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Sustainable Modular Recovery Units

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ABSTRACT

Architecture of this era is moving towards state of compaction and visualizing reality of the future, making you face the challenges of today's problems. This research paper focuses on architectural design techniques of sustainable modular recovery units used for emergency or any pandemic crisis. The aim is to showcase new alternatives to hospital projects and emphasize the importance of less time-consuming, lightweight structures that fulfill social duty, provide effective counteraction against diseases, and offer quick isolation rooms for underprivileged citizens. The research methodology employed in this study involves the analysis of case studies from literature sources worldwide, with a focus on the Leishenshan construction process in China. The key findings emphasize the suitability of assembled structures for disaster response and therapeutic emergency systems. The use of modular composite design and prefabricated construction methods plays a significant role in the success of these structures. The results have implications for governments, healthcare authorities, and architectural professionals, urging them to collaborate and develop standardized guidelines for the construction and amalgamation of modular structures. The emphasis should be on creating insubstantial and easily deployable units that can be quickly assembled during emergencies. The research highlights the significance of prefabricated construction for recovery units in managing potential virus outbreaks in the future. By adopting these findings, societies can enhance their preparedness and response capabilities to effectively address healthcare crises.

Keywords:

Modular, prefabricate, sustainable, emergency, recovery units.

1. Introduction

In a world marked by increasing frequency and intensity of natural disasters, pandemics, and other emergency crises, the need for efficient and sustainable solutions has become paramount. The lack of space in hospitals during pandemic required urgent response from authorities. However, in order to provide health services, distinct areas like halls, centres and barren lands were transformed into medical care. With this concept, hospitals can be constructed using prefabricated modular

units. Such methods indeed differ from the conventional construction process. Modular recovery units have been widely used to save lives. There are notable examples in the field, for instance, UNHCR have implemented sustainable modular unit solutions to provide temporary shelters in refugee camps, these types of units used during COVID -19 pandemic, used for deployment of housing and as mobile clinic. These examples demonstrate the versatility and effectiveness of sustainable modular recovery units.

(Yatmo, 2021) presented the architectural design proposal of modular Isolation recovery house (IRH) in emergencies. It can disassemble and reuse in post-pandemic situation.

Study by (Ahmed Salah Eldin Shiba, 2020) focused on the design of low-cost temporary infection recovery units in dry, hot, and arid climates, emphasizing the importance of architectural design in relation to these units.

(Gatheeshgar P., 2021) overviewed affordable steel-framed modular units and their suitability for emergency response situations, with novel suggestions on how their performance can be improved.

(SÖNMEZ, 2020) explored modular hospital ideas for emergency processes, comparing different designs and their suitability for future adaptations, as well as investigating variations to enhance the mechanical and structural plan for pandemic infections.

(Fiume F., 2020) developed a modular and modifiable building system, that is sustainable, flexible and fast to build. A pre-design matrix is under development that determines the composition of each module based on external environmental conditions. The research focused on the performance of the building envelope in severe environments and identifies the requirements for achieving indoor human comfort and energy efficiency.

(Ateek, 2020) discussed how the Coronavirus pandemic could reshape our cities, buildings and interiors with a focus on sustainable architecture and the use of advanced technology could be used, voice-activated elevators, automatic doors and cell phone-controlled hotel rooms to minimize physical contact and reduce diseases transmissions. Modular construction played an important role in building hospitals and recovery units for patients in limited time and with less embodied energy than on-site construction.

The current study evaluates the objective to propose architectural design techniques of sustainable modular recovery units that will be lightweight, easy assembled and affordable for any emergency, pandemic and disaster responsive strategy.

2. Methodology

For the research, a site is taken to process architectural design proposal for sustainable modular recovery units. This site will open doors for constructive techniques to be useful for the proposal.

2.1. Study area description

The site is a park called Usmania Family-park of 0.6 Acres in Bahadurabad with 24.8785° N, 67.0679° E coordinates (Figs. 1 & 2). The area has a moderate and humid climate. As my design is about modular recovery units and require some considerations that will help in achieve this design that is why the area was taken because the plot is permanently closed, carries a healing environment, socially active and have all amenities around and is also near hospitals.

Fig. 1: Location

Fig. 2: Site orientation

To the north and east are the residential blocks of G+2, while to the south-west road side are residential blocks of G+20 and other utility stores and marts are also available. Fig. 3 shows land use with hierarchy of blocks. The primary road, Shaheed-e-Millat usually has heavy traffic while the secondary road, Siraj-ud-Daulah has moderate traffic. Tertiary roads are the streets and nodes and internodes are connected via lanes. Fig. 4 shows road traffic and linkages.

Fig. 3: Land use

Fig. 4: Road links and traffic

The site area is depicted in Fig. 5. It has easy access, proper ventilation, and lighting, but there is a concern about street crime in the area. The area is well-planned with a mix of high posh and poor class residents. This design will help all needy people and will not differentiate between any group. People of all social groups can be healed at one place.

Fig. 5: Site area

2.2. Data collection and source

The research process includes qualitative methods of research. Qualitative research is given by textual data from books, newspapers and internet websites. If I talk about one scenario of Covid-19 in previous years, the following research concludes that:

Pakistan remained unaffected for a couple of weeks after the declaration of the outbreak and reported its first confirmed case on 26 February 2020 from Iran. The mishandling of pilgrims including the lack of effective quarantine facilities and testing capacities at the Taftan border crossing resulted in the importation of the virus in the country. Pakistan started to feel the impact of the outbreak in Mid-March with a sudden spike in cases crossing the first hundred confirmed cases (Noreen, 2020).

The rates were increasing day by day while the quantity of beds and spaces were decreasing. The province-wise isolation and quarantine facility are shown in Figs. 6 & 7 respectively with beds capacity in initial days of Covid-19 in Pakistan.

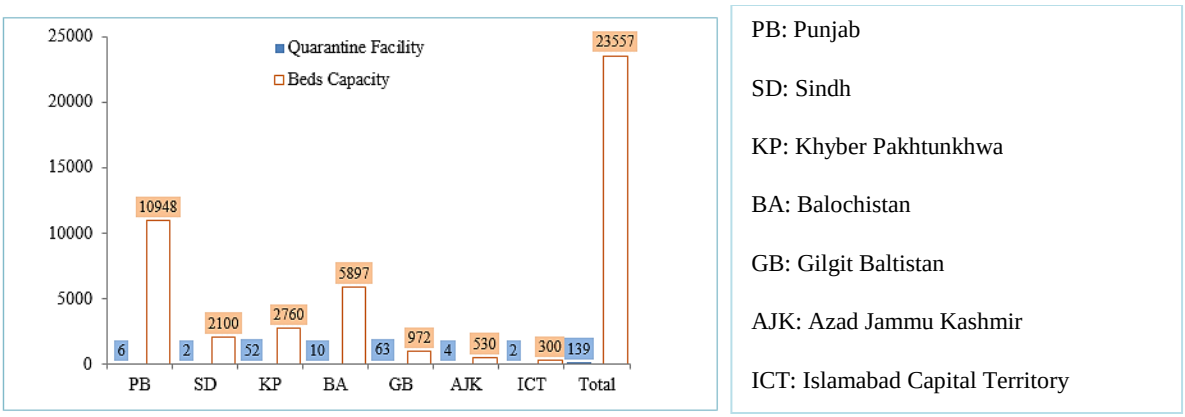

Fig. 6: Quarantine facilities

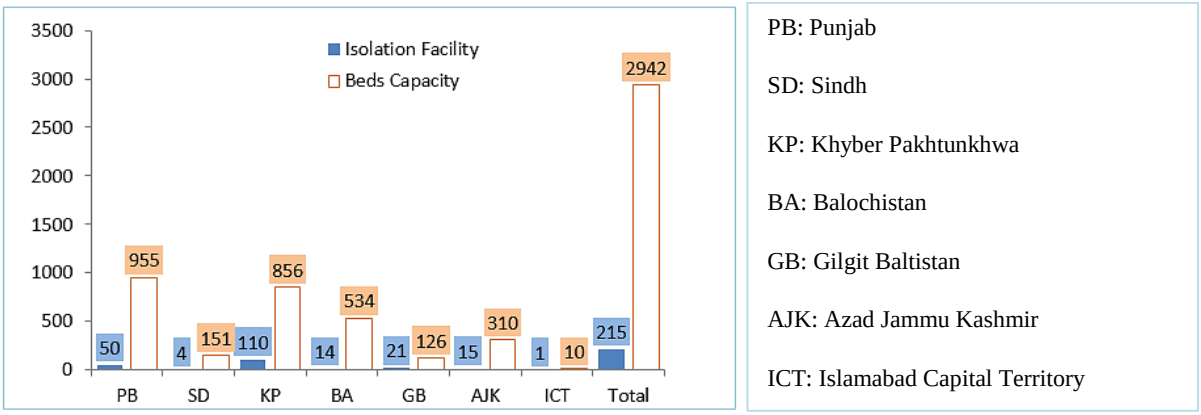

Fig. 7: Isolation facilities

With this rise, there were 12 hospitals or centres with total 1,198 beds respectively that's less for the cases of 2,03,716 in Karachi that time. For this reason, big halls and vacant areas were transformed into covid centres. For instance, Expo centre in Karachi was converted into isolation unit and another KMC hospital was suggested for 50 beds.

The procedure to take people into isolation requires all hygienic precautions from PPE stock, adequate room ventilation, post signs on the door, visitor's consultation to interacting with patients. So, a modular unit can fulfill this requirement. Moreover, not only this virus crisis, there are also other disaster responsive, housing deployment or emergency crisis in need of such sustainable modular recovery unit.

2.3. Design strategies

As pandemic situation led to transform spaces into medical services. So, parks are another source to utilize in such circumstances. Sustainable modular units are more efficient when rapid

construction is necessary. The design strategies for this structure will overcome the need of the health facility and barren park as it includes all sort of environment for recovery. The design is prefabricated and modular with sustainable material. Shipping containers converted into biocontainment pods and modular critical care units that can be easily transported. To reduce the workload and accelerate the design, modular prefabricated systems used. A steel structure was utilized as a primary modular assembly delivering various functions adopted to host operations in full isolation.

The standard size of containers used for modular units was 8x10x9 ft., with various other dimensions also adopted. These units utilized a skeleton system composed of corten steel walls as the main elements. The utilization of a composite system allowed for rigidity, safety, stability, and durability of the entire structure. As shown in Fig. 8, to form the module, walls, ceilings, and floor panels included polyurethane foam insulation and steel plate finishes with a touch of wood. Each modular unit was well insulated and equipped with a ventilation system placed up in a bay. The connection between modules was provided with inflatable tunnels, which could potentially be subdivided into regulating zones.

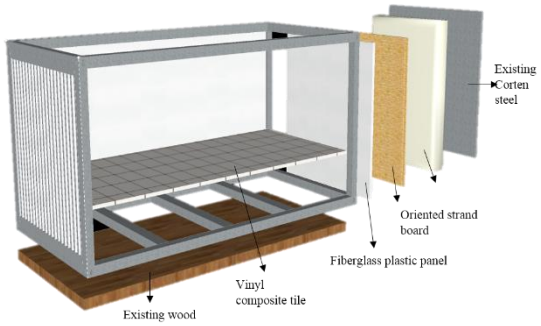

Fig. 8: Module

If we discussed the planning, the inflatable part consisted of a spraying booth and corridors for access. Separate entrances were provided for entry, exit, and garbage disposal. There was a reception area and waiting lobby with hygienic precautions in place. An examination room and laboratory were situated on the ground floor. Standard-sized containers were equipped with critical wards and isolation units, possessing all necessary capacities. The isolation units featured inbuilt theatre screens, a self-serving café with a glass bubble seating area, and balconies. These amenities were provided to ensure that nobody regretted being there and to facilitate all necessary procedures for maintaining health within a refreshing and pleasant environment. Figure 9 depicts the internal design and utilities provided in a critical ward, from the anteroom washbasin and disposal zone to

the interior, featuring a reading table, television, and a view.

Few mechanisms were incorporated to make the design more strategical for Covid purpose. Fig. 10, shows the mechanism of a safety meeting booth in which you can meet the one's you can't due to isolation through measure precautions. Then portable stairs with ramp that can be adjusted by pulling/pushing and an inflatable tunnel for access, air circulation and less cost, easy assemblage. Overall design exhibit sustainable growth that will improvise circumstances we are living in.

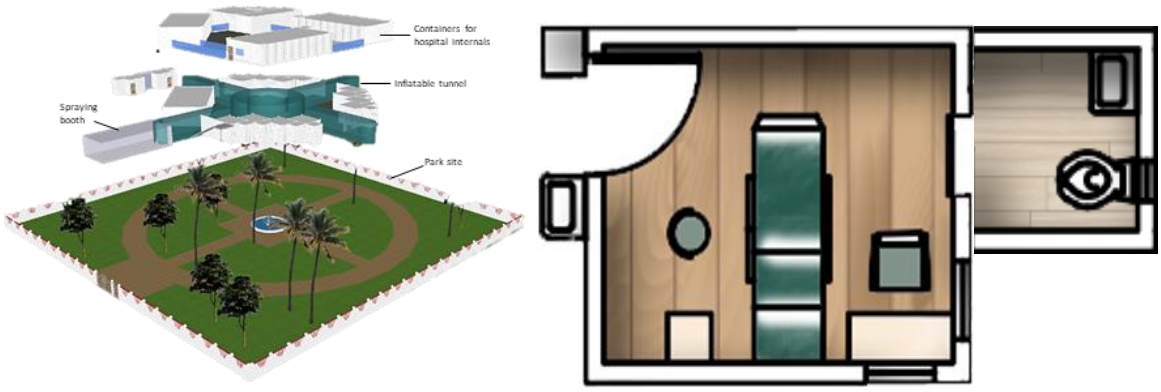

Fig. 9: Design & Planning

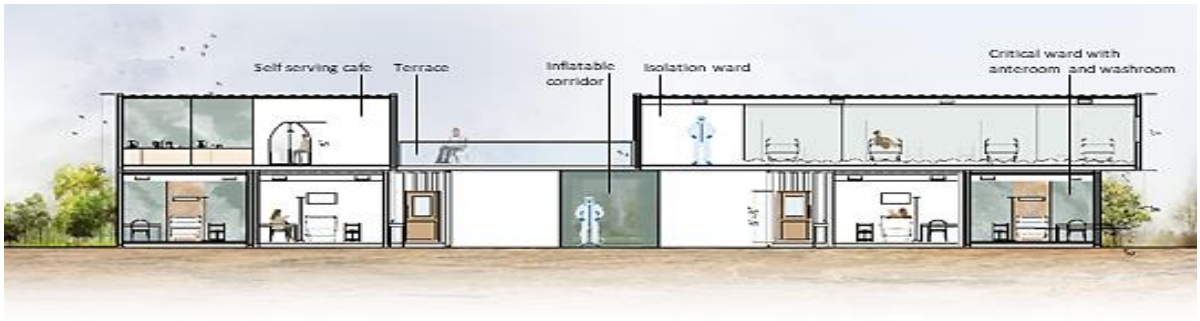

Fig. 10: Mechanisms

3. Results and discussion

The outcomes emphasize the significance of prefabricated construction for recovery units in managing potential virus outbreaks in the future, enhancing preparedness and response capabilities to effectively address healthcare or other emergency crises. The research highlights the suitability and versatility of assembled structures, emphasizing the use of modular composite design and prefabricated construction methods. By adopting the findings, societies can enhance their awareness and effectively response in emergency crises.

Architects and Urban planners set in stone to discover an answer for nations that need accessibility in emergency scenarios. For pandemic situation, despite isolation beds in our city, we need

different changes of inns and public spaces into clinical stations, Architects have proposed ideas of prefabricated proficient, and quick carrying out structures that might actually have host tainted individuals. The advancement of pre-assembled frameworks assumes a fundamental part in worldwide and reflects on a number of lives that can be saved. The integration of modular systems allows shortening of construction time and amount of labor on the site compared to conventional construction process. Estimate delivery time of building, which comprises of secluded frameworks depends on the readiness of modules offsite, and consequently could be conceivably ready ahead of time if there should be an occurrence of the crisis for a brief reaction. Then again, structures fabricated after traditional development measure is coordinated layer by layer and expect time to continue to the following stage. Also, execution of medical care offices with an ordinary strategy relies upon climate conditions, which can disturb development work during the interaction.

For example, Italian architects Carlo Ratti and Italo Rota have used basic shipping containers as a main component that could be adapted and fixed to existing structures of hospitals or converted into shipping communities for emergency. With such change, my pods will be designed and can be installed with various edifices following modular principle. This module can be placed as a separate self-standing system or as an expansion of existing hospital allowing continuation of ongoing treatments.

4. Conclusion and recommendations

Living in an expeditious time, Architects and specialists presently assume liability to give fast plan arrangements in crisis circumstances. It is now as never before important to develop a standardized design approach, which will allow quick response to pandemic outbreaks or emergency crisis. The sustainable modular recovery units will help in advancement of today flaws. The arrangement of modular pods will have every need required. The isolated patients or person living in those units will breath in an eco-friendly environment.

Governments and funding organizations should provide financial support and incentives for the development of sustainable modular recovery units and architectural professionals should invest their expertise and resources in creating innovative solutions for emergency crisis response.

Nevertheless, many of the emergency facilities can meet this design resource. In particular, the study adds insight into a possible low-tech modular facility that is not only quick to construct but also relevant to those areas with limited resources. The proposed design is open to further

development for more robust implementation both in the epidemic and for other possible future needs. Integration of the proposed design into relevant systems is essential to achieving the design purpose. All in all, this research paper is a tool for all those interested in tackling this circumstance and created in the certain knowledge that together we can endure it.

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