

GO WITH THE FLOW

**Pumping Structural
Lightweight Concrete**



| 973' TALL COMCAST BUILDING, PHILADELPHIA, PA



Expanded Shale, Clay and Slate Institute
Rotary Kiln Structural Lightweight Aggregate



Pumping technologies and a better understanding of the properties of lightweight aggregate allows easier and more efficient operations for pumping structural lightweight concrete.

Using this information, lightweight aggregate manufacturers, ready-mix producers, building and pumping contractors are working in concert with architects and engineers in a true “team approach” toward efficient use of lightweight concrete in today’s structures. With this team approach, ready-to-pump lightweight structural concrete can be produced, delivered and placed without complication. The following guidelines are intended to contribute to the success of your pumping operation.

What is Expanded Shale, Clay and Slate (ESCS)? It is a unique, ceramic lightweight aggregate prepared by expanding select shale, clay or slate in a rotary kiln at temperatures over 2000°F. The production and the raw materials selection processes are strictly controlled to insure a uniform, high quality product that is structurally strong, stable, durable and inert, yet also lightweight and insulative. ESCS gives designers greater flexibility in creating solutions to meet the challenges of dead load, terrain, seismic conditions, construction schedules and budgets in today’s marketplace.

Aggregate Saturation

The porous nature of lightweight aggregate may cause the material to absorb water when subjected to pumping pressures. Therefore, to achieve maximum pumpability for lightweight concrete, prewetting the aggregate is essential. The prewetting process is necessary to prevent the aggregate from absorbing water during the pumping process and allows the concrete to be delivered in a ready-to-pump condition. This minimizes slump loss, increases pumpability and maintains consistency.

Fresh & Cured Concrete Density

Prewetting the lightweight aggregate makes it more dense due to the absorption of the water. The fresh unit weight of the concrete increases proportionately. The water absorbed into the aggregate helps promote beneficial internal curing of the lightweight concrete. Most of this water is ultimately lost in the natural drying process which takes about 90 days, which is when the concrete approaches its equilibrium density. More economical mixes may be used if design requirements for strength and/or unit weight can be extended to 56 or 90 days. ESCS lightweight aggregate manufacturers should be consulted for specific concrete properties and mix design recommendations.



Mix Design Considerations

Concrete mixtures may lose slump and/or air content during pumping. This should be anticipated when preparing the mix. The total water content of the pumpable lightweight concrete mix is composed of two parts: water absorbed inside the lightweight aggregate, and free water. The absorbed water does not affect the cement paste; therefore, as noted in ASTM C125 (Standard Terminology Relating to Concrete Aggregates), absorbed water is not used when calculating the water-cementitious materials ratio.

Field Pumping Trial

A pre-job field pumping trial is recommended. The actual job site pumping equipment and mix design should be used. The participants should include the contractor, architect, structural engineer, ready-mix supplier, pumping subcontractor, testing laboratory, and the lightweight aggregate supplier. For the trial, the distance and height that the lightweight concrete is to be pumped at the actual construction site should be simulated as closely as possible.

The Pumping System

Avoid rapid reduction in line size from the pump to the lines. Use the largest size line available. Operating pressure inside the line should be as low as functionally possible; this may be accomplished by maximizing the amount of steel line and minimizing the number of elbows, reducers, and rubber hose in the system. Proper hardware and/or hose configuration that prevents the concrete from dropping is essential to avoid loss of air from the concrete mixture during placement.

Field Adjustments

The architect, engineer, contractor, project manager, and pumping subcontractor must be aware as the job progresses that certain adjustments of the mix design (slump, air, aggregate proportions, cement, etc.) may be necessary.

Testing

Sample the concrete at the point of discharge from the pump. Allow a higher slump and air content for concrete going into the pump to compensate for the possible loss during pumping and to achieve the desired in-place result.

The Team Approach



| CIVIC CENTER ADDITION - DENVER, CO

Design Engineer

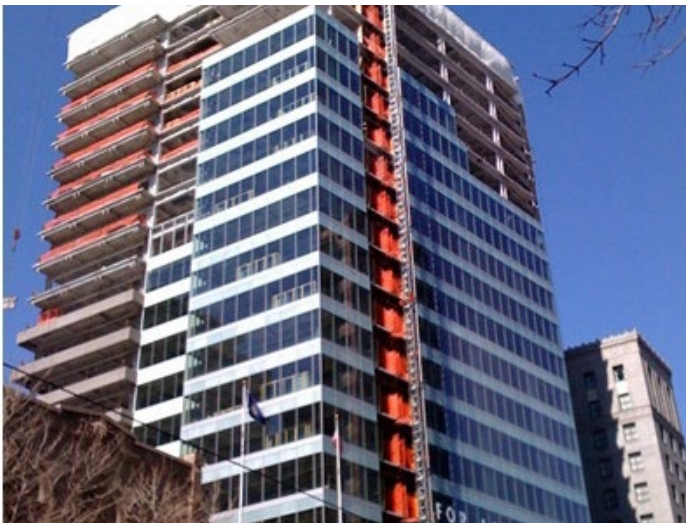
1. Mixes that are regularly used in a market area will be the most economical. Consult the lightweight aggregate suppliers for detailed mix design information and material capabilities (i.e., unit weight, strength, etc.).
2. Specify 4 to 7 percent air entrainment for pumpability, workability, finishability, and durability.
3. Specify the maximum size aggregate rather than specifying individual sizes.
4. Allow a higher slump into the pump to accommodate the possible slump loss.
5. Have the testing lab run design curves based on the maximum specified slump and air per ACI 301.
6. Specify a pre-pump meeting with the following present: engineer, architect, project manager, contractor, ready-mix supplier, lightweight aggregate supplier, testing agency, admixture supplier, and pumping subcontractor.
7. On large jobs, these same people that attended the pre-pump meeting should be present at the first concrete pump placement.
8. Specify where concrete should be tested, preferably at the end of the discharge line as per ACI 304.2R.
9. Realize that absorbed water does not affect water/cementations materials ratio, as defined in ASTM C125.

Ready-Mix Producers

1. The lightweight aggregate must be prewetted prior to batching using procedures recommended by the lightweight aggregate supplier.
2. Check with the lightweight aggregate supplier for a recommended concrete mix design and field correction procedures for pumped concrete.
3. The aggregate moisture content and/or unit weight should be checked at regular intervals through the day's placement. This is necessary for concrete yield control.
4. Make drivers aware of admixtures being used for slump control.
5. Maintain a minimum of 3" slump before the addition of high-range water reducing admixture.

Testing Labs

1. The field inspector shall be ACI Field Technician Grade 1 (or equivalent), per ASTM C94.
2. Make sure the inspector has properly calibrated tools including a roll-a-meter for volumetric air tests and a proper strike-off plate for unit weight determination.
3. On large jobs use the same inspector for all concrete placements.
4. The inspector should know fresh unit weight limitations (min & max).
5. Place test cylinders immediately upon casting in a curing box protected from vibration per ASTM C31.



| 307' TALL 222 S MAIN OFFICE TOWER - SALT LAKE CITY, UT



| 1,070' TALL SALESFORCE TOWER - SAN FRANCISCO, CA

Pumping Subcontractor

1. Know the required unit weight of the concrete being pumped.
2. Order concrete to coincide with actual pumping time, not when the pump arrives at the job site.
3. Maintain continuous placement.
4. Operator should know the maximum slump allowed.
5. Clean steel pump lines with a 5" minimum diameter should be used; minimize the use of rubber hose at the end of pump lines and avoid reducers if possible.
6. Keep the same pump and operator throughout the duration of the job.
7. Use a pump whose piston size is as close as possible to the line size to maintain the best performance and minimize slump loss.
8. It is necessary to properly lubricate the pump line before placing the concrete.

General Contractor

1. Keep everyone communicating; this is a team effort!
2. Use an experienced pumping subcontractor.
3. Make arrangements for two ready-mix trucks to unload simultaneously.
4. Designate a laborer to help the testing lab inspector.
5. Provide a washout area for ready-mix trucks.
6. Make use of the ready-mix truck radio when placement delays occur.
7. Specify to the ready-mix supplier the number of yards needed per hour, not how many truckloads.
8. Check that the pump line has been properly lubricated before placing the concrete.



Wherever you live, work, or play, ESCS improves your World!

For over 100 years, ESCS (Expanded Shale, Clay and Slate) has been used successfully around the world in more than 50 different types of applications. The most notable among these are concrete masonry, high-rise buildings, concrete bridge decks, precast and prestressed concrete elements, asphalt road surfaces, geo-technical fills and horticulture products.

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