AN INVESTIGATION ON EFFECT OF QUARRY DUST AS SAND REPLACEMENT ON COMPRESSION AND FLEXURAL STRENGTH OF FOAM CONCRETE

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ABSTRACT

Foam concrete is a type of lightweight concrete which is lighter than conventional concrete. It is non-load bearing structural element which has lower strength than conventional concrete. Foam concrete is widely used in construction field and quite popular for some application because of its light weight such as reduction of dead load, non-structural partitions and thermal insulating materials. Because of its low strength, some material is used in order to increase the foam concrete strength. A study on the effect of quarry dust as sand replacement material on compressive and flexural strength of foam concrete was conducted. This study was conducted to determine the compressive strength and flexural strength of foam concrete by using quarry as partial sand replacement material. This report presents the feasibility of the usage of quarry dust as 10 %, 20 % and 30 % substitutes for sand in foam concrete. Mix design was developed for four different proportion of quarry dust in foam concrete. Tests were conducted on cubes and beams to study the strength of concrete made of quarry dust and results were compared with the control foam concrete. It is found that the compressive and flexural strength of foam concrete made of quarry dust are nearly 40 % more than the control foam concrete.
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CHAPTER 1

INTRODUCTION

1.1 Background

Concrete is a manmade material used in the building construction consists of aggregates which is bonded together by cement and water. The other major part of concrete besides the cement is the aggregate. Aggregates include sand, crushed stone, gravel, slag, ashes, burned shale, and burned clay. Fine aggregate refers to the size of aggregate used in making concrete slabs and smooth surfaces. Coarse aggregate is used for massive structures or sections of cement. Concrete can be categorized into two which are conventional concrete, and lightweight concrete. Both concrete shows different properties and usage. Generally, conventional concrete has a density of about 2300 kg/m$^3$, while lightweight concrete has a density between 300 and 1800 kg/m$^3$.

Anyway, historically concrete has been used in construction for over 2,000 years, perhaps first by the Romans in their aqueducts and roadways. There has been no looking back for concrete since its modern development. Known as the strongest building material, concrete has found major uses in dams, highways, buildings and many different kinds of building and construction. The Romans made many developments in concrete technology including the use of lightweight aggregates as in the roof of the Pantheon, and embedded reinforcement in the form of bronze bars. There are so many types of concrete with different applications in the constructions; for example pre-stressed concrete, reinforced
concrete for carrying enormous load. Different types of concrete are produced depending upon the end application. The modern types of concrete include cellular or aerated concrete which is light weight and durable, making it easy to be handled.

Lightweight concrete is widely used for modern construction as it is mortar less and can be produced with different densities. Lightweight concrete also known as aerated, cellular lightweight concrete, or foam concrete. The first lightweight autoclaved aerated concrete factory was built in 1943 in Emmering, near Munich, Germany. The product is now made in a number of countries in Europe, Asia, South America and the Middle East. Production began at the Malaysian plant in August 1995. This study focuses on the foam concrete and quarry dust. Foam concrete is classified as lightweight concrete because it contains no large aggregates, only fine aggregate like fine sand, cement, water and foam.

Foam concrete is widely used in construction field and quite popular for some application because of its light weight such as reduction of dead load, faster building rates in construction and lower haulage and handling costs (Kamsiah et al). It also has several advantages because of its porous nature; it provides thermal insulation and considerable saving in materials (Puttappa et al. 2008). The important application of foam concrete includes structural elements, non-structural partitions and thermal insulating materials. Manufacturers developed foam concretes of different densities to suit the requirements. The density of foam concrete ranges from 300-1800 kg/m$^3$ and these products were used in trench reinstatement, bridge abutment, void filling, roof insulation, road sub base, wall construction, tunneling etc. (Puttappa et al. 2008).

Another material used in the formation of foam concrete is quarry dust as partial material replacement. Quarry dust is classified as fine material obtained from the crushing process during quarrying activity at the quarry site. In this
study, quarry dust will be studied as replacement material to sand as fine aggregate. Quarry dust has been use for different activities in the construction industry such as for road construction and manufacture of building materials such as lightweight aggregates, bricks, tiles and autoclave blocks. (M. Safiuddin et al.)

1.2 Problem Statement

Generally, lightweight foam concrete can be used to construct a non load bearing precast structural element in construction industry. Furthermore, the strength of lightweight foam concrete is lower than the strength of conventional concrete. Thus, strength of the foam concrete need to be improved in order to wide its application. According to Hamidah et al. (2003), the finer aggregates used in the foam concrete, the more increment of strength of the foam concrete. For size specification, quarry dust has been selected since it is finer waste material and by utilizing the quarry dust as sand replacement perhaps could increase the strength of foam concrete to enhance the properties of foam concrete.

1.3 Objective

The main objectives of this study were :

i) Determine the compressive strength of foam concrete under different percentage of quarry dust.

ii) Determine the flexural strength of foam concrete under different percentage of quarry dust.
1.4 Scope of Work

In this experimental study, the effect of quarry dust in lightweight foam concrete in terms of compressive strength and flexural strength had been focused. There were 36 numbers of cubes with dimension of $150 \times 150 \times 150$ mm and 12 numbers of beams with dimension of $100 \times 100 \times 500$ mm being considered.

Sample with 0% (no quarry dust), 10%, 20%, 30% of quarry dust in terms of sand mass were designated as B₁, B₂, B₃, B₄ for beam and C₁, C₂, C₃, C₄ for cube respectively. Foam concrete with density of 1200 kg/m$^3$ were prepared with the water cement ratio of 0.50 and sand cement ratio of 1.0.

All samples were cured in water curing. The cubical samples were used as compression test specimens to determine the compressive strength at the age of 7, 14, and 28 days. The beam samples were undergoing the flexural test at the age of 28 days to determine the flexural strength. Table 1.1 represents the mix proportion of the foam concrete.

<table>
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<tr>
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<th>No of Sample</th>
<th>% Quarry Dust</th>
<th>Cement (kg)</th>
<th>Sand (kg)</th>
<th>Quarry Dust (kg)</th>
<th>Water (kg)</th>
<th>Foam (liter)</th>
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<td>9</td>
<td>0</td>
<td>33.08</td>
<td>33.08</td>
<td>-</td>
<td>16.54</td>
<td>29.27</td>
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<tr>
<td>Beam, B₀%</td>
<td>3</td>
<td>10</td>
<td>33.08</td>
<td>29.77</td>
<td>3.31</td>
<td>16.54</td>
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<tr>
<td>Cube, C₁₀%</td>
<td>9</td>
<td>20</td>
<td>33.08</td>
<td>26.46</td>
<td>6.62</td>
<td>16.54</td>
<td>29.27</td>
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<tr>
<td>Beam, B₁₀%</td>
<td>3</td>
<td>30</td>
<td>33.08</td>
<td>23.16</td>
<td>9.92</td>
<td>16.54</td>
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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Lightweight foam concrete can be defined as a type of concrete which included an expanding agent in that it increased the volume of the mixture while giving additional qualities such as fallibility and lessened the dead weight (Mad Lazim Zakaria et al., 1978). It was lighter than the conventional concrete with the dry density of 300 kg/m$^3$ up to 1800 kg/m$^3$. Although the material was called foam concrete, it was not really concrete at all. Foam concrete is actually foamed mortar, where the mortar was made from cement and water or sand, cement and water. Foam concrete containing no coarse aggregates, only fine and extremely lightweight materials containing cement, water and foam. A few investigators had reported that foam concrete was one having an air content of more than 25 %, which disintegrated it from highly air entrained materials (C.G Puttappa et al. 2008).

Foam concrete can be placed easily, by pumping if necessary, and does not require compaction, vibrating or leveling. It has excellent resistance to water and frost, and provides a high level of both sound and thermal insulation. It is very versatile; since it can be tailored for optimum performance and minimum cost by choice of a suitable mix design especially the density of foam concrete.
This is because different density might give different use and performance of foam concrete.

The fact that foam concrete can be made using different mix designs meant that it was not a single product. Foam concrete was nearly made on-site and it was made using a mix design specifically selected for each application or job.

2.2 History of Foam Concrete

The history of foam or aerated concrete began much later than lightweight aggregate concrete. According to Dubral (1992), the development of the aerated concrete or foam concrete had begun approximately 100 years ago. In 1914, the Swedes first discovered a mixture of cement, lime, water and sand that expanded by adding aluminium powder. It entailed the use of aluminium powder to generate hydrogen gas in the cement slurry. Prior to that, inventive minds had tried beaten egg whites, yeast and other unusual methods of adding air to concrete. It was also reported that foamed concrete was developed in Europe over 60 years ago and has since then been on the international market for more than 20 years.

The foamed or aerated concrete was similar to wood in its characteristics but without the disadvantages of combustibility, decay, and termite damage, and this material was then further developed and later known as Autoclaved Aerated Concrete. AAC was developed by combining the processes of porosing concrete by means of metal powder and hardening the mixture through autoclave. This created a material that exhibited a wealth of desirable characteristics such as low weight, high material strength, very good heat insulation, excellent fire resistant and good impact and airborne sound insulation. In the same year, the first patent right on this particular method of producing foamed concrete was granted.
From then on, it took another 10 to 20 years for reinforced AAC elements to be developed. These elements were first used mainly in Scandinavia as roof and floor units and wall panels. The foaming process which is now most widely used was patented in 1931. It involved producing cellular concrete prepared by foaming methods followed by curing in high-pressure steam. Patents were issued in 1929 on foaming agent formulations, mixing procedures and mixing machines.

The Second World War halted temporarily the quick spread of AAC and foam concrete as the lightweight concrete, since it had quite same functions and characteristics. However, it regained its successful expansion in Europe and many parts of the world after the war ended, in 1950. The rapid development of the worldwide production of AAC products occurred in 1929 to 1975. In 1955, there were only thirteen (13) plants or licensed plants manufacturing AAC but later this number grew to more than 40 plants worldwide. By the year 1975, there were about two hundreds (200) AAC plants working on almost all continents in Western and Eastern Europe including the Asian part of the former Soviet Union fifty (50) plants in other Asia countries and six-teen (16) plants in other parts of the world. The global success of AAC was first achieved by two companies in Germany, YTONG Siporex and Durox, which are still well known today. Other companies such as Hebel in Germany and Hendriksen in Denmark followed with their own differing technologies (Dubral, 1991).

Preformed foam was developed in the early 1950's following the development of simple, reliable and easily controlled, foam-generating equipment and highly refined foam stabilizers. The method was cost effective and provided an accurate means of controlling density. This method had been widely used for the production of low-density cast-in-place roof decks, filling voids, tunnel gap filling and insulating underground heat distribution lines until today (Portland Cement Association, 1980).
2.3 Properties of Lightweight Foam Concrete

Foam concrete is not the same as conventional concrete and does not have the same characteristics. Foamed concrete is much lighter and does not have the same strength as conventional concrete. For this reason foamed concrete and conventional concrete are generally used for different applications, although there are applications where either may be specified. Properties of lightweight foam concrete can be classified into two properties which are mechanical properties and physical properties.

2.3.1 Air Void

The pore structure of cementitious material, predetermined by its porosity, permeability and pore size distribution, is a very important characteristic as it influences the properties such as strength and durability. The pore structure of foam concrete consists of gel pores, capillary pores as well as air-voids (Visagie et al., 2002). As foam concrete being a self-flowing and self-compacting concrete and without coarse aggregate, the possibilities of the entrapped air is negligible. The air-voids in the foam concrete can be characterized by a few parameters like volume, size, size distribution, shape and spacing between air-voids. The air-void distribution is one of the most important micro properties influencing strength of foam concrete. Foam concrete with narrower air-void distributions shows higher strength. The use of fly ash as filler helps in achieving more uniform distribution of air-voids by providing uniform coating on each bubble and thereby prevents merging of bubbles. At higher foam volume, merging of bubbles results in wide distribution of void sizes leading to lower strength. (Nambiar et al., 2007; Visagie et al., 2002). In addition to the air-void size and its distribution, the compressive strength of foam concrete is also be influenced by the void/paste ratio, spacing of
air-voids, number (frequency) of air-voids. Because of the uniform shape (characterized by shape factor) of air-voids, its influence on strength is negligible. (Wee et al., 2006; Kearsley et al., 1996; Nambiar et al., 2007)

2.3.2 Density

Another property which is very important in determining the foam concrete is its density. Foam concrete can be formed with the desired density and requirement. The density of foam concrete is 300 kg/m$^3$ up to 1800 kg/m$^3$ to suit different application. Usually, the lower densities of 400-600 kg/m$^3$ are ideal for thermal insulation applications. The density range 800-1000 kg/m$^3$ is utilized for making pre-cast blocks for non load bearing walling masonry in framed structures while the foam concrete range from 1200kg/m$^3$ to 1800 kg/m$^3$ is structural grade material utilized for in-situ casting of structural load bearing walls and roofs of low rise individual or group housing schemes or manufacture of reinforced structural cladding or partitioning panels or for making pre-cast blocks for load-bearing walling masonry for low-rise buildings. Density can be either in fresh or hardened state. Fresh density is required for mix design and casting control purposes. A theoretical equation for finding fresh density may not be applicable as there can be scatter in the results caused by a number of factors including continued expansion of the foam after its discharge, loss of foam during mixing (Regan et al., 1990). Many physical properties of foam concrete related to/depend upon its density in hardened state. While specifying the density, the moisture condition needs to be indicated as the comparison of properties of foam concrete from different sources can have little meaning without a close definition of the degree of dryness (Valore et al., 1954). McCormick (1967) studied the effect of types of fine aggregate, aggregate gradation, type of foam and sand–cement ratio on the wet density of foam concrete and reported that wet densities within about 5% of the design densities can be achieved by using solid volume calculations.
The cement–sand based non-autoclaved preformed foam concrete has relatively higher density and higher requirement of cement content. Greater the proportion of aggregate, higher will be the density. Compared to a product based on sand and cement, it is observed that replacement of sand with fly ash help in reducing the density with an increased strength (Durack et al., 1998). Alternately, to achieve a particular density of foam concrete, use of fly ash results in a reduction in foam volume requirement due to its lower specific gravity (Nambiar et al., 2006), thereby resulting in higher strength.

2.3.3 Stability

Furthermore, foam concrete cannot be subjected to compaction or vibration the foam concrete should have flowability and self-compactability. These two properties are evaluated in terms of consistency and stability of foam concrete, which are affected by the water content in the base mix, amount of foam added along with the other solid ingredients in the mix (Nambira et al., 2008). The stability of foam concrete is the consistency at which the density ratio is nearly one (the measured fresh density/design density), without any segregation and bleeding (Nambira et al., 2008). This ratio is higher than unity at both lower and higher consistencies due to either stiffer mix or segregation. The stability of test mixes can also be assessed by comparing the calculated and actual quantities of foam required to achieve a plastic density within 50 kg/m³ of the design value; and calculated and actual w/c ratios. The additional free water contents resulting from the foam collapse. Corresponded to an increase in actual w/c ratio (Jones et al., 2006). Thus the consistency of the base mix to which foam is added is an important factor, which affects the stability of mix. This consistency reduces considerably when foam is added and depends on the filler type also. Hence there is a need for determining the water–solids ratio, which would satisfy both stability and consistence of the mix. Regression equations based on the experimental
results, for predicting the spread flow value of foam concrete, knowing the proportion of the other ingredients, will help in arriving at this water content for the production of a stable and workable foam concrete mix. For typical materials used, an appropriate workability value has been arrived at as 45% of spread at which a foam concrete mix of good stability and consistency can be produced (Nambiar et al., 2008).

2.3.4 Compressive Strength

Besides, the mechanical property of foam concrete is the compressive strength. Study done by Kearsley et al., (1996) has reported that the compressive strength of the foam concrete decreases exponentially with a reduction in density of the foam concrete. the specimen size and shape, the method of pore formation, direction of loading, age, water content, characteristics of ingredients used, and the method of curing are reported to influence the strength of foam concrete in total (Valore et al., 1954). Other parameters affecting the strength of foam concrete are cement sand and water cement ratio, curing regime, type and particle size distribution of sand and types of foaming agent used (Aldridge et al., 2005; Hamidah et al., 2005). For dry density of foam concrete between 500 kg/m$^3$ and 1000 kg/m$^3$, the compressive strength decreases with an increase in void diameter. For densities higher than 1000 kg/m$^3$, as the air-voids are far apart to have an influence on the compressive strength, the composition of the paste determines the compressive strength. It has been reported that small changes in the water-cement ratio does not affect the strength of foam concrete as in the case of normal weight concrete.
2.3.5 Water Absorption

The durability properties include the water absorption of foam concrete. The water absorption of foam concrete decreases with a reduction in density, which is attributed to lower paste volume phase and thus to the lower capillary pore volume. The water absorption of foam concrete is mainly influenced by the paste phase and not all artificial pores are taking part in water absorption, as they are not interconnected (Nambiar et al., 2006; Kearsley et al., 2001). Expressing water absorption as percentage by mass can lead to misleading results when foam concrete is concerned because of larger differences in density. The oxygen and water vapor permeability of foam concrete have been observed to increase with increasing porosity and fly ash content (Kearsley et al., 1998). Permeability coefficient of lightweight foamed concrete is proportional to unit weight and inversely proportional to pore ratio (Byun et al., 1998).

2.3.6 Resistance to Aggressive Environment

Foam concrete mixture designed at low density taking into consideration of depth of initial penetration, absorption and absorption rate, provided good freeze-thaw resistance (Jones et al., 2008; Tikalsky et al., 2004). Sulphate resistance of foam concrete, studied by Jones and McCarthy (Jones et al., 2005) for 12 months, reveals that foam concrete has good resistance to aggressive chemical attack. A study on accelerated carbonation of foam concrete by Jones and McCarthy (2005) indicate that lower density concrete appears to carbonate at a relatively higher rate. Comparing the performance of mixes with sand and fly ash, mixes with fly ash exhibited higher carbonation than that with sand. An accelerated chloride ingress tests suggested that foam concrete performance is equivalent to that of normal concrete, with enhanced corrosion resistance at lower density (Giannakou et al., 2002). The cell-like structure of foam concrete and
possible porosity of cell wall do not necessarily make the foam concrete less resistant to penetration of moisture than dense concrete; the air-voids appears to act as a buffer preventing rapid penetration.

2.4 Advantages of Lightweight Foam Concrete

Foam concrete is classified as lightweight concrete because it contains no large aggregates, only fine aggregate like fine sand, cement, water and foam. There also air voids entrapped in it shows one of the properties of the foam concrete. Foam concrete is widely used in construction field and quite popular for application because of its light weight which ensures economic aspects such as the trench reinstatement. It also has several advantages because of its porous nature; it provides thermal insulation and considerable saving in materials (C.G Puttappa et al, 2008). The important application of foam concrete includes structural elements, non-structural partitions and thermal insulating materials. Manufacturers developed foam concretes of different densities to suit the requirements. The density of foam concrete ranges from 300-1800 kg/m³ and these products were used in trench reinstatement, bridge abutment, void filling, roof insulation, road sub base, wall construction, tunneling etc. (C.G Puttappa et al, 2008).

2.4.1 Thermal Insulation

Foam concrete has excellent thermal insulating properties due to its cellular microstructure. The thermal conductivity of foam concrete of density 1000 kg/m³ is reported to be one-sixth the value of typical cement–sand mortar (Aldrige et al., 2001). A study by Giannakau and Jones (2002) exploring the potential of foam concrete to enhance the thermal performance of low rise
building has shown that the foam concrete ground supported slab foundation is possessing better thermal insulation and lower sorptivity properties while producing satisfactory strength. The thermal conductivity values are 5–30% of those measured on normal weight concrete and range from between 0.1 and 0.7 W/mK for dry densities values of 600–1600 kg/m³, reducing with decreasing densities. Thermal insulation of brick wall can be increased by 23% when inner leaf is replaced with foamed concrete of unit weight 800 kg/m³.

### 2.4.2 Sound Insulation or Acoustical Properties

Valore (1954) has stated that cellular concrete does not possess unique or significant sound insulation characteristics. Foamed concrete is stated to be less effective than dense concrete in resisting the transmission of air-borne sound (Taylor et al., 1969) because the Transmission Loss (TL) of air-borne sound is dependant on mass law, which is a product of frequency and surface density of the component. Tada (1986) attributed the TL to the rigidity and internal resistance of the wall, in addition to the mass law and gives an acoustical performance design of cellular concrete based on bulk density and thickness. Sound transmission of a cellular concrete wall, over most of the audible frequency range may be higher by 2–3% as compared to normal weight concrete. While dense concrete tends to deflect sound, foam concrete absorbs it, and hence the foam concrete has higher sound absorption capacity (Taylor et al., 1969).

### 2.4.3 Fire Resistance

At high temperature the heat transfer through porous materials is influenced by radiation, which is an inverse function of the number of air–solid
interfaces traversed. Hence along with its lower thermal conductivity and diffusivity, the foam concrete may result in better fire resistance properties (Valore et al., 1954). Fire resistance tests on different densities of foam concrete indicated that the fire endurance enhanced with reductions in density. While reviewing earlier studies on fire resistance, Jones and McCarthy (2005) summarize that, for lower densities of foam concrete, the proportional strength loss was less when compared to normal concrete. As compared to vermiculite concrete, lower densities of foam concrete is reported to have exhibited better fire resistance, while with higher densities, this trend is stated to be reversed (Aldridge et al., 2005). Kearsley and Mostert (2005) studied the effect of cement composition on the behaviour of foam concrete at high temperature and concluded that foam concrete containing hydraulic cement with an Al2O3/CaO ratio higher than two can withstand temperatures as high as 1450 °C without showing sign of damage.

2.4.4 Construction Field (Tunnel Infill)

Foam concrete has been used for the tunnel infill in United Kingdom has showed many advantages. The infill of the tunnel was successfully completed in nine working days and required 1300 kg/m3 of foam concrete made. The superior flowing and self-compacting properties of foam concrete ensure that all voids are completely eliminated. As foam concrete is compressed during collapse or subsidence of material above, due to its cellular structure, the resistance of the foam concrete increases, absorbing the kinetic energy. Unlike some synthetic, lightweight foams (polystyrene for example), hardened foam concrete is not susceptible to breakdown due to the presence of hydrocarbons, bacteria or fungi. Foam concrete is insect, rodent and fireproof. The exclusive design and technology employed in on site batching plants allow recycled materials such as fuel ash and limestone dust to be used in many of the mixes. These industrial by-
products are often disposed of in landfill sites but, by blending them with cement, they are encapsulated within the foam concrete, thereby mitigating any adverse effects on the environment.

2.4.5 Construction Field (Road Sub Base)

The foam concrete has been used as the road sub-bases. A recent development has been the use of foam concrete as a road sub-base. It is a highly effective way to improve unstable soil conditions or to replace unsuitable soils. A typical application would be to raise the elevation of the roadway by using foam concrete as a sub base, especially where the soil is unstable. Foam concrete does not require compacting, imposes no lateral forces on adjacent structures, may be applied directly to existing marginal ground such as peat concentrations or poor soils, and weighs 20-25% of the weight of the standard soils. Foam concrete can be applied on the uneven ground as it does not need a completely flat surface, eliminating the requirement for surcharging with soil. Less consolidation is required for subsoil and it also achieves equilibrium with surrounding pressures. Advantages of using foam concrete for road construction are ease and speed of placement, total void-fill, and good energy absorbing qualities. When judged against other more labor/time intensive methods, the ability to produce quantities of up to 400m³ a day means that construction times can be significantly reduced, with consequent cost savings. The flowing, self-compacting properties of foam concrete mean that you can be assured that all voids are completely eliminated. As the foam concrete is compressed during the collapse or subsidence of material above, due to its cellular structure, the resistance of the foam concrete increases, absorbing the kinetic energy. Unlike some synthetic lightweight foams (polystyrene for example), hardened foam concrete is not susceptible to breakdown due to the presence of hydrocarbons, bacteria or fungi. It is insect, rodent and fireproof. Using foam on-site batching plant means less traffic
disruption both on-site and in the surrounding area. Around 109 m³ of 400 kg/m³ density lightweight foam concrete can be produced from one bulk powder tanker delivery, making it safer for site-workers and local residents as well as being friendlier to the environment.

2.4.6 Savings in Construction Material

Reduction in dead weights contributes substantially to savings in reinforcing steels in foundations. The dimensions and therefore, the overall quantity of steel reinforcement in foamed concrete can be reduced by as much as 50%. Savings are also substantial in transportation, crane- and man-handling related activities as well as in raw materials, as no gravel is required to produce foamed concrete but sand, cement, water and air, with the resulting mortar/paste subsequently embedded in the foam. Casting very slender walls can optimize the amount of concrete used, and wall as thin as 50 mm have been produced with foamed concrete. The high ability flow of foamed concrete makes vibration unnecessary, and thus requires no prescription of vibrating equipment/accessories (Liew, 2003).

2.4.7 Ease of Application

No special skill is required in using the system. It is fully adoptable or at least adaptable into existing concrete or prefabrication plants, adding only a foaming agent into the mixer at a precise dose, which is discharged from a foam generator. Foamed concrete may later be pumped using conventional concrete pumps. Due to the absence of gravel and the ball-bearing effect of the foam, foamed concrete possesses a high degree of flowability. No vibration is thus