Weight reduction is a prime requirement
in more and more construction projects.
One way to accomplish it is by building floors with...

PERLITE CONCRETE FILL

More and more of the nation's leading architects and contractors are today engaged in an all-out search for materials and methods with which to achieve economy in building. Out of this search a definite trend has developed toward lightweight floor construction as one of the most effective ways to keep costs down and at the same time improve the quality of the structure.

One of the more successful materials being used in lightweight floors is perlite concrete fill. Applied over various types of light structural forms including corrugated and ribbed steel, cellular steel floor units, ribbed metal lath and paper-backed wire mesh, lightweight perlite concrete fill results in a dead load considerably less than the rated live load.

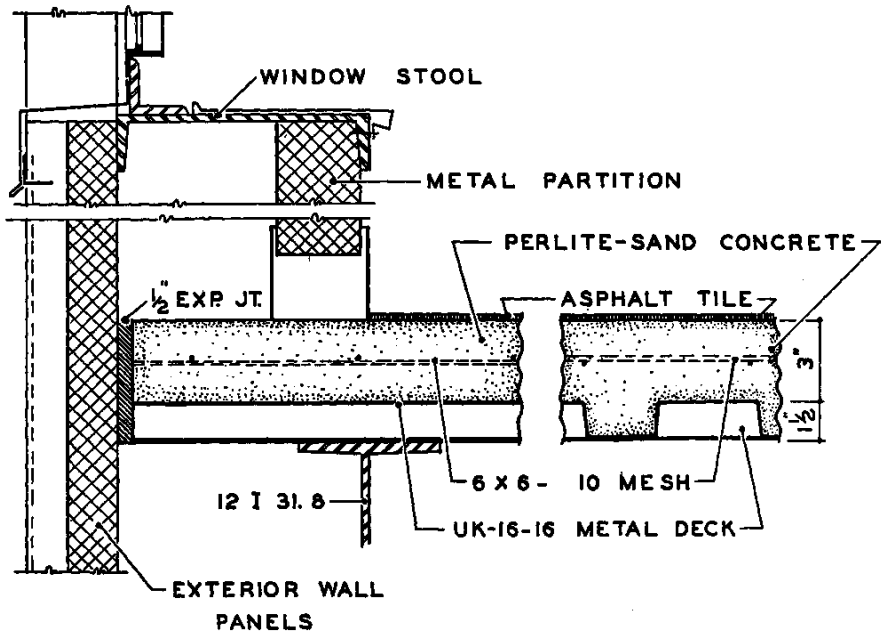
Two interesting new buildings now under construction present excellent examples of the methods of application and the advantages of this type of design. They are the quality control and general office building of the Mallory-Sharon Metals Corporation, Niles, Ohio, and the administration building of the Lansing, Michigan, airport.

According to Donald Lloyd Bostwick, AIA, designer of the Mallory-Sharon building, a perlite-sand concrete fill was specified because it permitted a dead load saving of 690,184 pounds. This total includes weight savings over regular concrete as well as the savings in structural steel that resulted from the reduced floor dead loads.

The architect specified a three-inch perlite-sand concrete fill over steel decking welded to the framing system. Floor ducts and conduits for electrical, telephone and other utility systems were embedded within the fill, which was specified for a minimum compressive strength of 900 psi.

F. Ivan Law Company, Youngstown, Ohio, was the concrete contractor who poured the 30,000 square feet of floor fill. The mix used was one bag of cement to one cubic foot of sand and four cubic feet of perlite concrete aggregate.

The 1½-cubic yard batches consisted of 8 bags of cement, 8 cubic feet of sand and 32 cubic feet (8



Detail of floor system using lightweight perlite-sand concrete

bags) of perlite concrete aggregate. To this was added 72 gallons of water and two pints of air entraining agent. The mixing time was seven minutes at 16 rpm.

The perlite-sand concrete was elevated to the second floor through a window by a bucket and tower arrangement, then dumped and transported to the point of application in motorized buggies of 10-cubic foot capacity. The lighter weight of the perlite concrete mix is said to make it easier and faster to apply, resulting in significant labor savings. When finished by steel troweling, the perlite-sand concrete was covered with asphalt tile.

"Since the lightweight perlite-sand concrete weighed approximately 55 pounds per cubic foot against 144 pounds per cubic foot for regular concrete," the architect reports, "there was a weight saving of over 22 pounds per square foot of the three-inch slab."

Another consideration, Mr. Bostwick adds, is that the perlite-concrete has good sound-deadening properties, an important efficiency factor in a building where exacting research is carried out.

Now nearing completion, the new 4-story airport terminal building at Lansing, Michigan, also features perlite-sand floor fills to lighten the weight of the structure and contribute to the fireproofing of the building. This project demonstrates the application of perlite-sand concrete over a metal pan deck. The mix design called for 1 bag of cement to three cubic feet of perlite concrete aggregate and two cubic feet of sand. A total of 125 cubic yards of the mix was poured to a floor thickness of three inches. The building was designed by Louis C. Kingscott & Associates, Kalamazoo, Michigan. Norstrom & Myers, Lansing, Michigan, is the general contractor.

General Application Techniques

Perlite concrete floor fill in composite structural systems not only permits substantial weight savings compared with regular concrete but cuts costs by reducing the erection and removal of concrete forms. It also represents at least a 40 percent weight saving over the use of heavier expanded aggregate concrete floor fills. According to the Perlite Institute, the perlite industry's international trade association, perlite-sand concrete fill can be applied without any topping, which is an expensive "must" for some types of concrete fill. In addition to being a one time application, the substantially lighter perlite-sand concrete is reported to be faster and easier to handle.

Perlite-Sand Concrete Mixes

There are actually several popular perlite-sand concrete mixes that are used to obtain different compressive strengths ranging from 700 to 1,500 psi. These blends are easily specified. Finished like ordinary concrete, they will produce floor fills with a dry weight between 50 and 75 Ibs. per cubic foot—or from one-third to one-half the weight of ordinary sand-gravel concrete.

The mix proportions and other data for perlite-sand mixes shown in the accompanying table are typical of the results encountered on the job by member companies of the Perlite Institute. Of course, contractors planning to use perlite-sand floor fills should consult their aggregate supplier for recommended mix proportions for any specific application.

Ready Mixed Perlite Concrete

Ready mixed concrete is very definitely in the perlite picture. When transit mixing perlite concrete for the first time, it is suggested that the perlite manufacturer be consulted for suggestions as to the correct mixing time and procedure. These may vary with the type and age of locally available equipment.

The mixing procedure used by many transit mix operations is as follows:

(1) Determine the load, based on the mixer rating as shown on the name plate.

(2) Add to the mixer the correct amount of water for the load, leaving out about 30 gallons.

(3) The correct amount of air entraining agent and cement is added to the mixer and mixed until a slurry is formed.

(4) Add the correct number of bags of perlite concrete aggregate and then, while the truck drum is revolving, slowly add the last 30 gallons of water to insure that all the perlite is in the mix. If the drum is rotated between plant and job it should be rotated at slow speed.

(5) Upon arriving at job, mix at top speed for not less than 5 or more than 30 minutes. Check wet density for conformance to specification range, dump and place immediately.

TYPICAL PERLITE-SAND CONCRETE MIXES

Cement (sacks)	Perlite (cu.ft.)	Sand (cu.ft.)	AEA (oz.)	Water (gal/sack)	Cement factor 100% yield	Density wet	Density dry	Compression 28-day, psi
1	4	1	8	9	5.4	60	50	700
1	3	2	12	8.2	5.87	83	69	1005
1	2.4	1.5	10	8.1	6.8	84	74	1230

RIGHT: Airport terminal floors are formed for three-inch thick perlite-sand concrete floor fill applied over a metal pan deck. This photo shows the screeding operation. When dry the floors will be finished with a variety of surfaces including asphalt tile, vinyl tiles, terrazzo, and quarry tile.

When mixing perlite concrete in regular paddle type mixers it is generally mixed for about 3 minutes in a 40 rpm mixer to achieve the proper wet density and workability. It is therefore suggested that 100 to 120 revolutions of the transit mixer drum should give good perlite concrete. Experience indicates that high-discharge type truck mixers have some advantages in handling perlite concrete.

If desired, the drum can be charged with water, air entraining agent and cement at the batching plant, and the perlite aggregate can be added at the job site, mixing at high speed until the desired density and consistency is reached.

Care must be taken to ensure proper mixing time for the perlite insulating concrete. Using the correct amount of water as specified, the perlite concrete should have a slump of approximately 7 inches when properly mixed and may appear too wet by normal concrete practices. However, if the mix appears too dry or stiff, the mixing time has probably been too short. Continue mixing until the desired plasticity is reached. Extra water

BELOW: Transit mixed perlite-sand concrete floor fill is shown being hoisted to the second floor of the new Airport Terminal Building of the Lansing, Michigan, airport. Scheduled for completion this fall, the new structure features perlite-sand concrete floor fills as a weight-saving material that also contributes to the fireproofing of the building.

and under mixing may reduce the yield.

The first truck load of perlite concrete will usually discharge about one-third of a yard short since this quantity will coat the inner walls of the truck drum. However, this will not occur in subsequent loads, because the walls will be coated sufficiently. After discharging the last load, 7-10 gallons of water may be added to the revolving drum to wash out this coating and this "soupy" mixture dumped and blended with other concrete from the previous load. This will not impair the perlite concrete properties because the excess water bleeds out without loss of cement.

Wire fabric reinforcement is recommended for all types of perlite concrete floor fills except where wire fabric is incorporated as part of the forming material.

Many contractors prefer high early strength portland cement in order to speed up finishing operations, to minimize the chances of damaging the slab before it has set, and to prepare the floor for traffic at an earlier date.

Another point to keep in mind is that all perlite-sand concrete floor fills should be protected for at least the first three days to keep them from drying out too rapidly or freezing.

The recommended method of finishing perlite concrete is steel troweling which produces a smooth hard finish to receive the final floor covering.

Finally, expansion and contraction joints should be provided at all junctures of floor and walls, and transverse expansion joints should be installed across every 100 lineal feet of fill.

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