Is the U.S. ready for cellular concrete block?

Two competitive companies are investing millions to develop the American market for this lightweight material

By Carolyn Schierhorn

Americans never have been quick to embrace concepts originating overseas, even when they evolve into practices popular just about everyplace else in the world. Think of soccer and the metric system. Widely used in every industrialized nation but the United States and Canada, autoclaved cellular concrete (ACC) is no exception.

Invented in Sweden in 1914, this lightweight building material was first commercialized in Sweden and Germany in the 1920s; after World War II, it became popular in the rest of Europe, then spread throughout the world. Today about 200 plants in 35 countries produce ACC blocks and panels (Ref. 1). Also known as autoclaved aerated concrete (AAC), the material is common in residential, commercial, and industrial applications—in low-rise loadbearing walls and high-rise separation and curtain walls. In addition, ACC often is used as a structural insulation material.

Its popularity is understandable. Although ACC has low compressive strengths (Table 1) and must be covered with siding, stucco, or another weather-resistant coating, the product has excellent insulating, fire-resisting, and sound-dampening properties (see Tables 2 and 3).

The product can be sawed and nailed like wood. What's more, with densities typically ranging from 25 to 40 pounds per cubic foot, ACC block is only ¼ to ⅓ the weight of conventional concrete block, even though the units are solid. Consequently, ACC proponents see its potential to increase productivity.

These properties are the result of a chemical reaction in the concrete mixture. ACC contains portland cement, lime, water, fine sand or fly ash as the aggregate, and a small amount of aluminum powder, which acts as the rising agent. The aluminum powder reacts to create millions of tiny air bubbles that cause the concrete to expand to about twice its original volume. After the expansion is complete, the concrete is removed from the mold, wire-cut into precisely dimensioned blocks or panels, then cured for 10 to 12 hours in an airtight pressurized steam chamber called an autoclave.

Wire-cut to precise dimensions, autoclaved aerated concrete block require only ⅛ inch of mortar at head and bed joints.

Despite the product's merits, European manufacturers tried unsuccessfully to introduce ACC to the United States in the 1950s. The early 1970s saw another aborted attempt to launch production in North America. Using Swedish technology, a company in Montreal began to manufacture ACC panels, which were used to construct several warehouses and factory buildings in the United States. However, the Canadian plant shut down due to a labor dispute, and builders comfortable with the product no longer had a source of supply (Ref. 2).

In the 1980s, Weyerhaeuser Co. planned to produce ACC panels in the United States, then abandoned the idea. Meanwhile, the National Concrete Masonry Association (NCMA) ran tests on ACC

for a German producer, and was approached by other ACC concerns seeking NCMA's support. NCMA members, however, weren't interested because ACC production technology is so different from that of conventional block.

Why ACC never caught on in the United States remains a matter of debate. But one reason is the capital investment required for a typical European-size ACC plant—$20 million to $50 million. To justify such a large investment, manufacturers needed immediate acceptance of the product and large-volume sales (Ref. 3).

In spite of the risks, today two separate organizations are trying to introduce ACC block to the American market—Providence, R.I.-based North American Cellular Concrete (NACC) and The Hebel Group of Germany. They are not working cooperatively.

Table 1. Compressive Strength of ACC

Density	psi
19 pcf	72-232
25 pcf	189-464
31 pcf	290-725
37 pcf	435-870

Source: North American Cellular Concrete

Table 2. Thermal Insulation of ACC

Density	R-value per inch
25 pcf	1.66
31 pcf	1.14

Source: North American Cellular Concrete

Table 3. Fire Resistance of ACC

Wall thickness	Fire rating
6 inches	6 hours
4 inches	4 hours
2.5 inches	2 hours
2 inches	1 hour

Source: North American Cellular Concrete

NACC promotes fly ash block

NACC received a $1 million grant from the Electric Power Research Institute (EPRI), as well as private funding, to research and promote the use of fly ash in ACC block. This venture has financial backing from electric utility companies because fly ash is a by-product of combustion in coal-burning power plants. In the United States, power plants produce more than 70 million tons of fly ash per year, which costs utility companies from $10 to $50 a ton to dispose of in landfills.

Fly ash is used as the aggregate in ACC primarily in the United Kingdom; elsewhere sand is used much more often. Although the fly ash product appears to perform comparably to the more-established sand product, NACC has been conducting tests. The organization wants to make sure the process can be adapted to the various coal ashes found in the United States (Ref. 4). And it wants to see how buildings constructed of the product perform in different U.S. climates.

NACC has taken an incremental approach to market development.

First, the organization developed a mobile ACC block plant, built on three flatbed trucks. For the past two years, the plant has been traveling to electric utility plants throughout the United States. Using fly ash from its host power company, the ACC plant can produce 90 concrete blocks per day. Some of the blocks produced are being used to build ventilation walls in a coal mine (see *Masonry Construction,* May 1993, page 202).

At each site, well-publicized demonstrations have attracted contractors, architects, conventional concrete block producers, and utility company executives. "Our whole project in the past few years has been to generate interest," notes NACC managing director Bob Sauber.

Second, NACC has financed the construction of test homes to compare the performance of fly ash block to wood. In the Pittsburgh area, two 1,400-square-foot homes have been constructed by a local builder, T. Ryan Enterprises. Otherwise identical, one home is built of fly ash block, the other of conventional wood framing. The homes will remain unoccupied for six months, while an electric power company monitors their energy consumption. Test homes also are under construction in Florida, to assess the performance of fly ash ACC in a hot climate.

Third, NACC has developed and is promoting the small-plant concept for ACC production. NACC has designed a $3 million to $5 million plant that could produce about 1,000,000 blocks per year. As demand for the product grows, the plant could be expanded to 10 to 20 times its original size, according to Sauber. NACC is trying to interest electric utility companies and conventional block producers in investing in a small ACC plant, which could be incorporated into an existing power or block plant.

Hebel plunges in confidently

In business more than 50 years, The Hebel Group of Germany owns and operates 11 aerated concrete plants in Germany. In addition, Hebel licenses its production technology to other facilities, forming partnerships with these companies. At present, 40 licensed plants around the world produce more than 6.5 million cubic yards of aerated concrete annually. Besides experience, the key difference between Hebel and NACC is that Hebel plants use sand as the aggregate, not fly ash.

Hebel USA, a subsidiary of The Hebel Group, has been established in Roswell, Ga., to license aerated concrete technology to companies throughout the United States. Atlanta-based Hebel Southeast is its first licensee.

A joint partnership among The Hebel Group and private Mexican and European investors, Hebel Southeast is building a plant in Adel, Ga., scheduled to begin oper-

ation in late summer of 1995. The plant initially will produce more than 80,000 cubic yards of aerated concrete annually—blocks, panels, and other system components. Three grades will be offered: Grade 2 (360 psi), Grade 3 (720 psi), and Grade 4 (1080 psi). Block units will be 10 inches high, 25 inches long, and 4 to 15 inches thick.

Meanwhile, Hebel Southeast has been aggressively marketing the aerated concrete block as an alternative to wood and conventional concrete block in residential construction. The company has formed partnerships with several builders—providing training, special tools, and imported materials for about 50 homes in Florida and Georgia.

Hebel block is being used mainly in higher-end homes, but one builder in St. Augustine, Fla., is laying the units in $80,000 to $100,000 homes, observes William Abbate, vice president and general manager of Hebel Southeast.

Though the company is presently targeting residential construction, it will pursue commercial, institutional, and industrial markets once the plant begins production. "That will be a very large part of our business," says Abbate. The plant will produce aerated concrete floor, roof, and wall panels primarily for nonresidential applications.

To differentiate Hebel block from NACC's fly ash product, Abbate calls his product autoclaved aerated concrete, not autoclaved cellular concrete. But the terms typically are used interchangeably.

Abbate admits that fly ash- and sand-based aerated concrete are very similar; however, he contends that the sand-based product shrinks less and its quality can be controlled more easily.

Hebel Southeast is banking on several trends that could make time ripe for aerated concrete's introduction—environmental restrictions on logging, concern over energy consumption, and the shortage of skilled labor.

"Reaction from the masonry industry has been very mixed—everything from fear to open arms," Abbate notes. "Some of the more innovative masonry contractors have come after us wanting to work with the product. But other people are scared to death about it due to their lack of knowledge of the product."

Because the product is lightweight and can be laid easily, Abbate claims it offers tremendous gains in productivity with large units and lower-cost labor. "The skill level required for our product is lower than that required for typical masonry," he says. "In fact, six of our homes so far have been built by carpenters who had never touched a concrete block before." Masonry contractors can use laborers, rather than skilled masons, to do much of the construction, he says.

Skill still is required

Whether sand or fly ash is used as the aggregate, the same construction methods are used for ACC block. Because the units are wire-cut in the plant to exact dimensions, only a thin ⅛-inch mortar joint is needed at the head and bed joints. The adhesive-type, thin-set mortar used in ACC construction is normally proprietary and supplied premixed from the block producer. Blocklayers apply the mortar with a special trowel that looks like a small dustpan with notches.

Masonry contractor Dave Jollay of Atlanta-based O.L. Jollay & Co. has used Hebel block to build separation walls between apartments in a South Carolina resort complex. The material works well in this application because of its fire and sound resistance, he says.

However, Jollay says he didn't realize the big gains in productivity touted by the manufacturer. He admits this may partly be due to a learning curve, since he has used the ACC block on only one project. But skill definitely is needed to lay the product, he emphasizes.

"It is manufactured to tight tolerances and it has the weight Hebel indicates, but we weren't able to change our crew makeup to just having a couple of craftsmen and the rest laborers," Jollay says. "We found that you still have to hold plumb point. You still have to meet the same finish criteria that you do on a regular masonry wall."

North American Cellular Concrete

A special trowel is used when laying ACC block.

Even though ACC is lightweight, the units aren't easier to lay because they are large and have no cells, Jollay says. "It still requires some strength to lay an 8-inch-wide or 10-inch-wide block that's 2 feet long and 10 inches high." In addition, it takes two hands to pick up a block, he says, because solid units don't have natural hand-holds as hollow units do.

"The product chips easily, as you start moving it onto the scaffold and stacking it," Jollay

North American Cellular Concrete

Autoclaved cellular concrete block can be nailed like wood.

adds. The bad spots can be patched, but this just highlights the fact that once the wall is up, it's not finished even to the standard of a conventional concrete masonry wall.

ACC needs a niche

Michael Chusid, an architect and building materials consultant in Reseda, Calif., is a long-time enthusiast of ACC because of its thermal and environmental benefits and light weight. In addition, "it's got wonderful architectural potential in that it is very easily sculpted or shaped," he says. "For example, I can envision building a wall with the material; then after the wall is in place, coming by with hand tools and rounding the corners and rounding the masonry openings for the windows."

However, Chusid observes, today a number of other innovative building materials are available, which offer many of the same performance benefits. "I'm not sure ACC's success is as assured as it could have been at one time."

Inventor and architect Jorge Pardo, founder of Reston, Va.-based Synthesis Inc., says that despite its many benefits, ACC could have trouble winning acceptance in the United States if positioned as a competitor to well-entrenched building systems.

Instead, he suggests, ACC should be marketed as a complementary material: One potential niche for the product is the insulation market because ACC is extremely fire-resistant and does not emit noxious fumes.

Perhaps this time ACC will emerge as a specialized alternative like soccer and the metric system.

North American Cellular Concrete

North American Cellular Concrete test home in the Pittsburgh area, built of fly-ash ACC block, is shown under construction.

Hebel Southeast

Stuccoed 4,000-square-foot luxury model home in Alpharetta, Ga., was built through a partnership of Hebel Southeast and Chatford Properties to showcase Hebel autoclaved aerated concrete block.

References

1. Norman J. Bright, "Developments in Autoclaved Aerated Concrete Masonry," 1994, *Proceedings of the 10th International Brick and Block Masonry Conference,* Calgary, Alberta, Canada.

2. Virginia Kent Dorris, "Autoclaved Cellular Concrete," October 1992, *Architecture,* American Institute of Architects, 1735 New York Ave. N.W., Washington, DC 20006.

3. Bob Sauber, "Mobile Demonstration Plant Will Produce Fly Ash-based Cellular Concrete," March 1992, *Concrete Technology Today,* Portland Cement Association, 5420 Old Orchard Rd., Skokie, IL 60077.

4. R.C. Rittenhouse, "EPA, Miracle Concrete, Nonhazardous Wastes," October 1993, *Power Engineering.*

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