

Healthy *living* environments

THE PRACTICES OF
**SUSTAINABLE
DESIGN**, GREEN BUILDING,
**IMPROVED BUILDING
HYGIENE**, AND IMPROVING
**ENVIRONMENTAL
HEALTH** ARE BECOMING
THE NORM.

By Douglas Pancake

Hillside view of Atria at Newport Beach targeting LEED Silver and designed to incorporate many of the 9 Foundations of a Healthy Building. Rendering by Digital Imaging Studio. Photo courtesy of Douglas Pancake Architects.



Many of us are enjoying healthier indoor living environments resulting from better design and construction practices and regulation driven requirements in building and system standards. The practices of sustainable design, green building, improved building hygiene, and improving environmental health are becoming the norm. These practices are driven by government regulation, as well as a changing moral conscience and social accountability-centered practices across the building industry. Not to mention, green sells.

The notion of healthy building design can be complex. Most of us are familiar with LEED certification, which requires a complicated strategy of point selection, which, in turn, balances cost with the benefit until enough points are achieved to reach the level of certification desired.

Additionally, in California we have the relatively new CALGREEN code, also a complicated regulatory document, but not dissimilar to the Green Building Council's LEED requirements. All these requirements may be overwhelming and difficult to implement in your senior living building without the assistance of a high-priced architect or LEED consultant. However, there is now a fresh approach where responsible design and operational programming can lead to a healthier indoor environment for your residents. Researchers at Harvard University, T.H. Chan School of Public Health, and the Center for Health and Global Environment have identified the 9 Foundations for Health. This is a standardized and holistic approach to a building program and design that is easy to understand and applicable to a building project or ongoing maintenance practices.

Meeting these standards in senior living communities will contribute to the health and well-being of assisted living residents and the caring people who serve them.

1. VENTILATION

Along with thermal health, removing dust and managing moisture, ventilation is certainly a big component of indoor air quality. The fundamental purpose of the mechanical system is to provide ventilation and replace old air with fresh air. The mechanical system will import outdoor air, heat or cool it, filter it, and deliver it to the interior environment. At the same time, it removes, or exhausts contaminated or stale air to the outdoors. Indoor environments with poor ventilation are experienced as stuffy and uncomfortable. This can be experienced as unpleasant, and the added air contamination can cause an array of undesirable health symptoms, including headache, fatigue, congestion, and many more. The World Health Organization has defined this collection of health symptoms caused by poor air quality as sick building syndrome.

- 1 MEET** or exceed local outdoor air ventilation rate guidelines to control indoor sources of odors, chemicals and carbon dioxide.
- 2 FILTER** outdoor and recirculated air with a minimum removal efficiency of 75 percent for all particle size fractions, including nano.
- 3 AVOID** outdoor air intakes at street level or near other outdoor sources of pollutants. Commission systems, conduct regular maintenance and monitor ventilation in real-time to prevent and resolve ventilation issues promptly.

SUGGESTED PRACTICES

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

2. AIR QUALITY

The air we breathe affects our health. Indoor air pollution often contains organic and inorganic particles, toxins, and microbes that can cause allergic or toxic reaction, or lead to respiratory discomfort or more serious health problems with aging residents, particularly those with weakened immune systems. When selecting finishes, supplies, furniture, and other materials for the interior environment, always consider materials with low-chemical emissions to limit sources of volatile and semi-volatile organic compounds. Check for all potential pollutants, including those defined as legacy pollutants such as lead, PCBs, and asbestos. Local climate conditions will dictate design targets, but maintaining humidity levels between 30 percent to 60 percent will mitigate odor issues.

One less expensive, but effective, modification is to upgrade the filtration capacity of existing heating and cooling ventilation equipment. Providing HEPA filters that can filter smaller-sized particulates costs more than other filters, but substantially improves the indoor air quality.

Construction projects and extended maintenance programs in a facility provide the greatest potential for contaminating indoor air quality that can lead to poor health. Health care construction industry expert Wayne Hansen, PE, REA, CEM, in the book he edited, *Infection Control During Construction: A Guide to Prevention and JCAHO Compliance*, writes, "All buildings, including hospitals, harbor biological pathogens in the cavities of walls, floors, and ceilings. Whenever these cavities are penetrated and the air in them disturbed, the risk of aerosolizing these pathogens is high. An infectious containment and environmental monitoring program must be established to eliminate or minimize the incidence of nosocomial infections associated with construction or repair projects.

Hansen outlines the following list of common contaminants found during construction:

- 1) Inorganic nuisance dust and respirable dust that can cause eye and throat irritation and general discomfort.
- 2) Fibers that can be a source of mechanical irritation to mucous membranes.
- 3) Chemical odors (often caused by microbiological contamination) that can be hard to trace.
- 4) Microbiological contaminants that include bacteria and fungi in health care facilities. Opportunistic infection, caused by exposure of highly susceptible patient populations to environmental organisms such as the fungus *Aspergillus* and the bacteria *Legionella*, is of critical concern, according to Philip R. Morey, Ph.D., CIH, director of microbiology and IAQ, vice president for AQS Sciences, and a contributor to Hansen's book.

In the book, *Control the Chaos and the Spread of Infection During Construction*, by Kelly M. Pyrek, the emphasis is on hospital construction. However, these standards should be achieved when a construction project is contemplated in an occupied senior living community. Any construction project, with the potential to contaminate an adjacent environment shared by assisted living residents, should contain an air-quality management plan developed between the operator and contractor. All construction areas should be separated from a resident-occupied environment, with a sealed air barrier to prevent the passage of air from the affected construction area to the occupied area.

SUGGESTED PRACTICES

- 1 **CHOOSE** supplies, office supplies, furnishings, and building materials with low-chemical emissions to limit sources of volatile and semi-volatile organic compounds.
- 2 **CHECK** for legacy pollutants such as lead, PCBs, and asbestos.
- 3 **LIMIT** vapor intrusion by using a vapor barrier.
- 4 **MAINTAIN** humidity levels between 30 percent to 60 percent to mitigate odor issues.
- 5 **CONDUCT** annual air quality testing.
- 6 **RESPOND** to and evaluate occupant concerns.

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3. THERMAL HEALTH

Aside from the effects on humidity and indoor air quality, thermal health is an important consideration in the design of your building's environmental controls. Minimum thermal comfort standards for temperature and humidity ensure that thermal conditions are maintained consistently, and that spikes or dips in temperature are avoided, thus reducing thermal stress. When temperatures become too extreme for the body to accommodate or adapt to, thermal stress can occur. This may include hot or cold stress. An extreme example is hypothermia where an individual's temperature will decrease in the case of cold stress, causing a potentially life-threatening condition.

More commonly, when there is more heat than the body can dissipate, heat stress can occur in various forms. These may include heat rash, heat cramps, heat exhaustion and—most serious of all—heat stroke. Awareness of the potential for heat stress and drinking plenty of fluids can help minimize the potential for trouble.

Individual thermostat control in resident units are a market demand. The common areas should be constantly supervised to assess both thermal comfort and thermal stress.

- 1 **MEET** minimum thermal comfort standards for temperature and humidity, and keep thermal conditions consistent throughout the day.

- 2 **PROVIDE** individual level thermal control, where possible. Survey the space and occupants regularly to identify zones that underperform.

- 3 **RESPOND** to and evaluate occupant concerns.

- 4 **COMMISSION** systems, conduct regular maintenance, and monitor temperature and humidity in real-time to prevent and resolve thermal comfort issues promptly.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

SUGGESTED PRACTICES



Courtyard view of Atria at Newport Beach targeting LEED Silver and designed to incorporate many of the 9 Foundations of a Healthy Building. Rendering by Digital Imaging Studio. Photo courtesy of Douglas Pancake Architects.

4. MOISTURE

Water intrusion from internal sources such as leaking pipes and condensation, or from external sources like rain water or roof leaks, can lead to dampness and growth of mold and mildew. Mold spores released in the air can cause environmental-born illness as described above.

Excessive moisture can lead to the growth of mold, fungi, and bacteria, the release of volatile organic compounds, and the breakdown of building materials.

Throughout the indoor and outdoor environment, molds live in the soil, on plants, and potentially everywhere. There are thousands of species of molds, which can adapt to a variety of different moisture conditions. Research studies have shown that exposure to building dampness and mold are directly associated with respiratory discomfort or disease, including asthma and bronchitis.

1 CONDUCT regular inspections of roofing, plumbing, ceilings, and HVAC equipment to identify sources of moisture and potential condensation spots.

2 WHEN moisture or mold is found, immediately address moisture source, and dry or replace contaminated materials. Identify and remediate underlying source of the moisture issue.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

SUGGESTED PRACTICES

1 USE high-efficiency filter vacuums and clean surfaces regularly to limit dust and dirt accumulation, which are reservoirs for chemicals, allergens, and metals.

2 FOR HOMES, take off shoes at the door to limit tracking in dirt.

3 DEVELOP an integrated pest management plan with a focus on preventative measures, such as sealing entry points, preventing moisture buildup and removing trash.

4 AVOID pesticide use, if possible.

5 TRAIN building management how to respond to pest problems and complaints.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

SUGGESTED PRACTICES

5. DUST AND PESTS

A variety of harmful agents are transmitted through dust. Viruses, bacteria, chemicals, allergens, building materials, dander, fabric fibers, and paint particles are all present in indoor environments.

SUGGESTED PRACTICES

6. SAFETY AND SECURITY

Security and safety is important to our residents on several levels. The reason it has been included in the 9 Foundations for Health is because perceived safety is an important psychological need. Assisted living residents often experience fear and vulnerability. When one's perception of safety and security is threatened, a variety of behavior responses may be triggered. These range from "fight or flight" in the extreme to chronic psychological stress, which can negatively affect the immune system.

- 1 MEET** fire safety and carbon monoxide monitoring standards.
- 2 PROVIDE** adequate lighting in common areas, stairwells, emergency egress points, parking lots and building entryways.
- 3 MANAGE** points of egress and the physical perimeter.
- 4 BE** situationally aware through video monitoring, interactive patrols and incident reporting.
- 5 MAINTAIN** a holistic emergency action plan and mechanism for communication to building occupants.

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7. WATER QUALITY

Fortunately, the United States has one of the best and safest public drinking water supply and distribution infrastructure in the world. We have one of the lowest incidents of waterborne illnesses, however, they do periodically occur.

Water quality in a building may be compromised for several reasons. Most common is age-related deterioration of building services pipes. They corrode, dissolve, and react with chemical contents found in the water supply. The result is often elevated levels of lead, copper, or other heavy metals contaminating the drinking water.

Water quality may be compromised due to poor or inadequate treatment at the distribution system. But, the most compelling problem results from water that is stored within the system before being dispensed. The effects on human health include lead or heavy metal poisoning. Organic chemical poisoning, including polyfluorinated chemicals, elevates risks of cancer, higher cholesterol, obesity, endocrine system disruption, and immune system suppression. Still to this day, Legionella bacteria in building drinking water systems accounts for 26

percent of reported illnesses, and all 14 deaths reported in 2011-2012. Taking a shower with water contaminated with Legionella can result in infections and, in extreme cases, lead to a severe pneumonia.

SUGGESTED PRACTICES

- 1 MEET** the U.S. National Drinking Water Standards at point-of-use.
- 2 TEST** water quality regularly. Install a water purification system for removal of contaminants, if necessary.
- 3 ENSURE** residual disinfectant levels are sufficient to control microbes, but not in excess.
- 4 PREVENT** water stagnation in pipes.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

SUGGESTED PRACTICES

- 1 PROTECT** against outdoor noises such as traffic, aircraft and construction.
- 2 CONTROL** indoor sources of noise such as mechanical equipment, office equipment, and machinery.
- 3 PROVIDE** spaces that minimize background noise to 35db for unoccupied work and learning areas, and a maximum reverberation time of 0.7 seconds.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

8. NOISE

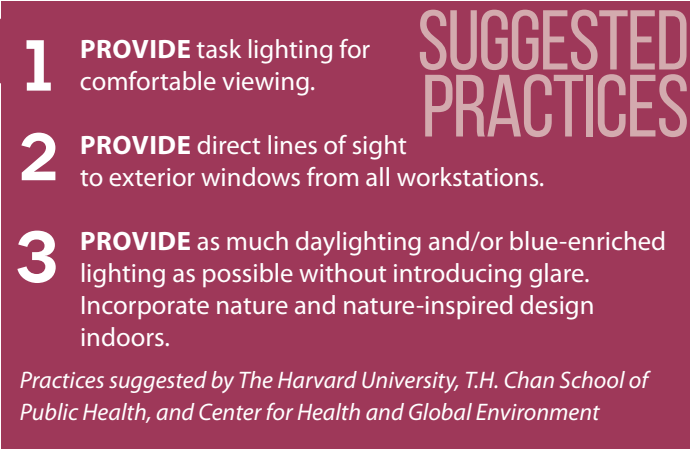
Noise and unwanted disturbing sounds may be the greatest contributor to unmanageable environmental stress. Noise has been determined to negatively impact and interfere with our health and well-being on several levels, including the audiology level, which is the fundamental performance of the hearing mechanism. Noise can impact our health at the biological level. Combine elevated noise-driven levels of environmental stress noise or sound with residents already experiencing reduced cognitive function, and the result can be elevated levels of aggravation, agitation, aggression and can trigger other behavior problems.

9. LIGHTING AND VIEWS

Perhaps, the greatest contribution to design for aging is the growing understanding of the importance of natural light and its role in the environment, and in the health of our aging residents. The quality of light contributes to the perception of space and higher levels of cognitive functioning. It also contributes to the maintenance of a health circadian rhythm, leading to better sleep patterns, and a host of health benefits. Two areas of human experience and light quality should be considered in long-term care facility design. These are the visual and the non-visual pathways. Too much light can be distracting and cause glare. Confusing light patterns shining on walls and floors can be hazardous for seniors with vision problems.

Too little light, however, may be just as dangerous as it contributes to trips and falls if areas are not adequately lit. Providing the necessary amounts of light at the correct times of the day is equally important for architects and lighting designers to consider in senior communities. The 24-hour light/dark cycle is the most important consideration in maintaining residents' daily routines and normal, healthy sleep patterns.

When designing new communities, optimizing the building footprint to efficiently maximize sun exposure can be a powerful strategy. Including sun rooms, skylights, clerestory windows, tubular daylighting devices, and daylight-responsive electric lighting controls are all appropriate options in new and existing construction.

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- 1** **PROVIDE** task lighting for comfortable viewing.
- 2** **PROVIDE** direct lines of sight to exterior windows from all workstations.
- 3** **PROVIDE** as much daylighting and/or blue-enriched lighting as possible without introducing glare. Incorporate nature and nature-inspired design indoors.

Practices suggested by The Harvard University, T.H. Chan School of Public Health, and Center for Health and Global Environment

The notion of a healthy building has become increasingly complicated and difficult to achieve. CALGREEN requirements will be enforced in new and renovation construction projects, and LEED certification is admirable and desirable for many reasons. However, in the absence of a construction project requiring plan submittal and inspections, implementing these nine foundations, in whole or in part, will lead to healthier buildings and healthier residents without the complexity and sometimes contradiction of the certification programs. ■

Douglas Pancake, AIA, is the owner of Douglas Pancake Architects (DPA), an architectural firm specializing in senior housing and health care industries across the United States. For more information about this topic, please email Douglas at Dougp@pancakearchitects.com.



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Douglas Pancake Architects (DPA) specializes in design for the aging and serves the senior living and healthcare industries across the United States. For 25 years, Douglas Pancake has been a leader in the evolution of senior housing design, code development, and advocacy for our elders. The architects at DPA are compassionate and talented individuals, who are focused on creating supportive and meaningful healing environments for the frailest and most vulnerable members of our community.



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