Autoclaved aerated concrete gains a new foothold

A material reintroduced to North America appears to be here to stay, thanks to its benefits to contractors and building owners

By Michael Chusid

Planning corporate strategy is a lot like navigating a large ship; it's easier to avoid icebergs by turning a few degrees toward Acapulco when you're in the South Pacific than to dodge them once you've made it to the Alaskan coast. Roger Babb, president of Babb International of Ringgold, Ga., sees icebergs on the horizon for a core product that's in the mature stage of its life cycle. And his company is starting to produce a substitute product now, while the economy is hot, before the market for the family-owned business' core product begins to decline.

Babb, whose family has owned a lumber operation for 47 years, saw good reasons to start up a research and development facility for autoclaved aerated concrete (AAC) in 1998 and break ground for a full-scale plant last year.

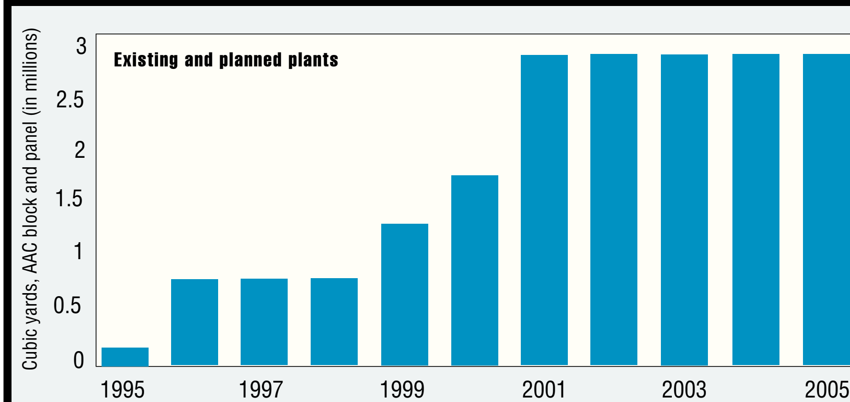
In a strong economy, traditional building products such as lumber, gypsum board, and glass fiber insulation can't keep up with demand in some areas. Moreover, "it is our opinion that the U.S. market will go the way of the European markets," says Babb, noting their stronger reliance on masonry construction. "We don't know how long it will take, but some years down the road, we will not see wood as the dominant framing structure for homes and businesses."

Economic reality is one reason for the reintroduction of AAC in North America in the mid-1990s after the concept failed in the '60s and '70s. The benefits of AAC, developed more than 70 years ago and produced in more than 200 plants around the world, are other reasons the material is getting a second look from producers such as Babb.

What is AAC?

AAC is a factory-produced precast concrete used for masonry building blocks and reinforced structural panels.

AAC in North America



Existing producers are experiencing steady growth in demand, encouraging them to expand and new producers to enter the market. Some industry analysts predict the need for up to 40 plants in North America.

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"We don't know how long it will take, but some years down the road, we will not see wood as the dominant framing structure for homes and businesses," says Roger Babb of Babb International, shown here with a home built with AAC masonry units supplied by Babb International.

AAC can be described as a rigid "concrete foam" since up to 80% of its volume consists of small air bubbles. The structure of the concrete gives the material exceptionally light weight, high thermal and fire resistance, and suitability for cutting with ordinary hand or power tools.

AAC can be used as walls, partitions, floor and roof decks, and other building components, or as an integrated system for structures up to seven stories high. It is substantially unaffected by shrinkage, moisture, decay, termites, and other common causes of building deterioration, and it is an environmentally "green" building material because it is easily recycled back into its own production process.

AAC also appears to be a cost-competitive building material. The light weight and ease of cutting boosts construction productivity. AAC also simplifies construction by performing a wide range of functions, including structure, insulation, and enclosure, with just a single wythe, significantly reducing setup costs. Prefabrication of AAC panels shortens building erection time to allow earlier occupancy. AAC also offers indirect benefits: lighter weight means reduced foundation costs, better insulation reduces HVAC requirements, and increased fire resistance can cut insurance costs.

Current economic conditions appear favorable to AAC. For example, lumber prices have increased, forcing builders to consider alternatives. Building codes have been strengthened in regard to hurricanes, earthquakes, and fires. An aging Baby Boom generation and low inflation have made many investors and home builders more sensitive to the life-cycle economy of buildings. Finally, energy conservation and environmental concerns play an increasing role in design decisions.

Bringing the added value home

What's a good strategy for swaying those decisions toward AAC at the local level? For Babb, the way to get builders to accept a slightly higher cost is to market AAC as a value-added wood substitute. He notes that a house built with AAC uses less energy and has lower insurance rates.

"Plus, it's a safer, more solid house, a very durable house, and the benefits of the AAC from an energy point of view don't diminish with time," he says. "In fact, they increase over time, because with conventional stick framing, the insulation value and airtightness of the house deteriorates over time, and with AAC it remains constant. In looking at a history of masonry vs. wood homes, the margin of difference in market

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Bob Phillips, quality-control manager at Babb International, demonstrates a major benefit of building with autoclaved aerated concrete: fire resistance equivalent to 4 hours in an 8-inch block.

value for an older home of masonry vs. wood is greater than when the houses are new."

Babb points to his experience with an AAC backdrop used at home shows and with actual AAC projects as evidence that owners like the appearance of buildings framed with AAC and covered with stucco, brick, or vinyl siding. "We're typically marketing it not against masonry but against something that otherwise would have been studs and vinyl siding, or steel studs and some sort of siding, he says.

"Cost is a minor issue," Babb says. The cost of an AAC house vs. a stick-frame with a siding product such as vinyl siding will be slightly higher. We built a $245,000 house, and we tracked the cost very closely with its original plan, which was stick frame with brick veneer on the front and vinyl siding on the ends and the back, and it was about $3,000 more."

Another potential segment in which AAC has huge growth potential is schools. Ytong, a leading Europe-based AAC producer that is competing in Florida with Matrix and Florida Crushed Stone subsidiary ACCO Systems, is focusing on schools. Ytong has pre-engineered AAC systems and sold them as a superior alternative to conventional construction and prefab classroom modules. One project is a new 245,000-square-foot residence hall complex at the University of South Florida. "There is a tight labor market in central Florida, and builders are concerned about how fast they can complete a building," says Bill Abbate, President of Ytong Florida Inc. "Our panelized systems are competitive and can be erected very quickly."

AAC has also found early acceptance in motel, commercial, apartment, industrial, and residential construction. Nonstructural applications for AAC are also emerging. For example, thin veneers of AAC are being used as a replacement for failing exterior insulation and finish systems (EIFS). Taking advantage of suitability for carving, AAC is also being fabricated into moldings and trim pieces for the plastering trades.

Local trades like working with AAC, says Babb. "Number one, they like laying AAC [units] because they're lighter than regular CMUs," he says. "The other thing is that AAC is not taking away from other masonry work but adding new masonry work because it's much more likely that AAC is replacing wood studs or metal studs than it is replacing CMUs. It grows their market share at the expense of the stud market."

Two trade associations have combined into the Autoclaved Aerated Concrete Products Association (706-965-6061) to promote use of the material and coordinate the development of industry standards. The material is already recognized under ASTM C 1386-98A, "Standard Specification for Precast Autoclaved Aerated Wall Units" and ACI 523.2R, "Guide for Precast Cellular Concrete Floor, Roof, and Wall Units" and has been approved by the model building codes. Masonry labor organizations have endorsed the material, seeing it as a way to boost productivity and keep their members competitive.

While most producers are actively recruiting and training contractors to install AAC, Angelo Coduto, manager of Corporate Development at ACCO, says his firm has embraced a design-build strategy. "We sell a total package including the AAC structure, erection, and finishes, complete with a 7-year system warranty," he says. "By offering our customers a single-source responsibility, we have been able to overcome their concerns about using a new material."

Led by these companies, AAC has established a foothold in North America and appears set to break out into the construction mainstream. Since 1995, four AAC factories have been constructed here, a fifth will open this summer, equipment is on order for two more plants, two firms, including Babb International, have pilot plants to conduct R&D and test local markets, and plans are being laid for plants throughout the country.

Some leaders of this invasion predict that AAC production capacity will reach an eventual force of 40 or more AAC factories in North America. If plans for new production facilities are realized this year, North America will produce 3 million cubic yards of AAC in the next 2 to 3 years (see graph, page **32**). That total equates to more than 150 million square feet of wall, floors, and roofs and enough for an estimated 10,000 to 15,000 buildings per year.

Babb sees enough potential in AAC to eventually replace the framing material the company offers. In 1998 Babb International started AAC production out of a small research and development facility in Ringgold, which produces up to 500,000 units used mainly for demonstration projects. The next year, the company began building an AAC production facility on the site of its fly ash supplier in Clinton, Tenn., which will provide up to 110,000 tons of ash to allow

The AAC production process: a little like baking bread

The basic ingredients of autoclaved aerated concrete (AAC) include portland cement, lime, water, a siliceous fine-grained material like sand, and enough water to produce thin slurry. In lieu of some or all of the sand, it's possible to use fuel ash or mine trailings to reduce material costs and qualify a plant for tax credits or other incentives for recycling an industrial byproduct.

After these materials are mixed into slurry, a small amount of powdered aluminum slurry is added just before placement into large, rail-mounted forms. Because the mixture foams, forms are filled only partially at this stage. The aluminum reacts with alkaline elements in the cement and lime, forming hydrogen gas, which in turn forms a uniformly dispersed cellular structure. This increases the volume of the concrete by about fivefold and causes the fresh concrete to rise much like yeast causes bread to rise. During this roughly one-hour precuring stage, the forms must remain completely still, or the AAC collapses much as bread would collapse if the oven door were slammed.

When the concrete has hardened sufficiently for handling, the green concrete is removed from the mold. The molds are cleaned, treated with a form release agent, and returned to the head of the production line for the next batch. A machine resembling a giant bread slicer then cuts the aerated concrete to the required block or reinforced panel sizes and, when required, with tongues and grooves on the units.

Next the units go into an autoclave, an enclosed pressurized chamber, which steam-cures them at about 350° F. The pressure from the autoclave causes the green concrete to crystallize, forming a fully hydrated, inert, dimensionally stable mineral called Tobermorite (Ca5 Si6 O17 $5H_2O$), which gives AAC its unique performance attributes. Finally, the units go into a milling (separating) machine before being loaded on pallets for storage or shipping.

Any excess trimmings or scrap are ground and mixed back into the slurry, resulting in a process with almost no waste. Most plants are highly automated and can be run with a fairly small crew.

Depending upon the capacity of the plant and whether it is designed to produce panels as well as block, the total investment for an AAC plant is generally estimated at $20 million to $35 million. Used plants are also available. Another cost variable is whether the operation requires a ball mill to grind siliceous material to the required size.

Acknowledgement

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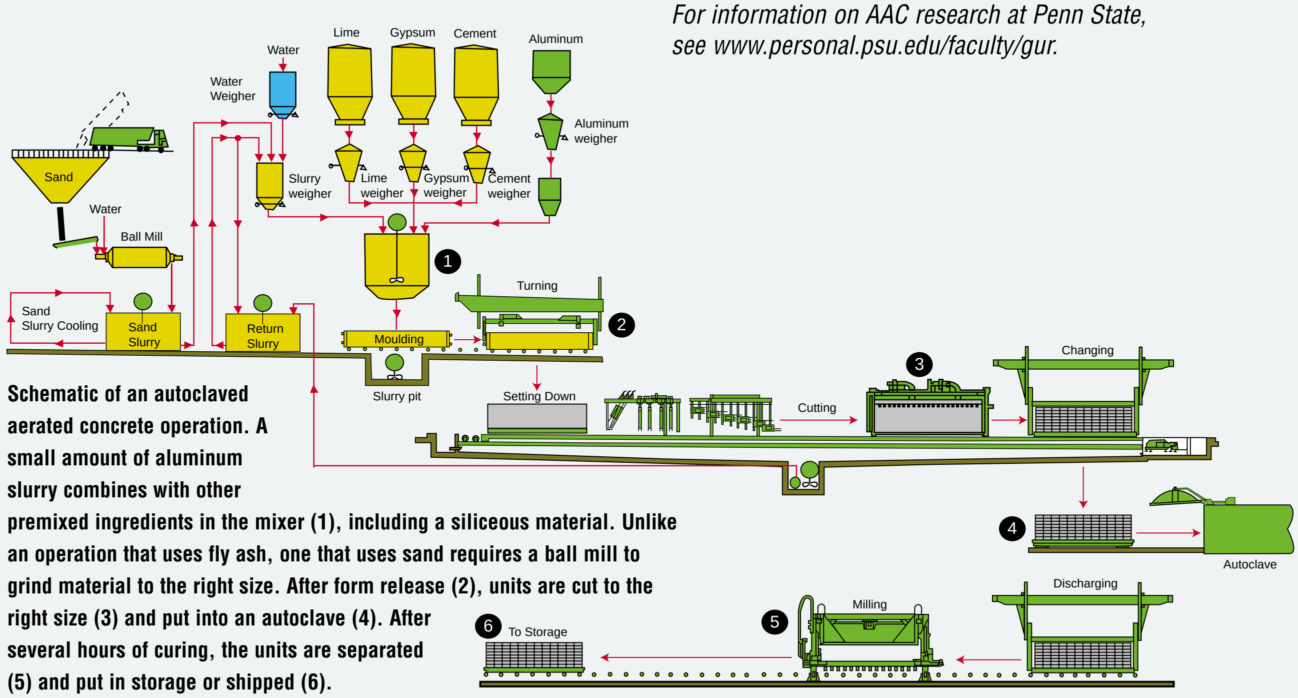

Schematic of an autoclaved aerated concrete operation. A small amount of aluminum slurry combines with other premixed ingredients in the mixer (1), including a siliceous material. Unlike an operation that uses fly ash, one that uses sand requires a ball mill to grind material to the right size. After form release (2), units are cut to the right size (3) and put into an autoclave (4). After several hours of curing, the units are separated (5) and put in storage or shipped (6).

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the facility to produce 6 million to 10 million AAC blocks per year. As the AAC market develops, the company plans to build additional facilities next to coal-burning power plants.

Threat or opportunity?

AAC will reach critical mass in North America only if producers embrace it as an addition to the products they already offer. The best strategy may be for domestic producers to combine the best of the old products with that of the new. For example, the producer could offer prestressed members for structural framing and light-weight AAC panels for floor and wall infill. A CMU producer who also offered AAC could be assured of offering customers their choice of the best masonry unit for a particular job.

Who would be better suited than a concrete producer to introduce AAC into the local market? With their existing material-handling capabilities, basic understanding of cement technology, sales and distribution channels, and access to an established client base, producers already have much of the infrastructure for an AAC business in place.

The real victory will be for the U.S. building industry, which will gain, with AAC, a valuable new product in its arsenal of building materials.

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