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STACKING UP

Housing concepts

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From Habitat to Inhabit

A Seattle developer crafts a multifamily modular system of workforce housing for urban infill sites.

More than forty years ago, architect Moshe Safdie designed and built a ten-story pyramid of cantilevered concrete-box modular units for Expo 1967 in Montreal. The flat roof of one was the large deck of the one above it, and it became the iconic image of mass-produced modular multifamily housing. Now, Seattle-based Unico Properties has built a demonstration model of two units of wood-frame multifamily housing modules, branded Inhabit, which it plans to develop at densities of about 150 units per acre (370 per ha) in projects of about 75 units each on multiple urban infill sites in Seattle; Portland, Oregon; and other markets.

Unico has crafted its approach to be able to develop a strategy large enough to benefit from large-scale production, yet compatible with smaller sites. Targeting urban infill development that attracts young professional echo boomers, Unico is stressing the kind of clean, modern, urbane, stylish, and environmentally friendly designs that have attracted this demographic group to the hip housing magazine *Dwell*.

Important objectives of the design were to make the units both scalable and flexible so they could be assembled in multiple ways at various scales. Though it may seem counterintuitive, the key to accomplishing both objectives was to make the modules a standard size. Seattle architecture firms HyBrid and Mithun jointly designed a module 15 feet (4.6 m) wide by 45 feet (14 m) long. The 675-square-foot (63-sq-m) module can house a single unit or be joined with others to create larger ones. They can be placed either side by side or end to end. The 3-to-1 proportion permits three units on one side of a double-loaded corridor to equal a single one perpendicular to it, meaning that the units can fit on sites as narrow as 35 feet (11 m) or as wide as 95 feet (29 m) and still achieve double-loaded efficiency. The insertion of open courtyards can vary the design.

Another configuration with the same-sized modules places them in single- or double-loaded configuration, end-to-end, in the shape of a capital E with courtyards between the wings. Glass walls along the long sides maximize the light and air coming into units. Similar to the Moho modules built in Manchester, England, such configurations still can achieve high density without losing cost-effectiveness because their modular construction produces full exterior walls on all four sides. (See "Modules Modernize Manchester," February 2007, page 114.) Exterior staircases can be used to vary the outside appearance, expand the units, and eliminate the need to heat and cool interior hallways.

The 45-foot- (14-m-) long dimension neatly divides the structural system into three 15-foot (4.6-m) bays. That means that the living area in a single module can be as small as 450 square feet (42 sq m), yet can also be enlarged with its own spacious 15-by-15-foot, 225-square-foot (21-sq-m) covered outdoor living room deck. In a temperate climate with winter rains, like that found in Seattle and Portland, that outdoor living space is far more commodious and usable than the typical Juliet balcony normally associated with housing targeting the same market. One of the model units constructed for Unico is just this type of unit, with a full 15-foot-long wall of full-height sliding glass doors leading to the deck from the living room/dining area. The effect is to give the unit a lightness and openness on three sides, expanding the visual and livable space beyond its small size. Unico also designed a smaller 15-by-30-foot (4.6-by-9.1-m) module studio unit that can be integrated within the 15-by-15-foot planning grid.

Unico Properties has built a demonstration model of two units of wood-frame multifamily housing modules, branded Inhabit, which it plans to develop at densities of about 150 units to the acre (370 per ha) in projects of about 75 units each on multiple urban infill sites in Seattle and Portland, Oregon.

Other floor plan layouts can make the units as large as a 1,200-square-foot (110-sq-m), three-bedroom unit with a covered terrace. Intermediate units are a 525-square-foot (50-sq-m), one-bedroom unit with a 12-by-15-foot (3.7-by-4.6-m) terrace; the standard 675-square-foot (63-sq-m), one-bedroom unit; and a 900-square-foot (85-sq-m), two-bedroom unit with the bedrooms in a 15-by-30-foot (4.6-by-9.1-m) module.

The wooden modules can be stacked as high as five stories over parking, and their solid construction allows them to span parking bays. Key to their efficiency is that the bathroom and kitchens in each type stack immediately over units below, eliminating extra and special plumbing runs. In-wall heating, venting, and air-conditioning heat pumps eliminate heating ducts.

Impressive densities can be obtained even stacking the units only four stories high over a podium above a parking level. On a 24,000-square-foot (2,230-sq-m) Seattle site 200 feet (61 m) long and 120 feet (37 m) wide, HyBrid and Mithun were able to design 18 units per floor with all units placed in a single-loaded configuration around a 48-by-95-foot (15-by-29-m) open courtyard surrounded by covered, open walkways. Still, the plan achieves a density above 130 units per acre (321 per ha). The unit mix can vary to incorporate studios and one-, two-, and three-bedroom units. If a fifth floor were added, densities would top 163 units per acre (403 per ha), yet still be in a low-rise, infill location.

Not only is this system flexible in that it can be configured to fit different sites to yield units of varying sizes, it is also scalable. Multiple small infill sites can be acquired, each needing to contain relatively few units. However, factory construction capitalizing on the economies of large scale can still be realized, lowering overall capital costs. For example, four disparate sites smaller than a half acre (0.2 ha) each could house more than 300 units.

One of the most unusual characteristics of the Inhabit project is the methodical way in which Unico organized the research and development process. It structured an internal design competition between Mithun and HyBrid, along with Bellevue-based contractor RAFN, to provide cost estimates for alternative building systems. Before choosing the wood-frame modules, Unico studied the possible use of steel-frame shipping containers for its modular housing; Hybrid has done extensive work with the containers, which it calls "cargotecture." The enormous U.S. trade deficit has left a surplus of used containers at ports like Seattle because it is usually cheaper to build new ones in China than return used ones by ship for reuse.

Because the containers can be stacked higher than wooden modules, they may be more suited to taller structures. "Cargotecture is a good fit for buildings whose proportions are taller than they are wide, for skinny lots, and for movable buildings," says HyBrid architect Joel Egan. "They are extremely durable as movable buildings. They are an overt symbol of sustainability. As a subset of the steel-shell module, they are also good for buildings six to nine stories tall. The taller they are, the better they pencil out against wood." In addition, reuse of the containers allows exploitation of the embodied energy, materials, and labor required to build them—an approach that is greener than recycling.

Among other factors, the recent completion of a 125,000-square-foot (11,600-sq-m) Transform LLC factory in Burlington, Washington, less than an hour from Seattle, was important to Unico's decision to use the wooden modules. Transform uses state-of-the-art German equipment to rationalize and accelerate the building process.

Computers in the equipment can read the three-dimensional computer-assisted design (CAD) files and translate them into the computer-assisted manufacturing (CAM) for the optimizing saw, and other robotic equipment, guiding the machinery to precisely cut and assemble components to reduce waste. A framing station uses automated nail guns, nail plate presses, and multistage drills and routers to assemble walls in full lengths, horizontally. Floors and ceilings are assembled on rolling platforms at separate stations. Licensed professionals install plumbing and wiring in easily accessible open sections. Insulation is easily applied. Walls are run through a multifunction bridge that nails, screws, glues, and staples sheathing to them.

Because most work is done while module components are lying flat, men and machines use the force of gravity to improve quality with easy access without ladders. Sliding ceiling cranes then lift walls onto the floor platforms. Sheetrock compound and tape are applied in a closed environment that captures dust from sanding and fumes from painting. Flooring, windows, cabinets, fixtures, and appliances are installed in nearly finished modules that are shrink-wrapped for transport to the site.

Unico chief executive Dale Sperling says permits for the units can be obtained in only six days from the state's Bureau of Labor and Industries, compared with about 150 days for traditional housing from the city of Seattle. According to Transform chairman and chief executive William Maris, the company can build several units in a day. Shipment can occur on a just-in-time basis whenever the site is ready to receive units, thereby reducing theft, vandalism, and weather damage.

Somewhat surprisingly, cost estimates for wooden modules, containers, and stick-built construction are relatively close. However, because the Inhabit project has not yet gone into the production phase beyond the demonstration model units, economies of scale have not been tested. But it is erroneous to think that cost savings will come primarily from actual construction: Unico conservatively projects overall cost savings of 5 to 12 percent for the first project—a figure that should improve over time, says project manager Robert Miranda.

Those savings will come from a combination of soft, hard, and financing costs. Because an entire system has been designed, soft costs for planning, design, and engineering can be reduced. The speed of construction can reduce development time by at least six to eight months, which reduces construction financing carrying costs. Because on-site construction time can be significantly shortened, each project can be completed earlier and phasing need not delay occupancy, which accelerates operating income.

Developing modular systems can also change financing. Unlike typical on-site building, construction lenders cannot place liens on completed portions at the site. However, Unico seeks institutional lenders for complete debt and equity financing that can effectively eliminate the distinction between construction and permanent lending. Because of the short construction time—days or weeks rather than months—Sperling says he expects housing manufacturers to float working capital costs, much as other industries do.

Because Unico is primarily a commercial developer and owner that builds to hold projects long term, it is much more comfortable developing a long-term rental rather than a for-sale project, Sperling says. Construction costs are rising faster than rents, he notes, which are set by the market and not by the developer, so the nub of the problem faced by the company was to drive those costs down while holding rents constant. Unico tar-

gets creative-class workforce renters making 80 to 150 percent of median income. "If we could build to a positive spread over the cost of debt, then Unico can hold these assets long term instead of selling to take advantage of near-term cap rate compression," he says.

So Unico is targeting the tech-savvy echo-boomer generation that makes up much of the Seattle and Portland workforce, which Sperling says wants to live an urban, modern, and green lifestyle. The units are constructed with engineered wood floors, energy-efficient fiberglass-framed windows and heat pumps, dual-flush toilets, recycled rubber flooring, and decking made of recycled plastic and cellulose. Kitchens have efficient tall refrigerators only 24 inches (61 cm) wide, and bathrooms have single-unit ventless combination front-loading washer/dryers. Flat roofs will hold a green roof system to further reduce stormwater runoff, and there is minimal on-site waste, noise, or pollution because the units are built in a factory. Sperling says Unico will seek certification of its Inhabit developments under the Leadership in Energy and Environmental Design (LEED) building rating program.

Sperling notes that the iPod typifies those early adopters he seeks. Inside the modules an integrated computer system controls the lights, heating, and cooling, and audio and video systems. But in a larger sense, the Inhabit modular system units might be called iMods because they are urban, modern, and green—and if Sperling has his way, affordable. UL

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