MEASURE 5.3.3 Keep conditioned air from discharging on windows and exterior walls.

RATINGS

New Facilities	Retrofit	O&M
A	C	

If a conditioning unit blows directly on the interior surface of a window or an exterior wall, heat loss through the window or wall is greatly increased. This is because conductive heat loss is proportional to temperature differential, and discharging directly on the wall raises the temperature differential across the wall. Also, the air blowing on the surface destroys the insulating air layer that attaches itself to the wall surface.

This problem is worst if draperies or other window treatments trap the discharge against windows. Figure 1 shows an example. Other types of obstructions can cause the same problem. For example, in warehouses, goods may be stacked tightly in front of a conditioning unit. This causes the unit to operate more intensely in order to heat or cool the space. While doing so, it increases heat loss through the wall.

If the windows allow air leakage, this may greatly increase the heat loss. The most extreme energy waste occurs if the fan-coil unit can discharge toward an open window, as in Figure 2.

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Fig. 1 Discharge trapped by drapery Almost all the heating output of this unit is discharged between the drapery and a large window. Much of the heat is lost by conduction through the window, and the small insulating value of the drapery is lost.

SUMMARY

Corrects a common, unexpected cause of heat loss. Draperies are likely to cause the problem, or to aggravate it.

SELECTION SCORECARD

Savings Potential	$
Rate of Return, New Facilities	% %
Rate of Return, Retrofit	%
Reliability	✓ ✓ ✓ ✓
Ease of Retrofit	☺

In most cases, you can eliminate or greatly reduce these types of energy waste with simple changes.

Energy Saving Potential

■ Conductive Heat Loss

The additional heat loss depends on the thermal resistance of the surface, the discharge temperature of the fan-coil unit, and the amount of surface area that is affected.

If a drapery or other window treatment hangs above the fan-coil unit, it can greatly increase the area of the

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Fig. 2 Discharge to an open window Much of the heating or cooling energy goes directly outdoors through this library window. And, books may block the discharge to the space. Another case where the architect did not talk to the engineer. There are several possible solutions.

wall or window that is affected. For example, if the outside temperature is 40°F and the room temperature is 70°F, the temperature differential is 30°F. Now, assume that a fan-coil unit discharges air at 140°F toward the wall. This air is trapped between the drapery and the wall, raising the surface temperature of the wall to 100°F. This doubles the temperature differential across the wall, and doubles the conductive heat loss.

In addition, the insulation value of the drapery itself is lost. A heavy drapery and its air layers has an R-value of about 1.0, which could account for a large fraction of the total thermal resistance of a window or a poorly insulated wall.

The thermal resistance of the wall determines the heat loss in absolute terms. Glass walls are the worst, with typical R-values ranging from 0.8 (single glazing) to 1.8 (double glazing with fancy coatings). At the other extreme, well insulated walls in newer commercial buildings have R-values between 10 and 20, but such buildings are exceptional. A typical uninsulated masonry wall with a furred interior surface has an R-value of about 4.

■ Loss of the Insulating Air Layer

Any vertical surface in relatively still air has an air layer attached to it that has an R-value in the range of 0.4 to 0.8. The direct discharge of a fan-coil unit is strong enough to scrub this air layer away, reducing the thermal resistance of the surface. The effect is especially significant with glazing, where the air layers on each side provide a large fraction of the total thermal resistance. With well insulated walls, the loss of the air layer matters much less than the increase in temperature differential.

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Fig. 3 Simple, effective baffle on a fan-coil unit This piece of flat clear plastic is bent to form a flange that is screwed to the top of the unit. It keeps the unit's air discharge from blowing behind the curtain and being trapped against the window.

■ Solar Heat Gain in Window Treatments

Curtains, blinds, and other interior shading devices absorb a significant amount of heat from the entering sunlight. Some of this heat is returned to the outside by a combination of radiation from the shading device and conduction through the window glass. If the fan-coil unit forces conditioned air through the space between the window and the shading device, the air picks up much of the absorbed heat. If the space requires heating, this effect saves energy. If the space requires cooling, this effect wastes energy.

■ Air Leakage

If the windows are leaky, blowing air against them increases leakage considerably because of the velocity pressure of the air. Furthermore, since the air from the fan-coil unit is warmed (or cooled), it carries away more energy than an equal amount of air from the space.

If a conditioning unit blows toward an open window, as in Figure 2, a large fraction of the heating or cooling energy is lost directly to the outside.

How to Avoid This Problem

In new construction, if the potential problem is draperies or window treatments, you can get models of fan-coil units that extend into the room and underneath curtains. Check with the interior designer. Bear in mind that the interior decor may change over the life of the building.

If the fan-coil unit is to be installed under a window, the window design can minimize the problem. If the wall is reasonably thick and the windows are installed flush with the outside surface of the wall, this leaves a space for installing curtains or other window treatments next to the window, without extending out over the fan-coil units. (Aside from this, the window design should exploit the Measures in Subsections 6.3, 7.3, 8.1, 8.3, and 8.4.)

In retrofit applications, the appropriate corrective action depends on the present installation. Most fan-coil units have louvers that control the direction of air discharge. These are usually adjustable. The trick is to fix them in position so that air does not discharge on the window or wall, and also does not cause an unwanted draft in the space. Once the louvers are adjusted properly, fasten them in place. You may be able to do this with a few sheetmetal screws.

In some cases, you may have to install an external baffle to direct the air discharge. Figure 3 shows an effective and inexpensive type of baffle that is widely applicable.

If there is a problem with heat trapping by draperies or other window treatments, use solutions similar to those recommended by Measure 5.2.5.

Comfort Dilemma with Poorly Insulated Walls

If a large fraction of the envelope surface is poorly insulated, e.g., if the building has a glass curtain wall, reducing the heating of the surface creates a comfort dilemma for occupants close to the wall. In order for a person to feel comfortable, heat loss from the person's body must be limited. Heat is lost both by conduction to the surrounding air and by radiation. If there is a large cold surface nearby, the person will feel chilly even though the air temperature would normally be comfortable. Therefore, designers locate heating units where they warm surfaces that have high heat loss.

To a certain extent, you can compensate for colder walls by increasing the space temperature. However, this makes people far inside the space too warm, and it increases heat loss elsewhere. Cold walls are an intractable comfort problem. The only solution that is entirely satisfactory is improving the insulation value of exterior surfaces. See Subsection 7.2 for the methods.

(Unfortunately, cold and leaky walls are a common problem in modern architecture, proliferated by a misconception that envelope integrity is unimportant in large buildings. Someone observed that larger buildings have a higher ratio of interior volume to surface area, so that the total heat gain of the building may be positive, even in cold weather. This may be true, but it provides no comfort for people in the perimeter zones.)

ECONOMICS

SAVINGS POTENTIAL: *3 to 50 percent of heating energy. Depends on the amount of wall or window area affected, the thermal resistance of the surface, the discharge temperature, and the extent of heat trapping.*

COST: *In new construction, this activity is mainly a matter of thoughtful equipment layout and selection, and it should add little cost. In retrofit, the cost is usually modest, unless you have to modify or replace window treatments.*

PAYBACK PERIOD: *Less than one year, to many years.*

TRAPS & TRICKS

INGENUITY: *A simple, neat solution is often possible. Make it permanent, and don't create a comfort problem.*

MEASURE 5.3.4 Install thermostatic controls that allow space temperature to drift within comfortable limits.

RATINGS

New Facilities	Retrofit	O&M
A	B	B

In most HVAC applications, comfort does not require a fixed space temperature. People remain comfortable within a range of temperatures. You can save energy by using thermostatic controls that turn off heating and cooling within this temperature range. There are several ways to do this. See Measures 4.3.4 ff for the details.