

Net Zero Acceptability

By Dan Int-Hout, Fellow ASHRAE

ASHRAE and the U.S. Green Building Council (USGBC) have adopted the slogan “Net Zero Energy Buildings” as the goal for building design. This is an admirable goal. Energy efficiency is a worthwhile, and likely a critical, strategic goal. It is important, however, to place everything in a proper perspective.

In commercial buildings, which are a significant percentage of our building energy use, energy costs are insignificant compared to building salaries. Saving energy at the expense of building occupant productivity is a “zero-net-sum” solution. Building Owners and Managers Association International (BOMA) has stated the highest reason given for not renewing the lease has been “occupant dissatisfaction with the environment.”

The function of buildings is to provide a suitable environment for the occupants. The average occupant salary in commercial office buildings has been estimated at between \$200 and \$300 per square foot per year (\$2,100 and \$3,200 per square meter per year) of office space. Total building energy costs are on the order of \$2 to \$3 per square foot per year (\$22 to \$33 per square meter per year). If we could achieve a net zero building, it would account for a savings of 1% of the total.

It is more likely that we can achieve less than half of that energy savings in most buildings, even with the most aggressive energy-efficiency plans. And, should building energy costs even triple (shudder!), it would still be a fraction of occupant salaries.

Photo 1 is a true net zero building.

All too often the occupant expenses are missing in the analysis of real building costs. Most important in determining the cost of occupancy is the issue of occupant

productivity, as that is where the real costs (and savings) are realized. A number of factors affect productivity, but occupant satisfaction with the thermal environment is one of the most significant ones.

Thermal comfort can be estimated in a building design using a number of available tools. Issues such as ventilation air delivery method, actual space loads, and radiant effects can be taken into account.



Photo 1: A true net zero building.

ASHRAE Standard 55, the *ASHRAE Handbook* and equivalent ISO standards provide guidance and even computer program listings for determination of occupant comfort levels.

In attempts to reduce energy by using different (and often untested) systems, there is an opportunity to overlook the occupant satisfaction in the resulting environment. In fact, sometimes there is a negotiated tradeoff between energy and system comfort. I assume they did not consult the occupants in these negotiations. It is proposed for LEED 2012 that

a comprehensive occupant survey be a mandatory requirement. A building that is unacceptable to the occupants should be considered a design failure, no matter how much or how little energy it uses.

Unfortunately, improperly selected, designed and installed air delivery systems often result in excessive stratification, even though it is clear how to avoid this at the design stage. When systems are overly stratified, feet are cold, ventilation mixing is likely compromised, and thermostat response can be orders of magnitude slower than with properly mixed systems.

The energy savings of more non-traditional systems compared to standard overhead well-mixed methods of air delivery are mostly undocumented. These newer systems are often being considered on the basis of unvalidated energy models alone, and occupant issues are quite often ignored, or at least poorly understood.

Some question that the USGBC's LEED rating system is not resulting in measurable energy savings. It is not apparent that any system is significantly more efficient than any other (except for the open window). In the end, of course, a building is essentially a closed system, and if we decrease the internal load, energy use will go down. Future LEED requirements are sure to include validation requirements.

Proper selection of the air delivery system for a building can ensure occupant satisfaction, assuming the design follows known and accepted guidelines. Ignoring these rules can result in drafty uncomfortable spaces. Saving energy is an admirable goal, but we need to assess, and include, the real cost of productivity. Failure to do so guarantees what will be achieved is a net zero acceptable building.

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