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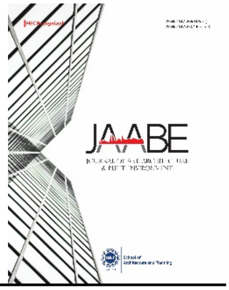

Title: **Deep Beauty at the Functional Level: A Case Study of HarSukh Mansion, Lahore**

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Deep Beauty at the Functional Level: A Case Study of HarSukh Mansion, Lahore

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Abstract

There is growing apprehension about the well-being and substantiality of our planet due to global warming, rising energy consumption by the building sector, and depletion of natural resources. Architects and designers are in pursuit of the methods that may prove useful to limit the negative impacts of the building sector in order to respond to the changing needs of contemporary times. In Pakistan, along with the use and development of technologically advanced approaches, the revival of traditional vernacular architecture is seen as a way to achieve a sustainable future. In this study, the HarSukh Mansion, designed by the renowned traditionalist architect Kamil Khan Mumtaz, wasevaluatedbased on the functional level of the Deep Beauty framework. In addition to examining the pragmatic needs of the users with respect to the building architecture, the case study also investigated the fundamentals of sustainable living, including modern passive energy strategies, recycling of natural resources, use of locally available building materials, and various traditional design elements and strategies. The analysis determined that Deep Beauty in architecture can be used to build a sustainable future for the building sector.

Keywords**:** Deep beauty, energy-efficient, functional beauty, lifestyle, self-sufficient, sustainability, traditional architecture

Introduction

At present, the world is facing a global energy crisis caused by rapid population growth, due to an increase in the demand and constant reliance on fossil-based fuels for energy production (Coyle & Simmons, 2014). It is commonly understood that if the greenhouse gas concentration levels continue to rise, major changes will occur in the climate around the world, having substantial consequences on our society and economy. Hence, there is a dire need to focus our efforts on sustainability and sustainable living.

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Pakistan, a developing country, with rising demands for energy and no considerable expansion in the power sector, is dealing with an acute energy crisis. According to certain estimations, energy shortages have set the country back up to 4% of GDP over the past few years (Kugelman, 2013). The building sector in Pakistan consumes 55% of the country's total available energy and requires serious scrutiny (Amber et al., 2018). The reliance on machines amidst an energy crisis, the modernization of architecture based on western concepts despite its rich architectural heritage, as well as the lack of aesthetics and beauty in the built environment, are all fine points making the contemporary architectural practices inappropriate. For this reason, with a focus on sustainable development, we must revisit the traditional building models that have withstood the test of time.

Lahore, the second-largest city in Pakistan, has grown manifold in terms of urban development and population over the last few decades (Rana & Bhatti, 2018). There are several Mughal heritage buildings in Lahore. Their architecture has various sustainable attributes that can withstand extreme climatic conditions. Known for its extravagant gardens, intricate water bodies, courtyard houses, and brick and lime structures, the city is the epitome of sustainability and sustainable living. Even though numerous pieces of research have shown the advantages of following the vernacular traditions of Mughal architecture, most contemporary architects adopt western models and architectural concepts in designs. Kamil Khan Mumtaz is among the very few contemporary architects of Pakistan, who is learning from the traditional architecture of this region and applying similar concepts in their architectural designs (Shah et al., 2021). One of his recent works, the HarSukh Mansion, based on principles and construction technologies of Mughal architecture, is a peculiar example of bringing back traditional beauty and sustainability. In this article, the HarSukh Mansion project is analyzed for its functional beauty using the framework of Deep Beauty. The framework of "Deep Beauty", devised by Prof. Gary J. Coates, involves three levels including functional, typological, and archetypal levels (Coates, 2014). The three levels are concerned with practicability, regional, and cultural relevance of the holistic buildings as well as their aspects of universal beauty related to sustainability.

Literature Review

The Discourse of Beauty and Functional Beauty

Energy-efficient strategies are not the only focus of sustainability and sustainable living, they are also focused on beauty, Philosophers such as Plato and Aristotle might disagree on the meaning of beauty, yet they both regard it as the most important feature. In nature, beauty has been used for survival purposes. For example, animals use their form and appearance to camouflage themselves and divert the attention of the predators. Living beings interact with their environments in ways that enhance survival and reproduction (Rothenberg, 2013). The notion that form affects function and appearance influences the survival rate, can also be applied to architecture. For architecture to be sustainable, it must also be beautiful (Qureshi, 2015). Hosey (2012) reports that beauty is a fundamental constituent of sustainability since an ugly building has more chances of being demolished and replaced, making it short-term and unsustainable.

Architecture, intended as an art, is peculiar in a sense, as most of the time, functional and pragmatic concerns are considered fundamental for the artistic assessment of the buildings. If a building fails to fulfil its prime function, it is also considered an architectural failure during its artistic evaluation (Mumford, 1951). Moreover, sustainable architecture has put so much emphasis on environmental impact and energy conservation that form and aesthetics are becoming irrelevant. Functionality and aesthetics are linked due to the notion of "functional beauty". The idea of functional beauty is a prime variant of architectural anti-formalism and has roots in the late modernist tradition of judging an object as beautiful if it fits its intended function (Parsons & Carlson, 2008).

On the one hand, formalist aestheticians are generally of the view that aesthetic value should be determined exclusively based on the objective value of shapes, lines, colours, as well as what can be perceived through them (Zangwill, 2021). While on the other hand, functionalist aestheticians, such as Parsons and Carlson (2008), stand against recognizing art as only an objective appreciation of form. They argue that background knowledge of the object frequently affects its aesthetic judgment. They propose that function and pragmatic needs can also be considered an alternative cognitive factor for aesthetic judgment. Hence, function cannot solely determine the form of architectural buildings since that would overlook other features, such as cultural meanings, historical significance, traditional principles, or aspects of beauty.

There are many examples of aesthetic judgment being influenced by spectacular forms of buildings who have several function insufficiencies. (Shiner, 2011) reported that on several occasions practical or pragmatic failures of iconic or visionary buildings are often absolved due to their astounding forms and objective value. Hence, functional beauty can be considered an important aspect since it fulfils both the practical and pragmatic requirement of the building as well as the aesthetic requirement. As quoted by Socrates in "The Symposium", (Plato, 385-370 BC/1989):

> "*In short, everything which we use is considered both good and beautiful from the same point of view, namely its use.*"

Functional Level of the Deep Beauty Framework

The Deep Beauty framework in architecture analyzes the sustainability of a building in a holistic way. It reveals whether a building can respond to the sustainability problems of contemporary times. Coates (2014) explains that Deep Beauty exists in a realm beyond simple aesthetics, and is based on the ecological ethos and spiritual worldview. It recognizes the interconnectedness, harmony, and unity of all aspects of life and manifests the complicated mystery within which everything exists. It reestablishes balance, harmony, and composure of both self and the world. He further states:

> "*To create Deep Beauty in whatever we make and do is an act of love, because only that which is loved is beautiful.*"

This framework is holistic and consists of three interconnected levels including functional, typological, and archetypal. It can be asserted that 'Deep Beauty' is a possible way of making architecture sustainable and beautiful at the same time. In this study, we only focused on the functional level for analysis. This level is defined as:

> "*The Functional Level includes design for all the pragmatic needs of the building's users. Truly functional buildings are also artfully integrated with their sites and respond simply and appropriately to available sun, wind and light. Such buildings, which are always no bigger than they need to be, are necessarily energy-efficient and make maximum use of healthy and locally available building*

materials. Biomimicry, as a functionalist approach to biophilic design, is included in this level. Everything associated with the technological and functional aspects of ecologically and humanly sustainable design is included in this first, and necessary level of sustainable design" (Coates, 2014).

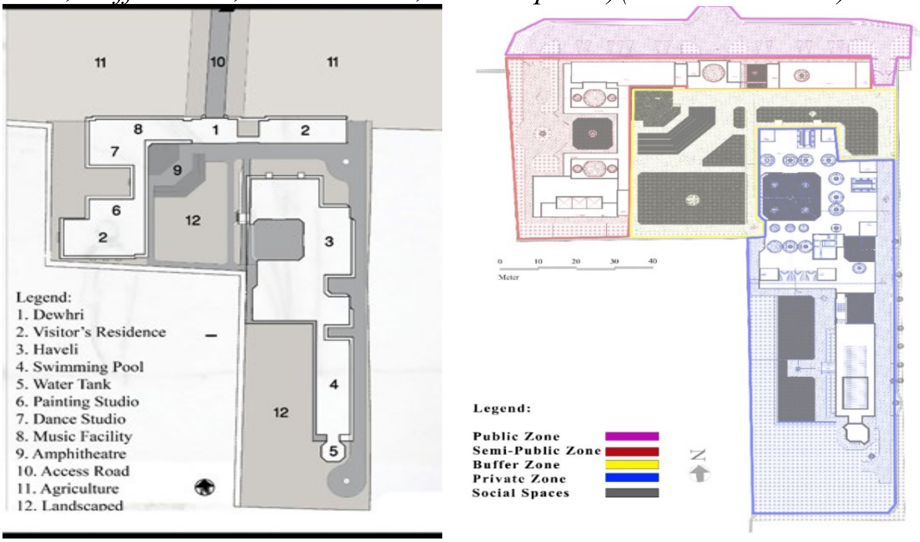
Hence, something that is both functional and attractive has a much greater chance of survival than something that is one or the other (Qureshi, 2015). HarSukh Mansion, also known as the BJK Residential Complex(Figure 1a), is the family residence of Bina and Jawad Khawaja. It is an organic farm complex with a school and hostel facility that is located on fifteen acres of land. It is located at Jasmine Lane, Village Theatre, Bedian Road, Lahore, Pakistan (Figure 1b). The project was designed by Architect Kamil Khan Mumtaz, a leading and prominent architect of Pakistan who is well known for his contributions in conserving architectural heritage and reviving the traditional methods of construction by using indigenous materials and techniques. The project was completed in the year 2015 and consists of two major building blocks: one residential and the other public. The blocks are combined with an open stepped court or amphitheatre in between (Figure 2a). The residential block attached with a swimming pool, consists of three individual dwelling units with double-height living rooms, while the public block accommodates working and teaching studios for painting, dancing, and music along with a library, servant quarters, and residential accommodation for visiting scholars (Figure 2b).

Figure 1

***1a** Har Sukh Mansion (Bina - Jawad KhwajaResidential Complex) (Source:Authors), **1b:** Satellite Image, (Google Earth, 2021)*

Figure 2

***2a:** Layout Plan, Mumtaz, 2014), **2b:**Site Plan, (Public Zone, Semi-public Zone, Buffer Zone, Private Zone, Social Spaces)(Source: Authors)*



Mumtaz availed this unique opportunity to conduct experimentation with brick and explored its potential to create various kinds of structures while avoiding the use of modern, energy-intensive building materials. The major features of the project encompass well-lighted courtyards with plantation, semi-covered verandas with four-centred arches, ribbed domes on double-height spaces with *muqarnas* (ornamented vaulting) at the corners, staircase constructed as a series of arches, terracotta *jali* (screen) for parapets, *jheroka* (overhang enclosed balcony),and *shahnasheen* (balcony) to create a link with outside, double-height and massive proportions of *dewrhi* (entrance portal), *baradari* (square pavilion)on the rooftop to enjoy the rain, andflat domes to create a useable first floor. The spaces are designed in ways to fulfil the pragmatic requirements of a contemporary life style along with crafting an ambience of a typical historical/traditional *haveli* (courtyard house). One remarkable feature of the building is amassivestar-shaped dome with *muqarnas* at the base corners adorned with high-level ventilators, it appears to be inspired by the dome present in the Mosque of Cordoba in Spain (Shah et al., 2021). The thick-wall massive structure, built with brick, bonded in lime, plastered with lime and jute, is expected to be sustainable as evident in many buildings of Mughal architecture, which have been made with similar construction techniques. The concepts and technologies learnt from traditional/Mughal architecture, developed, and combined with advanced passive energy techniques are used to promote vernacular traditions together with sustainability. Similarly, as indicated by renowned vernacular architect, Fathy (1986), Suggestion given: the traditional techniques offer the best results in hot arid regions of the world due to their origins.

Research Methodology

This study employed the observational data collection method. For this purpose, data was collected in the form of photographs and drawings, interviews with the architect and residents of the mansion, by reviewing previously published literature focusing on the concept and research framework, as well as through observations taken during recurring site visits by the authors. Other visitors, such as tourists, of the complex have been interviewed multiple times about the design and user experience. Hence, in this study, the HarSukh Mansion (BJK Residential Complex) is evaluated at the functional level by using the Deep Beauty framework. According to Coates (2014), this level has its own set of parameters that are studied discretely. The functional analysis learns how well a project fulfils its practical requirements in association with the regional climate, available natural materials, as well as the locality of the building.

The project was extensively documented and photographed at various stages of construction and close-out. The authors, based on their qualifications and experience in the field, identified the design elements and strategies used for the sustainable construction of the building. In this study, the literature, as well as scientific explanations relevant to certain aspects of Deep Beauty at the functional level, were examined and discussed. Mumtaz's perceptions of the design regarding sustainability, based on the use of local materials and culturally-relevant technology, were also investigated. Furthermore, a thorough inquiry of the construction techniques was also performed at various stages of construction. Comprehensive explanations provided by the masons and engineers employing the traditional techniques on-site, such as curing and application of lime mortar, constructing ribbed domes without formwork, and levelling of flat domes with mud insulation, on-site water-seasoning of timber, along with the details of other decorative crafts, were also recorded. The rubric developed for the analysis of Deep Beauty at the functional level includes the following parameters: orientation, materials, construction methods, family structure, social setup, comfort, and energy efficiency (Qureshi, 2015).

Analysis

Orientation of the Building

The complex is divided into two distinct parts, a rectangular residential block, and an l-shaped institutional block (Figure 3). The complex is designed in a way that the main entrance, *dewrhi*, faces north (Figure 4a & 4b). Organic farms exist on this side and windows are built on the façade to get diffused light and to allow optimum wind movement. Upon entering the complex, visitors can see a large green space and an amphitheatre (Figure5a) oriented towards the south. This open space faces the sun throughout the year. As stated by (Alexander et al., 1977),

> "*People, use open space if it is sunny, and do not use it if it isn't, in all but desert climates*."

Most of the rooms in the complex have windows facing the north-south direction, which is considered better for the composite climate of Lahore. Most of the windows and openings on the west and east side have verandas to minimize the impact of direct sunlight. For further vertical shading, Mumtaz has retained the existing trees on the east side and planted indigenous trees on the west side. Double-height arches are used on the south façade of the residence to allow sunlight and heat to enter the building in winters (Figure 5b). The layout of the rooms around the courtyard and their orientation plays an important role in developing the micro-climate of the area (Bagneid, 2010).

The HarSukh Mansion (Mumtaz, 2014) has a series of courtyards, one being the prime stepped court that divides the building into two parts: the institutional zone and the residential area. Courtyards can mitigate higher temperatures, channel the breezes, and adjust the degree of humidity level (Saxon, 1986). The residential courtyard has a fountain in the centre(Figure 5b).Its three sides (north, south, and east) are enclosed with verandahs leading to the three dwelling units (Figure 5c). The Western side is screened with a semi-perforated arched wall, giving a partial view of the lawn on the other side, located adjacent to the stepped court. Another smaller courtyard leads from the residential area into the swimming pool area. The institutional courtyard also has a similar orientation. A drop-off area for cars is on the west side, two covered units are on the north and south sides, while the east side has a semi-covered verandah leading to the stepped court. A three-sided courtyard creates a preferable climatic condition, especially when the orientation and ventilation are sought during the design process (Muhaisen, 2006).

Figure 3

Ground Floor Plan Showing Green Areas, Open Areas, and Semi-covered Areas (Verrandahs), (Source: Authors)

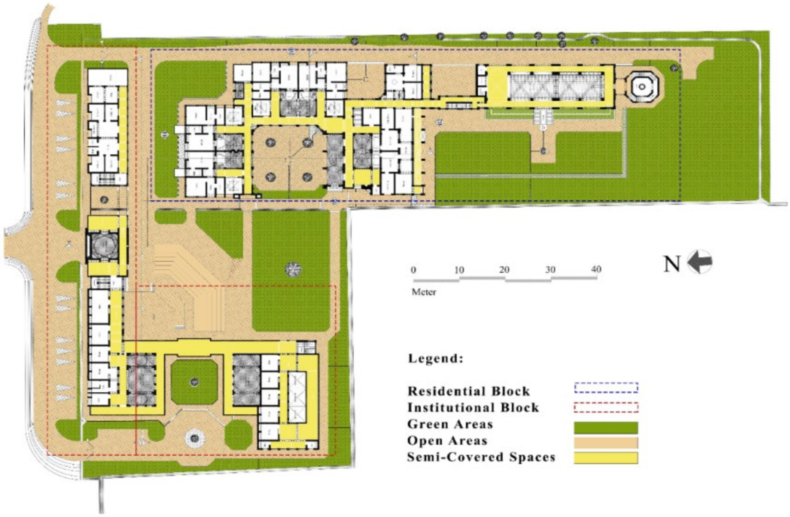


Figure 4

4a: *Dewrhi (Entrance Portal)(Source: Author)* ***4b:****Dewrhi Geometric Construction, Plans and Sections(Mumtaz, 2014)*

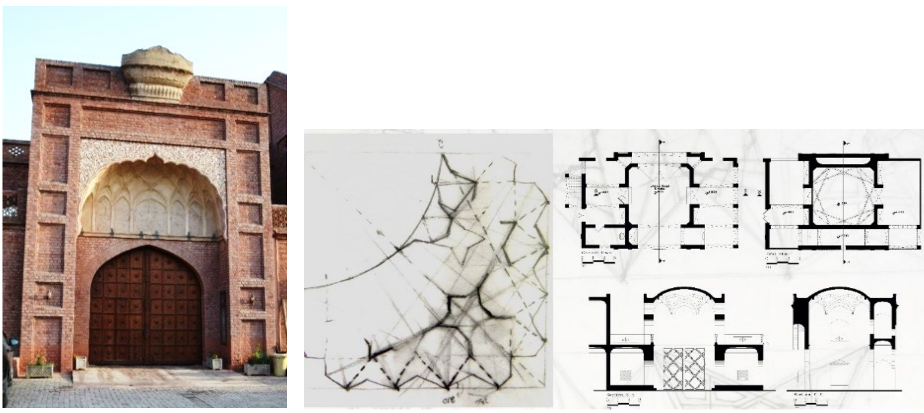


Figure 5

***5a:** Stepped Court, Amphitheatre(Hub of Social Activities),* ***5b:** Central Courtyard of the Residential Quarters (private zone) with Jheroka on South Façade* ***5c:** Adjacent Double-height Social Space in Verandah (Source: Authors)*

Building Materials and Construction Methods

Locally available and indigenous building materials, having a low carbon footprint and low embedded manufacturing and processing energy, were used for construction. The chief constituents of construction were Brick, *kankar* (grit),white lime mortar and plaster, terra-cotta clay tiles, and *sheesham* and *neem* wood. Mumtaz, havinga strong belief in sustainability, evaded the use of industry-produced materials, such as steel, cement, and concrete, since their manufacturing processes are energy-intensive and are largely dependent on foreign/modern technology. In one of his interviews, he explains:

> "*...using steel and many of these modern materials, such as glass, aluminum, also requires a lot of energy inputs. It is very expensive and dependent on foreign technology. So, we try to avoid the use of*

steel, as we try to avoid the use of cement. One of the ways of doing that is with brick domes, arches, and vaults" (Mumtaz, 2006).

To accomplish this form of construction, Mumtaz, along with his masons and craftsmen, re-learned and re-introduced the traditional techniques of making forms, such as flat domes (Figure 6a), ribbed domes, and *muqarnas*, without the use of shuttering and by only using brick and lime mortar. He claims that the use of lime is an alternative to industrially produced cement, and is a regional and rational response to the crisis of economy and environmental degradation (Mumtaz, 2006). Modern cement production requires high energy inputs and the burning of fossil fuels, which pollutes the environment. On the other hand, lime work does not need complex machinery and only requires a simple kiln for its curing at the construction site (Figure6b).

Figure 6

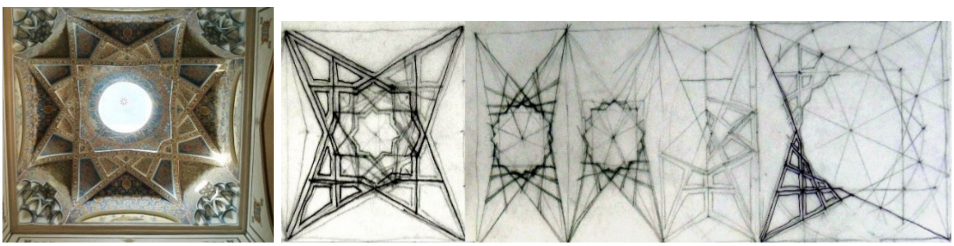
***6a:** Construction of Flat Domes on Site (Source: Authors),**6b:** Lime Kiln Made for Curing of Lime (Mumtaz, 2014),**6c:** Under Construction Four-Centered Pointed Arch (Mumtaz, 2014).*

Because of the hygroscopic quality and high moisture absorbent value of lime, surfaces finished using lime have a cooling effect. A mixture of white lime and *kankar* (crit) lime, mixed with mud, straw, or jute fibre, cured in the lime kiln is used for the construction and finishing of this project. According to many traditional craftsmen, structures made with limestone and other natural materials form complex protein bonds and gain their full strength after many years of construction. Consequently, these bonds take a lot longer to deteriorate, resulting in long-term sustainability. Using only brick and lime as basic construction materials along with the technology of flat, ribbed, and cross-arched domes, this building is an efficacious example of a structural system in contemporary architecture. A highly polished lime surface, locally known as *pukka kali*, not only lowers the carbon footprint in comparison to the use of ordinary cement but also reduces the interior temperature and absorbs excess moisture from the air, improving the Indoor Environmental Quality (IEQ).

As Mumtaz rejected the use of modern industry-produced construction materials in favour of practicing sustainable architecture, he found it most appropriate to use traditional methods of construction (Shah et al., 2021). He used various types of arches that span a series of columns to form verandas. The four-centred pointed arch (Figure 6c) is frequently used in the mansion, it consists of four arched segments each with its own centre forming a sheer-curved arch that transcends and smoothens at the top. Semi-circular and multi-foil arches are also used to separate different interior spaces. To span larger spaces, small bricks are laid in circular patterns without using steel, concrete, or any kind of formwork or shuttering. Star-shaped ribbed domes (Figure7a) are constructed with pairs of corresponding arches that revolve, intersect, and createa star pattern (Figure 7b). The main purpose of forming ribs into the dome is to make the construction process simpler.

Figure 7

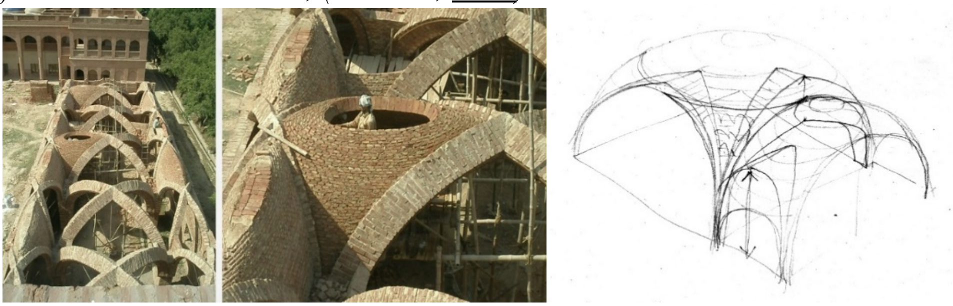
*7**a:** Ribbed Dome with Muqarnas on Four Corners(Source: Authors),7**b:** Mumtaz's delineations for the development of star-shaped ribbed dome (Mumtaz, 2014)*



Crossed-arch domes (Figure8a) are a peculiar type of ribbed vaults. Their distinctive feature is that the ribs intertwine into the vault, forming polygonal shapes or stars, creating a deep space in the centre. Historically, crossed-arch domes are the earliest form of modified ribbed vaults, where the ribs are knotted to create polygons (Figure 8b). Another technique used Figure 6 awas flat domes, allowing a flat roof above that is used for functional purposes, doing away with the need for steel reinforcement and concrete. During the construction of the flat domes, the corners of the square or rectangular space are made with bricks; then, space is achieved where a proper circle can be marked. Subsequently, bricks are laid in a circular pattern and are bonded together to form a flat dome (Figure 6a). *Muqarnas*, a three-dimensional architectural adornment and a stalactite vault (Swinford, 2020), is used to make a smooth transition from the rectangular base of the building to the vaulted ceiling.

Figure 8

***8a:** Under-construction Cross-arched Dome, **8b:** Mumtaz's Delineations for Cross-arched Dome, (Mumtaz, 2014)*



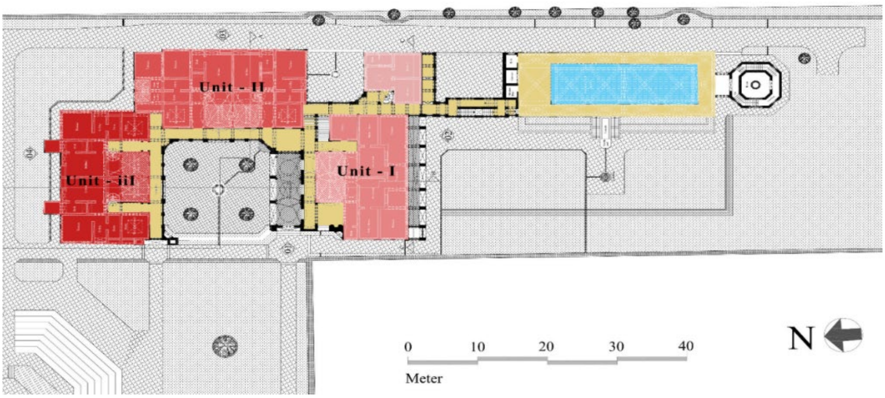
Family Structure

As one enters the open green area through the double-height entrance portal, *dewrhi* (Figure 3a), the division of the public and private zones is evident. The public zone has three major units. The central building, which primarily consists of studios and their allied facilities, is used to conduct regular music and dance classes. The second block serves as a dwelling place for servants, while the third block act as a dwelling unit for guests and scholars associated with the HarSukh organization.

Three generations of the family currently reside in the complex, encompassing a traditional joint-family system. Generally, a joint family system is considered to have better prospects for sustainability of life and sharing of resources. Three independent residential units are planned around the three sides of the common central courtyard (Figure9) to give the families privacy and independence, while the common courtyard provides them with the chance to socialize. The verandah surrounding the three sides of the common courtyard offers access to these dwelling units. Each unit has a double-height living room, kitchen, bedrooms, study room, dressing rooms, and bathrooms. The fourth side of the courtyard has a wall with terracotta *jail* (lattice screen), which separates the residential block from the public zone. It offers privacy by providing a limited view of the lawn in addition to lowering the temperature by regulating air movement across it. A rear-side verandah, leading to the swimming pool, is accessed through a connecting corridor of the residential zone (Figure 9).

Figure 9

Residential Zone with Three Independent Units (Source: Authors)



Social Setup

HarSukh is a community of artists, thinkers, and organic farmers that promote an alternative view of life that is deeply rooted in our culture. In this community, people live by being self-sufficient. They grow their own food, raise cattle, home-school the children as well as construct the houses with the help of each other. These customs and ways of living eventually develop a collective style of living. HarSukh epitomizes self-sufficient collective living, where like-minded people, concerned with a sustainable lifestyle, have formed a sustainable unit. According to Guallart (2006), such a sustainable unit can be compared to a living organisms inceit is an entirely self-sufficient entity. Mrs Bina Jawad Khwaja, apprehensive of the educational needs of the children of their servants as well as children from rural areas in the vicinity, established the HarSukh school on their farmhouse. The idea was not only to build another school but to set up a school where children are taught while playing and spending more time outdoors with nature. For this purpose, the syllabus has been evenly divided to incorporate curricular and extra-curricular activities, which are mostly performed in the exterior areas such as the courtyards, amphitheatre, and the swimming pool. The hierarchical position of lawns, courtyards, verandahs and interior spaces offers optimum location, adapted in accordance with the local climate, for outdoor activities. Throughout the hot dry season, thick walls keeps interior spaces comfortable and prevents the users from prickly heat. In the rainy season, semi-covered verandahs (Figure2b) are considered to be better since they allow various activities to be performed. Alexander et al. (1977) examined the pattern of 'common areas at the heart' by saying:

> "*No social group…can survive without constant informal contact among its members.*"

The amphitheatre (Figure 10a) and a series of courtyards (Figure 10b) in the centre of each building unit are spaces that efficiently endorse such contact. They are used to perform classical music, art, and dance performances. These spaces have three characteristics. First, they are placed at the focal point of the complex. Second, the pathways and verandas lie tangent to them, and third, they off era communal area for social activities.

Figure 10

10a: HarSukh School activities in Amphitheater, ***10b.*** Social gatherings in courtyard,(Harsukh Artist Community, Organic Farm and Children's School in Lahore, 2018)

Comfort and Energy Efficiency

Functional or sustainable architecture primarily aims to ensure the comfort and satisfaction of the users at multiple levels. Comfort is defined as:

> "*the condition of mind that expresses satisfaction with the…environment*"(CIBSE, 2006).

Simple design principles and elements for comfort are incorporated into the design of the complex. To fully experience the sunlight, open to sky courtyards with efficient orientation for hot-dry summer evenings and winter days have been designed. Verandas (exposed, roof-top room) (Figure 11a) are incorporated to maximize air movement, particularly in the warm-humid season of the monsoon. Cross-ventilation is an important method of cooling indoor spaces in warm temperatures since it raises the rate of evaporation (DeKay & Brown, 2013).The corridors are planned in such a way that both its ends are open, and a continuous flow of air occurs within them. Anatural cooling effect is achieved by reducing the absorption of solar radiation and slowing down the transmission of heat through verandahs. These areas serve as buffer zones between the exterior and interior spaces. They also provide shaded spaces where a person can feel connected to the outside but remain protected from extreme climatic conditions.

Living rooms and studios in the complex are made to be double-heightened with both high-level ventilators and low-level windows, causing a stack effect that allows the cooler air to enter and removes hot air when it rises (Figure 12). All walls are at least eighteen inches thick which helps maintain a comfortable interior temperature. The porosity of bricks and the hygroscopic nature of lime further reduce the transference of heat. The supplementary mud layer used to flatten the roof of flat domes enhances the insulation of the structure, which minimizes solar gains and controls the indoor temperature. Balconies and *jheroka* are also designed for the residents to experience the outdoor environment in a shaded area. Green areas have been merged into the design, not only for their symbolic significance but also to improve the outdoor environment, which ultimately enhances the quality of the interior environment (Figure 11c). Water bodies, particularly fountains, are positioned in a way to improve the air quality and ambience.

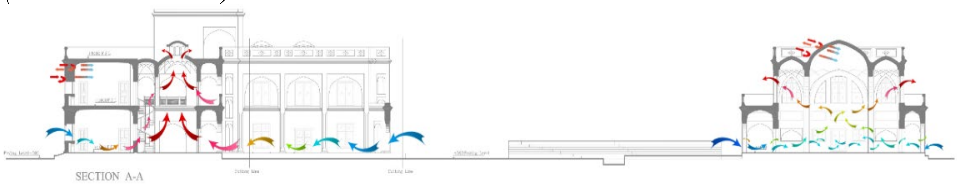
Figure 11

11a:*Verandahas Buffer Zone between Rooms and Courtyard, Barsati and Roof Top Ventilators,* ***11b:*** *Roof with Ventialtors, Barsati, and Photo-Voltaic Solar Panels* ***11c:*** *Patio with Plants and Water Pond, (Source: Authors)*

The modern lifestyle is largely dependent on energy, due to which its demand is continuously increasing. According to the US Energy Information Administration (Doman, 2016), it is estimated that by 2040, world energy consumption will increase by over 48%. In comparison to the traditional buildings, our present-day 'modern' buildings consume more energy and offer less comfortable living conditions (Sundarraja et al., 2009). As energy constraint is one of the biggest challenges the world is facing, we should look for ways to reduce its demand. The HarSukh mansion, built on traditional principles has a thick structure, which is largely due to the spanning and structural limitations of the construction techniques. These techniques provide extra insulation against heat transfer. Thick walls made of locally-available, low thermal conductivity materials (brick and lime) have high insulation properties with low heat-transmittance value. In contrast to usual flat roofs, semi-circular surfaces of domes and vaults absorb less solar radiation from the vertical summer sun since some section of the dome is always under its own shade. Subsequently, it re-radiates heat to the outside due to the large temperature difference present across the surfaces. Although, flat domes are also used to make part of the roof available for use, additional mud to attain the horizontalness increases thermal insulation.

Figure 12

Section Showing Thermal Mass, Stack Effect and Cross Ventilation (Source: Authors)



Heightened-arched ceilings provide more space for warm air to rise and leave the interior through high-level ventilators. Cool air from verandahs enters space through low-level windows, creating a stack effect and enhancing thermal comfort (Figure 12). An evaporative cooling system keeps the interior spaces cool through ducts that are connected with roof-top mounted desert coolers. Solar energy is utilized in the form of photo-voltaic panels that are mounted on the roof (Figure 11b). Major electricity demand is fulfilled by this passive technique. Biogas and biomass, produced from animal waste on the farm, are used for cooking purposes in the kitchens. Wood burning fireplaces, provided in all living rooms, are used for warming the spaces along with being an important interior decorative element. Water conservation and rain-water harvesting have also been incorporated into the design. Surface water and wastewater are collected through open channels and brought to an anaerobic and aerobic treatment plant. Effluent storage ponds and recycled water are used to supplement farm irrigation.

Sustainable Ecosystem (Biomimicry)

Natural ecosystems can inspire design on two levels: functional level and processual level (Zari, 2012). To achieve sustainability, our communities must provide for themselves similar to how nature is self-sufficient. If our environment functioned in such a self-sufficient manner – generating for itself, sustaining itself, and continuing in balance with its surroundings – it would be a correct replication of nature (Qureshi, 2015). In the HarSukh Mansion, the community produces for itself and maintains a lifestyle that is self-supporting to an extent. Located many kilometres away from the main urban city, the farms can provide organic food. Biomass is converted to energy and water is recycled and reused. The overall energy needs of the building are reduced due to the intelligent use of passive techniques, while the remaining energy demands are met through renewable resources. Biodiversity is maintained in the large open green spaces. Hence, the HarSukh mansion illustrates a fine example of self-sufficient collective living by building communal spaces for human-centric activities, such as farming, raising livestock, and conserve natural resources.

Conclusion

As Pakistan is experiencing one of the worst energy crises in decades, public exasperation and unrest are readily discernible. After many years of power outages due to the usage of non-renewable energy resources, voices are being raised in favour of sustainability, notably in the building sector. This study is an attempt to acknowledge and learn from our historic building traditions, rooted in our history and culture. It utilized the "Deep Beauty" framework to investigate the sustainability and aesthetic value of the selected building. Lahore contains many fine examples of Mughal architectural heritage buildings, which were designed to adapt to the local environment and climate. While most contemporary architects in the city follow the Western model, Kamil Khan Mumtaz is re-learning and re-discovering the methods and principles of traditional vernacular architecture. This research analyzes one of his recent projects, HarSukh Mansion (BJK Residential Complex) in Lahore, on the functional level in accordance with the framework of Deep Beauty. The functional level investigates both the practical and the pragmatic requirements, such as beauty, of a building. Functional and sustainable buildings are built to adapt to the local environment, are energy-efficient, and make use of local building materials (Coates, 2014).

For example, to minimize the impact of direct sunlight, this building complex is oriented in such a way that the main entrance and the organic farms face north, while a large green space and an amphitheatre face south. Most rooms have windows in a north-south orientation and the ones on the east and the west ends have verandas to provide shade. Double-height arches are used on the south façade to welcome the winter sun. The residential courtyard has a fountain in the centre (Figure 5) and its three sides (north, south, and east) are enclosed with verandahs leading to the three residential units. Every space has been smartly allocated to make the most effective use of the solar path and temperature changes throughout the year. Locally available building materials and indigenous construction techniques are used. These materials have a low carbon footprint and low-embedded manufacturing and processing energy. The locally available materials include brick, *kankar* (grit), white lime mortar and plaster, terra-cotta clay tiles, and *sheesham* and *neem* woods. Traditional techniques of building forms, such as flat domes, ribbed domes, traditional arches, and *muqarnas,* are applied without using steel, concrete, or any kind of formwork, such as shuttering.

The building complex is carefully divided in to public and private zones. A joint family system comprising three generations resides in the residential units. Three independent residential units are placed around a central courtyard, which serves as a communal space for all the families. Courtyards and other communal spaces are designed in such a way as to fulfil the users' requirements for having a vibrant social life. The position of lawns, courtyards, verandahs, and interior spaces offer ample space for outdoor activities in all climatic and seasonal contexts. The verandas, *barsati* (exposed roof-top room), and open-ended corridors allow cross-ventilation. Subsequently, stack-effect is achieved through high-level ventilators in double-height rooms, which improves Indoor Environmental Quality (IEQ). The porosity of bricks, hygroscopic nature of lime, water bodies, and desert coolers on the roof cause an evaporative cooling effect in the building. Thick brick walls and additional mud layers on the flat domes increase insulation, while balconies and verandas provide shade. Photo-voltaic panels mounted on the roof, biomass from the farm, water conservation, rainwater harvesting, and water recycling are all methods in which renewable energy resources are used and re-used effectively.

Just like a naturally sustainable ecosystem, this complex offers a self-sufficient and sustainable lifestyle to its community. The people living here can produce food, save energy, and reuse their resources to maintain a sustainable lifestyle. Hence, HarSukh Mansion shows how Deep Beauty in architecture can be attained by utilizing indigenous architectural techniques in order to realize a sustainable future in the building sector.

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References

Alexander, C. (1977). *A pattern language: Towns, buildings, construction*. Oxford University Press.

Amber, K. P., Aslam, M. W., Ikram, F., Kousar, A., Ali, H. M., Akram, N., Afzal, K., & Mushtaq, H. (2018). Heating and cooling degree-days maps of Pakistan. *Energies*, *11*(1), 94-100. https://doi.org/10.3390/en11010094

Bagneid, A. M. R. (2010). *The creation of a courtyard microclimate thermal model for the analysis of courtyard houses* [Doctoral Dissertation]. Texas A & M University.

CIBSE. (2006). Chartered Institution of Building Services Engineers. *Guide A: Environmental design*. CIBSE London.

Coates, G. J. (2014). Deep beauty, toward a sustainable and life-enhancing architecture of place. *Department of Architecture, Kansas State University, Manhattan, KS*, 1-2.

Coyle, E. D., & Simmons, R. A. (2014). *Understanding the global energy crisis*. Purdue University Press.

Davies, S., Higgins, K. M., Hopkins, R., Stecker, R., & Cooper, D. E. (Eds.). (2009). *A companion to aesthetics* (Vol. 67). John Wiley & Sons.

DeKay, M., & Brown, G. Z. (2013). *Sun, wind, and light: Architectural design strategies*. John Wiley & Sons.

Doman, L. (2016, May 12). *EIA - Independent Statistics and Analysis.*U.S. Energy Information Administration. https://www.eia.gov/todayinenergy/detail.php?id=26212

Fathy, H. (1986). *Natural Energy and Vernacular Architecture: Principles and examples with reference to Hot Arid Climate.* Chicago: The University of Chicago Press.

Guallart, V., Müller, W., &Cappelli, L. (Eds.). (2006). *Self-sufficient Housing: 1st Advanced Architecture Contest: The Competition*. Actar.

Harsukh Artist Community, Organic Farm and Children's School in Lahore. (2018, September). *Harsukh*. Artist Community, Organic Farm and Children's School in Lahore. https://harsukh.business.site/ #gallery

Hosey, L. (2012). *The shape of green: Aesthetics, ecology, and design.* Washington: Island Press.

Kugelman, M. (2013). *Pakistan's Energy Crisis.* The National Bureau of Asian Research. https://www.nbr.org/publication/pakistans-energy-crisis

Muhaisen, A. S. (2006). Shading simulation of the courtyard form in different climatic regions. *Building and Environment, 41*(12), 1731-1741.

Mumford, L. (1951). Function and Expression in Architecture. *Architectural Record*, *110*(5), 106-115.

Mumtaz, K. K. (2006, July/August). *The Grand Master of Traditional and Green Architecture*. (S. Minhas, Interviewer) Lahore, Pakistan: The South Asian. http://www.the-south-asian.com/July-Aug2006/Kamil_Khan_Mumtaz_1.htm

Mumtaz, K. K. (2014). *HarSukh Mansion. Data, Drawings, and Dellineations of Har Sukh Mansion*. Abubakar Zubair.

Nehamas, A., & Woodruff, P. (Eds.). (1989). *Symposium*. Hackett Publishing Company Incorporated.

Parsons, G., & Carlson, A. (2008). *Functional Beauty.* Oxford University Press.

Qureshi, R. A. (2015). *The traditional courtyard house of Lahore: an analysis with respect to Deep Beauty and sustainability.* Kansas State University. http://krex.k-state.edu/dspace/handle/2097/19154

Rana, I. A., & Bhatti, S. S. (2018). Lahore, Pakistan–Urbanization challenges and opportunities. *Cities*, *72*, 348-355. https://doi.org/10.1016/j.cities.2017.09.014

Rothenberg, D. (2013). *Survival of the beautiful: Art, science, and evolution.* New York: Bloomsbury Press.

Saxon, R. (1986). *Atrium Buildings - Design and Development.* London: Longmans.

Shah, S. J., Qureshi, R. A., & Akhtar, M. (2021). Quest for Architectural Identity of Pakistan: Ideological Shifts in the Works of Kamil Khan Mumtaz. *Pakistan Journal of Engineering and Applied Sciences, 28*(1), 1-15.

Shiner, L. (2011). The case of the "spectacle" art museum. The Journal of Aesthetics and Art Criticism. *Journal of Aesthetics and Art Criticism, 69*(1), 31-41.

Sundarraja, D. M., Radhakrishnan, S., & Priya, R. S. (2009). Understanding vernacular architecture as a tool for sustainable development. *10th National Conference on Technological Trends (NCTT09)* (pp. 249 - 255). Trivandrum: College of Engineering Trivandrum.

Swinford, D. (2020). *The Muqarnas: A Key Component of Islamic Architecture.* Encyclopedia.com. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/muqarnas-key-component-islamic-architecture

Zari, M. P. (2012). Ecosystem services analysis for the design of regenerative built environments. *Building Research & Information, 40*(1), 54-64. https://doi.org/10.1080/09613218.2011.628547

Zangwill, N. (2021, December). *Aesthetic Judgment.* (E. N. Zalta, Ed.). The Stanford Encyclopedia of Philosophy (Winter 2021 Edition). https://plato.stanford.edu/archives/win2021/entries/aesthetic-judgment/