SOLAR PASSIVE DESIGN IN HOT-HUMID COASTAL ZONES
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 planet’s 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
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
High direct normal solar radiation between January and May
Moderate radiation during the remaining months

- Months between January and May most conducive for using solar energy
- Semi-clear days between January and May
- Cloudy days during the remaining months
Comfort zone
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