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**Thermal
Comfort in
Traditional
and
sustainable
buildings**

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Abstract

Keywords: passive cooling, climate change, traditional architecture.

Architecture in the Middle East and Southeast Asia plays a role in the fight against extreme temperatures. The countenance of traditional houses and collective spaces in such areas can be considered precursory examples of environmental and sustainable design in the modern sense and response to external climatic conditions. When respect for the environment and the struggle against climate change are in place, finding low-impact building solutions that use natural ventilation is vital. But not all the newly constructed buildings present the same conventional and historical features; of course, globalization, and changes in the behavior of the populations contribute to shaping the construction and the face of such properties. This research studies the thermal comfort and perception, green cooling strategies of traditional buildings, and at the same time, their modern counterparts. What's the thermal perception inside such buildings? How does traditional architecture influence and is used in the construction of contemporary buildings? What's the importance of religion in building construction? How much can social aspects affect the choice of alternative cooling? Does aesthetics matter? These are some of the issues that will be covered in the research, where also the population that lives in such areas will be a focus. The relationship between the environment and sustainable, traditional architecture will be studied both from secondary sources and interviews with historical and sociological approaches. Given that in Western culture there is extensive abuse of air conditioning in buildings, which of course has a significant impact on the environment, this research aims to understand and study the traditional and low-impact cooling methods of two of the hottest areas of the world deeply to see if some cooling strategies and architectural features can be considered valid alternatives to our cooling approaches and in case exported to Europe.

Prologue

As Koolhaas (2021a) writes in his book, transforming quantity into quality through abstraction seemed the alchemical promise of modernism, but it ended up as a failure, a fraud. Its ideas, aesthetics, and strategies are exhausted. All the attempts put together to give rise to a new beginning did nothing more than discredit the idea of a new start. Such a sense of failure, led to a collective perception of shame, leaving an enormous gap in our comprehension of modernity and modernization. Except for a few airports and a limited number of buildings in the urban outskirts, the image of the contemporary city, or at least its conception, has never been realized. Nowadays we have to make do with living in cities constituted by fragments of innovation. In the last 15 years, we have assisted in the massive production of cities' images, which either highly populated or not, attract many people. The problem resides in the fact that cities have been conceived in an unconscious utopic way. As if the establishment, decision-making power, and the resources available could remain enchanted by the beauty or interesting features they present. As if reality could adhere to schemes and comprehend how it would have been important to make them come true. According to Rem Koolhaas, we should be wondering instead in which directions are heading the forces that contribute to defining space. Right around the time when the apotheosis of urbanization is noticeable and inevitable, a long series of actions and policies are put in place to delay the showdown for architects because the ubiquity of urbanization has modified the urban condition beyond all recognition. "The city doesn't exist anymore", as its conception and ideas around it has been turned upside down and amplified like never before. Nowadays Europe is ridiculously beautiful almost everywhere, at least for those who can forget the nonarbitrary illusions of order, integrity, and good taste. European cities have become catalogs of imperfections. Metropolis in Europe, always according to Rem Koolhaas, can be compared to a reef in which every ambition, intention, solution, question, or answer remains stranded. What we can do is imagine our cities and shape them in our minds as if they were an unbelievable and magnificent show. Europe and the United States produced creative manifestos of modern cities

between 1900 and 1980, namely when the inhabitants of cities were doubling. The rapid expansion of modern Asiatic cities (three times faster than ours) started when we stopped thinking about the city as on one side, there was the end of something new, and on the other one an explosion in the concept of the city in the East. In *Singapore Songlines*, the author explores a political system that is different from what Europe considers “Natural”. He investigates the consequences of an emerging city. The text suggests that even a young city like Singapore has its history and, in the meantime, “more and more aspects of Singapore’s artificiality perpetrated the ecologies of *our* cities”. The city-state has evolved from being the semantic laboratory where disturbing concerns have been analyzed to a place that has become the model for development and sustainability, overcoming every kind of denigration (Koolhaas, 2021a, 50-63, 137-141)

1. INTRODUCTION

We are now living in the “Anthropocene” era, concept introduced by Paul Crutzen and Eugene Stroermer in 2000, which means that we are currently living in a time when the environment is shaped by human impact and activities rather than vice versa (Edwards, 2015). Basically, in the developed world, we exploit and use more resources than necessary. Therefore, these driving forces are causing inequity in the distribution of wealth, the globalization of consumer culture, widespread habitat destruction, the mass extinction of species, and climate change. These major problems are destroying quite rapidly the planet in which we live life (Irwin, 2010) but as the Indian writer and anthropologist, Amitav Gosh narrates in his book (2017), we are blind to the recognition of the impacts of our lifestyles on our earth and climate change. One of the main sources of climate change is the incautious use of energy. At the same time, energy is used to deal with the effects of climate change. Indeed, the Intergovernmental Panel on Climate Change confirms that global temperatures will keep increasing until 2050, at minimum. So, it is almost mandatory to drastically reduce greenhouse gas emissions to avoid temperatures reaching unadaptable or lethal levels in certain areas of the world. We are massively dependent on energy, and in the future, a large part of society will continue to adapt to rising temperatures by increasing the demand for cooling energy. Without a massive advancement in energy efficiency and a reduction in low-carbon energy sources, it will be far harder and more expensive to reduce greenhouse gas emissions. Since the 50s the use of air conditioning has become the main and most established technological solution to fight against extreme temperatures. Looking at the spread of AC across the world we can notice that it doesn't match perfectly extreme climatic conditions. Air conditioning as a cooling strategy is far more used in the United States than in the Global South. Researchers like Mazzone and Khosla, cited by De Cian (2023) studied and questioned to what extent the choice of AC adoption is influenced by the psychological and social aspects. They found that the concept of temperature, heat perception, thermal comfort, and consequently the use of air conditioning is profoundly rooted and linked to culture and society. Nowadays, not only air conditioning is the most used cooling tool but also it has displaced an endless of other traditional and

ancient cooling strategies (De Cian, 2023). Having this information as a starting point, this research is about thermal comfort and passive cooling techniques for sustainable buildings in Turkey, India, and Indonesia, especially traditional and vernacular techniques will be examined from a historical and socio-economic perspective to find alternatives to AC to achieve thermal comfort in buildings located in hot and humid areas of the world. The analysis offers various insights into the social and historical aspects of thermal perception and space conception. The reasons that have led me to deepen this subject have a twofold nature. Attention to passive cooling techniques was influenced and certainly encouraged by certain experiences during my academic internship for EnergyA, which made it possible for me to get in touch first with the Brazilian reality and stories told by the people, and then Indonesia. I have had the opportunity to learn and understand deeply about the project and the research. After reviewing studies conducted on this topic, I decided to expand my area of research to India and Turkey, two countries that have extreme temperatures, and whose history and architecture fascinate me. The purpose of this thesis is to provide a precise analysis of passive cooling strategies adopted in traditional architecture, from a literary review and interviews, realized by me. I met the architect and owner of RAW Indonesia (an Architecture studio, owned by Realrich Sjarief) via Zoom meeting and I interviewed him for 30 minutes, in which he explained to me the sustainable features of some of his projects and also his social commitment. Then I had the same experience with SOUR studio (Turkey) where I had the opportunity to talk to the designer Inanc Eray who explained his works and the political aspect of his country. I wanted also to interview the creator of Krushi Bhawan from Studio Lotus, but it was not possible. Cultural peculiarities, figures, and architectural features will be highlighted. The project aims at proposing new interpretations of the traditional architecture and thermal comfort of two areas of the world. The cultural, and gender relationship to energy consumption and religious aspects play a role in the research. An investigation was carried out through interviews that saw sample architects from major architectural firms in major cities in Indonesia, Turkey, and India, after an analysis of the related case studies. The questions mainly concerned the sustainability of buildings, the relationship between passive cooling, and thermal

comfort, and the historical-cultural prospect, aesthetics, and economic aspect. The analysis of the data collected was carried out by comparing the most interesting aspects found in the realities treated in the case studies. The thesis is divided into six parts: the first one provides an introduction, then a literature review on society, culture, and cooling strategies is presented. Then, the framework will outline the aim and methodology used. Consequently, there will be a presentation of the case studies, divided by geographical area: The first one focus on India and the Moghul Empire, and it is based on my unpublished previous essay “Sustainable Architecture in Mughal Empire: Passive cooling techniques of Medieval Vernacular Architecture”. Each case study starts with the country profile and historical background, continues with an explanation of the cooling strategies in traditional architecture, and ends with an interview analysis of today’s practices, for the Indian case study, the interview has not been done by me. Indonesia is the location of the second case study, whose organization is like the Indian one, but I will present, this time, interviews on the Pyandeling artisan residence and workshop and Guha by RAW Architecture. The last case study is in Turkey. Still, it starts with the country profile and historical background, it continues with the explanation of cooling strategies in Ottoman architecture and ends with the analysis of the Urban Rural V1 and the Geomdan by Sour Studio. In each case study, I will analyze the relationship as well between architecture and religion. I will try to answer questions related to thermal perception, influence of the traditional architecture, the importance of religion, and social commitment. To conclude, answers obtained by literary review and interviewers will be interpreted so that the most important features as well as Asian traditional green alternatives to AC in buildings will be proposed. Thanks to this research work it has been possible to analyze and discover some important factors related to green construction and passive cooling techniques in the Middle East and Southeast Asia, and the deep connection between religion and architecture. Finally, I would try to understand if modern constructions presented as case studies could inspire the construction sector in Europe. Results will be detailed in the last chapter of this work.

2. LITERATURE REVIEW ON SOCIETY, CULTURE, AND COOLING STRATEGIES

It is estimated that approximately 1.3 billion people in developing countries do not have access to electricity and more than 2.5 billion have inadequate access to safe cooking fuels. Despite this, we have seen substantial advances in the number of households that have access to modern energy services in India after its independence, however, the country still is composed of the greatest number of energy-deprived people in the world. For instance, according to the International Energy Agency (*The Future of Cooling – Analysis*, s.d.) (IEA), of the approximately 1.1 billion people in the world without electricity access in 2016, about 239.2 million lived in India, which makes it the country with the largest unelectrified population in the world (Rosenberg et al., 2020) Considering that the total population of India is approximately one-fifth of the world's total, the energy consumed in India is more or less only 4% of the world's total (Saxena & Bhattacharya, 2018). Unfortunately, energy continuity is still not achieved, and in many villages, and urban areas as well, it is common to have access to electricity just a few hours during the day even if the official estimates show that more than the 90% of the rural areas and the totality of the urban areas have been electrified between 2000 and 2010. It is the public sector that controls the energy system in India, where aid is usually provided and is not targeted properly, even if the national government always underlined its commitment to grant energy to the low-income part of the population. In fact, in early 2000, the primary objective was to increment farm production, so the actual dwelling supply was overlooked, therefore the more affluent farmers and landowners are the ones who benefitted the most from energy subsidies. The same happens in urban areas because the high-income regions are the ones where electricity is least interrupted (Saxena & Bhattacharya, 2018). The lowest caste of the Hindu group called the scheduled caste, compose 16% of the population in India and the daily deal with disadvantages, despite the declaration by the Indian constitution that caste discrimination is now illegal. The people considered outside the caste system compose 8% of the population, but both groups are considered at the lowest level of society. Muslims in India represent 14% of the total but are still considered unprivileged in

many spheres. These three marginalized groups face difficulties in their access to energy, and often live in the poorer neighborhoods or slums in the urban area, while in the rural areas, they are often isolated in hamlets outside the villages, so they are discriminated against in terms of electricity access. So, the groups of people who come from the lowest levels of the caste used to live in the outlying areas, while Muslim communities in India live in the urban neighborhoods, but within the city boundaries, like ghettos, where dwellings are not always correctly registered by the official authorities. Moreover, the Scheduled Tribe and Scheduled caste households consume less than the Muslim community, which in turn consumes less than the upper caste households. As opposed to developed countries, where access to any kind of energy and its consumption depend on the house status, in developing countries like India, not only is it important to possess the ordinary factors, but also “hidden” supply-side factors like being part of a particular marginalized group. In this sense education level, income, and age play a role in the access to modern energy resources. Cases of illegal access to electricity caused by the absence of law enforcement in various urban slums are registered. (Saxena & Bhattacharya, 2018) Here below some tables to show the energy distribution and consumption in India divided by social class:

Table 1: Distribution of LPG AND electricity by social groups. Source: Saxena & Bhattacharya, 2018, 47.

Distribution of LPG and electricity by social groups.

	LPG	Average electricity consumption
Upper caste Hindu households (others)	0.545 (0.497)	95.212 (96.158)
Scheduled tribes households	0.388 (0.488)	64.090 (55.218)
Scheduled caste households	0.337 (0.472)	72.715 (63.622)
Muslim households	0.453 (0.497)	89.140 (92.010)
Total sample size	87,753	87,753

Mean coefficients; sd in parentheses.

From a gender perspective, if we look at the internal spaces of the houses, we can notice that even the basic electricity tools are not necessarily used equitably. In analyzing the use of energy in households, from the study conducted by M. Rosenberg et al. 2020, it emerges that women do not benefit from energetic resources as much as men. There is an asymmetrical power inside the dwellings where the male tends to dominate, and resources look based on male preferences. Resources like television, non-kitchen fans, and mobile phones are used more by men, as reported by the women interviewed. While “gender-neutral” appliances like non-kitchen bulbs, water pumps, and refrigerators are used equally. Consequently, appliances that are categorized as “female used” like kitchen lights, kitchen fans, iron, mixer, sewing machine, and grinder are used less by the males. Gender-neutral and “female tools” are considered special appliances, so affordable for hush-status families. Among high-income households 57% use “gender neutral and female appliances”, while only 26% of the lowest socioeconomic status dwellings have these accessories. Hence, to conclude, about 78% of the decisions concerning houses in India are made by male (Rosenberg et al., 2020)

Table 2: Household matrices of appliance ownership and use. Source: Rosenberg et al.,2020,112

a

	More male-used appliances											
	Appliance access						Appliance usage					
	Has appliance			Average points of use			Female usage			Male usage		
	TV	Non-kitchen fan	Mobile	TV	Non-kitchen fan	Mobile	TV	Non-kitchen fan	Mobile	TV	Non-kitchen fan	Mobile
Payment problems (n = 22)	82%	100%	95%	0.86	3.73	2.55	72%	91%	62%	100%	100%	100%
No payment problems (n = 8)	75%	88%	88%	0.75	2.63	1.25	33%	63%	43%	100%	100%	100%
Land owner (n = 8)	100%	100%	100%	1.00	4.75	3.38	88%	88%	75%	100%	100%	100%
Not a land owner (n = 23)	70%	91%	91%	0.74	2.83	1.74	50%	82%	52%	100%	100%	100%
Kids (n = 19)	79%	95%	89%	0.84	3.21	2.16	73%	89%	59%	100%	100%	100%
No kids (n = 12)	75%	92%	100%	0.75	3.50	2.17	44%	73%	58%	100%	100%	100%
High caste (n = 7)	100%	100%	100%	1.00	4.43	2.86	71%	71%	71%	100%	100%	100%
Not high caste (n = 24)	71%	92%	92%	0.75	3.00	1.96	59%	87%	55%	100%	100%	100%
All households (n = 31)	77%	94%	94%	0.81	3.32	2.16	83%	90%	66%	100%	100%	100%

b

	Gender-neutral appliances (both female and male usage)											
	Appliance access						Appliance usage					
	Has appliance			Average points of use			Female usage			Male usage		
	Non-kitchen bulb	Water pump	Refrigerator	Non-kitchen bulb	Water pump	Refrigerator	Non-kitchen bulb	Water pump	Refrigerator	Non-kitchen bulb	Water pump	Refrigerator
Payment problems (n = 22)	100%	64%	64%	4.91	0.64	0.64	100%	93%	100%	100%	100%	100%
No payment problems (n = 8)	100%	25%	25%	3.13	0.25	0.25	100%	100%	100%	100%	100%	100%
Land owner (n = 8)	100%	88%	75%	5.88	0.88	0.75	100%	86%	100%	100%	100%	100%
Not a land owner (n = 23)	96%	39%	43%	3.74	0.39	0.43	100%	100%	100%	100%	100%	100%
kids (n = 19)	100%	53%	53%	3.84	0.53	0.53	100%	90%	100%	100%	100%	100%
No kids (n = 12)	92%	50%	50%	5.00	0.50	0.50	100%	100%	100%	100%	100%	100%
High caste (n = 7)	100%	86%	71%	6.00	0.86	0.71	100%	83%	100%	100%	100%	100%
Not high caste (n = 24)	96%	42%	46%	3.79	0.42	0.46	100%	100%	100%	100%	100%	100%
All households (n = 31)	97%	52%	52%	4.29	0.52	0.52	100%	94%	100%	100%	100%	100%

c

	More female-used appliances																	
	Appliance access						Appliance usage											
	Average points of use						Female usage						Male usage					
	Iron	Kitchen light	Kitchen fan	Mixer	Sewing machine	Grinder	Iron	Kitchen light	Kitchen fan	Mixer	Sewing machine	Grinder	Iron	Kitchen light	Kitchen fan	Mixer	Sewing machine	Grinder
Payment problems (n = 22)	0.50	0.64	0.18	0.59	0.27	0.23	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	17%	0%
No payment problems (n = 8)	0.38	0.13	0.00	0.00	0.00	0.00	100%	100%	NA	NA	NA	NA	0%	0%	NA	NA	NA	NA
Land owner (n = 8)	1.00	1.00	0.25	0.88	0.63	0.38	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	20%	0%
Not a land owner (n = 23)	0.26	0.30	0.09	0.30	0.04	0.09	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
kids (n = 19)	0.53	0.58	0.05	0.47	0.26	0.21	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	20%	0%
No kids (n = 12)	0.33	0.33	0.25	0.42	0.08	0.08	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
High caste (n = 7)	0.86	0.86	0.29	0.71	0.43	0.14	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	33%	0%
Not high caste (n = 24)	0.33	0.38	0.08	0.38	0.13	0.17	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
All households (n = 31)	0.45	0.48	0.13	0.45	0.19	0.13	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	17%	0%

¹Table 2 from M. Rosenberg et al.,2020,112²

¹ Image from M. Rosenberg et al.,2020,112

² “male-used (a), gender-neutral (b), more female-used (c) which does not include the percentage of households with the specific device, as households surveyed only own one of each of these appliances so these values are the same as the average points of use. For the inductive study, we measure appliance ownership as either percentage of households with the appliance of interest or average points of use of each device of interest. Similarly, we classify appliance use on the basis of the gender of the household members that most use the appliance of interest. Darker green indicates more use or ownership; darker red suggests less use or ownership. For the ‘has appliance’, ‘female usage’ and ‘male usage’ columns, darkest red represents 0%, darkest green represents 100%, and 50% is the midpoint. For the ‘average points of use’ column, darkest red represents 0, darkest green represents the maximum value for all of the appliances in the panel, and 0.5 is the midpoint. In both instances, the midpoint value represents the cut-off above which a majority possess or use the appliance of interest NA signifies those households without the appliance, therefore use cannot be ascertained

On the contrary, in Indonesia, the woman takes decisions for the house. Let's see in detail. Indonesia, which has a population of more than 270 million people living in the archipelago, it is the fourth most populated state in the world. According to a survey published by Statista Research Department on the Jan 10 of 2023, 2018, the population density in the archipelago was about 142.57 individuals per square kilometer, of which 60% of residents on Java Island making it the most crowded and multi-ethnic island in the world. Despite this diversity, more than 87% of the population identify themselves as Muslim, no matter if it is the majority, the country recognizes six religions: Islam, Protestantism, Catholicism, Buddhism, Hinduism, and Confucianism (Facts: *Demographics of Indonesia - statistics & facts* | Statista, s.d., 2023). The population grows on average by 2.6% per year, and it is expected to reach 300 million by the year 2025. At the same time, the country's economic development is increasing in all sectors. Such growths are producing improvements in lifestyles and living standards, leading to a rise in energy consumption demand as well (Sukarno, 2015). Due to the overwhelming predominance of a single ethnic and religious group within the population, it has not been possible in this case, to analyze the relationship between religion and energy consumption. For Indonesia, gender, income, education level, and control over household expenditures are the variables taken into consideration. The family structure is organized as the men being the breadwinner, and source of income. Meanwhile, the woman is designed to control the household. It is a sort of pact that originated in their engagement. Such rational distribution of duties between the couple reflects the social and cultural norms of the country. Indeed, it is socially accepted that the woman or wife bears the responsibility of managing the household expenditures and the man or husband plays the breadwinner but when a decision may affect the global efficiency of the dwelling it is common to decide together (Permana et al., 2015). Another factor influencing who will choose how to spend money is the level of

for these appliances. These households, namely those with payment problems (n = 8) without these appliances, are distributed within the other categorizations.” (Rosenberg et al,2020,112)

education, so it has been analyzed the relationship between women's education level and decision power. Not surprisingly, it can be noted that when her education level is higher, she has more decision-making responsibility, until the university level, as it becomes a joint decision because, in the majority of cases, men tend to have the same or higher level of education. It is shown that 63.5% of women owning a high school diploma represent the decision-makers of the family. This percentage goes down to 27.0% for a college-level degree. Of course, the higher the degree level, the higher would be its decision-making power, income, and independence from the husband. Here Below is a table on the percentages and relationship to gender and decision-making, which can explain and underline the importance of the role of women in dwellings regarding energy consumption management (Ibid.):

Table 3: Wife's education level and decision-making power. Source: Permana et al.,2015, 82

		Decision for overall expenditure [n, %]			Total
		Husband	Wife	Joint decision	
Wife education level					
Primary school and below	n	0	1	0	1
	% Within overall decision	0.0%	0.9%	0.0%	0.3%
Secondary school	n	0	10	11	21
	% Within overall decision	0.0%	8.7%	5.6%	6.4%
High school	n	12	73	113	198
	% Within overall decision	60.0%	63.5%	57.9%	60.0%
University (3-year diploma and above)	n	8	31	71	110
	% Within overall decision	40.0%	27.0%	36.4%	33.3%
Total	n	20	115	195	330
	% Within overall decision	100.0%	100.0%	100.0%	100.0%

It is estimated that the average expenditure per month of energy consumption in dwellings ranges from 2954 to 1182 MJ more or less, while the typical average salary covers 393 to 147 USD. And in most cases, people tend to spend around 10–15% of their income on energy, which means that energy is a heavy household expense (Sukarno, 2015). The fact that the wife is easily the decision maker for the household, reveals reports that levels of energy consumption are lower than if the

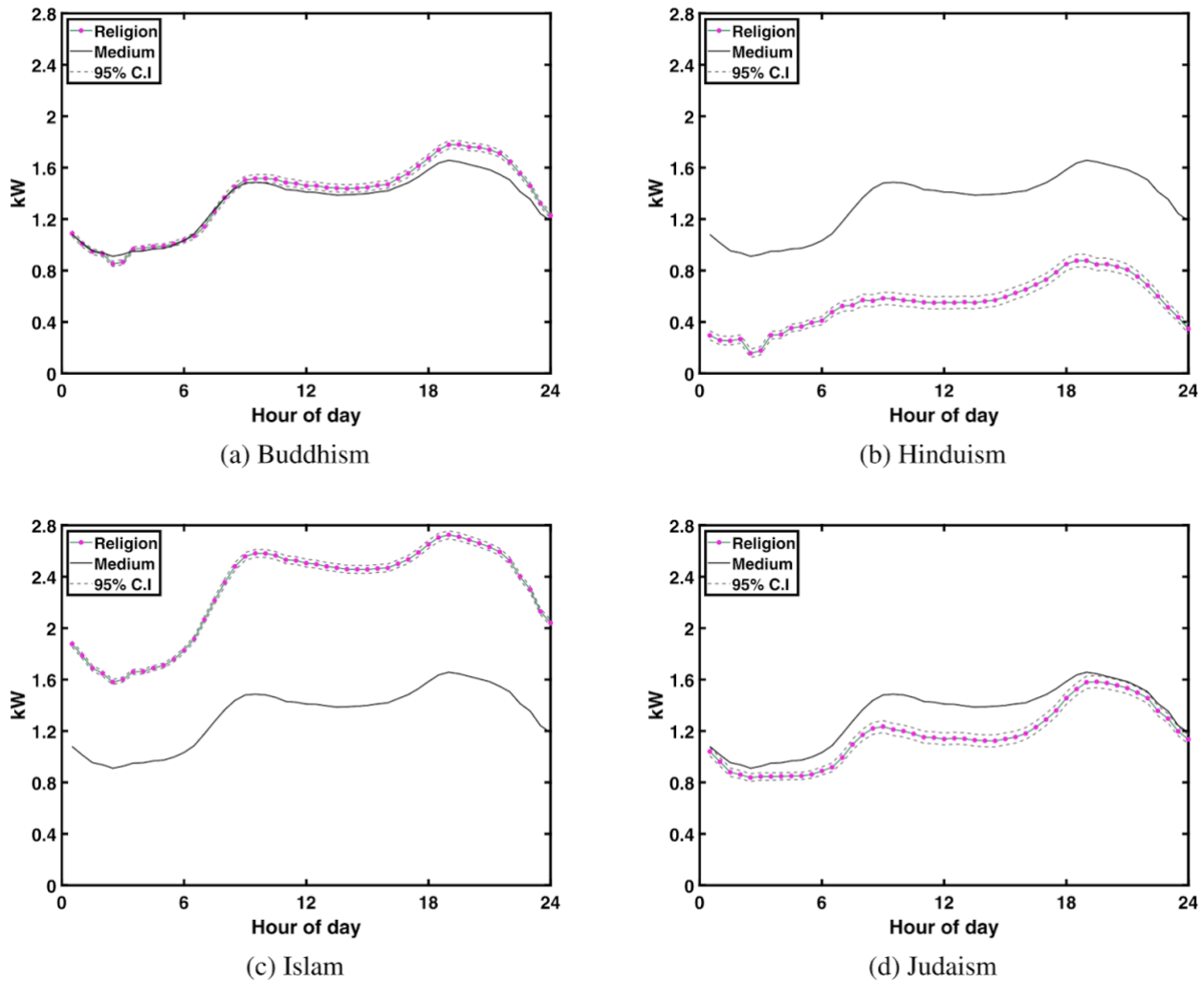
³ Source Permana et al.,2015, 82

decision was made by the husband or a collective decision. Henceforth, the average consumption of energy is lower than the mean and this signifies that women are significant energy savers. Being better household energy managers, possessing a higher awareness of energy conservation, and finally spending money more carefully are all qualities that help them to consume less energy. Similar parameters to measure the energy consumption in dwellings are applied to Turkey, where the current population is more than 80 million people, as the majority of the citizens are Muslim. In this case, two driving forces influence energy choice. The first one is more oriented toward dwelling factors such as the type of house, the heating system, and the construction year. The other feature includes the socio-economic sphere such as income, age, gender, and education. According to some research, the determining factor for the choice of energy in Turkey is the household type (İpek & İpek, 2022). Talking in figures, the amount of energy consumed in the housing sector, which is the third sector with the highest energy consumption, was 22,836 thousand TOE in 2017, it reached 26,148 thousand TOE in 2021. The average energy consumption rate in the housing sector was calculated as 21.34% in the period between the years mentioned above (Gungor, 2023). Similar to the case of Indonesia, also in Turkey. It is important the gender aspect of energy consumption, indeed it has been noted that it is a key variable as women normally seem to pay more attention to energy conservation. In countries where the housework is generally designed for women or female members in general, like Turkey or Indonesia, household appliances are mostly used by women, as they spend more time at home than men. It is important to underline that most household electricity consumption today derives from the use of home appliances. So, the understanding and desire of women to reduce energy consumption have a crucial role in controlling household energy efficiency. Studies on education level and climate change awareness have been conducted in Turkey, where the questions were addressed to women. What has emerged also is that it is more likely to know about climate change and energy-saving electrical appliances for highly educated women. It is important then, because, as mentioned before, women control households and energy expenditures more often than men.

As a consequence, putting efforts towards enhancing the general education of females may help to raise consciousness and reduce energy consumption (Ucal, 2017). It is also shown in an assessment published by The Energy Sector Management Assistance Program that Women and men have different thermal perceptions and comfort, but it also agreed on the fact that women are generally more worried about the impacts of energy consumption on the environment its potential implications for future generations including their own children, so they consume less. Another relevant finding is that women and men access different sources of information concerning energy consumption and efficiency as women tend to rely more on the Internet, advertisements, and social circles to collect information while men get most of their knowledge from sales representatives and acquaintances, but in general a lack of awareness emerges. (Canpolat & Casabonne, 2021). Is there a relationship between energy consumption and religion? As a special social ideology and cultural phenomenon, religion affects most aspects of human society. The United Nations Statistics Division states that currently, about 90% of people still believe in various forms of religion. As a result, we may still observe religious belief playing a distinctive role in many fields of modern social life. The influence of religion on ideology, culture, customs, politics, military, and other fields is known. However, in the realm of consumption, we notice that the issue of how much influence religion has and in what aspects this influence is felt has received little attention (He et al., 2022). Generally speaking, spirituality is roughly described as a supernatural relationship with the sacral aspect of life or with something that goes beyond us, divine. Spirituality refers to existential and experiential focus upon an individual's internalized faith, values, and beliefs along with the consequences in daily behavior. At the same time, Mitroff and Denton (1999, p. 6), cited by Casidy, R. and Arli, D. (2018) viewed spirituality as "universal, non-denominational, broadly inclusive, and tolerant, and as the basic feeling of being connected with one's complete self, others, and the entire universe." It is true that spirituality is usually an integral part of the religion which can be defined as the extent to which a person lives out his or her religious beliefs. Morberg 2008, 101, cited by Casidy, R. and Arli, D. (2018) religiosity or

religiousness refers “to membership and participation in the organizational structures, beliefs, rituals, and other activities related to a religious faith”. Spirituality and religion are different theories that usually coincide. Regardless of the theoretical and conceptual diversity between the two entities both spirituality and religion have significant impacts on consumption and influence on many aspects of consumers’ attitude and behavior (Casidy & Arli, 2018). G.W. Leslie et al. 2022, propose a statistical model and a descriptive analysis that identifies discrepancies in energy consumption during the day across different ethnic groups with respect to their religion. The statistical analysis is because individuals that come from diverse contexts and cultures may not react in the same way to situations, for instance, consumption decisions could be diverse even if the price shown is the same, so that could be explained by the background variable. This is to say that sure our choices, decisions, and inclinations are designed and influenced by the environment in which we live, education, religion, and rules that we must respect. The reasons why such differences emerge cannot be totally justified by the following analysis and data because there is a lack of household budgets, equipment, and dwelling (Leslie et al., 2022). It is estimated that areas with a meaningful minority of residents born in Europe are prone to use less energy across the day. Zones inhabited by minorities from Africa, the Middle East, and Southeast Asia, tend to consume more than the average. On the contrary, neighborhoods where significant minorities from Southern and Central Asia together with Northeast Asia display an energy consumption more in line with the average. It is also noted that there is not a huge difference in the results of summer and winter periods (Leslie et al., 2022) Here below the findings of the energy use related to religion:

Table 4: Estimates of household electricity use model (Religion). Source: Leslie et al., 2022,6



It can be noted that in areas that present a high number of Hindu presences, household consumption during the day fluctuates and they consume less energy than the average. On the contrary, in Muslim neighborhoods, dwellings consume notably more, and with a different load profile. Finally, in more Jewish and Buddhist zones, the departure from the mean is small but the load profile is more accentuated. One reason behind these differences may be laying on the fact that each religion may have a different level of community engagement or social norms which affect private lifestyle but also environmental and so civil responsibility. It is also presented that the consumer's behaviors depend on the neighborhood. For example, a very effective message for the Muslim community could

be understood differently in a mostly- Hindu area. For this reason, in areas that experience a higher level of energy consumption, energy efficiency measures are likely to have a greater marginal impact (Leslie et al., 2022). In addition, various religions express their messages on energy-related issues. For example, religion can reduce trust in problem resolution using technology and science, which may be felt as a conflicting source against faith. To the religiously inclined, modern innovations that edge into traditional values may cast doubt on the broader scientific enterprise, a suspicion of science likely bolstered by the perception of scientists as being personally irreligious (Urbatsch & Wang, 2021). It also happens sometimes that religious beliefs promote “millennialism”⁴ so that environmental and energy policies seem useless. Such sort of anticipation of the close end of the world is more common in small cults, but also the most spread religions worldwide like Christianity, Islam, and Judaism contain traditions as well that discourage long-term worries. Hence, it could be explained why religiosity strongly tends to demand current mitigation rather than future environmental threats (Urbatsch & Wang, 2021). By the way, religious adherence might encourage sustainable energy consumption in the case where people perceive risk from current energy sources, as religion also deals with the reaction to danger. For instance, religions can dissuade believers of human responsibility for global warming and climate change, intensifying the assumption of the partial powerlessness of people in the face of the divine entity. Moreover, it may inspire people to trust in faith and the providential order rather than demand changes. Indeed, believing in the divine hand may reduce the perceived need for intervention and environmental actions. That may be the reason why, in various research, religious people, especially conservative believers, generally support fewer policies and actions toward the protection of the environment. Henceforth, traditional rituals and religious views may enhance and support some political actions against energy efficiency projects, that indicate a primary role in the decision on the energy-consumption position (Urbatsch & Wang, 2021). What might be the challenge for religion in relation to climate change and sustainable

⁴ Feeling that the apocalypse or the end of the world is near

consumption? Religion should come back to where it started and examine again everything from its onset and speak the truth in the best way possible. Transitioning to a new and different way of life, for religions means entering a new ecological phase, in which it would be “faith Earth-oriented” and “Earth-honoring”. That means, for a believer, to be converted to Earth and God at the same time, to measure all religious impulses with the same criterion. Contribution to the planet Earth's well-being through religious institutions as well as in the habits of the heart, in theology and ethics together with rituals and practice (Rasmussen, 2011). Such ecological transition will come easier for some religions compared to others. For example, Judaism, Islam, and Christianity may face more obstacles rather than Hinduism, Buddhism, or numerous indigenous traditions, partly because of their roots, scriptures, and most of the shaping practices of these religions are rooted worldwide. Yet, religions are all about ways of life and shaping people inside and out for those ways of life” (Rasmussen, 2011). Nowadays, the global trend involves, in most cases, the use of air conditioning and electric fans to fight extreme temperatures contributes to generating nearly 20 % of the total electricity used in estates. As incomes rise and populations grow, especially in the world’s hotter regions like India, the use of air conditioners is becoming increasingly common. In fact, the use of air conditioners and electric fans already accounts for about a fifth of the total electricity in buildings around the world – or 10% of all global electricity consumption. Over the next three decades, the use of ACs is expected to rise, becoming one of the top drivers of global electricity demand (The Future of Cooling – Analysis, s.d.). According to the Worldwatch Institute, buildings consume about 40% of the world’s energy production. As a result, buildings are involved in producing about 40% of the sulfur dioxide and nitrogen oxides that cause acid rain and contribute to smog formation. Building energy use also produces 33% of all annual carbon dioxide emissions, significantly contributing to the climate changes brought about by the accumulation of this heat-trapping gas (Kamal, 2012). Before the advent of mechanical refrigeration, ingenious use was made of the many means of cooling (e.g., damp cloths hung in draughts created by the connective stack effect in buildings). So, dwellings and lifestyles were developed to make the best possible use of these sources of cooling. The introduction

of mechanical refrigeration permitted not only the ability to increase the likelihood of achieving complete thermal comfort for more extended periods, but also a great deal of flexibility in building design, and simultaneously led to changes in lifestyle and work habits. However, increasingly, the use of a 'higher technology' resulted in natural-cooling techniques being ignored or implemented as an emergency tool, in case the other ones are out of order. Now with the growing realization of the rapid depletion of non-renewable energy sources and of the adverse environmental impacts of fossil-fuel dissipating processes, it is accepted that it is foolish to continue consuming vast amounts of non-renewable fuels for the air-conditioning of buildings when our ancestors achieved thermal comfort by natural means. Hence reducing the emission of greenhouse gasses, caused by fossil fuels to power the cooling requirement of buildings, has stimulated interest in the adoption of passive cooling techniques for buildings (Kamal, 2012). According to scientific definition, Passive cooling systems “do not require any external power source” In fact, it uses free, renewable sources of energy such as the sun and wind to provide cooling, ventilation, and lighting needs for a household. This additionally removes the need to use mechanical cooling. Applying passive cooling means reducing differences between outdoor and indoor temperatures, improving indoor air quality, and making the building both a better and more comfortable environment to live or work in. It can also reduce levels of energy use and environmental impacts such as greenhouse gas (Taleb, 2014b). On the contrary, thermal comfort is defined as “...that condition of mind which expresses satisfaction with the thermal environment” (ASHRAE/ANSI, Standard 55) (Jenkins, 2019). Thermal comfort has a significant implication on the health, psychology, and productivity of the working population and forms the foundation of a country's economy. To achieve thermal comfort, especially in tropical climates, passive design techniques can be applied in buildings, to avoid or limit solar heat gain, optimize natural ventilation, engage prevailing winds, and provide adequate daylight (Tatarestaghi et al., 2018). Therefore, a transition of the building industry towards sustainable options is vital for the mitigation of the effects of climate change. In this context, Bioclimatic architecture plays a role, as it should be applied both to infrastructure and buildings. Bioclimatic architecture is a way of designing buildings based on the

local climate, with the aim of ensuring thermal comfort using environmental resources. They must also blend into their natural surroundings (Aghimien et al., 2021). The main purposes of bioclimatic architecture are to create comfortable, safe, and healthy dwellings in respect of the environment. To achieve that it is important to take care of the local biodiversity and use energy efficiently. The most common bioclimatic strategies in architecture include: first of all, an efficient design capable of local climate adaptation that minimizes energy waste. Second of all, the materials should be sustainable like stone, natural fiber, wood, and recycled materials. Then, to reduce their consumption, bioclimatic buildings use various types of renewable energies like solar, geothermal, and so on. To conclude, it is essential to use smart materials capable of repairing themselves over time. Buildings, for being considered bioclimatic, have to have specific elements that help in the reduction of energy consumption and a low environmental impact. Namely, the features include orientation, size, and shape. Even the color of these dwellings is taught for energy efficiency. First, the surface area is reduced by the compactness of the buildings. Moreover, the materials (like walls, windows, and roof...) that surround the external part of the structure must be insulated correctly to avoid heat loss by transmission. Furthermore, ventilation systems assure that hot air, detached from the indoors, is conveyed into the fresh air that comes in thanks to heat exchangers, to elude thermal losses. In hotter and more humid climates the use of vegetation, vertical gardens, and garden roofs create cooler zones that act as heat protectors. Thermal accumulators such as heat exchangers and pumps make it possible to capture and store the heat generated by the heating system or the sun and avoid losses. The airtightness of the building is essential. Leaks through gaps should be minimal with respect to the total volume of the house. Thermal bridges must be avoided: edges, corners, and joints must be created carefully to avoid heat loss through these bridges. Hygrothermal comfort can be achieved by efficiently controlling air currents, evaporation caused by the sun, or by reducing condensation, particularly in warm climates (CORPORATIVA, s.d.) There are several advantages that come from bioclimatic architecture. Indeed, eco-efficient buildings benefit the environment, the entire society, and of course their users. The key points are the following:

- Better energy management and environmental integration enable a reduction of costs.
- The temperature is kept stable at every time of the year, it does not depend on weather conditions or the season of the year, but on the optimization of thermal comfort.
- The reduction in the use of air conditioning will reduce greenhouse gas emissions (GGE) and as a consequence, lower carbon footprint. Lessened water footprint, by the optimization of water consumption.
- Insulation reduces the levels of noise pollution.
- Enhanced and promoted sustainable habits through the reduction in the use of resources.
- Electrical self-consumption, renewable energy, and aérothermal heating could represent an investment opportunity.

Building a house using bioclimatic principles is just the first step of sustainable architecture. The next step is represented by passive buildings or houses. The concept of the passive house has grown into a favorite approach not only in the field of research but also for architects in European countries like Germany and Austria, as it has proven a high level of thermal comfort compared to the energy consumed. The main feature of a passive house is its internal constant comfortable temperature, which requires a low quantity of energy for heating or cooling the spaces. Basically, the main idea behind this is the reduction of heat losses, achieved by high thermal insulation and a raised thermal capacity of the envelope, which would keep the energy inside, passive solar gains, and an efficient heat recovery system (Taleb, 2014b)

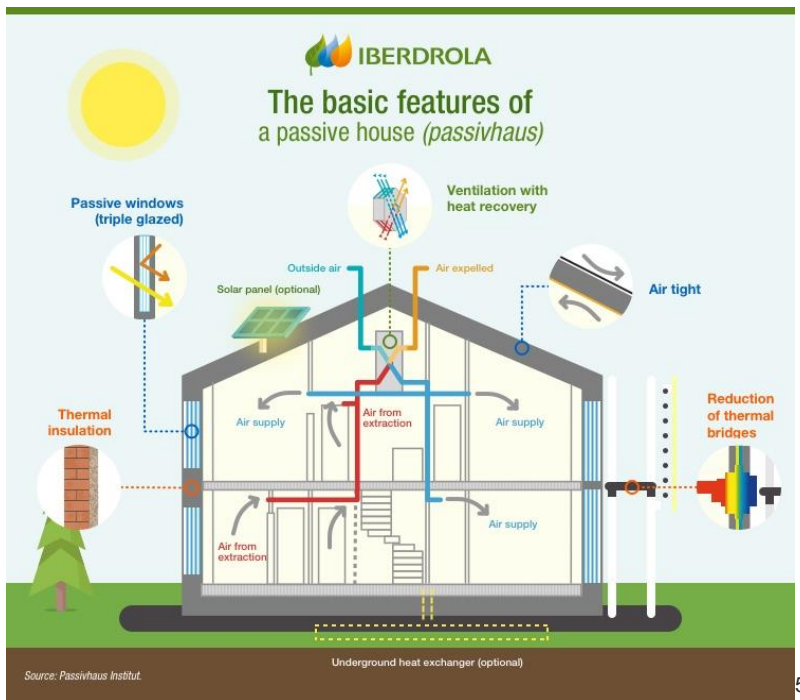
- The concept of Passive House was used for the first time in Darmstadt, Germany, and refers to a house with the following characteristics:
- annual space heat requirement of 15 kW h/ (m² year).

- total energy consumption for heating, hot water, and electricity should not exceed 120 kW h/ (m² year).
- leaked air volume must not be higher than 0.6 of the house volume per hour (h) as measured at a pressure of 50 Pa (Mihai et al., 2017). As Chetan et al affirm, there are different cooling methods for the reduction of the cooling load on sustainable buildings. There are the Passive Cooling Methods and the Active Cooling Methods. Passive cooling strategies are used to implement energy efficiency and are the “Design or technological feature formed for providing cooling to the buildings with or without using a minimum amount of energy is known as Passive Cooling” (Chen et al., 2021). Passive cooling techniques are one of the most important elements for keeping a building naturally cool, and adequate knowledge in the field of air flows around construction and its effects on the environment and neighborhood is mandatory (Chen et al., 2021) There are different types of passive cooling methods, but the main strategies for buildings, for Aida Zare, can be categorized in six “items’ ’: Shading, Convection cooling, Evaporating cooling, Radiative cooling, Geo Cooling, and greening. The shading system is the most ancient and basic way of cooling, its mechanism focuses on the prevention of extra heat entering the indoor spaces. To be correct and useful, the shading system should guarantee daylight and privacy during the day, avoiding warming. Moreover, according to their location, they provide a different efficiency: the shades from the outside are more efficient than the indoor ones. In consonance with its shape, self-shade is an option to be considered, as it can be designed in compliance with the form of the construction. Right orientations utilize passive cooling and passive solar heating systems. Orientation is a feature that allows being in harmony with the surroundings with the climate. Ventilation as well plays an important role in passive cooling techniques, because it creates movement between the outside and spaces. It is possible, nowadays, to analyze the ventilation performance of a building by using computational fluid dynamics (CFD) programs and computers. The CFD program is based on the finite volume method, which makes calculations easier and generates useful graphical results. The results are easier to interpret because

they not only contain numerical velocity values but also graphic information about the air distribution pattern (Berrak & Kapoor, 2021). What plays a role in the efficiency and functionality of a shade system is for sure the type of glasses and the conformation of the windows (Share your green design, 2023) The other mechanism is cooling by convection which is based on the principle that the hot air goes up and the cool air falls, we can find it with the chimney effect, stack effect, and cross ventilation. Windcatchers are among the most traditional and efficient systems that can catch cool air from the outdoors, but, in addition to this example, the characteristics of these strategies emerge on appropriate openings, clerestory windows, roof ventilators, and wind scoops. Evaporation as a cooling technique comes from Middle East traditional architecture. It is basically possible thanks to the evaporation that absorbs a high quantity of heat and as a consequence, the temperature of the air decreases, while humidity increases which makes room for the creation of indoor thermal comfort in hot and dry climates (Ibid.). At the same time, radiative cooling is a strategy based on heat transmission from a hotter unit to a lower temperature unit through long-wave radiation (Share your green design, 2023).“With regard to buildings, the outer surfaces of the building are cooled by the sky (heat sink) because its temperature is lower than the outer surface temperature of the building. Thus, it is the principle that enables the earth to waste the heat received by the sun in order to maintain its heat balance” (Al-Shamkhee et al., 2022). At nighttime, due to the lower temperatures, the building facades lose their heat, and this leads to indoor cooling. Finally, high albedo materials that compose cool roofs and surfaces reflect directly the sun, so they are responsible for the increase of heat loss during the night (Share your green design, 2023). Still, in accordance with Aida Zare, on geo cooling, the earth has an incredible heat capacity that can grant a temperature balance during the entire year, thus cooling in summer and heating in winter can be obtained by using earth sheltering and ground source heat pumps. Such a strategy was widely used to keep food refrigerated during summer in desertic cities of the middle east (Share your green design, 2023).Vegetation not only helps provide fresh and clean air, reduces pollution, and makes spaces aesthetically pleasant but also moderates the temperature and the humidity of the air around. Implementing green areas is also a technique for

passive cooling in buildings. For example, as illustrated by Kamarulzaman et al, green roofs represent a concrete option for buildings as they can offer a sustainable green surface by improving urban climate, minimizing heat island effects, and simultaneously protecting biodiversity. This is possible because a green roof is able to diminish the consumption of energy by lowering thermal absorption, as many studies can prove (Kamarulzaman et al., 2014). Indeed, Niachou A, et al find out that the indoor temperatures ,which discovered the indoor temperature values in the building with green roofs, are lower during the day, and they also concluded that the existence of large temperature differences due to the installation of a green roof could contribute to energy saving potential (Niachou et al., 2001).Worldwide, there are huge sustainable buildings that show a standard design that is used to assess the energy efficiency in buildings, such as BREEAM in the UK, LEED in the USA, and Passive House in Germany. The BREEAM means the Building Research Establishment Environmental Assessment Method for master planning projects, infrastructure, and buildings. BREEAM represents the measurement values of all categories in buildings from energy to ecology. The most certified buildings are in the UK and the other 50 countries around the world are made by BREEAM. The LEED means Leadership in Energy and Environmental Design evaluates the buildings, in terms of systems, design construction, operation, and maintenance of homes and neighborhoods which help the owners to have a performance and sustainable house s.d. In the picture below, some of the basic features of Passivhaus are shown (Niachou et al., 2001).

Figure 1: The basic features of a passive house. Source: : Passivehaus Institut



Generally speaking, the building construction phase implies the use of a significant number of natural resources as raw materials and often ends its useful period of life by generating large quantities of waste. Over the years, this process has culminated in the over-exploitation of environmental resources, global warming, damage to biotic and abiotic components, and the creation of higher environmental toxicity potentials (Thomas & Praveen, 2020). On the contrary, sustainable construction involves a systematic approach that considers climate, society, and local raw materials, as well as incorporating technologies that reduce resource use, ecological footprint, and associated life cycle cost (LCC). Besides, an essential aspect of sustainability is the adaptation of the building to climate change. Due to climate change and the UHI (Urban Heat Island), the cooling needs are expected to double by 2050 and far outweigh the decrease in heating needs, leading to an increase in total energy consumption and a reduction in energy efficiency, and an increased life cycle cost. According to Díaz-Lopez et al 2022, a sustainable design is closely related to the principles of the circular economy, an approach that promotes the responsible and cyclical use of resources (Moraga

⁵ Figure from Iberdrola (Source: Passivehaus Institut)

et al., 2019). Indeed, the circular economy seeks to maintain building components and resources at their highest intrinsic value for as long as possible. Thus, building components are kept in continuous use, reuse, repair, and recycling (Díaz-López et al., 2022). Bioclimatic architecture is about reducing waste and carbon footprint and preventing CO₂ emissions. Moreover, according to studies conducted by Gamero-Salinas et al, passive cooling design strategies in buildings significantly help reduce the overheating risk in the warm-humid tropical context as these passive cooling design strategies act as an effective adaptation measure for the present and the future. However, it is evident that providing indoor thermal comfort solely through bioclimatic architecture is a harder challenge in cities that register higher outdoor temperatures, and therefore air conditioning is required for many hours during the day (Gamero-Salinas et al., 2021). According to research conducted by M. Hu et al., who analyzed a total number of 42 studies on the effects of passive design on indoor thermal comfort and energy savings for residential buildings in hot and dry climates, the three most considered and efficient passive cooling strategies are the augmentation of the thermal property of the roof, exterior wall, exterior glazing and window, horizontal shading, and optimizing cross ventilation. It is demonstrated by Mahmud and Ismaeel (2019), that using high thermal resistance materials for roofs can reduce the energy consumption of about 73% and the cooling load by 31%. In the same way, Onyenokporo and Ochedi (2019) indicated that increasing the reflectivity of the exterior roof and walls by using low-emissivity paint, combined with external shading, could reduce the cooling load by 37.6% and the indoor temperature by 6.7%. As Hu et al explain, the external wall thermal property and thermal properties of windows are the most frequent strategy that is applied in hot and humid climate regions. Overall, all these strategies combined benefit a reduction in the cooling load by up to 64.5 % (Hu et al., 2023). To conclude, as Taleb states, passive cooling uses free, renewable sources of energy such as the sun and wind to provide cooling, ventilation, and lighting needs for a household. This additionally removes the need to use mechanical cooling. Applying passive cooling means reducing differences between outdoor and indoor temperatures, improving indoor air quality, and making the

building both a better and more comfortable environment to live or work in. It can also reduce levels of energy use such as greenhouse gas emissions (Taleb, 2014b).

3.METHOD AND THEORETICAL GUIDELINES

In parallel with the most traditional technical disciplines that covered the topic of passive cooling, there is a minority of research on thermal comfort in the field of social sciences and humanities. The aim of this paper is to investigate and resume the niche of studies related to green cooling, from a historical and sociological approach, going beyond the engineering or mechanical viewpoints. Therefore, deliberately I tried to include articles and interviews which maintain a social and historical focus for the understanding of cooling choices, in addition to the ones that keep a technological asset. Namely, the thesis is based on a wide variety of journals from social sciences like *Journal of Natural and Social Sciences*, *Journal of Energy Economics and Policy*, *Journal of Islamic Civilization*, *Journal of Architecture and Built Environment*, *Local Wisdom Scientific Online Journal*, *International Journal of Engineering & Technology*, therefore, my research has been multidisciplinary, but conducted by highlighting the sociological and historical aspects, “the purpose of the review is not to cover all articles ever published on the topic but rather to combine perspectives to create new theoretical models” (Snyder, 2019);(Mazzone & Koshla, 2021). Additionally, more focused research has been conducted on Islamic religion and Indigenous practices. Direct interviews represent fundamental sources that helped me to come to conclusions. The purpose of the research was to find thermal comfortable techniques in sustainable buildings from the traditional Ottoman, Mughal and Inonesian architecture. In addition, the influence of the traditional design for the constructure of contemporary buildings. Furthermore, the social (religious and gender) aspects in the cooling choices. For the geographical areas examined in the thesis, but not only, I think that including the religious and gender approach to the research could lead to more realistic and deep results, as still represent not-insignificant driving aspect.

4.CASE STUDIES

Berrak & Kapoor state that designing directions and guidelines to modern construction come from climate sensitivity and energy efficiency of classic building (2021). One of the aims of the analysis of the case studies is to comprehend the thermal perception, sustainability and energy efficiency techniques used in buildings whose tradition is inherited by ancestors. The case studies will comprehend India, Indonesia and Turkey, so at the beginning of each case study I will provide a little overview of traditional buildings features from countries historic cities: Jaipur, Jakarta, Ankara. The common thread is the influence of religion on architecture. Islamic religion is the link among the case studies analyzed and plays a role in passive cooling techniques found in its corresponding architecture. Therefore, it is important to understand the Muslim vision of the natural environment and its preservation.

“Allah is he who raised The Heavens without any pillars that ye can see... He has subjected the sun and the moon! Each one runs (its course) for a term appointed. He doth regulate all affairs, explaining the Signs in detail... And it is He who spread out The Earth, and set thereon Mountains standing firm, and (flowing) rivers: and fruit of every kind He made in pairs, two and two: He draweth the Night as a veil O’er the day. Behold, verily in these things, there are signs for those who consider”
(Qur’an 13: 2-4)(Surat Ar-Ra`d [13:2] - The Noble Qur’an - □□□□□□ □□□□□□, s.d.); (Surat Ar-Ra`d [13:4] - The Noble Qur’an - □□□□□□ □□□□□□, s.d.).

These lines from the Qur'an that explain the Muslim vision of the environment, which is central to the understanding of Islamic architecture, as both a concept and sensory reality (Al-Qemaqchi, 2018): Muslims should seek to protect and preserve their habitat. The Islamic attitude of duty towards the environment does not merely derive from the fact that God is its creator. There are other reasons as well. One is that humans act as the agents of God on earth. This agency is not blind and mechanical but is creative in its way and it must be fulfilled by operating according to God's instructions. Another reason why, in Islam, humans are expected to protect the environment is that no other creature can

perform this task. By this act of acceptance, humans accepted responsibility for the custody of the environment (Jusoff et al., 2023).

4.1 INDIA

Jaipur (26° latitude) has a hot and dry climate, where the temperature during the day is around 11 degrees. The desired time lag is high so that the daily temperature stays under a limit. That's why we can notice higher wall thickness, insulating materials, and few openings on the facade. Room distributions follow the time lag rules: the bedrooms are in most cases located in the east due to the warmer facades and the living areas are in the western part, always for temperature reasons. energy efficiency, making the building more comfortable to live in and less expensive to run (Berrak & Kapoor, 2021). The main construction materials comprehend brick, sandstone, marble, timber, plaster, and granite materials due to their thermal resistance properties and the fact that they are available locally. Especially timber is used for windows, as its thermal insulator qualities are proven. Heat-related issues are figured out thanks to wall thickness. Heat-related issues are figured out thanks to wall thickness. The courtyard is usually located at the core of the living areas in the traditional *Haveli*, that is because they create shadows close to the building. Another main feature of the Indian mansion is the typical flat roof, which reduces the area which is exposed to solar radiation (Berrak & Kapoor).

Figure 2 : Traditional Haveli house in Rajasthan, Eric Lafforgue/Art in All of Us / Contributor



4.1.1. COUNTRY PROFILE AND HISTORICAL BACKGROUND

India has a great history, reflected in its cities' artistic and architectural heritage. Before discussing the magnificent Mughal architecture style, I want to start the deep analysis with a short introduction to the Indian subcontinent during its last empire before British colonization. Indian territory had been, between 1600 and 1700, the home of a unique empire where the problematic coexistence of Muslims and Hinduists started to emerge. The majority of the Indian population was still Hinduist while, in the northern part of the country, in the XIII, a Muslim community began to flourish a Muslim community in the area of Delhi Sultanate. Such harmony is still partially to be found today, in India and Pakistan. Around 1526, such precarious balance failed because the Sultanate had been defeated and wiped out by the Turkish and Mongol Islamic army, led by Babur the conqueror who managed to invade northern India and became the founder of what would later become the Moghul empire until 1707. The word Moghul comes from Mongol. The empire expanded during the centuries and at the

beginning of the XVII century reached its maximum extension, with a territory that ranged from Kabul in the north to the southern region of modern India. The Mughal empire was based on a feudalist approach, with a large part of the lands assigned to the emperor's vassals and local princes subjected and aggregated to the structure of the empire. Said feudal lords had military origins, but differently from Europeans, they could not transmit their powers and possessions to their descendants (Ferretti, 2022). The Moghul empire managed to thrive thanks to the maintenance of some traditional habits that already existed in the area, such as the taxation system or the balance of the villages which were partially autonomous and at the same time controlled by the central government by a capillary network that enabled functionaries to check the administration and the cleanliness of villages. The economy was the real jewel in the crown, one of the richest globally. Even if, with many inequalities. Thanks to commercial vitality, merchants developed a highly efficient system that enhanced manufacturing and at the same time mediated to meet the needs of the market. Merchants were financing workmanship, making it efficient despite the more backward processing techniques compared to Europeans. Thanks to their flexibility and their willingness to move, their products were far more easily created and disposed of worldwide. The cutting-edge trade was the textile industry, which remained the best in terms of quantity and quality during the decades, till the industrial revolution. Such economic vitality was reflected in the arts and architecture. Several buildings were constructed in that era, but it was in 1632 when Shah Jahan commissioned the construction of the Taj Mahal in Agra for the loss of his wife and to create something that showed through time the real power of the Empire. On the other side of the coin, difficulties emerged in the religious differences and views of life between Muslims and Hinduists starting from the caste system of Hindus to the monotheism of Islam. Such discrepancies have been experienced in many ways because emperors tried to find compromises by introducing religious tolerance measures. From this point of view, the most crucial emperor has been Akbar, who ruled between 1556 and 1605. He was the one who managed to engage the Hindu aristocracy in politics, making them feel proud to be part of the empire, reducing both the ranks of the opponents and trends towards autonomy that from time to time emerged

in the Hindu community. He decided to remove the taxes imposed on non-Muslim servants as a sign of tolerance, peace, and acceptance. However, such a measure was an exception because its successors were for iron-first politics, which led to extremism.(Ibid.) One of these was Aurangzeb who governed between 1658 to 1707, the end of the Empire. Aurangzeb decided to persecute Hinduists which led Hindu leaders (Maratha Sultanate) to declare themselves autonomous from the empire. With the advent of Islamic rulers in the early thirteenth century, Indian culture rigidified, political life gave way to despotism, and the gap between foreign ‘Muslim’ rulers and a native ‘Hindu’ populace of necessity made for a fragile structure (Metcalf & Metcalf, 2006).These occurrences led to the central power’s final crisis and marked the Mughal Empire’s end. The vestiges of the old gold empire remain until 1765 when the last Moghul entitled the East India Company to tax exemption. From then, the Indian empire made room for British colonization. Mughal Architecture is a building style that was developed by Mughal emperors, first set up by Babur and then developed under the reign of Akbar from the period of 1526, up until 1707 (Kapoor, 2022). It was the first building style to make extensive use of indigenous motifs along with standard Islamic forms (Mohamed Nasr, s.d.), and the monuments were primarily made up of red sandstone and a hint of white marble (Kapoor, 2022). With the arrival of Muslims in India, from the twelfth century AD onwards, the merger of local and immigrated architectural techniques resulted in an astounding style (Ali, 2012). Despite being an amazing fusion of Hindu and Muslim craftsmanship, buildings represented an expression of Islam that was established and revealed in the territory. Known for its strategic symmetrical design and harmony, Mughal architecture adopts intrinsic dome structures of Islamic architecture inspiration and uses natural forms such as greenery and water to represent the symbolism of nature present in the Qur’an (Zarghami et al., 2015). Religious pluralism has constituted, for centuries, the ethic of India, the major-Hindu country that shares the territory with Muslims, Christians, Sikhs, Buddhists, Jains and other groups minorities as well. Ground-breaking research conducted by the Pew Research Center, indicates that India’s religious composition has maintained quite immovable since the 1947 division of the Indian subcontinent that divided the region into Hindu-majority India and Muslim-

majority Pakistan and Bangladesh: 79.8% of Indians is Hindus. 14.2% is Muslim and the remaining 6% includes Christians, Sikhs, Buddhists and Jains (*The Religious Composition of India | Pew Research Center*, s.d.). The (Kramer, s.d.) research found out that in the 1951–2011-time frame, the Indian population growth has risen three times that previous times, but it have slowed since the 1990s and it is the Muslim community that experiences the most elevated number of fertility rate, which in India is strictly linked to the education level of women (Kramer, s.d.). Before discussing green building techniques, having an idea of the climate of Northern India would be relevant. India is home to an extraordinary variety of climatic regions, ranging from tropical in the south, to temperate and alpine in the Himalayan north, where elevated regions receive sustained winter snowfall and the nation's climate is strongly influenced by the Himalayas and the Thar Desert, The area ruled by the Mughals is located in the north and it is defined by hot and dry conditions two third of the year, a somewhat cold and warm humid season occurs in the remaining one-third of the year (Ali, 2012). Moreover, this region experiences clear seasonal changes in solar radiations and wind directions and humidity reaches up to 95% during the wet period. There is little or no rain during the dry season. Hot and dusty winds blow during the dry season. Monsoon winds are strong and steady and hot and dry seasons have remained a problematic situation in this region throughout the centuries (Attri & Tyagi, 2010). Babur complained bitterly about the climate, waters, and culture of Hindustan immediately after the conquest in 1526 CE. To counter these deficiencies, he ordered the construction of waterworks, gardens, and baths (Wescoat, 2014).

4.1.2 INFLUENCE OF RELIGION ON ARCHITECTURE

Given that sustainability is one of the most dominant elements in Islamic Architecture, then Indian Islamic cities comprised several features, practices, and techniques that were positively integrated with the natural environment and were ecologically favorable(*Medieval (Islamic) Cities in India (1206–1764): An Environmental Review and its Contemporary Relevance - Anjali Sharma, Manoj*

Kumar, M. P. Singh, H. K. Mazhari, 2019, s.d.). Delhi, during the Mughal Empire, was the epicenter of the entire phase of Islamic urbanization in India. Islam favored the development of cities right from its inception, giving rise to a new form of urbanism in India. The cities comprised exquisitely designed buildings such as mosques, palaces, mausoleums, hammams (Turkish baths), bazaars (markets), and saris (rest-houses) built at a monumental scale, safeguarded by impressive fortifications. (*Medieval (Islamic) Cities in India (1206–1764): An Environmental Review and its Contemporary Relevance - Anjali Sharma, Manoj Kumar, M. P. Singh, H. K. Mazhari, 2019, s.d.*). Some of the key features include the use of local materials, natural ventilation, natural lighting, water, and building underground. The use of local materials not only was important for its social sustainability aspects, because of its benefits to both the architecture and the people, as it increased as it improved local business income and quality of life, but also the materials were crucial for protecting the building and people from the external, harsh conditions (Kapoor, 2022): because of its properties, clay was known to be an optimum and popular building material. Clay bricks as building materials are acoustic protection, dimensional exactness, sturdiness, energy effectiveness, fire protection, strength, and natural cordial. According to Hebert P and Chaney (2011), clay is a solid breathing construction material that improves the air around it. Henceforth, clay building structures store heat in the colder time of year and coolness in the late spring. Considering that planning and working with clay building items will contribute significantly to energy reserve funds and working with it is harmless to the ecosystem (Muntari & Windapo, 2021). Other very important features of Islamic sustainable vernacular Architecture include natural ventilation, as the airspeed increases the rate of heat transfer from the body to the environment, it also helps to get rid of moisture and cool the building. We find its implementation through the malqaf, which is the most important appliance to catch and enter the wind into a house (Sirryeh, 2021). It is one of the distinctive elements in Islamic buildings, especially in hot areas. It is defined as entrances that ventilate the building in the presence of air exits. It is a wooden roof above the building in a sloped way with an entirely open side facing the direction of the desired wind and directed to the inside of the house to temper the atmosphere of the hall (Albasyoni,

2020). Another ingredient of sustainable construction is the underground building, which was done to minimize the effect of the outdoor climate on the inside of buildings. Light in Islamic thinking is very sacred and respected because it is considered a manifestation of God's existence and is based on the preference for mystical aspects over physical aspects of light use in buildings, it is the cornerstone of Islamic aesthetic architecture, and it is referred to as the main purpose of movement from the darkness. Light and architecture are interrelated themes (Mishra & Jha, 2021): The mashrabiya is one of its most traditional architectural representations, which also reflects the environmental conditions. Wooden screens with casement or double-hung windows provide shade from the summer sun while permitting the flow of cool air from the road (Ashour, 2018). As Muslims consider natural elements as a sign of the Supreme Being, also mystics and poets have pointed out the holiness of water, and traditional architects have tried to enrich Islamic buildings by considering these implications. For example, water was mostly shaped in the middle of the palaces and gardens (Zarghami et al., 2015) which in turn are considered as an ultimate and eternal abode of a person who lives his life on a righteous path, hence associated with the idea of paradise ((PDF) *Mughal Gardens in India: Symbolic or Climate Responsive*, s.d.). The importance of nature presented in the Qur'an led Islamic architecture to be very sustainable and ecological, theoretically poorly affecting the environment. To introduce the Indian case study, I would like to see which elements from traditional Islamic architecture we can find in Islamic-Mughal architecture, its sustainability aspects and passive cooling techniques of cities.

4.1.3 SUSTAINABILITY AND COOLING STRATEGIES IN TRADITIONAL ARCHITECTURE

The Mughal architecture not only was very peculiar, but it was also ecological as it took on the Islamic, in a cultural and spiritual sense, some practices of Muslim sovereignty. Such influences can be seen in the Mughal conception of green spaces, like gardens, that are the symbols of paradise as a couplet written by famous poet Amir Khusru is inscribed at the black pavilion at Shalimar Bagh, Kashmir, 'Gar Firdaus bar rōy-e zamin ast, hamin ast-o hamin ast-o hamin ast' which means 'If there

is a paradise on earth, it is here, it is here, it is here'. The image of the King as a God among Mughals demanded a symbolic divine throne. Even after the death of the emperor, the tombs were necessitated to be constructed with a garden as a symbol of paradise ((PDF) *Mughal Gardens in India: Symbolic or Climate Responsive*, s.d.). Gardens were useful to improve the quality of the immediate surrounding environment of their buildings thanks to the addition of vegetation, which enhanced cooling by evapotranspiration. To enhance the process of evaporation, fountains were used which mixed the moisture into the air and increased the humidity (Ali, 2012). Another important aspect in the construction of most of the buildings in the Mughal era was principally the use of red sandstone, which is found in large quantities in the Agra district and neighboring areas including Rajasthan, a local and easily available material (Joshi, 2018). Concerning natural lighting, Jaali is used frequently in Mughal architecture and is a prominent element in places like Rajasthan, they are a key feature of the design as in every fort: when there is sunshine outside in the day, the internal spaces are not visible from outside; however, the diffused light is spread throughout the interiors (Ali, 2012), allows visual connectivity from the inside to the outside surroundings (Verma, 2021). It guarantees privacy as well. Aesthetics and ornamentation played a role from ancient times in all forms of construction: from ancient times, the design of water storage in Indian temple architecture is significant, stepwells were beautifully ornamented for their time and offered space for the local artistic talents to express themselves. Additionally, its technology relies on green building materials and sustainable construction with concept cognizance as the driving force (Selvaraj et al., 2022). Other features of comfort adopted by the Mughals are the courtyard or "sahan", sunshades, and verandas which protect the indoor spaces from heat and solar radiation, often combined with vegetation, and water bodies, and usually open to the sky to enhance evaporative cooling, provision of shade and infuse maximum daylight in the buildings (Gupta, 2017). Last but not least, thermal comfort is the geometry of a construction, helpful in reducing energy consumption. The Red Fort roof is an example of very common Islamic architecture, the domed roof structure, which is recognized as being more efficient (Ibid.). It is becoming day by day necessary to recognize and include in our daily lives passive cooling

technologies that have been used for centuries in vernacular architecture, as the serious harm and consequences of the abuse of electric air-conditioning are in front of us. The vernacular term refers to the construction done by the local people using traditional technologies, using locally available materials in accordance with the environmental context (Gupta, 2017). Meanwhile, passive cooling techniques use ambient cooling sinks like building material, air, water, night sky, etc. to mitigate the rise in temperature of the building due to heat sources such as ambient air, direct solar heat gain, and building an internal heat gain. Also, can help in maintaining the required comfort conditions of the building with minimum energy consumption (Bhamare et al., 2019). Some of the “modern” approaches towards low-energy architecture can already be found in medieval Indian architecture such as the concept of evaporative cooling and landscaping, which can be seen for example in the Amber Fort, Rajasthan, India. The idea of surrounding water or gardens can be seen in Red Fort, New Delhi where the entire building has been surrounded by a water body, which helps in the creation of a microclimate, done in order to reduce the surrounding temperatures using landscaping (Gupta, 2017). In Mughal times, horizontal shading devices were another way to keep buildings and their interiors cool by the reduction of heat gains. As we can see in Amber Fort, India to certify the visibility and block the air outside, small windows (less than 100 mm in diameter) were created near the floor and the top levels, to let the cool air in from the bottom opening and let the hot air out from the top opening. Another crucial feature was Jali windows, the artistically sculpted details of the Amber Fort built by Raja Man Singh I near Jaipur at the end of the 16th century (Bokor et al., 2013), used to reduce the indoor temperature but at the same time have gained vast popularity as impressive frontal decorative elements. Hawa Mahal or the Palace of Breeze is an outstanding example of a passive cooling structure in the hot-dry region of Rajasthan. With 953 windows, it acts like a lattice screen, and due to the presence of a water duct, the hot air converts into a cooler one. The geometry enhances the wind movement in the structure. The abundance of windows and their variations is also very contrasting, but the cooling effect happens when wind passes from these geometric patterns and comes in contact with water (Verma, 2021).The last example I give is the Chand Baori, a deep four-

sided wall with a large temple. Its extension makes it the biggest one in India. The main purpose of the board was to collect water, nevertheless, it acts as a passive cooling entity. It is an open-to-sky structure with a stone enclosure on four sides and a down-water collecting pit at the end. The wide walls used in construction help in thermal insulation and the vaulted roofs restrict the warm air to come inside the structure. The stored water by the process of evaporation and condensation changes its state according to the climate and weather conditions giving rise to evaporative cooling and more comfortable temperatures. Finally, gardens, developed by Bahar constituted an important element, not only from a religious and aesthetic point of view but also in terms of cooling. In Moghul times they were usually constituted by a series of terraces of sloping ground, inspired by Persian and Turkish architecture, which were viewed in gardens as the religious concept of paradise. Like paradise, the garden was divided into eight parts, however in some places, the garden was divided into seven, representing the planets (P. B. Bhagwat, the Gardens of India, chapter 4 pg.59)(*Bhagwat, the Gardens of India - Google Search*, s.d.). In these pleasant gardens, that helped to keep cool, it was normal to find a fountain, a great spiritual element, and a green cooling tool. Wind catchers are another tool to keep buildings fresh that come from the Arab world but despite the huge architectural creativity, there are only a few examples that could be mentioned. “However, the earliest form of wind catcher could be traced in the form of wind houses/palaces in Jaipur and Jaisalmer in the northwest of India. Wind houses/palaces are magnificent enclosures, which constitute the integral space of royal palaces and havelis (big/merchant houses). These enclosures were designed as a family place, particularly for women. The purpose of these structures was to allow royal women to relax in the evening hours in airy spaces enclosed by finely perforated walls and projected windows. The finest examples of such air rooms are Hawa Mahal, Jaipur and Badal Vilas (Tazia Tower), and Jaisalmer, and most of these marvels were designed and crafted by the ‘Silawats’ (stone carvers) of Rajasthan” (Chohan & Awad, 2022).

4.1.4 IMPLICATIONS OF TODAY'S PRACTICES AND CONTEMPORANEOUS CHOICES

Krusha Bhawan, Studio Lotus, Bhubaneswar

The present project caught particularly my interest: it is presented as a learning center, library, auditorium, training rooms, garden, and a public plaza. In addition, on the upper floors, there are offices, while the rooftop is an open and public realization and demonstration of urban farming the offices have been moved to the upper floors. The rooftop too has been opened up to the public as a demonstration of urban farming. The space was initially built as a Governmental department, intended only for official uses. But then, thanks to Studio Lotus there have been inserted public spaces, to be shared as the social infrastructure of the city. The basement has been thought of as a free-glowing stilted connection area that serves as pedestrian circulation. Krusha Bhawan has been designed as a building cooled passively, with a night-purging ventilation system and a high thermal mass. The facade is made up of a brick-louvered screen that functions as a solar shading tool and expresses itself in the pattern of local ornamental features and colors, that are representative of the geographical heterogeneity of the region. Again the design team works in contact with local craftsmen, proposing an alternative way to integrate artisanal work into the modern environment. The palette of materials comprehends a bricks blend and local stones, that have been shaped according to local customs in an out-of-the-ordinary way, also because of the magnitude of the project. From a political perspective, it emerges as an example of how institutions have a primary role in sponsoring regional artisans, art, and crafts. Krusha Bhawan creates a strong identity “imbues a beautiful regional narrative of local craftsmanship through handcrafted furniture, stone carvings bred from agricultural folklores, and screens and installations in metal depicting local mythologies”(ArchiDiaries, 2021). Ambrish Arora, from Studio Lotus, states that “The government probably owns the best properties in the city, that are the greenest parts of the city and the regular citizens have no access to engage with that urban plaza

so that we used it as a basis to lift all the offices in the upper part and open up the ground plane and allow access and engagement at the ground level so that it becomes a small lung for the city”(*Krushī Bhawan by Studio Lotus | 2020-03-03 | Architectural Record*, s.d.). Over the last several years, worries regarding the little amount or the loss of green areas in Indian urban areas have emerged due to the decline in the quality of the environmental side of Indian cities. Even if previous studies have underestimated the importance of natural elements in cities, recently there have been promoted national initiatives for the protection of ecosystems (Turaga et al., 2020). Moreover, the complex enhances the interaction and collaboration of every kind of citizen, starting from the farmer to the politician. The innovative building celebrates diversity, culture, and tradition and it is on the look for neighborhood inclusion in a green and sustainable way, which countries like India need. The clear-cut identity of the complex comes can be attributed to the fact that it is built with local materials and follows the vernacular path, finally realized in harmony with the environment and climate. It is a very delicate and precise work, done by more than 100 highly skilled artists that have come together to work for creating a vibrant and modern energetic narrative of regional traditional craft that reproduce agricultural folklore and mythological stories, imagined and created on an unprecedented architectural scale for the first time. Specifically, the indigenous techniques used to create light comfort are called the tribal craft of *dhokra* (cast metal craft). The sense of enclosure of Central Court is provided by khondalite lattices carved by hands. Diversities in craft techniques are shown throughout the building spaces through agricultural motifs. In the Central Court, a regional crop calendar has been ideated and realized on a stone inlay floor, from which you can learn all the harvesting cycles for the most widespread crops in regional lands. The elevated grounds of the Krushī Bhawan call attention to a distinguishing brick façade inspired by Ikat decorations of traditional handlooms. The facade, which basically acts as a second skin for the building, is realized using three different shades of clay, that stand for the geographical diversification of the area. Traditional green design strategies help to keep the sustainability parameters of the construction. The courtyard design, with the inclusion of a stilt level, makes the air circulation optimal in the construction whereas the

lower heat gain is reached both by the low window-to-wall ratio and deeply recessed windows or balconies. Self-shading and direct glare are enabled by the staggered masses in the Cental court, along the building profile. Moreover, the carbon footprint of the construction process has been maintained low, thanks to the use of local materials. The daylight into the internal spaces is granted by the facade. In addition to this design of the facade, a double-skin strategy has been put in place in the Krushi Bhawan. The double-skin mechanism consists of DGU on outdoor fenestration, and louvers that play as a shading tool, able to reduce up to 40% of the heat gain, through the regulation of the sunlight. The city of Bhubaneswar, where the complex is located, sees significant night shifts in terms of temperatures. So, this aspect has been taken into consideration, so the architects realized a devised system for cooling and ventilation. This passive system works from the northern facade, when temperatures drop at night, the cool air is pushed inside, by a green personalized damper system: when the temperatures rise so much, the ‘coolth’ is trapped by the high thermal mass of the complex which turns into a ‘coolth’ exchanger with the external and environmental air during the day. This technique leads to thermal comfort and eliminates the need for users to turn on the air-conditioning, which currently is used just for 20% of the space. Other green strategies that make Krushi Bhawan a sustainable building include the presence of solar panels on the rooftop, on-site rainwater harvesting and wastewater method, and also an “anaerobic bio-digestive solid waste management system” that produces compost and fertigation water for the natural environment. It oversteps the common typology of campus or office closed to the public, as it integrates governmental functions with social engagement and education. Moreover, it enhances interaction and collaboration among people, thanks to the conscientious organization and planification of the space. Beyond sustainability, what the building is seeking is to promote a design and building construction to be a prototype that recognizes and honor culture, offer a green free and inclusive area for the neighborhood. Finally, it wants to be an example of how the governmental institutions may become the first supporter of regional artisans and crafts. Created for the people, built by the people. It is the expression of cultural identity (*Krushu Bhawan / Studio Lotus, s.d.*).

Figure 3: Krushi Bhawan. Source: ArchiDiaries, 2021



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At this point, I made some research to understand our counterpart in Europe. How does our sustainable building look like? What could we learn from the others? Starting from the most sustainable non-residential building in Europe, and one of the greenest worldwide, the Edge is located on the Amsterdam Zuidas, uses photovoltaic and LED technologies to measure and reach efficiency in terms of energy, indeed it uses less than 30% of electricity, compared to other office buildings of the same size(*10 of the Most Sustainable Buildings in Europe*, s.d.). It is an almost entirely built-in glass building, that helps the natural lightning. It is a workplace organized in 15 floors, with an extension of 40,000 square meters and has received various green certifications. The roof and facade

⁶ Photo via (ArchiDiaries, 2021)

on the southern part are provided with photovoltaic panels in addition, the complex can rely on an aquifer thermal energy storage system, which totally provides the energy needed for thermal comfort in every period of the year, lighting, humidity, and finally for AI (Bruno et al., 2021). Another sustainable landmark in Europe is One Angel Square, 328,000 sq ft of the best quality office area, ideated to grant the maximum possible flexibility. The mechanical and electrical systems allow users to manage accommodation, needs, and any division of spaces. Innovative engineering characteristics encompass a double-skinned facade that can minimize temperature extremes all year long. The structure is provided as well underground tubes that give unconfined heating and cooling for the entering fresh air. The ceilings of the office floors are in concrete, which has the property to act as a thermal sponge, reducing the energy needs of the building. The misused air is finally detached over the balcony edge using the natural stack effect. Before being expelled, the air crosses through a recycling heat exchanger that recycles the warm air coming from the lower offices. In the building, it is also integrated a recycling system useful to grant no water waste. Rape seeds by British Co-operative farms are used to generate fuel for the building's power plant and also to achieve sustainability principles, in fact, what is left from the cultivation will be used again as feed for animals. Energy in excess can be given back and used to cool the structure. The designers of One Angel Square have looked forward to the problem of global warming and predictions regarding weather data for 2050, and it can deal with a potential 3-5 degree rise in summer temperature and 30% more precipitations in winter. The structure of the building and environmental systems has been thought to become more efficient as long as average annual temperatures increment. Finally, have developed an app that is able to control in real time your position and location availability, as well as the building performance (*1 Angel Square / 3D Reid | ArchDaily*, s.d.). My analysis is not comprehensive of all the sustainable buildings in Europe and India, but, from my research, I have noticed a few things. The first one is the fact that the majority of sustainable buildings in Europe are offices. Just a few of them, which are museums, are open to the public. The majority of them are not multi-functional like Krushi Bhawan, where you can find the learning area, public space, and the zone

dedicated to work. Moreover, I see many natural elements on the Indian side, but the most sustainable ones in northern Europe are built with sophisticated and refined artificial materials, as opposed to Khrushi Bhawan, which is constructed with local natural materials. Henceforth, to be a place, it should enhance interaction between people, but I see that in cases like One Angel Square, everything is controlled by technologies and apps. And finally, the most important aspect in my point of view is that there is a lack of national cultural elements in the modern Europeans constructions, that make you feel rooted to the place where you are. Everything is so modern, and aseptic that you could be anywhere in the world. I think that we should consider the cultural and artistic heritage of each country as well while building the most sustainable structures, and try to integrate it to the design, as it is a key point for our identity and sense of belonging.

4.2 INDONESIA

Jakarta, has a latitude of 0° . Here the thermal shock between the day and night is around 5°C . Thanks to its higher altitude angle, traditional buildings can be constructed with steep slopes. Due to the lower time lag, in this case, heat can be dissipated with no interruption, achieved using permeable material. The purpose of the decorations is to create permeable wooden building fronts. The shape of the roofs (with long eaves) allows protection from rain and sun, which doesn't directly affect the fronts. The buildings orientation in Jakarta is influenced by culture and religion which have an east-west orientation. The entrance and veranda look south, and the roof of the living spaces play an important role. The core of the building is also the center of action, where in some places the columns join the walls, with openings equally allocated in all the areas. To counter possible flooding, the building is placed on raised ground. Different slopes, with the highest at the top, shape the roof which performs as a collector and disposer of hot air as well as intensifying the rainwater and being the splitting point of the core area (Berrak & Kapoor, 2021). Moreover, thanks to the length of the eaves of the roof, it is easy to dump the rain and daylight. The air circulation inside is obtained by the material used for the facades, which is semi-permeable. Air circulation is essential for this climate, and it can be

obtained by the use of winds. “Joglo” is the name given to the traditional roof style of Indonesian traditional buildings. This roof solves many climatic problems of the area: first of all, it has the power to drive out the hot air and enhance air circulation. Further, thanks to its breathability, it can transfer the collected hot air to the outside. Horizontal air flows exist by virtue of the mutual diagonal openings on the building front which is also built using semi-permeable materials that make certain that the maximum level of air comes in (Ibid.). Berrak and Kapoor explain that the shape of the building envelope, which has the task of protecting the interior environment from less desirable exterior conditions (McKeen & Fung, 2014), represents an important component for the heat exchange from the environment. It is in the external part of the building when thermal transfers happen, so the more surface area the more the thermal transfer rises. The amount of the surface area from where heat exchange will take place is determined by the shape ratio⁷ of the structure. As a measurement of a building’s footprint, it permits comparisons between different designs and forms. It is obvious that the quantity of the surface of the building exposed to solar radiation may be dependent on the shape ratio. Designs that require more surface area will thus have a greater quantity of heat transfer. The effect of the shape ratio on the exterior surface area will have a larger impact on smaller building footprints. The minimum surface area is achieved with a 1:1 aspect ratio. However, in the presence of solar radiation, the ideal shape ratio becomes a balance of heat loss and gain (Berrak & Kapoor, 2021; McKeen & Fung, 2014).

⁷ The shape ratio of a building is a measure of the building’s compactness and expresses the ratio between the building’s thermal envelope area and its volume (Danielski et al., 2012)

4.2.1 COUNTRY PROFILE AND HISTORICAL BACKGROUND

Indonesia is a gigantic tropical archipelago, brimming with volcanoes, rainforest, and marvelous creatures. A land of typhoons and monsoons and over 17,000 islands and islets, of which Java, Sumatra, Sulawesi, and Bali are the most known and populated. Indonesia shares Borneo, New Guinea, and Timor with other states (Shaikhang, 2022); (“73 Indonesian Culture Facts to Prove How Vibrant the Country Is,” 2023). As the researcher Tim Hannagan explains, this gargantuan assortment of equatorial isles was never unified into a single sovereign state until recently. Before that, its variegated segments were as separated as its hundreds of different languages. Before the arrival of Malaysians, many millennia ago, Indonesia was a fossilized conundrum. Melanesians hunted and hand-printed their routes in the jungle. Nowadays, their descendants are located in the east side of the nation, but the country faces the presence of ethnic majorities and minorities all around. Majorities like the Austronesian, who came sailing from Taiwan, firstly landed in Sulawesi, and then around the time the Egyptians were assembling the great pyramid disembarked on Java, Sumatra, Borneo, and Timor bringing rice and pigs, and pottery through original animists who worshiped their ancestors (Hannagan, 2015). Indonesian culture and spirituality were taken from India, including religions like Hinduism and Buddhism, indeed one of the very first kingdoms of Indonesia were Hindu. The Srivijaya kingdom on Sumatra rose in the 7th century, noticeably wealthy and powerful thanks to commerce, and naval routes tied India to China. A large number of highly skilled Srivijaya artists captivated invaders, like Rajindra Chola. In the meanwhile, on Java, we face the presence of the ascent of the Madang Kingdom, the cryptic Seylendra dynasty ordered the construction of the extraordinary Borobudur, the world's biggest Buddhist temple. Such monument construction was successively followed, in the 9th century, by the Hindu Sanjaya dynasty, who built the *Prambanan*, the biggest Hindu temple. Some more were built by Javanese as they were fascinated by such architectural oddity, but then they faced the eruption of the Merapi volcano in the early 900s, and building works were stopped. In the late 1200s, in the eastern part of Java, the power was in the hands of the Mongol emperor of China, who sent emissaries to the

territory to ask for a tribute, which never came. So that outraged the emperor who ordered the massive invasion. Raden Vijaya initially allied with the invaders, Mongols, to defeat his rival for the conquest of the throne. But after that, they turned against the Mongols, who were quite unbeatable, and some inconvenience came out, also due to the thick hot weather of Java. After two months of the fight, Mongols retreated and *Vaijaya* established the *Majapahit* empire, known for being a majestic and maritime mercantile power, it was compared to Venice. The empire reached its sublimity under the reign of King Hayam and his highly skilled prime minister Gaja Madha. At that time the Hindu faith was the main religion of the country, but with the arrival of Muslim merchants, the situation consistently changed because by the 1500s there were Sultanates and today Islam is the main religion of Indonesia. Such a rich country caught the interest of Europeans, especially the Portuguese who were the first to settle the islands and try to enter the trade but their ambition to acquire the monopoly of commerce suffered a setback with the entrance of the Dutch who by the early 1600s were already muscling the Portuguese out of ports and forts. Though, they couldn't expel them from eastern Timor (Hannagan, 2015). Bantam, in western Java, was the first permanent Dutch settlement, which of course meant business. As we can see from the conquest, by John Piteshon the merciless, of Bandar Island, the sultan of central Java Agung of Mataram fully conquered the surrounding regions to turn his interest to the Dutch and tried to assault them twice, but without success. The Dutch and Portuguese joined together and invited workers from China to Batavia. Issues started to emerge, and the situation became uneasy in 1740 because Chinese sugar mill workers started a revolution and killed fifty soldiers of the Dutch army. Chinese homes started to be burned because of gossip that circulated among different multi-ethnic communities. So that it ended up as a massacre in which ten thousand Chinese were mutilated in front of Governor Adrian Falconer, who in the end was arrested and died in prison. Now, since the Dutch East India Company has been rooted in the area the high maintenance costs, administration, and risk of rebellion lessen a large part of resources. Henceforth, began to be felt antagonism and corruption from other powers like the British in India and meant bankruptcy for the Dutch

government, giving room to French and British command for a while. When the Dutch gained control again crushed an insurrection conducted by Prince de Bonacorso and the governor Johannes Fondon institutionalized a system based on forced labor to boost revenue. There were conflicts in Bali, in Borneo, and in the Achaea region of Sumatra that encouraged the Chinese to proclaim jihad against the invaders but to no advantage. The Dutch East Indies expanded more and “as if to vent the region's frustrations” Krakatoa exploded in one of history's biggest and loudest volcanic eruptions. Unfortunately, nothing could stop the ascent of the Dutch who continued to invade land until 1920 taking from northwest New Guinea, thus reaching a new great extent. Hollanders started to implement reforms and “modernity”, sharing their education with the indigenous people (Hannagan, 2015). Indeed, Dutch colonization of Indonesia lasted for practically 350 years, from 1596 to 1945, the period in which Indonesia was called the Dutch East Indies where were experienced a large number of exploitative practices (Manurung & Rezasyah, 2021). But Indonesians never stopped fighting for freedom and activists began promoting their ideas to the people. Whilst forming political parties ranging from communist to Islamic, still it was clear that something very big would be needed to drive the Dutch out of the country (Hannagan, 2021). Then World War two happened, and the Japanese invaded, in 1942, Indonesia which quickly took control of the country even though Indonesians welcomed them as bearers of freedom, suddenly was clear that Japan simply saw Indonesia as a rich place to get stuff from and supplies their feed their army. Millions of Indonesians found themselves subjugated to work many of them died. Even if the Japanese gave chance, for a while, the independence movement the boost they needed, it was after the Japanese surrender (in 1945) that Indonesia declared its sovereignty, with socialist Sukharino as the first president of the state. Between August 1945 and December 1949, the Netherlands displaced around 220,000 military units for the decolonization war in Indonesia. Both throughout and after the conflict, the Dutch government has refused to admit that its army played a part in war crimes, besides little offences considered as ‘exceptional’ (Oostindie et al., 2018). In 1949 finally, Indonesia was free from the Netherlands, which agreed to abandon the state.

Despite this, Indonesia faced a crisis of mixed ambitions ranging from secularism on one side to pushing for an Islamic state. Sukarno worked hard to inspire a sense of unity during a period of economic instability. The issues were rising also because of his closeness to communism ideology and the army in 1965 undertook a vicious purge of communists slaughtering over half a million and then Sukarno himself was ousted. In 1967, General Suharto assumed power as a military dictator (Hannagan,2015). General Suharto was anti-communist, for this reason, the West supported him during the cold war which led to an improvement, through corruption, in the economy of the state. Portugal renounced its colony of East Timor in 1975, so Indonesia invaded the land but had to deal with the uneasiness of East Timorese. Besides being accused of multiple rights abuses, Indonesia still could count on the political support of the United States and countries like the United Kingdom, Japan, and Australia. The 1991 Santa Cruz massacre shocked the world, and when in 1997 Asia faced a financial crisis Suharto lost his legitimacy and resigned, and East Timor gained independence. In 2002, cruel bombings organized by Islamists killed 202 people, mostly tourists in Bali subsequently hit by an earthquake and tsunami leaving over a hundred thousand people dead in the years after. Indonesia enjoyed steady financial growth and today has achieved a high level of human development and is the world's 16th biggest economy, a fascinating country (Ibid.). Today, Indonesia represents the fourth largest country in the world in terms of population, which is projected to increase by 2045, reaching 320 million. The country's fertility rate shifted from 5.6 during the half of the 1960s to 2.7 in the mid-1990s and the majority of the population is Muslim. Moreover, it is a well-known country of origin of labor migrants. Furthermore, thanks to its strategic location it represents an appealing destiny for asylum seekers. The population is distributed mainly on Java's Island, believed to be the most densely populated area of the world, followed by Sumatra and Banjarmasin. The archipelago is home to the highest number of volcanoes compared to other places on Earth, counting 76 historically active ones («Indonesia», 2023). The climate is shaped by uniformly warm water that makes up 81% of Indonesia's area ensures that temperatures on land are about 28°C on average in the coastal

area, 26°C in the inland area, and about 23°C for the higher mountain area. Indonesia has less temperature variability from season to season (BMKG, s.d.) (BMKG,2019). It is a tropical country, located between latitude 8° to the north and 13° to the south. It is part of Southeast Asia and passed by the equator line. Indonesia broadly has two seasons, i.e.: The dry season from April until October, and the rainy season occurs from November until March. The average daily temperature in Indonesia varies according to the region's topography, but roughly 30°C throughout the year. In particular areas, the temperature can reach 36°C in the dry season e.g. For Two provincial capitals in Java Island, Semarang (the capital of central Java province) has a temperature between 23 33°C and humidity between 30% - 95%, and Surabaya (the capital of East Java province) has a temperature between 24 35°C and humidity between 40% - 98%. The humidity in Indonesia varies between 30% - 98%. The rainfall on average reaches 700 mm/year. The highest rainfall in Indonesia is found in Central Java, Baturaden. In this area, the rainfall reached 7.069 mm/year. The minimal rainfall is in Palu Central Sulawesi, which is the most arid region with rainfall of about 547 mm/year. Air movement the air movement in Indonesia is under the influence of the Asia and Australian continents, and the Pacific and Hindi oceans. In the dry season (April - October), the hot wind blows from Asia to Australia. Vice versa, the wind that blows in November and March carries water vapor and causes the rainy season in Indonesia. The air movement varies in every region. Basically, the position of the sun is always above all areas over the years, with sun radiation intensity of about 11.5 hours per day. To create comfort in buildings in Indonesia, the humidity in the office should be approximately 50% with a wind speed of 0.1 m / s (Widjaja & Setiawan, 2018).

4.2.2 INFLUENCE OF RELIGION ON ARCHITECTURE

The origin and spread of Islam in Indonesia are not certain. Indeed, there are many theories hypnotized by scholars: One of them supposed that Islam was brought by Indian people, the second one assumed it came from Arabs, the third one from Persia, and the last one thought that Islam came from China. What is known is that Islam in Indonesia is very peculiar, and it is the only one in its

genre. It is unique because Indonesia is composed of people and cultures from the most diverse backgrounds. And the way it is unique is due to the fact that not only it has accepted the background, but also it adopted some native customs and beliefs, making it different from other kinds of Islam (especially from the Middle East)(*Why the Ottoman Empire Rose and Fell*, 2019). Nowadays Indonesia is the largest Muslim country in the world, where live around 200 million believers out of a total population of 230 million people and it is considered a moderate country. Indeed, it is not regulated by Syariah law (Islamic law) and most Indonesians believe that religion has an important place in people's lives but still should remain a personal and private choice. They are open-minded, they support democracy as a natural political system, and they are convinced that human rights and gender equality constitute part of the religious teaching, even if a small part of religious extremists still exist. Moreover, Islam followers believe that the defining factors of the economy are the private sector and the marketplace, not forgetting that social justice is key to considering the market system acceptable (Wanandi, 2002). The close relationship between religion and culture can be seen in the architecture, which, in the case of Indonesia is very diverse. Being the most spread religion in the country, Indonesia has a rich heritage and presence of Islamic architecture, with many mosques and other religious building spread (Nafi,2023). Even if Indonesia is the 4th most populous country in the world, 40 percent of the population lives in Central Java, Yogyakarta and East Java. Before converting to Islam nearly in the 13th century the most common religions were Hinduism and Buddhism. The Javanese, as open-minded people, accepted since the beginnings the new beliefs, they incorporated into the previous heritage, integrating and maintaining at the same time. As it is more difficult to rapidly move from old costumes to new ones, they prefer to adopt new habits. Such distinctive features gave birth to "Javanese Islam". Consequently, the discourse about Mosques in Indonesia is difficult because they are supposed to be inspired by Chinese pagodas or Hindu or Buddhist temples (Idham, 2021). Islamic civilization in Indonesia started with the appearance of the Sultanate of Pasai in Northern Sumatra in 1292 and Islam spread in the region due to trading two and a half centuries later, which involved less violence compared to other zones. It was interesting because

its rapidly spread was due to a new social structure that omitted differences among classes, typical of Hinduism and the zoomorphic figures were replaced with floral and geometric patterns. At the same time, Hindu-Buddhism was not necessarily extinct, but rather, preserved by moving its center to another island. (Ibid.) Most scholars claim the universality of Islamic art but contextualized in each area, it always has a local side. Titus Burckhardt, mentioned by the author, describes Islamic art as a phenomenon of “unity in diversity and diversity in unity. “In this sense, the universality of Islamic art and architecture stands in the capability of the lies artists to generate artistic expressions and adapt Islamic features to the local context. Considering this, the case of Javanese Islamic art is not totally unique. With respect to the context of Java, architecture has been a means for Islamization (Lien Iffah Naf’atu Fina, 2018). The architectural style of Islam displays the beauty that it is rich in meaning, as every detail contains very deep symbolism, one of which is that “our sense of admiration for beauty and aesthetics in architecture is inseparable from submission and surrender to the greatness and majesty of God, as the One who has all the beauty” (Alifuddin et al., 2021). The first type of Indonesian Islamic architecture that I am going to analyze is the “Buton”, which has a close relationship with the Hindu ancestor beliefs, for the confirmation of the roof and the cosmology symbolism. However, the Islamic influence can be seen in the division of indoor spaces. Basically, the gendered division of the rooms (with the exception of neutral spaces) is associated with Islamic values. Moreover, the use of the word “banua” (value) for a house means the requirement for careful maintenance. Hence, the orientation also could be linked to Islamic ethics, finally, this could be an example of local wisdom and Islamic adaptation (Alifuddin et al., 2021). Some Islamic beliefs are applied directly to house design, and that’s the case of gendered spaces. Edward Hall (1973), cited by Zalloom researched the link between the use of space and cultural aspects. He assumed that humans have distancing mechanisms that depend on social relationships and events. Privacy can be considered a central element to be considered in Muslim architecture because it shapes their perception and use of spaces. Such spatial requirements are usually met by the separation of private life and public sphere, however, Othman et al. (2014) and Mortada (2011) cited by Zalloom suggested

that “privacy in traditional Muslim’s houses comprises four layers: Privacy between neighbors, privacy between males and females, privacy between family members inside a house, and Individual privacy”. Therefore, gendered division spaces are the key, in Islam, to achieve privacy for males and females (Zalloom, 2019). In Java Island the Muslim influence on homes can be noticed by the fact that the houses tend to be more compact than those of the Hindu/Buddhist community, due to different needs in terms of space. Hindu community needs space in dwellings as a place of worship, but Muslims use the remaining space of homes as a place for worship. Abstract patterns, flowers, and plants are the typical architectural elements for decoration and aesthetics, in contrast to the Hindu one, characterized by animals and human patterns. The presence of verandas and gendered spaces, as well as spatial arrangements that divide private and semi-private areas of the house, marks a very special trait that differentiates these kinds of buildings from the indigenous or Hindu ones (Sulaksono et al., 2023). As mentioned before, the *kampung*, *limasan*, and *joglo* are the different roof-design houses in Java. The most complex and advanced is the *joglo*, as it is the highest and it is often associated with Hindu/Buddhism culture. However, it is rare that *joglo* houses never appeared before the 15 century, in previous civilizations before Islam. At that time, the used building types were *limasan and tajung*. The absence of the dominant feature in the early times may suggest that that style first appeared because of the development of Islamic culture. Consequently, the *joglo* can be treated as one of the cultural achievements of the island that comes from Islam. Another reason for the association stands in the internal spatial organization, which for Muslims, is gendered. Like in mosques, several dwellings in Java have flower patterns in the column, or the basis is in stone, related to Muslim calligraphy. Sure enough, columns and their foundations are imperative elements for houses, for praying purposes, and mandatory to show respect to the Prophet. It looks like only Muslims from Java realize such a combination of decorative elements (Idham, 2018). Concerning the religious buildings, mosques, are places for worship but also a center for social activities and public relations and a learning center for ummah (Muslim community). In the archipelago, we assist in various types and designs of mosques. In the specific case of Java, the influence is the aslant roof

design, but the shapes of shadings roofs encompass the majority of the ones seen for typical dwellings, namely: *joglo*, *limasan* (pyramid), *tajuk*, *kampong*, and *panggung*. Each of them has its own properties regarding the climate response to climate events (Sugini et al., 2017). Islamic architecture is distinguished for its specific balance between profane and spiritual values, in addition to its flexibility in adapting to local cultures, and thus suits everybody (Elreish & Prima, 2021). Generally speaking, a necessary conclusion can be understood there is an extreme similarity, or in some cases, equality between architectural elements forms the traditional dwellings and the mosques, especially in the Kauman region. The cultural association between indigenous culture, Hinduism, and Islam syncretizes in the ornaments and decorations (Ashadi, 2017). Samadora introduces his research on the fact that Indonesia has a tropical climate, which is represented by the geographical altitude: lowland and highland. The difference in altitudes explains all the environmental and climatic variations (Samodra, 2017). But, taking as an example the most populous Indonesian island, where the average outdoor temperature in March-August is higher than the neutral temperature in West Java from 11:00 am to 15:00 pm. Based on measurements in the existing house, it can be seen that the indoor temperature is below the outdoor temperature from 08:00 until 14:00. The highest indoor temperature is around 28°C and occurs at 14:00. The indoor temperature looks higher than the outdoor temperature at the afternoon and at night. The temperature starts to increase at 15:00 and reaches the peak at midnight until 07:00. The measurement also shows the existing house can reduce indoor temperature but is still above thermal comfort neutral temperature in the West Javanese area (24.9°C) at 13:00 until 15:00. Based on measurements, it can be seen that indoor temperature is below the outdoor temperature at 09:00 until 15:00. The highest temperature reduction is 1.5°C at 12:00 until 13:00. Proceeding from the neutral temperature forecast in West Java, it can be noted that 24.9 degrees is the comfortable room temperature, and the comfort temperature level range is from 22.4° to 27.4°. Thermal conditions in the existing house show that during the day the indoor temperature is higher than the neutral temperature (Nugroho et al., 2020). Due to evident cooling needs, green cooling measures that use very little or no electric energy have been conceived and realized in the hottest part

of the world and across cultures to achieve thermal comfort, even before the creation and commerce of air conditioning. The reason for that is that passive cooling measures require low maintenance, the running cost is not as high as possessing AC, do not use refrigerants and sometimes religious and cultural aspects play a role. Alternative cooling solutions, moreover, are better integrated directly into the building design, compared to the air conditioning solutions. As explained by R. Khosla et al. 2022, passive cooling techniques incorporated in the design of the structure can be divided into three categories: the first one is heating gain prevention and protection measures to avoid heat gains by blocking or minimizing incoming solar irradiation, and it can be achieved by using vegetation, water bodies, shading, and glazing. The second category is made up of heat modulation, for delaying or displacing peak temperature, created by using certain types of building materials. The last one is heating dissipation, namely the thermal energy transfer from the building to the surrounding air by convective, evaporative, and radiative cooling (Khosla et al., 2022). Indonesia is composed of thousands of ethnic groups, and each of that group has its own experiences, stories, and cosmologies of the founders. Such an aspect has affected the development of vernacular architecture, which, as said is sustainable thanks to building materials and physical design. As a tropical country region, they have huge varieties from forests even though the most used is bamboo, of which there are two varieties organic black bamboo (mentah hitam) and yellow bamboo (kuning), for their strength and elasticity virtues, both used to build foundations. The other building material is stone, generally taken from the nearby river (Widjaja & Setiawan, 2018). For example, stilt houses are conceived to catch the most rapid wind, for this reason, a lot of people are suggesting this design because it also absorbs water in a superlative way and the flooring material does not cover the soil, a common feature in vernacular architecture, and this decision is related to the fact that according to this principle, the water should not precipitate into the pole material, that is normally made in wood (bamboo). In tropical buildings, the main function of the building facade is to protect from direct solar radiation, and it is the best device that follows the principles of shadowing and filtering, useful as well for overcoming rainy problems. Indoor thermal comfort is key, given the fact that air conditioning is a

relatively new machine, and not everyone can afford it so, tropical houses are conceived and designed with embedded ventilation devices, in the case of Indonesia, there are two ways for optimization. The first one is through the creation of openings on the building facade or on the roof. The other opportunity is to enhance the flow of wind inside the construction by roof gap (Widjaja & Setiawan, 2018). It is certain that the “optimization of climate responsive buildings will help to reduce energy consumption and improve the indoor thermal environment” (Pramitasari & Harjanto, 2022) which in indoor spaces cooled by air conditioning is considered between 25 and 27 degrees and a range of humidity between 40% and 60% (Uno et al., 2018). One of the most influencing factors of indoor comfort level is the thermal comfort, which includes Indoor Air Quality (IAQ), and in every building assessment, it is recommended for its important role in health. It is influenced by both physical factors like temperature, humidity, and speed of the wind and chemical factors like air composition. Traditional buildings in Indonesia have been considered for a long time by IAQ for its passive design approach (Tedjokoesoemo & Thendean, 2020). Indeed, as regards to a survey conducted on the thermal comfort perception in religious buildings (Banten and Yogyakarta mosques) show that almost 80% of the users feel comfortable in terms of comfort, and wind and air humidity is less than 70%. therefore, it can be stated that the mosque that presents a pyramid shading has a more variational radiation temperature in diverse seasons of the year. Meanwhile, the mosque with dome shading has a quite stable radiation temperature throughout the year. Finally, the thermal comfort pattern is determined by the position, size, number, and overture of the openings (Sugini et al., 2017).

4.2.3 COOLING STRATEGIES AND SUSTAINABILITY IN TRADITIONAL ARCHITECTURE

Architecture is a demonstration of different traditions, societies, and lifestyles. From time to time, traditional societies have developed diverse architectural forms to protect themselves while maintaining the sanctity of the environment. The balance between human society and the natural environment depends heavily on human beings' interactions and communal activities. In the Indonesian Archipelago, these traditions trace their roots back millennia, when the area's first cultures emerged. They encompass not only the relationship between human beings but also the interconnection between humanity and its surroundings (Wasilah, 2023). Indonesia is known for its diversity, which also can be found in its long-established architecture. According to Toe and Kubota (2015), most traditional houses in Indonesia follow a certain rule in their local tradition, or culture-driven (Kubota & Toe, 2015). But there are also some of the houses that are only driven by needs and technical reasons. Nevertheless, traditional houses are known for their good thermal performance (*Investigation of Indonesian Traditional Houses through CFD Simulation Suhendri.pdf*, s.d.) (Koerniawan & Suhendri, 2016) and their construction adheres to the climatic and natural conditions of the surrounding environment. The shape and form of buildings in several areas vary according to the characteristics of the location and the social system of the community so that the sustainability system in architecture can be understood from the "typical" building of the area (Wasilah, 2023). Specific shapes and designs are certainly influenced by local wisdom, whose aim is not only to keep balance and safeguard the sustainable aspect, but also seeks to protect native values and ideas, used as a guide and a force for problem resolution. The vernacular architecture successfully overcomes the challenges of adaptation to extreme local conditions and serves as a model for a sustainable design approach. Indeed, as (Rahim, 2022) explains in his essay, there has been conducted research that explains that vernacular architecture is a model for sustainable architecture, as its principles for construction are taken from indigenous features. Traditional houses in the tropics refer to the concept of bioclimatic design with passive solar strategies for natural lighting and ventilation, and also the usage of natural materials for protection from hot and humid weather conditions (Rahim,

2022). Gartiwa says that in Indonesia a wide variety of vernacular village and house styles are the product of the cultural and ethnic groups. The state is made up of many islands, many worldviews, languages, habits, and social cultures. As explained before, building technology is largely shaped by nature and the availability of the material. Traditionally the roof is the most important element of the building components, which epitomizes shelter and which perhaps, dominates all buildings. The importance of the roof as a major architectural form is underlined by the need to shelter from the hot sun and rain (Gartiwa, 2023). Now, I am going to describe the traditional buildings of the archipelago from a sustainability point of view and I will be starting from Rumah Tongkonan, the traditional dwelling of the Torajan people in South Sulawesi. Toraja land is located in the Northern part of the South Sulawesi Province, between the *Latimojong* Mountain range and Mount *Reute Kambola*. Toraja communities are made up of three groups, the Eastern around Lake *Poso*, Western Toraja around the Palu River, and *Kalawi* in Center Sulawesi. The typical architecture of Toraja dwelling has its own shape. They are modeled like a boat and the two ends form a bow. Toraja legends believe that they came from the north by sea. Caught in a violent storm, their boats were so damaged as to be unseaworthy, so instead they used them as roofs for their new homes, the ‘tongkonan’ with their boat-shaped roofs, always facing towards the north. Toraja house is usually a compound building consisting of traditional houses (‘tongkonan’) and rice barns (‘alang’)(Julistiono & Arch,2005). The constructions are engraved with ornaments, and painted in traditional black and red colors, altogether creating the aesthetic of the houses of the island. The gables and the wooden wall panels are created with geometric, spiraling designs and motifs such as buffalo heads and cockerels painted in red, white, yellow, and black, the colors that represent the various festivals of *Aluk To Dolo* (‘the Way of the Ancestors’), the indigenous Toraja religion. Black symbolizes death and darkness; yellow, God's blessing and power; white, the color of flesh and bone, means purity; and red, the color of blood, symbolizes human life. The pigments used were of readily available materials, soot for black, lime for white and colored earth for red and yellow; *tuak* (palm wine) was used to strengthen the colors. Many of the designs are associated with water, which in itself symbolizes life, fertility, and prolific

rice fields. Tadpoles and waterweeds, both of which breed rapidly, represent hopes for many children. In general, the biggest settlements of Toraja are settled in a row, facing the north. Every house form, together with its own rice bran, which is located on the opposite side, a complementary row parallel to the dwellings. Roofs are aligned on a north-south axis. The major agricultural ceremonies of the Toraja year are celebrated in the area between the houses and the barns (Ibid.).

Figure 4: Agricultural activities in front of the dwelling. Source: Julistiono & Arch, 2005

Figure 5: The *tongkonan*'s ornaments. Source: (Julistiono & Arch, 2005)



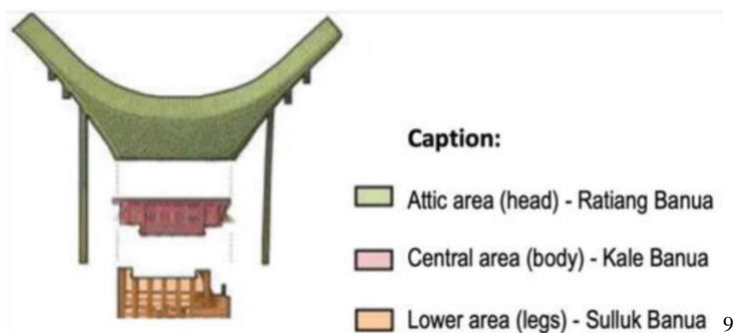
8

The traditional building material of the 'Tongkonan' structure is wood, especially bamboo, assembled in a tongue and groove system without nails, in combination with rattan, coconut leaf, and a variety of woods such as teak and ironwood, producing similar '*tongkonan*' construction throughout the region (Julistiono & Arch, 2005). The structure of the *Ruah* Tongkonan, of course, is influenced by the natural environment and geography. It is proven that this kind of traditional house performs greatly in terms of climate control. They are built on pillars and composed of three primary

⁸ Agricultural activities in front of the dwelling, and the *tongkonan*'s ornaments (picture from Julistiono & Arch, 2005)

elements: “*Sulluk Banua*”, “*Kale Bauna*” and “*Ratiang Bauna*”. *Sulluk Bauna* corresponds to the base, which consists of pillars and pillars and horizontal beams (*roroan*). As such, it endures vertical and horizontal stresses well. These dwellings are sturdy in their construction, which enables them to carry their burdens well. The pillars and horizontal bars are connected through a pins-and-holes system, which is sufficient for distributing the weight of the building (Wasilah, 2022). On the contrary, the Kale Banua is the main body of the construction. Composed of the indoor and outdoor walls, needed to support the roof. The materials and orientation of the walls are various. The rating Banua is needed to connect the Kale Banua and the Sulluk Banua, it helps to carry the weight of the house. Finally, the roof, or the “*Ratiang Banua*”, covers entirely the building. Structurally, consists of the roof itself as well as a series of pillars and beams, which are connected through joints, notches, pins, and holes (Wasilah, 2022). The elements are combined as a whole and represent a very suitable stable option for natural disasters.

Figure 6. Source (Oktawati, 2017)



The visual appearance of the architecture is important also for the understanding of society. Optic and dimensional aspects include axis and balance, with proportionate and geometrical dwellings that

⁹ Image from Oktawati, 2017

speak the language of society. Soil, which expresses that the regional community can prevent threats from dangerous animals from wildlife and seism. Orientation, that explicit their skills in the realization of sustainable design, taking advantage of natural sources of energy (sun and wind). The efficient selection of building materials is completely taken from nature for the construction of every part of the building, given the abundance and ease to access of to such inputs. Such renewable organic materials grant the maintenance of sustainability through time. These materials perfectly adapt to the climate of the area and its geographic conditions. The orientation of the building is possible through a set of beams. The oversized but balanced roof is the dominant element of the house. Thanks to the flexibility of the structure of the Rumah Tongkonan, it is uniquely constructed for its geographical area and so sustainable. To conclude, the design and maximal use of wind and sun minimizes the environmental consequences respond positively to disasters, protects citizens from wildlife, and absorbs as much water as possible. Safety is guaranteed by the light materials. Environmental impact is reduced due to the little waste production by Rumah Tongkonan and the choice of organic materials. Building systems and principles, materials vary in the archipelago. The majority use local materials, like specific qualities of woods that are aces. This door is usually near the kitchen area. Placing doors on opposite walls is forbidden, as well as when all buildings face the east (Darmayanti, 2016).The form of Kampung Naga dwelling is known as rumah panggung with julang ngapak roof type. The shape of the “capit” configuration of the roof above may stand for women and men. The other typical sustainable architecture of Indonesian households is the Kampung, the word that stands for the informal establishment of people. Kampung Naga is a customary Sundanese settlement in Neglasari Village, Salawu District, Tasikmalaya Regency, West Java (Wasilah, 2022) but in many big cities like Surabaya, kampungs become home to almost 70% of inhabitants that built their own houses. Indeed, Kampungs are informal constructions, low-income housing areas found throughout south-east Asia. They provide homes for 63 percent of the population of Subraya but cover only 7 percent of the city. Even if habitually the inhabitants of the Kampungs come from different socio-economic groups (low and middle-income), most of the dwellings are low-income. (Ernawati,

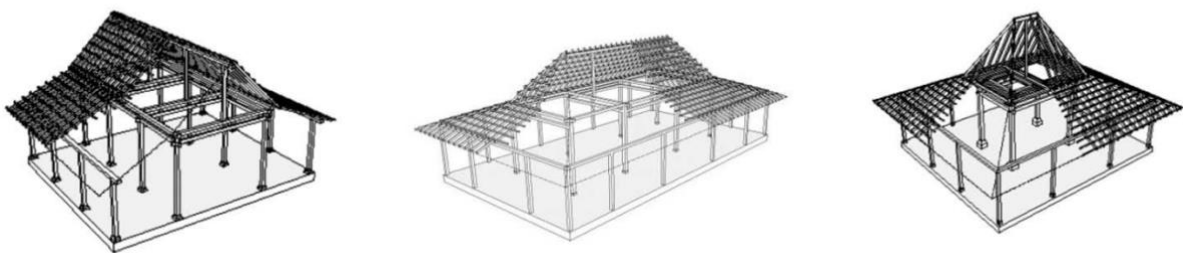
2013) To reduce the social differences among residents, it is a tradition to maintain the same color, shape, and materials as the ones used by ancestors. Moreover, according to indigenous knowledge, building homes with true walls and tiled roofs should be avoided, even if affordable. Kampung are built collectively, and they must ensure natural ventilation and high air quality, using local materials collected in the enclosing area. It is even true that some parts of the dwellings are in prefabricated materials, but they are mainly built using clear and environmentally friendly raw materials besides glass and clay. Indonesian communities rely on local stones and vegetation, nature is the starting point there. As Wasilah explains, dwellings in Kampung Naga are built upon a foundation of natural stone, measuring 40x40x40 cm. These foundations are pedestals, reaching approximately ± 50 cm above ground level, thanks to this basis, the dwellings are free of termites but also, this foundation ensures stability in the area's mountainous terrain. In the same way, Kampung Naga is walled with *gedhek* (woven bamboo), *albasia* wood, or jaro (sturdy wooden shafts, bound together with bamboo). Walls may be left bare or covered in chalk, which serves as an insulator for the room and protector from termites. Along the walls, about 23 cm above the floor are wooden bars that are 20 cm in width. Bars that serve to prevent the walls from collapsing and chalk from peeling. Such materials are highly flammable; as such, the door frames and kitchen walls are made of *sasag*. Dwellings are made of *albasia/sengon* wood. The ceilings consist of two layers. The lower layer is made up of palm leaves, while the upper layer consists of palm fibers that are held together with bamboo reeds. These ceilings have several panes of glass to allow light to enter the home. The roof takes the form of a Julang Ngapak, which spreads to both sides akin to a bird's wings (Wasilah, 2023). The presence of verandas promotes circulation, as explained by Gartiwa, the *golodog* improves the thermal comfort of the house in hot and humid climates, is dominant in Kanekes and provides shading, useful space for a number of domestic activities the outdoor climate in hot and humid regions is more pleasant than the indoors. It also enables the transition from public to private spaces and also protects the house from the sun's radiation and rain. Golodog integrates the house with the public's way of the *kampung*. Basically, because the house cannot accommodate all household activities, many functions have to be carried

out outdoors. In this respect, outdoor areas must be protected from solar radiation, therefore the *golodog* was once a regular feature of the house. Most *golodog* are narrow strips as roof extensions. These *golodog* act as outdoor spaces for family gatherings and relaxation activities. The length of *golodog* is primarily related to the design of the dwelling (Gartiwa, 2023). As Funo et al explain, the room at the front is called '*ruang tamu*' (guest room) but it is also used as a living room, laid along the access road. It is common to live in the access area in Kampung dwellings. The "guest room" is commonly not divided by walls, but it is a flexible space that connects to the backside of the house. In the rear, there are bedrooms (*ruang tidur*), a kitchen (*dapur*), followed by a bathroom (*kamar mandi*). It is also common that utility space is laid at the end of the house. Starting from a temporary structure, the standard type of Kampung is constructed gradually, with additions and changes according to the needs. One-room unit is the minimum and the archetype of a kampung house. Indeed, those who live in one-room kampung units, utilize the open space for daily activities. Another example of the kampung archetype style is the '*ruang tamu*', where there are two rooms ('*ruang tamu*' + '*ruang tidur*') in the form of a minimum house (Funo et al., 2002). In Java, there are other types of traditional vernacular architecture, classified on the shape of the roof: *Joglo*, *Limasan*, *Panggung pe*, and *Tajug*. As Idham affirms, the *Joglo* and *Limasan* houses are the main preferences and are still utilized to some degree in urban and rural areas in Central Java, Yogyakarta, to the East Java Provinces. These two architectural types come from the same origin, but their architectural association significantly differs. For Javanese people, *Joglo* is perceived as a masterpiece of traditional architecture, and it is considered sacred. For those who prefer or need an extra spacious place, *Limasan* is considered a better option because the price is much more affordable than other options compared to the extension. On the contrary, the social reputation of the kampung is less desirable because it is traditionally belonging to the low social class, and in most cases, it acts as contemporary-style houses without or with less local values. *Panggung Pe* is non-permanent construction, while *Tajug* is mainly religious building. During that time, the Javanese lived mainly in *Joglo* and *Limasan* as they associate the traditional *Joglo* and *Limasan* with the high social status of

the nobility or those who hold an essential position in society, such as the royal family or Priyayi (Idham,2018, 318). As the archeologist Mitu M. Prie affirms in her book "Pancaran Limasan" (Brilliant Limasan), which tells the story of *the limasan* traditional Javanese style, before the 1970s, the great number of Javanese houses were built as limasans since other styles like the joglo or the *loji* were reserved for the aristocrats and Java's rich traders, despite some researches prove the existence of Joglos owned by farmers (Wibawa, 2020.), who built smaller Joglo houses than the ones from other regions, and the local Joglo is primarily constructed from a combination of wooden structures and brick walls (Idham, 2018.). The orientation of most houses faces the south, and openings are placed well in both brick and wooden walls. The orientation to the sea is the thing that guarantees thermal comfort despite the dimension of the houses. The corrugated metal roof on the top of the house, however, heats the air below without allowing the hot air to escape (Idham, 2018). Gaffara et al tell that the origin and historical development of Joglo go together with an ancient building called *punden* terraces, a sacred structure that converges from the higher to the smaller. The shape of the Joglo roof is "like a mountain", at the top connected to the longitudinal mala, which commonly Javanese call *panuwun*. Saka guru is the name of the structure at the top, in the middle of Joglo. It has the shape of a wooden material. From a very close perspective, the constitution and the form of the Joglo house look identical to the shape of a Hindu temple. As a consequence, according to Gutierrez (2004) and Gaffara, it can be assumed that the joglo dwelling is a sort of transformation of the temple shape (Gaffara et al., 2021). The traditional and cultural aspect of the Joglo constructions plays an important role. Indeed, norms and values are applied to the owners of Joglo, which entails its customs, philosophy, and religious aspects. "Elements of religion/belief against gods manifested by space worship of Dewi Sri (Goddess of fertility and household happiness) according to Javanese people's livelihood (*petaniagraris*)" (Ibid.). Therefore, the house for the Javanese is not simply a place to live, but it is a symbolic unit for the owner, in this sense, the position of the house and the house itself is a reflection of the personality and lifestyle of its inhabitants. As mentioned before, Joglos are the reproduction of the Meru Mountain, which is believed to be the residence of the gods.

That height structure becomes the medium and the axis mundi which connects the immanent human world with the supernatural world which is transcendent (Gaffara et al., 2021). Weichart explains that Indian influence in architecture can be seen by the fact that Javanese houses are not elevated but positioned on the ground. Rectangular is the most common shape of the dwellings that are composed of two rooms, divided by bamboo walls. The poles are unified with the building, and have the important duty of supporting the roof, which is the most important element of the house as the most socially distinguishable in accordance with the collective hierarchy, there is a reciprocal hierarchy of roof types (Weichart, 2020). As shown in the picture above, the roof of the kampung is the cleanest one. As Weichart argues, in the past, the kampung dwelling was, as is the custom, owned by “ordinary” people of the Javanese society. Larger houses belonged to high-income families, and the type of roof of such dwellings is limasan. The Joglo is the highest, reserved for nobility. Tumpang sari is the name for the central element, the most internal and sacred area of the house, held by four columns (Ibid.).

Figure 7: Javanese house types (from left): Kampung, Limasan, Joglo. Source: Luritzhofer 2019.



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¹⁰ Javanese house types (from left): Kampung, Limasan, Joglo. Source: Luritzhofer 2019.

Figure 8: a *tumpang sari* (the internal part of the Joglo roof , wood engraved that indicates the social status of the owner. Source: <https://indosphere.medium.com/joglo-and-limasan-the-art-of-javanese-housing-9d11e0a111af>

Figure 9: column. Source: <https://indosphere.medium.com/joglo-and-limasan-the-art-of-javanese-housing-9d11e0a111af>



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All three types of roofs can be extended. So, roofs of different sizes can be found but still belong to the same category of people. As the conformation of the top of the building defines the category of the owner, the construction process must follow specific rules. So, people consider the whole building as a Joglo or Limasan structure. Nowadays there are nuclear families that live in a single house. Weichart adds as well that those who could manage it and had a wide piece of land, used to live in a walled compound that ideally consists of three main structures, the *pendapa* (pavilion), the *peringgitan* (corridor), and the *omah* (main building), supplemented by additional buildings as living spaces, kitchen, and bathroom. We still can find such composites but with the contemporary land scarcity, joined with the modern “trend” of small residential units, such compounds are gradually

¹¹ In the first picture, a *tumpang sari* (the internal part of the Joglo roof , wood engraved that indicates the social status of the owner). In the second picture, column. Pictures via <https://indosphere.medium.com/joglo-and-limasan-the-art-of-javanese-housing-9d11e0a111af>

disappearing from the urban landscape (Weichart, 2021). Another example of a sustainable traditional dwelling is the *Aceh aboh ineung* house (one bedroom). The construction materials for the walls and internal columns are wood, while the roof, which is internally visible due to the lack of a ceiling, is made up of thatch leaves. The ventilation system is provided by translucent carvings on the walls of the building as well as the distance between the parts of the betel nut used on the floor and the holes that occur in the connection boards (Sawab et al., 2021). The following peculiar building is called Baileo. It is like a social house, but it does not have walls. Like all the ancestral buildings it is made up of all-natural and local materials like wood for the floor and palm leaves as a roof. It is a place for traditional ceremonies. For the local people but mostly children, Baileo is a very special “gift” and has a huge value as it is passed by from the country’s grandchildren who have the moral duty to carry out cultural activities and ceremonies.

Figure 10: 3D representation of Baileo. Source: <https://www.turbosquid.com/3d-models/3d-model-traditional-house-baileo-maluku-1952251>



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It represents also the epicenter of the activities (Dandirwalu & Souhuwat, 2019). Finally, *Baileo* represents an example of peace among different religious believers in those regions as it is conceived

¹² 3D representation of Baileo, picture via <https://www.turbosquid.com/3d-models/3d-model-traditional-house-baileo-maluku-1952251>

as a place to build solidarity. Moreover, local traditions of *Baileo* and *gandong* became the meeting point of Christian and Muslim communities because such constructions are related to a sacred value, and they understand *gandong* as a physical implementation of protection and promises made by their ancestors. It brings back the unity of the various communities, underlying their shared values, after the social conflict that occurred in 1999 (Dandirwalu & Qodim, 2021). Continuing with the explanations on the various typologies of traditional vernacular architecture we can say that the position of the kitchen, always situated at the back of the house, is the universal standard for home design, even if there are some indigenous dwellings where the kitchen is located in the front side like *Atoni* houses in Timor (*gadang*). In *gadang* houses, there isn't a porch the space is more partitioned, and they don't have multifunctional space or specific zones ideated as kitchens. One reason for this mat resides in the fact that functionality is separated from family aspects, for the Tetum people, and socialization is realized outside the dwelling (Wazir & Indriani, 2019). But going back to sustainable buildings, in Indonesia we can find as well the very typical Rumah Godang, of whom there are various kinds, depending on the area. Rumah Gadang is a family house composed by more than one family. The structure was constructed thanks to the local wisdom which took into consideration the geographical characteristics of the area. For example, the roof has been adapted as well as the house orientation. The interesting point is the fact that the shape of the house and the direction of the wind are strictly interrelated, together with land (Ramele & Wongso, 2021). It is not possible to give or sell this type of traditional house. For instance, it should remain inside the family's possessions. The most distinctive feature of Rumah Gadang is the roof, whose extremities are shaped like buffalo horns, "*gonjong*". Moreover, the parts made of wood are craved following the influence of the historical period of the house. At its conception, female family members lived there, and it was used to carry out daily life activities, but its function has gradually changed, transforming it into a communal place for ceremonies celebrations, and open space for social discussions (Canrath et al., 2022). The sustainability aspect of the *Rumah Gadang* is found first of all in the choice of materials used for the construction, which are locally available: *Kulim* wood and *palm fiber*. Wood is firstly

processed and conserved in the *tabek*, by using traditional techniques that do not pollute, which allows for maintaining the natural material properties. Such treatments allow the wood to endure for a lot of time. Moreover, it satisfies the passive cooling principles thanks to its low thermal conductivity. The processing requires low energy expenditure (Canrath et al., 2022). Verandas play an important role and as mentioned before, they are constructed simply and with the use of local, renewable, farmable materials (such as timber) and this contributes to maintaining a low impact on the planet, compared to more contemporary materials, also because are accessible locally and the effort required to acquire them is very low. Another important aspect is the fact that local, social, and cultural values are related and required. The internal parts don't present precise boundaries, and the space usage is determined by the activity. Such indoor openness creates the inner feeling of ventilated and bigger space, moreover, the ceiling is not present, so the structure of the roof is left open, which creates a double volume space and enables internal cool in tropical areas thanks to the roof configuration. The roof configuration includes as well craved air vents that put together aesthetics and function because provide natural cross ventilation. The motifs of the carvings depend on the owner's culture, but the most common patterns are based on Islamic arts and teachings. All these features together are very important parts of the beauty and structure of the house (Bahauddin et al., 2012). The last traditional sustainable house examined is the Sudanese dwelling located in *Baduy Village*, and like the other cases, it is the manifestation of the cultural heritage of its inhabitants, and it is called *Imah Panggung*. The word *imah* has the meaning of a place to take refuge from meteorological events. Another way, more sophisticated to call a house is *Bumi*, which also signifies land, as a place where someone comes from, its essence. For the most rooted ancestral beliefs, the house has a metaphysical dimension, according to their view houses have souls like humans, so the building practice should follow certain rules, to avoid further problems. Starting from the sustainability and thermal comfort of the building, the house presents an empty space under the floor called *Kolong*, and it is used for air circulation and thermal comfort in the internal spaces. The peculiar fact about this house is that it's built within a community that values a lot of ancestral customs to the point that there are strict rules. Starting from

the material that must be organic and the fabricated materials are forbidden by custom, building materials should be touched only with skin. The construction can be divided into two groups: the first one is the *Handap* framework that is to say the foundation parts which include the *lelemah* (ground surface) and *umpak* foundation, the other one is the middle framework, the body of the building which in turn is constituted of wall (*pangadeg*) and floor (*lantayan*). The *suhunan* is the roof that joined with *palapon* (ceiling) acts as a protector of the structure and a place to store plant seeds. The concept of the villagers, and thus followed by the builder is that if there is scarcity in size of the natural building materials like (bamboo) should not be changed, because it could sound like changing their nature, and thus breaking the rules with ancestors. According to their culture, to obtain the natural building material, the cutting and manufacturing process should be very precise. Bamboo, it should be cut only in the rainy season at dawn to not disturb pests (Nuryanto et al., 2021). The last type of traditional building is the mosque, that in Indonesia has integrated various vernacular features into its architectural applications and experienced significant changes from its original concept typical of the Middle East architecture. The first element that emerges is certainly the roof, which varies and takes the shape of each area where the religious building is located. New styles and elements are formed and used in buildings without eliminating the local ones. The shape of Gadang House together with the design of the spring and crescent moon have been the source of inspiration for the construction of the Great Mosque of West Sumatra. The roof in this case is shaped, and it is influenced by the story of the Prophet Muhammed, but also from a naturalistic perspective, the roof is the symbol of the moon, the icon of the Islamic religion. The shape of the roof of the Great Mosque reminds of a buffalo horn, taken from the Minangkabau traditional dwelling (bagonjogo roof) (Satwiko et al., 2023). Mosques roofs in Java and Sumatera island generally take the shape of a pyramid representing a trilogy of Islam treatises, those are faith (Iman), surrender (Islam), good deeds (Ihsan) (Bahauddin & Darmayanti, 2017), and referring to nature the shape comes from the mountain, which is a very sacred element, as it reminds of Meru (Jamaludin & Salura, 2018). Initially, mosques were constructed using natural materials, but nowadays, due to renovations it happens that they use factory materials,

however, wood is maintained as much as possible in columns, roofs, and openings. The wood is needed to represent the simplicity of Islamic architecture. Concerning the interiors, the Great Mosque of Central Java can be seen as a very unified blend of Islamic architecture from Java and the Middle East (Satwiko et al., 2023). Typically, mosques in Java have a minimum of two roofs, up to five. While in the Banten great mosque, there are five levels of roofs: “The bottom level is the largest roof representing all Muslims (Islam), the second level is faithful (*mukminin*), the third represents benefactor (*muhsinin*), the fourth represents sincere (*muhlisin*) and the fifth roof represents the cautious (*muttaqin*)” Nowadays, the construction of the mosques and their architecture evolved, and there is a significant presence of elements taken from Arab and Middle East style, Recognizable from the appearance of minarets and domes (Jamaludin & Salura, 2018). Indonesian buildings can apply a sustainable architectural approach in terms of the use of internal and external spaces which means that Mosque also functions as a place of worship for many social and activities cultural activities besides praying, which produces a conscious use and management of natural resources like water whose management becomes crucial in the understanding of the importance of environmental preservation (Adi, 2016).

4.2.4 TODAY’S PRACTICES AND CONTEMPORANEOUS CHOICES

RAW Architecture, Jakarta, Indonesia. Guha and Piyandeliang projects.

Concerning the Realrich Architecture Workshop, I had the opportunity to talk directly with the founder, who explained to me about two projects, that are experimental and innovative because they combine sustainability, vernacular architecture, working areas, and learning zones. The first one is called Guha, and it is a mixture of new and renovation projects, inspired by the prior "The Guild", which is situated in Taman Villa Meruya. The space projected is composed of Omah Library, Dental Clinic, a residential area, and Realrich Sjarief’s studio named Guha Bambu. The renovated part consists of added refined schedules for Omah Library, for example, more space for bookshelves, bookstores, and galleries. The circulation is conceived for separation and privacy between the public

area and the private one, done by the separation of the access at the entrance. The added part is located on the east side, and it is called Guha Bambu, the construction is the in a lot of 7.5 x 26m size consisting of 3 floors of brand-new Bamboo structures. The technique used to build the structure is taken from the avant-garde school complex of the Alfa Omega project¹³. The approach divides the steel plane truss construct as a roof and bamboo structure to bear the 3-floor plate under the steel structure roof. The Guha has been built using 9 materials combined with craftsmanship experimentation. The materials are both natural like wood, bamboo, and stone, and artificial like steel, glass, metal, and plastic. The arrangement is flexible and open. By the way, some rooms have 2 doors minimum, which allows changes in the scenarios and utilization through time. Such kind of construction has been thought for tropical climates, with north-south openings and west-side orientation. The Facade is realized in a simple way in concrete, upright louver in bamboo and steel. The aim of the project, as underlined in the interview, is seen, by Realich, as a challenge, a social challenge. He wants to modernize the typical concept of a house in Indonesia and include it in micro business programs like education or coffee shop, still maintaining each one's individual privacy. The project building process maintains the typical construction procedures done by generations of craftsmen from the island of Java, who joint the traditional manufacturing techniques of bamboo with up-to-date building methods and materials like steel (Raw Architecture studio, 2023).Again, the Piyandeling is a brand-new project that consists of the residence of the artisans that work for RAW architecture studio, inspired by the "Guha" project. Mekarwangi Village in North Bandung is where the Piyandeling is located. The Residence is composed of a three-store house with a grid of 3.0 x 3.0 m for a single family. Three bedrooms and shared bathrooms. The building sleeve can be opened and created using 300 x 600 mm recycled plastic panels to envelop and protect the internal bamboo structure. The residence is called Sumarah due to the fact that it is constituted of plastic panels, 99%

¹³ Alfa Omega is an educational building with a local spirit. Located in the city of Tangerang, this building stands on 11700 sqm of swampland and paddy fields. The design responded to this unstable soil condition by raising the structure to 2.1 m high above the ground. This site was chosen as part of the design scheme, aligned with the goal of bringing children closer to nature, through an outdoor learning experience (Raw Architecture Studio, Unpublished)

recycled from Sumarah Pavilion. The corridor is an example of double cross-air ventilation and double wall insulation, of 800 mm that leads to the center of the living space of the construction. It is the physical representation of the adaptation of traditional methods to more industrial ones. The manufacturing technique is developed from the aforementioned projects, and thus, that allows the testing of 3 stores of the structure entirely realized in bamboo (Raw Architecture studio, 2023). “Construction of Piyandeling is designed as an exercise using 3 types of main material such as recycled plastic, a local type of sympodial bamboo, and local stone for the foundation. The composition started as an exploration of how bamboo craftsmanship integrated with modular rectangular space to create such integrated craft carving bamboo composition from the ceiling, floor, column, door handle, lock, and finishing details handcrafted in site creating art and craft composition in the whole integrated space”(Raw Architecture Studio, 2023). Finally, the last project mentioned in the interview is called “*Kujang*” and it is a two-store suspended structure created as an open-air hall for conventions, in contact with organic farms. It is built from the 4 - 5 m grids of bamboo structure and shielded by Nipah leaf along with a waterproofing membrane that acts as a roof. This typology of Julang Ngapak, is from traditional West Java vernacular architecture, with the difference of the balustrade, which is here much more elaborated, strong, and flexible, and creates a shape that fits perfectly in the natural environment. The other building (named Saderhana) is simply a single store of two buildings which on the outside has a dentist room, design studio, and an underground area. The basement of the first floor of the building was constructed with stone, while the bamboo was used as a roof, making it possible to realize the “*Talahap*”(curved vernacular bamboo construction, shielded by layers of waterproofing membrane and Nipah). On the other side, the lower-level studio was built using materials like bamboo skeletal, and concrete, which gives the idea of raw, humble, basic, and honest expression. To conclude, the Piyandeling can be considered a patchwork expression of architecture because they created something that is rooted in local genius but adapted to craftsmanship abilities and materials availability (Raw Architecture studio). The most interesting aspect of the speech with R. has been his answer to my question about targeting the projects. “Ok,

this is quite interesting because I believe that architecture is the agency to change something for the greater. We provoke something and we feel something that we have constructed for each situation. So I think that this agency that I started in Guha may provoke some bad climatic architecture in terms of the nine different combinations of the structure. And in Pyandelyng we provoked another thing. Like a waste material with, low carbon footprint, the structure, and the ornaments are made 99% of ornamental bamboo which is not common. People generally try to shut down all the creativity from the craftsman, if we consider the environment in Indonesia.” (Realrich Sjarief) If we consider the history of Indonesia, it can be divided into several periods, that comprehend the pre, colonial and post-colonial periods. Even before the arrival to the archipelago of English, Portuguese, Dutch, and Japanese, an abundant number of indigenous tribes and kingdoms already lived there, and it was organized according to a primordial system. In pre-colonial times, the *keraton* (palace) was the emblem of conventional bureaucracies that controlled the socio-economic tissue of the archipelago. The palace was often surrounded by housing complexes for high social classes and aristocracy, officials square for the community, and places for prayer and market. In this context, social and cultural values among elites and common people were exercised in a coercive relation, as rules must be accepted and observed by society. On the contrary, in the Dutch era, the aim was to plan up-to-date cities inspired by Europeans, so that dwellings for Dutch or Europeans that wanted to live there were an option. Colonialism in Indonesia is considered a factor that constitutes the modern Indonesian acculturation process, along with the influence of different religions (Sururi et al., 2022). The Old Era is a period characterized by difficulties in the development of residences as the government of Soekarno had to focus on issues for national independence, but despite this, that period has represented an important point for policies related to the housing field, as they started to develop a recovery plan after independence. This time the developmental challenge pays attention to healthy, low-cost, and durable houses. Subsequently, *kampung* housing began to grow independently. At those times, the key factor for housing policy is that it was centralized, and the experts or supporters chose the Neo-Keynesian approach to enhance development. An important step in the Suharto era policies

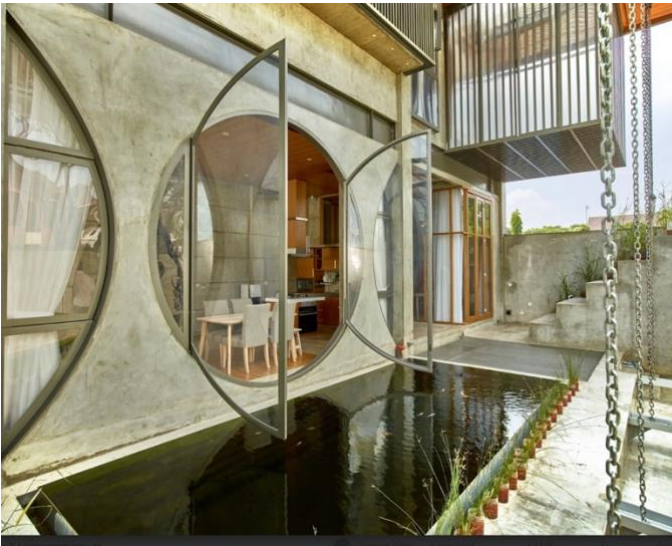
was the creation of the National Urban Development Corporation (Perum Perumnas). But, at times, only the groups that supported the government could benefit from cheap houses, whereas, for the majority, the housing support for cheap houses was very partial, and the complexity of the control by a little community group still happened and led both to the 1998 crisis and disproportion between the birth rate and needs in terms of housing, exacerbated by socio-economic inequalities. In 2007, was created the Thousand Tower Simple Flats, a program that had the goal to support housing for people with low income, but it could not be continued due to the lack of incentives, barriers, low affordability, and most of all, the flats programs no longer attracted the interests of the builder of the houses. Nowadays, there are still assorted important problems related to housing policies for low-income citizens, issues that need to be prioritized and resolved. Starting from the gap between the purchasing power, and high prices compared to the average salaries (Sururi et al., 2022). The Constitutional Decree (Indonesia, the President of the Republic of Indonesia, Article 27, 1945) recognizes that safe and comfortable space for living is a basic human right. Nowadays, healthy and sustainable houses keep being acknowledged in the great part of the governmental policies on social housing. Convening Indonesia, during the Dutch colonialist government, they standardized all living spaces, to provide fair accommodation for everyone. But the dimension of the standardized living spaces created by the Dutch created remonstrance among locals. Through time, internal spaces in social Indonesian houses have depended on political and economic agendas. 15 m² was the minimum space stipulation by the Dutch colonial government, but after they obtained again their independence, Indonesian refused those measurements and aligned themselves with the European standard of 54 m². In the 1970s, in the Soekarno government, social housing was needed to satisfy the demand for decent houses and also to raise the income of the nation. So policies became influenced by private firms and the minimum standard was again 15 m², building developers could gain profit (Susanto et al., 2020). Moreover, research has been conducted on the preferences in terms of dwellings for low-income Indonesian, and the results can be divided into two parts: indoor and outdoor. The internal characteristics include the physical appearance of the house whereas the external ones include factors

like the location. It has resulted that for low-income citizens in Surabaya, the most important aspect is the legal and tenure, considering their house vulnerability. Just after that, what emerges is the indoor look of the house which includes the size, price, and quality. The less prioritized facility by low-income people is the external aspect and the location (Rahmadaniyati, 2016) Furthermore, for Muhammad Hidayat Isa (2021), Indonesian workers prefer to own a house rather than rent it, and a house with land is preferred to an apartment. Additionally, the most desired distance with public transportation ranges between 1 to 5 km, consequently, workers consider the distance between public transportation and the price of the house the most important influencing factor. So, coming back to Raw architecture provocative projects, Realich said to me “This space is a provocation space, so there will be a library here, the Guha, the omah, some of the extensions of the family residence and it is going to be open for Airbnb as well for maintaining the costs of the building. It is coming and people can come to Guha with almost 60 people, that is a lot in Jakarta. So we have two more projects like that where we are nesting our provocation space, we have like this kind of heritage of working and staying together like the worker and the craftsmen, the library, the designers and the researchers, all living together in one compound and it will be briefly be open to people because many people need access for alliteration, for reading skills, writing skills and we are teaching them for having the advanced skill to understand”(Realrich Sjarief). Then, I asked the target and the price for workers to live there, and he continued “The target it is very cheap, for one month is only 20 USD. Can you imagine? I mean, the living cost here is like in Malaysia. If we consider that I think that craftsmen live very pressurized and live in slums and ghettos, it is inevitable because of the price. Here, they can work and live quite decent and then bring the money home” (Realrich Sjarief) (Scalon, 2007).

Figure 11-12-13: Guha and Pyandelyng. Source: Raw Architecture, Unpublished



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¹⁴ Picture from Raw Architecture, Unpublished

¹⁵ Picture from RAW architecture, Unpublished

¹⁶ Picture from Raw architecture Unpublished

Considering all, I asked myself if we have something similar in Europe, and what could we learn from the aforementioned system. Unfortunately, statistics show that more than half of Indonesia is urbanized with a single person in every five urban residents living in slums, reaching an amount of almost 25 million families that live in urban slums, between railway tracks, riverbanks, or streets. What is a relevant factor in this vulnerability of the land that had to deal with rapid expansion and urbanization, but first of all extreme natural events? Leading to a displacement of 705,000 in 2020¹⁷. Indeed, according to the World Health Organization “A slum household is defined as a group of individuals living under the same roof lacking one or more of the following conditions: Access to improved water; Access to improved sanitation Sufficient-living area; Durability of housing; Security of tenure”¹⁸ Slums and ghettos are commonly associated to the Global South, however, their existence in Europe is rarely documented. Refugee camps aside, housing forms of poverty are mostly associated with slums or informal settlements, predominantly known in Global South, but in Europe, they commonly find their origin in social phenomena like inequalities, discrimination, segregation, crisis, natural disasters, terrorism, or war. But compared to the world, Europe can be considered a wealthy area. But it shouldn't be forgotten that there are noticeable poor areas, especially in the south (Kraff et al., 2022). According to K. Scanlon et al. (2015), the EU has no direct expertise in the area of housing policy as it is normally defined. But this topic is becoming day by day very important in the European Union, since the global financial crack, but even before the crisis, problems of affordability were exacerbating across Europe where the sector of rental (supported by public investments) has been put under great pressure. In the context of competition policy, the European Commission began to express preoccupation, and since 2008 the part that the EU is trying to play in dwellings has incremented on the macro and micro levels, as it has been seen as a driving factor in the crisis of the banks. The result is that EU policies now massively challenge the private and public housing systems.

¹⁷ [https://www.homelessworldcup.org/indonesia#:~:text=Country%20statistics&text=More%20than%20half%20of%20Indonesia,streets%20\(Habitat%2C%202019\).](https://www.homelessworldcup.org/indonesia#:~:text=Country%20statistics&text=More%20than%20half%20of%20Indonesia,streets%20(Habitat%2C%202019).)

¹⁸ <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/2476> ,(Indicator Metadata Registry Details, s.d.)

Nevertheless, social housing¹⁹ has been a key part of house allocation for many decades with regard to investments and citizens' support (Malpass,2014). In the great majority of European countries, social housing properties have been declining in proportional terms (with the exception of Denmark). Especially in some nations, the numbers have dropped remarkably. Nevertheless, in countries like Eastern Germany, there is an oversupply, and it is a rising emphasis on large-scale policies for demolition and restructuring. The dwellings that have been totally or partially knocked down are frequently replaced by mixed-tenure housing (France, England, and the Netherlands), and occasionally at higher densities aimed at offering variegated communities and appreciable sustainability. Privatization has contributed to removing better-quality availability from the social field. Some countries (Ireland and the UK) have permitted sales for decades compared to others that started just in the late 1990s, but still, others are only now just starting. Finally, there are places where the resident can purchase, while in others, it is the landlords who decide (Scalon et al., 2007). Right now, Europe is facing a crisis in the social housing sector. "From Paris to Warsaw, Dublin to Athens, an increasing number of people in the EU are struggling to afford the rising cost of housing. Even before the start of the pandemic, one in ten Europeans was spending more than 40% of their income on housing. In urban areas in particular, many people find themselves in a dire situation and are driven out of the city. Also, the quality of housing is often deplorable. Far too many people in Europe are living in overcrowded dwellings and damp or poorly insulated homes, with unaffordable utility bills"²⁰. I think that the concept of social housing offered by RAW architecture studio, which I presented in the thesis, could be an alternative to the residential and climatic crisis. Not only because of the low prices offered but also for the sustainability aspect and the low carbon footprint of the

¹⁹ Hand flats that are owned by local government or by other organizations that do not make a profit, and that are rented to people who have low incomes (definition by <https://dictionary.cambridge.org/dictionary/english/social-housing>) (*Social Housing*, 2023)

²⁰ <https://www.oecd-forum.org/posts/tackling-europe-s-housing-crisis> (Network, 2021)

buildings, which have been realized using natural materials without forgetting the traditional Indonesian features and inspiration. Aesthetics plays a role, but in my opinion, the most groundbreaking aspect of the concept is the integration with the educational aspect, as they conceived an internal area dedicated to knowledge, free and with no limitations. They are not just houses, they include communal space and interaction between humans and directly with the environment. I think that in a hyper-connected world, that is “overheating”²¹, coming back to slow life, as much as possible in contact with natural elements, could be a choice that safeguards the health of the planet and of ourselves.

4.3 TURKEY

Ankara (40° latitude) weather is characterized by cold winters and hot summers: during the day, the temperature ranges to 15 degrees. Also, in this case, the choice of materials used in building construction is key to minimizing the effects of climate. Materials like timber, adobe, stone, or composite materials are for the facades to increment the time lag. The utility of the rooms changes during the seasons, as warming up is the main priority during winter, while reducing the heat is the first preference in the summer. Turkish traditional buildings are characterized by the rooms that are dispersed over all facades, while the area between them is considered as a living space, called a "sofa". Due to the materials used and its east-west direction, this area boasts warm air during winter and cool air in summer. The location of a building with respect to seasonal fluctuations in the sun's course as well as prevailing wind patterns is referred to as orientation. A good orientation may improve the building's energy efficiency, making the building more comfortable to live in and less expensive to run (Berrak & Kapoor, 2021).

²¹ T. H. Eriksen, *Overheating: An Anthropology of Accelerated Change*, 2016

4.3.1 COUNTRY PROFILE ANF HISTORICAL BACKGROUND

One of the greatest governmental organizations in history that have organized the Muslim world is the Ottoman Empire. It was born at the end of the Middle age and lasted until the first world war; the empire lasted for 700 years. From a religious point of view, it is an Islamic country as the sultanate and the majority of the citizens were Islamic. The empire controlled what is today known as Saudi Arabia, Mecca so the sultan is the caliph as well. The Empire is officially Muslim, but this does not mean that a large part of the population couldn't be Christian or Jewish. Such a religious composition of the population was possible because the Ottoman Empire was founded by the Turkish people but the extension of the empire does not coincide with what we know today as Turkey, as it was much more extended. It was spreading from Istanbul towards Europe by the Balkans and dominated our contemporary Greece, Bulgaria, Serbia, Albania to Vienna. So, a large part of what is Europe today, for many centuries was under the Ottoman domain, which in turn, expanded as well toward the Middle East, East, and Northern Africa. As a consequence, it was an empire that incorporated a lot of diversities and ethnic groups. (Barbero,2015). For sure, the power was in the hands of the Ottoman Turkish who were the ones who fought the battles, but day by, as mentioned before it included many European ethnic groups, Jewish and Armenians. To control such diversities, the power was organized in a vertical way, a hierarchy, where at the top we could find the sultanate, who had unlimited power, political and religious powers. In the beginning, the functionaries that helped the sultan were chosen only on a meritocracy basis, often chosen from the slaves, who were not Islamic but Christian in most cases, of the sultan. The slaves, after being captured, if they showed themselves as talented and intelligent had the opportunity to go out and enhance their social and working status, becoming "Visir", the most powerful minister helping the sultan. Actually, the sultan was also very able to "exploit" such capabilities, also from a military point of view to the point that he created selected troops called "janissaries". For the time, we can say that the Empire was quite religious and ethnically tolerant, to the point that many religious minorities that were persecuted in Europe emigrated to the Ottoman Empire, where it was possible to practice whichever religion after paying a fee. The only

religious request made by Ottomans to Orthodox clergy: the sultan asked to separate from the Roman church. From a military perspective, by the end of the XV century, with the death of Mohammed II, their conquest initiatives stopped for a while. It is with Selim I and Suleiman the Magnificent that the conquests started again (Ferretti, 2021). But taking a step back to its conception, the Ottoman Empire was born in Western Asia Minor in the late thirteenth century, and since its birth, it was ruled by the House of Osman, named for the founder of the dynasty, Osman I (d. 1324). Its successors, who contributed to creating the longest multi-ethnic and multi-confessional empire in Eurasia, called themselves Osmanlı in Turkish, which in English came to be rendered as ‘Ottoman’. The empire was composed of more than 13 million people in the 1520s and it was ruled with pragmatism. Its military compartment was administered almost perfectly compared to other empires (Ágoston, 2021). The rapid expansion culminates in 1453 when Sultan Mohamed II took possession of Constantinople. For a long time, Europe was scared they would conquer the entire world, and at some time in history it was considered to be unbeatable, and for Europeans, it was a rival also from the social perspective, as it appeared as another religious and cultural model, an alternative to the European one (Barbero, 2015). From that moment on, Istanbul became the capital of the dynastic empire which continued to expand in the Balkans, the Middle East, and North Africa. The peak of the Ottomans’ power and influence was reached in the 16th century with the domain of Suleiman the Magnificent when the arts, and technology developed together with architecture. And in the empire, there was peace, religious tolerance, and economic and political stability. The other side of the coin is that in the empire female slaves were forced into sexual slavery whereas males were expected to work in the military (*Why the Ottoman Empire rose and fell*, s.d.). After long centuries of wars for gaining back, but also losing territories, we can see a period of changes in the Ottoman Empire, as the leaders started to focus only on consolidating territories. Sultans started to lose some of their power and credibility in the 17 century, as they ruled for a short period of time, as a result of political competition, revolts, and resistance from the high society. As opposed to Europe, where the European monarchs still had absolute power over lands and people, in the empire the power was becoming less centralized, and

the bureaucracy of citizens gained strength. Local leaders helped the sultan to control and organize the vast empire by collecting taxes and sending them to Istanbul and also by recruiting soldiers to fight for the emperor. The society was divided between bureaucrats, religious scholars, and military officials who owned the greatest quantity of power, on the opposite side we could find the lower classes which included merchants, farmers, herdsmen, manufacturers, and seafarers that were the true strength and engine of the empire as they produced goods and provided taxes. Despite the fact that religion, gender and economic level played a role in someone's social status, people had the opportunity to enhance and change their condition. The condition of women was of dependency on men for money and social status. At the same time, Islamic law granted the right to divorce, inherit money and educate themselves. Unfortunately, religions were used as well to limit the power of women as some interpretation of the Quran could justify keeping them at home (*The Ottoman Empire By Eman M. Elshaikh - Google Search*, s.d.) (Eman M. Elshaikh, 2019). The Ottoman Empire was an important factor in the international politics at that times and along with the socio-economic development of the empire, the social high income part of the society, started to buy art, crafts and goods from foreign countries, so in this sense it started as well to lose its influence since for centuries it had been at the core of the commerce between Europe and Asia. A lot of goods passed through the Silk Road, but possessing less territory, the power faded (Elshaikh, 2019, 2-4). Already lost its power and influence beyond recognition, the current governing Sultan Abdul Hamid II thought about constitutional monarchy before changing course again in late 1870s. In 1908, the reform-minded Young Turks staged a full-fledged revolt and restored the Constitution. The Young Turks who now ruled the Ottoman Empire wanted to strengthen it, spooking its Balkan neighbors. The Balkan Wars that followed resulted in the loss of 33 percent of the empire's remaining territory and up to 20 percent of its population (Blakemore, 2021). The Empire fell by the end of the 16 century after their attempt to take Vienna in 1683, such defeat in Austria led them to renounce to Hungary (*Ottoman Empire - Expansion, Conquest, Decadence, Vassals, and Timur's Invasion | Britannica*, s.d.). Along with the technological revolution and the Enlightenment, and soon the liberalism in Europe, corruption and

decadence started to weaken the empire. Turkish wars towards Russia, Austria, and Poland further debilitated the empire which, in the 19th century, started to be called the “sick man of Europe.” The European territory that still remained were the Balkans, lost in 1912-1913 with the Balkan Wars. During the First World War, the Ottoman Empire entered secretly into an alliance with Germany and the postwar treaties dissolved the Empire. Actually, that war was a disaster that caused the death of up to 3 million civilians. Among them were around 1.5 million Armenians who were wiped out in massacres and in death marches during their expulsion from the Ottoman territory. (*Why the Ottoman Empire Rose and Fell*, 2019) In 1922 Mustafa Kemal Atatürk abolished the sultanate and proclaimed the Republic of Turkey the following year (*Ottoman Empire - Expansion, Conquest, Decadence, Vassals, and Timur’s Invasion* | *Britannica*, s.d.). The last Address Based Census conducted in 2016, showed that the population in Turkey is around 82.003.882, with an annual rate of population growth of 14.7 in 2018. Generally speaking, the augmentation of people is by 2 to 107 compared to 2017. Istanbul province experiences the highest number of people per square kilometer (2,900 people). As the Article 2 of the Anayasa Constitution declares, Turkey is a secular state, that grants the freedom of faith but the 99% of Turkish citizens are Muslims (*Population: demographic situation, languages and religions* | *Eurydice*, s.d.).

4.3.2 INFLUENCE OF RELIGION ON TRADITIONAL ARCHITECTURE

Extensive research has been carried out in the field of the influence of religion on architecture. As demonstrated by previous cases, every region or country has its own architectural heritage, but religion highly influences buildings more than other factors, especially in certain parts of the world. In the Islamic religion, all aspects of life are under the influence of the sacred order. Which means that there is no separation between sacred and non-sacred. The only hierarchy is established by the divine. In ancient Islamic towns, large streets or landscapes are not present, and the most significant building for the citizens is uplifted as a symbol of cultural accomplishments. The most sacred Islamic

architecture is represented of course by the mosque, that is always in the center of the urban fabric. (Salimi et al., 2016). Indeed, Salimi et al. (2016) state that the “The mosques in the Muslim world cannot be exactly seen from outside, because the structure of dense urban environment surround them. The experience of this architecture is in its internal architecture; therefore, this architecture emits human from out of the plurality of worlds to the deep thinking and spirit territory of world” (Salimi et al., 2016, 26). It can be argued that the Ottoman Turkish mosques, especially the ones in Istanbul, represent the most aesthetically pleasant works of Islamic architecture, even though, their aesthetic characteristics and arts that have spread in that times cannot be ascribed to sultans, as the traditional Ottoman mosques are more elaborated and decorated than the original ones. Certainly, the Ottomans originated new shapes for their religious buildings. Ottoman mosques have a large central dome and half-domes, their use of minarets follows the pathway of the Byzantines. On the contrary, after an examination of palaces and houses, Islamic architecture style has been followed, still taking in consideration the artistic and socio-cultural background of the area (Al-Sulaiman, 2018). Rabbat (2012) states: “Islamic architecture is of course the architecture of those cultures, regions, or societies that have directly or via some intermediary processes accepted Islam as an integral component of their epistemological and socio-cultural makeup. From that perspective, the term ‘Islamic architecture’ is still a valid designation for architecture being built today because Islam has never ceased being that constitutive component, even though the ways in which it expresses itself have drastically changed over time and space. The actual architectural forms that those expressions take, important as they are in identifying Islamic architecture, are tangential in understanding it. It is the impact – legal, spiritual, symbolic, social, political, functional, behavioral, and yes formal – of Islam on architecture as seen and used by the people that gives that architecture its Islamic designation, even though it has always had to coexist with other powerful and effective universal phenomena, such as competing world religions and more advanced cultures in its formative stages, and modernity, secularism, capitalism, and globally networked tastes and techniques of representation today” (Rabbat, 2012).

4.3.3 COOLING STRATEGIES AND SUSTAINABILITY IN TRADITIONAL ARCHITECTURE

The Ottoman Empire identifies itself as the representative of the Islamic world, and architecture was used as a beneficial tool. Turkish people's interest in living and working in open and natural spaces was very high. Concerning the specific case of the Ottoman traditional architecture, we can say that existed certain typical and constant characteristics that shaped the house construction, together with fixed convention that existed for a long time. One of these is its timber setting and infill construction material that ranges from bricks to wood. The second feature is referred to the ground floor, the most strength part of the dwelling, generally dedicated to hay storage and animals. Above which, it is raised a lighter living floor with modular windows, which come from the idea of a timber frame and an angled roof covered with circular bricks. The Turkish upper classes' architecture was composed of two or three floors and the main reason was the view and perspective from the upper floors. Indeed, the upper parts of the houses were made of wood, while the lowers of stone. The distance between wooden frames was charged by brick and then painted. The final color depended on the area and the temporal era (Hassanpour & Soltanzadeh, 2016). Given the Ottoman's need to live and work in the open surrounding, the spatial distribution inside the dwelling is an important feature and it can be subdivided into three categories: open space, semi-open, and confined. The sustainable aspect of open space construction is that Turks mainly built their dwellings with a yard or garden, even if small. The green area was a crucial part of the house, the core, which was used to do many activities, allowed thermal comfort. On the contrary, with semi-open (Eyvan) space or *Sofa*, the internal part of the house is the core of the dwelling and comes from the nomadic way of living²². Namely, in the 11th century, massive immigration of Turks to Anatolia occurred and transformed totally the residential tradition of the place, which presented Byzantine features, constructed on natural streets, upon ancient cities,

²² In the previous periods, due to the lack of stability of the weather and natural conditions of the land, continuous migration was needed.

and finally protected by fortification walls. What happened is that the Turkish tribes that moved to Anatolia were from two distinct groups, the “*kentliler*” (sedentarians, or town dwellers) and the “*göçerler*” (nomads) (Hassanpour & Soltanzadeh, 2015)(N. Ş. Güçhan, 2017). The sofa (*hayat*), which is situated in the upper part of the house, is the living space of the house, a place where all the spaces are optimized, as the majority of the activities are done here. In cases of spatial extension, we can find the *eyvan* (iwan, also spelled ivan, a rectangular room that has walls on three sides, and one side open to the living room or the courtyard) and elements such as the *oak* (fireplace, used for both cooking and heating), the *sedir* (sitting platform), and the *merdiven* (stairway). The room in a house where an extended family lived is the private space that belonged to the nuclear family. The room, with its built-in furniture such as *ocak*, *sedir*, *yüklük* (cabinet), and *gusülhane* (bathing cabin), was the place for living during the day and resting at night. Of course, the number of rooms and decorations depended on the socio-economic situation of the owner, but generally, among the rooms in the traditional house, the best room in terms of decoration and space was dedicated to the guests (Güçhan,2017). Due to the internal division from the natural environment, in traditional houses appeared the ideas of closure to the outside and extended family, the most common characteristic of Middle Asian lifestyles. In semi-open spaces in the 16 and 17 centuries, the view was towards gardens or yards. The last typology is the Confined spaces or rooms. Its structure is characterized by a room inside a house because all the daily life functions are done inside the house. In addition, another feature of indoor design that comes from the nomadic lifestyle is flexibility, because one single space, decorated with carpets, chests, and kilims can be used in many ways. Moreover, as privacy is an important feature in the Islamic world, decorated wooden gate windows were put in the rooms to preserve privacy, but also for light control and efficiency. The introverted conception of life is reflected as well in the architecture because the attention to details and decorations can be found in the internal parts (Hassanpour & Soltanzadeh, 2015). To this purpose the orientation and location of the buildings are designed to avoid shading the other buildings and exploit the sunlight but also the windows of different dwellings should not be mirroring the windows of other houses. The external

decoration of the houses is simple but realized with local and natural materials like wood (Akyıldız, 2020)The hot and dry climate of the central and south-eastern parts of Turkey is not the only driving factor for the shape of buildings. Even socio-cultural issue forms the house. Indeed, the religion of Turks is Islam, so they try as much as possible to orient the house towards Mecca, the holy place for them. Furthermore, still, for cultural beliefs the windows never face the outside, there is no direct and visual contact with the outside. Moreover, in the hottest areas of Turkey, the shape of the vernacular roof was flat, so that people could rest and sleep there at night and the materials used presented a high heat capacity and prevented hot air transmission. On an urban perspective, the distance between one house and another one is reduced, so that roads are constantly shaded. Moreover, the dwellings are designed with courtyards and high and thick walls to preserve the internal temperature (Mashhadi, s.d.)(Mashhadi,2012,47-51). Courtyards constitute one of the basic elements of Islamic architecture because of their cultural value, but they are helpful as well to save energy and obtain thermal comfort. For this reason, all buildings in the hottest Islamic countries display courtyards (Al-Mamoori,2016). Finally, every facade is built depending on the solar radiation and gain at different times of the year (Mashhadi,2012). One of the most sustainable aspects of Ottoman vernacular architecture is the construction technique called *hımış*, and basically, it is “a hybrid system in which timber-framed upper floor(s) are built on top of a masonry ground floor” (Güçhan,2017) and it made up the majority of the Ottoman houses, from the Balkans to Syria. The prototypical Ottoman house that is built following this principle is composed of three parts: the masonry base (ground floor and foundations), and it is made totally with stones and mud bricks, according to local availability and costumes. After that, timber wall plates surround the internal and external surfaces of the ground floor. Taking into consideration the specific period of construction, after the timber framework is completed, the objective is to cover the roof, normally it is hipped or gabled in which all the connections are with nails. Adaptability, quickness, and easiness make timber a practical and sustainable building material. It was largely used in the Ottoman period also because of its low price. Moreover, it is proven to be more resistant to lateral forces (and so earthquakes) because of its lightness and elasticity (N. Ş.

Güçhan,2017). Another peculiar and emblematic device for covering openings and achieving thermal comfort and privacy in Islamic architecture is the mashrabeya. The name originally came from the Arabic word “drink”, so that meant “place for drinking”. Namely, jars full of water were used in front of the openings to decrease the temperature of air that entered the room, exploiting the evaporative cooling effect. Mashrabeya were little round wooden balusters collocated at different intervals that created a decorative pattern, and the size depended on the function needed in the interior space. In addition to what was mentioned, they were useful to light comfort, regulation, and absorbing humidity which in turn was retained and dissipated while water was passing through. Its origin and spread in the Islamic world were far before the Ottoman Empire, but during that period, mashrabeya contained more decorative shapes and floral patterns (Naguib & Talaat, 2018). Considering its dimensions, Turkish identity was created by taking various cultural components from other cultures, specifically from the Byzantine Empire, Seljuk state, and the Islamic Nations, moreover in the early times of the Ottoman Empire churches were converted into Mosque due to the lack of resources, as they were employed for the defense or conquer other cities (Kelly, 2019). The mosque represents the central part of Ottoman architecture, to the point that its symbolisms, use of light, and space are reflected in civil architecture such as madrasahs²³ and caravanserais as lifestyle and beliefs affect every part of someone’s life (Artkan, 2021). Finally, Wind catchers in Turkey (Badgel) are used in the old residential buildings of Sanliurfa city, but their origin is Iran, where the shapes and models are various. Wind catchers look like big chimneys, they are vertical shafts with vents on top to let the wind flow to the interior spaces and give thermal comfort. The given architectural element shows its compatibility with the natural environment around it, and it stores energy functioning respecting sustainability principles (Ahmadkhani, 2011). According to the Islamic perspective, the idea of sustainability includes meeting social and economic needs that connect to the environment. As Attia 2021 states “Ecological, biodiversity, and utility values for humankind both as spiritual substance and

²³ Multifunctional resting place

material resources, which applied in both city planning and the house design reflected that. Moreover, the house design is considered sustainable architecture. The house design and unique organization fulfill the ethical, social, and religious traditions. At the same time, the architectural elements, inner courts, Mashrabeiyah, and windcatchers fulfill the climate requirements regarding human comfort and energy consumption” (Attia, 2021). Traditional buildings present themselves as naturally energy efficient since they were built respecting the environmental conditions of the place they were located, and they required very little energy demand. Cooling systems and solutions were meaningful parts of ancient buildings, to keep the body healthy and fresh in harsh climates but also for food conservation and security. In old Turkish houses, they used various tools for cooling, such as the proper direction of spaces, sloped topography of the land, pottery vessels, and wooden granaries. Along with natural building materials such as mudbrick, timber, and stone that also provided cool interiors during hotter summer days. Ventilation is mostly granted using windows, doors, and chimney openings. Chimney openings can generally be noticed in all living spaces and provide smoke evacuation when in action but are also useful for natural ventilation of the space all year long (Ankaralıgil & Dişli,2021). Mosques, from the Arabic word Masjid which means to prostrate, represent a vital place for Muslims as they spend a lot of time there during the day. Actually, besides the worship side, there is the socio-cultural side of the place, but also the political one since old times.²⁴ The mosque is made up of the prayer hall (Bait as-Salah) which usually has a rectangular or square shape. Then the dome and minaret represent the symbolic value: the dome represents the face of heaven, and the minaret is the faith declaration but most of all the dome is the roofing system that covers all, with a little number of columns, it provides natural ventilation and light. Minaret calls believers to pray. Then we have the courtyard, attached to the areas dedicated to prayers. Usually the center of social activities (Asfour,

²⁴ “In the majority of Islamic world still there isn’t the separation between the state and the religion. Indeed, the separation between religion and civic affairs represents a controversial concept for Islamic political thought. The notion of secularism has acquired a very negative meaning as it is associated with the removal of Islamic influences from legal and political spheres under foreign colonial domination. Consequently, it is often perceived as an ideology which came from foreign countries imposed by invaders and carried out by post-colonial dominant elites. Usually felt as the equivalent of atheism of anti-religion”(Huang,2022).

2009). It is clear that there are many styles of mosque in the world, but the Ottoman style was particularly spread in the Anatolia region and what makes it different from the others is the use of domes and minarets shaped like pencils. Ottoman's focus on mosques is dome integration with the space around them. The size and shape of the dome had been increased in height and as a result, is much more evident. It can be said that such a style has changed the concept of mosques, from a semi-opened enclosure to an entirely closed building, covered by a huge dome. In previous research, it has been noticed that the architecture of mosques is environmentally friendly, so its thermal potential should be taken into account for further design processes. It is founded that in Arabic mosques, that are made up of a large courtyard and a covered prayer hall with flat or pitched roof and Domes and minarets further integrated, there is better thermal performance in winter than Ottoman ones because building users feel less discomfort by about 50% in the case of higher temperatures and by about 35% in case of temperate climate. On the contrary, the Ottoman Mosque style provides better thermal performance in summer, compared to the Arabic one as Muslims feel less discomfort by about 30% in the case of high and harsh and by about 80% in the case of temperate climates (Ibid.). Many Turkish mosques have been built using clay pots, a multi-functional material that can reduce building load, sewerage pipes, and help in the ventilation system. In Anatolia, the practice of using clay pottery for construction dates back in history. Clay pottery for ventilation purposes is used to attenuate the fume caused by candles through the creation of channels for ventilation. In Turkish architecture, clay pots are used in Baths as well as in chimneys called "tüteklik" which were used to control and adjust the internal temperature of places when needed. Here below is a list of buildings that have been constructed using clay pottery for ventilation purposes:

Table 5: “Selected structures with clay pottery employment for ventilation purposes in Ottoman Architecture.

Source: Atay & Gül, 2020,9

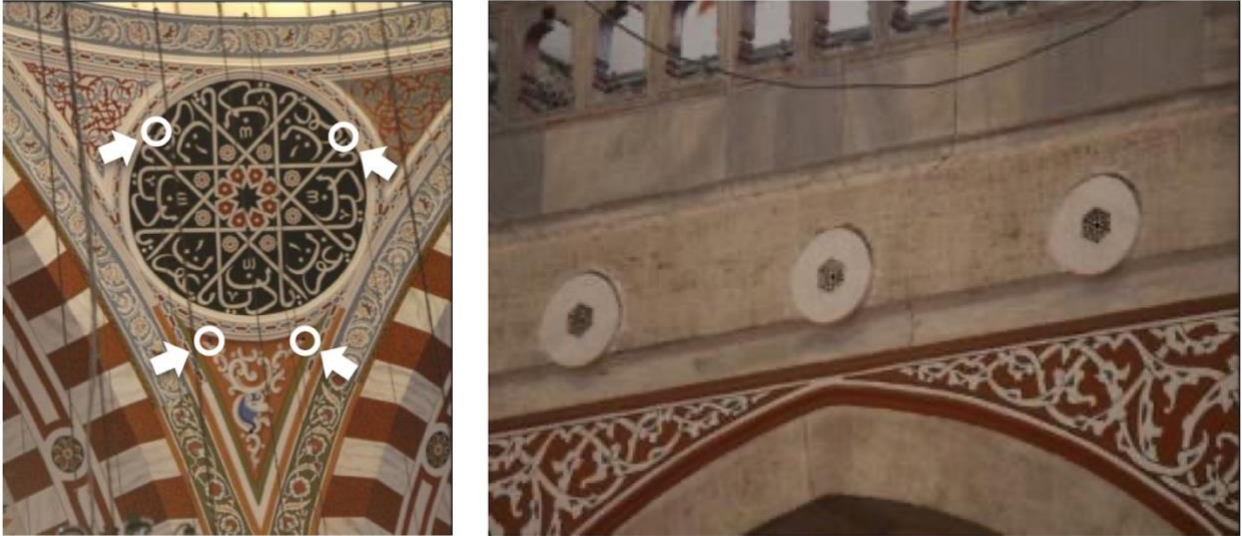
Structure	Date	Architect	Location	Placement
Piyale Paşa Mosque	16th cent	Sinan the Architect	İstanbul	Pendentives ^{29,35}
Tomb of Suleyman the Magnificent	16th cent	Sinan the Architect	İstanbul	Between the double domes ^{35,36}
Şehzade Mosque	16th cent	Sinan the Architect	İstanbul	Pendentives & walls ^{21,22,26}

25

(Asfour, 2009).The Şehzade Mosque in Istanbul contains clay pipes not only on its dome structure but also on its pendentives and side walls. According to Erçağ, cited by G. Atay and Z.S. Gül (2020), an 100cm depth air gap, linked to the air shaft inside the piers, was found behind the pendentive walls when restoration of the structure happened in 1990. The main prayer hall is connected to this plenum space through four clay pipes that are placed in the pendentive. And it is considered that their function is for ventilative purposes. Such a suggestion is validated by the southern part of the building. The clay pots' dimensions are similar to the ones used in the dome. These ones on the walls have a diameter of 20cm with a depth of 40cm. (Atay & Gül, 2020). According to some analysis of thermal quality, it can be affirmed that Mosque Sehzade on the hottest day in Istanbul City, had a thermal comfort condition of 70%. Whereas, on the coolest day, it is outside the limit of thermal comfort (Sugini et al., 2017).

²⁵ Selected structures with clay pottery employment for ventilation purposes in Ottoman Architecture”, picture from Atay & Gül, 2020,9

Figure 14: Şehzade Mosque, pots placement. Source: Atay & Gül, 2022, 9



26

The last element that will be analyzed comes from Iran, it is the well-known Malqaf or wind catcher. It is famous for its architectural capability of achieving indoor thermal comfort, a Persian tool that has been used for centuries in the most humid and hot climate of the Middle East. As stated by Mohamed & Mohammed : “It is a tower, where there are air outlets that rise above the building facades to pull cold air down to let it enter in the interior rooms of the house. The external air movement of its dome creates a pressure differential that helps more air to the inside. So, its presence with the Mashrabiya -that opens to the internal courtyard- ensures the constant renewal of the cabin air. It is also useful to reduce sand and dust in windy regions and the size of the Malqaf depends on the average air temperature outside, if the temperature at the outlet entrance is low, the area of the horizontal section should be larger and vice versa. In case of airflow over a water element, can be directed to

²⁶ Şehzade Mosque, Istanbul. Pots placement in the pendentive on the left. placement of the pots in the pendentive Şehzade Mosque, Openings of the pots on the walls on the right (via Atay & Gül, 2022, 9)

increase its moisture content It is also useful in dense cities where the airflow at the window level is very slow” (Mohamed & Mohammed, 2018). The construction materials used for Malqaf are strictly related to climate. For this reason, the choice of materials depends on the climate of the area, and also, they need to grant their passive cooling efficiency. In hot and dry climates, they are built using both mud brick, which passes heat for a long time, or more commonly baked brick and covered by mud plaster (*Kah gel*) a combination of wet earth with fine or chopped coarse straw. These building materials make the wind tower a course, and the covering facade is light, and therefore reflects better the rays of sunshine (Ibid.). The most spread and used wind catcher is a tubular arrangement that has a rectangular or square basis. As mentioned before, depending on the climatic conditions of the region, they can be designed with a single overture and single wind scoop or a multi-directional and multi-barrel *malqaf* with heat-basin fundamental (Chohan & Awad, 2022). Malqaf structures differ, and in Arab countries like UAE or Egypt people use two-sided wind catchers in their buildings. But in regions like Pakistan, there have been used in residential buildings one single one-sided barrel. Some studies conducted reveal that the functioning and effectiveness of wind catchers are heavily determined by the physical characteristics of the tower, for example, the number of openings and the height. For this reason, based on their features, they can be organized into four groups: internal division, cross-sections, number of stores, and openings. Additionally, a more specific classification of wind catchers can also be made according to the basis of a number of openings, such as single-side, two-side, four-sides, six-sides, and eight-sides. According to the shape of their fundamentals, they further can be divided into five groups such as square-based, rectangular-based, circular-based, hexagonal-based, and octagonal-based. According to some studies, the best performance and effectiveness were the single- and two-sided wind catchers compared to all the other designs. Consequently, one-sided and two-sided wind catchers are very popular in mono-directional wind regions due to the unstoppable high flow. In addition, it is considered an environmentally friendly and low-priced ventilation strategy (Ibid.) .

Sour Studio, Istanbul

4.3.4 Urban Rural V1 Project - Geomdan Museum & Library Cultural Complex (Incheon, South Korea)

The percentage of the population living in the countryside in Turkey has drastically decreased in two or three decades, in relative and absolute terms. Since the 1950s, the Turkish rural population living in the natural environment has decreased from three-quarters of the country's total to less than a quarter. At the beginning of the 80s, the population was growing in the countryside, but still to a lesser extent compared to its urban counterpart. But with the advent of the millennium, the exact number of people that lived in rural areas has strongly dropped (Öztürk et al., 2018). Such a statement asks to answer to what is then the notion of "rural". According to Wiggins and Proctor, cited by S. Abdulwakeel, there not a definitive definition of the term, but rural zones can be easily recognized as they are constituted by the space where human establishment and infrastructure cover only a small portion of the landscape, most of which is dominated by fields and natural elements like pastures woods and forest, water, mountain, and desert (Abdulwakeel, 2017). Such massive migration represents a problem in the present framework, for situations like small arrangements where a lot of people commute to work, and therefore it is not anymore, the primary source of natural resources. Moreover, the mechanization of agriculture played an important role in the reduction of the labor needed during the second half of the twentieth century. On the other side, industrialization and urbanization flourished rapidly in Turkey in the 1960s, with a large number of people reaching the cities, in particular Istanbul. It also should be noted that in the period that ranges from 1975 and 2000, around 3.5 million people moved from rural areas to urban zones (Öztürk et al., 2018). The urban area is the place that undergoes the urbanization process and where an incredible number of people reside, so as a consequence, it is subject to constant and significant changes. What is important to know is that the definition of urban is different from one country to another. For example, in places

like Canada or Australia, if the inhabitants are less than 1.000, then it is called an urban area. Differently, in Norway, the urban area is defined by house distance, which should not be more than two meters away from each other, with the exception of parks, sports centers, and industrial zones. In France, urban establishments are considered as such if they are made up of municipalities that contain an urban hub and rural municipalities, where at least provide work for 97% of the population. In any case, we can say that urban zones are crowded locations where a lot of people live. The concept of “urban transformation” has been at the core of the public authorities' and politicians' speeches since the beginning of the present century, and often it is used as a tool to justify the way they planned and organized the physical aspect of the cities. The rhetoric of the politicians surrounding the theme is persuasive, “promoted as it is to the general public as a solution to almost all of the city’s ills: it helps to avoid earthquakes, reduces crime, decreases segregation, removes stigma, increases poor living conditions and even combats terrorism!” (İslam, 2010). The highly convincing power of such political discourse has actually helped substantially in the development of support by the majority of the population, which has been translated into the transformation of the urban space of Istanbul, giving rise to urban projects, gentrification, and renewal of historic neighborhoods (İslam, 2010). In a gentrification area, Sour Architecture studio realized the project Urban Rural V1, a new typology of dwelling that presents the features of a sustainable transformation strategy, that possibly will become exemplary in the urban landscape of Istanbul, as it offers a hybrid design of lifestyle that puts together elements of rural life within a city. A key value of the construction is community cultivation by a booming interaction point for different uses (<https://www.sour.studio/projects/urban-rural-v1>). Urban Rural aims to downplay the building’s ecological footprint and maximize its positive impact on the environment. The ecological footprint, a concept created by Canadian ecologist “estimates the biologically productive land and sea area needed to provide the renewable resources that a population consumes and to absorb the wastes it generates—using prevailing technology and resource-management practices—rather than trying to determine how many people a given land area or the entire planet can support. It measures the requirements for productive areas (croplands, grazing lands

for animal products, forested areas to produce wood products, marine areas for fisheries, built-up land for housing and infrastructure, and forested land needed to absorb carbon dioxide emissions from energy consumption). One can estimate the EF, measured in “global hectares” (gha), at various scales—for individuals, regions, countries, and humanity as a whole (One hectare equals 2.47 acres.). The resulting figures can allow much productive area—or biocapacity—to be available” (Hayden, 2023). Thus, ecological footprint analysis seeks the sustainability and equity of consumption in production practices. Nowadays, the world, lives of human and non-human entities is threatened by too high levels of greenhouse gases in the atmosphere and changes in the climate. On a global scale, CO₂ emissions in 2020 have increased by 2% reaching 30 billion tons. And it seems that the building sector is the first responsible for energy resource depletion and rise in the CO₂ emissions levels, even if the majority of the CO₂ emissions reach the atmosphere by burning fossil fuels to generate electricity for industries, beyond residential and commercial constructions. Turkey, in 2020, have been emitted almost 392.79 million tons of CO₂, which is approximately 1.3% of the global amount (Hayden, 2023). According to Atmaca (2018a, 2018b), the concept of carbon footprint in the construction sector should be defined as” the total CO₂ emissions through land clearance and consumption of energy, fuels, building materials (cement, steel, aluminum, etc.), transportation and other services”. It is clear that there is a strong link between energy consumption and environmental degradation. As a consequence, energy consumption, which is an increasing function of emissions, proportionally rise the amount of global CO₂ emissions (Atmaca et al., 2022). To talk again in figures, about 32.4% of the building stock in Turkey has been built between 2000 and 2020 and according to EIA (2019) around 21% of the total energy is depleted by buildings. Consequently, “about 50.2% of the total energy use in buildings is supplied by natural gas, followed by electrical energy (21.1%), renewables and wastes (18.8%) and solid fuels (8.9%) (Eurostat, 2019). The utilization of electrical energy in Turkey rose constantly from 2001 to 2020 (from 1652 to 2847 kWh per capita). Likewise, the depletion of natural gas has risen from 25.7 to 43.2 billion m³ in the sector. CO₂ emissions in Turkey were calculated to be around 5 metric tons per capita in 2015 by the World Bank (2019). Besides, Turkey updated

its 2023 targets about preparing policy instruments for improving fuel efficiency and reducing emissions in its 11th Development Plan. The country's CO₂ emissions are continuously rising, and the country needs to decrease emissions below 226 MtCO₂e by 2050. By 2030, the national emissions reduction target of Turkey is to decrease the levels by 21% to meet the 1.5 °C limit of the Paris Agreement. However, the CO₂ emissions of Turkey are projected to be between 730 and 884 MtCO₂eq in 2030 with current policies” (Atmaca et al., 2022).

As explained before, the aim of Urban Rural is the reduction of the building's waste footprint and on the other side, to bring vegetation to dense city centers like Istanbul. The presence of green areas has not only proven to be an optimal tool for passive cooling but also to control the Urban Heat Island²⁷ effect. Another positive effect of the integration of vegetation in buildings is Biophilia²⁸. Indeed, Biophilic cities, or elements in cities, provide plenty of positive benefits, both in personal life and a family one, as that natural integration will help you to be more resilient, enhancing the capabilities for dealing with stressors elements. Therefore, biophilic cities are more resilient too. Green elements in cities prove to underestimate health benefits. Still according to research, citizens that live in greener districts are keen on walking more and spending much more time in nature, reducing risks for diseases and experiencing health-positive effects (Beatley & Newman, 2013).

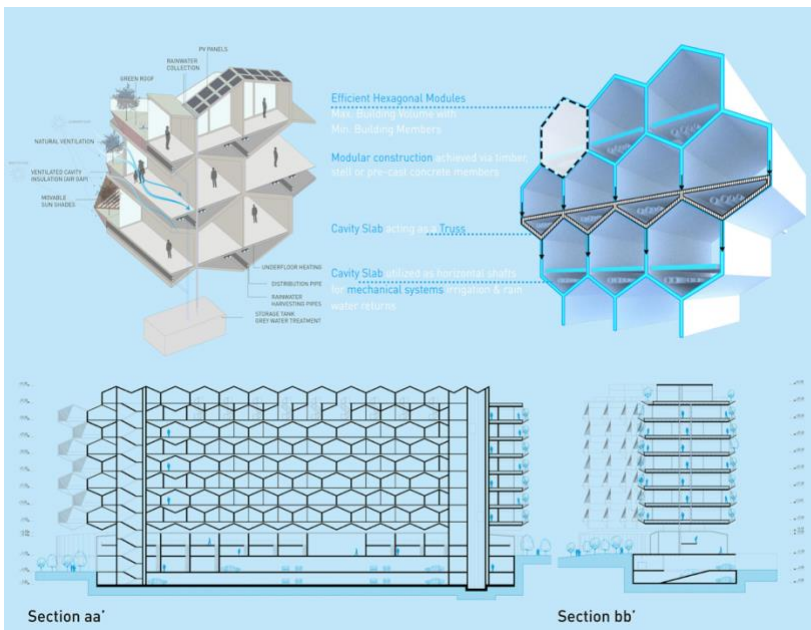
²⁷ “urban areas where temperatures are higher than their surrounding rural areas which occurs when vegetation and water bodies are replaced by impervious materials with higher heat capacities and conductivity such as pavements and buildings” (Tuczek et al., 2022,1)

²⁸ “Biophilia was initially used by Erich Fromm to describe the psychological orientation to preserve life, and subsequently by Edward O. Wilson to describe the evolutionary adaptation that allows us to develop an affective bond with the living world (the Biophilia Hypothesis). Wilson identified two principal constructs of biophilia: fascination for and affiliation with life. Biophilia depends on the ability to focus attention on natural stimuli effortlessly, to be fascinated by Nature, and the ability to connect emotionally to the various life forms, namely, to affiliate with them” (via [Network, 2021](#))

Figures 15-16: Urban-Rural project. Source: <https://www.sour.studio/projects/urban-rural-v1>



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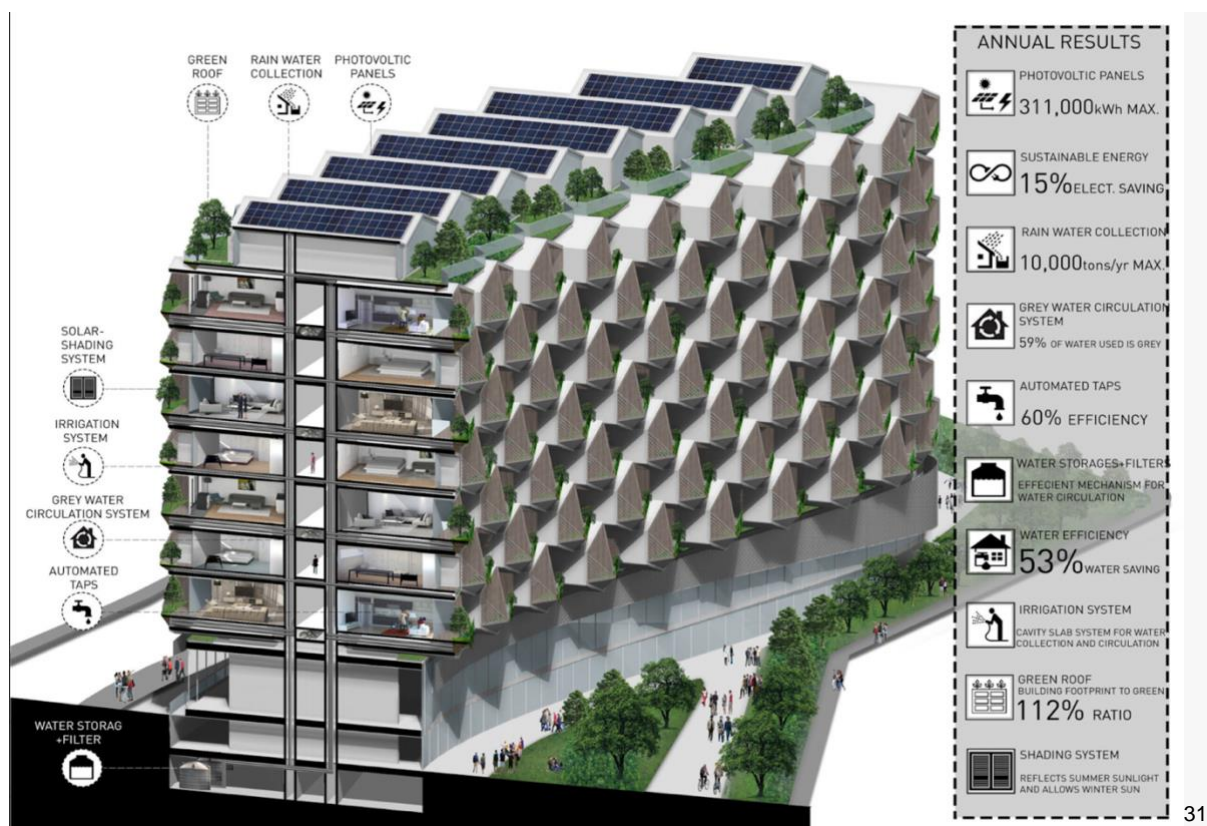
“It is a modular design with mechanical components that collapse for ease and efficiency in transportation, reducing the carbon footprint of sourcing for construction. One hexagon unit consists of a polygonal area to inhabit and a triangular cavity to be used as an irrigable garden. When all

²⁹ Photo via <https://www.sour.studio/projects/urban-rural-v1>

³⁰ Photo via <https://www.sour.studio/projects/urban-rural-v1>

modules are combined, these triangle cavities act as a truss structure transferring the building's loads to lower members. As a whole, Urban-Rural creates interdependencies between building systems, structure, landscape, and architecture. Integration of such complex systems is achieved through a modular design that perseveres flexibility". (Sour Studio, <https://www.sour.studio/projects/urban-rural-v1>) The size of the structure is 30,000 m2, and it is first of all a residential construction (239 apartments) with common areas like Gym, Spa, and pool. There are shops as well.

Figure 17: Urban-Rural. Source: <https://www.sour.studio/projects/urban-rural-v1>



What can be noticed from the picture of the Urban-Rural V1 project is the adoption of passive cooling techniques to keep cool and inspired by traditional architecture. Green roofs symbolize well-consolidated solutions recent buildings reduce considerably energy expenditures. Both theoretical

³¹ Photo via <https://www.sour.studio/projects/urban-rural-v1>

and experimental analyses have been conducted and they all show that in summer the temperature between green and structural roofs diminishes noticeably, if compared to traditional options. Moreover, they limit the amount of thermal energy that enters the internal spaces. Consequently, have been conducted empirical measurements on a green roof in areas characterized by a Mediterranean climate, and what they showed is that the cooling peak powers noticeably decreased and cooling demands were 37.9% lower than for another dark building roof. To a larger extent, green roofs grant their support in the urban heat islands (UHIs) mitigations, thus leading to enhance quality standards and lifestyles in cities all around the world (Bruno et al., 2021). As confirmed by Inanc Eray, in the interview, the project takes inspiration from traditional architecture: “The principles come from there, the architecture in Turkey is really traditional. We are taking the rural villa and putting it in a complex. So like the form, it comes directly from the Turkish house. But then it becomes very modern, and in the end, it is a very modern project” (Inanc Eray). Personally, I find the facade the most typical feature of traditional Islamic architecture. In my opinion, the most evident traditional element is the design, based on the concept shading and the “mashrabiya”, the original wooden shading device, that comes from the Islamic architecture and influence and since its origin was needed to obtain privacy and maintain indoor spaces fresh, reducing the heat caused by solar sunlight in hottest days. Similarly to the Al Bahr Towers (office building) in Abu Dhabi, United Arab Emirates, I find in this project all the elements of regional architecture inspired by nature and orientation towards the best performances, also having in mind sustainability, performance, and geometric configuration, applying the innovative version of the mashrabiya-like façade creating an aesthetic and practical design (*Al Bahr Towers / Aedas - Arch2O.Com*, s.d.)³²The Urban-Rural, announced by Eray Carbajo is then a groundbreaking construction that have been constructed in 2019, with the aim of a sustainable transformation. But the first aspect that the designer underlined is the Turkish financial model: “The financial model has changed as well because of the economy in Turkey. Let me start by

³² <https://www.arch2o.com/al-bahr-towers-aedas/>

saying that at the beginning the project was one-to-one, but now it is one-to-twenty, so there has been a value change” (Inanc Eray). According to the World Bank, Turkey is the 19th largest economy worldwide, with a GDP of \$906 billion, and a member state as well of the OECD and the G20 but it is currently facing a financial crisis (*Overview*, s.d.). Turkey’s economic issues come from the policies adopted by Recep Erdogan. In 2002, when the country’s economy was getting better from the financial crisis of 2000-2001, the AKP³³ took power. The 2000-2001 crisis originated as the worst recession of the state since World War II. The reforms were implemented by the Minister of Economic Affairs and Treasury of Turkey, Kemal Derviş in 2001, resulted as successful but it was not sufficient for winning the election, giving room to AKP party, initially led by the Prime Minister Abdullah Gül who from 2003 gave the chair to Recep Erdoğan, who kept following the political lines and reforms started from its predecessors, which brought great success and empowered the coalition. Since the start, Erdoğan has applied aggressive and pro-growth strategies, obtaining remarkable results («Economic Crisis in Turkey», 2022). At that point, he decided to implement big-budget infrastructure deals, attracted foreign investors, and boosted firms and consumers to debt. These given assets gave chance to Turkish economy to grow fast, and according to Daily Telegraph that was supposed to be an “economic miracle” as in that period there has been an achievement in poverty reduction, and the society's Poverty was reduced. The governmental ability to deal with the global financial crisis of 2007-2009 can be proven by the following figures. “ A slowdown in the GDP grows by strong girth in 2008 to 0.6 percent and a recession of -4.8 percent in 2009 were followed by 8.4 percent in 2010 and 11.2 percent in 2011” The reasons that “overheated the economy were linked also to their dependence on foreign energetic resources but at the same time it was not able to achieve a foreign trade surplus («Economic Crisis in Turkey», 2022)³⁴. The aggressive and dynamic economy that expanded at a 10% annual rate of GDP in 2011, crashed in 2012. The Turkish lira (TRY) dropped by a quarter between November 2010 and September 2011, making it the world’s worst-performing

³³ Justice Development Party

³⁴ <https://www.economist.com/special-report/2023/01/16/the-turkish-economy-is-in-pressing-need-of-reform-and-repair>

emerging market currency (Goldman, s.d.)(David P. Goldman,2012). Indeed, just from the beginning of 2012 until now, the Turkish lira has lost more than 80 percent of its value, so that for Turkish inhabitants, the prices keep rising and inflation rate reached almost the 20 percent in September 2021(Sazak, 2021). According to the Turkish Inflation Research Group (ENAG), which conducts measurements on goods and services, a 105.19% of price increase in May 2023, compared to the previous year, with a consequence of rising prices of three times. And as confirmed by the economist Bilge Yılmaz of the nationalist IYI party, “Right now is deprived of foreign capital because it’s not predictable, it’s not trustworthy”(Michaelson, 2023). So, when I asked for the target of the apartments, the designer answered to me is “ We were targeting the 40% of affordability. But when the economy changes so drastically, when it is so volatile, no plans is basically and the construction of the projects from planning to build is around 5 years and 5 years is a very long time for Turkey. It is seriously a devaluation of money that becomes a huge problem” and he continues “Basically whoever pays the money, gets the world. So, when you target this kind of social agenda, inclusion and sustainability and then all of a sudden you are facing a developer making a deal with the government saying “ I cannot build this... I am not able to make any money... Or I am not profitable here like “I am going to quit”, then the government gives him like “ok then you don’t have to do any affordable house ... you don’t have to do this and that so the plan kind of changes along the way. So with this volatile economy unfortunately it’s like that. In the USA, where now I am based, there are not these kinds of problems, also in the UK, where there is a rule, is a rule. But the economy there is also very stable, not volatile. The pound and dollar value are like. what I try to say is that is all about the economy at some point. You know, the financial model has to make sense and then kind of the price. But now the price point I think, because of that as well doesn’t make sense at all. Now, nobody would buy, basically. That’s why we turned all the apartments into 1 bedroom, from 3 or 4 to one, the value changes daily, you can check on the website” (Inanc Eray). Despite the volatility of economy and values in prices, what emerged from the interview is the corruption of the government. Indeed, corruption has been recognized as a major problem in construction projects (Zhai et al., 2021).

Owusu, Chan, and Shan (2019), cited by D.Sanderson et al (2021) carried out a review of causes beyond building corruption and they found several triggers worldwide. Namely, too-close relationships, poor professional ethical standards, negative industrial and working conditions, negative role models, and finally inadequate sanctions throughout the phases of construction. The final assumption is that it looks like no country's building industry is immune from corruption. Moreover, the corruption of "consent" and a safe mindset toward building also depends on social status and education (Sanderson et al., 2021). Finally, I asked him if he could mention to me another similar project, that combines both traditional Islamic architecture and passive cooling features and he presented me with their latest project "Geomdan Museum & Library Cultural Complex (Incheon, South Korea)It is a museum and library complex (around 26 thousand square meters). As you know, the urban-rural is like a residential and commercial complex on the ground floor. This one is now a public building. Both are good examples. But the second one is more focused on the cooling, heating, and mechanical strategy becoming the aesthetics of the building. So we are basically using chimneys. The project title is also like "Chimneys are the new sexy", so we are saying that we need to change the way we are designing. As architects the design criteria should be climate impact first." "Chimneys are the new sexy" is an archeological park, shaped as an archeological museum and library, that is going to become a peculiar and unique complex and public building for the area. The builders believe that the project to be a great opportunity to restore the traditional aesthetics and adapt them more towards climate resilience and green architecture. With this project, the aim is to connect and merge urban spaces and landscapes on a morphological basis, by using well-known rooted traditional methods that reduce energy consumption. The inspiration actually comes from the Windcatcher mechanism, which comes from Iran, but also from Anatolian houses that are built following these characteristics in terms of ventilation (Via ([Sazak, 2021](#))).³⁵ The interview ended with the hope of creating more projects like these ones. "Hopefully, I am very hopeful. I think that again it depends

³⁵ <https://www.sour.studio/projects/incheon-archeological-park>

on the economy. Turkey is not in a good place right now. I think maybe in 5 or 10 years, there will be a run-up, depending also on the elections in May, 14. Let's see what happens but I am always hopeful" (Inanc Eray).

Figure 18: Geomdan Museum & Library Cultural Complex (Incheon, South Korea). Source:

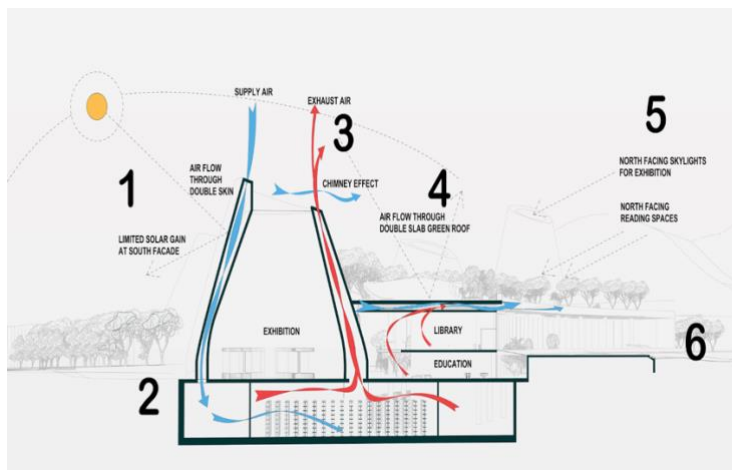
<https://www.sour.studio/projects/incheon-archeological-park>

Figure 19: Cooling mechanism of the Geomdan Museum & Library Cultural Complex. Source:

<https://www.sour.studio/projects/incheon-archeological-park>



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³⁶ <https://www.sour.studio/projects/incheon-archeological-park>

³⁷ <https://www.sour.studio/projects/incheon-archeological-park>

5. Conclusion

The aim of the research was to find alternatives to air conditioning technologies to maintain thermal comfort in buildings from the traditional sustainable architecture of Turkey's Ottoman period, of Indian Mughal's one and of Indonesia. A historical and sociological approach was used to understand how socioeconomic and cultural dynamics shape the way people adapt to extreme heat in selected countries. I wanted to find green inspirations in traditional vernacular and monumental architecture from Middle East countries (with a focus on Turkey), Indonesia, and India, as they present a long relationship in coping with harsh hot and dry climates. Moreover, I find their artistic heritage very beautiful, in terms of aesthetics. As I wanted to understand the social and cultural dynamics of the chosen countries, the very first part of the thesis is a literature review on the gender and economy-related consume of energy and the role of religion in driving sustainable choices in terms of cooling and energy. Starting from the case of India, where social status still heavily impacts daily life, it resulted that education level, income, and age are factors influencing the access and consumption of up-to-date energy resources (Saxena & Bhattacharya, 2018). Moreover, from a gender-based perspective, if we consider the indoor spaces and facilities of the houses, we can easily understand that even the basic electricity tools are not always used in an equitable way, the asymmetrical power is reflected as well in the use of electronic devices, while "gender equal" is used with no distinctions (Rosenberg et al., 2020). At the same time, in Indonesia, it is the woman who has control of the house, so it is in her hands the amount of energy consumed but still gender, income and education level, and control over household expenditures are the variables taken into consideration. In Indonesia, there is a rational distribution of duties between genders, but the female power in decision-making depended on her education level in most cases, and when there is the same

educational level between men and women, the decision-making is shared (Permana et al., 2015). Similar parameters have been used to measure the energy consumption in Turkish houses, but the additional element that was included in the calculation was the house typology. Again here, the gender aspect of energy consumption is determining because women, who tend to spend more time at home and use more energy for electronic devices (like air conditioning) definitely pay more attention to energy waste (Ucal, 2017). Then I moved towards the relationship between religion linked to energy consumption among Hindu, Muslim, Buddhism, and Judaism followers and it resulted that Muslim neighborhoods are the ones who consume the most. Then I asked myself if religion, which in some sort is still followed by 90% of the population, can have an impact on climate change perception and consequently drive cooling choices . What emerged is that it has a negative impact on climate change awareness as religiosity strongly tends to demand current mitigation rather than future environmental threats (Urbatsch & Wang, 2021). After that, I proceeded with an explanation of the main features of passive cooling techniques in buildings and energy efficiency and a definition of when a construction can be defined as bioclimatic, namely it has to be built following principles of orientation, shape, colors, windows, and material used. Moreover, I provided an overview of the various types of passive cooling methods, which can be categorized for into six main categories: Shading, Convection cooling, Evaporating cooling, Radiative cooling, Geo Cooling, and greening and I concluded by explaining why do we need passive cooling strategies in construction: it means reducing thermal shifts between internal and external temperatures, creating comfortable thermal perception to live or work in, without harming the environment, possibly reducing the impact of the greenhouse gas emissions derived from the overuse of air conditioning (Taleb, 2014b) After that, I started to introduce the cases studies, divided according to the country. Each case study, started with the country profile, which included facts on population, religion and growth rate and historical background. Then, I moved to the description of cooling strategies and sustainable techniques of classical architecture: starting from Indonesia, in the traditional vernacular architecture we can find the *Rumah Tongkonan*, the traditional home of the Torajan people in South Sulawesi, modeled like a wooden boat, engraved

and painted. Then, *Kampung Naga* is a customary Sundanese settlement in Neglasari Village, Salawu District, Tasikmalaya, home to almost 70% of the population there, built collectively for low-income citizens, and they must ensure natural ventilation and high air quality, using local materials collected in the enclosing area. Furthermore, I showed the three traditional vernacular architecture of the Javanese people. Dwelling differences depend on the shape of the roof: *Joglo*, *Limasan*, *Panggangpe* (temporary residence), and *Tajug* (religious buildings). *Joglo* is the most elaborate and well-known. Although it is considered to be sacred. Other examples include the *Aceh aboh ineung* house (one bedroom), which is entirely built of wood. It does not have an internal visible roof, but the external part is made of thatch leaves. Then we have the *Baileo*, typical of the Maluku province, and it is a meeting place, it is an inherited gift, and it is the epicenter of the activities of the community. Finally, the Rumah Gadang, which has the most peculiar and recognizable roof, whose extremities are shaped as buffalo horns, *gonjong*. Its sustainability relies on the choice of materials for making it. Cultural and indigenous elements emerged as well, as the architectural element is just another side of the culture, it is its reflection. The last type of traditional sustainable building is the mosque. The peculiarity, in this case, is that such religious buildings have adapted to the previous socio-cultural background. Commonly, mosques adopt the typical ornaments of Islamic art from the Middle East, but in this case, we see typical Indonesian roofs on religious buildings. The interesting aspect, already underlined in previous research is the “Javanese Islam” that can be found in the architecture of the archipelago, as the Javanese accepted the beginning of the new belief, integrating into the previous background and religious knowledge. Another aspect that is interesting about the relationship between architecture and religion of the county is the dwelling gendered division of space, a typical feature of the Islamic view. Finally, it has been proven that almost 80% of the users feel thermal comfort inside religious buildings in Indonesia. After Indonesia, I shifted the focus of the research to another country: India. The period analyzed was the Moghul one, with the related Islamic influence on architecture. This part of the research is based on a previous essay that I wrote “Sustainable Architecture in Mughal Empire: Passive cooling techniques of Medieval Vernacular Architecture”,

but I integrated some new parts. An important contribution is provided by the point of view of Islamic followers toward the idea of sustainability. For them, preserving the environment is considered a duty, as they are agents of God on earth, and no other creature can do that for themselves. That vision is quite interesting, considering that they are the ones that consume more energy for appliances compared to the other faiths. The Islamic sustainable features that can be recognized in the Mughal architecture include gardens (symbols of paradise), Jaalis which are perforated lattice screens, and landmarks of the Indo-Islamic architecture of the Subcontinent. They are useful to filter light but at the same time grant privacy. Their aesthetic connotation plays a role. Still, the use of local materials for construction is a key element to maintaining a reduced carbon footprint. Moving then to the case of Turkey, I decided to talk about the traditional architecture of the Ottoman Empire. The liaison among the three different states is the influence of Islam on sustainable architectural features. For India, the sustainable characteristics of monumental architecture are reflected in the vernacular one as well. But, coming back to Turkey, after an analysis of the historical background and climatic conditions, what emerges as a traditional sustainable architectural element is their idea of living and working, as long as possible, in open natural areas so that the spatial distribution inside the dwelling is an important feature, and can be subdivided into three categories: open space, semi-open, and confined. As a consequence, they always try to build dwellings with a yard, even if small. The other sustainable aspect is their maximization and flexibility in the use of space: the *Sofa* is the internal part of the house, the core of the dwelling. It originated from the nomadic way of living, and it can be used in many ways. The privacy conception of life is reflected in the building, as they are generally simple in the external areas, but decorated and full of details in the internal parts. Finally, thanks to their use of orienting buildings, it can be stated that they are bioclimatic, as they can evade too much shade. Similar to the Jali, in Turkey they have mashrabiya, a wooden lattice screen that protects from sun radiations, so helps keeping cool, and ensures privacy. Again, the thermal comfort in Ottoman mosques is better in summer, compared to the Arabic ones as Muslims feel less discomfort by about 30% in the case of high and harsh and by about 80% in the case of temperate climates (Asfour, 2009)

and the reason behind is the use of clay pottery, for ventilation purposes, to build the religious buildings. The last element taken from the traditional Islamic background is the windcatcher from Iran. It is well known for its passive cooling potential, as it can achieve internal thermal comfort, thanks to the shape of its dome and its color. Finally, each case study is concluded by the contemporary implications on today's choices, realized by an analysis of interviews. The first one has been with the owner of Raw Architecture Studio, who explained to me his vision of architecture. He wants to provoke change; he wants to have a social impact on the population. To this purpose, he created a ground-breaking typology of social housing, located close to the working area, that embed free educational areas and libraries, in a sustainable and aesthetically pleasant building. He said to me that he wants to provide his workers, but Indonesians in general, with a decent living environment, because still, there is a very high percentage of people that live in slums or ghettos there and the government still has to work in this direction. In Europe, we are currently facing a social housing crisis, so in my opinion, this new type of housing presented by RAW architecture could be an option to export to Europe. It combines functionality, sustainability aesthetics, and affordability. Concerning the Sour Studio projects, it is interesting to notice how they integrated traditional elements into the very modern construction of apartments and museums. To conclude, even if I didn't have the opportunity to interview Studio Lotus, I found some interesting facts. Krushi Bahawan is a multi-functional passive and sustainable building. Beyond that, what caught my attention is the reproduction of a strong and cultural identity in the complex. Done by indigenous crafts integration into the structure of the building, it saves a lot of energy but also enhances the connection and collaboration between people, which I think is a very important element. I then compared the concept of this multi-functional building to our European counterpart. What I found is the homologation and aseptic shapes of the construction. Maybe we are more advanced in terms of technologies, as for example the case of One Angel Square, everything can be controlled by an app, but I think that we should learn from them to keep and integrate our crafts into our contemporary construction. Looking at the pictures, I felt the sensation of disorientation, because nothing from the architecture made me understand

something about the location where it was built or its culture. Therefore I suggest amalgamating vernacular aspects to these brand-new buildings, as that constitutes our identity in a certain sense. The purpose of the research has been partially achieved, as the traditional Ottoman, Mughal, and Indonesian architectures provide a huge number of alternatives to air conditioning. In addition, the traditional influence on the design of modern buildings appears in every construction analyzed. The interesting part, which was not planned, has been the discovery of alternative multi-functional buildings typology. What is missing, is the part related to the tools used to obtain thermal comfort by people from different income levels. At the same time, I wish I had the opportunity to do on-field research to directly speak with workers and users of the multi-functional buildings analyzed. Further research on traditional architecture cooling tools in other parts of Asia would be interesting. I want to conclude with a translation of a quote from B. Calder, 2021,418-419: “As for Uruk structures, inspired by textiles, in architecture change always came from something that already exists, it may happen that the most important ideas and technologies that will constitute the basis of sustainable architecture are already being used somewhere: maybe their combination or modification will not lead to new revolutionary technology but will be a key to create aesthetic and high-quality buildings that don’t necessarily need a large number of fossil fuels (...) From radical changes that will be mandatory in the next few years, we will see rising new forms of beauty”(Calder, 2021).

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7.APPENDIX

URBAN RURAL V1 INTERVIEW

C: Hello, I am Cecilia Petrucci, and I am working on a project about sustainable buildings that use passive cooling techniques and buildings in Asian cities, and Turkey of course. Modern buildings have features from the traditional architecture of the country. I am interested in your Urban Rural V1 project because it reminds me of the idea of modernity and sustainability which transport nature in the city center, to me it seems amazing. I would like to know the passive cooling techniques of the structure and the cooling mechanisms, how it works, and also if there are and what elements are taken from the traditional architecture.

S: I would say, I mean now it is completed, finished but it faced many changes. The financial model has changed as well because of the economy in Turkey. Let me start by saying that at the beginning the project was one-to-one, but now it is one-to-twenty, so there has been a value change. In the building there is ventilation, but I don't think there is a proper passive strategy there, only a green strategy there. So the balconies still work as gardens. More in the very center of the city and when it was designed there was a variety of 3 plus 1 or 2 plus one kind of units but what it ended up with is like one plus one. We basically did up until the construction set, then we marked the construction set and the execution was done by local architecture in Turkey. Because you know, there are always these misspelt relationships in projects, so we don't get involved in them. So you know there is a lot of corruption, and we don't like to get involved. (Maybe like in Italy- C: Unfortunately yes) - So we basically handed it over there. I can say that the green strategy there worked, and the apartments are fully occupied, so it is a good thing. It is also in a very low-income area of the city. And since then, there is a museum coming next to the Urban Rural V1, and a hotel coming. So the area is also changing, so there is a social impact as well behind it. But if you focus on passive cooling and all that, I really recommend you look at the latest project which we did in South Korea. It is a museum and library complex (around 26 thousand square meters) . As you know, the urban-rural is like a residential and commercial complex on the ground floor. This one is now a public building. Both are

good examples. But the second one is more focused on the cooling, heating, mechanical strategy becoming the aesthetics of the building. So we are basically using chimneys. The project title is also like “chimneys are the new sexy”, so we are saying that we need to change the way we are designing. As architects the design criteria should be climate impact first. And then we are basically saying that there is x in hard climate especially middle east, humid climate. Very similar to Seoul or Atlanta climate or middle east. There is this cooling covers that already are already with natural cooling heating. We are able to drastically change the operational cost and the initial cost of the building, and they are more sustainable in that sense. So we designed the whole structure according to the heating and cooling strategy and the aesthetics come from there . If you look at that project, you will see basically six towers . think of them as station chimneys and inside of them, instead of a nuclear core, we have museums exhibitions. That is a better example, for me, if you are focusing on cooling and that. I don't think that anyone did a project like that before, so it is one of a kind. So it would be a good example (website.)

Sorry can I ask you more about urban rural, maybe I can put in my thesis both projects because one is more “social building” and the other one is residential.

C: What's the target of Urban rural v1? Who can buy it? Who can live there ? Is it expensive ?

S: Yes, depends on the whole agenda there. We were targeting the 40% of affordability. But when the economy changes so drastically, when it is so volatile, no plans is basically and the construction of the projects from planning to build is around 5 years and 5 years is a very long time for Turkey. It is seriously a devaluation of money that becomes a huge problem. And then, the policy in turkey is also. You know. I don't want to comment on it . but basically it is super corrupted. Basically whoever pays the money, gets the world. So, when you target this kind of social agenda, inclusion and sustainability and then all of a sudden you are facing a developer making a deal with the government saying “ I cannot build this. I am not able to make any money. Or I am not profitable here like “I am going to quit”, then the government gives him like “ok then you don't have to do any affordable house. you don't have to do this and that so the plan kind of changes along the way. So with this

volatile economy unfortunately it's like that. In the us, where now I am based, there are not these kinds of problems, also in the UK, where there is a rule, is a rule. But the economy there is also very stable, not volatile. The pound and dollar value are like ... what I try to say is that is all about the economy at some point. You know, the financial model has to make sense and then kind of the price. But now the price point I think, because of that as well doesn't make sense at all. Now, nobody would buy, basically. That's why we turned all the apartments into 1 bedroom, from 3 or 4 to one. It becomes like easier. There is a website called xxx . And the business developers are called esta and . If you search, you will see the price, I am not sure about the current value. But I would say that any new development in turkey is expensive, I mean the area is like the city center. All the old apartments in which we live in are not new, historical buildings that I personally find beautiful. Are there any traditional architectural elements in the project or not?

Yes, the principles come from there, the architecture in Turkey is really traditional. We are taking the rural villa and putting it in a complex. So like the form, it comes directly from the Turkish house. But then it becomes very modern, and in the end, it is a very modern project.

Do you think you could do more projects like this one ?

Hopefully, I am very hopeful. I think that again it depends on the economy. Turkey is not in a good place right now. I think maybe in 5 or 10 years, there will be a run up, depending also on the elections in May 14. Let's see what happens but I am always hopeful. We are this young generation of architects and there are few guys in Turkey that are very progressive and try to create and build international work. So hopefully yes, but you never know.

C : I lived one month in Istanbul, Turkey and I was shocked about its dimensions, it is very big.

S: It is chaos, but we love that chaos.

Last question. What is the thermal perception inside the building Urban Rural?

S: it is a new project, we just wanted to win the competitions (joke). I can't tell you the metrics, I really don't think that has not been measured. So I don't know. But with the new project there is so much of it. Which comes from Anatolian houses, built like that : with the ventilated attic, with the

stones, double skin facade. So in summer they are super cool and in winter they are warm, they keep the thermal mass, so in that sense, they are super sustainable. Now we are doing so many projects based on sustainability principles. I think that will be the way to go, local material, circularity is the term for us now. All right?

Thank you so much, have a nice day.

Again, if you have any questions, reach us out. Have a nice day .

Bye. Bye.

Project 14

Hello Cecilia.

Hello, nice to meet you. Thank you for your support.

I just came back from working on the project you were asking for. Let's go.

So, could you explain to me the cooling techniques of the project?

You know I have to explain to you about the site first. Because the site is at the top of the hill, and the temperature is quite cool, and it is between 18 degrees to 27/28 degrees. So for Indonesia the temperature is quite cool. So in Jakarta, our main city, the temperature is 30-35 degrees . you know the difference, so it is a high-altitude location. So you have huge wind pressure, because the location is on top of the hill. 20x50 (length). And it faces the north. So we basically preserve some of the heat, because we don't want to be very cool and then that's why we put a lot of double insulation. So you see the round shape, which is actually good for the structure. What we are using is the very simple and conventional bamboo structures, so all is made by bamboo that keeps moving. That's why we need to reduce wind pressure and the shape is tubular. And then we have two layers, one is a circle. Another one is a rectangle inside it, so there are the corridors in between. So the corridor acts as insulation's, for not letting the heat go outside. So, in the nighttime, there is a little amount of air circulation that is going on. So we try to close all of the sats and in the morning or in the afternoon we try to open up some x and the cool will enter, and it will trap some of the heat below the roof,

because there are two layers of roof and there are like a gap 1.5 square meters and the air gap that maintains the warm stays inside the building. So, by using these techniques, the people stay warm inside at night. Humidity is pretty high, and this can maintain the thermal comfort.

C: So, the thermal comfort inside is maintained by the properties of the structure ? How is the thermal perception inside the building ?

S: Yes, we try to tap the thermostat, so it does not go out, especially in the nighttime when it can be a problem for us, and electricity is pretty low because it is very cold there. And we design by using local materials. So if you see the x itself is polycarbonate, which can capture and absorb the UV and inside it is like segmented (glass or glass). So it is recycled glass, we try to reuse natural materials from other projects. So, that's why the size is only 45 cm. So there are reasons why the kind of x is like ornamental. It is not like a top down, it is not the way the project is efficient, just only the aesthetic. I think that the aesthetic is something to be optimized with the resources that we have and try to reduce. You know how many people made this building ? 8 people.

8 people for the structure and 4 for finishing. With hands and crafts.

I think that you should see the article in Art Daily. On the inside, there are like ornaments and it is quite interesting, and I think it is quite interesting because I believe that Indonesia is in the face of arts and crafts. We have many craftsmen that live with me. Until now, un-GUHA, our office. We live all together, with the craftsman. So, it is like an artisan, there are 4 people living there and they are like exchanging the security face, I mean you have to schedule that you go in and out. Of course you have a day off and day in for your family, for taking care and I have been working with them since I have made the projects, so I think it is 2016 when we used Bamboo as a material for the first time. And it is quite shocking because it is a very powerful material to use. It has the characteristic of being unpredictable, you cannot control it 100%. All the complexities with the bamboo and we need to rely on the craftsman to use all of the details and ornament. I asked them if it is a natural project, and asked them about the composition, the art and how it works on the ceiling skin, the wall skin. And they make beautiful doors like that.

C: Do you think that the traditional architecture influenced the construction, idea and design of this project?

S: I think that in every project we are doing. I think that traditional architecture is so important. For sure all the compositions, one to another, I think a lot of patience is needed to make it authentic in a way. We can get a storyline, we have mahamen roots, meaning the food is the foundation and at the top of the mountain there is a family living in. So the concept like that in the tradition does make sense while keeping all of the program is more efficient together. You know, in the pynadelyng, in the workshop. The program itself is only one free plan bathroom or office, open plan. It is a cross program if you want to use it as an office, you can. The space is very compact. The size is only 3.5 mt x 2 and the top part is like 6. So actually it has a very limited footprint.

C: Who is addressed to this building ? What's the target ? Who can afford to live there ?

S : Ok, this is quite interesting because I believe that architecture is the agency to change something for the greater. We provoke something and we feel something that we have constructed for each situation. So I think that this agency that I started in Guha may provoke some bad climatic architecture in terms of the nine different combinations of the structure. And in Pyandelyng we provoked another thing. Like a waste material, low carbon footprint, the structure and the ornaments are made 99% of ornamental bamboo which is not common. People generally try to shut down all the creativity from the craftsman, if we consider the environment in Indonesia. It is quite different in the USA. In Indonesia is quite slow, like 100 years late compared to west Europe for example, because the industrialization process here is like a gap, we have many in. between Therefore, the ones who are pressurized are the builders because all of the money comes from the capital and things like that. Seeing these provocations we try to open up some of the heart because we live only once. At least architecture can touch the heart of the people. Even if it is small, I think it could be very high technology and it is inspired from the local wisdom. It does not mean it must be a sort of replication of the joglo or whatever the traditional temples, but it should be more critical and prove that it produces something great by using a smaller carbon footprint. So I think that is what the global issues

are looking for in case studies and at least we are trying as much as we can to open up some of the pressures in there. So by using all that, this space is a provocation space, so there will be a library here, the Guha, the omah, some of the extensions of the family residence and it is going to be open for Airbnb as well for maintaining the costs of the building. It is coming and people can come to Guha with almost 60 people, that is a lot in Jakarta. So we have two more projects like that where we are nesting our provocation space, we have like this kind of hermitage of working and staying together like the worker and the craftsmen, the library, the designers and the researchers, all living together in one compound and it will be briefly be open to people because many people need an access for alliteration, for reading skills, writing skills and we are teaching them for having advanced skills and understand something, like post-colonial countries. I have to admit that in terms of resources we are quite rich but in terms of understanding between the analytical skills we still have a huge amount of homework on that. So this is the huge work I am doing and my mission as an architect, to provoke things and do public projects as well.

C: So your work has a high social impact, responsibility. You give chances to many people to grow knowledge. So it is very interesting as well.

S: I just remembered that we, in the Pyiandeling, we have one word that is used by the people "It is raining and when it is rainy and when it is dry season can still get the water" and it is agreed that they can take our water. That's why we have the permission to drill the water. It is 120 mt. It is quite deep. I believe we need to add harmony in society. We are pushing the limits of the projects in every other situation .

C : You mentioned other projects you are working on, so if you have similar projects that you are working on just tell me because I am very interested

S: There are other projects that have never been mentioned before, and almost finished. I call it bobo do" Bodo means bricks, it is another brick composition. It is interesting because it is another community space, library space. It is a community between dry panel and layers of the bricks that has wooden structures inside. In that project is another kind of layers that come alive. It is very thin and

light and combined with the axis thing of wooden structures, very tight in a space of 400 square meters. It is like a complexity. So actually it is for my father craftsman. There is one craftsman that is working for my father since the 80s, so I made this composition for him. I call it composition because I like to think about it as a poetic object. I got inspired from another thing, but we needed to ground it into details that's why I call it composition like music. I see architecture sometimes as mechanistic, so I wanted to put a flavor and breath of the people living inside, to have like identities. The client/ chief comes from East Java and the technique and the materials that we use are very efficient. You have seen a low-quality bricks and then comfort with some of the layers of the performed bricks that make the sun go in. We have tiny corridors, so the sun doesn't go in and wind panels so that the air flows in between the rooms. Inside there are 13 rooms, and it is not the same compositions. So it is a library, office. A place for the craftsman as well. And in that area, it is the center of the city, surrounded by beautiful cafe. So I am about to provoke some of the layers of the gentrification because in that area we are assisting gentrification. We are going to fight not a commercial thing, looking at the library itself, it is not commercial, but I believe that can sustain the good circle, to break down this trap of the post-colonial countries which is the flow of capital. Russians to quit. We are losing our ground, our roots. I mean architecture can be thought of in this way, like more economical and political layers. I think it is important to understand the story of our country, but it is not simple.

Our work can transform to another layer, and it is quite delicate, and layer by layer. Other projects we have like residential, few layers. Because there are clients who like to stop us from bringing us down. I think that we are quite pushing perimeters in every project until the client says no.

C: Which kind of clients do you have ? Are your apartments expensive ?

S: The target it is very cheap, for one month is only 20 USD. Can you imagine ? I mean, living cost here is like in Malaysia. If we consider that I think that craftsmen live very pressurized and live in slums and ghettos, it is inevitable because the price. Here, they can work and live quite decent and then bring the money home only by architecture and designing homes. I remember Rem Koohas coin

about cross programming , I think that cross programming is another layer of the economic side, which is the tension of one type of country you live in. What kind of pressure of the building industry of the country you live in ? So, we really focus on architecture. It is a way for releasing the stressed agonitions of our ecosystem. SO i think that they are very happy and quite energetic making our projects come alive. I think it is still good and getting good, like a circle, we are trying to make other provocations in another kind of ecosystem in different areas in Jakarta or Bandung.

C : Thank you for your time and your work, I don't have any further questions. If you want to add something, i am here to listen.

S: Tell me about your thesis, your projects.