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UPGRADING HERITAGE URBAN PUBLIC SPACES BY USING RECYCLING WASTE PLASTIC MATERIALS

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Recycle Plastic, upgrade urban, open public spaces, Recycled Plastic Pavilion.

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UPGRADING HERITAGE URBAN PUBLIC SPACES BY USING RECYCLING WASTE PLASTIC MATERIALS

Abstract

In low-income countries, population expansion and urbanization bring challenges of inadequate living standards to the fore. Some of the issues could be solved if well-functioning plastic recycling systems were built. To reduce the environmental burden and improve the overall situation in dense cities, the already existing local informal waste treatment system, which is widespread in many low-income nations, needs to be developed with efficient sorting and composting solutions. A case study is carried out in the city of Mina, Lebanon, with the goal of establishing a viable decentralized recycling plastic pavilion material. The effort aims to lessen the climate harm caused by non-recycled waste, improve the quality of life for residents, and enhance the affected locations' aesthetical, educational, and recreational attributes. The concepts were generated according to the resident's needs and to find solutions to the existing problem of the area under study. The goals are based on data and observations about the city, the current waste management system, the stakeholders, the project organization, and any roadblocks. The project's overall work method is known as the Logical Framework Approach. It's a goal-oriented project planning method that relies on disciplined thinking and logical analysis. Literature review, observations, study visits, site analyses, photography, drawing, 3D modeling, and other sub-methods are included in the study. Proposals for plastic pavilions and plastic features for open public spaces in Al Mina are the result of the process. Because the areas have both comparable and dissimilar characteristics, site-specific solutions are required.

Keywords

Recycle Plastic, upgrade urban, open public spaces, Recycled Plastic Pavilion.

1. INTRODUCTION

The purpose of this research is to highlight on the importance of the link through upgrading urban settlement of residents engaged in open public spaces and the importance of recycling plastic waste, by designing a plastic pavilion. This research also provides solutions and techniques that could be applied to reach this purpose.

This study is to sort out the best organization of the open public spaces and their distribution with the maximum amount of comfort and maximum usage of recycled plastic. Indeed, it is important to better understand how open public spaces should be comfortably organized and arranged to get the optimum solution plastic recycling.

This study also emphasizes the necessity of having this type of recycling for open public spaces and analyzes the different solutions to achieve such interaction.

The aim of this research is to upgrade heritage urban public spaces throughout recycling waste plastic materials, define the role of plastic recycling as a model that fills the open public spaces, display the different recycling techniques that could be used to create new elements, street furniture..., and find out what are the recyclable plastic materials used in the open public spaces and where the focus is on people's tendencies and preferences.

This research studies how to transform waste plastic from raw material to hardscape and how to use it in open public spaces such as street furniture and pavilion, etc.....

All the topics studied in previous research have been literature related, which means it talked about the same selected topics or has some common ideas with the desirable thesis.

This topic "Upgrading heritage urban public spaces by using recycling waste plastic materials" has different literature meanings connected to it and is divided into five categories or classifications.

The selected topic could be divided into waste management. Thus, one topic is related to urban heritage and talks about them, their needs, their organization and types, and the other topic is related to recycled plastic waste with its different types and importance and how it is applied in open public spaces.

1.1. Heritage

Combining heritage asset's preservation with improved infrastructure services creates more livable and vibrant surroundings that have a direct impact on underprivileged population's ability to take advantage of possibilities for a better living while also boosting city competitiveness. (Ebbe, K. ,2009).

Cultural tourism is a collection of activities that not only allows the affirmation of cultural-historical causes, but also the rejuvenation of cultural-historical monuments, physical and intangible assets, and resources. (Đokić, V., Radivojević, A., & Roter-Blagojević, M. ,2008).

When considering redevelopment projects in urban areas, the arrow's complication recommends that a messy situation and detailed investigation of these crucial factors is required. (Razzu, G. ,2005).

1.2. Open Public Spaces

Public realms are defined as "spaces that are neither geographically or neither physically rooted." They are social boundaries rather than physical boundaries. It is not the result of any unchangeable culturally or legally granted classification whether there is a domain in either real physiological location, or whether something is personal, communal, or municipal. (Gehl, J., & Matan, A., 2009).

Open public spaces have been regarded as key community facilities for promoting physical exercise. The major objectives of this research are to describe the characteristics of people who frequently visit open public places. To be more effective and reach a wider number of individuals, initiatives to increase physical activity levels in community settings should take into account user's traits and preferences. (R. C., & Fermino, R. C., 2010).

Various interventions, such as organizing festivals and activities in the open areas, can optimize the use of the space. Shade devices and thermally suitable seating, as well as limiting vehicular access, would all help to achieve the goal. (Muneerudeen, A., Al Khani, F., & Furlan, R., 2016).



Fig.1: Open public spaces, Ref. Porta, S., 1999.

1.3. Waste Management

Solid waste generated trash, among the most prominent consequences of city areas, is increasing at a quicker pace in comparison of population. (Hoornweg, D., & Bhada-Tata, P., 2012).

Many cities and municipalities deal with solid waste by building landfills; others burn trash in incinerators. Composting is the most effective method for disposing of solid waste. (Demirbas, A., 2011).

The Global Waste Management Outlook is a collaboration between the UN Environment Program and the International Waste Management Association. (Simonett, O., 2015).

1.4. Recycled Waste Plastic

Recycled plastic debris has been shown to improve the fracture and deformation resistance of standard asphalt mixtures. Further laboratory study is necessary to confirm the projected performance of recycled plastic materials, as well as a field trial to confirm the digestion and distribution efficiency of asphalt plants. The development of the procedure for preparing representative samples of extended/modified binder without the requirement to remove binder from generated asphalt samples would also necessitate research. (White, G., & Reid, G., 2018, April).

A suggestion about the resignification of the plastic as a resource, offering expert, minimal, and effective solutions, is permitting the manufacturing of bollards, and causing a disruption to those relationship processes saturated by a consuming actuality that necessitates residential developments. (Jaramillo, H., Gallardo, R., & Martinez, C, 2018).

Studies discuss a number of concerns related to PSW management including material recycling. Reducing the usage of raw materials and repurposing PSW will help ensuring the environment's and global warming's long-term viability. Landfilling is the simplest way to dispose of PSW. However, it is creating worldwide difficulties while also increasing space requirements. Studies discuss numerous technologies, as well as unique blends, thick plastic

material, and reinforced PSW solutions, in order to prevent landfilling. There are numerous separation/identification strategies for PSW. (Feo, L., & Fraternali, F., 2017).



Fig.2: Advanced recycling, Ref. White, G., 2018, April

PET	HDPE	PVC	LDPE	PP	PS	OTHER
POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYVINYL CHLORIDE	LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	OTHER
WATER BOTTLES; JARS; CAPS	SHAMPOO BOTTLES; GROCERY BAGS	CLEANING PRODUCTS; SHEETINGS	BREAD BAGS; PLASTIC FILMS	YOGURT CUPS; STRAWS; HANGERS	TAKE-AWAY AND HARD PACKAGING; TOYS	BABY BOTTLES; NYLON; CDS

Fig.3: Types of plastic, Ref. White, G., & Reid, G., 2018

1.5. Recycled Plastic Elements

According to information from the business Refill, if plastic is recycled at a rate of 100 percent in terms of producing fibers, then around 497.089 tons of fibers can be produced yearly in Turkey. In the “Print Your City” initiative, an estimate of about 90-kilogram recycled plastic was utilized for a chair that could seat one or two persons (Print Your City). Using 497.089 tons of garbage, an average of 5,523 playground seats was manufactured, indicating where a large amount of Turkey's urban furnishings demands might have been supplied. It is recognized that this kind of manufacturing process's demands may become satisfied on an urban scale, and it would supply waste recycling to academic buildings, crowded locations, and households. (Yücesan & Ozar, 2019).



Fig.4: Plastic street furniture, Ref. Yücesan & Ozar, 2019

2. RESEARCH METHODOLOGY

The research methodology is based on a qualitative and interpretive research approach and built on case studies as a research design.

Towards comprehending this exclusive expertise of residents, the investigation borrows ways from the ethnographic type, jointly with visual ways from open public spaces, such as describing culture, people and writings via in-depth interviews and observation techniques. It also evokes adult's opinions in expressing their environment, simultaneously with informal conversations and observations.

The methods of data collection in the research are:

1. Analysis Case studies of similar projects.
2. Application

3. CASE STUDY

Many cases of open public spaces could be analyzed to estimate how urban heritage has proved that it can upgrade in open public spaces. In this research, 2 cases are studied:

Case study 1: AIA Pavilion, USA.

Case study 2: MEAN* designs 3D printed pavilion in Dubai.

3.1. Case Study 1: AIA Pavilion, USA

Every pattern was carved through without being thermoformed in form with the help of a well-thought-out adjustable mold. That kind of material can be produced from recycled plastic.

The pavilion uses diethyl ether plasticizers as well as the expertise of Riether's data science construct workshop at Georgia Tech in Atlanta (PETG). New or recycled plastic can be used to create this substance.

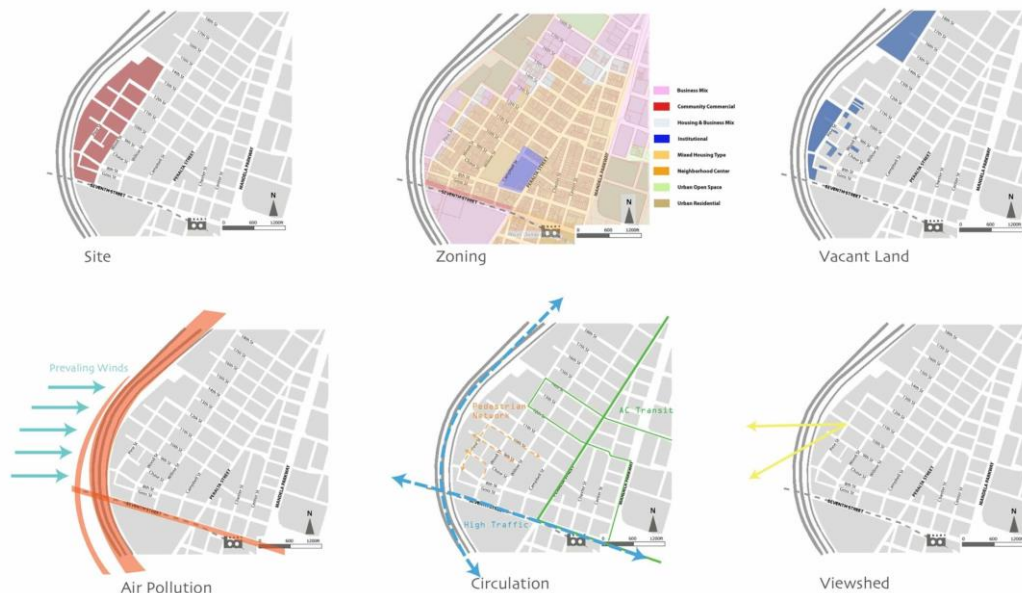


Fig.5: Plastic pavilion, Ref. Riether, G. 2011.



Fig.6: Pavilion, Ref. Riether, G. 2011.

The 18 sqm pavilion contains 320 distinct PETG cells and is located on a terrace that has been renovated of a small studio, near to the North Rampart at 1025 Orleans Road. Riether and eight students have built and constructed the cells into six bigger components, which were intended to be packed and transported on a tiny car, and to be made in a very little time (about 2 days). The pavilion costed about 2,500\$.

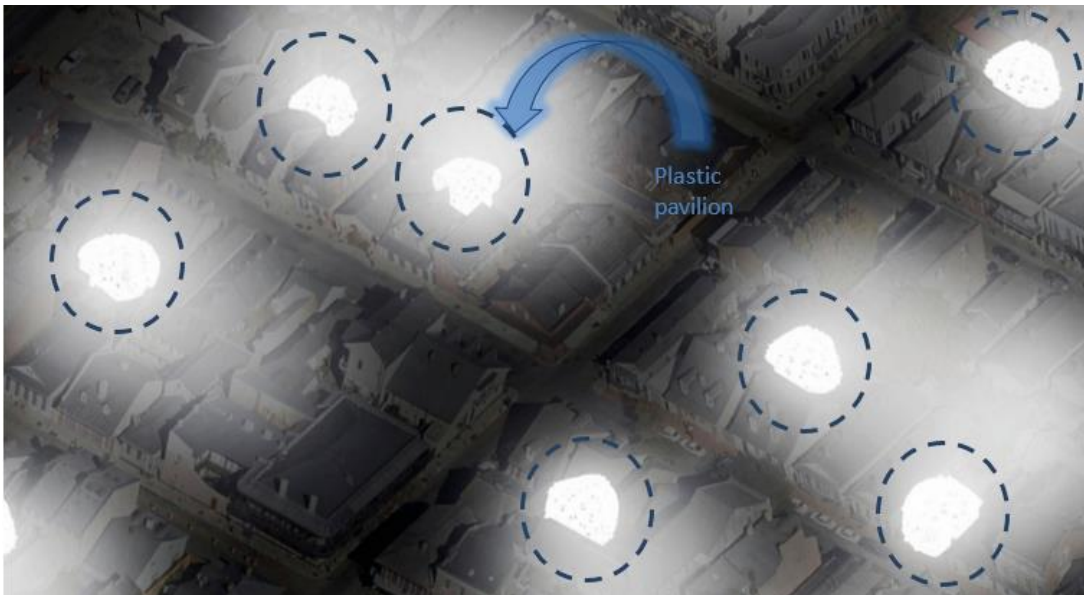


Fig.7: layout, Ref. Riether, G. 2011.

3.2. Case Study 2: MEAN* designs 3D printed pavilion in Dubai

The pavilion is "an inquiry in scaling processes to the architectural world" and was designed for the Dubai International Financial Center (DIFC). It's a mix of three various textures. CNC-milled birch plywood is used for the ground. The bottom is built of concrete that was 3D printed robotically. Finally, the stems are constructed of a plastic polymer produced from 30,000 old water bottles and are 3D printed.



Fig.8: Dubai pavillion, Ref. Fischer, T., & Herr, C. M. (2016).

The name “Deciduous” refers to trees that lose their leaves yearly, typically in Autumn, which is the subject for this year's Art Night festivities at DIFC. The pavilion was constructed entirely off-site. There is no need for heavy machinery because the components are manually linked on-site. To develop and define the design to an appropriate level of complexity inside the limitations and constraints of Large Format Robotic 3D Printing, quantitative data was collected was applied.

3.3. Case Studies Comparative Analysis

Two different analyzes were studied in two different countries and using different plastics, as shown below a comparison between them.

Case Study Name	Location	Main material	Final product	Level of flexibility
AIA Pavilion	USA	Waste Plastic	Plastic Panels	Moderate
3D printed pavilion	UAE	Waste Plastic	Plastic Yarn	Low

It will be based on the first model so that it will be easier to implement, and the new Pavilion in this study will be implemented like it, converting plastic into panels.

4. APPLIED STUDY

Located in Tripoli – AL Mina (figure 4), North Lebanon. It contains a combination of some modern buildings especially in Port said street. It has a very important cultural places such as, khan al tamasili, AL-Mina municipality, Omar ben al Khattab mosque, etc. with altitude and longitude 34.4511113, and 35.819503,15, as shown in figure 9.

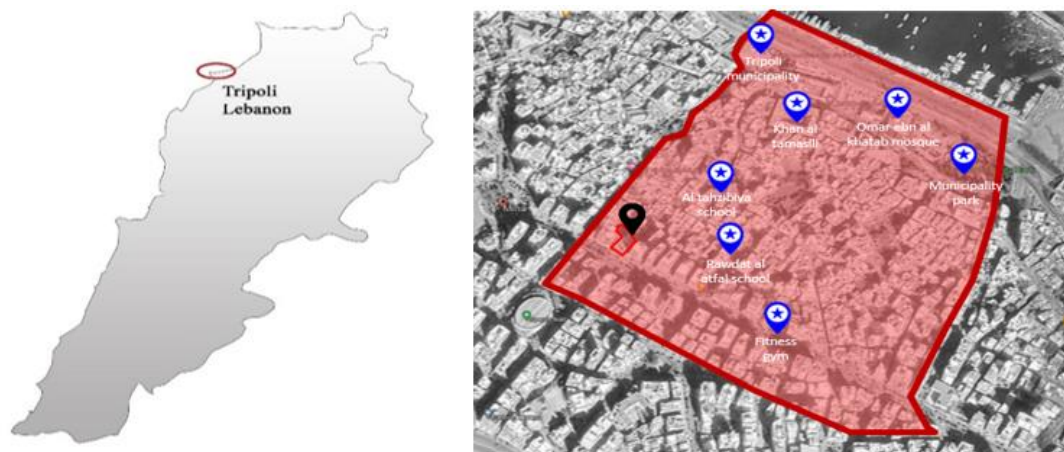


Fig.9: Site location, Ref. Researcher (2021).

It is located in port said street; new Mina, which is a parking surrounded by unvaluable buildings and through it we can reach the old mina where we can find empty spaces. This location will be a workshop to recycle plastic and make the residents work on it.

4.1. Site Selection

I've been locating the empty areas in the area that allows pavilions to be made of recycled plastic. This means that the visitor who will come to this area to explore will start from the point of Port Said Street, point A, and walks in the area. The visitor had to pass seven stations. From this space to A, B, C, D and till E. This non-stop tour will take the tourists 15 minutes, and in this way, they will have explored and made a tour at once in almost the entire area. As a result, the tourist will not lose their way and more residents will be attracted to visit this area and improve it.

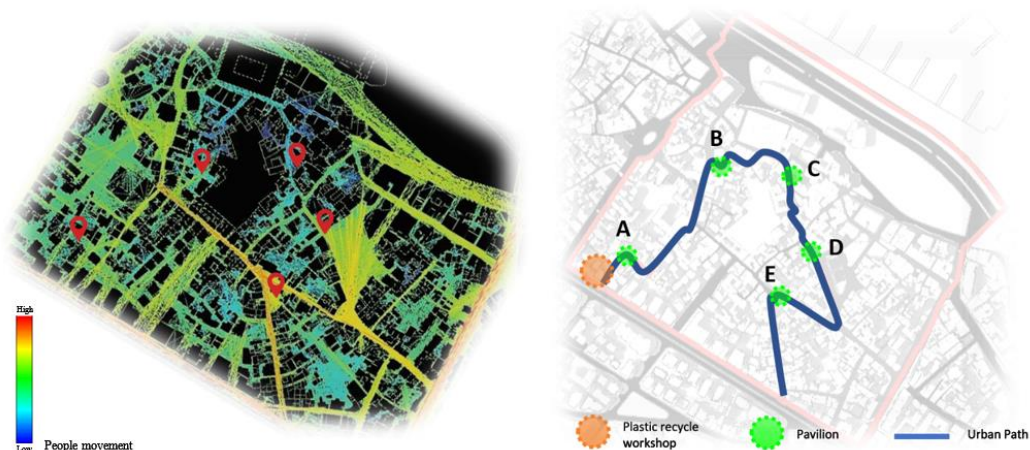


Fig.10: Site Selection. Ref. Space Syntax (2021).

Located in Port said street; new Mina which is a car park surrounded by invaluable buildings and through it we can reach the old Mina and found an empty spaces, as shown in the figure 11.

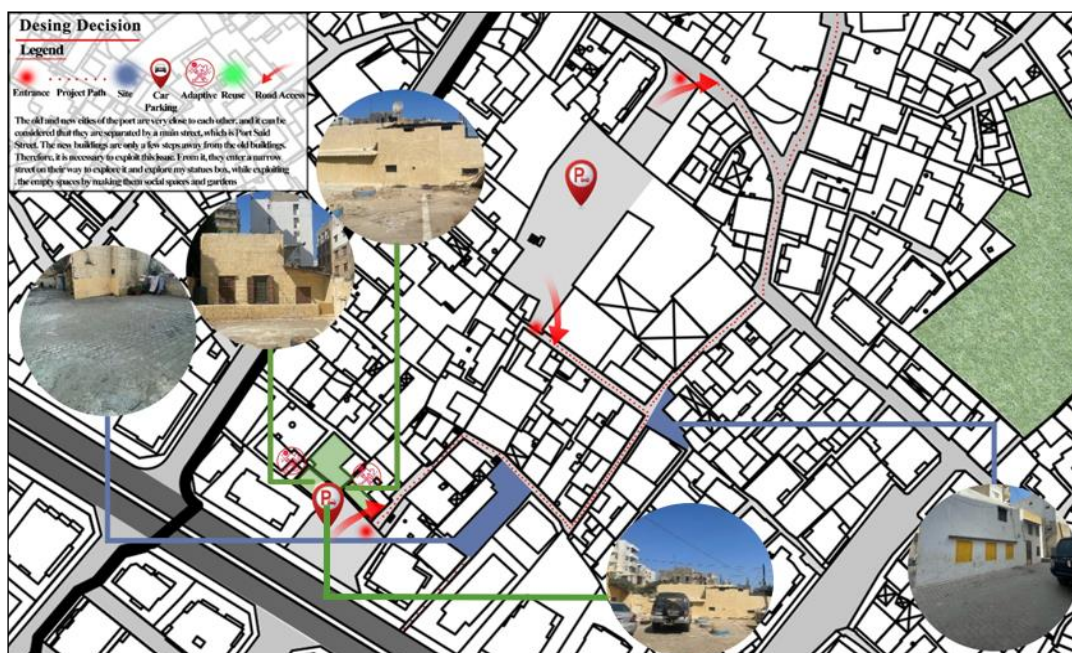


Fig.11: Site Workshop Site, Ref. Researcher (2021).

This site's total area is 800 m², it contains a parking area of 485 m², and there are 3 buildings existing in this site with different areas, which are: 62 m², 50 m², and 132 m².

This site is surrounded by a lot of buildings and empty areas as shown in the pictures below, figure 12.

Plastic is one of the basic materials that must be used daily. This type of material takes a very long time to decompose. It has to be found in a sustainable way that this plastic that we make can be reused in other things and in terms of architecture by making some pavilion, and street furniture.

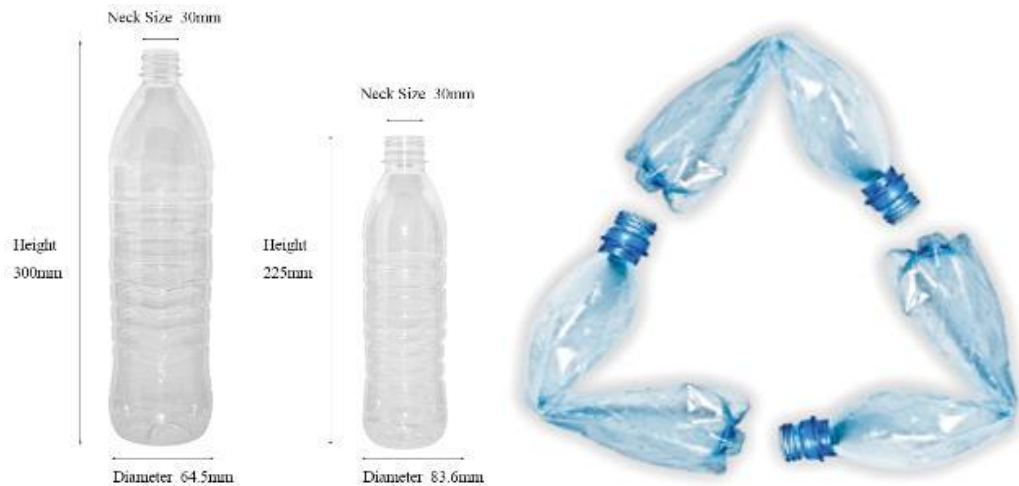


Fig.12: Plastic bottle dimensions, Ref. Researcher (2021).

4.2. Pavilion Unit Design Progress and Proposals

Take these units and combine them together with different number of unit and different orientation, in order to have different form and size of pavilion size. That could be suitable to all the open zones in the urban, as shown in the figure 13.



Fig.13: Pavilion process and Proposal, Ref. Researcher, 2021.

4.3. Pavilion Prototype

Extrude the unit as it is with steel pipes for structure in phase 1, then put the grid in the mesh of extrude in form of plastic panels in phase 2, and finally the last form with added concrete square as base to increase the stability of the pavilion in phase 3, as shown in the figure 14.

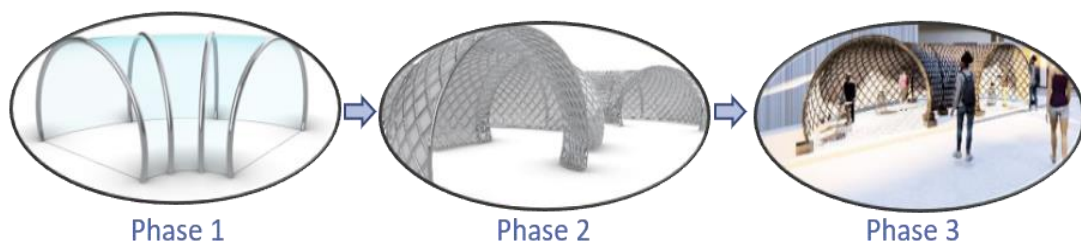


Fig.14: Pavilion Progress, Ref. Researcher (2021).

4.4. Studies

The most used materials are forming the recycled plastic founded in the area work; plastic pavement used to ensure the urban path, plastic panels to put it in the south façade in the workshop and make the pavilions from it and last type of plastic used is to light and make the area safer and to indicate the path, as shown in the figure 15.



Fig.15: Uses of Recycle Plastic in The Project, Ref. Researcher (2021).

4.5. Simulation Phase

Space syntax is a set of techniques for analyzing spatial layouts and patterns of human activity in buildings and urban areas. It is also a set of theories that connect space and society. The syntax of space deals with where people are, how they move, how they are adapted, how they develop.

We can notice the changing of people's flow after the making of pavilions in the software space syntax, in the redder zone in the site, that means the pavilions add more flow and motion to the zone, as shown in figure 16.

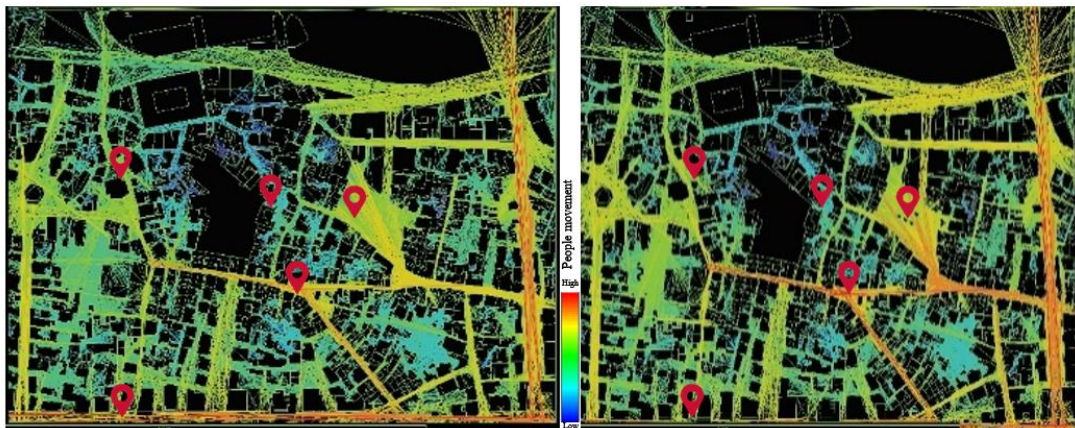
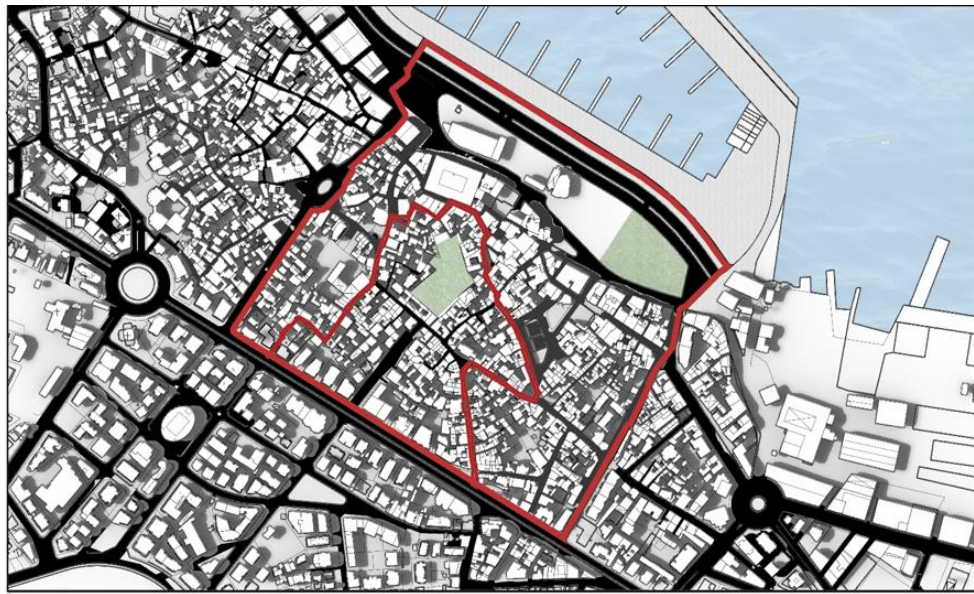


Fig.16: Simulation before and after Pavilions, Ref, Space syntax, 2022.

The street has a south façade and it needs to have a beautiful and attractive elevation like curtain wall but it appears gaining a lot of heat, so I decided to put panels in this façade.

4.6. Architectural Drawings

After all these studies and simulations, now we can show all the drawings from layout, plans, sections, and elevations for the pavilion, as showing in the figures 17,18,19, and 20.



Layout
viii

Fig.17: Layout, Ref. Researcher (2021).

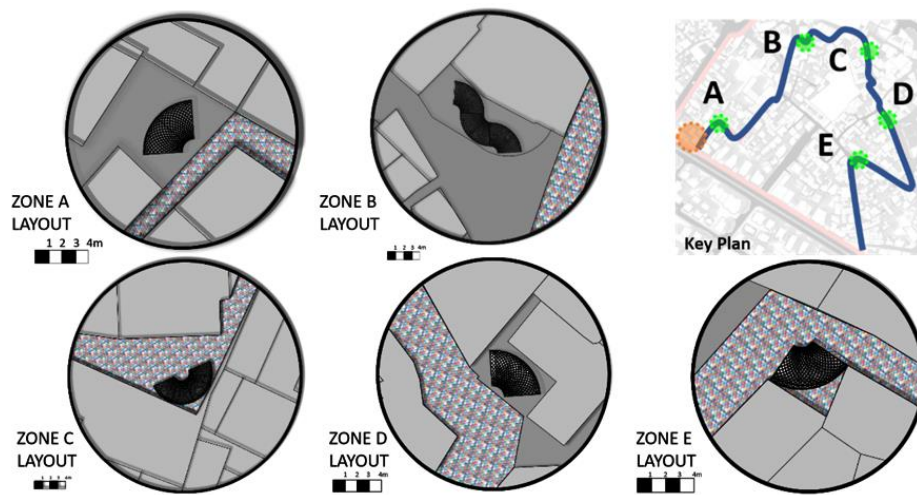


Fig.18: Pavilions Layout, Ref. Researcher (2021).

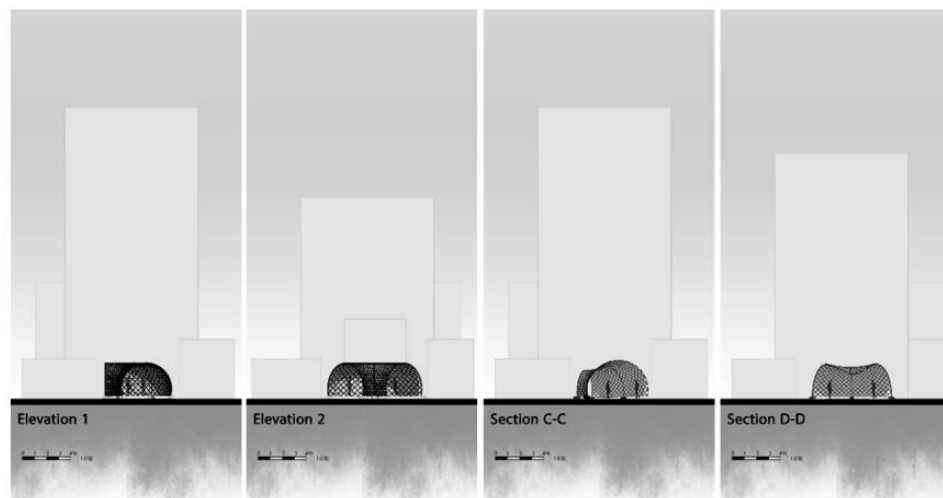


Fig.19: Pavilions elevations and sections, Ref. Researcher (2021).



Fig.20: Perspectives, Ref. Researcher (2021).

5. CONCLUSION

This article mainly focuses on the reuse and their ways of recycling plastics, that showed the volubility of plastic in architecture and to upgrade the urban by using it as finishing materials such as the plastic panels that are used in this project and to create a usable unit made by plastic and steel for the structure such as the pavilion. It can also be used in landscape such as street furniture, as paths to indicated pathways and used as light elements. This article didn't discuss the quantity and the Weight of plastic needed to transform it into a new product. Therefore, it didn't mention their ability of withstand Pressure and weights. Indeed, if we make any product of recycled plastic, we have to take into consideration the safety measures regarding the lightweight to make sure that it will resist the strong wind especially in windy areas such as this location.

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