# 3.2 Innovation Ecosystem

3.2.2 Number of workshops/seminars/Conference including programs conducted on Research Methodology, Intellectual Property Rights (IPR) and entrepreneurship during the last five years

Principal
Bombay Suburban Art & Craft Education Society's
L.S. Raheja School of Architecture,
Raheja Education Complex,
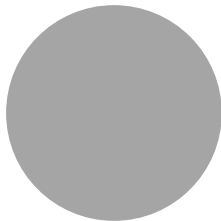Kher Nagar, Bandra (E), Mumbai - 400 051.
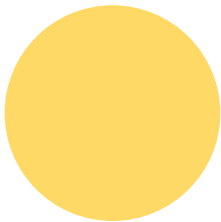
The Building Design by considering Micro-Climate
Ar. Sachin Prabhu
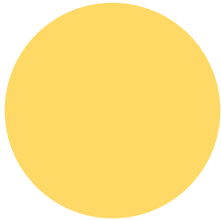Revisiting the role of Architecture for 'surviving' Development (ASA Conference 2019)
53rd International Conference of Architectural Science Association to be organized at Department of Architecture and Planning, IIT Roorkee

Relation of urban population density and urban identity resilience - *Example of Mumbai's residential development*
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Blurred Boundaries- In search of an Identity

The Building Design by considering Micro-Climate
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Conferences - ANZAScA (archscience.org)

Year	#	Location	Host	Theme	Website
2022	55	Perth, Australia	Curtin University	Architectural Science and User Experience: How can Design Enhance the Quality of Life	Open
2021	55	Online			
2020	54	Auckland	AUT		
2019	53	Roorkee, India	Indian Institute of Technology	Revisiting the role of Architecture for 'surviving' Development	Open
2018	52	Melbourne	RMIT University	Engaging Architectural Science: Meeting the Challenges of Higher Density	Open
2017	51	Wellington	Victoria University	Back to the Future: The Next 50 Years	Open
2016	50	Australia	University of Adelaide	Fifty years later: revisiting the role of architectural science in design and practice	Open
2015	49	Australia	University of Melbourne	Living and Learning	Open
2014	48	Italy	University of Genoa	ACROSS: Architectural Research through to Practice	
2013	47	Hong Kong	Chinese University of Hong Kong	Cutting Edge	Open
2012	46	Gold Coast	Griffith School of Environment		
2011	45	Australia	The University of Sydney		
2010	44	Auckland	Unitec Institute of Technology		Open
2009	43	Australia	University of Tasmania	Performative Ecologies in the Built Environment: Sustainability Research Across Disciplines	Open
2008	42	Australia	University of Newcastle		

Papers - ANZAScA (archscience.org)

Transforming spaces in higher education: academic office environments and their influence on staff, a case-study from Melbourne, Australia

Authors: Francis, Matthew C.; Andamon, Mary Myla

Despite cellular offices historically having a predominant role in facilitating academic productivity, alternative office configurations for academic staff have emerged in Australian universities. This paper presents key post-occupancy evaluation (POE) survey results of a high-performance university office building (c.2012) in the urban centre of Melbourne, Australia. The POE survey responses of full-time academic research staff···

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Micro-Climate oriented Building Design

Authors: Prabhu, Sachin

India is a country where we see a lot of architectural versatility from Vedic Period, Rock-cut Architecture, Blends of different foreign architecture with various Indian regional architecture, Vernacular Architecture, Contemporary Architecture, Green Architecture, etc. The Vernacular Architecture in India meaning variety of aspects of climate, materials, local craftsmen and utmost comfort. In true sense these···

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Rethink: Interdisciplinary evaluation of academic workspaces

Authors: Backhouse, Sarah; Newton, Clare; Fisher, Kenn; Cleveland, Ben; Naccarella, Lucio

Academic workspace remains an emotive topic. It is bound tightly with each academic's identity, purpose and status. As universities increasingly focus on cross-disciplinary collaboration to produce new knowledge, the

Micro-Climate oriented Building Design

Sachin Prabhu

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Abstract: India is a country where we see a lot of architectural versatility from Vedic Period, Rock-cut Architecture, Blends of different foreign architecture with various Indian regional architecture, Vernacular Architecture, Contemporary Architecture, Green Architecture, etc. The Vernacular Architecture in India meaning variety of aspects of climate, materials, local craftsmen and utmost comfort. In true sense these designs are energy efficient. But in Modern Architecture majority of time buildings are designed based on passive, mechanical systems to consume more energy. But in comparative analysis they prove how they are energy efficient. But if these buildings are designed by understanding proper sun-path, climate and wind directions; these buildings can be more energy efficient than the former one. This paper is showcasing the different possibilities for building zonings, orientations, and fragmentation of the building foot-print to get more responsive design with respect to climate, sun-path and wind flows along with proper landscape to divert wind flows. If at schematic levels buildings are designed with these strategies energy consumption after building completion is reduced.

Keywords: Sustainability, sun-path, wind-flow, building orientation

1. Introduction

In India right from ancient time buildings are schematically designed based on Vastupurusha Mandala, Nav-graha Mandala, Nav-Rasa, etc. Kautilya has showcased many town planning modules based on "Eight Orientations and Vastupurusha Mandala". But in Modern Era buildings are designed many times by overlooking the sun-path, climatic aspects, and wind directions. Majority of time such buildings are relying on mechanical aspects to get comfort.

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2. Reality for Sustainability in India

India is now in intensive development, which will bring with it many new and varied changes, economically and socially, for the general well being of the population.

On this background there are many choices with the developer and designer:

- Non-sustainable, copying the conventions, fashions, and mistakes of the 'developed world'.
- Sustainable, developing fresh, original, appropriate patterns of development, responsive to the need of Indian society and resources, contributing to the 'New world environmental order'.

India houses about 16% of world's population (a proportion which is still increasing); China about 21%, and if one looks at all Asia, the region accounts for 59% of the people of the world – and the whole region is in a greater or lesser state of accelerated development. (Source: Climate responsive architecture)

If the per capita energy consumption of the Asian region increases to the levels of Europe, global energy consumption will increase by 115%, (Source: Climate responsive architecture) with almost unthinkable global environmental consequences. The global environment in future is in danger. So just copying the planning strategies of developed world is unfair. The Indian architects should think of the strategies suiting to Indian climate, economy and society. At the planning stage only, they should think of surrounding, local micro climate, wind flows, sun path, available resources and minimalism. India is preoccupied with its own problems, will hopefully make some serious efforts to put their own house in order to follow reduction in possible energy consumption.

3. Sustainable Architecture

How are we going to achieve architectural sustainability? Certainly not through following "conventional" western design pattern, copying stylistic fashion, or adopting inappropriate technological fixes from other climates, regions, or cultures. The rigid beaurocratic controls help in achieving this in diverse country like India. But the real solutions must come from "within", by following:

- Select diverse and locally adapted solutions for development.
- Use of locally available appropriate resources suitable to local climate response.
- Design for local social customs, conventions and aspirations.
- Use original thinking based on vernacular aspects rather than adopting or copying readymade ideas.
- Conserve non-renewable energy – limit it to use highly efficient, essential functions, understand the need of massive consumption.
- Introduce incentives for energy efficiency, climatically responsive developments, by understanding micro climate, sun-path, wind flows.
- Utilize energy performance equipment's and systems.

These are just few ideas, approaches and concepts that are fundamental to a sustainable approach to development of the built environment.

4. Methodology

The following 10 steps can be considered before designing the building:

4.1. Perform a site analysis

Determine the weather patterns, climate, soil types, wind speed and direction, sun path, habitat and geology of the site. Document all these aspects while zoning the building. This is an approach which considers the best environmental sustainability practices.

4.2. Layout the building on the site

By understanding the factors of site analysis, use a basic massing of the building layout by understanding design constrains like access, entrance, circulation, connectivity, design program, etc.

4.3. Orientation of the building based upon cardinal directions (sun path)

By understanding the sun path orient the building to reduce direct heat on the facades of the building as well as to minimise heat generation due to radiation.

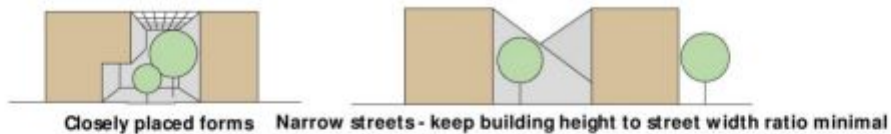Maximise mutual shading through built forms

Closely placed forms   Narrow streets - keep building height to street width ratio minimal

Fig 1: Shading of the building.
(Source: https://fairconditioning.org/knowledge/passive-design/form-and)orientation/)

4.4. Select the appropriate window areas and glazing types based on orientation

The window openings on the wall can be planned by understanding figure no. 2. Avoid massive openings on south facades. If not possible south facing facades should utilize a window area appropriate to its orientation and glazing should utilize a double or triple paned glass with a low e-coating.

4.5. Design building envelope by understanding sun path

When designing the envelope of the building, especially southern façade inclined it by understanding altitudes and azimuth for critical conditions. The opacity, transparency and openings can be determined by understanding surroundings.
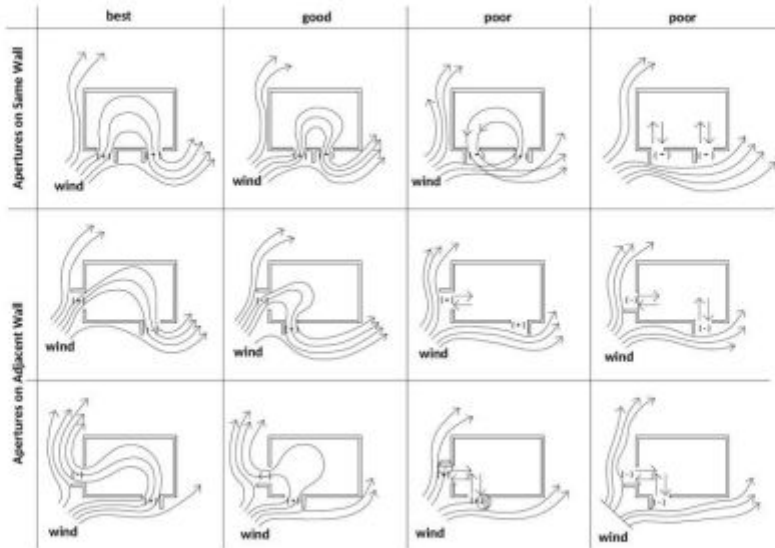
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Fig 2: Window locations and wind flow.
(Source: http://www.yourhome.gov.au/passive-design/orientation)

4.6. Minimize the building foot print

Minimise S/V ratio in ectreme climates

Increase compactness by reducing
surface area forthe same volume

Minimise P/A ratio in ectreme climates
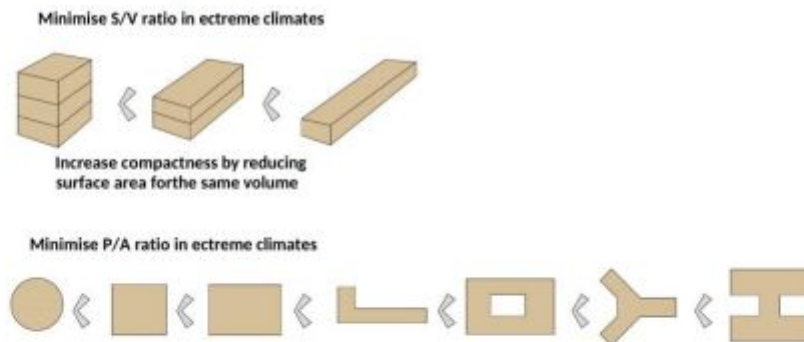
Fig 3: Design of foot print of building
(Source: http://www.nzeb.in/knowledge-centre/passive-design/form-orientation/)

By minimizing the building foot print the cost on massive excavation can be saved. Facades will be more in area to get sufficient light and cross ventilation. Desired space will be available for plantation to cool down surrounding and to divert desired wind flows.

4.7. Design for natural ventilation

By understanding natural wind flows and diverted wind flows design inlets of appropriate sizes and design outlets to escape warm air at higher locations compare to inlets. It can cut down the consumption of electrical devices indoor.
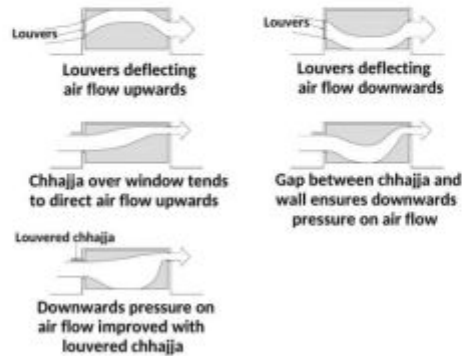
Fig 4: Design of natural ventilation different types

(Source: http://www.yourhome.gov.au/passive-design/passive-cooling)

4.8. Design for occupants comfort

By using natural systems i.e. sun and wind, reduce the amount of energy used to cool and heat the building can result in using natural systems, meaning the sun and the wind. The window openings are operatable to adjust comfort condition indoor as per occupant's whim.

4.9. Energy modeling and analysis

Energy modeling, lighting models, day lighting studies, computational fluid dynamics are other different tools that designers can use while designing by understanding the local climate and micro-climate features specific to the site.

4.10. Perform multiple iterations

If you are not successful in desired results, then utilize above constrain with other alternatives repeatedly and arrive at the best solution with comparative analysis.

5. Sun path with eight orientations

By considering four main orientations and four sub orientations, building can be divided into 9 parts. The four sub orientations are having their own significance. Being in Northern hemisphere of the world India has geographical significance. North-East (Ishanya – God) is very significant orientation.

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India gets secured from the freezing winds of north flowing from China due to Himalayan Ranges. The rising sun enters the Indian continent from this orientation only. India got many perennial rivers originating from the Himalayan Ranges. From north-east side we get rich D vitamin from rising sun. Hence with respect to Indian context this orientation is having divine nature, hence termed as God. Because of Himalayan Ranges India has got tropical climate. The building at north-east side can be opened more to get ample morning sun rays, the orientation of the doors and entrances of the building are preferred the most at north-east side.

The South-East orientation is termed as Agneya (Agni – Fire), depicting fire element. Hence functions like Kitchens, Toilets, and Gardens are placed here. Generally massive openings are minimized here to stop heat radiation creeping indoor of the building, happening from South-East and South direction. South-East side may be cooled down by growing lush Green trees, bushes and lawns in the surroundings. The building elevations at North-East side can be inclined properly by understanding sun-path for critical span of time. Due to inclined surface the requirement of surface treatment in such cases can be minimized. The boxes, fins, heavy chhajjas, pergolas can be avoided to save extra cost of material, labour and supervision. Hence lot of energy is saved.

The South-West orientation is termed as Nairutya (Neer – Water) depicting water element. But for tropical India monsoon arrives from this side only for an average 4 months. This orientation is termed as "Earth Element."

The fourth orientation North-West i.e. Vayavya (Vayu – Wind), is depicting "Wind Element." In the context of India, the wind flowing to this direction is coming from Afghanistan and Pakistan, with warm air. This warm air can be avoided with various aspects. So, in design criteria while zoning these are the strong elements which can be considered. For sun-path with respect to India, sun rises at East, move
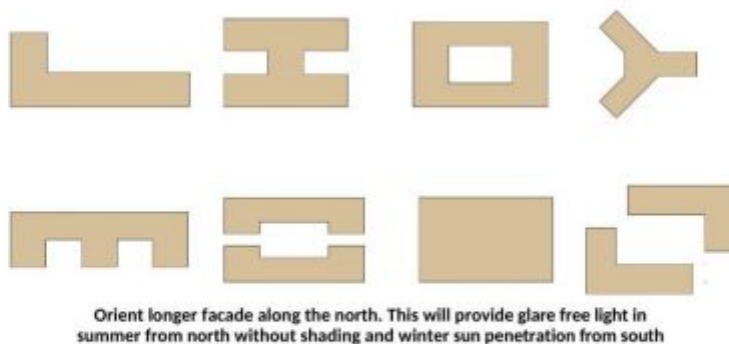

Orient longer facade along the north. This will provide glare free light in summer from north without shading and winter sun penetration from south

Fig 5: Orientation of longer facades towards north

(Source: http://www.nzeb.in/knowledge-centre/passive-design/form-orientation/)

towards South and sets at West. From January to July sun is more vertical and days are bigger than nights. For this period the heat due to sun is more and critical. From August to December sun is more

inclined and the days are smaller compare to the nights. When the sun is vertical the heat generated is more and in Indian context the heat spread indoor due to heat radiation happens from the south direction. To control the heat creeping indoors, we can design weather protections or inclined the Southern Facade by considering altitude and azimuth for that date. From north we are getting diffuse sun light throughout the year.

At the time of design if these points are considered then the typologies utilized after construction is over to cool down the façade can be eliminated; to save the energy, material and labour cost in future.

6. Wind Flow

Another important criterion is the "Wind Direction." Generally, wind direction for any plot is changing in a day many times. By considering the possible wind directions for the particular plot there are different remedies to follow. In general, when obstacles are coming in the way of wind direction, they cause wind shaded areas on the opposite side of the obstacle. If buildings are becoming the obstacle for wind flow, then they are creating wind shadow regions at the opposite side of the building, causing problems. In this shadow area if dwarfed buildings are placed with proper openings, such dwarfed buildings get surprisingly good cross ventilation as illustrated below in the figure 6.
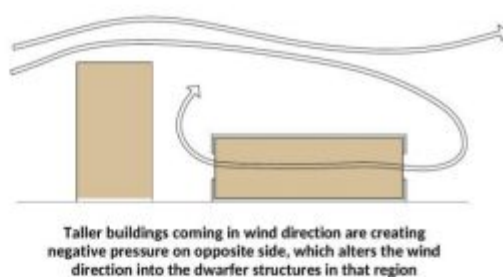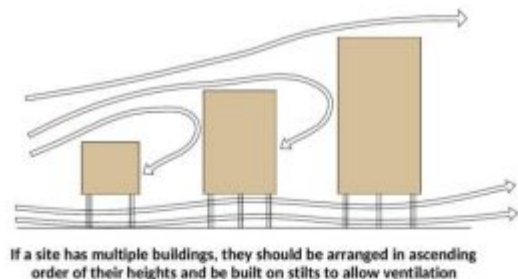

Taller buildings coming in wind direction are creating negative pressure on opposite side, which alters the wind direction into the dwarfer structures in that region

If a site has multiple buildings, they should be arranged in ascending order of their heights and be built on stilts to allow ventilation

Fig 6: Tall buildings and wind (Source: http://www.nzeb.in/knowledge centre/passive-design/form-orientation)

Fig 7: Variable height buildings and wind flow (Source:http://www.nzeb.in/knowledge-centre/passive-design/form-orientation)

While designing the buildings in big layout we designed variable height buildings. The placement and zoning of the buildings can be decided by understanding wind flow. The building can be stilted and placed in ascending order of heights along the win direction to achieve maximum cross ventilation in all buildings. This is illustrated in figure 7.

When the buildings are zoned perpendicular to the wind flow, wind shadow effect occurs at the opposite side of buildings creating uncomfortable conditions. To overcome these buildings can be

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placed in angular way i.e. to an angle of 30 or 45 degree to get ample wind flow and cross ventilation (figure 8). Even the buildings can be staggered to divert the wind flow within the buildings (figure 9).
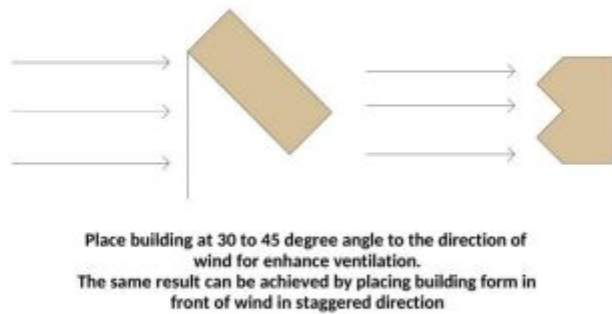
Place building at 30 to 45 degree angle to the direction of
wind for enhance ventilation.
The same result can be achieved by placing building form in
front of wind in staggered direction

Fig 8: Angular placement of buildings and wind flow (Source: http://www.nzeb.in/knowledge-centre/passive-design/form-orientation/)

Staggered building layout helps in enhanced wind movement
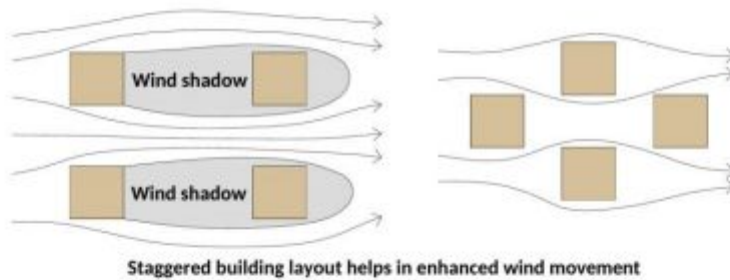
Fig 9: wind flow and staggered buildings (Source: http://www.nzeb.in/knowledge-centre/passive-design/form-orientation/)

Many times as per the microclimate site gets good wind flow. But if it is not captured well it just blows around the building but cannot flow inside the building if it is not managed well in design. The following example illustrates how wind can be forced to flow inside the building with proper openings and plantation of trees.

The fragmentation of building or staggering the rooms give ample cross ventilation and even enhance the aesthetics of the building. This is achieved by providing tree plantation at require places. Due to desirable cross ventilation the comfort level of the building is as well enhance and additional sources for mechanical ventilation can be omitted. (Fig. 10)

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northern side of the passage can be designed with ventilators to allow cross ventilation. Now the comfort level of the occupants is increases much more than the previous state.

CROSS VENTILATION PRODUCED WITHIN THE BUILDINGBYBY CREATING NAGATIVE PRESSURE WITHIN THE BUILDING BY PLACEMENT OF EXHAUST FAN
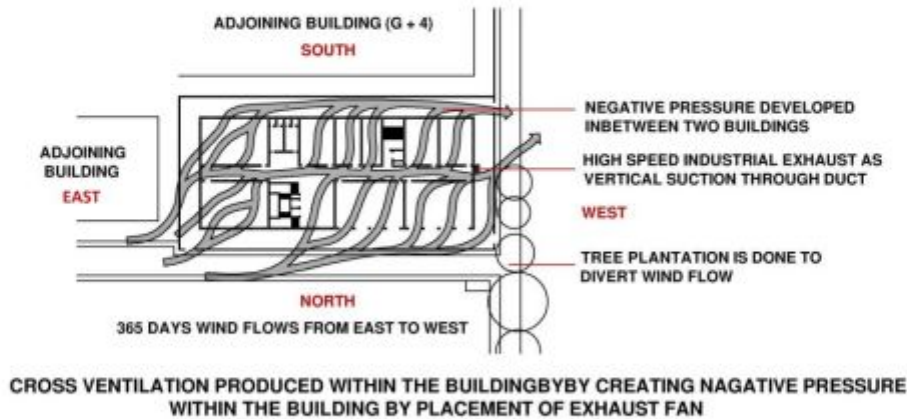
Fig 12: plan of existing educational building from Mumbai after treatment

7. Conclusion

In developing country like India, the architectural designs can be made very sensible at planning stage only by understanding sun path, micro climate of the site, wind directions, locally available material and vernacular aspects like culture, social and economical impacts of the society, to conserve energy for every development.

How much energy is being saved in such cases? Further research can be done to calculate amount of energy saved with comparative analysis of various methods adopted for mechanical ventilation.

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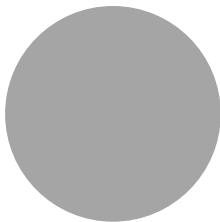Vellard Gerd Hatje, *Architecture and the Sun*, Thames and Hudson, London.

Sergi Costa Duran, *Architecture and Energy Efficiency*, Loft Publication, Barcelona, Spain, 2011.

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http://www.yourhome.gov.au/passive-design/orientation

http://www.nzeb.in/knowledge-centre/passive-design/form-orientation/

http://www.vaastuinternational.com/vaastuhouse.html

**Relation of urban population density and urban identity resilience
 - Example of Mumbai's residential development**
Ar.Deepa Desai & Ar. Ninad Sansare
Blurred Boundaries- In search of an Identity

International conference
on
Blurred boundaries:
In search of an identity

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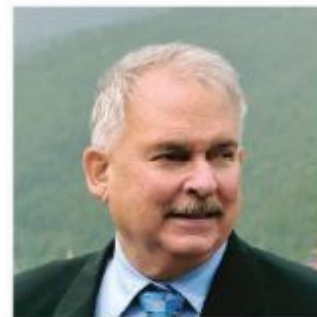
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Contents

Resilience in the Era of Change

Relation of urban population density and urban identity resilience: Example of Mumbai's residential development

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2 Assistant Professor of Urban Planning at L.S.Raheja School of Architecture, Mumbai University

Abstract:

Cities are prone to changes in every era; currently, urban growth and population density increasingly challenge their resiliency. This paper reviews the key concepts and ideas from urban identity, urban identity resilience, urban density, and planning policies to formulate a theoretical framework to analyse the adverse effects of urban density on the urban identity of Indian cities. This framework then studies the case of Mumbai's residential development in terms of space dynamics, building typologies, architectural character, and building materials that adversely affect cities' liveability and identity. It further argues that the lack of liveable space in Mumbai's residential area affects people's capacity to retail their cultural identity and sense of belonging to space. Finally, this paper highlights that the root cause of these issues lies in the residential development policies formulated to cater to urban population growth but ignore the liveability aspects and associational value of the space.

Keywords:- Urban population growth; Urban density; Urban identity; Urban identity resilience

1. Introduction :

The urban population is increasing exponentially. It is projected that by the end of 2050, more than 68% of the world's population will reside in cities (United Nations, 2019). This growth will likely happen in the countries from the global south (United Nations, 2019). This implies that the already well-functioning cities from the developed countries such as London, Amsterdam, New York, and Sydney will not have as significant an impact of urban population growth on the cities from developing countries such as Mumbai, Cairo, Cape Town, and Dhaka (World Economic Forum, 2021). However, rapid urbanisation will be responsible for the increase in urban density of these already overcrowded cities from the developing world, which are experiencing severe urban issues due to the disproportionate balance of urban infrastructure to the urban population. The direct result of this phenomenon can be seen in the housing shortage (slums and affordable), high land values, poor sanitation, low infrastructure services, etc. (World Economic Forum, 2018). In this context, the resilience of systems in such cities will be damaged. As a result, the citizen's right to have equitable resources and services will be challenged, and it will abolish the city's identity.

A considerable amount of research on urban density and resilience has focused on the impacts of urban population growth and density on the urban infrastructure; however, little attention has been given to the impacts on the city's identity, an integral part of the resiliency studies. This paper aims to address the impacts of urban population growth and density on the identity of the city system's resilience. It does so by empirically studying the housing infrastructure development in Mumbai. It further provides insights into the provisions in the urban residential development policies responsible for the degradation of urban identity. Finally, we conclude with the recommendation to the policymakers to pay attention to urban identity resilience while formulating such policies.

2. Urban identity and resilience:

To use the word urban identity, it is essential to define what is an urban identity. There are various parallel views on this topic; however, most urban researchers (see Hayden, 1997; Neill, 2004; Zukin, 1995) defined urban identity as a perceived impression of people about the urban space. This implies that identity is not space but the people who occupy that space; hence, it is crucial to direct the focus of the urban identity study into the relationship of people and urban space. Further, Hayden (1997)argues that the place has a strong relation to the identity as the place itself is a powerful source of memory, as a form where one strand ties in another. Similarly, Neill (2004) and Doshi (1985)referred to space as a cultural product since it will be associated with the meaning of one sort or another within some cultural frame. In this context, Alexander (1977) mentioned the identifiable neighbourhood, highlighting the human need to belong to an identifiable space unite. He further explained that people aspire to live in a city with a distinct character from other cities. The sense of belonging, in this case, plays a vital role in making behavioural territory (Lynch, 1990).

What constitutes an urban identity is another question that is essential to address at this stage. The essence of the city is not always

fixed as it develops and changes according to time. Also, culture is adaptive in nature, fundamentally accepting or rejecting different values (Bell & De-Shalit, 2014). In other words, the urban identity develops over time based on the residents' lifestyle, customs, traditions, values, religion, socio-economic practices, etc. (Zukin, 1995). Along with these experiential and performative features, the physical features of the city, such as architectural style, building typology, also frame the identity of the city as it can be seen as the reflection of the residents' lifestyle (Littlefield, 2012; Sansare & Jacinto, 2019). Thus, the urban identity is the resultant of these tangible and intangible aspects, essentially focusing on the usability of space by the inhabitants. This implies that the urban identity plays an important role in making cities relatable and habitable for the people. Hence urban identity needs to be cherished, preserved, and enhanced.

The idea of urban identity and urban resilience are interconnected with others. As mentioned earlier, urban identity develops over time, adapting to the surrounding conditions; it is an integral part of the city. To transfer this understanding of an urban identity with system thinking (see Brown et al., 2020; Lang, 2010), urban identity can be seen as a city subsystem. On the other hand, most of the literature on resilience study applies the same system thinking to describes resilience as a systemic property to stay balanced during any shocks. Hence, the concept of resilience can be defined as understanding, managing, and governing complex adaptive systems (Walker et al., 2006). Based on this, urban identity resilience can be understood as the capacity of complex systems to retain their identity irrespective of any shift in population growth and urban density (Leixnering & Hollerer, 2021).

Based on the above discussion, the urban identity can be derived as an identity of people and a character of the space that has to accommodate various attributes attached in the formation of the identity. We consider the identity of cities as an aspect of the space occupied by people and has a strong association with their memories and the aesthetic character of the buildings in the city. In the further section, we described in detail how urban population density is a threat to the urban identity resiliency of the cities by using the case of housing infrastructure development of Mumbai.

3. Urban density and urban identity of Mumbai:

Since colonial times, the growth of Mumbai started. It was always a developing city with a high-density neighbourhoods. Mumbai being the cotton trade hub, many infrastructures were pumped in the city by the rulers. In 1860s, introduction of railways was one of them (Deshpande & Deshpande, 1991). Before that, as a building typology, there were many agrarian and fishing villages, several administrative structures that were built in Indo-Saracenic style na dnewly developed mills which started dominating city's skyline (Planning Commission of India, 2005). In 1839 the Land Reformation Act included the private sector in Mumbai's growing housing industry. This changed the living pattern of Mumbai, from ownership to more towards tenancy. At the start of 19th century, affordable housing became the need of the hour as industries were growing, so the requirement of labour (Deshpande & Deshpande, 1991). Based on this, one more typology evolved to cater the specific needs of migrant labourers. As the economy was booming, more workforce was needed, which stayed in this new affordable housing typology called Chawls. It was placed near industrial zones and had a minimum capacity of three tenents, with shared infrastructure.

After a few decades, it evolved from labour housing to residential space for families of four and more. In that evolution, based on cultural backgrounds, people started forming ghettos. Although these ghettos got specific architectural characteristics based on their cultural influences, they also shaped the shared open spaces within the city. Later the inclusion of private sectors in housing, policies like the town planning act of 1915 led to reducing the per capita built-up area in the city (Planning Commission of India, 2005). The introduction of automobiles also changed the city's streetscape. Earlier, due to trade hubs, these streets were the shared public spaces. Mumbai bazaars have this typology *niche dukan upar makan*[1], developed based on the needs of merchants of the port city (Mahajan & Merchant, n.d.). Nevertheless, because of the constant influx and up-gradation in technology, Mumbai streets was transformed; they were not ready for these shifts in the social structure. All of these were to give Mumbai a definite identity.

Post-independence, many such neighbourhoods were formed, and the city had its sprawl, specifically towards the north and the east. Other railway networks with highways were introduced to improve connectivity within the city. This was a time when Reinforced Cement Concrete (RCC) got introduced in India as a building material and the exploitation of Floor Space Index (FSI) also simultaneously made the city lose its character (Deshpande & Deshpande, 1991; Niazi & Kumar, 2018). Deterioration of the city's identity and an inhabitant is based on high density (Mahajan & Merchant, n.d.), introduction of newer materials and policies that forced developers to build vertically by compromising city's cultural identity and liveability quotient.

4. Housing scenario and urban identity of Mumbai:

Most of the migration in Mumbai is from the underdeveloped parts of the country in search of free and fair economic opportunities (O'Hare et al., 1998). However, the housing infrastructure of Mumbai, which is already overburdened, does not cater sufficiently to these people. Hence, many times, many of the population that migrates to the cities end up in an area where living conditions

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[1] It is a Hindi proverb to discribe housing typology of Mumbai. *Niche dukan* means shop below and *upar makan* means house above.

are poor, and the occupancy rate is relatively high. In other words, informal settlements or slums become the preferred place for residence (Nijman, 2015). As land is still an essential commodity in such densely populated cities in an overburdened housing market (Nijman, 2015). It is estimated that 60% of the city's population does not have access to formal housing and hence live in 10% of the city's land, which is locally referred to as slums (Mehrotra, 2013).

When people shift, they take their culture with them, but the tangible aspects like built form are left behind, assuming that the new place will help them to retain and develop their culture. As discussed in the previous section, cultural and spatial identity's experiential and performative features contribute to forming the urban identity. However, the habitable space in the slums is hardly contributing to such features due to the lack of space and high occupancy rate. The main reasons being - lack of indoor space for carrying out activities that have significant cultural relevance, such as cooking and celebrating festivals (see Figure 1), lack of outdoor spaces for community gatherings, and poor architectural aesthetics of the area (Debnath et al., 2019).

Figure1: Images on the left showing textile workers in the slum area in Mumbai, and the image on the right is of a religious festival celebration in a low-income house hold in Mumbai.

Reference: www.hindustantimes.com; www.financialexpress.com

The other significant threat to the urban identity is the architectural character of these informal settlements. The urgency of having shelter and lack of financial resources using temporary materials is a common choice in such settlements (see Figure 2). However, houses made of such temporary materials are questionable in structural stability and lack architectural aesthetics. As shown in figure 2, the use of cheap materials such as plastic sheets, asbestos sheets, cloths, scrap corrugated iron sheets, and poor sanitation infrastructure contribute to a dysfunctional and orderless building arrangement in the slums. Several studies on slums in Mumbai (see Bardhan et al., 2018; Debnath et al., 2019) identified that people feel that space does not provide any opportunity to develop a sense of belonging.

Figure2: Images on the left showing slum area in Bandra, Mumbai, and the image on the right showing slum area in Dharavi, Mumbai.

Reference: Image on the left by Ninad Sansare and image on the right by Rajanish Kakade

Furthermore, the migrants who can afford not to live in slums also face issues in preserving their cultural identity in densely populated city. Due to a vast demand-supply gap between available land and housing demand, land prices are skyrocketing in Mumbai (Rashmi, 2020; Shukla, 2015). Land prices are directly proportional to economic opportunities, and scarcity of land

increases the demand and the pricing. In such cities, due to unaffordability, even people who fall under the category of the low and middle-income groups end up living in bare minimum living spaces with low or no infrastructure that can provide opportunities to promote and preserve their identity. According to the liveability survey done by Economist Intelligence Unit (EIU), the cities of Delhi and Mumbai rank 118 and 119 out of 140 (The Economist Intelligence Unit, 2021) in promoting such opportunities, which further strengthen this argument. People in these cities are compelled to live within the idea of minimalism. In terms of space affordability, people end up with two options either to compromise on their functional requirement or compromise on the cultural requirement of space. People tend to compromise on cultural space requirements rather than functional requirements (Mahajan & Merchant, n.d.). For example, in low and middle-income housing where a minimum of four (which is often higher than that in these income groups) family members stay, people, use their space primarily for the sanitation facilities (toilet and bathroom), cooking and sleeping. People in such cases are least worried about the character or identity of the space or even whether space is sufficient to preserve and promote their cultural identity.

Figure3: Images showing residential buildings of different cities in India.

Reference: www.de51gn.com; www.deccanchronicle.com; wbhousingboard.in; www.proptiger.com

This excessive need for housing and infrastructure impacts the overall building typology and urban language of Mumbai. Mumbai hardly have any architectural character that is arsthetically pleasing (Mahajan & Merchant, n.d.). Most of the new development in such cities is governed by the mass housing complexes using globally available materials, easy to construct with, and cheap such as concrete, glass, and steel. It forces developers, architects, planners, and policymakers to use the maximum capacity of the land to provide such services to its inhabitants and cop up with the growing demand as a direct result of an increase in the urban population and density, creating a vacuum of creativity in architectural expression in built form. As shown in Figure 3, the buildings in Mumbai, Kolkata, Delhi, and Chennai look alike, making them monotonous in the urban fabric. This situation is seen across the country irrespective of the scale of the cities. Due to the lack of architectural character in the cities in India, people find it difficult to associate themselves with space, which further fuels the problem of the crisis of identity of such cities, thus threatening its urban identity resilience.

5. Housing policies and urban identity resilience of Mumbai:

Housing policies play a significant role in shaping the urban fabric. For example, the National Building Code (NBC) of India identifies that the minimum size of a dwelling is 45sq.m. for four inhabitants. Based on this, several municipal councils in their development regulation considered the 45 sq.m. an ideal space for dwelling (Bureau of Indian Standards, 2016). The cities that performed better in terms of promoting urban identity have a much higher minimum area requirement. For example, London mandates 70 sq. m for four inhabitants (Department for Communities and Local Government of UK, 2015), New York requires 71 sq.m for four inhabitants (Fontan, 2020). The minimum area requirement further reduces in the slum rehabilitation projects; for example, 30 sq.m. is a minimum dwelling area for a four-member family in Slum Rehabilitation Authority (SRA) schemes in Mumbai (Kamath, 2018). The basis of having such low standards in India's national and state policy is due to the explosion of the urban population and poor density planning (Ahluwalia, 2014; Das, 2007; Shukla, 2015). However, such low area requirements create an opportunity for developers to build more houses on a small piece of land. Due to the high land value to make more profit by compromising the liveability.

The other aspect related to the Floor Space Index (FSI), in Mumbai the current FSI varies from 1.00 in suburban to 1.33 in the Island city (Development Control Regulations for Greater Bombay, 1991), but in the new draft proposal of the FSI regulation are likely to get doubled than it was previously (Chitnis, 2017). This change in FSI will encourage landowners/developers to densify further the housing market of Mumbai (Shankar, 2018). It will create new houses for the inhabitants, but at the same time, it will put immense

adverse impact on the capacity of the city to accommodate people. As discussed in the previous section, this will compromise various intangible cultural aspects, impacting the city's urban identity. This section prominently highlights that the policymakers are more concerned about providing shelter for everyone. In the process, the impact of such regulations on the people's cultural identity who will reside in those spaces are overlooked.

6. Conclusion and discussion:

The projected urban population growth and urban density will have devastating impacts on the urban identity, deeply rooted in the urban system. Our cities do not hold the capacity to deal with such massive density and retain their urban identity. The city's identity is adaptive because it depends on the identity of the people that it resides in it. The social, cultural, and economic practices of people and the space that provides a platform to cherish, retain, and develop together form the basis of forming the urban identity. Because of the urban identity, people associate themselves with a city and make it a relatable and habitable space. Hence, urban identity resilience is an essential factor to be considered while making urban policies.

In Mumbai, it is evident that continuously growing urban density is putting massive pressure on the city's infrastructure, especially housing and forcing policymakers to construct new houses with minimum living standards, which results in the space crunch in informal and formal LIG-MIG settlements of the city and deprives inhabitants of their socio-cultural practices. It further disturbs the overall architectural character of the city due to the use of low-grade construction or cheap construction material, which is not only architecturally unpleasing but also does not provide liveable conditions.

This leads to our recommendation that planners and facilitators should not focus on controlling the density in the old cities but should plan new cities for high density in the future. On a Macro level, to manage the growing urban population density of current cities, it is desirable to put some cap on the capacity of the population that one city can bear to promote the newer urban nucleus to flourish. However, several past attempts, such as Modak-Mayer Municipal Plan 1948 and Bombay Land-use plan since 1981 (see Correa et al., 1965), have failed due to the poor management of the implementation of such policies. Hence, we recommend that the strategic vision for improving the implementation of controlling the urban density will be of central importance. We further recommend that the collaborative approach of urban governance for the success of such strategic visions is necessary.

As mentioned in this paper earlier, the density of existing Indian cities is directly proportional to migration. This high influx in the city centre becomes the reason for the loss of identity and low livability quotient. To tackle this issue, decentralisation on a regional policy level should be encouraged. The old idea of proposing another nucleus can still be relevant today as well. A phase-wise and controlled development should be promoted in both the new and the old city. Here, to achieve the desired urban density in the new nuclei, it is necessary to restrict the development in the existing urban centre, at least for a certain amount of time. Also, the PLU (proposed land use plan) for new nuclei should support mixed-used development. Nevertheless, there are setbacks when it comes to shifting beneficiary focus from an old city centre to the new one. The policy level interventions are mandatory, which will incentivise the insatiable. These incentives will address the issue of space crunch in the existing urban centre. However, the success of such drastic changes in the policy will require a significant amount of consensus-building among the multi-layered stakeholder system.

This paper further points out that the current policies of FSI and minimum dwelling sizes for the new residential development are indeed having low standards in terms of space provision, resulting in the minimum functional habitable space and monotonous residential buildings all over the city. We urge policymakers to acknowledge that urban population growth and density threaten the urban identity and recommend that policymakers investigate these policies again to retain the urban identity of Indian cities and make our cities liveable for everyone. Finally, the paper mentioned few international cities that have some guidelines to address these problems that might be useful here to strengthen the urban identity resilience of Indian cities.

We consider this paper a steppingstone in correlating urban density and urban identity resilience. As an initial paper, we only manage to cover just one aspect of housing with the case study of Mumbai. However, in the rapidly changing global scenario where the boundaries between the different urban identities are becoming porous and blurred, what is the essence that should be preserved, could be another extension for further studies that can be done in the same manner considering examples of different urban infrastructure facilities and/or other cities.

Authors contribution
Both the authors contributed equally to the construction of this paper.

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