Planned Productions of Vernacularized Dwellings and Settings in India: A Settlement in Baroda Designed by Balkrishna Doshi

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Received	Accepted	Published
28.12.2023	23.03.2024	31.03.2024

https://doi.org/10.61275/ISVSej-2024-11-03-04

Abstract

After India's independence in 1947, the new policy framework imposed by the government would encourage the industrialization of independent India. The creation of these industries was associated with the construction of housing for their workers. This article examines the work of Balkrishna V Doshi in the settlement for the Gujarat State Fertilizers Corporation, carried out during the first stage of his architectural discourse. It is an architecture committed to the country both from a perspective of adaptation to the climate and attention to the social needs of the time.

It employs a case study method that involves the analysis of existing writings, plans and photographs of the project and an interview with the architect. Documentation has been obtained after a trip to the site of work, consulting the library of the Faculty of Architecture of CEPT University, the documentary archive of the architect in Sangath. Drawings have been developed by the authors while having a conversation about the project with Balkrishna Doshi in his office.

It concludes that the built project achieves an urban space capable of maintaining the identity and cultural values of its country. In addition to being exemplary in terms of in terms of climate sensitivity and social meaningfulness, it reaches, in 1968, most of the parameters that define a smart and sustainable city today.

Keywords: Balkrishna Doshi, Settlement, Vernacular architecture, India, Urban strategies.

Introduction

After India's independence in 1947, the first economic policies were aimed at overcoming poverty inherited from the colonial period. However, the way of understanding the policies of industrialization of the rural environment became an object of dispute and each position was defended by a leader of the revolution. On the one hand, Mahatma Gandhi encouraged the creation of cottage industries self-managed by communities. The communities would recover the Panchayati Raj, a system of traditional village government that entrusted the management of the village to the wisest elders of the place. On the other hand, Jawaharlal. Nehru was in favor of a centralized aggressive industrialization, with the aim of catching up

with western developments (Prakash, 2002). The outcome of this ideological conflict unfortunately led to the assassination of Mahatma Gandhi by a Hindu religious fanatic.

Commitment to socialism that was enunciated in the 1950 constitution by J. Nerhu was somewhat diluted. However, there was a steering of private companies towards the sectors that were of most interest to the state, based on incentives and bonuses for the fulfillment of objectives (Prakash, 2002). This was the case of the industries located in the rural areas for the revitalization of the Indian countryside. The aim was to avoid the concentration of wealth in the big cities and for this reason, industries were spread throughout the rural areas. The companies were financially subsidized. In return, the state ensured that the conditions of hygiene and comfort of the workers were complied with. Otherwise, the subsidy would not be obtained. According to Steele (1998), such industrial complexes were the result of J. Nehru's determination to close the distance between the third world countries and the developed nations as soon as possible.

Creation of these industries involved the construction of houses for their workers, since in most cases, the offer of housing in the nearby towns could not cover the needs associated with the number of employees that would arrive. Thus, an idea was mooted to build small autonomous cities around the sponsoring companies (Curtis, 1988). According to Doshi, (2011), these settlements were intended to attract skilled labor and technicians not available in the areas where industries were being built. In fact, the settlements had to compete with the benefits of living in a city in terms of services offered and at the same time, lower the costs in order to be competitive. The benefit for the rural community where they settled lay in the social mixing and the possible transfer of knowledge that could take place. Balakrishnan V Doshi, rose to take up this challenge as an architect. He has thus designed a number of such settlements all over India.

The purpose of this paper is to analyze one of the settlements designed by Doshi for the Gujarat State Fertilizer Corporation in Baroda built in 1968. Its objectives are as follows:

1. To identify features that relate the development of the new settlement to Indian traditions and vernacular architecture.
2. To identify strategies of urban design for improving neighborhood living.
3. To determine decisions of the house designs that improve their adaptation to climate.
4. To identify strategies for adapting urban and housing design to the local climate and existing resources, in terms of sustainability.
5. To establish the validity of this project as exemplary in terms of climate-sensitivity and social meaningfulness in its context and time.

Theoretical Framework

Every rural settlement is the result of a political planning decision, which involves a subsequent urbanization in a specific environment with cultural values rooted in the tradition of place. According to Lawson (2007), planning is an intense political act as much as it is scientific because every place is invested with cultural/political meanings. Therefore, its development must take into account both its strategic intent from a political point of view and its attention to the culture rooted in its immediate environment. When this planning develops an urbanization proposal, it is coming to transform the environment and all the layers of meanings and values associated with that place. As Seto, Dhakal and Bigio (2014) say, urbanization is a global phenomenon that is transforming the human settlements. The shift from primarily rural to more urban societies is evident through the transformation of places, populations, economies, and the built environment. They add that it is a process that involves simultaneous transitions and transformations across multiple dimensions, including demographic, economic and physical changes in the landscape.

According to Tyagi, Shrivastava and Kumar (2023) rural settlements in India are collections of buildings and spaces in specific geographically bounded locations where a group of people co-exist with the environment while satisfactorily engaging in land-based economic activities without relying on sophisticated technological developments. However, a rural settlement cannot be just a group of people living together. According to Crow and Allan

(1994), it should be a place where quality of life of its citizens is improved, creating neighborhoods, as positive behavior in a given geographic area.

Neighborhood, as Jenks and Dempsey (2007) say, is defined in urban sociology as a starting point in a discussion of social relations within a spatially bounded area. In other words, Castells (2000) says that, the concept of nearness can be interpreted as the physical proximity between neighbors as well as the social proximity between contacts in a social network. Friedkin (2004) insists that nearness and the strength of relationships between neighbors may be central to the understanding of social cohesion within an urban neighborhood. On the other hand, Raman and Dempsey (2012) add that the spatial layout of a neighborhood can influence physical proximity which may in turn affect the relationship between potential contacts in a social network. Thus, planning and design related to urbanization has an important influence on the neighborhood behavior and development not only as a collection of organized buildings. According to Gulati (2019), neighborhood spaces in a residential development are unbuilt, open or semi open areas, which are in consonance with built areas that serve as facilities for interaction, community bonding, and other supporting activities. Good design and use of these spaces is one of the most important aspects for the good use of urban design.

Other important concept developed in this paper is the idea of identity, culture and tradition of a place where a settlement is located. Indeed, it relates with the concept of vernacular architecture. According to Glassie (2000), vernacular architecture means the local, traditional, or indigenous style of buildings and constructions that reflect the cultural, environmental and historical contexts of a specific region or a community. However, as Mohapatra (2023) says, vernacular architecture is not to be studied simply to imitate it, but to be recognized for its eco-sensitivity and community character. Needless to say, efforts are needed to conserve it where appropriate.

Regarding vernacular architecture in India, it´s important to talk about the Pol house as the tradictional typoligy in Gurabat. According to Neeta and Alpana (2016), the Pol house is not a list of activities or rooms. Indeed, it is a pattern of spaces that are connected and sequenced. As they explain, its linear structure depicts the social behavior: the front part is public, and the inner-most parts are private spaces. Design of the courtyard is such that it acts as a separation of public and private spaces.

Pol houses are mainly for a joint family where at least three generations live together. Due to the constraints, spaces have more flexibility and are used for different activities throughout the year. Gender also has no role in spatial segregation and it is sequenced as per the use pattern. Regarding the urban settlements with Pol houses, Gangwar and Kaur (2020) say that they are very compact; streets are narrow to create shades in summers and the lengths of the streets are short for natural pedestrian movement. One Pol consists of 45-50 houses. Thus, community interaction is effortless.

These ideas in fact contribute to the generation of inclusive villages. The research on the settlement planned by Doshi in Baroda aims to demonstrate the architect's approach to create a neighborhood with climatic sensitivity and social sense at a time in India's history when industrialization did not allow attention to tradition.

Literature Review

Literature on this issue is somewhat scarce. However, some literature related to development exist. For example, according to Ferguson (1990), the post-colonial state offers a development framework where people's sentiment can be sympathized but not defended by the state science, as a development machine. As Tripathy (2018) says, it comes as no surprise that in the first few decades after India's independence, there was a discernible anti-urban sentiment. As he says, these lost decades have been crucial for creating and sustaining the idea of village as authentic India and the representation of the city as a fake social space and everything decadent that ailed India. It shows there was not a clear direction about new urban developments.

In this context, Doshi proposes his own way of doing. As Nasution and Rahman (2023) says, it is important to understand the Indian context that influenced the design thinking of

Doshi to have a vernacular spirit. As a developing country, even decades after independence, the economy in India is faced with shortages of food, clothing, housing, educational and health facilities.

According to Nasution and Rahman (2023) Balkrishna Doshi sees the synthesis of modernism with local Indian traditions—such as characters, customs, religions, and ubiquitous mythology—and European and American avant-garde ideas merging in harmony with Nature—such as sun and rain, the drama of light and shadows—and sustainability creates the concept of contemporary vernacular architecture as he applies to his every work in India. As Verma, Kamal and Brar (2022) say, vernacular architecture responds to the region and the social structure of the place. The rich architecture of the natives is like an open book which gives us clues on the rich culture, customs and traditions, philosophy of the local people, the occupation and the socio-economic standing.

This knowledge and concern for the situation of Indian society by Doshi is what Smith and Levermore (2008) pointed saying at the local scale, the long-term implications of decisions concerning the built environment mean that any action taken must be based on detailed information covering a range of disciplines. A fundamental first step towards adaptation in the urban environment is the identification of vulnerable parties. Gulati (2019) says Gujarat State Fertilizers Corporate settlement is notable for its recreation of a scale that is similar to that of conventional pol houses, which have intimate courtyards that respond well to human scale and gradually change in the narrow streets. At same time that he says that India is a fast-developing country where housing has been a chief concern due to the rapidly growing population coupled with surging urbanization. In pursuit of providing enough and as a result of wide-ranging negligence, contemporary housing neighborhoods are non-conducive to the well-being of inhabitants. Gulati adds that exist numerous macro-level problems associated with present-day housing environments include the lack of hierarchical open spaces and movement patterns, loss of enclosure and scale, non-suitability of open spaces, absence of informal character, indifference to prevailing climatic conditions, and missing visual relief and spatial character among others. As a result, in most housing schemes, neighborhood spaces and outdoor areas are mere leftover negative spaces rather than purposely designed activity or interaction areas.

As Rai (2023) says, a sustainable community is not only one in which people are able to live successfully, but they also have a strong sense of belongingness towards the place. She also adds layering of spaces in a residential neighborhood plays a significant role towards creating a societal connection. Doshi designed the settlement focusing on all spaces created, indoor and outdoor, understanding the relation of both to create a complete and connected atmosphere for the better life for the citizens.

In terms of climate, according to Ahmed (2003), comfortable outdoor spaces have a significant bearing on the comfort perception of the indoor ambience. The demand for comfort conditions in buildings is significantly increased as a result of exposure to uncomfortable outdoors. Ahmed says that traditionally in the tropics outdoor environment has been regarded as important as indoors in the life of the populace and which is remarkably evident in the vernacular architecture of the region. Thermal comfort of persons staying outdoors is one of the factors influencing outdoor activities in streets, plazas, playgrounds, urban parks, etc. The amount and intensity of such activities is affected by the level of the discomfort experienced by the inhabitants when they are exposed to the climatic conditions in these outdoor spaces (Givonia, et al., 2003). Ahmed also says the objective of urban design in relation to outdoor comfort should be to create or to provide a reasonable thermal range, instead of attempting to create an exacting thermal condition. Such multitude of thermal conditions can be achieved by providing a range of spatial characteristics, where users will find comfort depending on individual dispositions.

In those terms, at the neighborhood scale, the presence of vegetation in the city can have a significant cooling effect on the local temperature (Graves, et al., 2001) and Dimoudi and Nikolopouloua (2003) add that the physical impact of vegetation in the urban environment affects the thermal environment, air quality and noise levels. According to the Greater London Authority (2005), the typical 20- to 100-year lifespan of buildings means that designers and

developers have a responsibility to anticipate future climates and avoid changes that damage the structural integrity, exterior fabric, and interior environment of buildings. In a more recent research, Allah (2023) says urban climate resilience can be understood as the ongoing capacity of urban areas to absorb and adapt to the direct and indirect impacts of climate change, to maintain its functioning, and to respond more effectively to future climate change.

Research Method

The research approach is qualitative, based on a case study. The data were collected on previous research, original documents a visit to India doing research about Balkrishna Doshi and from the interview with the architect himself, author of the project.

The Gujarat State Fertilizers Corporation settlement in Baroda built in 1968 is selected as a case study is due to its importance both in the professional career of the architect, being his first project on urban development, and its importance as a reference for the country given the moment of postcolonial expansion in which it finds itself. This project is understood a prototype of urban development, which aims to offer a new way of living, offering a contemporary architecture from tradition and vernacular references rooted to the place and its climate. It is a significant project in Doshi's career as it lays the foundation for an urban settlement strategy that will be repeated and evolved in subsequent urban settlement projects for the Electronic Corporation of India Hyderabad in 1972, for the Life Insurance Corporation in Ahmedabad and for the Indian Farmers Fertilizer Cooperative Limited in Kalil in 1973, including the Aranya Low-Cost Housing developed in 1982 in Indore.

For the case study, following steps have been developed:

1. Through the reading of writings, it has been possible to understand the ideas of the architect and his theoretical purposes for this project.
2. Through the observation and analysis of plans, it has been possible to understand the strategies applied in the urban and dwelling design.
3. Through the redrawing of the plans, it has been possible to dimension the project decisions to understand better the real conditions of both, urban and dwelling proposals.
4. Through the observation of the photographs, it has been possible to find the achievement of the objectives intended by the architect.
5. The personal interview with the architect corroborates his ideas and objectives intended in this project, not only seen at the time of the origin of the project but also from the interesting overview of it, 60 years later.

Case Study: Residential Community for a Gujarat State Fertilizers Corporation in Baroda

The Gujarat State Fertilizers Corporation settlement is located on the northwest outskirts of Baroda, right next to the industry it is linked to, as we can see in Figure 1.

Fig. 1: Residential Community for a Gujarat State Fertilizers Corporation location.
Source: The authors, 2024.

As explained in the introduction, after India's independence, the first economic policies have been aimed at overcoming the poverty inherited from the colonial period. J. Nehru

proposed intensive industrialization, with the aim of reaching the development levels of the Western countries. One of the main measures adopted has been to locate new industries in rural areas to revitalize them. The creation of these industries implied the construction of housing for their workers and it was thought to build small autonomous cities around the associated company.

In the case of Baroda, the company is the Gujarat State Fertilizers Corporation (GSFC). It was incorporated in 1962 and its plants went into the production of fertilizers in 1967. In its very first decade of existence, GSFC became known for its path-breaking achievements. To name a few, it was the first industrial complex in the country set up in the joint sector, the first company to set up fertilizer plants within a short span of two years of getting requisite approvals. (GSFC, 2024). This settlement is described by Sangath (2024) as the first industrial township for 2000 families focuses on a unique pedestrianized master plan. The plan accommodates seven clusters through a string of roads and courts with a central community hub. The main feature of this growing township is the bye-lanes that ensure accessibility to existing and future houses. The central public space provides an iconic water tower and a public hall, schools and medical facilities with a shopping centre.

Fig. 2: Left: Original plan for the GSFC settlement, 1964. Right: current aerial view.
Source: Curtis & Doshi,1988.

As we can see in the comparison between Figure 2, which shows Doshi's original plan of the settlement and the current aerial view, the project was built keeping each of the urban planning decisions proposed by the architect and they are still maintained today. The main difference between the 1964 plan and the current reality, also envisioned by Doshi, is the presence of vegetation as an important factor for the functioning of the common life of its inhabitants.

Findings and Analysis

Design from the Indian Tradition and Vernacular Architecture.

Balkrishna Doshi's work on such settlement, done during the early stage of his architectural discourse, is a pioneering example of how to design urban space in arid climates. In these early years of his profession, his approach towards an architecture committed to the country was for a climate adaptation perspective but also from a sociological or symbolic point of view. In this project, Doshi's desire to establish relationships among the members of the settlement, in a way revitalizing the rural way of life despite the primary objective of such settlements: the industrialization of the country. The architect tried to keep the identity of the country as he remembered when he was a child:

> *"My first lovely memory is the street where my grandfather constructed his house. I spent my childhood in that house with my family. We were playing in that street protected from the traffic - only some bicycles and*

> *some horse cart - under the protection of elder people that were watching us from the wood verandas that every house had. That street was a lively place where there were developing multiple activities I still remember. On the other hand, I also remember Pune's streets where I learned that the scale of a house is insignificant in relation with the city that surrounds it and that's the same with the human relations. I began to value the community life, the sense of the public opposite to the private and the flexibility of the housings that they were adapting to the spontaneous growths. All this, I tried to reflect it in my later works"*
>
> Doshi, 2014:38

This urban-scale project explains Doshi's understanding of the vernacular architecture in India, traditions and customs of daily life in India. In this case, it is not a matter of abstracting isolated elements of popular architecture but of understanding the overall urban functioning of a traditional city. For this purpose, Doshi focuses his studies on the city of Ahmedabad and is concerned with finding those typologies that work better for the local climatology and for the development of social functions. The traditional houses of the medieval old town of Ahmedabad, known as Havelis, are grouped in "pols", which are neighborhoods with very specific boundaries characterized by an iron control of privacy, for greater comfort of the inhabitants. For this purpose, the access to each "pol" has its own door and the interior of the streets that form it has no exit (Kaza, 2010). The "pols" is the minimum urban scale that provides a basic community life. This type of neighborhoods favors community links, its system of streets inhibits vehicular traffic, allows the use of public space by its neighbors and densifies the urban fabric improving the climatic behavior of the whole.

Doshi had lived in Paris for three years and knew the advantages and disadvantages of life in Europe. And upon his return, he became aware of the levels of poverty in his country and the existing needs, knowing how to apply what he had learned in a different context and specific to a particular place, his native country.

"India, that human and profound civilization (...) brotherhood, relationship between the cosmos and the living elements: stars, nature, sacred animals, birds, monkeys and cows (...) in rural villages, adult children and old people next to fruit trees (...) poor but provided" (Doshi, 1990).

Urban Design for Improving Neighborhood Living.

Doshi establishes a radial plan with diagonal streets that converge in a central green space with some community buildings and a water tower that acts as a landmark.

> *"We tried to generate a central space for social events, which here in India are great. So finally everybody was meeting in this central space for the social activities"*
>
> Doshi, 2014:56

This type of road layout consists of the main street being a continuous ring and the rest of the streets are towards the interior of the block. The objective is to minimize traffic to the interior of the residential communities allowing for greater privacy. The residential community is formed and arranged with row housing. These are situated around streets of no more than 100 meters in length that guide to the center of the development. The streets have orderly 45º turns that avoid long views and recover the scale of the pedestrian.

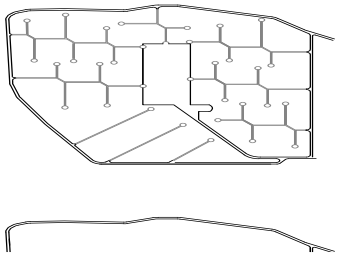

Fig. 3: Plan of the residential community in Baroda.
Left: Exterior ring circulation. Center: Interior circulation. Right: Interior public spaces.
Source: Authors, 2024.

> *"Undoubtedly, the main proposal of the settlement was based on the privacy of the inhabitants thanks to the accesses rolled without exit that disable the traffic in the residential zones. It was a question of creating a gradual hierarchy of privacy, not only for the individual but for the different social groups that we were in this settlement. Also we took in consideration the worker's families. Thus, we provided some benches in the squares for old people could chat and spend his time in a relaxing way, or parents could watch out the children while they play"*
>
> Doshi. 2014:69

As the Figure 3 shows, there is a clear urban structure and hierarchy. From the metropolitan scale of the outer ring to the small public spaces located in each interior path, there is a place and a moment for what the inhabitants could need, as is mentioned in Doshi´s quote before.

Figure 4 shows the dimension of the bigger cluster unit circulation. Each of the roads is less than 100 meters and none of them has continuity, reducing the traffic to de minimum needed of the residents. The 45º breaks any continuity and reduce the scale of the place to a human feeling, as traditional Indian urban areas.

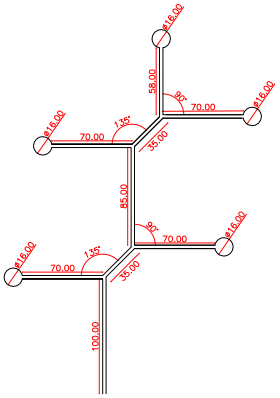

Fig. 4: Scheme and dimensions of interior structure of one of the residential clusters.
Source: Authors, 2024

Housing Design as a Tool for Design from the Individual to the Global.

The next aspect of his study is the dwelling. Doshi is interested in the less recognized popular architecture and put the focus on the typologies of the state of Gujarat, the Pol houses, specifically those made by the Bohras community. They were a group of merchants who came to the port city of Khambat and spread to a dozen towns in Gujarat, as their prosperity and number of members increased.

Doshi dissects traditional housing to extract from it those elements that could be adapted to contemporary architecture. He focuses his efforts on the linear structure, the

sequence of spaces, the presence of the patios and mainly the entrance to the traditional dwellings because it is the most characteristic space and the one in which the most social relations occur of the entire dwelling.

> *"The entry space, as a transition zone, is an important concept in the cultural study of any traditional house. On the one hand, it is an architectural solution to the problem of connecting the dwelling with the street; on the other hand, it possesses many meanings symbolizing welcome, status or good omens (...) It is also an indirect form of passive control of social behavior"*
>
> Desay, 2009:125

Within the popular architecture of Gujarat, this transitional space from the street to the house is called Otla. It usually features a change of level from the street and a change of material, it represents the boundary between the private and the public, the sacred and the profane respectively. It becomes the place for informal conversations of small groups that give life to the street (Kaza, 2010). The otla performs an important social function in the neighborhood: it acts as a transitional element where to socialize or interact. In this way, streets are not simply vehicular passageways but are essentially linear open spaces for group activities.

The different housing typologies, identified in Figure 5, respond to a defined economic status and are grouped by units belonging to the same type, with the consequent segregation of classes. This fact is not casual, the dwellings are designed to show the hierarchy and social status of their inhabitants.

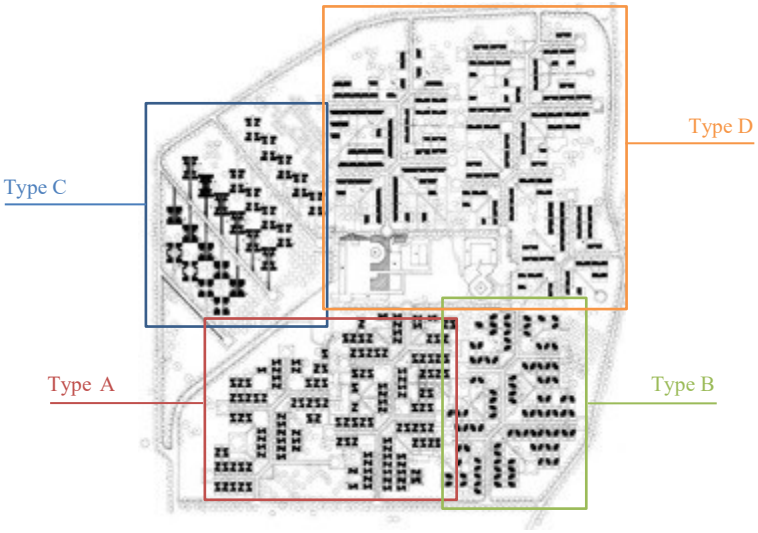

Fig. 5: Different typologies of housing in GSFC
Source: Authors, 2024.

Although it is not possible at all to break down the social hierarchies - so deeply rooted in India - in this first project, the architecture is adapted to the inhabitants' own behaviors or the local climate. As we have already explained, being subsidized projects there were certain rules to follow, with which Doshi is very critical as they rigidified his initial urban projects:

> *"In government projects for industrial communities there is usually a definite pattern of rules to follow, these emphasize house sizes more than habitat concepts: a four-walled room rather than a space, a protective cubicle rather than a home, as a result, India has crates rather than homes. There are few attempts to raise the average built environment due to a poor approach to the problem".*
>
> Curtis, 1988:78

However, Doshi insists in this goal of breaking this hierarchy:

> *"The main challenge was to try to reduce the social hierarchy generated by their job positions, how to avoid the social classism between the head workers and the basic workers. In order to avoid this, we use the same materiality or technology in all the houses, obviously some of them they were bigger"*
>
> Doshi, 2014:145

To understand better the housing typologies, it has been chosen one of them, the type A to explore it and identify the main decisions of the architect about its design according to the whole project identity.

Regarding the individual unit of dwelling, as Figure 6 shows, it's a 50 sqm unit linked to 2 courtyards, one public of 42,5 sqm and other private of 16,5 sqm. It´s a proof of the importance of exterior spaces linked to the interiors in order to extend the dimension of the interior through the intermediate exterior spaces blurring the limits of interior and exterior and public and private.

It´s important to analyze in the left part of Figure 6, how the interior spaces are and how they are organized to avoid circulation spaces. As it was mentioned before regarding the Pol houses, this dwelling is designed as a sequence of spaces, one directly linked to each other. In the central part of Figure 6, it shows the façade decisions in terms of openings. All of them are strategically situated to get privacy at same time than visual continuity interior exterior, allowing the walls be extended from one side to the other, without interruptions. At same time, the situation of the openings in the corner of the spaces let the air cross diagonally all the rooms improving the natural cross ventilation of them.

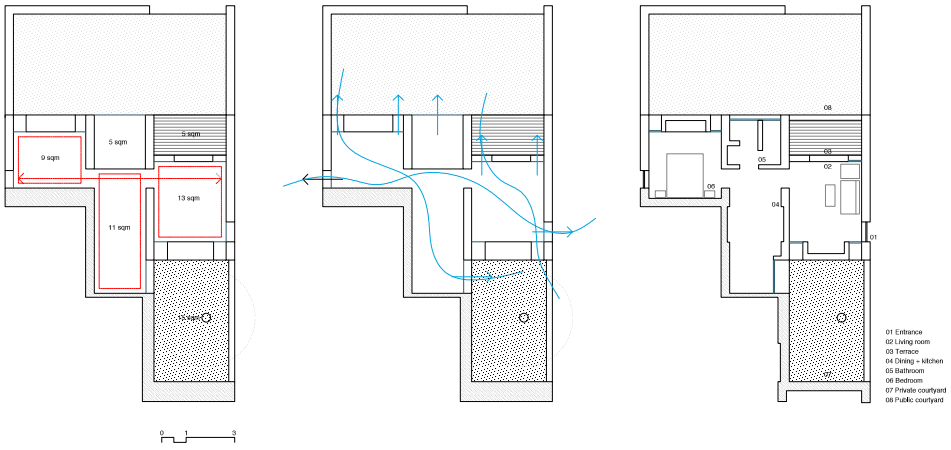

Fig. 6: Analysis of type A housing. The dwelling.
Left. Sequence of spaces / Center. Exterior connections / Right. Uses distribution.
Source: Authors, 2024

The individual dwelling is not understood as an isolated unit. The minimum unit is the couple, sharing a zigzag wall that separates one to each other and gives the privacy needed. As Figure 7 explains, both dwellings work together to have their own freedom and flexibility of movement of spaces at same time that creates together the rectangular shape that gives order to the urban complex. Both dwellings are designed in a double symmetry, and, because of that, their entrances are opposite even they share a wall, thus this design let them feel isolated at same time than together.

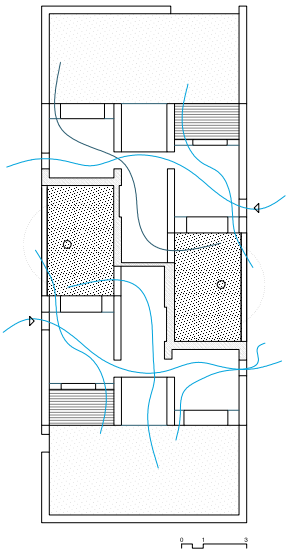

Fig. 7: Analysis of type A housing. The unit.
Source: Authors, 2024

Once the unit is defined, it is in its grouping where the intermediate spaces appear in which Doshi places its trust to generate spaces for the community. Spaces that circulate around the dwellings to access them, but also to house other undefined daily uses that expand the use of the dwelling and allow for common coexistence. A reinterpretation of the traditional otla, elevated to another dimension and position, but with the same objective of generating coexistence and social fabric. As shown in Figure 8, the opposite entrance of the two dwellings in the unit again creates a double symmetry with stairs and bridges for connections with the adjacent ones. The unit, which is built on 2 floors with 4 dwellings in total, one involves vertical connections that add movement and vibration to the whole.

As shown in Figure 9, the already built set allows to identify the decisions commented in the plans: the depth of the openings, understood from the outside more as a shadow than as windows; the rhythm of the units, recognizing each one by the void that creates the common space between them; and the reading of the set made by the individual units that make the space regular but not

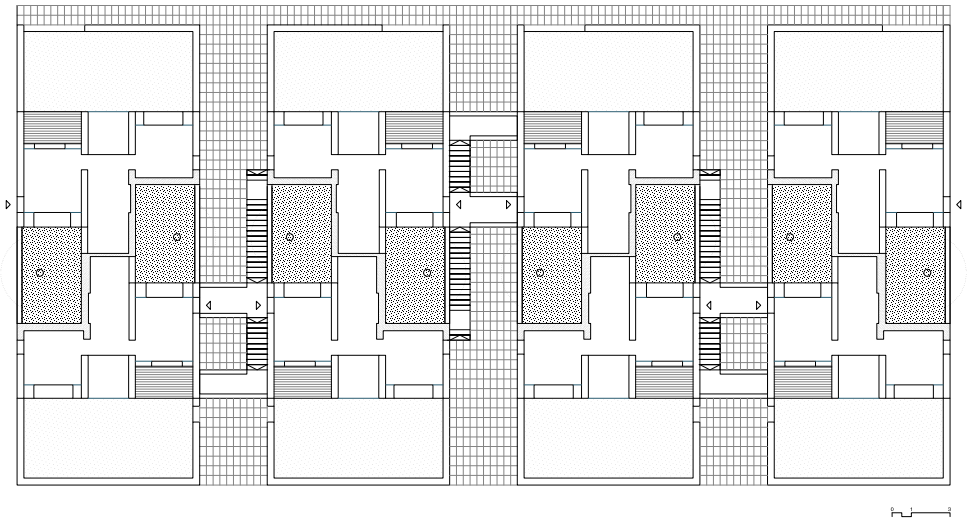

Fig. 8: Analysis of type A housing. The group and common spaces.
Source: Authors, 2024.

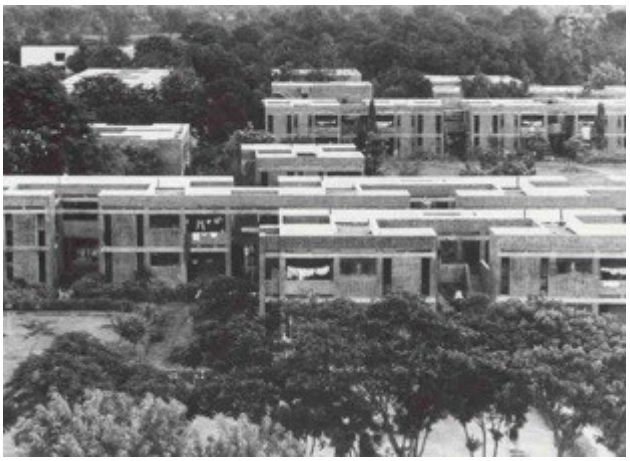

Fig. 9: Type A housing in GSFC.
Source : Curtis & Doshi. An architecture for India, 1988

Strategies for Adapting Urban and Housing Design to the Local Climate and Existing Resources, in terms of Sustainability.

The intermediate spaces. The urban design establishes a community that is understood as much more than square meters, it is conceived in relation to the landscape to which it belongs. Both the urban layout and the arrangement and grouping of the houses articulate intermediate spaces that, in addition to generating social relations, function as transitional spaces between the house and the exterior. These spaces, protected from the sun, reduce the temperature of the houses while cooling the air before it crosses them. Such indoor-outdoor spaces reduce the heat by allowing air to pass through. The intermediate spaces and courtyards, common elements in the traditional Indian typology, are incorporated into the urban design, not spontaneously as it usually happens in Indian settlements but in a premeditated and orderly manner. On the other hand, these intermediate spaces also have a social value, as do the passages, stairs and bridges that connect the dwellings. It is a pedestrian communication system away from traffic, where neighbors can stop and talk, generating community and social welfare, which leads to a better way of living and maintaining the common spaces in good condition over time.

> *"In my projects, I have tried to create a scheme of behavior like that of the ancient communities, still valid and recognized by its inhabitants, still visible in cities like ancient Jaipur, Ahmedabad, Jaisalmer, Udaipur. The elements that were used in the past against the adverse climate are again used, porches, courtyards, narrow streets. These solutions arise from the various needs and survive thanks to their informal character"*
>
> Curtis, 1988:86

Fig. 10: Residential community in Baroda.
Source: Balkrishna Doshi´s documentary archive.

The greenery as temperature and humidity regulator. The physical impact of vegetation in the urban environment affects the thermal environment, air quality and noise levels. (Dimoudi and Nikolopouloua, 2003).

In Doshi's urban design, houses are arranged in shaded streets lined with trees and oriented to receive as little afternoon sun as possible. The presence of vegetation is a fundamental factor in the image and well-being of the urban space envisioned by the architect.

Figure 11 shows the current state of vegetation in the area under study, where you can see the final visual impact of vegetation in the context. The different spacing, heights and densities of the trees give the site different layers of texture, color and shade, in the same way that Doshi proposes with the layers of interstitial spaces before the houses. On the other hand, the geometry, naturalness and color of the vegetation intentionally contrasts with the materiality planned for the houses, both working in a complementary way to create the identity of the complex.

Fig. 11: Presence of greenery in the current situation residential community in Baroda.
Source: Gujarat State Fertilizers and Chemical Limited, 2024.

The housing typology. The typological approach to housing uses passive means to combat the negative effects of sun and rain and enhances natural ventilation or air flow through the buildings. The facades are pierced by balconies and deep windows that shade the interior spaces. These areas build a passive thermal protection façade thickness that reduces the air temperature prior to its passage into the interior of the dwelling. The number of perforations connecting the interior spaces to the exterior and the position and dimensions of these spaces ensure adequate cross ventilation and thermal comfort. These perforations are limited in size and depth, thus reducing their exposure to the sun without losing natural air ventilation properties, as can be seen in Figure 6.

On the other hand, the perimeter of the typologies created is related to the daily activities of indigenous life: sleeping terraces, stairs, overhangs, or corridors are conceived as extensions of the house itself. This exterior environment enlarges the surface of the houses and, at the same time, protects the facades from rain and sunlight, reducing their temperature and improving thermal comfort inside.

The local materiality and traditional construction methods. The Residential Community for a Gujarat State Fertilizers Corporation in Baroda is built using a combination of local materials and the essential importation of external technologies, keeping the identity of the country, as Doshi understands it:

> *"Identity became important to me, how to adapt modernity to local conditions, in the same way that Japanese or Italian architects were trying to do. It was not a new architecture, but rather an appropriate one"*
>
> Doshi, 2014:134

Thus, the project combines concrete and local methods and materials as Figure 12 shows, whereby the architect aims to provide employment in the region and employs local construction methods, using all kinds of local resources to minimize resource consumption and

avoid importing foreign technology as much as possible. In addition, the main motivation is to maintain, once again, the identity of India, as he discovered in Japan a few years earlier.

> *"The key was my visit to Japan in 1958 where I met Kenzo Tange. His projects sought to preserve the traditional timber construction style of his country but incorporated reinforced concrete. The new material adopted the construction sections of wood and was used in the same way as the traditional material. I realized that this was the way to go. You could say that that trip was vital to my interests in finding an identity for India."*
>
> Doshi, 2014:345

Fig. 12: GSFC common spaces.
Source: Balkrishna Doshi´s documentary archive.

Conclusion

The prestige achieved thanks to his collaborations with Le Corbusier, his friendships with the wealthiest families in Gujarat, the growth of the country's economy and the government's expansive industrialization policies, led Balkrishna Doshi to be part of the new settlements in India.

The care with which Balkrishna Doshi designed these places, in continuity with the traditional modus vivendi and in keeping with the local climate, created an exemplary model of city and urban planning. In Baroda settlement he shows his concerns for the social fabric and his desire to establish links between the members of the settlement. He revitalizes the rural way of life despite the primary objective of such settlements: the industrialization of the country. He includes symbolic elements of the local architectural culture in his projects. He abstracts those aspects of tradition and fit them under a modern language.

The analysis of the Baroda settlement designed by Doshi allows us to understand the principles that motivated its design and the results obtained by the architect after its construction. Both concepts allow us to validate the objectives set out in this article. The ability to integrate traditional culture into a contemporary design has been demonstrated.

The strategies of both urban design and housing design that allow Doshi to offer a better life to its inhabitants, especially in terms of climatic comfort and social relations among community members, have been identified.

This paper concludes that this first project by Doshi, despite his youth as an architect, seizes its opportunity to become an exemplar in terms of climatic sensitivity and social significance in its context and time.

According to Dhingra and Chattopadhyay (2016) their work titled "Advancing smartness of traditional settlements-case analysis of Indian and Arab old cities", they describe the smart city as the one with following goals to be achieved in an adaptable, reliable, scalable, accessible and resilient manner.

1. Improve quality of life of its citizens.
2. Ensure economic growth with better employment opportunities.
3. Improve well-being of its citizens by ensuring access to social and community services.
4. Establish an environmentally responsible and sustainable approach to development.
5. Ensure efficient service delivery of basic services and infrastructure such as public transportation, water supply and drainage, telecommunication and other utilities.
6. Ability to address climate change and environmental issues.
7. Provide an effective regulatory and local governance mechanism ensuring equitable policies.

After the analysis and understanding of the settlement designed by Doshi in Baroda, we can identify how these seven points are mostly fulfilled in his proposal, anticipating, in his 1964 project, the parameters that define a smart city today. With this project and his subsequent settlements in Hiderabad, Ahmedabad, he worked for the visibility of the informal sector that was crowded in the surroundings of most of the large state capitals, offering a suitable way for its development. As Doshi says, he know how to be on the side of the most needy by providing them with appropriate solutions without taking them away from the use of materials in keeping with the new times and making them participants in modernity.

> *"I should take an oath and remember it all my life: To provide the poorest class with the most adequate housing for their needs."*
>
> Curtis, 1988:89

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