May 2022

EXTENDING THE ROLE OF ARCHITECTURE INTERVENTION ACROSS THE DISASTER LIFE CYCLE

Khaled Zahra
*Master Student, Faculty of Architecture - Design and Built Environment, Beirut Arab University, Beirut, Lebanon,* khaledz96@hotmail.com

Ayman Afify
*Professor, Faculty of Architecture - Design and Built Environment, Beirut Arab University, Beirut, Lebanon,* a.afifi@bau.edu.lb

Hiba Mohsen
*Assistant Professor, Faculty of Architecture - Design and Built Environment, Beirut Arab University, Beirut, Lebanon,* h.mohsen@bau.edu.lb

Maged Youssef
*Associate Professor, Faculty of Architecture, Design and Built Environment, Beirut Arab University, Beirut, Lebanon,* m.nabilyoussef@bau.edu.lb

Follow this and additional works at: [https://digitalcommons.bau.edu.lb/csdjournal](https://digitalcommons.bau.edu.lb/csdjournal)

Part of the Environmental Design Commons, and the Other Architecture Commons

Disaster Life Cycle, Response System, Flexible Structures, Mobile Operative Design, Disaster Relief, Pre-Fabrication, Modular Units

**Recommended Citation**

Zahra, Khaled; Afify, Ayman; Mohsen, Hiba; and Youssef, Maged (2022) "EXTENDING THE ROLE OF ARCHITECTURE INTERVENTION ACROSS THE DISASTER LIFE CYCLE," *BAU Journal - Creative Sustainable Development*; Vol. 3: Iss. 2, Article 6.

DOI: [https://doi.org/10.54729/LSOY2015](https://doi.org/10.54729/LSOY2015)

This Article is brought to you for free and open access by the BAU Journals at Digital Commons @ BAU. It has been accepted for inclusion in BAU Journal - Creative Sustainable Development by an authorized editor of Digital Commons @ BAU. For more information, please contact ibthial@bau.edu.lb.
EXTENDING THE ROLE OF ARCHITECTURE INTERVENTION ACROSS THE
DISASTER LIFE CYCLE

Abstract
Disasters have been a common occurrence since the beginning of time, yet they are increasing phenomenally worldwide and especially in developing countries. Factors that led to the cause of destructive disasters are often complex and interrelated; researchers detect human influence and rapid development is intensifying the damage and scale of disaster-prone areas through urban sprawl and human interference. Observing the disaster life cycle, it is made up of four stages: preparedness stage, resilience and mitigation stage, response and relief stage, and finally reconstruction and recovery stage. The main focus usually lies in the response and relief stage which comes immediately after the disaster has struck. The aim of this research is to extend the architectural intervention across all stages of the disaster; using a dynamic disaster response system made up of three components, primarily a disaster educational centre that can reliably respond to any disaster occurrence using a network of prebuilt structures spread across the perimeters of disaster-prone areas. The structures help with strategic preparedness, promote resilience, mitigating damage and spread, provide recovery and relief, and aid in eventual reforestations and reconstructions. As well as, designed to host an adaptable module of prefabricated units that can be easily mobilized and transported to plug-in to the host structures; the hosting structures will also provide a mechanical response across all stages of the disaster life cycle with a minimum disruptive footprint. Utilizing primarily the inductive method, this research will analyse the effectiveness of this unconventional architectural design approach in how it functions both reactively and strategically across all stages of any disaster life cycle. The paper also relies on analytical and deductive methods to help portray the effectiveness of the unconventional architectural design approach in how it functions both reactively and strategically across all stages of any disaster life cycle.

Keywords
Disaster Life Cycle, Response System, Flexible Structures, Mobile Operative Design, Disaster Relief, Pre-Fabrication, Modular Units

This article is available in BAU Journal - Creative Sustainable Development: https://digitalcommons.bau.edu.lb/csdjournal/vol3/iss2/6
1. INTRODUCTION

Disasters are natural or man-made crisis that transpires when a hazardous event occurs for a short or long period of time; a disaster exposes human and environmental vulnerability and has lasting effects on materials and environments. A disaster is also distinguished by the infliction of significant harm that surpasses the afflicted community’s or society’s capabilities and resources to cope with and recover from. (IFRC, 2017) Developing countries are the most affected by the aftermaths of disasters, the damage sustained can extend beyond physical damage into social and economic turbulence. The human loss is also at the largest in developing countries, with more than 95% of global deaths occurring in developing countries than in the industrialized ones. However, regardless of where they occurred and what scale they were, disasters tend to induce a marginal shift and impact in the authority and public communities. (Ballesteros, 2008)

Experts claim that disasters are certain to rise globally because of climate change and consistent human expansion; the same study also revealed that little to no action was taken by governments or responsible bodies when considering future disaster impacts and how to avert them. This is especially common in developing countries, which are not yet fully prepared to face disasters alone and place heavy reliance on other global countries for support and relief. (Tatlow, 2016)

This research examines common Lebanese catastrophe occurrences as a case study, deducing the primary elements that cause those disasters in targeted locations and finding the most efficient and feasible response technique. As a result, an existing norm is used to overcome and improve upon, with an architectural intervention serving as the driving force. There is no established technique of forecasting when and where catastrophes will occur, but specialists in the disaster response field have offered a variety of strategies that may be used to mitigate their effect throughout the years. (Winston, 2017) There is an alarming steady increase of disasters across developing countries, including Lebanon, because of government corruption either embezzling funds that were meant to go to defensive systems, or due to showing complete incompetence in deploying an emergency strategy and setting a disaster relief and mitigation plan.

Under the theme of Care for disaster relief, the project aims to present a dynamic architectural solution for disasters using adaptive design methods. Creating an easy to construct, efficient, and affordable network of vertical structures that can be transformed from operational structures into a tower-housing units meant to serve as multi-purpose hub for any relief operation and during different types of disasters. The network would be spread around perimeters of (previously afflicted areas, dense wildlife and forests, and areas with proven high level of fire outbreaks). The structure would utilize an unconventional approach of handling wildfires using the disaster life cycle as a structure. (Winston, 2017) To best understand how an architectural solution can be benefit humans during a disaster, it is best to break down a disaster into multiple stages and look beyond solely human benefits.

The disaster life cycle includes several phases:

Mitigation: Work on disaster mitigation entails directly averting future disasters and/or reducing their harmful consequences.

Disaster preparedness: Plans or preparations made ahead of time to assist people and communities prepare for a disaster are included in disaster preparedness activities.

Disaster response: Any measures conducted during or soon after a disaster, including attempts to preserve lives and avoid additional property damage, are considered disaster response activity.

Disaster recovery: After the damage has been evaluated, disaster recovery entails taking steps to restore the afflicted community to its pre-disaster condition or better – and, ideally, to make it less vulnerable to future risk. (Winston, 2017)
Wildfires have been the most frequent disaster occurrence in Lebanon in the last 5 years. The design seeks to fulfill a responsive and strategic role that would allow it to play a multi-purpose space that may be utilized to provide relief prior to, during, and after disasters. As well as, striving to be an affordable method of combating wildfires, similarly being easily assembled, disassembled, and transportable. Therefore, making the project both desirable in quality and quantity. There is also a distinctive approach in utilizing the ground water aquifers as a sustainable source for mitigating fire, used domestically and in reforestation relief. (Baker, 2017)

2. LITERATURE REVIEW

2.1 Definition of Post-Disaster/Emergency Architecture

Following the aftermath of natural disasters and/or conflicts, responders introduce architecture as a tool that plays a critical role in coping and recovery. It is part of the disaster relief structure that attempts to restore the damage caused by the disaster, restoring, and reconstructing damaged infrastructure, and responding to the needs of the people affected by the disaster. Part of the disaster life cycle includes response and relief as the reactive process that is most focused on yet fail to comply with the equally important phase that comes afterwards, the reconstruction and recovery phase, as well as the previous phases of preparedness. (Ban, 2014)

Architectural intervention is successful when it meets the short-term need of a sheltering space to host people with damaged houses or away from danger. However, it extends its benefit of an immediate shelter to a long-term tool that supports responders in reconstructing and providing stability. When the earthquake of 2010 occurred in Haiti, many people who were effected and displaced are still currently residing in temporary units meant for short-term use; the largest disbenefit comes in the lack of adequate infrastructure and an ability to provide access to plumbing and electricity, revealing the critical importance of addressing long-term needs after disaster and conflict. (Shen, 2018)

It makes sense to hold a government accountable when a natural disaster occurs, even when said government had no way of predicting and fully preventing natural disasters, unless the primary factor that led and caused the disaster was because of negligence and corruption. Therefore, it is the full responsibility of the government to reconstruct and recover damaged human settlements, but a government’s approach to reconstruction benefits itself with its own interests and not the community harmed. Hence, architects can also be held accountable in the recovery stage and eventual reconstruction of damaged man-made environments.
Architects should commune with people who had their community destroyed and focus not on restoring it to its former self, but also improve on it and help reduce future risks, it is also an opportunity for the architectures to improve the life conditions of the denizens; chances are the environment they lived in was not ideal in their vision and they will wish to improve it through this stage. The structures may not be the only damaged aspect, as communities may be harmed economically, psychologically, and socially. (Luhong Huang, 2015)

One of the most popular cases comes from the far east, in 2008 a horrifying 8.0 magnitude earthquake hit the town of Wenchuan, China: collapsing an entire residential block and killing 87,587 people and injuring 374,643, marking it as the 18th deadliest earthquake of all time. Following the Wenchuan earthquake, there were several post-disaster temporary communities with high construction density, which was the first instance in China or the globe. Some problems in architectural and planning design were revealed as a result of this relationship's examination. (Luhong Huang, 2015) From this case study, it is understood that sometimes architects’ designs, and actions can have a negative effect when not applied correctly.

Temporary architectures mean constructed shelters that can be used for a determined certain amount of time, they are usually made from more affordable materials than permanent adobes and may be disassembled after proper transition. The current state of temporary post disaster architecture is a mess; for one, depending on the catastrophe, it takes to much surface area space: and occupants may be forced to remain in the specified area far away from where they were or even at the edge of cities/towns. Another problem is the design of these structures, they are not flexible and are fixed in both space and function, restricting the activities allowed within the space. Listing the negatives is endless, so sufficing with the last point is transportability of the units and how slow they and unreliable they are at reaching affected areas, since there is a lack of designated areas and an absence of transporting through authority.

Fig. 4: Examples of post-disaster shelters: Future Further shelter (left) La Matriz shelters (right)

The research aims to identify the factors that make a successful post-disaster architecture and introduce an adaptive architecture design that intends to avoid the mistake of the current traditional way it exists. As well as, extending its benefit from not only being a shelter, but partaking an active role during the disaster and after the disaster. Disasters usually affect man-made constructions more than humans themselves, and as human construction increases and continues sprawling into nature, more wildfire disasters are bound to happen, hence it is logical to introduce architecture intervention as a primary method in mitigating and preventing disasters.

2.2 Historical Background of Post-Disaster Architecture

Natural disasters have been occurring since the beginning of time, some disasters have been so massive they have been recorded in time before recording disasters was even common, usually because of the impact they caused not only physically but also emotionally and economically. The entire structure of society may be damaged by a disaster, and it is uncommon for societies to take years to recover, even today damages can be so large it is beyond the capital’s budget. To be classified as a disaster, it will have profound environmental effect and/or human loss and frequently causes financial loss. (Truskin, 2010)
Wildfires are the most common natural catastrophe in the Mediterranean, and while they are not the deadliest in terms of deaths, they are among the most damaging. Wildfires are massive flames that frequently begin in wilderness regions. Lightning and dryness are common causes, although wildfires can also be sparked by human negligence or arson. They have the potential to spread to inhabited regions, posing a harm to individuals, property, and animals. (Victoria government page, 2019)

Observing the case study of Lebanese natural disasters, the 1956 earthquake was a 5.5 magnitude earthquake that occurred in Chhim and largely affected the region along with Saida and Beirut. In Saida the earthquake caused a massive flood that sunk the old city and people were relocated into a new region called “Al-Taamir”, this expensive expenditure was allowed because Lebanon was one of the wealthiest countries in the world at that time; a disaster of this magnitude will not be easily resolved in current times and standards, hence present post-disaster architecture focuses on more affordable design concepts and efficiency.

The August 4th explosion that happened in 2020 showed how difficult it is to recover from an unplanned disaster, as of the time of writing this research paper, only 10% of the damage has been repaired. (Abouzeid, 2021)

Ironically, the area of “Taamir Ain el Helwe” in Saida which was designed to bring relief, is now in need of relief and is being assessed for improvement. (Hammoud, 2018) This is because the design was meant for short term, one of the biggest obstacles is deciding if the post-disaster design introduced is built to last.

One way to design long-term architecture is to design a regenerative module, module architecture are very adaptive and easily replaceable architecture components that essentially renew pieces of architecture at a time.

2.3 TYPOLOGICAL CRITERIA OF DISASTER ADAPTIVE ARCHITECTURE

2.3.1 Response and Relief

Human involvement and reaction are the initial points of contact with a catastrophe; traditionally, the architecture function of relief arrived shortly after the disaster happened and was never used to counteract or mitigate the damage. One of the key motivations for this research is to extend the benefits of architectural intervention beyond this period and extend them across the full cycle.

2.3.2 Recovery and Reconstruction

A main part of post-disaster architecture is providing a space that accommodates people until their homes are fixed, the time expected can vary and the units should be designed accordingly. In terms of program spaces, it should provide the necessary amenities and needs: like sleeping areas, but also beyond that like workshops, meeting rooms, intermediate areas, gathering area, recreation, and storages.

2.3.3 Comforting Transition

One of the largest challenges is creating an environment familiar to their previous one, people shouldn’t feel as captives or degraded, the space accommodating them should be safe and comfortable, until their eventual return. Space design usually comes to mind, especially of human scale.
2.4 Analysis of Similar Example

2.4.1 Jintai Village Reconstruction/Bahzong – China

On May 12, 2008, an earthquake rocked the isolated town of Wenchuan County, displacing approximately five million people and damaging up to 80% of the structures in various regions. Jintai is one example, where the destruction caused by seismic earthquakes was exacerbated by the July 2011 floods. The town was rebuilt by the local government and various non-governmental groups, and one of the projects completed was this cluster of 22 dwellings cantered on a community centre. (Huang & Wu, 2018)

This is an examination of present rural livelihoods. The purpose of today's tens of thousands of newly planned villages in China is to develop villages as actual places, with spatial organization and physical expression derived directly from their relationship to their natural environment. Because land for home building is limited, the hamlet combines intensive urban living in a rural environment. Individual home farming is encouraged on the roofs, while open sections on the ground floor are available for individual family-owned workshops. The architecture of the community retains the concept of common good while suggesting a reworking of the contemporary rural setting. (Huang & Wu, 2018)

2.4.2 Disaster Prevention & Education Centre/OODA – Turkey

Part of an architectural competition held in 2015, this proposal made by OODA architectural team believe that resilient architecture cannot be generated without the use of imagination. Imagination can be used as a powerful tool to formulate scenarios and predict certain space reaction and ambient environments. This unique approach was to merge the most efficient program articulated with a cohesive concept which branches in the overall theme of integrating with Istanbul’s context. (Lynch, 2017)

The project utilizes new technology and techniques to simulate and image disaster scenario and build studies based on them, the primary subject at test is earthquake which is the most common type of disaster the city faces annually. The form and position of the project also challenges the nature of the earthquake and places itself as an unmovable object that faces an unstoppable force.
2.5 PARAMETERS OF ADAPTIVE POST-DISASTER ARCHITECTURE

Based on the analysis of traditional post-disaster Architecture, there are features that must be preserved, the conclusion of the research should expand on these features and attributes and not change them. Structures are not built to last forever, and adaptive reuse should be kept in mind, structures should withstand harsh environments and climates, and most importantly provide safety and resilience.

The quality of design varies from country to country and budget, but usually it should respond to the human needs primarily. One of the main aspects of post-disaster architecture is how fast they can be built, and how easily they can be transported to zones. Adaptability means the ability for the design to change and accept new features and programs. Local materials are hands-down the best material to withstand its own environment and not cause major impact or damage, it is not strange for the design to elapse many seasons and face many harsh circumstances, so environmental resistance and sustainability are taken into consideration. Sustainable features are a basic feature found in this typology of design, as some areas may be isolated from infrastructure. The spaces should have a large variety that hosts multiple activities, the design is a main focus, but the human needs are even larger. (Fitz, 2020)

Table 1: Disaster life cycle – Parameters and architectural guidelines

<table>
<thead>
<tr>
<th>Post-Disaster Parameters and Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing Safety and Recluse from Disaster</td>
</tr>
<tr>
<td>Solving human needs and requirements</td>
</tr>
<tr>
<td>Preserving Quality of life</td>
</tr>
<tr>
<td>Encouraging community involvement in recovery</td>
</tr>
<tr>
<td>Portability and easy transportability</td>
</tr>
<tr>
<td>Easily Mass producible</td>
</tr>
<tr>
<td>Local or sustainable material choice</td>
</tr>
<tr>
<td>Proximity of architecture relief to city</td>
</tr>
<tr>
<td>Reusability of deployed unit</td>
</tr>
<tr>
<td>Avoiding long-term displacement</td>
</tr>
</tbody>
</table>

Application of Post disaster Architecture across the Disaster Life Cycle

| Simulations, experimentation and information gathering |
| Hosting structures with centralised infrastructure    |
| Adaptable modular spaces for various functions        |
| Using Sustainable and smart design tools              |
| Exhibitions, Seminars, training areas                 |
3. METHODOLOGY

This paper features the use of various types of research methodology, both from the mental and physical branches. The chosen methodology types are the following: **First**, an inductive method is used in the collection of data required to satisfy the requirements of the selected case study, in order to fulfil its purpose. **Second**, an analytical method was used in the paper to analyse the results of public questionnaire and in comparative assessment of different tools and techniques that will or might be used in the adaptive post-disaster architecture modular units. **Third**, a deductive method was used in deducing strategies and approaches in responding to various disaster situations in order to present a resilient architecture model that can adapt to the generated crisis. **Finally**, the field method; the author visited various types of geographies across Lebanon to better understand the type of architecture that can respond without having a large environmental impact. Questionnaire were taken to comprehend the public opinion on the current state of disaster management in Lebanon; as well as interviews to people who faced disaster situations in their lifetime. The empirical approach contains experiences and previous encounters that proved valuable in the total improvement of the research’s quality.

3.1 Introducing the Case Study “Disaster Responsive Structure: Emergency Education Centre”

Lebanon, as of the time of writing this research, has faced for two years now one of its most difficult crises – specifically, in the economic and financial spectrum. The compounded challenges have had a large impact of the daily lives of the Lebanese people; the effect of this crisis extends to questionable governmental actions that concerns people safety and wellbeing. According to research done by the Centre for Public Impact, over 80% of Lebanese people lost faith in the Lebanese government being able to solve an internal problem without external help. (Moufarrej, 2020) The negligence and unreliability of the governmental course of actions have left a clear footprint during disasters, both natural and man-made.

Inspired by the Japanese method of problem solving, the research paper adopted the Poka-Yoke approach, or in other words reducing human intervention and increasing automation to improve success and reduce errors; this is achieved by creating a safe and tested environment that can tackle the problem before it has been created. Architecture fits this aspect very well and can attempt to fulfil the project’s aim following this method. (Dudek-Burlikowska & Szewieczek, 2009)

The project is made of 3 components:

a- The Emergency Educational Centre: This is fixed in location and is equipped with educational resources including audio-visual equipment, seminars, exhibitions, and simulations. There is an additional unique part of the centre in the form of a fabrication lab that, with the help of local community, produces prefabricated units that can be assembled, disassembled, and transported. The centre serves as the main hub connected to the disaster responsive structures spread across the region.
b- Disaster Responsive Structure
Vertical structures connected to the underground water aquifers; these structures serve as a hosting construct that prefabricated units can be plugged into similar to that of the metabolism architecture style. The structure extends its benefits with multiple functions that help serve the community better.

c- Prefabricated Units
The prefabricated units are made from recycled construction material that are designed to be light material, transportable by air and ground, packable, disassemble-able and assemble-able. They like the rest of the project can be reused in reconstruction and recovery beyond their relief phase.

3.2 SITE AND WATER ANALYSIS OF “JBEIL HBOUB REGION”
Lebanon has a massive water reserve that is not exploited, 95 of the Lebanese water reserves exist in underground aquifers. The largest of these aquifers exist in Keserwan/Jbeil Limestone formation. The natural borders of Jbeil exists between two rivers: Nahr Ibrham river from the south and Nahr Madfoun river from the north. This made the region very fertile and rich in water, home to some of the largest natural reserves in Lebanon. Unlike the coastal cities where water is over extracted faster than the aquifers can recharge, the region cannot have sea water intrusion as it is further from the sea, and it recharges faster because the nature of limestone formations permeable. (Comair, 2021)

The project aims to utilize the water reserve spread across the region and use it as a responding tool against disaster situations and especially against wildfire hazards that threaten the towns, villages, and surrounding ecosystem.

The area is at risk of primarily forest fires, due to the difficult terrain, and the weak state of fire brigade in terms of equipment and manpower. The terrain proves difficult to manoeuvre with current equipment or lack thereof, the smoke can also be trapped within the mountains making it difficult to evacuate and mitigate the damages. Lebanon also lacks a fire GPS satellite that other countries rely on, so the reaction is slower than desired. (Mitri, 2021)

The site area chosen is between 2 river streams, on a high altitude overlooking the entire area, this area is bound to be rich is groundwater and will be beneficial in the umbrella of disaster management and risk centre. The project will consist of disaster response and educational centre with spread structural towers across all 59 towns and cities in the caza.

The urban site lies between the Yaamoune fault line, and the mount Lebanon thrust making it have its fair share of earthquake episodes across the years, but it is very uncommon with the last episode occurring in 1956. The Jbeil region is also a popular touristic attraction, containing ancient important landmarks and various natural reserves and forestated areas. The region is also moderately populated with over 400,000 people living across the caza. (Salibi, 2003)

Recently the area has begun witnessing an influx of return due to the corona virus and the cost of life in Beirut becoming too extensive. The proximity of the region to the Capital of Lebanon, Beirut, makes it an ideal region to consider for a project. The only downside might
come from the distance the project has compared to other centres, and not being near any educational institute or university really hurts it.

The city itself sees an annual increase of new settlers and visitors alike, proudly labelling itself as a Sanctuary city. Until the end of WWI, the city was a little fishing village of 2000 people. Throughout the 1950s, the city saw considerable urban inflow from surrounding areas. During difficult times such as the 1860s mountain wars, the 1915 famine and persecution, and the 1975 civil war, many sought refuge in Jbeil. During the civil war, Jbeil remained peaceful, with Christians and Muslims coexisting together, and the population grew by 230 percent. Between 1960 and 1990, the city roughly doubled in size, holding 40,000 people. The Highway's construction divided the city in two, and the consequences of its design may still be felt today.

Fig.11: Physical Analysis of Jbeil

The city is split in half by the highway with most of the commercial and touristic activity taking place in the western side of the city, while the eastern side houses most of the affordable housing and the majority of the population lives in the eastern side. The spine of the main road also houses the Municipality building at the centre of the intersection, while the serail exists on the western side. The city has put effort into creating nodes on the eastern side that would attract more visitors and investors; such nodes include the LAU Jbeil campus in Blat and Le Mall in Mar Jergas. The project is located in the Eastern side of the city similarly to be closer to the mountains and forests and also to increase activity on the eastern side of the city.

Fig.12: Neighbourhoods of Jbeil
The site is distinguished by the presence of three main vital elements – the bridges. The problematic of these components is that they break the flow of the city’s expansion.

Therefore, my concept is to unify what has been interrupted by these physical elements via this valley which would connect the western and the eastern sides. In this manner, the traces of the valley are revived and kept intact to uplift its value and beauty with landscape architecture embedded on both sides.

Jbeil and its surroundings also hold a tourist potential as they encompass a wide array of attractive sites including:

**Environmental sites:** Bahsa Beach, Nahr Ibrahim, Bentael Nature Reserve, Fish fossil stores, Mount-Lebanon Ski (Laqlouq).

**Educational centres:** Lebanese American University (in Blat), Wax Museum, and Research Academic centre: The International Centre for Human Sciences created with the co-operation of UNESCO and based in Jbeil.

**Religious and Memorial sites:** Mar Charbel Monastery (accessible with a bus shuttle from the bus station next to the Municipality to the monastery), Armenian Orphanage and Museum (South of the Archaeological site).
3.3 Identifying Problems of “Disaster Response System (Drs)”

As the impacts of urbanization and overpopulation grow, human civilization is rapidly approaching a dystopian state. This has the unintended consequence of producing more natural and man-made disasters. The major concerns are a lack of space and resources, which might lead to future segregation, conflict, and ecological disturbance. The traditional approach of architecture intervention when it comes to disasters is undeveloped and very rushed. There is a potential in improving the current state of architecture intervention and have it be more involved in the disaster life cycle.

Introduce an architectural Intervention that extends across all stages of the disaster life cycle, presenting a solid disaster and management plan that is flexible and adaptable to both disaster type and surrounding. Using the water reserve of Lebanon as a primary tool that assists in daily normal life, mitigates damage and spread of fire, used responsively for relief, and as a reforestation and recovery enabler.

![Fig.14: Traditional properties and function of the architectural intervention during post-disaster](image)

One of the primaries aims to this problem is proposed in the research to introduce an architectural Intervention that extends across all stages of the disaster life cycle, presenting a solid disaster and management plan that is flexible and adaptable to both disaster type and surrounding. Using the water reserve of Lebanon as a primary tool that assists in daily normal life, mitigates damage and spread of fire, used responsively for relief, and as a reforestation and recovery enabler.

Lebanon has a very rich water reserve that is not fully taken advantage of water is the most essential element during a disaster, both for human needs and as a combating tool during wildfires. Groundwater accounts for 95% of all freshwaters in Lebanon. (Comair, 2021)

2 Largest aquifer systems in Lebanon:
- Keserwan/Jbeil Limestone Formation (the one selected by the author)
- Sannine Limestone Formation

Limestone and sandstone are permeable rock formations that allows and filters water that passes through, this generates over 2000 springs across Lebanon. Coastal aquifers are over extracted and suffer from declining water tables and sea-water intrusion. The area is also at risk of primarily forest fires, due to the difficult terrain, and the weak state of fire brigade in terms of equipment and manpower. The terrain proves difficult to manoeuvre with current equipment, the smoke can also be trapped within the mountains making it difficult to evacuate
and mitigate the damages. Lebanon also lacks a fire GPS satellite that other countries rely on, so the reaction is slower than desired. (Thomson, et al., 2019)

3.4 Specific Area of “Drs-1 Emergency Education Centre”

3.4.1 Natural Reserve Zone
The specific area of the site is situated near the valleys directly after the eastern side of the city of Jbeil; the area between rivers is usually very fertile and prosperous for plant growth. The proven water reserve from the region’s limestone formation is also an added benefit to the site. Its altitude allows it to overlook the entire area and has a view towards both Jounieh and Jbeil. The site is necessarily distant from dense cities because of the overextraction of ground water in coastal cities. Project success is reliant on the surrounding communities’ and authorities’ support. The project focuses on the entire building life cycle, as the structures can be used for different function when idle. (Comair, 2021)

3.4.2 Surrounding nodes
The extracted water can be used for more than disaster mitigation, it can expand its uses in agriculture, domestic use, aiding in reforestation, and keeping the soil surface hydrated.
Transporting units to disaster areas are reliant on external vehicles such as helicopter. There are limited road networks leading from and towards the project. If something were to affect the ground water, the project concept would be heavily damaged. So, protecting and monitoring the ground water reserve is a priority to the project’s concept.

3.4.3 Rivers and geography

The 4 major disasters that threaten the site are: wildfires that are caused naturally or due to human error, the same fire reaching houses and effecting towns and cities. Rivers supply the area with a decent amount of freshwater since salt water can’t be used to put out wildfires, as that leads to damaged ecosystems. The two notable rivers of the region are the Nahr Ibrahim/Adonis River and the Nahr Madfoun river. (Al-Hajj, Khalil, Abou-el Hassan, Kaafarani, & El Sayed, 2020)

3.4 Different Perspective of Public on the “Current State of Disaster Management”

The public’s opinion surrounding the topic is invaluable, the idea of architecture intervention during a disaster is meant to protect and assist people’s needs. Hence, to seek credibility and people experience, the author preformed an online questionnaire to gather information people’s opinion on the current state of disaster management planning and response in Lebanon. Due to the pandemic, an online sample was chosen rather than a physical form of questionnaire, and this helps enlarge the number of people to better meet the validity of the research. People in the region selected hold priority in the interviews and questionnaire form.

3.4.1 Questionnaire

A series of 8 close-ended question with multiple choice were distributed to over 200 people from various fields and age groups; to not bore the participants and have the questionnaire feel redundant: only 3 options/answers were given per question. Of the 200 people who were invited to participate, 52 people responded to the online questionnaire and solved it till the end.

The following questions were asked:
1) What is your opinion on the current state of the governmental response to disasters?
2) How much faith do you have in the success of disaster response that would not include other countries?
3) What is the largest reason behind the weak disaster response?
4) Which disaster do you think causes the most damage?
5) Do you think Architecture can improve with disaster response?
6) Which aspect of life is most damaged by mismanaged disasters?
7) Which part of the disaster should most of the effort go; before, during, or after?
8) Do you think an educational disaster management centre can solve most of problems caused by disasters?
After the completion of the field methodology part of the research, the paper analyses the results and displays them visually in the “Findings” chapter.

3.4.2 Interviews

An interview was held specifically to the people in the case study’s region/site. However, due to the current distance of the site from the author’s residence and the difficulty to transport around Lebanon due to the inflation and the impact it has had, the interview portion of the research was done online using the internet. The target audience of the interviews should be people of mature awareness and age, so people between 20 to 55 should be able to meet these criteria.

The interview was more focused than the questionnaire, asking 4 people intimate questions about the topic at hand. The main focus of the interview should be on the architecture intervention and how it can help impact the disaster life cycle positively. The information gathered from the field methodology is empirical and based on real life experience

1) How do you think of the way Lebanon handles disaster management here?
2) What do you think we can do to improve disaster management and protect our nature and built cities/towns?
3) What is the biggest mistake in disaster management from your experience?

Michel Saliby, 39 years old – Banker:
The reason the disaster management in Lebanon is so bad because there is lack of preparedness and maintenance done by the people responsible, nobody bothers doing anything until the disaster has already happened. I feel if like you are suggesting, we automatize the disaster management using architecture this can have a position impact on disaster management definitely. I just hope that a funding to such a project is feasible with how greedy our politicians are.

Rita Iddih, 28 years old – Architect:
Nothing is worse than having the wrong people in charge during the worst time, this is the way Lebanon is disaster management is not an easy task, and with the human element present there is bound to be mistakes. The reason an architecture intervention might work is because it is less likely to make mistakes. Unlike our mistakes, we bring the wrong people and make us in charge, and now not only are we paying the price but our beautiful nature as well.

4. FINDINGS

To test the validity of the project’s approach, a series of questionnaire questions were distributed to over 200 across multiple social media platforms; of the 200+ people contacted 56 people committed to the questionnaire and unfortunately on 52 people were finalized as 4 applicants were found to have answered off topic or gibberish: The results showed that 92% of people lack trust in the government to handle disaster management and find the current state of risk management and reduction equipment either mishandled or outdated. 87% of applicants were approving and welcoming in introducing architecture intervention as a tool in disaster management and across multiple life cycles. Finally, almost 79% believe that the project if implemented correctly can have a positive impact on confronting disasters and mitigating damages.
The number of factors was unconstrained. These factors totalling 8 questions, were labelled as the building components: research centre, adaptable structure towers, and modular transportable units. The results show that participants found the structural towers distributed across many regions can have the most immediate positive impact and incidentally it is the cheapest to construct and will show instant improvement on the short run. The towers also have the benefit of being able to be distributed along all the different regions of Lebanon indiscriminately, as well as, possibly requiring the least maintenance and operation (as almost all the functions are automated). The Lebanese people are frustrated in the pitiful state that the country finds itself in, depending on outside support in terms of handling the disaster damages and costs; making Lebanon seem like a pauper country when it is just very badly mismanaged in every conceivable way possible.

5. CONCLUSION

This paper analyses and assesses the beneficial impact of architecture intervention across the multiple stages of a disaster life cycle, helping alleviate the current state of disaster management by introducing a zero-error environment that minimizes human error and automates most of the disaster management system. The system is comprised of 3 separate components that work cohesively to prepare for disasters, mitigate damage, provide relief and support during the crisis, and promote recovery and reconstruction. The project would improve on the stated weak areas of disaster management by introducing structural nodes spread across a risked area which in return will be monitored and interconnected by the enduring research centre.

The case study observes and focuses on the wildfire disasters that have been frequent in the last few years, concentrating on the region of Jbeil and Keserwan, one of the most commonly afflicted regions by wildfires over the last 5 years. The components that make up the project were equally important to the sustainability of the overall project, but the field method showed promising acceptance and probability of success from the adaptable structure towers that can easily be setup and deployed in any region. Adding to the overall adaptability of the towers to accommodate any space and function using the modular units that can be implemented into the structural towers. The tower would sustain the units in an interdependent relationship, providing a centralised infrastructure that would provide basic human needs and more.

The paper also investigates the difference between the introduced method of design and the conventional method, comparing both and analysing the benefits of the case study and how it can handle a disaster better in any shape or form. The main benefit would come from the self-sustaining approach the project takes, using already present technology and resources present in Lebanon to create an ideal environment at facing disasters.
REFERENCES

- Fitz, A. (2020) Critical Care: Architecture for a broken planet. 17-33 and 130-274