Energy Design Update

The pressure pulse method works like this: one single blast of air is suddenly released from a compressed air cylinder placed inside the living space. A recording instrument measures and records the decay of the induced pressure over time (how long it takes for the pressure to die down to zero). The tighter the house, the longer the decay will take. According to Yuil, a leaky house will have a decay time of about 1.2 seconds, a typical recently built house about 5.6 seconds, and an airtight house about 24.5 seconds.

The attractiveness of the idea is that it is very quick, easy and relatively inexpensive. Its most useful application would be for building inspectors (if airtightness became a code requirement) or for a builder's final evaluation of his own work. It is not useful for finding leaks.

There are a few problems. Some have been worked out, some not. First of all, the initial pulse is equivalent to an instantaneous 20 mph gust of wind on all surfaces of the house - possible damage. The initial nozzle design pointed up. This created a downward thrust of 3500 lbs - too much for any floor. This problem was overcome with new nozzle design. A third problem was the refrigeration effect - air suddenly released through a small hole gets very cold. Finally, there is a problem with flexibility of the building walls - sheetrock and even glass will bend a little under the sudden pressure; this will introduce error into the calculation.

Yuil added finally that the test had not actually been performed on a real house yet. Any volunteers?

The House Doctor's View of the Blower Door

by Thomas Blandy

House doctoring is distinguished from other energy audit services by the use of the blower door. With a blower door, house doctors are actually able to quantify the air infiltration rate of a house. Not only can infiltration be measured, but every source can be easily located using the blower door in conjunction with other detection devices (infra-red scanner, smoke gun, back of one's hand, eyes, etc.) Once the leaks are plugged, the retrofit job can be evaluated by remeasuring infiltration.

SETTING UP THE DOOR

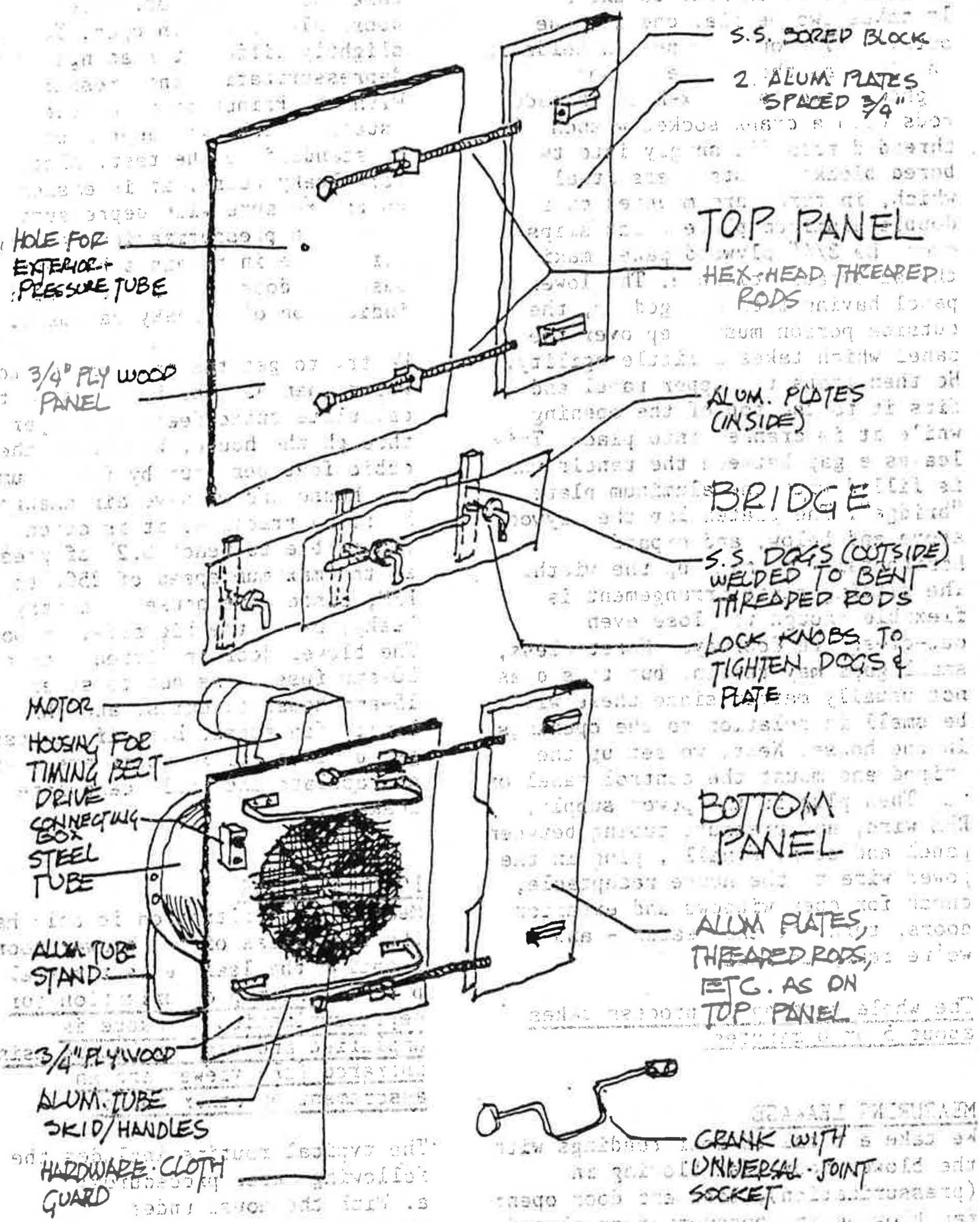
We use the Gadzco blower door, which consists of four parts (see illustration): a lower panel with the fan, an upper panel to fill in the top of the door, a "bridge" to fill in the middle, and the control panel. Optional but definitely recommended is a good photographic tripod for the instruments.

The door is designed to fit any doorway from 32" x 78" to 36" x 84". It can be used in other sized doorways, both larger and smaller, by jury-rigging.

To set up, we move all the parts of the door except the fan, plus all the other house-doctor equipment inside the house. The door is opened and the screen/storm blocked open. We then

THE GADZCO BLOWERDOOR

Illustration by Thomas Blandy



lug the fan up to the doorway (it weighs about 100 pounds) and maneuver it into position next to the stops. It takes two people, one in, one outside. The outside person holds it in place as the inside person tightens two long hex-head threaded rods with a crank socket wrench. The threaded rods fit snugly into two bored blocks of stainless steel which, in turn, are mounted on a double aluminum plate which slips over the 3/4" plywood panel making the adjustable closure. The lower panel having been snugged up, the outside person must step over the panel which takes a little agility. He then grabs the upper panel and fits it to the top of the opening while it is cranked into place. This leaves a gap between the panels which is filled with the aluminum plate "bridge". The plates lap the plywood above and below, and expand horizontally to make up the width. The sliding plate arrangement is flexible enough to close even out-of-square doorways. Nonetheless, small gaps may remain, but this does not usually matter since these will be small in relation to the openings in the house. Next, we set up the tripod and mount the control panel on it. Then plug in the power supply, RPM wire, and pressure tubing between panel and door. Finally, plug in the power wire to the house receptacle, check for open windows and exterior doors, turn off the heater - and we're ready to test.

The whole setting up process takes about 5 or 6 minutes.

MEASURING LEAKAGE

We take a total of four readings with the blower door; fan blowing in (pressurization), basement door open; fan blowing in, basement door closed; fan blowing out (depressurization), basement door open; fan blowing out, basement door closed. Interior room doors always remain open. You get slightly different readings under depressurization and pressurization. With the Princeton technique we usually stick with depressurization to standardize the test. Also, with a very leaky house, it is easier to get up to pressure with depressurization than with pressurization. A large difference in readings between basement door open and closed is an indication of a leaky basement.

We try to get the pressure up to 0.2" water then use the RPM reading to calculate cubic feet of air per hour through the house. We divide the cubic feet per hour by the volume of the house and we have air changes per hour. In practice, it is often impossible to reach 0.2" of pressure at the maximum speed of 2500 to 2600 RPM, since some houses are very leaky, or on the big side, or both. The blower door is fitted with a 10-amp fuse so as not to strain 15-amp house circuits, and this limits fan speed. Even if you can't get up to pressure there are ways to extrapolate and still calculate leakage.

LOCATING LEAKS

Measuring infiltration is only half the usefulness of the blower door. Locating the leakage is the real payoff. Under pressurization (or depressurization) leakage is amplified and easy to locate using an infrared (IR) viewer and an assortment of other tools.

The typical routine includes the following three procedures:

a. With the house under pressurization, we go up into the attic. Warm air that is forced up into the attic through the building seal can be detected by a technician with the infrared viewer.

b. Next the house is depressurized and we go to the living space. We use the infrared camera to detect cold air entering around baseboards, coming down interior partitions, etc.

c. The house is then pressurized again and we go around the living space with a smoke gun looking for suspected cracks. The smoke gun is wonderfully handy, also dramatic for demonstrations. The smoke just zips into the cracks. In addition to this, there are a number of more informal procedures. We watch the movement of cobwebs, and use our hands and even faces to detect air flows. We tug or push on attic and other interior doors to determine if major amounts of air are leaking out or into the spaces behind. Often in doing our caulking, stuffing, or polyethylene sealing we leave the fan on as we work to check our progress. For locating leaks, you don't need to maintain 0.2" pressure; 0.05" to 0.1" is usually sufficient.

<u>We work as we go, sealing as many of the leaks as possible in the time allowed</u> (usually one half to one day).

EVALUATING THE RETROFIT WORK

The final step is to test for results. The blower door is used to measure the new leakage rate after improvements are done. Sometimes we get air leakage reduced by 25 to 35%; more often it is less unless we can spend more time in the house.

We should note here, however, that the house doctor analysis and retrofit work detects and fixes more than simple air leaks. Energy savings from house doctor work can therefore be greater than that simply represented by reduction in air leakage rate.

SIDE EFFECTS AND DIFFICULTIES

-- The house can get very cool during winter visits, especially using pressurization. We try to get our testing done as fast as possible, but in a larger house it can go on for some time. The inhabitants are usually cheerful about it, or go away. However, once finished and the heater turned on, the house will warm up quickly. We have done jobs in near zero weather without problems.

-- Objects near the fan can get blown around. Plants and anything delicate should be moved out of the way.

-- In any case, the blower door location is out of action for access during our visit.

-- For depressurization, it's important for the heater or wood stove to be turned off or closed up as the negative pressure can pull smoke into the room, or wood ashes from a fireplace with the damper open.

THE GADZCO DOOR

We are not familiar with any other but the Gadzco blower door. We have been quite satisfied with it. It is a very handsome and suitable piece of industrial design. Many little details have been thoughtfully worked out such as the controls/instrument set, neatly packaged onto aluminum plates with a carrying handle cut in; it is tapped on the bottom for tripod mounting. Other house doctor teams have built a box for the unit, but we haven't bothered as it is reasonably rugged. The panels mount to the doorway without disturbing the existing stops or weatherstripping, and install reasonably quickly. The fan unit is a bit cumbersome and heavy, but this is not a major problem since most of the time it is a short trip from the vehicle to the front door of the house. One person can just manage to get it out of the vehicle and carry it a short, level distance, but two people is normal. It is no fun getting it up a flight of steps. I believe it will just fit in an airline seat space next to a bulkhead. One reason for the weight is the tube for air flow, around the fan. The fan is mounted on a streamlined hollow strut across the tube; both tube and strut are fairly heavy gauge steel. The bridge unit sometimes gives trouble if the gap is at the maximum. The plate just barely laps and must be held just so as the lock handles are tightened. Any bigger gap (doorway higher than 7'-0") and it is useless; one resorts to cardboard and tape. Ken Gadsby, of Gadzco, tells me he is working on lightening up the unit and providing a larger bridge. The motor has sealed lubricants. The plywood panels get dents and minor scrapes and one needs to do minor repairs and touch up. (Ken Gadsby says newer models have formica over the plywood.) Generally, however, it has been trouble free.

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Radon: First in a Series on Indoor Air Quality

by J.D. Ned Nisson

Indoor air quality must be considered when building an energy efficient building. If not correctly dealt with, it becomes a problem.

A stuffy room has an air quality problem. The solution is simple - open a window. Not only was the solution simple, but the problem was easy to detect.

Not so simple to detect or solve are the potential problems associated with indoor air pollutants such as formaldehyde, nitrogen oxides, organic fumes, particulates and radon. These substances are often undetectable by the average person, even when they are present in harmful quantities.

In this article, the first in a series, we will discuss radon. What is it? Where does it come from? What harm does it do and, most important, what should the concientious designer/builder do about it. Much of this information is from Air to Air Heat Exchangers by William Shurcliff.

WHAT IS RADON?

Radon is a naturally occurring radioactive gas. It is a disintegration product of radium which itself is a decay product of uranium or thorium.