

PLASTICS IN CONSTRUCTION: FINDING NEW NICHES

by Marylee MacDonald

Innovative construction plastics will compete with wood, masonry, and metal in years to come.

Plastics are on the rise in construction. In 1982, builders used 29 pounds of plastic for every \$1,000 of new construction, but by 1989 this figure had nearly doubled to 43 pounds. Total use of plastics in construction is now rising about 5% to 6% per year, according to Dow Chemical's Building and Construction Division.

Researchers at the big plastics companies are working hard on new plastic structural products, such as roof and wall systems that will take the place of three-tab shingles, stud framing, and wood siding. And a host of small inventors are experimenting with plastics and finding market niches for products ranging from plastic batt insulation to foam blocks.

In many cases, new plastic products will require less skilled labor, and skilled trades will be displaced. Plastic plumbing, for example, has not been widely welcomed by the plumbing trades. In other cases, such as bendable window trim or improved insulations, the plastic solution will be readily accepted.

A hotly debated issue concerning all plastics is the environmental impact. Many wonder if it is wise to promote a product made of a non-renewable resource—oil. Yet others see construction products as a perfect use of recycled plastics. Seven percent of landfill wastes come from plastics, says Steve Loken, a Montana builder who is building an experimental home from recycled products. "If that waste could be used for building products," says Loken, "building could form a permanent and environmentally sound repository for long-term storage of trash."

Below is a look at some of the newer and more innovative uses of plastics in the construction marketplace. While we won't see an all-plastic house any time soon, and many hope we never will, a number of uses seem to make good sense.

Structural Plastics

Plastics may one day become an integral part of the building's structure, and new products show a range of applica-

tions. Here's a look at some of them.

Lightweight block. How would you like to lay a 13-ounce block instead of hefting the standard 28- to 40-pound block—and have an energy efficient structure to boot? Phoenix builder Carl Hendrickson has patented a unique "Ener-G" block made from closed cell polyurethane foam. The lightweight 13-ounce blocks stack and interlock, creating the formwork for a concrete post-and-beam matrix. Stucco covers the exterior.

Hendrickson says the construction method costs no more than standard construction, "and the utility savings per month are dramatic—\$30 to \$50." Using the insulating block allows him to downsize the mechanical system, and the home is so tight he uses an air-to-air heat exchanger routinely. Hendrickson uses the block on his own "Creston" custom homes, and he expects to concentrate on the Arizona market before taking the product nationwide.

Soft studs. We're not sure if plastic studs will hold up the roof, but they

come in handy if you're framing a curved, interior wall (see Figure 1). General contractor Billy Pappas invented "Billee-Board" (see *JLC* "For What It's Worth," 5/89) studs several years ago, making the polyurethane lumber in his garage for friends. Pappas sold off the patent rights to I.M.G. (which stands for "Imaginative Materials Group"), and they have turned the material over to the company's president, Curt Caldwell, a former custom builder, to see what kinds of applications he could devise.

Caldwell says, "The products we're developing are things I'd like to have had as a builder." He's made improvements in Billee-Board, such as putting tracks in the board for wiring, and he has developed other products such as a bendable formwork, called "Bender-Bord." You can use it to form curving walkways or driveways.

Recycled fencing. A lumber look-alike made from recycled plastics is sturdy enough for decks and fences. According to general manager Mike Dahl, of Eaglebrook Products, Inc., "The company specializes in 'post consumer' scrap." (Otherwise known as garbage.)

Eaglebrook converts plastic milk jugs and laundry detergent containers to "Durawood." Durawood is slightly more flexible than 2x4s, so you have to put it on joists 12 to 16 inches on-center. Right now the product costs two to three times as much as wood, but it will last indefinitely and never needs repainting.

Contractor Steve Kaster, from the SK Fence Company, Champaign, Ill., likes the stuff. "Frankly, I'm tired of treated lumber splitting, warping, and checking." The fences he's built from Durawood look very much like painted wood from a few feet away.

Beefy beams. One of the problems with using plastics for structural applications has been flexibility. Plastics that are "extruded" (pushed through a mold) can sag at higher temperatures. However, a newly developed fabrication process call "pultrusion" can create plastics



Figure 1. Plastic studs may come in handy if you're framing a curved interior wall or stairway. The "Billee-Board" studs are made of flexible polyurethane lumber.

nearly as strong as steel. In pultrusion, fiberglass strands are pulled through a thermoset resin bath. Companies, such as Composite Technologies, which make pultruded structural plastics, generally make all the components for a complete building kit, including roof panels, beams, and girders (see Figure 2). So far, pultruded plastics are expensive, and they are only used for special construction needs, such as for magnetic resonance imaging rooms in hospitals or for corrosive environments, like pulp mills. If the price comes down, you may see more of them used on commercial and residential jobs.



Figure 2. Pultruded plastics are strong but costly. They are used primarily for special construction needs such as these all-plastic outbuildings used in pulp mills and other corrosive environments.



Figure 3. New "Puffiber" is a cavity-wall insulation that looks like fiberglass, but is made from recycled plastics. Inventor Mark Meade touts its non-toxic status by posing with a mouthful.



Figure 4. Inventor Allen Jones has developed a strong, impact-resistant material, called "Flextrim," that bends without soaking or kerfing. The product sells for 40% to 50% less than comparable millwork.

Plastic rebar. Metal rebar can interfere with computer chip manufacturing or hospital diagnostic equipment, so some buildings must use plastic rebar instead. The rebar is made of pultruded fiberglass by Vega Technologies and Composite Technologies.

Insulation

Rigid plastic foam insulation has become commonplace, but now there are new fiber insulating products.

Recycled fibers. Inventor Mark Meade, Embrace Systems Corp., has invented a new insulation made from 100% recycled plastics (see Figure 3).

He describes "Puffiber" as a cavity wall insulation that looks like fiberglass, but uses plastic that would otherwise end up in the landfill.

"You can eat our product if you want. You can sleep on it; it doesn't itch." The R-value is 3 per inch.

A second product, "Clump Foam," is made from particles of polystyrene that you pour and rake into place. With an R-value of 4.5 per inch, it is meant to compete with cellulose.

A third product, "Puff Foam," is a combination of the above—a puff fiber with chips of polystyrene, with a reported R-value of 4.5. Meade says, "Using Puff Foam would allow a builder to get the same R-value from a 2x4 wall as from a typical 2x6 wall."

With five plants scheduled to open in 1990, and 11 total soon thereafter, the new foam should show up in your local lumberyard within the year. Prices for Puffiber will be comparable to fiberglass; Clump Foam will come in even with cellulose; and the Clump Foam Board will cost about 10% to 15% more than comparable rigid exterior insulation.

Plumbing

Because plastics can be molded, they're perfect for ergonomically designed spas and tubs. More and more manufacturers, especially those with European styling, such as Hansgrohe, are making faucets and fixtures from colored plastics.

Lightweight tubs. Plastic tubs eliminate having to lug a cast-iron behemoth up to the master suite. Several manufacturers, such as Eljer, make their bathtub and shower enclosures from acrylic; but Aqua Glass Corp., goes one step further and makes theirs from recycled plastics.

Soft tubs. A new product that could work well in the luxury market is the "soft" bathtub, available from Softub Products, Inc. The "Softub" whirlpool weighs only 100 pounds, and has over an inch of flexible urethane padding that springs back into shape after being compressed. A flexible, elastomeric film covering the foam core looks almost like the color and finish of an ordinary tub.

Electrical

Plastics don't conduct electricity, so their use in switches and receptacles has been widespread. New developments include colored switches and improved design.

Light mount. A new polyurethane product that could be immediately useful to contractors is the "Uni-Mount," a universal mounting block for exterior light fixtures. The "Uni-Mount" screws directly to all electrical work boxes and can be installed before or after siding.

Wire Mold. If you're tired of hack-sawing Wire Mold, you could switch to a new PVC surface-mounted electrical raceway system called "Baseway." It's wide enough to serve as a baseboard or chair rail, and it can hold cable, telephone, or computer lines, in addition to electrical wiring.

Interior Trim

Some plastic trim looks cheap, but new products look so much like wood, you'd swear they were the real thing.

Flexible trim. "Flextrim" was the brainchild of Allen Jones, who started the company, Flextrim, as a small business (see Figure 4). While Allen's back-

CONSTRUCTION PLASTICS GLOSSARY

Plastics are synthetic polymers produced from petroleum, driers, extenders, and other chemicals. Although each plastic is chemically distinct, all plastics polymers create materials that can be formed, extruded, molded, or cast. Here are some of the kinds of plastics used in construction.

Foamed Plastics

Insulating foams provide compressive strength, moisture resistance, and long-term R-values.

Isocyanurate foam. These foams have slightly better fire-retardant characteristics than urethanes, and their high compressive and flexural strength make them useful in building panels.

Polystyrene foam. Both extruded and expanded foam are made from polystyrene. Both foams are used for roofing insulation and wall panel construction.

Urethane foam. Urethane foam can vary from a tough, hard structural foam to a pliable material that can be used for bedding. The foam has a good R-value, but it has some problems with retarding fire.

Thermoplastics

Thermoplastics are a broad range of man-made polymers that melt when heated and turn solid when cooled. To get a mental picture of "thermoplastics," think of chocolate which can be heated, poured into a mold, cooled to shape, then reheated, repoured, etc. Injection molding and extrusion are fabrication techniques that can take advantage of the material's thermal behavior.

ABS. ABS stands for acrylonitrile-butadiene-styrene. This plastic outperforms polystyrene, and offers increased chemical resistance, greater toughness, and impact resistance. It is most commonly used for drain-waste-vent pipes, molded hardware, and

shower surrounds.

Acrylic. Acrylics are tough, durable plastics that weather well. Abrasion resistance makes acrylics useful as skylight glazing or in pool rooms. Acrylics can be colored, and they are widely used for molded tub and shower surrounds and vanity tops. Acrylics, when co-extruded over ABS resins, are formed into specialty items like spas.

PB. Polybutylene (PB) materials have an unusual combination of flexibility, toughness, and abrasion resistance. They don't sag when temperatures rise (up to 230° F), and they are resistant to soap, detergent, and chemicals. PB is used in plumbing.

Polycarbonate. A strong, tough, and transparent plastic, polycarbonate can be extruded as a sheet or molded. Since it is clear, like glass, but not fragile, it can be used for durable, weatherable glazing, and even eyeglasses.

Polyethylene. A strong plastic with good fire resistance, polyethylene also functions as an excellent moisture and vapor barrier. Polyethylene shows up in extruded piping, wire and cable jacketing, profile extrusions, and molded hardware parts. CPE (chlorinated polyethylene) is an even stronger plastic with excellent fire resistance properties and is used for wire and cable jacketing. CPE is also used to give impact resistance to PVC siding and pipe.

Polystyrene. Polystyrenes can be clear or opaque—clear, general-purpose resins and opaque high-impact grades. They can be used for insulation (polystyrene foams), for trim and molding pieces (polystyrene profile extrusions), and for light fixtures (extruded polystyrene).

PVC. By percentage, PVC is probably the plastic most widely used in the industry. PVC is extruded to form replacement win-

dows, laminated to fiberboard (for a wood look), molded into siding, and shrink-wrapped around refrigerators to protect them during delivery.

Thermoset Plastics

Thermosetting plastics are a broad category of man-made polymers. These plastics start out as liquids, powders, or solids, but when you add heat or mix in additives, the material forms a solid. To picture a "thermoset polymer" think of an egg. The natural, semi-liquid egg can be poured into a mold, but once "cooked" it becomes a solid, and you can't reverse the process by adding heat again. These plastics can't be recycled because you can't melt or reform them. Pultrusions generally use thermoset plastics.

Glass-reinforced pultruded thermosets. These materials are used in structural applications where metal cannot be used, such as in corrosive environments. Pultrusions are beginning to be used in window frames. In pultrusion, a strand of fiberglass is pulled through a die, soaked in a thermoset liquid, and cured.

Phenolics (thermoset). Plastics such as "Bakelite" are made from thermoset phenolics. Phenolics are used in electrical applications.

Polyester (thermoset). Thermoset polyester resins are molded into power tool housings, insulators, pipe fittings, and circuit breaker cases and covers.

Epoxies

With the addition of different curing agents, epoxies can change from hard to flexible, and vary in their chemical resistance, toughness, clarity, and abrasion resistance.

Epoxy. Because of their great adhesive properties, epoxies are used as structural adhesives, sealants, synthetic and terrazzo flooring, and chemical-resistant piping.

Epoxy novolacs. Novolacs have more complex molecular structures than regular epoxy resins. This improves their resistance to chemicals and high temperatures. They are used in the same way as epoxy resins.

Alloys

Alloys are composite materials made by blending polymers or copolymers with other polymers or elastomers. Plastics alloys, like metal alloys, blend materials to create hybrid plastics that have more desirable working qualities than either of the original materials. Dow's new Rovel polymer is an example of a plastic alloy that was designed for improved weatherability and dimensional stability.

—M.M.



Plastics start out as resins created from petroleum products and other chemicals.



Figure 5. "Flexible Window Arch," made from a bendable preprimed polyurethane, can be used to trim out arched windows or curved walls.

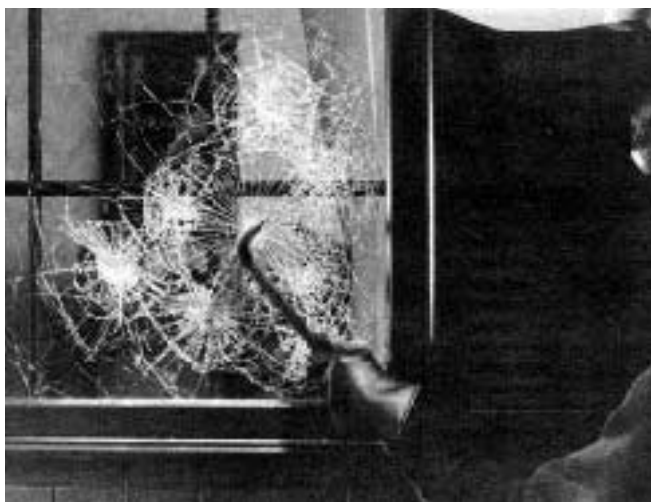


Figure 6. Monsanto's "Saflex" safety glass has plastic laminated between two glass panes making it eight times stronger than tempered glass. The plastic layer also muffles noise and filters out UV.

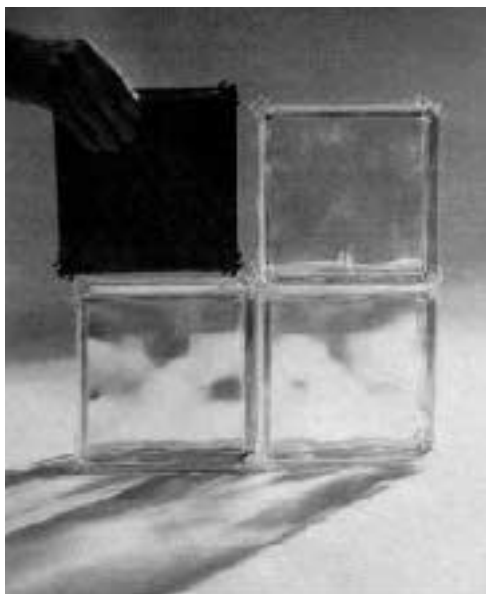


Figure 7. "Deco Blocs" snap-lock together, weigh 50% less than glass block, and are nearly indestructible. The plastic blocks cost about \$5 each.

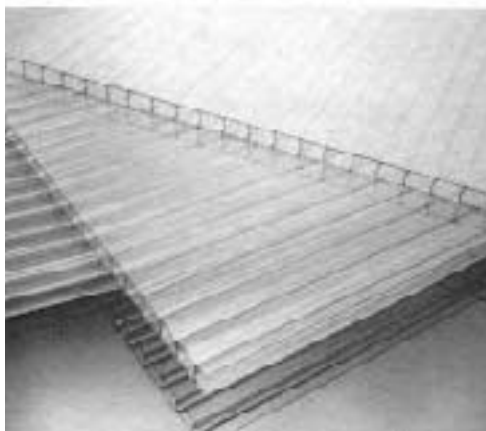


Figure 8. A new Dow resin promises to protect its "Twinwall" polycarbonate from yellowing in sunlight. Because the ribbed plastic sheets can bend, you may soon see the material used in curved sunspace glazing.

ground was in industrial arts and plastics, his father's had been in millwork.

"I realized the number of hours he put in, thought about the number of round windows in construction, and thought there might be a simpler solution with composites," explains Jones.

Jones assembled materials in his garage and began experimenting. Now, he believes he has found a strong, impact-resistant material that bends around a curved radius without soaking or back-cutting. The product sells for 40% to 50% less than comparable millwork.

Arched window trim. Curt Caldwell has also developed a product to trim out arched windows called "Flexible Window Arch" (see Figure 5). You make up a box-beam header from plywood and 2x material in the shape of an arch. Then install the window, and trim out the inside of the arch with a flexible, preprimed, polyurethane. This product already has corner bead attached, so all you need to do is bring your drywall down behind the corner bead, lay on a couple of coats of joint compound, and paint. "Flexible Window Arch" sells for \$2.50 to \$3 a foot.

Plastic plaster. Cornice molding, chair rail, and exterior moldings that duplicate wood and plaster originals have been developed by several companies, such as Focal Point and Fypon. These plastics, and many others, are sold through Outwater's Warehouse-in-a-Book catalogue.

Windows

Glass doesn't make the ideal glazing material for windows—it breaks, it conducts heat, and it's relatively heavy. Innovations in plastic glazing combine glass and plastics to take advantage of the best characteristics of each. Pultruded plastics are also being used for the first time for window frames.

Laminated safety glass. To improve home security, Monsanto has developed "Saflex" laminated safety glass that is eight times stronger than tempered glass. Saflex has a bonded plastic interlayer between two glass panes. The plastic layer muffles noise and filters out ultra-violet rays (see Figure 6).

Plastic block. Plastic block, copying the design of glass, is made from abrasion-resistant Lexan plastic (see Figure 7). "Deco Bloc" snap-lock together, weigh 50% less than glass, and are nearly indestructible. The blocks cost about \$5 each.

Plastic glazing. New plastics can help windows resist shattering and yellowing. Double-pane plastic glazing can be made from acrylic or polycarbonate, but polycarbonate is the stronger of the two, with greater tensile strength than steel. Dow has just come up with a new resin to protect their "Twinwall" polycarbonate from yellowing in sunlight. Because the polycarbonate sheets can bend, you may soon see the material used for glazing in sunrooms and atriums (see Figure 8).

Pultruded frames. Until now, plastic windows have been made from PVC, and very few have penetrated the high-end market. This might change as pultruded plastics are used for window frames. PVC extrusions generally have rounded profiles, but pultruded window frames, besides being stronger, have crisper lines more like wood windows.

Owens-Corning has just developed a pultruded window frame that surrounds a core of insulation, and the technology should greatly reduce heat loss through the frame. The pultruded frame appears to be stronger and more dimensionally stable than vinyl frames.



Figure 9. Rovel, a new wood look-alike from Dow, is stainable and paintable, with either water or oil-based coatings. The dimensionally stable material may be picked up by siding and door manufacturers.

The windows are coated with a protective brown or white urethane paint and look like painted wood windows, not plastic.

Jamile Shibley, marketing director for the new "Premium" windows, says the price will be comparable to high-quality wood windows. You can expect to see these windows sold initially in Pennsylvania, New Jersey, Delaware, Maryland, and Virginia.

Doors and Siding

To combat the image of plastic as a cheap material, plastics manufacturers have been working overtime to develop products that have some of the benefits of wood, but the low maintenance of plastics. The large companies, like Dow, G.E., B.F. Goodrich, and others, often sign licensing agreements with manufacturers of specific products. This allows the parent company to use

its research team to improve materials, and it allows the smaller companies access to new materials (see "Construction Plastics Glossary")

Stainable doors. One innovative development that may be picked up by door and siding manufacturers is Dow's new "Rovel" polymer. Rovel is stainable and paintable, using either water or oil-based stains. The dimensionally stable material has the raised grain pattern of real wood (see Figure 9).

Stable siding. Dow has also developed a new "Pulse" thermoplastic resin that can be used for siding. The new plastic expands and contracts less than the material used in standard siding. "Now there will be more freedom to design siding and other products" explained Kathy McCreedy, Dow's Building and Construction Group marketing manager. ■

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For More Information

Many of the products mentioned in this article are just coming on the market. If you want to find a local distributor, or inquire about becoming a licensed dealer or installer, you can contact the companies at the addresses below.

Structural Systems

Ener-G
Ener-G Corp.
2316 W. Huntington Drive
Tempe, AZ 85282
602/470-0223

Billee-Board
I.M.G.
1170 N. Armando St.
Anaheim, CA 92806
714/632-1290

Durawood
Eaglebrook Products, Inc.
2650 W. Roosevelt Road
Chicago, IL 60608
312/638-0033

Tuffspan
Composite Technology
1005 Blue Mound Road
Fort Worth, TX 76131
817/232-1127

Plastic rebar
Vega Technologies
Drawer 200
Marshall, AR 72650
501/448-3111

Insulation

Puffiber
Embrace Systems Corp.
Suite 200
300 Pearl St.
Buffalo, NY 14202
716/842-6032

Plumbing

Colored Plastic Fixtures
Hansgrohe
Suite 100
2840 Research Park Drive
Soquel, CA 95073
408/479-0515

Acrylic bathtub
Eljer
820 Avenue F
Suite 100
Plano, TX 75074
800/753-5537

Acrylic bathtub
Aqua Glass Corp.
Box 412
Adamsville, TN 38310
901/632-0911

Softub
Softub Products, Inc.
1026 Florida Ave.
Suite A
Palm Harbor, FL 34683
813/785-4688

Electrical

Uni-Mount
Russell Enterprises
2550 Boyce Plaza Road
Pittsburgh, PA 15241
800/367-1076

Baseway
Delaware Industries, Inc.
8987 State Route 14, Unit C
Streetsboro, OH 44241
216/626-1165

Interior Trim

Flextrim
Flextrim
8434 Rochester Ave.
Rancho Cucamonga, CA 91730
714/944-6665

Flexible Window Arch
I.M.G.
1170 N. Armando St.
Anaheim, CA 92806
714/279-8033

Plastic Plaster

Plastic Molding
Focal Point
Box 93327
Atlanta, GA 30377-0327
800/662-5550

Plastic Molding
Fypon
22 W. Pennsylvania Ave.
Stewartstown, PA 17363
717/993-2593

Warehouse-in-a-Book
Outwater Plastic/Industries
4 Passaic Street
Wood-Ridge, NJ 07075
800/543-3217

Windows

Saflex
Monsanto Chemical Co.
800 N. Lindbergh Boulevard
St. Louis, MO 63167
314/694-1000

Deco-Bloc
Glass Alternatives Corp.
65 Fochtman Industrial Drive
Potoskey, MI 49770
616/347-1135

Twinwall
Dow Plastics
2040 W.H. Dow Center
Midland, MI 48674
517/636-3593

Pultruded Window Frames
Jamil Shibley
Owens Corning Fiberglas Corp.
Window Products Div.
Fiberglas Tower
Toledo, OH 43659
419/248-7806

Doors and Siding

Pulse and Rovel
Dow Plastics
2040 W.H. Dow Center
Midland, MI 48674
517/636-3593

Ceiling

Barrisol
Ed Agazehanian
1340 Depot St.
Suite 110
Cleveland, OH 44116
216/331-0485