

Passive Design Approach to Sustainable Buildings

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Buildings- Context, Role and Importance

- Buildings-- integral part of human history, growth, development
- Buildings --continue to define future journey of human growth
- Buildings-- manmade environment
- Buildings-- vital for human growth
- Buildings are living organism
- Buildings are structures catering to all human activities
 - Duildings valuable 900/ human life

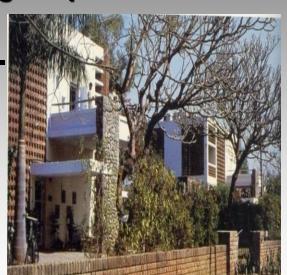
Buildings- Built Environment Operational domain of Architects /Engineers revolves around:

- -- Siting,
- -- designing,
- --construction,
- --operation,
- -- maintenance
- --Demolition and
- -Reconstruction
- -creating state of art built environment.
- Professionals-- have critical role and responsibility to;
 - --make value addition to resources, environment, ecology
 - -- by creating sustainable built environment.
 - Considering implications of Buildings-- resources, environment and ecology
- -- Going green
- -- a necessity to ensure sustainable tomorrow
- -Each building unique--requires different options to make it green

BUILDINGS -- AS CONSUMERS OF RESOURCES

Built environment— significantly impact environment /consumption of resources/generators of waste/climate change/rising temperature:

- >16% of world's fresh water withdrawal.
- >25% of wood harvested.
- >30% of consumption of raw material.
- >50% of global energy consumption.
- >35% of world's CO2 emission
- >40% of Municipal solid waste.
- >50% of Ozone depleting CFC's still in use.
- >30% of residents having sick building syndrome
- --70% of global warming outcome of;
- --built environment & transportation
- -- Majority of existing buildings
- --- low concern for energy conservation.



Implications of Built Environment

Aspects of Built Environment	Consumption	Environmental Effects	Ultimate Effects
 Siting Design Construction Operation Maintenance Renovation Deconstruction 	 Energy Water Materials Natural Resources 	 Waste Air pollution Water pollution Indoor pollution Heat islands Stormwater runoff Noise 	Harm to Human Health Environment Degradation Loss of Resources

Need for Sustainable Buildings > Annual addition of 700-900 msqm- built space;

- >---global energy/ environment implications critical.
- ➤ Buildings--must be designed with utmost care/considerations for—
- >-- energy/ sustainability/ resources/pollution.
- Large reduction of-- energy consumption/ water/ resources/ green house gas emission possible by:
 - > Adopting integrated approach to creating built environment.
 - > Evolving climatic responsive building designs
 - Using Energy efficient equipment/technologies.
 - > Retro fitting existing buildings
- -- To make buildings sustainable -
- -- a new field -- "green building" -- gaining momentum
- --SDG calls for
- -- Promoting Energy efficient buildings,
 - ----Net Zero energy buildings and
- -- Green Rated Buildings

SDG 11- Make cities / human settlements-inclusive ,safe, resilient and sustainable



































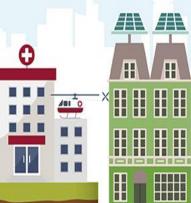




WORLD **GREEN** BUILDING COUNCIL







Green building design can spur innovation & contribute to climate resilient infrastructure









Green buildings produce fewer emissions. helping to combat climate change

Green buildings can improve biodiversity, save water resources & help to protect

Through building green we create strong, global partnerships

Green buildings can improve people's health & wellbeing

Building green infrastructure creates jobs & economy

8 DECENT WORK AND ECONOMIC GROWTH

boosts the

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE







12 RESPONSIBLE CONSUMPTION AND PRODUCTION

aren't wasted



13 CLIMATE ACTION



15 LIFE ON LAND



17 PARTNERSHIPS FOR THE GOALS











Defining- Green Buildings DEFINITION:

"A green building is one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building."



Tangible Benefits

- Reduce operating costs
- Optimize life cycle economic performance
 - Sustained savings



HPCL-Admin Building, Vizag

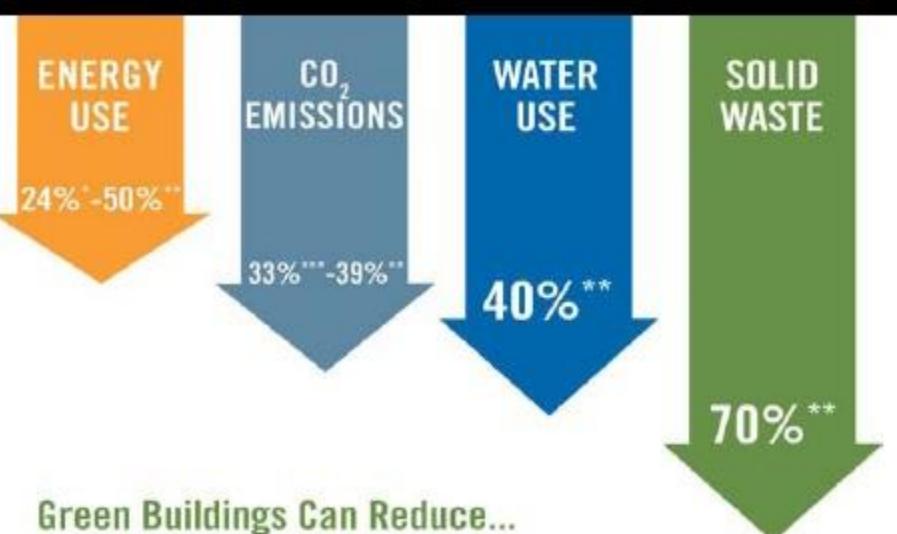
- Energy savings: up to 50 %
- ❖ Water savings: up to 40 %

In-tangible Benefits of Green Design

- Environmental benefits
 - Reduce impact on environment
- Health and Safety benefits
 - Enhance occupant comfort
- Improve Productivity of occupants

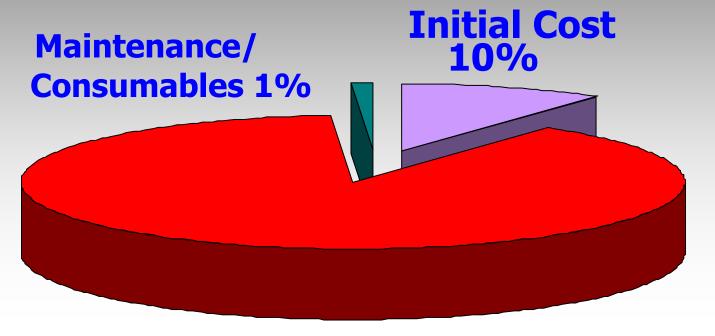


Advantages of Green Buildings



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"" Kets, G. (2002). The Costs and Funercial Deposits of Orien Building: A Report to California's Sectionable Building Tesk from
""" SIA Public Buildings Service (2008). Assessing green building performance: A post-occupancy eve hadron of 12 GSA buildings.

Green Buildingslife cycle costs



Operating Cost 89%











Cost of Green Buildings-Indian Experience Building Year Built-in Area Rating % Payback

Building	Year awarded	Built-in Area (sq.ft)	Rating Achieved	% Increase in cost	Payback (Yrs)

20,000

1,70,000

1,75,000

72,000

15,000

3,00,000

8,00,000

❖ Incremental Cost lower-- if base design has already factored normal Green features

18 %

15 %

8 %

6%

8%

2%

2%

7 years

6 years

5 years

3 years

4 years

2 years

2 years

Platinum

Platinum

Platinum

Gold

Platinum

Platinum

Platinum

2003

2004

2005

2006

2007

2008

2010

Cost showing a decreasing trend over the years

CII-Godrej GBC,

ITC Green Centre,

Technopolis, Kolkata

Consultants Office, Noida

Suzlon One Earth, Pune

Spectral Services

Kalpataru Square

Hyderabad

Gurgaon

Wipro,

Gurgaon

DESIGNING GREENBUILDINGS

Designing Green Buildings

i Decision to Build Green - taken initially in design process for:

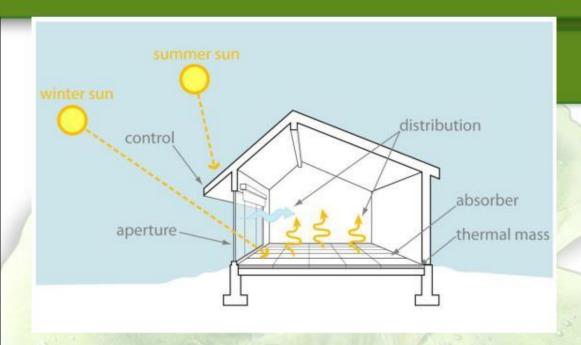
- --Maximizing green potential
- --Minimizing re-design
- --Assured overall success and
- --Achieving economic viability of Green Building Project
- Ii. Setting Green Goals/ Objectives for:
- -Energy Efficiency
- --Water consumption
- --On site treatment of rain/storm water
- --Material/ Resource management
- --Construction waste Management

iii. Building a Green Team-

- --Hiring a design team of-- Architect, Engineering Consultants with expertise, knowledge, experience, understanding of Green Concept
- Iv Adopting an Integrated Approach to Design-
- v Key Principles /Strategies-
- i Sustainable built environment,
- li Water/waste management,
- lii Energy Management,
- Iv Material/ Resource Management and
- V Indoor air Quality

Differentiating Passive vs. Active Design

Passive
design
results when
a building is
created and
simply works
"on its own".



Active design uses equipment to modify the state of the building, create energy and comfort; ie. Fans, pumps, etc.



Passive Design/ Green Building Passive Design/Green building design involves:

- i. Designing building in harmony with nature— using natural resources
- ii. Optimizing use of site potential
- iii Specify 'green' building materials sourced locally
- Iv Reducing structural loads---
 - V Optimize systems--- HVAC
- Vi Generating on-site renewable energy.
 - vii Finding balance between building and environment
 - viii Promoting energy reduction
- ix Preparing plans with energy as focus,
 - x Making best use of sun and wind energy
 - xi Involving cooperation of design team at all stages— Architects, Engineers, Promoters
- xii Minimizing water consumption
- xiii Using non-toxic, sustainable materials
 - xiv Preserving/promoting environment in design, construction and operation
- xv Promoting quality of life-- of occupants in design, construction and operation
 - xvi Promoting re-use and recycling
- xvii Ensuring Good indoor environmental air quality

Green Building practice expands/complements

- economy,
- -utility,
- -durability,
- -comfort.

Passive Design/Designing Green Buildings 1. Adopting integrated approach to building design

- 2. Design based on Climate
- Macro Climate Regional climate; Meso Climate- local climate
- Micro Climate--Site climate -- based on site characteristics.
- 3. Orientation -- to optimize light, heat gain/heat loss
- 4. Sun movement-- to maximizes use of free solar energy for heating /lighting
 - 5. Wind direction---using air movement for ventilation/ cooling
- 6. Planning of Building-- optimize site, size, shape, planning spaces, allocating uses, placing rooms, circulation, promoting building efficiency, promoting natural sunlight, air / ventilation
- 7. Designing Building Envelop— Mass space relationships/ solids/voids, positioning -openings/projections, shading devices, height, shape of building, natural lighting and ventilations etc
- 8. Materials- low embodied energy; locally; natural form, lightweight
 - 9.-Technology- cost effective/material efficient/speedier/energy efficient
- 10.ndoor Air Quality-Creating optimum living conditions for occupants

Indian Way of approaching design

- **Rediscovery of Indian ethos**
- We worship 5 elements of Nature (Panchahhutas)

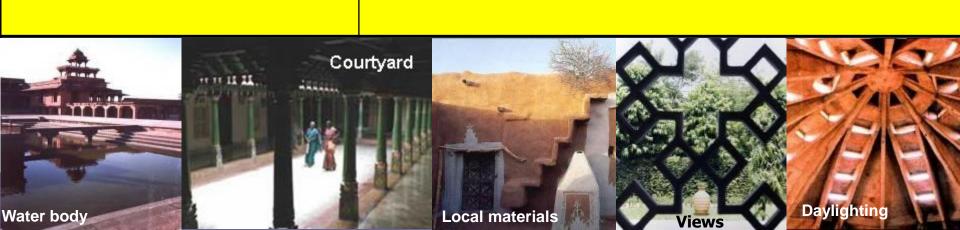
- We worship 3 elements of Nature (Fanchabilities				
Prithvi (Earth)	Sustainable Sites			

Jal (Water) **Water Efficiency**

Agni (Energy) **Energy Efficiency**

Vayu (Air) **Indoor Environmental Quality**

Akash (Sky) **Daylight**

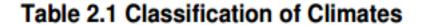


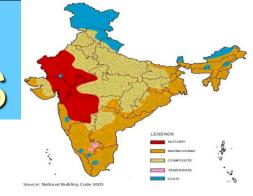
Focus Areas: Green Buildings



Climatic Zones in India

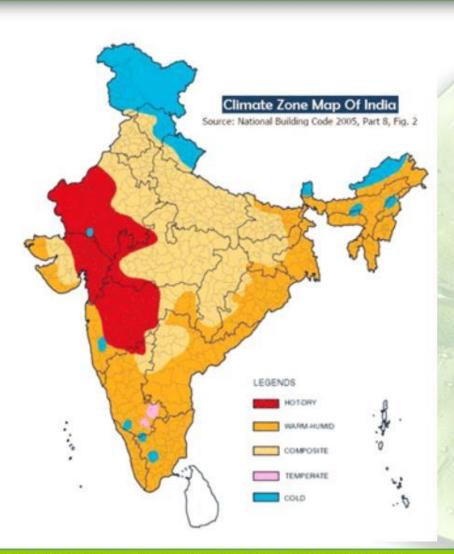
CLIMATIC ZONES AND THEIR CHARACTERISTICS





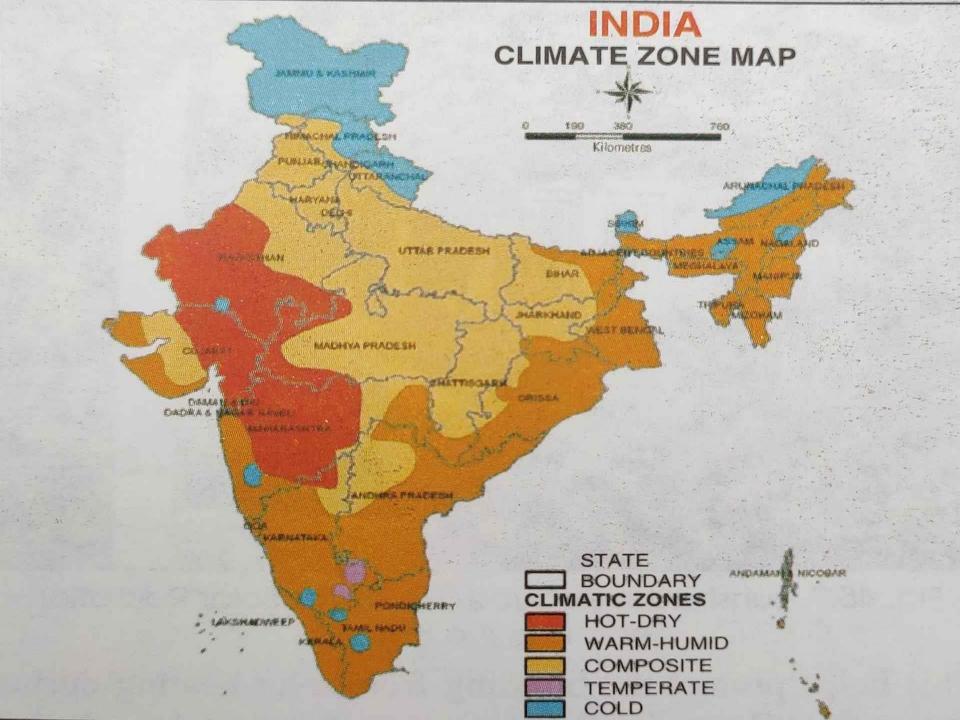
Criteria of Bansal et al. [1]			Criteria of SP 7: 2005 [9]		
Climate	Mean monthly temperature (°C)	Relative humidity (%)	Climate	Mean monthly maximum temperature(°C)	Relative humidity (%)
Hot and dry	>30	<55	Hot and dry	>30	<55
Warm and humid	>30	>55	Warm and humid	>30 >25	>55 >75
Moderate	25-30	<75	Temperate	25-30	<75
Cold and cloudy	<25	>55	Cold	05	Alluskuss
Cold and sunny	<25	<55	Cold	<25	All values
Composite	This applies, when six months or more do not fall within any of the above categories		Composite	This applies, when six months or more do not fall within any of the above categories	

Climatic zones of India

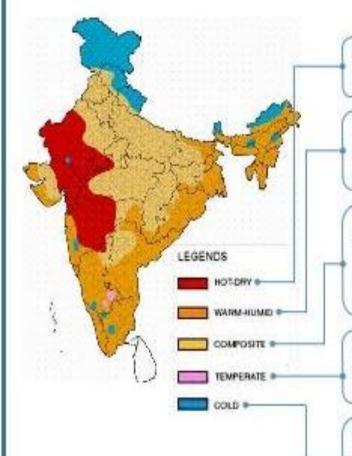


- Hot & Dry
- Warm & Humid
- Composite
- Temperate
- Cold





Climate Zones in India



High temperature • Low humidity and rainfall • Intense solar radiation and a generally clear sky • Hot winds during the day and cool winds at night

Temperature is moderately high during day and night • Very high humidity and rainfall
• Diffused solar radiation if cloud cover is high and intense if sky is clear • Calm to very high winds from prevailing wind directions

This applies when 6 months or more do not fall within any of the other categories.

High temperature in summer and cold in winter. Low humidity in summer and high in monsoons. High direct solar radiation in all seasons except monsoons high diffused radiation. Occasional hazy sky Hot winds in summer, cold winds in winter and strong wind in monsoons.

Moderate temperature • Moderate humidity and rainfall • Solar radiations ame throughout the year and sky is generally clear • High winds during summer depending on topography

Moderate summer temperatures and very low in winter * Low humidity in cold/sunny and high humidity in cold/cloudy * Low precipitation in cold/sunny and high in cold/cloudy * High solar radiation in cold/sunny and low in cold/cloudy * Cold winds in winter

SOUNCE: Summar of Nation Standards, National Building Code of richa 2005, Partid Building Service, Section 3 Ar Conditioning, Healing and Mechanical Verificiant Buildings, Code of richa 2005, Partid Buildings and Buildings and Buildings and Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congression Buildings, Take Mechanical Section 2005, Consist Responses Architecture: A Congress Responses Architecture: A Congress Responses Responses

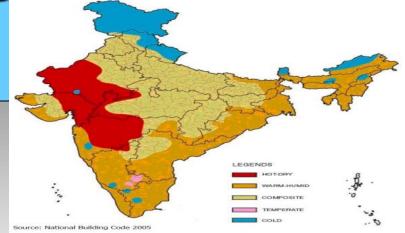






Integrated Design Process

- Five Climatic Zones In India-
- Hot and Dry
- Warm and Humid
- Moderate / Temperate
- Cold (Cloudy/Sunny)
- Composite
- All green buildings need not-- to be same
 - All zones have specific requirements regarding:
 - --light,
 - --heat,
 - --ventilation and
 - --thermal comfort
- Different zones require different design strategies regarding building envelop,
 - --HVAC,
 - -- Lighting,
 - -- Fenestration,
- -- Performance standards



Site

Analysis

Site Analysis- Factors considered

- i) Understanding Site
- ii) Location
- iii) Orientation- rising sun- position of a building in relation to an east-west axis.
- iv) Wind direction
- v) Soil conditions
- vi) Topography
- vii) Vegetation and Natural Features
- viii) Hydrology and Precipitation
- ix) Infrastructures
- x) Surrounding Land uses & Buildings
- xi) Vision / Visual Linkages

Site Analysis



SWOT

STRENGTH

- The site is near to the business and a orlouture land of the place
- it has good condition of accessibility
- The area has enough water supply power lines, telephones and communication lines are available.

WFAKNESSES

- There are problems in heavy traffic during

OPPORTUNITIES

- it can also provide job opportunities to the
- The rich and the poor have the opportunity to socialize with one another.
- Can also provide opportunities for families with no sufficient income for the facilities
- All families have the opportunity to choose their residence to the best of their
- This pioject can also add to the development increase of the city.

THREATS

INTRODUCTION

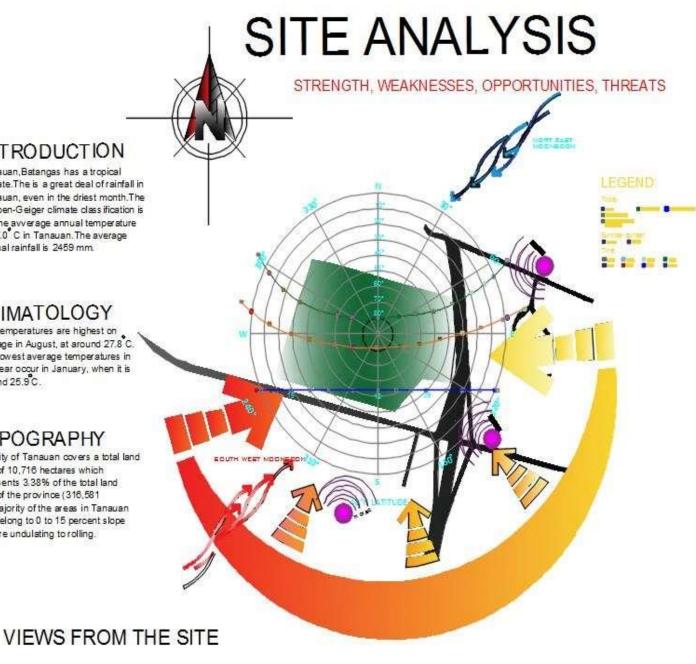
Tanauan, Batangas has a tropical climate. The is a great deal of rainfall in Tanauan, even in the driest month. The Koppen-Geiger climate classification is Af. The avverage annual temperature is 27.0°C in Tanauan. The average annual rainfall is 2459 mm.

CLIMATOLOGY

The temperatures are highest on average in August, at around 27.8 C. The lowest average temperatures in the year occur in January, when it is around 25.9 C.

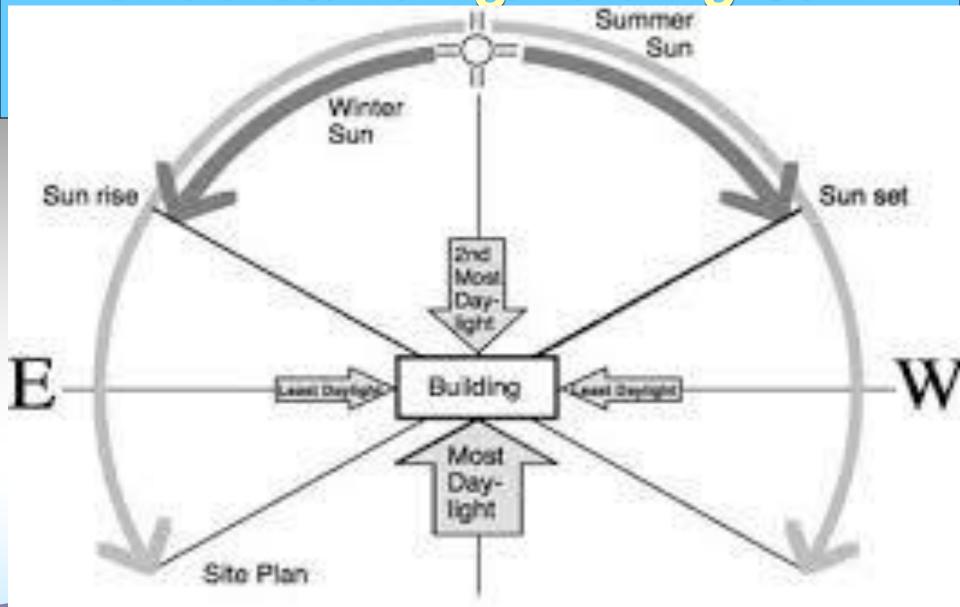
TOPOGRAPHY

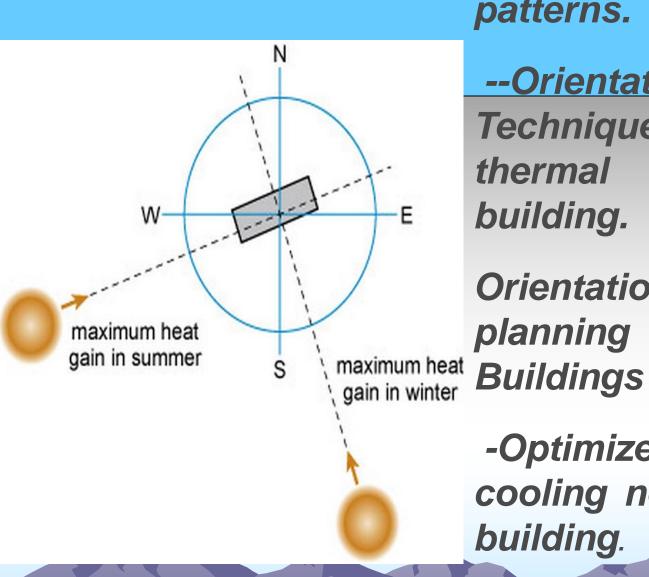
The city of Tanauan covers a total land area of 10.716 hectares which represents 3.38% of the total land area of the province (316,581 ha). Majority of the areas in Tanauan City belong to 0 to 15 percent slope that are undulating to rolling.



Orientation & Buildings

Understanding/Valuing Sun





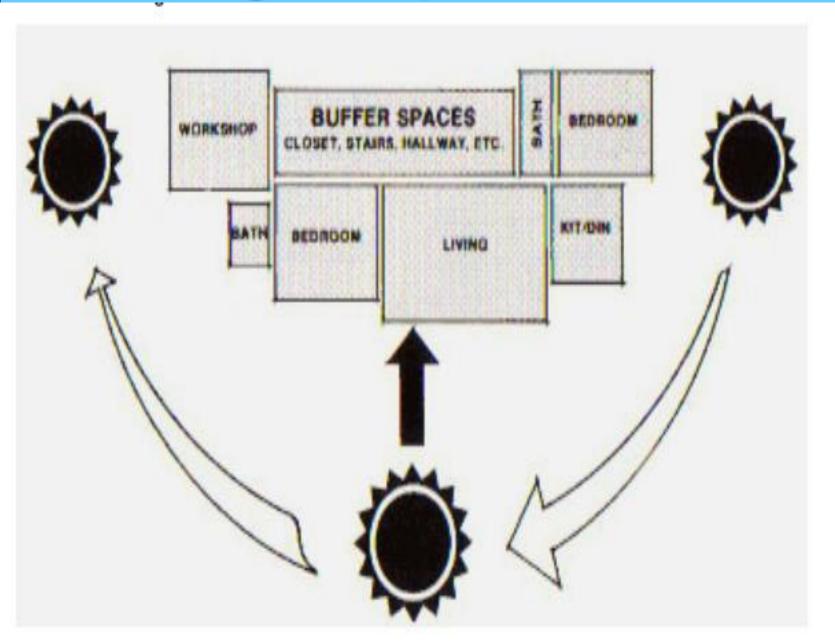
WEST; SUN & WIND patterns.

--Orientation – a
Technique for improving thermal comfort inside building.

Orientation- critical for planning /Designing Buildings

-Optimizes heating / cooling needs throughout building.

Planning for spaces in buildings

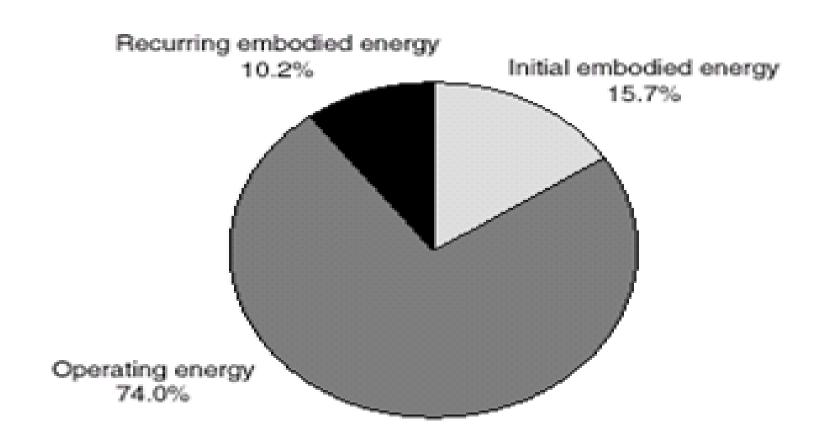




TOWER OF SHADOWS

Energy Implications of buildings

Figure 3: Distribution of Life-cycle Energy Consumption.



Energy Efficiency

Green buildings reduce energy consumption in two ways-

- i. Embodied energy- extract, process, transport and install building materials and
- li. Operating energy-- to provide services to make buildings operational-- such as heating, lighting, air conditioning, ventilation and power for equipment.
- High-performance buildings use less operating energy,
- Embodied Energy importance upto 15.7 % of total energy consumption.
- For reducing Embodied energy –Use local materials/ materials in natural form- which consume less energy for manufacturing --buildings made of wood have lower embodied energy than steel/concrete
 - For reducing Operating energy --- reduce air leakage through building envelop
- --Specify high-performance windows
- --Provide extra insulation in walls, ceilings, and floors.
 - -- use Passive solar building design
 - -- Orient windows and walls rationally,
 - -- Use trees shade windows /roofs during summer for cutting sun- in hot areas/zones
- while ensuring maximizing solar gain in winter- in cold areas
- -- effective window placement (day lighting)-- to provide more natural light /reduce need for electric lighting during day.
- -- Solar water heating reduces energy costs.
- --Onsite generation of renewable energy through solar power wind power, hydro power or biomass significantly reduce environmental impact Of building

Energy efficiency- Embodied energy



What is embodied energy?

The quantity of energy required to manufacture, and supply to the point of use including:



- Extraction
- Transportation
- Manufacturing

- Assembly
- Installation
- Some definitions also include: Disassembly & Removal

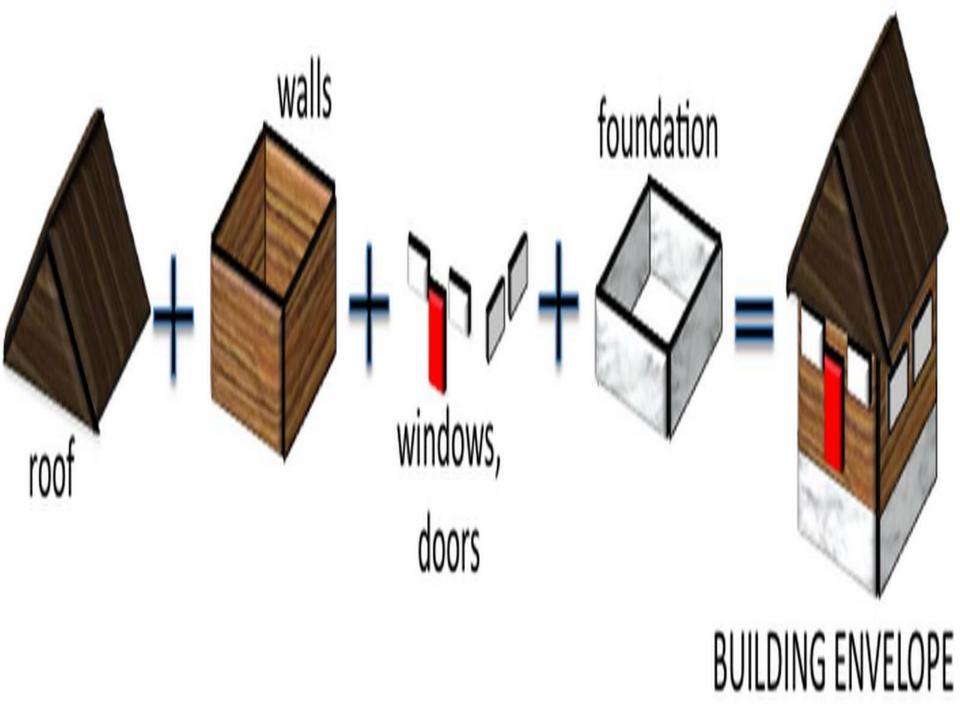
Building Envelop-Heat Loss/Gain, Cooling Natural Light, Ventilation

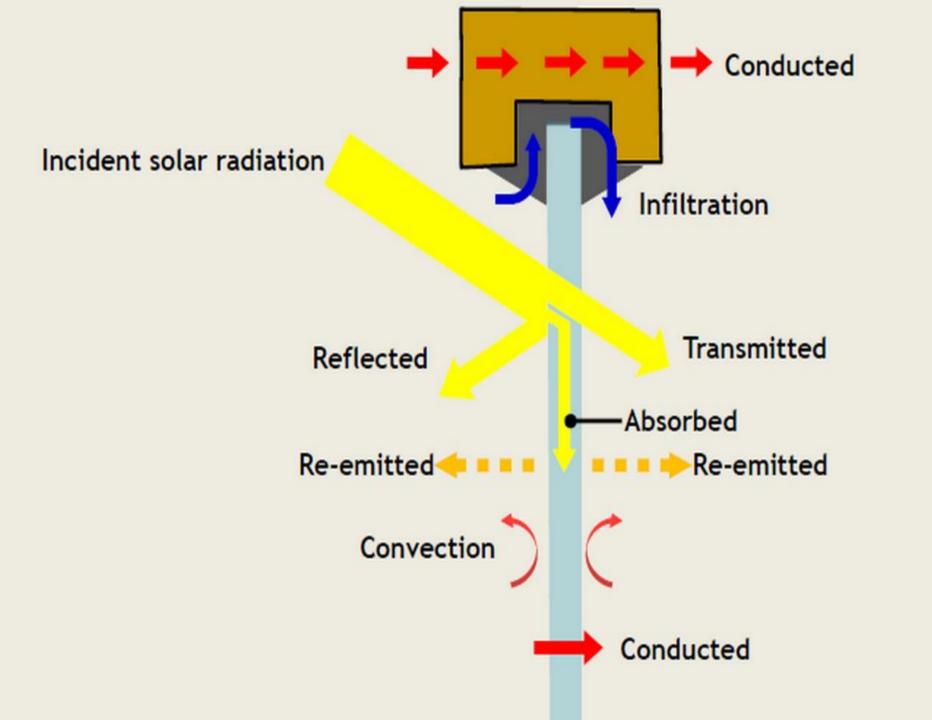
Building Envelope



Building Envelope

- Building envelope;
- - Divides natural / Manmade Environment
- --First line of defense- against natural forces rain , heat, cold, storm
- -- Barrier between interior/exterior of a building
- controls exchange of air/water/heating/ cooling in interior.
- -Components constituting Envelope; Roof, Walls, Doors, Windows, Foundations, Projections, Recesses, Louvers; shading devices
- --Envelop- Involves structural loads, air, heat, moisture loads.
- Colour/texture- contributes to heat gain/loss within





Efficiency of Building Envelope

HOW HEAT IS LOST FROM AN UNINSULATED HOME



FACADE ARTICULATION

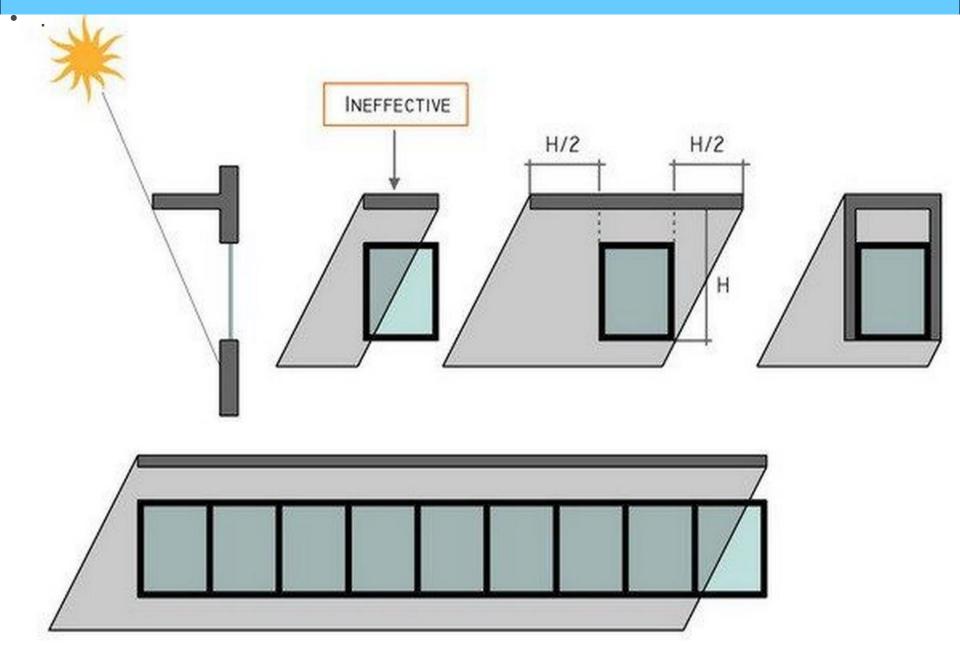


- Max. ventilation
- Orientation of smaller side of structure along east-west
- North-south orientation for max. air movement
- High density of façade that is open and yet shaded.
- Faint/pale colours on outer surfaces
- *Building materials with insulating/reflecting properties that resist heat transfer.

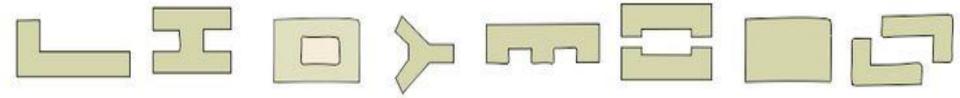
Solar Shading

- Solar control / shading --directly impact -- energy efficiency
- --cooling load minimized to one-fourth of building's load.
- -Shading devices fins/ chajjas (overhangs) designed
- --to get a minimum exposure of sun in summer
- -- while allowing winter sun inside the space.
- -- helps in regulating /reducing electrical load on building.
- -- Solar orientation important -- while designing an effective shading device.
- -- Some solar shading elements -- trees, hedges, overhangs, vertical fins, low-shading coefficient glass, blinds, and louvers

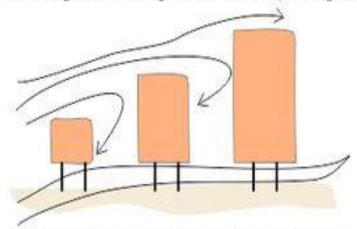
Solar shading



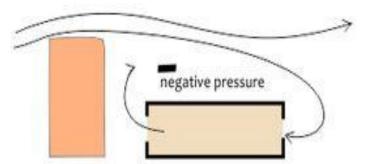
Planning with wind



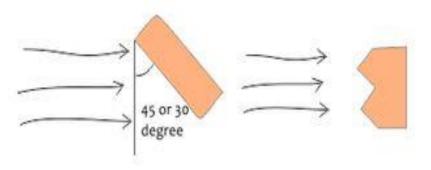
Orient longer facades along the north. This will provide glare free light in summer from north without shading and winter sun penetration from the south.



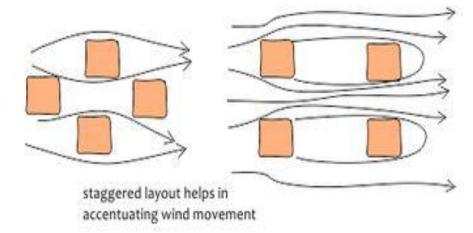
if a site has multiple buildings, they should be arranged in ascending order of their heights and be built on stilts to allow ventilation

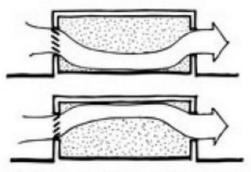


Taller forms in the wind direction of prevailing wind can alter the wind movement pattern for low lying buildings behind them

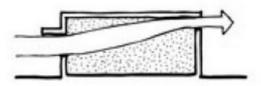


Place buildings at a 30 or 45 degree angle to the direction of wind for enhanced ventilation. Form can be staggered in the wind facing direction also to achieve the same result.

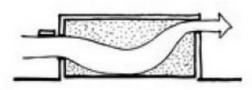




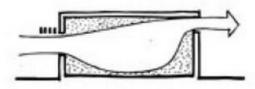
Louvres can direct airflow upward or downward.



A canopy over a window tends to direct air upward.

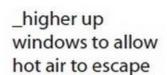


A gap between canopy and wall ensures a downward pressure.



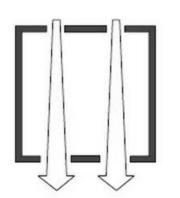
Downward pressure is improved further in the case of a louvered sunshade.







_smaller inlet windows facing prevailing winds and larger outlet windows on opposite side



Designing with Regional Climate

Hot & Dry Climate

Hot and dry climate



- This zone lies in western and central part of India, jaisalmer, jodhpur, etc.
- This region is usually flat, sandy, rocky ground with spares vegetation of cacti thorny bushes.
- Water level is very low here.
- The diurnal variation in temperature is quite high more than 10°C.

Hot and Dry Climate Zone-

Comfort requirements and Physical manifestations in Buildings

3 339		
Thermal Req	uirements	Phy

sical Manifestation

Orientation and shape of building

Insulation of building envelope/roof/walls

Air locks/lobbies/balconies/verandahs

Smaller windows openings, night ventilation

Reduce Heat Gain

Decrease exposed surface area

Increase thermal resistance

Increase thermal capacity (Time lag) Decrease air exchange rate

(ventilation during the day) Increase buffer spaces

Increase shading

Increase surface reflectivity

Promote Heat Loss

Increase air exchange rate

(ventilation during night-time)

Use glazing with lower Solar Heat Gain Co-Reduce solar heat gain

External surfaces protected-overhangs, fins, trees Pale colour, glazed china mosaic tiles etc.

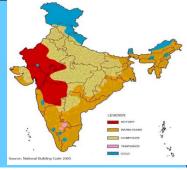
efficient-SHGC and provide shading for windows.

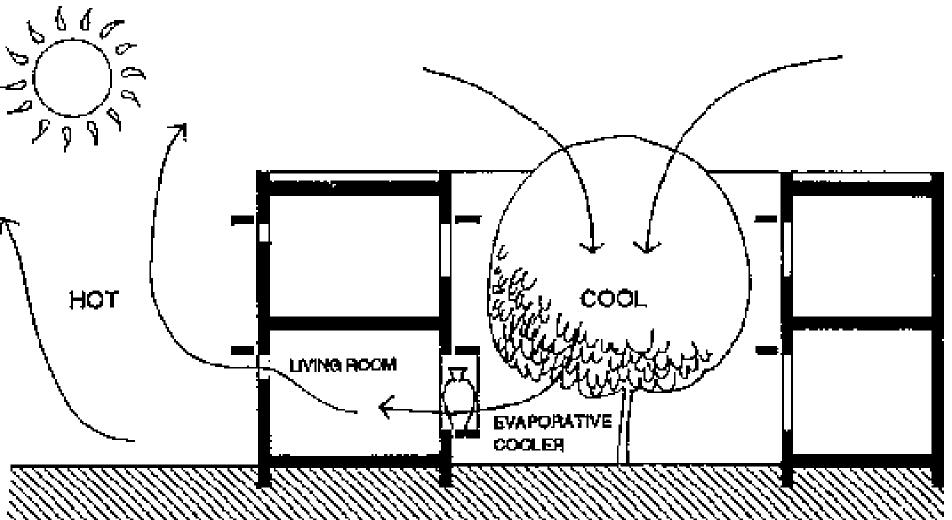
Minimize glazing in East and West Courtyards/wind tower/arrangement of openings

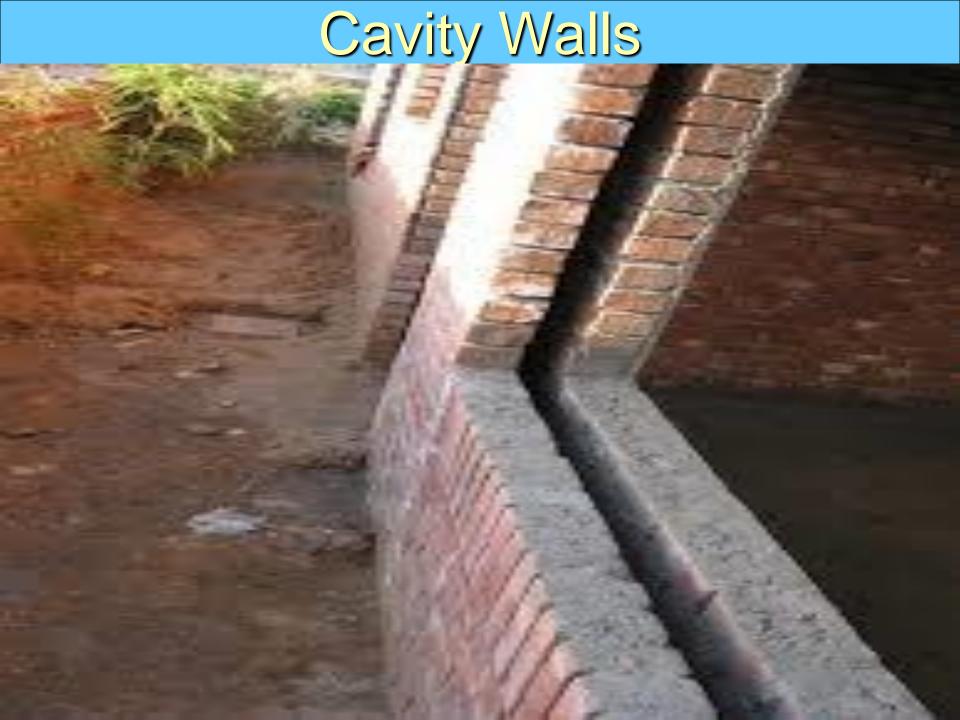
Massive structure

Hot and Dry Climate Zone-

Comfort requirements and Physical manifestations in Buildings



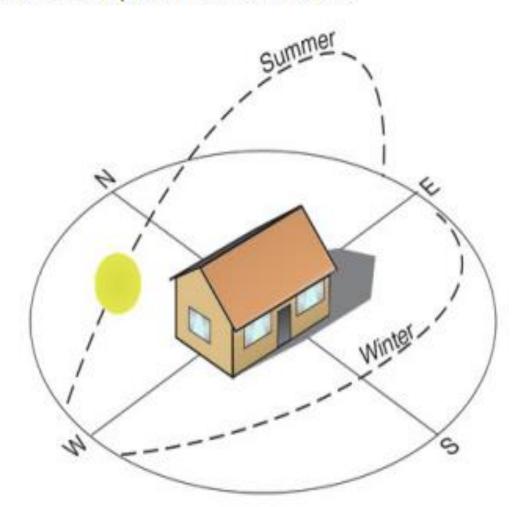




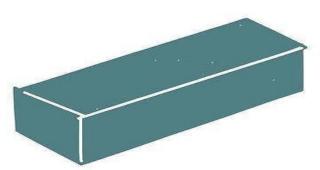
Understanding Orientation

5. Building Orientation and Shading

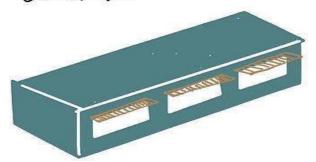
5.1 The building shall be oriented with the long sides facing north and south whenever the site and location permit such orientation.



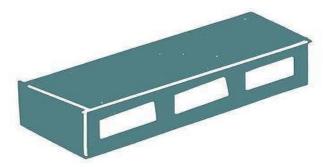
TEMPERATE CLIMATE



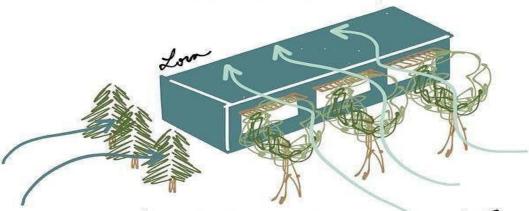
RECTANGULAR BLDG ON E/W AXIS. MEDIUM COLORS.



SUMMER SHAPE, WINTER

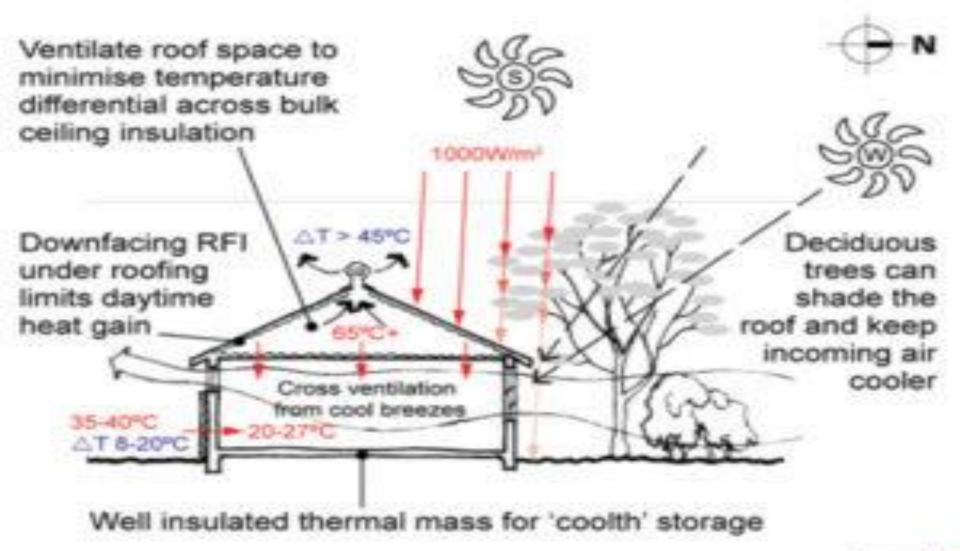


SOUTH OPENINGS CAPTURE WINTER SUNLIGHT.



ALLOW FOR COUNTY SUMMER WIND BUT BLOCK COLD WINTER WIND.

Minimise solar gains with passive shading





INDIGENOUS HUMAN HABITAT INDIA

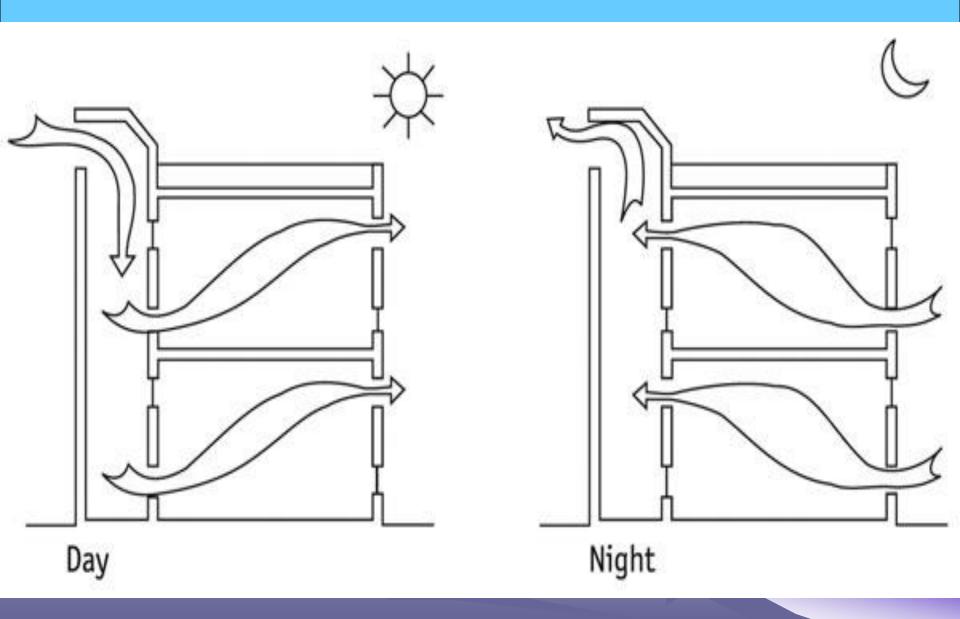
A Product of evolution in response to ecological context



Jaiselmer (Hot dry desert India

(Max. +52 C)

Wind Towers

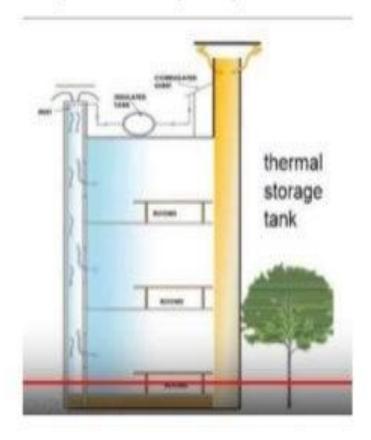


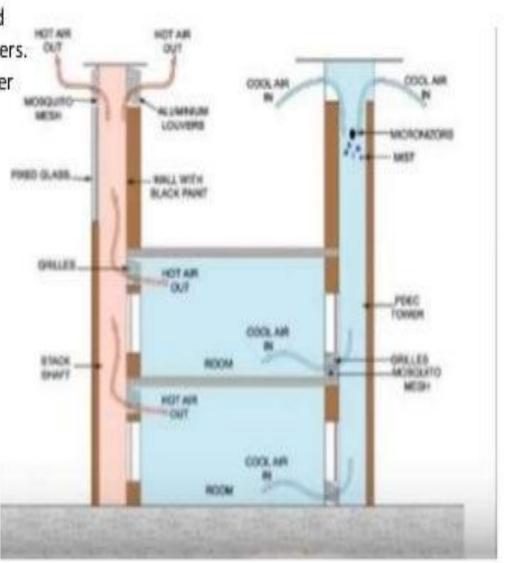
4. Passive downdraft evaporative cooling (PDEC) with night sky cooling

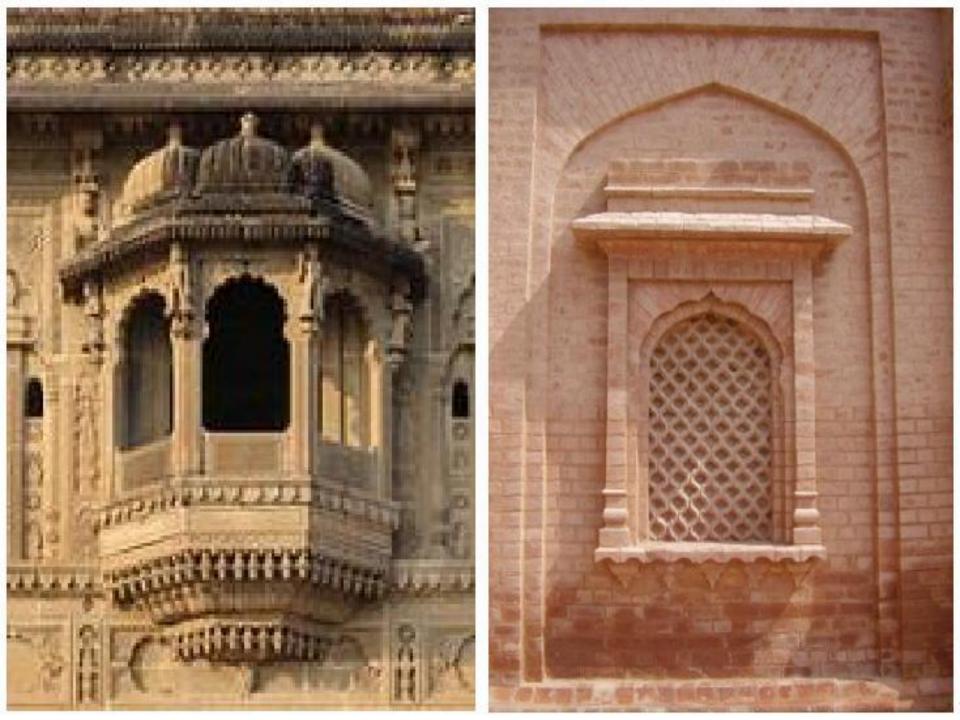
 The system comprises a down draft evaporative cooling tower the fine drops of water is sprayed vertically downwards with the help of mirconisers.

it is possible to achieve 26 deg.c in peak summer

 It is possible to achieve of 16 deg,c in Hyderabad using this system







HOT& HUMD

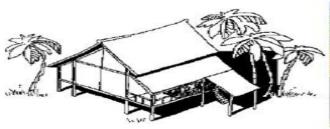
ZONE

BUILDING DESIGNS FOR HOT & HUMID ZONES

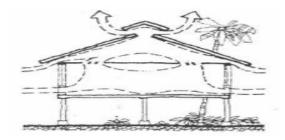
CLIMATIC DESIGNS

Environmental Science 1 (KKSB 1216) Session 2, 2009/2010

Prepared by: Nik Lukman Nik Ibrahim







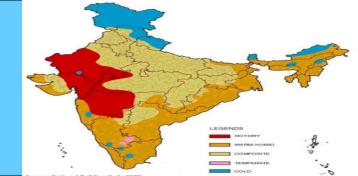
Hot & Humid Regions

Climatic conditions:

- -high rainfall and high humidity.
- -temperature range around 30 35°C and is fairly even during the day and throughout the year.
- -due to minimal temperature differences, winds are light or even non-existent for longer periods.
- -heavy precipitation and storms occur frequently.



Warm and Humid Climate Zone



|--|

Physical Manifestation

insulation of Roof and wall

Reflective surface of roof

Balconies and verandahs

fins and trees

Orientation and shape of building

Reduce Heat Gain

Decrease exposed surface area

Increase thermal resistance

Increase buffer spaces

Increase shading

Increase surface reflectivity Reduce solar heat gain

Decrease humidity levels

Promote Heat Loss

Increase air exchange rate (ventilation during night-time)

Pale colour, glazed china mosaic tiles etc. Use glazing with lower SHGC and provide shading for windows. Minimize glazing in East and West Ventilated roof construction, courtyards/

wind tower and arrangement of openings Dehumidifiers/desiccant cooling

Walls, glass surfaces protected by overhangs,

Warm & Humid (climate in India)

The warm and humid zone covers the coastal parts of the country, such as Kerala, Tamilnadu & Goa. The main design criteria in the warm and humid region are to reduce heat gain by providing shading, and promote heat loss by maximizing cross ventilation.

BUILDING DESIGN IN WARM-HUMID ZONES

Provide maximum ventilation and free air movement by large openings.

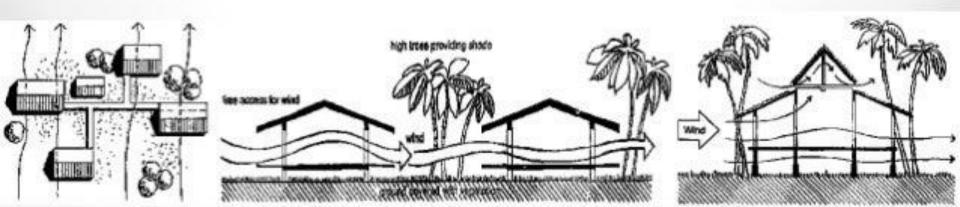
Provide maximum shading of direct and diffuse solar radiation.

Avoid heat storage.

Use reflective outer surfaces.

Use ventilated double roofs.

Use vegetation to moderate the solar impact



Warm and Humid Climate Zone

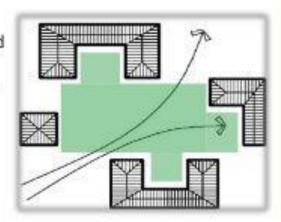
Comfort requirements and Physical manifestations in Buildings

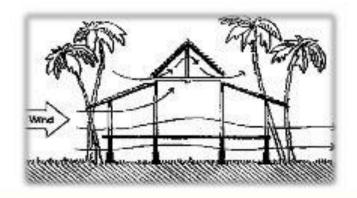


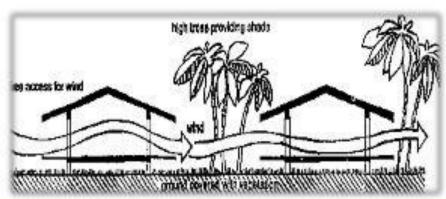
HOT AND HUMID

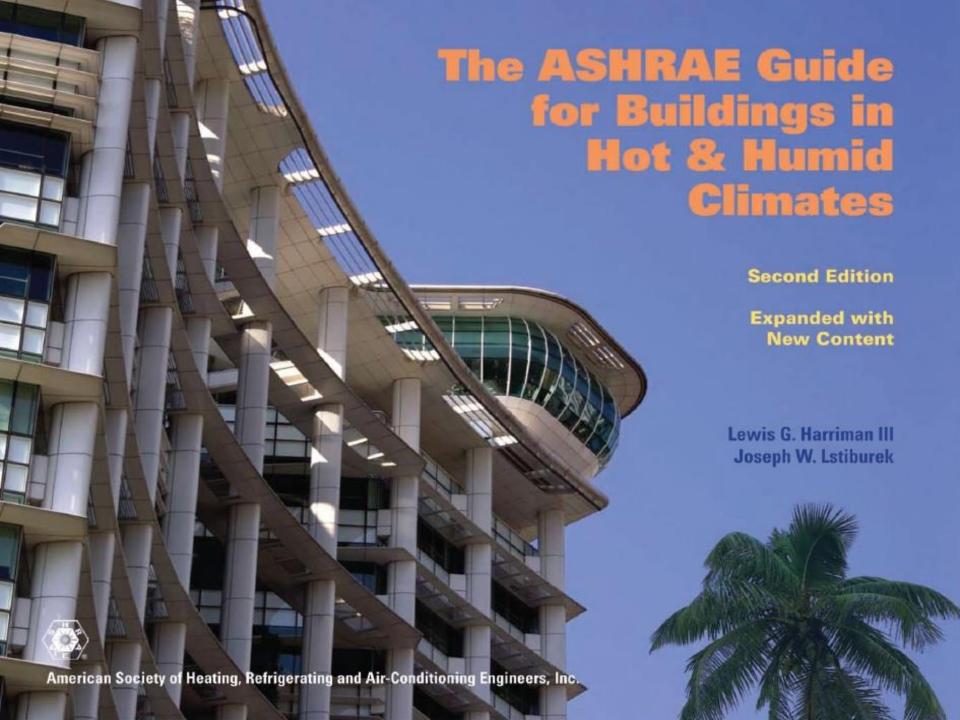
Orientation and ventilation:

- Semi open spaces for light and air movement.
- Buildings should be spread out with large open spaces in between for uninterrupted air movement.
- •Cross ventilation is very important. large openings to unobstructed air path and to ensure proper ventilation.
- •The openings should be shaded by external overhangs. Outlets at higher levels to vent hot air.
- Proper water proofing and quick drainage of water is essential due to heavy Rainfall.









• MODERATE • CLIMATE

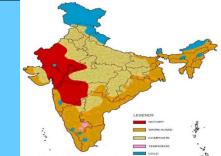
Moderate climate

- ☐The temperate climate has mild to warm summers and cool winters.
- The need for winter home heating is greater than the need for summer cooling.
- It is a relatively comfortable climate, especially near the coast, where summers are cooler and winters warmer than further inland.



Moderate/Temperate Climate Zone

Comfort requirements and Physical manifestations in Buildings



Thermal Requi	irements	Physi

ical Manifestation

Orientation and shape of building

Roof insulation and East and West wall

Walls, glass surfaces protected by overhangs,

Reduce Heat Gain

Decrease exposed surface area

Increase thermal resistance

Increase shading

Increase surface reflectivity

Promote Heat Loss

Increase air exchange rate (ventilation)

Pale colour, glazed china mosaic tiles etc.

insulation

East and West

fins and trees

Courtyards and arrangement of openings

MODERATE

{Local Places (Pune, Bangalore, Etc.)}

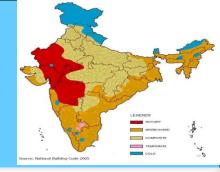
- SOLAR RADIATIONS (Moderate)
- TEMPERATURE RANGE (17–34°C)
- HUMIDITY (30-80%)
- •PRECIPITATION (<1000mm)</p>

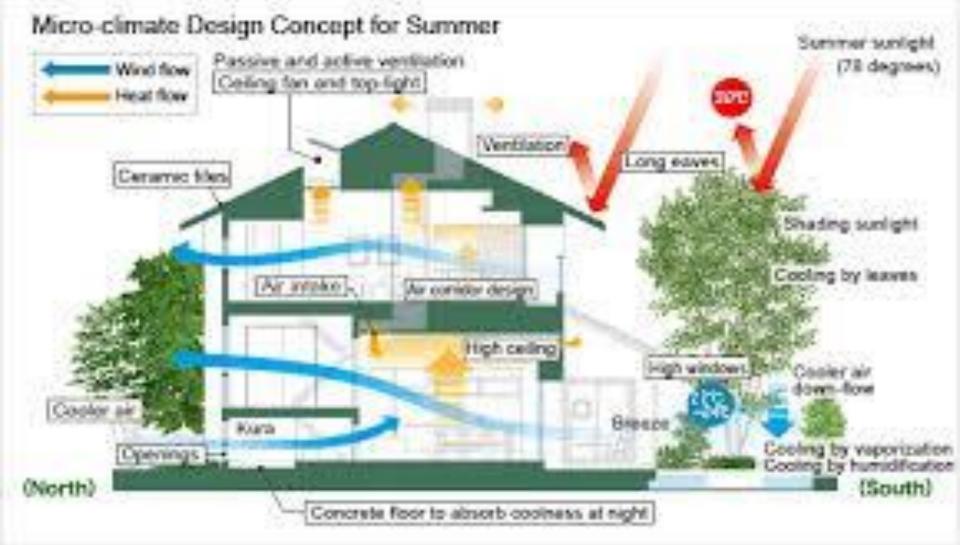


- •REDUCE HEAT GAIN BY SHADING DEVICES
- WALLS FACING EAST & WEST PROTECTED BY OVERHANGS.
- COURTYARD PLAN
- •WINTER HEATING IS MORE IMPORTANT
- SMALL OPENINGS IN EXTERIOR OF BUILDING
- PROPER CROSS VENTILATION

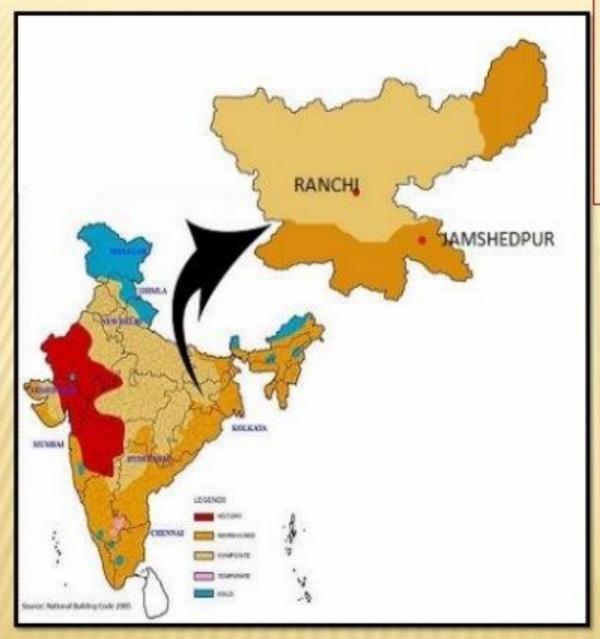
Moderate/Temperate Climate Zone

Comfort requirements and Physical manifestations in Buildings





· COMPOSITE · CLIMATE



AS PER NATIONAL BUILDING CODE, 2005 THE CLIMATIC ZONES IN INDIA IS-

1.HOT-DRY

2.WARM-HUMID

3.COMPOSITE

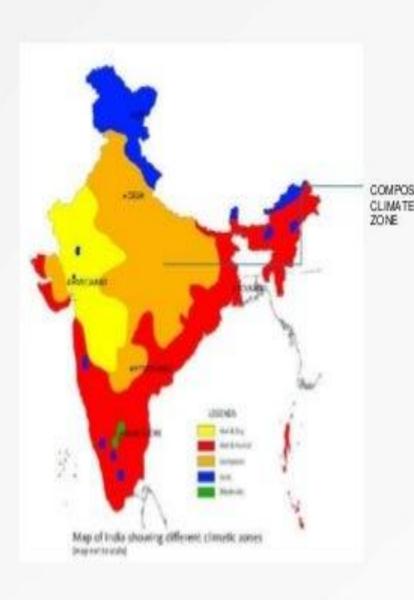
4.TEMPERATE

5.COLD

As can be seen from map the whole of Jharkhand, except a small portion of it to the south, falls within the composite zone of climate. Study-Area Ranchi district falls entirely in composite zone.

Hot and dry summer, followed by a humid season with monsoon rains. With the departure of the monsoon it gradually becomes comfortable in autumn. followed by a relatively short winter (3 months) with the cloudy and wet as well as sunny periods. Before the summer returns there is a comfortable but short spring season.

LOCATION AND MAIN CITIES



 The composite zone covers the central part of India. Some cities that experience this type of climate are New Delhi, Kanpur and Allahabad.

Composite Climate Zone-

Comfort requirements and Physical manifestations in Buildings



Thermal Requirements	Phy

ysical Manifestation

Reduce Heat Gain in Summer and Reduce Heat Loss in Winter

Decrease exposed surface area Orientation and shape of building. Use of trees as wind

barriers.

Increase thermal resistance

Roof insulation, wall insulation

Thicker walls Increase thermal capacity (Time Lag)

Air locks/Balconies Increase buffer spaces

Decrease air exchange rate Weather stripping (

> Walls, glass surfaces protected by overhangs, fins and trees

Pale color, glazed chins mosaic tiles, etc. Increase surface reflectivity

Use glazing with lower SHGC and provide shading for Reduce solar heat gain

windows. Minimize glazing in East and West

Increase shading

Promote Heat Loss in Summer/Monsoon

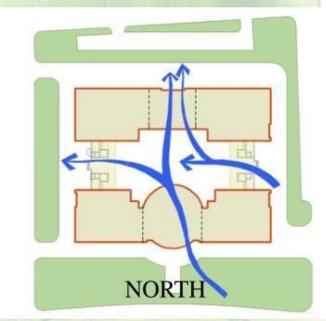
Increase air exchange rate (Ventilation) Courtyards/wind towers/arrangement of openings

Trees and water ponds for evaporative cooling

Increase humidity levels in dry summer Decrease humidity in monsoon Dehumidifiers/desiccant cooling

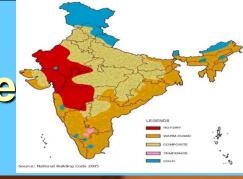
Design Strategies in Composite Climate

- Plan the building around the courtyard.
- Reduce heat gain in the building through building envelope.
- Plan water bodies
- cavity walls, terrace gardens, light shelves.



CROSS VENTILATION AT THE MICRO LEVEL THROUGH OPENINGS

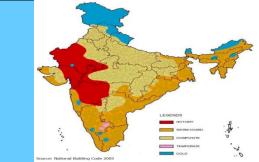
Composite Climate Zone





· COLD · CLIVIATE

Cold (Cloudy/Sunny) Climate Zone- Comfort requirements and Physical manifestations in Buildings



Thermal Requirements	Physical Manifestation	
Reduce Heat Loss		

Increase buffer spaces

Orientation and shape of building. Use of Decrease exposed surface area

trees as wind barriers.

Roof insulation, wall insulation and double Increase thermal resistance

glazing

Increase thermal capacity (Time Lag) Thicker walls

Air locks/Lobbies

Weather stripping and reducing air Decrease air exchange rate

leakage.

Darker colours

Promote Heat Gain

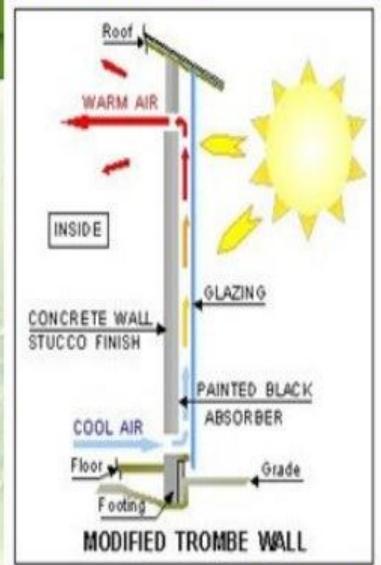
Increase surface absorption

Reduce shading Wall and glass surfaces Trapping heat

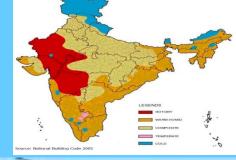
Sun spaces/green houses/trombe walls etc.

Design Strategies in Cold Climate

- Glazing windows up to 25% floor area
- Double glazing to avoid heat losses during winter nights.
- Adopt Trombe walls.
- Sunspaces



Cold (Cloudy/Sunny) Climate Zone- Comfort requirements and



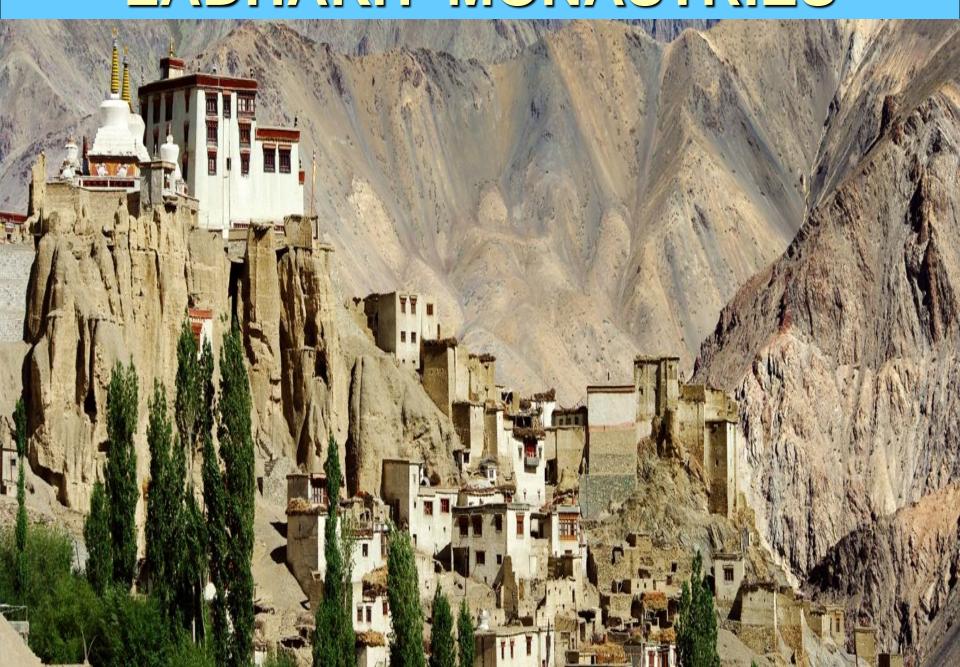




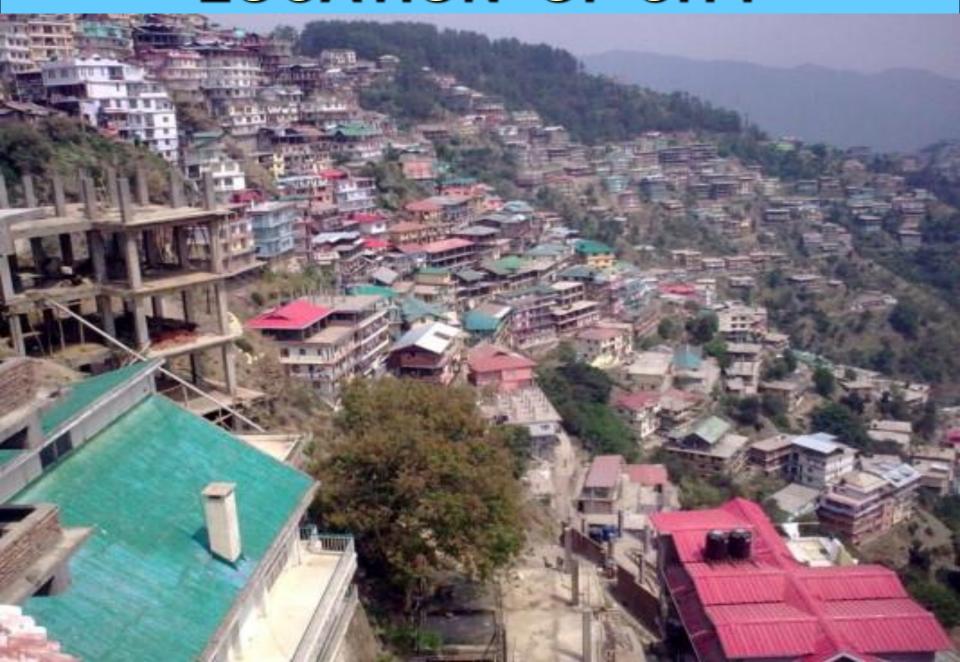
Cold (Cloudy/Sunny) Climate Zone



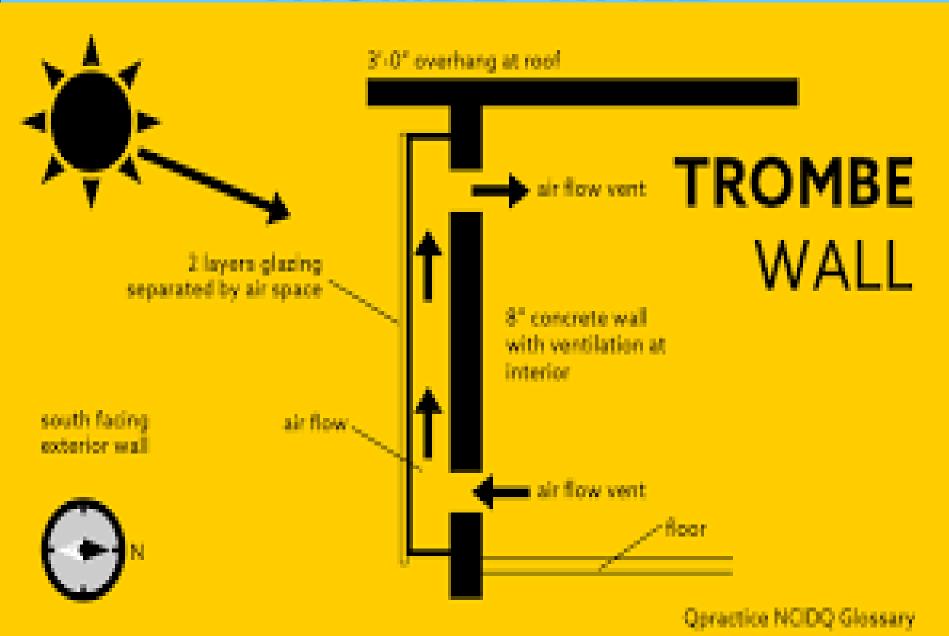
LADHAKH MONASTRIES



LOCATION OF CITY

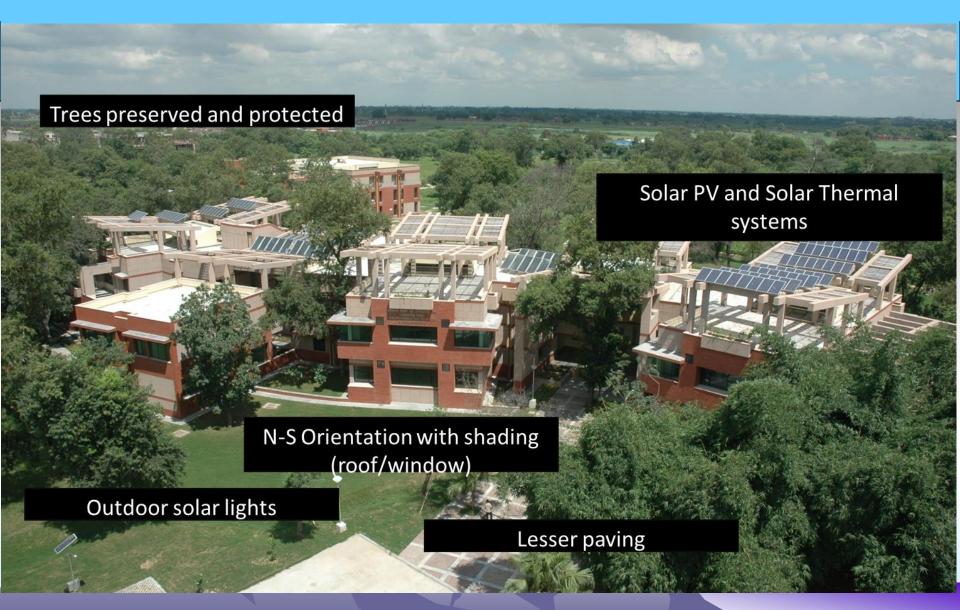


TROMBE WALL



Case Studies

Low Impact Design

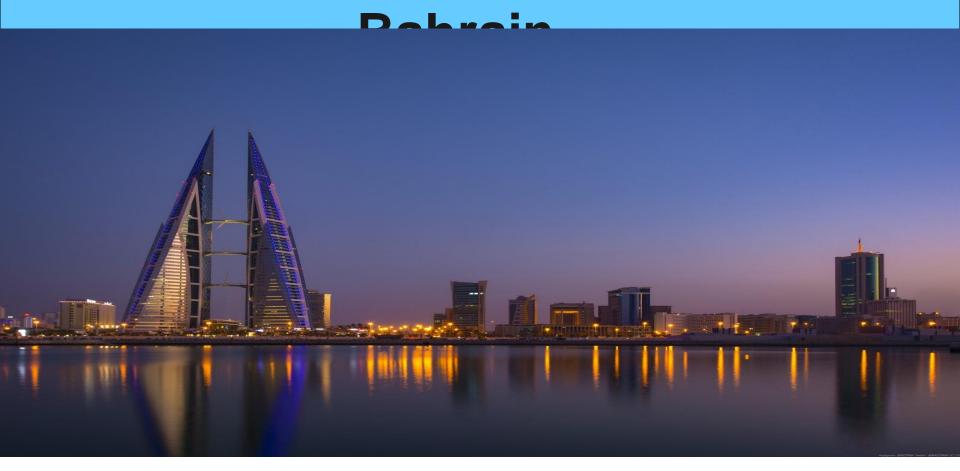






SECRETARIAT

Bahrain World Trade Center -



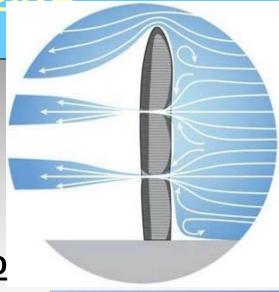
- Generating 15% energy from windmills
- Two 240 meter twin sky scrapers joined by three windmill--, each 3 meters wide, attached to walkways
- :designed/ built by Atkins in city of Manama

PEARL RIVER TOWER- GUANGZHOU, CHINA NET ZERO ENERGY BUILDING



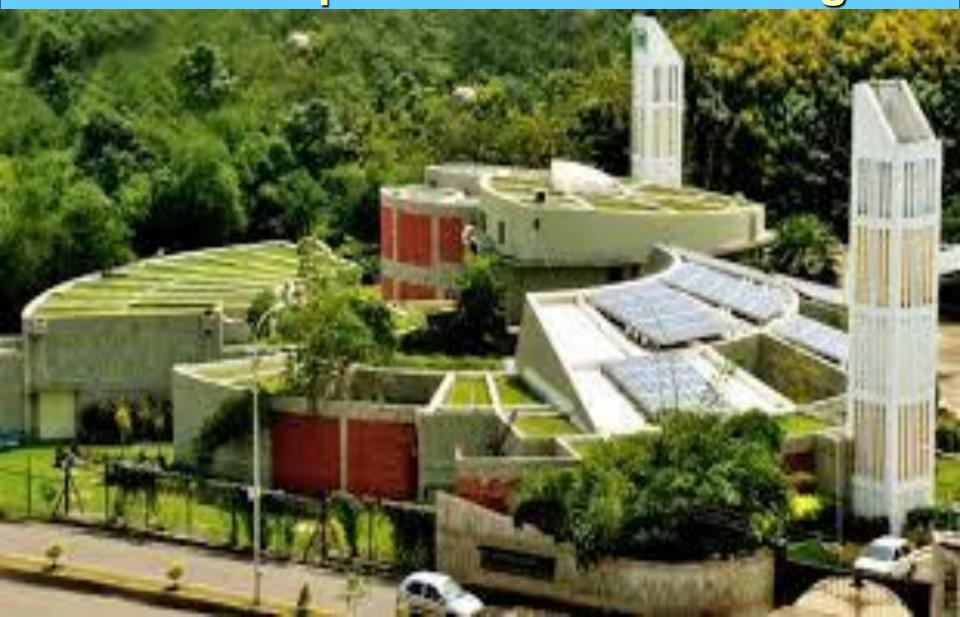
YEAR OF COMPLETION- 2011
SITE AREA-10635SQ.M.
PROJECT AREA- 214,100SQ.M.
(2.3MILLION SQ.FT.)
NO. OF STORIES- 71
HEIGHT OF BUILDING-309 M
ENERGY EFFICIENCY ACHIEVED
THROUGH

SOLAR PANELS
PHOTO VOLTAIC CELLS
WIND TURBINES
DAY LIGHT HARVESTING
DOUBLE SKIN CURTAIN WALLS
CHILLED CEILING WATER
UNDER FLOOR VENTILATION





Godrej Sohrab ji Building-Hyderabad-India's first platinum rated building



Indoor Environmental Quality

- Indoor Air Quality is continuously monitored and minimum fresh air is pumped into the conditioned spaces at all smes
- Fresh air is also drawn into the building through wind towers
- Use of low Volatile Organic Compound (VOC) Paints & Coatings, Adhesives, Sealants and Carpets
- Maximum day lighting
- Operable windows and lighting controls for better day lighting and views
- Fenestration maximized on the north orientation



Daylight & Views (Glazing)

Cost and Benefits

This was the first green building in the country. Hence, the incremental cost was 18 % higher.

However, green buildings coming up now are being delivered at an incremental cost of 6 - 8%. The initial incremental cost gets paid back in 3 to 4 years.

Benefits achieved so far

- Over 1,20,000 kWh of energy savings per year as compared to ASHRAE 90.1 base case
- Potable water savings of 40% vis-à-vis conventional building
- Excellent indoor air quality
- 100 % day lighting (Artificial lights are switched on just before dusk)
- Higher productivity of occupants



Swale

Project Details

Location

Hyderabad, India

Type

Office Building

Size

- 4,5 acres (Total site area)
- 1,858 sq m (Total built up area)
- 1,115 sq m (Total air conditioned area)

Building details

- Office building
- Seminar hall
- Green Technology Centre displaying the latest and emerging green building materials and technologies in India
- Large number of visitors are escorted on green building tour.

Rating

Awarded with LEED Platinum for New Construction (NC) v 2.0 by the US Green Building Council (USGBC) in November 2003

Measurable Results

- Energy savings
 120,000 kWh / year
- Reduction in CO2 emissions

100 tons / year (building is functional since January 2004)

- Water savings
 - 40% reduction in potable water consumption
- Renewable energy generated

31,000 kWh / year



Water Body



Parking shaded with trees

CII

Confederation of Indian Industry CII-Sohrabji Godrej Green Business Centre

S Srinivas

Principal Counsellor

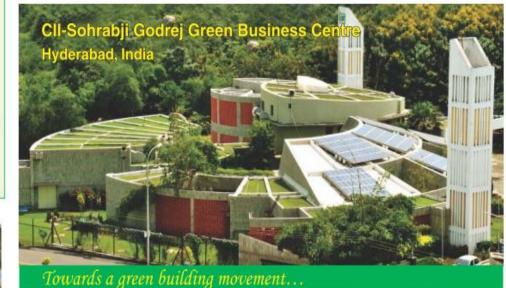
Principal Coursellor
CII-Sohrabij Godrej Green Business Centre,
Survey No 64, Kothaguda Post, Hyderabad - 500 084
Tel: +91 40 44185111, Fax: +91 40 23112837
s.srinivas@cil.in | igbo@cil.in

www.igbc.in





Greening Imffa since 2003



yderabad, the city of pearls and an IT hub of India can now boast of one of the Greenest Buildings in the world.

CII - Sohrabji Godrej Green Business Centre (CII - Godrej GBC), Hyderabad, is a unique and successful model of public - private partnership between the Government of Andhra Pradesh, Pirojsha Godrej Foundation and the Confederation of Indian Industry (CII), with the technical support of USAID.

CII - Godrej GBC building has been awarded the prestigious 'Platinum rating' under LEED (Leadership in Energy and Environmental Design) program of USGBC (US Green Building Council). The CII - Godrej GBC building is the first LEED Platinum Rated Green Building outside of USA and the third in the world.

The building has transformed a sleepy hamlet studded with undulating terrain and a rocky landscape to a focal point on all aspects related to Green.

Amidst environs surrounded by the HITEC City and an up-market residential area, the 20,000 sq ft building stands out as a symbol of harmony between nature and architecture.

The CII-Godrej GBC is the Centre of Excellence for Green Buildings, Energy Efficiency, Renewable energy, Environment & Recycling, Water Management and Climate Change activities in India.



The inner courtyard of the building

Green Features

The CII - Godrej GBC building heralds the beginning of the Green Building movement in India.

he building has been rated based on the following features:

- Water Efficiency
- Sustainable Site
- Energy Efficiency
- Materials & Resources
- Indoor Environmental Quality

Water Efficiency

Zero water discharge building

- The entire waste water, grey & black water generated in the building is treated by Phytoremediation or Natural Biological System (NBS). The system uses a wide range of natural elements such as plants with proven remediation abilities, sediments with different physical and chemical properties and various Hydrology regimes to treat the waste water. The treated water is reused for landscaping
- Water-less urinals used in men's rest room.
- Rain water harvesting system to reuse strom water
- Water efficient fixtures ultra low & low flow flush fixtures



Phytoremediation

Sustainable Site

Minimum disturbance to the site

 The building design was conceived to have minimum disturbance to the surrounding ecological environment. The disturbance to the site was limited within 40 feet from the building foot print during construction phase

- This has ensured to retain majority of the existing flora & fauna and natural microbiological organisms around the building
- Extensive erosion and sedimentation control measures to prevent top soil erosion have been done at the site during construction
- Large vegetative open spaces



Roof Garden

Boot Garden

Double Glazing

Energy Efficiency

- Installed the state-of-the-art Building Management System (BMS) for real time monitoring of energy consumption
- Use of aerated concrete blocks for facades reduces 15 - 20 % load on air-conditioning, U-Value of solid wall: 0.57 Watt/sq.m.*K
- Double glazed units with argon gas filling between the glass panes, have enhanced the thermal properties.
 U-Value of double glazing: 1.70 Watt /sq.m°K
- Water cooled scroll chiller: 0.8 kW / ton (Water cooled scroll chiller system with CoP; 4.23 at ARI condition)
- Installed two 25 TR chillers
- Secondary chilled water pumps installed with Variable Frequency Drives (VFDs)
- Energy efficient lighting design through Compact FluorescentLamps (CFLs)
- Roof garden covering 60% area. U-Value of roof; 0.294 Watt/sq.m.*K

Materials and Resources



Furniture made of composite wood

- 80% of the materials used in the building are sourced within 500 miles from the project site. Most of the construction material is also having post consumer & industrial waste as a raw material during manufacturing process
- Fly ash based bricks, glass, aluminum, and ceramic tiles, which have post consumer and industrial waste are used in constructing the building to encourage usage of recycled content
- Office furniture is made of bagasse based composite wood
- More than 50% of the construction waste is recycled within the building or sent to other sites and diverted from landfill



Salvaged tiles for pillar cladding

Wind Towers

Other Notable Green Features

- HFC Based refrigerant in chillers
- Swales for storm water collection
- Electric vehicle for staff use
- Car parking shaded with trees
- Energy Efficiency Index (EEI) 84 kWh / sq m / year

Renewable Energy

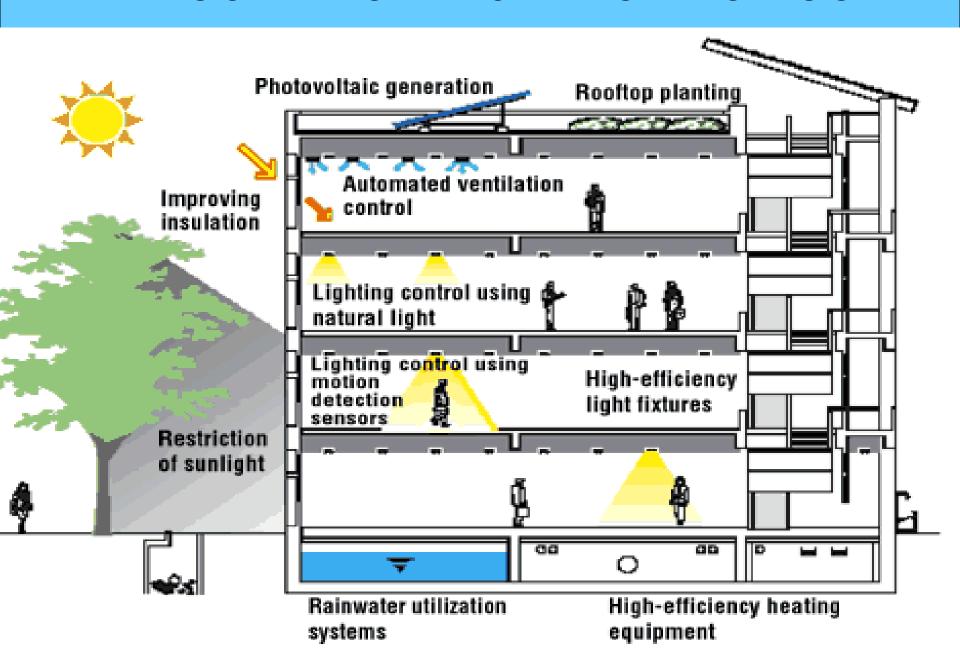
- 20 % of the building energy requirements are catered by Solar Photovottaics
- The Solar PV has an installed capacity of 23.5 kW



Solar Photovoltaics



ELEMENTS OF ENERGY EFFICIENT BUILDING DESIGN - 1



'A Green building makes you

Happy, Healthy and More Productive

Provides highest quality of indoor environment

Optimizes Resources, , Reduces Waste,

Reduces Carbon Footprints

makes building operations cost effective and energy efficientcreate win-win situation for owner; occupant; user; tenant

- 'Natural Capitalism'



