

When moisture condenses or is trapped within a wall, roof or floor assembly, it can cause structural damage as well as mold and mildew, a major cause of indoor air quality problems.

Moisture can enter a building envelope in three ways—rain transport from outside, diffusion of water vapor through the envelope materials, and transport of water vapor in air that leaks through cracks in the envelope. Rain transport must be controlled with proper drainage planes in the wall assemblies. A properly located vapor diffusion retarder will help retard diffusion through a building envelope assembly. Much more significant than vapor diffusion, however, is the amount of moisture that can be carried through currents of air escaping through cracks and voids; thus the importance of sealing these cracks. As warmer air rises, it causes high pressure at the top of a building and low pressure at the bottom, resulting in what is called the **stack effect**. (See Figure 2.2.) At these points of greater pressure differential (namely the attic and basement), it is especially crucial to seal air leaks and use airflow retarders.

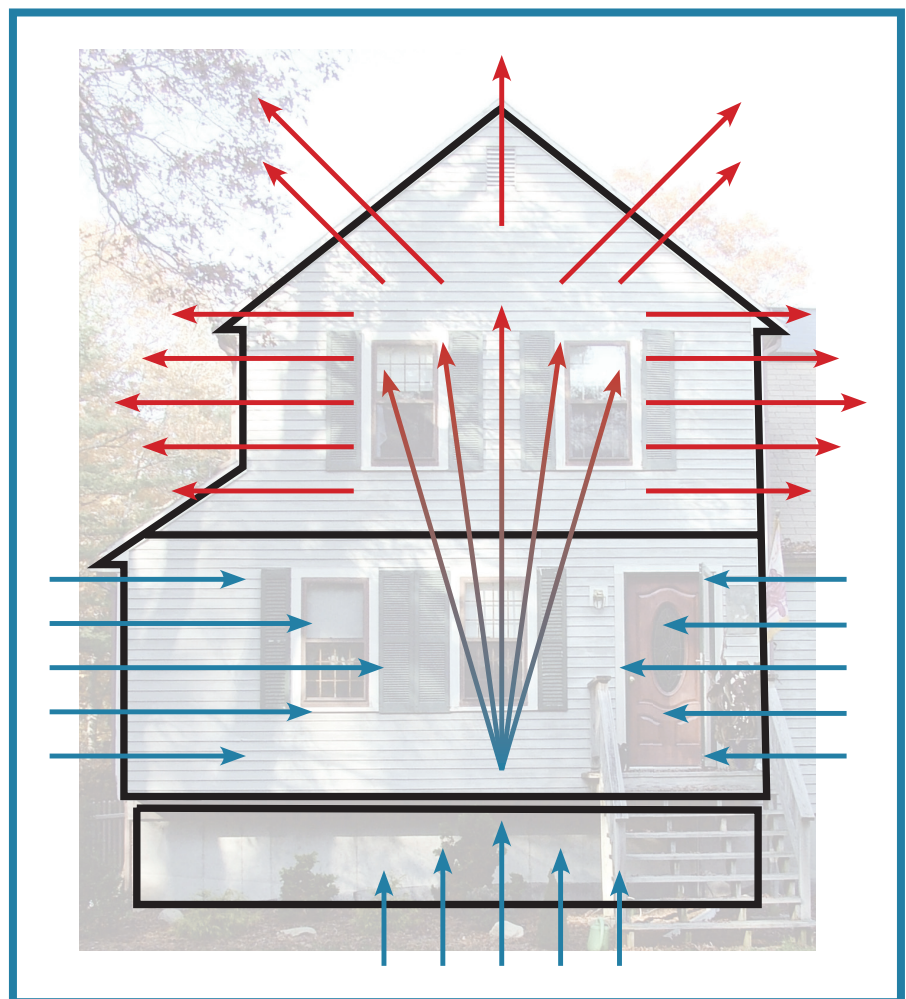


Figure 2.2 Stack Effect

As warmer air rises when surrounded by cooler temperatures outside, it causes high pressure at the top of the building and low pressure at the bottom. Cold air is drawn in through leaks and openings, such as doors and windows. At points of greater pressure differential, such as the attic and basement, it is especially crucial to seal air leaks and use airflow retarders.

Renewable Energy & Distributed Generation Technologies

carbonate, or solid oxide. (See Figure 3.5.) Fuel cells may eventually replace heat engines as the prime movers of our society. The nonprofit information center for all fuel cell manufacturers can be accessed at: <http://www.fuelcells.org>

Renewable energy is truly the best source of power for all of our project needs. Nonrenewable energy forms, such as fossil fuels, are not sustainable over the long term. Each type of renewable energy outlined below has advantages and challenges, including initial installation expense. However, appropriate application of these technologies can be economically advantageous over the long run, as major corporations and homeowners alike are discovering in their facilities and homes.

Distributed Generation & Cogeneration

Distributed generation is a technology that is used to create the power required for a facility at the point of use. Cogeneration is a form of distributed generation. In cogeneration systems, the system produces power at the point of use and also uses the waste heat generated by the process for other purposes within a facility. In green design, we strive to minimize waste and effectively use as much of a process as possible. Examples of cogeneration are described in the chiller portion of this chapter. The combined heat and power challenge website offers other examples at: <http://www.aceee.org/chp>

Photovoltaic Systems (PV)

Photovoltaic systems produce DC power, which can easily be converted to AC through an inverter. (See Chapter 4 for complete coverage of photovoltaic systems.)

Fuel Cell Types and Applications

Fuel Cell Type	Applications	Operating Temp.	Comments
Alkaline	Space	80–100°C	Needs pure fuel/oxidant
Phosphoric Acid	Stationary	200–220°C	Long life, useful heat
Proton Exchange Membrane	Stationary Transportation	80–100°C	Short start time, easily manufactured Small size/scalability Limited co-generation
Molten Carbonate	Stationary	600–650°C	High efficiency, good co-generation
Solid Oxide	Stationary	650–1000°C	High efficiency, good co-generation

Figure 3.5



Skylights provide daylight in the cafeteria at Whitman Hanson Regional High School in Whitman, MA. "We have known for years that research has shown that natural light in classrooms improves teaching and learning. It also improves the attitudes of staff and students." – Dr. John F. McEwan, Superintendent of Schools, Whitman-Hanson

Figure 5.5

Budgeting & Financing

Joseph Macaluso, CCC

Managing the budget for a green building project involves a greater depth and breadth of issues than most conventionally constructed projects.

A balance must be struck between creating the greenest possible building and staying within the limits of available funds. After all, what good is a green building if it can't be completed?

Developing a green project budget requires a balancing of long term savings against initial costs. The value of outside funding must also be considered along with the project goals. Overall value must be weighed against direct initial costs. Often the approach to green building costs is to get the most “bang for the buck” by incorporating as many low- or no-cost green measures as possible, or in the case of a LEED® project, earning the most credits at the lowest cost.

Initial Costs

It is difficult to make blanket statements about the cost of a green building because of the thousands of systems and components that make up a facility, and the countless design options. How those systems (or “assemblies”) are selected and interconnected and the green strategies used greatly affect both initial and future building costs. One recent study analyzed 600 buildings, comparing the overall cost of those considered “green” (those seeking LEED ratings) to those that were not. Not surprisingly, there was a wide range in square foot costs—in both green buildings and non-green buildings—even within the same usage categories. But globally, there was no statistical difference in the square foot cost of the buildings between those that were green and those that were not.

Green buildings and non-green buildings can have a high cost per square foot or a relatively low cost per square foot.¹ This does not mean

Cost Considerations

According to a growing collection of case studies, deconstruction is producing cost savings in projects throughout the U.S., often averaging 30% to 50% less overall than demolition costs. For example, University of Florida's Center for Construction and the Environment found deconstruction costs 37% less than demolition in a 2000 study involving deconstruction of six wood frame residences built between 1900–1950.³

Materials

The materials economics are relatively simple. There is the revenue (for sale—or tax benefit of donation to a nonprofit) from reused or recycled materials. There is then the “value” of avoiding the cost of disposal. For every ton of material diverted from a landfill, there is one less ton of disposal costs. To the extent deconstructed materials can be incorporated into a new building or space on the same site, the savings are two-fold—reduced disposal costs and new material costs.

The most salvageable materials tend to be finish and structural wood, windows and doors, cabinets and casework, masonry, metals (structural steel, doors, grates, grilles, railings, gutters and downspouts, etc.), lighting and plumbing fixtures, and even ceiling tiles and carpet. Among the more difficult items to profitably salvage include any that incorporate hazardous materials and inefficient fixtures (such as toilets, lighting, and mechanical) and appliances. Ductwork from an old building may be contaminated with mold and and/or other harmful substances, so would have to be thoroughly cleaned so that there is no possibility of indoor air quality problems.

Labor

Labor costs are higher for deconstruction than for demolition because of the manual work required to un-install materials and then process them, plus the time required to plan and organize and market/sell the salvaged materials. Figures 14.2 and 14.3 are tables from a deconstruction case study by the National Association of Home Builders Research Center published in 1997. The tables show a labor summary and time required per salvaged building component as a percentage of overall labor hours.⁴

Effect on the Project Schedule

Because it takes longer to salvage and process materials for deconstruction, versus demolition, additional time needs to be scheduled for it. This can be challenging in a tight time-frame project. It's important to identify the likely savings up-front in order to make