E-A-B Associates (**Bayley-Edge Ltd.**)
3 Craven Court, Craven Rd., Altrincham, Cheshire, WA14 5DY, England
Tel.(0)161-926 9077, Fax (0)161-927 7718, e-mail all@eabassoc.co.uk http://www.eabassoc.co.uk

The Use of Foamed Concrete for Roofing

Roofing is probably the most widespread application of foamed concrete. Foamed concrete has two benefits when it is used for roofing. The first benefit is that it provides both thermal and sound insulation. The second benefit is that it can be used to lay a flat roof to falls, i.e. to provide a slope for drainage.

In countries where roofs are flat and where roof surfaces are used as part of everyday life, foamed concrete is strong enough to support foot or even vehicular traffic on the roof. Foamed concrete is also much lighter than slopes made from mortar screeds. This means that a roof with a slope made of foamed concrete has a lower loading on the structure of the building.

Properties of Foamed Concrete used for Roofing

Typically the foamed concrete is made with dry densities of between ~ 400 and ~ 600 kg/m^3. At this density range the thermal conductivity of foamed concrete is about 0.1 W/mK. The 28-day compressive strength would be about 1.0 - 2.5 N/mm^2. Please see Table 1 below for more information.

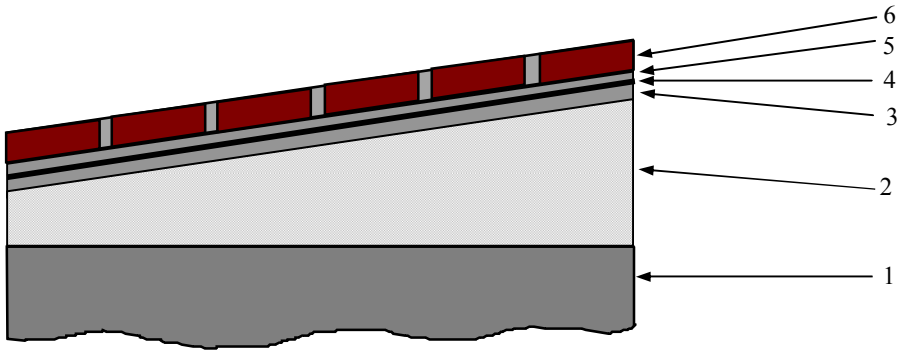
Traffic	Dry Density kg/m^3	Thermal Conductivity W/mK	Compressive Strength N/mm^2	Mix Design ratio sand:cement:water
no traffic	~ 400	0.1	1	0:1:0.55
foot traffic	~ 600	0.11	2.0 - 2.5	0:1:0.55
vehicular traffic, i.e. car parking	~ 1200	0.4	4.5 - 6.0	3:1:0.6

Table 1. Typical properties of foamed concrete using for roofing.

Foamed concrete with a dry density between ~ 400 and ~ 600 kg/m^3 is often made using a *cement only* mix design, as specified in Table 1. It is possible to make foamed concrete that contains sand, at this density, using a mix design ratio of 1:1:0.55 or even 1.5:1:0.55. The benefit of adding sand is that it will reduce the amount of cement required which will lower the cost of making the foamed concrete. However it will also reduce the strength of the foamed concrete. In its wet state, foamed concrete made using a cement only mix design will be more thixotropic or more 'sticky' than if sand is used. When making a slope from foamed concrete it is better for the foamed concrete to be more thixotropic.

TYPICAL FOAMED CONCRETE ROOFING SPECIFICATIONS

A typical roofing specification is shown below. In hot countries, where the temperature reaches about 45 °C additional insulation can be provided using expanded polystyrene, as shown in the diagrams on page 4.



Key

1. Structural Slab
2. Lightweight Foamed Concrete laid to falls (50 - 200 mm or more)
3. Sand Cement Screed (20 mm)
4. Waterproof membrane
5. Mortar
6. Tiles (cement or mosaic, spaced for expansion joint with sealant)

Placing Foamed Concrete on a Roof

A typical roofing specification would use a layer of foamed concrete from 50 to 200 mm. Please see figures 1 and 2 on the next page. These specifications include a layer of pre-formed insulation board which is used in hot countries where the temperature reaches about 45 °C. The pre-formed insulation board can be omitted in cooler climates. It is best to include a layer of waterproofing in the specification, however foamed concrete has a low water absorption so it is possible to omit the waterproofing layer.

To make the slopes on a roof, the depth of the foamed concrete is controlled in a variety of ways depending on the circumstances. On a narrow roof lines can be drawn on the parapet wall. On wider roofs, the best way is to work in strips of 2 to 3 meters wide, with wooden battons laid on the roof across which a timber bar can be pulled to smooth out the foamed concrete after pouring. The battons can either be placed across the roof, in which case the upper batton will be taller than the lower batton. Or the battons can be placed along the line of the slope, in which case the battons will be identical and angled up the line of the slope. It is also possible to use wooden pegs of different heights to mark the lines of the slope. Another way is to use scrap reinforcing bars fixed (at an angle) to the roof on little mounds of cement mortar. These can be left after the foamed concrete is poured, unlike the timber battons which can be removed and used again.

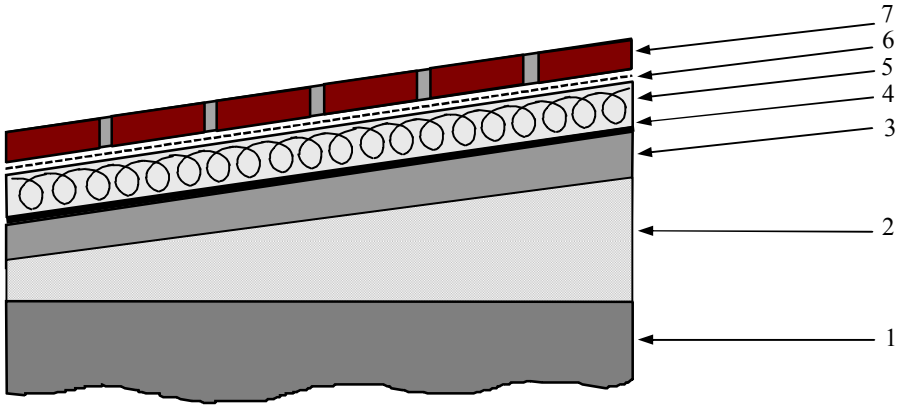
When working in strips (on large roofs), the normal way is to lay alternate strips, thus permitting workmen to walk either side of each strip as it is being laid so that it is easier to smooth off. Once the 'odd' numbered strips are hard enough to walk on, the 'even' strips can be laid.

When working with small batches, and/or on complicated roofs where making slopes by pulling bars across battons is not practical, wide, long handled squeegees can be used. The workmen may also have to wade through the foamed concrete to smooth it out, rather than walking along side strips.

If the roof is well organised, with battons in position and a knowledgeable work team, a 6 m^3 readymix load of foamed concrete can be pumped up and laid very quickly in one operation. In practice, things are rarely so easy, and work is often done in batches of about 1 m^3 a time. In this case it might take 2 or 3 hours to empty a readymix truck, which is impractical in hot countries. In this situation it is often better to use a small 2 m^3 capacity readymix truck or to make the foamed concrete in a site mixer. If a site mixer is used then the foamed concrete could even be made on the roof so that pumping the foamed concrete up to the roof can be avoided.

ROOFING SPECIFICATIONS – HOT COUNTRIES (45 °C)

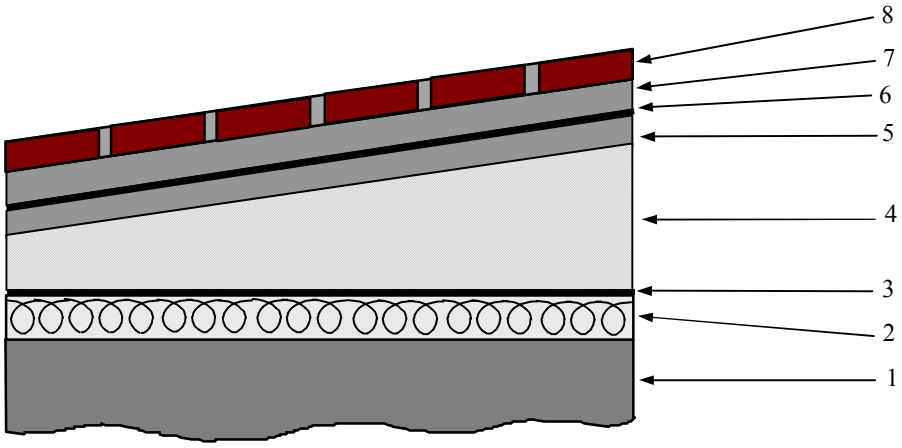
1



Key for 1

1. Structural Slab
2. Lightweight Foamed Concrete laid to falls (50 - 200 mm or more)
3. 20 mm sand cement screed to introduce a solid substrate prior to waterproof membrane
4. Waterproof membrane
5. 75 mm heat insulation (polystyrene boards)
6. Filter membrane
7. Tiles (cement or mosaic, spaced for expansion joint with sealant)

2



Key for 2

1. Structural Slab
2. 75 mm heat insulation polystyrene boards
3. Polythene sheeting
4. Lightweight foamed concrete laid to falls (50 - 200 mm or more)
5. 20 mm sand cement screed
6. Waterproof membrane
7. 20 mm thick sand cement screed as protective course
8. Tiles (cement or mosaic, spaced for expansion joint with sealant)