CHAPTER 2

REVIEW OF LITERATURE

2.1 GENERAL

In this chapter a critical review of literature on property of light weight concrete, light weight aggregates, strength and durability of fly ash aggregate concrete and mix proportioning of light weight concrete are presented.

2.2 LIGHT WEIGHT CONCRETE

An exhaustive research has been carried out to study the various properties of light weight concrete

Serkan Subasi (2009) investigated the effect of using fly ash in high strength light weight aggregate concrete produced with expanded clay aggregate on physical and mechanical properties of the concrete. The cement content with 450 Kg/m$^3$ among concrete mixtures produced high strength value and the mechanical properties could be enhanced by using 10% fly ash. A saving in cement content and cost could be achieved.

An experimental study was carried out by Nusret Bozkurt et al (2010) to investigate the influence of addition of pozzolanic materials and curing regions on the mechanical properties and the capillary water absorption (Sorptivity) characteristics of light weight concrete. The results showed a good correlation between the strength development of concrete and its
sorptivity. As the compressive and tensile strength increased due to the hydration, the sorptivity coefficients decreased significantly.

Josef Hadi Pramana et al (2010) have reported that light weight concrete can be utilized as a normal concrete replacement structure shield. Aerated concrete and light weight aggregate concrete can be used as energy absorbent. Good energy absorption is due to the homogenized microstructure of aerated concrete component and air void entrapment in cement depending upon the materials used light weight aggregate concrete improves its strength to prevent local damage caused by ballistic loading. Lower modulus of elasticity and higher tensile strain capacity provides better impact resistance to light weight concrete than normal weight concrete.

Abdullahi et al (2009) have employed a statistical technique for modelling of light weight concrete mixtures using palm oil clinker obtained from by-product of palm oil milling as aggregate. Mix design was conducted using absolute volume method. They carried out an experimental work involving 20 trial mixes at different factor and level combination. Statistical modelling was done at 95% confidence interval. The test results shows that a polynomial model is adequate to predict the slump, air-dry density and compressive strength of palm oil clinker concrete. The terms considered in the models were significant with Ø-Values less than 0.5. The analysis of variance shows that the developed models adequately fit the experimental data with a Ø-Value for the regression line less than 0.5 these statistics assures reasonable response prediction statistical approach is a useful tool for modelling of light weight concrete mixture.

A study was made by Ramazan Demirboga et al (2003) on the effects of expanded perlite aggregate, silica fume and fly ash on the thermal conductivity of light weight concrete. The silica fume and fly ash were added as replacement for cement by decreasing the cement weights in different
ratios by weight. They observed the decrease in thermal conductivity with the increase of silica fume and fly ash as replacement of cement.

Hjh Kamsiah Mohd.Ismail et al (1999) have studied the behaviour of light weight concrete and performance of aerated light weight concrete such as Compressive strength tests, water absorption and density and comparisons made with other types of light weight concrete.

Celik Ozyildirim (2009) has studied the durability of structural light weight concrete which includes the physical and chemical aspects of durability, the effect of cracking and resistance of light weight aggregates to freezing and thawing.

Emre Sancak et al (2008) have investigated structural light weight concrete produced by Pumice and concrete with normal light weight aggregate. Compressive strength and weight loss of the concrete were determined after being exposed to high temperatures. They replaced the Portland cement by silica fume in different ratio and added super plasticizer. They observed the rate of deterioration was higher in normal weight concrete when compared to light weight concrete.

Chen et al (1999) have reported that concrete is considered to be a composite material consisting of mortar and coarse aggregate and its strength depends on the mortar strength and coarse aggregate strength. During the strength development stage of light weight aggregate concrete, a critical condition under which the type of stress distribution changes occurs as the values of the modulus of elasticity of the light weight aggregate and mortar become the same. The concrete strength corresponding to this instant is named “Dividing Strength”. The concept of a dividing strength can be utilized to optimize a mix design for light weight aggregate concrete.
Daniel Rypl et al (2008) have dealt with the modelling of the concrete microstructure for the assessment of the percolation threshold of interfacial transition zone. They utilized hard core soft shell model, each aggregate particle described in terms of the spherical harmonic expansion surrounded by a shell of constant thickness representing the interfacial transition zone.

2.3 LIGHT WEIGHT AGGREGATE

Rajamane et al (2004) have reported that it is possible to produce coarse aggregates from fly ash by pelletisation techniques for use in structural grade concrete. They also studied the properties like bulk density, specific gravity, water absorption and aggregate crushing value. The concrete made with the bonded fly ash coarse aggregate has high slump, low density and also to produce minimum structural grade concrete as recommended in IS 456-2000. The permeability indicating tests such as sorptivity, rate of water absorption, rapid chloride permeability test, etc. indicate satisfactory durability characteristics.

Ramamoorthy (2006) discussed on light weight concrete and light weight aggregate concrete and its classification. It is also reported on properties of various light weight aggregate concrete. It is also discussed on proportioning of light weight aggregate concrete by weight method.

Carlos Videla et al (2001) reported in his experimental work that fly ash agglomeration by agitation methods by disc pelletizer is a simple and effective process of manufacturing aggregates. Paste mixtures agglomerated using cement binders show five times smaller setting times values them mixtures agglomerated with lime. The aggregates manufactured with 5% weight of Portland pozzolanic cement possess the greatest viability for use at full-scale production.
An investigation was made by Pantawee et al (2008) on the use of natural pozzolanic diatomaceous and perlite to replace sand and cement at various percentages by mass of binder. They formed that the mortar containing diatomaceous replacing Portland cement effectively increased the compressive strength better than replacing sand. They also found the optimum content of perlite that contributed to the highest compressive strength.

Jongsung Sim et al (2011) have investigated the fundamental characteristics of concrete using recycled concrete aggregate. They replaced cement by fly ash and fine and coarse aggregates by recycled aggregates. They observed that compressive strength of mortar add concrete which used recycled aggregates generally decreased as the amount of the recycled materials increased. The recycled aggregate concrete achieved sufficient resistance to the chloride in penetration and carbonation resistance.

Byung-wan Jo et al (2007) performed an experiment to investigate the properties of the hardened paste of fly ash by alkali activation and to determine the possible use of the paste in the production of light weight aggregates. The hardened paste and fly ash was granulated to produce alkali activated fly ash light weight aggregate and its properties were determined. The concrete using these aggregates exhibited a compressive strength of 26.47 MPa and good freeze-thaw resistance at 6% entrained air content.

Senbagam et al (2012) have studied the proportion, characterization and different utilization methods of synthetic aggregates in agriculture, physical and chemical properties of synthetic aggregates.

Ramadan et al (2007) have produced Light weight tetrapod aggregates from high calcium fly ash which have properties the light weight, strong, highly penetrate and have interlocking. They also obtained the results of physical and mechanical properties of the produced regular fly ash
aggregate. They also optimized the percentage of lime content for the best performance.

Mohsen Kashi et al (1999) described the development of innovative, synthetic aggregates consisted of various ratios and presents the results of laboratory test on these aggregates in light weight concrete. Coal combustion fly ash and recycled High density Polyethylene (HDPE) compared under heat and pressure.

A study was made by Wasserman et al (1996) on the interactions between sintered fly ash lightweight aggregates and the matrix in Portland cement concretes to resolve factors other than aggregate strength which influence the concrete strength. Aggregates of variable properties were produced and concretes of equal effective water/cement ratio were prepared and tested for strength and microstructure. It was found that differences in concrete strength could not always be accounted for by differences in the aggregate strength. The physical process identified was densification of the interfacial transition zone due to absorption of the aggregates; this process has considerable influence already at early age. The chemical processes were associated with pozzolanic activity of the aggregate and deposition of CH in the pores in the shell of the aggregates; these processes became effective only at later age, beyond 28 days. The enhancement in strength due to these influences ranged between 20 and 40%. Such influences should be taken into account in the design of lightweight aggregate of optimal properties.

Tommy et al (2004) have discussed about the increasing concern over the excessive exploitation of natural aggregates. Synthetic light weight aggregate produced from environmental waste is a visible new source of structural aggregate material. The uses of structural grade light weight concrete reduce considerably the self-load of a structure and permit larger precast units to be handled. The mechanical properties of a structural grade
light weight aggregate made with fly ash and clay were presented. The findings indicated that water absorption of the green aggregate is large but the crushing strength of the resulting concrete is high.

Obada Kayali (2005) describes fly ash has a new potential light weight aggregate manufactured from fly ash and compares them with other light weight and normal weight aggregates that are used in concrete. The paper presents the results of testing the aggregates for properties and the results of testing structural high strength grade concrete made from the new aggregates. The results show that the concrete made from the new aggregates is light weight, possesses low porosity, high strength and high durability potential. The light weight aggregate concrete made using this type of aggregate is more than 21% lighter than normal weight Granite and Dacite aggregate concrete.

Saradhi Babu et al (2005) have reported on the use of expanded polystyrene beads as lightweight aggregate, both in concrete and mortar. They studied the mechanical properties of expanded polystyrene concretes containing fly ash and compared with concrete containing ordinary Portland cement alone as the binder. They also investigated the stress-strain relations and the corresponding elastic modulus.

Rajamane et al (2006) have described the details of investigation on use of fly ash based lightweight aggregate as a coarse aggregate in polymer concrete which has sand fly ash and polyester resin as other components. They observed that the addition of lightweight aggregate reduces the density of polymer concrete and decreases its compressive strength and the ratio of tensile strength / compressive strength for such polymer concrete was found to be much higher than that of conventional concrete.

Ambily et al (2006) have studied the segregation phenomenon in polymer concrete with granite and sintered fly ash aggregate. They observed
that there is no segregation at the coarse aggregate contents when sintered fly ash aggregate is used and crushed granite stone aggregates particles settle towards the base resulting in noticeable segregation in the mix.

A study was made by Rajamane et al (2006) on geopolymer concrete containing sintered fly ash aggregates and granite aggregates. They observed higher compressive strength in geopolymer concrete containing crushed granite aggregates than sintered fly ash aggregates based geopolymer concrete. The ultrasonic pulse velocities of values of more than 4 km/sec in geopolymer concretes with above two aggregates indicate their dense microstructure.

The effect of polymer on performances of lightweight aggregate concrete was studied by Liguang Xiao et al (2006). They observed higher compressive strength and flexural strength in lightweight aggregate concrete when ethylene-vinyl acetate latex ranges from 5% to 15%. The ratio of flexural strength to compressive strength was highly improved, the brittleness was decreased and the toughness was improved in the lightweight aggregate concrete due to polymers.

Tayfun Uygunoglu et al (2012) have studied the influence of fly ash content and replacement of crushed sand stone aggregate with concrete wastes and marble wastes in pre-fabricated concrete interlocking blocks. They have compared properties of pre-fabricated concrete interlocking blocks with fly ash produced with three different replacement ratios of aggregates. The compressive strength, split tensile strength, density, apparent porosity, water absorption by weight, abrasion resistance, alkali-silica reaction and freeze-thaw resistance were determined. The lower physical and mechanical properties were observed when concrete waste and marble waste were used for replacing crushed sand stone.
2.4 STRENGTH AND DURABILITY OF FLY ASH AGGREGATE CONCRETE

Rajamane et al (2004) have reported that it is possible to produce coarse aggregates from fly ash by pelletisation techniques for use in structural grade concrete. They also studied the properties like bulk density, specific gravity, water absorption and aggregate crushing value. The concrete made with the bonded fly ash coarse aggregate has high slump, low density and also to produce minimum structural grade concrete as recommended in IS 456-2000. The permeability indicating tests such as sorptivity, rate of water absorption, rapid chloride permeability test etc. indicate satisfactory durability characteristics.

Ramamoorthy (2006) discussed on light weight concrete and light weight aggregate concrete and its classification. It is also reported on properties of various light weight aggregate concrete. It is also discussed on proportioning of light weight aggregate concrete by weight method.

Development of synthetic light weight aggregate from fly ash was discussed by Senguptha (1999). Production of sintered fly ash light weight aggregates provides an opening for large scale fly ash utilization. It is described that there are two ways of manufacturing aggregates with fly ash. The first method in down draft sintering technology which involves pelletisation of fly ash followed by sintering of the pellets at high temperature either in sintering strand or in a rotary kiln. Here heat energy from external sources is utilized for sintering. The second method is cold process or Aerodelite process for production of light weight synthetic gravel or aggregates out of coal residues is based on the control of pozzolana reactions. M/S Aerodelite holding B. V. Netherlands have developed this process which essentially utilize pozzolanic characteristics of fly ash by means of this
process various types of coal residues as well as other kinds of ash can be converted into light weight synthetic gravel/aggregate.

Carlos Videla and Patricia (2001) reported in their experimental work that fly ash agglomeration by agitation methods by disc pelletizer is a simple and effective process of manufacturing aggregates. Paste mixtures agglomerated using cement binders show five times smaller setting times values them mixtures agglomerated with lime. The aggregates manufactured with 5% weight of Portland pozzolanic cement possess the greatest viability for use at full-scale production.

Iyer and Scott (2001) reported that the disposal of fly ash from coal-fired power stations causes significant economic and environment problems. A relatively small percentage of the material finds application as an ingredient in cement and other construction products, but the vast majority of material generated each year is held in ash dams or similar dumps. Alternative uses for fly ash as a value added product beyond incorporation in construction materials are needed. Utilization of fly ash in such areas as novel materials, waste management, recovery of metals and agriculture is reviewed in this article with the aim of looking at new areas that will expand the positive reuse of fly ash, thereby helping to reduce the environmental and economic impacts of disposal.

Pantawee et al (2008) have investigated the use of natural pozzolanic diatomaceous and perlite to replace sand and cement at various percentages by mass of binder. They formed that the mortar containing diatomaceous replacing Portland cement effectively increased the compressive strength better than replacing sand. They also found the optimum content of perlite that contributed to the highest compressive strength.

The mechanical properties of ceramic microspheres known as cenospheres as primary aggregate have been studied by McBride et al (2002).
They found that the addition of high volumes of cenospheres significantly lowered the density of concrete some loss in strength. The losses in strength are recovered by improving the interfacial strength between the cenospheres and the cement. They also used the admixture silica fume and the coupling agent silica fume. They found the improvement in mechanical properties and fracture toughness by the addition of silica fume.

Niyazi Ugur Kockel et al (2010) have discussed the influence of different light weight fly ash aggregates on the behaviour of concrete mixtures. They studied the mechanical properties. They also studied the durability of concrete through rapid chloride permeability and rapid chloride permeability and rapid freezing and thawing cycling. They performed SEM observations to investigate the aggregate cement paste transition zone.

An investigation on the fundamental characteristics of concrete using recycled concrete aggregate was made by Jongsung Sim et al (2011) have They replaced cement by fly ash and fine and coarse aggregates by recycled aggregates. They observed that compressive strength of mortar add concrete which used recycled aggregates generally decreased as the amount of the recycled materials increased. the recycled aggregate concrete achieved sufficient resistance to the chloride in penetration and carbonation resistance.

Malhotra (2005) discussed on availability and management of fly ash in India and stressed to develop cost effective technology for the manufacture of bricks and aggregates from fly ash. He concluded that fly ash is a resource to be used in large volumes in construction.

Mullick (2012) described that conservation of natural resources, reduction of greenhouse gases and environmental pollution and utilization of waste materials are three objectives fulfilled by approximate choice of binder systems and aggregate cement blends containing industrial wastes, bottom ash
as fine aggregate and recycled aggregate were used in structural grade concrete.

Kumar Mehta (2004) discussed climatic change, resource, productivity and industrial ecology which are major issues in sustainable development and incorporation of high volume fly ash in concrete reduces the water demand, improves the workability, minimizes corrosion, sulphate attack and alkali-silica expansion.

An experimental investigation was undertaken by Prabakar et al (2011) to study the durability characteristics of ordinary Portland cement and Portland Pozzolana cement concrete with and without fly ash. The chloride diffusion value of concrete by 35% replacement of cement by fly ash was 9.95 times better than OPC concrete with 4.4 times decrease in RCPT values. The corrosion initiation period of was extend by 5.3 times than that of OPC concrete. The fly ash concrete showed an improved resistivity value about 3 times move in concrete with 35% replacement of cement by fly ash in OPC concrete.

Eco-friendly building materials and technologies Eco-housing assessment criteria-version II (2009) explained that up to 35% of suitable fly ash can be directly substituted for cement as blending material keeping the structural considerations fly ash significantly improves the quality and durability characteristics of the resulting concrete. Downdraft sintering process has been employed in the manufacture of cement clinkers and light weight aggregates from the mixture of fly ash, limestone/lime sludge. Sintered light weight aggregate substitutes stone chips in concrete, reducing dead weight. It promotes fuel efficiency because the carbon in the ash provides sufficient heat needed to evaporate the moisture in the pellets to the sintering temperature. As these aggregates have good shape, strength and
moderate water absorption, they are sulphate for providing light weight concrete blocks and structural light weight concrete.

Carolyne Namagga et al (2009) in their research paper seeks to optimize the benefits of using high lime fly ash in concrete as a replacement for large proportions of cement. They concluded that 25-35% fly ash replacement provides the most optimum strength results. Beyond 35% fly ash replacement the rate of gain of compressive strength decreases but maintains its strength value above the desired design strength.

Su-Chen Huang et al (2007) have investigated artificial light weight aggregate manufactured from recycled resources. Residues from mining, fly ash from an incinerator and heavy metal sludge from an electronic waste water plant were mixed into raw aggregate pellets and fed into a tunnel kiln to be sintered and finally cooled rapidly. Various feeding and sintering temperatures were employed to examine their impact on the extent of vitrification on the aggregate surface. Microstructural analysis and toxicity characteristic leaching procedure was also performed. The results show that the optimum condition of light weight aggregate fabrication is sintering at 1150°C for 15 minutes with raw aggregates pellets 750°C.

Mohsen et al (1999) described the development of new light weight synthetic aggregates and the subsequent laboratory testing of concrete mixes incorporating these aggregates. The light weight aggregates consisted of various ratios of coal combustion fly ash and recycled high density polyethylene compounded under heat and pressure. These concretes had values of unit weight compressive strength similar to those of other light weight aggregate concretes and they exhibit post-peak ductility; a potentially beneficial behaviour unique to light weight, or normal light weight aggregate concretes.
Ramamurthy et al (2006) have studied the relative performance of three binders, such as cement, lime and bentonite on the properties of sintered fly ash aggregate. They observed that the properties of aggregates depend on the type of binder and its dosage, the significant improvement in strength and reduction in water absorption of sintered fly ash aggregate when bentonite is added with fly ash and the binders did not alter the chemical composition while they influence the microstructure of the aggregate which results in enhancement in the properties of aggregates.

The strength development and water penetrability improvements of low calcium fly ash geopolymer concrete was studied by Monita Olivia et al (2008). They observed that the strength of fly ash geopolymer concrete can be improved by reducing the water/binder and aggregate/binder ratios. The water penetrability of low calcium fly ash geopolymer was found improved with decreasing the water/binder ratio, increasing the fly ash content, and using a well-graded aggregate.

Rajamane et al (2006) have reported the utility of particle packing theory for polymer concrete containing fly ash aggregates. The theory can be applied to optimize the relative proportions of ingredients such as fly ash, sand and sintered fly ash aggregates so that a minimum of resin content is used in preparing polymer concrete mixtures. When fly ash is added to sand-resin mortar, the resin requirement of mortar reduces due to particle packing effect.

Verma et al (1998) have studied techno-commercial perspective for sintered fly ash lightweight aggregates in India. They described the production method, pilot plant investigations, process engineering of a demonstrative unit, major plant and equipment specifications, cost economics, etc.
The effect of use of bottom (the coarser material, which falls into furnace bottom in modern large thermal power plants and constitute about 20% of total ash content of the coal fed in the boilers) as a replacement of fine aggregates was studied by Aggarwal et al (2007). The various strength properties studied consist of compressive strength, flexural strength and splitting tensile strength. The strength development of various percentages (0 – 50%) replacement of fine aggregates with bottom ash can easily be equated to the strength development of normal concrete at various ages.

Beth Brueggen et al (2010) reported that Fly ash is used in concrete to improve the fresh and hardened properties of concrete, including workability, initial hydration temperature, ultimate strength and durability. Scanning Electron Microscopy was used to investigate the physical effects of the grinding process on the fly ash particles in order to identify the mechanism by which grinding leads to improved concrete properties.

The use of sintered fly ash aggregate in concrete as a partial replacement of granite aggregate was examined by Behera et al (2004). It was observed that, with partial (20 %, 30% & 40% by volume) replacement of natural granite aggregate; the important physical properties of concrete such as compressive strength and Young’s modulus of elasticity were retained. In addition to the light weight characteristics, sintered fly ash aggregate concrete possesses strength and deformation characteristics similar to concrete with natural granite aggregate.

Gao Li-xiong et al (2004) have presented a research on sintered fly ash aggregate. The aggregate was manufactured through material orthogonal test and quick chilled firing schedule test. It displayed high strength and low water absorption. Light weight aggregate concrete made with this aggregate showed high compressive strength, workability and expansibility. Such properties meet the modern concrete requirements for high strength and
pump-ability. This new technology has important economic and social impacts on the use of industrial waste residue and on the environmental protection.

Mehmet Gesoglu et al (2006) have studied the effects of physical and chemical properties of the fly ash on the characteristics of the cold–bonded fly ash light weight aggregates. The produced fly ash aggregates were then examined by means of ESEM micrograph, EDX spectrum and XRD pattern to resolve the micro structural and the mineralogical characteristics of the light weight aggregates.

Mohd Mustafa Al Bakri Abdullah et al (2012) have reported on the possibility of producing foam concrete by using a geopolymer system. Class C fly ash was mixed with an alkaline activator solution (a mixture of sodium silicate and NaOH), and foam are added to the geopolymeric mixture to produce light weight concrete. The water absorption, porosity, chemical composition, micro structure, XRD and FTIR analyses were studied.

Montemor et al (1993) have specified the use of fly ash in concrete, in partial substitution of Portland cement. In this paper, the corrosion behaviour of steel reinforcement in concrete with different fly ash contents is followed by potential monitoring and electrochemical impedance spectroscopy (EIS), on concrete blocks in the presence and in the absence of chloride ion.

Yun Bai et al (2004) studied that fly ash, furnace bottom ash and lytag were used to replace ordinary Portland cement, natural sand and coarse aggregate, respectively, and thereby to manufacture light weight concrete. The density, compressive strength, pull–off surface tensile strength, air permeability, sorptivity and porosity of the concretes were investigated. With
part of OPC replaced with FA, the strength decreased but the permeability of resulting concrete improved.

Haydar Arsian and Gokhan Baykal (2004) have investigated that the fly ash aggregates produced from fly ash and cement mixing by pelletization method and evaluated Engineering properties such as crushing strength, specific gravity, water absorption, particle size distribution, surface characteristics and shear strength properties of the manufactured aggregates experimentally. The experimental investigation showed that these aggregates are a good alternative for wide range of Civil Engineering applications.

Rudolph Klotten (2003) expressed that the largest potential outlet for light weight aggregate manufactured from fly ash is in concrete, concrete products, block and masonry units. Light weight aggregate offer better thermal and acoustical insulation, high fire resistance, easy cutting and drilling.

Gokhan Baykal et al (2000) studied the properties of fly ash aggregate made by pelletization process such as unit weight, specific gravity, water absorption, crushing value test, California bearing ratio (CBR), direct shear tests, soundness tests, compressive and flexural strength and obtained good results when compared to conventional aggregates on concrete.

Somnuk Tangtermsirikul et al (2000) proposed a strength estimation method for fly ash aggregate. It was found that the tensile strength of fly ash aggregate was higher when the equivalent CaO content of raw materials used to produce the fly ash aggregate increased.
2.5 MIX PROPORTIONING OF LIGHT WEIGHT CONCRETE

The mix proportion is to combine different concrete ingredients based on their properties to obtain the required fresh as well as hardened concrete.

Andrew Short et al (1963) reported in the mix design of structural light weight aggregate concrete that most gradings of fine light weight aggregate fall in the grading zones 1 & 2 of B. S. 882 provided that the higher figure of 20 percent passing the No. 100 B.S. sieve allowed for crushed stone sands is used. The coarse aggregate can be produced to a grading complying with the requirements of B.S.882, although in Britain the maximum size used is generally limited to ½ inch or 3/8 inch. A high proportion of fine aggregate (3/16 inch down) is required for improved workability and in most of the work done at the Building Research Station the total aggregate proportion consisted of 50 percent fines and 50 percent coarse aggregate. When the grading of the fine aggregate is particularly coarse are for mixes leaner than 1:6 by volume, it may be advantageous to use an even higher fines content, to use an air entraining agent or to replace some of the light weight aggregate fines by natural sand.

The slump test does not seem to be suitable for measuring the workability of this type of concrete. A workable structural light weight concrete has a compaction factor ranging between 0.80 and 0.85.

For a given aggregate/cement ratio, the values of the water/cement ratio are considerably higher than those required for natural gravel and crushed rock aggregates, due to the high absorption of light weight aggregates. For a given aggregate and mix proportions, the water/cement ratio to give the required workability can be determined from a trial mix.
Satish Chandra et al (2003) have reported that in the mix proportioning of structural light weight aggregate concrete, the ingredients are restricted to two main components namely the binder and particles or rather cement mortar and coarse aggregate particles. The requirements of concrete are compressive strength and density of hardened concrete and consistency or workability and entrained air volume. The ingredients of concrete are the type of cement and mineral admixture, fine and coarse aggregate and its properties and chemical admixtures such as plasticiser and air entraining agent.

Rafat Siddique (2000) has reported that in the mix proportioning of light weight concrete mix, based on the extensive experimental investigations at the building research station UK which has developed empirical graphs relating the important parameters that influence the mix proportions are type of aggregate, cement content, water/cement ratio, workability, strength and relative density. The empirical graphs showing the relationship between mean design strength and total water/cement ratio, the relationship between total water/cement ratio and cement content and the relationship between relative density and cement content are used in arriving the mix proportions.

2.6 SUMMARY

Large scale utilization of fly ash is possible by using fly ash aggregates in concrete. The various advantages of light weight concrete and aggregate will pave the way for selection of a suitable alternate material for construction industry.

It is evident from the review of literature that exhaustive and comprehensive studies were carried on the characteristics of fly ash aggregate concrete related to strength and durability. However not much attention has been focused so far on the characteristics of concrete with complete replacement of conventional fine and coarse aggregates by fly ash aggregates.
Hence, in the present work the conventional aggregates have been completely replaced by fly ash aggregates in concrete and an attempt has been made to study the strength and durability aspects of fly ash aggregate concrete.