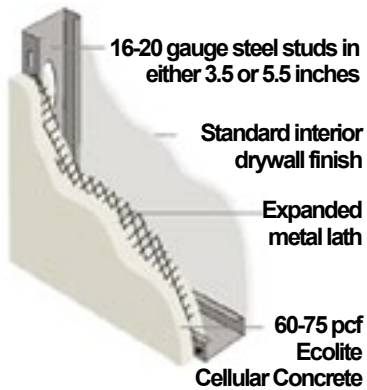


FROM
Concrete Products

**AMBITIOUS PROJECT
SPURS CELLULAR
CONCRETE
WALL SYSTEM'S
COMMERCIALIZATION**



SCHEMATIC: Ecolite Concrete USA

Ecolite's pre-engineered, prefabricated wall system incorporates cellular concrete cast into panelized cold-formed steel stud framing to produce a high-performance, ready-to-erect wall.

Cellular concrete is 50 percent air by volume. Billions of tiny air bubbles give the wall high fire resistance, excellent acoustic insulation, and three times the thermal resistance of concrete block, Ecolite developers affirm.

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THE ULTIMATE TEST

BY STEVEN H. MILLER

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A U.S. Army Corps of Engineers (USACE) contract for a 56-building complex in the southern California desert provided the brutal proving ground for Ecolite Concrete's new wall system. As a building mock-up incorporating Ecolite was the yield of three years of research and development, the USACE project supplied the first occasion to bridge the gap between prototype and proof of concept. And, it had to be accomplished quickly.

The design-build proposal that won the mid-2007 job was bold: completion of all 56 structures in just six months. Further compounding the challenge, that schedule included the time required to bring Ecolite's first factory online.

The six-month timetable spurred an exhilarating ride up the learning curve. Inevitable bugs in the system had to be resolved under real-world construction conditions, while big money was on the line, as well as the lives of soldiers, whose fate would depend on the structures' integrity. Having supplied ample proof of its benefits, Ecolite has since been approved by USACE for the project's next phase, while the system's developer is now poised to expand production nationwide.

LIGHTER, STRONGER, FASTER

Ecolite is a hybrid prefabricated wall, optimizing the strengths of lightweight cellular concrete and panelized cold-formed steel stud framing. It achieves composite strength and high performance with a weight of only 15 lb./sq. ft., i.e., 20 percent of the weight of typical precast panels, and 25 percent of the weight of concrete masonry units (CMUs). Accordingly, Ecolite panels comprising 2-in.-thick concrete can serve as load-bearing walls for structures up to six stories tall; or, they can be used as building cladding.

The brainchild of Brian Smith, CEO of Ecolite Concrete USA in Carlsbad, Calif., the hybrid system was conceived when he envisioned walls with precast's durability and speedy erection, but without the weight of conventional concrete. He was impressed by the light weight and strength of steel stud construction; yet, he had concerns that

light-gauge steel framing was time-consuming and did not provide a weather-resistant building enclosure. Thus, by combining the two proven technologies in a synergistic manner, Smith created an innovative system offering the best attributes of each material, plus enhanced performance properties.

The Ecolite Concrete wall system is elegant in its simplicity: studs are partially embedded in cellular concrete, with expanded metal lath aiding the bond, to create a complete, ready-to-erect wall. "The concrete and framing work together," Smith explains, "to provide both the skin and bones of a building."

Panelized steel-stud framing is fabricated with digital speed and precision. Architectural drawings are converted into a Building Information Modeling (BIM) format that provides computer instructions for an automated steel roll-former. The machine shapes and cuts the studs and rails to exact length; notches and swages them for precise fit; drills and dimples them for fasteners; and, prepunches utility access holes.

Digital precision in fabrication makes it possible for unskilled workers to assemble the panels using simple tools on a plain, flat table. Expanded metal mesh is then attached over one entire surface to form the composite bond between steel and concrete.

The panel is placed on a casting table, metal mesh facing down, with an edge-form suspending the panel at a precise height over the casting surface. Self-consolidating cementitious slurry is pumped into the panel until the metal lath and one inch of steel frame are embedded.

The slurry cures into a cellular concrete with unusual high-performance properties, owing to a powerful, yet extremely affordable and abundant additive—air. Billions of microscopic air bubbles comprise 50 percent of the concrete's volume.

Due to air content, an Ecolite wall of 2-in.-thick concrete tests to two hours of fire resistance. It demonstrates thermal resistance of R-4 (as compared to a 6-in. CMU's R-1.4). Add one layer of 5/8-in. drywall, plus simple insulation, and the Ecolite wall achieves a Sound Transmission Class (STC) of 52.



PLANT, SITE PHOTOS: Steven Miller for Ecolite Concrete USA

Fabricated by a computer-controlled system, steel elements conform to accurate dimensions that ensure they fit together precisely. Assembly requires small teams and simple tools. Expanded metal mesh attached to the light-gauge steel framing forms a composite bond with the concrete.



Self-consolidating cellular concrete slurry pumped into frames embeds the metal mesh and one inch of the steel stud. Composite action of the two materials enhances performance to exceed that of either material alone.

Proving that the composite action of concrete and steel imparts high strength, Ecolite walls passed the stringent Miami-Dade County Windblown Missile Impact test for hurricane safety.

Their shear resistance also has been determined adequate for use in highest seismic activity zones.

The finished walls are light enough to handle with a forklift or small crane. They are stacked vertically on A-frames for transport on a light-duty trailer. At the job site, they transition directly from A-frame to erection: a forklift lowers the wall onto the foundation, where embedded bolts mate with prepunched holes in the wall's bottom rail.

Panels are then bolted down and screwed edge-to-edge to adjoining walls. A crew of four plus a forklift operator can erect a wall in less than 10 minutes. While one member finishes wall-to-wall connections, the other three can position the next panel.

BOLD AMBITIONS

By the end of 2006, when the system was ready for launch, George Rogers, CEO of RQ Construction in Bonsall, Calif., realized that its economy and speed of construction could help him win a large military contract. The U.S. Army National Training Center (NTC) at Fort Irwin, Calif., planned to construct a 600-building Military Operations in Urban Terrain (MOUT) training facility to simulate Middle East combat conditions. Phase I of the project would entail construction of 56 buildings designed as the upscale neighborhood of "Jabal," one of 10 NTC training villages. In view of considerable logistical challenges presented by the remote Mojave desert site, USACE deemed its original cast-in-place and CMU design too costly and sought alternative proposals.

Addressing such concerns, Rogers offered to construct all 56 buildings with Ecolite, cutting the project's estimated cost 30 percent and slashing the schedule from one year to six months. The Army's examination of the new system prompted its acceptance of RQ Construction's bid.

At the outset, Rogers admitted that the venture as presented comprised "an incredibly fast project." Nonetheless, believing in both the product and the project's significance, he endeavored to meet the terms of the proposal. In a March 2007 interview, when basic site-work was just beginning, he said, "The troops will be able to train at MOUT six months earlier. Hopefully, it will save lives."

RAMPING UP

When the contract was let on February 1, 2007, an Ecolite plant had yet to be established. In short order, an existing 22,000-sq.-ft. building was acquired in Barstow, Calif., about 45 miles from the job site. In early February, while the foundation slab for two silos was curing, a batch plant arrived, operating from inside a standard shipping container. Tilt casting tables were installed. Automated roll-forming machines, customized with extra punches

for Ecolite production, were imported from New Zealand. And, panel-assembly tables were built with the first steel studs from those machines.

In early March, as site work began at Fort Irwin, engineering of the Ecolite walls commenced. Simultaneously, Ecolite Vice President of Operations Waco Merchant poured test cylinders to optimize the mix design. He needed a concrete that would develop strength quickly enough to enable stripping of panels from casting tables after curing overnight and shipment two days later. Containing up to 50 percent fly ash, Ecolite's concrete mix attains up to 4,000 psi in 180 days, a remarkable feat for concrete with a density of just 65 lb./cu. ft.

Meanwhile, Ecolite General Manager J.D. Standridge trained his primary steel-assembly crew—recruits from the local labor pool with no previous construction experience—in less than three weeks. In turn, they trained the next wave of novices. The plant eventually operated five assembly tables manned by three-worker teams, each table producing three walls per day.

Concrete pouring required teams of three or four men: one operated the slurry hose, which was managed by another; and, the others cleaned stray slurry. Two pouring teams casting continuously kept pace with the steel teams' output. The factory typically produced 12 wall units per day, totaling about 1,440 sq. ft. To produce twice that quantity with the same batch plant, only additional steel forming capacity and more casting tables would be needed.

WORKING OUT THE BUGS

The first walls were cast and erected in early April 2007. Two weeks into construction, problems became evident. "This was a prototype factory," says George Rogers. "No one had ever built with Ecolite, and we did the pioneering work for everyone who will build with this system from now on." Thus, an essentially experimental system was fine tuned to create a completely workable construction method.

Keeping the walls square and straight was the greatest challenge. Unlike site framing, where adjustments can be made on the fly, the walls had to be accurate to 1/16 in. as cast. Onsite engineers rejected a wall if a screw connecting adjacent wall units had more than three exposed threads. Despite tight quality control, some completed walls were out of square or had bowed edges.

J.D. Standridge recalls, "We shut down for an entire month to resolve the dilemma." Careful tracking through the production process led to a solution, and the plant was soon back on track.

The factory was not able to produce as many walls per day as predicted, because some tilt-tables were located outside the building. With summer temperatures reaching 120°F, tables exposed to the sun got as hot as 150°–180°F. Consequently, form-release compounds fried before the slurry could be poured. Eventually, outdoor tables could be used only at night. "If we had put

all the tables indoors," says Merchant, "we could have completed this project in half the time."

Other start-up issues were resolved without derailing the project schedule. "The hardest part was finding the right forklift operators," says Waco Merchant. "If the operator stripping walls from the tables doesn't lift them just right, corners spall and panels can be damaged. Training him was a lot harder than training a hose operator."

Extensive quality control at every step, with up to nine separate inspections, ensured highly consistent results and walls that were straight, square, smooth, and free from bug holes. The units survived a 45-mile trip to the job site that included 10 miles of rough, wash-boarded dirt roads. Panels damaged in handling were readily patched using WunderFixx, a rapid-setting, trowel-applied cementitious patching compound.

FAST WORK

Erection of the prefabricated walls was speedy, as crews were clocked placing walls in seven minutes each and completing a two-story, 10,000-sq.-ft. building in a single day. Overall, wall installation required four months.

"If we had known in the beginning what we knew by the end," says Rogers, "it would have taken two months." After interior finishing, as well as pouring concrete over panelized steel floor and roof decks, plus completing final details, the project was turned over to the owner on Oct 1.

John Kafides, MOUT manager for NTC, attests, "The Ecolite Concrete wall system saved a lot of time and money." Adds NTC Public Information Officer John Wagstaffe, "If the project were built with field-assembled framing, concrete block, stucco, or other conventional materials, they might have been able to build one building in the time it us took to build this entire town."

COMMERCIALIZATION

So encouraging was the construction experience of Phase I that USACE listed Ecolite by name

as an acceptable material in the bid specification for Phase II. RQ Construction is putting together bids using Ecolite on other military projects as well. Ecolite CEO Brian Smith foresees a broad array of applications for his product, both as load-bearing walls for low- and mid-rise buildings and as curtain wall for high-rise structures. "Although walls for NTC had no architectural details, the system is compatible with a wide range of architectural styles," Smith notes. "With form liners, we can create architectural detail or simulate wood or brick finishes. We also can cast in thin brick or natural stone veneers. We believe Ecolite will be an economical choice for schools, hospitals, multifamily housing, commercial, and retail applications. It is a new option for a wide range of general construction." Additionally, Ecolite's sustainable construction credentials are noteworthy. Its concrete component contains up to 50 percent recycled material, and locally extracted aggregate can be used in the mix. Steel studs also can be sourced with high recycled content. Plant fabrication produces less than 5 percent waste, all recyclable; and, virtually no jobsite waste is produced. Light wall weight minimizes both energy consumption and pollution associated with trucking. The walls emit zero VOCs and do not support mold growth. Cellular concrete provides thermal insulation, which can be easily augmented with insulation installed within stud cavities.

To build a nationwide network of Ecolite factories, Smith is seeking "distribution partners" through a business model that allows precasters, steel fabricators, or contractors to easily offer Ecolite to expand their operations. "We're looking for construction industry professionals with the right experience and contacts," explains Smith. "If a builder can guarantee a sufficient minimum number of square feet per year, we will build a factory and work out a profit-sharing arrangement. We want to make it easy for qualified people to build with Ecolite."

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Walls are stacked onto special A-frames for loading onto light-duty trailers for early-morning transport 45 miles to the job site. In spite of 10 miles of rough, wash-boarded dirt road, the panels arrived intact.



PHOTO: Ecolite Concrete USA

At Fort Irwin, a panel is placed for a 10,000-sq.-ft. structure erected in a single day. The lightweight walls at 15 lb./sq. ft. require only a small forklift or light-duty crane for handling.

