

Comfort Zone

The word “comfort” often conjures up images of warmth. The Comfort Zone contest is all about warmth, but not in the fuzzy, sentimental sense. Teams must keep their homes between 71°F and 76°F, with relative humidity less than 60%, throughout specified time periods of the competition. If the Department of Energy’s temperature and humidity sensors detect values outside this range, points are automatically deducted. This contest reminds teams that although the competition emphasizes energy efficiency and design, each home must have a functional living environment.

This portion of the contest has proven especially important to the SCU team. In fact, the house’s name stems in part from the radiant heating and cooling system used to maintain temperature levels. The system, developed by Messana Air-Ray Conditioning, installs radiant panels in the ceiling and walls in place of traditional drywall. Water circulates through the panels to warm and cool the surfaces of the house. This heat radiates into the rooms, providing a uniform temperature while reducing ducting.

A single radiant panel consists of a gypsum board with thin aluminum heat transfer plates inside. Previous materials profiles have spoken about the ethics of aluminum and gypsum board. It is unclear where Messana obtains their materials, so there is no way to conclude whether or not the system is ethically sourced. Radiant tubing winds around the plates, allowing water to circulate around the boards. According to Messana, the panels can provide up to 50% energy savings compared to traditional forced-air energy systems.

The Department of Energy touts the benefits of radiant heating and cooling on their website, <http://energy.gov/energysaver/articles/radiant-heating>. The reduced need for ducting cuts down on allergens, which increase when air is forced around the home. Using the natural

heating and cooling properties of water results in electricity savings. The amount of water required is less than one percent of the team's water budget. The heating and cooling for the water in the panels is supplied by a Daikin Altherma heat pump. It gets three-quarters of its heating ability from the ambient air, with the remaining one-quarter coming from photovoltaic power. Radiant panels respond faster to control system input than any other heating technology, especially when they are individually controlled. Their modular design allows homeowners to control the temperature of single rooms, rather than lowering or raising the temperature of a sparsely occupied house.

There are a few minor concerns with radiant panels, especially related to leakage. Gypsum board drywall is easily damaged by water, and rotting drywall can lead to health issues. Leaks in the walls and ceilings are not only annoying, but could prove dangerous if located near other electrical components. These risks can be mitigated by choosing quality panels, as the SCU team has done. In general, there is actually lower maintenance with a radiant system because there are fewer ducts to clean, appealing to the retired consumers to which this home is marketed.

To create an even more comfortable environment, the team is also implementing an under-floor air distribution (UFAD) system that circulates warm air from the ceiling under the raised floor. According to the Department of Energy, air cannot store heat effectively, making systems like these generally inefficient. However, the design of the Radiant House uses natural pressure differentials to circulate air with minimal energy required, making the UFAD a helpful if not entirely essential element of the comfort zone.

In addition, the house will include a dehumidifier, also supplied by Messana. The dehumidifier is crucial because the radiant cooling system relies on chilled water to circulate

through the panels. If outside vapor begins to condense on the tubing, it can warm the circulating water and render the system ineffective. The Department of Energy cautions against radiant cooling, noting that dehumidification costs often exceed energy savings, except in very arid environments. This should not pose too much of a problem as the team competes in the dry climate of Southern California, but it is worth recognizing that these technologies do have limits, and that in many cases, energy savings in one area require energy expenditures in another. Together, the heat pump and dehumidifier will account for 36% of the home's energy usage.

The question remains: Is all of this worth it? Is a radiant system really better than a simpler traditional forced-air system? Let us consider the benefits to the environment and to the consumer. Integrating panels into the walls reduces material use by integrating the insulating and heating systems together. The efficient method of radiative heat transfer means that the heating load on the house is reduced by 25 to 35 percent. Since the effect of the heating and cooling is evenly distributed through the walls and ceiling, the temperature within the home is uniform, creating a more comfortable environment for residents. Radiant heating is not widely utilized due to concerns about slow response times, leakage, and associated costs to heat and cool the water, but hopefully its incorporation in the Solar Decathlon can encourage builders to consider it a viable option for homes looking to reduce their energy usage.