

RESEARCH ARTICLE

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Alliance: the sustainable regeneration of al-Azbakeya historical garden

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Received: 29 November 2022 / Received in final form: 31 July 2023 / Accepted: 31 July 2023

Abstract. While the world is heading towards sustainability and climate action, Cairo is losing its greeneries. The project site lies in al-Azbakeya historical garden that lost more than 75% of its area to concrete structures, it is a part of historical Khedival Cairo that suffers from urban deterioration, high population, and pollution [1]. The project is a complex building that aims at converting al-Azbakeya garden into a hub of sustainable and green urbanism [2]. It also targets social and economic sustainability by tackling the problem of street vendors. The design approach is reached through site analysis to determine the challenges and opportunities of the site, and the project's targeted environmental, social, and economic impacts. Then, a functional program is established to integrate governmental and non-governmental organizations to provide collaborative sustainable solutions. The objectives are met by using four architectural design features: pixel-like interlocking masses, natural light, small buildings with local and recycled materials, and natural materials integrating with the garden context. Sustainable technologies are used in irrigation, energy use, and water use to ensure environmental sustainability [3]. Environmental analyses are developed to test the project's efficiency using Digital software plugins as Revit-Insight. Area Analysis is also carried out to check area distribution among different functions, while the Circulation Analysis shows best entrances and passages for pedestrians. The results are adding around 13 000 sqm (68% of total area) of green areas to the compact urban area, providing developed businesses in a regulated retail area for street vendors converting their problem into an asset supporting the Circular Economy Strategy, and reviving the livability of the community by cultural spaces like bookstores, open theater, and a second hand market promoting smart reuse. The project fulfills its objectives and meets the sustainable development goals 6, 7, 8, 11, 12, 13, 15, and 16.

Keywords: Digital design / energizing architecture / social sustainability / sustainable landscapes / urban regeneration

1 Introduction

Cairo is facing a major shift in urban and cultural development that started after the 23 July 1952 revolution and now it is clearly affecting the Urban Fabric of the city especially after 25 January 2011 revolution and the political events afterwards. Social and Governmental understandings of the importance of Open spaces and green areas have been changing which resulted in a major decrease in green areas in the city center to be replaced by commercial areas, cafes and restaurants. This project is proposing a prototype of green architecture integrated with new recreational functions while solving the socio-economic issues of the city's downtown.

2 Historical review of al-Azbakeya

Azbakeya is a Cairene neighborhood located in the heart of Cairo. The area is trapped between medieval Cairo and modern Cairo (Downtown). It is considered as one of the most crowded places in Cairo as it receives lots of daily visitors to attend some of the main administrative facilities in the capital, as well as being one of the main connective areas between eastern and western neighborhoods. Through the history in the Mamluk and Ottoman periods, it was the residence of the elite people in Cairo. After the French campaign and during the dynasty of Mohamed Ali Pasha's family, it was the cultural center of Cairo as it hosted the royal opera house and some other important theaters, as well as the most important and famous public garden at the time. In 1951, in the great blaze of Cairo, most of the historical buildings in the Azbakeya neighborhood

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Fig. 1. Attaba square adjacent to site – 2019 showing traffic congestion and street vendors.

Source: © Hayam Adel <https://www.alamy.com/people-shop-at-al-ataba-a-popular-market-in-central-cairo-egypt-august-2-2019-reutershayam-adel-image374199000.html>

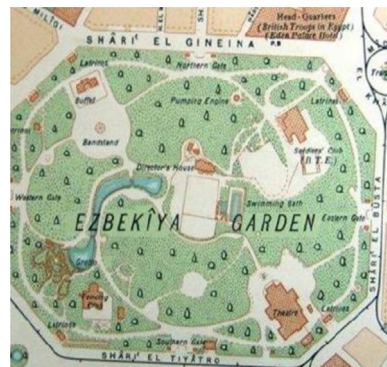


Fig. 2. Azbakeya garden Layout 1872–1952 published by the Survey of Egypt, 1927.

Source: https://www.researchgate.net/publication/258999025_The_floristic_composition_of_some_historical_botanical_gardens_in_the_metropolitan_of_Cairo_Egypt

were burnt and torn down including the Khedival Opera house. After 1952, Egypt became a republic and Lots of the theaters that were standing at Azbakeya for more than 150 years were torn down. The eastern half of the garden was used to build ministerial governmental buildings. Big part of it was transformed to one of the most crowded bus terminals in Cairo. and a big multi-story garage is built in the same area of the destroyed opera house with concrete facades which completely erase the story of the opera house from the memories of Cairene people.

2.1 Transformed appearance and structure

Now, the area surrounding the park is congested with traffic jams, street vendors leaning around the fence of the garden, formal and informal markets which wasted the appearance of the garden as shown in Figure 1, and the park itself has witnessed a physical transformation and vandalism, starting with its area that decreased from 10 acres, to 2 acres with a loss of 80% of it green area as illustrated in Figures 2 and 3 [1].

Many of the social experts have discussed the changes that the Egyptian communities have witnessed in the last 60 yr. The spatial preferences for recreation and entertainment purposes differed according to the social level class. Thus, the changed lifestyle of the present society has changed their view towards historical value which become more depreciative, as Wanas and Samir argued that the recent huge spread of shopping malls, and coffee shops in comparing with public gardens and landscapes are the reflections of globalization in the lifestyle that caused the transformation of the urban green open spaces physically and non-physically [2].

3 Site analysis

3.1 The urban status of Azbakeya

The site is a part of Al Azbakeya historical garden and it has a central location between the historical Fatimid Cairo in the East and the Khedival Cairo in the West. It is also

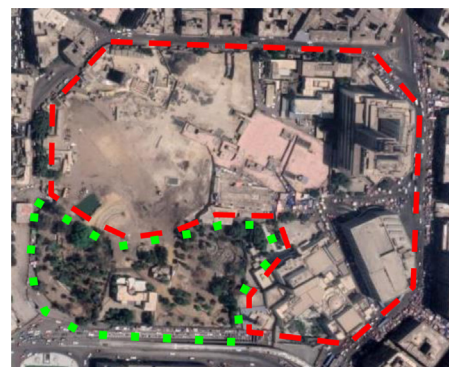


Fig. 3. Azbakeya garden layout 2022 showing the remaining part of the green area.

Source: Author

connected with Maspero triangle through the 26th of July street, Al Azhar park through Al Azhar street and with Ramses train station and Abdeen palace through Al Gomhoreya street.

The surrounding streets are Al Gomhoreya St. which is the main Street and the secondary street is Ali Al Kasar st.

Pedestrians and cyclists can reach the site from historical Cairo and from downtown Cairo as it is within walking distance but it is blocked by the street vendors in Al Azhar street and Al Attaba square.

The site is accessible by bus as there is a main bus station at Al Azhar parking building and a bus stop at Al Attaba square.

Al Attaba metro station is located underneath the site land and it has three exits, The first in Al Gomhoreya street while the second in Ali al Kasar street and finally the third is behind Al Azhar parking building as shown in Figure 4.

The surrounding area is rich in khedival neo-classical buildings as well as modern buildings from the second half of the 20th century. Some of the surrounding buildings which are shown in Figures 5–8, respectively are the Opera parking building, modern apartment buildings, the Telecom

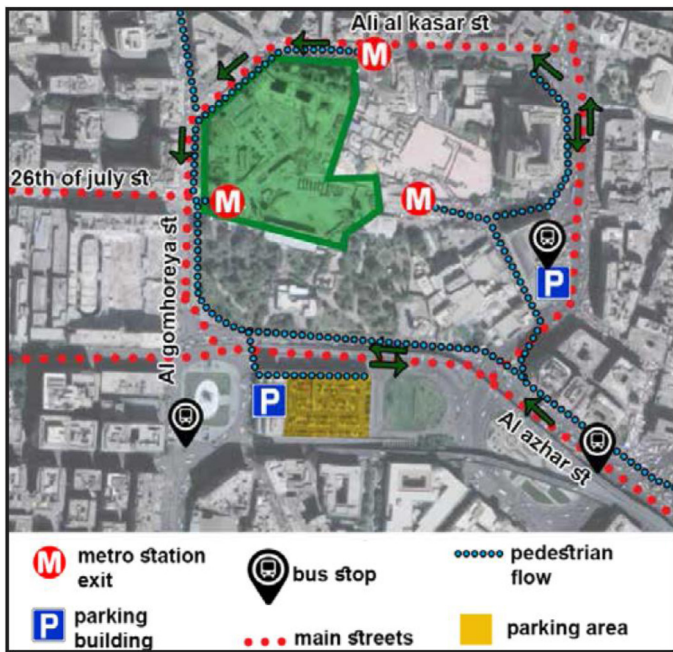


Figure 4. Accessibility map of Azbakeya and Attaba square
Source: Author



Fig. 5. Ataba parking.

Building, and The National theater. The area has some famous historical buildings such as the old Tiring Building, Sednawy Building, and Green Hotel as well which are threatened by urban deterioration and neglect. The surrounding styles are studied to be considered in the architectural design as the building must respect the surrounding context and integrate with the architectural heritage in the area.

3.2 Street vendors activities

Cairo is well-known for the duality of formal and informal economies where the public open spaces are used for selling different products informally. The products sold in the informal market of al-Azbakeya are very diverse as Clothes, Electronic spare parts, food and Books as shown in Figure 9 [3,4]. Al-Azbakeya is very famous for the used



Fig. 6. Green hotel.
Source: Author



Fig. 7. Telecom building.
Source: Google maps images



Fig. 8. National theater.
Source: <http://www.udc5.com/wp-content/uploads/2015/08/14.jpg>

book market “Al-Azbakeya Fence ” known as “Soor al-Azbakeya”. Where the informal vendors were occupying the fence of al-Azbakeya garden and its surrounding area for years till finally they were relocated near the garden and al-Attaba Metro station in small shops. The problem of Street vendors is the Economic Catalyst of the project that will ensure its sustainability later on.



Figure 9. Products sold in al-Azbakeya

Source: https://issuu.com/laylasabry/docs/final_report_-_thesis_i

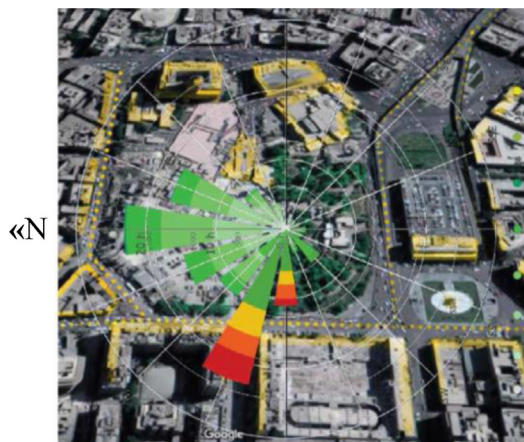


Figure 10. Wind rose over the site.

Source: author

3.3 Environmental analysis of al-Azbakeya, Cairo

Cairo, Egypt belongs to the Dry Hot-Arid climatic zone according to Köppen Classification [5], and the Cairo and Delta region according to housing and building research center in Egypt (HBRC) classification. The prevailing wind direction is the North as illustrated in Figure 10. Most importantly, the environmental conditions are severe during summer as the temperature rises high above the comfort limits which can reach 47°C. The Sun altitude is also high about 31.5° with very high exposure and it is getting worse each year due to climate change. Besides the sound and air pollution in the site due to high CO₂ emissions produced from traffic congestions. These severe conditions result in the crucial need to provide treatments using the building's skin and passive design tools to achieve high thermal insulation and natural ventilation inside as well as air purification by plantation.

3.4 Concept generation and architectural design

Alliance is taking a hybrid typology of Sustainable green architecture and modular architecture as it represents small-scale and informal entities. Therefore, a study of successful architectural precedents is necessary to fulfill the



Figure 11. Prestige University Building, India.

Source: <https://www.archdaily.com/973692/sanjaypuri-architects-designs-stepped-volume-with-green-terraces-for-prestige-university-building-in-india>



Figure 12. Hanging gardens of One central Park, Sydney.

Source: https://www.archdaily.com/551329/one-central-park-jean-nouvel-patrick-blanc?ad_medium=gallery

main aim of the project and three of the most significantly related projects are displayed as follows. The first project is Prestige University building in India demonstrated in Figure 11 as it has integrated its large green roof with the surrounding by creating a stepping pixel-like geometry [6]. One central park, Sydney used the wide facades to create vertical hanging gardens as shown in Figure 12 [7] and finally, the farm house used stacked green architectural modules where users add their homes modules integrated with vertical farming units in a designed triangular structural grid as illustrated in Figure 13 [8].

3.4.1 Conceptualization pool

Inspired by the informality issues facing the area and causing its deterioration and the possibility of turning this informality into an asset for revitalization. The project's main goal is to deal with the informal economy and



Figure 13. The farmhouse.

Source: <https://www.archdaily.com/912058/precht-designs-timber-skyscrapers-with-modular-homes-and-vertical-farming>

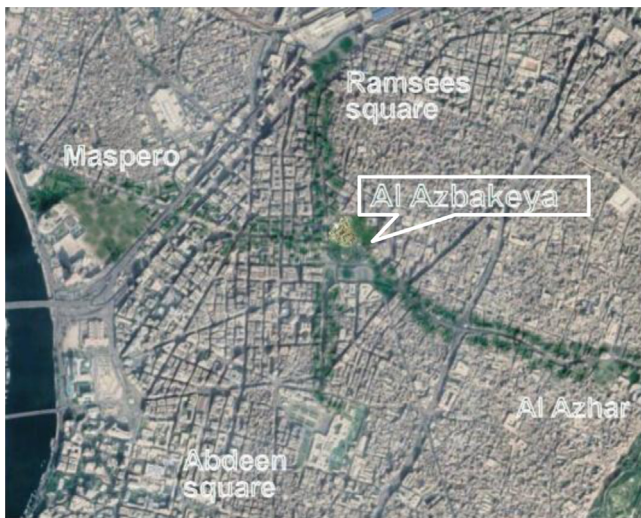


Fig. 14. Forecasted green axes.

Source: Author

informal interventions in the city, especially the problem of street vendors. The solution lies in the Egyptian human resources and with the proper help from the governmental and non-governmental organizations with the investors. Alliance is a hybrid of Governmental office building, market and community center that should energize People through Utilizing the Vast strength lying in the Egyptian Human Resources to provide both economic and social sustainability. Introducing a Quadri-actional Body composed of People, Government, Investors and NGOs would ensure serving People's needs, improve their local economy in a more organized, effective and legal manner.

The project will re-introduce the vendors to the community as legal and organized members. Therefore, it must have a down to earth design with human scale spaces with open public spaces that encourage interaction.

And finally, to introduce the concept of Green Architecture in the city's downtown, It will have a strong statement using green roofs and hanging gardens covering its masses horizontally and vertically. It aims to be a center for green architecture in Cairo and help it spread over two axes till it reaches other areas as Maspero at the west, Ramsees at the North, Al Azhar at the East and finally, Abdeen at the South as shown in Figure 14.

Four main Architectural features are used in the project design as follows:

- Using Pixel-Like interlocking Architectural Language as a Metaphor for the woven Fabric composed of small entities (Modular architecture).
- Using Natural Light which gives different experiences throughout the day to introduce the “Time” factor as a fourth Dimension.
- Using Small Particle Buildings with Local and Recycled Materials to try to relate to fresh, ordinary layman and small Business owners.
- Using natural Materials and interlocking buildings with the Garden context in a trial to integrate the Project with the garden and make a statement that development if made properly would not contradict with nature (Man with Nature)

3.4.2 Form generation and zoning

- The spaces of the project are distributed over 2 forms as demonstrated in Figure 15, main building at the edge of the site and fractioned modules distributed over the site. The building hosts formal governmental institutions and Institution of Urban Harmony, NGOs, Cultural center, Gallery, Library, Conference center and commercial spaces as market and book stores. The functions are distributed in these two forms according to the surroundings and views.
- The market is located in the open basement floor to be connected with the underground metro station easily. Also, to make sure that the spaces that need to be spread over a large area do not cover the park to protect it and make it continuous till it reaches the other side.
- The bookstore and reading areas are near the Azbakeya wall book market to give more services to the market and attract more people to the project.
- The NGOs units are above the market to observe it and to become easily accessed by the public from the market and the park. In addition, the units above the market provide shading to the open spaces and paths and create transitions between light and shadows to give different experiences.

On the other hand, Inside the building itself, the governmental institutions and conferences center are in the northern corner of the project near the neighboring buildings to become accessible by the public, and to have a wider view of the park. In the upper floor, there is a shared space for the employees in every institution in the project to meet and discuss their point of views towards the problems they are facing in their work.

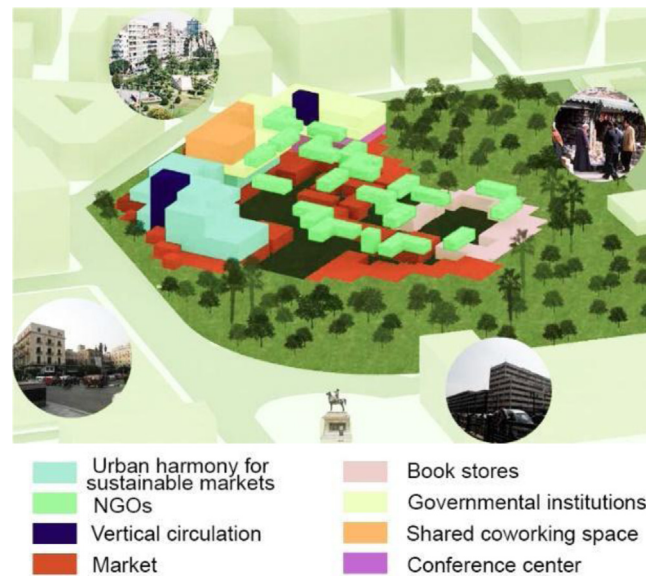


Fig. 15. 3D zoning.

Source: Author



Fig. 16. Two longitudinal sections showing stepping roof gardens and natural ventilation.

Source: Author

3.4.3 Architectural and environmental treatments

The morphology of the building allows green roofs on different levels which create a vertical garden view for the neighbors to compensate for the lost part of the park. The projecting masses also provide self-shading as shown in Figure 16. The facade is partially covered with double skin to and sun breakers of recycled materials, This provides shading, reduces the heat gain and reduces the glare indoors to provide thermal comfort and a convenient working environment indoors. The Tartan grid is emphasized by the vertical sun breakers to show the modularity of the design. The curtain wall is made of transparent insulating panels and instead of solid walls, translucent panels are used. The structure is also a main element

affecting the appearance of the project as the structure is a skeleton that imitates a woven fabric and connects all the masses together. It is also a medium for vertical farming as climbing plants can grow over it and it can act as a medium for hydroponic plantation as well. Finally, From Ali Al Kasar street the market is approached through an open passage that leads to the lower level through steps and it has an open view to the garden.

Neutral colors as white, beige and natural wood brown are selected to give the project a natural feeling integrating with nature and to blend with the surrounding context which is clear in the main Facade design shown in Figure 17. As observed from the context, the surrounding buildings are mostly modern with modular grid facades.



Fig. 17. Main facade from Aly al-kasar st.
Source: Author

3.5 Sustainable materials and technologies selection (Fig. 18, [9,10,11,12])

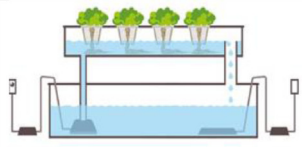
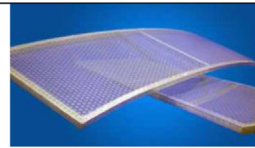
Material	Description	Image
1. Hydroponic farming system	It is a Soil-less cultivation that takes place mainly thanks to a nutrient solution dissolved in water and acts as a better and more efficient option for roof gardens. It can act as thermal insulation and reduce CO2 emissions [9].	
2. ETFE panels	Transparent and translucent panels that are made of 100 percent recyclable, non-stick, durable, lightweight material that also allows for excellent light transmission whilst maintaining a good level of insulation [10].	
3. Reused wood planks and sun breakers	Old wooden sun breakers are reused in the facade design in a creative way to give it a national identity. Recycled finishing materials are used such as the wood planks in the floor. [11] Using such materials promotes the idea of reuse and recycling among the users.	
4. ASCA® organic photovoltaic (OPV) film	It is Photovoltaic sheets made completely modular of Light, flexible and semi-transparent material; it can take on any shape to cover the surface of transparent curtain walls in the south side to generate electricity from a renewable source. [12]	

Fig. 18. Sustainable materials and technologies.

Images Source:

1. <https://farmlyplace.com/food-blog-en/urban-farming/can-hydroponics-be-a-better-option-than-soil-farming/>
2. <https://www.etfeproducts.co.uk/>
3. https://www.archdaily.com/896930/how-to-make-a-facade-with-recycled-materials-16-notable-examples?ad_medium=gallery
4. <https://www.pinterest.com/pin/18647785946128759/>



Fig. 19. Solar exposure analysis using Insight Revit.
Source: Author



Fig. 20. Final look of the environment inside the project in the commercial zone, level-1.
Source: Author

3.6 Environmental Impact assessment (solar exposure)

To test the efficiency of fractioned masses in self-shading, an analysis of solar exposure is carried out digitally using the Insight plug-in in Revit software. It measures the cumulative solar energy on the horizontal and vertical surfaces of the building throughout the year after determining the exact location of the building to import its weather data files. The results of the analysis shows

that the maximum exposure is on the horizontal roofs (which will be covered in green roofs to reduce the effect of solar radiation) and moderate exposure of the vertical walls especially at lower levels as illustrated in [Figure 19](#). The results of this analysis contributed in increasing the density of woven structural grid at some areas to add shading and vertical hanging gardens. modifying the height and orientation of the masses to optimize its performance.

4 Conclusion

To sum up, the site limitations and opportunities, the community and the collaboration between people are the key to this design. Powered by modern technologies and contemporary architecture, it can create a collaborative environment. Alliance as realized in Figure 20 is designed to address networking to people as its appearance is like a woven fabric and the articulation of spaces ensures fulfilling targeted goals. The belief that any problem can be solved by cooperation and creative thinking is what can make this project succeed. After all, people are the aim and target of this project and by re-energizing them with successful architecture, we can boost development, raise productivity, enhance the environment and even restore psychological well-being of the community.

5 Implications and influences

One of the advantages of the research and proposed design is that it is connected to many disciplines other than architecture as it impacts Socio-cultural, environmental, as well as business and entrepreneurship aspects. Therefore, the future implications and influences are in various fields. For example, a socio-economic mapping can be done before and after project implementation to measure the change in patterns in the area as the densities of street vendors and traffic. This would lead to either adjustments in the project design and numbers of suspended modules or spreading this proposed typology in the surrounding areas that need this form of solution. It will also influence social scientists and economists to collaborate with architects to create such solutions for other social and economic deficiencies. I believe that it will change the Egyptian road map towards micro-scale informal businesses and even change the traditional and historical areas' environment and appearance.

Conflict of Interest

The author declares that they have no conflict of interest.

Funding

This research did not receive any specific funding.

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Citation de l'article: May Loaay Mohamed Elhadidi, Alliance: the sustainable regeneration of al-Azbakeya historical garden, 8, 19 (2023)