

FLORIDA SOLAR



ENERGY CENTER®

Concepts in Passive Design #3

Passive Cooling Categorizations

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DESIGN NOTES

FLORIDA SOLAR ENERGY CENTER
CONCEPTS IN PASSIVE DESIGN #3

Passive Cooling Categorizations

(Editor's Note: While passive solar heating is relatively well evolved, passive cooling is only on the threshold of development, and many of its terms are new to the practicing professional. At the Fourth Annual Passive Cooling Conference this problem was addressed by William W. Holmes of the University of Nebraska with the presentation of a 10-point categorization of cooling techniques. We are indebted to Mr. Holmes for this contribution to the emerging field of passive cooling and present it here as a point of departure and working vocabulary for the design professional.)

1. Gain Prevention Techniques (the "ounce of prevention worth a pound of cure"):

- A. Geometry (shape, configuration and surface-to-volume ratio)
- B. Orientation (fundamental climatic response)
- C. Shading (solar control)
- D. Envelope (skin resistance, capacitance and infiltration effects)
- E. Surfaces (color, texture, absorptance, emissivity and reflectivity)
- F. Operational conservation (weatherization, daylighting, electrical load shedding, reclamation, etc.)

2. Site Cooling (all land surface non-building micro-climate variables):

- A. Vegetative control (shading, wind control, transpirational cooling)
- B. Water bodies
- C. Land forms
- D. Adjacent land surface materials

3. Earth Cooling (all earth-air heat exchanges affecting the interior environment of the building thermally):

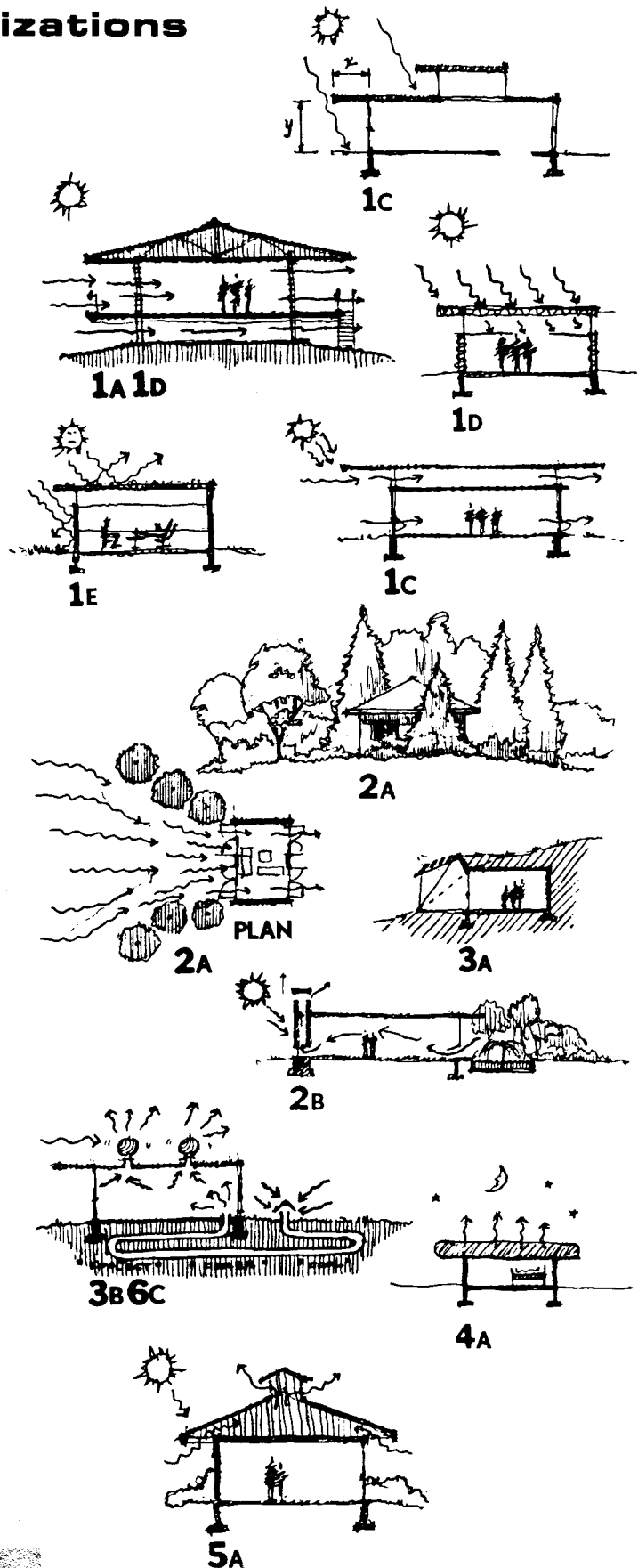
- A. Earth-contact cooling
- B. Earth-tube cooling
- C. Ground water cooling

4. Sky Cooling (all radiative sky-sink effects):

- A. Nocturnal radiation
- B. North sky radiation

5. Ventilative Cooling (all heat dissipation by convective air flows):

- A. Attic ventilation
- B. Space ventilation (wind, solar-stack or convectively induced)
- C. Internal heat gain exhaust (with makeup air cycle)
- D. Diurnal air cooling
- E. Wind towers



DESIGN NOTES

6. Vapor Cooling (all heat-of-vaporization cycles):

- A. Evaporative (adiabatic) cooling (to remove sensible heat)
- B. Desiccative dehumidification (to remove latent heat)
- C. Condensative dehumidification
- D. Evaporative roof sprays
- E. Evaporative ponds ("cool pools")

7. Flywheel Cooling (all natural capacitance effect cooling in buildings):

- A. Internal mass (or PCM) storage
- B. Insulated exterior walls as mass storage
- C. Rockbed cooling
- D. Annual cycle cooling

8. Solar Cooling (all solar thermal-powered cooling cycles, including active systems):

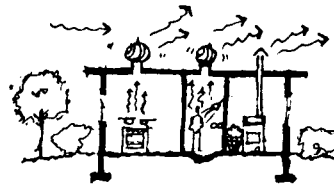
- A. Solar stack effect convection
- B. Solar/absorption cooling cycles
- C. Solar/Rankine/vapor compression cycles
- D. Photovoltaic/vapor compression cycles
- E. Solar/heat pump cycles

9. Venturi Cooling (all Bernoulli pressure-velocity-temperature cooling effects):

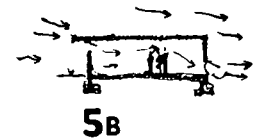
- A. Self "air conditioning" domes (see The Dymaxion World of Buckminster Fuller, Reinhold, 1960, p. 117)
- B. Aperture restriction at base of certain Iranian wind towers (see Bahadori)
- C. Others (much work needs to be done)

10. Hybrid Cooling (all actively augmented natural cooling systems):

- A. Forced ventilation
- B. Forced fluid transfers
- C. Forced air-motion effects
- D. Mechanical dehumidification
- E. Off-peak mechanical cooling



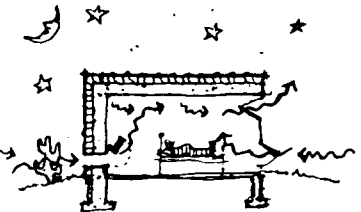
1F 5C



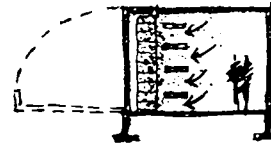
5B



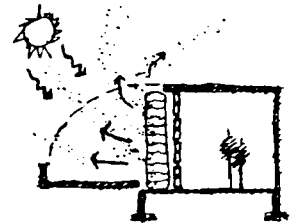
6E



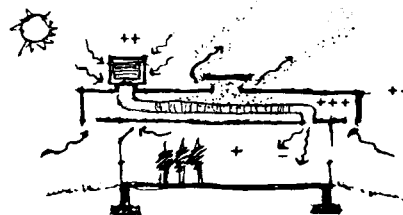
5D 7B



6B
Charging



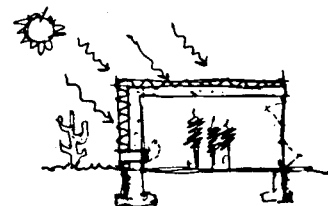
6B
Discharging



6A
(two stage)



6D



1D 7B



7A 10B



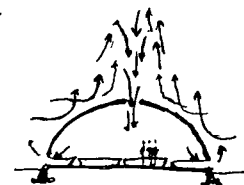
8B



8A



10c



9A



10d

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