

Sustainable Approaches Employed in Settlements Designed by Hassan Fathy: Lessons from New Gournas and New Baris in Egypt

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Abstract

Around 1940s, 75% of the population of Egypt had been living in the rural vernacular settlements. After independence and with the establishment of a parliamentary monarchy, the focus of Egypt has been the reform of these rural settlements. It became an opportunity to explore new ways of creating settlements from a conscious architecture. In this endeavour, the Egyptian architect Hassan Fathy rose as a humble yet visionary giant who was instrumental in making these transformations. This paper examines two settlements designed by Hassan Fathy in Egypt: New Gournas, completed in 1945 and New Baris, completed in 1964. They exemplify the sustainable design approach Fathy took, even before sustainability was discovered by the world. They employ powerful ideas about optimization of resources and the maintenance of identity of vernacular architecture.

The research employs a comparative method to examine the two settlements. The research involves observations and documentations during field trips to the sites, and examination of literature as well as photographs and drawings. It also examines existing documentation at the American University in Cairo. Moreover, new drawings have been developed based on the architect's original drawings. They show the evolution of the architect's approach to urban planning and housing typology, coupled deeply in sustainability in response to the desert climate.

The paper reveals the principles Hassan Fathy has employed deriving from the vernacular settlements in the projects and their evolution. It offers guidelines for the proper development of a sustainable settlement in any arid climate and environment. The paper concludes that despite not having been able to complete the construction of either of the two projects, the theoretical approaches of them are valid and should be considered for application in contemporary and future settlements.

Keywords: Hasan Fathy, Settlement, Vernacular architecture, Egypt, Sustainable strategies.

Introduction

Around 1940s, 75% of the population of Egypt had been living in the rural vernacular settlements. After independence and with the establishment of a parliamentary monarchy, the focus of Egypt was the reform of these rural settlements, where 75% of the country's population was concentrated. (Kholoussi, 2006). In 1939, within the Ministry of Social Affairs, a specific department for the peasantry had been created to apply new architectural experiences in terms of typologies and technologies to improve the living conditions of the peasants. (El-Wakil, 2009). In this endeavour, the Egyptian architect Hassan Fathy rose as a humble yet visionary giant who was instrumental in making these transformations. Fathy believes that Egypt had a unique opportunity to learn from the mistakes made in Europe during the 19th century regarding the industrialization of cities. According to Fathy (1980), Arab cities were starting to industrialize, and they could not fall into the same mistake that was made in Europe. In other words, they cannot follow in the footsteps of urban planners in the industrialized countries. He was of the opinion that the Arab world should not wait 100 more years to test the solutions and must rely on science for arguments.

From these precedents, Fathy establishes his strategies to limit population flows into Egypt's big cities. His aim was to create a strongly cohesive community, to revive cultural pride among the men of the countryside, and to make them aware of the rich cultural heritage they possessed. (Steele, 1997). Fathy values handicraft techniques and prevent the disappearance of traditional crafts and forms that had survived to the day since ancient Egypt (Fathy, 1945).

This article examines two settlements designed by Fathy in Egypt: the case of New Gournah, built in 1945 and New Baris, built in 1964. Both employ ideas about the identity of the country and its own architecture, but with the differences inherent to the maturity and learning of the architect in his accumulated professional career. The paper aims to reveal the approaches adopted by Hassan Fathy in developing these settlements.

Its objectives are:

1. To identify the salient urban characteristics of the two projects.
2. To describe the house designs produced in these two settlements.
3. To reveal the sustainable strategies employed to optimize the resources during the design and construction processes.
4. To identify the evolution of Fathy's work through both approaches and to produce guidelines that can be employed in contemporary urban planning and building design processes.

Theoretical Framework

As Rapoport (1979) says, the basic definition of architecture has to be concerned with the vernacular, which has always comprised the bulk of the built environments that are essential for any valid generalizations. This is because if humans as a species have certain characteristics, and if they have done certain things for a very long time, then there may be very good reasons for doing these things. Oliver (1987) defines vernacular architecture as the architecture of the people, and by the people, but not for the people. According to Oliver, the argument that vernacular architecture is not the product of a design process is uncritical. His approach exemplifies this view by defining vernacular architecture as all the types of building made by the people in tribal, folk, peasant, and popular societies where an architect or specialist designer is not employed. Noorwatha et al. (2024) add vernacular architecture is a result of people, place, and culture; it is one of the many elements of identity. According to Leila and Mohammad (2016), "vernacular architecture is that in which harmony with Nature, respect for other people and their houses, so the respect for the entire environment, whether it is man-made or natural environments are seen."

Srivastava and Das (2023) define vernacular architecture as the architecture, which is indigenous to the location, sensitive to climate, use local materials, and arise from the culture of the place. As Simoes et al. (2019) say, vernacular buildings provide optimal solutions for local problems that are in harmony with Nature, in a durable, healthy, and sustainable manner. According to Oliver (1997), the localized values, local wisdom, local methods, and community

participation are the key ingredients of architecture to be termed as vernacular. He also shows the sensitivity of such architecture towards culture, lifestyle, economy and principles that are pertinent to that community and location.

As Ishrat, et al. (2023) say, every area and region has evolved distinct features of vernacular architecture that distinguishes itself from other places over time. This is done through multifarious interaction of evolution and human adaption to the ambient environment, which is the core of 'identity. They explain vernacular architecture as a building process created to develop a response to people's basic necessities of life and communities as well as reflecting many factors like the environmental, cultural, economic, and technical evolutions.

As Noorwatha et al. (2024) say, understanding historic buildings and skills is essential to revitalize vernacular building forms. Identifying, understanding and creating a thorough inventory of vernacular structures and its makers, especially skilled artisans, is crucial. As Sala, Trombadore and Fantacci (2019) explain that vernacular architecture can also be linked to circular sustainable concepts. Indeed, it is the design of buildings based on local needs, using local materials, and reflecting the local culture and traditions. Moreover, they are usually built by the inhabitants without any formal design training. These undeniably make vernacular a sustainable practice. Sundarraja, Radhakrishnan and Priya (2009) add that many studies highlight the importance of learning from vernacular buildings for designing contemporary sustainable buildings and of returning to local approaches that are most suitable for their local environments.

Review of Literature

According to Givoni (1998), Egypt is characterized by arid climatic conditions with extremely high temperatures and almost no rain and a very high diurnal difference throughout the year. As Koenigsberger et al. (1974) say, in hot dry zones, two of the main problems facing local builders have been to ensure protection against intense solar radiation and to provide adequate cooling. For that reason, as Almaiyah, Elkadi and Cook (2011) say that enclosed, compactly planned urban forms, such as internal narrow streets, were among the most suitable forms developed in this type of climate to meet the problem caused by excessive heat. By placing buildings close to each other, surfaces exposed to the sun were often reduced with a large amount of shade and coolness that decrease the heat gains on external walls. In addition to the narrow winding streets and central opening courtyards that dominate the old city layout, covering the streets is yet another strategy that complements the architecture of Cairo.

According to Hamza (2019), the air flow in vernacular urban developments is more complex than just the natural ventilation processes of the relationship between the courtyards, basements and sometimes wind-catchers. The outdoor street patterns and their shading also played a role. These patterns not only respond to the need for movement of people and animals but also to the social needs to engage or not, and protect from the onslaught of harsh climatic conditions.

Elnabawi, Hamza and Dudek (2013), examine the thermal comfort and the climatic conditions of the streets in hot climate of Egypt, using urban performance simulation of the main street of the Islamic Quarters in Cairo. They demonstrate how an environmental system of alleyways if leading to closed-end alleyways leads to hot spots but this heat is flushed if connected to the air paths of the indoor courtyards. These courtyards are useful to improve the street climatic comfort. As Hamza says (2019), the courtyard is a common and characteristic form of residential architecture in hot arid and humid climatic zones. It serves as a collector of cool air at night and a source of shade in the daytime, and as a nucleus where families can meet to enjoy cultural activities of weaving, cooking and drying the seasonal produce.

Almaiyah, Elkadi and Cook (2011) add that the courtyard house type is one of the most well-known architectural characteristics of traditional architecture in hot arid regions. The main architectural feature that characterises this house style from the other types of houses is the outdoor space that is enclosed within the interior volumes and ultimately becomes the heart of its morphology and spatial organization. In the courtyards, according to Wazeri (2002), the phenomenon of the stack effect is employed to enhance thermal comfort by producing cool

breezes. As Oliver (1997) says, in the evening, the warm air of the courtyard heated directly by the sun and indirectly by the warm buildings, rises and is gradually replaced by the cooled night air from the above. This cooled air accumulates in the courtyard in layers and leaks into the surrounding rooms cooling them.

Maguid and El-Mahdy (2022) have examined materiality and construction processes in hot climates such as Egypt, Dabaieh, and say that vernacular settlements were constructed in a minimalistic way. Reducing the quantity of materials used in construction and reducing the quantity of waste materials was a conscious decision. Vernacular dwellers were aware of how precious the raw materials are, and they know from their accumulated experience how they can most effectively and efficiently use the raw materials. Almost no waste is produced during construction, and any leftovers are used for other functions. Shihembetsa and Madete (2018) add that with this high demand for shelter, the appropriate response to construction is to use locally available materials with simple construction techniques. Hence, the use of appropriate building materials is a vital sustainable design strategy, especially in hot and dry climates where thermal comfort is key but hard to achieve. In these areas, mudbrick is the most affordable, available, climatically, and contextually suitable construction material. As Ugochukwu (2016) says, mudbrick in hot-dry climates has been and still is a popular sustainable construction material choice due to its affordability, accessibility, recyclability and low embodied energy. Earth structures built over 100 years ago are still standing today proving the materials potential to be sustainable, durable, thermally comfortable and having little to no carbon footprint.

As Ahmed and El-Gizawy (2010) say, in Egypt, as in other Middle Eastern countries, there are many examples that illustrate this link through the sustainability features of vernacular architecture and urbanism in local communities. It is a rich heritage of knowledge on dealing with the hot arid climate of the region. According to Fernandes, et al. (2014), today, vernacular architecture is considered a model for sustainable architecture. The strategies that are now the basis of sustainable construction are derived from aspects and characteristics of this type of architecture. However, as Ayyad and Gabr (2013) say, the mainstream in developing countries, like Egypt, goes for fast developments rather than a sustainable one. Most new communities are built to provide shelter for the growing population without looking at the long-term footprint of these communities on the resources.

Research Methods

This research employs a qualitative approach based on comparing two case studies. Data is collected from scientific publications, original documents from the Digital Archive of the American University of El Cairo and from a field visit to Egypt doing research about Hassan Fathy.

The New Gourna and New Baris projects have been chosen for their innovative character in terms of sustainability principles applied to a specific place and time, minimizing the use of resources to obtain maximum benefits. Both projects, 20 years apart in the architect's career, show common concerns that are still valid in both approaches and allow to detect strategies that have been modified or added, showing the passage of time as a fundamental factor in the evolution and learning of architecture.

Case studies have been examined using the following steps:

1. **Reading written literature:** This revealed the ideas of the architect and his theoretical approaches to these projects.
2. **Observations and analysis of plans:** This revealed the sustainable strategies applied in the urban and building designs.
3. **Redrawing the plans:** This revealed the dimension of both the settlements to understand the main urban decisions.
4. **Visits to both places:** This enabled the imagination of the situation of the moment of the design of the projects and to evaluate each situation.

Case Study 1: New Gournna

Gournna is a small rural town of 7000 inhabitants built on the West side of the Nile River in front of the city of Luxor. The area is rich in archaeological sites, as it contains the ancient cemetery of the city of Thebes. This fact was not accidental; the inhabitants of this settlement have arrived attracted by the wealth of their ancestors. It is an area with abundant tombs, some of them still to be discovered, and many of the inhabitants of Gournna have made the plundering of archaeological treasures their "modus vivendi" (Pyla, 2009).

The Department of Antiquities of the Luxor region has taken decisions on the matter and has decided to prohibit the construction of more houses in the area. However, this has been an insufficient measure. Subsequently, a more drastic decision has been taken; the expropriation of their properties and the relocation of the settlement to another place far from the sites (Fathy, 1973). For Hassan Fathy, this has been an opportunity for a large-scale project to demonstrate his theories for the improvement of the rural environment in Egypt. The choice of the site has been agreed upon by the directors of the Department of Antiquities, five representatives of the tribes that make up Gournna and Hassan Fathy. An area has been sought in the fertile valley, protected from possible flooding by the dykes of the canals that irrigated the area. Fathy has expressed his dissatisfaction with the final choice of the site, believing that it was wiser to locate the people in a somewhat higher and drier area, but the area that met these requirements has been very close to the ruins. Therefore, the Department of Antiquities has objected (Fathy, 1973).

For the architect, the New Gournna project has been an experimental first step on the road to the complete regeneration of rural Egypt through the reconstruction of its villages. However, despite Fathy's efforts, the project has failed (Steele, 1997). The inhabitants of Gournna had eventually rejected the move and the Egyptian government had halted the construction in 1949, after completing only one-fifth of the Project, as seen in the Fig. 1.



Fig. 1: New Gournna, current situation.

Source: Authors, 2024.

Case Study 2: New Baris

In 1963, an aquifer has been discovered 60 km south of the city of Kharga, in the middle of Egypt's Western Desert. The Egyptian Desert Development Agency has decided to build a new city to serve as the administrative center of a 40 km diameter region with a series of satellite cities around the discovery of the aquifer that would allow its exploitation. The only existing city in the area is Baris, which has been founded during the Ptolemaic dynasty (Steele, 1997).

The case of New Baris is a project with fewer social constraints than that of Gournna because in this case, a specific community does not have to be rehoused. It becomes the opportunity to create an appropriate demographic pyramid, an optimal ratio between men and women or a balance between the services had been offered by the members of the community through their trades. Therefore, it is a more theoretical project, where more attention can be paid to the design of somewhat idealized and generic prototypes (Steele, 1997).

New Baris would have had an initial population of 250 families, of which 150 would have been dedicated to agriculture and the rest to other trades to cover the needs of a city of this size. In the memory of the project, Fathy warns of the dangers of a community where 90% of the population is dedicated to the cultivation of the land, highlighting the difficulties they would have had to resolve to meet the demands of the inhabitants (Bernard, 1978).

Unfortunately, the entire proposal could not be carried out because of the Six-Day War with Israel, which had halted all the construction in New Baris in 1967. It never resumed. As the Fig. 2 shows, only a few buildings have been completed, including the market, which was to be the most important building in the city due to the expected agricultural industry planned for the area.



Fig. 2: New Baris, current situation.
Source: The authors, 2024.

Findings and Analysis

Urban Planning

The urban plan of New Gourna is articulated around a large central square of irregular shape, configured by the main public buildings: Mosque, City Hall, Theater and Khan. The plot, deliberately irregular, seeks to develop the imaginary and favor rich and varied architecture. The plan is divided into four major parts, separated by wide streets of 10 meters, corresponding to the four major families that make up the village. Then, secondary streets of six meters are responsible for protecting the privacy of the interior of each of these four areas. The plan deliberately avoids any systematic character of symmetry and repetition that leads, as Hassan Fathy said, *"to those boring rows of identical dwellings considered the only thing the poor deserve."* (El-Wakil, 2009)

The project develops a strategy based on urban courtyards of different scales and functions depending on their location in relation to the city and the houses that make it up. Along the route of the secondary streets there are relationship spaces called "badana". These spaces allow the privacy of the inhabitant to be graduated, so that through small squares, which function as courtyards due to their dimensions, the passerby is incorporated into the busiest areas of the city.

Thus, first, we have the courtyards of the houses, then the different houses of a clan are grouped around these small squares. Finally, the pedestrian reaches the main arteries of communication. The routes to these roads are tortuous and slow to prevent non-residents of the area from using them as thoroughfares.



Fig. 3: New Gournah, general plan.

Source: The authors, 2024.

For New Baris, Fathy has evolved the previous model and has taken as a reference of urban layout the city of Kharga that presents an a priori free growth, where the houses seem to be added in a casual way from a curvilinear and tortuous layout (Steele, 1997).

All this organicism has a sense of climatic protection. The compact aggregation of the buildings reduces the surface area exposed to the sun's rays. The difference in height of the buildings, their overhanging balconies, the camber of the streets and their reduced section guarantee the presence of shaded areas. The covered street is analyzed as a characteristic element of its urban fabric. The elements that cover it are part of the adjacent dwellings and prevent glare on the street, providing breaks of coolness and shade to the streets of the village.

Fathy again relies on tradition to solve the climatic problems of the hostile desert environment. He understands that these timeless strategies are the only way for its inhabitants to survive. It is not a mimetic copy of the solutions of the past, but in the understanding of concepts and the abstraction of solutions to solve today's problems. The architect incorporates all these strategies into his project but in a more rigorous way. Despite his conviction and rootedness to the local culture and its urban layouts, Fathy's experience in the office of the Greek architect Dioxadis teaches him to value the virtues of order in urban planning. It can be said that there is a much more evolved rationalization of public space than in Gournah, and Dioxadis is the key to the change. Although their collaboration lasted only 3 years, the intellectual debate was very productive. The time spent in Dioxadis' office brings him closer to scientific trials to test his design ideas or those elements of tradition that he wished to incorporate into his projects. One proof of this is that Fathy conducted an experiment in collaboration with the Cairo Institute of Appropriate Technology that sought to demonstrate the importance of orientations in the city's streets for temperature regulation. He finds the urban layout of ancient Cairo has a very important control plan on the microclimate. Fathy exposes that the main street, the only relatively wide street, Sharia Al'Muiss runs north south, perpendicular to the sun's path. This orientation keeps the street in shade most of the day. The streets that cross the main street and run parallel to the direction of the sun are very narrow and have many bends. He continues to articulate these streets by design to create shadows. The only spaces in old Cairo that are open enough to receive solar radiation for a considerable time are the intersections of small streets with the main street and the courtyards of houses. These intersections, which tend to generate small squares, not only serve as popular gathering places

or visual landmarks, but also have micro-climatic functions. Then, due to solar radiation, the air is warmer in these small squares than in the adjacent shaded streets and is therefore less dense. At that moment, a natural convection system starts to work automatically when the cold air tends to occupy the space left by the warm air rising due to the heating. Thus, the side streets ventilate towards the main street thanks to air convection (Fathy, 1974).

This study lets him understand that the most advisable arrangement of the main axes of the urban fabric was north-south, due to the less sunlight they would receive. The main axes in Nueva Baris are intersected by much narrower perpendicular roads designed for pedestrian circulation. These pedestrian streets run from east to west following the path of the sun and considerably reduce their section to be able to free them from vehicular traffic. These roads have small changes of direction that break the monotony and the overly long views by housing a square inside them.

In the center of the proposal are public facilities such as the hospital, administrative offices, the mosque and a market, as a focus of activity and influx of inhabitants.

As the general plan of the intervention shows in the Fig. 4, the grid organization of the project is opposed to the much more sinuous and picturesque organization of Gourna. The two topographies are quite similar, so we cannot speak of different adaptations to the terrain.

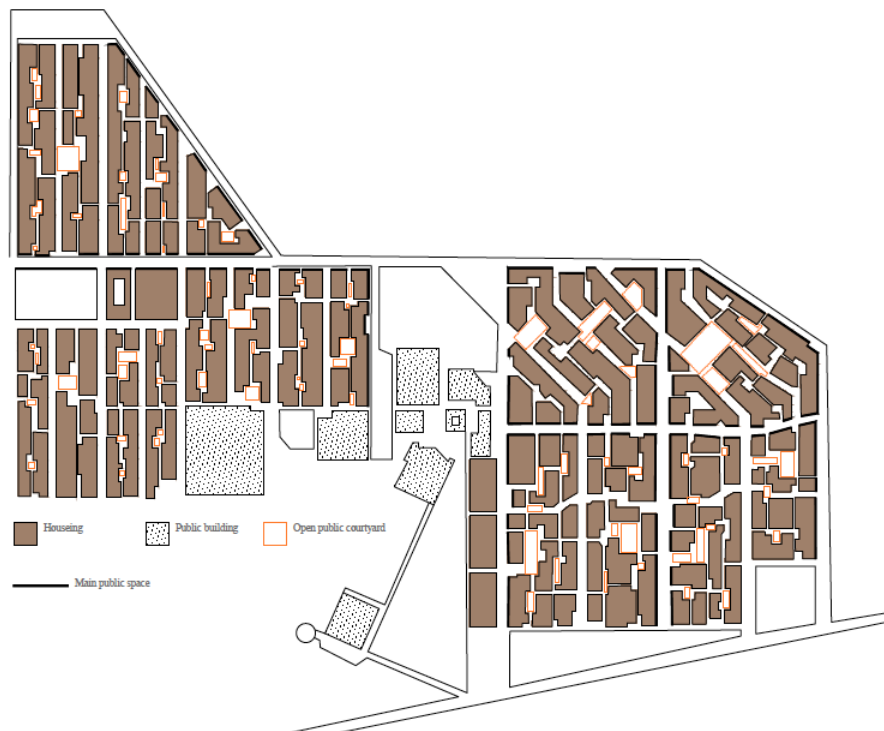


Fig. 4: New Gourna, general plan.

Source: Authors, 2024.

In those 20 years, several key events have occurred that in a way rationalize the conception of Hassan Fathy's urban plans. On the one hand, he faces a more industrialized Egypt and an increasingly fast-paced world. Thus, the urban fabric must allow for the absorption of the flow of vehicles while at the same time, not losing the scale of the pedestrians. On the other hand, Hassan Fathy is influenced by the work done with Doxiadis, in which he first assumed the grid as a suitable solution to solve the problems of the urban fabric of the Arab world. ekistics of Doxiadis came to systematize Hassan Fathy's creative patterns, establishing order and structure to the city. However, that order did not come to hinder the development of the pedestrian scale.

House Designs

For the design of the New Gournia house, Fathy relies on the use of traditional typologies adapted to the current needs of the farmers. Traditional Arab houses in such arid climates often function as a means of protection from the extreme heat that surrounds them. This means that there are few openings around the perimeter, so that the rooms breathe from a central courtyard, which is the lung of the house. Fathy thus initiates a campaign in support of the courtyard house as a legitimate solution linked to tradition in the Arab world. According to Fathy (1973), the courtyard brings to the villages something of the grace and urbanity of the life of the rich man of the city. He explains the palace of the Pasha has been always built around a courtyard or series of courtyards, which gave it a special atmosphere of calm and beauty. Fathy adds that open spaces such as these, unbuilt, are part of the character of Middle Eastern architecture, we find it in fact, from Morocco across desert areas to Syria, Iraq and Persia and it reaches perhaps its most refined expression in the houses of the city of Cairo.

Regarding the different housing typologies used in the plan, Fathy wants to know every family that is moving to New Gournia to adapt his design specifically to them. He makes also clear the differences between the house of a rural farmer and that of a city worker. As a sanitation measure, peasant houses should pay special attention to the segregation between animals and inhabitants. In this case, due to the density of the plan, it was not possible to establish two accesses to the houses; a rear one for the yard with the livestock and a front one for the inhabitants of the house. It was necessary to build on two levels, so that animals and activities related to the use of water, such as the kitchen and latrines, remained on the first floor, and the rest of the activities of the owners were moved to the second floor. In Figure 5, both plans show the individual courtyards as private exterior space and the common public courtyards, situated in between the buildings.

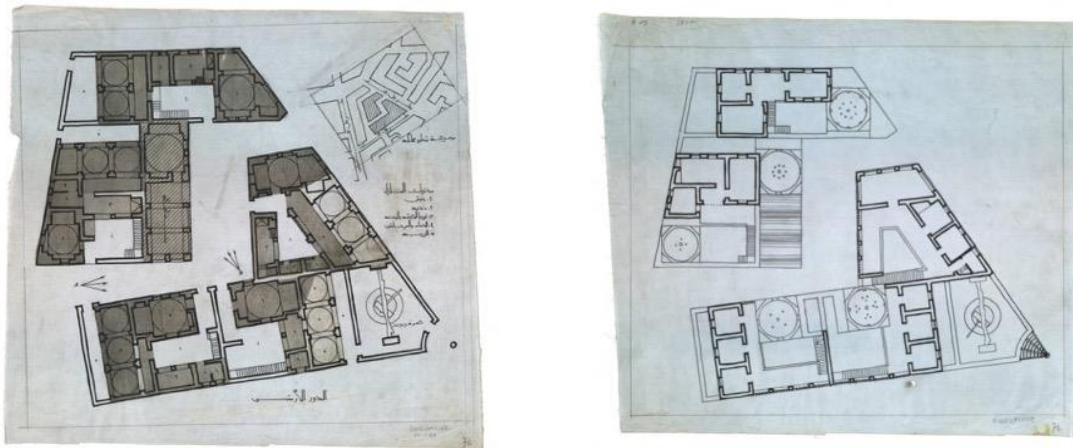


Fig. 5: New Gournia housing ground floor units. Left: Ground floor / Right: First floor

Source: The American University of Cairo.

In New Baris, Fathy insists again in the introverted typology with rooms opened to the inner courtyard. Fathy says:

“This design concept proved to be the best protection against the hot winds of the desert and for cooling air, by storing the cool air, which deposits in the courtyard during the night and keeping it until a late hour in the day.”

Fathy, 1977: 11

The main social difference that could affect to the housing design is Fathy doesn't know the name for whom he designs, as happened in Gourma. But he insists in the concept: unity in

variety and not in uniformity. He defends not two men are alike, even they are physically identical, they will differ in their dreams and the architecture of the house emerges from the dreams. Then, even maintaining the desire for typological variety, the major difference between the design of the houses of both projects is that, in New Baris, the families have no previous links to each other, and Hassan Fathy could not meet them. Because of that anthropological aspects are relegated to a secondary position, so that the architect concentrated all his efforts on developing an effective response -urban, architectural, and constructive- to an extreme climate whose temperatures could reach 48 degrees in summer periods. (Serrano, 2022)

In Figure 6, the plan of the ground floor of this module of housing units shows, as in New Gourna, the private and individual courtyards of each house and the common and public ones as part of the pedestrian street. Here we can see the broken movement of this path, keeping the axis direction but reducing the length and continuous perception of the space

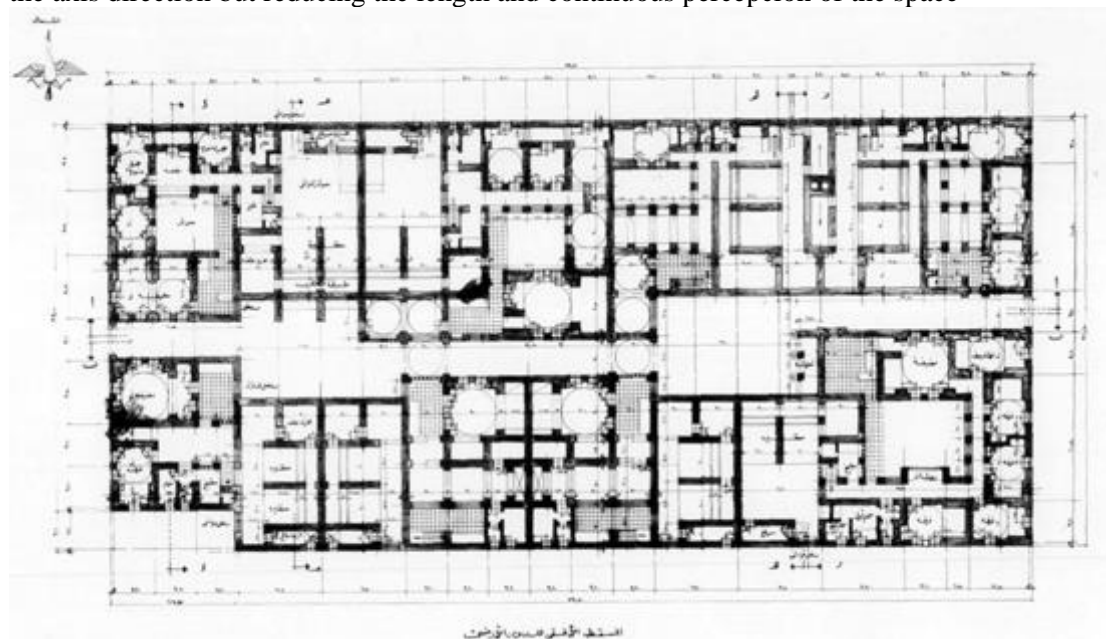


Fig. 6: New Baris housing ground floor units. Left: Ground floor / Right: First floor
Source: The American University of Cairo.

Sustainable Strategies Applied to Optimize the Resources During the Design and Construction Process

As it's show in the previous analysis about the urban and houses design, Fathy bases his decisions on the vernacular architecture knowledge and apply them to find the better adaptation to the climate situation of the environment. But these urban decisions in terms of organization, scale and orientation of the streets and the use of the courtyard on both designs, houses and urban, are not the only decisions of Fathy's projects regarding sustainable strategies.

In terms of construction, in New Gourna, the proposal is based on the involvement of the neighbors in the site development of the buildings. Fathy intends to escape from the usual system of contracting construction companies and the use of conventional materials. The architect is based on the experience he lives in Nubia when he visits the communities of the upper Nile and observes how they themselves are sufficient for the construction and maintenance of their homes. In this sense, one of the first tasks had carried out had been the restoration of craftsmanship, returning them to the place they deserve. Fathy's strategy is to avoid the use of construction techniques from developed countries, which were unattainable for the rural population due to price reasons. He explains that poverty forces them to use mudbrick and to adopt the vault and dome for roofing (Fathy, 1973).

Fathy tries to bring craftsmanship and architecture together, so that the artisans become elements of prefabrication, the industrial workshop of traditional architecture. Fathy considers that the architect has a strategic position to foster faith in the culture and traditions of the peasants, so the architect must respect them and try to adapt his designs as best as possible to their values. There is absolute control of the work to be done, everything is manufactured in the town and therefore all cost prices are known. As Fathy (1973) says, the high cost of rural constructions results not only from the expensive materials used, but it also results from the system by which the execution of the work is placed in the hands of private builders.



Fig. 7: Left: New Gurna Theater. / Right: New Gurna Market
Source: The authors, 2010.

In New Baris, as it's mentioned before, Fathy does not know the future inhabitants of the settlement, so he cannot count on them for the constructive development of the buildings (Fathy, 1977). This modifies his initial approach but not his principles about construction, materials and working methods. To all this Fathy adds the experience acquired during 20 years of work, including all his learning and experimentation on the climate control of buildings. For its materiality, Fathy continues to believe in mudbrick, but this time, supported by scientific research that supports the good performance of the material both in its structural behavior and its durability.

“The modern science of soils mechanics has solved the problems arising by using stabilizers by parafin and bitumin emulsions. This test shows that it is enough to stabilize just the outside plastering to make the material fit for use even in the humid zones.”

Fathy, 1977: 18

Fathy recognizes that in Baris they are in the same situation as the ancients, and they have recourse to the same methods and techniques. But he also recognizes that in this moment, to ensure the practicality of mudbrick into the design and building, altogether three persons are necessary: the soil mechanic engineer, the structural engineer specialized in shell structures and the architect specialized in mudbrick and the technique of vaulting.

“My collaborators in Baris are Dr. Mohamed Said Yousef, Professor of Soil Mechanics at the Cairo University and Dr Ibrahim Gafaar, Professor of Structures at the same University.”

Fathy, 1977: 19

In Baris, Fathy focuses his effort in applying and condensing all the popular knowledge for microclimatic control with the aim of improving the extreme climatic conditions without mechanical means. Fathy decides to use systems that incorporate moving air in constant renewal, with thermal control by massivity from high inertia walls. Once again, the stay in Iraq as a result of the collaboration with Doxiadis is fruitful, as Fathy imports the Bagdir. This

climate regulating element consists of the introduction of air through a duct from the roof to the basement, where the air slides over a raft in such a way that it takes in water particles and is humidified to cool the interior environment. With the interruption of the construction of the project, only a few buildings are completed, among them the market, where it's possible to find Fathy's decisions about climatic control. This harmonic path of fresh air is well reflected in the section that Fathy makes for the construction of the building, as it's shown in Figure 8 and Figure 9.

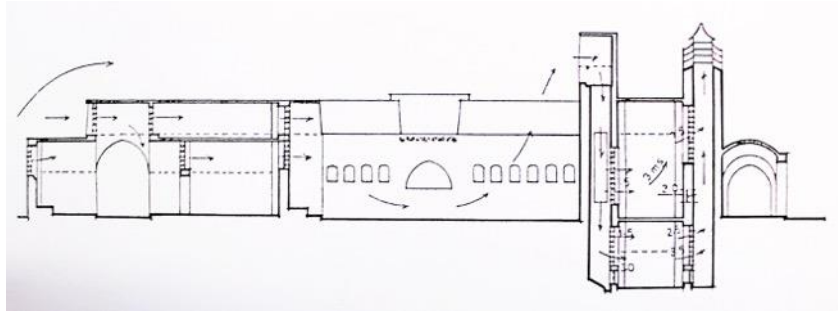


Fig. 8: Section of the New Baris market with the planned air flow.
Source: The American University of Cairo.



Fig. 9: New Baris Market.
Source: Authors, 2010.

The main sustainable strategies that Fathy applied to the design of New Gourna and New Baris are presented in Table 1.

Table 1: Sustainable Strategies Applied in New Gourna and New Baris
Source: Authors

No	Sustainable strategy	Aim	Project
1	To integrate local tradition into the urban and houses design	To ensure their proper use and maintenance.	New Gourna
2	To establish narrow street widths in secondary roads.	To create shade for pedestrian walkways.	New Gourna
3	To generate public courtyards in pedestrian circulation spaces.	To create air flows by its path's connections.	New Gourna
4	To establish the courtyard as a fundamental element of the house.	To be a climatic regulator of the rooms.	New Gourna

5	To adapt each house to each family.	To give it its own identity thus a better maintenance.	New Gourna
6	To involve future inhabitants in the construction of their homes.	To reduce economic costs.	New Gourna
7	To use traditional mud brick as the main building material.	To reduce production resources.	New Gourna
8	To locate the main roads in a North-South orientation.	To be in shade most of the day.	New Baris
9	To cover secondary and pedestrian roads, in an East-West orientation.	To generate shade on them.	New Baris
10	To leave urban courtyards sunny.	To heat its air and generate convective movement with adjacent shaded streets.	New Baris
11	To integrate a scientific technical staff in the design process.	To improve the mud brick construction and durability.	New Baris
12	To design passive ventilation strategies in the buildings	To combat the arid climate with natural resources.	New Baris

Conclusion

This research shows how both projects are directly related to Fathy's constant concern for vernacular architecture. The analysis of both the projects shows the evolution of his processes and his design strategies to perfect the defense mechanisms towards the climate.

New Baris shows how the architect maintains the architectural design strategies applied in New Gourna, adding the climate control techniques learned during the 20 years that separate the two projects. Both at the urban level, with the orientation of its layouts, and at the building design level, with the natural ventilation systems applied, Fathy achieves a high level of control and commitment to the arid climate so characteristic of Egypt.

New Gourna is the first large-scale project developed by Fathy and shows an ambitious and experimental character, capable of leading the future of the settlements of the new rural Egypt. New Baris shows a more mature and theoretical approach. In this project, the architect has more design and technical tools, capable of correcting previous mistakes and adding new concepts without losing the original objectives. Although it was not possible to complete either of the two projects, Fathy's documentary legacy allows us to understand his intentions. Furthermore, its condition of not having been built, allows us to idealize the hypothetical result obtained.

According to Al Tawayha, Braganca and Mateus (2019), in order to develop something and to improve it is necessary to learn from previous experiences, to learn from the past, especially when talking about a very rich background and a very poor reality. It is possible to highlight that vernacular strategies should be used as guidelines in contemporary urban planning and building design processes.

Table 1 shows the summary of the main strategies applied in both projects. All of them could be defined, today, as basic principles of sustainable architecture. And from them, it is possible to produce the key guidelines that can be employed in a contemporary and sustainable design process. They are as follows:

- **Learn from the past:** Study the existing vernacular architecture to understand its identity and properties to maintain them as a basis for the future. The techniques used during many years with minimum resources to obtain maximum benefits must be an example for contemporary architecture.
- **Understand the present:** Analyze the current context to act accordingly and anticipate future situations. Climate and thermal control are the main responsible for the wellbeing of the inhabitants. Its proper management to achieve maximum comfort with minimum consumption of resources should be the main concern and the greatest value of current architecture.

- **Respect the future:** Be aware of the local, regional, and global environmental impact when choosing materials and energy sources. Maintain the buildings' full performance with minimal required maintenance.

This paper examined two settlements designed by Hassan Fathy in Egypt: New Gourn, completed in 1945 and New Baris, completed in 1964. They exemplify the sustainable design approach Fathy took, even before sustainability was discovered by the world. They employ powerful ideas about optimization of resources and the maintenance of identity of vernacular architecture. As this paper shows, the world will be a better and a more sustainable place if these are adopted in the production of human settlements in the future.

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