

# foamed concrete

## 1. definition

Foamed concrete has been defined as a cementitious material, with a minimum of 20% (per volume) foam entrained into the plastic mortar. (As no coarse aggregate is used in foamed concrete, the term concrete is, strictly speaking, inappropriate.)

## 2. production

Foamed concrete is produced by entrapping numerous small bubbles of air in cement paste or mortar. Mechanical foaming can take place in two principal ways:

- By pre-foaming a suitable foaming agent with water and then combining the foam with the paste or mortar.
- By adding a quantity of foaming agent to the slurry and whisking the mixture into a stable mass with the required density.

The most commonly used foam concentrates are based on protein hydrolyzates or synthetic surfactants. They are formulated to produce air bubbles that are stable and able to resist the physical and chemical forces imposed during mixing, placing and hardening.

## 3. properties

Foamed concrete is the most popular of all low-density concretes in developing countries. The reasons for this are the low capital expenditure on equipment and the ready availability of the principal materials. Foamed concrete can be produced on a small scale, even at site level, and it is relatively easy to place and finish without heavy or expensive equipment. Foamed concrete is self-compacting, free flowing and pumpable and,

therefore, easy to place in inaccessible places. It has good thermal and acoustic properties and is also frost resistant. It is however too weak for direct exposure to traffic and hail and should be protected by a wearing layer (asphalt can be used for roads).

Typical properties of foamed concrete are listed in Table 1. It is standard practice to classify foamed concrete according to the dry density thereof, as indicated in Table 1. This density is determined from oven-dried specimens and the actual density of foamed concrete would usually be higher than this density as there would generally be evaporable water present in foamed concrete. The presence of water in foamed concrete elements also results in an increase in thermal conductivity.

## 4. applications

Since the introduction of cellular concrete systems to the construction industry over 50 years ago, the use of foamed concrete has been almost exclusively limited to non-structural void filling, thermal insulation, acoustic damping, trench filling for reinstatement of roads and for building blocks. In the Netherlands foamed concrete has been used not only for level corrections in housing developments, but also as a fill material where ground subsidence has taken place and as a founding layer for road works on very weak soils.

Historically, foamed concrete has been perceived to be weak and non-durable with high shrinkage characteristics. Unstable foams have in the past resulted in foamed concrete having properties unsuitable for reinforced, structural applications. Unprotected reinforcement in aerated concrete in which the voids are interconnected would be vulnerable to corrosion even when the external attack is not very severe.

**Table 1: Typical properties of foamed concrete**

Dry density, kg/m <sup>3</sup>	Compressive strength, MPa	Elastic modulus, GPa	Thermal conductivity, W/m.K
400	1	1	0,1
600	1,5	1,5	0,11
800	2	2,5	0,2
1000	5	3	0,3
1200	10	4	0,4
1400	15	6	0,55
1600	25	12	0,65

It is therefore important to ensure that the air entrained into the foamed concrete is contained in stable bubbles that remain intact and isolated, and do not thus increase the permeability of the cement paste between the voids.

The development of protein-hydrolysis-based foaming agents and specialised foam generating equipment has improved the stability of the foam, making it possible to manufacture foamed concrete for structural applications.

In recent years foamed concrete has been used as a structural material in schools, apartments and housing developments in countries such as Brazil, Singapore, Kuwait, Nigeria, Botswana, Mexico, Indonesia, Libya, Saudi Arabia, Algeria, Iraq and Egypt.

For information on suppliers of foamed concrete, or materials for foamed concrete, contact the C&CI Information Centre.

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