ISSN 2063-5346

DESIGN OF PUBLIC HOUSING IN DELHI WITH RESPECT TO COMPOSITE CLIMATE

Vijay Kumar[1], Bijay Kumar Das[2]

Article History: **Received:** 01.02.2023 **Revised:** 07.03.2023 **Accepted:** 10.04.2023

Abstract

New Delhi's climate is difficult to plan for due to the city's complex nature, which makes it difficult to predict weather patterns. The city has summers that are dry and scorching with temperatures that may reach 45 degrees Celsius, winters that can dip below 3 degrees Celsius, and a season in between that is both hot and humid. The city of Delhi has a long history that has not been broken up by any significant events; hence, each stage of the city's development may be found preserved as a record that is still accessible now. These phases include the times of the Middle Ages, the Colonial Era, and the Modern-Day Metropolis of New Delhi. There has been a particular pattern of urban expansion that can be linked to each period in the city's historical past. This pattern has been related to the city's growth. It is important to note that although the climate has always been a significant and consistent factor, the combination of cultural, socioeconomic, and technical advancements has led to the adoption of a wide variety of different types of urban construction. This is something that should be taken into consideration. This is something that has to be taken into account, so keep that in mind. Throughout the process of analyzing the many morphological changes in housing that occurred throughout all three phases of the city's growth, the climate was treated as a consistent component in the research. To grasp the ensuing constructed form, it was necessary to consider the factors of construction, urban structure, social patterns, and symbolic language as dynamic counterpoints. This was used to find principles of housing design of traditional and colonial forms of housing that may be implemented to satisfy the demands of present-day society. these principles can be found in traditional and colonial forms of housing. In addition to this, this was utilized to determine the permanent changes that have occurred, which are what differentiate our present situation from that of the past in a substantial way.

Keywords— Metropolis, Environmental Qualities, Climatic, Architectural, Housing

1. Research Scholar, Department of Architecture and Planning, NIT Patna. Email: vijayk.pg17.ar@nitp.ac.in

2. Associate Professor, Department of Architecture and Planning, NIT Patna. Email: bijay@nitp.ac.in

Corresponding Author: Vijay Kumar Email: vijayk.pg17.ar@nitp.ac.in

DOI: 10.31838/ecb/2023.12.s1.088

I. INTRODUCTION

The results of this research are now being implemented into two separate house design projects that may be categorized as examples of housing for individuals or families with middle incomes. These design approaches, which seek to maximize ecological attributes for housing as well as climatic pleasure or power consumption, indicate certain density and land use limitations beyond which ecological purity & resource performance start to deteriorate. These design concepts also seek to improve environmental attributes for homes, as well as climatic pleasure as well as power usage. In addition to improving climatic comfort and making better use of energy, the goals of these architectural solutions are to optimize the environmental attributes of the dwelling. It is advised that such design exercises be carried out to define both the lower and upper bounds of density and land utilization for housing to give a more comprehensive foundation for determining town planning rules. This would be accomplished via the use of a model (Kaur & Gupta, 2019). This would make it possible to devise methods that are more effective for establishing what constitutes acceptable standards for town planning.

II. OBJECTIVE

The research aimed to fulfill the following objectives:

- To study the development of climate-responsive housing from a philosophical perspective
- Report and examination concerning climate-responsive housing
- Interpretation and rationale proposal

III. METHODOLOGY

The findings of the study highlighted the following as important takeaways: (a) the importance of a tightly knit urban structure that protects outdoor or indoor areas, in addition to the street and presiding judge as purposeful and meaningful locational setups; and (b) the use of greenery as a microclimate modifier combined with a calming of built density to respond more favorably to humid or rather cold plains circumstances, as seen in imperial examples. These two insights were highlighted because they highlight the ways in which the current situation differs from previous or rather colonial ones, namely through the prevalence of motorized vehicle connectivity, the low mass of establishing construction methods or technology, and the land pressure caused by high demographic concentrations or high-rise buildings. Both high populations and skyscraper construction are detrimental to the natural environment. Because India only has a limited supply of conventional energy, the country has to work on developing all of the economically viable alternatives. Energy efficiency and conservation should be given a significant amount of priority. The production of electricity from renewable resources in India, such as wind, sun, biomass, hydro, etc., has significant untapped potential. letting solar power plant operators use roof space for their facilities. One may say that energy efficiency and the use of renewable energy sources make up the "twin pillars" of a sustainable energy strategy. Both techniques need to be developed simultaneously in order to achieve their respective goals of stabilizing and reducing carbon dioxide emissions.

IV. THE DEVELOPMENT OF CLIMATE-RESPONSIVE HOUSING FROM A PHILOSOPHICAL PERSPECTIVE

When considering home options, environmental considerations are an important factor to take into account. centered on the development of a living environment that is not only healthful, safe, and encouraging, but also capable of self-sufficiency within its natural surroundings. Both in the process of creating the constructed environment of the house and in the process of providing support for the way people live within that environment, there is a focus placed on the conservation of resources and the avoidance of pollution. This is because both processes have an impact on the natural environment. A home that is environmentally sustainable lessens its impact on the natural environment around it by incorporating eco-friendly features into its design. These features may include rainwater collection, energy-efficient hot water systems, and passive solar design, which makes use of the sun's rays that are present in the area (Jaakkola & Amegah, 2014).

Climate

Something used, withdrawn, or changed has the same effect on the environment as something replaced, maintained, or enhanced.

There are several technologies that may be added to buildings to reduce their energy use. This would reduce such constructions' typical energy use. These include renewable energy resources and energy-saving measures. In order to reduce energy use, financially stable, energy-efficient and ecologically beneficial buildings must start with building envelope design and construction. Reduce air leakage around the building's perimeter (Del Pero & Martire, 2022).

Climate-responsive constructions begin with site study and planning. Because every site is unique, a building's design must consider its natural surroundings. Climate change-responsive strategies reflect local climates.

- Temperature (T - C)
- Sun angles** (α - 0)
- The amount of radiation emitted by the sun, both horizontally and diffusely, expressed in kilowatt-hours per meter
- Relative humidity denoted as a percentage of RH
- The rate at which the wind blows, expressed in meters per second
- Precipitation (in millimeters per year).

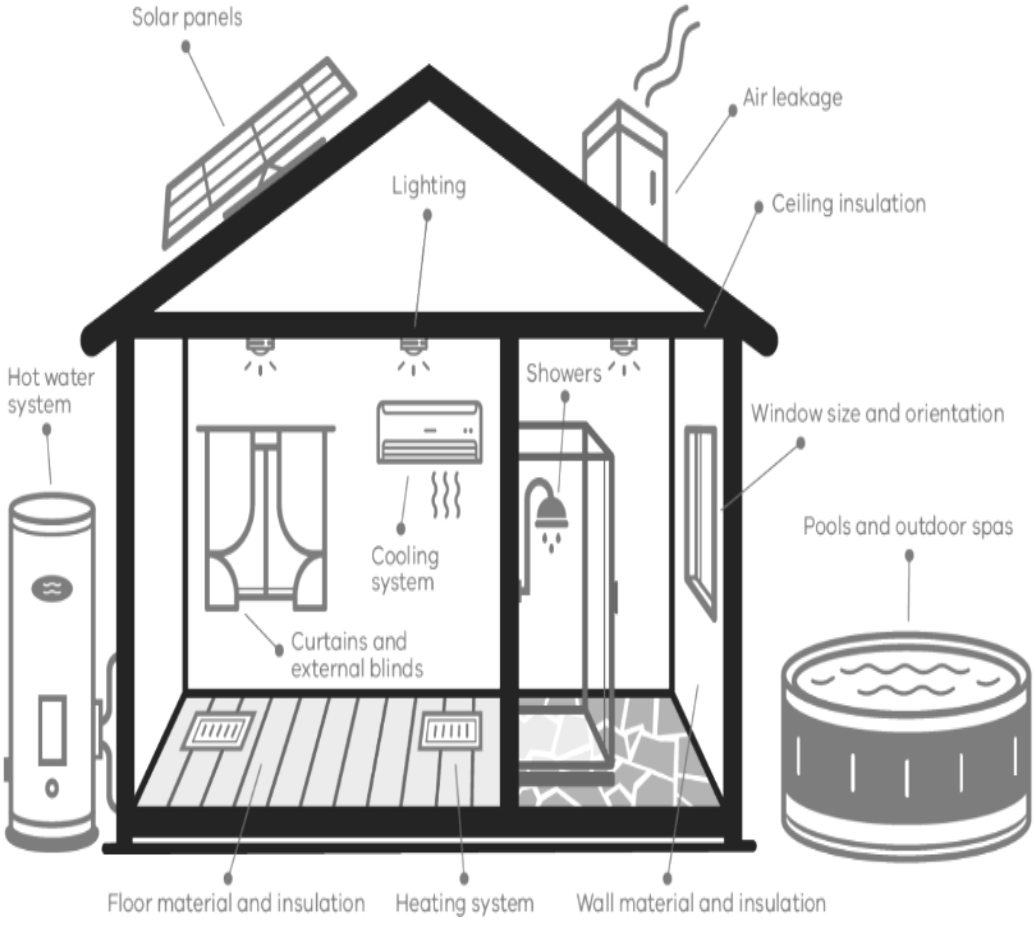

FIGURE 1: CLIMATE PROOFING OF HOUSE

V. REPORT AND EXAMINATION CONCERNING CLIMATE-RESPONSIVE HOUSING

A. Method of academic research

When designing at the site level, we need to take into consideration two fundamental methods, namely wind, and sun. Apply the analysis you just learned to the process of establishing some recommendations once you've studied these two criteria.

B. Analysis methodologies for site

These Analysis Techniques discover solar and wind-related benefits and downsides at the site. The "comfort zone" is a narrow temperature and humidity range where people are most comfortable. By studying the seasonal sun and wind pattern of the site, the building and outdoor spaces may be positioned to take advantage of the climate. Analyses focus on a context that affects building energy usage and time of day. Sun, wind and wind-sun combinations are the techniques. Solar analysis strategies allow the designer to analyze sun availability in two ways. The first illustration is a sun path diagram, while the second is a three-dimensional sundial. A preliminary solar study identifies sites with the most solar heat uptake and the best ways to reduce it. We'll evaluate the project's shadows (Del Pero & Martire, 2022).

Windways graphically represent weather bureau tabular data. This helps designers see wind direction, speed, and frequency. The investigation will reveal the project site's wind patterns. This information may help in the creation of natural ventilation or wind protection measures. Wind analysis concludes with an explanation of air movement concepts used to adjust meteorological data to a place. The sun and wind analysis let the designer evaluate various building and outdoor space locations by examining their combined effects. Sun and wind analysis uses these methodologies. Micro-climate analysis uses seasonal weightings to assess a location's microclimate. Microclimate analysis:

- Utilizing a sundial and a site model, determine the patterns of the shadow cast by the surrounding terrain in order to map out the portions of the site that will be shadowed throughout the relevant time periods and months of the year.
- It is your responsibility to figure out the wind flow patterns for the location, taking into account both summer and winter directions.
- Transform the depiction of the site's shadow and wind pattern into one using the grid-cell approach. Create unique graphical representations for each of the distinct weather conditions.
- Analysis

VI. THE OUTCOME OF ANALYZING SURVEY DATA

A. The analysis Result from the Solar Survey

- Only one side of each of the apartment buildings T9 to T17 will ever be exposed to direct sunshine, while the other side will always be in the shade. It has been noticed that the current configuration of these structures is inconsistent with the principles of design.
- The orientation of the apartment buildings T18 to T23 is northwest to northeast, so the areas in between these buildings will be in the shade during the summer months and will be open to the warmth of the sun during the winter months. It has been noticed that the current configuration of these structures adheres to the guidelines for architectural design (Ranalli, 2015).

B. The achievement of sustainability in housing through climate-responsive design

- The areas behind the apartment buildings T18 to T23 will be in the shade during the winter season, but during the summer season, they will be partly exposed to the heat of the sun. It has come to our attention that the current configuration of these buildings satisfies a number of architectural principles.
- The greenery provides protection for the south sides of the buildings that house studio apartments. This indicates that the places

over here will continue to be protected till the height of the vegetation.

- The heat of the sun will always be present in areas that are next to rivers. On the other hand, thanks to the foliage, this side is quite well sheltered.

C. Wind The findings of the survey and analysis

- The orientation of studio apartment buildings, apartment T3 to T6 buildings, and apartment T18 to T23 buildings are such that the areas over here are facing wind shadow during the course of the whole year. It has been noticed that the current configuration of the buildings is in direct opposition to the design ideas.
- During the wet season and the winter season, the side of apartment buildings T9 to T11 that faces away from the sun is in the shadow, however during the summer season, free wind movement is anticipated. While the other side of the structures, namely the south side, will be shielded from the wind during the summer months, it will be exposed to the elements during the rainy and winter seasons. It has been noticed that the current configuration of the buildings is in direct opposition to the design ideas.

D. The outcome of the survey and analysis of sun and wind overlap

- Since the direction of studio apartment buildings is northwest to southeast, the structures are constantly subjected to the heat of the sun as well as the shade of the wind throughout the year. While doing so, it generates a zone of high pressure and wind for a certain amount of time.
- Since the orientation of the apartment buildings T18 to T23 runs from northwest to northeast, these structures are in a partial sun shadow during the summer months and remain in a wind shadow throughout the year. It has been noticed that the current configuration of the building plan adheres to a number of design principles.
- Apartment buildings T1 through T6 are subject to the heat of the sun and the shade of the wind throughout the whole year. While doing so, it generates a region of high pressure and wind for a certain amount of time. It has been discovered that the current configuration of the buildings goes against the principles of design.
- The orientation of apartment towers T9 and T17 runs north to south and east to west, Because of this, the buildings are always in the shade of the sun and only partially in the shadow of the wind.

E. Energy sustainability

Energy sustainability refers to the idea that each generation should fulfill its own energy demands without sacrificing the needs of future generations. Efficiency and conservation are two essential components of the notion of energy sustainability. Additionally included is the encouragement of environmentally responsible policies and practices, as well as the promotion of the use of alternative forms of energy. The term "energy conservation" refers to any activity that results in a lower level of energy use. Utilizing technology that works with less amount of energy while yet accomplishing the same goals is one way to achieve energy efficiency.

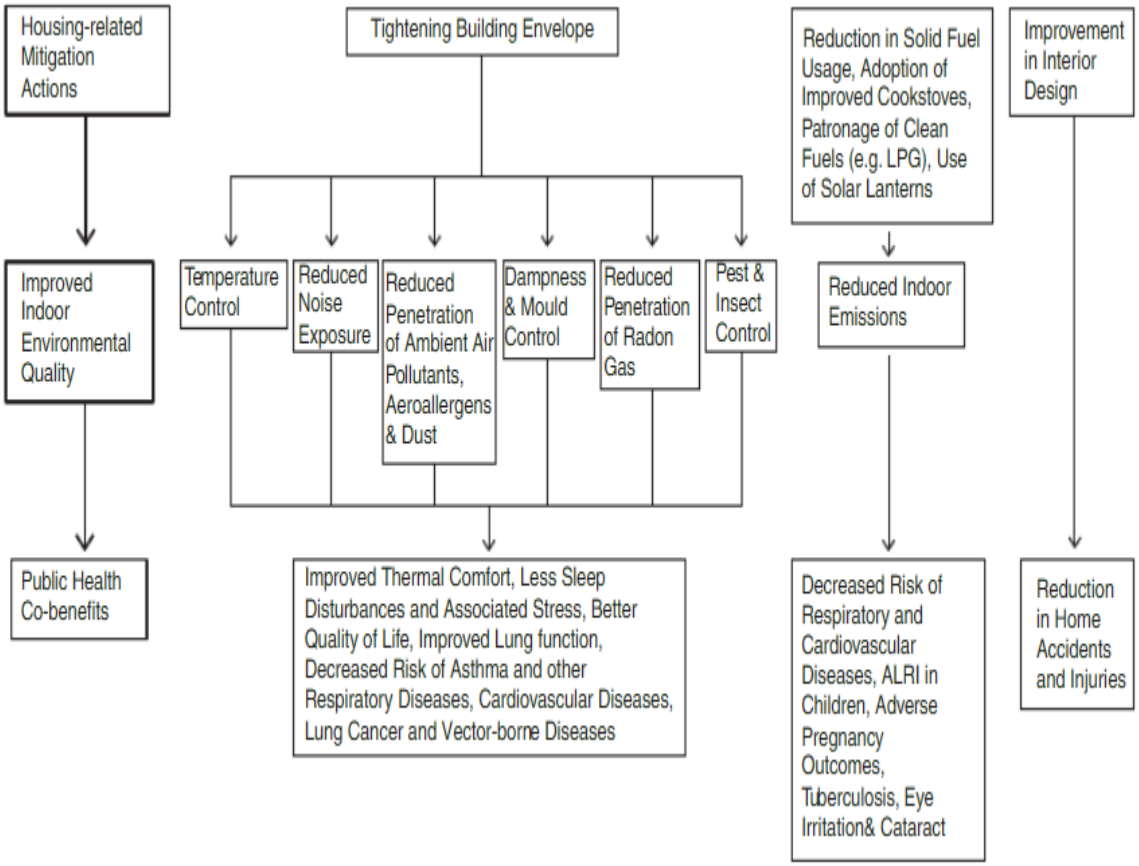

FIGURE 2. PATHWAY OF HOUSING RELATED TO CLIMATE CHANGE

VII. INTERPRETATION AND RATIONALE PROPOSAL

Most contemporary nations employ central solar hot water systems. This gadget cannot guarantee hot water. Thus, the Orange County SHWS is more efficient and only requires 2.5 square meters per apartment terrace, like a centralized SHWS (Fedrizzi & Bonato, 2020). Solar PV for Building Lighting and Power: SPV system infrastructure and payback costs are high, although space allowance should be allocated at the design stage.

Orange County's hybrid system of windmills and SPVs should increase performance and be a viable option because of the windmills' compact footprint and inexpensive maintenance. Since RTZS does not use electricity, it saves money over time. Water treatment plants, which take up little space but eliminate the need for individual units in housing complexes, may save a lot on energy expenditures. Rain All three civilizations employ water harvesting to save water and restore aquifers. Vermin composting is inexpensive, environmentally benign, and generates compost for gardening. After considerable study and analysis of renewable energy technology for residential housing societies, a proposal for Park Springs, Dhania, Pune was submitted. The authors' data and consultant and expert assumptions were used to create the strategy. The technology and techniques may be progressively implemented in similar housing communities and used to model new communities. All 10 buildings' water, sewage, solid waste, and electricity demands were calculated. Two buildings are proposed in terms of physical footprint. a way to build the remaining eight buildings. Each unit should have a water meter to reduce water waste. The root zone technique has several advantages: It cheaply meets tertiary treatment needs without energy or chemicals to change the ph. Lack of equipment reduces maintenance expenses. Running and monitoring it is easy. Landscaping and sludge management have improved. Over many years, it becomes a bird sanctuary. The sewage treatment plant smells nice. It becomes a mosquito-free oasis. It's eco-

friendly wastewater treatment. "Naturally" Vermicomposting may reduce solid waste. The proposed infrastructure includes an SPV system to illuminate the building's common spaces (Staircase, 1 lift, parking, lobby lighting). Solar panels and battery storage are on every deck. SPV panels will supply common utility lights on the clubhouse terrace and parking garage roof (clubhouse, Amphitheatre, and pool area). Each building's terrace SPV panels power it's street lighting and landscaping.

CONCLUSION

In all regions of the globe, climate-responsive architecture has the potential to enhance human comfort and, in turn, improve the general state of the human race. Buildings that are designed with climate responsiveness have significantly lower economic and environmental expenses, which is beneficial to individuals, regions, and countries. The shape of the site has a significant influence on the amount of sunshine, sunlight, and ventilation that are available in buildings and the areas surrounding them. The primary purpose of this research is to get an understanding of the environmental considerations that go into the urban design of dwellings in order to provide adequate access to solar gain, sunshine, and ventilation. Its goal is to make it possible to develop buildings that are comfortable, energy-efficient, and surrounded by beautiful outdoor areas. This is to be accomplished within an urban setting that reduces the amount of energy used by buildings by orienting them appropriately. Buildings may have less of an influence on the surrounding environment if they are oriented correctly and make use of alternative forms of energy. In general, research into and improvements made to climate comfort have the potential to significantly enhance the quality of life in metropolitan areas in consideration of future climatic circumstances.

Declaration:

- The authors have no relevant financial or non-financial interests to disclose.
- The authors have no competing interests to declare that are relevant to the content of this article.
- All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.
- The authors have no financial or proprietary interests in any material discussed in this article.

REFERENCES

1. Kaur, A., & Gupta, S. (2019). An evaluation of Middle-Income Group Housing in Kolkata, India. International Journal of Housing Markets and Analysis, 12(3), 487–503. https://doi.org/10.1108/ijhma-04-2018-0025

2. Jaakkola, J. J., & Amegah, A. K. (2014). Climate change, housing and Public Health. Climate Change and Global Health, 260–267. https://doi.org/10.1079/9781780642659.0260

3. Del Pero, C., & Martire, M. (2022). Climate-responsive design and Energy Performance Goals. Innovative Approach for the Development of Sustainable Settlements in East Africa, 79–95. https://doi.org/10.1007/978-3-031-00284-7_4

4. Del Pero, C., & Martire, M. (2022). Climate-responsive design and Energy Performance Goals. Innovative Approach for the Development of Sustainable Settlements in East Africa, 79–95. https://doi.org/10.1007/978-3-031-00284-7_4

5. The analysis of the microclimate. (2014). Microclimate, Vegetation & Fauna, 170–191. https://doi.org/10.1163/9789004297807_007

6. Ranalli, J. A. (2015). Solar survey: Development and validation of a smartphone-based Solar Site Assessment Tool. Solar Energy, 122, 1199–1213. https://doi.org/10.1016/j.solener.2015.10.039

7. Climate responsive design for Sustainability. (n.d.). SpringerReference.

https://doi.org/10.1007/springerreference_301236

8. The wind from the sun: An introduction. (2007). Basics of the Solar Wind, 1–40. https://doi.org/10.1017/cbo9780511535765.002

9. Energy Security and sustainability through wind energy. (2016). Energy Security and Sustainability, 273–288. https://doi.org/10.1201/9781315368047-20

10. Fedrizzi, R., & Bonato, P. (2020). Building Integrated Solar Envelope Systems for HVAC and lighting. https://doi.org/10.18777/ieashc-task56-2020-0008