

## STORING HEAT FOR CLOUDY WINTER DAYS AND COOLTH FOR SUNNY SUMMER NIGHTS

Overhead bare aluminum shutters are very effective for controlling heat flow from overhead storage to the room below. Heat flows 4 or 5 times as readily when open, as closed from ceiling storage composed of 8" pipes on 12" centers.

These temperatures taken in March '01 shows the Andy Shack with shutters closed at about 60°F while the outside is 45°F and the overhead pipes 90°F then with shutters open the shack temperature jumps to 75 or 80 with 90° tanks and 45° outside. Crudely balancing conductivities.

$U_0$  shutters open

$U_C$  shutters closed

$U_b$  building

We get  $30 U_C = 15 U_b$ ,  $U_C = 1/2 U_b$

and  $12U_0 = 32U_b$ ,  $U_0 = 32/12U_b$

thus  $U_0 \approx 5$

$U_C$

There are huge long cracks between the shutters, yet warm air does not leak down to the room. It doesn't want to.

In summer one can also open and close the shutters but the cool air around the pipes wants to leak through the cracks and so the thermal transfer continues even with the shutters closed, I believe over 1 BTU/°F per square foot per hour. Cold air pours down through cracks. When the shutters are open the transfer is superb. I believe about 3 BTU/°F per square foot per hour. (8" pipes on 12" centers offer over 2 square feet surface / square foot of ceiling.)

We have made sample ceilings with 9 each 1 liter coke bottles per square foot which transferred 3.75 BTU / °F per square foot. The odd habits of the shutters, working well in winter and not so well in summer, don't interfere with their job. In winter, one must be able to store enough heat for a cloudy day, and maybe two. You need to be able to live with high temperature water over head and you can. Reflective shutters have a high R-value. Perhaps 4 or 5.

Coolth does not need to be stored in such large amounts as heat. Night is certain to recharge coolth every 24 hours, the sun is not so reliable.

Thus we wish to store heat for cloudy winter days but need not store coolth for summer nights.

Shutters are silent and passive, radiant heating and cooling is always pleasant.