Green Building Features for Climate Resilient Buildings

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Presentation Outline

- Climate Vulnerabilities
- Climate Resilient Features for Built Environment
- GRIHA and resilience

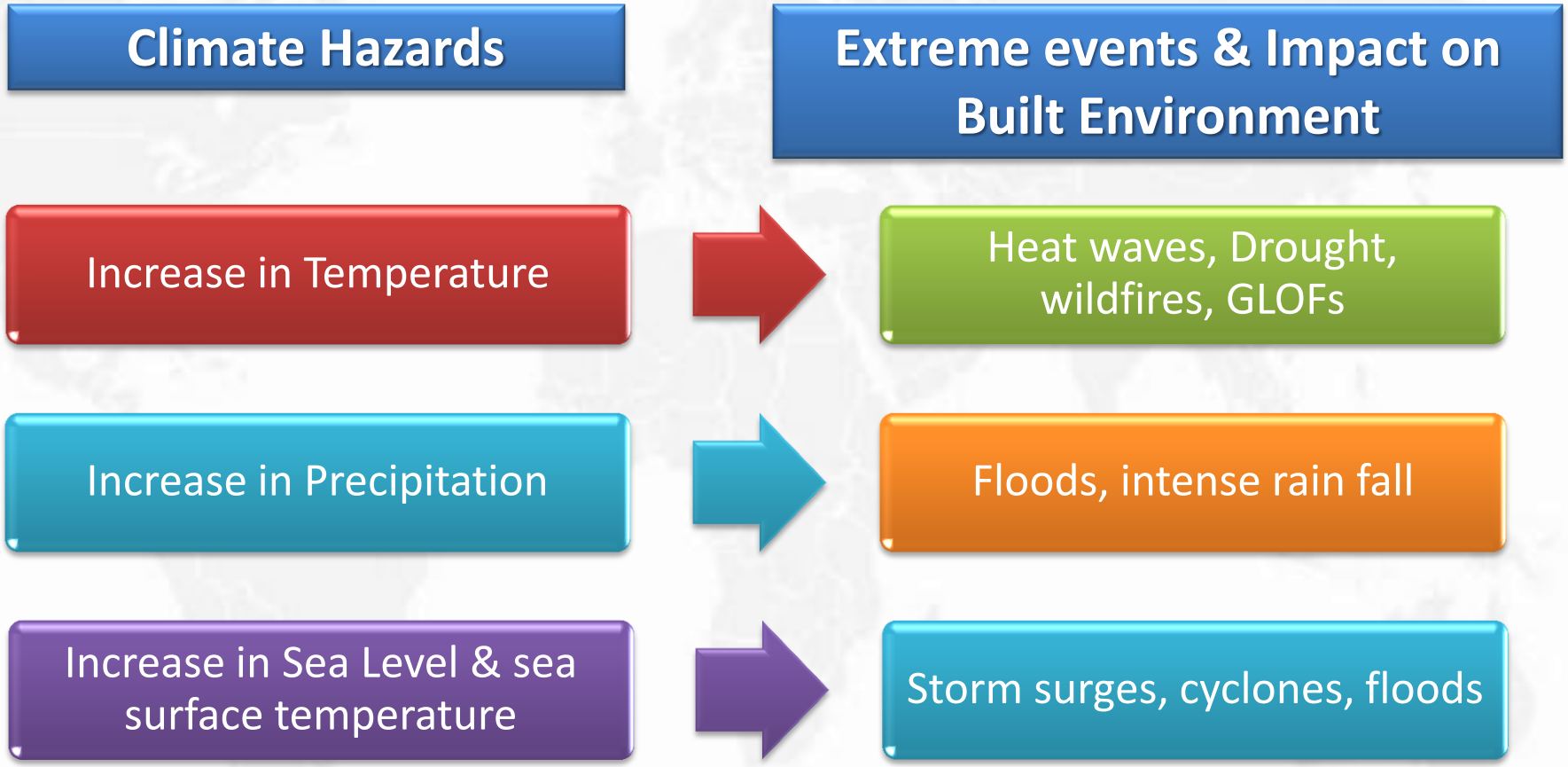
IPCC Climate Change 2014 Synthesis Report

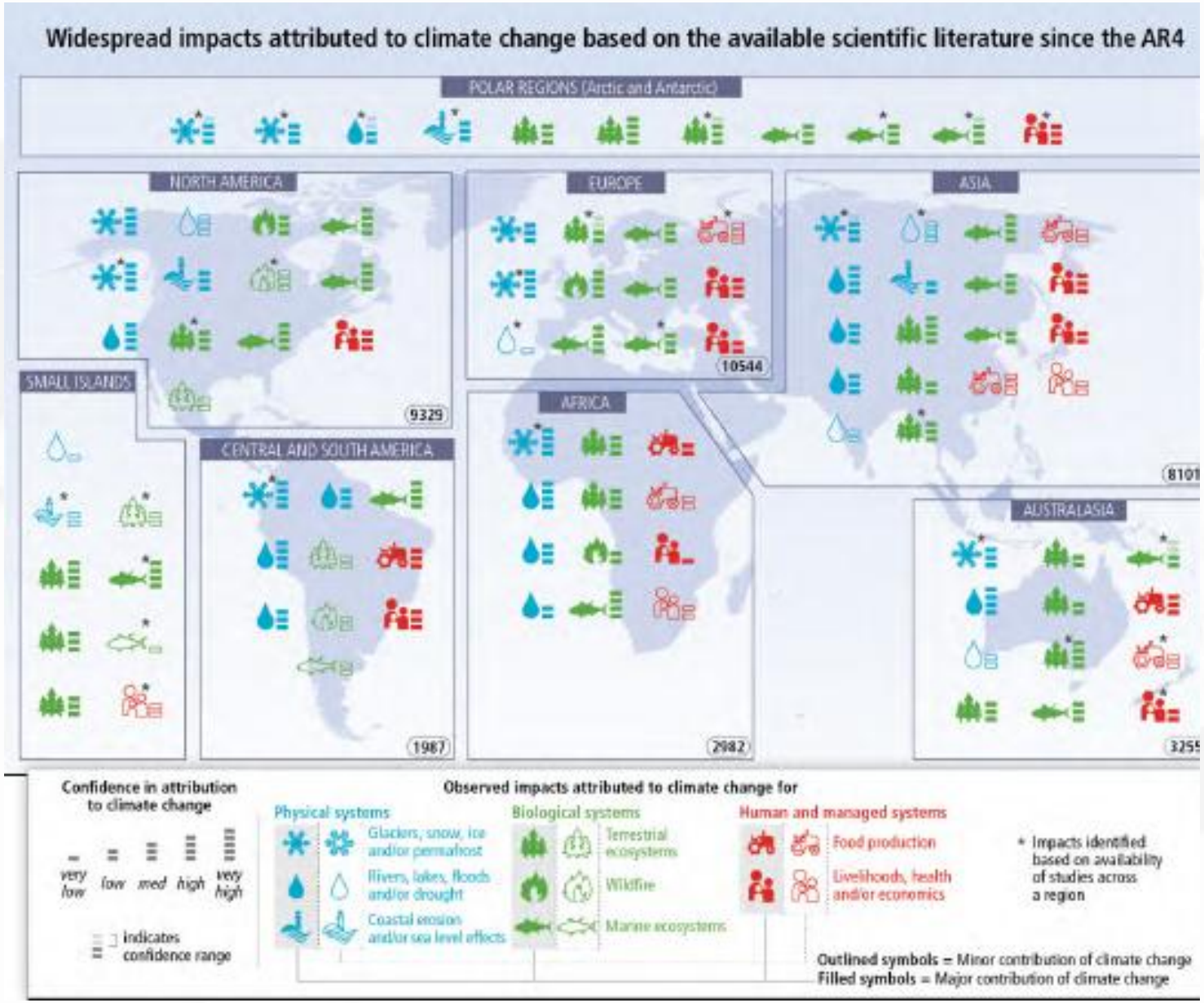
https://biocreativity.wordpress.com

Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including :

- Decrease in cold temperature extremes
- Increase in warm temperature extremes
- Increase in extreme high sea levels and
- Increase in the number of heavy precipitation events in a number of regions.

Impact of Climate Change on Built Environment





Source: IPCC Assessment Report 5

Coastal Systems and low lying areas

Coastal systems and low-lying areas are at risk from sea-level rise, which will continue for centuries even if the global mean temperature is stabilized.

Source: IPCC 5th Assessment Report

Defining Climate Resilient Housing

Climate Resilient Design Features make homes resilient to climate vulnerabilities, such that they maintain an acceptable level of functioning and structure.

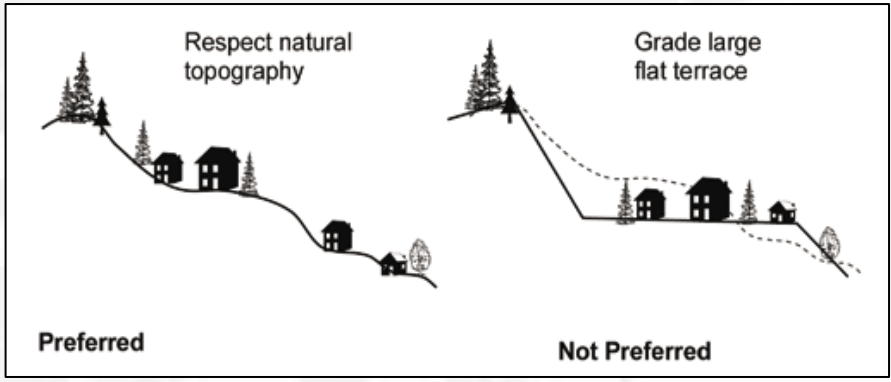
Uttarakhand: impacts of unrestrained urbanization

Design Features for Climate Resilient Affordable Housing

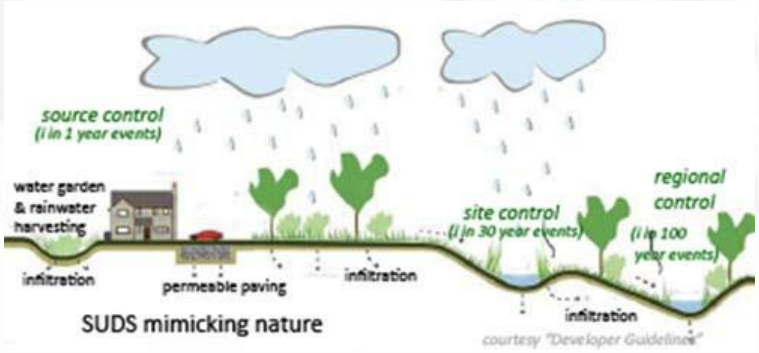
Floods, GLOFs, Landslides & Heavy Precipitation

For Settlement level

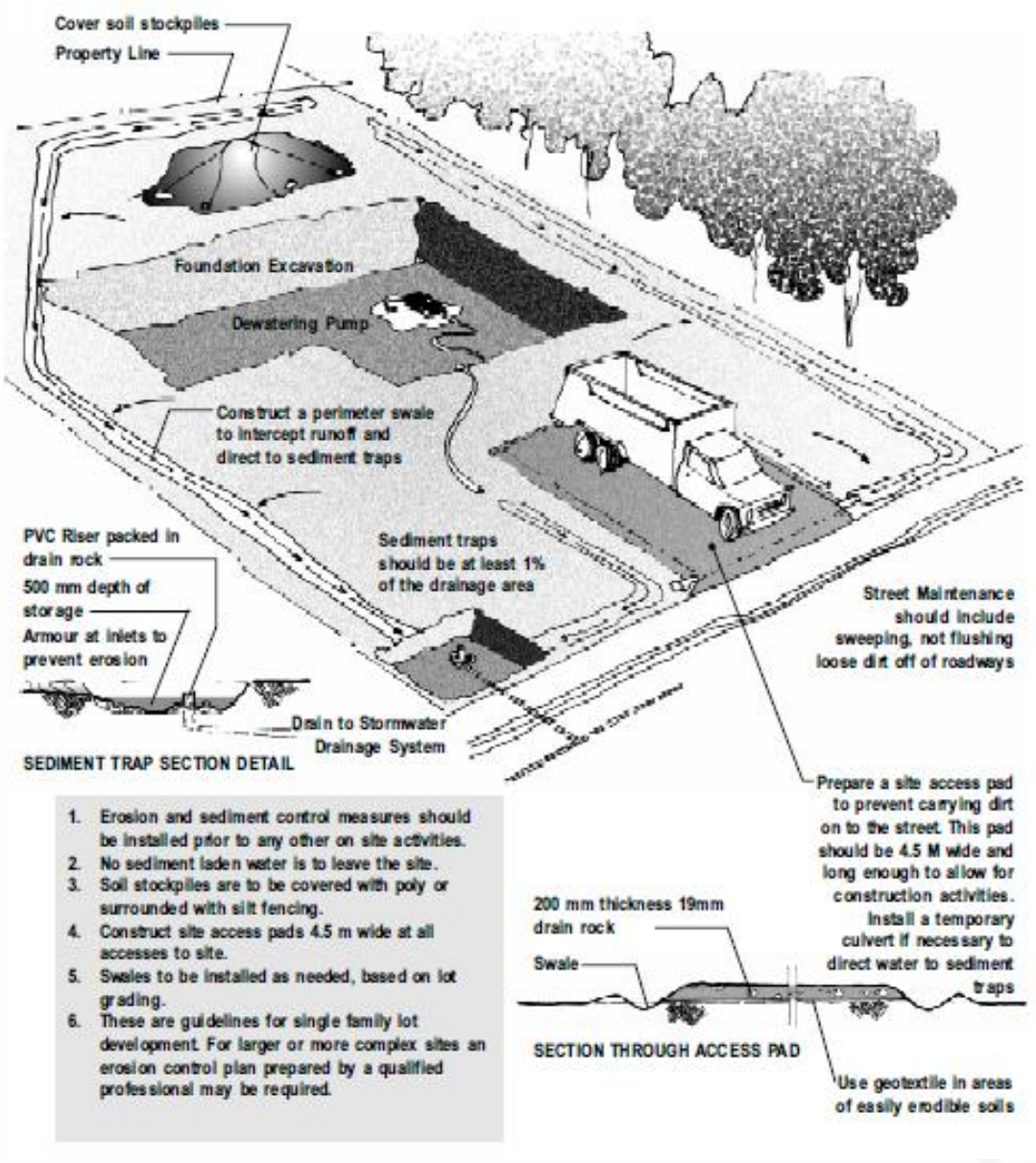
- Developments to adhere to natural site contours.
- Construction on natural drains to be avoided.
- Development to be planned in a manner to leave natural vegetation protected.
- Grading large flat terraces on hill side sites should not be allowed.
- Developments should integrate an effective storm water management system – infiltration trenches, retention ponds, downstream flood control measures.
- Reduce impervious paving
- Erosion and sedimentation control measures through swales, sedimentation pits, vegetation growth on exposed soils along with mulching.



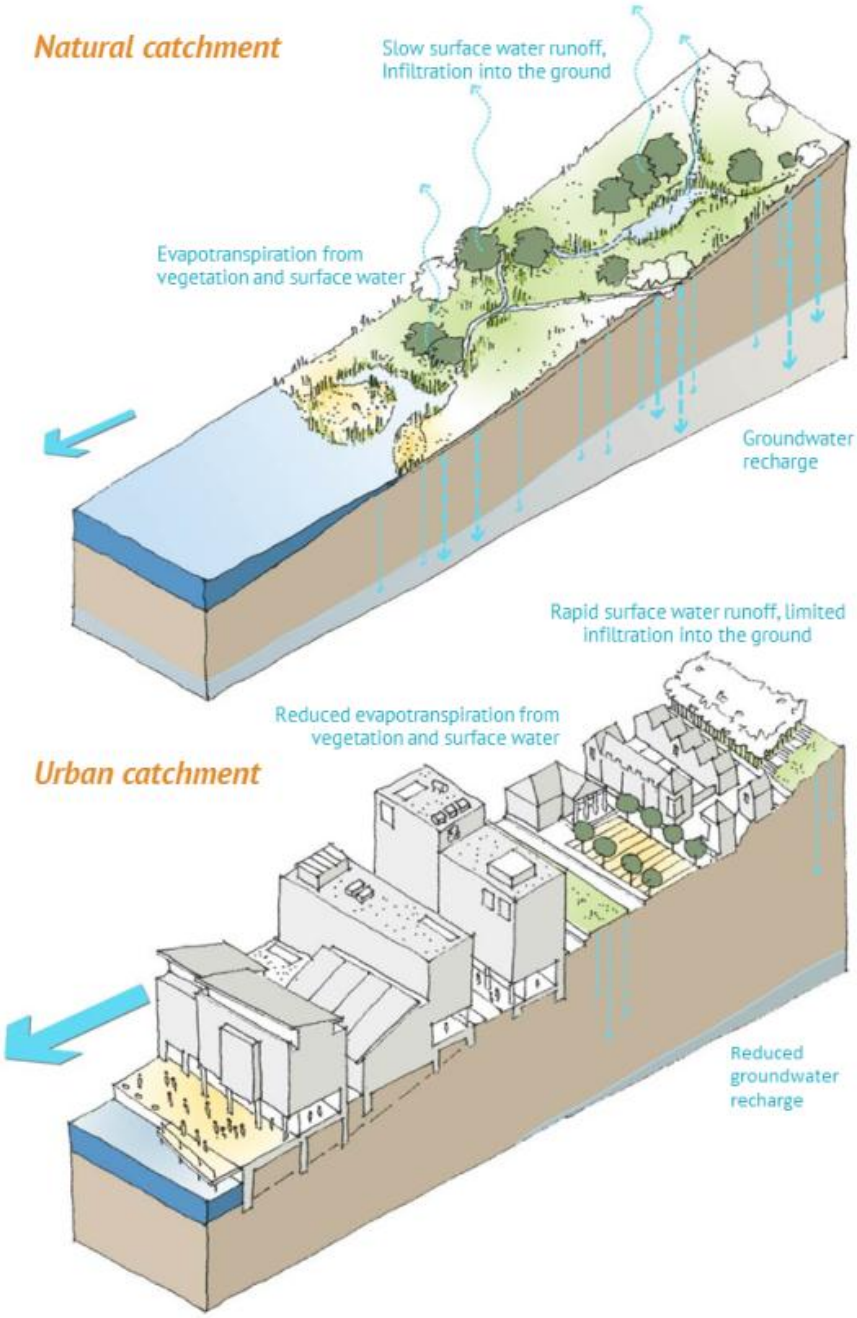
(Source: Steep Slope Development Guidelines, City of Nanaimo)



http://sd.defra.gov.uk/2011/05/surface-water-management-and-future-water-supplies/)



Erosion control measures especially important for construction on slopes; absence of such measures often trigger landslides and failure of storm drainage systems (man-made/natural)



SuDS Approach:

A must have at building, community and settlement level

SuDS are a sequence of management practices, control structures and strategies designed to efficiently and sustainably drain surface water, while minimising pollution and managing the impact on water quality of local water bodies.

Design Features for Climate Resilient Affordable Housing

Floods, GLOFs & Heavy Precipitation

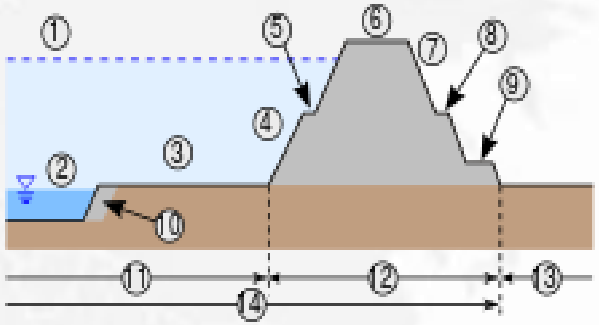
Building level

- Buildings with High Plinth.
- Raised floor level to prevent flood water entering inside the house.
- Basements for new construction should not be allowed in urban areas prone to flooding.
- Isolated RCC Foundations in hilly terrains with tie beams.
- Overhangs above openings.
- Homes to have attached toilets.
- Bitumen based damp proof course at plinth level and water proofing on roofs.

Design Features for Climate Resilient Affordable Housing

Cyclones, Floods & Storm Surges in Low lying coastal areas

- Deep Foundations – Pile foundations for Large buildings and RCC Strip foundation for homes
- Buildings with High Plinth, preferably 6” above highest flood level mark.
- Raised floor level to prevent flood water entering inside the house. Building on stilts.
- Basements for new construction should not be allowed in urban areas prone to flooding.
- Anchoring between building components.
- In low lying coastal areas, developments should be considered on higher grounds, or ground should be raised artificially.
- Construction of embankments or dykes is key for low lying settlements near coastal areas.

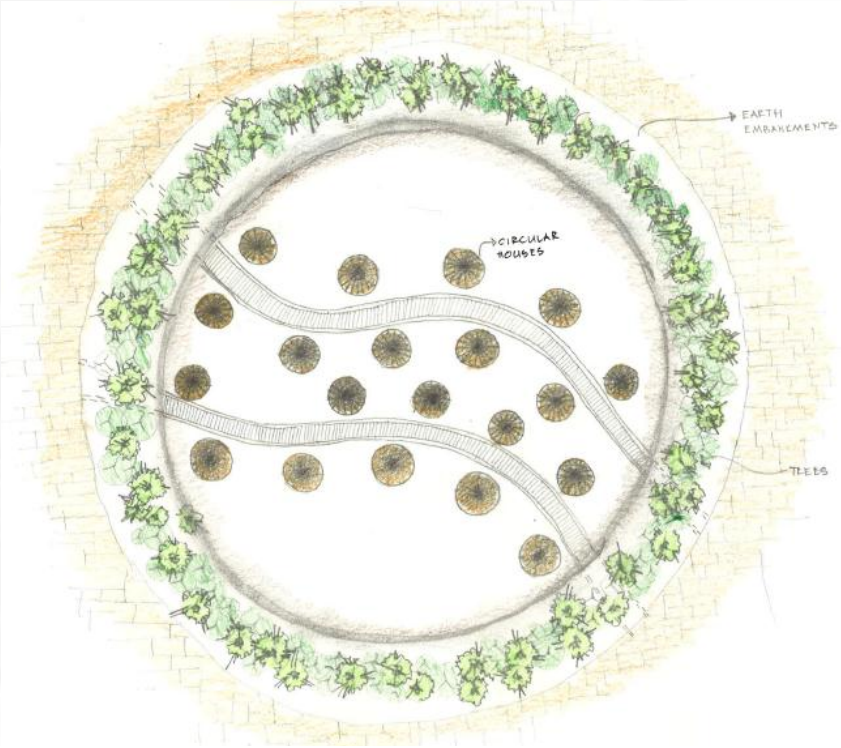


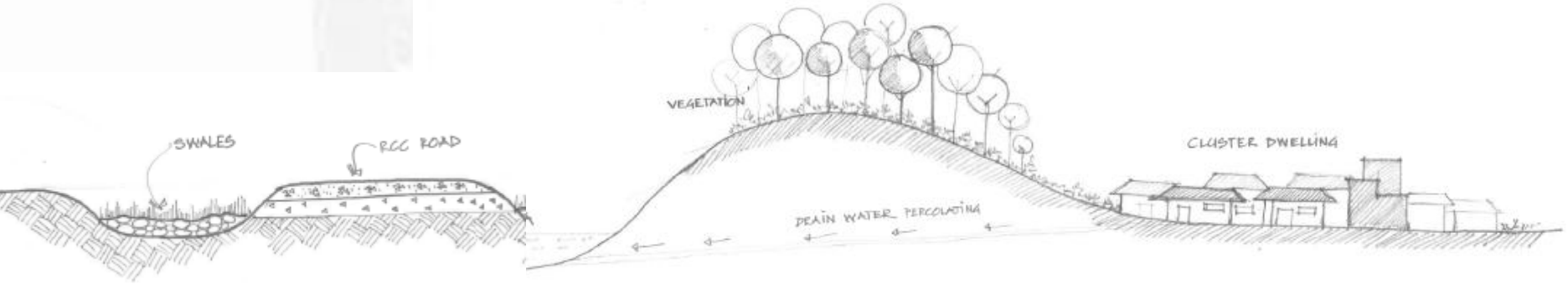
http://en.wikipedia.org/wiki/Levee

Design Features for Climate Resilient Affordable Housing

Cyclones, Floods & Storm Surges in Low lying coastal areas

- If higher grounds are not available, then settlements should be constructed on artificially raised grounds.
- Tree plantation to protect from cyclonic winds.
- Adopt a non regular layout in place of straight rows to prevent tunnel effect during cyclones.
- Square, hexagonal and round plan is safer than long rectangular plan.
- Pyramid shape roof is ideally suited.





GRIHA-Green Rating for Integrated Habitat Assessment

Tool to facilitate design, construction, operation of a green building ,and in turn ….measure "greenness" of a building in India

What gets measured gets managed

Sustainable urban drainage/Rain water harvesting to reduce flooding

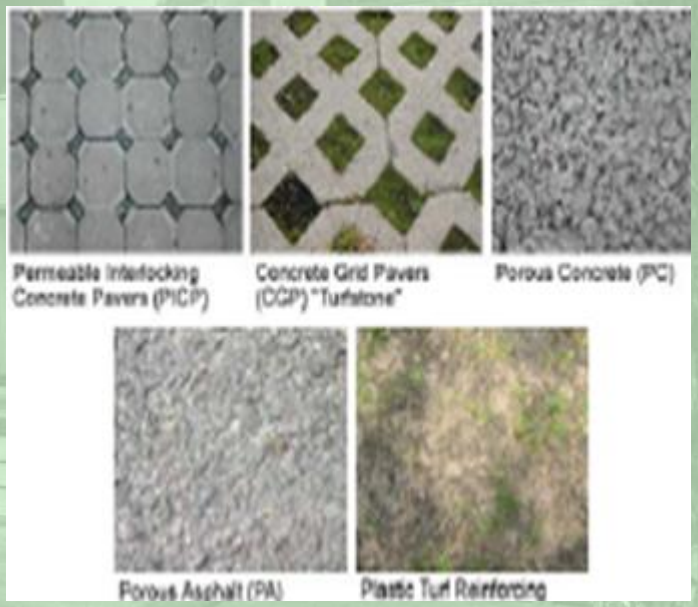
SUDS strategies

Rainwater harvesting

Detention basin

Swales

Wetlands

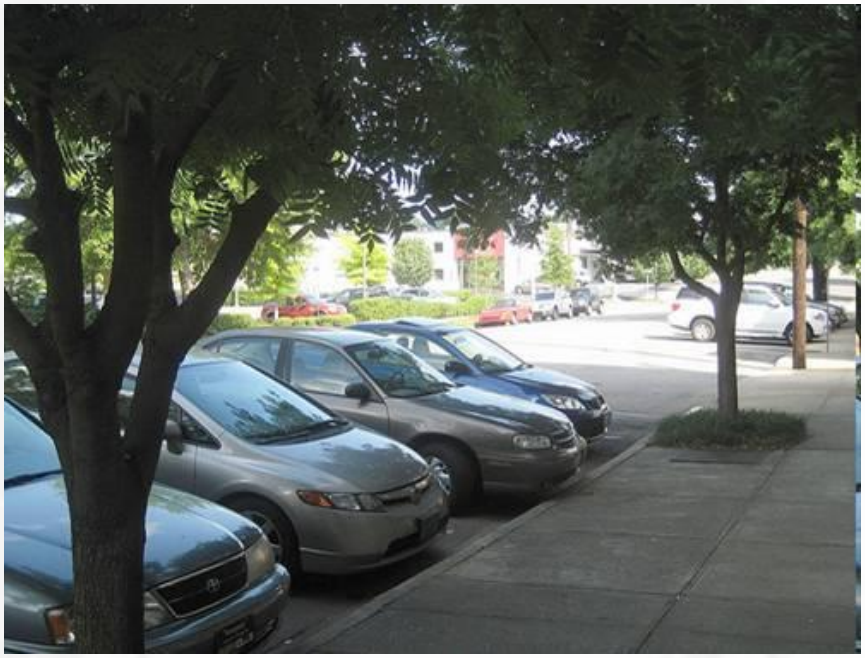


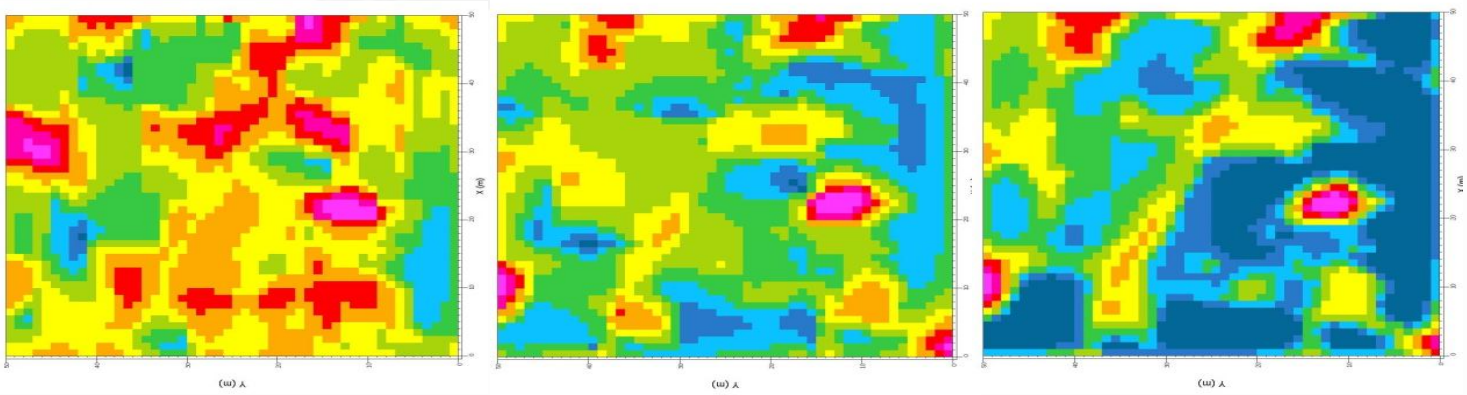
Design Features for Climate Resilient Affordable Housing

Increasing Temperatures & Heat Stress

For settlements

- In urban areas, one of the reasons for increase in temperature is urban heat island effect. Thus, reduced impervious pavements, increase in vegetation and shaded as well as light coloured building surfaces help maintain cooler microclimate.





GRIHA as a change agent in site management and design approach and a tool to promote adaptation/mitigation

Preserve protect vegetation and reduce paved areas: controls urban heat island

Reduced paving and green spaces

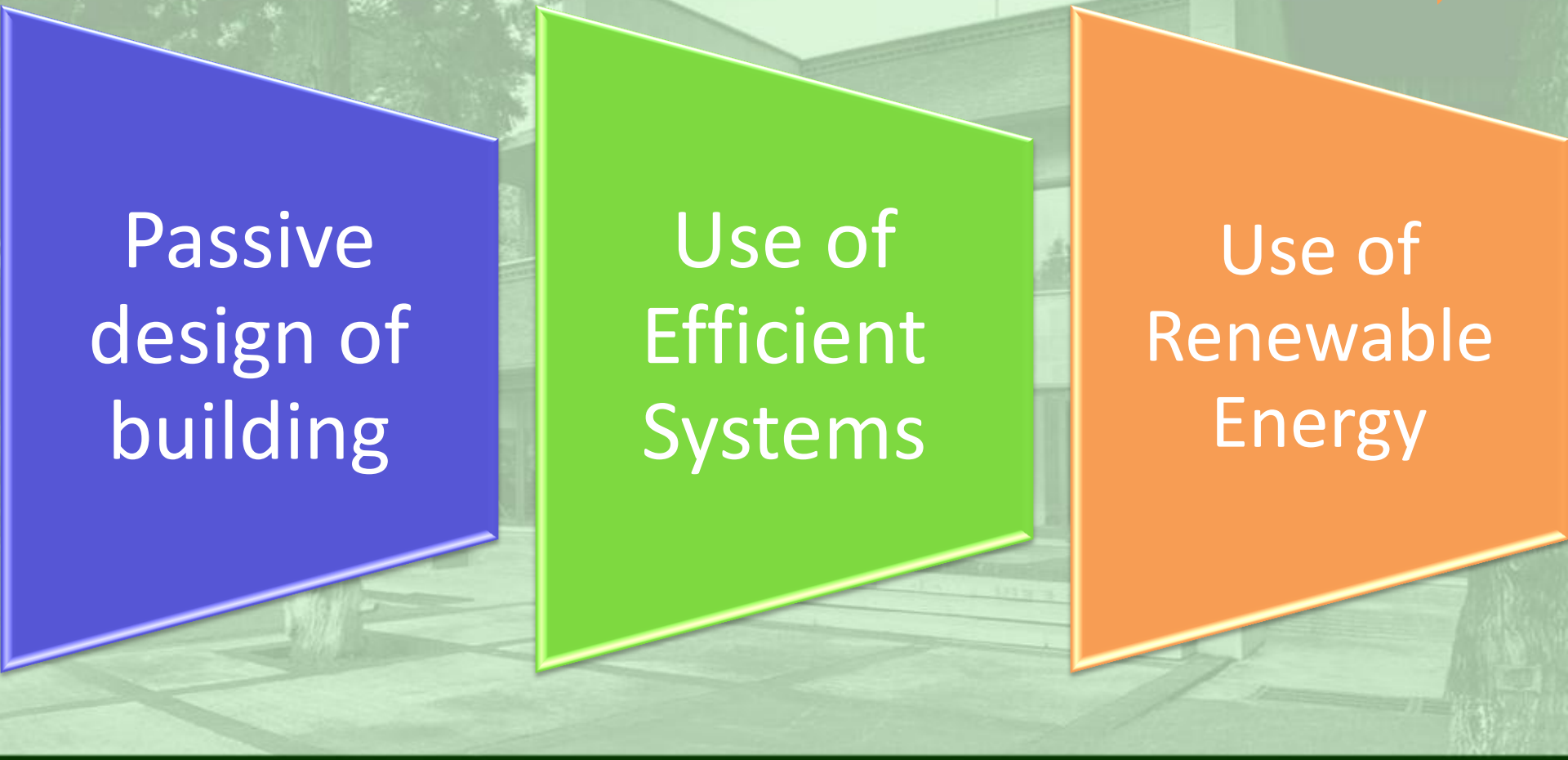
Reduced paving and green spaces: difficult to implement in urban areas due to conflicting statutory requirements

Promoting adaptive comfort and energy efficiency: GRIHA approach

For conserving energy – in a cost-effective manner

Cheapest Solution

Most Expensive Solution



Design Features for Climate Resilient Affordable Housing

Increasing Temperatures & Heat Stress

For New Construction

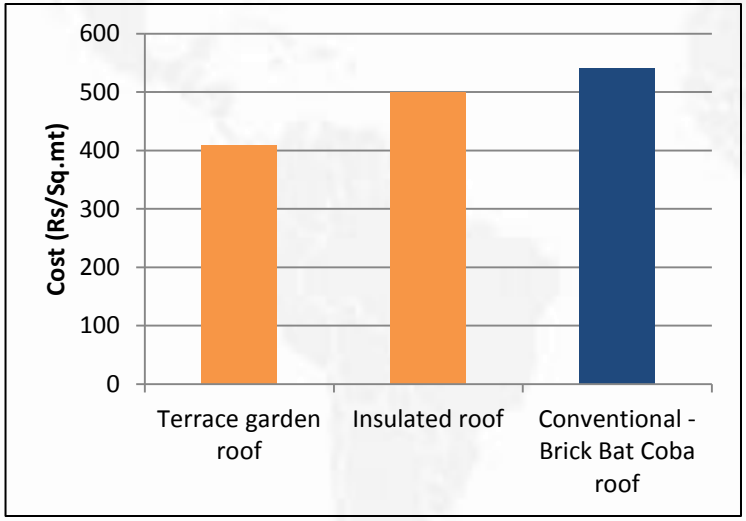
- Solar control strategies like shading, orientation and building morphology to reduce external heat gains and maintain comfortable indoor conditions.
- Increase in vegetation around the house.
- Increase in ventilation through optimization of window design and size.
- Cool roof/Roof Garden
- Use of thermal storage through building materials like local stone and stabilized earth blocks.

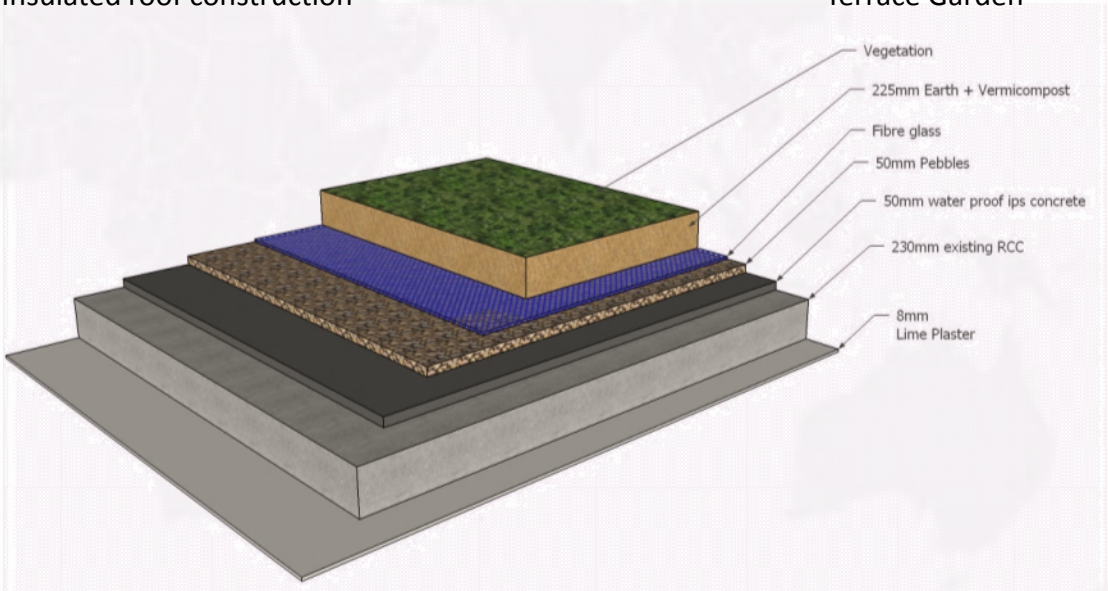
Green Roof

Brick Waste

Insulated roof construction

Terrace Garden





Terrace Garden Roof:

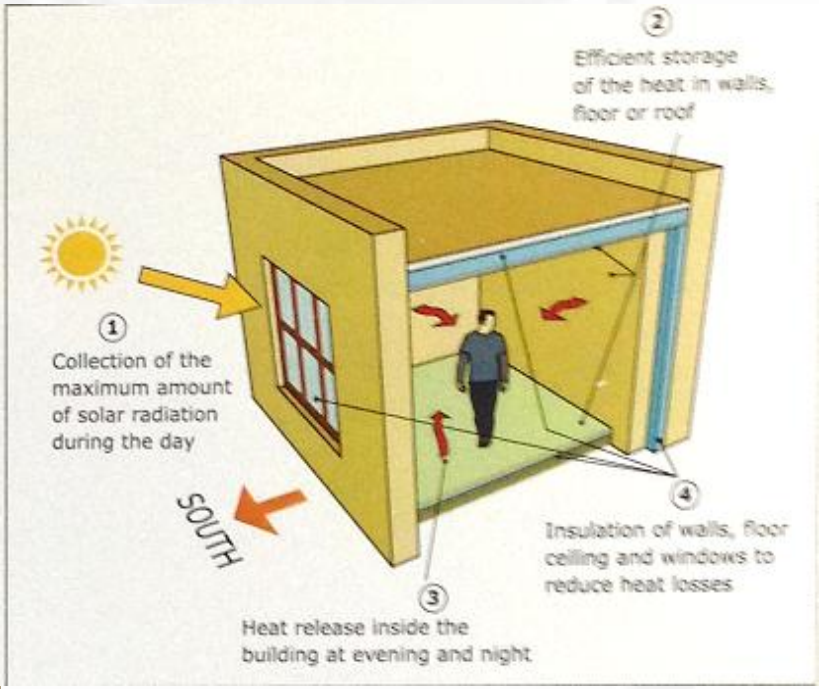
Earth + vermin compost + fiberglass mesh + cement + sand + grit + water proofing + RCC

Insulated Roof:

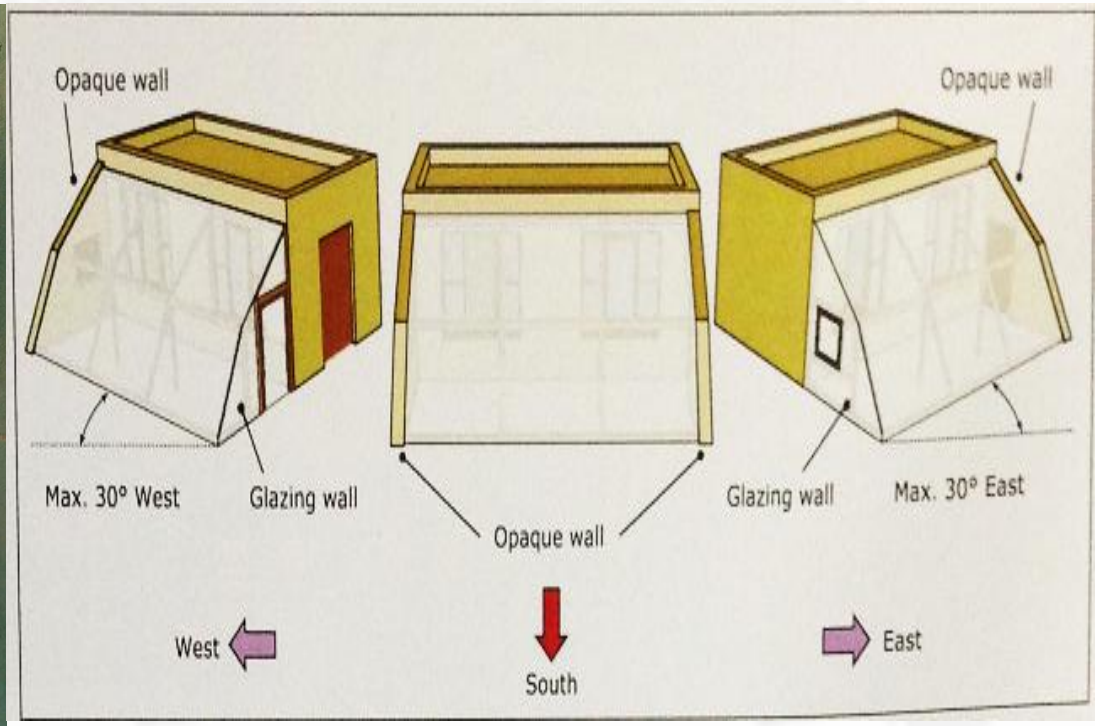
Waste brick + lime + sand + Waste Thermocol + RCC

Passive Solar House Design in Cold Climate Zones

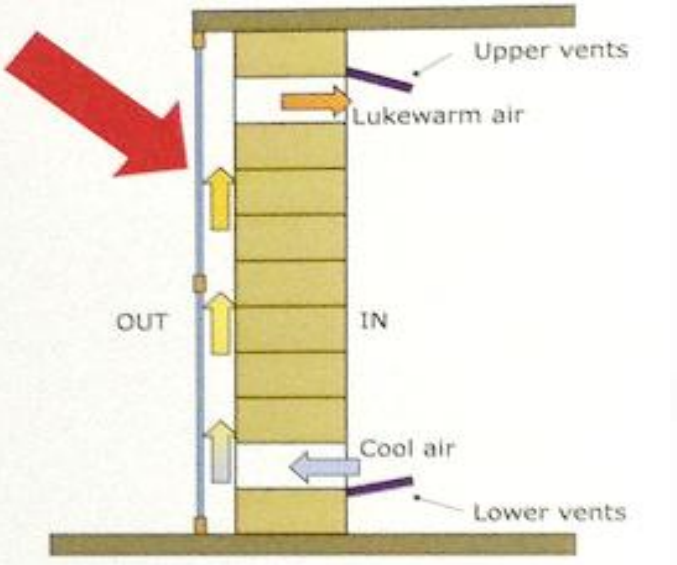
Direct gain (DG)

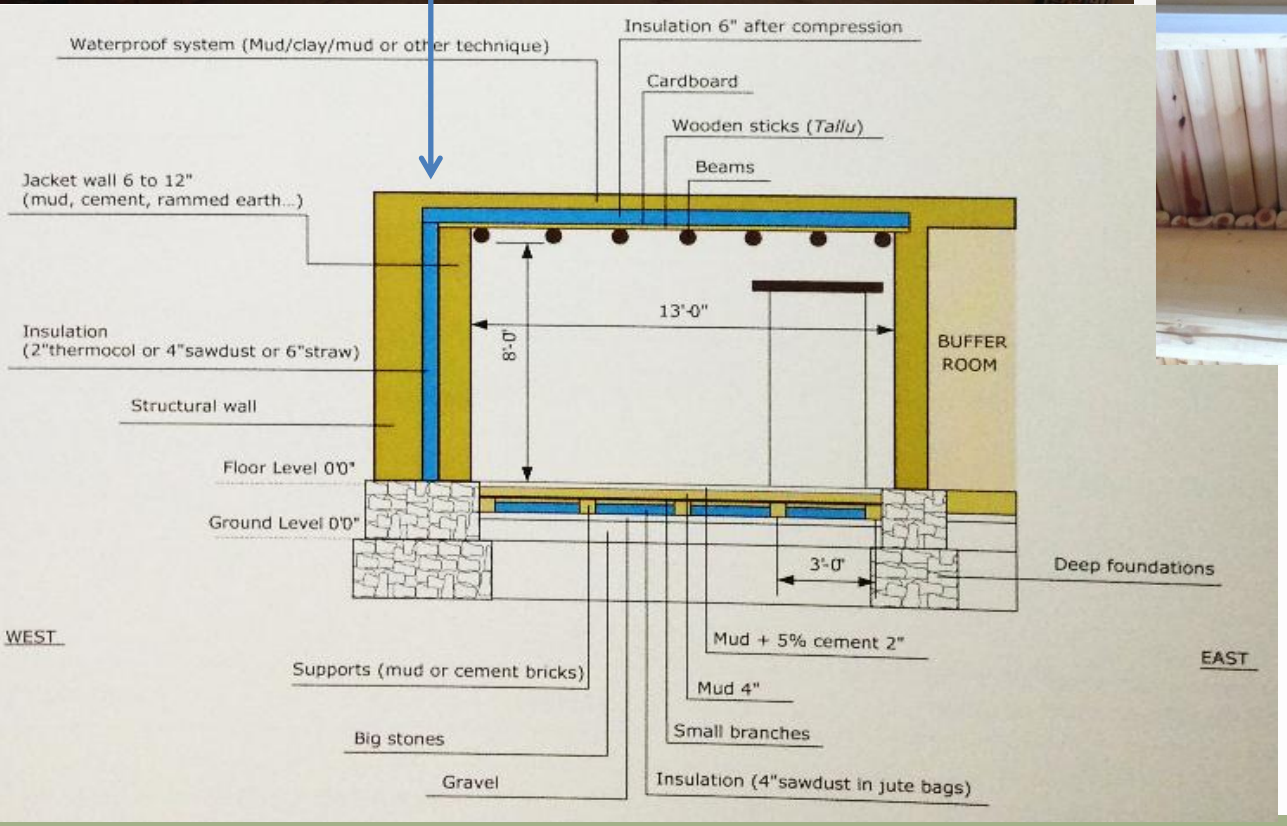


Attached Green House



Solar Wall (SW)





Energy efficient CFL tubes

On site monitoring

Parameters	DG	SW	AGH
Inside temperature (°C)	23.4	19.9	21.1
Inside lux (Middle of room)	350	210	160
Outside temperature(°C)	17.9	17.9	17.9
Relative Humidity (%) inside	26	20	20

Retrofit of Existing Housing to add climate resilience

Floods & Heavy precipitation

- Water proofing on roof and plinth level (Grouting)
- Water proofing on walls
- Protecting openings with overhangs
- Storm water Drainage systems

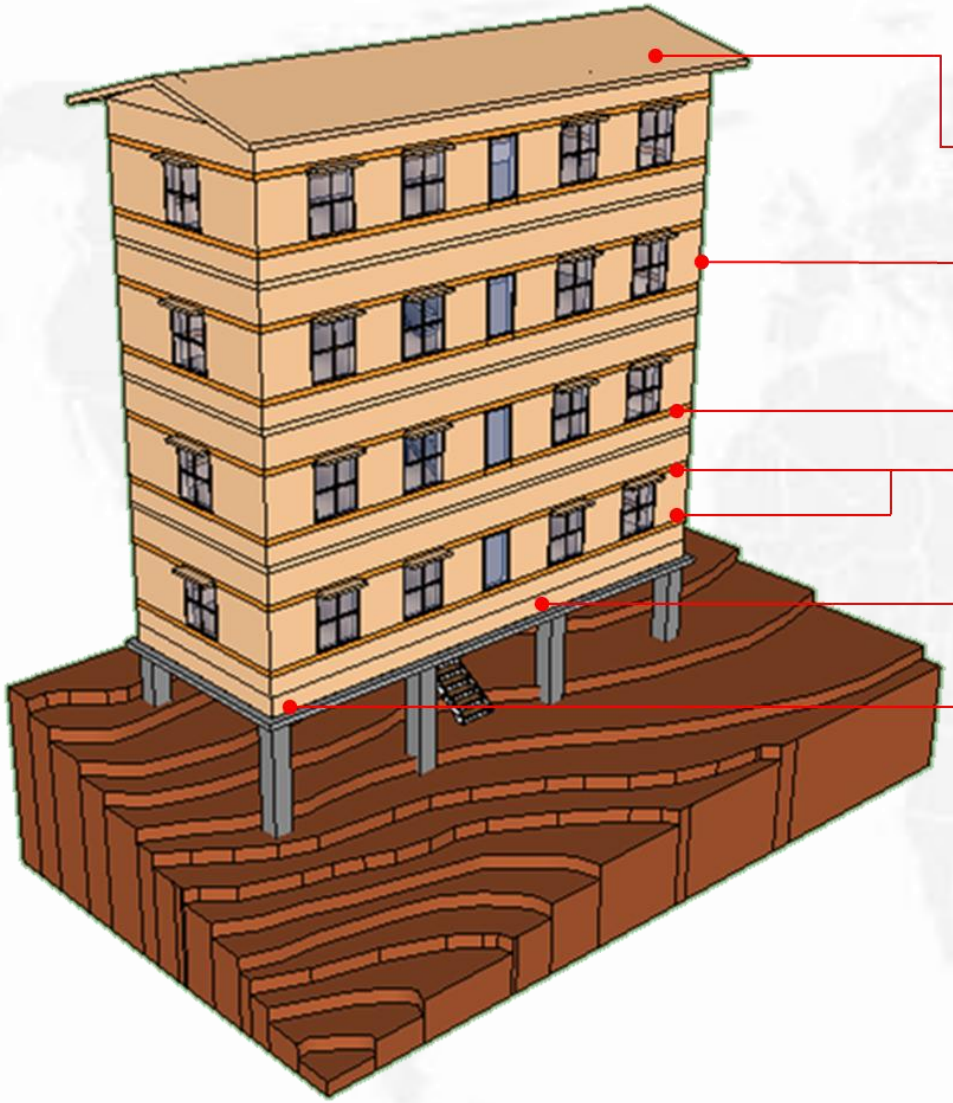
Increase in temperature and Heat Stress

- External insulation on the roof

Cyclone, storm surges

- Replacement of GI sheets in roof with composite boards anchored with the structure.
- Strengthening plinth and then caping with concrete.
- Tiling of walls for salinity resistance

House Design proposed for Multiple Hazard Locations



RCC Gable roof ⑥,
Damp proof course (DPC) ⑥

Hollow Concrete Block Masonry ④ ⑤

Ring beam at Sill level and Lintel level
② ⑦

Bitumen based DPC ① ③

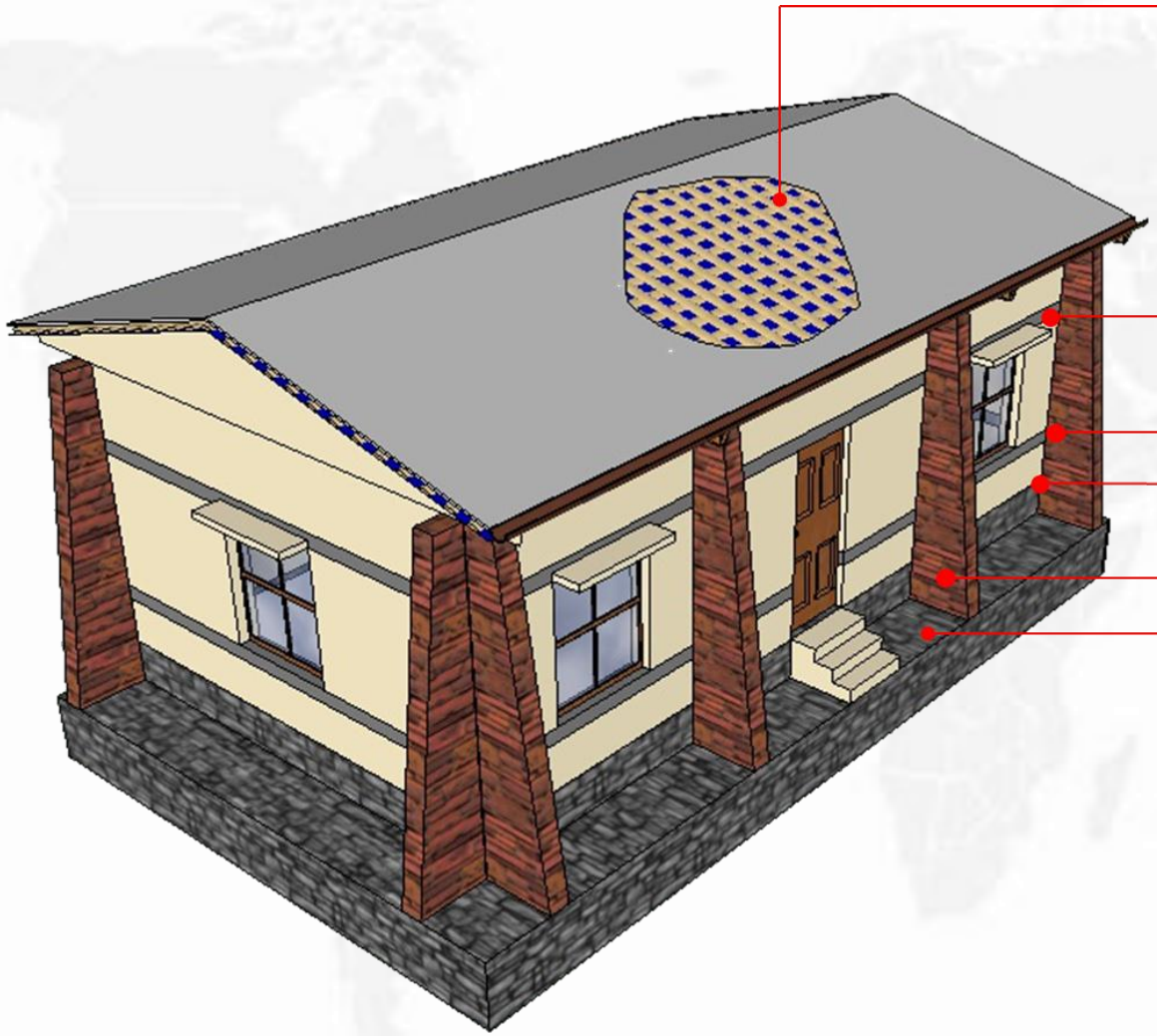
Raised floor ① ③

①	GLOFs
②	Landslides
③	Floods
④	Heat stress
⑤	Extreme cold
⑥	Heavy Rains
⑦*	Earthquake

Note: *Structure of the house to comply with the earthquake resistant design specifications provided in NBC

Proposed for Developer build Multi- Storey Climate resilient Home

House Design proposed for Multiple Hazard Locations



Ferro-cement roofing on bamboo supporting structure ⑥

Lintel & Sill beams with Bamboo Reinforcement ②⑦

Bitumen based DPC above Plinth Beam ③⑥

Buttress ②⑦

R C Strip foundation ①②⑦

①	GLOFs
②	Landslides
③	Floods
④	Heat stress
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*Note: Structure of the house to comply with the earthquake resistant design specifications provided in NBC

Proposed for Self construction Climate resilient Home

Thank You

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