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MODULAR TREATMENT CENTRES: AN APPROACH TOWARDS EMERGENCIES IN DISASTERS AND PANDEMICS

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Abstract - *The present paper consists of temporary methods of using modular units in construction. It is emphasized that modular construction has the potential to shorten project design and engineering time, reduce costs and improve construction productivity. The installation of modular units is cost-efficient, safe and eco-friendly. Modern modular systems are based on using not only large elements such as block rooms but various small 3D building elements. The effective use of modular structure in recent times can be done as quarantine centres, treatment centres, and COVID test centres. The report shows promise for developing modern modular construction systems in order to provide the population with affordable, comfortable and eco-friendly housing in times of disasters and pandemics.*

Key Words: Modular units, construction

1. INTRODUCTION

Healthcare industry has seen a massive change over the years, with every passing day the healthcare sector is facing challenges and the possible solution could be serving the patients and medical providers with high tech standards, this could be achieved by building these facilities in a smarter and better way but these highly specialised and technical construction needs to be dealt in a more cost-effective way in order to upgrade healthcare facilities. Disasters and pandemics not only affect human life but also economy, education and business.

A modular structure or building is a prefabricated building that consists of repeated sections called modules. These modules are produced by pre-engineered building units in factories with different units and assembled in the site. The modular structure consists of offsite prefabricated parts that are brought on site in easy to assemble parts or in completed state.

The modular construction can be completed within half the time, cost and labour than the traditional construction. As the structures are prefabricated in factories they are delivered in the best possible condition. Furthermore, these structures minimise long-term operating expenses. After medical assistance, the next item that is required after a calamity is refuge. Modular constructions may be built in a matter of minutes, giving a rapid, temporary option for persons in need of shelter. Pandemics and disasters are sudden and uncalled for, leading to the destruction of life as well as property. The impact faced by the citizens and the government around the world raises the question of how to tackle the situation at hand and deal with it in a better manner next time it occurs. Modular shelter units provide an efficient, cheaper, safe structure for treatment centres, morgues, and a refuge for disaster strike population. These prefabricated units can also be used by the government during pandemics and disasters such as a hurricane, forest fire, floods, etc. for providing appropriate support and essentials.

1.1 Literature Review

Earthquakes, Tsunamis, volcanic eruptions, and other natural calamities are uncontrollable, yet the first thing they take from people is their land and shelter. Portable shelter solutions are required in order to provide large-scale, modular housing in the safest possible locations for victims. This mobility is also important in order to keep emergency response teams close to the action to ensure better response times on the frontlines.

During a disaster, it is not always evident or possible to predetermine where an emergency response building or shelter will be placed. Relocatable modular structures guarantee that the site of your emergency services facilities may shift as environments and conditions change. The modular building installation method is extremely quick and effective. Modular structure guarantees that your community receives immediate aid in the event of a tragedy.

There is need of prevention and control in informal settlements, to assess the community risk perception, and thought process to enable community-based public health

emergency preparedness and risk informed policy making in future. Documentation of best practices, creating a knowledge platform for lessons-learning will promote an inclusive, participatory and well-informed preparedness strategy. [1]

Modular construction is a novel technique that has several advantages over traditional construction methods; however, along with the benefits, there are limitations that make it challenging. Various aspects of modular construction need to be studied in-depth to improve the construction process. [2]

After major catastrophic disasters, it is very important that the government agencies respond to post-disaster housing issues and provide resources such as temporary housing before the full rehabilitation and reconstruction of destroyed and damaged housing. To provide affordable temporary housing for residents who may lose their homes as the result of a catastrophic disaster including storms, government agencies must develop a post-disaster housing prototype. [3]

Modular construction requires minimum access roads as on-site construction will be minimal. Modular units can be shipped in or transported on trucks and placed on site using mobile cranes. This is a very convenient and practical method of construction, especially in a disaster struck area where vehicle access could be a key limiting factor. Modular structures have proven to be more environmentally friendly than conventional steel or concrete buildings. [4]

The infectious disease threats of our times are far from over, and if these are to be contained with lower magnitudes of loss to human life and economy, we need to invest in building up people-centric health systems, which pre-empt and prevent, rather than work in reactive, feedback loops driven by the burden of human misery. [5]

1.2 Methodology

The Plan has been drafted in the REVIT 2019 version software for providing sophisticated views to create models of real-world structures and buildings as shown in Fig. No. 1 Plan View of MTC. The total area of the modular treatment centre area will be 10.5m² (3.5m x 3m) and it will consist of an attached bathroom and W/C of 1.8m² (1.2m x 1.5m). The height of the treatment centre will be 2.3m.

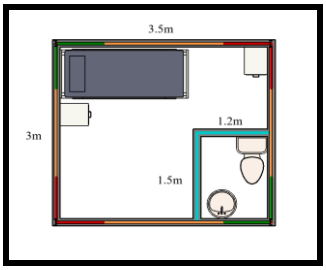

Fig -1: Plan View of MTC

For materials, A Cement Fibre board is used for walls and partition walls. Cement fibre is a composite building and construction material, used mainly in roofing and facade products because of its strength and durability. It gives high performance and is reliable green building materials it is proven to be 100% free from asbestos or other harmful materials. It is a light weight building material that gives a better and stable performance and it is also long lasting and requires low maintenance. Cement fibre boards also offers high resistance towards heat, humidity and moisture. The main top and bottom frame, posts and lifting points are made up of steel. We have used ISMB 100. Steel structures are very reliable. The reasons for this reliability include consistency and uniformity in properties, better quality control because of factory manufacture, large elasticity, and ductility. Magnesium oxide board is the material used for flooring. These boards are fungus resistance means they attract no rot, mildew, allergens or mould. It's 20 to 30 percent lighter than other cement-based boards. Extruded Polystyrene Sandwich Panel also called EPS Sandwich Panel is used as roofing material. The top & bottom Surface of this panel is Galvanized & pre-painted steel sheets, core material is polystyrene and it is formatted by laminating and pressing 2 components with Polyurethane glue. The sandwich panel is featured with temperature keeping, sound insulation, and water and fire resistant. UPVC doors and sliding windows are used in the MTC. It is made up of Unplasticized polyvinyl chloride, a strong material widely used to make doors, windows and pipes UPVC is strong and a cheaper alternative to expensive hardwood timber and aluminium. It is quite durable and a cost-effective option. Material used for varnishing are RAL 9002 epoxy paint. Epoxy coating durable and resistant to many corrosive substances. Epoxies are a top choice for many industrial coating applications including steel, metal, concrete, and more. The Acrylic Latex paint is used for painting the interiors of the MTC for Aesthetic purposes. Latex acrylic's advantages include superior adhesion, breathability, colour-retention, flexibility and opacity. While all the corners and joint materials have applied 60-micron thick electrostatic powder coating oven baked under 200°C. Powder coating is a type of coating that is applied as a free-flowing, dry powder. It is typically applied electrostatically and then cured under heat or with ultraviolet light. The powder may be a thermoplastic or a thermoset polymer. It is usually used to create a hard finish that is tougher than conventional paint. Fig. No. 2 shows the 3D-View of the structure.

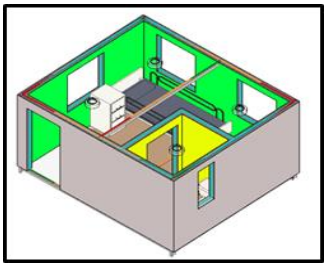

Fig -2: 3D-View of the structure.

Assembling the MTC:

The project is first designed in the software keeping the design norms under consideration. The components of MTC are manufactured at the factory which is provided with door

and window cuttings. The vertical PVC frame on which the doors are hinged is fitted in the Cement fibre board. The lifting points, vertical posts, EPS sandwich Panel for roof and MgO board for Flooring purpose along with installing mechanical, plumbing, and electrical components, and completing interior finishes are assembled and arranged on Site by the Labour force. The bottom frame of 2.2mm thickness is assembled using the bolt connections on the lifting points and The vertical posts of thickness of 2.3mm and height of 2.3m is fixed vertically on the lifting points placed on the edges. The top frame of 2.2mm thickness is assembled the same way using the lifting points. The cement Fibre boards walls and partition walls are fixed using Galvanized Sheet metal Screws placed 8 inches apart. Total 15 screws of 8mm diameter of M20 grade steel for each side are required for fixing it firmly on the frame. The electrical wiring and electrical components such as Fan, ceiling lights, Exhaust fan, sockets, etc. and the plumbing Fixtures are installed by desired labour on site and lastly Exterior surface is painted with the Acrylic latex paint. Fig. No. 3 shows the flow chart of Assembly of MTC.

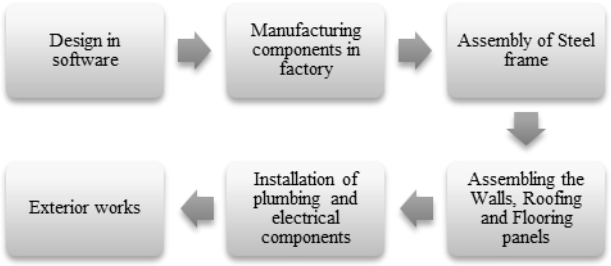

Fig -3: Flowchart of Assembly of MTC

1.2 Result and Analysis

This study presents a comprehensive analysis of the cost of structure of MTC and the cost of requirements in the table -1 and table -2 respectively as per market and local survey.

Table -1: Cost Analysis of the structure

Material	Dimensions (ft.)	Cost (₹)	Quantity	Total cost (₹)
Cement fibre board	9.8 x 7.5 (53.33sq. ft.)	60/-sq. ft.	2	8,820/-
	11.5 x 7.5 (69.45sq. ft.)		4	20,700/-
Flooring material (MGO board)	11.5 x 9.8	60/-sq. ft.	1	6,762/-
Roofing material (EPS sandwich panel)	11.5 x 9.8	1,150/-sq. ft.	1	1,29,605/-
Varnish (RAL 9002 Epoxy paint)		381/-kg	1(15 litre can)	515/-
Acrylic latex paint		1,148/-sq. ft.	1(10 litre can)	1,148/-
Steel (ISMB100)	11.48	62/-Kg	4	17,781.6/-
	9.8		6	3,645.6/-
	7.5		4	11,581.6/-
Sheet metal Screws	0.314	538/-set	140	538/-
Doors	2.5 x 6.5	550/-Piece	2	1,100/-
Windows	2.95 x 3.94	2,300/-Piece	3	6,900/-
	1.96 x 1.96	1,548/-Piece	1	1,548/-
				Total: ₹2,10,664.8/-

Total Cost of Structure = ₹ 2,10,664.8/-

Total Cost of Structure and Cost of Requirements
= ₹ 2,39,847.8/-

Refer Table -2**:** Cost Analysis of the Requirements

For the details of requirements
Mazdoor = Labor cost 10-15% of total cost
Electrician = ₹ 512/- day
Welder = ₹ 539/- day
Plumber = ₹ 560/- day
Site Supervisor = ₹ 854/- day
Cost of Sanitation = ₹ 225.92/-
Water Consumption: 115 liters per person per day
Water charges (Dispensaries, hospitals, nursing homes, maternity homes, dispensing chemists and other premises connected with medical services.) = ₹ 17.28 per 1000 liter.

Table -2: Cost Analysis of the Requirements

Material	Requirements	Cost(₹)	Quantity	Total cost(₹)
Electrical Fittings	Fan	900/-	1	900/-
	Lights	400/-	3	1,200/-
	Polycab wires	1,465/-	1	1,465/-
	Switchboard	150/-	3	450/-
	Socket	19/-	2	18/-
	switch button	20/-	12	240/-
Furniture	Desk	5,000/-	1	5,000/-
	Chair	2,000/-	1	2,000/-
	Bench	3,000/-	1	3,000/-
	Cabinet	2,000/-	1	2,000/-
	Bed	5,000/-	1	5,000/-
Sanitary equipment	W/C	2,400/-	1	2,400/-
	Wash basin	1,270/-	1	1,270/-
	Soap Holder	50/-	1	50/-
	Towel Bar	200/-	1	200/-
	Cistern	963/-	1	963/-
	Shower	560/-	1	560/-
	Exhaust Fan	967/-	1	967/-
	Plumbing fixtures set	1,500/-	1	1,500/-
				Total: ₹29,183/-

2. CONCLUSIONS

Modular structures can be transported to patients from the hospitals with all of the medical equipment required in calamities such as pandemics or disasters. For disaster relief housing, testing facilities, modular morgues, and care units, modular shelter units provide efficient, effective, and durable buildings. There are numerous environmental advantages because there is less construction waste because various modules are built at the same time, and materials that would be dumped on a traditional building site may be reused for future projects in a modular building facility. By synchronising offsite and onsite activities, modular construction enhances project speed-to-market. Modular construction can save money in a variety of ways, including less on-site labour, more predictable prices, less material waste, faster construction timetables, and less interruption on the job site. In light of the recent COVID outbreak, it might be used to provide patient beds or for isolation. It can also be used as a rehabilitation centre, providing a wide range of services and criteria to assist people in getting back on their feet. These can be extremely useful in the construction business as a temporary shelter for labour and raw materials in remote places, lowering transportation costs.

REFERENCES

[1] NIDM, (June 2020), New Delhi, _preparedness strategies and management during Pandemic.' - Article by NIDM and NDMA.

[2] Karthik Subramanya, Sharareh Kermanshachi, Behzad Rouhanizadeh (June 2020) _Modular Construction vs. Traditional Construction: Advantages and Limitations: A Comparative Study'.

[3] Dr. George Ford, Yong Han Ahn, Don Mook Choi (December 2014) _Modular building for urban disaster housing: Case study of urban post disaster housing Prototype in New York'.

[4] Gunawardena Tuan, Mendis P. Aye, L; Crawford, RH (September 2014) _Time efficient post disaster housing reconstruction with prefabricated modular structures.

[5] Dr. Abhishek Sharma, Dr. Bhuvnesh Kumar Sharma, Dr. Ramandeep Singh, Dr. Vishal Thakur, Dr. Supriya Jassal, Sachin Raina (September 2020) _A literature review on serious pandemic disease-COVID 19'- journal of CMRO.