



U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

SIP structural insulated panel Homes

Energy Efficient Affordable Homes in South Chicago

TECHNOLOGY HIGHLIGHTS:

Structural Insulated Panel (SIP)

Photovoltaic (PV)

Open Web Floor Trusses

Mastic Sealed Ducts

Recycled Flooring

Low-Flow Plumbing Fixtures

Recycled-Plastic Carpet

Recycled Wall Board

Low E Windows



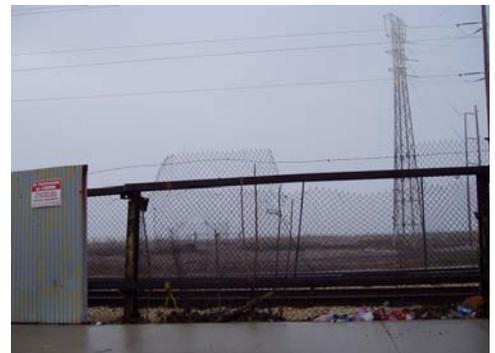
By improving energy efficiency, homes can be made significantly more affordable. This is the goal of Claretian Associates, a nonprofit developer building high energy efficient homes on the south side of Chicago in a neighborhood known as South Chicago. Just steps away from Claretian's development is the U.S. Steel Southworks 570-acre plant that employed over 20,000 workers. The plant closed in 1992 after 112 years of operation leaving behind empty neighborhoods and industrial wreckage.

For the past three years, Claretian Associates has been working with South Chicago Workforce, a non-profit developer, and Sam Marts Architects on the "New Homes for South Chicago" program. The development consists of 25 single-family and two-flat homes. The cost of the homes is affordable by Chicago standards.

The prices vary depending on the buyer's income and family size. Single-family homes are 1,700 square feet and are built with full basements. The two-flats contain 3,312 square feet: the owners unit has 2,208 square feet and the rental unit has 1,104 square feet.

Costs

The homes cost between \$155,000 and \$220,000 and sell for between \$165,000 and \$230,000 with



“Homebuyers are intensely interested in the energy saving that will result from SIPs”

-David Sullivan, South Chicago Workforce



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“We concentrate on minimizing space-heating loads through insulation and air sealing measures.”

a package of city-funded subsidies. The homes are more than 50% more energy efficient than typical homes and use environmentally friendly materials for construction.

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 is affordable to the developer and beneficial to the homeowner. Highlighted below are the PATH technologies utilized in this project.

Structural Insulated Panels (SIPs)

Superior energy performance is achieved through integrated design and careful choice of building materials. The homes are constructed with structural insulated panels (SIPs). The structural insulated panels consist of a continuous core of rigid expanded foam insulation that is pressure laminated between two layers of 7/16-inch oriented strand board (OSB) to form a solid, structural panel. The air leakage and thermal bridging through the walls are reduced due to the long spans of seamless rigid foam insulation in each panel. The panels can be pre-cut to specified sizes and are assembled on the job site by fitting dimensional lumber splines into pre-routed grooves and nailing the panels together or to other building members. By caulking the seams between SIPs and the rough openings around windows, doors, and other penetrations through the building, the building envelope is sealed to provide superior resistance to air leakage.

There are a variety of SIP panels on the market that offer different materials and services such as cement or metal siding rather than OSB. W.H. Porter manufactured the SIPs in this project. They were shipped from Holland, Michigan about 70 miles away.

SIP Installation (I)

The Claretian homes have a cast-in-place foundation. The footing and foundation is poured before the SIPs are delivered. The treated bottom plate is installed on top of the foundation wall. The SIPs sit on top of the top plate and are secured with nails. The dimensional lumber spline attaches the panels on the vertical side. When framing with panels it is important to make sure that the panels are not inverted or inside out and both inside and outside skins must be fully supported by the floor or foundation.

The SIPs for the Claretian project were delivered in two packages, the walls as one shipment and a few days later the roof panels are delivered. Note that panels should be blocked up and covered for storage onsite to avoid warping. With a little more coordination, all the SIPs can be delivered as one shipment. Simultaneously receiving deliveries from lumber suppliers and truss manufacturers enables the erection of the shell of the house as quick as possible to be out of the weather and to have a secure job site. Walls should be allowed to dry before the installation of siding materials so that water is not trapped behind them.

SIP Benefits

One of the main benefits of SIPs is their superior thermal performance. The Claretian homes will use 6 ½-inch SIPs for the walls and 10 ¼-inch SIPs for the roof. The corresponding R-values are 24.7 for the walls and 42.5 for the roof. Tests have shown that SIP walls perform at approximately 97% of their rated R-value with only 3% of thermal performance lost to thermal bridging at nail holes, splines, and seams. For comparison, a typical framed 2x4 wall rated at R-11 will actually provide a whole-wall R-value of only R-9.6, due to heat loss through thermal bridging at the studs.

“SIPs are light but bulky so transportation is a cost factor.”

*- David Sullivan,
Executive Director, South
Chicago Work Force*



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“This project shows that houses with photovoltaics can look just as good as comparable nonsolar homes when they are well designed and well constructed.”

The use of SIPs minimizes the amount of wood used to construct each home and can significantly reduce the generation of construction waste. To further reduce construction waste, the house plans attempt to conform as closely as possible to the size of standard building materials (4 x 8) panels, for example, which will also reduce labor costs by minimizing on-site modifications of building materials.

Builder’s Experience Using SIPs

- The Claretian Associates development was the first project in Chicago to use SIPs. Chicago has its own unique building code and getting SIPs approved was a huge hurdle.
- The use of SIPs can affect the scheduling of construction. The builder is dependent on the manufacturer’s schedule. With at least 2-3 weeks lead time the manufacturer was able to deliver a custom set of panels each time.
- No erection of panels took place while it was raining because there was a risk of sealing moisture into the panels.
- The manufacturer, W.H. Porter, offers technical support on the job site. This is helpful at the beginning to ensure the panels are getting installed correctly.
- The interface between the panel system and other sub-systems in the house worked beautifully.

Cost of SIPs

The SIP package is more expensive than a conventional framed lumber package. On the affordable housing project, cost was important. Although the materials were more expensive there was a labor savings involved in erecting the SIPs.

Photovoltaic (PV)

Twelve of the twenty-five homes in the development have a 1.2 kilowatt DC (2) solar photovoltaic (PV) system that produces 1 kilowatt of AC. This is at no additional cost to the homeowner. The state of Illinois covers roughly half the cost of PV on most residential projects. Chicago’s Department of Environment covered much of the remaining cost of the PV system on this project. DOE’s Zero Energy Homes program is also providing funding to monitor the first urban affordable housing studied under the program. It is estimated that the panels will produce 1,100 kWh per year.

PV Cost

Each system is worth \$14,000 and generates an average of 3 kWh per day, potentially saving a few hundred dollars a year in electric bills. This significantly reduce each household’s electricity bills, making the homes even more affordable.

Ventilation

An AirCycler provides ventilation and evens out temperature and humidity between rooms when the thermostat is not calling for heating or cooling. Additional ventilation is provided by a whole-house fan, reducing the need for air condition in the summer.

Mastic Sealed Ducts

The air-handling ducts are sealed with mastic (a non-toxic paste). Mastic sealed ducts reduce heating costs by approximately 20% and help prevent dust, soil and other pollutants from entering the system.

Open Web Floor Truss (4)

The open webs eliminate the need to cut through the joists to install the ducts (4a) (which can compromise the structure) and help trades to coordinate their work. They also simplify the compact duct layout and enable the ducts to remain in conditioned space, which drastically reduces the distribution losses.



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Low-E 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.

Energy-efficient appliances are installed in the homes, including an Energy Star refrigerator and the option of Energy Star washer, dryer, and dishwasher.

Low-Flow Plumbing Fixtures

Pressure-assisted *Flushmate* toilets by *Sloan Valve Co.* significantly reduce water consumption over the life of the house compared to standard 1.6 gallons per flush toilets.

Flooring

Bathroom tiles are made from recycled glass. This tile is manufactured from over 55% recycled glass and selected ceramic materials and features through body color and an excellent wear rating. It is offered in 16 colors, which vary in price.

The kitchen has cork tile flooring (5). Cork is a natural product and a renewable resource that is harvested from the bark of the Cork Oak tree. It creates a cushiony floor that is comfortable to stand on and more forgiving than a ceramic or wood floor when dishes are dropped on it.

The Mamoleum flooring is an excellent quality substitute for vinyl composition tile, offered both in sheet form and as cut tiles in a wide range of colors. It is manufactured primarily from natural materials, including linseed oil, wood flour, rosin binders and dry pigments.

Shelving

A 5/8-inch thick engineered strawboard is used for shelving. Manufactured by *Isobord* it is made using chopped straw and an isocyanate (MDI) binder that results in no formaldehyde offgassing. It contains no wood species and does not emit any Volatile Organic Compounds (VOC).

Porch Decking and Framing

The porch decking is *Trex*, a wood-polymer lumber product manufactured from reclaimed/recycled grocery bags and stretch film(40%-50%) and furniture factory and/or waste pallet



4a



5



sawdust (50%-60%). It will not crack, splinter, check, shrink or rot.

The porch framing and foundation sill plates are *Natural Select* treated wood lumber. The preservative used in this product is copper azole, providing long-term protection from rot, decay, and termite attack. It contains none of the EPA listed hazardous compounds and scraps can be disposed of safely in landfills. The copper in the preservative is derived from recycled products and the treating process is a closed system that releases no air pollutants or wastewater.

Recycled-Plastic Carpeting

This 30 oz. polyester carpet is manufactured from recycled plastic food and beverage containers (primarily soda and ketchup bottles) and is naturally stain resistant. Plastic beverage bottles are made with top quality PET (polyethylene terephthalate) resins as required by the US Food & Drug Administration. This recycled product is superior to lower grades of synthetic fibers used in making other brands of carpet yarns. PET bottles are sorted, ground into fine chips, and then cleaned. These chips are then melted and extruded into fiber and spun into carpet yarn.

The carpet padding is a synthetic felt carpet pad that contains no Butylated Hydroxytoluene (BHT's), is non-allergenic, will not support bacterial growth, and has superior insulating and sound absorption qualities.

Recycled Wallboard

The exterior and interior Gypsum Board contains between 95% and 99% recycled content, depending on the type of board. It is made from synthetic gypsum created from the byproducts of pollution control systems at a Tennessee Valley Authority electrical generation plant. The sulfur emissions captured in this process are the precursor to acid rain. They, and other emissions, while prevented from entering the atmosphere by the pollution control systems, would end up in landfill if not captured for the production of synthetic gypsum.

Total Costs

The cost of using energy-efficient building materials and appliances add only 4-5% to the cost of each home. This was covered by various subsidies. In return, homeowners will benefit from a more comfortable and healthier indoor environment, as well as energy bills that are 50% lower than the average homeowner's.

Conclusion

This innovative project will serve as a model for developing high-quality, affordable, and energy-efficient housing. The superior energy performance of these homes will reduce the burden of monthly energy costs which is crucial to making a home truly affordable.

The city has invested on improvements of a near-by commuter train station, upgrading local public schools, and helping to finance retail construction. The future for South Chicago is looking bright.



Product Link and Additional Information:**Carpet padding:** *Right Step by Mohawk*, www.mohawkarpet.com**Ceramic Tile:** *Terra Traffic by Terra Green Ceramics*, www.terragreenceramics.com**Cork Floors:** *Expanko*, www.expanko.com**Countertop substrate:** *Medex MDF by Sierra Pine*, www.sierrapine.com**Gypsum Board:** *Certified Gypsum Wallboard by Temple-Inland Company*, www.temple.com**Low VOC primer and paints for all interior painting:** *Pristine EcoSpec Interior Latex Primer Sealer*, www.benjaminmoore.com**Marmoleum Flooring:** *Marmoleum Dual by Forbo Industries*, www.themarmoleumstore.com**Porch decking:** *Trex*, www.trex.com**Porch framing and foundation sill plates:** *Natural Select*, www.naturalselect.com**Recycled Content Carpet:** *Aladdin 4601 Commitment by Mohawk*, www.mohawkarpet.com**Shelving:** *ShelfBord by Isobord***Toilets:** *Flushmate by Sloan Valve Co.*, www.sloanvalve.com**Window Sills:** *Medex MDF by Sierra Pine*, www.sierrapine.com**Architect,** Sam Marts Architects and Planners LTD, PH. 773.862.0123**Builder,** *South Chicago Workforce*; David Sullivan Executive Director, PH. 773.933.0842**Developer,** *Claretian Associates*, www.claretianassociates.org

For information contact:
Steven Winter
Associates, Inc.
5 Washington St.
Norwalk, CT 06854
203-857-0200
Attn: Mike Crosbie
Mcrosbie@swinter.com