Société
RAYMOND BARAKEH S.A.L
شركة ريمون بركه ش. م.ل.

CE 2138
2138-CPD-132/12
EN 934-2: 2009

ISO 9001 BUREAU VERITAS Certification

ISOLITE

TECHNICAL DATA

SOCIETE RAYMOND BARAKEH SAL – PO BOX 119737 – BEIRUT – LEBANON
Phone : + 961 1 690594 – 3 264868 Fax: + 961 1 690594
www.barakeh.com E.Mail: info@barakeh.com

ISOLITE

TECHNICAL DATA

TABLE OF CONTENTS

GRAPHS & FIGURES

ISOLITE

GENERAL TECHNICAL SPECIFICATIONS

A. DESCRIPTION

Isolite is a mixture of cement, fine sand, water and special chemical which produces a strong, lightweight concrete containing many evenly distributed air cells which have excellent insulating properties.

These air cells provide both the thermal and acoustic insulation as well as provide a barrier to prevent moisture absorption.

A special patented foam generator and mixer is used to generate and blend a measured volume of foamed air cells into concrete slurry.

The resulting lightweight concrete is then transported or pumped into place.

B. CONSISTENT QUALITY

The Isolite process can be accurately controlled to 1/100 lbs./cu.ft. density and consistently produces minute air cells which, because of their small size, give better physical properties regarding strength, insulation, moisture control etc..

C. CONTROLLABLE DENSITY

Density control allows a wide variety of uses for Isolite foam concrete. Very low densities are used for thermal insulation of metal or concrete roofs or for cold storage buildings, underground pipeline insulation, etc. Medium and higher densities are suitable for building blocks, solar roof slabs, acoustical floor insulation, reinforced panels, and partitions and prefabricated low cost housing.

D. HIGH THERMAL INSULATION

The thermal insulating "K" factor of Isolite varies according to the density, but in all cases is considerably lower than normal concrete. Low density, lightweight concrete roof insulation would have a "K" factor between 0.56 and 0.70; while the "K" factor for denser blocks or partitions would be 1 to 3. Normal concrete "K" factor is 12. A 2.5" (6.3 cm) thick layer of Isolite on a roof provides a "U" value of 0.187 and with 4" (10 cm) thickness of Isolite, it is possible to obtain the excellent "U" value of 14.

E. NOISE CONTROL

Isolite has excellent acoustical properties and has been used extensively to sound insulate floors at lower cost and with greater sound transmission loss than fibre insulation board or other traditional materials. Test with Isolite proved almost a 50% reduction in apparent noise level.

F. WATERPROOF CHARACTERISTICS

Isolite absorbs very little water on submersion or penetration tests due to the mass of non-interconnecting air cells which provide a moisture barrier. Water absorption by ordinary concrete products is almost 20 times greater than Isolite.

G. FIRE RATING

Isolite made with ordinary Portland cement, can be used as fire resisting partitions, floor fill or roof screed.
U.S. Underwriters Laboratories Inc. has given it's "Two-Hour Fire Rating" approval.

H. CHEMICALLY INERT

Isolite chemical and the resulting foam are completely inert non toxic and will not affect the skin. The foaming action is purely physical and not chemical. Steel reinforcing rods or mesh can be placed in Isolite in the usual manner. The waterproof characteristic of Isolite also serves to protect the reinforcement from corrosion.

I. EASILY SAWN, NAILED & DRILLED

Isolite can be readily sawn to any size and nails can be driven into the material without plugging which is convenient for nailing in window frames, door frames, picture hooks, curtain rods etc... Chasing for electric cables or water pipes can easily be made with ordinary joinery tools. When nailing, it is best to use cut or pressed nails.

J. ALTERNATIVE INGREDIENTS

The Isolite process allows for a great variety of aerated compounds the most common being cements and sand. However, lime or plaster can also be aerated. Sand may be replaced partially or totally by other aggregates such as perlite, glass or mineral wool, asbestos, etc… One may add to the mix bituminous emulsions, latex, synthetic resins, etc… (Non-fibrous aggregates must be passed through a 3/16” gauge sieve).

ISOLITE

STRUCTURAL & MECHANICAL PROPERTIES

A. STRUCTURAL STRENGTH FACTORS

The structural strength of foamed concrete is dependent upon;

1 - Density.
2 - Age.
3 - Moisture Content.
4 - Cement Quantity.
5 - Quality of Sand and Cement.
6 - Size of Air Cells.

These factors are investigated in this report.

B. DENSITY v/s STRENGTH

The strength of Isolite at certain age is largely dependent on the density. Graph No. 1 on the following page shows the relationship between the crushing strength and density for different quantities of cement in the mix. Specimens were subject to curing under moist conditions for full hydration of cement and then dried thoroughly.

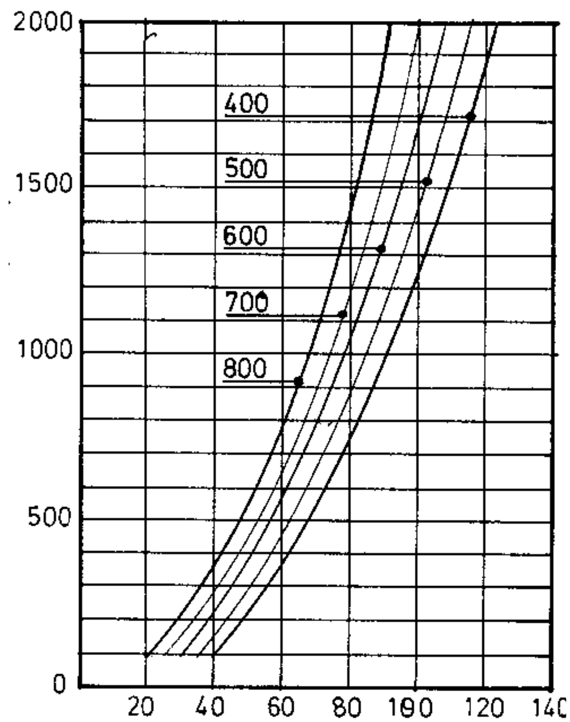
Curing by steam or water submersion will increase the strength of foam concrete considerably – especially for the lower densities. Further tests are being carried out in this respect

RELATION BETWEEN COMPRESSIVE STRENGTH AND DENSITY FOR VARIATION IN CEMENT

RELATION BETWEEN AGE AND COMPRESSIVE STRENGTH

GRAPH No. 1

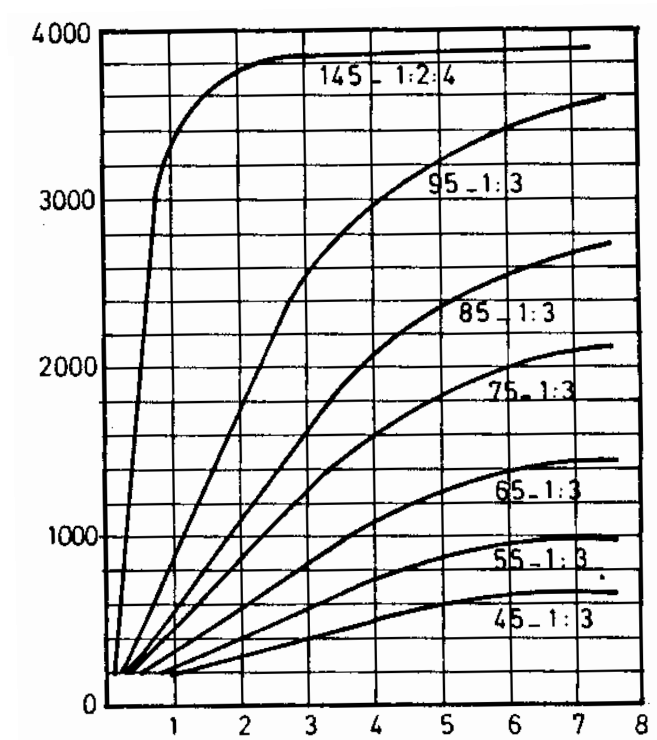
COMPRESSIVE STRENGTH (PSI)



DENSITY IN LBS/CU.FT.
FIGURES AT CURVES BEING
CEMENT IN LBS/CU.YD.
OF ISOLITE

GRAPH No. 2

COMPRESSIVE STRENGTH (PSI)



AGE OF CONCRETE (MONTHS)
FIGURES AT CURVES BEING
DENSITY AND MIX DESIGN
OF ISOLITE

C. AGE v/s. STRENGTH

It is a special feature of foamed concrete that its strength develops considerably slower than does normal dense concrete. Whereas, normal concrete, under good curing conditions, approaches its ultimate strength after a month or two, it is important to notice that the compressive strength of Isolite increases considerably in the first six to twelve months. This has been illustrated in graph No.2. It should be noted that the increase in strength here shown is based on normal moisture curing. However certain chemical additions can be used to accelerate strength development.

D. MOISTURE CONTENT

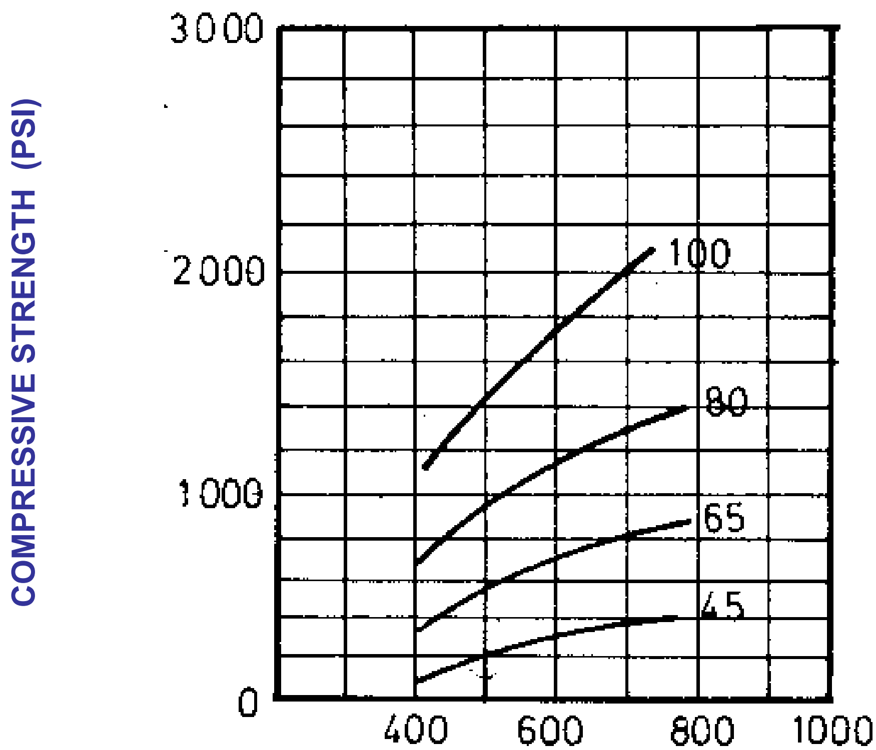
An increase in moisture content will have a slight reducing effect on the strength of foamed concrete. This factor will in practice have very little influence on Isolite as the product when once dried out at the factory, will have practically no tendency to absorb moisture. Investigations have shown not more than 3% variation in strength on wide extremes of external moisture conditions.

E. QUANTITY OF CEMENT v/s STRENGTH

Graph No.3 indicates the relation between the quantity of cement and compression strength after two months for the densities mentioned.

RELATION BETWEEN CEMENT CONSUMPTION AND STRUCTURAL STRENGTH

GRAPH No. 3



AGE OF CONCRETE (MONTHS)
FIGURES AT CURVES BEING DENSITY AND MIX DESIGN OF ISOLITE

F. QUALITY OF CEMENT AND SAND

Whenever possible the finest grade of Portland cement should be used for maximum strength in the higher density range. However a less fine cement in the low density range will provide better strength. Colored or aluminous cement may be used for maximum strength in all densities. Sand should be clean and free of salt which reduces air volume.

G. AIR CELL DISTRIBUTION

Investigations have proved that the crushing strength of a foamed concrete increases with diminishing size of the air cells. Furthermore, uniformity in size and even distribution of the air bubbles is of highest importance, not only for the strength result but also for obtaining the same crushing strength for tests in all directions . The unique, mechanical Isolite process ensures even distribution of air cells and multidirectional uniformity of strength. No differences in tests results for crushing along various axes of a test specimen are experienced;

Note: other processes with chemically aerate concrete show strength differences of 50% or more along different axes.

H. MODULUS OF RUPTURE

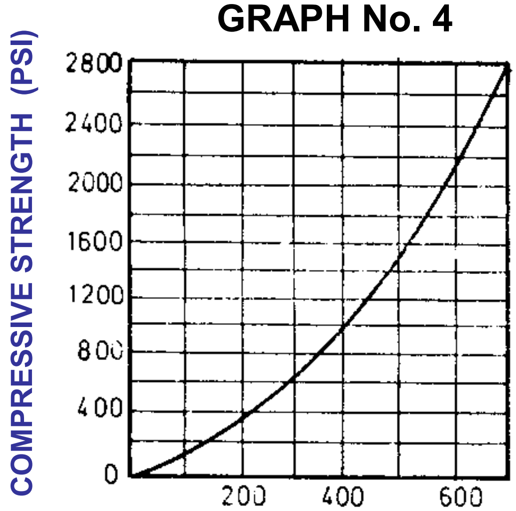
The relation between the Modulus of Rupture and the crushing strength varies as indicated in Graph No. 4. Numerical tests have proved that the relationship for foamed concrete of average quality with regard to size of air cells, uniformity: etc… may be calculated from:

$$y = 0.75X + 0.005X^2$$

For smaller air cells and greater uniformity in structure as obtained in Isolite the Modulus of Rupture is greater.

RELATION BETWEEN MODULUS OF RUPTURE & COMPRESSIVE STRENGTH

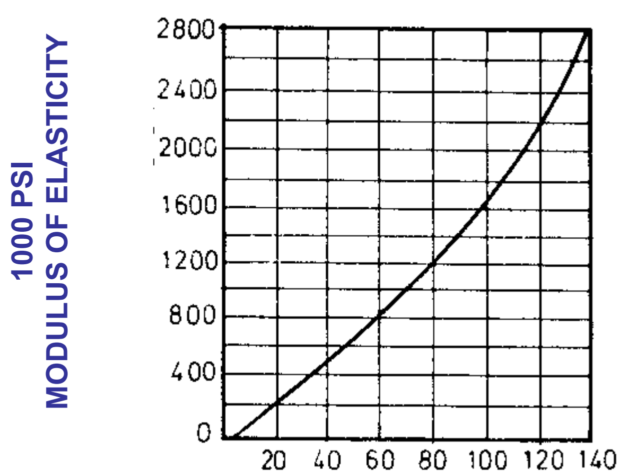
GRAPH No. 4



MODULUS OF RUPTURE (PSI)

RELATION BETWEEN MODULUS OF ELASTICITY & DENSITY

GRAPH No. 5



DENSITY (LBS/CU.FT.)

I. MODULUS OF ELASTICITY

The Modulus of Elasticity varies with the density as indicated in Graph No.5. This graph describes the relationship between the two factors for a cement quantity of approximately 500 LBS/CU.YD Isolite.

J. HARDNESS OF TILE FLOORS

Over Isolite Foam Concrete

Floor tiles can be laid directly over Isolite Foam Concrete floors having a density of 80 to 90 LBS/CU.FT.

Indentation tests were made as follows: Various types of tiles such as vinyl, asphalt, PVC and rubber tiles were placed over Isolite and over normal dense concrete.

Test Method I. 30 LBS. load on 0.25” dia. spherical foot for 60 seconds.

Test Method II. 100 LBS. load on 0.178” dia. flat cylindrical foot for 30 seconds.

Conclusion In all cases, the tile indentation was the same for Isolite as for normal dense concrete.

K. GENERAL

It can be seen from the above specifications concerning the mechanical properties of Isolite that this building material is very versatile, and it is possible to adjust its various characteristics to comply with almost any reasonable structural or physical request.

ISOLITE

DIMENSIONAL MOVEMENT PROPERTIES

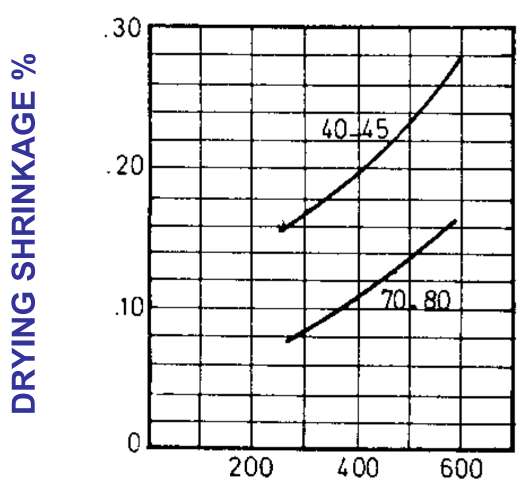
A. <u>DRYING SHRINKAGE</u>

Reports on most other types of foamed concrete indicate that the initial drying shrinkage is sometimes greater than that normally experienced from ordinary dense concrete. The drying shrinkage is mainly dependant on the cement factor, the water ratio, the density, the curing and the size of the air cells. In extreme cases, the cells for certain types of foamed concrete are so large that they collapse and cause considerable initial subsidence.

Isolite minute air cells and special foam stabilizer ensure no initial subsidence and the process of manufacture allows most advantageous cement factor and water ratio. Furthermore, the minute size of the air cells greatly minimizes the tendency of aerated concrete to show increased shrinkage. In cases of ‘in situ” Isolite the curing has to be watched and provisions made for expansion and contraction joints. Graph No. 6 shows the trend of variations in drying shrinkage for Isolite using various amounts of cement. The relationship between drying shrinkage at various densities is indicated in Graph No. 7. It will be noted that for densities higher than 70 LBS/CU.FT. the drying shrinkage is similar to that for dense concrete.

RELATION BETWEEN DRYING SHRINKAGE & CEMENT FACTOR

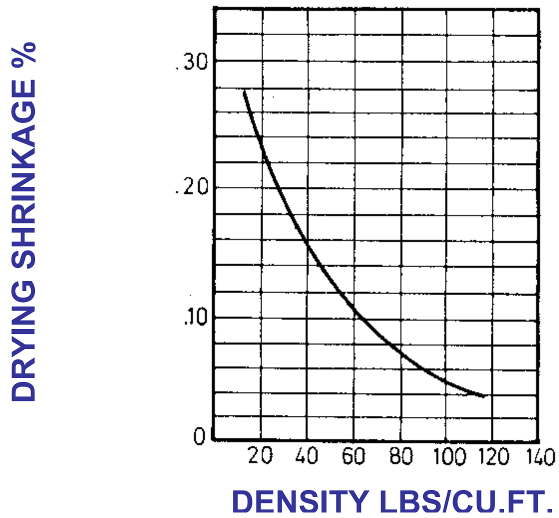
GRAPH No. 6



CEMENT LBS/CU.YD.
FIGURES AT CURVE BEING DENSITY

RELATION BETWEEN DRYING SHRINKAGE & DENSITY

GRAPH No. 7



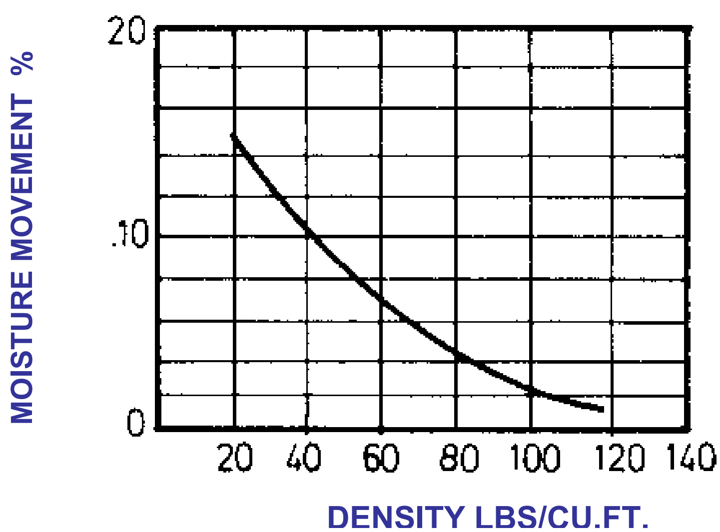
B. MOISTURE & TEMPERATURE MOVEMENT

The moisture movement of Isolite varies to some extent with the quantity of cement used but mainly with variations in density. Graph No. 8 shows the relationship between moisture movement and density of Isolite. It will be seen that for the densities normally used in outdoor constructions (75 to 80 LBS/CU.FT) the moisture movement is not to any extent greater than that for brick and orthodox concrete constructions.

The Temperature Movement even though dependant upon the density, does not exceed 0.018 to 0.026% for normally experienced temperature variations to which building structures are exposed.

RELATION BETWEEN MOISTURE MOVEMENT & DENSITY

GRAPH No. 8



C. GENERAL

For normal building constructions using Isolite under average conditions, precautions with regard to expansion and contraction should be taken at least to the same extent as in the case for normal dense concrete.

In reinforced Isolite structures, the dimensional changes have to be taken into consideration in accordance with normal practice and theory for normal reinforced concrete.

The technique of pre-stressed concrete by pre-tensioning or by post-tensioning of the reinforcement wires can to some extent be used with advantage for foamed concrete.

Isolite can be used with good result for pre-cast units in “composite structural members” where pre-stressed tie-rods in grooves are keeping the units together and giving the full member its structural strength. This latter technique is very economical and advantageous for girders, floor members, roofing members, etc…

ISOLITE

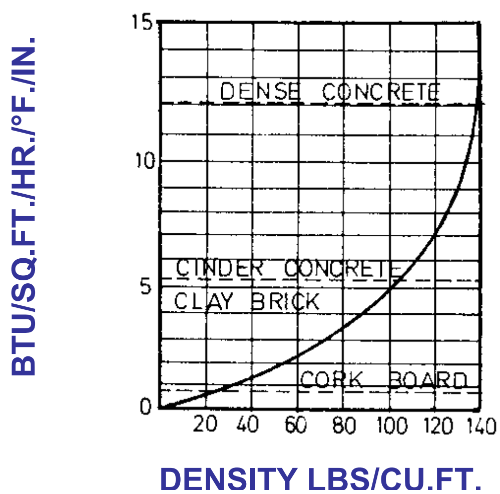
THERMAL INSULATING PROPERTIES

A. THERMAL CONDUCTIVITY

The excellent insulating properties of Isolite are caused by the great number of closed, minute, air cells of uniform size evenly distributed and forming a multi-cellular structure. The thermal conductivity of Isolite varies with the density as per the graph No. 9. As comparison, in the same graph are shown the thermal conductivity figures for some other building and insulating material.

RELATION BETWEEN THERMAL CONDUCTIVITY & DENSITY

GRAPH No. 9



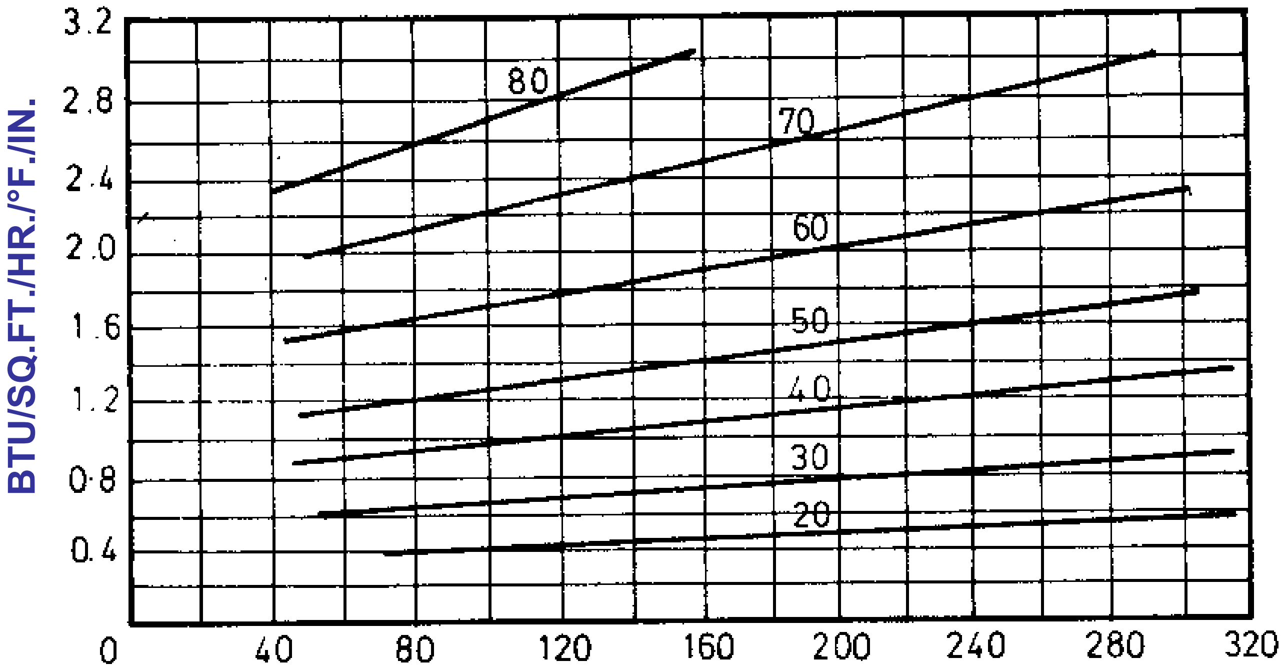
It will be seen from the graph that Isolite at a low density is almost as good an insulation material as cork. Isolite with a density of 75 to 80 LBS/CU.FT. normally used for external walls, has more than twice the insulation capacity of ordinary clay bricks and is about five times better than dense concrete.

B. VARIATION OF THERMAL CONDUCTIVITY

For special insulation purposes, e.g. cool stores, steam pipe lines, etc…, it is important to notice that the thermal conductivity of Isolite varies slightly with the mean temperature of the insulating layer. The trend of variation for various densities is show in graph No. 10.

RELATION CONDUCTIVITY AT VARIOUS TEMPERATURES

GRAPH No. 10



MEAN TEMPERATURE °F
FIGURES AT LINES BEING DENSITIES

C. COLD STORAGE APPLICATION

Low density isolite is very suitable as insulating material for cold storage because of its low thermal conductivity combined with its very low water absorption, its strength and stability.

D. INSULATING HOT PIPELINES

Thermal insulation of pipelines carrying steam or hot water can be carried out efficiently and at low cost by use of low density Isolite when the pipelines are laid underground, the advantage of using of Isolite is especially great as compared with any other method of insulation. The insulation with Isolite is carried out either by pre-cast units or by pouring Isolite around the pipelines. The mechanical and physical features already mentioned are a big advantage for this practice.
Differential movements between the pipes and the concrete may be provided for by wrapping the pipes with corrugated paper or coating them with bituminous mastics.

E. COMPARISON WITH OTHER MATERIALS

Isolite is one of the very few materials available having good mechanical strength combined with low weight and low thermal conductivity. Its value to the building industry is perhaps best illustrated in Fig. 1. Where comparison is made between the thickness of various solid materials required in order to give the same insulation as a 12" solid brick wall.

Other tests have shown that the thermal insulation gained from an 11" cavity type brick wall can be achieved with a 5" cavity type Isolite wall panel.

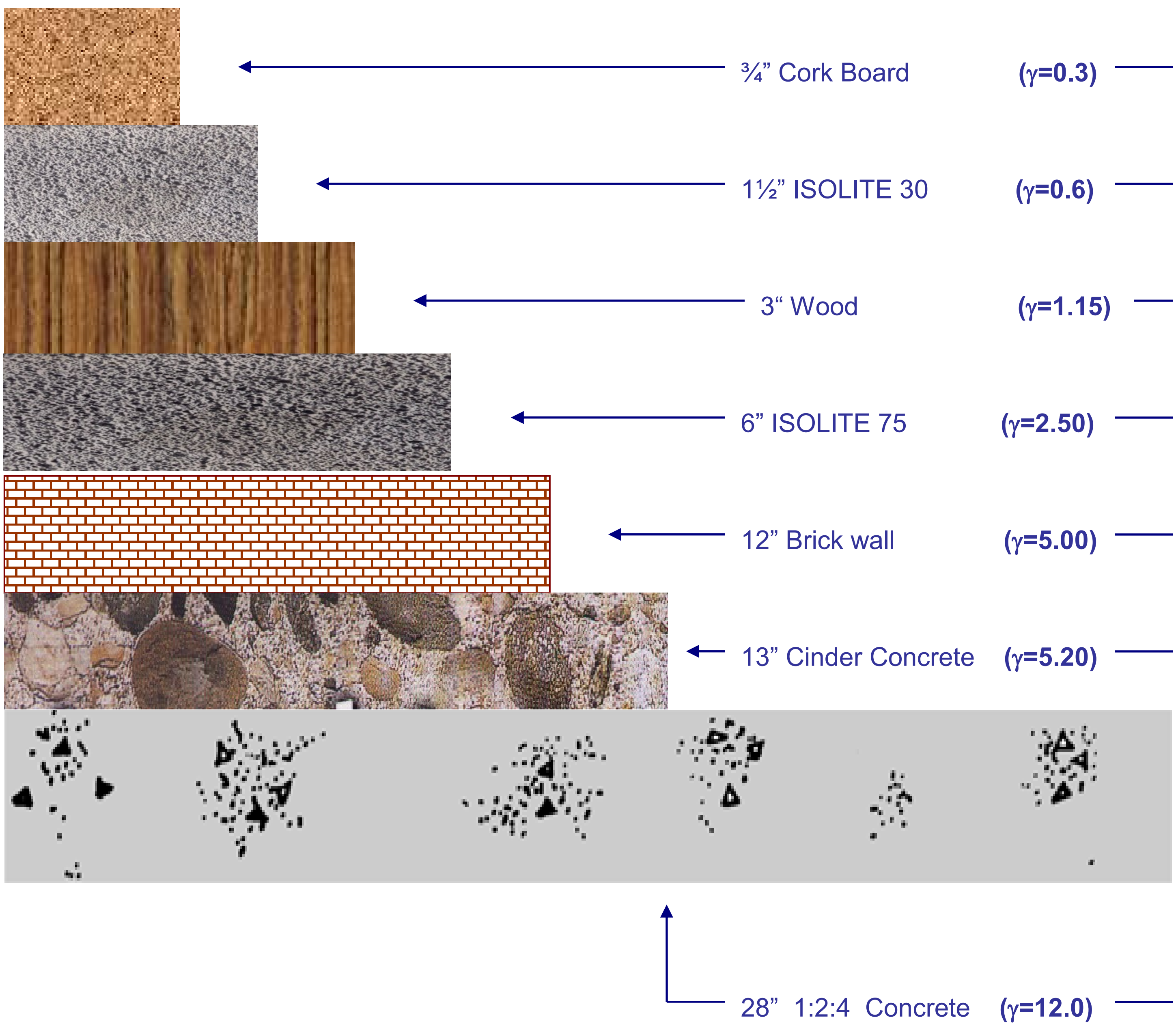
The low thermal conductivity of Isolite means that it can be used with success as an inner lining to coat existing walls where the problem of condensation has to be eliminated…

If, for decorative purposes, an external wall is to be made from clay bricks, Isolite building blocks may very often be used with advantage as inner lining. Isolite will ensure comfort, summer and winter, reduce fuel bills and make the living quarters more healthful.

Furthermore, the absence of condensation on the walls prevents decorating difficulties and discoloration.

MATERIALS COMPARISON

FIGURE 1



ISOLITE

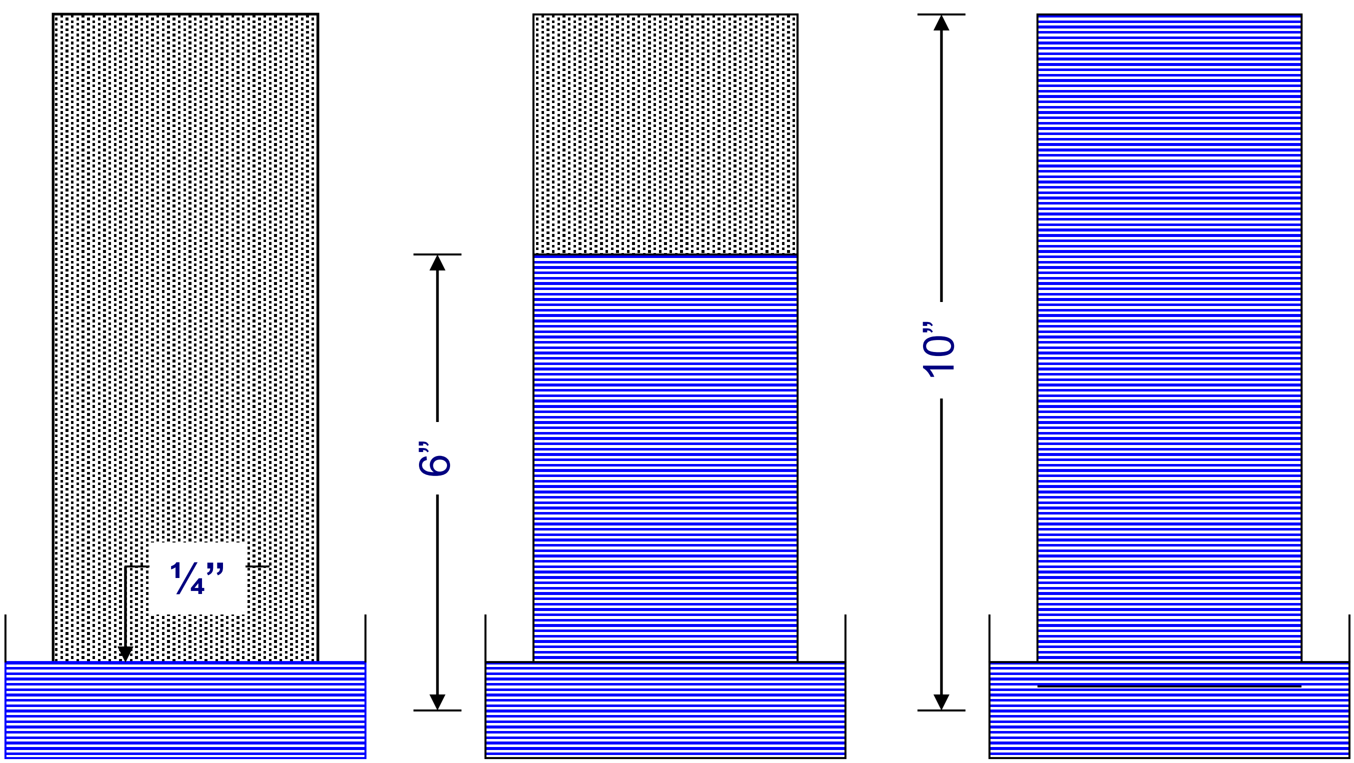
WATER ABSORPTION PROPERTIES

THE AIR CELLS IN Isolite are non-interconnecting and no water gains or voids will occur. The material is practically non-absorbent, moisture being absorbed only to a small degree on the surface.

Tests have proved that the water absorption by volume is practically the same for all densities, increasing slightly for higher densities above 120 to 130 LBS/CU.FT.

WATER ABSORPTION TEST AFTER 24 HOURS

FIGURE 2



ISOLITE 75 CONCRETE CLAY BRICK

ISOLITE

PERMEABILITY PROPERTIES

Isolite has been described by building authorities as being “virtually waterproof”. Permeability tests, as shown in Fig. 3, that the material is practically impermeable to water as compared with other building materials.

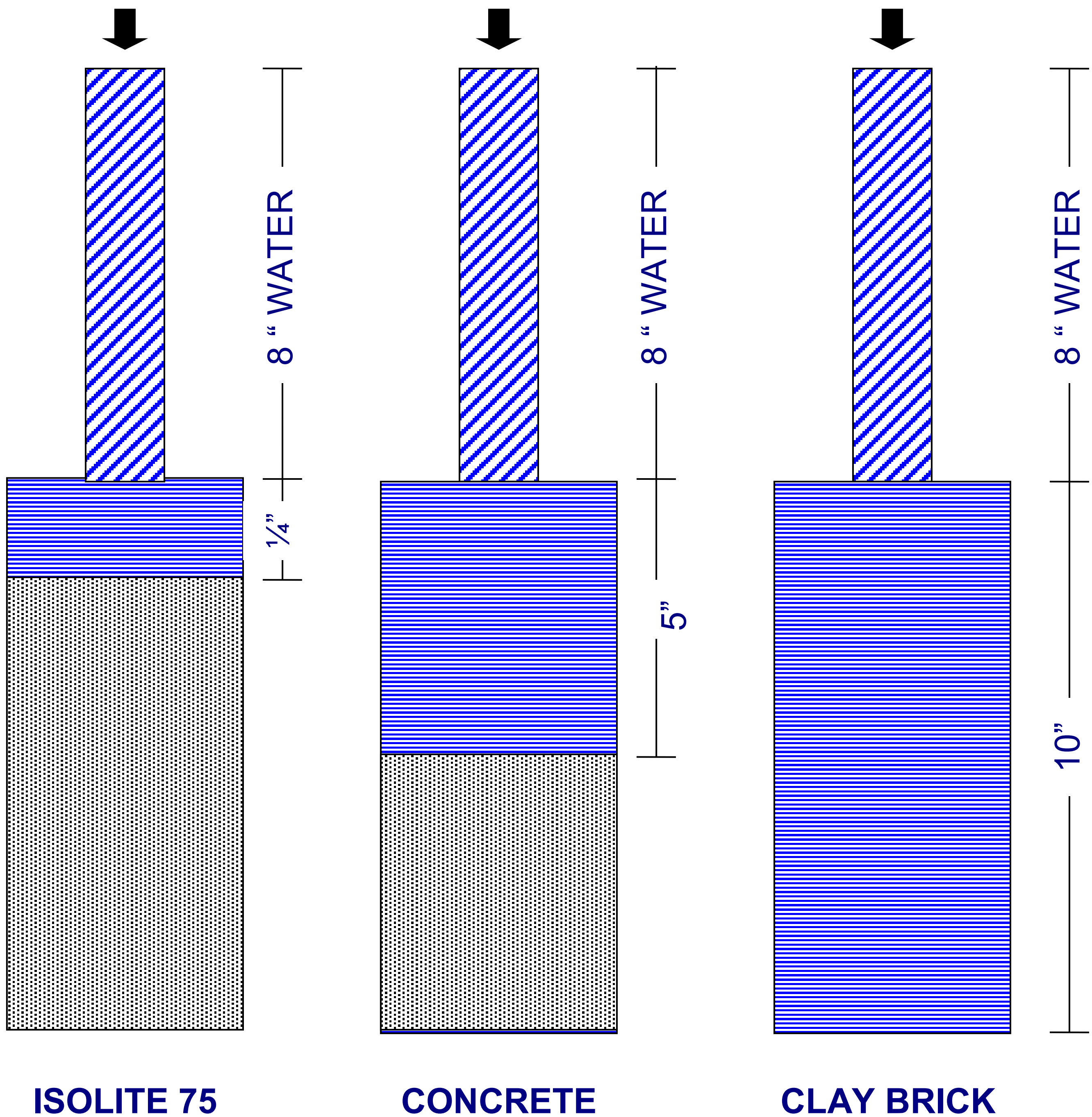
Outdoor exposure and accelerated weathering tests have proved that Isolite offers excellent resistance to wide extremes of weather. Isolite withstood tests on frost resistance as specified in UK and even the Scandinavian requirements.

The low water absorption and the virtual impermeability of Isolite together with its weather resistance, makes Isolite most suitable for outdoor construction and makes rendering optional. The same features indicate that Isolite can be classified as probably the most suitable material available for flat roofs, as it can be made sufficiently strong to carry all normal loads and its strength is not appreciably affected by the presence of moisture resulting from a leak in the covering layer.

It is obvious that the use of pre-cast reinforced roof slabs made from Isolite have distinct possibilities – it saves materials, labor, and reduces the load on the roof structures, combined with improved insulation.

PERMEABILITY AFTER 24 HOUR

FIGURE 3



ISOLITE

ACOUSTIC PROPERTIES

A. SOUND TRANSMISSION LOSS THROUGH WALLS

The sound insulation of a homogeneous wall usually depends on its weight, and sound insulation increases in direct proportion to the logarithm of the weight of the wall per square foot. Isolite is one of the materials, which is an exception to this rule and tests have shown that the sound insulation for Isolite is greater than that of any other wall material of the same weight.

The innumerable small cells in Isolite absorb the sound to a much higher degree than a solid and non-porous material. Isolite is therefore very suitable for light partition walls where sound insulation is of importance. The following tests results indicate the high acoustic properties of Isolite. The results are given as the ratio of the power of the sound waves on one side of the wall to the power of the sound waves on the other side after penetration. In accordance with the usual practice, the value of sound insulation is given as ten times the common Logarithm of this ratio and is expressed in decibels.

Test I. Isolite with density 90 LBS/CU.FT. showed following result for a decibel frequency of 256:
20.7 decibels reduction for 2” thickness of Isolite wall.
39.5 decibels reduction for 3” thickness of Isolite wall.

Test II. An Isolite wall of 4” thickness and a density of 40 LBS/CU.FT. gave following results for various ranges of frequency:

100 – 300 frequency range :	44	decibels reduction.
300 – 1000 frequency range :	46	decibels reduction.
1000 – 3000 frequency range :	58	decibels reduction.
100 – 3000 frequency range :	49.6	decibels reduction.

Test III. For the purpose of comparison, the same test were carried out for a 4¾" thick ordinary clay brick wall rendered on each side with ⅝ of plaster : (total thickness 6").

100 – 300 frequency range :	42	decibels reduction.
300 – 1000 frequency range :	45	decibels reduction.
1000 – 3000 frequency range :	56	decibels reduction.
100 – 3000 frequency range :	47.7	decibels reduction.

If can be seen from this result that the sound insulation of the Isolite wall is better than that of the thicker and heavier brick wall.

Present day buildings demand more efficient sound insulation than ever before, thus the advantage of building with Isolite is obvious. It may be of interest to add the following table of approximate power values of various sounds:

Whisper (at 4 ft)	20 decibels.
Talking	40 decibels.
Shouting	50 decibels.
Street noises (USA)	60 decibels.

In conclusion it can be seen that a 4" wall of Isolite will exclude almost all ordinary household noises and a 6" cavity external wall will prevent penetration of street noises.

B. SOUND TRANSMISSION
LOSS THROUGH FLOORS

Isolite has been used with great success for sound insulating floors (while at the same time covering piping etc…) and can be pumped directly in place, trowel smoothed and covered with tiles or rugs placed directly on the Isolite.
Isolite sound insulated floors, 2" thickness, will meet or exceed USA specification S.T.C. 58 I.N.C. + 41 (Footfall) N.C. 30 – 20, and will reduce the apparent noise level by 50% or more.