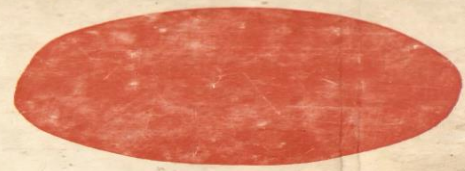


THE RADIANT CITY

THE ORION PRESS

soleil



espace

verdure



What makes a Building Green

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Buildings- Role and Importance

- **Buildings-- integral part of human history, growth and development since inception**
- **Buildings –also to define future journey of human growth**
- **Buildings-- constitute manmade environment-**
- **Buildings-- remain vital for human growth**
- **Buildings – are living organism**
- **Buildings – cater to all human activities**
- **Buildings- full of dualities and contradictions**
- **Buildings -- largest consumers of energy**
- **Buildings - largest consumers of resources**
- **Buildings – largest generators of waste**
- **Buildings- largest polluter of environment /ecology**
- **Buildings --- responsible for largest carbon footprints**
- **Buildings -- responsible for global warming**
- **Buildings -- major determinant of global sustainability**

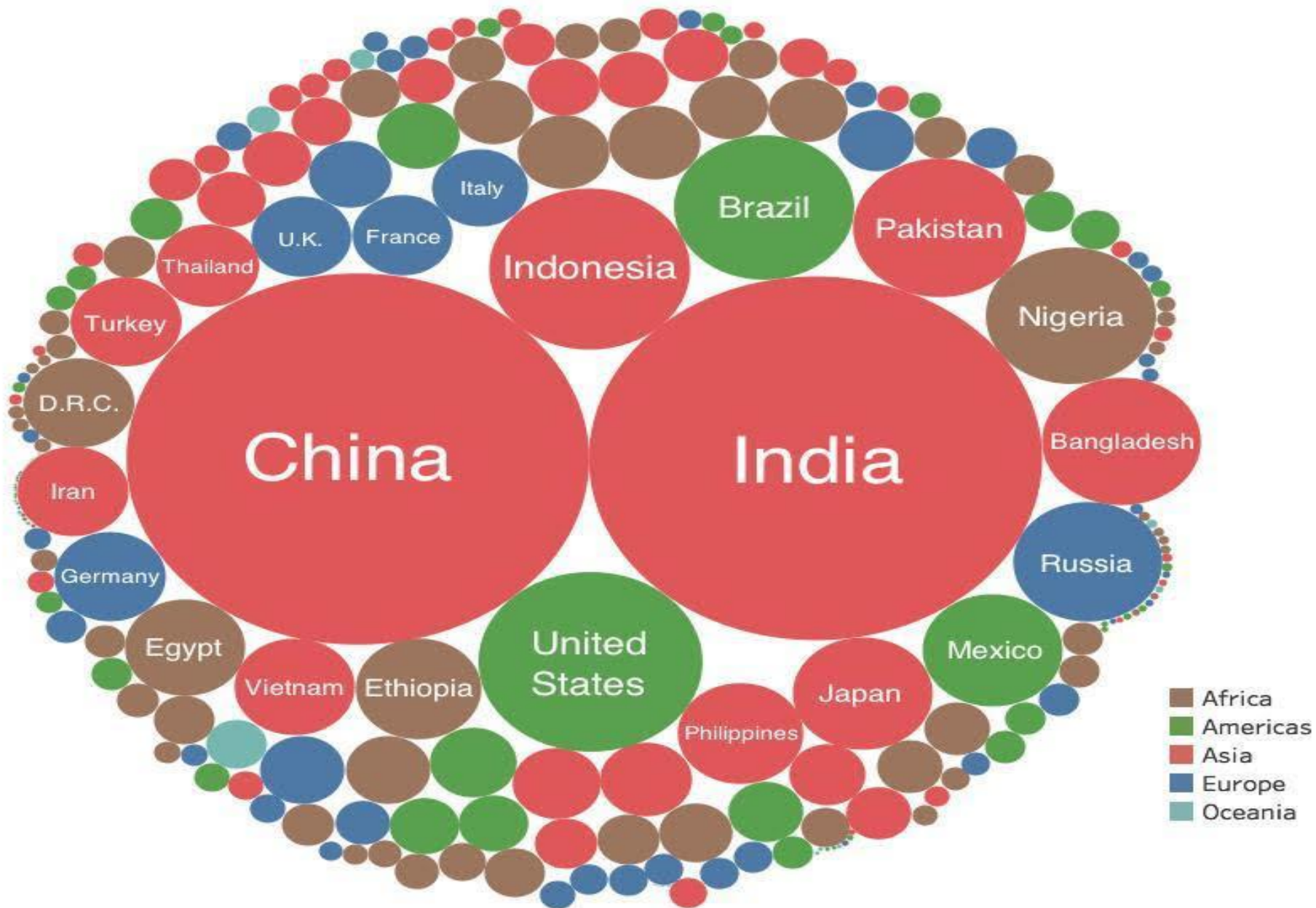
Buildings- Role and Importance

- **Buildings— providers of optimum/worst living conditions**
- **Buildings -- make people healthy/sick**
- **Buildings --critical because 80% human life spent in buildings**
- **Buildings vital to overcome human/ ecological concerns**
- **Making Buildings Sustainable-- essential for;**
- **-- making value addition to;**
- **-- resources,**
- **-- environment ,**
- **--ecology**
- **Studies have revealed —**
- **A Green School--makes learning easy/ more meaningful**
- **A Green House--- makes people happy and healthy**
- **A Green Hospital-- cures patients quickly**
- **A Green Shopping Mall-- can increase sales / profits**

Buildings- Built Environment

- **Operational domain of professions of Architecture/ Engineering revolves around;**
- **--creating state of art built environment, involving;**
- **--Siting**
- **-- planning/ designing,**
- **--construction,**
- **--operation,**
- **-- maintenance**
- **--Demolition and**
- **-Reconstruction**
- Professionals– have critical role & responsibility for**
- making value addition to-resources ,environment ,ecology**
 - **-- by creating sustainable built environment.**
- Going green --necessity--to ensure -sustainable tomorrow**
- Each building remains unique**
- need different options to make it green**

Countries by Population Size



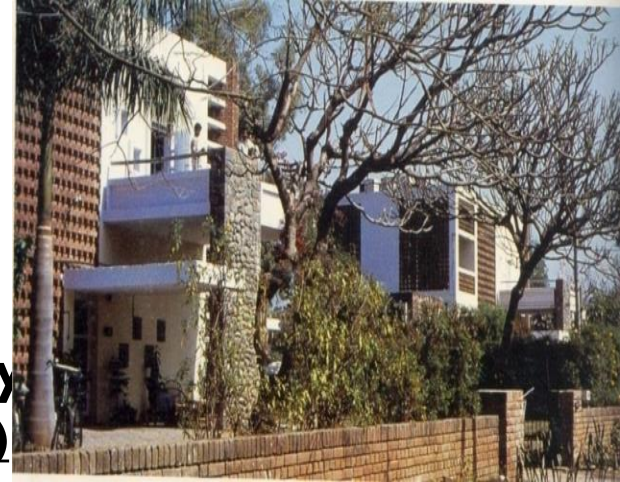
Population Scenario- India-2011

- Population of India reached
- 1210 million in 2011
- 2050- Indian population- 1600 mil. -- 50% in Urban India.
- During last 100 years, India witnessed—
 - Urbanization level going up by 3 times
 - --Urban settlements growing merely 4 times
 - --Total Population multiplying 5 times
 - -Urban population increasing 15 times and
 - -Rural population increasing 3.5 times
- Increased population requires
 - --More cities,
 - -More Buildings
 - More housing,
- More educational/ healthcare/ institutions

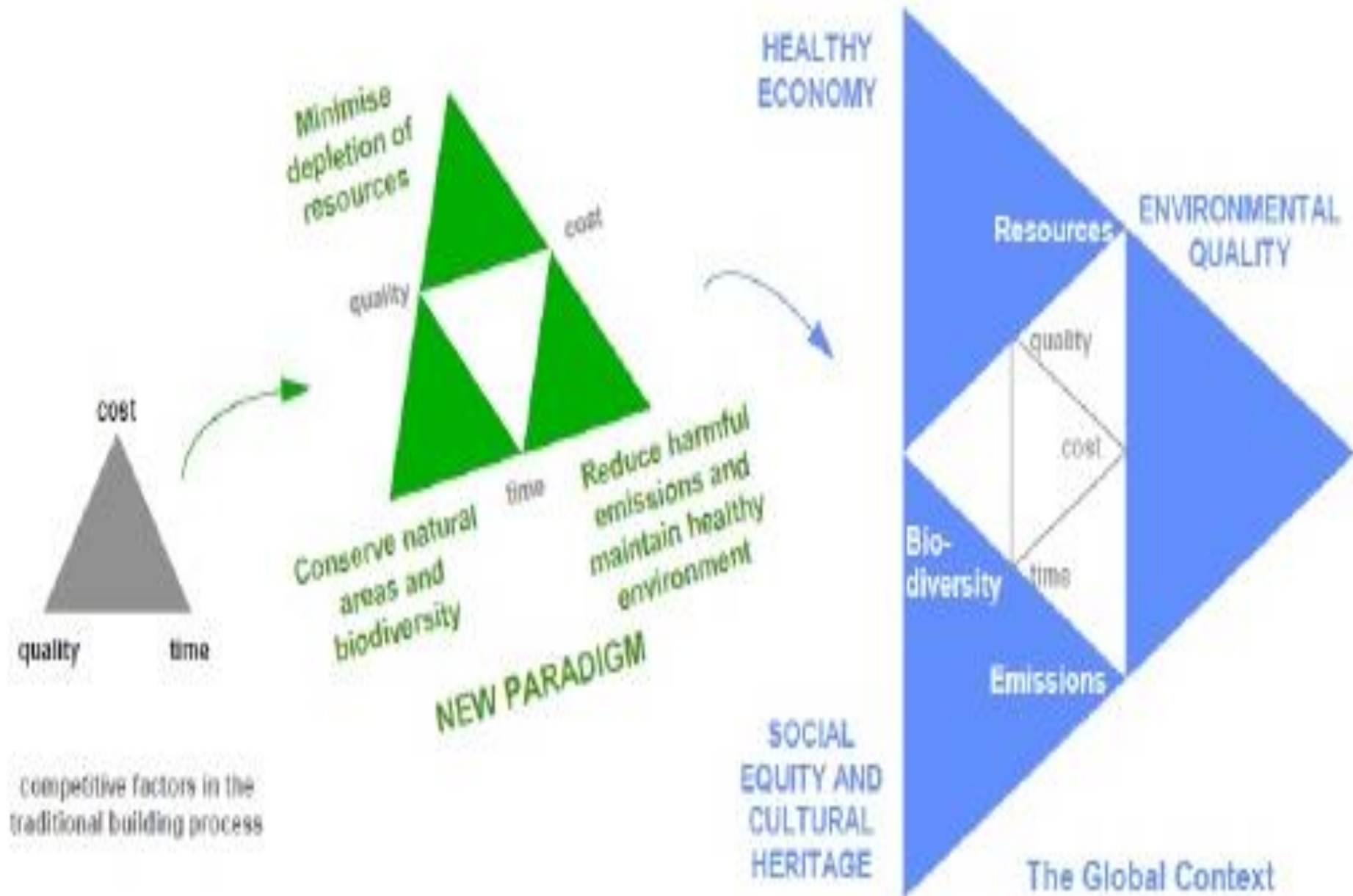


BUILDINGS AS CONSUMERS OF RESOURCES

- **Built environment impact environment / consumption of resources:**
 - **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 the residents having sick building syndrome**
(Roodman and Lenssen, 1995)
- **70% global warming--outcome of buildings / transportation**
- **Existing buildings--low concern for energy conservation.**
- **Considering annual addition of- 700-900msqmts**
 - **energy/ environment implications can be critical.**
- **Buildings to be designed /constructed and operated with utmost care for**
 - **energy**
 - **sustainability**
 - **resources**



Changing construction perceptions





Designing 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

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



Need for Green Buildings

- ---Considering major implications of built environment
- -- buildings made Sustainable---Energy efficient--Eco-friendly- Water efficient-- Green
- large Reduction of--- Energy / Resources/ Green house gas emission possible by;
 - *Adopting integrated approach to creating built environment.*
 - *Evolving climatic responsive building designs*
 - *Using Energy efficient- low energy -Materials -- Equipment--- Technologies.*
 - *Retro fitting of existing buildings.*
 - --for making buildings sustainable
 - --- new field - “Green Building” -- gaining momentum
- --Sustainable Dev Goals also calls for;
- - -Promoting Energy efficient buildings,
- -Net Zero energy buildings and
- - Green Rated Buildings

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

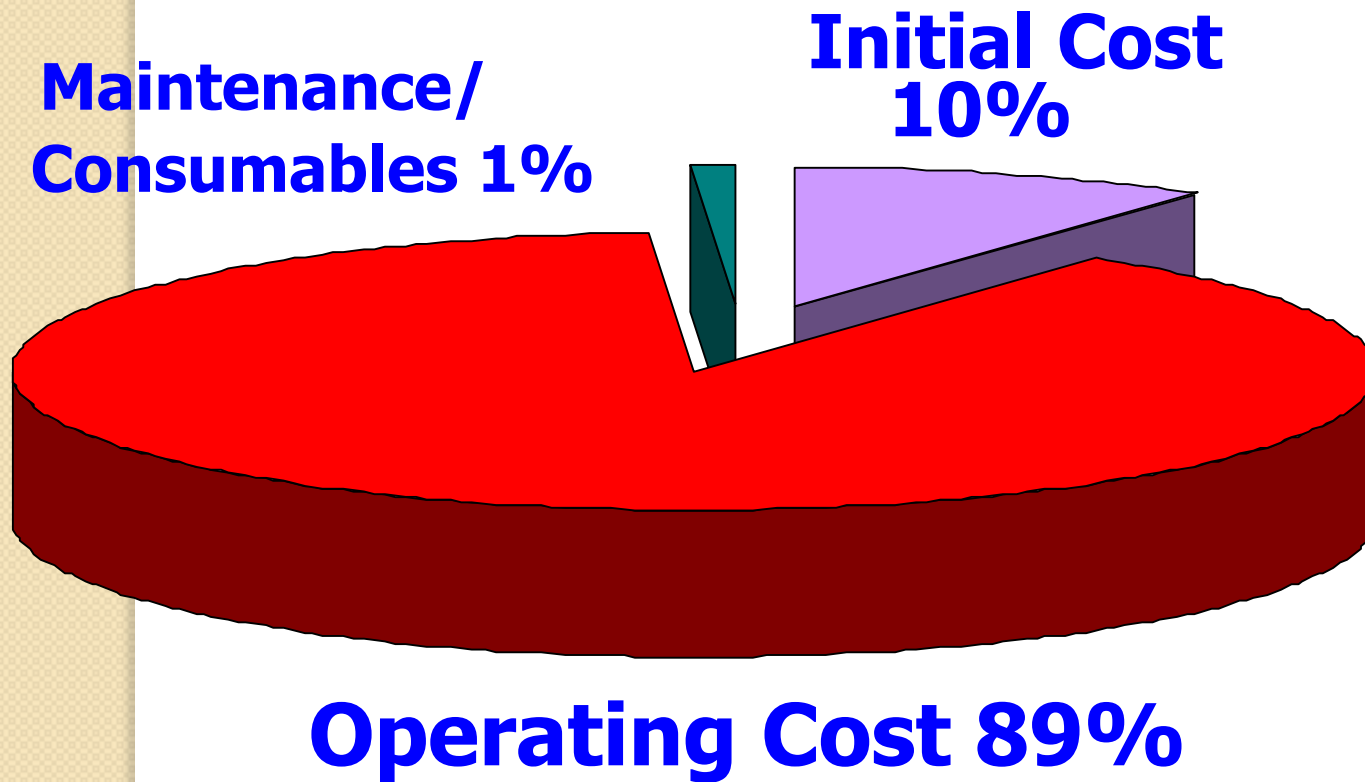
- **Environmental benefits**
 - **Reduce impact on environment--** Reduce destruction of natural areas, habitats, biodiversity
- **Health and Safety benefits**
 - **Enhance occupant comfort--** Improve Productivity of occupants



ISRO-NRSC, Shadnagar, Hyderabad

Cost of Green Buildings-Indian Experience					
Building	Year awarded	Built-in Area (sq.ft)	Rating Achieved	% Increase in cost	Payback (Yrs)
CII-Godrej GBC, Hyderabad	2003	20,000	Platinum	18 %	7 years
ITC Green Centre, Gurgaon	2004	1,70,000	Platinum	15 %	6 years
Wipro, Gurgaon	2005	1,75,000	Platinum	8 %	5 years
Technopolis, Kolkata	2006	72,000	Gold	6%	3 years
Spectral Services Consultants Office, Noida	2007	15,000	Platinum	8%	4 years
Kalpataru Square	2008	3,00,000	Platinum	2%	2 years
Suzlon One Earth, Pune	2010	8,00,000	Platinum	2%	2 years
❖ Cost showing a decreasing trend over the years					
❖ Incremental Cost lower-- if base design has already factored normal Green features					

Green Buildings- life cycle costs



Designing Green Buildings

i **Decision to build Green - taken at earliest in design process for::**

- --Maximizing green potential
- --Minimizing re-design
- --Assured overall success and
- --Achieving economic viability of Green Building Project
- **li. Setting Green Goals/ Objectives for:**
- -Energy Efficiency
- --Water consumption
- --On site treatment of rain/storm water
- —Material/ Resource management
- -Construction waste Management
- **lii. 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 Adopting Key Principles/Strategies-**
- i Sustainability in built environment,
- li Water/waste management ,
- lii Energy Management,
- Iv Material/ Resource Management and V Indoor air Quality

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 natural light and heat gain/heat loss

4-- **Sun movement**-- to maximizes use of free solar energy for heating /lighting

5.--**Wind direction**---using movement of air for ventilation/ cooling

6. --**Planning of Building**-- to optimize the site, shape of building, planning spaces, allocating uses, placing of rooms, circulation, promoting building efficiency, promoting natural sunlight, air and ventilation

7. --**Designing Building Envelop**---positioning of openings and projections, planning for shading devices, determining height/ shape of building, natural lighting and ventilations etc

8.--**Materials**- Materials used for buildings- low embodied materials locally available and - in natural form, lightweight – reduce self load

9.--**Technology**- cost- effective/ material efficient, speedier construction, energy efficient

10.-**Indoor Air Quality**- Creating optimum living conditions for residents

Rediscovery of the Indian ethos

- 5 elements of Nature (Panchabhutas)

Prithvi (Earth)	Site Selection and Planning
Jal (Water)	Water Conservation
Agni (Fire)	Energy Efficiency
Vayu (Air)	Indoor Environmental Quality
Akash (Sky)	Daylight, Night Sky Pollution



Water Body



Courtyard



Local materials



Views



Daylighting

Integrated Design Process

- **Five Climatic Zones In India-**

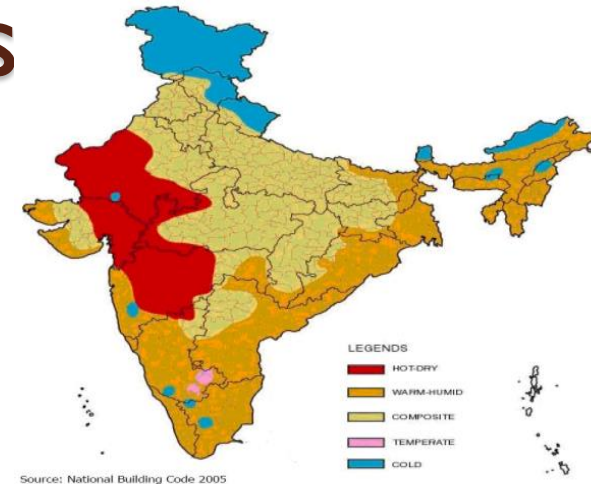
- Hot and Dry
- Warm and Humid
- Moderate / Temperate
- Cold (Cloudy/Sunny)
- Composite

- **All green buildings cannot be same**

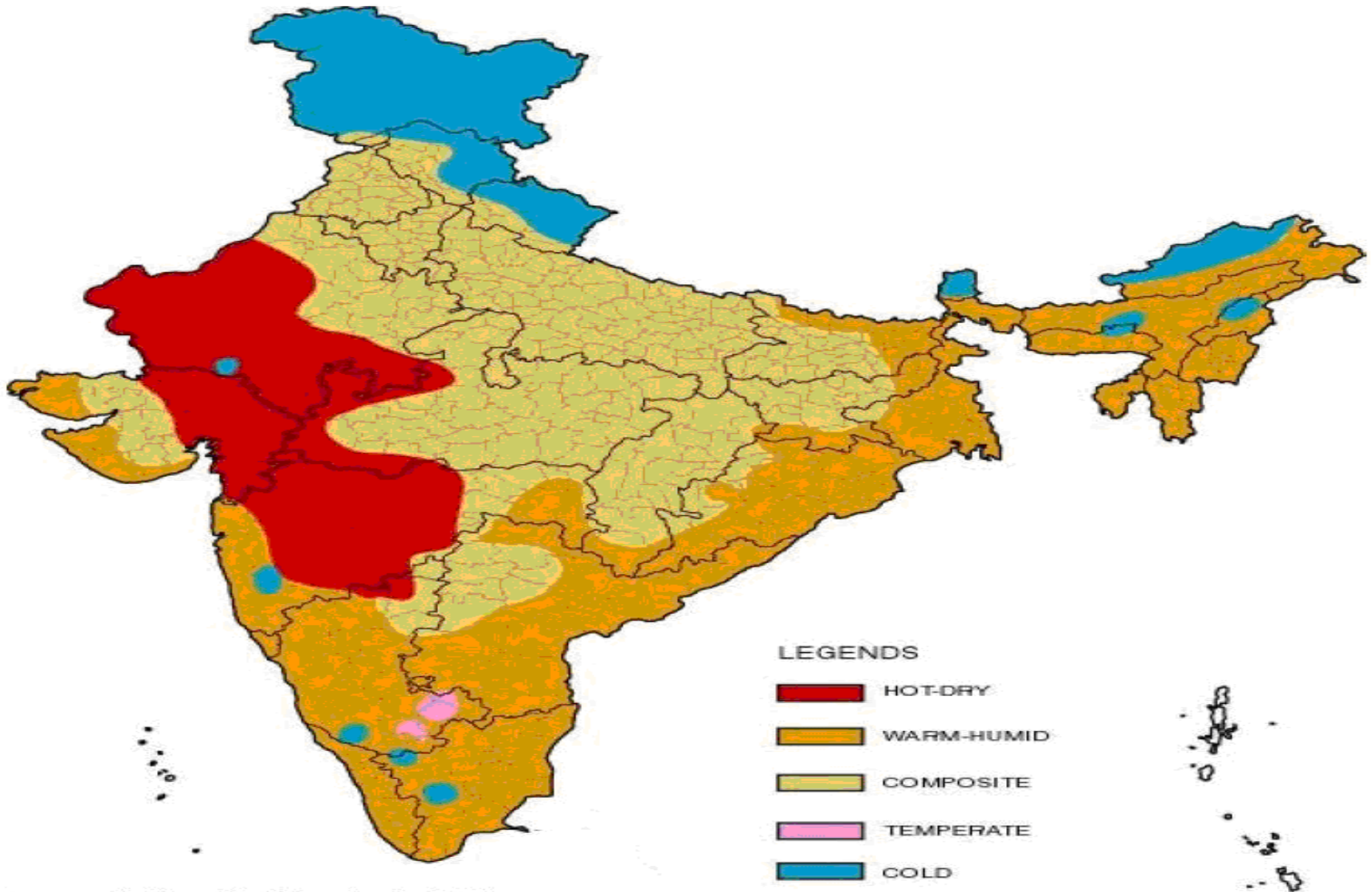
All zones have specific requirements regarding:

- light,
- heat,
- ventilation and
- thermal comfort

- **Different zones require different design strategies regarding --**
building envelop,
- --HVAC,
- -- lighting ,
- -- fenestration,
- -- performance standards

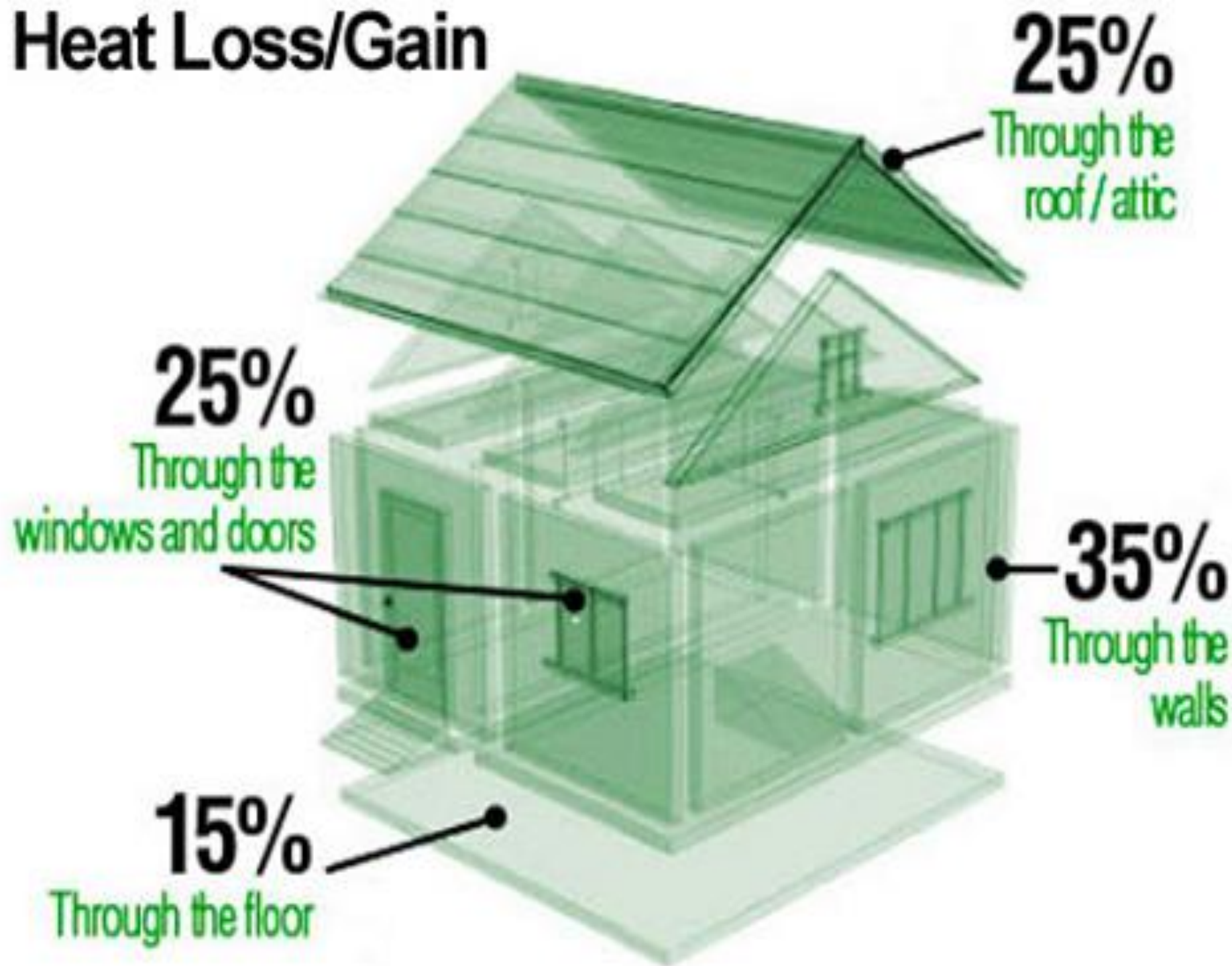


INDIAN CLIMATIC ZONES



Source: National Building Code 2005

Heat Loss/Gain



Hot and Dry Climate Zone-

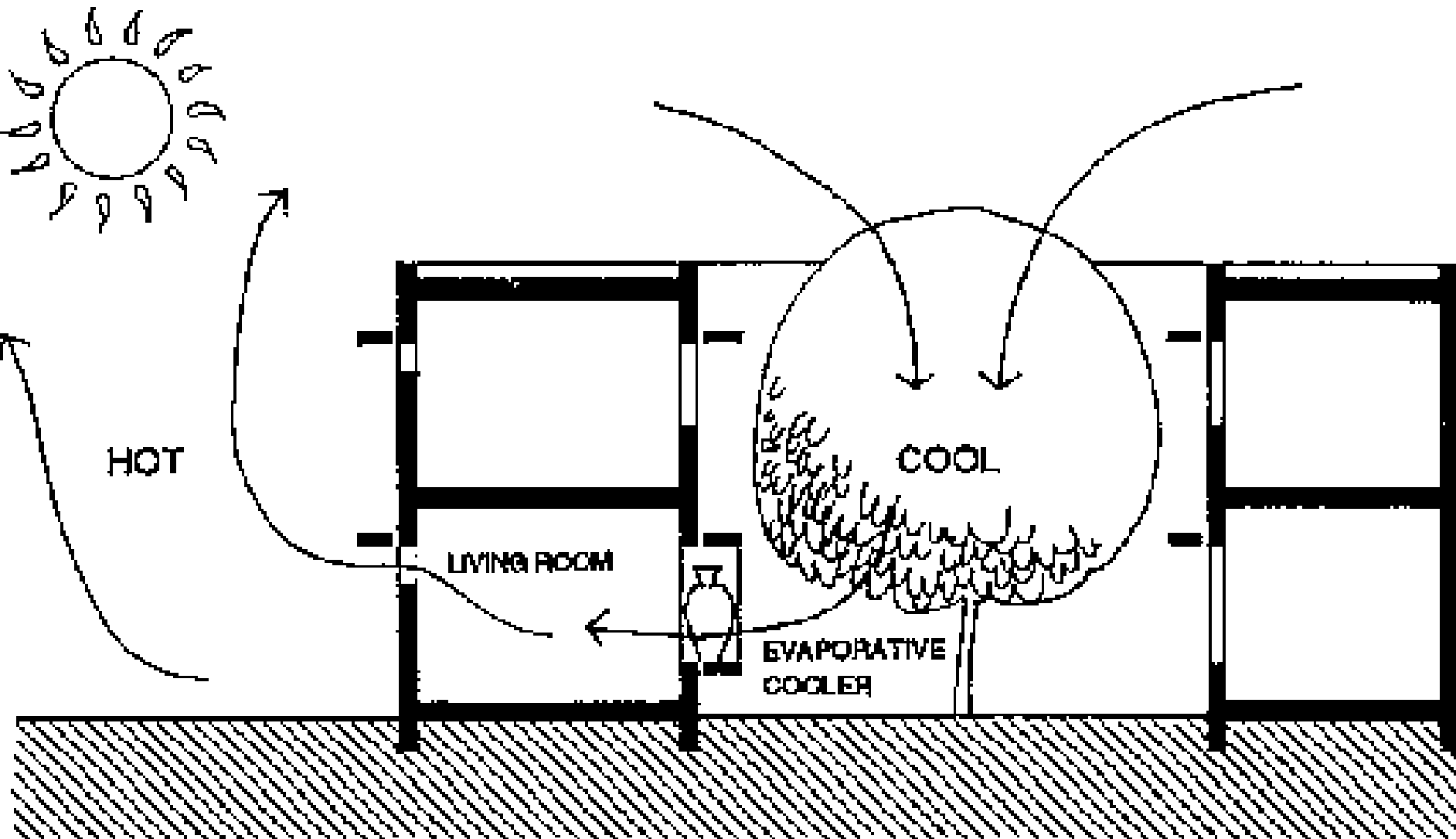
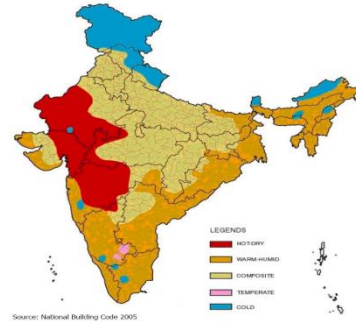
Comfort requirements and Physical manifestations in Buildings

Source: National Building Code 2005

Thermal Requirements	Physical Manifestation
Reduce Heat Gain	
Decrease exposed surface area	Orientation and shape of building
Increase thermal resistance	Insulation of building envelope/roof/walls
Increase thermal capacity (Time lag)	Massive structure
Decrease air exchange rate (ventilation during the day)	Smaller windows openings, night ventilation
Increase buffer spaces	Create Air locks/lobbies/balconies/verandahs
Increase shading	Protect External surfaces by- Overhangs, Fins and Trees
Increase surface reflectivity	Use Pale Colour, glazed china mosaic tiles etc.
Reduce solar heat gain	Use glazing with Lower Solar Heat Gain Co-efficient-SHGC and provide shading for windows. Minimize glazing in East and West
Promote Heat Loss	
Increase air exchange rate (ventilation during night-time)	Courtyards/wind tower/arrangement of openings

Hot and Dry Climate Zone-

Comfort requirements and Physical manifestations in Buildings

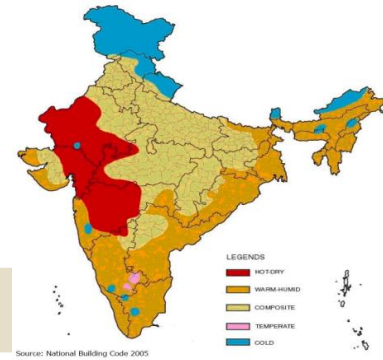


Cavity Walls



Warm and Humid Climate Zone

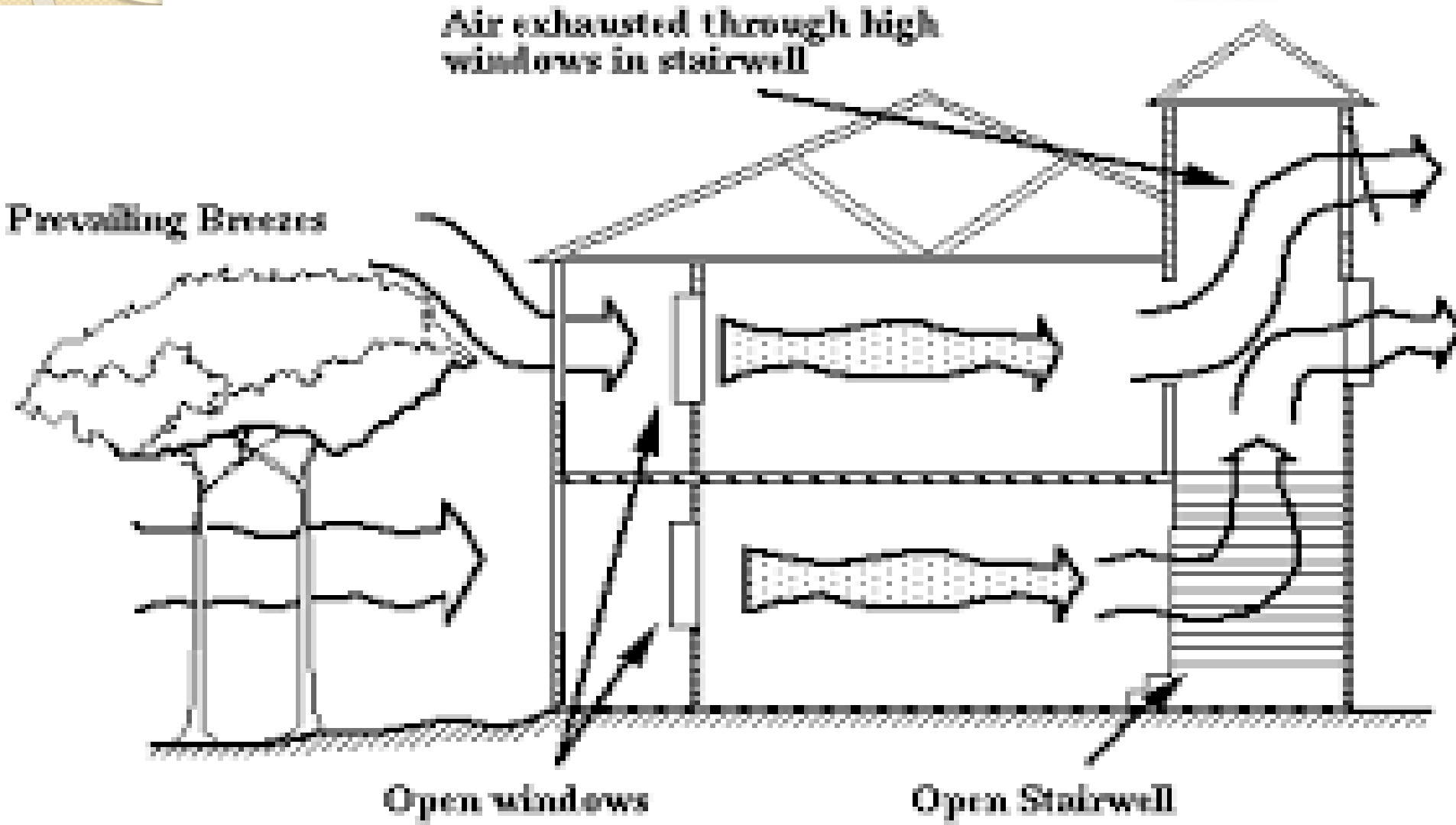
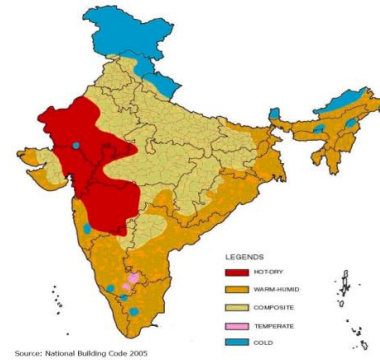
Comfort requirements and Physical manifestations in Buildings



Thermal Requirements	Physical Manifestation
Reduce Heat Gain	
Decrease exposed surface area	Orientation and shape of building
Increase thermal resistance	insulation of Roof and wall
	Reflective surface of roof
Increase buffer spaces	Balconies and verandahs
Increase shading	Walls, glass surfaces protected by overhangs, fins and trees
Increase surface reflectivity	Pale colour, glazed china mosaic tiles etc.
Reduce solar heat gain	Use glazing with Lower SHGC and provide shading for windows. Minimize glazing in East and West
Promote Heat Loss	
Increase air exchange rate (ventilation during night-time)	Ventilated roof construction, courtyards/ wind tower and arrangement of openings
Decrease humidity levels	Dehumidifiers/desiccant cooling

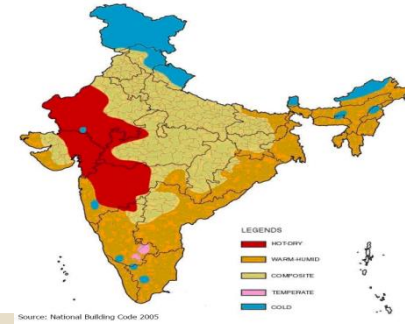
Warm and Humid Climate Zone

Comfort requirements and Physical manifestations in Buildings



Moderate/Temperate Climate Zone

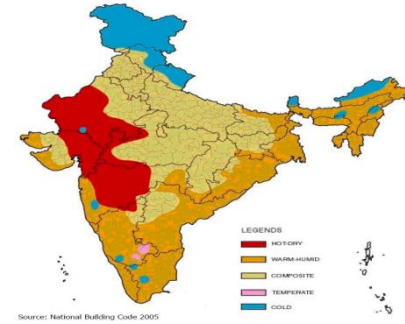
Comfort requirements and Physical manifestations in Buildings



Thermal Requirements	Physical Manifestation
Reduce Heat Gain	
Decrease exposed surface area	Orientation and shape of building
Increase thermal resistance	Roof insulation and East and West wall insulation
Increase shading	East and West Walls, glass surfaces protected by overhangs, fins and trees
Increase surface reflectivity	Pale colour, glazed china mosaic tiles etc.
Promote Heat Loss	
Increase air exchange rate (ventilation)	Courtyards and arrangement of openings

Moderate/Temperate Climate Zone

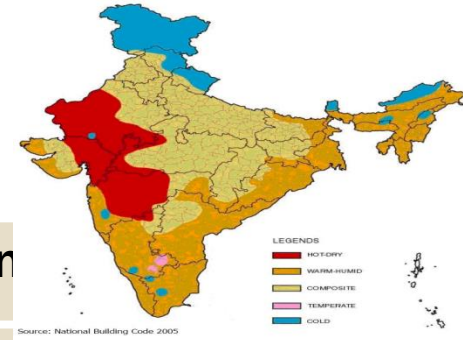
Comfort requirements and Physical manifestations in Buildings



Micro-climate Design Concept for Summer



Composite Climate Zone-



Thermal Requirements

Physical 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
Increase thermal capacity (Time Lag)	Thicker walls
Increase buffer spaces	Air locks/Balconies
Decrease air exchange rate	Weather stripping (
Increase shading	Walls, glass surfaces protected by overhangs, fins and trees
Increase surface reflectivity	Pale color, glazed chins mosaic tiles, etc.
Reduce solar heat gain	Use glazing with Lower SHGC and provide shading for windows. Minimize glazing in East and West
Promote Heat Loss in Summer/Monsoon	
Increase air exchange rate (Ventilation)	Courtyards/wind towers/arrangement of openings
Increase humidity levels in dry summer	Trees and water ponds for evaporative cooling
Decrease humidity in monsoon	Dehumidifiers/desiccant cooling

Low Impact Design

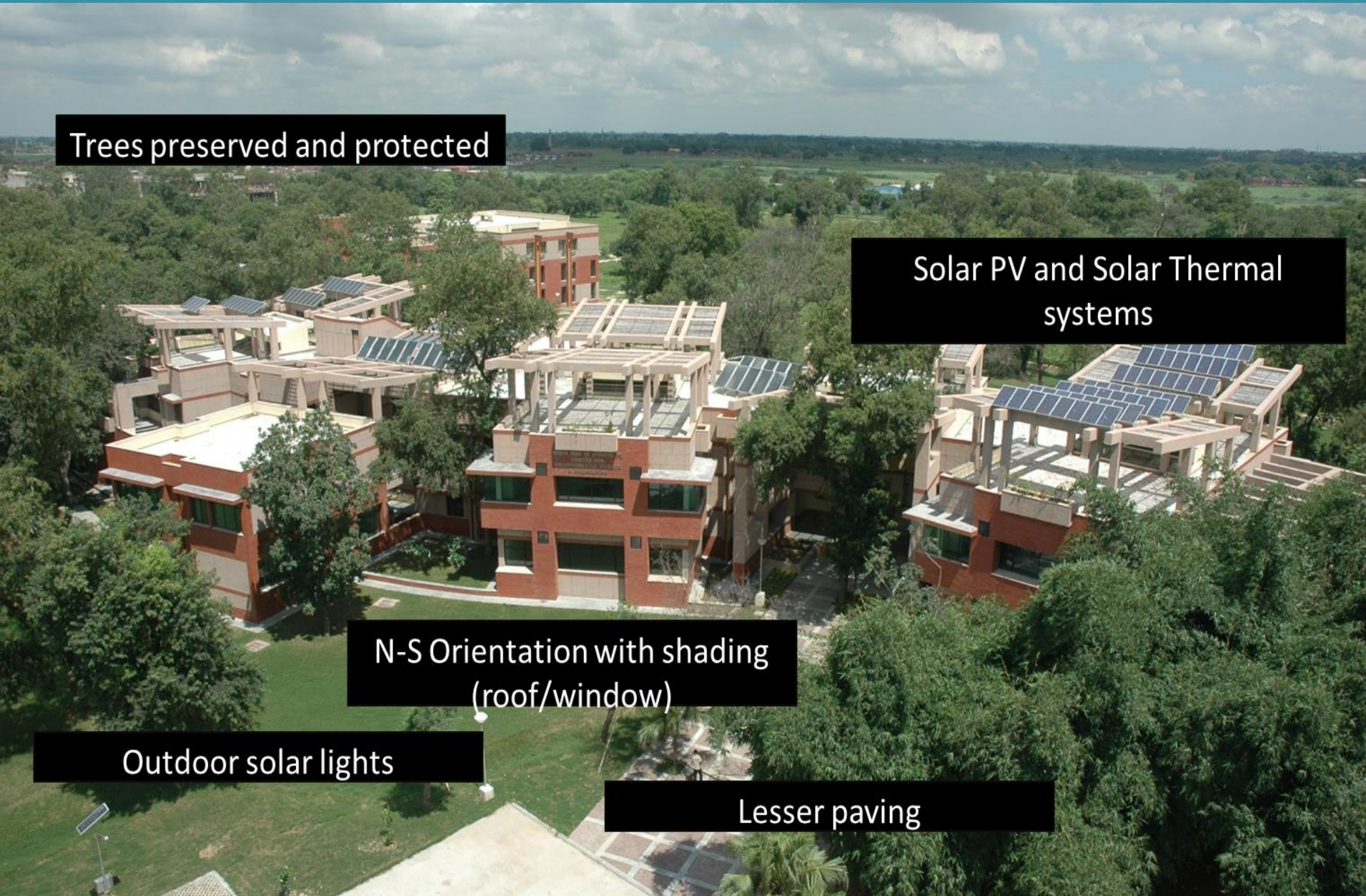
Trees preserved and protected

Solar PV and Solar Thermal systems

N-S Orientation with shading
(roof/window)

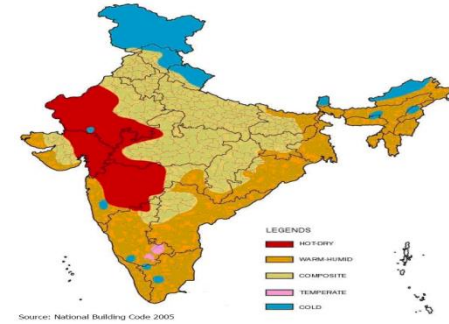
Outdoor solar lights

Lesser paving



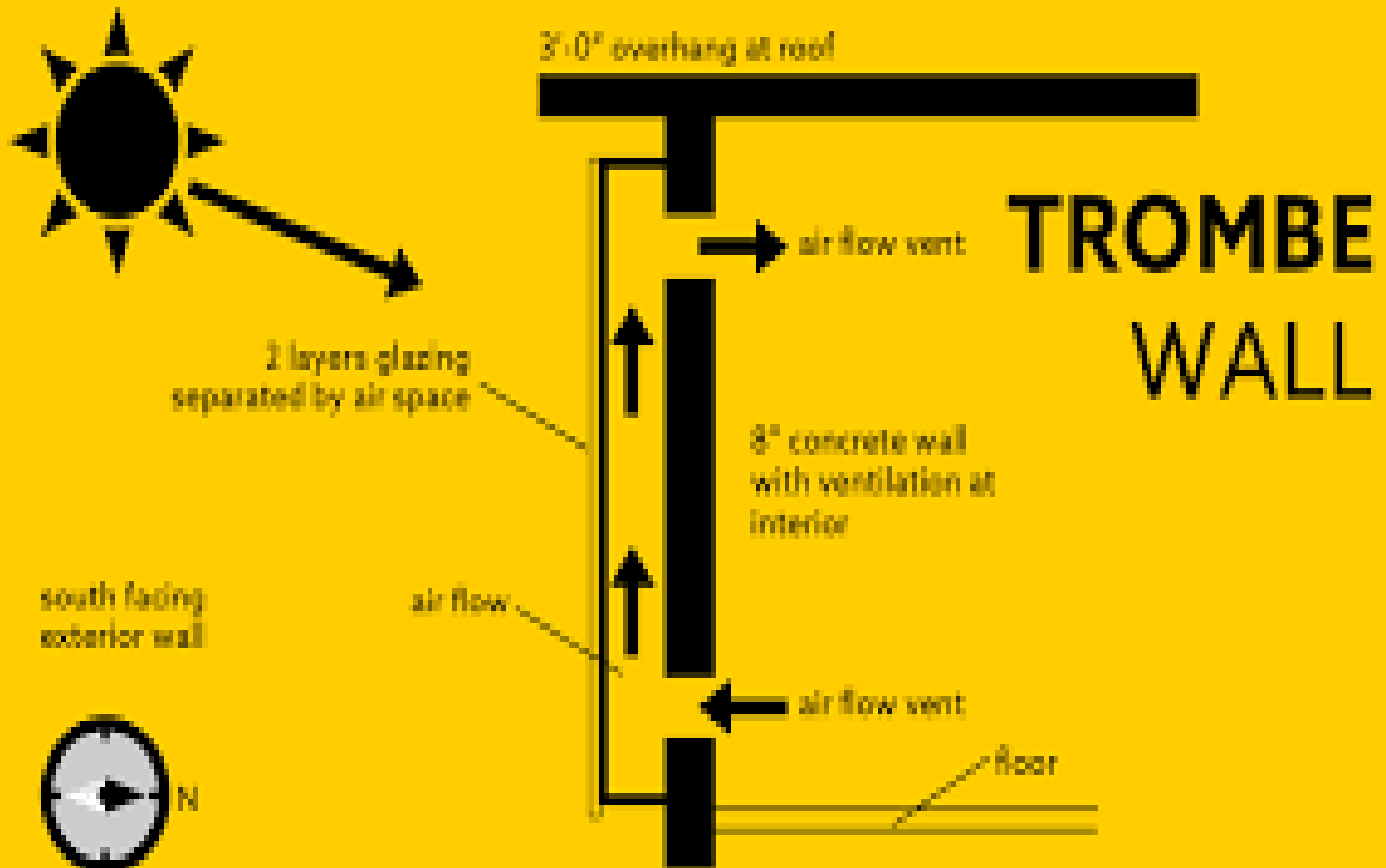
Cold (Cloudy/Sunny) Climate

Zone- Comfort requirements and Physical manifestations in Buildings



Thermal Requirements	Physical Manifestation
Reduce Heat Loss	
Decrease exposed surface area	Orientation and shape of building. Use of trees as wind barriers.
Increase thermal resistance	Roof insulation, wall insulation and double glazing
Increase thermal capacity (Time Lag)	Thicker walls
Increase buffer spaces	Air locks/Lobbies
Decrease air exchange rate	Weather stripping and reducing air leakage.
Increase surface absorption	Darker colours
Promote Heat Gain	
Reduce shading	Wall and glass surfaces
Trapping heat	Sun spaces/green houses/trombe walls etc.

TROMBE WALL



Solarium



Site Analysis- Factors considered

-Context of Site in Green Buildings—

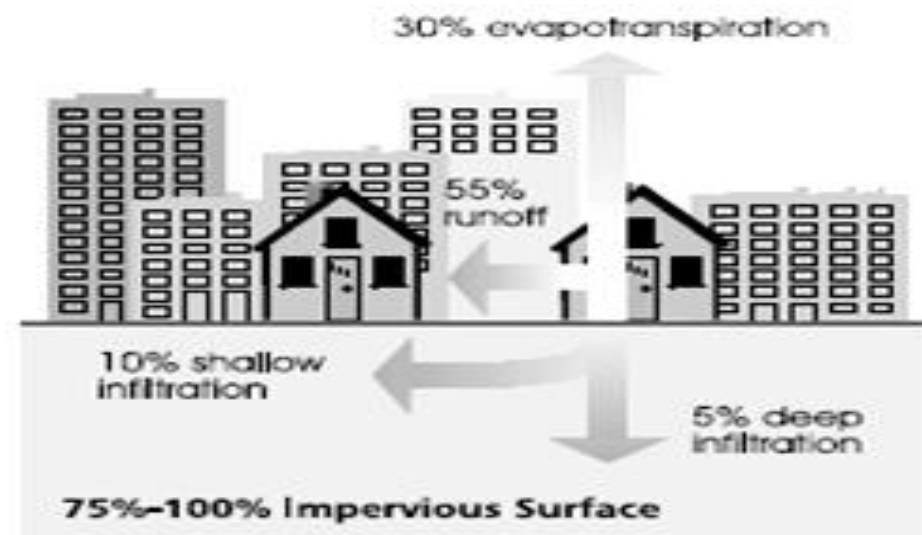
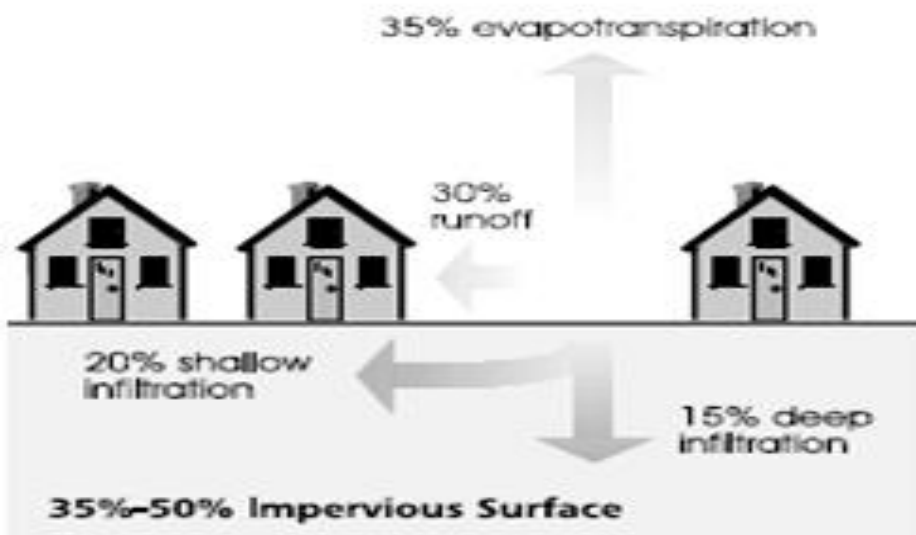
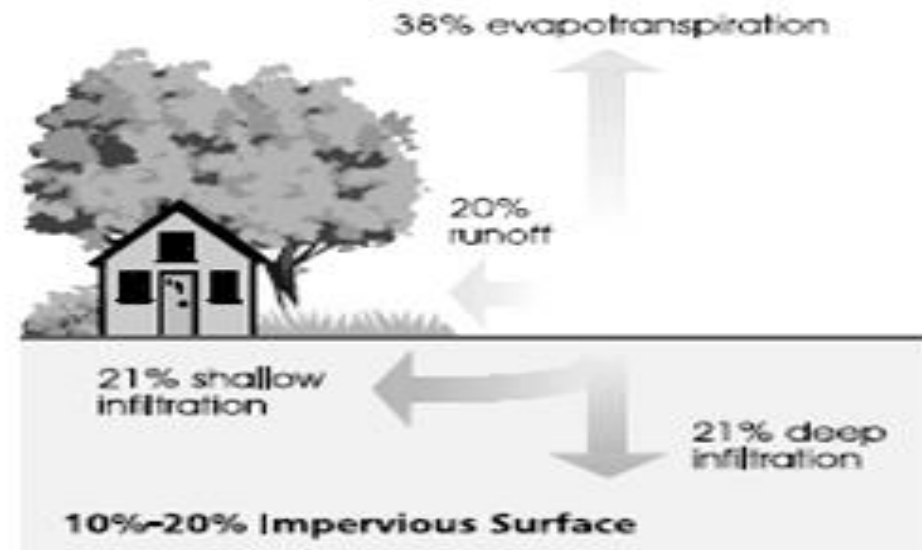
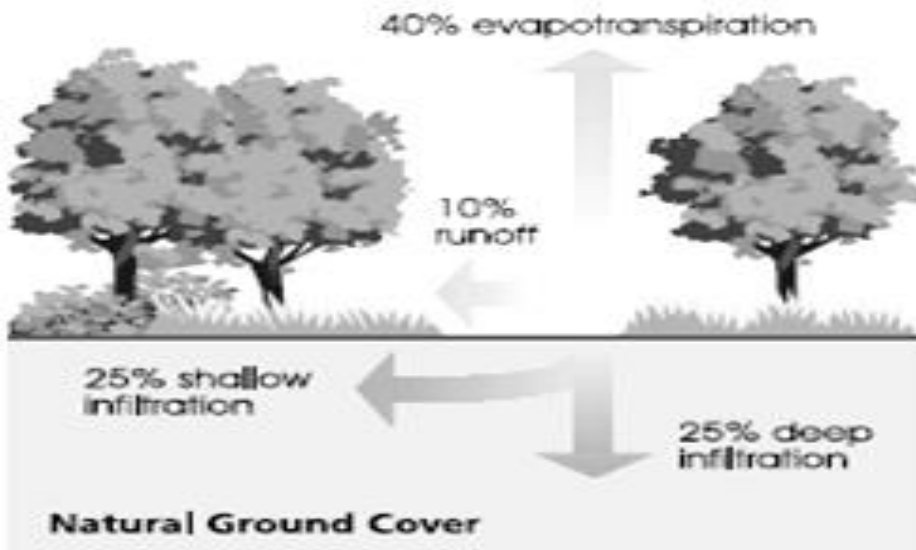
- i) Understanding Site**
- ii) Location**
- iii) Orientation**
- iv) Wind direction**
- v) Soil conditions**
- vi) Topography**
- vii)Vegetation and Natural Features**
- viii) Hydrology and Precipitation**
- ix) Infrastructures**
- x) Surrounding Land uses & Buildings**
- xi) Vision / Visual Linkages**

Site Planning Principles

Site Planning to be based on;

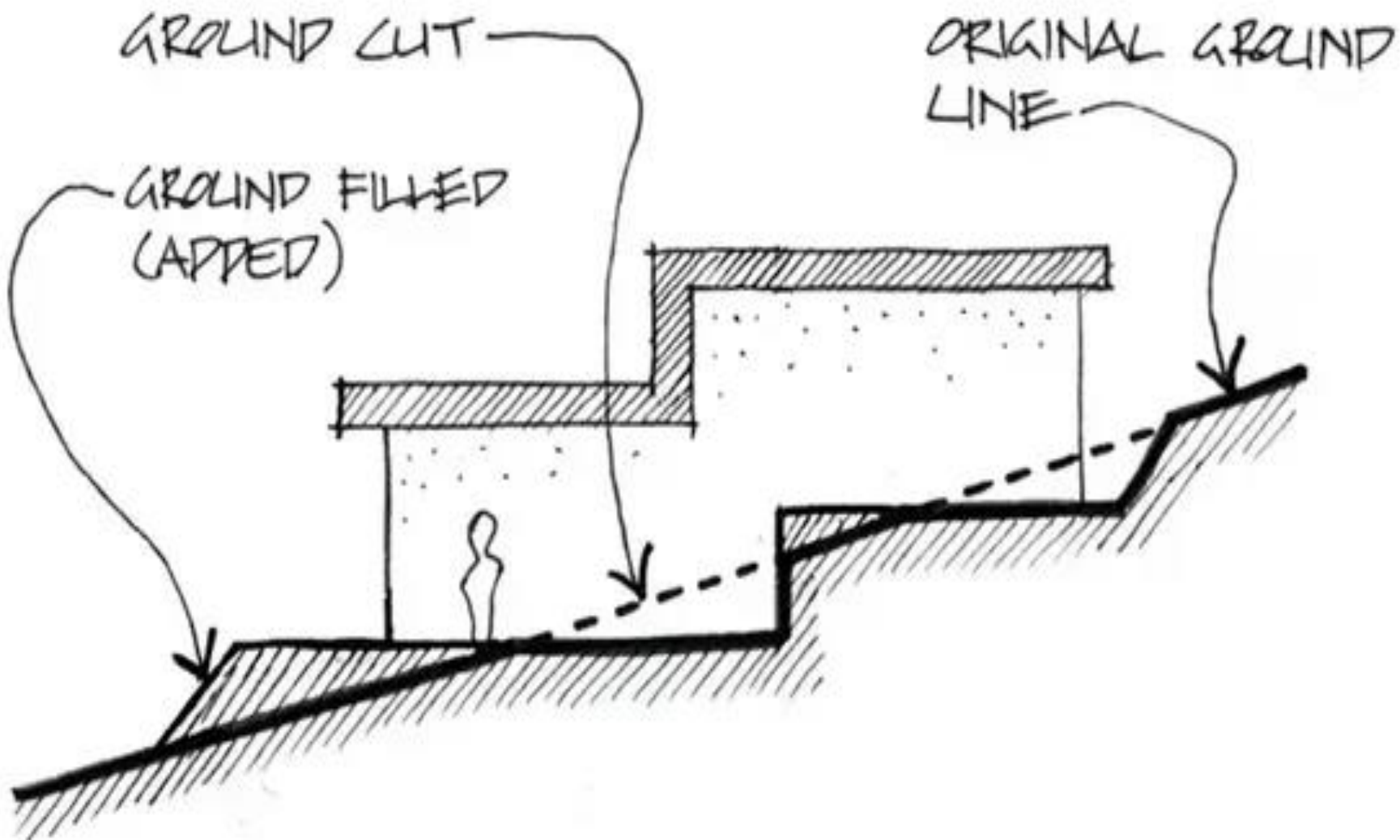
- i) Neighbourhood Character**
- ii) Physical Characteristics of site- flora , fauna**
- iii) Existing Site- Levels and Slopes**
- iv) Minimum Fingerprints of Building**
- v) Minimum damage to site**
- vi) Design with Nature and local Culture**
- vii) Promoting Pedestrianisation**
- viii) Using hierarchy of**
 - Preservation,**
 - Conservation and**
 - Regeneration**

Impact of Buildings- minimizing Building Footprints





MANAGING SITE- MIN. CUTTING & FILLING



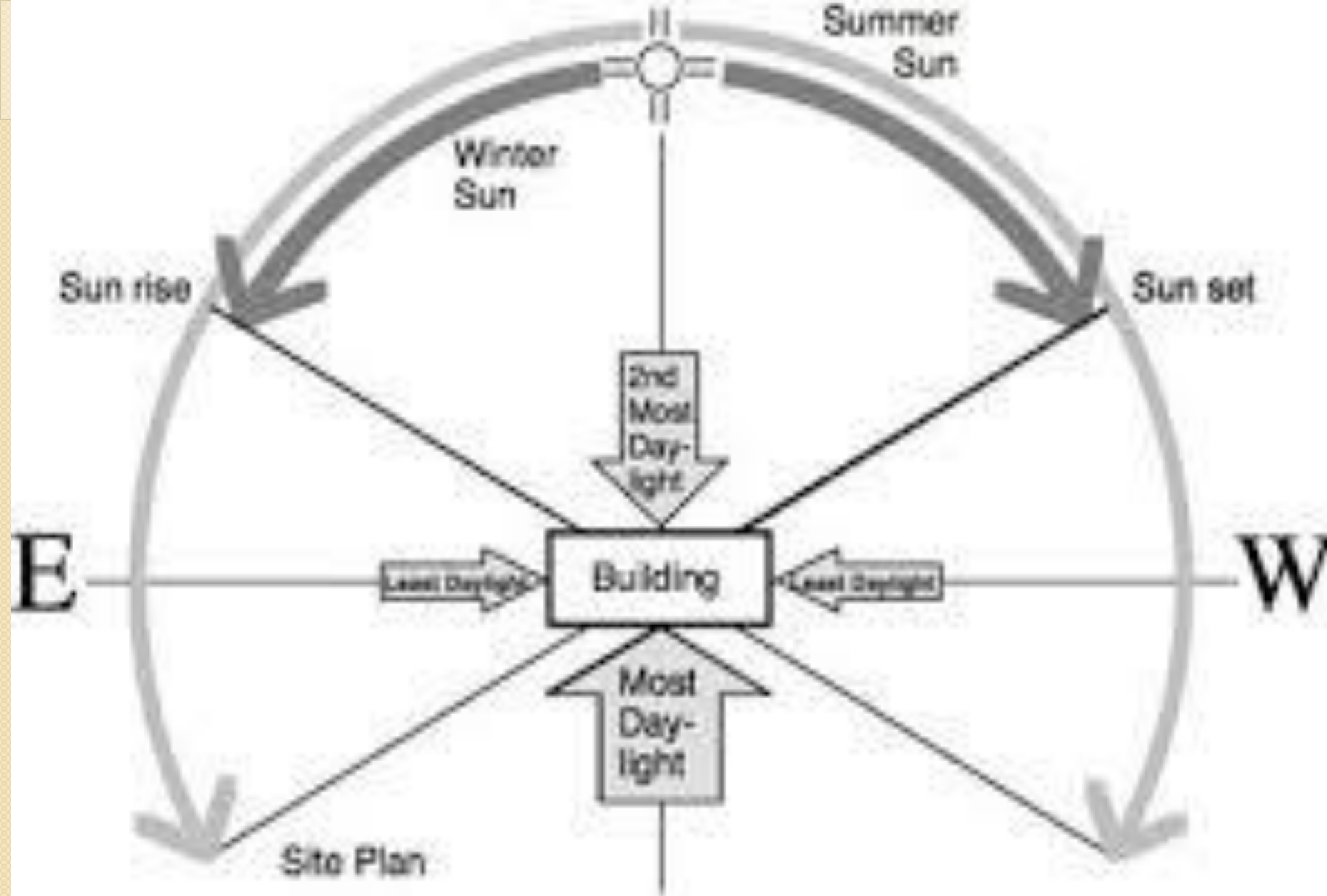
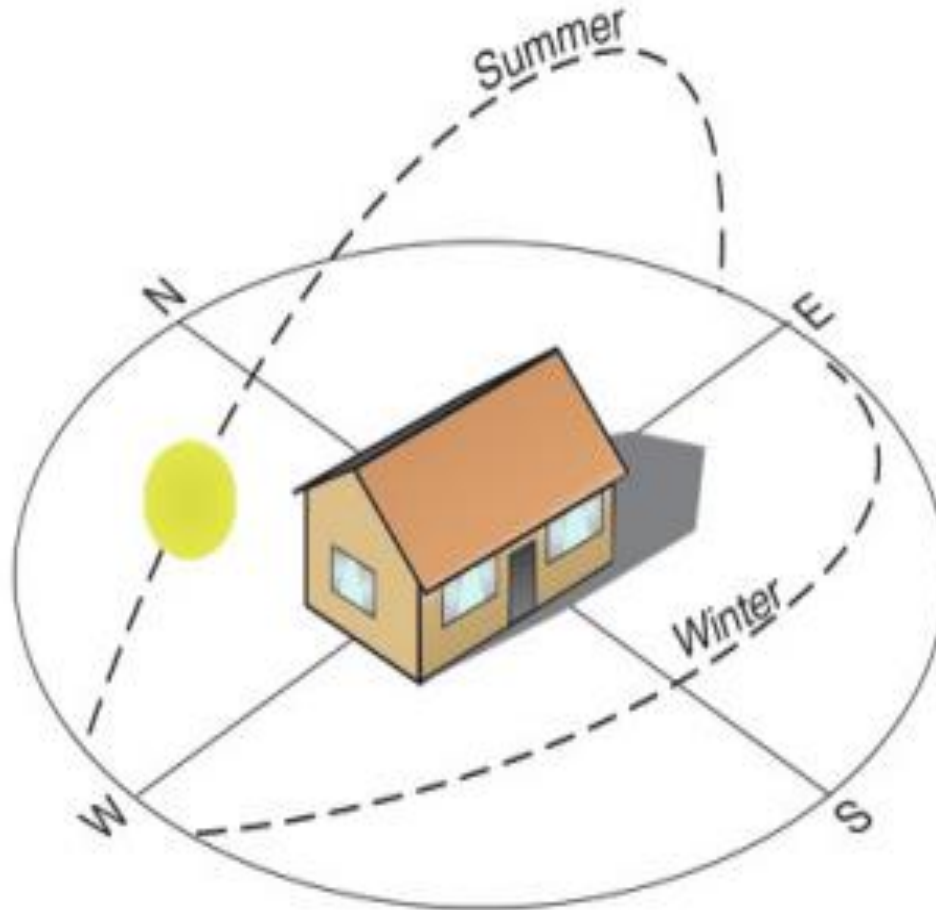


Figure 1

BUILDING ORIENTATION AND SHADING

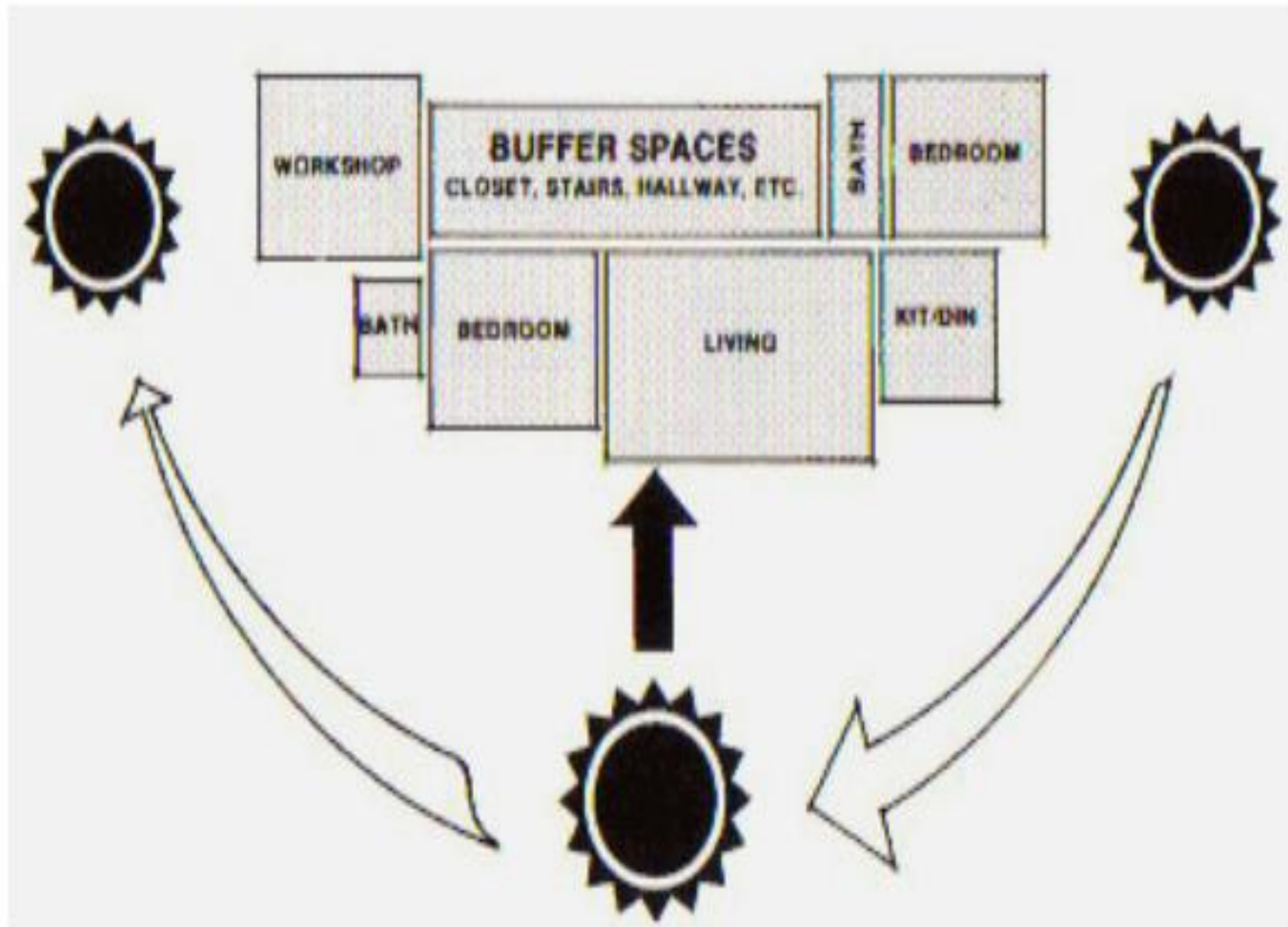
5. Building Orientation and Shading

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

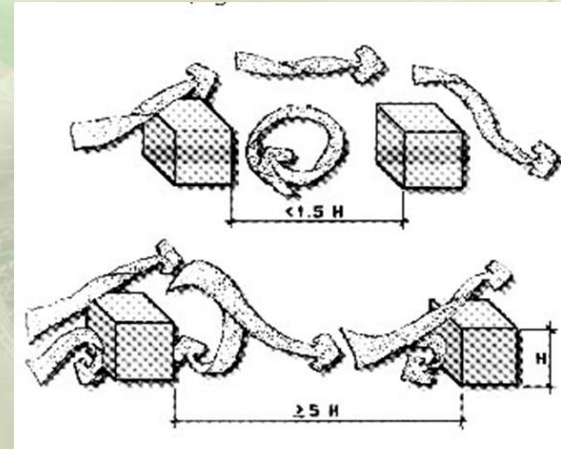




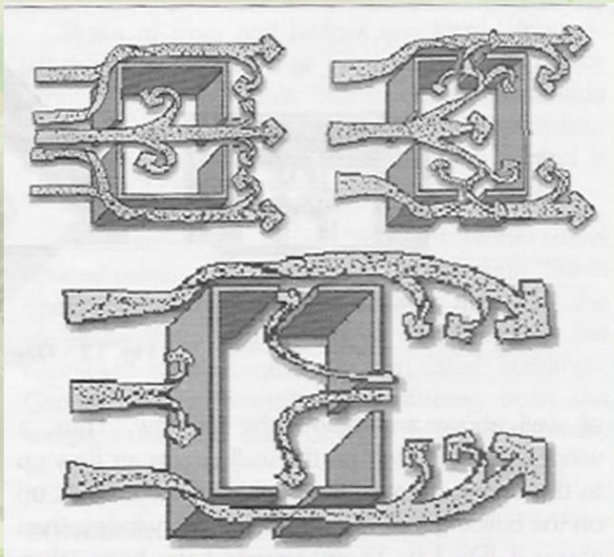
Planning for spaces in buildings



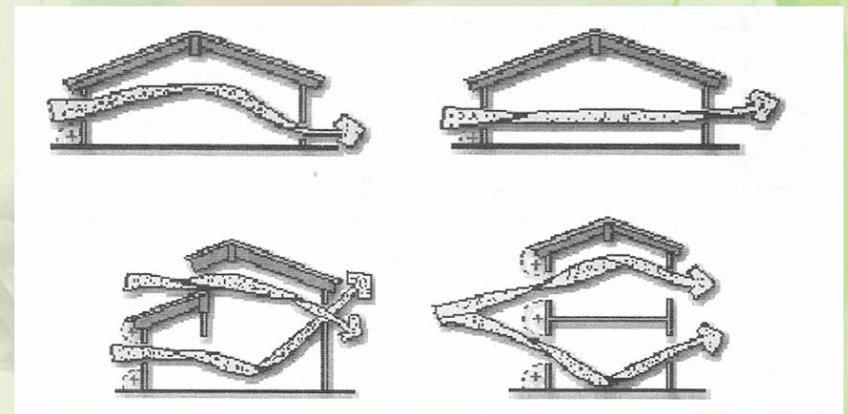
Natural Ventilation



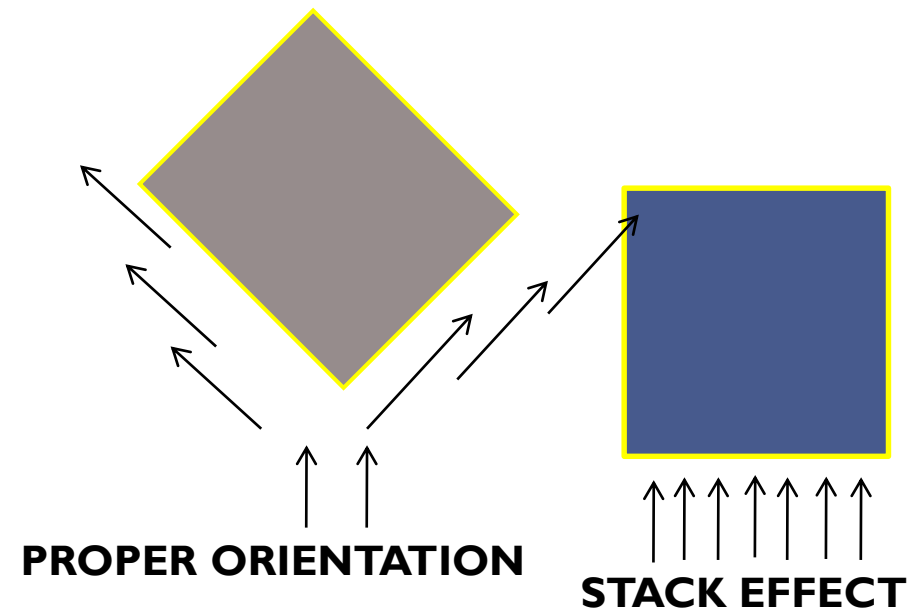
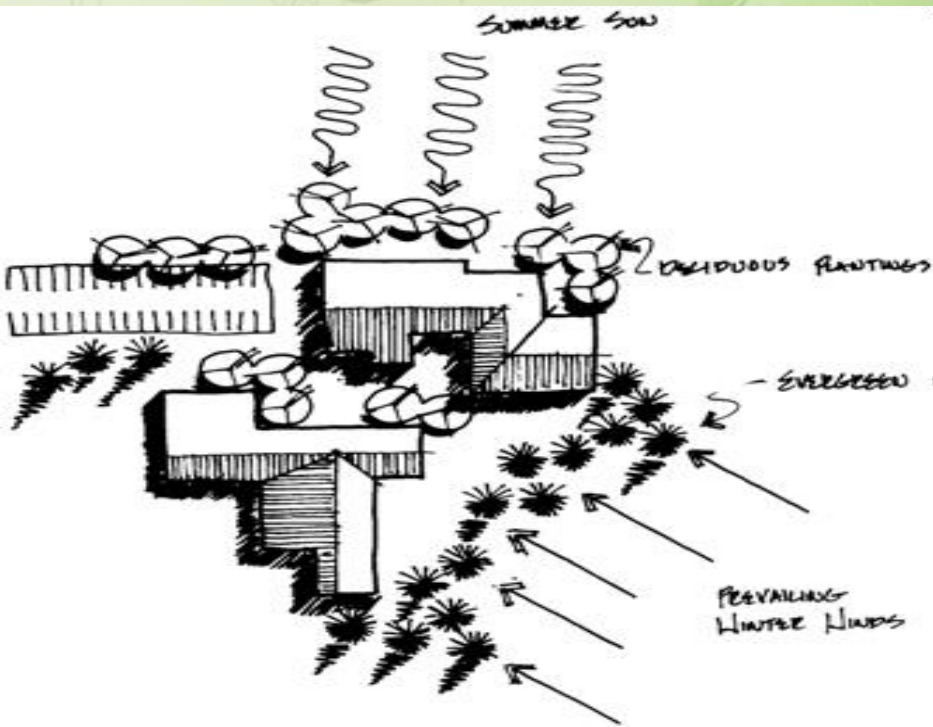
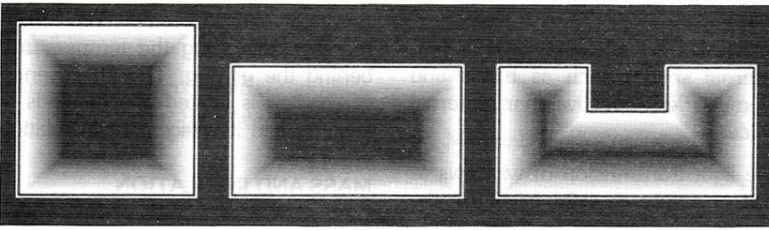
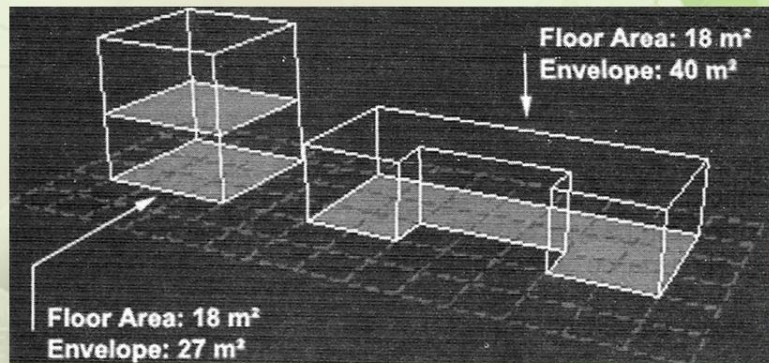
Cross Ventilation



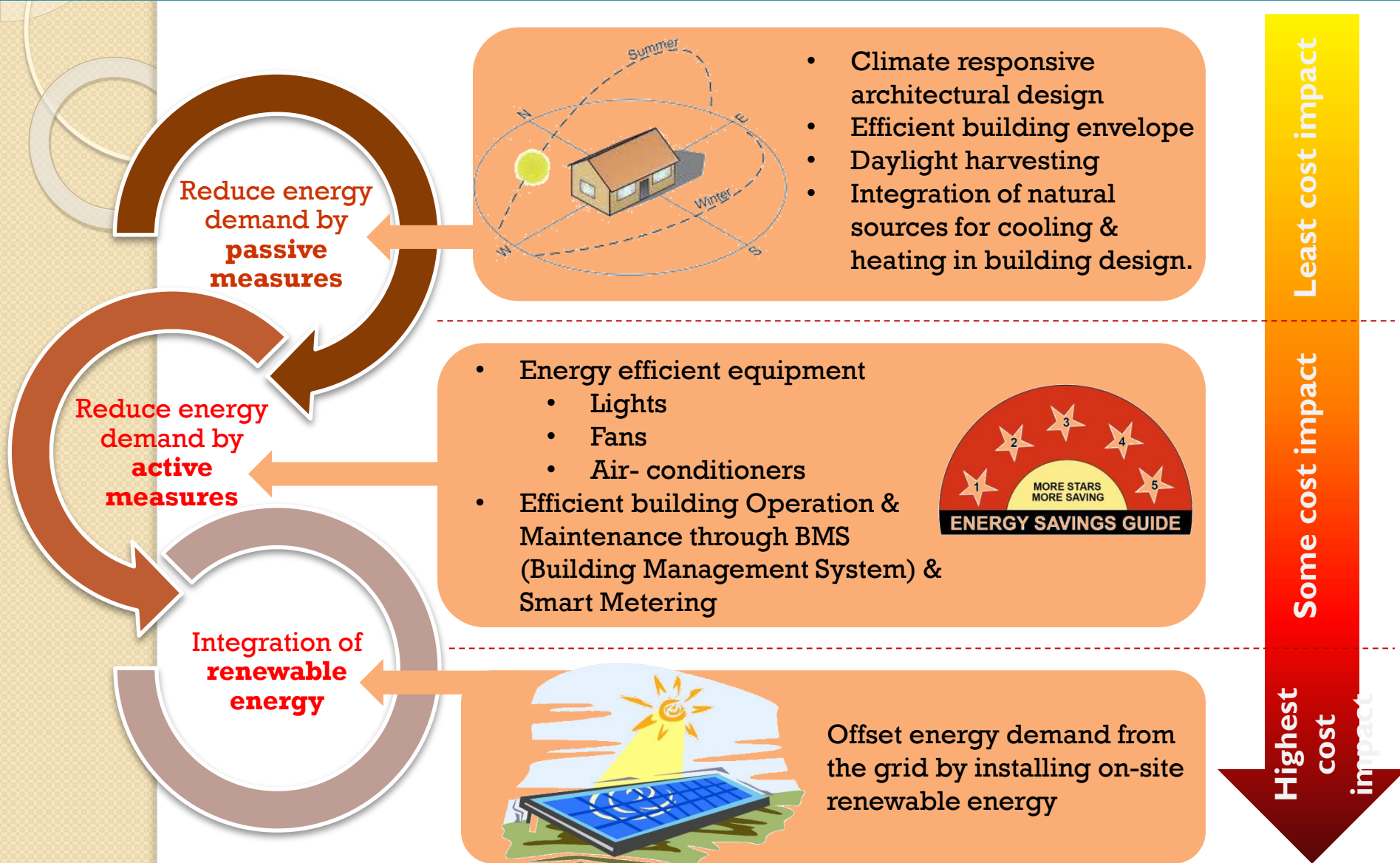
Height & Shape of the inlet Window



Shape



Cost effective strategy for energy efficiency



Energy Efficiency

- Energy efficiency achieved through ;
- *Adopting Passive design strategies* -- through building shape , orientation, passive solar design, use of natural lighting.
- *Planning and Designing Spaces-* differentiating habitation/non-habitation, cool roof
- *Using natural light-* positively impact on productivity /well being.
- *Installing high-efficiency lighting systems--* with advanced lighting controls-- motion sensors / dimmable lighting controls.
- *Using properly sized* / energy-efficient heat/cooling system in a thermally efficient building shell.

Energy Efficiency

- Maximize light/ dark colours for roofing / wall finish materials in hot/cold regions;
- -- install high R-value wall/ ceiling insulation;
- -- using minimal glass on east/ west exposures.
- -- Minimizing electric loads from lighting, equipment, appliances.
- -- Involving alternative energy sources -- photovoltaic /fuel cells
- Computer modelling -- for optimizing design of electrical and mechanical systems and building shell.

High Performance Envelope

Cavity Walls, Double Glazed Units, & Roof insulation

- ❖ **Reduced heat gain by design**
- ❖ **Significant energy savings**



What Green Buildings did differently

Air-conditioning Design

150 sq.ft / TR



Conventional Buildings

600 sq.ft / TR



Green Buildings



Day Lighting



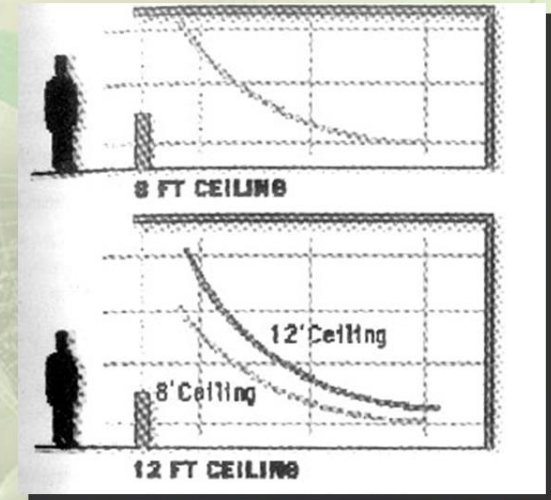
Reduced lighting energy consumption through efficient use of skylight and light pipes

Bifacial Solar PV Modules

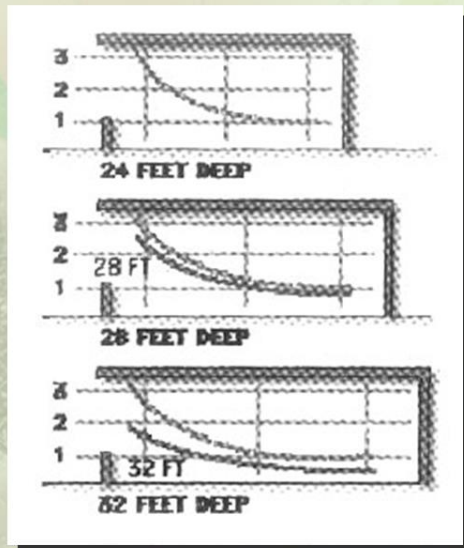
- ❖ Transparent & frameless
- ❖ Energy yield enhanced with higher reflectivity
 - PV module with all-round & undisturbed reflection will have potential of higher energy yield
 - 20-30% with an elevation of 1.5 m



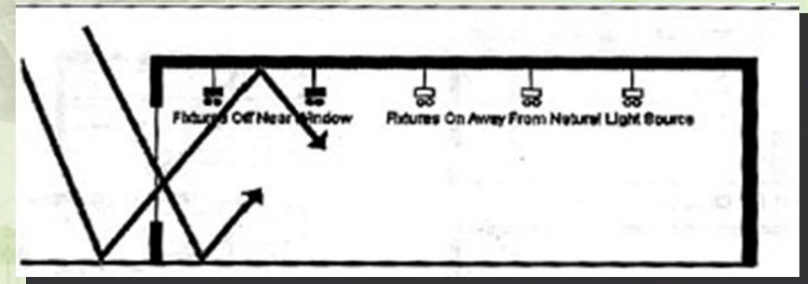
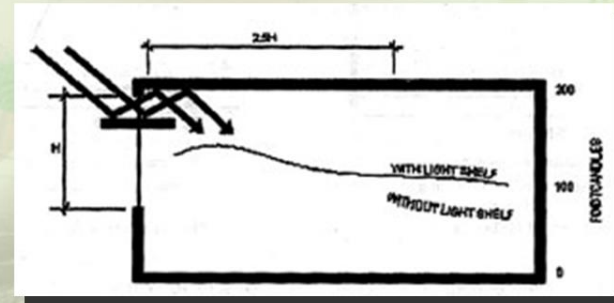
DAY LIGHTING



EFFECT OF ROOM DEPTH



INTELLIGENT LIGHTING CONTROL



Sun pipe- Day Light Harvesting

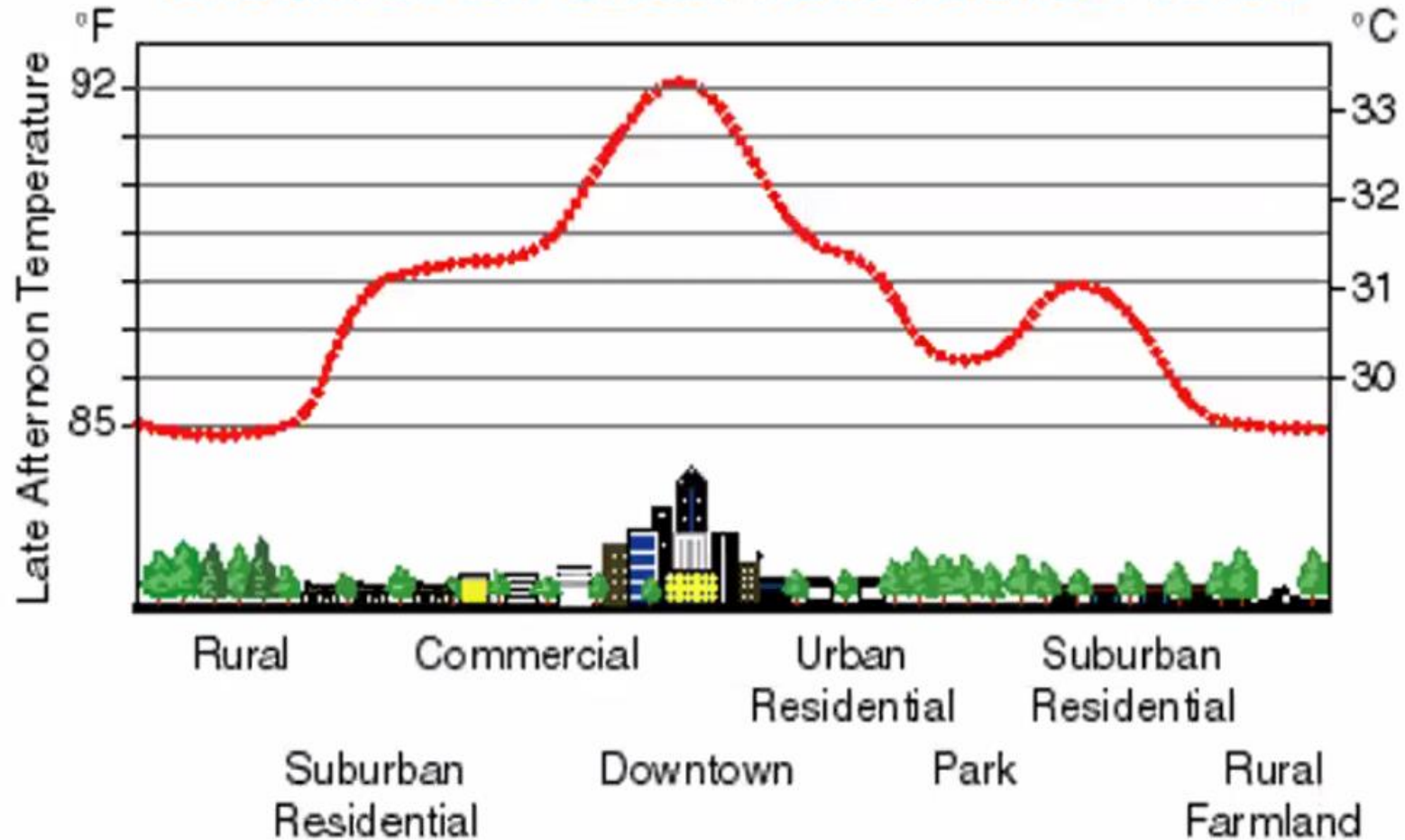


Present Cities- Concrete Jungle !! ??



Urban Roofs : Heat Islands

Sketch of an Urban Heat-Island Profile



● **GREEN ROOF**

- - decreases stormwater runoff- Avoid flooding .
- --reduces air pollution- - Increases oxygen supply
- -- improves air quality; -- encourages biodiversity,
- minimizss greenhouse gas emissions, removes air particulates;
- reduces carbon-footprints of buildings; improves property value ; promotes economy-- generates employment.
- Improves greenery in building/neighbourhood;
- makes people happy, heathy/more productive.
- Promotes optimum utilization of unused space
- Lowers air- conditioning demand,
- Improves efficiency of mechanical equipment





Present Best Practices *Green Roofs & Walls*



PEARL RIVER TOWER- GUANGZHOU, CHINA **NET ZERO ENERGY BUILDING**

YEAR OF COMPLETION- 2011

SITE AREA-10635 SQ.M.

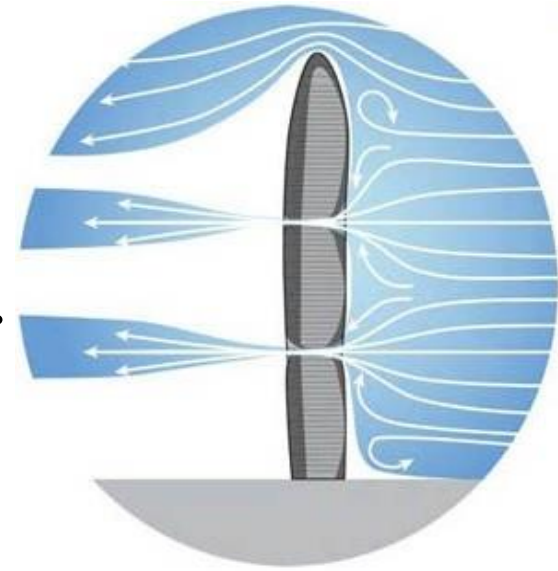
**PROJECT AREA- 214,100 SQ.M.
(2.3MILLION SQ.FT.)**

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**



Please

USE WATER

WISELY



EVERY

DROP

COUNTS

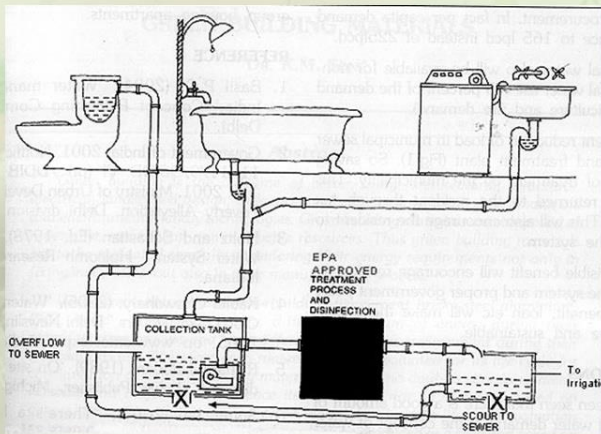
Water Efficiency- 4Rs- Refuse, Reduce, Recycle, Reuse

- **Adopt Strategies for** - Slow the flow/ break water in ions /Conserve water /RW Harvesting/Ground water charging/ multiple use of water
- **Design for dual plumbing--** using recycled water for toilet flushing / gray water system that recovers rainwater or other non-potable water for site irrigation.
- **Minimize wastewater--** use ultra low-flush toilets, low-flow shower heads/ water conserving fixtures.
- **Use Re-circulating systems** for centralized hot water distribution.
- **Installing point-of-use hot water** heating systems-- for more distant locations.
- **Metering water use** – both for domestic/ landscape separately
- -- **Promote micro-irrigation** /sprinklers / high-pressure sprayer-- to supply water in non-turf areas.
- **Involving communities** --Through education /incentives

Water Efficiency

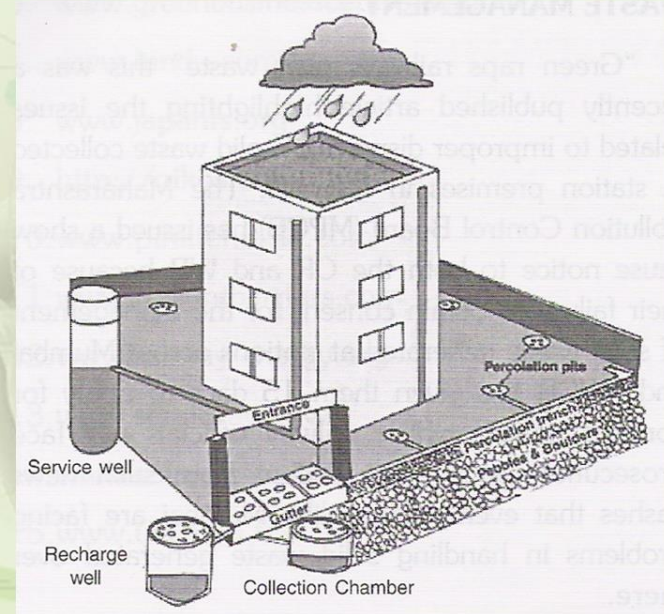
Use of low – flush toilets,
water less urinals,
sensors control taps for washbasin
and
water conserving system to
minimize the waste of water

Recycling of grey water



The dual plumbing system in which used water can be recycled for flushing of toilets and drain water can be used for irrigation and gardening purposes.

Rain Water Harvesting



Wastewater Treatment through Plants

❖ Phytoremediation

- Natural system - Aesthetically pleasing and gives picturesque garden like appearance
- Low capital cost – no usage of chemicals
- Treated water - reused or recycled or recharged & meets CPCB Norms



Phytoremediation – Nature at its Best!



- ☐ Implemented at CII – Godrej GBC, Hyderabad
- ☐ Investment Rs 50,000 per m³ per day
- ☐ No operating cost
- ☐ Payback: 3 to 5 yrs
- ☐ Application
 - ✓ Domestic sewage

Green Materials

- Materials for green building are obtained from;
 - -- natural, renewable sources
 - -- harvested in a sustainable way;
 - -- obtained locally-- to reduce embedded energy-- costs of transportation; or
 - -- salvaged from reclaimed materials at nearby sites.
- -- Materials assessed looking at;
 - -- Life Cycle Analysis (LCA)
 - --- embodied energy, durability, recycled contents , waste minimisation, and
 - --- ability to be reused/ recycled.

Sustainable Building Materials

❖ Focus Areas:

i. Building Reuse/



ii. Reuse of salvaged Material



iii. Material with Recycled Content



iv. Local Material/ Regional Material



v. Wood Based Materials



Handling of Waste Material, During Construction

❖ Segregation of construction & demolition waste at source

- To encourage reuse or recycling of materials, thereby avoiding waste being sent to land-fills



Wood Waste



Brick Waste



Metal waste



Segregation of metal

Green Material - Fly Ash Bricks



Green Material- Fly Ash Bricks-

- **Reduced Embodied Energy:** using Fly ash- lime- Gypsum bricks-- 40% reduction in embodied energy of masonry.
- **Environment Friendly:** Fly ash brick uses unfired Fly Ash technology – limited CO2 emissions in manufacturing process
- **Excellent Thermal Insulation:** Buildings using fly ash bricks -- cool in summers & warm in winters.
- **High Fire Resistance:** -- Since bricks composed of fly ash as major constituents, - un-burnt residue of coal fired in a thermal power plant.
- **No Efflorescence:** Fly ash bricks resist salt & other sulphate attack, ensuring no efflorescence in structure.

Green Material - Autoclaved Aerated Concrete



Advantages

- AAC has been produced for more than 70 years, and it offers several significant advantages over other cement construction materials, one of the most important being its lower environmental impact.
- ** Improved thermal efficiency reduces the heating and cooling load in buildings.*
- ** Workability allows accurate cutting, which minimizes the generation of solid waste during use.*
- ** Resource efficiency gives it lower environmental impact in all phases of its life cycle, from processing of raw materials to the disposal of waste.*
- ** Light weight saves cost & energy in transportation.*
- ** Light weight saves labor expenses.*
- ** Light weight increases chances of survival during seismic activity.*

Green Material--UPVC(Unplastisized Polyvinyl chloride) doors and Windows



Vinyl windows

- **Excellent insulators :**
- **Reduced heating /cooling loads**
- **Prevent thermal loss** through frame / sash material .
- **Not impacted by;**
weather/
- air pollution / salt,
- acid rain
- industrial pollution
- pesticides
- smog,
- discoloration and
- structural damage .
- **User friendly**
- **Eco- Friendly ,**
- **Readily accepted**
- **Safe .**

Bamboo- Advantages

- **Bamboo-- Higher Compressive**
- **Bamboo -- High Tensile Strength**
- **Earthquake Resistance –**
- **Lightweight -.**
- **Cost-effective**
- **Durable -**
- **Fast Growing**
- **Simple designing-**
- **Reducing use of wood**
- **Eco- friendly**
- **Promoting Employment**
- **Promoting Welfare of society/poor-**
- **Reduced Global warming-**
- **Improved indoor air Quality-**



Indoor Air Quality

- Indoor air quality essential for **work places**
 - fosters better health
 - Good indoor environmental quality--
 - reduces respiratory disease, allergy, asthma, sick building symptoms
 - enhances worker performance.
- When people are main source of emission.
 - Carbon dioxide concentration and indoor air quality in interiors important indicator
 - that quality of indoor air is bad/good
- Poor indoor air quality leads to
 - tiredness,
 - lack of concentration
 - can bring illnesses.

Causes of Poor indoor air Quality

- i. Poor ventilation**
- ii. Outdoor air quality/impurities**
- iii. Poorly insulated Building Envelop**
- iv. Smoking**
- v. Use of toxic building material**
- vi. Use of High VOC compound based paints for walls**
- vii. Dampness/water intrusion- microbial contamination**
- viii. Use of VOC based cleaning agents**
- ix. Poor Lighting**
- x. Furniture**
- xi. Floor Coverings- Carpets, Carpeting of floor**
- xii. Poor pollution controls-- during construction**
- xiii. Damaging existing vegetation/trees**
- xiv. Poor site planning/management**
- xv. Using pesticides**

Promoting health and wellbeing

- **Promoting health and wellbeing by;**
- **Bringing fresh air inside/ Delivering good indoor air quality--** through ventilation-- avoiding materials / chemicals -- creating harmful /toxic emissions.
- **Incorporating natural light** / views--to ensure building users' comfort /enjoyment of surroundings/ reducing lighting energy needs .
- **Designing for ears/ eyes** – promoting Acoustics /sound insulation-- for achieving concentration, recuperation/ peaceful enjoyment -- in educational, health /residential buildings.
- **Ensuring Environment comfort** --through right indoor temperature
- **Passive design/ using plants**
- **Building management / monitoring systems**

Improving Indoor Air Quality through Plants – Air Purifiers

Areca Palm



Best air purifying plants for general air cleanliness

Snake Plant



Removes Nitrogen Oxides & absorbs formaldehydes

Money Plant



Best Air Purifier

How TO make Buildings Green

- **Adopting Green approach to Site /Site Planning**
- **Adopting Green approach to Design Solution**
- **Adopting an Green approach to energy**
- **Safeguarding water resources**
- **Minimising waste and maximising reuse**
- **Using fewer, more durable/local materials-- generating less waste**
- **Keeping Environment green**
- **Creating structures- lean' smart, Resilient and flexible**
- **Connecting Communities and people**
- **Exploring potential of ICT**
- **Considering building in the context of life-cycle cost**
- **Lowering environmental impacts**
- **maximise social / economic value**
- **Minimizing embodied energy/water**

- **Rating Green
Buildings- Indian
Green Building
Council- IGBC**

Evaluating Green Buildings:-IGBC 52 - 10+42

I Sustainable Architecture & Design- 5/5

- Integrated design approach, Site preservation, Passive Architecture

• ii Site Selection and Planning - 14/14

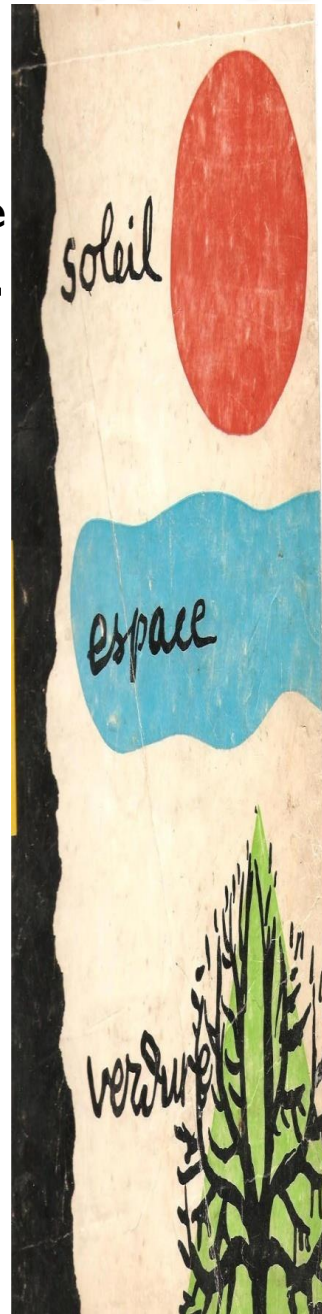
basic amenities, proximity to local transport, natural topography, tree preservation, heat island reduction, low emitting vehicle, outdoor light pollution, facilities for construction workers etc

• iii. Water Conservation --18/19

- Rain water harvesting – roof/non-roof, efficient plumbing fixtures, Sustainable landscape design , waste water treatment/recycling, water metering

• iv Energy Conservation --28/30

- use of chlorofluorocarbon-free equipment,
- Minimum energy consumption ,
- enhanced energy efficiency,
- On/off site renewable energy generation,
- energy saving measures in appliances other/equipment and energy metering



Parameters for Evaluating Green Buildings

- **v. Building Materials/Resources— 16/16**
 - waste segregation- post occupation ;handling of construction waste materials,;reuse of salvaged materials,; using green building materials,products and equipment
 - organic waste management- post occupation,
- **vi Indoor Environment Quality- 12/9**
 - tobacco smoke control, fresh air ventilation ,CO2 monitoring,
 - low emitting compound materials, paints and adhesives,
 - Day lighting, outdoor view, indoor/outdoor pollution
 - Indoor Air Quality management during construction,
 - Indoor Air Quality testing after construction/ before occupation
- **vii. Innovations and Development -- 7/7**
 - Innovations in design process; optimisation of structural design,Waste water reuse during construction.; IGBC accredited professional

soleil



espace



verdure

RATING OF NEW GREEN BUILDINGS

IGBC Green New Buildings Rating System Checklist		Points Available	
		Owner-occupied Buildings	Tenant-occupied Buildings
Modules		100	100
Sustainable Architecture and Design		5	5
SA Credit 1	Integrated Design Approach	1	1
SA Credit 2	Site Preservation	2	2
SA Credit 3	Passive Architecture	2	2
Site Selection and Planning		14	14
SSP Mandatory Requirement 1	Local Building Regulations	Required	Required
SSP Mandatory Requirement 2	Soil Erosion Control	Required	Required
SSP Credit 1	Basic Amenities	1	1
SSP Credit 2	Proximity to Public Transport	1	1
SSP Credit 3	Low-emitting Vehicles	1	1
SSP Credit 4	Natural Topography or Vegetation	2	2
SSP Credit 5	Preservation or Transplantation of Trees	1	1
SSP Credit 6	Heat Island Reduction, Non-roof	2	2
SSP Credit 7	Heat Island Reduction, Roof	2	2
SSP Credit 8	Outdoor Light Pollution Reduction	1	1
SSP Credit 9	Universal Design	1	1
SSP Credit 10	Basic Facilities for Construction Workforce	1	1
SSP Credit 11	Green Building Guidelines	1	1
Water Conservation		18	19
WC Mandatory Requirement 1	Rainwater Harvesting, Roof & Non-roof	Required	Required
WC Mandatory Requirement 2	Water Efficient Plumbing Fixtures	Required	Required
WC Credit 1	Landscape Design	2	2
WC Credit 2	Management of Irrigation Systems	1	1
WC Credit 3	Rainwater Harvesting, Roof & Non-roof	4	4
WC Credit 4	Water Efficient Plumbing Fixtures	5	5
WC Credit 5	Wastewater Treatment and Reuse	5	5
WC Credit 6	Water Metering	1	2

RATING OF NEW GREEN BUILDINGS

Modules		Points Available	
		Owner-occupied Buildings	Tenant-occupied Buildings
Energy Efficiency		28	28
EE Mandatory Requirement 1	Ozone Depleting Substances	Required	Required
EE Mandatory Requirement 2	Minimum Energy Efficiency	Required	Required
EE Mandatory Requirement 3	Commissioning Plan for Building Equipment & Systems	Required	Required
EE Credit 1	Eco-friendly Refrigerants	1	1
EE Credit 2	Enhanced Energy Efficiency	15	15
EE Credit 3	On-site Renewable Energy	6	6
EE Credit 4	Off-site Renewable Energy	2	2
EE Credit 5	Commissioning, Post-installation of Equipment & Systems	2	2
EE Credit 6	Energy Metering and Management	2	2
Building Materials and Resources		16	16
BMR Mandatory Requirement 1	Segregation of Waste, Post-occupancy	Required	Required
BMR Credit 1	Sustainable Building Materials	8	8
BMR Credit 2	Organic Waste Management, Post-occupancy	2	2
BMR Credit 3	Handling of Waste Materials, During Construction	1	1
BMR Credit 4	Use of Certified Green Building Materials, Products & Equipment	5	5
Indoor Environmental Quality		12	11
IEQ Mandatory Requirement 1	Minimum Fresh Air Ventilation	Required	Required
IEQ Mandatory Requirement 2	Tobacco Smoke Control	Required	Required
IEQ Credit 1	CO ₂ Monitoring	1	1
IEQ Credit 2	Daylighting	2	2
IEQ Credit 3	Outdoor Views	1	1



RATING OF NEW GREEN BUILDINGS

Modules		Points Available	
		Owner-occupied Buildings	Tenant-occupied Buildings
IEQ Credit 4	Minimise Indoor and Outdoor Pollutants	1	1
IEQ Credit 5	Low-emitting Materials	3	3
IEQ Credit 6	Occupant Well-being Facilities	1	-
IEQ Credit 7	Indoor Air Quality Testing, After Construction and Before Occupancy	2	-
IEQ Credit 8	Indoor Air Quality Management, During Construction	1	1
Innovation and Development		7	7
ID Credit 1	Innovation in Design Process	4	4
ID Credit 2	Optimisation in Structural Design	1	1
ID Credit 3	Waste Water Reuse, During Construction	1	1
ID Credit 4	IGBC Accredited Professional	1	1

The threshold criteria for certification levels are as under:

Certification Level	Owner-occupied Buildings	Tenant-occupied Buildings	Recognition
Certified	40 - 49	40 - 49	Best Practices
Silver	50 - 59	50 - 59	Outstanding Performance
Gold	60 - 74	60 - 74	National Excellence
Platinum	75 -100	75 - 100	Global Leadership

'A Green building makes you

Happy, Healthy and More Productive

- Provides highest quality of indoor environment***
- Optimizes Resources, , Reduces Waste,***
 - Minimizes Carbon Footprints***
- Makes building operations cost effective and Energy efficient- creates win- win situation for both owner/ user***

