

Energy Efficiency Through Green Building Concepts



ITC Green Centre, Gurgaon
Platinum Rating



CII – Godrej GBC, Hyderabad
Platinum Rating



Wipro Tech., Gurgaon
Platinum Rating



NEG Micon, Chennai
Gold Rating



Spectral Services, Noida
Platinum Rating



Grundfos Pumps, Chennai
Gold Rating


Indian Green Building Council (IGBC)

❖ Vision of IGBC

- To usher in a green building revolution in India
- To become one of the world leaders in green buildings by 2010



The Green Building Movement - Over the Years

No	Criteria	2001		Till Date
1	CEOs & senior people involved	50		≈ 2000
2	No. of professionals trained on LEED rating	10		≈ 3000
3	No. of registered LEED Green Buildings	1		140
4	Built – in Area (sq.ft)	0		67 Million
5	Green Building products & equipments	5		50
6	IGBC Membership	0		141

Green Building vs. Conventional Building

- ❖ **Externally** : both look alike
- ❖ **Building Use** : both are same
- ❖ **Differences**
 - **Concern for human comfort & indoor environment**
 - **Operational savings**



Tangible Benefits

- ❖ Reduce operating costs
- ❖ Optimize life cycle economic performance

➤ Sustained savings

- ❖ Energy savings: 40 – 50 %
- ❖ Water savings: 20 – 30 %
- ❖ Reduction in initial investment



LEED 2.0 Certified Gold Ebensburg, PA

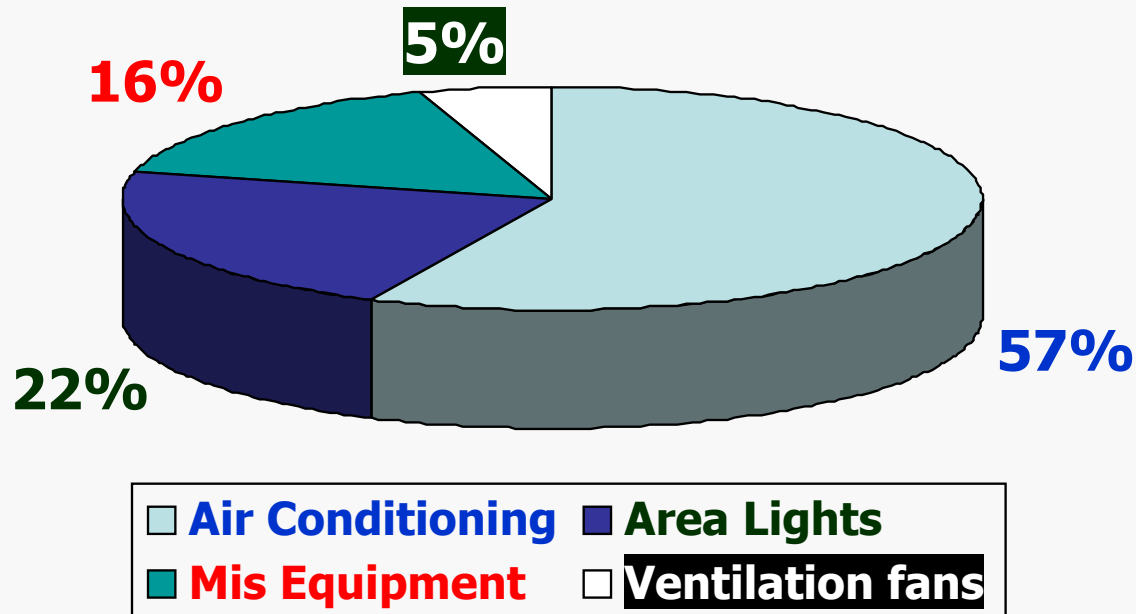
Intangible Benefits of Green Design

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



❖ **World Class Standards & Procedures**

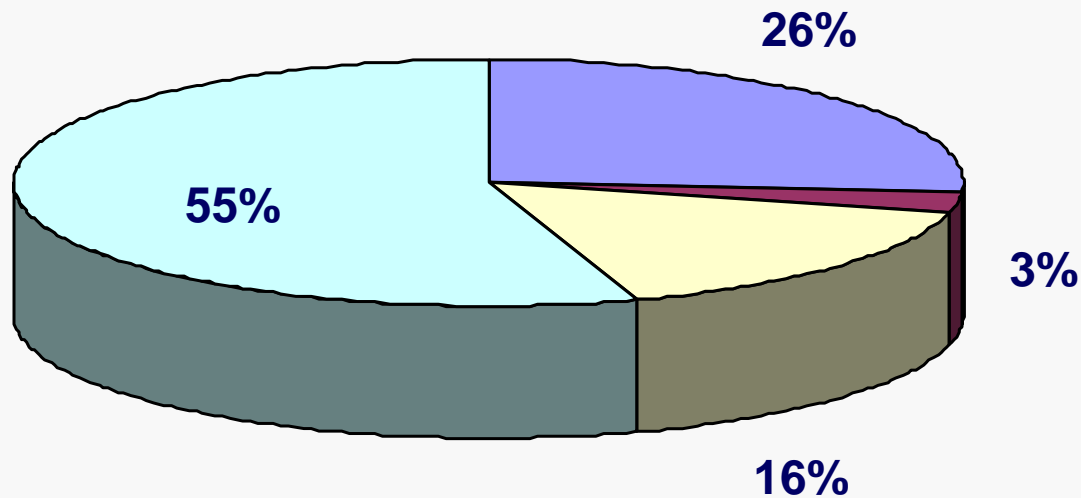
Building Energy Consumption



Break-up of energy consumption in a building

Cooling Load Components

A Break Up Of The Heat Gain Through Various Building Components



- WALL CONDUCTION
- GLAZING CONDUCTION
- INTERNAL GAINS (LIGHT, PEOPLE, COMPUTERS)
- ROOF CONDUCTION

Approach

1. Orientation

2. Envelope measures

- **Wall, Glazing, Fenestration, Shading, Skylighting, Roof**

3. Equipment & systems

- **Chiller, VFD, Lighting**

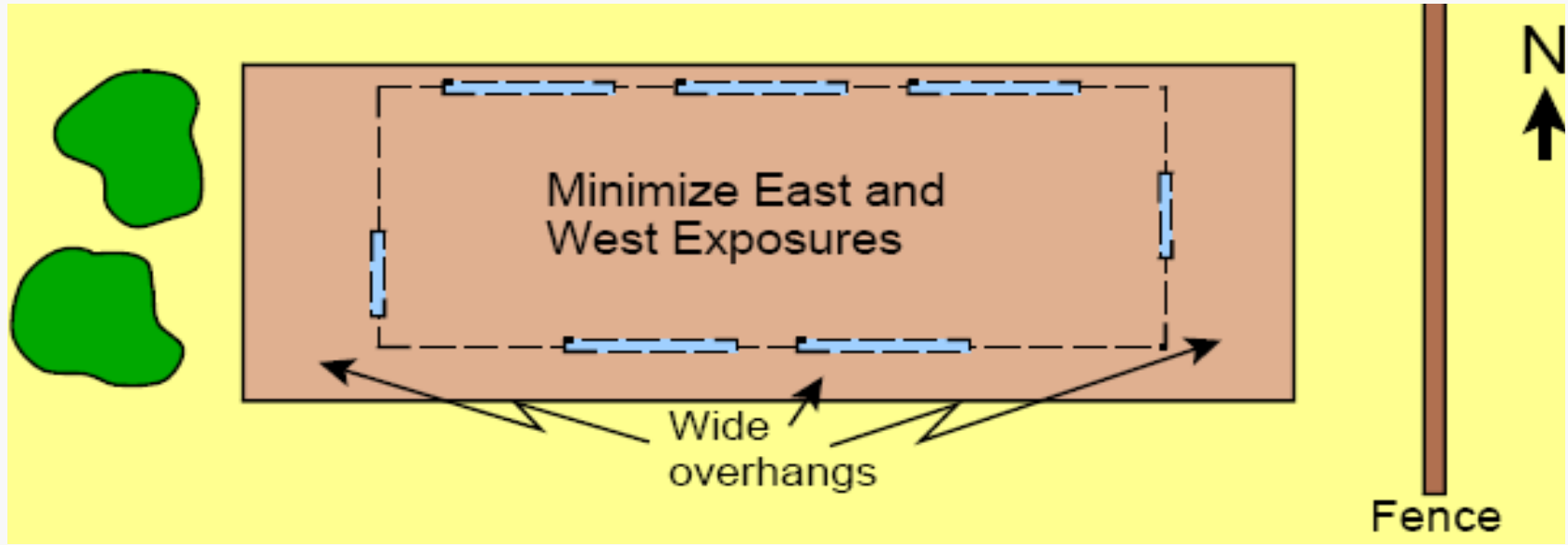
4. Controls

- **BMS, Temperature, Humidity**

5. Commissioning

- **Additional commissioning ,M & V**

1) Orientation



- ❖ What is the ideal orientation ?
- ❖ East-West ?
- ❖ North-South ?
- ❖ Does not matter ?
- ❖ Buffer East and West Exposures with garages, utility rooms etc.

Saving potential : 2-3 % for 90% rotation



2) Envelop Measures

❖ Glass & glazing

- How much glazing ?

❖ High glazing

- Tremendous daylighting
- Heat ingress

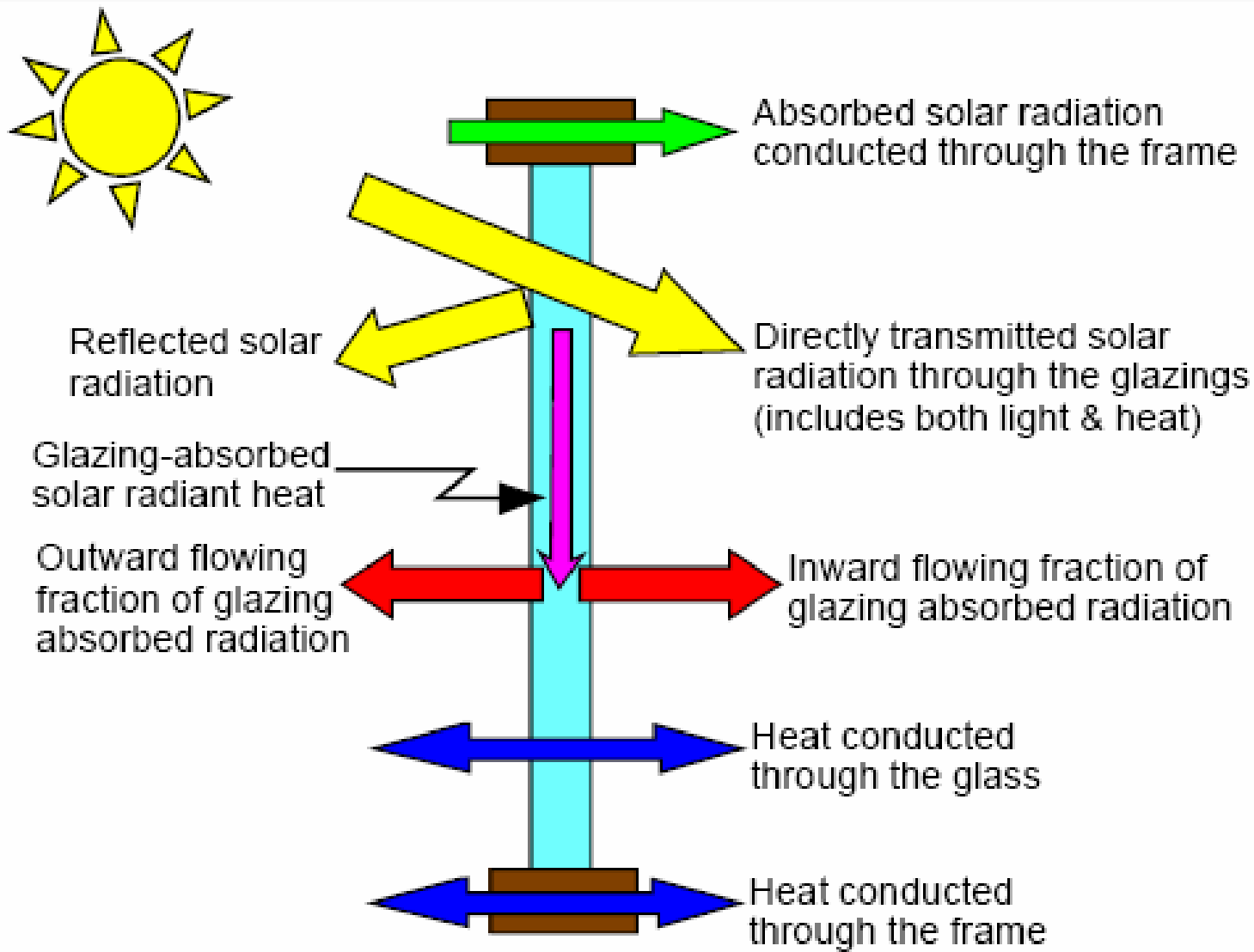
❑ Need to balance

❖ High performance glass & glazing

- Low U-value
- Low Shading Coefficient
- High VLT (Visual Light Transmittance)



Heat Flows Through Windows



U-value

- ❖ **U value – (w/m².C)**
- ❖ **Heat transfer due to temperature difference (conduction)**
- ❖ **Typical U values**
 - **Single glazed glass (6mm) : 5-6**
 - **High Performance glass : 1.7 – 3.0**
(6mm+airgap+6mm)

Shading coefficient

❖ Shading coefficient

Heat gain thru' a given glazing (SHGC)

Heat gain thru' 3 mm clear glass (0.87)

❖ Solar heat gain coefficient (SHGC)

- Also called as Solar factor by manufacturers
- Indicates direct heat gain

❖ Typical values

- Single glazed 6mm glass : 0.5 – 0.8 W/m² deg K
- High performance glass : 0.1 – 0.4

Significance of Glazing Properties

- ❖ **Which one is more important ?**
- ❖ **U-value ?**
- ❖ **Shading coefficient ?**
- ❖ **Both ?**

Relative heat gain

❖ **RHG= Direct heat gain+Conductive heat gain**

$$= SC (630) + U (35-24)$$

❖ **Direct heat gain : 90 %**

❖ **Conductive heat gain : 10 %**

Walls & Roofs

❖ RCC Walls

- U-value : 1.95 W/m² deg K
- Heat Storage higher

 **Due to high mass**

❖ Concrete Roof

- U value 2.5 – 3.0 W/m² deg K

- ❖ **Efficient roof in a flat building**
- ❖ **Efficient wall in multi-storeyed building**

Wall options

❖ Brick wall with insulation

- Extruded polystyrene, Expanded polystyrene (thermocol), Glass wool etc.,

❖ Brick wall with air cavity

❖ Hollow blocks

❖ Flyash bricks

❖ Autoclaved Aerated Concrete Blocks

Saving potential 3-8 %

Insulation Materials-Relative U-values

❖ Glass wool stuffed

- U value :0.25 W/m² deg C
(150 mm thick)

❖ Thermocol

- U-Value : 0.3 W/m² (100 mm)

❖ Extruded Polysterene

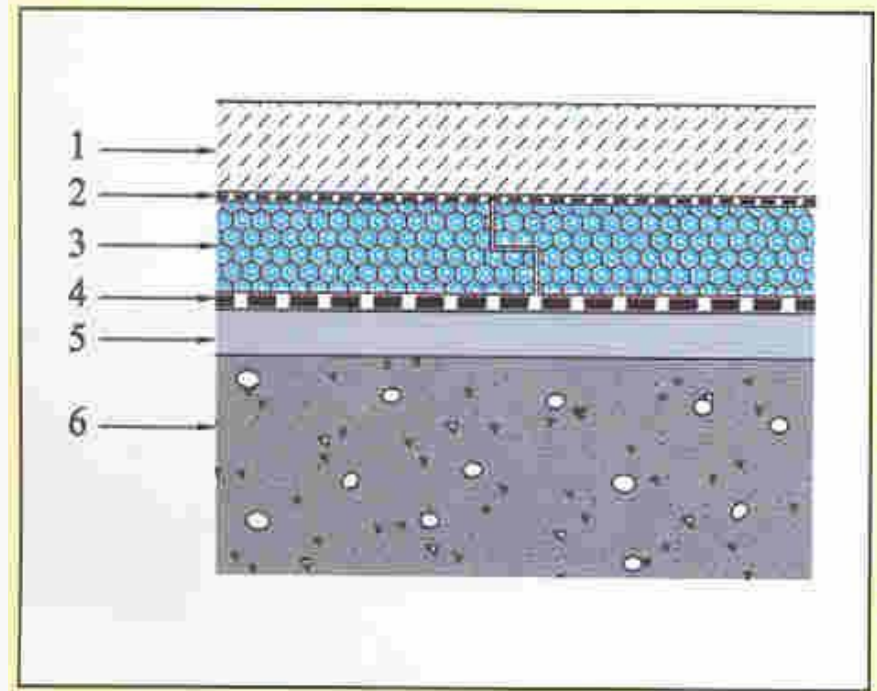
- U-Value : 0.028 W/m² (60 mm)



Roof Insulation

- ❖ Over-deck ?
- ❖ Under-deck ?
- ❖ Insulation sandwiched
- ❖ Saving potential

➤ 3-8 % depending on extent of roof



- 1: Reinforced concrete
- 2: Separation layer
- 3: Insulation
- 4: Water proof membrane
- 5: Screed
- 6: Concrete roof deck

Wall Insulation

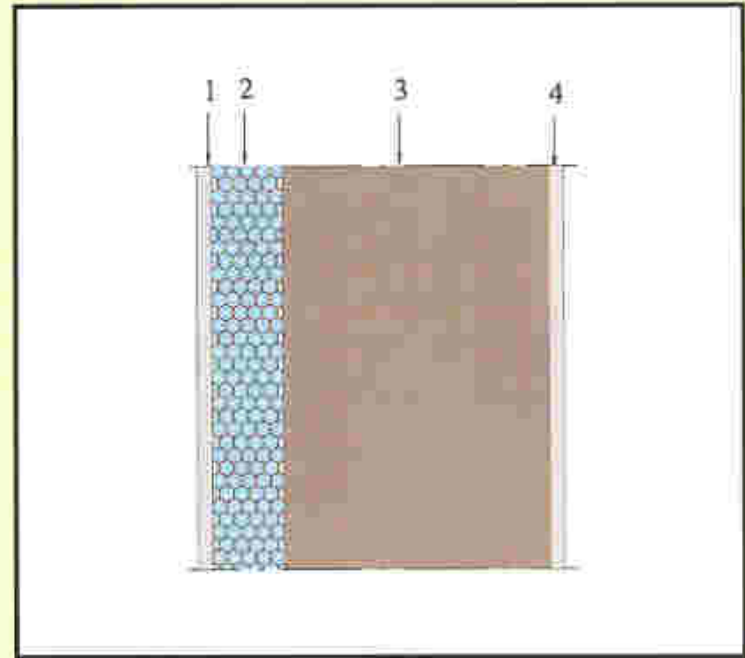
❖ External or Internal

❖ Internal if brick

exterior required

❖ Saving potential

➤ 3 – 8 %



- 1: Cement plaster / Gypsum wall board
- 2: Insulation
- 3: Brick or concrete wall
- 4: Interior gypsum or plaster

Autoclaved Aerated Concrete Blocks

❖ AAC blocks

- Composed of fly ash, cement, lime, Aluminum powder and water

❖ Unique properties

- Low U value: $0.67 \text{ W/m}^2\text{°k}$
- Reduction in temp possible : $4\text{-}5\text{°C}$

❖ Economic Benefits

- 15-20% savings in A/c Load
- Savings in Cement



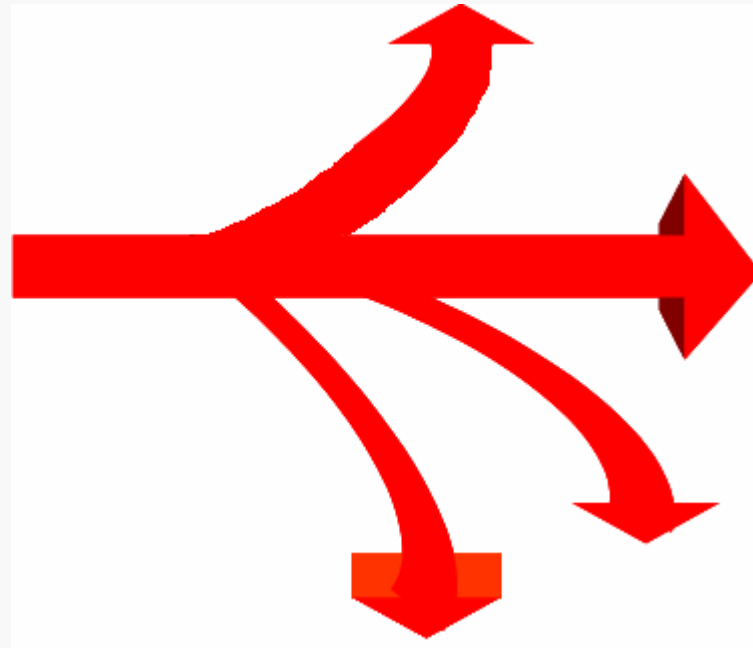
Envelope measures : Typical saving potential

- ❖ **Orientation** : **0.5-1 %**
- ❖ **AAC wall** : **3-8 %**
- ❖ **Brick wall with 75mm extruded polysterene insulation** : **3-8 %**
- ❖ **High Albedo roofing material** : **2-3 %**
- ❖ **Roof garden** : **1-2 %**
- ❖ **Low-U glass & glazing** : **6-8 %**
- ❖ **Thermal break** : **1-2 %**
- ❖ **Roof insulation (extr.polyst)** : **5-6 %**

Green Building – Air Conditioning

Conventional System

Design Stage



Wind Tower System

Geothermal Cooling

Earth Tunnel Cooling

ASHRAE COP requirements

Equipment Type	Size Category	Minimum Efficiency	Efficiency as on 10/29/2001*
Air Cooled, with condenser electrically Operated	< 150 tons	2.70 COP 2.80 IPLV	2.80 COP 2.80 IPLV
	≥150 tons	2.50 COP 2.50 IPLV	
Air cooled without condenser, electrically Operated	All capacities	3.10 COP 3.20 IPLV	3.10 COP 3.10 IPLV
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	3.80 COP 3.90 IPLV	4.20 COP 4.65 IPLV

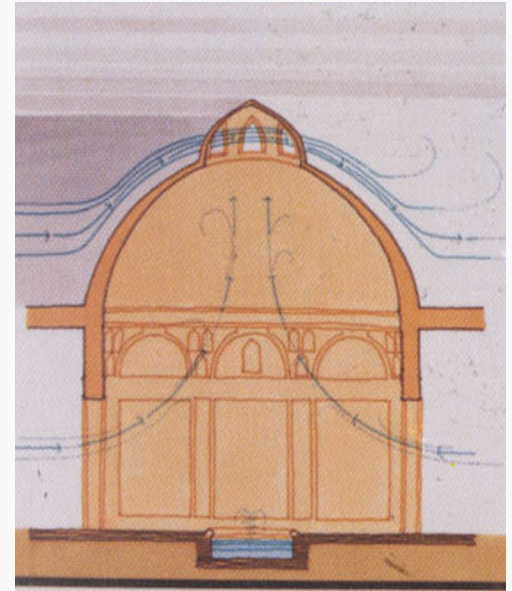
ASHRAE COP requirements

Water cooled, electrically operated, positive displacement (rotary screw and scroll)	<150 tons	3.80 COP 3.90 IPLV	4.45 COP 4.50 IPLV
	≥150 tons and <300 tons	4.20 COP 4.50 IPLV	4.90 COP 4.95 IPLV
	≥300 tons	5.20 COP 5.30 IPLV	5.50 COP 5.60 IPLV
Water cooled, electrically operated, centrifugal	<150 tons	3.80 COP 3.90 IPLV	5.00 COP 5.00 IPLV
	≥150 tons and <300 tons	4.20 COP 4.50 IPLV	5.55 COP 5.55 IPLV
	≥300 tons	5.20 COP 5.30 IPLV	6.10 COP 6.10 IPLV
Air-cooled absorption single effect	All capacities	0.48 COP	0.60 COP
Water-cooled absorption single effect	All capacities	0.60 COP	0.70 COP
Absorption double effect, indirect-fired	All capacities	0.95 COP 1.00 IPLV	1.00 COP 1.05 IPLV
Absorption double effect, direct-fired	All capacities	0.95 COP 1.00 IPLV	1.00 COP 1.00 IPLV

Wind Towers

Advantages

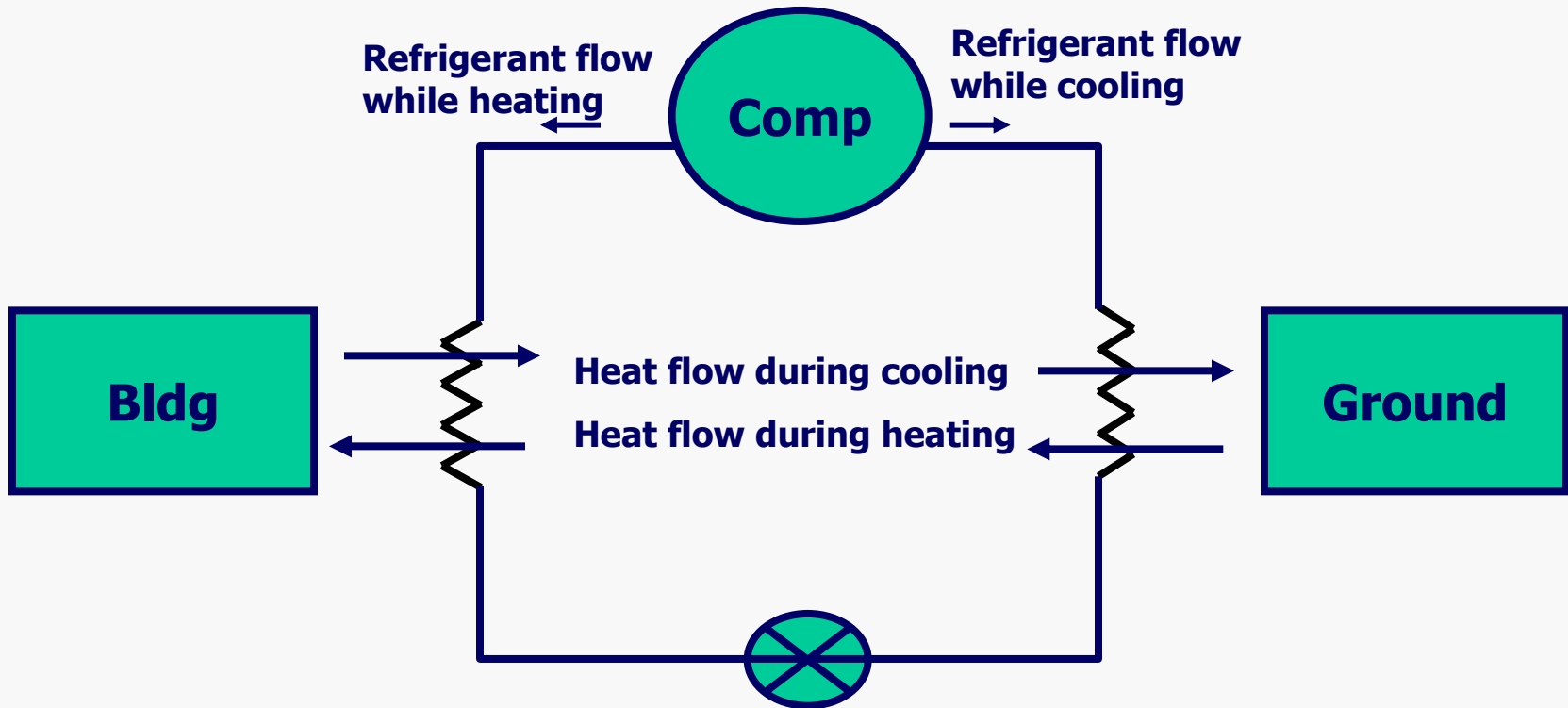
- ❖ **Requires little / no energy**
- ❖ **Indoor air quality good**
 - **Fresh air entry**
- ❖ **Disadvantage**
 - **Performance dependent on wind availability**



CII- Institute of Quality Building, Bangalore



Geo Thermal System



- ❖ Refrigerant : Environmentally safe Anti-freeze liquid (Water + Propylene Glycol)
- ❖ Polyethylene pipe (HDPE) pipes underground, Life 50 years
- ❖ Length of pipes depends on area conditioned

Saving potential : 30 – 50 %

IGP Office, Gulbarga



AREA IN SQ.FT
LEED RATING AWARDED
RATING SYSTEM

- 30,000
- GOLD RATED
- LEED FOR NEW CONSTRUCTION

GREEN FEATURES

- EVAPORATIVE COOLING TECHNIQUE
- USE OF SOLAR ENERGY
- RAT TRAP TYPE OF BRICK MASONRY
- TERRACE GARDEN & HIGH ALBEDO PAINT, etc

HYDERABAD INSTITUTE OF TECHNOLOGY & MANAGEMENT



AREA IN SQ.FT

- 78,000

LEED RATING AWARDED
RATING SYSTEM

- SILVER RATED
- LEED FOR NEW CONSTRUCTION

GREEN FEATURES

- 85% OF AREAS ARE DAYLIT
- FLY ASH BRICK CONSTRUCTION
- PASSIVE DOWNDRAFT EVAPORATIVE COOLING SYSTEM
- EXTENSIVE USE OF REUSED FURNITURE



Benefits Experienced in LEED Rated Buildings

- ❖ 3 LEED Platinum Buildings monitored to validate tangible benefits
- ❖ Benefits far exceeding the initial estimates

Building	Sq.ft	Normal Building (kWh)	Actual Building (kWh)	% Reduction	Annual Energy Savings (Rs in Lakhs)
Wipro	1,75,000	48,00,000	31,00,000	40%	102
ITC	1,70,000	35,00,000	20,00,000	45%	90
CII Godrej GBC	20,000	3,50,000	1,30,000	63%	9

- ❖ Energy consumption depends on
 - Local climate, Density of occupancy, Occupancy schedule, Orientation of the building, Internal loads

Wipro – Benefits Experienced

❖ Wipro building in Gurgaon

- **LEED Platinum rated**
 - ❑ Daytime building (12 hours/day)
 - ❑ Composite weather
 - 📄 Extremes of summer & winter
 - ❑ Area: 1,80,000 sft

❖ Specific Energy consumption

- **Comparison between May-Sep 06 and May-Sep 07**
- **Non-LEED building**
 - ❑ 506 kWh/person/month
- **LEED rated building**
 - ❑ 329 kWh/person/month
- **Annual savings: Rs. 100 Lakhs**



Co2 Emissions Reduction Potential

❖ 140 registered LEED buildings

- 67 million sq.ft
- Reduction of 800,000 tonnes of CO2 emission per year

❖ Technopolis

- 600,000 sq.ft
- Benefits anticipated: Rs.75 L /year



Technopolis, Kolkatta

Data Centres

- ❖ **Excellent opportunity for implementing green building concepts**
- ❖ **Building consumption as % of overall consumption can be reduced substantially**



Olympia Tech Park

Where Do We Go From Here?

❖ **Aspiring India to be one of the world leaders in green buildings by 2010**

❖ **Goals**

- **1 Billion sq.ft of green building footprint by 2015**
- **1000 Green Buildings registration by 2010**
- **Facilitate tapping Green Building materials market of Rs.15000 Cr by 2010**
- **5000 IGBC Accredited Professionals by 2010**
- **Pilot & launch of other LEED products**
 - ❑ **IGBC Homes & Residential,**
 - ❑ **LEED EB, LEED India ND, LEED India Schools, etc**



A close-up photograph of vibrant green fern fronds, with the text "Go Green . . ." overlaid in the center. The fronds are detailed and layered, creating a lush, textured background. The text is in a bold, white, sans-serif font.

Go Green . . .