The Indio Cool Pool Experiment

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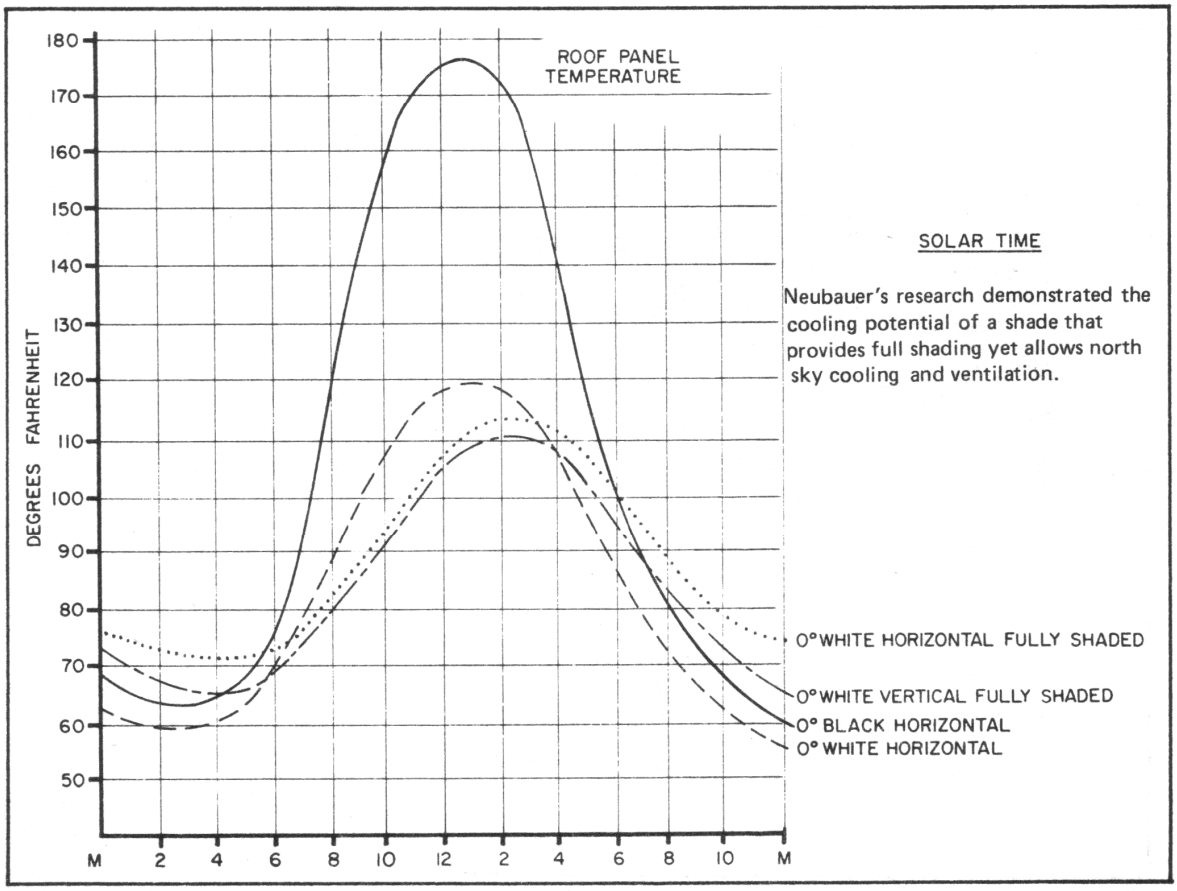
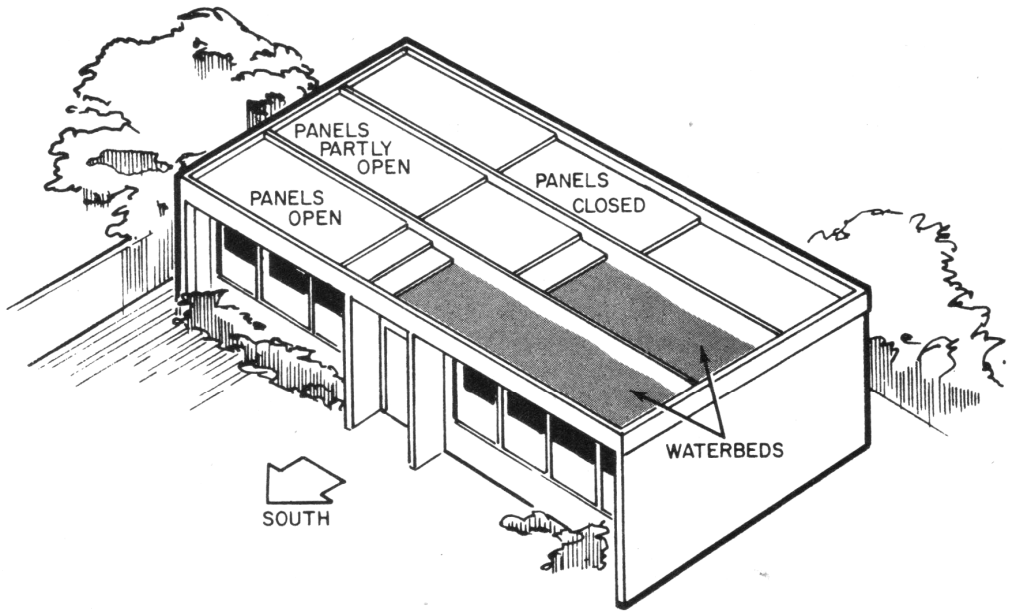
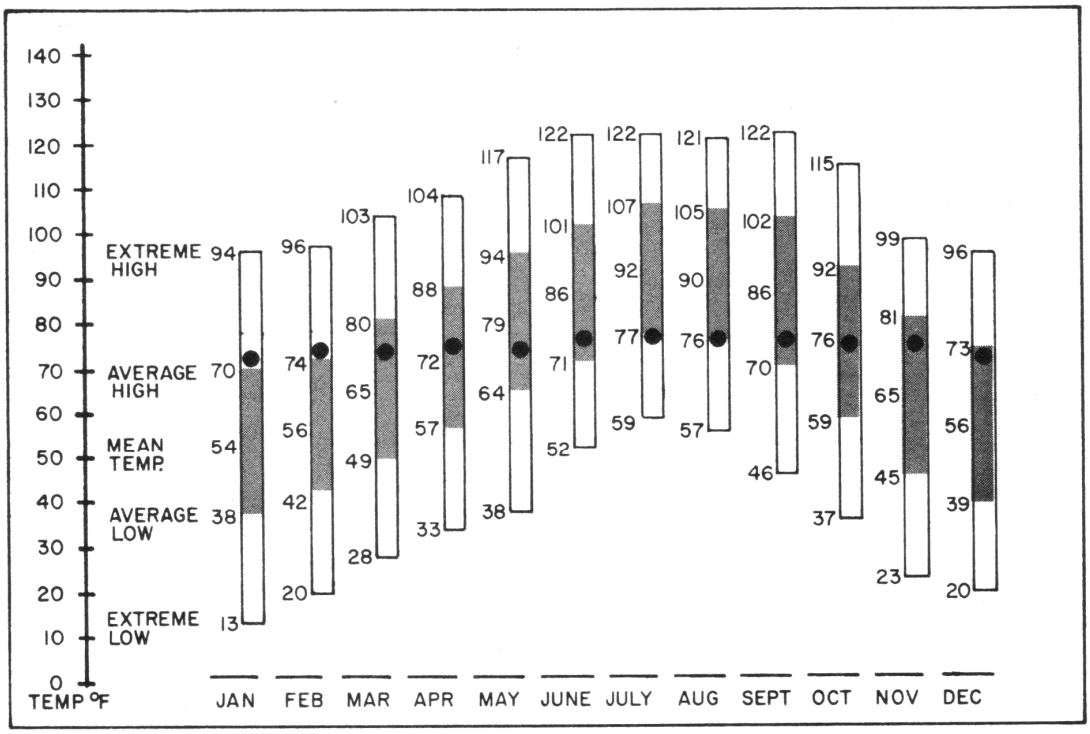
In the summer of 1976, Living Systems conducted a series of experiments at the Date and Citrus Station in Indio, Calif. to test the potential for natural cooling in hot areas. These experiments were designed to test a method of natural cooling developed by Living Systems after a careful review of the previous efforts. The work of Loren Neubauer and Harold Hay was of particular value.

Neubauer's research involved shading for livestock which demonstrated the cooling potential of a shade that provides full shading yet allows north sky cooling and ventilation. [2,3]





Cooling Mode Operation for the Skytherm Hay House: Panels opened at night to allow radiant loss from the waterbeds. During extremely hot months the tops of the waterbeds were covered with a layer of water to all evaporative cooling. The panels closed during the day.



The performance of the Hay Skytherm Prototype superimposed on the Indio temperature data.

Harold Hay's work on roof tanks with movable insulation was also of value. The results from the Phoenix test house were of particular value because the climate is very similar to Indio. By using flooded roof tanks and movable insulation, very comfortable temperatures were maintained. [4,5] The principle drawback has been the difficulty of developing an inexpensive insulation system with automatic controls and tracks.[6]

Living Systems conducted several experiments at their office in Winters on the concept of a cool pool. In brief, the cool pool consists of an insulated pool of water fully shaded from the sun during the day. The pool stays cool primarily by radiating heat to the cool night sky and by evaporation. The results were encouraging and led to construction of a "cool pool" room for the California State Fair in Sacramento.

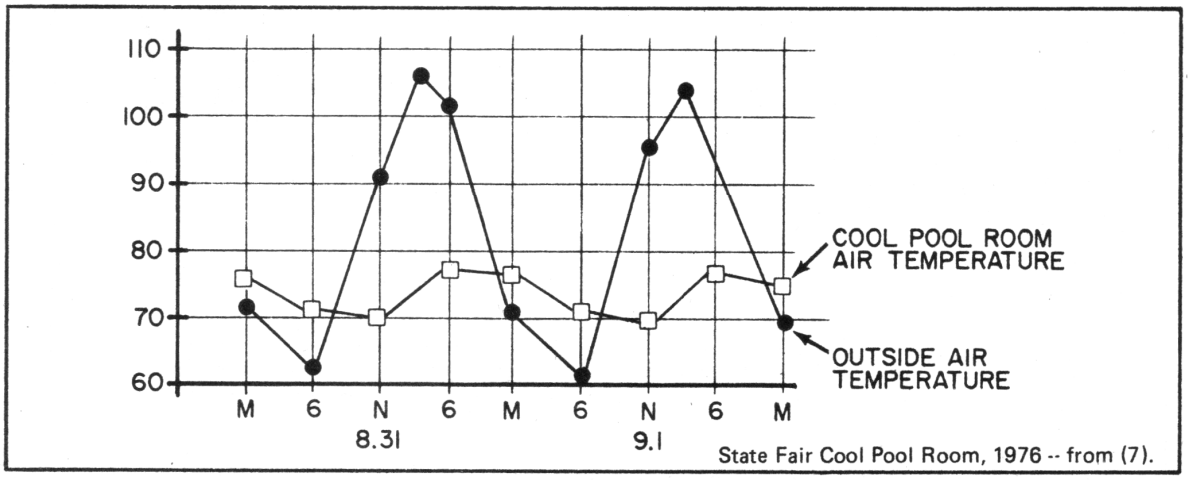
These results were very encouraging, and Living Systems developed a research program that was conducted at the Date and Citrus Station in Indio during the summer of 1976. Indio is an excellent site for a cool pool, as the summer temperatures are very high yet humidity is very low. In addition, the energy costs in a traditional house are very high, typically about $300 a year, and if an economical natural cooling system could be developed it would very likely be used.

Three experiments were conducted in an effort to assess more precisely how the cool pool worked. The first test used two open pools in an effort to establish a baseline. For the second test, one pool was covered with clear plastic in an effort to establish the importance of evaporation in cooling. And the final test evaluated the cooling ability of the cool pool when a constant heat load is added.

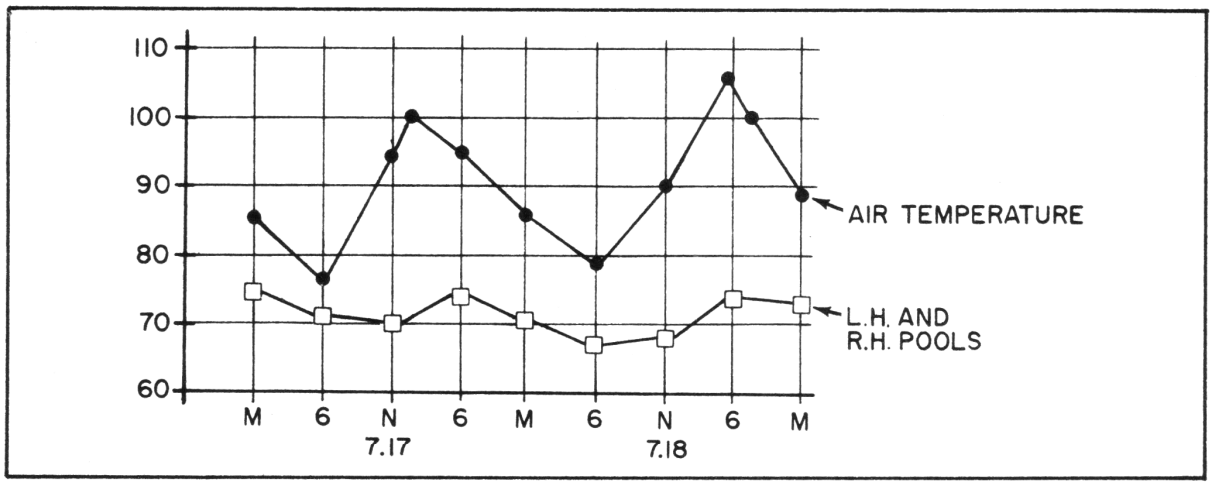
The first experiment was a very useful test and established a good performance baseline. The temperature of the water from the hose was 85° and the "cool pool" responded quite well, bringing the temperature down in two days to 70°.

The second test compared a cool pool covered with plastic with an uncovered cool pool. As expected, this revealed the importance of evaporative cooling.

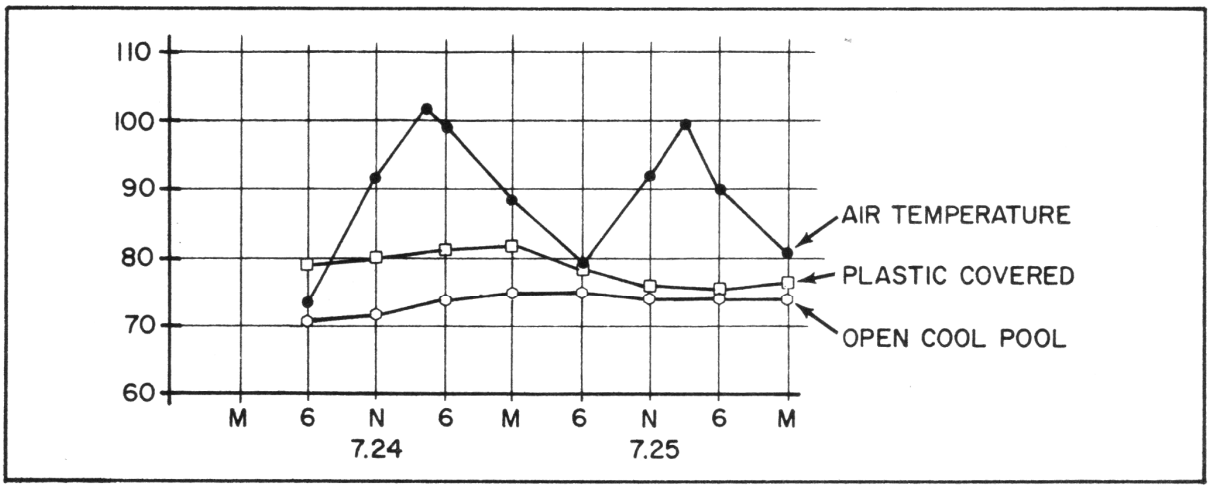
In the final test, a heat source was added to one cool pool to evaluate the cool pool's response to added heat input. The heat source at the bottom of the pool stimulates the operation of the cool pool building where heat from the room below would be transferred to the pool.



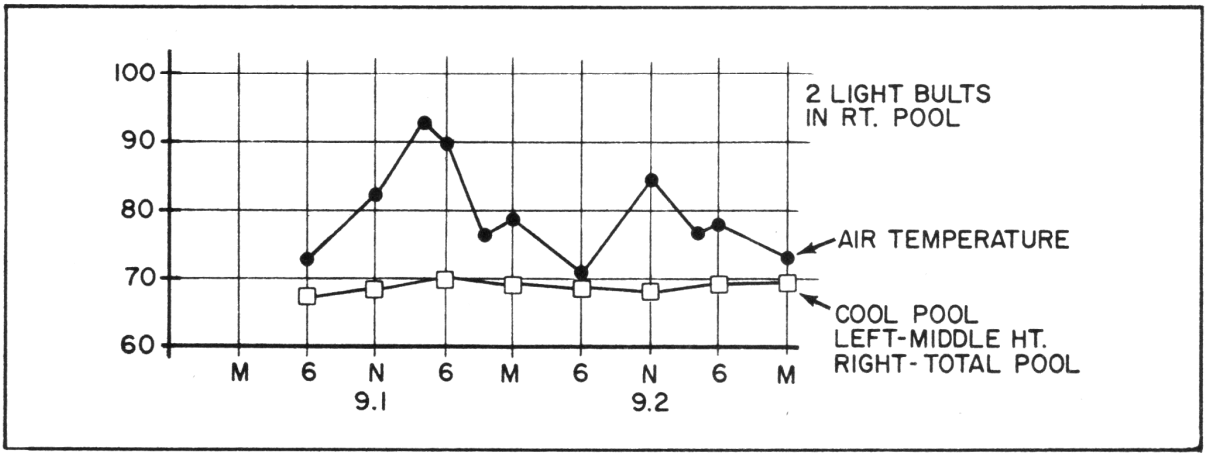
State Fair Cool Pool Room, 1976 -- from (7).



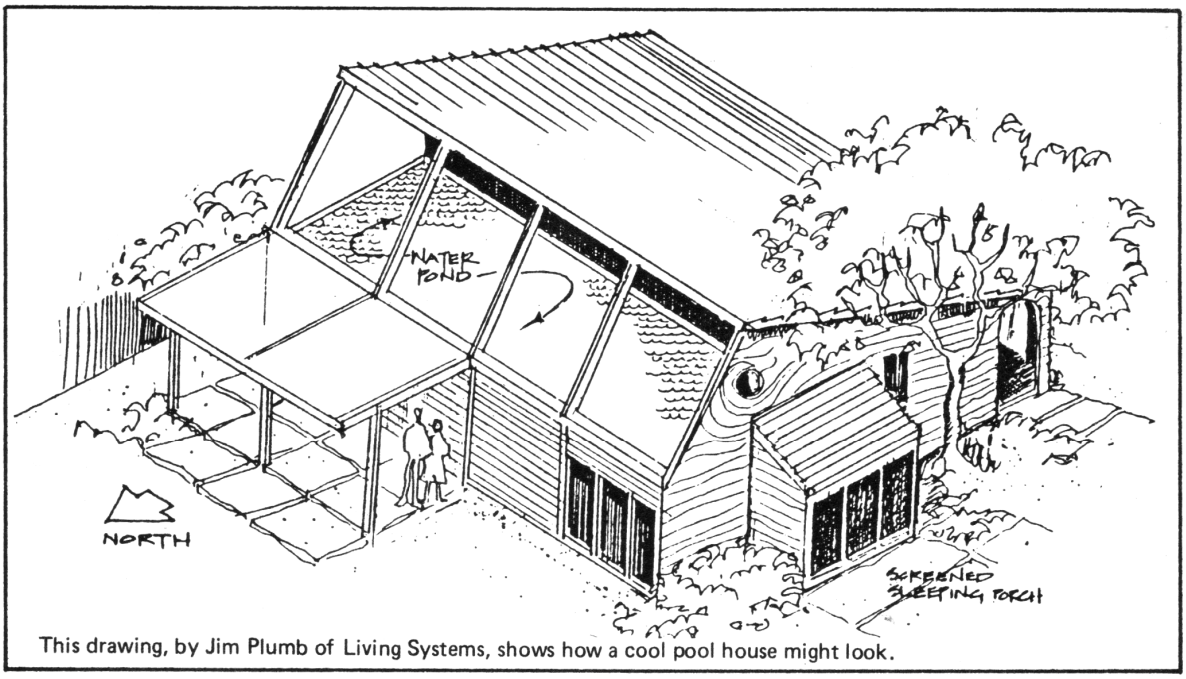
Indio Cool Pool, first run, midweek.



Indio Cool Pool, second run, midweek.



Indio Cool Pool, third run, midweek. Two light bulbs in right pool.



This drawing, by Jim Plumb of Living Systems, shows how a cool pool house might look.

The results of this test series were very encouraging. The results are summarized below:

Data Summary - Cool Pool Experiments

	1	2	3
Average Air Temperature	93	90	91
Average Cool Pool Temperature	72	74	78
Average Temperature with Plastic Cover on Cool Pool		80	
Average Temperature with Light Bulb Heat Source			78

For Full Experiment:

Average Cool Pool Temperature	75°	(Desert comfort range 75-82°F)
Average Air Temperature	91°	
Average High Air Temperature	102°	
Average Low Air Temperature	77°	

Differential between average cool pool temperature and average air temperature: 16 degrees.
Differential between average cool pool temperature and average high air temperature: 27 degrees.

Further research is now being conducted by Living Systems to more fully evaluate cool pool performance. The experimental program was conducted by City staff, on limited parameters, and with a recording device with a history of instability. Ideally the experiment would include: cloudiness, wind speed, radiant exchange, and an instrument cross check. However, on the basis of the work here, it is safe to say that a cool pool house could be built and that it would work very well, providing all or almost all of the cooling needs of a house in Indio.

The drawing below is a preliminary sketch of how a cool pool house might look. In the winter the water would be drained and insulation placed in the tank. The low heating demand could be met by use of passive solar heating with little difficulty.

References

1. Nelson, F. et al. (1976) "Solar, **Sunset**, November, p. 88. (note shading device was inadvertently left out of diagram).
2. Neubauer, L.W., Cramer, R.D., and Laraway, M. (1964) "Temperature Control of Solar Radiation on Roof Surfaces," **Transactions of the ASAE**, V. 7, N. 4; pp. 432-434, 438, Saint Joseph, Michigan.
3. Neubauer, L.W. and Cramer, R.D. (1965) "Shading Device to Limit Solar Heat Gain But Increase Cold Sky Radiation", **Transactions of the ASAE**, V. 8, N. 4; pp. 470-472, 475, Saint Joseph, Michigan.
4. Hay, H.R. and Yellot, J.I. (1969) "Natural Air Conditioning with Roof Ponds and Moveable Insulation", **ASHRAE Transactions**, V. 75, p. 165.
5. Yellot, J.I. and Hay, H.R. (1969) "Thermal Analysis of a Building with Natural Air Conditioning" **ASHRAE Transactions**, V. 75, p. 165.
6. Niles, P.W.B. (1976) "Thermal Evaluation of a House Using a Moveable-Insulation Heating and Cool System" **Solar Energy**, V. 18, p. 413-419, Pergamon Press, Dublin, Ireland.
7. Hunt, M. et al. (1976) **The Indio Energy Conservation Project**: Draft, Living Systems, Winters, CA. ●