ENERGY STAR GOES MULTIFAMILY

Along with beautifully designed brickwork and a landscaped backyard with a children's play area, residents of 1212 MLK Apartments can enjoy affordable apartments, low energy bills, and healthy indoor environments.

by MARC ZULUAGA and GAYATHRI VIJAYAKUMAR

SWA

1212 MLK Apartments contains 54 units of affordable housing: 10 studios, 15 one-bedroom apartments, 28 two-bedroom apartments, and 1 three-bedroom apartment. A dozen energy efficiency measures have been implemented. The building is the first to earn Energy Star status through a pilot program for multifamily buildings.

Up until recently, high-rise multifamily buildings have not been able to reap the performance and marketing benefits associated with the Energy Star label. That changed when, earlier this year, EPA launched its pilot program for Energy Star multifamily homes in New York, Wisconsin, and Oregon. As the New York Energy and Research Development Authority (NYSERDA) has taken a national leadership role in developing the pilot, it is perhaps not surprising that New York is the location of the first of the pilot program buildings to be completed. Built by Dunn Development Corporation and Beulah HDFC, Incorporated, 1212 MLK Apartments is a six-story building on Dr. Martin Luther King, Jr., Boulevard in the Highbridge neighborhood of the Bronx. The first tenants moved in during the summer of 2006.

The company we work for, Steven Winter Associates, served as an energy consultant for the project and assisted Dunn Development in meeting the program requirements. NYSERDA is using data from the pilot to establish the up-front cost of efficiency and to set cost-effective efficiency goals for future construction projects. The experience gained from the pilot project in New York will help EPA generate standards for Energy Star labeling of high-rise multifamily buildings nationally.

Affordable Housing at Its Best

1212 MLK Apartments contains 54 units of affordable housing: 10 studios, 15 one-bedroom apartments, 28 two-bedroom apartments, and 1 three-bedroom apartment. In addition, the first floor has a community room with a kitchen and bathroom, a laundry room, utility rooms, and three offices. Residents and their guests can enjoy a beautifully landscaped backyard with a children's play area and plenty of benches. The building totals 51,000 ft^2, including apartments, common areas, and other first-floor spaces. The brick and concrete masonry unit (CMU) block walls rest on a crawlspace foundation. The boiler room is located on the roof.

In order to meet the NYSERDA program requirements, 1212 MLK Apartments includes a dozen energy conservation measures (ECMs) that were incorporated into the design in order to reduce the modeled whole-building energy use by 20% compared to a baseline ASHRAE 90.1-2004-compliant building (see Table 1).

The building walls are insulated with R-4.3 Roxul 1-inch rigid (mineral wool) insulation and R-13 fiberglass batts within 3 1/2-inch interior steel framing. The rigid insulation, placed between the steel studs and the CMU block wall, minimizes thermal bridging through the steel. In New York City, for multifamily buildings with more than four units, the Energy Conservation Construction Code of New York State requires a continuous layer of R-3 insulation with metal framing. However, this requirement is usually ignored, resulting in a standard practice for new construction that does not address thermal bridging through steel studs.

The windows are low-e, argon-filled aluminum frame with a thermal break, resulting in an assembly U-value of 0.44. These windows also feature a custom-made removable panel below a standard double-hung unit. During the summer, an insulated replacement panel with a cutout for a window A/C unit will be installed in the bottom section of those windows where tenants desire window air conditioning. The panel for the A/C is replaced with a window panel during the winter to provide extra light. The developer decided to try this new window design approach in order to avoid air conditioner sleeves, which are prone to air leakage and limit the potential efficiency of A/C equipment.

Two 87% efficient, direct-vent Lochinvar boilers meet heating needs—a significant improvement over conventional 80% efficient atmospheric equipment. These boilers have a fully modulating firing rate of 25%–100% and are used in combination with two 119-gallon indirect storage tanks to meet domestic hot water (DHW) needs efficiently. While combustion efficiencies of 90%–95% are possible with condensing boilers, actually achieving this performance level requires a boiler return water temperature that is low enough to allow for condensation. The boiler return water temperatures of 140°F–180°F in a standard hydronic baseboard loop will not

Table 1. Energy Conservation Measures (ECMs) and Incremental Costs

Energy conservation recommendations			Related baseline components			
Recommendation description	Total estimated cost	Source	Related baseline Component description	Total estimated cost	Source	Incremental cost
Envelope measures						
1. **ROOF:** Insulate with 6-in polyisocyanurate, R-37	$ 34,000	Dunn Development	**ROOF:** Insulate with 3-in XPS rigid insulation, R-15	$ 16,200	EMP* estimated costs	$ 17,800
2. **WALLS:** Install 1 in of rigid & 3 1/2 in of R-13 batt insulation	$ 61,300	Dunn Development	**WALLS:** Install 3 1/2 in of R-13 batt insulation	$ 16,300	EMP estimated costs	$ 45,000
3. **WINDOWS:** Custom, low-e, argon filled, alum. frame windows, U<0.44	$ 90,000	Dunn Development	**WINDOWS:** Install double pane windows, wood/vinyl frame, U≤0.57	$ 61,600	EMP estimated costs	$ 28,400
4. **FOUNDATION:** Install 2 in rigid insulation on crawl space walls, R-12	$ 18,900	EMP estimated costs	**FOUNDATION:** Uninsulated concrete block, R-2	$ 16,400	EMP estimated costs	$ 2,500
HVAC measures						
5. **HEATING:** Install two high efficiency space heat boilers and indirect water heaters	$ 70,000	Dunn Development	**HEATING:** Install one space heat boiler and one hot water boiler and 1,000 gal storage tank	$ 34,200	RS Means Co.	$ 35,800
6. **VENTILATION:** Attach Constant Air Flow regulators to exhaust fans	$ 7,200	Manufacturer	**VENTILATION:** Standard exhaust fans, no regulators	$ 0		$ 7,200
Domestic Hot Water Measures						
See measure 5	NA	NA	NA	NA	NA	NA
7. **WATER SAVING FIXTURES:** Install 1.5 gpm low-flow faucets and 2.2 gpm showerheads	$ 165	EFI	**WATER SAVING FIXTURES:** All faucets are 2.2 gpm, all showerheads are 2.5 gpm	$ 0		$ 200
Base Electrical Measures						
8. **LIGHTING:** Install motion sensors and low watt LED exit signs	$ 5,300	RS Means 2004	**LIGHTING:** Install incandescent, LED and fluorescent lighting	$ 1,600	RS Means 2004	$ 3,700
9. **APPLIANCES:** Install Energy Star refrigerators	$ 36,400	www.ge.com	**APPLIANCES:** Install non-Energy Star refrigerators	$ 26,000	EMP estimated costs	$ 10,400
10. **APPLIANCES:** Install front-loading Energy Star clothes washers	$ 5,600	Dunn Development	**APPLIANCES:** Install top-loading non-Energy Star clothes washers	$ 2,400	Dunn Development	$ 3,200
11. **ELEVATOR:** Install 2 Otis Gen2 Elevators	$262,000	Dunn Development	**ELEVATOR:** Install 2 Hydraulic Elevators	$189,000	Dunn Development	$ 73,000
			Subtotal—1212 MLK Apartments			**$227,200**
			TOTAL ESTIMATED INCREMENTAL COST:			**$227,200**

* Energy Star Multifamily pilot

yield condensation in the combustion stack. In this type of conventional application, a condensing boiler will result in combustion efficiency comparable to that of direct-vent equipment.

It is possible to lower return water temperature enough to take advantage of condensing equipment by increasing the radiation output of the hydronic loop with larger baseboard units. The cost-effectiveness of this type of approach was not evaluated, although it may represent the next logical step in improving heating-plant performance.

More than any other factor, mechanical ventilation drives the heating load in new multifamily buildings in New York City. Small apartments combined with strict exhaust CFM requirements in the city's building code result in relatively high mechanical air change rates. At 1212 MLK Apartments, the ventilation system was designed to minimize overall apartment air change rate while still meeting code. The design exhaust ventilation rate for all bathrooms is 50 CFM. Most kitchens qualified as "super kitchens," which are greater than 59 ft² floor area with a pass-through to an adjacent room with operable windows, and did not require mechanical ventilation. The studio kitchens are smaller than 59 ft² and can't use the living area as a pass-through to get to an operable window. Indeed, the living area is also a sleeping area in a studio apartment. The small kitchens therefore required a provision for 120 CFM of mechanical ventilation (not necessarily continuous). Ironically, the smallest apartment requires the most ventilation by code.

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The building walls are insulated with R-4.3 Roxul 1-inch rigid (mineral wool) insulation and R-13 fiberglass batts within 3 ½-inch interior steel framing. The rigid insulation, placed between the steel studs and the CMU block wall, minimizes thermal bridging through the steel.

Table 2. Simulation Summary—1212 MLK

	Baseline simulation	Final design simulation
Annual energy cost, all fuels	$65,000	$52,000
Electricity consumption	262,000 kWh/year	210,000 kWh/year
All other fuels consumption	1,700 MMBtu/year	1,300 MMBtu/year
Total estimated energy consumption	2,600 MMBtu/year	2,000 MMBtu/year

These ventilation requirements are met by a central exhaust system with roof-mounted exhaust fans connected to duct riser shafts with takeoffs at each floor for bathroom and kitchen exhaust grilles. Bathroom doors are undercut to provide for makeup air. As an improvement on this standard-practice ventilation system, 1212 MLK Apartments also incorporates Aldes Constant Air Regulator (CAR) dampers at each bathroom exhaust point in order to assist in balancing exhaust air flows from floor to floor and from season to season. CAR dampers incorporate a silicone bulb that expands when the pressure drop across the damper exceeds 50 Pa in order to regulate air flow. At 1212 MLK Apartments, the CAR dampers are integrated with an exhaust grille and fire damper assembly.

High-efficiency fluorescent lighting is used throughout the building. Apartments feature wall sconces with four-pin CFL bulbs (2 x 13W), T-8 lamps with electronic ballasts for kitchens (2 x 32W), and 55W fluorescents for the bathrooms. Overhead fixtures in public corridors are CFLs (2 x 26W), also with electronic ballasts. To further minimize electricity bills, occupancy sensors were installed throughout the offices, community room, and janitor closets. In each public corridor, ceiling-mounted long-range occupancy sensors are wired to a power switch pack (PSP) that turns off every other overhead light fixture when these spaces are not being used. The overhead light lamps that are not controlled by the PSP are designated emergency fixtures with battery pack backup for power failures.

Competitive Costs

SWA compared the specifications and component costs for a baseline building to the ECMs implemented in the building (see Table 1). The baseline building specifications were determined using Appendix G of ASHRAE Standard 90.1-2004 along with a few minimum-performance standards required by NYSERDA. Since ASHRAE 90.1 is a relatively stringent standard, baseline requirements exceed standard practice for New York City. Pegging the program to a national standard will eventually allow for the normalized comparison of buildings in different parts of the country, as is done with single-family homes. From a developer standpoint, this baseline approach does not give credit for those specifications that

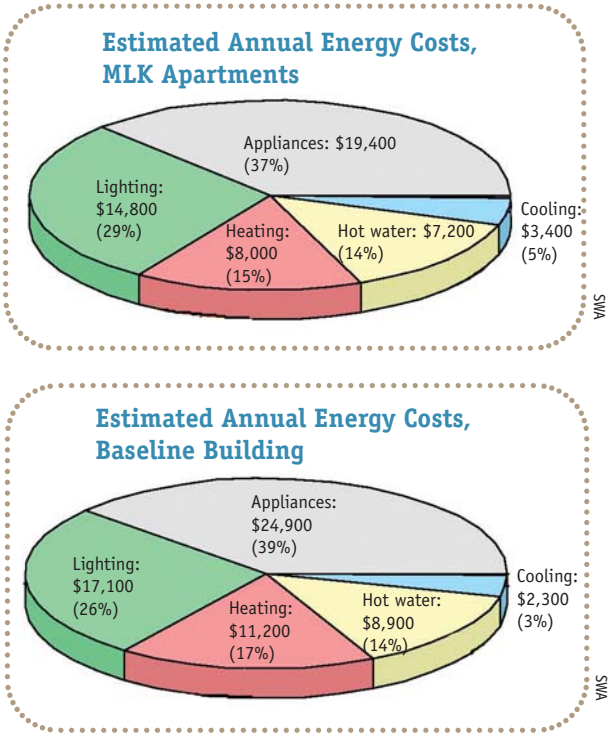
are found in ASHRAE 90.1 but have not been included in a developer's previous projects. However, the goal of this program is to raise the bar and encourage the construction of better buildings.

Whole-Building Energy Performance

Energy savings were evaluated by comparing simulations of the building to the baseline building. All simulations and projected energy savings have been developed using TREAT, Version 3.0.19 software. The final design resulted in a 20% reduction in estimated energy consumption compared to the baseline building. Put another way, the energy performance of 1212 MLK Apartments is 20% better than that of an already pretty good (ASHRAE 90.1-compliant) building (see Table 2 and Figures 1 and 2). Projected costs are based on energy prices of $0.15/kWh and $1.49/therm.

Installing four high-efficiency front-loading clothes washers in the first-floor laundry room was the most cost-effective ECM. Both electricity and hot water use of clothes washers is reflected in the "Appliances" wedge of the pie charts. Based on an assumption of nine loads of laundry per day per washer, upgrading the Modified Energy Factor (MEF) of equipment from 1.04 (baseline) to 1.89 (as built) will result in a savings of $5,127 per year. As is typical in New York City, washers and dryers are leased, which means that one of the most important ECM decisions was not finalized until the very end of the construction process.

Installing top-of-the-line OTIS Gen2 "machine room-less" elevators was the least cost-effective ECM. Using an online Otis Energy Expense calculator, SWA estimated a savings of 800 kWh per year. This savings estimate was based on an assumption of 360 rides per day for the building that was derived from research done by Henry Gifford in another six-story New York City building. These results indicate that in a six-story multifamily building, state-of-the-art elevator technology is not justified based on energy savings alone (there are, of course, maintenance and reliability benefits associated with new elevator technology).



Figures 1 and 2. Installing four high-efficiency front-loading clothes washers in the first-floor laundry room was the most cost-effective ECM. Both electricity and hot water use of clothes washers is reflected in the "Appliances" wedge of the pie charts.

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Next Steps

Now that the 1212 MLK Apartments are occupied, SWA will collect utility bills for a year in order to provide a reality check on simulation results and to provide feedback to Dunn Development Corporation and Beulah HDFC, Incorporated, on building performance. In addition, with funding from HUD's Partnership for Advancing Technologies in Housing (PATH) program, SWA also installed long-term monitoring equipment to assess ventilation system performance in one line of six apartments.

Dunn Development Corporation has already incorporated some details from 1212 MLK Apartments, such as the 1-inch Roxul insulation, into its standard specifications for future projects. SWA hopes that information from the field monitoring will prove useful, both by giving the developer confidence in the performance of new building systems and by helping to identify opportunities for further improvement.

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FOR MORE INFORMATION:

For more on 1212 MLK Apartments, go to www.dunndev.com/L3/mlk.html.