A New York Success Story

Value engineering allows a development of 30 affordable three-family homes to meet Energy Star standards.

by Andrew Padian

Typically, affordable housing in New York City is built to be affordable only in terms of the first cost, making maintenance and energy costs a burden to first-time home buyers, cooperators, and not-for-profit organizations that own or manage such buildings. Melrose Commons II, a one-block grouping of 30 beautiful, highly energy-efficient owner-occupied three-family homes, is breaking that mold.

Melrose Commons II began as a challenge that the New York City Partnership set itself in 2000: Could an affordable housing developer, with the assistance of industry professionals, build high-performance affordable housing in New York City that met Energy Star standards? Within two years—with the assistance of banks, government, and a highly motivated developer—that question has been answered with a resounding yes. Melrose Commons II homes are constructed from recycled products and low-toxicity materials and have Energy Star lighting and appliances throughout. Designed for the first-time home buyer, these are the first affordable Energy Star three-family homes in New York State.

These townhouse dwellings total 4,400 ft^2 for three units. The basement and the first full floor, as well as half of the second floor, comprise the owner's residence. There is a half-floor one bedroom apartment on the second floor and a full-floor two-bedroom apartment on the top floor. The townhouses are located in a one-block area in the Melrose section of the Bronx, six blocks from either a commuter railway or two major New York City subway lines, as well as one of the busiest shopping areas in the Bronx, the Hub. They face the street and have ample off-street parking in the rear.

The homes are designed and financed to be affordable for families making as little as $42,000 per year. Each three-family home costs on average $289,000, and the owners can use rental income from the two other units to meet their mortgage payments. The owners are responsible for paying for heat, hot water, and the gas used for cooking. The residents pay the electricity bills for their apartments.

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Antonio Perez, a first time homeowner, spoke at the ribbon cutting ceremony for the Melrose Commons II energy-efficient houses.

Construction began on the project in September 2001 and was completed last October. Testing confirmed that the homes qualified for a New York State Energy Star rating, which enabled the developer to receive financial incentives that partially offset the increased efficiency costs (see Table 1).

Steven Winter Associates (SWA) acted as consultant to the developers, and consultant fees were cost-shared between the DOE's Building America program and the New York City Partnership, who acted as the sponsor of Melrose Commons II. The Partnership is a nonprofit arm of the New York City Chamber of Commerce, and acts as the voice of New York City's business community on legislation, regulation, and public issues that affect business and the economy. The developer was MC II Associates, and the general contractor was Blue Sea Construction Corporation.

A Concrete Advantage

The starting point for upgrading Melrose Commons II was to make the building envelopes perform better through increased insulation, better windows, and airtightness. To achieve these goals, the Melrose developers started with an exterior concrete panelized system, which was manufactured by Oldcastle Precast, and also incorporated precast floors and ceilings into the units. They picked a precast system for four reasons:

- Units could be erected throughout the winter, which would pick up the speed of construction.
- A panelized system would reduce labor costs.
- On-site waste would be dramatically reduced.
- With fewer seams, the buildings would be naturally tighter.

The panels were shipped to the site and loaded in place with a crane. The developers were very pleased with the speed at which the buildings could be assembled.

Using Algor—a finite-element heat transfer modeling software that calculates the effective R-values of wall assemblies—to analyze the wall insulation package, SWA found that a significant amount of thermal bridging would occur between the concrete exterior and the metal studs. To reduce this potentially dramatic drop in R-value, SWA suggested using a $^1/_2$-inch expanded polystyrene (XPS) board between the exterior walls and the interior metal studs. The insulation was installed correctly throughout the complex at the exterior concrete walls and acts as a significant barrier to thermal bridging. This was specified throughout the building; unfortunately, New York City code requirements did not allow it on the rear

walls, which for cost reasons were nonconcrete, so it was not used there. Our Algor analysis demonstrates the heat lost in the rear walls through thermal bridging (see Figure 1).

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The panelized wall systems for the Melrose Commons II development arrive on the job site.

Building Tightness

A major portion of an Energy Star rating derives from how airtight a building is and whether it is properly ventilated. Both of these performance specifications were important priorities at Melrose Commons II (see Table 2 for other building specifications). The development featured three separate types of unit: end units that had three exposed exterior walls; middle units that had two exposed exterior walls; and detached units that had four exposed exterior walls. Each building type in each row of homes—27 out of a total of 90 units—was tested for tightness using a blower door.

All three types of unit performed similarly in blower door tests, easily reaching the modeled tightness of 0.5–0.35 natural ACH. SWA tested both finished and unfinished units, and it became clear that the principal reason for the better-performing building tightness was the panelized exterior construction. Special attention was paid to sealing all exterior openings, projections, and joints throughout the development.

Single-System HVAC

As is typical in standard construction, the original design had called for a low-efficiency atmospheric gas boiler that was oversized for the load combined with a separate hot water maker, which would also have been a low-efficiency atmospheric gas unit. With the combination of atmospheric gas systems, boiler rooms vented to the outside, and oversized chimneys, configurations such as this can have massive on- and off-cycle losses. These losses are exacerbated when colder outdoor temperatures create a greater stack effect through the fully open combustion chambers of atmospheric gas equipment.

Knowing that the precast concrete would reduce air infiltration and the building's heating load, SWA recommended the use of a single, properly sized, high-efficiency sealed-combustion boiler to provide both heat and hot water for the homes. So instead of two oversized appliances, each three-family home came equipped with a single Burnham Revolution gas boiler,

Table 1. Value-Engineering Tradeoffs

Recommended Improvements	
Proposed Technology/Material Incremental	**Cost per 3-Family Home**
1/2-in rigid insulation on outside of studs and R-11 batts between studs	$675
Double-glazed low-e vinyl windows	$896
High-efficiency 60-gal indirect water heater	$928
87% efficient 164 kBtu/h sealed-combustion direct-vent boiler	$1,897
Digital programmable thermostats	(4)Honeywell T8000 1C $184
Outdoor reset control	(Tekmar) $45
Energy Star Refrigerator (rated at 437 kWh/yr)	($65x4) - NYSERDA rebate ($50x4) = $60
Energy Star Dishwasher	$48 - $30 = $18
Exterior lighting hard-wired fluorescent or CFL (3 fixtures), interior CFL (22 fixtures)	CFL fixtures less cost of standard fixture less $25 NYSERDA rebate = $375
Benjamin Moore Pristine EcoSpec low VOC paint	(Manufacturer provides paint to builder at no add'l cost) $0
Total Increased Costs Per Unit	**$5,492**
Energy Star Funding (anticipated)	$1,500
Deutsche Bank hard cost grant	$333
To be absorbed in project budget (developer)	$834
To be financed with Deutsche Bank PRI loan	$2,825

with a 65-gallon Bradford-White automatic-storage water heater. With these sealed-combustion units, there is no risk of combustion backdrafting. As most homes in New York City are heated by boilers and radiators, few duct systems and even fewer central A/C systems exist. Should the Melrose residents need A/C, they will have to rely on window units, as do most New York City residents.

Residents' ability to adjust heating temperatures can be crucial to the efficient use of heating energy. SWA's upgraded specifications called for Honeywell digital thermostats in each unit, and a Tekmar separate outdoor reset control to modulate water temperatures in the radiators depending upon outdoor temperature. These controls combine to help reduce overheating, which can be rampant in buildings that have central heating systems and many separate dwelling units with different envelope loads and occupancy requirements.

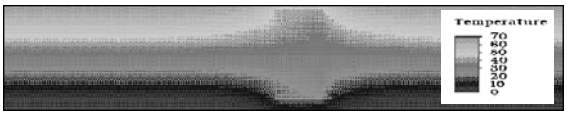

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Figure 1. The Algor analysis *(top)* shows the heat loss that would occur through thermal bridging at the steel studs without the addition of rigid insulation shown in the photo *(bottom)*.

Low-Emissivity Windows

Although vinyl low-e windows are common in the construction industry, they have only recently crept into the New York City market. One obstacle has been a misinformation campaign that led developers to believe that vinyl windows did not meet fire code. They are allowed in buildings that are less than seven stories and don't have elevators, or buildings that have sprinkler systems. The developer of this project found a local manufacturer of high-quality vinyl windows featuring AFG Industries Comfort E2 low-e glazing. The change in performance from aluminum to vinyl frame windows is dramatic, and again allowed for a properly sized smaller boiler.

Quality Control on the Site

As these 30 buildings and 90 homes are located on a single block, construction management on the part of the developer occurred during virtually every hour of construction. On our visits to the buildings, virtually all trades were working at various stages of construction, and the developer and general contractor were on the site all the time to check the subcontractors' work. The on-site construction manager was attentive to the details of several new technologies,

Table 2. Building Specifications

Foundation	Full basement, insulated perimeter with 2-in EPS 2 ft below grade; 2-in rigid fiberglass batts at all exposed foundation wall surfaces
Wall construction	6-in and 8-in concrete panels for 3 floors on all but the rear of the buildings; 3-in light-gauge structural steel framing, 16-in and 24-in on-center. *Block and plank is more conventional.*
Exterior finish	Front of buildings: brick set in poured concrete; rear of buildings: aluminum siding over Tyvek and exterior gypsum sheathing at frame walls
Roof construction	Concrete plank
Windows	Insulated soft-coat low-e (Comfort E2) glass in vinyl frames with continuous thermal break. *Clear double-pane aluminum windows, many times without continuous thermal break, are more conventional.*
Wall insulation	Faced R-11 batts in frame walls, ½-in XPS against interior concrete surface: *R-8 fiberglass is more common; XPS is rarely if ever used.*
Ceiling Insulation	R-21 3.1-in polyisosuranurate foam board. *2-in is more common.*
HVAC	Hydronic baseboard radiation served by an 87% AFUE sealed-combustion boiler with separate insulated DHW storage; mechanical ventilation for each bath and kitchen separately switched; 50 CFM bath, 150 CFM kitchen with programmable timer switches; no A/C. *Low-efficiency oversized atmospheric gas boilers with oversized atmospheric gas DHW units with full-sized chimneys are common practice.*

Note: For those specifications that are vast upgrades from typical affordable housing practice, more conventional practices or specifications are shown in *italics*.

such as the XPS behind the steel studs. Crews were trained in the liberal use of mastic and other sealants, and air sealing from unit to unit was aggressively construction managed. Since sealing off each unit from other units is mandated for fire safety, it was also verified through regular visits by city inspectors.

Probably the most rewarding aspect of Melrose Commons II is that it breaks a cycle of so-called affordable housing in New York City that is actually not affordable when energy costs are included. In 1996, a study of more than 400 buildings of low-income housing preparing to enter the Weatherization Assistance program (WAP) showed average heating usage at over 24 Btu/ft^2/heating degree-days (HDD). This study also found that these buildings used just as much energy to provide domestic hot water (DHW) as they did to provide heat, which adds up to about 50 Btu/ft^2/HDD in total gas usage. Strangely, the highest consumers of the study group, which typically used twice the average amount of energy, appeared to be recently rehabilitated "affordable" buildings that requested WAP assistance because their energy bills were so high. SWA's REM/Design models estimate that the heating usage in a Melrose Commons II building will be less than 5 Btu/ft^2/HDD, and DHW usage will be approximately 40% of the total gas usage; these numbers suggest significant reductions in fuel consumption compared to typical New York City affordable housing stock. The units also feature Energy Star lighting fixtures and appliances throughout, resulting in a projected average electricity usage per unit that is 15% less than the per unit average for New York City. Actual utility bills were not available at presstime, as the residents had just moved in.

Affordable housing developers should look at Melrose Commons II as an example of how to value-engineer components of a building in order to add high-performance components. While this building has better insulation and windows and more expensive heating equipment than conventionally constructed buildings do, sizing the equipment smaller and removing the cost of a chimney translates into big savings. Most government entities define value-engineering as taking things out of the scope of work. A more correct definition is: thinking better, not wasting anything, and acting more efficiently. Melrose II is an example of affordable housing that didn't skimp on the details—and will still be affordable years after it is occupied.

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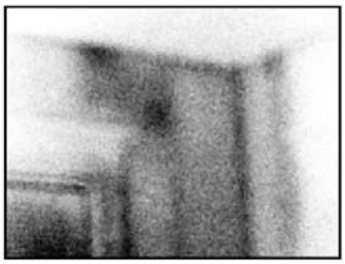

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