Cellular Concrete

What Is It and Why Would I Use It

By Scott M. Taylor, P.E., MBA

Too many Pipes! Using a lightweight flowable product saved significant time and labor.

Despite the fact that cellular concrete has been used in the construction industry for nearly a century, it is not uncommon for designers to be unfamiliar with this versatile lightweight product. "What is this stuff?" and "Why haven't I heard of this before?" are very common questions.

The primary reason cellular concrete has gained popularity so slowly in the civil/structural market is that the manufacturers have focused on flooring and roofing for the past 50 years. Now that installers are casting a wider net due to the recent economic downturn, the civil/structural engineering world is starting to realize the vast benefits of cellular concrete. We are seeing the variety of uses expanding daily by enthusiastic and creative engineers everywhere.

There are rumors of a Swedish patent for cellular concrete from 1923. If the patent is proven true, the origins of cellular concrete could be traced back to before 1923. Unfortunately, the actual origins remain unconfirmed. It has also been widely believed that cellular concrete was developed in Germany in the 1940s. We do know it was brought to the United States in the 1950s as a lightweight floor leveling product.

What Is Cellular Concrete?

Cellular concrete is a carefully crafted mixture of cement, water and preformed foam. This material is mixed to a specified density and pumped into any void. The fundamentals are simple, but the applications and the ability to mix properly and at high production rates can be challenging.

The highly specialized equipment varies by contracting company. Each has spent years developing its own version of high-production equipment. The equipment cannot be purchased off the shelf and must be custom made. There is a network of foam manufacturers and highly trained specialty contractors throughout in the country to provide competitive pricing.

In many areas of the country, state departments of transportation (DOTs) have developed standards

Large volumes in congested areas and difficult access are easy with cellular concrete. Shown is an 18-inch deep utility fill in San Francisco.

Scott M. Taylor, P.E., MBA, is Vice President for Cell-Crete Corporation, managing the Engineered Fill department. He can be reached at ***staylor@cell-crete.com****.*

Lightweight foundation fills that are excavatable yet placed cost effectively and extremely fast.

Load balancing fills adjacent to existing structures do not cause adverse movement.

for cellular concrete, and more are in development. Large agencies, such as the U.S. Army Corp of Engineers, Caltrans, Florida DOT and many large-scale builders are steady consumers of this product and proponents for its many uses. Many agencies and engineers are learning about the benefits, and the cellular concrete industry hopes the product will soon be a standard product in all 50 states.

Cellular concrete can be provided at any density desired. As it gets heavier, it gets stronger but also more expensive. Your local provider is the best source for the determining the strength-to-weight relationship, as it varies a little with local cement quality and fly ash content. The standard cellular concrete mix weighs 30 pcf, with an average compressive strength of approximately 100 psi (14,400 psf).

Where Does It Go and Why?

Basically, cellular concrete can be pumped into any space. It is highly fluid and easily pumpable. This geotechnically strong, ultra-lightweight fill provides the following benefits to the structural engineer:

1) Lightweight fill in or below the structure
2) Zero lateral loading on adjacent walls, sheet piles or retaining structures
3) Long distance placement for tight locations
4) Extremely high bearing capacities
5) Insulation properties
6) Quick and easy void filling within the structure
7) Plaza fills at lower costs than those of other lightweight fills
8) Roof fills paired with expanded polystyrene (EPS)
9) Rat slabs

Why Would I Use Cellular Concrete on My Project?

The reason is simple: money!!! Basic economics require any new solution to be either better or more cost-effective than the current system. With cellular concrete, both may apply depending on the application. Here are a few examples:

Building Support and Load Balancing

What if you put the material under your building because you are concerned about the bearing capacity of the site soils or deep settlement? Placing cellular concrete in a uniform layer under the building provides a strong non-expansive base and reduces the overall weight of the new structure. Structural engineers then can revise the foundation system for this stronger, more stable, non-expansive subgrade. A win-win situation, especially in challenging site conditions such as those near waterfronts and over soft soils.

Zero Lateral Loading

Another standard use for cellular concrete is the "zero lateral load" concept. For a structure that requires exterior retaining walls, replacing some amount of heavy soil on the outside of the structure significantly reduces the lateral loading in the design. Cellular is placed in relatively shallow lifts, creating minor lateral fluid pressure for about 6 hours. After it hardens, the cohesion is so strong there is no lateral loading applied to the retaining structure. If there is no lateral loading, why does it need a retaining wall at all? A simple erosion face, is all that's needed to protect the vertical face which is self-supporting.

Rehabilitations and Metropolitan Work

In rehabilitation work, there are often voids under slabs, behind walls, or in newly

Cellular concrete flows into every nook and cranny with no vibration or placement effort.

continued on page 44

constructed hidden areas. An example is buildings constructed in pits, which are then backfilled around each building after the below-grade portion is complete. Utility trenches also require backfilling, but the large numbers of pipes within a trench may pose a challenge for proper compaction. These areas can be filled with highly fluid cellular concrete at high-volume rates by running a hose to the location and pumping from the street. This method is relatively easy and clean (no wheelbarrows). The work above the fill can proceed the next work day.

Lightweight Plaza Fills

Large structures are often designed to include roof gardens. To create the feel of a proper garden, the structure is built 4 feet below the finished grade to allow room for utilities and tree roots. This area is then filled with a lightweight material to provide subgrade for the surface slabs. Cellular Concrete is easy to apply in this situation as a poured-in-place product. There is no cutting required, and there is no concern about the shape/sloping of the structure. Nearly the lightest of all fills, Cellular Concrete is simply the most cost effective solution. When designed for a mix design density of 25-27 pcf, the structural reinforcing rarely changes due to the weight of this fill over other alternatives.

Hillside Residential Foundations: A Simpler Design

For a new home to be built on a hill, a typical foundation design is to install deep piles typically spaced 8 feet apart. An alternative is excavating a trench at foundation lines down to bedrock and then backfill with cellular concrete. In some cases, savings of over 75% have been realized, with a dramatically more stable foundation system as it interlocks with the bedrock over larger areas. The foundation system should then be revised according to the new subgrade.

Lightweight Insulated Concrete Roofs

This long-standing hybrid system combines the high insulation value of Expanded PolyStyrene (EPS) with the strength of cellular concrete. In this system, an EPS tapered system is installed to create the insulation value then a 2-inch layer of 250 psi cellular concrete gives the roof the strong surface for the waterproofing layer to adhere. The savings starts in the ability to build the structure with a simple flat roof, and construct the slope-to-drain in the foam. Savings continue since EPS and Cellular are typically the least expensive insulation/sloping system. A very important long term benefit for the customer is that the insulation does not need to be replaced when reroofing the building.

Conclusions

The various applications and benefits described above, as well as many others, are available to the knowledgeable structural engineer who has cellular concrete in his toolbox. This versatile, easy-to-apply material is readily available from regional specialty contractors who can provide a wealth of knowledge, experience and design assistance.▪