HAHN READY MIX

Lightweight Concrete

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A versatile material for the modern construction industry.

Lightweight concrete is a fascinating and useful material that allows us to overcome various engineering challenges. But what is it? How does it work? Is it a fit for your next project?

What is Lightweight Concrete?

Lightweight concrete is made by replacing the coarse aggregate (or coarse and some of the fine aggregates) with a lighter weight particle. This results in two subcategories of lightweight, based on the type of lightweight particle used. **Structural Lightweight Concrete** uses a porous stone such as pumice, or expanded materials such as expanded shale or expanded slag to replace the coarse aggregate. Traditional concrete has a unit weight typically between 140-155lbs/ft^3, Structural Lightweight concrete will weigh in at 90-120lbs/ft^3. **Cellular Concrete**, sometimes known as foamed concrete, uses injected foam as a replacement for the coarse aggregate. Cellular concrete has a density of 25-80lbs/ft^3.

Expanded Shale

What is the purpose of Lightweight Concrete?

The primary use for structural lightweight is to reduce the dead load of the concrete and thus reduce the necessary size or quantity of columns, footings, or structural steel. This is very beneficial in high rise buildings, where the cost savings of making lightweight floors and reducing the steel could be immense. Lightweight concrete has other benefits too: it has a higher R-value for insulation than conventional concrete, is a much better sound-proofer and has a better fire rating. Often it will be used in rooms that are designed to be loud for noise insulation, or in a room where critical files or servers are to be kept and extra fire resistance is desirable.

Restrained Assembly Fire Rating	Minimum Slab Thickness on 2 or 3 in. Steel Floor or Form Deck without Spray-Applied Fireproofing	
	Lightweight Concrete (107-113 pcf)	Normal-weight Concrete (147-153 pcf)
1 hour	2⅝ in.	3½ in.
2 hours	3¼ in.	4½ in.
3 hours	4³⁄₁₆ in.	5¼ in.

My Lightweight spec has limits on density, how does that work?

Most lightweight jobs will specify a limit for the maximum weight per cubic foot of concrete. This can be confusing though, as there are three different phases of moisture that can affect a density value. **Oven-Dry or Dry Density** is assuming the concrete is absolutely absent of free moisture when it is tested. This is impractical to get to this state without an oven, and unlikely to be the state the concrete will experience in service. If a spec calls out an oven dry density, it may be good to clarify

with the engineer what they are really looking for. **Equilibrium Density** is the assumed state of the concrete in service when it has been allowed to air dry. This should be the metric that is used to specify density. **Fresh Density** is the weight of a cubic foot of plastic concrete at time of placement. Often, inspectors will try to enforce equilibrium density limits on fresh concrete, but fresh density should be 3-8lbs heavier than equilibrium density. The exact value of this can be determined during the trial batch process to help make sure concrete being placed will meet specified density requirements.

Sounds Great! Are there any downsides to Lightweight Concrete?

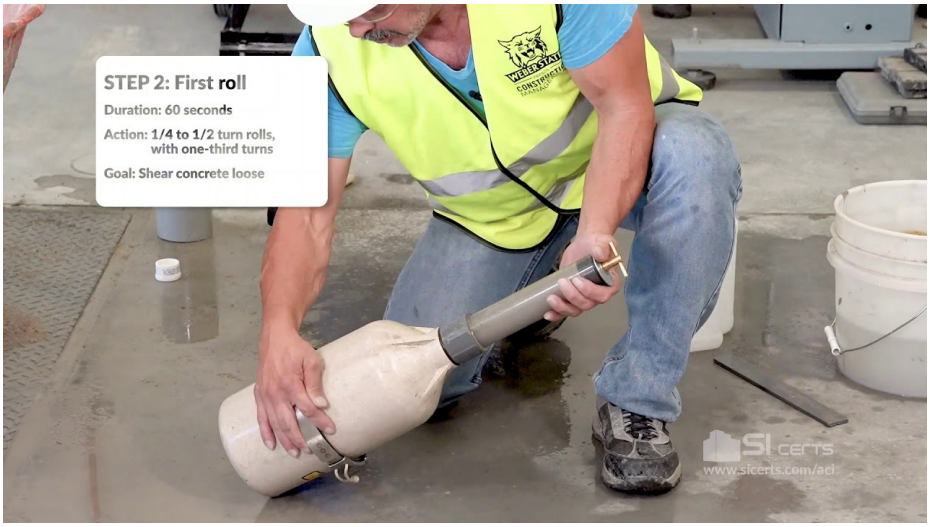
Unfortunately, yes. First and foremost is strength. In general, as density decreases so correlates strength. It is very possible to make a 110lb/ft^3 mix achieve 4000psi, but that would be quite the achievement at 90lbs/ft3. Cellular concretes that are say 30lbs/ft^3 might only achieve 100psi.

Lightweight aggregates MUST be saturated with water prior to use in a lightweight concrete mix. In a perfect world, this would mean the aggregate is completely submerged for at least 72 hours. Such a process is challenging as many ready mix producers are not set up with a great mechanism to complete this saturation even in good weather. During the winter months, this challenge is near unachievable. Lightweight mixes without complete saturation of the aggregate are neigh impossible to pump, will have variable densities, finishing and bleeding characteristics.

Pumping is difficult for lightweight concrete even with proper saturation of the aggregates. Care must be taken to use the largest line possible (5" at least), use the lowest pressure possible, and the vertical fall of the concrete should be minimized.

Due to the saturation of the aggregates and the moisture they carry into the concrete mix, it is not possible to accurately access a w/cm ratio. Some engineers struggle with this idea and reject the prospect of lightweight concrete due to this factor alone.

One of the mechanisms used for reducing the weight of lightweight is targeting 7% air. A pressure air pot cannot be used to test air in lightweight concrete, a roll-a-meter must be used, which is a tiresome and not often used process. The presence of entrained air in the mix design also presents a finishing issue on lightweight floors. Air can cause the concrete to stick to trowels like it can with conventional concrete, but this is partially mitigated by the excessive bleed often present in fully saturated lightweight concrete.



If proper preparations are made and executed, lightweight concrete can save a project huge sums in construction costs. It allows us to overcome some very specific challenges and use concrete in new and exciting ways.

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Hahn Ready Mix
3636 West River Drive, Davenport, IA 52802