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Low-Cost Flood Resilient Interior Design for Indian Homes

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***Abstract*:- Climate change is leading to severe weather conditions in Indian cities. Cloud bursts and heavy rains are reported in several Indian cities. Urban and semi-urban localities lack robust sewerage infrastructure. Heavy rains during monsoons, cyclones and other weather conditions related to climate change are causing flash floods and inundating homes is low lying areas. Lower income households especially in the ground floor are highly impacted by flooding. Water entering homes and water level raising to couple of feet height is regularly reported. Loss to individual houses in enormous and several surveys undertaken by government bodies have published reports on nature and extent of damage during recent floods in Chennai and Hyderabad. In terms of public infrastructure, the problems are similar in other cities and acute in coastal cities. This paper proposes minimalist and low-cost interior design ideas for lower income households to minimise the damage during flooding. Emphasis is on to protect precious household essential equipment like refrigerator, washing machine, cots, storage unts, kitchen platform which are expensive to replace and damage to them will lead to severe difficulties to lower income households. Design is based on locally available material and hardware. The key emphasis of the design is to protect the household articles and reuse the furniture after floods and ensure that people can manage to stay at home during moderate floods with some adjustments. Detailed design sketches and prototype images are presented.**

Keywords— Flood resilient interiors, Climate change, Urban floods, Water logging, Flood damage.

1 INTRODUCTION

Frequency of extreme weather events is increasing in India to global warming and climate change. As per various research (Krishnan, 2013) (Vasudeva, 2021), these reports detail the trend in such events. Rapid urbanization and poor sewerage infrastructure is compounding the problem of floods in India cities. South Indian cities (Vasudeva, 2021) are experiencing frequent cloud bursts and extreme precipitation events causing floods leading to severe economic loss. The problem is not unique to south Indian cities and it is similar situation in other Indian cities too (2015 South India floods, 2022). Coastal cities like Mumbai, Vishakhapatnam too experience severe flooding during peak monsoon periods and cyclones. In recent years Hyderabad city is experiencing extreme single day precipitation leading to water logging and floods (Vadlamani, 2020) (2020 Hyderabad floods, 2022).

Zameer Ahmed et al. in their paper- URBAN FLOODING – CASE STUDY OF HYDERABAD (Ahmed, Rao, Reddy, & Raj, 2013) have done extensive research on historical and current flood situation in Hyderabad. Floods cause severe economic loss to households. Damaged furniture, domestic equipment will to extreme difficulty to people and lower income families take several years to get them repaired or replaced. Home insurance is not a viable option as they are expensive premiums and less than 1% of Indian households are insured against natural calamities (Khanna, 2017) when compared to developed countries where household insurance exceeds 97%. While insurance penetration, urban planning, urban infrastructure are long term solutions to address this problem, this paper attempts to explore low-cost design alternatives which are within the affordable reach of low-income families to prepare the households to mitigate the risk of flooding.

The following published photo essay with excellent images documents the loss and type of household articles that get damaged during floods. Government of India appointed task force committee (Vadlamani, 2020) has done extensive study of damages done to households during Chennai floods and recommended certain steps to mitigate the risk. ((NDMA), 2015) Basements are severely impacted by floods. Cars and other vehicles get damaged beyond repair. It is reported that car owners take out the cars and park them on flyovers and other elevated places after receiving the flood warning. Making basements flood resistant is an expensive proposition. Diesel motor pump-based drainage, hydraulic ramps for lifting cars require lot of investment and beyond the scope of this paper. Globally governments and other non-government agencies have published detailed guidelines for make homes flood resilient (TNN, 2021). A detailed study is done on the published documents and best in class design ideas are taken and modified to suite Indian requirements (Board) (IAHV, 2017) (FLOODPROOF YOUR HOME, 2021). The designs proposed in this paper have used extensively the available of published literature on nature of damage caused by floods and attempts to mitigate those risk factors. It is common for government agencies to ask the people living in flood prone areas and huddle them in community cyclone shelters, make shift camps in schools and colleges. General amenities and hygiene, sanitation facilities are inadequate. Covid pandemic has compounded the problem and people are hesitant to move to crowded camps. Designs proposed in this paper are cost effective and will facilitate the people to live in their homes for few days during moderate floods.

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2 FLOOD RESILIENT DESIGN ELEMENTS

This paper proposes following design elements to make the home flood resilient. Design is based on low cost and commonly available material in India.

2.1 *Wooden pallet-based stools to raise the height of cots and racks*

Wooden pallets are extensively used in the manufacturing industry to transport machinery and finished goods. They are scrapped after they reach the destination and available at very low price in neighbourhood scrap shops. Stackable 1 foot X 1 foot X 1 foot stool is designed. These stools can be stored on a loft, rooftop or in a corner in the house and can be used to raise the height of racks, cots and other furniture elements.

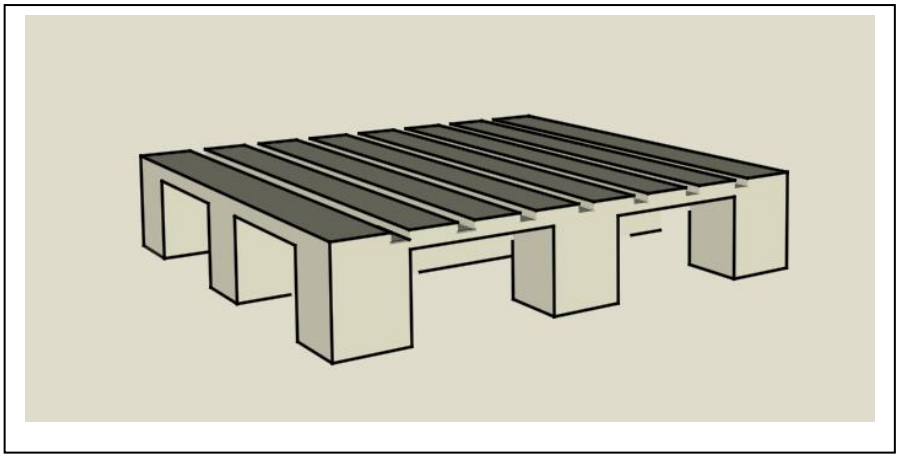

Figure 1 Wooden Pallet based stool

2.2 *Cement Brick platform for refrigerator and washing machine*

Few cement bricks can be stocked either on rooftop and vacant corner outside the house. It can be covered with a granite stone or cement slab to work an outdoor seat during normal times and moved into the house to make a make shift platform for refrigerator and washing machine during floods.

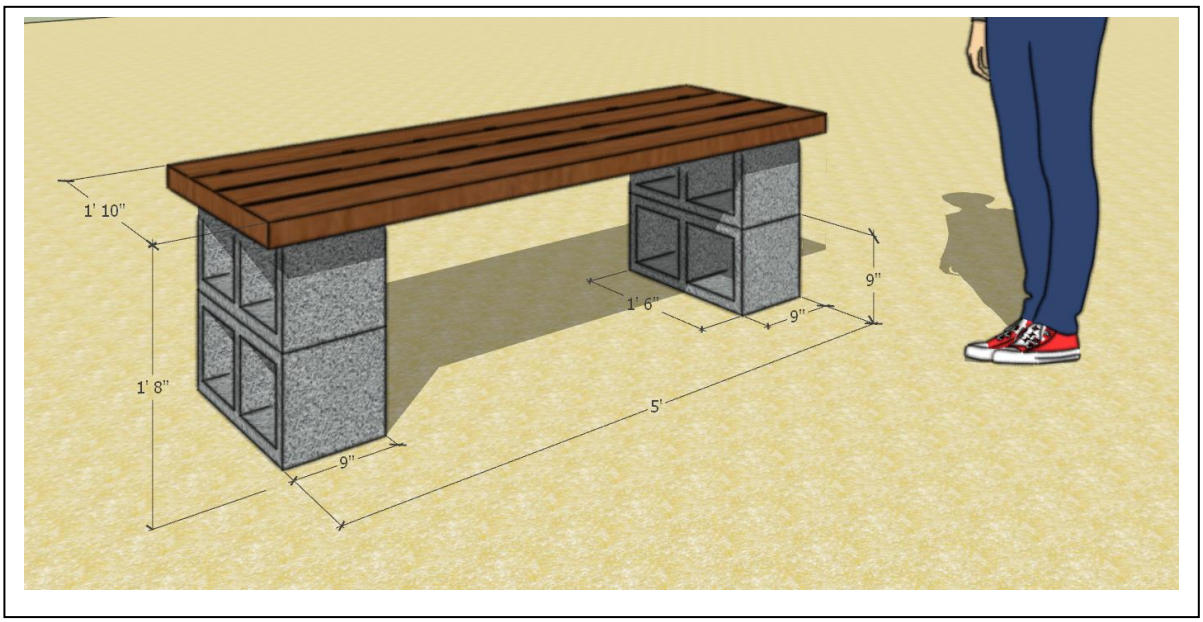

Figure 2 Concrete Brick platform concept

2.3 *Foldable wall bracket racks*

In typical India Household, documents, clothes and other articles are stuffed in suitcases and they are place below the cots due to space constrains. When flood water enters the home, it wets and damages the contents in the suitcases. As mentioned in the

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report ((NDMA), 2015) many people reported loss of their identity documents (Aadhar card, Passport, Voters ID etc.) and other property documents during the floods.

Wall mounted foldable brackets are available in the market and they can be nailed into the wall at ventilator level. During floods, the foldable brackets can be opened and suitcases can be placed on the brackets. For heavier loads, steel brackets and wooden pallets can be used to make a make shift loft. Racks which are 5 feet above floor level can be used to store emergency food supplies, bottled drinking water, medicines and with a camp stove can work as a make shift kitchen platform to heat ready to eat food, boil water, milk and make hot beverages.

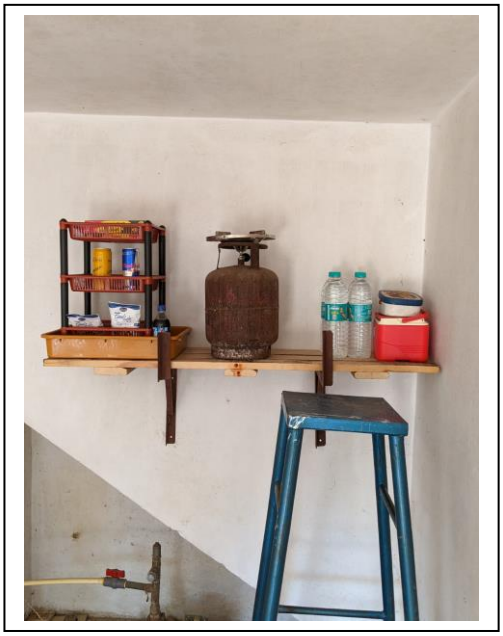

Figure 3 Wall Bracket Rack

2.4 *Stackable Drum/Barrel storage*

Plastic oil /chemical barrels(200 Litres capacity) are extensively used in the industry and are cheaply available with local scrap dealers(Around Rs.750/). Households use these were storing water. During floods, these barrels with top cover open can be moved into the house. Groceries, clothes, bed sheets, mattresses can be stuffed and stacked in one corner for safe storage during floods. Top lid of the barrels can be cut and removed and can be used as lid. All household articles which are prone to damage due to floods can be pushed into these water proof barrels and can be stacked. A suitable wall bracket with a U-hook anchor and a nylon rope can be used to anchor the barrels so that they do not drift in flood waters.

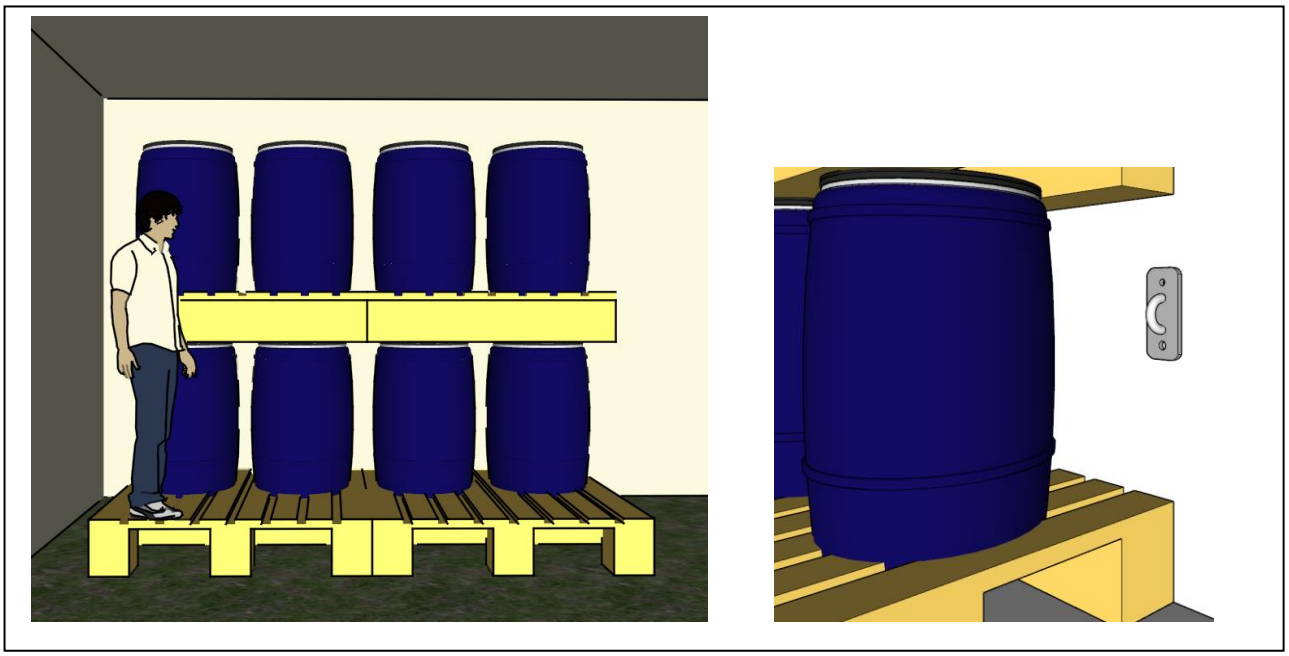

Figure 4 Stackable Barrels to store groceries and other perishables

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2.5 *Kitchen platform and storage shelves*

Lower kitchen platforms can be built with cement and concrete slabs with PVC shutters/doors which are water proof.

Figure 5 Kitchen platform and bottom storage with PVC shutters

2.6 *Flood drainage points at 5 feet and 8 feet level*

At strategic flood prone points flood drain pipes with non-return valve have to be installed. A diesel operated pump can be taken on rent to drain the water through these drain pipes.

Figure 6 Diesel Based Water Pump (Taizhou Wokun Machinery Co., 2017)

2.7 *Non return valves in drainage exits*

During floods, sewerage system gets flooded and drainage water enters home with the risk of pathogenic bacteria. All exit pipes, non-return valves have to be installed to stop the water entering home.

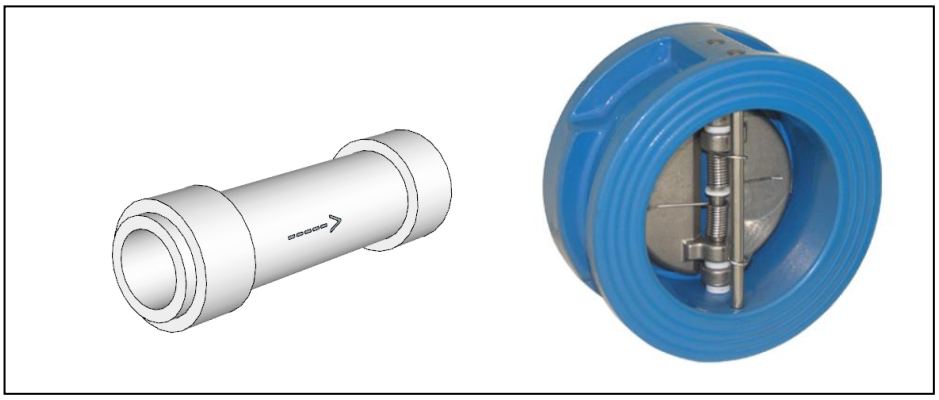

Figure 7 Non-Return valves to block water (Systems, 2017)

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2.8 *Portable toilet*

Toilet and bath areas built on an elevated one feet fight platform can be operational under moderate flood situation. During severe floods, sanitation and hygiene are difficult to maintain because toilet facilities become flooded and unusable, causing severe difficulties for inmates in the house. Portable camping toilet can be used as an alternative, they are inexpensive and readily available in the market. The same can be placed on elevated makeshift cement brick platform during floods. Alternatively, if vacant place is available, a make shift septic tank using a barrel can be installed along with a toilet on elevated platform for use during floods (How to Construct a Small Septic System, 2022).

Figure 8 Portable camping Toilet and an Image showing elevated Toilet area

3 SUMMARY OF EXPERIMENTAL RESULTS AND PROTOTYPES

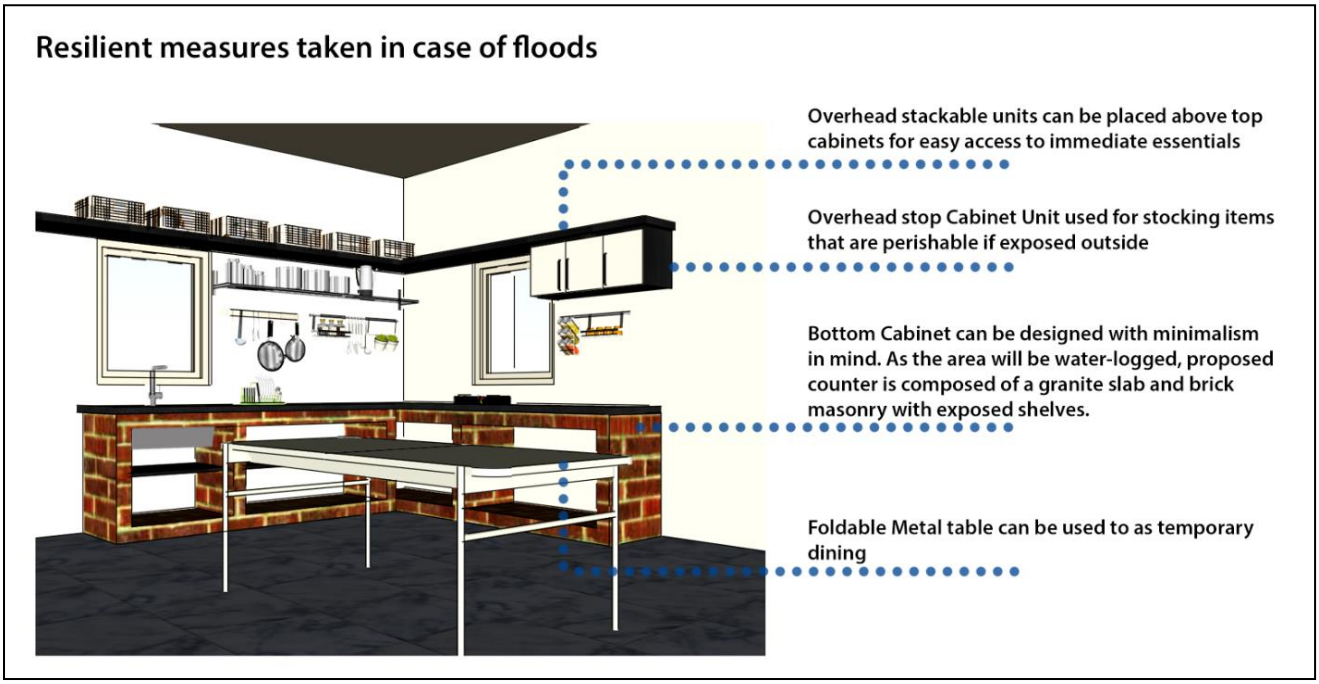

Figure 9 Flood Resilient Design Concept - Proposing a minimalist Kitchen with raised platform and exposed bottom storage

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Figure 10 Design concept for raised racks using wooden stools

4 CONCLUSION

Global warming and climate change are here to stay. Extreme weather conditions like cloud bursts and severe rains are causing floods. Rapid urbanisation and lack of infrastructure is compounding the problem. Economic loss and impact of floods is severe on low- income households. This paper has proposed minimalist and low-cost design approach to encourage lower income families to spend little and mitigate the risk of flooding and minimize the economic loss. Detailed sketches and prototype images are presented so that with locally available material and local carpenters and plumbers the components can be built and installed.

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