Builder's Experience

The builder of Melrose Commons II, Les Bluestone who owns Blue Sea Construction Corporation, had the following comments on *why* to build energy efficient, durable, and marketable affordable housing:

- Energy Savings - The savings from an efficient home mean *very* real dollars to new homeowners in our targeted income group; these savings also increase affordability in our mortgage underwriting, where they are added to a purchaser's total annual income.
- Public Perception –Dispel the notion that the words "affordable" or "subsidized" are some sort of subliminal code for substandard housing.
- Callbacks—While we expected some improved performance, a 90% reduction in callbacks for heat, drafts, and leaks through some of the coldest and wettest years in recent history, was more than we ever could have imagined.
- Marketing –It was a way to distinguish our quality from other housing developments in the marketplace.

Builder's Advice

- Attention to Detail –As an example, using sealed combustion boilers requires careful location of exhaust vents. At Eldert Heights, venting to the roof added $1,200 to each home's cost compared to Melrose Commons' side wall venting.
- Increased Availability of Products and Technology –Shop, Shop, and Shop! There are many more manufacturers and technologies in the market place than there were just four years ago when we started.
- Challenge your Suppliers and Contractors –Don't accept "we always do it this way" practices. At our request, the concrete precast company is now making prototype insulated panels with metal studs attached.
- Supervision –There is no substitute for supervision. Spend time with subcontractors and your own personnel, to be sure that they know what you want and expect from them.

"Challenge your suppliers and contractor."

Coupled together, all of aforementioned technologies come together in a home that is affordable while maintaining a high level of quality. For a community that is accustomed to high maintenance costs (heating and hot water) and sub-par housing, these homes are confirmation that there is a better alternative through advanced technology.

Product Link and Additional Information:

Boiler: Dual Sealed-Combustion Gas-Burning *Burnham Revolution Boiler*, www.burnham.com
Precast Concrete Wall Panels: *Oldcastle Precast*, www.oldcastle-precast.com
Tekmar Outdoor Reset Control for Boiler: *tekmar*, www.tekmarcontrols.com
Ventilation Bathroom Fan Timer: *Panasonic High-Efficiency Fan*, www.panasonic.com
Builder: *Blue Sea Construction Corporation*, NY, NY, 212-532-0333

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Norwalk, CT 06854
203-857-0200
Attn: Michael J. Crosbie
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PATH
PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING
U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Melrose II– Bronx, NY Affordable Housing

TECHNOLOGY HILIGHTS

Precast Concrete Wall Panels

Fly Ash Concrete in Walls and Floors

Sealed Combustion Boiler for Heat and Hot Water

Outdoor Reset Control for Boiler

Programmable Thermostat

Efficient Ventilation

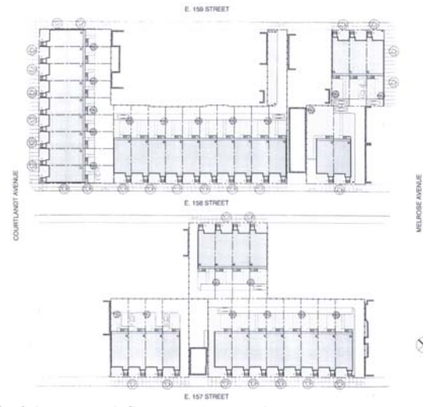
Sustainable Finish Materials

Low-E Windows

Fluorescent Lighting

Photovoltaic Panel

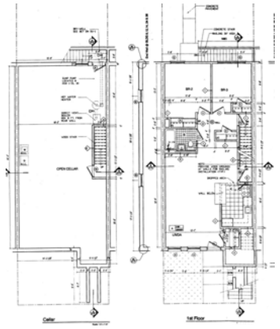
Overall Electricity Usage



Melrose Common II, a community of townhomes located in Bronx, New York, exemplifies how high-performance and affordability can successfully be combined to create a home that is not just affordable to purchase, but affordable to maintain as well. Typically, affordable housing in New York City is built to be affordable on a first-cost basis, making maintenance and energy costs a burden to homebuyers and not-for profit organizations that own or manage such buildings. Melrose Commons II breaks this mold, implementing various PATH technologies (such as precast wall panels) and design strategies that lower the life-cycle costs.

The 90 unit project was funded by the New York City Department of Housing Preservation and Development through the New York City Partnership. Developed by MC II Associates and built by Blue Sea Construction Corporation, these homes are the first affordable three-family housing in New York State that meet the US Environmental Protection Agency (EPA) and the New York State Energy Research and Development Authority (NYSERDA) ENERGY STAR Standards. The homes were designed for first-time homebuyers, promoting small business in the community. The basement, the first full floor, and half of the second floor, comprise the owner's two-bedroom residence (*1*). There is a half-floor one-bedroom apartment on the second floor and a full-floor two-bedroom apartment on the top floor (*2*). The top two units can be rented out to further subsidize the already affordable mortgage.

The completion of this project brought much needed affordable housing to a community in the midst of revitalization. The architecture is such that the homes blend well with the surrounding buildings. The homes feature a 3 story high precast concrete panels which form an elegant stone and brick façades. Crown lintels project over windows and doors and a detail cornice caps the perimeter. Totaling 132,000 square feet of dwelling space, the homes span four city blocks in the Melrose section of the Bronx. The builders and the owners benefited for advanced housing technologies that accent affordability, durability, and marketability.



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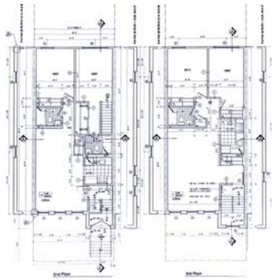

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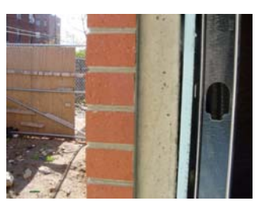

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Advanced Technologies

It is the goal of the US Department of Housing and Urban Development's Partnership for Advanced Technology in Housing (PATH) to accelerate the development and use of technologies that radically improve the quality, durability, energy efficiency, environmental performance, and affordability of America's housing market. These homes feature several of PATH's proven technologies, combined in such a way that implementation was affordable to the developer and beneficial to the homeowner. Highlighted below are the PATH technologies utilized in this project.

Precast Concrete Wall Panels - The Oldcastle precast concrete panelized wall system offered the builder a means to fast and efficient home construction in lieu of the typical block and plank method. 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 of the 22-foot-wide and 50-foot-deep homes were constructed from five major precast concrete elements: load-bearing panels used to support precast floor planks and roof; non-load bearing panels with decorative precast windows and exterior brick facade; U-shaped panels for entry facade; cornice capping the exterior perimeter; and exterior stairs. The project also used hollow-core panels for the floor and roof. The hollow core panels offered the same durability and strength of traditional precast panels but weigh significantly less. The exterior face of the exterior panels featured a thin brick inlay, a new feature of the Old Castle panels. The placement of bricks in the panel is feasible as a result of the self-compacting mixture created by the addition of superplactizers. The self-compacting mixture eliminates the need to vibrate the forms to achieve a uniform consistency.

The panels took approximately three months to manufacturer. After the site was prepared and the foundation laid, the panels were shipped to the Melrose Commons II site where they were quickly erected with a crane (*3*). The buildings were constructed with a six-man erection crew – one welder, one grouter, and four assemblers – between December 2001 and March 2002. After the panels were placed, the building crew air sealed around floor, electrical boxes, and inside to outside connections.

Steven Winter Associates, Inc. (SWA), an architecture and engineering firm, conducted THERM analysis on the insulation package, and found that a significant amount of thermal bridging would occur between the concrete exterior and the metal studs. To reduce this potential failure in R-value, SWA suggested using a 1/2-inch expanded polystyrene (XPS) board between the exterior walls and interior metal studs (*4*). The insulation was installed throughout the complex and provided a significant barrier to thermal bridging.

The use of panels were ***beneficial*** in respect to both construction and energy efficiency. Typical practices in this urban neighborhood call for concrete block and plank construction. The panels arrive on the site ready to be placed together, allowing for speedy construction throughout the cold and wet winter months. This in turn made financing the project easier by reducing carrying charges and the opportunity for theft and vandalism. Because the panels were fabricated off site to exact specifications, the amount of on-site waste is significantly reduced. Concrete as a material offers increased durability and fire resistance. The use of precast concrete panels increased the tightness of the building envelope. Each panel spanned the entire side of a unit, reducing the number of seams and therefore chance of infiltration.

Although the XPS was specified throughout the building, New York City ***code requirements*** did not allow it at the non-combustible exterior assembly on the rear (non-concrete) walls.

A 90% reduction in callbacks for heat, drafts, and leaks through some of the coldest and wettest years in recent history.

Recovery of the increased costs:

	Per 3 Family Home
Total Increased Costs	$5,877
NYSERDA Energy Star Incentive	$1,500
Deutsche Bank Grant	$ 333
Absorbed by Project Developer	$1,219
Addition to House Purchase Price	$2,825
Estimated Space and Water Heating Energy Cost for Code Compliant House	$4,364
Estimated Space and Water Heating Energy Cost with the Improvements	$3,376
Annual Energy Cost Savings	$ 988
Monthly Energy Cost Savings	$ 82
Simple Payback	5.7 Years

Comparing Melrose II costs to conventional NYC affordable housing:

	Total Therms/Year	**Total Cost Per Year**
Conventional NYC Affordable Housing = 2.32 Therms/SF Per Year	7,656 Therms/Year	$7,656
Melrose Commons II = .53 Therms/SF Per Year	1,749 Therms/Year	$1,749
Savings Melrose Commons II Offers		$5,907

Photovoltaic (or PV) systems convert light energy into electricity. The term "photo" is a stem from the Greek "phos," which means "light." "Volt" is named for Alessandro Volta (1745-1827), a pioneer in the study of electricity. Electricity is produced as a result of the absorption of photons, across a semiconductor material, usually silicon. Photovoltaic cells come in many sizes, but most are 10 cm square. PV cells are bundled together in modules or panels to produce higher voltages and increased power. PV modules generate direct current (DC), the kind of electricity produced by batteries. Although incandescent lights can operate on DC, most electric devices require 120-volt alternating current (AC) as supplied by utilities. A device known as an inverter converts DC to AC current. Inverters vary in size and in the quality of electricity they supply.

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Solar electricity is ***beneficial*** to both the environment and to the home owner. Unlike electricity produced by fossil fuels, the production of solar electricity does not produce any pollutants. The initial ***cost*** of a PV system can be prohibitive, however, in this case the cost was subsidized by NYSERDA. Beyond the first costs of equipment, there are no additional costs to produce solar electricity.

Electricity Usage

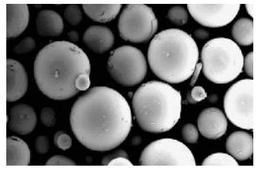
Over the past year, SWA has been tracking the electricity usage of the Melrose II. On average each unit uses 8.4 kWh every day. Compared to a 30 kWh national average for affordable housing, these homes are exceptional in their electricity savings. Going a step further, the PV panel in Melrose III generates on average 35% of the building owner's electrical needs.

"These homes are confirmation that there is a better alternative through advanced technology."

Cost

The following table represents the additional costs incurred to use the advanced technologies:

Technology/Materials	**Incremental Cost Per Home**
1/2" Rigid EPS at All Exterior Precast Concrete Walls	$675
Low-E Vinyl Windows with 7/8" Glazing	$896
Digital Programmable Thermostats	$184
Outdoor Boiler Reset Control with DHW Priority	$459
Energy Star Refrigerators	$45 (w/NYSERDA incentive)
Energy Star Dishwasher	$18 (w/NYSERDA incentive)
Energy Star fluorescent Fixtures	$375 (w/NYSERDA incentive)
Sealed Combustion 88% Efficient Direct Vent Boiler	$1,897
High Efficiency Indirect HW Coil and Storage Tank	$ 928
Recycled Content—Flooring, Vapor Barrier, Aggregate	$ 300
Benjamin Moore's Pristine EcoSpec Low VOC Paint	$ 100
Total Increased Costs Per 3 Family Home	**$5,877**



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Fly-Ash Concrete - Fly-ash concrete is used for the wall and floor panels of Melrose II. Fly ash is a common substitute for cement, an energy-intensive material typically used in concrete. Fly ash is a byproduct of coal burning and comes from the impurities in the coal that evaporate in the boiler and then condense into tiny glass spheres (*5, 6*). Fly ash is known as a "pozzolan" and reacts with hydrated lime, an unwanted byproduct of concrete, curing to produce additional cement-like gel.

There are two types of fly ash, Class C and Class F, which are delineated by their source. Class C is produced in the western US from lignite coal and contains little carbon, while Class F is produced primarily from anthracite and bituminous coal and contains significant amounts of carbon. The two classes can also differ in strength, rate of strength gain, color, and weatherability. Class F is more effective than Class C in reducing alkalinity through pozzolanic action. Class C fly ash results in a buff-colored concrete while Class F is a darker gray.

6

The spherical shape of fly ash offers ***benefits*** to the concrete mixture by filling water channels and reducing permeability, and by increasing workability as a result of its easy-flowing shape. The additional cement-like gel increases the strength of the concrete over a longer period of time. In addition to increasing material quality, the use fly ash also diverts material from the waste stream. Two-thirds of the 55 million tons of fly ash produced in the US in 1999 were sent to waste piles. The use of fly ash, however, does increase the curing time, which must be considered when establishing a construction schedule. In the case of Melrose II, the fly-ash concrete panels were manufactured in a plant ahead of time, eliminating the construction manager's concern for curing time. The use of fly ash should not increase the ***cost*** of the project.

"The use of fly ash, increases the curing time, which must be considered when establishing a construction schedule."

Dual Sealed-Combustion Boiler - Each three-family home comes equipped with a single sealed-combustion gas-burning Burnham Revolution boiler with a 65-gallon Bradford-White automatic-storage water heater (*7*). The single boiler system in each home provides both heating and hot water to all thee units. The boilers are ENERGY STAR certified and have an AFUE rating of 87.2 (this rating measures the amount of heat that is delivered to the home compared to the amount of fuel supplied to the system). The homes are heated through a hydronic system, circulating hot water to radiators in the units. Oversized heating units are common in multifamily housing. Properly accounting for the building's insulation, reduced air infiltration, and heating load allowed the boiler in the Melrose II units to be properly sized.

7

The ***benefits*** of this system are three-fold. First, the boiler has an AFUE rating of 87.2, which means that 87.2% of the fuel is converted into heat while the other 12.8% is lost. Compared to an atmospheric heating system, which exhausts hot air even when the boiler is not firing, this system vents only gases and air when water is actually being heated. Second, the sealed combustion provides added safety to the system by eliminating the risk of combustion back draft. As fuel is burned, combustion gases such as carbon monoxide and nitrogen oxides are produced. If not properly vented, occupants may be exposed to these gases, possibly leading to health problems. Sealed-combustion equipment draws its combustion air from outside the home and exhausts combustion gases directly outdoors. The air intakes and exhaust are sealed off from the inside of the home, greatly reducing the chance of the leakage of combustion products into the living space. Third, the use of one system for both heat and hot water is cheaper and simpler to maintain than two systems each with separate combustion mechanisms. This third point can also be seen as a drawback: if the system does malfunction, both heat and hot water are affected.

Tekmar Outdoor Reset Control for Boiler - Outside of each home is a Tekmar reset control used to modulate the water temperature in radiators based on the outdoor ambient temperature. To avoid boiler short cycling and large temperature swings, the boiler supply and the mixed supply water temperatures can be adjusted based on outdoor temperature.

The ***benefit*** of these controls is the reduced chance of overheating, which is common in buildings that have a central heating system, and improve occupant comfort. As a result, the amount of energy required to heat a home and hot water may be reduced.

8

Programmable Thermostats - Each unit in Melrose II is equipped with a programmable thermostat (*8*). Programmable thermostats offer tenants the opportunity to set temperatures according to when the house is occupied. These thermostats can automatically store and repeat settings daily with allowance for manual override. By eliminating manual setback, which is easy to forget, they allow the setting of more comfortable temperatures in the morning before occupants wake. Temperature setback can be adjusted for both heating and cooling seasons.

"Programmable thermostats offer tenants the opportunity to set temperatures according to when the house is occupied."

Programmable thermostats typically offer a number of programming options:

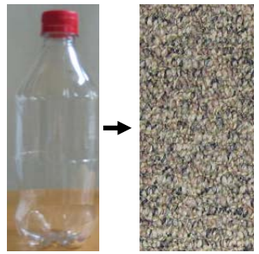
- Daily programming that allows one schedule to be used each day.
- Weekday/Weekend (5/2) programming that allows adjustment of timing for setbacks with different settings for weekdays and weekends, and with 5/1/1 programming that permits separate schedules for Saturday and Sunday.
- Full seven-day programming that permits a different setback schedule for each day of the week.

Occupants will realize the ***benefits*** of this technology in their heating bills. Residences that do not use a programmable thermostat have a higher chance of heating a space when not occupied, increasing heating costs.

Ventilation Fan Timer - Both the bathroom and kitchen are equipped with Panasonic high-efficiency fans. The bathroom fan in the owner's unit runs 24 hours a day while the bathroom fans in the other two units must be turned on manually, similar to the fan in the kitchen. The fans provide air circulation throughout the unit by pulling air in through small cracks and under doors. The ***benefit*** of a well ventilated space is the reduced chance of mold growth and unwanted odors.

Sustainable Finish Materials - Choosing sustainable finish materials are not only ***beneficial*** to the environment but to the home occupant as well. Many materials contain chemicals that release toxins into the surrounding air in an action referred to as "off-gassing." Off-gassing of particular chemicals has been shown to cause headaches, nausea, and in some cases asthma. Environmentally sustainable materials may be sold at a higher *cost* than traditional materials, however, they are quickly penetrating the market, causing the price to drop. Environmentally sound products were chosen for the construction and the finishing of all the Melrose II units including:

Recycled polyethlene terephthalate carpeting: Recycled carpet can be made from recycled polyethelene terephthalate (PET) or from recovered textile fibers. PET plastic is typically found in plastic soda bottles (*9*). About 40 two-liter soda bottles are recycled per square yard of carpeting. Recycled content carpet fiber is said to be more resilient and colorfast than virgin fiber carpet. Recycled carpet usually comes with the same warranties for colorfastness, static control, and resistance to stain, crushing, and matting as virgin synthetic fiber carpets.



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Low Volatile Organic Compound (VOC) paint: In response to the concerns about adverse health effects due to VOCs, manufacturers now produce low- and no-VOC paints an sealants, mainly by developing high quality latex-based coatings for a wide variety of uses (*10*). The ***benefits*** of latex paint comes from the use of water as the solvent and carrier, allowing both easier cleanup, faster drying time, and generally lower toxicity. Today, latex paints may be equal or better in quality and durability than conventional oil-based formulas. Waterborne stains and clear finishes for floors and cabinets are also commonly available.

It should be noted that not every latex-based coating is low in VOCs, and that low-VOC paints may not meet all ***performance requirements***. Products may be described as "low VOC" when they off-gas significantly less than products made with conventional carriers. Some oil-based paints qualify as low-VOC because of how their formulas have been modified. Technical data sheets that state VOC levels in a particular paint can be obtained from distributors or online. Levels are expressed in pounds per gallon (lbs/gal) or grams per liter (g/l).

Countertop construction with low-VOC adhesives and finishes: With such a large volume used, adhesives have generally been a large source of short-term VOC emissions. Volatile solvents are used to emulsify (or liquefy) the resin that acts as the bonding agent. To reduce VOC concentration, heat or other processes are used to emulsify the resin. As a general rule, water-based adhesives emit far less VOCs than their conventional solvent based counterparts.

"The most effective position for the low-e layer is based on the window's orientation and the climate in which it is installed."

Low - Emmisivity Windows - Emissivity is a measure of how much a glass surface transfers radiant heat. Low-e windows have a coating that consist of microscopically thin metal or metal-oxide layers deposited on the glazing surfaces that diffuse radiated heat by reflecting it, rather than allowing it into the air layer. Low-e coatings are strategically placed between double panes. The most effective position for the low-e layer is based on the window's orientation and the climate in which it is installed. For example in northerly climates, where heating costs are high and little or no air conditioning is required, the coating is placed on the interior glass surface. This allows solar radiation to pass through the exterior pane, contributing to heat gain during the winter, but interior heat is reflected back towards the living area. Where cooling costs are the dominant factor, the low-e surface is placed on the exterior pane to reflect solar radiation away from the window. Many variations exist for particular applications, including low-e coating on a plastic film suspended between the panes.

Low-e windows bring ***benefits*** to the occupant by contributing to a more consistent indoor temperature and by reducing heating and cooling costs. Selective low-e coatings may add $2 per square foot or more to the ***cost*** of glazing materials. The Model Energy Code and some local building *codes* require energy rated window assemblies for new construction.

10

Compact Fluorescent Lighting (CFL) - All of the homes are equipped with 100% fluorescent lighting. CFLs can be placed in various types of lighting fixtures including table lamps, ceiling lights, spot lights, and other applications. CFLs offer electricity and cost saving ***benefits***. CFLs use one-quarter to one-third as much electricity as incandescent bulbs and last up to ten times as long. Although the initial ***cost*** of the bulb is slightly higher than a standard incandescent bulb, the electricity savings and the longevity of the bulbs life will more than pay it back over the course of the CFL's lifetime.

Photovoltaic Panel - Building on the success of Melrose II, the construction of Melrose III has recently been completed. Melrose III has an identical layout and specifications as Melrose II, and features a 2.2-kW photovoltaic (PV) panel (*11*). The PV system, which sits on the roof of one of the units, was installed as part of the New York State Energy Research and Development Authority's (NYSERDA) ENERGY STAR/PV Demonstration project. The system provides electricity to the owners unit.