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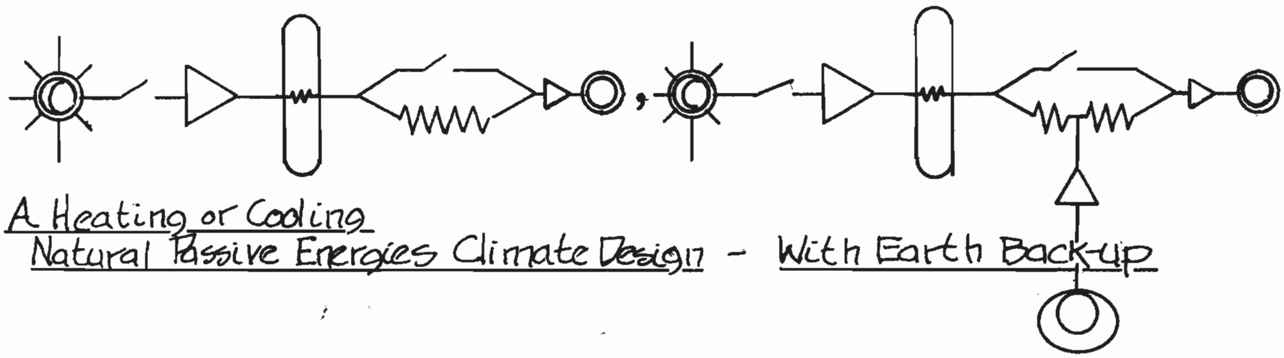
Jan 29, 1979

BUILDING CLIMATE PATHWAYS

PASSIVE SOLAR DIAGRAMING

A FIRST ATTEMPT



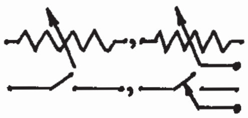
DEFINITION: A 'natural passive energies building climate design' (help!) is a heat pump, usually with special storage, which works on unequal rates of natural energies flow. For example, heating is addomplished when the entrance of heat is easier than its exit. Cooling is accomplished when the exit of heat is easier than its entrance.

INTRODUCTION: Present passive solar designs utilize only a small portion of the opportunity availible, partly because there is not yet a flexible and comprehensive climate pathways diagraming method. This is an attempt to assemble one which encourages innovation in both conceptual design and mathematical analysis. This experimentally developed symbolism would, when further developed, translate building climates into scientific formulas but more importantly serve as a conceptual aid to building designers in the initial arrangement of design ideas before any calculation is done. Thus, a very central aspect to this experiment is the attempt to conceive of a symbolism that can be drawn at various levels of complexity and still be complete. For both a simple and a complex diagram to be fully complete the symbols themselves must be inclusive of natural behavior rather than exclusive. My expectation is that though such a method might be difficult to learn the resultant flexibility would make it far superior to easy-to-learn but highly inflexible exclusive symbol diagrams.

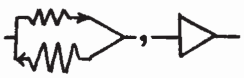
BASIC SYMBOLS:

1. Circuit lines, dominant or particular lines.

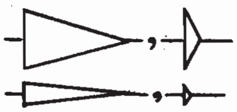
2. Resistance, high and low. A reduced connection between energy sources. This symbol represents a complex of convective, conductive, radiative and chemical properties.



3. Manually and automaticly variable resistances and switches (doors, dampers, curtains, awnings etc.)



4. Thermal process diodes. A diode is a complex resistance with 'foreward' resistance smaller than 'backward' resistance.

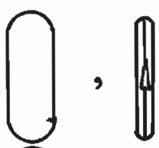


5. High flow diode (low resistance plus high or low foreward-backward difference)
Low flow diode (high resistance plus high or low foreward-backward difference)

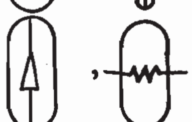
6. Air environment, combining large heat capacity, temperature, moisture, wind, diffuse light and thermal radiation.

7, Sun environment, including total air environment conditions unless otherwise provided for.

8. Earth environment, combining large heat capacity temperature, moisture , thermal resistance and surface characteristics.

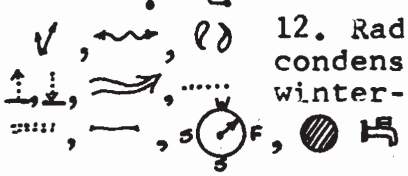


9. Thermal storage, mass wall, room air, etc. drawn so that the long dimension is proportional to the structure being diagrammed and the area proportional to the heat capacity. - unity for rock



10. Thermal storage with assumed linear stratification, with internal resistance and lag.

11. People, equipment and lights, plants, fans, variable fans (volume & speed)

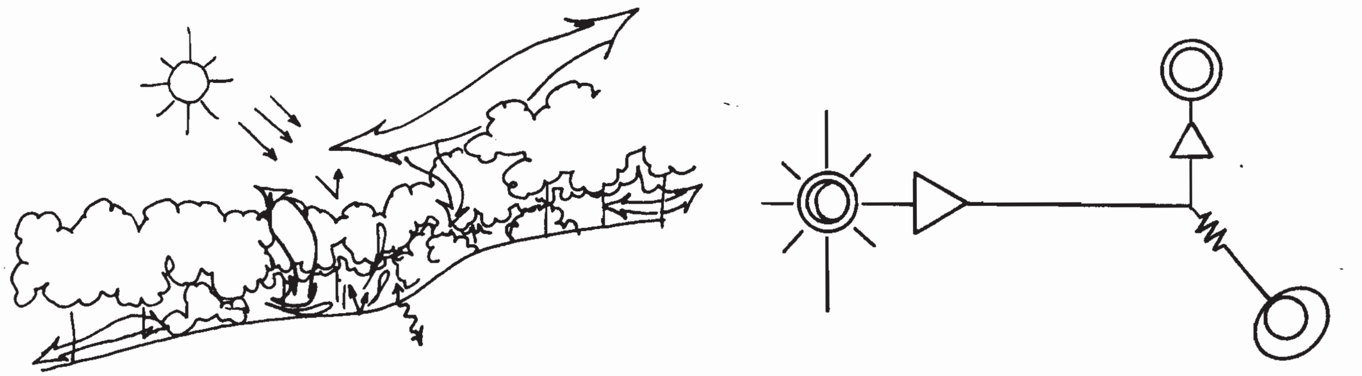


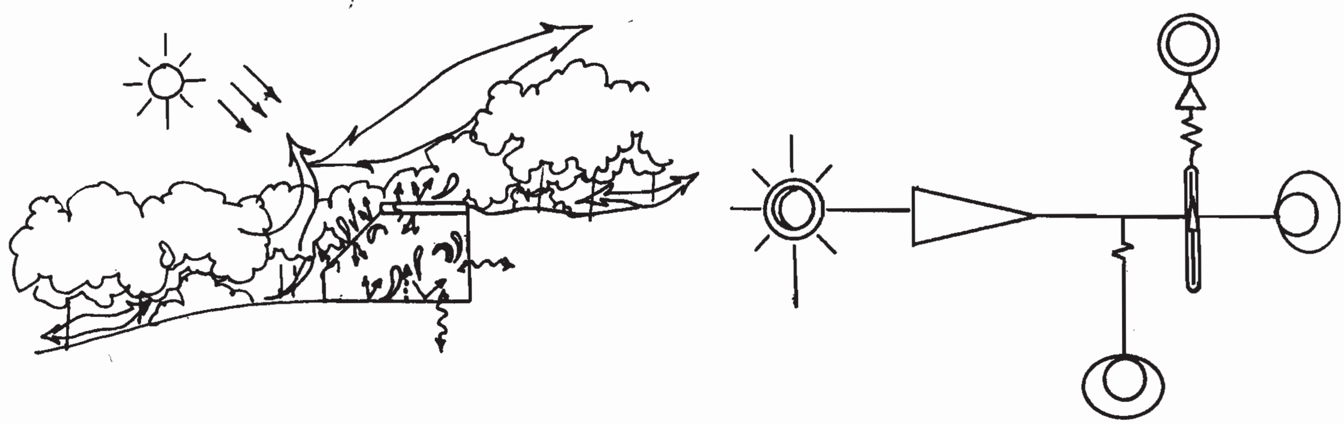
12. Radiation, conduction, convection, evaporation condensation, wind, screen, filter, absorber plate winter-spring-summer-fall, water

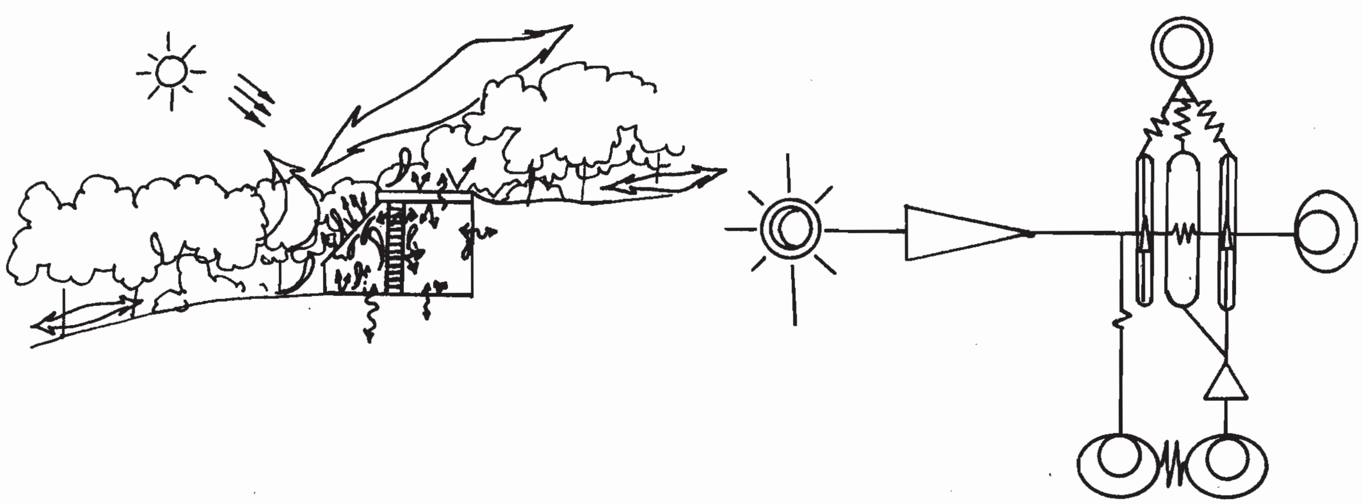
MAKING A DIAGRAM:

The process would start with drawing the structures in the microclimate under consideration and then noting all the rudimentary flows on that drawing. With an informed imagination you then draw the connections from the microclimate to itself through the structure. Because all diagram elements involve complex dynamic elements there will never be a substitute for a well informed imagination.

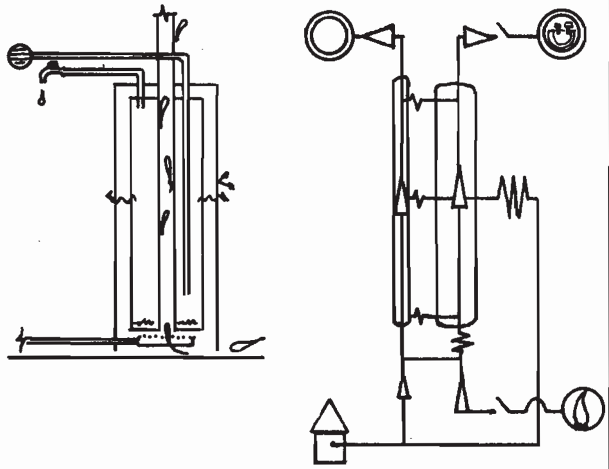
EXAMPLE (1): A sunny clearing with two additions.



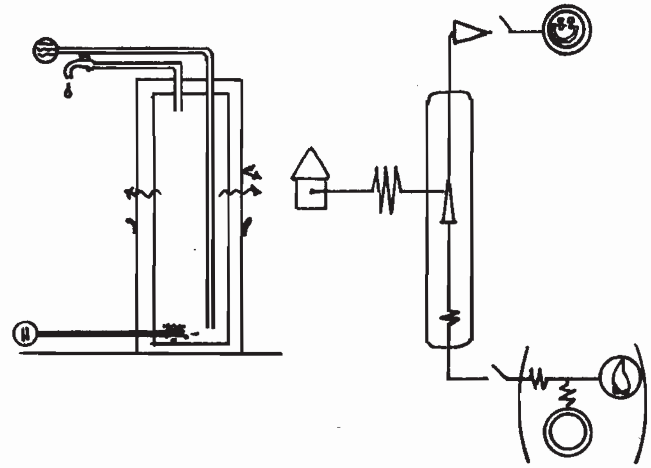




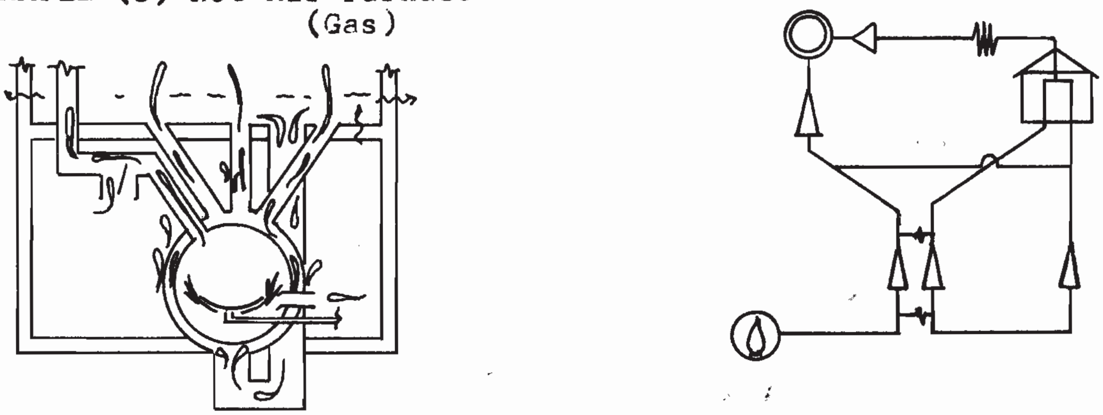
EXAMPLE (2) Hot Water Heater (Gas)



Hot Water Heater (Electric)

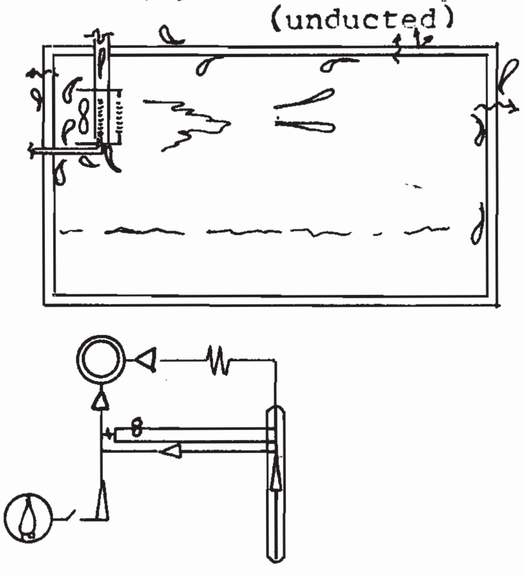


EXAMPLE (3) Hot Air Furnace (Gas)

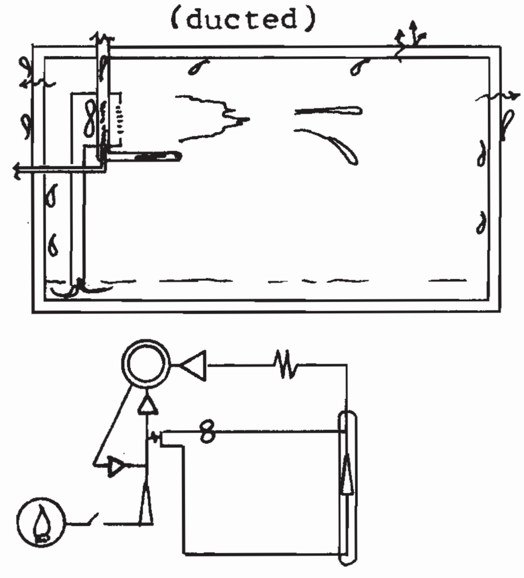


EXAMPLE (4) Industrial Space-heater

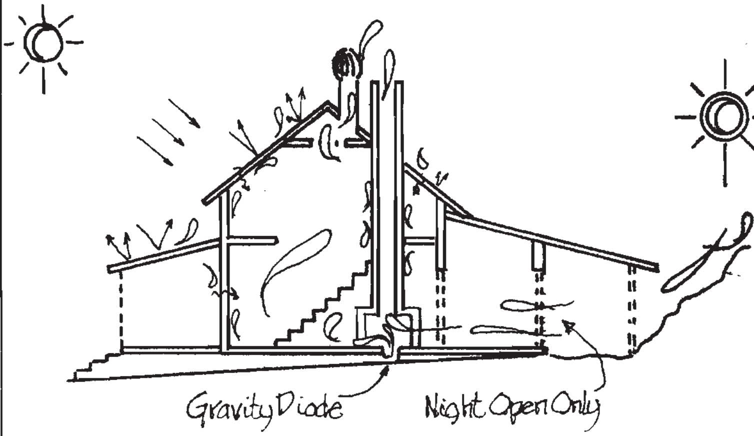
(unducted)

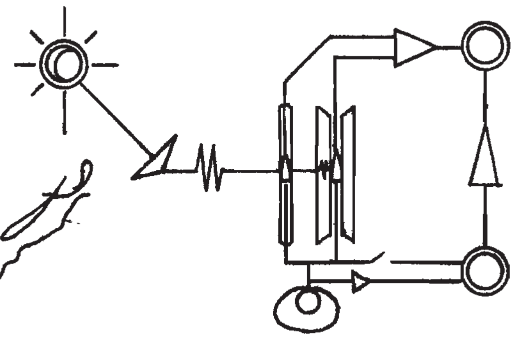


(ducted)

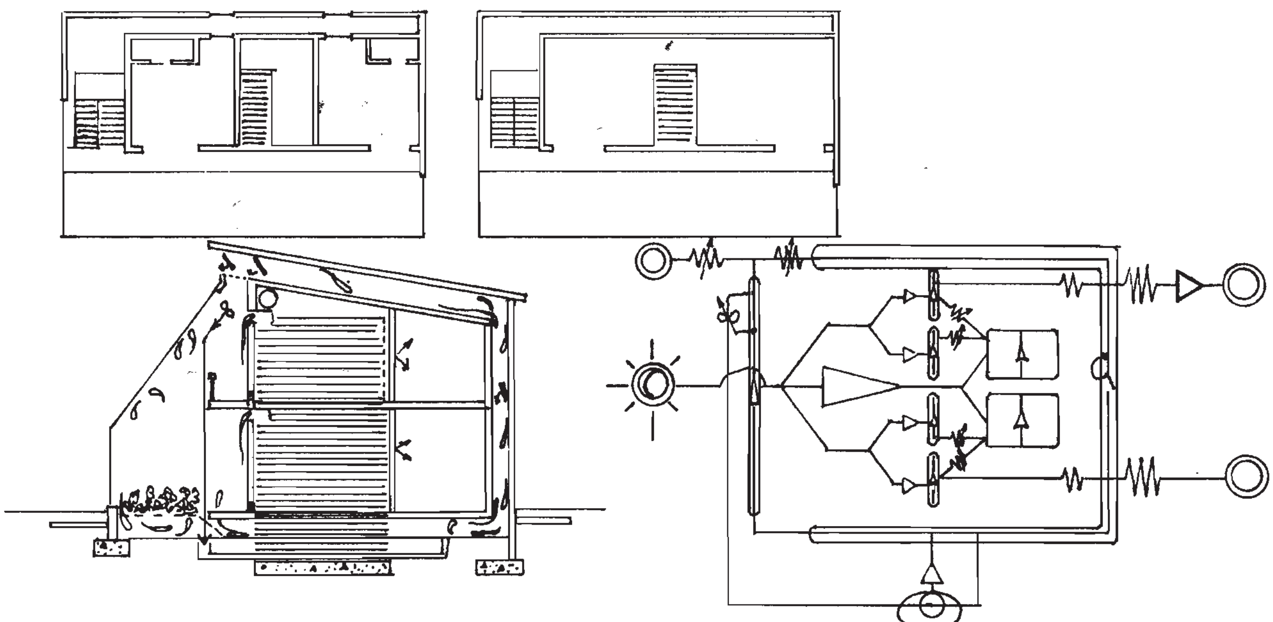


EXAMPLE (5) - Old house, Summer cooling

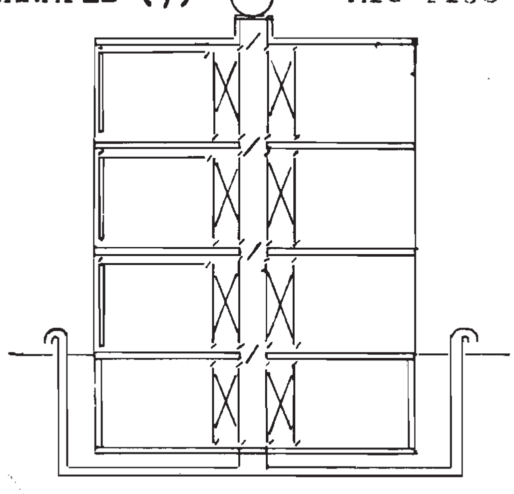


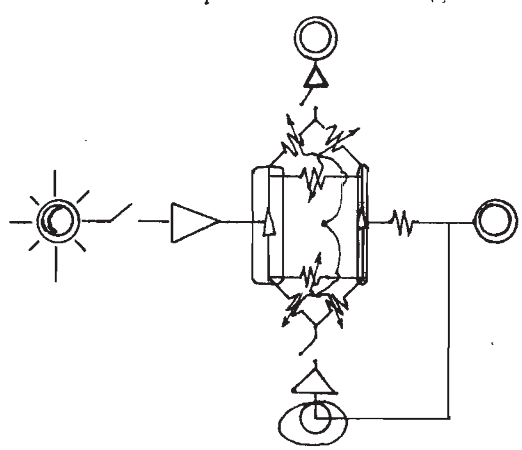


EXAMPLE (6) - Central Selective Current Storage in a Double Shell



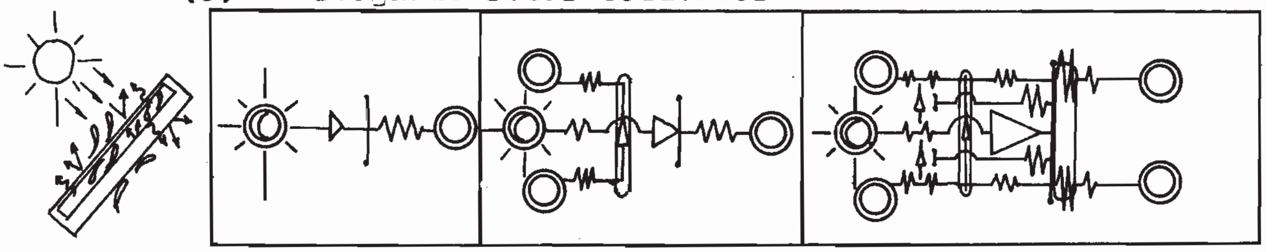
EXAMPLE (7) - Mid-rise all season passive design





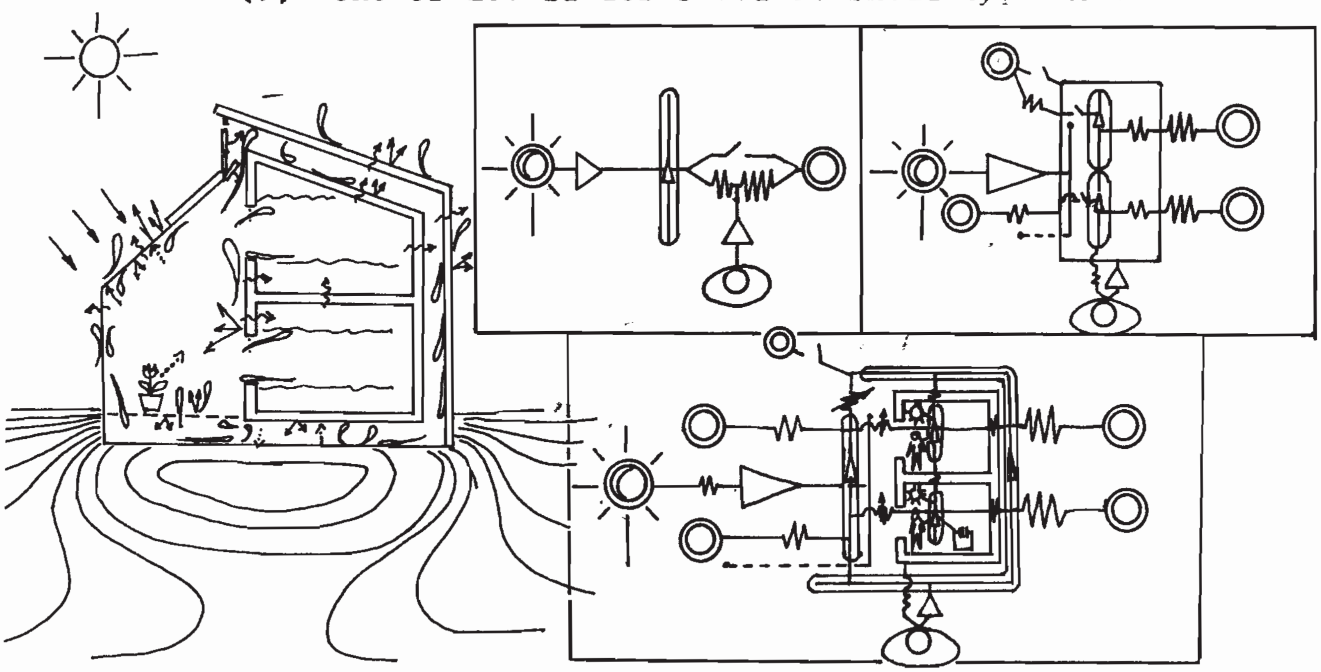
RANGES OF COMPLEXITY: If a diagram is to both be usable as a design tool and an analytic tool it must be able to expand and contract to various levels of detail. As I don't really know how valid analytical moddles will eventually be constructed, the following are drawn just to display a flexible range of detail.

EXAMPLE (8) A stagnant solar collector



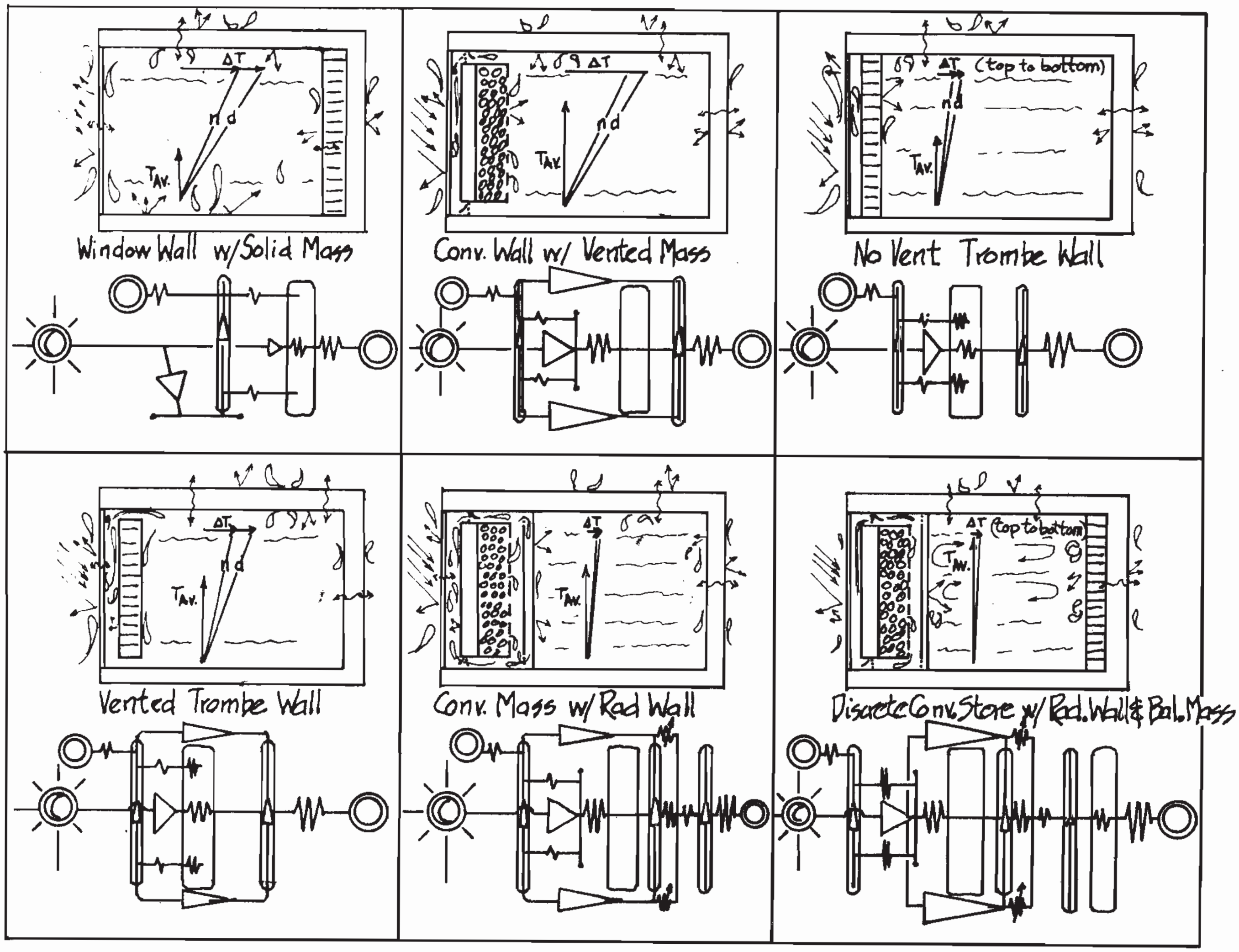
(Here the 'ᐅ' symbol in the first diagram means the composite balance of the glazing, air space and absorber with the front side environment. In subsequent use it is less inclusive)

EXAMPLE (9) One of Lee Butler's double shell type houses



SHOWING SIMPLE DIFFERENCES: One of the valuable opportunities this method provides is a simple way to communicate the critical differences between 'minor' changes in design. The following sequence also demonstrates one of the 'advantageous weaknesses' of the diagram method. The weakness is that it can display proportional differences without adequate verification. The advantage is that it thereby suggests where verification should be made when no question might have initially existed. This should further underline the necessity of a well informed imagination.

EXAMPLE (10) SIMPLE DIFFERENCES , stratification and storage method in mass wall designs for one room buildings.



NOTES: Temp. stratification reduced by higher insul., rad. heat distribution and internal mass convectivity.

Average temp increases with higher gain efficiency and higher insulation.

Day-Night temp. swing (not shown above) reduced by higher mass, arrangement of mass, secondary heat distribution balances

The above sequence of drawings demonstrates some of the 'advantageous weaknesses' of the method. Centrally, this is that the diagrams adapt to suggestive statements unsupported by adequate verification. The advantage is both that dry data can be made expressive, and, more importantly, that suggestion that verification be made,where no question might have initially existed, becomes clear.

CONSIDERATIONS: There are many questions which would pertain to the development, from scratch, of a tool for communicating a thoroughly complex and important subject which no one understands very well at all. I have tried to display a clear conceptual framework for suggesting limited understanding of natural process which is also flexible enough to be evolved into a concrete analytical framework. I hope that the following considerations will be amplified and adapted by others.

1. The method concentrates on the existance and type of connections with an occasional hint as to the proportionality of connections. In this way, the method serves best as a set of reminders for people with a highly developed awareness of the habits of nature and might seriously mislead those who have not carefully studied natural process previously. One of the serious ommissions is a way of graphicly symbolizing heat flow lag.

2. The primary strength of the method lies in its ability to interpret any natural climate behavior in a range of complexities. This breaks the hold of using archetypal building forms which necessarily stifles innovation. Developing a skill in stepping a diagram between levels of complexity is probably a sure way of verifying whether one's awareness is consistant and would be a primary tool for developing design freedom. Whether this method is a good one or not depends on the convenience of successivly expanding and contracting its expressions. The ideal level of complexity for design development and communication drawings would be a simple 'all at once readable' graphic, to which an addendum of details could be attached.

3. How do you make a meaningful defense of a diagram to those who have done limited or no direct building climate observation? I think an important part of this rests (other than on great patience) upon accompanying every diagram with a sketch of the structure diagrammed, along with lots of ↕, ⇝, 69, ↯, buddies. Conversely, I dont think there is anything a person who has limited or no experience in observing building climate can do to keep from being mislead.