

It's not very often that a single publication can have a major influence over building design and ultimately an improvement in the health, wellness and comfort of its occupants. ASHRAE/ANSI Standard 55 - 2004, Thermal Environmental Conditions for Human Occupancy is one of those documents. Published by the 100 year old American Society of Heating, Refrigeration and Air Conditioning Engineers, a 55,000 member organization with chapters throughout the world including every major city in North America; and having a core value which reads, "*We are*

*committed to the advancement of the arts and sciences of HVAC&R for the benefit of society, whether through technology transfer or education and training.*"

Let's explore how Standard 55 could influence the housing industry. According to the World Health Organization, "The quality of housing conditions plays a decisive role in the health status of the residents, because many health problems are either directly or indirectly related to the building itself, the construction materials that were used, and the equipment or the size or structure of the individual dwellings." Studies show that over 80% of our time is spent indoors and so it makes complete sense that our interior environments have a major influence on our physiology and psychology, both which play big roles on our aging process. Research also shows that our bodies lose most of its heat via radiation (think standing next to a cold window or shopping for groceries in the frozen food section); in fact, it's well over 50% with the rest made up of evaporation, conduction, and convection.

If one were to hire a Thermal Environmental Comfort Technician<sup>®</sup>, i.e. a person who specializes in interior thermal environmental design they would approach the inside of one's new home by first looking at what makes your mind and body happy. Then literally working back wards from the inside out, they would design a heating, ventilation and air conditioning system to satisfy one's individual needs inside the habitable void created by the architect and builder. This is completely opposite to residential traditions which for the most part ignore the human physiological and psychological interface with architecture. A test of this statement is to ask potential residential designers how they calculate the HVAC loads; inevitably the answer will include something about the building heat loss or gain. While it's a necessary function to perform the calculations, without an occupant the building doesn't know or care if it's hot, cold, drafty, dry or clammy. It's only important when a person occupies the environment and since people are the ultimate judge and jury doesn't it make sense that one's mind and body be consulted first? I think so, and since each and every one of us goes through different metabolic changes as we get older it's not acceptable that general assumptions are made about who we are as individuals which is what happens when HVAC systems are designed to condition buildings rather than the occupants in them. So why is it ignored? It's all in the process of building homes. Over 75% of all HVAC designs are done by individuals who never get the chance to talk to the occupant about their expectations. Even if they had the opportunity, many are not familiar with human physiology and psychology and its relationship to architectural design, but the framework one needs to create this personalized interior environment resides inside ASHRAE/ANSI Standard 55, Thermal Environmental Conditions for Human Occupancy.

Let's take a look at the six key measurable metrics, and talk about how they make one feel comfortable. The research that went into Standard 55 was in a very large part developed by Dr. Ole Fanger who determined that it is possible to predict satisfaction by controlling floor temperatures, radiant asymmetry, humidity, air speed (Draft), thermal stratification, and temperature drifts and ramps. Now most of these words the average educated person would understand but what is radiant asymmetry or a temperature drift? Let's define all six terms in every day language.

Dr. Fanger and his team found that the majority of people are happy when the floor temperature is controlled between 75°F and 85°F for the heating season and between 66°F and 75°F in the cooling season. Without some form of radiant floor heating or cooling it's difficult if not impossible with today's construction practices in extreme climates to meet these criteria because of the way we condition spaces. A good way to understand this is to ask how much hot air would we need to blow at the floor to raise the temperature to 85°F and would it make more sense to heat it directly with warm or cool pipes? The researchers also found that when our bodies are simultaneously exposed to different surface temperatures we'll be less than comfortable. Think back to the last time you stood in front of the fireplace, campfire or had an airline window seat. What your body experienced was two extremes in temperature...this sensation is called radiant asymmetry and the greater the difference between your bodies skin temperature and the surface you are next to, the more you will feel uncomfortable. To keep us satisfied in the heating season, the temperature difference between our skin temperature (nominal 82°F) and a wall surface should be less than 9°F or 41°F for a ceiling. For this reason, particularly in climate extremes, it's psychologically and physiologically worth having very efficient windows so we can enjoy the outdoor views without the discomfort while standing or sitting next to them. The next area to measure and one which there has been much research work done is humidity and its influence on health and mold concerns; researchers know when humidity is controlled between 30% and 50% more of the occupants will express satisfaction with their environments while keep the potential for humidity related disease and mold growth at bay. In some climates it may be necessary to remove moisture from the air and in others it is necessary to add moisture. The key to health, wellness and comfort and for the benefit of such things as hardwood floors and cabinetry is consistency which means we can't rely on Mother Nature to control humidity in many climates. Draft is another and more common complaint and occurs when air speeds are too high in relationship to the air temperature. We all love the feeling of a cool breeze on a hot humid day because of the cooling affect it creates but the same breeze can cause a wind chill factor if the air temperature drops. The team of researchers found that when air speeds in a room exceed 25 feet per minute in heating or 40 feet per

minute in cooling it has a negative affect and the only way to counter this is to raise or lower the room temperature. Given a choice between consuming more fuel/electricity or lowering the air speed we believe most occupants would prefer the lower air speeds. The next criterion for comfort has to do with temperature stratification which essentially means the difference between what a thermometer at your ankles and one at your head would read. We've heard about cold feet and hot heads...well this is in fact an actual measurement of comfort and to meet Standard 55, the difference should not exceed 5°F if we truly want to be thermally happy most of the time. Last but not least are what building scientist call temperature drifts and ramps and the simplest way to experience them are in your car. Try to pay attention to how you adjust your air conditioning or heating controls from the moment you get in and drive. Is it cold outside, hot, windy? Is the temperature rising or is it getting colder? Our bodies will tolerate and adapt to changes in temperature over a period of time; the longer the time the less we notice it...but when the temperature rises or drops very quickly we react by adjusting the controls and depending on number



Thermal Comfort Data Logger used by Thermal Environmental Comfort Technicians to measure the six metrics.

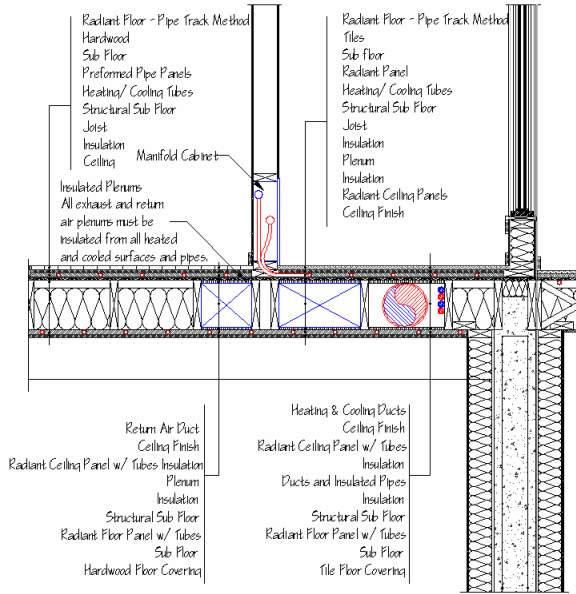
of factors we might find ourselves constantly playing with the controls or not at all. A healthy human body will accept a 2°F difference as long as it's spread over 15 minutes or as high as 6°F as long as it takes 4 hours to make the change. What influences temperature changes over a period of time is building efficiency. The more efficient the home the less we notice a change in temperature. All of these measurable metrics directly

influence your mind and body which again spends 80% of its time indoors and most of it at home. So how does a builder deliver a Standard 55 environment?

The first step is to have ones clients take an inventory of their current physical and mental health with their family doctor and define what could be expected as they age. Second step is to work with a person or team of people who fit the definition of a Thermal Environmental Comfort Technicians<sup>®</sup>. These people typically are part of the architectural design team of professionals including interior designers, engineers and technicians. We're not talking about just about someone who knows how to calculate

heating loads and pick furnaces and boilers. This person or team of people knows how to integrate the architectural/mechanical features with the mind (psychology) and body (physiology) and this means a greater investment in the quality of team, after all we're talking about one's health, wellness and comfort so it's not to be taken for granted. Third, expect these professionals to propose a combination or hybrid mechanical system. One needs to have some form of air handling system for indoor air quality issues like fresh air, humidity and possibly cooling. To introduce "Indoor Comfort Quality" some form of radiant heating will be required...remember over 50% of our bodies heat loss is via radiation so it only makes sense to heat with this method. Finally, I have yet to come across a project which truly delivers both on indoor air quality and indoor comfort quality without investing a significant portion of the project cost in the mechanical systems. This shocks most folks who have been conditioned to pay less than 10% of the entire budget on HVAC but this explains why, according to Home Comfort Survey™ by Decision Analyst, 50% of people are unhappy with their interior environments when the ASHRAE/ANSI Standard 55 target is 80%. So if one really wanted to make a house a home by the way it makes one feel then some homework is required, have clients talk with their family physician, work with a team of professionals who place a priority on the HVAC and building efficiency budget. Health, wellness and comfort can be only attained by design and Standard 55 is such a tool and a significant document to support the sales of hybrid HVAC systems.

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Robert Bean is a Registered Engineering Technologist in the discipline of Building Construction Engineering. He can be contacted at [www.healthyheating.com](http://www.healthyheating.com)

When assembling a hybrid air/water system it's important to isolate the heating system from the ventilation and a/c systems to prevent parasitic heat gains and losses in the distribution network.