IAQ: Whose Responsibility?

The problem is not energy conservation

by Hal Levin

A popular myth holds that energy conservation measures, implemented since the oil crises of the 1970s, cause indoor air pollution problems. This myth ignores the fact that most indoor air pollutant sources have little or nothing to do with energy conservation. In at least one study conducted before 1973, the air inside buildings was found to be more polluted than outdoor air even during severe air pollution events. In fact, only two types of conservation measures directly increase indoor air pollutant concentrations: inappropriately reducing ventilation and using sealants and caulks that emit pollutants.

The myth ignores the fundamental responsibility (and ability) of architects, engineers, and building operators to create indoor environments that are both habitable and environmentally responsible. Achieving good indoor air quality (IAQ) is as essential as providing comfortable, healthy thermal conditions and functional, aesthetically sound lighting and acoustical environments.

How Ventilation Affects IAQ

Changes in ventilation rates generally affect IAQ only indirectly. What directly impacts IAQ is the *relationship* between ventilation and pollutant sources. Consider the following three factors.

First, there would be no indoor air contamination if there were no pollutant sources. The sources have changed in number and kind during the past 45 years or so; abundant, harmful pollutant sources have resulted from new building materials, furnishings, equipment, and consumer products.

Second, thermal control has become the dominant driving force in system design. The need to maintain good IAQ by adequate outdoor air exchange has become incidental.

Finally, in the majority of buildings with IAQ problems, ventilation systems do not function as designed. Many of these failures result from problems in operation and maintenance. As many as 75 percent stem from design and construction flaws because designers simply did not place enough emphasis on IAQ.

Thermal Control vs. Air Quality

Historically, ventilation requirements were set to maintain air quality. In the 19th century, before people began to bathe frequently and use personal deodorants, rates were specified to keep human body odor at acceptable levels. Traditionally, architects and engineers designed mechanical or natural building ventilation on the basis of established outside air requirements for assumed occupant loads and activities in the building program.

With the advent of variable air volume systems in the 1950s, thermal control objectives came to drive system design. The shift became more important as buildings became larger. There was more space remote from the envelope, or exterior, of the building and concomitant lost access to daylight and ventilation through windows. This shift has led to the notion that "energy conservation causes indoor air pollution." At most, reduced air exchange to conserve energy exacerbates IAQ problems, but, for the most part, the causes of indoor air pollution are not the direct result of energy conservation.

Determining Loads

Maintaining a healthy, safe, and productive environment requires that ventilation be sufficient to maintain air quality. The amount of ventilation required depends on the occupant density, the types of activities that take place in the building, and the strength of pollutant sources (from equipment, building materials, and consumer products). Since these factors vary independently, it is difficult to provide universally applicable ventilation rates. The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) sets minimum ventilation values, but these assume no "unusual sources" of indoor pollutants. The burden is on designers to determine the nature of pollutant sources and whether they require more than the recommended minimums.

Sources of Indoor Air Pollutants

There are many sources of pollutants in buildings, and they vary considerably from building to building. For that reason, addressing these sources effectively must be part of the design process. Simply following the general guidance for ventilation as a means of controlling pollutants means choosing the default solution; it does not represent the best effort of a good designer.

It is important to understand the relative contributions of various sources and to address the strongest ones. We must go after the ones with the most surface area, the most mass, and the emissions that we know or believe to be most irritating or toxic.

Emissions from new building materials far exceed emissions from aged materials. However, maintenance, refinishing, and replacement activities do result in significant increases in

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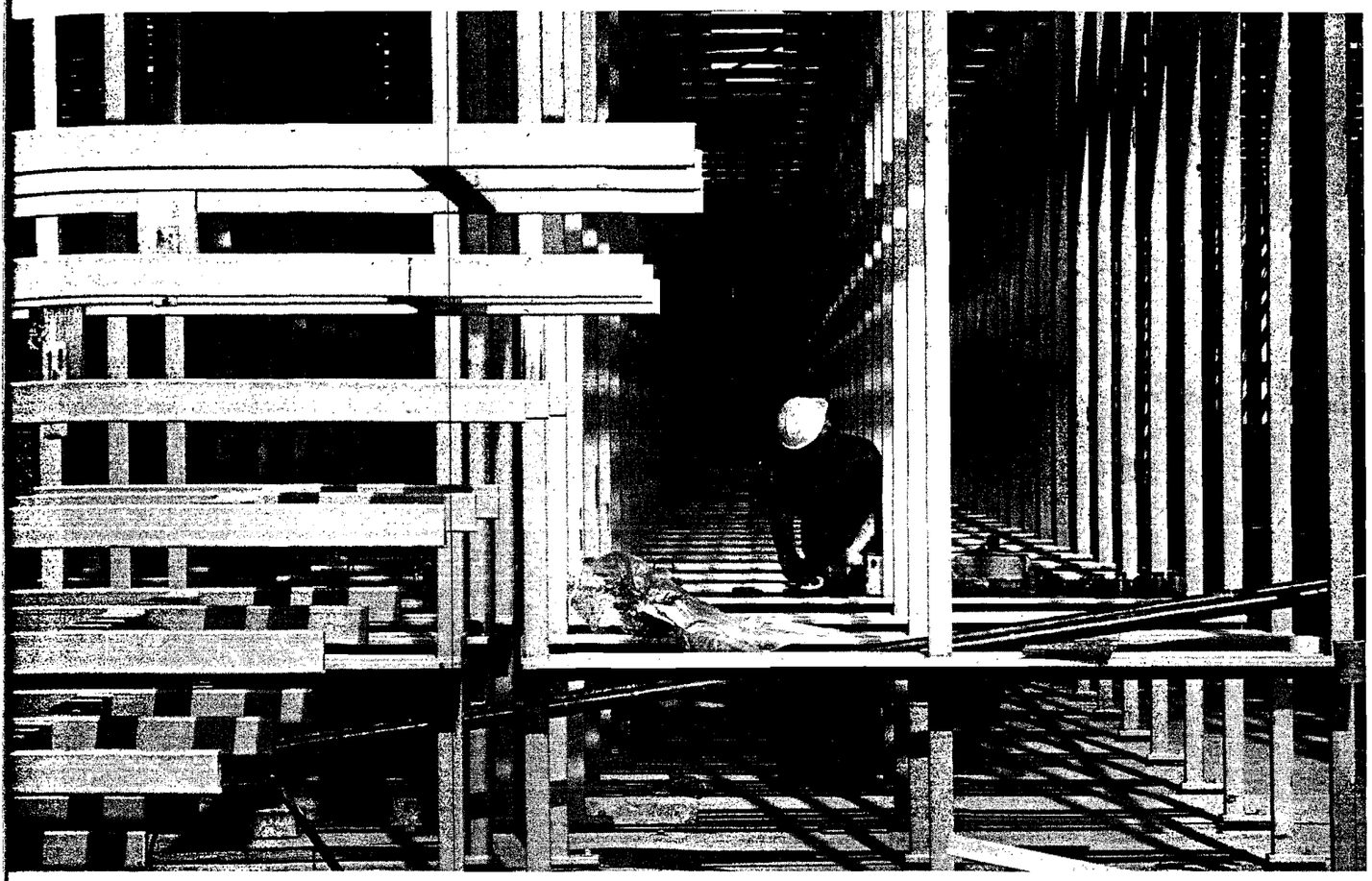

The fundamental responsibility of architects, engineers, and building operators is to create habitable indoor environments.

Mike Brisson photo.

pollutant emissions. Therefore, the durability of a material impacts IAQ significantly. It is important to note that "wet" products such as paints, adhesives, caulks, cleaners, waxes, and polishes emit very large fractions of their mass into the building air, and usually soon after application. However, even after these products are functionally dry, they continue to emit very slowly for a very long time.

In the past 40 years, building materials have changed in ways that make them stronger sources of indoor air pollutants than "traditional" materials. For example, composite wood products have replaced solid wood materials, bringing binders, adhesives, and other chemical additives indoors. The best-known and perhaps most widely used examples are particleboard, plywood, and other composite wood products based on urea-formaldehyde resins. Fortunately, these resins are being replaced by more stable phenol-formaldehyde resins, and some manufacturers are developing and even marketing products that use no formaldehyde-based resins at all.

New low-emitting adhesives are now available for installing flooring products. Paints that use far less organic solvent are also becoming more common. However, replacing a strong emitter with a nondurable, low-emitting product may result in more maintenance and replacement. This can mean more frequent, short-term emissions. Durability can therefore be a very important determinant of IAQ.

Architects' and Designers' Roles

Architects and designers can substantially reduce indoor air pollution by proactively minimizing undesirable sources. They can limit chemicals with known toxic effects to levels that will not cause adverse reactions. For example, the California Air Resources Board recommends that formaldehyde levels not exceed 50 parts per billion. Since it's known that most particleboard, plywood, hard-board fiberglass insulation batts and boards, some textiles, and many other building products emit formaldehyde, architects and designers must try to limit their quantities, select lower-emitting products, or choose substitute materials. They can calculate emissions from these products based on test data. Knowing ventilation rates, they can estimate formaldehyde concentrations in indoor air and change specifications if necessary.

This approach, although it seems rather unscientific and not very specific, is, in fact, similar to the way we design illumination and acoustic and thermal control. This brings us back to our title topic. We don't say that energy efficiency causes poor lighting or visibility problems in buildings; instead we determine what lighting levels are necessary to perform the task for which the building is designed and built, then we attempt to achieve those levels in an energy-efficient manner. We must recognize the need to apply the same approach to IAQ. □