Minimizing Excess Outside Air by Charles C. Copeland, PE

We have worked on two large NYC energy conservation efforts. The first was managing NYC's 1980's Energy Conservation Capital program, the largest of its kind, and our more recent effort is to improve the energy performance of NYC's existing office buildings (see my article in the August issue of the ASHRAE Journal).

It is interesting to note that despite the intervening decades, at least one large wasteful issue persists: the excessive amounts of outside air most buildings draw in through leaking dampers. Though not inexpensive, replacing outside air dampers is a relatively straightforward measure and one that most building owners and managers should consider.

As noted in the ASHRAE article, during an early demand controlled ventilation (DCV) multi-year study in one major office building (see Test Building 1 in Table #4) we discovered that the CO_2 level seldom varied much above the outdoor level of roughly 450 ppm. When the outside air quantities were eventually field tested, it was apparent that leaking dampers allowed significant amounts of excess outside air to be introduced into the building. Moreover, upon further testing, even with ostensibly closed dampers the leakage rate exceeded 40% which results in more outside air than suggested by the ASHRAE Standard 62.1-2007; sometimes, several times more. Testing in subsequent buildings confirmed that a large majority of older commercial office buildings are over-ventilated, resulting in wasted energy, some for heating, but mostly for cooling. Understandably, many of these dampers date from the original construction of the building.

Test Building #	ASHRAE 62.1-2007 OA Requirement (CFM)	Measured OA (CFM)	% OA vs. ASHRAE Required *	Excess Air (CFM)
1	145,040	694,448	479%	549,408
2	94,120	210,978	224%	116,858
3	234,040	282,026	119%	47,986
4	49,452	72,986	148%	23,534
5	97,800	177,017	181%	79,217
6	124,599	163,266	131%	38,667

* Dampers open to minimum position

Table #4 Excess outside air is common in these large, commercial vintage buildings.

If a majority of Manhattan office buildings have excess outside air quantities similar to Table #4, installing new dampers would significantly reduce CO_2 emissions, as well as overall energy costs.

In many of these vintage buildings, even with relatively tight-closed dampers on the interior air systems, we rarely see interior air CO_2 levels exceed 600 or 800 ppm, well below the 1100 ppm (400 outside + 700) recommended by ASHRAE 62.1-2007 for indoor air quality. This is in part due to the perimeter induction air systems which are generally fixed at 50 to 60% outside air (in some cases, 100%) which contribute significant amounts of fresh air to the system.

Clearly, unless new tight-closing dampers are installed in these over-ventilated buildings, DCV will not be fully effective. Using Test Building 1 as an example, Figure #2 shows the extent to which installing low-leakage dampers can be crucial to effective use of DCV.

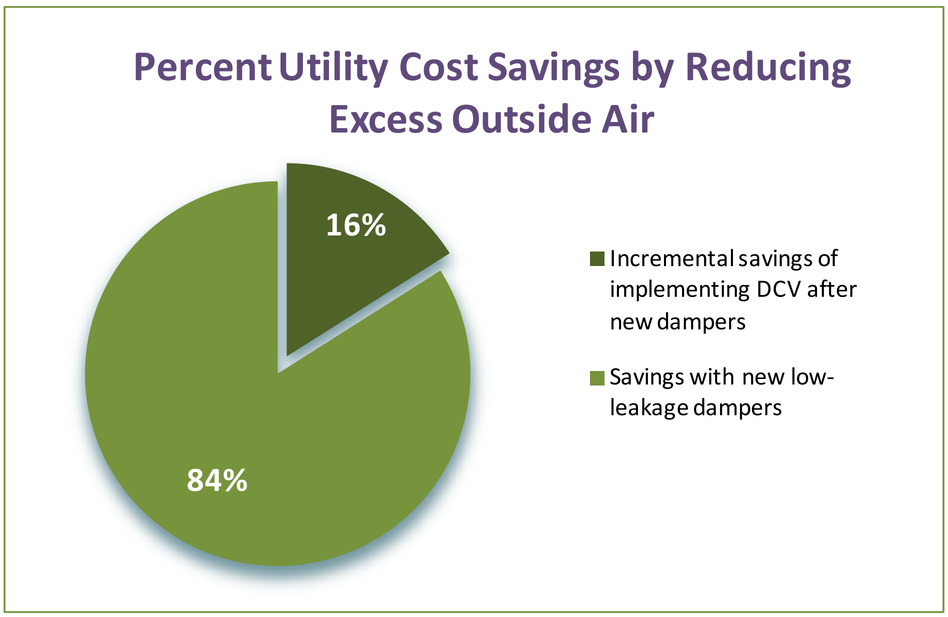

Figure #2 Test Building 1 proportional outside air savings; low-leakage dampers vs. DCV.

Unfortunately, some dampers constructed by local shops have not been engineered adequately to minimize excessive outside air. The linkages and damper motors do not properly close the large damper assemblies (often 10 feet high and as much as 20 feet wide) and the damper blades become misaligned. Outside air dampers must be installed on a modular basis, with appropriate damper motors and linkages, to provide adequate torque to close the dampers leaktight. Only when good dampers are installed can DCV become effective.