PLANNING FOR CYCLONE RESILIENT CITY – A CASE STUDY OF PARADEEP PORT CITY

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ABSTRACT

India have a coast line of 7516 km, which is one of the worst affected regions in the world in terms of tropical cyclones (NCRMP). Out of total tropical cyclones which formed in Indian coast, 80% formed in the Bay of Bengal and rest in Arabian Sea (O.P.Singh, 2007). Ports constitutes an important economic activity in coastal area and contributes about 2% of India's GDP (Economictimes, 2015). Port always supports a city and Port city infrastructures are most vulnerable to cyclones. Due to climate change ocean surface temperature is rising leading to increase in occurrence of cyclones. So need of resilient infrastructure which can support port & urban infrastructures for economic, social and environmental co-benefits. The research will focus on critical infrastructure and services of Port city and its significance. Also analysis of impact of cyclones on Port city infrastructures and existing planning practices for cyclone resilient infrastructure.

Keyword : - *Tropical Cyclone, Resilient Infrastructure, Port, Port City, Urban Infrastructure, Port Infrastructure*

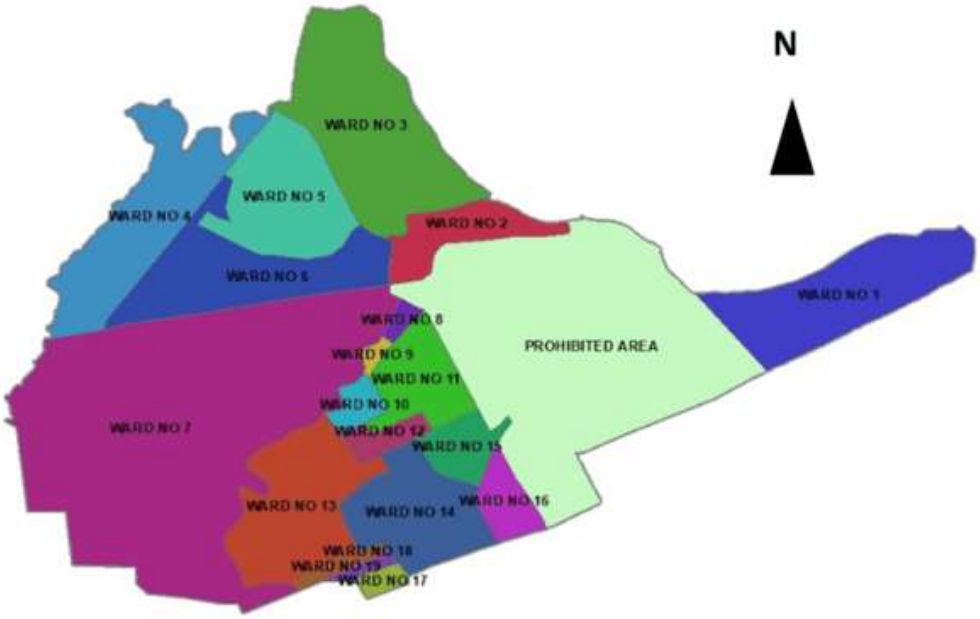
1. IMPACT OF CYCLONE IN ODISHA

1999 Super cyclone - It was the strongest cyclone ever recorded in the region, 10,000 killed, extreme damage reported across coast.
Phailin 2013 - Extremely severe cyclonic storm, it was second strongest tropical cyclone ever to make landfall in India. More than 5,50,000 people had to be evacuated in Odisha and Andhra Pradesh, 30 killed toll was low due to mass evacuation.
Hudhud 2014 - Extremely severe cyclonic storm, made landfall near Visakhapatnam and then passed through interior of Odisha.
Titli 2018 - Very severe cyclonic storm Titli made landfall in Andhra Pradesh but then changed course to wreak damage in interior districts of Odisha, 77 killed.
Fani 2019 - Extremely severe cyclonic storm Fani made landfall in Puri, Odisha the strong wind of more than 200 km/h has caused extensive damage to the infrastructure, people's assets and vegetation with a total death toll of 64 people.
Amphan 2020 - Super Cyclonic Storm Amphan made landfall in West Bengal affected Bengal and northern Odisha, destroyed 500 homes and killed 4people in Odisha.

2. PARADEEP CITY PROFILE

Latitude: 20.16°N
Longitude: 86.40°E

Area of city: 105 km2
Area of municipality: 47.4 Sq.km
Total population: 81,449
Population density: 650/km2
Sex ratio: 839 female/1000 men
Length of road under Municipality: 156.40 km
No. of wards: 19
No. of household: 20884
Female population: 37285
Male population: 44164



Map -1: Paradeep ward map

Major cyclone hitting Paradeep is in the year 1969, 1999 (Super Cyclone), 2013 (Phailin), 2019 (Fani), 2020 (Amphan) the whole city is vulnerable to cyclone but in 2020 along with destruction of cyclone Amphan paradeep also had to deal with covid-19 pandemic

3. CYCLONE AMPHAN

- Amphan made a landfall in west Bengal at a speed of 240 kmph affected Bengal and northern Odisha.
- 4 people died in Odisha
- At least 500 homes were destroyed, 15000 were damaged
- 4.4 million people were affected in some way by the cyclone .
- 4000 livestock died

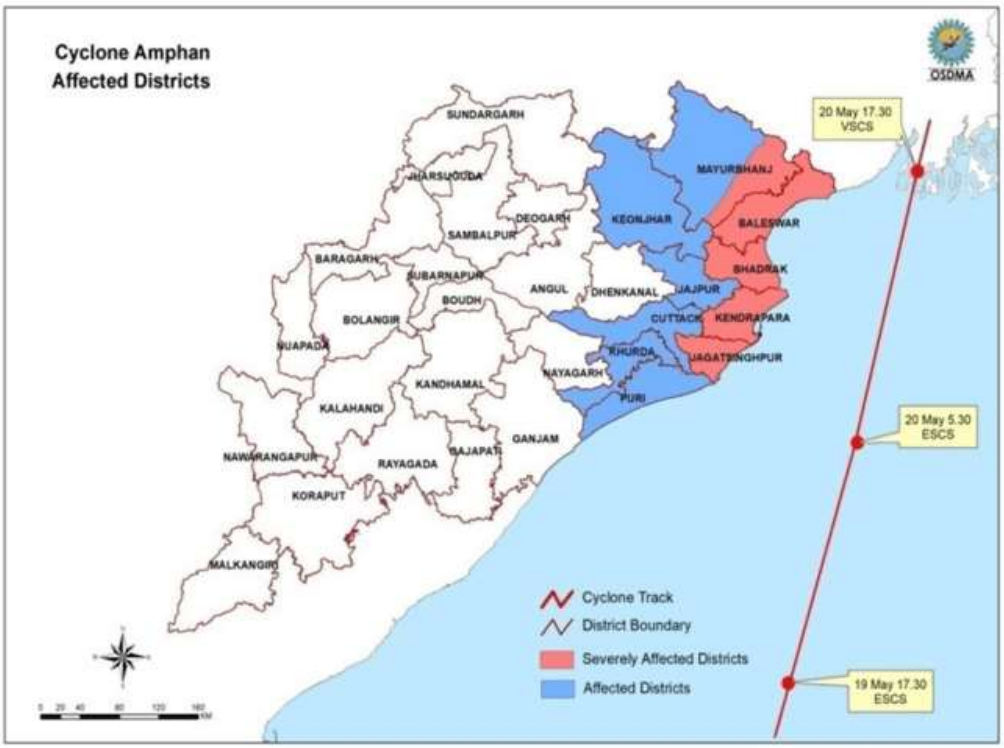


Fig -1: Cyclone Amphan affected districts of Odisha

4. EFFECTS OF CYCLONE AMPHAN

SECTORS DAMAGED

- SOCIAL SECTOR – Housing, land and settlements, education and child protection, health nutrition and food security
- PRODUCTIVE SECTOR – Agriculture, fisheries and livestock
- INFRASTRUCTURE SECTOR – Power, telecommunication, roads, water resources, hygiene, public building
- CROSS CUTTING – Employment, gender and social inclusion, environment, etc.

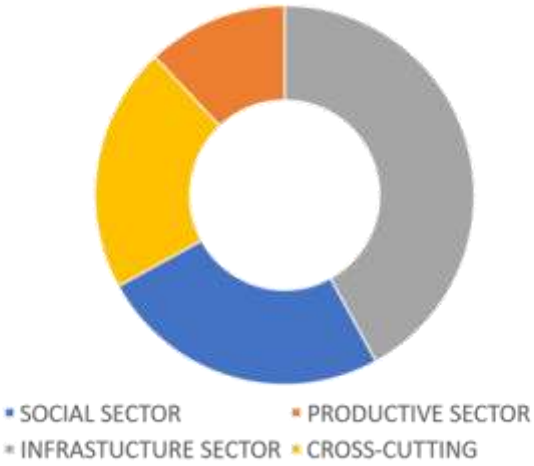


Chart -1: Damage across different sectors

4.1. HOUSING

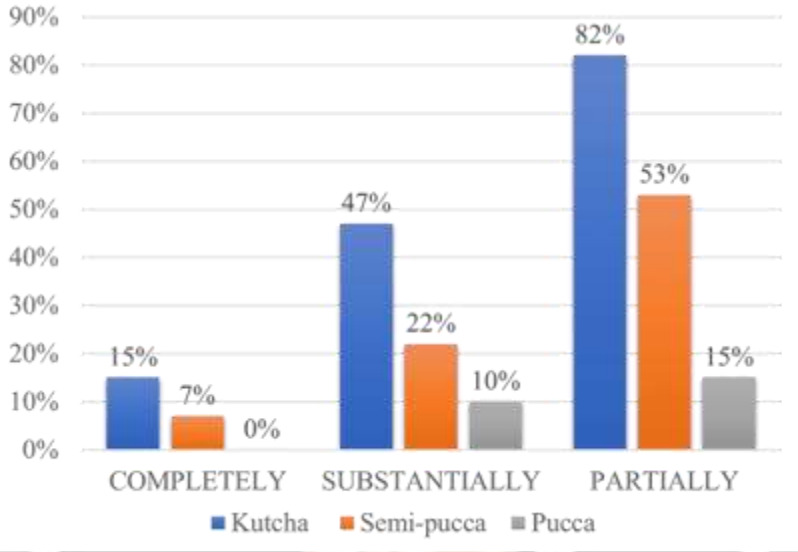


Chart -2: Damage to housing

The pucca buildings generally withstood the high wind load, so pucca buildings were partially damaged while more no. of kutcha house was destroyed as compared to pucca house.

Families whose houses have been damaged have been provided with polythene sheets for temporary shelter @ Rs.1600/- per family.

392 families whose houses (fully/ severely) and hut have been damaged are to be provided with clothing and utensils as per the SDRF Norms.

4.2. POWER

The power network in Odisha is classified into 4 categories – 400kv network, 33kv network, 11kv network, 415 v network, low tension network.

Power was restored in five days in all affected areas.

No. of 33KV poles damaged	60
Length of 33KV conductor damaged (in km)	32
No. of 11KV poles damaged	280
Length of 11KV conductor damaged (in KM)	68
No. of DTs damaged	27
No. of LT line poles damaged	831
Length of LT line conductor damaged (in km)	131

4.3. ROAD

Length of drain damaged	12.6
Road length affected in km	38.62

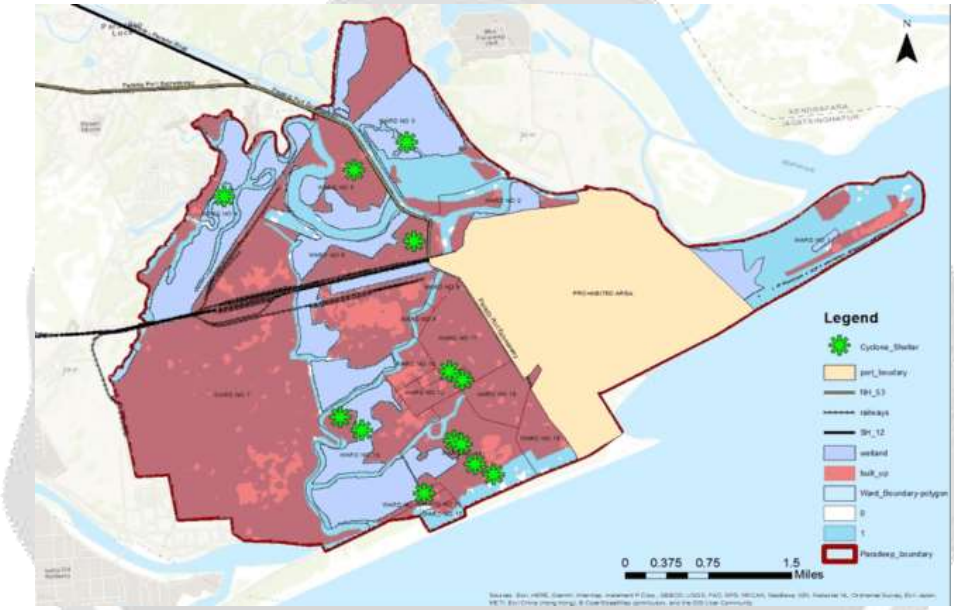
The damage includes:

- Damage to carriageways, footpaths and drains
- Damage to culverts
- Uprooting and dislodging of gantries and traffic signs

4.4. WATER RESOURCES

NO. OF WATER TREATMENT PLANTS AFFECTED	1
NO. OF HOUSE CONNECTION DAMAGED	182
NO. OF HANDPUMPS AFFECTED	52

4.5. EXISTING CYCLONE CENTERS AND GAP ANALYSIS

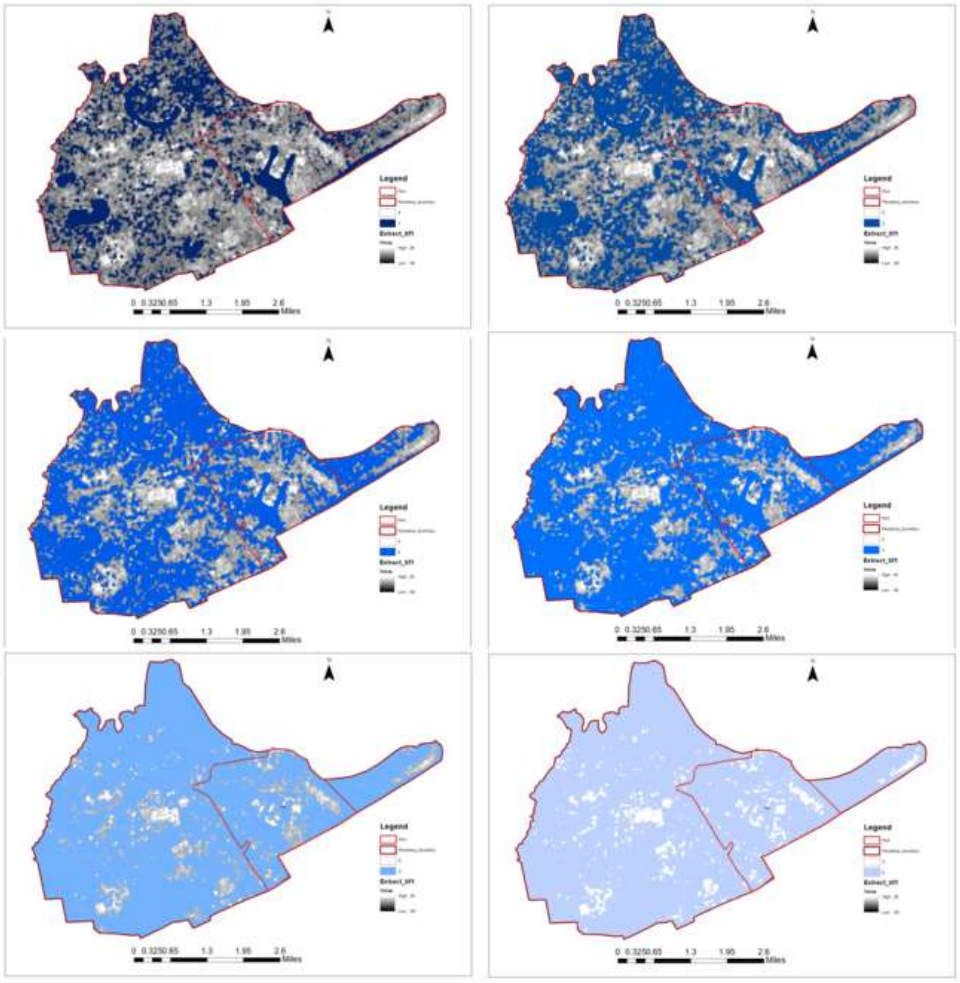


Map -2: Cyclone centers in paradeep municipality

SL. NO.	NAME OF CYCLONE SHELTER	CARPET FLOOR AREA	CAPACITY	STATUS	FIRST AID AVAILABILITY
1	PORT TRUST H.S	2500	1350	OPERATIONAL	NO
2	NAC MUNICIPAL H.S	3000	1500	OPERATIONAL	YES
3	MAA AMBIKA H.S	2300	1200	OPERATIONAL	NO
4	CHAKRADHARPUR H.S	2350	1200	OPERATIONAL	NO
5	PARICHHAL H.S	2150	1150	OPERATIONAL	YES
6	NAC GIRLS H.S	2500	1350	OPERATIONAL	YES
7	PATITAPABAN H.S	2000	1050	OPERATIONAL	YES
8	GOJABANDHA H.S	2300	1200	OPERATIONAL	NO
9	SANJAY GANDHI VIDYA PITHA	2500	1300	OPERATIONAL	NO
10	GOBINDRA CHANDRA H.S	2300	1200	OPERATIONAL	NO
11	PARESWARA GOVT. GIRLS H.S	2100	1100	OPERATIONAL	YES

According to capacity assessment of cyclone shelter taken by NIDM, indicates that on an average about 50% to 60% of total population of vulnerable location may be using the cyclone shelter during emergencies.
Presently in Paradeep municipality, approximate 60% of vulnerable population can have access to cyclone shelter during disturbances i.e. only 11 cyclone shelter which is not sufficient.
To accommodate remaining 30% to 40% of vulnerable population 8 more cyclone shelters are required.

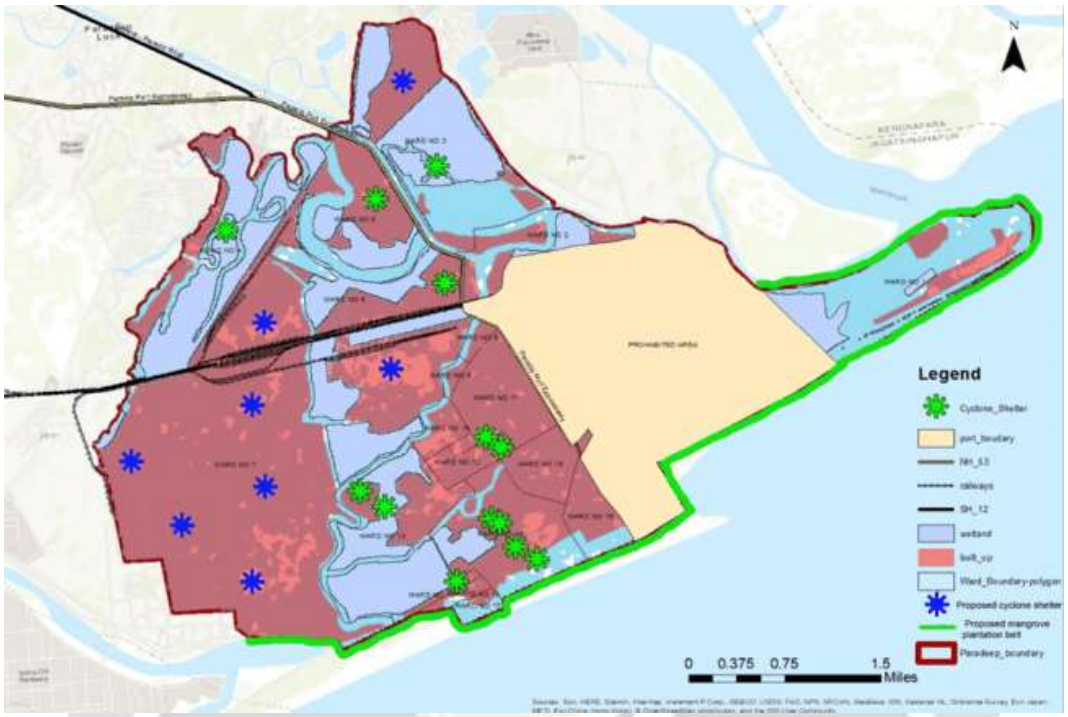
4.6. EXISTING CYCLONE CENTERS AND GAP ANALYSIS



Map -3: Vulnerability map of paradeep municipality

The maps showing level of water rising from 1m to 6m, as the level of water rises we can see the most vulnerable areas of paradeep municipality.

5. CONCLUSIONS (PROPOSALS & RECOMMENDATIONS)



Map -4: Proposed MCS and mangrove plantation belt

SL. NO.	NAME OF CYCLONE SHELTER	CARPET FLOOR AREA	CAPACITY
1	BALI H.S	2300	1200
2	SUKHA LATA H.S	2500	1350
3	GOPINATH H.S	2400	1250
4	SANTOSHI VIDYA MANDIR	3000	1500
5	SARASWATI VIDYA MANDIR	4000	2000
6	M.S GIRLS H.S	2100	1100
7	KRUPESWAR H.S	2500	1350
8	BHAGABATI H.S	3000	1500

- The cyclone shelters proposed for population within 10km from coastal areas.
- They are also sustainable, have good capacity and have separate toilets, proper water supply, etc.
- The mangroves plantation line is also proposed which helps to reduce the impact of cyclonic winds.
- These shelters can also be used as quarantine shelters for people during pandemic.

5.1. TRADITIONAL METHOD OF CYCLONE MITIGATION

Building homes on a raised platform

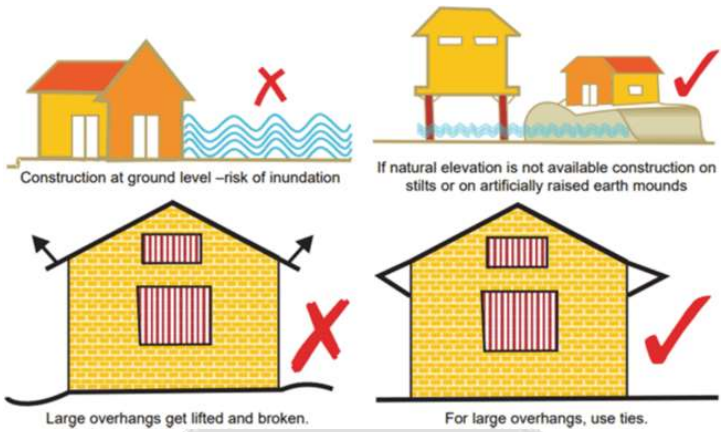


Fig -2: construction on slits or artificial raised earth mounds

Providing protection windbreak through trees such as coconut, mangrove plantation

Fig -3: windbreak through mangroves and coconut plantation

Shielding of house by hillock and strong trees

Fig -4: Natural shielding through hillock and trees

5.2. STRUCTURAL CONSTRUCTION OF HOUSES

Provide stability to the complete building under lateral loads

Fixing of walls to the foundation using tie-down bolt

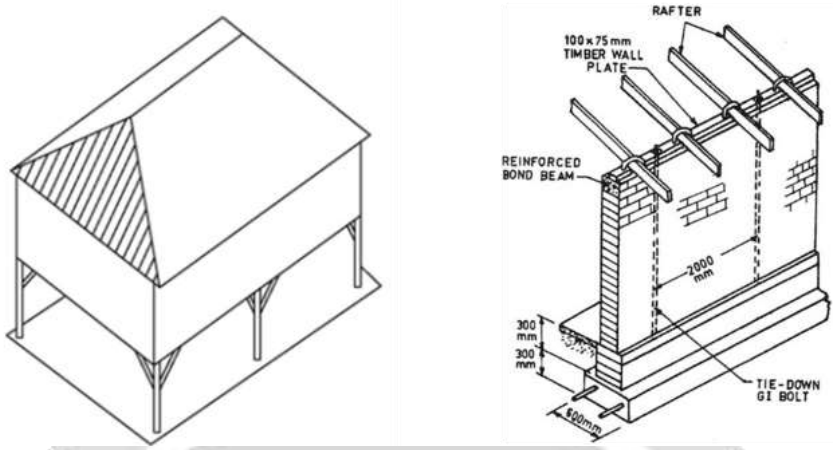


Fig -5: Stilt construction for better stability & fixing of walls to the foundation

Hip roofs are used to lessen the effect of the uplifting forces on the roof

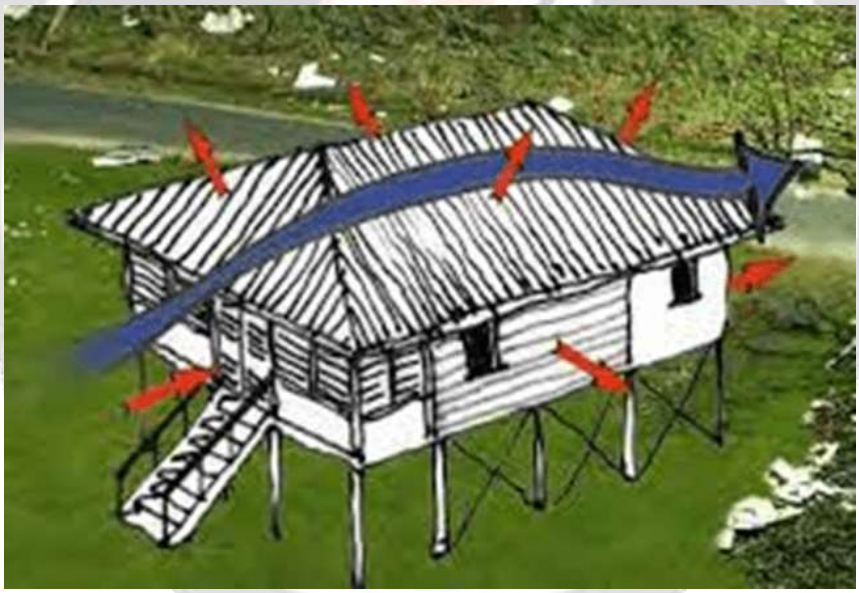


Fig -5: hip roof best preferred for cyclonic areas

Adequate anchorage of doors and windows to uplift pressures under roof

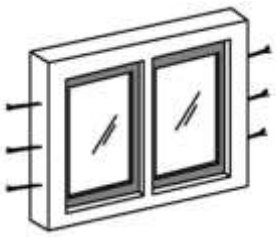


Fig -6: adequate anchorage of door and window frames