



Physics Behind the Houses in Odisha

CBSE Art Integration Physics Project

Krishnaraj PT &

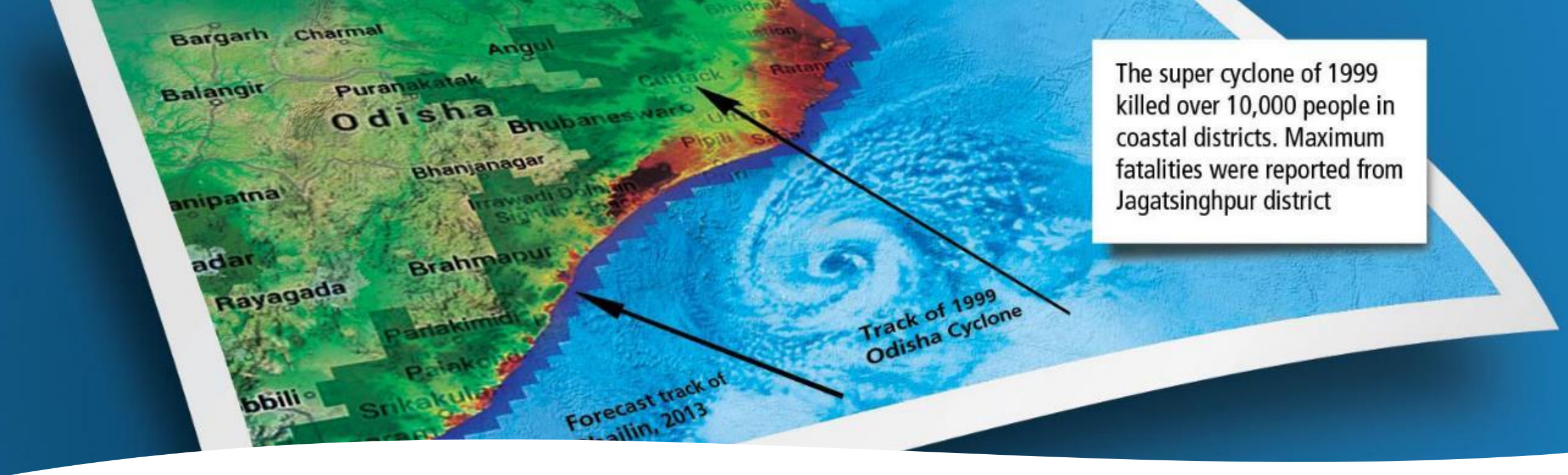
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Class 12 A



1

Factors Behind Construction of Houses



A. Geography

- The geography of a place is an essential factor in architecture. It's where architects can base their design elements.
- Some of the things that should be thought of when it comes to geography are the topography or the location of the place, they wish to construct a building on.
- This is one of the first things that surveyors do, which is to evaluate a location first before building.

B. Climate

- Climate is all about the weather conditions of a place. With this, architects have the choice of making designs that are tough if the weather conditions of the location are harsh.
- On the other hand, a different design is made if the location is sunnier than usual.

C. Religion and Culture

Buddhist Family House, Himalayas



- Religion is usually not a specific requirements of clients, but there are locations where religion is a big deal to the community such that constructing a building that may seem offensive is not a good idea for the sales of the building.
- Culture is another determining factor in designing a building.
- Architects need to bend their design aesthetic and talk to their clients on how they can make the building follow those requirements.
- For example, if the client is of Chinese descent, the owners may want to build according to Feng Shui beliefs.



D. Technology

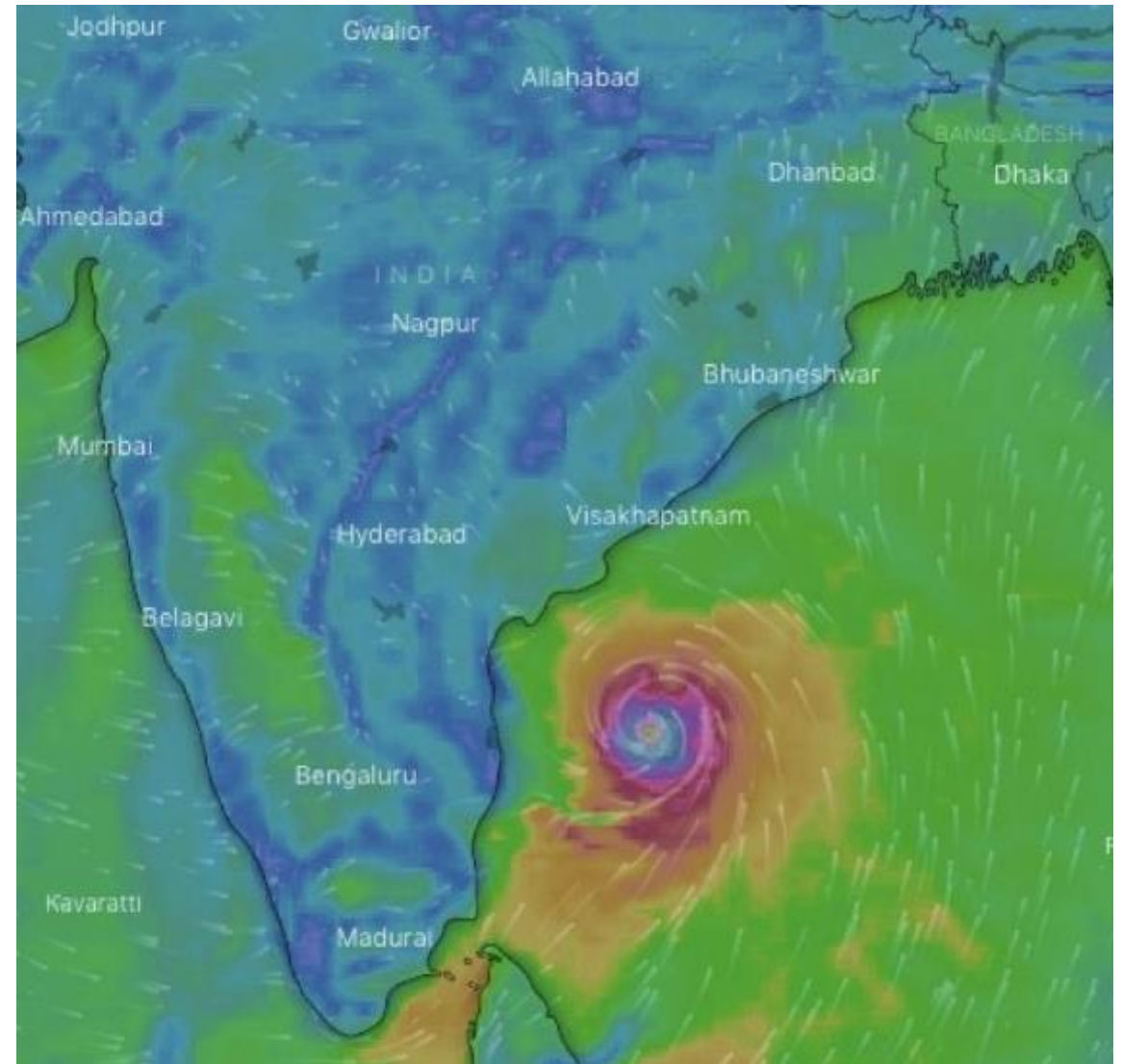
- Technology has paved the way for many buildings and establishments to be fully-functional.
- Having a building automation system is one obvious sign that technology helped in making structures systematized and functioning to their full capacity.
- Additionally, technology makes it easier for everyone coming in the building or the ones using it to access areas or feel comfortable.

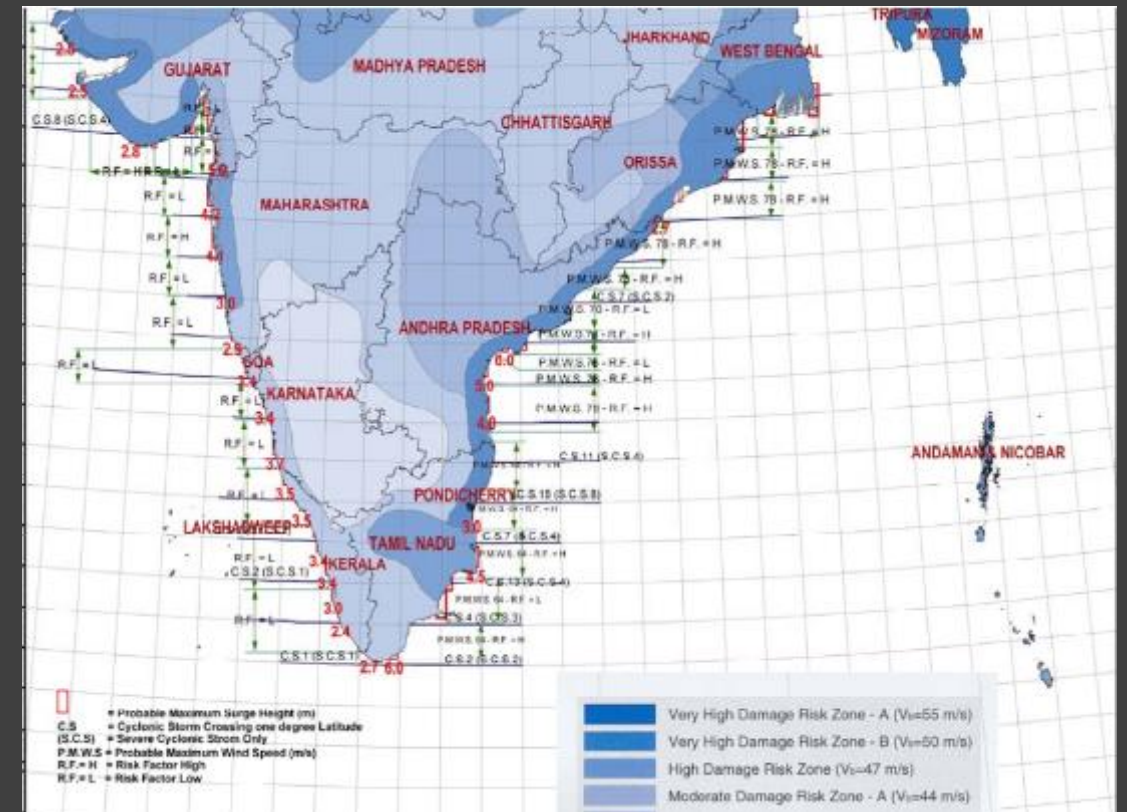
2. Why Odisha needs Special buildings



A. Geography

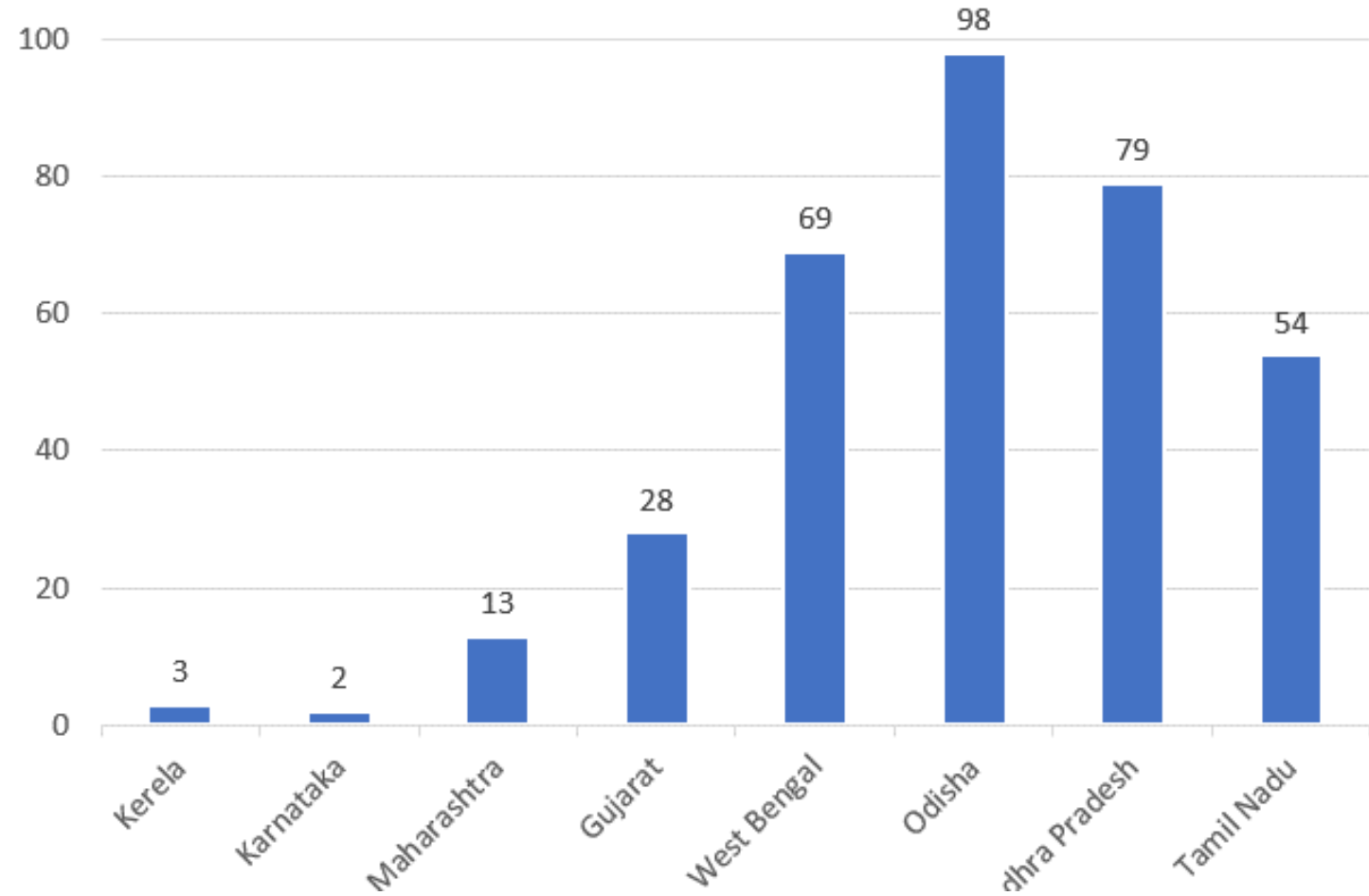
- Geographically, the landmass between Puri to Bhadrak in the map of Odisha juts out a little into the sea, making it vulnerable to any cyclonic activity in the Bay of Bengal.





B. High Risk of Natural Calamities

C. Odisha
has the
Highest
number of
Cyclones in
India





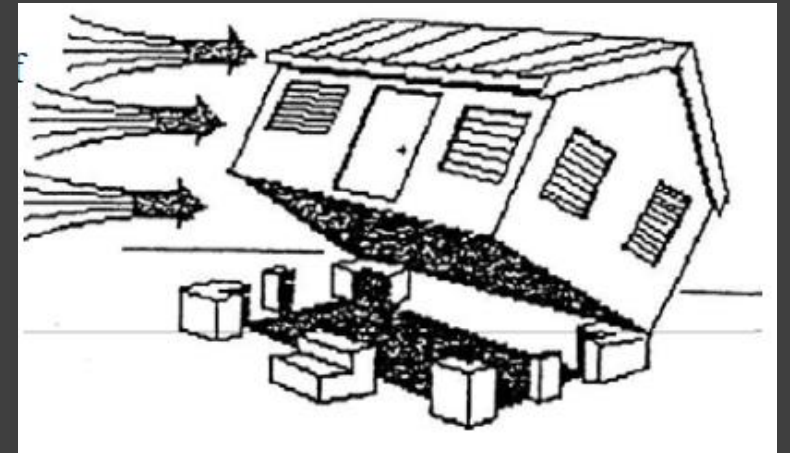
3. Why Special Construction is required for Cyclone prone regions

A. Damage incurred by high winds

- Contrary to popular belief, few houses are blown over. Instead, they are pulled apart by winds moving swiftly around and over the building. This lowers the pressure on the outside and creates suction on the walls and roof, effectively causing the equivalent of an explosion.
- Whether or not a building will be able to resist the effects of wind is dependent not so much upon the materials that are used but the way they are used. It is a common belief that heavier buildings, such as those made of concrete block, are safer.
- While it is true that a well-built and properly-engineered masonry house offers a better margin of safety than other types of buildings, safe housing can be and has been provided by a variety of other materials including wood and many others



Loss of corrugated, metal, roof sheets

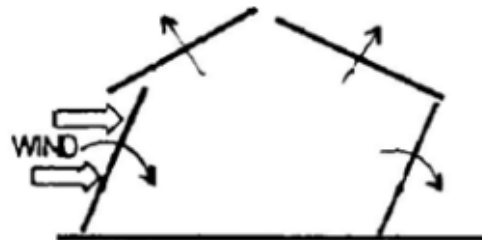


B. Impact of High winds on Structure

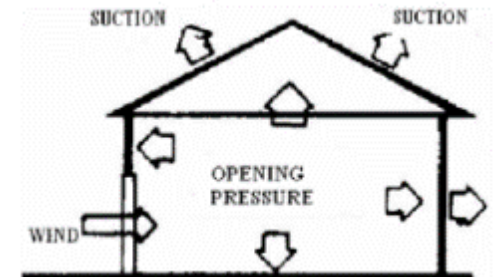
- Due to the high wind pressure and improper connection of the house to the footings it can be blown away.
- Roofing materials not anchored can be blown away
- Wind generating opening on the windward side during a cyclone will increase the pressure on the internal surfaces.
- This pressure, in combination with the external suction, may be sufficient to cause the roof to blow off and the walls to explode.
- If the building is not securely tied to its foundations, and the walls cannot resist push/pull forces the house tends to collapse starting the roof with the building leaning in the direction of the wind.



Windward face of the building collapses under pressure of wind force



Collapse start at the roof building leaning in the wind direction





C. Vulnerable Communities and human settlement

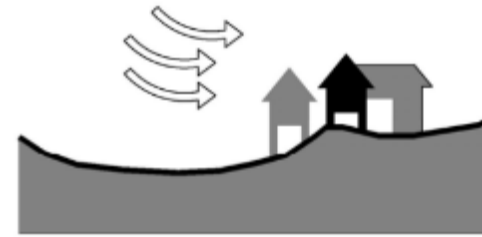
- The vulnerability of a human settlement to a cyclone is determined by its siting, the probability that a cyclone will occur, and the degree to which its structures can be damaged by it.
- Buildings are considered vulnerable if they cannot withstand the forces of high winds. Generally those most vulnerable to cyclones are lightweight structures with wood frames, especially older buildings where wood has deteriorated and weakened the walls. Houses made of unreinforced or poorly-constructed concrete block are also vulnerable.
- Urban and rural communities on low islands or in unprotected, low-lying coastal areas or river floodplains are considered vulnerable to cyclones.
- Furthermore, the degree of exposure of land and buildings will affect the velocity of the cyclone wind at ground level, with open country, seashore areas and rolling plains being the most vulnerable. Certain settlement patterns may create a "funnel effect" that increases the wind speed between buildings, leading to even greater damage.

A dark gray background featuring a faint, technical drawing of a mechanical part, possibly a piston or a valve, with various circular and rectangular features and lines.

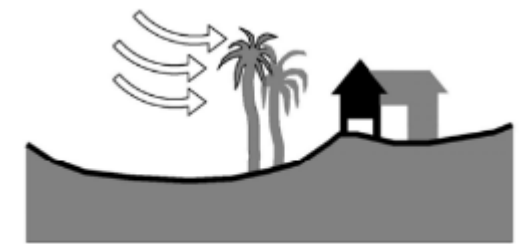
4. Precautions to take while construction of houses in Calamity Prone Areas

Natural Shielding

- Though cyclonic storms always approach from the direction of the sea towards the coast, the wind velocity and direction relative to a building remain random due to the rotating motion of the high velocity winds.
- In non-cyclonic region where the predominant strong wind direction is well established, the area behind a mound or a hillock should be preferred to provide for natural shielding.
- Similarly a row of trees planted upwind will act as a shield. The influence of such a shield will be over a limited distance, only for 8 – 10 times the height of the trees.
- A tree broken close to the house may damage the house also hence distance of tree from the house may be kept 1.5 times the height of the tree.



No shielding from high wind due to absence of barriers



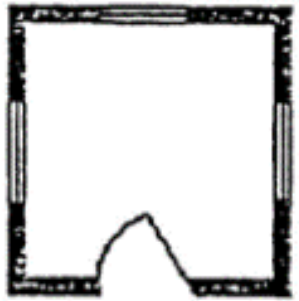
Shielding from high wind by permeable barriers such as strong trees



Shielding of house by hillock

Design of the House

- We do have control over the shape of new buildings and shape is the most important single factor in determining the performance of buildings in cyclones.
- Simple, compact, symmetrical shapes are best. The square plan is better than the rectangle since it allows high winds to go around them. The rectangle is better than the L-shaped plan.



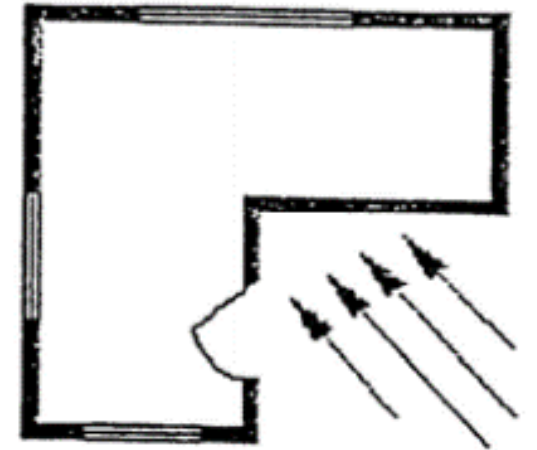
Square (Best)



Rectangle



Long Rectangle



L-Shape

Group of Buildings

In case of construction of group of buildings, a cluster arrangement can be followed in preference to row type, as it creates way for the wind, and the zig-zag type tries to avoid way for the wind.



Row planning creates wind

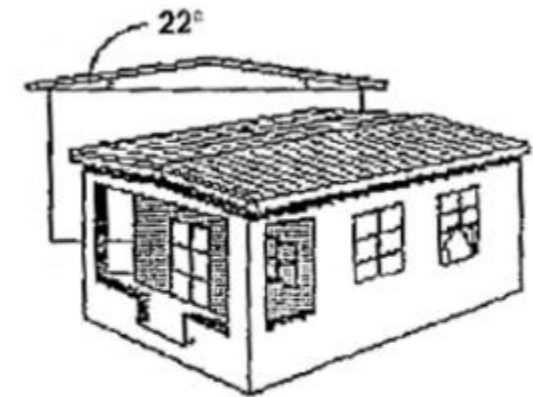
Zig-zag planning avoids wind

Roofs

- Lightweight flat roofs are easily blown off in high winds.
- In order to lessen the effect of the uplifting forces on the roof, the roof Pitch should not be less than 22° .
- Hip roofs are best, they have been found to be more cyclone resistant than gable roofs



Hip Roof



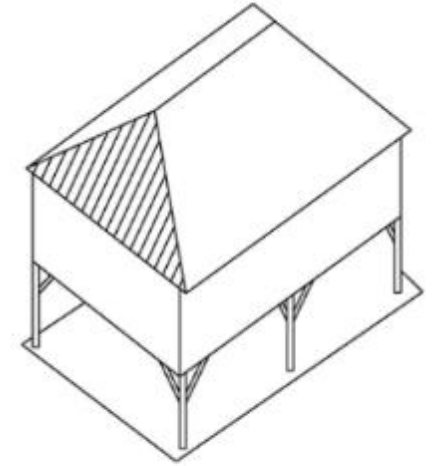
Flat Roof

Foundations

- The foundation is the part of the house which transfers the weight of the building to the ground. It is essential to construct a suitable foundation for a house as the stability of a building depends primarily on its foundation.
- Buildings usually have shallow foundation on stiff sandy soil and deep foundations in liquefiable or expansive clayey soils.
- It is desirable that information about soil type be obtained and estimates of safe bearing capacity made from the available records of past constructions in the area or by proper soil investigation



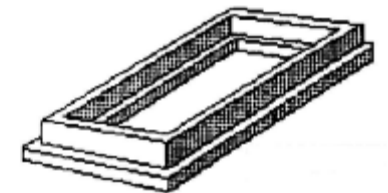
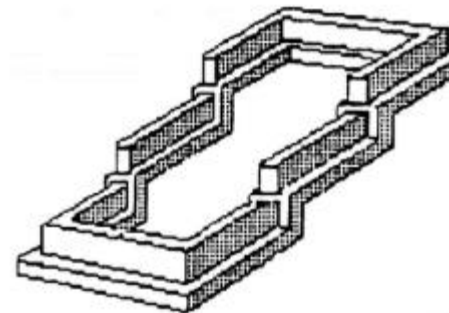
Foundation (too small for light weight building) pulled completely out of ground



Building on stilts

Strip Foundation

- Used for areas where the soil varies.
- Most common.
- Supports a wall.



Stepped Foundation

- Used on sloping ground.
- Is a form of strip foundation.



5.

Conclusion and Bibliography



Conclusion

- A lot of factors must be considered when constructing buildings and residential apartments.
- Odisha is special from other states as it has some of the best infrastructure of buildings that are resistant to its climate which is highly prone to natural calamities.
- In the past 50 years, Odisha received the highest number of Cyclones than any other state in India.
- Because of these Facts, Architects must thoroughly consider the phenomena that causes destruction of man-made property, and build designs that are resistant to such calamities, cost less, and last longer.

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