

Perlite Aggregate for Lightweight Insulating Concrete

PERLITE—Its Origin and Use

Perlite is a siliceous volcanic rock mined in western United States. When crushed and quickly heated to above 15000 F., it expands to form lightweight, non-combustible, glass-like particles of cellular structure. This material, white or light gray in color, is about 1/10 the weight of sand or gravel.

Perlite aggregate consists of expanded perlite sized for use in lightweight fire retardant plaster or insulating concrete in place of sand or gravel. For easy handling and accurate on-the-job mixing, it is usually marketed in multi-wall paper bags of 3 or 4-cu. ft. capacity ready for use with cement or gypsum.

The many, tiny glass-sealed cells in each particle of expanded perlite make it highly insulating as well as comparatively non- absorptive. Thus perlite mixes with about 30% less water than comparable lightweight aggregates.

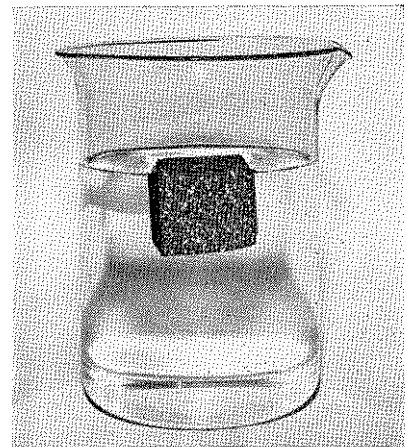
These advantages save time, labor and materials...

Light weight- Perlite in combination with Portland cement is the lightest of all mineral aggregate concretes. It can be designed with a density of 20 to 50 lb. per cu. Ft. By greatly reducing the deadweight of floor, roof and wall constructions, perlite concrete permits significant savings in structural steel and other building materials.

Fire-retardant - perlite concrete is incombustible and has received 4-hour ratings in Underwriters Laboratories fire tests. It is ideal for fire-retardant roof and floor fills, for thin concrete curtain walls and for precast panel and block constructions where insulation and fire resistance are required.

Insulating- Countless tiny air cells in perlite aggregate produce concrete with an insulating value up to 20 times better than ordinary concrete. A 2-inch thickness of perlite concrete provides insulation equal to that of 1-inch top quality insulation hoard, and is entirely inorganic—not subject to damage by water, vermin or fungus.

Workable- versatile perlite concrete can be job-mixed or transit-mixed, -and then poured, pumped, or plastered into place. Its light weight simplifies handling, speeds construction and reduces cost of placement. The dry concrete can be nailed, sawed and worked with ordinary carpentry tools.



Perlite concrete weighing 20 to 50 lbs./cu. ft. naturally floats on water weighing 62½ lbs./cu. ft.

Specifications

1. Recommendations

- a. For lightweight insulating perlite concrete, the proper mix proportions required for the compressive strength, thermal conductivity or other physical properties desired should be specified from the typical mix design table below.
- b. For insulating roof fills and short span structural roof decks, use a 27 lb. per cu. ft. density perlite concrete. Use 27 to 36 lb. per cu. ft. density perlite concrete for floor fills and short span lightweight floors.

2. Materials

- a. Cement shall be Type I, Type IT or Type III Portland cement meeting the requirements of ASTM Specification C-150.

- b. Aggregate shall meet the sieve analysis of Perlite Institute specifications for lightweight Type "A" concrete aggregate and shall have a loose density of 7½ to 12 lb. per cu. ft. when measured by the Shoveling Procedure of ASTM C-29.
- c. Air entraining admixture shall be a standard solution recommended by Perlite Institute aggregate manufacturers.
- d. Water shall be clear and free from oil, acid, alkali, organic matter or other deleterious substances, preferably potable.

3. Mixing

- a. Perlite concrete shall be mixed in a paddle type plaster or a drum type concrete mixer. The required amounts of water, air entraining admixture and Portland cement shall be placed in the mixer and shall be mixed until a slurry is formed. The proper quantity of perlite concrete aggregate shall then be added to the slurry and all materials mixed until design wet density is reached.
- b. Perlite concrete may also be transit mixed according to the procedure outlined above. The perlite aggregate manufacturer shall be consulted for transit-mix recommendations.

4. Placing

- a. Perlite concrete shall be carefully deposited and screeded in a continuous operation until a panel or section is completed. Steel troweling shall be avoided. Rodding, tamping and vibrating shall not be used unless so specified by the architect.
- b. One transverse highly compressible expansion joint one-inch thick shall be installed for every 100 lineal ft. of concrete and at all junctures of walls and concrete. A highly compressible expansion joint shall consist of any suitable material which will compress to at least half of its thickness under a compressive load of 25 lb. per sq. in.

5. Curing

- a. Perlite concrete shall be protected for at least the first three days in accordance with good job practice to keep it from drying too rapidly or freezing. Freshly poured concrete shall be given adequate protection against damage by heavy rain. No traffic shall be allowed until concrete can sustain a man's weight without indentation. For roof deck use, concrete shall cure at least 5 to 7 days before placing of the built-sip roof. If rain occurs at the end of the curing period, 1 to 2 additional days must be allowed before the built-up roof is placed.
- b. Perlite concrete shall not be placed in temperatures under 40° F, or on frosted surfaces. When it is anticipated that temperatures will be near or below 40°F. after the placing of the concrete, the mixing water shall be heated to a temperature of 75°F to 100°F. Provision also shall be made to protect the concrete from freezing until adequate strength is developed.

typical mix designs for lightweight Perlite insulating concrete

†Dry Concrete Properties							Mix Proportion by Volume				Field Tests	Materials Required for One Cubic Yard of Perlite Concrete†			
* oven dry density (lb per cu ft)	* compressive strength (psi at 28 days)	** thermal conductivity "k"	* coefficient of thermal expansion (per unit per °F)	* tensile strength (psi at 28 days)	* bond strength to steel (psi at 28 days)	* modulus of elasticity in compression (psi at 28 days)	cement (sacks)	Perlite (cu ft)	water (gal per sack cement)	air entraining agent *** (pints)	**† wet density as poured (lb per cu ft)	cement (sacks)	Perlite (cu ft)	water (gal)	air entraining agent *** (pints)
36	440	0.77	0.0000061	75	83	248,000	1	4	9	1	50½	6.75	27	61	6¾
30½	270	0.64	0.0000055	50	53	158,000	1	5	11	1½	45½	5.40	27	59½	6¾
27	180	0.58	0.0000048	40	23	120,000	1	6	12	1½	40½	4.50	27	54	6¾
††24	130	0.54	0.0000045	30	—	94,000	1	7	14	1¾	38	3.85	27	54	6¾
22	95	0.51	0.0000043	20	—	69,000	1	8	16	2	36½	3.38	27	54	6¾

* Based on impartial laboratory test data of Robert W. Hunt Co., Engrs. under sponsorship of the Perlite Institute. Average density of the aggregates used was 8.0 lb. per cu. ft. Strength data based on ASTM type I Portland cement.
† Data subject to modification due to variations in mixers and job conditions.

** From report dated April 8, 1953, of Armour Research Foundation of Illinois Institute of Technology.
*** Available from Perlite Institute members.
†† All data for this density is interpolated.

Ideal insulation for all types of roof deck designs

Due to its lightness, insulation value and permanence, perlite concrete fill is an economical and efficient roof insulation over structural roof decks of concrete or metal decking, and for light structural use over steel ribbed metal lath, asbestos board, paper-backed wire mesh and other suitable forms.

Perlite insulating concrete screeds smooth without steel troweling and forms a firm, monolithic surface, free from flaking, assuring a good bond for built-up roofing. In comparison with other concretes in the same weight class, perlite concrete mixes with 36% to 43% less water, sets up quicker, cures faster, and develops up to 58% greater strength.

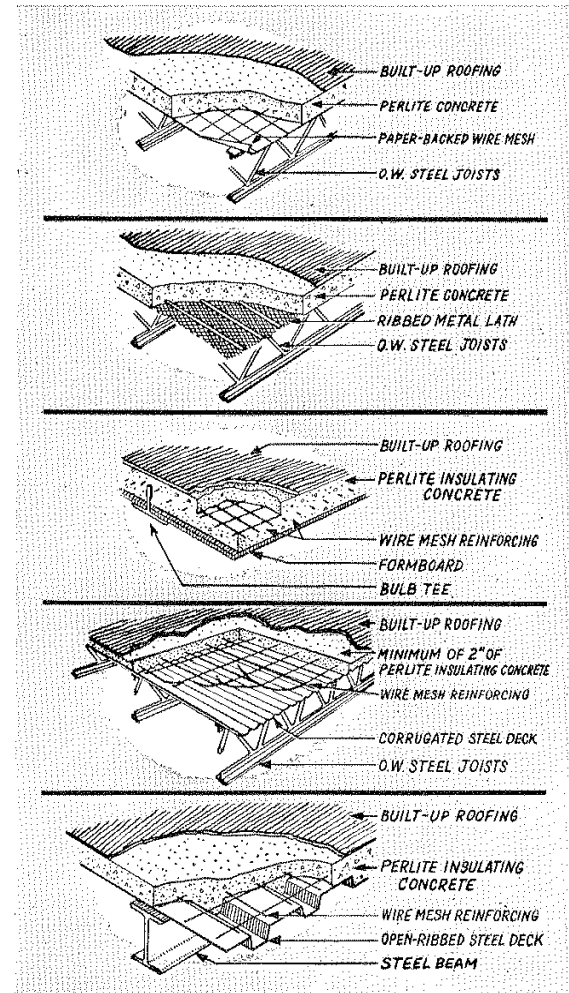
typical U factors of perlite concrete

The following calculated heat transmission coefficients for various thicknesses of perlite insulating concretes are based on values from the mix design chart on the opposite page.

mix ratio	1:4	1:5	1:6	1:7	1:8
average compressive strength	440 psi	270 psi	180 psi	130 psi	95 psi
oven dry density	36 pcf	30½ pcf	27 pcf	24 pcf	22 pcf
*2"	0.296	0.256	0.236	0.222	0.212
*3"	0.214	0.183	0.168	0.158	0.150
*4"	0.167	0.142	0.130	0.122	0.116
*6"	0.117	0.099	0.090	0.084	0.080
*8"	0.090	0.076	0.069	0.064	0.061

*calculated with the "c" values of inside air as 1.65 and outside air as 6.00

pour roof deck and insulation in one low-cost operation* . . .



For insulating fill on structural concrete or metal decks, the Perlite Institute recommends a minimum 2 in. thickness of a 1:6 mix of perlite concrete (one bag of Portland cement to 6 cu. ft. of perlite concrete aggregate). Perlite concrete is also recommended for light structural decks where it combines the functions of both roof slab and insulation. On flat roofs, the thickness of the perlite concrete insulation can be varied to provide adequate drainage slope so long as the minimum thickness required to provide the specified U factor is maintained.

Lightweight floor fill

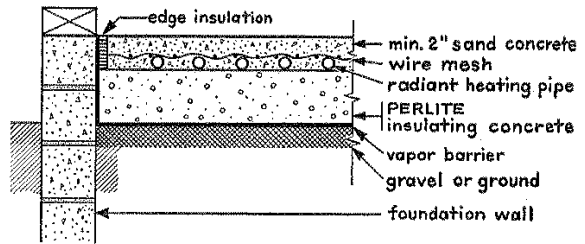
Immense savings in dead weight are possible by using perlite concrete as a floor fill over cellular steel or pan type floors in multistory buildings. A fill of not less than two-inch thickness is recommended. Ceramic tile or terrazzo may be applied directly over the perlite concrete. Where asphalt tile or similar floor covering is desired, the top surface of the perlite Concrete should be prepared according to the recommendation of the perlite manufacturer.

Grade level floor slabs and radiant heating

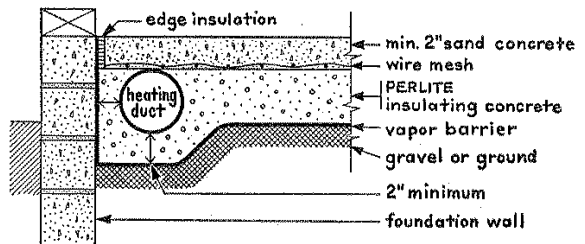
Used in floor slabs in basement-less homes, perlite insulating concrete minimizes costly heat loss into the ground, prevents moisture condensation on the floor surface during hot and humid weather, and increases year-round comfort. A moisture resistant harrier should be placed under the perlite concrete and a suitable wearing surface applied over it.

The operating economy of slab type radiant heating systems can be improved greatly by placing a slab of perlite insulating concrete under radiant heating pipes before they are embedded in heavy density concrete. Heat loss from hot air perimeter heating systems can also be minimized by embedding the hot air pipes in a perlite concrete sub-floor slab as shown below.

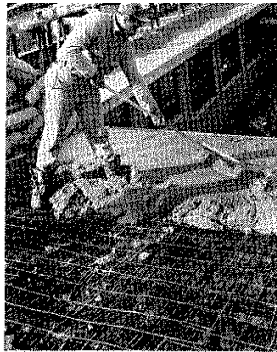
slab for radiant heating systems



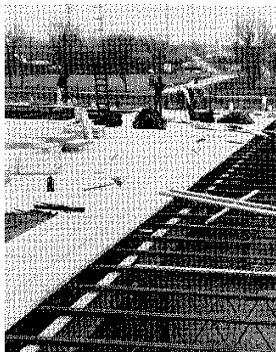
slab for perimeter heating systems



Perlite blocks have 4-hour fire rating in curtain wall construction.



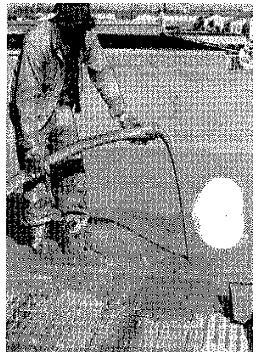
poured-in-place roof deck is light, insulating, fireproof. Screeds smooth for roofing.



Perlite slabs are light and easy to erect; combine roof deck and insulation in one unit.



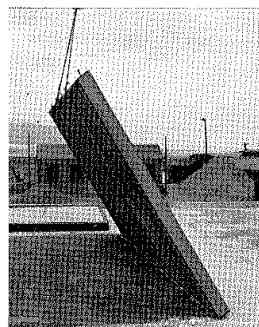
insulating slab of perlite concrete under radiant piping cuts heat loss to ground.



pumped-in-place roofs and sprayed-in-place walls can reduce costs.



floor fill of perlite concrete can save tons of deadload in multi-story buildings.



tilt-up panels are light, easy to handle; combine insulation with strength for many uses.



saw it, nail it—Perlite concrete can be worked with carpentry tools.



Perlite Institute, Inc.
4305 North Sixth Street, Suite A, Harrisburg, PA 17110
717.238.9723 / fax 717.238.9985 / www.perlite.org

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