



Waste Recycling Trends in Architecture

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ABSTRACT

Egypt faces an immense problem of high population density that negatively affects the natural resources. This overpopulation problem results in a huge amount of waste materials produced that should be invested via the various recycling process to preserve the environment. Efforts by the Egyptian government as well as by many individuals are enacted in waste recycling to preserve the environment. Therefore, this paper highlights the potentials of recycling waste materials to the socio-economic integrity. The paper also illustrates that the recycled materials offers great possibilities to the architecture creativity. This is reflected in the design of the Biennale of Architecture (2022), as a case study by Alaa Hassan, Mohamed Elsayed and Hassan Mokhtar, a competition by the Ministry of Culture, represented by the National Organization for Urban Harmony. The design illustrated here in this paper communicates the efforts of individual organizations and how small efforts can make a big difference. **

1. Introduction

Population increase at the present time poses a challenge to countries of different systems, whether developed or developing. There are facts that cannot be ignored about the population problem now because it affects the individual and society as much as possible. Its dimensions have transcended regional boundaries into global ones, until they are imposed on the international community to confront and address them, and the population increase comes as one of the important issues that remain the subject of permanent and continuous discussion at the table of Parliament and the government, especially as it devours the fruits of development, in addition to the pressure it causes on the labor market [1]. Many studies were done to highlight the endanger of the generated waste materials in Egypt, see [2]. The National Solid Waste Management Program (NSWMP), Commissioned by: German Federal Ministry for Economic Cooperation and

development (BMZ), stated that Egypt generates 100 million tons of waste every year [3].

Province	Daily Waste (ton)	Yearly Waste (ton)
Cairo	15000	5.4
Alexandria	4000	1.46
Giza	4500	1.64
Gharbya	3500	1.27
Behyra	3500	1.27

TABLE 1 WASTE GENERATION IN EGYPT PROVINCES [2]

The absorptive capacity of economic activities, which makes it a major challenge to the Egyptian state. In recent

years, the Egyptian government has devoted its efforts to addressing the problems resulting from the high density, which aims to achieve the required developments based on a clear sustainable base.

2. Literature Review

Many initiatives were enthusiastic about reusing neglected material wastes worldwide. Architect William McDonough and chemist Michael Braungart, in *Cradle to Cradle: Remaking the Way We Make Things* (2002) [4], offered an amalgamation of design and science. Their approach provides enduring benefits for society from safe materials, water and energy in circular economies and eliminates the concept of waste. Moreover, the organization of Architecture for Humanity through applied practices manifested the unearthed treasure of the wasted materials in various locations worldwide [5]. Also, efforts done by architect Wes Janz and his students at Ball State University in his book and project *One Small Project*, are remarkable. They used 1.9 million tons of wood pallets in squatter housing [6][7].

This paper will focus on the experiment of designing the Egyptian pavilion in the Venice Biennale / Biennale di Venezia by Alaa Hassan, Mohamed Elsayed and Hassan Mokhtar, a competition by the Ministry of Culture, represented by the National Organization for Urban Harmony. It is noteworthy that the Venice Biennale / Biennale di Venezia is the oldest exhibition on the international level, which is held in the city of Venice, Italy, every two years since 1980, and it is one of the most important international architectural exhibitions and forums, and all countries are keen to participate and represent in this important meeting.

2.1. Biennale 2022 & Recycling:

Egypt is one of the most important pavilions in the Venice Biennale. Therefore, the Ministry of Culture, represented by the National Organization for Urban Harmony, presents it for the eighth time in a row to select the best ideas for architecture projects that fulfill the theme of this competition, entitled The Laboratory of the Future. In line with the objective of this year's Biennale exhibition, solutions to the most important problems produced by high density were highlighted, which is recycling.

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The countries of the world differ from each other, of course, in the waste left behind in terms of its composition, distribution, density, and the energy value expected to be extracted from it. This, of course, is related to the population density of the country, the difference in agriculture and the industries that exist in it, the customs of its people, whether in cities or the countryside, and the differences in classes and social and living standards [8]. The volume of waste generated is also associated with per capita income and energy consumption [9].

2.2. Government & Individual initiatives:

At the Cop27 climate conference, the primary objective was to accelerate global climate action by reducing emissions, scaling up adaptation efforts, and promoting appropriate financing flows. The most prominent projects that Egypt focused on in the recent period were presented, the first of which was investing in renewable and clean energy, such as solar, wind and green hydrogen. The most important of these projects is the Benban station, as it is the largest solar power station in the world with a capacity of 2000 megawatts and 60 million solar cells on an area of 37 square kilometers, 40 stations owned by 32 companies from 12 participating countries. Also, one of the most important renewable energy projects is the Jabal Al-Zayt station, as it contains 290 turbines, thus producing 580 megawatts, as it provides 7.50% of Egypt's electricity needs, and it is planned that wind energy will contribute 14% of the total energy consumed. Secondly, transportation projects with low emissions, and the most important of these projects is the monorail project of the Administrative Capital and 6th of October, as it represents a major transformation in the means of transportation because it increases connectivity between cities and urban areas and reduces the use of private cars, thus saving fuel use and reducing environmental pollution rates [10]. Third, water treatment and reuse projects, which are water treatment and desalination plants, such as triple sewage treatment plants and seawater desalination plants in coastal cities. Fourth, household, industrial, and agricultural waste management. The most important example of this is the Egyptian Company for Solid Waste Recycling, ECARU, which owns a sanitary landfill with a capacity of 2200 tons per day on an area of 65 acres, where 3.70 tons have been buried so far. The largest example of sanitary landfills for waste is Al-Azhar Park, where it remained a landfill for 150 years and then turned into a global park.

In parallel with the efforts of the Egyptian government, this research sheds light on individual informal efforts in the environmental problems resulting from the increase in the population and directed towards the recycling of waste generated by the population, whether solid or plastic waste or agricultural waste and others [11].

2.3. Agricultural waste:

In the past years, the sky of Egypt was filled with the black cloud in Egypt resulting from the burning of rice straw, which constituted a great threat to the climate and the environment, as it was harmful to birds and agricultural crops, and its negative effects were dire. The damage was not limited to that only, but it also caused a decrease in the percentage of oxygen in the soil, which led to the death of all living organisms beneficial to the soil. Also, the percentage of car accidents on highways was increasing. It increases the percentage of chest diseases and allergies, which affects human health [12].

All these consequences aroused the Egyptian government's attention, so it took the initiative to publish penalties against anyone who burns rice straw. Not burning rice straw led to its accumulation, so several individual initiatives took the initiative to exploit it in the manufacture of paper. The most important of these initiatives is the "Nafezeti" group, which is an initiative based on recycling rice straw to turn it into paper. First, the rice straw is collected from farmers, then the rice straw is soaked in water and boiled to make it look soft and brittle. Then it is firmly combined in a machine, after that it is placed in molds and manually pressed and completely filtered from water to take the shape of paper, then placed on the wall until it dries completely and becomes usable and writing paper [13].

Agricultural waste also includes sugar cane waste, and several institutions contributed to its recycling, the most important of which is the (Bermouda) Foundation, which is led by three young men from Upper Egypt. Bermuda relies on converting sugar cane into organic fertilizer for plants. The sugar cane waste is ground to turn it into a powder, then it goes through several manufacturing stages to become an organic fertilizer. Members of the "Bermuda" organization called it the "Secret of the Earth" fertilizer. There are other initiatives for agricultural waste that is recycled or recycled, such as corn stover and other waste.

2.4. Plastic waste:

One of the most important individual efforts in preserving the environment is the garbage collectors in the Zabbaleen neighborhood. The materials are collected, sorted, recycled, and then resold. Approximately 85% of the materials collected are recycled. After conducting several interviews with the residents of the neighborhood, several types of waste that are recycled were monitored, the most important of which is the plastic collector. The plastic collector collects all kinds of plastic from bags of goods, bags of chips, etc., then exposes the goods to a high temperature to melt them, and then reshape them again. The resulting dough is reshaped into very thin strips and then divided into many balls. After that, sacks of these balls are collected, sold, and exported abroad. There are some who deal with plastic and produce clothes hangers that bear the name "Shams", which is the nickname of the famous

Egyptian family of hangers that are distinguished by their shape and black color.

2.5. Solid waste:

Solid waste is the most widespread and abundant waste, as it is the product of daily uses, the most famous of which is soft drink cans. Collecting soft drink cans is done by collecting many different cans, then melting them at a high temperature, and then pouring them into ready-made molds to take the shape of the molds, and they are sold in this form and sold [14].

3. Pavilion Design

Individual initiatives are neither binding nor under supervision to provide that service to their country. Rather, they are effective efforts due to their sense of responsibility towards the environment. All of them face difficulties and challenges to implement their initiatives, whether it is the difficulty of collecting resources and materials, the costs of recycling work, or the obligations towards their assistants, and so on. But they are like the Egyptian eagle, as soon as it sets a goal for itself, it achieves it, and the osprey does not fly in a fixed line, but rather goes through continuous challenges, many periods of decline, but it continues until it rises again and returns to fly towards its goal until it reaches it. The trajectory of individual initiatives was inspired by the Egyptian eagle, so its movement was tracked and evaluated into successive frames to draw that trajectory, called snapshots as shown in figures 1,2 below.



Figure 1

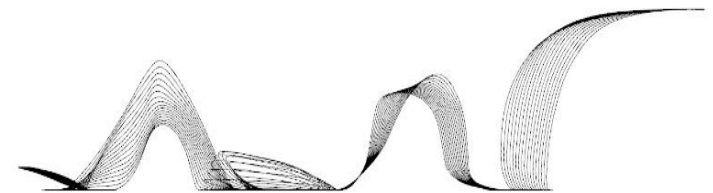


Figure 2

3.1. Used Materials:

During the journey of meetings with individual initiatives, the most flexible materials that support the design and help us deliver their clear message were tested, so the best solution was recycled paper from rice straw. Using lightweight steel tubes as in Figure 3, the basic base of the shape was formed, and using rhino and grasshopper digital design programs, the composition was divided into several small, numbered parts to make the assembly easy and flexible. After that, many these papers were collected and the contributions of individuals in preserving the environment were printed. Several challenges that are being faced were mentioned, and they are compiled in Figure 4,5 below. Specific seats were made due to the shape provided by the flexibility of the glass, which are sheets of glass that were placed on a group of reinforced paper as shown in figure below 6.



Figure 5

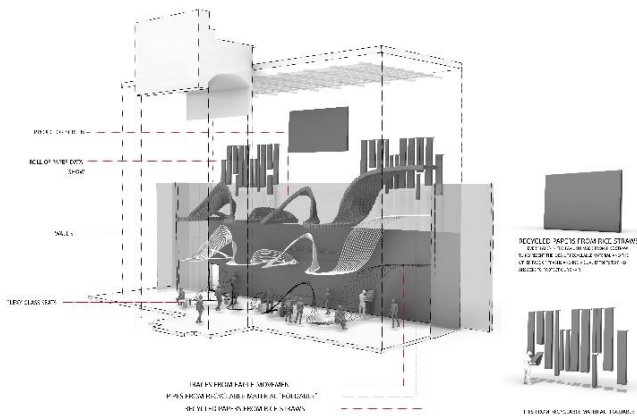


Figure 3



Figure 6

3.2. Circulation:

The entrance to the formation is as shown from the southern side of the figure as in picture 7. Upon entering, the user finds a large display opposite him showing the story of the project and an overview of the exhibition. The smooth movement of the Egyptian eagle led to the presence of arches through which the user could pass and pause to read clearly what was on the paper, shown in figure 8, 9.

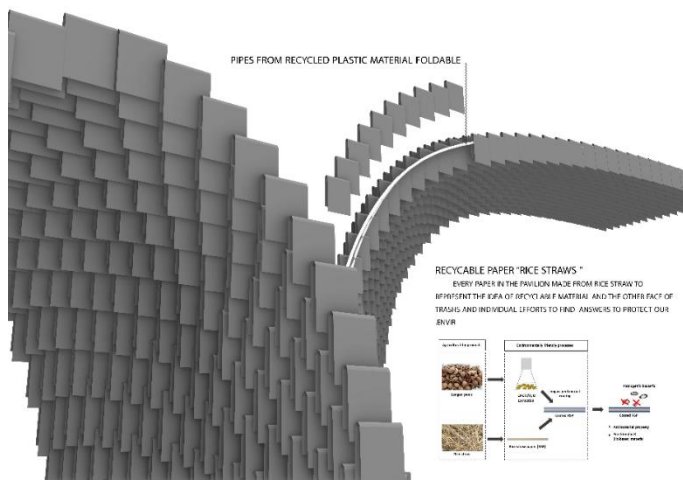


Figure 4

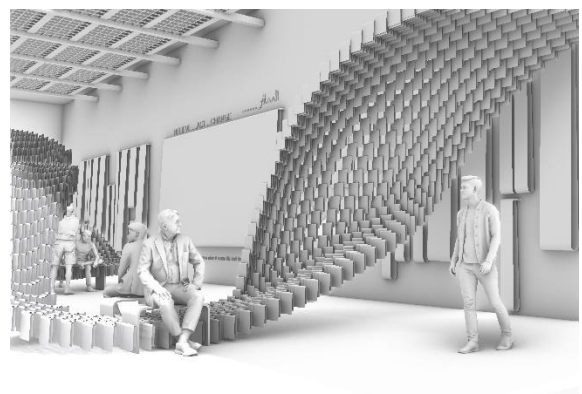


Figure 7



Figure 8

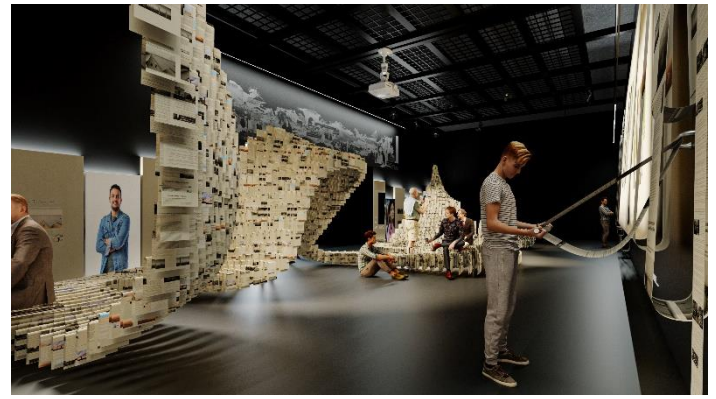


Figure 11



Figure 9

3.3. User Journey:

The use of paper was not limited to this point, but on the back walls of the exhibition, easy-to-move rolls were placed in which the latest contributions of the Egyptian government in challenging environmental problems and recycling were highlighted. On the opposite wall, personalities contributing to individual initiatives are highlighted. Next to each person is the name of his initiative and its positive effects on the environment, shown in figure 10, 11, 12.



Figure 12

4. Conclusion

From time to time, some environmental efforts may shine or disappear, some of these attempts may succeed and others may not see the light of day. The proposed Egyptian Pavilion highlights the environmental efforts of small entities and individuals. The struggles of these unsung heroes are full of inspiring successes and failures. Many of the stories are inspiring, impressive, and educational. Here we try to shed light on some of these inspiring efforts. But it makes us think of those whose struggles have not reached us. Even a little effort towards the environment is important. Even if it's the slightest bit, it matters. As Wes Janz puts it clearly "one small project" is enough for a huge change. In fact, any attempt to save the environment should be encouraged and supported. Consequently, in the architecture's professional and academic levels, it is of significant importance to highlight the potentiality of the recycled materials. This is to emphasize the great responsibility architecture profession have towards our surrounding environment.

5. References

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Figure 10

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