Definitions

Climatic design- “principles of solar design” as an interrelationship between architectural design, building materials, human behaviour and climatic factors.

Energy efficient design- interventions to reduce the amount of energy required to provide products and services like heating / cooling / lighting

Solar passive design - uses sunlight without active mechanical systems, converting sunlight into usable heat, causing air-movement for ventilating, orientation for reduced heat and enhanced lighting.
embodied energy - is the sum of all the energy required to produce goods or services, considered as if that energy was incorporated or 'embodied' in the product life-cycle including assessing the relevance and extent of energy into raw material extraction, transport, manufacture, assembly, installation, dis-assembly, deconstruction and/or decomposition as well as human and secondary resources

Carbon neutral- is having a net zero carbon footprint, or achieving net zero carbon emissions by balancing the amount of carbon released with an equivalent amount sequestered or offset. It is used in the context of carbon dioxide releasing processes, associated with transportation, energy production and industrial processes.

Carbon footprint - "A measure of the total amount of carbon dioxide (CO₂) and methane (CH₄) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as carbon dioxide equivalent (CO₂e) using the relevant 100-year global warming potential (GWP100)"
THE TROPICS

Area between tropic of Cancer and Capricorn - 50,000 square km = 1/3 of the planets surface, accounting for more than 1/3 of the global population.

More than 100 countries lie within this zone and most of them on the way of becoming industrialized with increasing energy consumption.

Energy consumption in:

- Asia/Africa per capita is about 0.5 tons of oil equivalent (TOE)
- Latin America is about 1.0 TOE
- Europe is about 3.5 TOE
- United States of America is 8.0 TOE
Passive solar systems in buildings to take advantage of natural cycles of sun in order to reduce the operational energy needs.

Comparing operational energy use in the tropics between countries…..

- Florida in USA is a developed area in the tropical zone where 47% of the total energy is used in buildings and 35% is used in transport
- Brazil a developing country uses 42% of its energy in buildings
- India – 36% industry, 20% agriculture, 15% transportation, 29% in buildings*

Most countries in the tropics have a history of solar passive buildings and it is called “Vernacular architecture”.

In hot dry regions with hot days and cold nights, the vernacular architecture developed a balance between

1. Thermal mass / time lag with controlled ventilation
2. Shading systems with indirect lighting

- In hot humid regions

1. Low thermal mass with Natural ventilation
2. Shading Systems

With the introduction of air conditioning architecture become independent from climate – “birth of pure aesthetics” – “Clearly expressed pure forms wrapped in glass”-

Result – increased energy consumption globally………of electrical energy mostly generated with fossil fuel. And architecture looses its “sustainability”
Urban design and Architecture have tremendous impact on energy efficiency and sustainability of societies.

The principle concepts are similar for residential and commercial buildings but the approaches are different.

In residential buildings the low tech approach can prevail for most buildings, if there is an active user behavior.

In commercial buildings the electro-mechanical approach with higher initial capital investment and more passive user behavior.

Providing thermal comfort in a building is essential – without it the body gets stressed and the immune system suffers significantly.
The idea of solar passive design is to modulate the conditions such that they are always within or as close as possible to the comfort zone.

- Identification of the climatic zone
- Collection of Climatic data for the last decade
- Study of site specific features
- Identification of local / unique weather conditions and features
PARAMETERS TO BE CONSIDERED FOR SOLAR PASSIVE DESIGN

RELATIVE HUMIDITY
AIR TEMPERATURE AND MOVEMENT
SHADING DAY & LIGHTING
RADIATION RECEIVED
INTERNAL MATERIALS AND FINISHES
MICRO-CLIMATE
Cool & Monsoon Season

- Night flushing is not advisable - night time RH is very high though diurnal swings can be observed.
Cool & Monsoon Season

- Low to moderate wind speeds during high rainfall period
- Driving rain is not a concern
Annual Solar Radiation & Sky Cover

Direct Normal Solar Radiation

- High direct normal solar radiation between January and May
- Moderate radiation during the remaining months

Sky Cover

- Semi-clear days between January and May
- Cloudy days during the remaining months

Months between January and May most conducive for using solar energy
Comfort zone

A: Context = Ecological and Physical
B: Settlement pattern and Site Planning
C: Passive Heating and Cooling Design Strategies
D: Openings, Day lighting and Natural Ventilation
E: Building Envelope
F: Active Strategies / Interventions

Band of appropriate design

Find Synergies

Climate
Building Context
Use
Occupancy Program & Schedule
Small Loads
Building & Site Design
Efficient Systems
HVAC Envelope Lighting Site
Orientation – for reduced solar gain + glare and maximum ventilation
Ceiling and roof level opening to vent hot air

Solar chimneys for increased wind speed
Creation of transition spaces & green ground cover - reduce reflected ground radiation, lowered the air temperature around the buildings.
Roof insulation and shading to reduce heat gain
protection from monsoons and cyclonic driving rain
- U value in building materials
- Internal heat gain – heat output from people, lamps, computers and appliances
- Evaporation – from surfaces (sweat, walls and plants)
Finishing materials –
dust and grime resistant / easy maintenance
TARGET GROUP

1. Planners / decision makers / architects
2. Developers / financial institutions
3. Owner built and / or petty contractor with owner built
4. Small developers cum builders
5. Citizen action groups

WHAT THEY REQUIRE

1. Awareness on climate responsive design issues
2. Access to specific information on weather and geo-physical data
3. Consultation agency; real and virtual

HOW TO INFLUENCE THIS MARKET

1. Town planning / municipal office to have hand-outs / booklets
2. Set up design cells
3. Public information ads in the media combined with contact info
THANK YOU