Photo by Nonya Grenader

FOAM HOME

BY GORDON WITTENBERG AND MARK OBERHOLZER

FOAM CONSTRUCTION IS CHEAP AND EASY. SO WHY ISN'T IT MORE POPULAR?

Photo by Nonya Grenader

Left and above: Congregation at work constructing the Spanish Bible Fellowship church in Sugar Land.

Anyone who has lived in Houston for long has experienced the frenzy of building that accompanies the city's perpetual boom and bust of construction. When the boom is on, there is non-stop action. Things are constantly being torn down. Whole blocks disappear overnight, and new structures appear in weeks. There is so much change that it's hard to notice if anything is really new or just part of the endless cycle of obsolescence and replacement. New methods of construction are especially hard to notice in Houston, where structures that begin as simple concrete shells end up as strange latter-day California Mission buildings.

But there are at least two buildings under construction, a house in Southampton and a church in Sugar Land, that utilize a system of total foam construction not encountered in Houston before. Both of these buildings eschew traditional construction materials and methods for a structural system that employs the material of cheap beer coolers: lightweight foam. In this method of construction, large blocks of foam are stacked up like a house of cards and then encased with metal lathe and stucco to form inside and outside walls.

These structures can be thought of as the latest stage in an evolutionary process in which synthetic materials are becoming more and more integral to the construction of buildings.

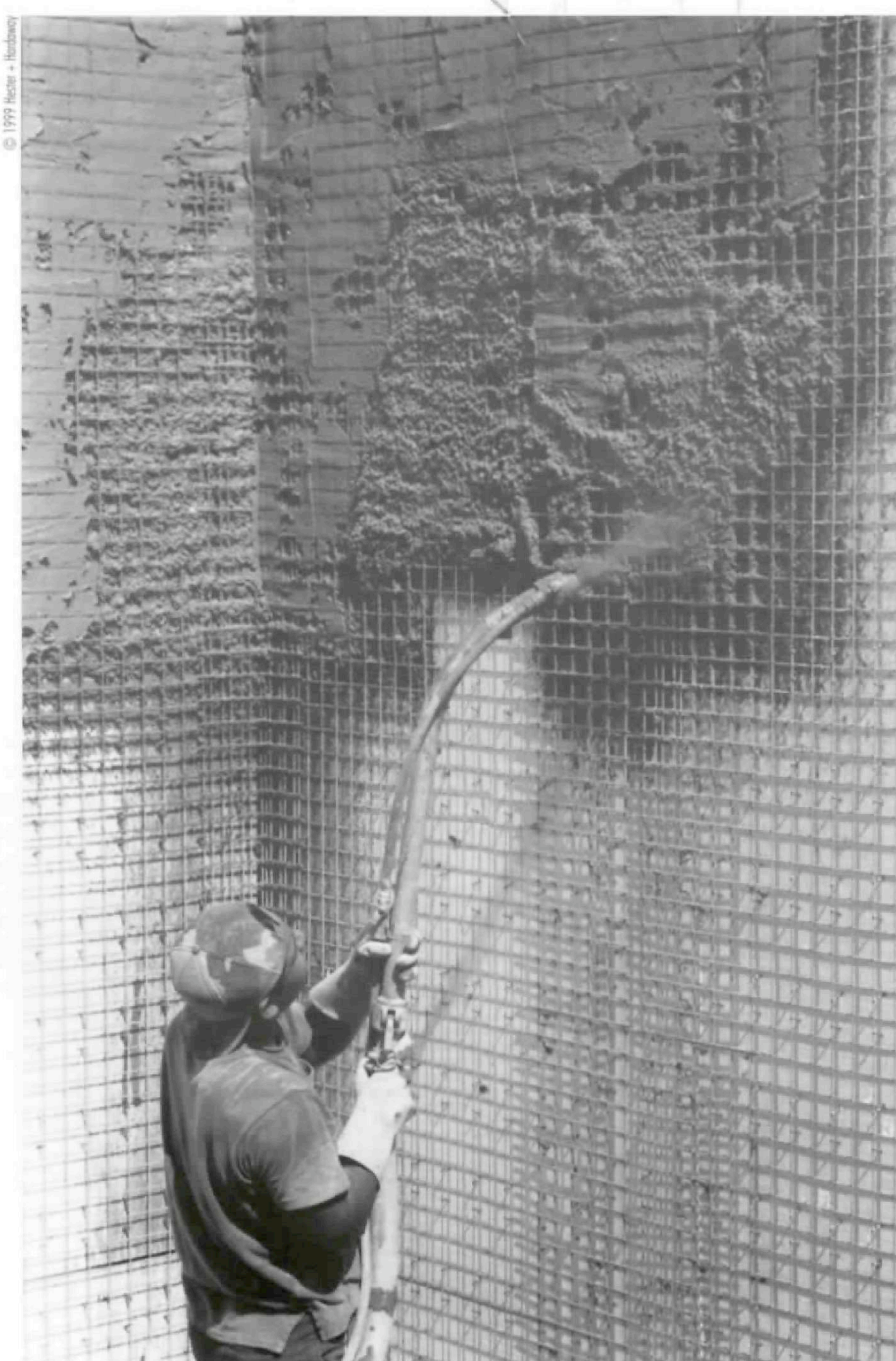
A typical house built in the 1920s used wood for structure, exterior siding, interior sheathing (before gypsum wallboard came into use), and flooring. Moisture protection was provided by shaping the wood siding to discourage water from entering the house. Wood baseboards and shoe moldings helped prevent air movement through the uninsulated walls. Except for the occasional piece of sheet metal flashing, most functional and aesthetic ends were achieved with wood itself.

Wood houses built today, however, rely extensively on synthetic materials, including silicone caulks, fiberglass insulation and plastic house wraps. Silicone sealants are used because they prevent air flow much better than an assembly of wood moldings. Fiberglass insulation traps pockets of air with an efficiency that wood or masonry could never match. Plastics prevent the movement of moisture through the walls and floor, protecting a building from condensation and rot. Synthetic materials, though not immediately visible, play an important role in construction.

In some buildings, the use of synthetic materials is taken a step further and integrated into the structural system itself. The utilization of foam, especially Styrofoam, blocks as a structural material has been actively considered since the aftermath of the energy crisis of the 1970s. There were a number of foam houses built in Nevada and Arizona during this time that reduced building construction and operating costs by using foam for both structure and insulation. The idea did not catch on, however, because most interior and exterior finishes have to be applied using nails or screws, which foam does not easily support. Typically, another wall made of adobe or masonry had to be added to the outside of the construction. Although the use of foam decreased the cost of the structure and insulation, the increased cost of finish materials negated any real savings.

The first commercially viable construction system to use foam was the structural insulated panel originally developed and tested by the Forest Products Laboratory in 1935. In this system, four or six inches of foam were sandwiched between two layers of plywood in the factory and transported to the building site as a single unit, usually four feet wide and eight feet high. Although a few demonstration houses were built using this system during the '40s and '50s (most notably by Alden Dow in Midland, Michigan), the system did not begin to be used commercially until the late 1980s, when strand board replaced plywood as the outer layer of the sandwich. The strand-board-clad foam units, like the plywood-clad units before them, solved the problem of attachment, since a finish material could be attached to the strand board. This system was also interchangeable with conventional stud construction and could be easily integrated into an otherwise conventional building. Another foam-based construction system utilizes foam as formwork. These giant-sized "smart-wall" blocks can be stacked up and filled with concrete, after which the foam formwork remains in place, insulating the wall.

Although foam is important to these two relatively recent construction systems, the material has had little effect on the characteristics of the completed



building. In the case of the Southampton house and the Sugar Land church, however, foam has taken center stage and completely changed the way the buildings are built.

Both buildings use a foam panel system currently produced by a company named ICS that features large foam panels with two-inch by two-inch welded wire reinforcement on both sides, connected through the foam by additional wire. Manufactured in Mexico, the panels are four inches thick and four feet wide and range from eight to 20 feet in height. The panels are set atop steel dowels embedded into a concrete foundation and wired to each other. Plumbing and electrical lines are placed inside cavities created by burning the foam away with propane torches. After new foam is packed over the wires and pipes to protect them, concrete is sprayed onto both sides of the foam, similar to the way the sides of an in-ground swimming pool are created. The result is a wall about seven inches thick consisting of a foam core and an inch-and-a-half concrete surface on both sides.

The finished surface of the wall — rough concrete — belies the manufactured quality of its components. In contrast to an aluminum curtain wall or a wood framed wall, the concrete and foam walls are rougher and more massive. They also differ in character from a traditional poured-in-place concrete wall — there is no evidence of formwork, so the concrete assumes a rough, stucco-like texture. In addition, because it is already insulated and almost impermeable, there is no need to add other interior or exterior layers to the concrete. The exterior material quality and simplicity of the wall make it architecturally appealing.

The house utilizing the foam and concrete system is located in the 2200 block of Bissonnet. Designed and built by Robert Burrow, the house actually uses a mix of construction systems: while the floors and interior partitions are built of wood, the two-story exterior walls use foam panel construction. The house is built around a small courtyard, onto which most of the windows face. Two-story concrete walls face Bissonnet in front and an alley in back.

The house derives considerable architectural interest from the contrast between the massive two-story concrete walls and the much lighter interior framing, a difference most apparent in the midst of construction. In addition to providing contrast, the foam-and-concrete walls are, Burrow says, about 20 percent less expensive than their traditional concrete block wall counterpart. Still, despite the economic justification, it is clear that Burrow decided to use the foam system in his house not so much to save money, but because of his interest in materials and their architectural impact.

Although this construction system is relatively high-tech in its manufacture, it has some interesting low-tech characteristics. Those become most evident when the system is used for an entire building, as is the case with the Spanish Bible Fellowship at West Bellfort and Dairy Ashford, for which Benson Ford is architect and Luis Lemus engineer.

That building consists of a series of meeting rooms and a large sanctuary. Except for a few steel beams in the sanctuary space, which support the relatively long span of the roof, no other wood or steel framing is used anywhere in the single-story building. The panels are made of foam and wire, and are relatively light and easy to lift (a four-foot by eight-foot panel weighs just 38 pounds). In addition, the panels are connected to each other very simply, with pieces of twisted wire. Since assembling the walls and roof requires very little construction skill, the church can be — and is being — built primarily by the congregation itself. As a result, the church building is much more economical than one constructed more conventionally. In fact, this "high tech" material may become the material of choice for the lowest-tech, self-built projects because it can be built with relatively low-skilled volunteer labor. In addition, since the inherent weather resistance of this material means it can be left on site without deteriorating, or be safely stored for long periods of time, it is ideal for buildings that are erected episodically over a long period of time — as volunteer-built buildings tend to be.

While the Spanish Bible Fellowship building is in some ways a good match between construction system, program, and client, its departure from conventional building construction is not without consequences. Although electrical, plumbing, and phone lines are easily installed before the concrete is applied, once the concrete is in place, making changes or repairs is more difficult than with standard walls. In terms of finish, the buildings have more in common with adobe construction than the carefully crafted interiors of more conventional buildings — typical interior finishes such as hung ceilings and door trim are not easily incorporated into the foam and concrete system. Also, the system does not lend itself to use in floors because of the difficulty of achieving a smooth surface. In fact, the finished concrete surface is more similar in texture to rough stucco than the smooth finish of poured-in-place concrete floor slabs.

In another dimension of building, sustainability, there may be further concern. Many early applications of foam to building presented formaldehyde outgassing problems that caused their use to be discontinued. More recently, the structural insulated panel system experienced a similar problem from the glue used to bond strand board or plywood to the foam. In all fairness, Styrofoam has not exhibited this disturbing characteristic. However, it is a petroleum product and by using it we take on, even if unintentionally, the resource and pollution problems of petrochemical production.

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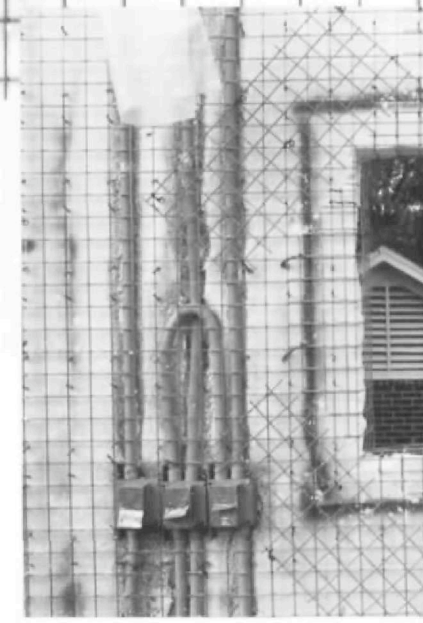
The integration of synthetic materials into buildings has always had its price.



At the Burrow house on Bissonnet, the steps in building a foam wall are clear. First, erect the wire-covered foam panels (above right); cut and burn out spaces for windows and wiring (above); then spray on a layer of concrete (above left).

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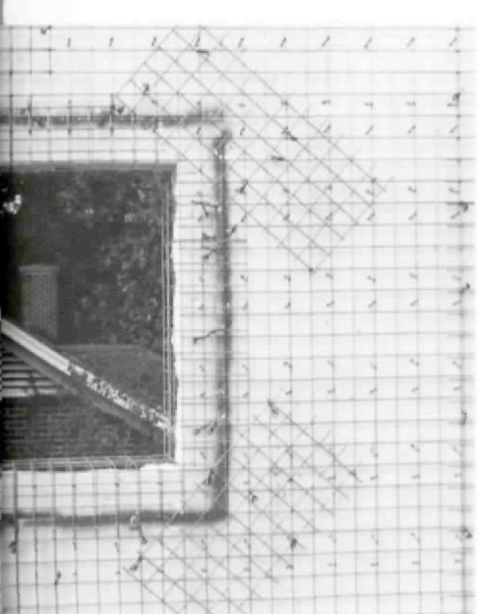
Windows, once made principally of wood and glass and often assembled on site, are now completely manufactured products incorporating nylon, vinyl, aluminum, and silicone in addition to wood and glass. They are impervious to water and virtually maintenance-free, but because windows are so standardized, subtleties of expression and function are difficult to



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achieve. If a window is leaking, you're better off reaching for the warranty than a hammer.

Vinyl siding is the most demonstrative example of the problems with synthetic materials. There is no functional criticism of vinyl siding. It's easy to install and maintenance free. Yet it lacks the material quality of wood and cannot achieve the same precision of detail. It clearly is synthetic material used without spirit.

So far, even those experimenting with foam as a quasi-structural material have used it only in the most pragmatic ways. The foam panel system is perhaps the most architecturally interesting foam-based construction system to date, mostly because it completely obscures the foam inside a layer of concrete, thus simplifying the walls in both practical and aesthetic ways. Although foam panels of this type have been used on a small number of residences in Florida, Arizona, and California, their primary appeal seems to be its low cost and ease of construction. The main impetus for using the system is clearly economic rather than aesthetic.

Unfortunately, even as foam-based construction methods slowly become more refined, the romantic characteristics of foam continue to be evasive. Foam is, perhaps, reminiscent of another material once argued as a vanguard of modern construction. At the beginning of the 20th century, reinforced concrete was embraced by a number of architects, including Wright and Le Corbusier, as the quintessential modern material. Its ability to be formed easily, its simplicity, and its inherent rationalism established an important part of the vocabulary of modern design. Another generation of architects (and even an older Le Corbusier) found different characteristics in the concrete. Kahn admired its roughness, monumentality, and even romantic characteristics. And architects continue to debate reinforced concrete's phenomenological characteristics.

Modern architects have been blessed, or burdened, with an imperative from 19th-century architecture to find new forms for new materials. Three qualities of foam — its light weight, inherent weather resistance, and ability to be shaped — seem to suggest new forms not so bound to the characteristics that have shaped buildings in the past. Foam's light weight — or, more specifically, volume without weight — suggests forms that do not stack or get larger toward the ground, but expand upwards, no longer apparently subject to gravity. Its weather resistance suggests a smoothing of the traditional distinction between surfaces such as roof and wall and the elaborate detailing that arose around those transitions. Finally, foam's ability to be easily shaped is crucial to achieving the potential of the first two qualities.

Experimentation with form or building shape, best characterized by the sculptural quality of Frank Gehry's various museum buildings, is a current interest of many architects. Yet despite the unconventional form of these buildings, they are constructed in a surprisingly conventional manner. If architects have lately been trying to overcome the limitations of form imposed by conventional construction systems, what might they make of the freedom offered by foam?

For the answer to that question, we'll just have to wait and see. So far, few architects seem to be taking on the challenge offered by foam. That may be because while the foam panel system might allow architects to experiment with form and sculptural surface, as a construction system it lacks the apparent visual precision that characterizes most architectural projects. And anyone hoping that the construction industry will do what the architects have not and give foam a chance is likely to be disappointed. In the U.S., the construction industry has also shown itself to be more receptive to evolution in building systems than outright revolution. ■

FOAM IN THE '50s

As notable as they are, the church in Sugar Land and the home in Southampton aren't the first Houston structures to use total foam construction. That honor goes to a house built in 1956 by Dean Emerson, then a 43-year-old employee of Dow Chemical. Emerson was trying to develop new uses for Styrofoam, which until then had primarily been used in floral arrangements. Since Styrofoam has a high insulation value, Emerson reasoned that it might be used for insulating buildings. And because he wanted foam to be used universally, and not just in wood frame construction in North America, Emerson decided to find a way to integrate foam into concrete construction, which is used by most of the world.

With the help of a contractor, Emerson built his own home as a test case for his new system. He used three-inch thick, one-foot wide, and eight- to 12-foot long foam panels manufactured to his specifications by Dow. The major challenge Emerson encountered was in tying his foam walls down to the concrete slab. To do this, he devised a system of steel wires that ran from bolts in the slab to bolts in a wood plank placed atop the foam panels. Once the panels were placed on the slab and tied down with wires, an inch of concrete was sprayed on both sides of the wall.

The 3,000-square-foot house, located in a wooded area just off the 9800 block of Memorial Drive, consisted of four bedrooms, a large living/kitchen area, and a playroom. The one-story structure — low slung with an open floor plan — was similar in design to many other contemporary ranch houses of the era. As Emerson had expected, the insulation value of the foam kept his utility bills down to just a little more than half of that for similar houses built out of wood. An unexpected advantage of the foam and concrete walls was their effectiveness in blocking sound — even the loudest noises from the playroom were muffled.

Emerson and his family lived in their foam house for 38 years. When they sold it in 1994, the house was still solid — as the new owners discovered when they tried to tear it down so they could replace it with a larger wood-framed home. Nearly four decades after they were put into place, the foam and concrete walls proved difficult to dismantle.

In the early 1960s, Emerson and a home builder used this same foam-and-concrete system to build more than 50 houses on the west side of Houston. Although the venture proved successful, the foam and concrete system failed to catch on, perhaps because it utilized different materials and laborers than standard wood-frame construction. But Emerson, now 86 and content after living in his experiment for nearly half his life, still advocates the use of foam in construction. — *Mark Oberholzer*