscrapers. The study of skyscrapers from different climate zones is significant in terms of its applicability in various parts of India having diverse climatic conditions. Solar passive design principles, generation of energy from solar and wind energy could be an appropriate solution at present, especially for the high-rise buildings in India. Photovoltaic is already gaining popularity in our country due to availability of sun in abundance in most of the regions for production of electricity. Several developments are emphasizing sincerely on reducing the energy loads and meeting their energy requirement through renewable sources of energy. Major initiatives are already being taken by global organizations, governments, public and private sectors to promote generation of power though solar energy in India (Ministry of Commerce and Industry, India, 2017). Thin film advancement for solar PV makes it more convenient to develop photovoltaic facades for skyscrapers (Quesada et.al).

Incorporating wind turbines in tall buildings would require specialized structural design to support huge wind turbines and aerodynamic form for efficient functioning; hence, incorporating more number of smaller wind turbines could be a better solution rather than installing massive turbines which is more cost intensive presently. However, the resultant output would be a major concern. Possibilities are already being explored to promote wind energy in our country through various incentive schemes (GBI Scheme, 2015). Similar incentive schemes in building industry will encourage Architects, Designers and Developers to incorporate the use of photovoltaic, wind turbines in their designs and further innovate and promote more such environment-friendly techniques. Some buildings can be incorporated also with vegetation as an integral part of the design, for cleaner air quality and further reduction of heat gain.

Combination of BIPV, wind turbines and plantation will be an efficient and economical solution in the long run, as compared to conventional methods, if mass produced, promoted and incorporated in the building design, development of townships and public places. Use of renewable sources of energy is a futuristic approach for a better tomorrow, and presently the most encouraging aspect for the development of eco-friendly techniques is the development of green skyscrapers. An integrated multidisciplinary design approach would encourage green skyscrapers as an integral part of a development plan rather than designing skyscrapers which stand alone in isolation.

FUTURE RESEARCH

The future research may examine the social acceptability of sustainable skyscrapers in our country for all age-groups. The age-friendliness of such skyscrapers, with an emphasis towards senior citizens and their requirements, need to be studied for further incorporation in the design. The concept

Figure 16 Iconic skyline of Dubai, UAE

Figure 17 Skyline of Bahrain

of high-rise living is newer in our country and is emerging rapidly; hence, an investigation of its impact socially, culturally and economically is required. Furthermore, there is a possibility to utilize geo-thermal sources, to further meet energy requirement of high-rise buildings in India for optimal use of renewable sources of energy by the building industry.

REFERENCES

- Afonso C, Oliveira A. (2000), 'Solar chimneys: simulation and experiment', Energy Build 2000;32(1):71–9. http://dx.doi.org/10.1016/S0378-7788(99)00038-9.
- Agora Tower, Taipei (2020) [Online], Available: https://www.designbuild-network.com/projects/agora-tower-taipei/
- Attia S. (2016) Evaluation of Adaptive Facades: The case study of Al Bahr Towers in the UAE; Qscience Connect, Hamad Bin Khalifa University Press
- Bahrain World Trade Center (2020), OTIS [Online], Available: https://www.otis.com/en/hk/projects/case-studies/Bahrain-World-Trade-Center/
- BEGEÇ, H., (2013), "Sürdürülebilir Yüksek Yapı Tasarımında Yönelimler", Egemimarlık, 2013/1-83, syf:30-36
- Carey H.L. (2006). The Solaire: Green by Design, Battery Park City Authority, New York.
- Campi M.(2000), 'Skyscrapers: an architectural type of modern urbanism'. Boston: Birkhäuser; 2000.
- Chan B. (1997), 'Banking on ventilation', Archit J 1997;202:36–9
- Council on Tall Buildings and Urban Habitat [Online] https://awards.ctbuh.org/winners/?award-year=2012
- Cruickshank A. (2018) World's Smartest Building: Bosco Verticale, [Online], Available: https://placetech.net/analysis/worlds-smartestbuildings-bosco-verticale/
- Doha Tower (2020) – Facts and Information [Online] Available: https://thetowerinfo.com/buildings-list/doha-tower/
- Design Build (no date). Pertmina Energy Tower, Jakarta, Design Build [Online] Available : https://www.designbuildnetwork.com/projects/pertamina-energy-towerjakarta/#cNavBarChannelContentCentralNervousSystem
- Emporis (2000). High rise buildings (ESN 18727), Emporis [Online] Available: https://www.emporis.com/building/standard/3/high-risebuilding
- EU, 2010.Directive2010/31/EU of the European Parliament and of the Council on the Energy Performance of Buildings.
- Foster, N. (2001), Green Architecture, AD Architectural Design, Vol.71 No.4 July 2001, ISBN 0-471-49193-4
- Foster, & Partners. FosterþPartners; 2014.http://www.fosterandpartners.com/projects/Commerzbankheadquarters/ Frearson A. (2013) Agora Garden by Vincent Callebaut, Dezeen [Online], Available: https://www.dezeen.com/2013/04/05/agora-garden-by-vincent-callebaut/
- GBI Scheme (2015), http://www.energysector.in/wind-news/gbischeme-for-wind-extended-for-12th-period Accessed on January 9, 2015.
- Hocaoglu FO, Gerek ON, Kurban M. A novel hybrid (wind–photovoltaic) system sizing procedure. Sol Energy 2009;83:2019–28
- Horsley C. (no date)). The Solaire, 20 River Terrace, CITY REALTY [online], Available : https://www.cityrealty.com/nyc/battery-parkcity/the-solaire-20-river-terrace/26573
- Imeche (2020) Case Study: CIS Tower Manchester, Instituition of Mechanical Engineers [Online] Available: https://www.imeche.org/policy-and-press/from-our-perspective/energytheme/renewable-energy/what-is-renewable-energy/cis-towermanchester
- Karanouh A. And Kerber E. (2015) Innovations in Dynamic Architectural – The Al Bahr Towers Design and delivery of complex facade; Journal of Facade Design and Engineering, IOS Press
- Killa S. (2008) Lighthouse tower with low carbon foortprint, LafargeHolcim Foundation [Online] Available: https://www.lafargeholcim-foundation.org/projects/lighthouse-towerwith-low-carbon-footprint-dubai-uae
- McKeegen N. (2008) Burj Al Taqa: self-sufficient skyscraper design, New Atlas [Online] Available: https://newatlas.com/burj-al-taqa-selfsufficient-skyscraper-design/9431/
- Ministry of Commerce and Industry, India (2017), 'Power Sector report,' Brand Equity Foundation, Department of Commerce, , GoI. http://www.ibef.org/industry/power-sector-india.aspx (Accessed on 01.09.2017)
- Newman P. (2001), Sustainability and Cities: The Role of Tall Buildings in the New Global Agenda, Proceedings of the CTBUH Sixth World Congress. Melbourne, Australia. Pp. 76-109
- Nouvel J., Beissel B. (2014), 'Case Study: One Central Park, Sydney', CTBUH Journal, Issue IV
- Owano N. (2013). Jakarta's 99-story Pertamina tower makes energy key design principle, Phys.org. [Online] Available : https://phys.org/news/2013-12-jakarta-story-pertamina-towerenergy.html
- Park J., Reem A. (2017) The Evolving Transformation of Mashrabiya as a Traditional Middle Eastern Architectural Element, International Journal of Civil & Environmental Engineering
- Paulo J.S. Cruz (2016), Structures and Architecture: Beyond their limits, 2016.
- Quesada G.; Rousse D.; Dutil Y; Badache M.; Hallé S., 'A comprehensive review of solar facades. Transparent and translucent solar facades' , Industrial Research Chair, École de technologie supérieure, University of Québec
- Rachael, J. (2005), Green Building Movement, Washington State Department of Ecology,
- Reiser J.; Umemoto N.; Ocampo J. (2010), 'Case Study: O-14 folded exoskeleton', CTBUH Journal, Issue III
- Smith A. (2015). Heat Pumps: Bosco Verticale. CIBSE Journal, 19 Available:https://www.designingbuildings.co.uk/wiki/CIBSE_Case_Study:_Bosco_Verticale
- Strong S. (2016) Building Integrated Photovoltaics (BIPV), Whole Building Design Guide [Online], Available: https://www.wbdg.org/resources/building-integrated-photovoltaics-bipv
- Tomlinson R.;Baker W.;Leung L.;Chien S.;Zhu Y. (2014), 'Case Study: Pearl River Tower, Guangzhou', CTBUH Journal, Issue II
- Webber, M. (2008) 'Skyline gets facelift ahead of Asian games', Wall Street Journal of Real Estate, http://online.wsj.com/article/SB121917541789554165.html?mod=reside ntial_real_estate
- Yeang, K.; Powell, R. Designing the ecoskyscraper: Premise for tall building design. Struct. Des. Tall Build. 2007, 16, 411–427 (for EDITT)
- Yoneda Y. (2008), 'Singapore's Ecological EDITT Tower'. Inhabitat [Online], Available: https://inhabitat.com/editt-tower-by-trhamzah-andyeang/
- Zhigulina A. , Ponomarenko A. (2018), 'Energy efficiency of high-rise building', E3S Web Conf. Volume 33, 2018, High-Rise Construction 2017 (HRC 2017) [Online], Available: https://doi.org/10.1051/e3sconf/20183302003

Conservation: The Bridge between Past and Future

- Prof Sunanda Satwah

Sunanda Satwah, Associate Professor at CTES College of Architecture, is an Environmental Architect with 17years experience in the field of Architecture and Healthcare Design. Proprietor of 'Sunanda Satwah Architects' (sunarcs), she is an IGBC-AP, GRIHA-CP and GRIHA Evaluator. Ms. Satwah graduated from Rizvi College of Architecture, Mumbai (2002) and acquired Master's degree in Environmental Architecture from Rachana Sansad's Institute of Environmental Architecture, Mumbai (2016). An Architect, Educator and Writer, Ms. Satwah has presented papers at several International Conferences & has had over 60 articles published in various National & International publications.

satwah1@rediffmail.com

ABSTRACT

Urban Conservation is a bridge across the past and the future- the narration between historic preservation and future sustainability. The paper explores this connect in context to Corbusier's contribution to 2 Indian cities, both UNESCO World Heritage sites. It analyses Corbusier's modern movement, stringing through architectural experimentation, material application and climatic consciousness - looking at the Architect's buildings through the lens of Climate responsive design and Environmental Sustainability. The paper raises a critical comment on the local context, contemporary regionalism and how the architect's work shaped the fate of the new city of Independent India- Chandigarh; and how the brutalist style held its own amongst Ahmedabad's vernacular jaalis, pols, kunds and vavs.

This paper explores the jugalbandi (a back and forth process) of past and future; a medley of historical associations and sustainable possibilities that together explore why conservation is more than an exercise of historical preservation. It may have, hidden within it, the key to our future.

Key Words: Le Corbusier, Climate Responsive Architecture, Contemporary Regionalism. Chandigarh.

What makes a building, city or culture worth conserving, while others crumble away to negligence, and are abandoned to the corrosion of time?

UNESCO cites 10 criteria. In 2016, UNESCO added 17 buildings* built over half a century, by Architect Charles-Édouard Jeanneret, better known as Le Corbusier, in the UNESCO World Heritage List. These buildings lauded for being outstanding contributions to the modern movement, under Criteria 1, 2 & 6. by the master of Modernist Architecture are strewn across 3 continents and 7 countries, including France, Switzerland, Belgium, Germany, Argentina, Japan and India. They reflect the Architect's experimental solutions to the Modern movement in response to 20th century's building needs, leading to the evolution of a new architectural style. The listing celebrates an unprecedented internationalization of architectural practices. The world is a global village, and we are not unaffected by development half way across the globe. However, for the people who inhabit or use the buildings protected under Heritage status, there is a need to be rooted to the local context. Can buildings be global and yet local? Can a glocal approach to architecture be sensitive to its site context? Corbusier, has often been accused of designing buildings in response to his personal expressions, beliefs and experimental whims. Sixty-six years later when we examine the buildings he designed in Chandigarh and Ahmedabad, through the lens of regional context and climate responsive design, we find them having stood the test of time. Whereas the city of Chandigarh, the only city design executed by Le Corbusier, presents a brutalist and purist backdrop to Nehru's vision for free urban India; the heritage city of Ahmedabad with its history of stone cut Architecture, creates an interesting backdrop for Corbusier's Mill Owner's Association Building, and Villa Shodhan.

Le Corbusier's contribution to the 3 trends of modern architecture: brutalism, purism and sculptural architecture, continue to be studied and emulated; while his buildings are identifiable by their distinct vocabulary of geometry, modularity, repetition, exposed finishes and inclusion of light.

COMPLEXE DU CAPITOLE, CHANDIGARH

The Capitol Complex, a UNESCO World Heritage Site since 2016, is a government compound spanning 100 acres, consisting of 4 monuments, including the Open Hand, Geometric Hill, Martyrs' Memorial and Tower of Shadows; and 3 buildings, which are the Legislative Assembly building or Palace of Assembly, Secretariat and High Court or Palace of Justice. These buildings amongst others in Chandigarh, reflect the collective environment- conscious philosophy of Jane Drew, Maxwell Fry, Otto Königsberger and Le Corbusier.

THE CITY, THE ARCHITECT AND EARLY INFLUENCES

People are the sum total of their experiences. (B. J. Neblett)

Le Corbusier challenged the building status quo of his times, experimented extensively and evolved new styles and systems that were replicable and efficient. The decision to appoint a Swiss-French architect to build a new city for free India was mired in political ambitions and symbolism. The message Pt. Nehru sought was to liberate the country's image from its agrarian past and elevate it to a futuristic modern urban city. The intent was to provide a capital for the divided state and move on from the wounds of partition.

A similar approach was also observed in Brasilia, when Brazil decided to usher progress by building a new capital. History is witness that recently liberated nations, often declare their independence from shackling pasts by planning strategical Capital Cities as symbols of the new world, claiming freedom from old monarchies and painful memories.

In the middle of difficulty, lies opportunity. (Albert Einstein)

A remarkable trait that lent itself to Le Corbusier's signature style is the unabashed use of exposed concrete. Whereas, some argue that the excessive use of concrete was an unsuitable approach for Tropical Chandigarh, one must recall that the design brief required to build a new city quickly to house half a million war refugees, and to become a symbol of hope for its people. To this effect, the site for procuring large scale limestone deposits for setting up a cement factory was in close proximity to the new city, ensuring ease of transportation and financial viability. Speed of construction was a major factor and concrete in modular formwork, offered the advantage of quick replicability.

A TALE OF TWO HERITAGE CITIES

Ahmedabad, was declared India's first Heritage City by UNESCO in 2017, while the Capitol Complex, in India's first planned city, acquired the World Heritage status in 2016. Whereas Chandigarh is a modern city built from scratch, Ahmedabad enjoys old-world charm.

Ahmedabad as a city, narrates the visual timeline of India – periods of transition that document the socio-political journey of the Nation, documented in its Architecture of pols, havelis, mosques and minarets that survived to tell its story.

CLIMATE RESPONSIVE DESIGN IS FOREVER

The sun that shone on this land a hundred years ago, shines even today.
Buildings that are designed in response to climate, shall forever by relevant.

Both the cities of Chandigarh and Ahmedabad experience composite climate, and for thermal comfort need to reduce heat gains during summers and heat loss during winters.

Le Corbusier's buildings have often been appreciated on the merit of style, however, a closer look reveals that they were also sensitive to local Iconography and the climate in an unobtrusive manner. The buildings were rooted in context and designed in response to the sun and wind.

CITY AS AN ORGANISM

Something as small as the flutter of a butterfly's wing can cause a typhoon halfway around the world. (Chaos Theory)
The Vedas, Fengshui, Taoists and Buddhist philosophies believe that we are all connected. We are thus, not independent of our buildings; and our health, well-being and longevity is influenced by our surroundings.

Corbusier's design reflects this interweave between man and the city. He planned the city as an organism, where the Capitol complex at the foot of Shivalik Hills forms the head, commercial centre-heart, industrial areas- limbs, green areas and parks-lungs, and the veins and nerves represent the connectivity of roads and service pipelines.

Figure #1: Aerial view of Chandigarh

Figure #2: Map of Chandigarh

The design of each sector as a self-sufficient independent unit underlies the philosophy of sustainability. The walkable sectors are an example of the innate connection between

Figure 1: Tree diagram of methodology used

man and nature, planned as a conscious approach to harmony. In recent times, this idea resonates with the super-blocks of Barcelona, where the city is making way for pedestrians and green interventions within the grids.

Climate responsive features observed in the Capitol Complex, and the vocabulary that carries itself to the rest of the city's architecture, has its basis within two of Corbusier's famous 5point principles: the pilotis & the free façade design. Whereas the pilotis helped achieve tall heights unencumbered by walls, allowing natural sunlight inside; the free façade with brise soleils, controlled the amount of sunlight streaming in. The use of pilotis in the Palace of Assembly, allows for a multiple level atrium with the offices looking into the central waiting area outside the Punjab Legislative Assembly chamber.

BRISE SOLEIL AND PARASOL ROOFS

The use of sun-breakers as observed in the High Court, Secretariat and several other public buildings in Chandigarh, protects the interiors from direct sunlight on the South-East and North-West facades, while allowing free flow of cross ventilation. Prevalent winds in Chandigarh are experienced from SE in summers and NW in winters. The use of an elevated parasol roof in the High Court building serves as a thermal cooling device, by blocking direct radiation to the terrace slab and thus reducing thermal heat gains and by allowing cross ventilation to cool the terrace slab. The roof also diverts rain water from the central trough to spouts on either end.

Figure #3: Brise Soleil at Palace of Justice

Variations in opening sizes of sun-breakers (brise soleils) as observed in the Palace of Justice, are inspired from the modular- adapted to golden proportions, creating visual interest and breaking monotony.

Tower of Shadows, the only building in the Capitol Complex designed in alignment with the North-South axis, is an open-sided hall, designed as an experimental building by Corbusier to understand the solar movement and establish shade, thermal comfort and lowered temperatures in a hot country. Considered a monument, it was designed on site to study the sun path, solar ingress and to determine the design and depth of solar shading devices (overhangs and fins) to ensure comfort.

The tower of shadows claims that the sun never enters the built form and the interior is always cast in shadows

Figure #4: Mill Owner's Association

especially in summers, even though the building has no walls on the north and the other three sides are a juxtaposition of brise-soleil.

SKYLIGHTS, RIBBON VENTILATOR OPENINGS

Corbusier designed with light; but he was also aware of its unforgiving nature during the harsh hot summers, and designed skylights and high windows to offer diffused light. This can be observed in the Punjab Legislative Assembly - within the circular assembly room and also in the waiting area outside. The triple height waiting area is an impressive space, the high roof supported by mushrooming white pilotis, while the central atrium is enveloped by corridors and offices on the periphery.

Figure : Tower of Shadows in front of Palace of Assembly

Figure : Government Museum and Art Gallery

Ribbon windows high on the wall, under the ceiling slab, punctuated with sun-breakers is a vocabulary that is also observed in the Government Museum and Art Gallery, Chandigarh, allowing ample natural light without disturbing the exhibits.

WIND & VERANDAS

The composite climate of Chandigarh necessitates reducing heat ingress and allowing cooling through shading and cross ventilation. This has been achieved by providing deep verandas, colonnades in shopping areas, small windows, high ventilators and brick jaalis. The houses are designed for outdoor sleeping at night, for which front yards, backyards and roof top terraces were provided. The parapet walls to the terraces are often designed as an assembly of brick jaalis or provided with windows to allow for night time ventilation.

SPOUTS, WATER CHANNELS AND SUKHNA

The spouts on roof terraces was designed to divert water into shallow tanks, as observed in the Palace of Assembly and Palace of Justice, which would help humidify the air and cool the microclimate. This fascination with water, at a unit level, is observed in the Chandigarh museum and Gandhi Bhawan, designed by cousin Pierre Jeanneret; and at a macro city level, in the leisure valley and the Sukhna lake. The architect, planned for the water from the Himalayan Shivalik hills to be collected into a manmade catchment area, by damming the Sukhna choe, creating the rain-fed Sukhna lake. The biophilic impact of nature and water has been well incorporated in the city plan. A history of water bodies in India reveals the ingenuity of its people, even in places where water has been scarce. The kunds, tankas, baoris, jaseris, rejanis and vavs of Gujrat, Rajasthan, Delhi and Karnataka, speak of a nation that valued water, worshipped it and cherished it. It is thus mortifying to realize that a culture that was once rich in water wisdom, and a land that is blessed with ample monsoons and good rainfall, finds itself in UN's severely water-stressed map of the world.

UNIVERSAL ACCESSIBILITY

Another endearing feature of Le Corbusier's buildings is the inclusion of ramps. Asides from serving the obvious purpose of carrying construction material and workers to the required level, today they render these buildings universally accessible. The usage of these buildings is independent of the sporadic load-shedding that Chandigarh experiences in summers, and the ramps contribute towards making the city senior-citizen-friendly.

Ramps can be observed in the Secretariat building, Palace of Assembly, Mill Owner's Association building, and several other buildings within the planned city. The Punjab

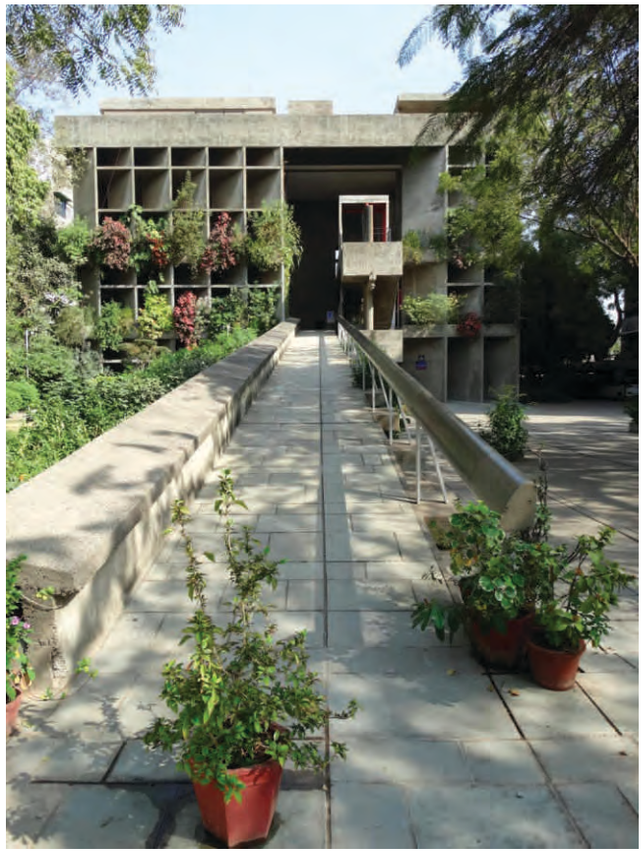


Figure 7: Mill Owner's Association Building

Figure 8: Punjab University Students' Council Building

University Student Council Building, even though not designed by Corbusier himself, sports his trademark style of ramps, exposed concrete and slim vertical windows.

DAY, NIGHT & SEASONS

Buildings are designed in sync with the cycle of day, night and seasons. This philosophy is graphically reflected in the Geometric Hill monument within the Capitol Complex, and also painted on the ceremonial door of the Assembly building.

The exposed concrete and brick masonry were left un-plastered not only to save on unnecessary expenditure, but to also offer visual comfort. Red clay bricks on a summer day are easy on the eyes, unlike white surfaces that reflect light and cause glare, as experienced in the white city of Anandpur Sahib. The recessed mortar pointing within the brick courses, over the years has offered reprieve to small creatures in the form of homes, food hiding places, perches and footholds, contributing to the biodiversity of the green city. Squirrels scurrying up and down the walls; babblers, mynahs and parrots perched on brick edges are common sights in Chandigarh. These visual delights are starkly absent in glass clad buildings of most modern cities today. The monolithic rising towers of neighbouring Zirakpur serve as an antithesis to Corbusier's haptic city.

Since the city is planned on a grid iron layout, all roads span in NE-SW and SE-NW axis, intersecting at right angles. Asides from offering visual relief to the drivers from direct sunrays while driving, the tree-lined avenues further provide visual and ecological delight. The 7V Circulation system of roads proposed for the city ensure that the roads are mindful of pedestrians and cyclists, and are marked with certain types of trees. The V3 roads for instance, are planted with mango (Mangifera indica), imli (Tamarindus indica), kusum (Schleichea trijuga) and chukrasia (Chukrasia tabularis) trees which have spreading forms and create 'green tunnels.' Whereas, the V4 streets abutting shopping complexes are provided with aesthetic flowering trees such as amaltas (Cassia fistula) and different species of lagerstroemias.

The roads have been rendered unique identities based on the trees that are planted, affording them a distinct association. The transition of the seasons can be admired in the changing colours of the trees. Streets can be recognised by the sight of amaltas, chukrasisas and mangoes.

The flowering trees are veritable reminders of where a person is, both with reference to geographical location within the city and the season of the year.

GARDENS GALORE

Each sector has been allocated green pockets shared amongst residential units. Asides from these there are larger gardens within the city that serve as community gathering spaces, some of which are also dedicated to a certain plant species, such as the rose garden, bougainvillea garden, garden of fragrance, topiary garden, hibiscus garden and botanical garden. There is also a green stretch that meanders across the city, known as leisure valley. Green strips of native grass and trees, run parallel to major roads, separating the polluting vehicular roads from the narrow cycle and pedestrian tracks. Traffic islands dotting the city are marked by landscape.

PEOPLE RESPONSIVE DESIGN

How can a city be sustainable if it cannot sustain its people? People need more than food, clothing and shelter. To thrive, people need social communication, connectivity and common beliefs. They need spaces that can facilitate such interactions.

Even though the sectoral unit planning is designed to be independent and self-sufficient with residential, commercial, market spaces and green pockets for leisure and interaction; the city as a whole also provided for centralized interaction spaces such as the commercial hub in sector 17 or large gardens and grounds for celebrations of community festivals.

Figure 9: Geometric Hill showing passage of sun

Figure 10: Assembly Door

Indian iconography and symbolism form an integral part of the city's culture and can be observed in several motifs strewn around the city, in the form of concrete casts, lithographs and tapestries. The motifs celebrate nature: pastoral animals, Harappan seals commemorating the Ghaggar river, replicas of birds and fishes, and the sun's path in the sky.

The city of Chandigarh was planned to house victims of partition, scarred by separation. It was intended to be more than another refugee land; it was meant to be a message. And even though enough has been said about the choice of architect, materials used and style of architecture; there are valuable lessons we can learn from the city: Lessons we can choose to adopt, discard or ignore. The lessons we learn, will determine where we go next.

Urban Conservation tells us what was; and what can be.

CONCLUSION

We conserve so that history may be preserved. However, in the case of Chandigarh, the buildings also serve a lesson for the present and the future. They continue to offer lessons on how to reduce heat gain, encourage heat loss, channel wind and water. The knowledge accumulated from Chandigarh's archiscape is a legacy, espoused in designs by M.N. Sharma, B.V. Doshi, Christopher Beninger and several others. Through a guru-shishya (teacher- student) relationship, the lessons have carried themselves into the future.

Urban conservation serves as a path to sustainability. It savours & preserves for us the lessons of the past, lest we forget. The road to the future can be found in the footprints of the past. Let us reclaim that which is important, honour that which is our identity, and in the process save our future. Let's learn from our past, so that we may be able to transfer its wisdom to our future.

NOTES:

*17 buildings by Le Corbusier under UNESCO World Heritage List, include: The Unité d' Habitation in Marseille, Notre Dame chapel in Ronchamp, The National Museum of Western Art in Tokyo, Villa Savoye in Poissy, Petite maison au bord du lac Léman in Corseaux, Cité Frugès in Pessac, Maison La Roche-Jeanneret in Paris, Maison Guiette in Antwerp, Weissenhof Estate in Stuttgart, Immeuble Clarté in Geneva, Immeuble locatif à la porte Molitor in Paris, Usine Claude et Duval Factory in Saint-Dié, Maison Curutchet in La Plata, Cabanon de Le Corbusier in Roquebrune-Cap-Martin, Maison de la Culture in Firminy, Couvent Sainte Marie de LaTourette in Eveux-sur-L'Arbresle, and Complexe du Capitole in Chandigarh. ■

REFERENCES

Referenced Books:

- Bahga, S., & Bahga, S. (2000). Le Corbusier and Pierre Jeanneret: Footprints on the Sands of Indian Architecture. New Delhi: Galgotia Publishing Company.

Corbusier, L. (2000). Modulor 2. (P. d. Francia, & A. Bostock, Trans.) Switzerland: Birkhauser.

- Kalia, R. (2002). Chandigarh: The Making of an Indian City (New Updated ed.). New Delhi: Oxford University Press.
- Khan, H. U., Beinart, J., & Correa, C. (2009). Le Corbusier: Chandigarh and the Modern City. Ahmedabad, India: Mapin Publishing.
- Pallasmaa, J. (2012). The Eyes of the Skin: Architecture and the Senses. West Sussex, UK: John Wiley & Sons Ltd.
- Prakash, V. (2014). CHD Chandigarh. (A. A. Garreta, Ed.) New Delhi: Bloomsbury.
- Samuel, F. (2007). Le Corbusier in Detail. Massachusetts: Elsevier Ltd.
- Singh, C., Wattas, R., & Dhillon, H. S. (1998). Trees of Chandigarh. Delhi: B.R. Publishing Corporation.
- UNESCO. (2010). The World's Heritage: A Complete Guide to the Most Extraordinary Places. UK: UNESCO Publishing & Harper Collins Publishers Ltd.
- Unwin, S. (2014). Analysing Architecture (Fourth ed.). New York: Routledge.

WEB DOCUMENT:

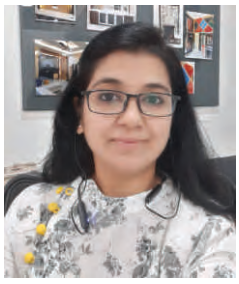
- Basu, S. (2018, March). NPTEL online course. Retrieved from https://onlinecourses.nptel.ac.in/noc18_ar04/preview
- UNESCO. (n.d.). The Architectural Work of Le Corbusier, an Outstanding Contribution to the Modern Movement. Retrieved from A UNESCO website: https://whc.unesco.org/en/list/1321
- UNESCO. (n.d.). UNESCO . Retrieved from https://whc.unesco.org/en/criteria/
- Winston, A. (2016, July 19). UNESCO adds 17 Le Corbusier projects to World Heritage List. Retrieved from dezeen: https://www.dezeen.com/2016/07/19/unesco-adds-17-le-corbusier-projects-world-heritage-list/

PHOTO COURTESY:

Prashant Chauhan: Mill Owner's Association Building, Ahmedabad
Sunanda Satwah: Images in Chandigarh

Understanding Relationship of Recycle and Architecture for a Sustainable Habitat

- Ar Jai Shejwalkar



Ms Jai Shejwalkar an alumnus from NDMVPS's College of Architecture, Nashik, Maharashtra (2003) followed by Post Graduation in Urban Management from M I T S, Gwalior, Madhya Pradesh (2010), is an practicing architect and has an overall experience of seventeen years in the field of architecture. As an academician, she has been associated with the School of Architecture, ITM University Gwalior since 2014 to date as Associate Professor teaching Urban Planning Building Construction and Design. Prior to this, she has also taught at her alma mater M I T S, Gwalior, Madhya Pradesh as a visitng lecturer from 2010-2011. Her professional experience has been in residential and commercial projects including interiors, and her research interests are in sustainability in built environment. She has also qualified in the prestigious IGBC Associateship Examination.

ar.jaishejwalkar@gmail.com

ABSTRACT

With the invention of new technologies in all fields came its side effects. Side effects, which are worsening our environment. All the man-made things and inventions are useful to mankind but their insensitive use lead to putting some pressure on our environment through all types of pollution. The use of all types of non- biodegradable materials produces tons and tons of waste impacting our mother earth. Our changing lifestyle of "use and throw" creates huge municipal waste every day. And very few percentages of it undergo recycling. Even building industry is second largest waste producing industry in the world. As an architect, being sensitive to the issue, can different ways to handle the waste be thought of? The three "R" – Reduce, Reuse and Recycle are needed to be studied in the architectural context. 'Reduce' will include ways how to reduce building foot print on environment and without creating waste; while 'Reuse' includes sensitive methods of demolition and adoptive reuse of buildings and materials. 'Recycle' includes producing and understanding different ways to handle non-biodegradable waste in architecture and construction.

This paper is a review of innovative practices going on above three models "reduce, reuse, and recycle". Understanding, analyzing and its elaboration of these practices is the focus of the paper.

Keywords: Sustainable, recycle, reduce, reuse, innovative, architecture, construction, plastic waste

Recycling is the process of converting waste materials into new materials and objects. It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing: energy usage, air pollution (from incineration), and water pollution (from landfilling).

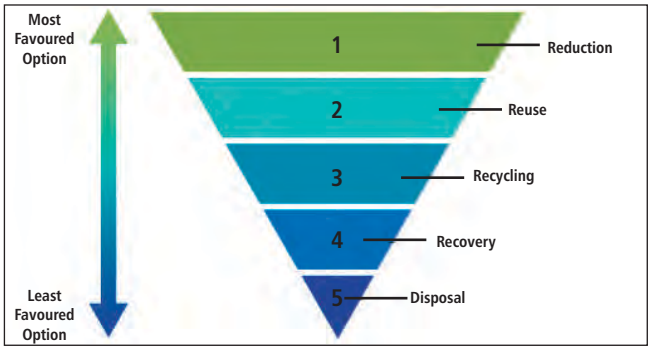


Fig-1 sustainable waste management hierarchy

A. Understanding "reduce" aspect with reference to building and construction industry:

Any construction process impacts and modifies local ecology. For an environmentally sensitive architect, it is crucial to analyze the nature of these impacts to take correct decisions. Measurement of construction project's impact is done by understanding the interplay of factors shaping the local ecology: geographical location, land topography, rivers and waterways, rainwater catchments and architect's interventions in each of these.

For example, a building uses bricks which have to be brought from far away distances – usually rural areas. This results in exploitation of a distant resource, air pollution and transportation wastage.

Biome, a Bangalore based architectural firm headed by Ar Chitra Vishwanathan and team make bricks on site by using the mud which was excavated during foundation laying of building. Further several houses have basements which apart from acting as a cool space, give additional mud for building a home. All houses built by them have Rainwater Harvesting thus reducing dependence upon the grid for supply of water. They also experiment extensively with waste water treatment and re-use. "Filler slabs" have had discarded computer keyboards put in them thus reducing

demand for cement. In building foundations, they use plastic bags thus making them effective "waste sinks".

B. Understanding "reuse" aspect with reference to building and construction industry:

Reuse can be defined as using a waste product without further transformation and without changing its shape or original nature. This is the second option in the waste hierarchy. Different types of solid wastes can be reused, such as bottles, old clothes, books and anything else that is used again for a similar purpose to that originally intended. Reuse means that less solid waste is produced. It brings other benefits by taking useful products discarded by those who no longer want them and passing them to those who do.

Reuse of construction and demolition waste

One way to reduce construction waste is to start with a "soft" tear-down of a building, called deconstruction, prior to a complete demolition. Deconstruction involves dismantling the structure in an effort to salvage construction materials for reuse. Through deconstruction, materials like windows, plumbing fixtures, ceiling and floor tiles, or large pieces of lumber are removed intact for use in new construction or renovation.

Not only building material but also asphalt toppings can be used as the base for new asphalt pavement. As it is well said that reuse is the most beneficial form of recycling the waste products. In developing countries like India where there is poverty and massive requirement of low-cost housing, these products can be consumed easily and also reduce cost of construction of affordable houses. Once the reusable item is taken out rest of the construction and demolition waste can be processed for recycling

C. "Recycle"

Non- biodegradable waste, which cannot be decomposed by biological processes is called non-biodegradable waste. These are of two types - Recyclable: waste having economic values but destined for disposal can be recovered and reused along with their energy value. e g. Plastic, paper, old cloth etc. Non-recyclable: waste which do not have economic value of recovery. e.g. Carbon paper, thermo coal, tetra packs etc. Disposal of non-biodegradable waste is a major concern, not just plastic, a variety of waste being accumulated.Some of the non - biodegradable waste which can be recycled and used in construction

Year	Bio-Degradables	Paper	Plastic/ Rubber	Metal	Glass	Rags	Others	Inert
1996	42.21	3.63	0.6	0.49	0.60	-----	-----	45.13
2005	47.43	8.13	9.22	0.50	1.01	4.49	4.02	25.16
2011	42.51	9.63	10.11	0.63	0.96	-----	-----	17.00

Source: Planning Commission Report

Table: Change in composition of Municipal solid waste with time (in %)

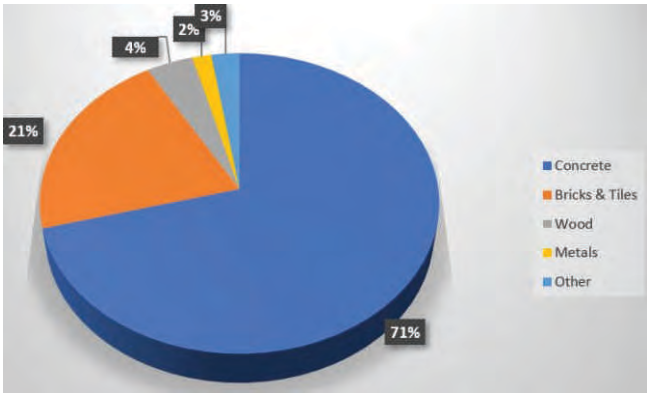
industry are- Rubber, Glass, Construction waste, Metals, metal cans, tins, metal scraps, man-made fibers like nylon, Plastic products like grocery bags, plastic bags, water bottles, Computer hardware like glass, CDs, DVDS, cellophane, processed woods, cable wires, Styrofoam etc.

In this paper, we are focusing on two major products- Construction and demotion waste as well as plastic waste.

1. Construction and Demolition Waste

Most construction materials can be recovered with the right recycling equipment, such as trash compactors, shredders, crushers and balers. Commonly recovered materials from construction projects include: Wood, brick and concrete. Gypsum wallboard**.**

When structures made of concrete are demolished or



Source: (Bhattacharya et. al 2013)

Fig-2- C & D waste composition in India (2013)

renovated, concrete recycling is an increasingly common method of utilizing the rubble.

Concrete aggregate collected from demolition sites is put through a crushing machine. Crushing facilities accept only uncontaminated concrete, which must be free of trash, wood, paper and other such materials. Metals such as rebar are accepted, since they can be removed with magnets and other sorting devices and melted down for recycling elsewhere. The remaining aggregate chunks are sorted by size. Larger chunks may go through the crusher again.

Although use of Recycled Aggregates (RA) are being studied since last 50 years but not being used in new

structures due to lack of consistency in their properties and non-availability of regulatory framework for their use.

Lot of processed recycled Aggregates are still used in nonstructural components like paver blocks, Plain Cement Concrete, Sub-base below road pavement, Concrete pipes, asphalt mix and fire insulation blocks.
In collaboration with Municipal Corporation of Delhi (MCD), Infrastructure Leasing & Financial Services Limited (IL&FS) set up India's first Construction & Demolition (C&D) waste recycling. Facility in Burari, New Delhi in 2009 with operating capacity of 500 tons per day (TPD). The plant has been successfully processing C&D waste into recycled aggregates which can be used for brick making and building roads.

2. Recycled plastic

Globally, of the 8.3 billion metric tons waste that has been produced, 6.3 billion metric tons has become plastic waste. Of that, only nine percent has been recycled. The vast majority—79 percent—is accumulating in landfills or sloughing off in the natural environment as litter. In India, approximately 8 Million tones plastic products are consumed every year (2008). It has broad range of application in films, wrapping materials, shopping and garbage bags, fluid containers, clothing, toys, household and industrial products, and building materials. Once plastic is discarded after its utility is over, it is known as plastic waste.

It is a fact that plastics waste never degrades, and remain on landscape for several years. Mostly, plastic waste is recyclable but, recycled products are more harmful to the environment as thus contains additives and colors. The recycling of a virgin plastic material can be done 2-3 times only, because after every recycling, the plastic material deteriorates due to thermal pressure and its life span is reduced. Hence recycling is not a safer and permanent solution for plastic waste disposal. It is estimated that approximately 70% of plastic packaging products are converted into plastic waste in a short span. Approximately 5.6 million tons per annum (TPA) plastic waste is generated in country, which amounts to 15342 tons per day (TPD) [2]

TYPES OF PLASTICS

As per BIS Codification as notified in Rule 8 (b) of the Plastic Waste (Management and Handling) (Amendment) Rules, 2011, there are seven categories of plastics:

SYMBOL	SHORT NAME	SCIENTIFIC NAME	USED IN
1	PET	Polyethylene Terepthalate	Water Bottles PET Bottles etc.,
2	PET	High Density Polyethylene	Milk / Detergent Bags, Carry bags, Container etc.
3	PVC	Polyethylene Terepthalate	Cables, Pipes Floorings, etc.
4	LDPE	Low Density Polyethylene	Carry Bags, Films
5	PP	Polypropylene	Medicine Bottles, Cereal Liners, Packaging Films etc.,
6	PS	Polystyrene	Foam Packaging, Tea Cups, Ice Cream cups
7	O	Others	Thermoset Plastics, Multilayer & Laminated Plastics PUF, Bakelite, Polycarbonate Melamine, Nylon, etc.,

Table 2: Various types of Plastics

Architecture and use of plastics: Understanding recyclability of plastic and how architects can reduce their dependence on it.

Plastics being one of the most significant—are accelerating faster than that for any other bulk material. Between 1971 and 2015, industrial plastic production volume grew by more than 10 times—more than cement (6.6), aluminum (4.9), or steel (2.9). This demand will even outstrip the original use of petroleum. The construction sector, the second largest consumer of plastics behind packaging, accounts for 16 percent of plastic's total global consumption. Thermal insulation, carpet, piping, and window and door frames are now commonly made of plastic. But despite its functionality, versatility, and low cost, plastic plays an alarming role in exacerbating climate change and global pollution. Given these truths, architects should be compelled to rethink their use of the material.

Proportions of different Plastics in use

- The recycled proportion of type 1 plastic, polyethylene terephthalate **(PET),** in current supply is about **21** percent—making it the most recycled plastic,
- The fraction of recycled polyethylene (types 2 and 4) is 9 percent,
- polypropylene (type 5) and polystyrene (type 6) at under 6 percent,
- Finally, other plastics, including ABS, nylon, and polycarbonate (type 7) at under 5 percent.
- The sequential exception is polyvinyl chloride (Type 3), which constitutes only 2 percent of current supply in recycled form.

Unfortunately, PET is not commonly used in building construction, aside from electrical connectors and fittings; the polymer is mainly seen in consumer

beverage containers and product packaging. However, other plastics are employed more frequently. Polystyrene (PS), for example, features prominently in building insulation products such as expanded polystyrene (EPS) and extruded polystyrene (XPS). As a thermoplastic, PS can be melted down and re-molded into new products up to 20 times without a loss of performance. Although EPS earned a bad reputation due to its high disposal rate and bulky volume, industry efforts have increased the recycling rate measurably in recent years PS thus compares favorably with vinyl, which is recycled less frequently. However, PS management still has a long way to go before achieving a circular economy.

PLASTIC WASTE MANAGEMENT

It has been observed that disposal of plastic waste is a serious concern due to improper collection and segregation system. However, a few technologies have been developed to minimize its adverse effect on the environment. Currently Worldwide accepted technology used for the plastic disposal is incineration, though it is not preferred option in India because it releases toxic gases. Another strategy is to look for recycled plastic materials as surrogates for other traditional materials.

Making ceramic products from recycled polymers, which combines melted waste plastic and sand to form resilient modular tiles designed to overlap like their ceramic counterparts. That includes products such as, decking, siding, fences, and concrete additives.

Construction of polymer bitumen roads is also successful and an economical method of recycling plastic. In the building industry, many experiments, innovations are going in and around the world. Few of them are as follows:

1. RECYCLED BOTTLE HOUSE

Thousands of pieces of trash that would otherwise be clogging waterways and landfills in Nigeria have been turned into sturdy, and surprisingly attractive, construction materials in the village of Yelwa, where the country's first plastic-bottle house is drawing curious visitors and plenty of press. The bottles are actually filled with dry soil or construction waste, not sand (an "unnecessary expense). They are then laid in rows like bricks and bound together with mud, producing a sturdy, well-insulated, and inexpensive three-room structure that is resistant to both bullets and earthquakes.

2. PLASTIC BRICKS

Fig-3- PET waste bottle houses in Nigeria.

Peter Lewis, a New Zealand based inventor, has been following a similar process with a company called “ByFusion”, where he works as an engineer. The company's main focus is to convert plastic rubbish into a range of sustainable building materials. The process involves a modular platform that is portable and designed to run on gas or electric. His machine (The Blocker) doesn't even need the plastic to be sorted or washed; it just compresses the plastic scrap directly into bricks. As you can see from the image below, the "Blocker" can be easily transported in a standard 40ft (12M) shipping container and once installed, plastic trash is emptied into the shredder and then moves on to the water boiler and compactor section. Using super-heated water, the plastic is then simply compressed and shaped into durable bricks.

The bricks require no glues or adhesives for use, and the non-toxic production process produces 95% lower Greenhouse Gas Emissions (GhG) compared to concrete blocks and have very high thermal and acoustic insulation. One of the drawbacks of these type of bricks is that they can't be used like standard bricks because the plastic compresses under heavy structural loads. However, their saving grace is that because of their awesome sound and thermal insulating properties, they make superb wall fillers.

3. PLASTIC BRICKS

Conceptos Plasticos, a company founded by architect Oscar Mendez, in Philippines, collects recyclable plastic material, melts it down and moulds it into bricks which are then used to build houses for the local community. The hope is that using plastic to build homes will be the answer to both recycling and housing shortages.

CONCLUSION

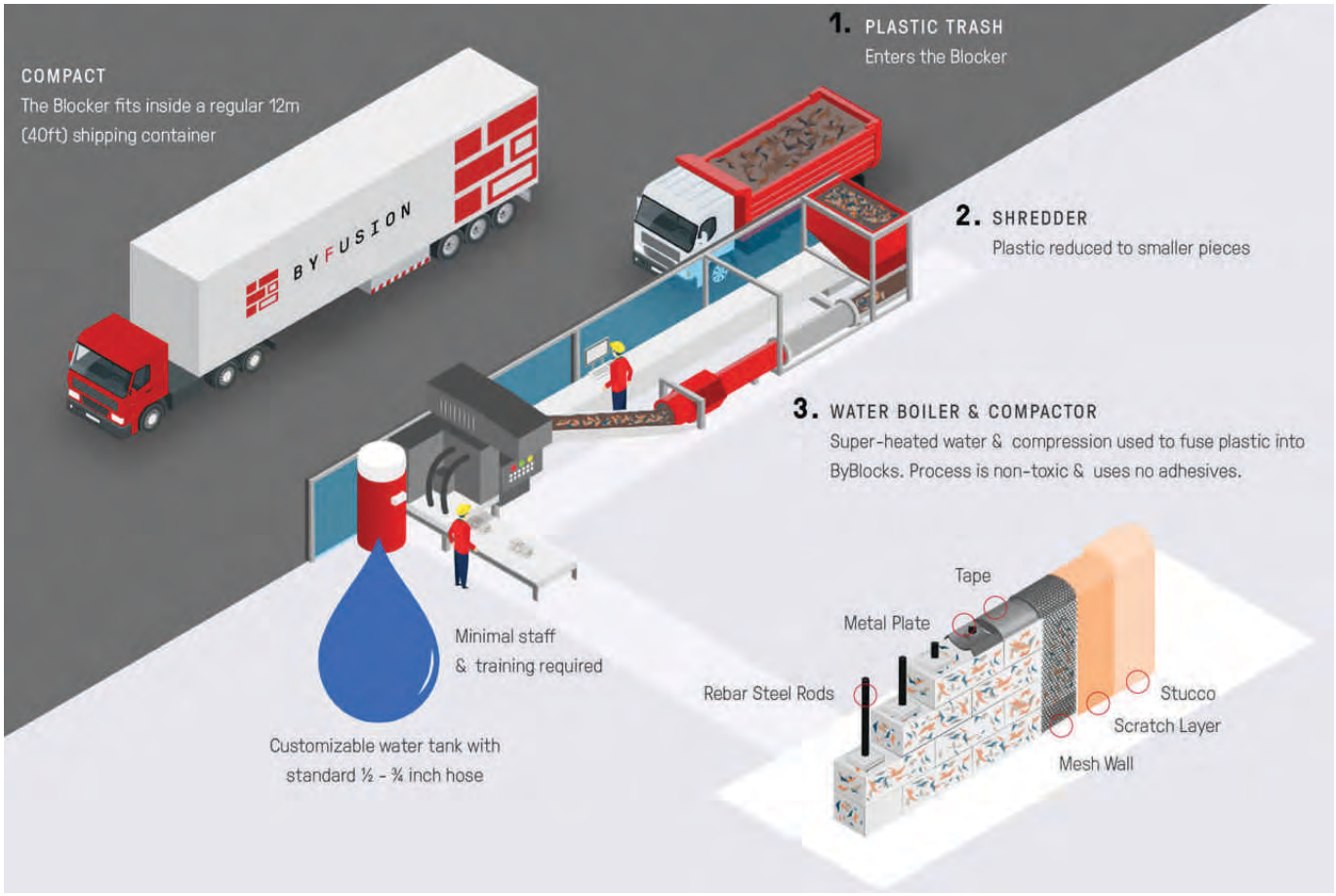


Fig- 4 Plastic brick construction process in New Zealand by "byfusion" company.

Today it is needed that this threat posed by non-biodegradable material waste to human beings should be considered and taken seriously. We need to first "reduce" and "reuse" as we discussed in the paper and we should prefer these recycled materials over conventional building materials.

This paper also shows that these recycled building materials are many drawbacks such as structural strength, volatile nature, and poisonous gas emission during production etc. More and more research is required in this field.

Courtesy: www.conceptosplasticos.com/

Plastic Brick Lego houses in Philippines

In India, there is systematic planning required for all the process. That starts from segregation of waste at source to its recycling in producing building material. After understanding relationship between recycling and architecture for sustainable habitat, we should take inspiration from all the research works going on all over the world in this field and more and more use of recycled materials should be encouraged in our country.

REFERENCES

1. Bansal A., Mishra G. and Bishnoi S., Recycling and reuse of construction and demolition waste: sustainable approach in 7th International Conference on Sustainable Built Environment at Kandy, Sri Lanka, 2016.
2. Šijaković, Milan & Perić ,Ana, 20Recycling Architecture: the Redefinition of Recycling Principles in the Context of Sustainable Architectural Design in 19th REAL CORP 2014 International Conference at Vienna, retrieved from https://www.researchgate.net/publication/328812634
3. Central Pollution Control Board, 2013, Overview of Plastic Waste Management,Delhi.
4. http://www.byfusion.com
5. www.conceptosplasticos.com
6. https://www.treehugger.com/green-architecture/nigeria-plastic-bottle-house.html
7. https://www.biome-solutions.com/
8. https://www.researchgate.net/publication/301283637

Gender based Behaviour Patterns in Temple Precincts of Pune

- Ar Aniket Jadhav

Ar Aniket Jadhav is an alumnus of Marathwada Mitra Mandal's College of Architecture, Pune. The design process of 'why' always interests him, which helps in developing conceptual metaphors. Passion for self-development and desire to learn new functional and technical characteristics has helped him pursue higher goals in architecture. Beside architecture and design, his primary interest lies in exploring and documenting historic Temples, Religious Cities and Forts. He also has special interest in Architectural Research and inculcating it in architectural design which will help contribute to the design of spaces to be functional in terms of Gender Sensitivity, Userprofile and Context.

anijadhav2015@gmail.com

Abstract

In urban context, the people are busy with their hectic life. There is a need for an interactive space where people can relieve stress. In this scenario, Temple precincts offer many activities which can give emotional, mental, psychological harmony and a spiritual environment to human beings. A Hindu temple is meant to encourage reflection facilitate purification of one‟s mind and trigger the process of inner realization within the devotee (Kramrish, 1946). Historically temples were utilised as an interactive spaces where in today‟s context it is underutilized to some extent. There is a variation in the number of male and female visiting temples and also in their behavioural patterns .The importance of leisure time activities in psychological, cognitive and physical development of people is recognised in all societies (Sudnya mahimkar, 2015). Environmental factors play a vital role in determining behaviour of an individual. This study aims to find out the different behaviour patterns of people in the temple precincts of Pune and analysing the factors essential to enhance the gender behaviour pattern which can provide a comfortable environment to men and women.

Key words: ***Religious precincts, behavioural pattern, famous temples in Pune, psychology***

INTRODUCTION

The lifestyle in urban areas is associated with lots of stress resulting in physical and mental health related issues. Mood and anxiety disorders are more common among city dwellers (Lederbogen .F. Kirsch P . Haddal, 2011). There are many sobriquet titles that Pune holds with much pride. Though the image and features of Pune changed over the time, it has managed to keep its traditional charm intact. This is evident through historic places and buildings wherein temples and their precinct have played a vital role. When it comes to temple, Pune tops the list as it houses some of the most popular temples in Maharashtra. **(www.transindiatravels.com)**

Pune has many temples built over a period of time. Each temple was constructed having a specific philosophy, purpose and human psychology behind it. Most of the temples were constructed by the Peshwas for performing many different activities like meetings, religious activities etc. In Hindu tradition, there is no dividing line between the secular and lonely sacred (Lewandowski, 1976). In the same way Hindu temples were not just sacred spaces, they were also secular spaces as earlier days they served as a venue to mark festivals, to celebrate arts through dance and music, to get married, to commemorate the birth of child, other significant life events or to mark the death of loved one (Karmrisch, 1976).Temples also acted as a refuge area during times of political unrest and danger (Michell, 1977).

Every temple has a special day in a week which is allotted to the deity and people visit temples on that specific day of week, people also uses the outdoor spaces of temple for many different activities which contribute towards their need for the interactive space.Visit to a religious place offers an alternative frame for new time structuring where religiosity provides strong motivation (Banerjee, 2014).

Public spaces play a vital role in day to day life of human beings. They are used by a variety of user groups with uniquely different physical and psychological frames thus generating variety of experiences and perceptions (Grover, 2015).

Gender can be seen in terms of social structure or as a symbolic order which is the way in which notion of masculinity & femininity is described (Davis and Cowles 1991). The concept of gender is composed of a package of culture differences and factors that shape the lives and expectations of women and men, in relation to their social role and duties (Grover, 2015). This outcome inspires the further inquiries into gender based behaviour and religious precincts as how the temple spaces are being used by both men and women in today‟s context. This also triggers to investigate the design factors that affect their visits and usage patterns so as to encourage them access such spaces to improve their quality life. Following are the objectives derived to achieve the research question.

i. To study how gender is relevant in the Temple Precinct.
ii. To define the extent of religious precinct used as an interactive space in today‟s context.
iii. To evaluate the gender based activities within the precinct in the urban context of Pune.

BACKGROUND STUDIES

Women seldom use outdoor spaces for their own leisure activities and their usage pattern in such spaces is influenced by various factors such as:

1) Risk and perception analysis –Many women did not feel safe outside, certain spaces are perceived by women as more prone to risks.

2) Socio-cultural background & acceptance of the concept of women's recreation exclusively for her own sake by society and herself.

3) They have restrictions on their attire, movement & time.

4) They visit such spaces as a duty towards family such as accompanying children or elderly (Mahimkar, 2014).

Religious architecture more often encompasses the religious structure than addressing the spaces used by the cross section of the people. It has continued the social, cultural and architectural tradition from past to future. Hindu temples comprise a major part of Indian religious architecture which is marked as vibrant space for multiple activities (Banerjee, 2014).

Architectural and planning aspects of a residential area largely affect the social 'behavior' of its residents (Goodchild, 2008). Architects and planners are supposed to seek ways to make neighborhoods better places to live in by creating social spaces that maximize social interaction to enhance residents' quality of life (Carmona et al, 2003). Visit to a temple involves a physical component for older individuals and may entail health benefits in addition to psychological strength. Temples play many roles in the lives of elder people in India as they find fulfillment in a variety of religious activities. Religious events which are numerous provide elderly a purpose and motivation to move out of their homes every day (Grover, 2015).

The background studies outcomes that outdoor leisure spaces has imbalance between men & women using the spaces like parks, Temples or some other public spaces and such spaces are needed in urban context for social interaction of people from various age groups which offers them psychological harmony. But the question arise whether the parameters of research used by the earlier scholars to study Gender Sensitivity in any public place applies to the Temple precincts? Or whether the existing patterns truly provide a comfortable environment for both men and women?

LIMITATIONS AND FURTHER SCOPE OF STUDY

This study is limited to Gender Behaviour in Temple precincts on a particular day of a week which is allotted to that deity, but does not consider the festival time. Further research can be done to check whether this same behaviour pattern is observed during the festivals and does it provide a comfortable condition for men and women. Also this study is limited to only two genders; further study can be made by considering the behaviour pattern of transgender if any. The scope of the research is to study the behaviour patterns of gender in the temple precinct in Pune city only. Also the surrounding area of the precinct is not considered in this study.

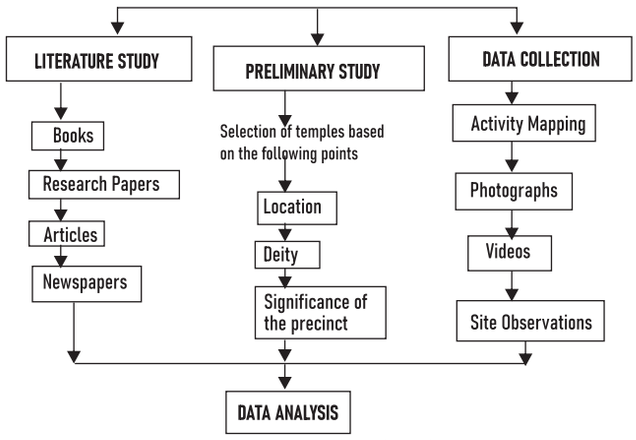


Figure 1: Tree diagram of methodology used

For carrying out the research for gender behaviour pattern in temple precincts the case examples selected for the study is based on the following:

a. **Location:** The quality of spaces, people visiting, behavioural patterns in the precinct is directly related to the surrounding areas, hence location plays a key role in this scenario.

b. **Deity:** There are many Gods and Goddess in Hindu religion. Each deity (male/ female) have different methods for worshipping them. Female deity(durga) is worshipped by women by offering „Saree", „Bangles", „Haldi- Kumkum" and other things which are used by women in her day to day life,while a male deity is worshiped by offering different things like „Sowala"(a Pooja Dhoti), Flowers, „Durva leaves"(for Ganesha) or „Bel Patra"(for Lord Shiva). Hence because of this the Behaviour Pattern of people and the users of such Temple precincts changes according to the Method of worshipping a particular Deity. In this scenario the selection of Temple Precincts are made according to the gender of deity to check the variation in Male:Female ratio and the proportion in which a space is used by men or women.

c. **Significance of the precinct:** As discussed earlier Pune has lots of temples which have historical background behind them and earlier this Temple precincts were used by people for various purposes. Each Temple precincts selected for study is being constructed having a specific purpose. The Historic Temples are heritage structures of Pune city, hence this attracts number of devotees and tourists to visit them.

To study the gender behaviour patterns in religious precincts, six famous temples from the urban context of Pune were selected based on the deity viz.

Temple precinct	Deity	Gender of Deity
1)Chaturshringi Temple	Goddess Chaturshringi	Female
2)Sarasbaug Temple	Ganpati	Male
3)Omkareshwar Temple	Shiva	Male
4)Tulsibaug Temple	Ram & Sita	Male and Female
5)Swami Narayan Temple	Saint Swami Narayan	Male
6)Parvati Temple	Kartikeya, Vishnu, Shiva and Goddess Parvati	Male and Female

Source:Author

Table 1: Selection of Temple Precinct

4.1 RESEARCH METHODS

Research method of activity mapping and visual observations by video recording is used in this scenario. The activity mapping is made at three times in a day viz. morning, afternoon evening and also according to the age groups in order to study the changes behavioural patterns of people. The video recordings were made at all three times in a day by taking a walk in the Temple Precincts (except some „Photography Restricted Areas" like „Garbhagriha" of all temples, some Residential part in the precincts like „Ashrams" in Swami Narayan Temple etc.).

The Video Recording done for each Temple was different depending on the scale of the Precinct (Min 5-10 minutes for small and Medium Precincts, Max 20 minutes for Large Precincts). The recordings gave the entire view of the precincts and the idea of the spaces preferred by the genders for various activities. Total 11.14 GB data was recorded and analysed to study the Gender Behavioural Patterns at all three times.

4.2 DATA COLLECTION METHOD

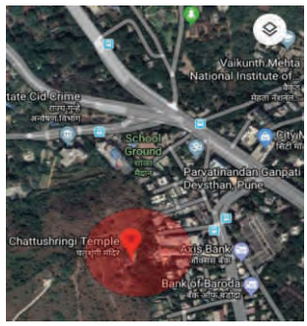
Identification of time frame: Generally a temple is visited by people in morning and at evening time in a day but during a specific day of week which is allotted to that deity the temple is visited by the devotes at all three times in a day. It is also visited by different age groups of people according to his/her convenience at different times. Therefore the difference in their behaviour pattern can be seen according to age groups and gender wise, also the male: female ratio in all the six precincts could be worked out.

Hence for this study, various research methods like activity mapping, video recording and site observation were applied by visiting this temple precincts three times in a day viz. morning, afternoon, evening.

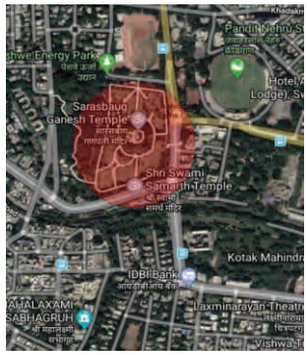
The data collection was carried out by actually tracing the path which a men and female follow (Religious path) when they visit a temple precinct, their activities and behaviour patterns were mapped on the layout plan of each temple precinct. The videos recorded are converted into various frames of spatial significance and observations were recorded on the layout plan of the temple precinct to have the complete view of the space covered. A comparative analysis of the entire six temple precinct is made according to the parameters mentioned in (Table 2).

5. OBSERVATIONS

5.1 Context studies

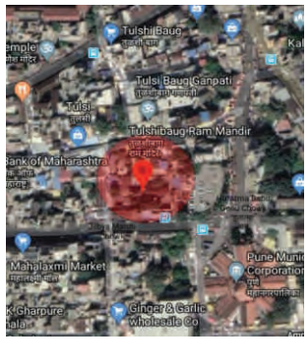


5.1.1 Case 1: Chaturshringi Temple complex: A big temple complex located on the hill top having an area of approx. (22257.7 sqm). It is located on Senapati Bapat Road in Pune which connects further to the university road. It is a very busy road during peak hours.
Context: It is surrounded by residential bungalows mostly occupied by higher income groups and has many commercial developments around it.
Character: It is a big complex having many seating plazas as we go up to the main temple mostly occupied by aged people, middle aged couples, retired men etc.

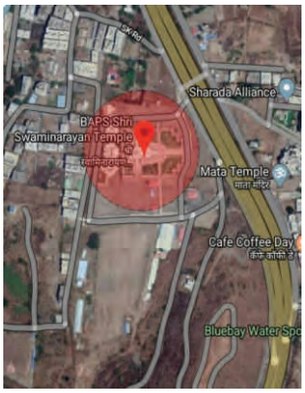


5.1.2 Case 2: Sarasbaug Siddhivinayak Temple: It is a small temple situated in the lake but surrounded by a huge garden. It is located on the Sinhagad road of Pune with an area of 30351.42 sqm.
Context: Surrounded by some residential area, religious temples, educational facilities and commercial development around. It mostly visited by Medium income group, medium higher income group and low income group people.
Character: It's a big complex which also has a museum exactly at the back side of the temple which contains hundreds of old Ganesh idols. Mostly occupied by young couples and used for recreational activities like jogging, walking and exercising by some aged people and middle aged people.

5.1.3 Case 3: Omkareshwar temple complex, Pune: It is located on the banks of Mutha river of Pune, mainly accessed through the Balgandharva bridge. It is a small temple complex with a total area of approx. 3500 sqm.
Context: The main temple is surrounded by residential houses around the courtyard and 'Nandimandap' which is used by the Pujari and his family. It also has rooms which are provided to students on rent. Mostly visited by Medium income group & medium higher income group.
Character: It is a Historic temple built by Sadashiv Bhau, brother of Bajirao-1. The courtyard provides healthy, cool and airy spaces for the occupants however today they are misused and used by as residences. Mostly occupied by aged people, middle aged people for mediation, courtyard space used by students for studying.

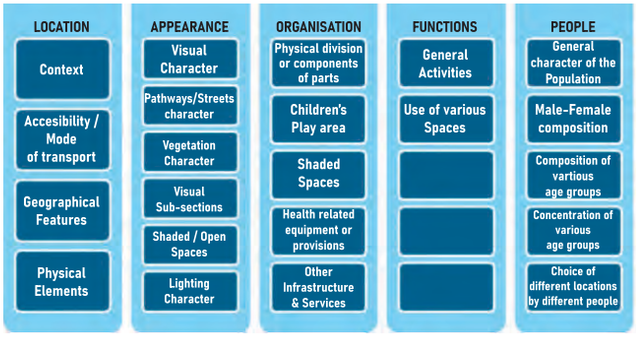


5.1.4 Case 4: Tulsibaug temple comple: It is located in the crowded main shopping market pf Laxmi road. It is a small temple complex with total area of 2725 sqm.
Context: The temple complex is surrounded by shops selling a variety of household items, hence it mainly has commercial area on all sides. Mostly visited by lower income group and medium income group.
Character: This temple was constructed by Naro Appaji Tulshibaug wale. It is mainly occupied by young and middle aged ladies visiting Tulsibaug for shopping, and is mostly used by old ladies for performing 'Parayan' and 'Bhajans'.



5.1.5 Case 5: Swami Narayan Temple, Pune: It is located on the Mumbai highway in the outskirts ofPune city. It is a medium size temple complex with a total area of (10000 sqm approx.).
Context- The Temple complex is exactly near the Mumbai highway hence has moderate noise of vehicles but the temple complex is very peaceful. It has some residential area around it. The backside area of the temple consists of ashrams of the swamis hence, this area is restricted for women. Mostly visited by higher income group and middle income group people.
Character – The temple is newly constructed as a copy of Swami Narayan Temple in Ahmedabad, hence, mostly visited by the people across city. It is visited by old people, young men and women for meditation. The outer areas are mostly occupied by young couples for sitting, chatting etc.

5.1.6 Case 6: Parvati temple, Pune: This temple is located on top of Parvati hill. It is Located on the Nanasaheb Peshwa Road in Swargate area. It is a large size temple comples with area of 101171.41 sqm.
Context: The hill temple is surrounded by lots of slum area yet it has a peaceful environment. It has the view of the city from the top of the hill. Mainly visited by lower income group and medium income group people.
Character: It is a huge complex which also has a Peshwa museum and is visited by many people. This Museum has many Old instruments which were used by the Peshwas when they were living in Pune. Today this precinct is used by people for recreational activities like walking, exercising etc. It is visited mainly by middle aged people for recreational activities and is mostly occupied by young couples.



Source: (Sudnya mahimkar, 2015)

Figure 2

5.2 USERS AND USAGE PATTERNS

The usage of the space by men or women with specific details of number of visitors, active or passive is completely dependent on the typology, context, location and various other parameters that are mentioned in the diagram shown above (Figure 2). Analysis of each temple precinct is done with the help of another matrix incorporating the details of observations with reference to number of male & female users, activities and spatial attributes (Table 2).

6. RESULTS

6.1 Typology preference

Women were seen more in the precincts which had women centric activities around for example in cases 1, 3, 4. Other precincts like Sarasbaug, Parvati etc. were occupied more by men than women. Hence the men to women ratio are found to be different in all the six case examples (Figure 3).

6.2 ACTIVITY PATTERNS

Photograph 1: case 1
More women about 35% were found shopping for religious activities in all 5 cases except the 6th one. Women were more in number in case1.

Photograph 2: case 4
More women were engaged in religious activities like „Bhajan" especially above 50 year women. They were found more in number in case 4.

Photograph 3: case5
About 50-50 men and women (mostly couples) were engaged in photography, taking selfie in all the case examples.

Photograph 4: case5
Men above 50 years of age were mainly found in the outer areas of the temple sitting and chatting in groups.

Photograph 5: case4
Women were mostly found in groups sitting and chatting in all the cases especially in the areas with moderate privacy.

Photograph 6: case4
In play areas women mostly preferred the spaces where she can keep a watch on her children.

Photograph 7: case 6
Presence of couples in some areas of the precinct makes it inaccessible to other people.

Photograph 8: case 3
Men found meditating more in number especially in evening time in the Mandapa of the temple.

Photograph 9: case 3
Women were found meditating in the morning especially at the corners at niches in the Mandapa of the temple.

Photograph 10: case 2
About 50% of men were found resting in
the lawn area. This creates uncomfortable condition for women to access it.

Photograph 11: case 2
Though women were found in large precincts about 70% were accompanied with their family

Photograph 12: case 2 About 60% men were found performing recreational activities like walking, exercising etc. in case of women performing recreational activities she was found with other women in a group.

6.3 SPATIAL PREFERENCES

Mostly women preferred the spaces which had moderate privacy. They occupied the shaded spaces in the precincts where there were some public sitting. They preferred this space for activities like sitting, chatting and studying. Some women above 20years of age were found using the 'Mandapa' of the temple for studying, meditation etc.

Figure 6: Layout of Sarasbaug temple precinct showing Spatial preferences.

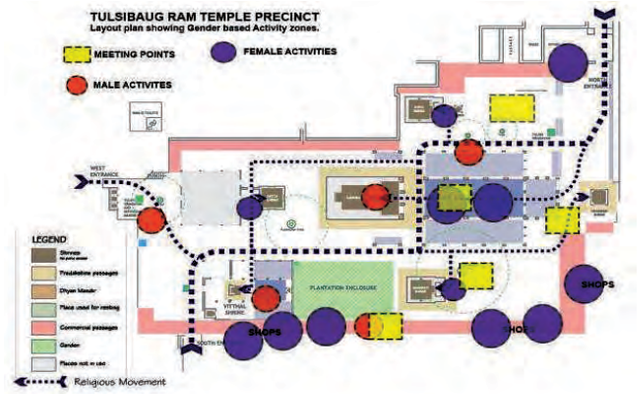


Figure 7: Layout plan of Tulsibaug Temple Precinct showing Spatial preferences. ***(Only two layouts of Temple Precincts are shown here highlighting the Space Preferences by Men and Women. For more drawings refer annexure 7.)***

especially in the morning. Mostly more women above 50years of age were found the religious activities like 'parayan' and 'bhajan'. Women visiting the precinct having play areas mostly preferred the spaces where they can keep a watch on their children (Photograph 6).

In large precincts men were found more in the recreational spaces and the seating areas at the corner, for resting, studying and chatting etc. Mostly men were found using the outdoor spaces of the temple for sitting in groups and chatting in all the cases. Men were found more in numbers performing meditation in the Mandapas of the temple especially at evening (Photograph 8). Though large precincts had shaded areas like gazebos etc. women were not found sitting there, when women are seen there, they are generally in groups or with family. The presence of couples in some areas of the precinct makes it uncomfortable and inaccessible to both men and women equally.

7. Discussion

The men to women ratio were found to be different in all the six typologies of temple precincts viz.

Chaturshringi Temple	**Men 20 : Women 75**
Sarasbaug Temple	**Men 85 : Women 35**
Omkareshwar Temple	**Men 44 : Women 67**
Tulsibaug Temple	**Men 11 : Women 80**
Swami Narayan Temple	**Men 57 : Women 65**
Parvati Temple	**Men 55 : Women 20**

Table 3: Variation in Men to Women Ratio, Source: Author

This result indicates that women are found more in the precincts like Omkareshwar, Swami Narayan which has a good security. They also prefer a space which has women oriented activities around it for example,

i. **Case 4:** Tulsibaug Ram Temple is surrounded by the shop which sells all the things which are needed by women in their daily life.
ii. **Case 1:** Chaturshringi Temple has a female deity and shops which has all things related for worshipping goddess.

In case of large precincts like Sarasbaug and Parvati women were found using the spaces which has moderate privacy and they used the spaces that were occupied by other women. In such precincts women were found more with their family.
In case 5: Swami Narayan Temple some part of precinct consists of Ashrams for Swamis which was restricted for women and men both, even they were not allowed to enter that pathway hence such spaces was not used by anyone, sometimes men were allowed to enter this area of Ashrams with prior appointments. Therefore the areas near to those spaces were occupied by some couples as it was not occupied by public.

Men were mostly found in the open spaces where they can get maximum view of the space. Some men used the precinct as a resting place in the afternoon and in the morning (Photograph 10) also they were found using the inner corner spaces of the temple for meditation (Photograph 8) which may be helping them to reduce the stress level and provide harmony to their mind.

Hence the spaces which are occupied by men for recreational activities and resting didn‟t provide a comfortable environment to women to use it as an interactive space.

7.1 RECOMMENDATIONS

Following are the recommendations derived from the observations of Gender Behaviour Pattern in Temple Precincts of Pune which can help to enhance the gender behaviour pattern by providing comfortable conditions to men and women. This can help to contribute to their needs for interactive space.

1. Activities need to be introduced within the temple precinct.
2. Zones with restricted entry or „NO ENTRY‟ should be minimum.
3. Circulation needs to be improvise so that the zones in the precinct are well monitored.
4. In case 5: Swami Narayan Temple, people are not allowed to use the lawn area for maintenance of the precinct therefore too much rules can harm their requirement of interactive spaces.
5. Seating area should be avoided mainly at the corners so as to avoid the misuse of that space.
6. In case of Parvati and Sarasbaug Temple precinct Women centric activities should be introduced at panoptical locations. This can impart some sense of security to the precinct.
7. To bring more women for performing group activities in such spaces various classes like singing etc. should be provided in such spaces.
8. For hill Temples like Parvati more activities like shopping, play areas, café etc. should be introduced from the bottom of the precinct to the top. This will make a space livelier.
9. In case 3: Omkareshwar temple precinct the residential use of the precinct should be avoided as it spoils the use of an interactive courtyard space to be used by the visitors.

8. CONCLUSIONS

This study supports the existing body of knowledge that men and women have different preferences for deity, activities and locations within the temple precinct. The physical survey from this study indicates that there is a imbalance between male and female visiting a religious precinct. Women are found less in numbers in the precincts which had less security they need an environment which is more open, accessible and has women centric activities in the surrounding area. Thus the differential behaviour pattern is evident through all the six case examples. The religious precincts do offer many activities which are contributing towards their need for an interactive space to some extent; this is evident from case examples like Chaturshringi Temple precinct, Tulsibaug ram Temple, Omkareshwar Temple etc. Evolved through this study is the understanding of gender behaviour patterns in religious precincts. The outcome and suggestions will help contribute to design of religious precincts from gender point of view and further facilitate landscape architects, conservation architects, and urban planners to decide the future directions for gender sensitivity in developing urban interactive spaces.

Glossary of Terms

Saree: A garment worn by Hindu women, consisting of a long piece of cotton or silk wrapped around the body with one end draped over the head or over one shoulder.
Haldi Kumkum: Turmeric and vermilion powder which is applied by Hindu women on their forehead as a symbol of their married status.
Sowala: a garment worn by Hindu males consisting of a piece of material tied around the waist and extending to cover most of the legs. It is mostly worn during ritualistic worship, religious functions etc. It is also called as pitambar.
Durva: A small herb spreading in the soil with its small roots emerging from the thin stem like structure. These leaves are generally used by Hindus when they worship lord Ganesha.
Bel patra: It is the sacred tree of Hindus. Leaves of the Bel tree is used when people worship Lord Shiva.
Ashram: A place where a group of Hindus live together away from the rest of the society, or a place where Hindus can go in

order to pray.

Garbhagriha: It is a sanctum sanctorum, the innermost sanctum of a Hindu temple where resides the murti (idol or icon) of the primary deity of the temple.

Nandimandapa: It is also called Mandi Mandir. In Shiva temples, it is a pavilion with the statue of the scared bull (Nandi), looking at the statue or the lingam of Shiva.

Mandapa: In Hindu temple it is a porch like structure through the gateway leading to the temple. It is used for religious dancing and music and is the part of the basic temple compound.

Pujari: A Hindu temple priest. The word comes from Sanskrit word pooja meaning worship. They are responsible for performing temple rituals, including pooja and aarti. They are mainly drawn from Brahmin family. Both men and women can be pujari.

Swami: a Hindu male religious teacher.

Bhajan: It is a Sanskrit word meaning "singing to glorify god." It is a wide range of devotional music typically lyrical and conveys love for the divine.

Parayan: Reading a scripture from beginning to end.

REFERENCES

01. Banerjee Banani (2014), Temple as "place in ageing" for elderly people in Indian urban settings, Journal of the Indian Institute of Architects.
02. Carmona, M and Tiesdell, S (2003). Public Places, Urban Spaces: the dimensions of urban design London: Architectural Press.
03. Davis, C & Cowls, M. (1991). Body Image & Exercise: A Study of Relationships and Comparisons between Physical Active Men & Women, Ramchandran, S.K. 2012, April 12).
04. George Michell (1977). The Hindu Temple: An Introduction to Its Meaning and Forms. University of Chicago Press. pp. 58-59.
05. Goodchild, 13(2008). Homes, Cities & Neighbourhoods, Planning the Residential Landscapes of Modern Britain, Aldershot: Ashgate.
06. Grover Arti (2015), Examining Inclusivity in Urban Public Spaces: Gender perspective in Indian context, Journal of the Indian Institute of Architects.
07. Lederbogen .F. Kirsch P. Haddal, L, Streit F; City living and upbringing affect neutral social stress processing in humans, Nature, 474(7352).
08. Mahimkar Sudnya & Gokhale V.A (2014), Women's perception of safety and security with reference to urban public leisure spaces: exploration of the geography of fear. ACS Women's and gender studies conference, Greenville, South Carolina, US: Furman University.
09. Mahimkar Sudnya & Gokhale V.A (2015), Inclusive Cities: Towards Gender Sensitive Urban India, Tekton Volume 2, Issue 1.
10. Mahimkar Sudnya & Gokhale V.A (2015), Incorporating Gender Sensitivity in Architectural Design Education in India, Compilation of papers presented at DDEI Conference 2013.
11. Mahimkar Sudnya (2015), Gender space dynamics of urban outdoor public leisure spaces. Proceedings of the international conference on changing cities II: Spatial, Design, Landscape and Socio-Economic Dimensions.
12. Pyong Gap Min, Religion and Maintenance of Ethnicity among Immigrants- A Comparison of Indian Hindus and Korean Protestants, Chapter 6, pp.102-103.
13. Stella Kramrisch (1976). The Hindu Temple, Volume 1, Motilal Banarsidass Publ. 1976.
14. Susan Lewandowski, the Hindu Temple in South India, In Buildings and Society: Essays on the Social Development of the Built Environment.

Convention Centre, Siruseri, Chennai, Tamil Nadu

- Ar Meyyappan M M

Having completed Diploma in Civil engineering and gained experience from different architectural firms, M Meyyappan, a native of Tamil Nadu has realised his dream of an architectural degree from The Indian Institute of Architects while topping the exams in the final year. The scale of buildings that left him awestruck since his childhood and the passion for learning about space, environment and its relationship to human beings, has inspired him to pursue the path to architecture.

Every project he does has an emotional value attached to it, thus bringing out the most efficient design solution for his clients. Architecture to him is the culmination of essentiality and intuitively, organising spaces in a methodical and holistic manner. This is the virtue for creation, through which design emerges naturally, as a masterpiece that surpasses time.

mmmeyyappan@gmail.com

Globalisation is at its peak over the last few decades, people have started settling in groups in various parts of the world, expanding their culture all around. This has given rise for radically new insights every day and the public arena continues to crave for new discoveries on multicultural issues. The development of convention centres, performing art venues are increasingly being acknowledged for their role in stimulating local economies and improving the quality of life of a nation's citizens. Conference and business tourism is hence a very important sector of the global tourism industry.

The Chennai Metropolitan area is one of the largest municipal economies of India. Chennai has been nicknamed 'The Detroit od India' with more than one-third of the automobile industry being based in the city. Chennai has been selected as one of the 100 cities to be developed as a smart city under smart cities mission.

AIM

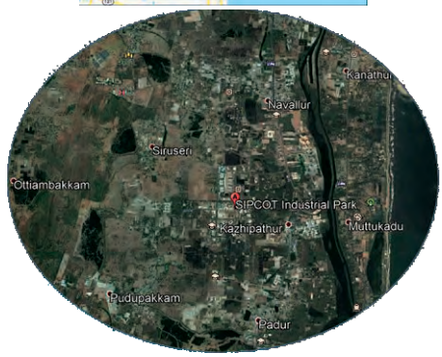
The multi-purpose space will accommodate exhibitions, lectures, fashion shows, concerts, open air theatres, plazas and social gatherings. It will also have convention facilities like conference hall-banquets; for business meetings and socio cultural conference conventions. With this scheme, it is an effective way to counter the problem about the issue of spatial shortage in the future and also lack of public spaces.

OBJECTIVE

The convention-centre is one of the types of building that act as an icon of the city. It not only reflects the cultural and economy of the place, it publishes the city's values internationally. To create a space which can form a node for holding and experiencing commercial, social and cultural activities. People can gather to share and earn various experiences. These centres emphasize both public and private events.

SITE JUSTIFICATION : (SIRUSERI)

Important Convention centres in Chennai

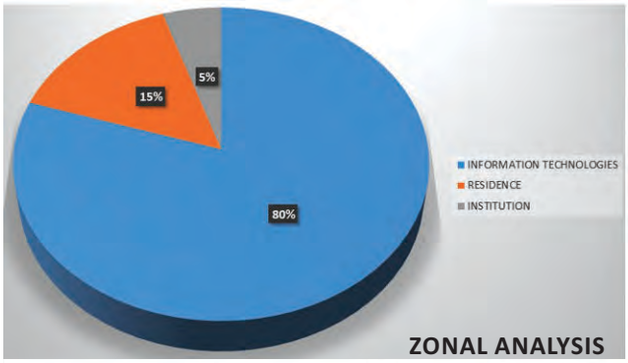


There are no prominent convention centres within 5 Kms radius of Siruseri. Apart from Chennai Trade Centre, which is located in Nandambakkam, there are no convention centres that caters to the needs of both, the business community, corporates and the public. Although there are mini convention centres which are scattereds in and around the city, catering to only certain groups of society.

Siruseri is a locality in Muttukadu village in Kanchipuram district. It is located between Navalur and Kelambakkam. Siruseri is after the IT Corridor of Chennai along Old Mahabalipuram road. Siruseri is home to the SIPCOT IT park, a technology park.

Siruseri acts as a major cyber corridor which promotes the area value. The proposal of a Concention Centre in this area would decrease the congestion in the city centre ansd thereby decrease the distance between the IT hub and the convention centre.

The nearby IT park acts as a major magnetic element in attracting visitors to the convention cerntre.



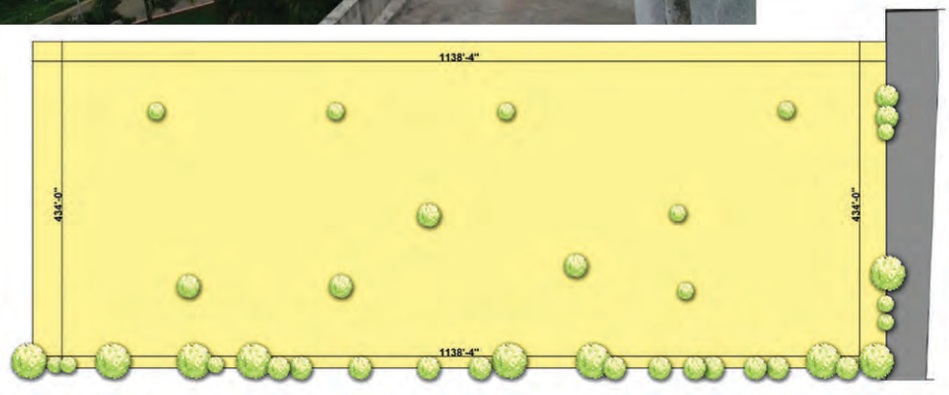
ZONAL ANALYSIS

The site is strategically located in close proximity to the Information technology hub with fast, and efficient transit connections to the city, the downtown areas of Chennai, and the suburban areas.

Siruseri's main bus stop is on old Mahabalipuram road, outside the SIPCOT IT Park, between Padur and Igattur areas.

Assuch a world class convention facility is intended to serve a greater regional areas as well ads attract wider business opportunities from multi MICE activities.

SITE POSITIONING & CONNECTIVITY



THE CONCEPT

Sustainable architecture:

Source:Author

Sustainable design seeks to reduce negative impacts on the environment, and the health and comfort of building occupants, thereby improving building performance.

The basic objectives of sustainability are to reduce consumption of non-renewable resources, minimize waste, and create healthy productive environments.

An ecological approach to design aims to integrate the systems being introduced with the existing on-site ecological functions performed by mother nature. These ecological functions provide habitat, respond to the movements of the Sun, purify the air as well as catch, filter and store water.

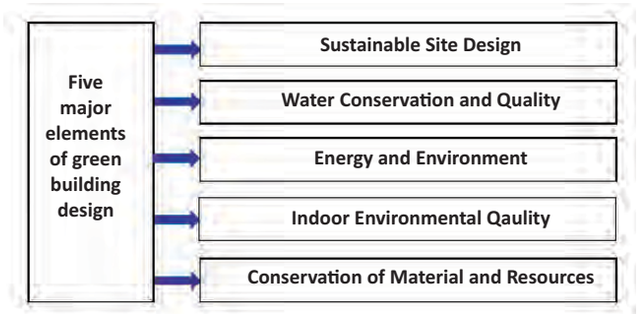


Fig.1: Elements of Green Building design

Green Building materials:

The materials common to many types of natural buildings are clay and sand. Other materials commonly used are: earth, wood, straw, rice-hulls, bamboo and stone. A wide variety of reused or recycled non-toxic materials are common in natural building, including urbanite, vehicle windscreens and other recycled glass.

Living Architecture:

The environment like our bodies can metabolize nutrients and waste. Living architecture focuses on these processes, integrating ecological functions into the building to catch, store and filter water, purify air. Throughout history greening of outside walls and roofs of buildings has taken place. Reasons for doing so were the increase of insulation, improved aesthetics, improved indoor and outdoor climate, reduce the greenhouse gases such as carbon dioxide, carbon monoxide, and nitrogen dioxide as well as increasing ecological values by creating habitats for birds and insects.

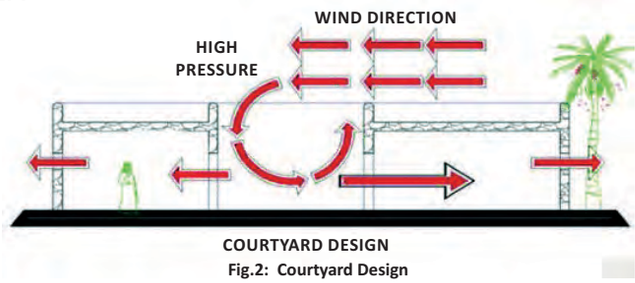
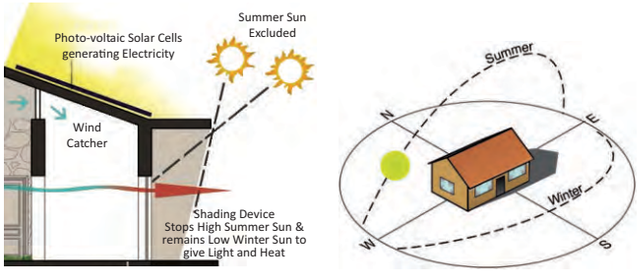


Fig.2: Courtyard Design

Courtyards:

Courtyards draw fresh air down through the wind catch. The comforts offered by a courtyard – air, light, privacy, security and tranquility are needed for the smooth working of a building.



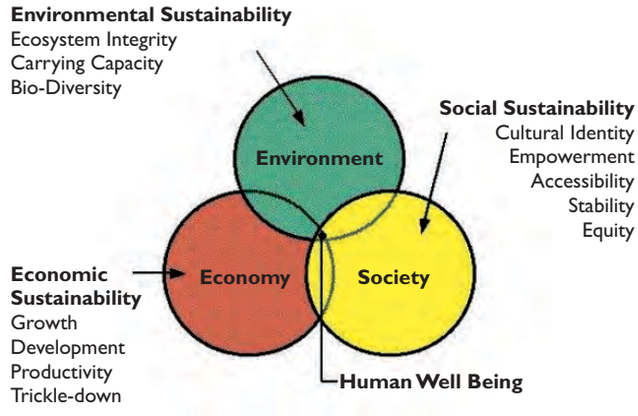
Building Orientation:

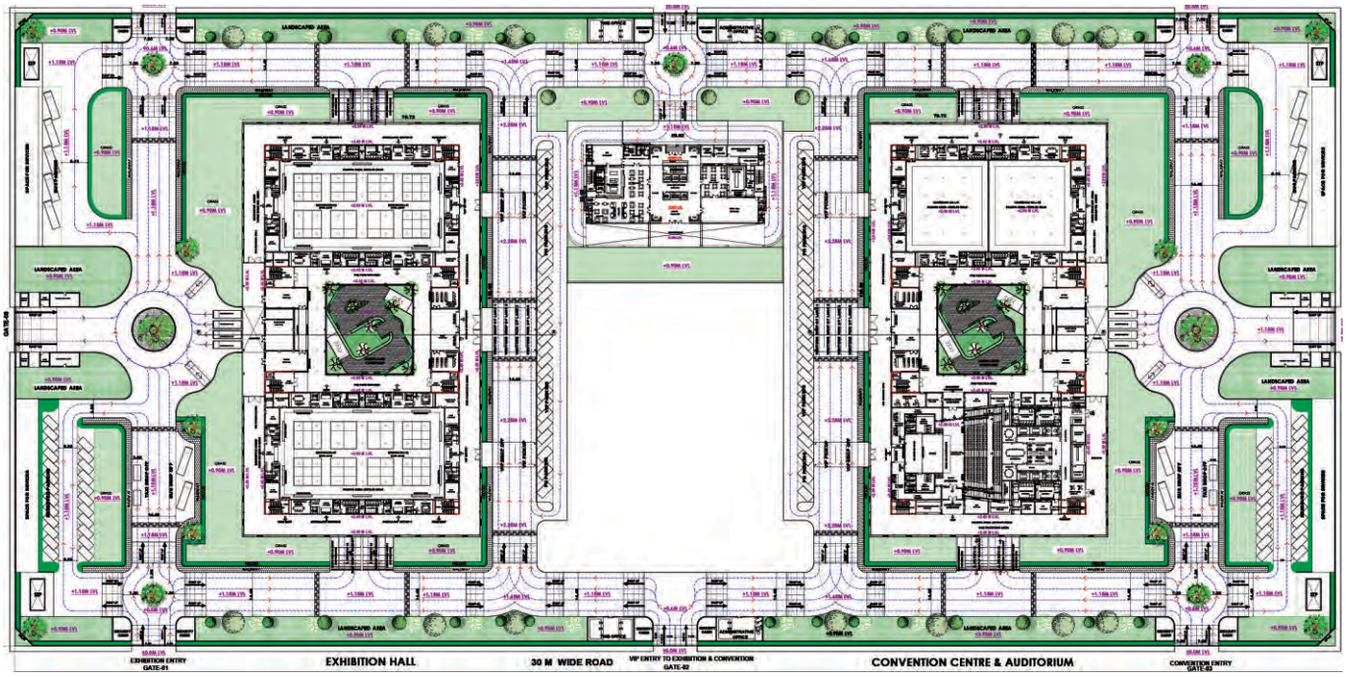
Orient the buildings with longer axis in the East – West direction.

The buildings with glazed curtain wall facing northwest shows a substantial reduction in load compared to southwest orientation. The West and North orientations are also better than the Southwest direction.

East and West receive maximum solar radiation during summer. West is a crucial orientation because high intensity of solar radiation is received during summer when the internal gains are also at its peak.

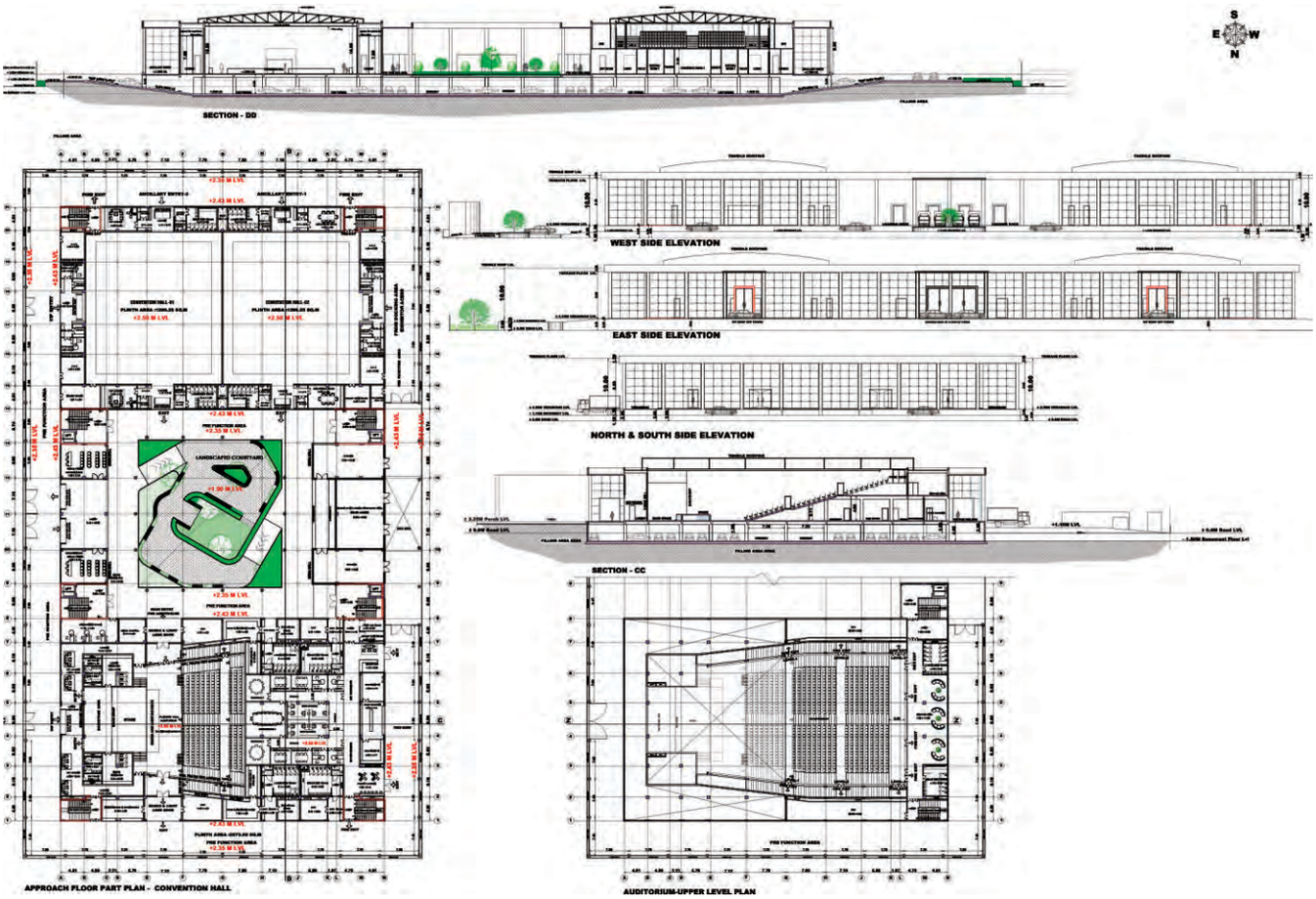
Thus, orientation needs to be paid attention, while designing West facade and spaces behind West facade.





MASTER PLAN

PLANS, SECTION & ELEVATION DETAILS

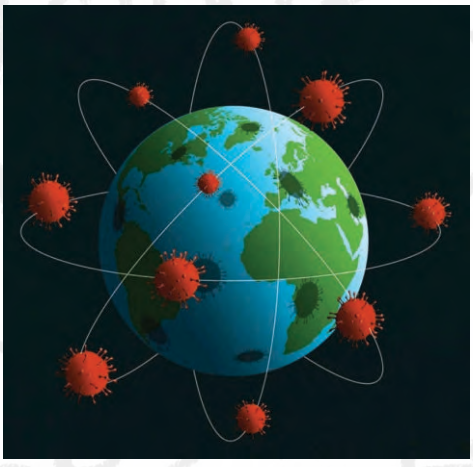


Source: (Sudnya mahimkar, 2015)

Entry View

Aerial View

Front View



THE BATTLE IS WITHIN...

Ar Chintan Shah

The time of sorrow has begun..
And there is no place to go,
There is a shortage of resources..
But no one is ready to use less,
There is a shortage of hours..
But no one is ready to initiate,
Crisis is clasping us day by day..
And we are unable to spread our wings,
Holding the closed ones is threatening..
It's a situation which wants us to bleed,
It will compete us to our last breathe..
Cause it is utterly determined to its will,
We are fighting for the wounds of each other..
But the battle is within.

Running from the situation is futile..
Distancing is the real wisdom,
Keep yourself in a closed space..
A built environment that can save,
It is a lesson to learn for a lifetime..
That a nature to be given its own space,
Now there is no point of regret..
We need to respond calmly to restrain,
Safer world is a need of the time..
Resurgence of our voices is desired,
Patience will bring the peace..
Unless we limit our needs,
Responsive to awful condition is requisite..
Cause the battle is within.

Source : https://indianfolk.com/understanding-two-worlds-pre-post-covid-19/

WELCOME NEW IIA MEMBERS

1st Com dated 28th January, 2021 Meeting Online Elected Members

Sr. No.	Name	Memb. No.	Place
	ASSOCIATE MEMBERS ELECTED AS FELLOW MEMBERS OF THE INSTITUTE		
1	Ar. Samir Mathur	F-08727	New Delhi
2	Ar. Abhishek Kanjalia	F20978	Faridabad
3	Ar. Gaurav Agrawal	F13004	Rajasthan
4	Ar. Liladhar Tanu Parab	F08068	Mumbai
	ARCHITECTS ELECTED AS ASSOCIATE MEMBERS OF THE INSTITUTE		
1	Ar. Geddam Renuka Sai	A24200	Visakhapatnam
2	Ar. Rohit Vijay Darda	A24201	Nashik
3	Ar. Rashmi Jain	A24202	Mumbai
4	Ar. Sanjay S	A24203	Chennai
5	Ar. Mohammed Fazil U T	A24204	Kerala
6	Ar. Satish Kumar Katwal	A24205	Himachal Pradesh
7	Ar. Peeyush Jain	A24206	Rajasthan
8	Ar. Anuradha Mishra	A24207	Uttar Pradesh
9	Ar. Pradeepa C	A24208	Tamil Nadu
10	Ar. R. Balamaheshwaran	A24209	Tamil Nadu
11	Ar. Koushik Krishna N	A24210	Chennai
12	Ar. Shrikrishna Prakash Phaldesai	A24211	Goa
13	Ar. Prashanthini Rajagopal	A24212	Chennai
14	Ar. Mythili Jaideep	A24213	Tamil Nadu
15	Ar. Sri Vallaba M	A24214	Coimbatore
16	Ar. Anoop Menon	A24215	Chennai
17	Ar. Nirrupama N .U.	A24216	Tamil Nadu
18	Ar. Rengarajan N	A24217	Tamil Nadu
19	Ar. A Grace Ansica	A24218	Tamil Nadu
20	Ar. Saravana Raja R	A24219	Chennai
21	Ar. Esther Cherine V.	A24220	Tamil Nadu
22	Ar. Narayani A. R	A24221	Tamil Nadu
23	Ar. Suriya Prakash M	A24222	Tamil Nadu
24	Ar. Thiagu M	A24223	Tamil Nadu
25	Ar. Yamini L.	A24224	Tamil Nadu
26	Ar. Ganesh J	A24225	Tamil Nadu
27	Ar. Manjari Krishnamoorthy K	A24226	Tamil Nadu
28	Ar. Karthick K.A.	A24227	Tamil Nadu
29	Ar. Prashant P	A24228	Tamil Nadu
30	Ar. Gajendran T	A24229	Tamil Nadu
31	Ar. Nivetha Devi R	A24230	Tamil Nadu
32	Ar. Harish Raman	A24231	Tamil Nadu
33	Ar. Anju Sara Abraham	A24232	Tamil Nadu
34	Ar. Krithika R	A24233	Tamil Nadu
35	Ar. Navabharathi T .N .	A24234	Tamil Nadu
36	Ar. Praveen N .	A24235	Tamil Nadu
37	Ar. Geeva Chandana B.	A24236	Tamil Nadu
38	Ar. Pradhyumna U	A24237	Tamil Nadu
39	Ar. A.Misba	A24238	Tamil Nadu
40	Ar. Ramesh Kumar M. C	A24239	Tamil Nadu
41	Ar. Dhushyanth Kumar L.	A24240	Tamil Nadu
42	Ar. Krishnasudha B.G	A24241	Tamil Nadu
43	Ar. Kanakathara .K .	A24242	Tamil Nadu
44	Ar. Nikhil Yashwant Apte	A24243	Maharashtra
45	Ar. Mansi Narayan Bannatwala	A24244	Bilaspur
46	Ar. Rishi Vishwakarma	A24245	Bilaspur
47	Ar. Tania Ajit Singh Gour	A24246	Bilaspur
48	Ar. Shashwato Ghosh	A24247	Bilaspur
49	Ar. Ayushree Khanna	A24248	Bilaspur
50	Ar. Akhilendra Sharad Kumar Jain	A24249	Bilaspur
51	Ar. Gaurav Agrawal	A24250	Bilaspur
52	Ar. Kshitij Kumar Thawaith	A24251	Bilaspur
53	Ar. Shubham Nigam	A24252	Bilaspur
54	Ar. Parul Agrawal	A24253	Bilaspur
55	Ar. Sukhpreet kaur	A24254	Patiala
56	Ar. Chacko. S. Kidacheril	A24255	Thrissur
57	Ar. Abhishek Kumar Soni	A24256	Bilaspur
58	Ar. Pooja Sao	A24257	Bilaspur
59	Ar. Jal Satram Jethmalani	A24258	Bilaspur
60	Ar. Garima Gupta	A24259	Bilaspur
61	Ar. Vivek kumar Yadav	A24260	Bilaspur
62	Ar. Shashidhar Chandreshekhar Hatti	A24261	Hubballi
63	Ar. Shruthi N	A24262	Telangana
64	Ar. Anup Naik	A24263	Karnataka
65	Ar. Alka Sharma	A24264	Jammu & Kashmir
66	Ar. Karan Narendra Trivedi	A24265	Saurashtra
67	Ar. Samhitha B S	A24266	Karnataka
68	Ar. Sandhya R.	A24267	Karnataka
69	Ar. Shubhashri Vinod Patil	A24268	Maharashtra
70	Ar. Rashmi M	A24269	Tamil Nadu
71	Ar. Shrikant Namdeo Dhanokar	A24270	Maharashtra
72	Ar. Jeevanantham M	A24271	Tamil Nadu
73	Ar. Aditi Dhiresh Patalia	A24272	Gujarat
74	Ar. Namrata Gupta	A24273	Bilaspur
75	Ar. Avani Jayesh Pataliya	A24274	Gujarat
76	Ar. Akansha Verma	A24275	Bilaspur
77	Ar. Vishal Dhiman	A24276	Chandigarh
78	Ar. Prakhar Ajay Agrawal	A24277	Bilaspur
79	Ar. Sumit Agrawal	A24278	Bilaspur
80	Ar. Vipul Sameer Deshpande	A24279	Bilaspur
81	Ar. Anjali Agrawal	A24280	Chhattisgarh
82	Ar. Kaustubh Madhav Manjiri Kashelkar	A24281	Kalyan - Dombilvi
83	Ar. Ankur Arvind Shetye	A24282	Kalyan - Dombilvi
84	Ar. Laxmi Sudhir Rajshree Magdum	A24283	Mumbai
85	Ar. Vahida P A	A24284	Kerala
86	Ar. Meenakshi Gaud	A24285	Karnataka
87	Ar. Karan	A24286	Haryana
88	Ar. Rahul Ganesh Nagwekar	A24287	Goa
89	Ar. Anuditha	A24288	Karnataka
90	Ar. Rogin Roy	A24289	Kottayam
91	Ar. Manu Sunny Munenchira	A24290	Kerala
92	Ar. Akash Purseth	A24291	Chhattisgarh
93	Ar. Himanshu Kasera	A24292	Rajasthan
94	Ar. Karunakumari Bokka	A24293	Telangana
95	Ar. Shivaji	A24294	Telangana
96	Ar. Seema U Maiya	A24295	Karnataka
97	Ar. Tata Nagendra	A24296	Andhra Pradesh
98	Ar. Pooja Narayanrao Agarkar	A24297	Maharashtra

Sr. No.	Name	Memb. No.	Place
99	Ar. Dhanush Vijayan Vayalambron	A24298	Thiruvananthapuram
100	Ar. M P Sabnis	A24299	Karnataka
101	Ar. Clara Rose Jose	A24300	Kottayam
102	Ar. Karthikeyan K.H	A24301	Tamil Nadu
103	Ar. Devyani Shrikant Khadilkar	A24302	Mumbai
104	Ar. Surya Prakash B	A24303	Tamil Nadu
105	Ar. Mohammed Sultan	A24304	Northen
106	Ar. Sabharish P R	A24305	Tamil Nadu
107	Ar. Rajeshwari B. E.	A24306	Karnataka
108	Ar. Yati Kumar Misra	A24307	Maharashtra
109	Ar. Naim Hamid Waikar	A24308	Satara
110	Ar. Komal Tanaji Thorat	A24309	Satara
111	Ar. Gourav Nandkumar Pawar	A24310	Maharashtra
112	Ar. Joshiraju Kunchala	A24311	Visakhapatnam
113	Ar. Pooja Jugalkishor Kakaraniya	A24312	Kalyan - Dombilvi
114	Ar. Anita M	A24313	Chennai
115	Ar. Neel Mahendra Ujwala Parakh	A24314	Navi Mumbai
116	Ar. Kirti Saxena	A24315	Uttar Pradesh
117	Ar. Ar. Shreya Sunilkumar Rathore	A24316	Mumbai
118	Ar. Shilpi Mehra	A24317	Noida
119	Ar. Farhan M Hanif Mariyam Valsadia	A24318	Gujarat

Sr. No.	Name	Memb. No.	Place
120	Ar. Rahul Sajeevan Nair	A24319	Kochin
121	Ar. Swapnil Mohan Kalyankar	A24320	Navi Mumbai
122	Ar. Chetan Anil Daga	A24321	Nashik
123	Ar. Ankush Mohanrao Pingle	A24322	Nashik
124	Ar. Jagtap Pavan Prakash	A24323	Nashik
125	Ar. Sunil Raveendran Nair	A24324	Maharashtra
126	Ar. Anubhav Nilim Barua	A24325	Assam
127	Ar. Debashree Mahanta	A24326	Assam
128	Ar. Himanshu Bansal	A24327	New Delhi
129	Ar. Adarsh Binesh	A24328	Kerala
130	Ar. Radhika V	A24329	Chennai
131	Ar. Rekha Rawat	A24330	Delhi
132	Ar. Pinali Kamlesh Usha Patel	A24331	Mumbai
133	Ar. Adedayo Jeremiah Adeyekun	A24332	Haryana
134	Ar. Dheeraj Kumar	A24333	Gurgaon
135	Ar. Ambica Ramlakhan Singh	A24334	Gurgaon
136	Ar. Priyanka Gupta	A24335	Noida
137	Ar. Akshat Jain	A24336	Noida
138	Ar. Sujata Agraj Singh	A24337	Bilaspur
139	Ar. Shailaja Ajit Vaidya	A24338	Kalyan - Dombilvi

WELCOME NEW IIA MEMBERS

2nd Com dated 27th February, 2021 Meeting at Chennai

Sr. No.	Name	Memb. No.	Place
	ASSOCIATE MEMBERS ELECTED AS FELLOW MEMBERS OF THE INSTITUTE		
1	Ar. Vijayaram K.	F17344	Tamil Nadu
2	Ar. Arun S. R.	F15863	Thiruvananthapuram
3	Ar. J. A. Richardson Perez	F06021	Chennai
	ARCHITECTS ELECTED AS ASSOCIATE MEMBERS OF THE INSTITUTE		
1	Ar. Subham Somani	A24339	Raipur
2	Ar. Manisha V. Dharwadkar	A24340	Thrissur
3	Ar. Namraota Jain	A24341	Uttar Pradesh
4	Ar. Karanveer Singh Chawla	A24342	Jammu & Kashmir
5	Ar.Neha Aditya Bhaiya	A24343	Akola
6	Ar. Bhakti Ruturaj Jadhav	A24344	Sangli
7	Ar. Sandeep Pandurang Hinge	A24345	Satara
8	Ar. Neena Raicha	A24346	Chhattisgarh
9	Ar.Samragni Madhav Deshpande	A24347	Mumbai
10	Ar. Radhika K Chivate	A24348	Belgaum
11	Ar.Hemant Jiwnani	A24349	Chhattisgarh
12	Ar.Abhishek D	A24350	Coimbatore
13	Ar. Varsha M.B.	A24351	Kochi
14	Ar. Raguraman P.	A24352	Coimbatore
15	Ar. Fazil Moidunny Kutty	A24353	Kerala
16	Ar. Nisham Mohamed	A24354	Kerala
17	Ar. Matinder Kumar	A24355	Ahmedabad
18	Ar. Niral Kantilal Patel	A24356	Mumbai
19	Ar. Paras Subhash Netragaonkar	A24357	Pune
20	Ar.Sandeep U	A24358	Karanataka

Sr. No.	Name	Memb. No.	Place
21	Ar. Amirah Ahamed	A24359	Karanataka
22	Ar. Nandita	A24360	Karanataka
23	Ar. Anchit Sharma	A24361	Jammu & Kashmir
24	Ar. Aditya Jain	A24362	Delhi
25	Ar. Kubair Vatsa	A24363	Gurgaon
26	Ar. Abhishek Jain	A24364	Delhi
27	Ar. Pragya Mittal	A24365	Jharkhand
28	Ar. Madhav Raman	A24366	New Delhi
29	Ar. Aniket Rajendra Khade	A24367	Nashik
30	Ar. Ashutosh Kumar	A24368	Bihar
31	Ar. Ankur Prakashnath Dadheech	A24369	Rajasthan
32	Ar. Ayyappan G.	A24370	Kerala
33	Ar. Subeesh S.	A24371	Kollam
34	Ar. Amrita Madan	A24372	Noida
35	Ar. Stuti Bindlish	A24373	Hisar
36	Ar. Khushboo Agarwal	A24374	Uttar Pradesh
37	Ar. Javed Iqbal	A24375	Rajasthan
38	Ar. Nitin Nehra	A24376	Rajasthan
39	Ar. Rishabh Sharma	A24377	Rajasthan
40	Ar. Ashish Kumar Singh	A24378	Jharkhand
41	Ar. Deepa S. Wani	A24379	Karanataka
42	Ar. Deepti S. Mayee	A24380	Kalyan - Dombivli
43	Ar. Shabnam Kutub Kapasi	A24381	Gujarat
44	Ar. Yashpal Singh Sengar	A24382	Uttarakhand

JIIA ONE YEAR SUBSCRIPTION

GENERAL

MEGASAVER

GENERAL SUBSCRIPTION
Other than IIA members

J O U R N A L
OF THE INDIAN INSTITUTE OF
A R C H I T E C T S

Prospect Chambers Annexe, 5th Flr., D.N. Road, Mumbai 400 001
Tel.: +91 22 22046972/22818491/22884805 Fax: +91 22 2283 2516
Email: iiapublication@gmail.com / iiaho1214@gmail.com
Website: www.indianinstituteofarchitects.com

Please enter my annual subscription at ₹ **1,000/-**
Payment is enclosed herewith. (Please tick appropriately)

☐ Demand Draft ☐ Cheque ☐ Money Order

Name : Title

Address :

City : Pin :

Signature : Date :

Please tick the appropriate box only

- ☐ Architect registered with the Council of Arch
  Arch. CA No.
- ☐ Planner
- ☐ Engineer
- ☐ Builder
- ☐ Designer
- ☐ Educationist
- ☐ Administrator
- ☐ Business
- ☐ Other than above
  (Please Specify)

STUDENT

MEGASAVER

GENERAL SUBSCRIPTION
Other than IIA members

J O U R N A L
OF THE INDIAN INSTITUTE OF
A R C H I T E C T S

Prospect Chambers Annexe, 5th Flr., D.N. Road, Mumbai 400 001
Tel.: +91 22 22046972/22818491/22884805 Fax: +91 22 2283 2516
Email: iiapublication@gmail.com / iiaho1214@gmail.com
Website: www.indianinstituteofarchitects.com

Please enter my annual subscription at ₹ **500/-**
Payment is enclosed herewith. (Please tick appropriately)

☐ Demand Draft ☐ Cheque ☐ Money Order

Name : Title

Address :

City : Pin :

Signature : Date :

CERTIFICATE

This is to certify that

(Student's Name)

is a bonafide student of

(School, College of Arch.)

City

Please enter student Subscription

Signature of Head of the Institution
(Please affix stamp of the Institution)

THE INDIAN INSTITUTE OF ARCHITECTS

Prospect Chambers Annexe, 5th Floor, Dr. D. N. Road, Fort, Mumbai – 400 001.
Tel. : +91.22.2204 6972 / 2281 8491 / 2288 4805 • Fax : +91.22.2283 2516
Email : iiapublication@gmail.com / iiaho1214@gmail.com • Website : www.indianinstituteofarchitects.com

STUDENT MEMBERSHIP FORM

(TO BE FILLED WITH BLOCK LETTERS ONLY)

Photo

To,
The Jt. Hon. Secretary
The Indian Institute of Architects
Prospect Chambers Annexe, 5th Floor,
Dr. D. N. Road, Fort,
Mumbai – 400 001.

Subscription Payment Details : (*Cash will be accepted only at IIA Office in Mumbai, against receipt*)
₹ 200/- (Yearly Subscription)
Add GST @ 18% on the amount payable

cheque *(Multicity Cheque for outstation)* D.D. No. dt.

of ₹ drawn on

in favour of **"The Indian Institute of Architects" payable at Mumbai.**

Personal Information :

Name (As appearing on my graduation certificate) :

First Name

Middle Name

Last Name

(In case of change of my name I shall attach the ncessary legal documents, as required by IIA).

Gender : Male Female Date of Birth :

Contact Information :

Telephone : Res. Mobile :

Email :

Residential Address :

State : Pin Code :

Year of Joining Architectural Studies **Nationality**

Name of Parents / Guardian :

Address :

State : Pin Code :

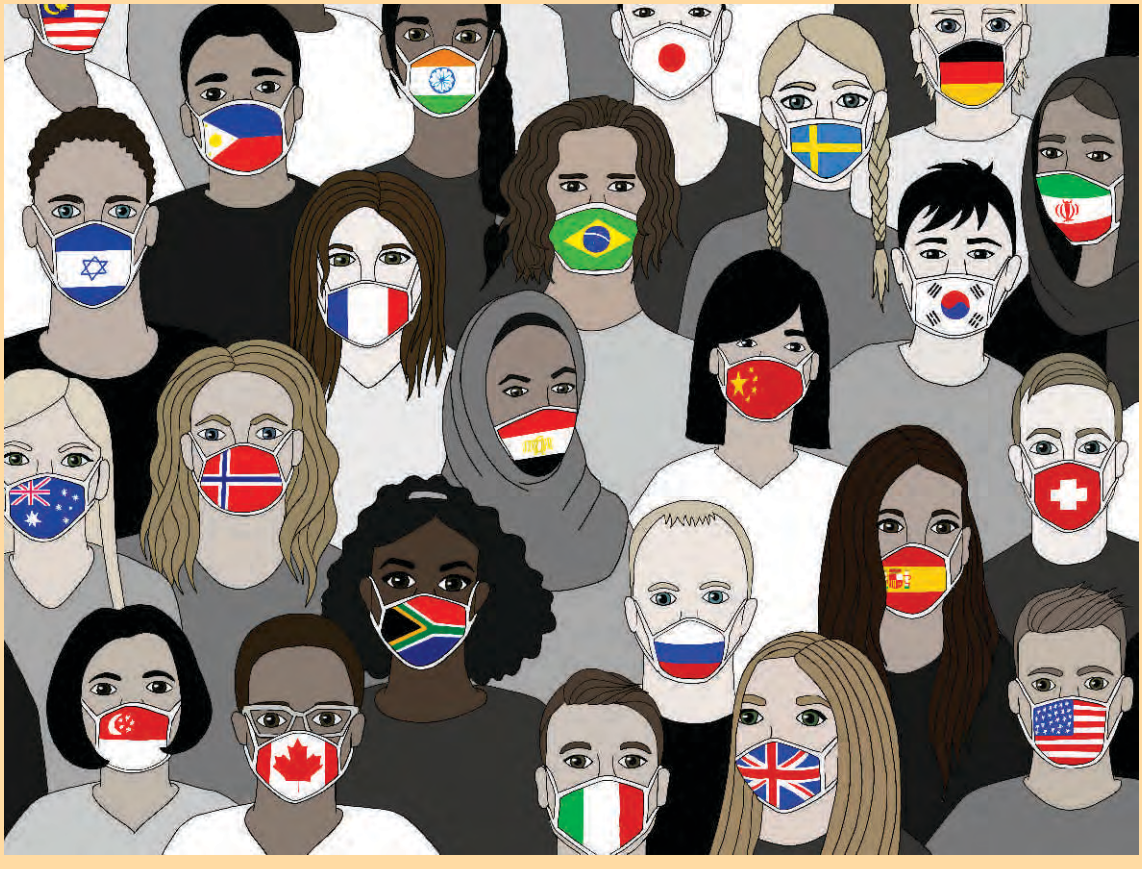
I have gone through the rules and regulations of **The Indian Institute of Architects** and shall abide by them.

JOURNAL
OF
THE INDIAN INSTITUTE OF ARCHITECTS

ADVERTISEMENT TARIFF CHART (w.e.f. 01.04.2019)

S.No.	Location	1 to 4 issues Per Insertion	1 to 8 issues Per Insertion	1 to 12 issues Per Insertion
1	**COLOUR**			
	Inside front cover	1,50,000	1,25,000	1,00,000
	Back cover	1,50,000	1,25,000	1,00,000
	Inside back cover	1,25,000	1,00,000	75,000
	Full page Right Hand Side	80,000	70,000	60,000
	Full page Left Hand Side	70,000	60,000	50,000
	Half page	40,000	35,000	30,000
	Quarter page	25,000	22,500	20,000
2	**BLACK & WHITE**			
	Full page Right Hand Side	60,000	50,000	40,000
	Full page Left Hand Side	50,000	40,000	30,000
	Half page	30,000	25,000	20,000
	Quarter Page	15,000	12,500	10,000

"The Cheques to be issued in the name of **"THE INDIAN INSTITUTE OF ARCHITECTS".**



Courtesy: WORLD HEALTH ORGANISATION

86/01-02
IIA PUBLICATION
POSTAL REGD. NO.MCS/007/2021-23

RNI NO.9469/57
POSTED AT PATRIKA CHANNEL SORTING OFFICE, MUMBAI-400001
PUBLISHED ON 14TH OF EVERY FOLLOWING MONTH AND
POSTED ON 15TH & 16TH OF EVERY FOLLOWING MONTH