GRIHA Summit 2017
Transforming habitats through Sustainable & Resilient buildings

Building Energy Efficiency Project,
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www.beepindia.org

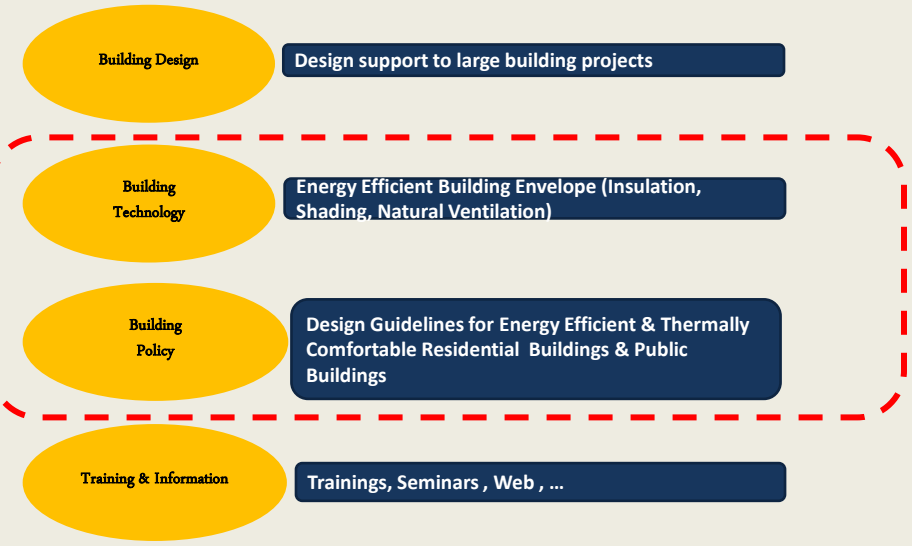
Indo-Swiss Building Energy Efficiency Project (BEEP)

Phase I: 2012-2016

Phase II: 2017-2021

To assist Government of India in mainstreaming thermally comfortable and energy efficient building design in India

Indo-Swiss Building Energy Efficiency Project (BEEP)



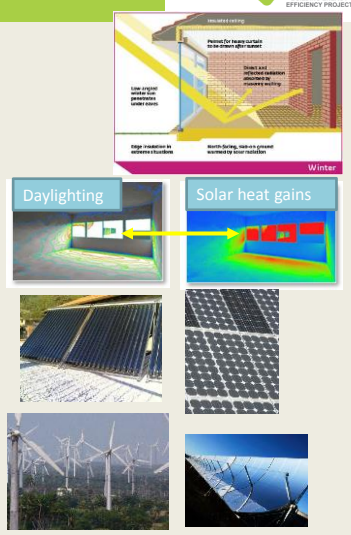
Building Design

My exposure to the Indian context

- 1981-1983 worked on the development of a solar thermal irrigation pump at the CSMCRI Bhavnagar, Gujarat, Indo-Swiss project
- 1983 → date:
  - working as an energy consultant and researcher for buildings and industry in Switzerland and Europe
- 1994→ date
  - Involved the development of the energy efficiency programme of SDC in India
    - Worked closely with TERI in Foundry, Glass, Brick SME's and on biomass gasification
    - Assisted TERI in the development of the GRIHA rating for evaporative cooling
    - Since 2011 in charge of the Project Technical Management Unit (Switzerland) for the BEEP project

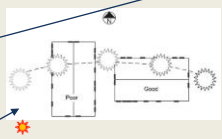
When is solar beneficial ?

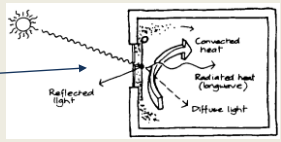
- Passive solar heating in cold climates (not of much interest for hot climates)
- Daylighting ←→ overheating
  - Find the optimum solution (much easier with external movable shading)
- Solar energy harvesting
  - Solar thermal collectors
  - Solar Photovoltaics
  - Solar thermal electric power
  - Windmills (indirect effect)
    - Wind is a form of solar energy and is essentially a result of the uneven heating of the atmosphere by the sun



When is solar detrimental ?

- It is causing overheating of buildings in hot climates in summer (and even in cold climates if not properly thought through)
- Solar radiation heat gains through glazing are the most important overheating factors (~60% of the heat gains) for low internal gains and shallow buildings
  - daylight offices
  - residential buildings
- Main causes for excessive solar gains
  - East-West orientations (worst cases)
  - High window to wall ratio
  - Inefficient shading strategies
    - Static shading
      - Does not cut the direct all the time (East, West facades)
      - Does not cut the diffuse radiation
    - Internal shading does protect from glare, but hardly from solar heat gains





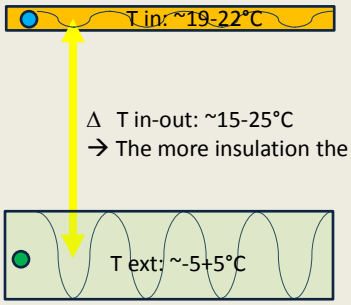
Ancient architecture (low window to wall ratio, natural ventilation, …

«modern» architecture 70-100% glazed, no natural ventilation, all air systems

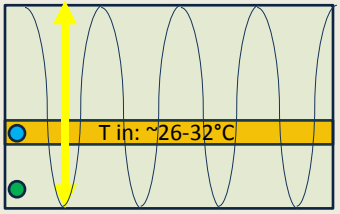
«sustainable» architecture, 25-40% window to wall ratio, natural ventilation, external movable solar protection

Building physic is the same everywhere but: North and Southern countries weather conditions differ in nature

- Northern in winter summer

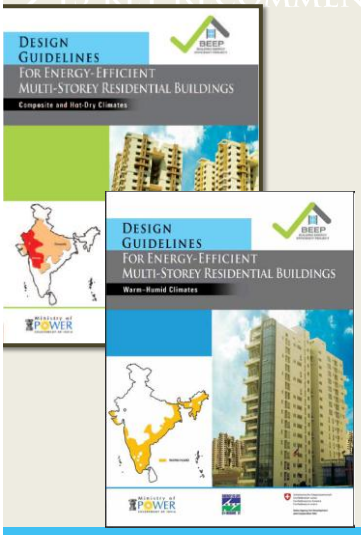


South in



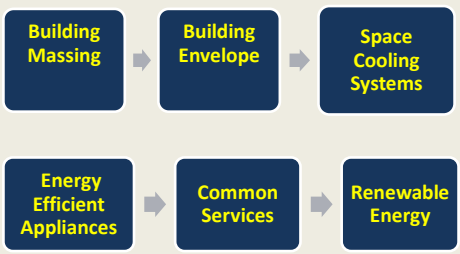
Δ T in-out: ~-15+5°C
Insulation alone not sufficient for non AC buildings, it must be part of and integrated design approach

Design Guidelines for Energy Efficient Residential Buildings 1) for composite climates and hot and dry 2) for warm and humid climates → 15 key Recommend...



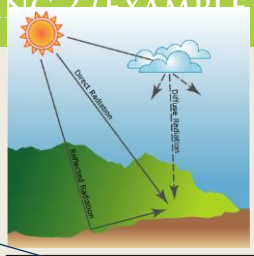
These design guidelines (composite ..) were mentioned beside ECBC as part of India's Intended Nationally Determined Contribution (IINDC) towards the COP21 in Paris in December 2015.

"Design Guidelines for Energy Efficient Multi-storey Residential buildings" have also been launched.

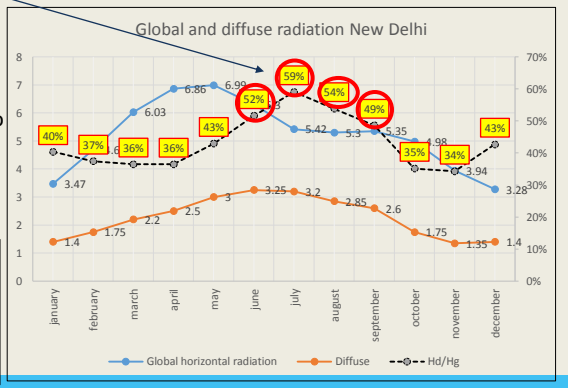


WHY IS IT SO IMPORTANT TO CUT NOT ONLY DIRECT BUT ALSO DIFFUSE SOLAR RADIATION WITH EXTERNAL SHADING ? (EXAMPLE OF DELHI CLIMATE)

- Solar heat gains (direct and diffuse radiation) are the main contributors to overheating !!
- **The solar diffuse radiation reaches more than 50% of the global radiation in hot summer in Delhi when overheating occurs**
- Protecting against solar heat gain with overhangs is not sufficient !!!!!, especially on East and West facades where it does not work during summer
- Today's trends in window to wall ratio (often >50%) require the use of external movable blinds (SHGC <15%)



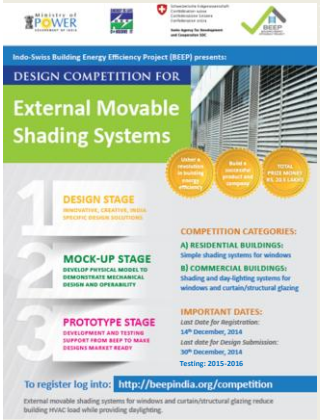
Solar diffuse radiation on horizontal surfaces
In India, the total daily radiation may reach about 6.5 kWh/m2-day on horizontal surfaces. The figure below show that the diffuse radiation reaches in the order of 50% of the total irradiation for a day especially during hot summer. The calculation models are also almost systematically underestimating the diffuse intensity, which is partly explained by the turbidity.



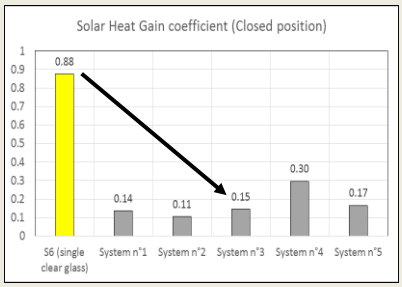
Predicting monthly mean daily diffuse radiation for India
Indira Karakoti, Prasun Kumar Das, S.K. Singh
***Solar Energy Centre, MNRE**, New Delhi 110 003, India, Applied Energy, 2012, vol. 91, issue 1, pages 412-425*

INCOMPLETE INVENTORY OF COUNTRIES USING EXTERNAL SHUTTERS

National Design Competition for external movable shadings (→ reducing 15-50% of cooling demand in BHEB)



- Selection of laureates → prototypes
- Testing at Ahmedabad (CEPT University, CARBSE) completed
- Results
- **Reduction of solar gains by a factor 4 with indian designs → large potential of applications**
- **New buildings**
- **Retrofits kits to develop**



External Movable Shading in India

Experience of working with residential projects

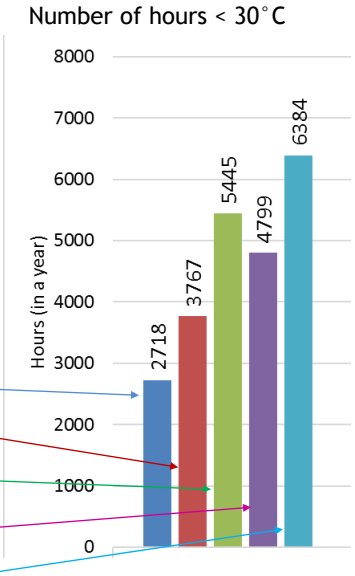
- **D B Pride, Indore (1743 units)**

- **P-17 Residential Project, Mahindra World City, Chennai (874 units)**

- **Smart GHAR 3, Rajkot (1176 units)**

Rajkot Charrette

- Summary of the Strategies developed and assessed for the low cost housing project Smart Ghar



- Baseline
- Casement windows (100% operable opening)
- External movable shading (shutter)
- Partly opaques shutters/windows with top glazing
- Assisted cross ventilation

Transforming habitats through Sustainable & Resilient buildings

- The issues for resilient buildings
  - Improve thermal comfort by passive measures
    - 1) Re-introduce lower Window to Wall Ratio
    - 2) Reduce heat gains in residential by 40-60% → Equip the buildings with external movable shadings (SHGC < 0.15)
    - 3) Efficient natural/or low energy assisted natural ventilation
- No rocket science, simple passive strategies giving significant results can improve the thermal comfort in residential sector → more resilience to towards sustainability, slower penetration of AC's and lower energy consumption for cooling

- Thank you
- Design Guidelines for Energy Efficient Multi-Storey Residential Buildings can be download from BEEP website at: www.beepindia.org