

CHALLENGES FOR THE AIR-CONDITIONING INDUSTRY  
IN THE CONTEXT OF SUSTAINABILITY AND AFFORDABILITY

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REFRACON 2003, 7 FEBRUARY 2003, NEW DELHI



COOLING INDIA

Comfort and well-being is a basic human need that promotes good health, vitality and productivity. These are NOT seen as luxuries.

Productivity is a major incentive.



With urbanisation, as a greater share of the population gets engaged in services, the demand for **commercial built space** will grow...

... **offices, retail, entertainment, education...**

In India, urbanisation is concentrated in the warm and composite climate regions of the country.

The purpose of this presentation is to consider some strategic initiatives that can be taken to make airconditioning as widely affordable as possible and also an environmentally sustainable means of obtaining the goal of comfort and well-being.



**Initial costs**

Rs. 2500 - 3500 per sq.m.  
of built space

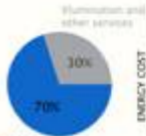
Air conditioning



BUILDING COST

**Running costs**

Air conditioning



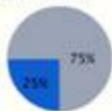
ENERGY COST

If airconditioning were possible at lower costs, of course many more of us would use it.

## Buildings as contributors of global warming



TOTAL CO<sub>2</sub> EMISSIONS



25% OF GLOBAL WARMING SHARE TO AIR CONDITIONING  
IF ALL BUILDINGS WERE AIR-CONDITIONED



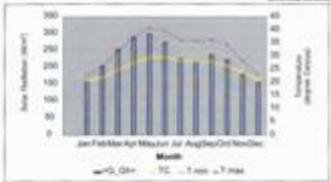
This means that it is incumbent on our fraternity of creative engineering and building designers to devise ways of obtaining thermal comfort in more sustainable ways.

## A LOOK AT

some strategies that will be productive complements to the advances in engineering and technology, and a recommendation that if these form an integral part of your strategy for growth we shall see a greater share of our populations enjoying their right to comfort and well-being.

1. THEORY OF COMFORT
2. BUILDING FABRIC DESIGN
3. TAKING ADVANTAGE OF ENVIRONMENTAL FACTORS
4. STRETCHING THE NET: "AIR-CONDITIONING" TECHNOLOGIES

Comfort standard for different climatic / cultural regions to be re-defined



CS 12.2.  
Typical graph of New Delhi

Comfort conditions seen as variables according to season

Minimise energy consumption for air conditioning through various strategies in the design of the building fabric :

- EXPOSURE
- INSULATION
- HEAT TRANSFER
- INTERNAL MICROCLIMATE

CASE STUDY: OFFICE FOR TCI LTD. IN GURGAON

**COMPACT SHAPE & COMPACT HEIGHT**

Controlling exposed surface area to floor area ratio.



**ORIENTATION !!**

Dictated by site and building setback lines.



SUPPORT FRAMEWORK FOR SHADING SCREENS

- Retract/ remove in winter, stretch in summer
- forecourt
- fountain court
- garden terrace



TREES AND PLANTS

- Shade external walls,  
early morning and late afternoon

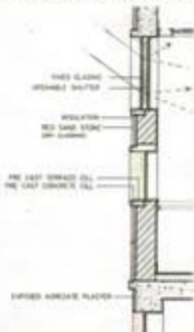
CONTROL WINDOW AREA

- 18% of external wall is glazed, rest is opaque

VENETIAN BLINDS IN SANDWICH WINDOWS & EXTERNAL GLASS IS TINTED

SELF SHADING FOR SMALL WINDOWS

- Deep reveal provides shade



External wall area badly exposed to low morning/ afternoon sun, therefore, control heat transfer through walls,

#### EXTERNAL WALL

- Large window (11% of wall area) - 2.80 watts/sqm k
- Small window (5% of wall area) - 6.42 watts/sqm k
- Opaque area (81% of wall area) - 0.75 watts/sqm k
- Effective (average) "U" value - 1.35 watts/sqm k

#### ROOF

- Reflective Roof Surface
- Effective (average) "U" value - 0.60 watts/sqm k



## FOUNTAIN COURT

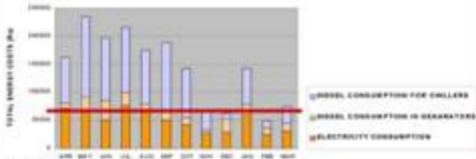
- Evaporative cooling
- Psychological comfort in seeing and hearing the play of water



## BUILDING FABRIC DESIGN

Area above red line denotes air-conditioning bill due to external heat gain.  
Heating Load in January!

ENERGY CONSUMPTION FOR YEAR 2000-2001



Average energy bill per month : Rs. 4.83/sqft

Average air-conditioning bill per month : Rs. 2.9/sqft

ADDITIONAL CIVIL WORKS SHARE



### ADDITIONAL CIVIL WORKS COST

Double Window : Rs. 1,90,000

Roof and Wall insulation : Rs. 8,60,000

Fountain pool : Rs. 4,50,000

TOTAL : Rs. 15,00,000

OVERALL CIVIL COST : Rs. 3,30,00,000

# ENVIRONMENTAL FACTORS

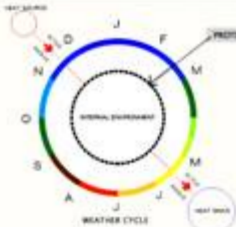
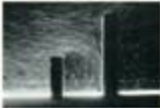
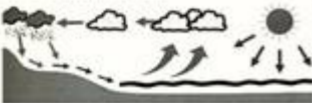
## Climate analysis

diurnal temperature variations  
night ventilation and thermal storage



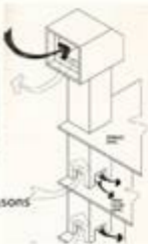
(a) Annualized (15°C and 25°C)

humidity and heat exchangers between  
fresh and conditioned air



using alternative **heat sinks**:  
ground, subsoil water, other water bodies

## STRETCHING THE NET: "AIR-CONDITIONING" TECHNOLOGIES



Positive ventilation and air movement in good seasons

Evaporative cooling: direct and indirect



Hybrid systems: air movement evaporative cooling + refrigeration

COOLING INDIA

1. Critical look and development of true comfort standards
2. Expanding the discipline of airconditioning and refrigeration conceptually to that of indoor climate control, integrating a wider range of complementary sciences and technologies
3. Professional consultancy for indoor climate control to integrate building fabric design with mechanical systems.

This is as important for retrofit of existing buildings as it is for new buildings.

4. Adoption of national standards according to climatic region laying limits on CO<sub>2</sub> emissions / sq.m. of served space for obtaining comfort conditions
5. Institution of awards for efficiency in indoor climatic control design and installation.

TOWARDS SUSTAINABILITY



Energy



Environmental Impact



Environmental Impact



Health

Indoor Air Quality

Well-being

