CHAPTER 2
LITERATURE REVIEW

2.0 LITERATURE REVIEW:

Brief review of available studies related to the experimental study of light weight aggregate concrete is presented in this chapter. And also the review covers in addition to the study on mode-II fracture parameters, strength properties including temperature and durability studies are studied experimentally and analytically to the light weight aggregate concrete properties.

2.1 INTRODUCTION

Based on the available literature on mode-II fracture and strength properties of light weight aggregate concrete an attempt has been made to review briefly related to mechanical strength properties and Mode-II fracture. The review covers is as follows:

(1) The various test specimen geometries proposed for experimental and analytical studies carried to determine the fracture parameters in Mode-II fracture for cold bonded pelletized light weight aggregate concrete.

(2) The strength parameters of cold bonded pelletized light weight aggregate concrete.

(3) Durability studies like acid attack and temperature studies

(4) The mineralogical composition of different cold bonded pelletized light weight aggregate concrete mixes.

For better understanding of past experimental investigations and the following literature survey is conducted.

Abeles, P.W. and Bardhan-Roy B.K., (1) 1981, reported on temperature studies and also on the residual strength of light weight concrete up to nearly 500°C. And also stated that the residual strength of light weight concrete after fire decreases linearly from 100% to 40% as a result of increasing the temperature from 500°C to 800°C.
F.W. Lydon., (2) 1982, investigated about strength studies related to cement content for light weight aggregate concrete, it is more relevant for mix design purpose to relate strength to cement content.

Robert W. Styron (3) 1984, studied on "Light Weight Aggregate". The test results were compared with those of normal weight concrete as obtained from the ACI code equations. In general, for the same grade of concrete the modulus of elasticity is about 30 percent lower and tensile strength is about 11 percent higher than normal weight concrete. Empirical equations predicting modulus of elasticity and tensile strength of brick aggregate concrete had been derived. As the properties of brick aggregate concrete lie between those of normal weight and lightweight concrete, it may be classified as medium weight concrete.

Bijen, J.M.J.M., (4) 1986, investigated on manufacturing processes of artificial light weight aggregate from fly ash by different processes like autoclaving, cold bonding or sintering etc.

Neville, A.M., (5) 1988, stated that due to the rapid economic development and growth in the world population, there is a strong demand on natural aggregate usage. Such aggregates are available in many parts of the world and can be used in producing concrete in a wide range of unit weights and suitable strength values for different fields of applications.

W.C. Piasta, et.al., (6) 1988, made their investigation on sulfate durability of concrete under constant sustained load. The aim of this paper is to study of durability of concrete with limestone and granite aggregate under simultaneous long-term compressive stress and sulfate attack.

Min-Hong Zhang, Odd E., Gjorv., (7) 1991, had made study on "Characteristics of lightweight aggregate for high-strength concrete". Light weight aggregate are produced from a wide variety of raw materials, and the production conditions may also vary. The characteristics of light weight aggregate may vary within wide limits.

K.D. Hertz., (8) 1992, had studied on "Davish investigation on silica fume concrete at elevated temperatures". This explains the fire tests in which the increased
risk of explosive spalling of concrete densified by silica fume was first discovered. Results were discussed from test to define appropriate limits of SF content and to develop a new concrete for slender column units. Observations were made about circumstances under which super plasticize ring addictive in concrete gave rise to development of toxic gases.

Xiaofeng Cong, et.al. (9) 1992, had noticed that the strengths of concrete using silica fume as partial replacement in cement is higher side when compared to normal concrete, this is due to an addition of silica fume in binding material.

Owens, P.L., (10) 1993, conducted experimental studies on densities of light weight aggregate concrete and normal weight aggregate concrete and stated that the density of light weight aggregate concrete ranges from 1400 to 2000 kg/m³ compared with that of normal weight aggregate concrete (about 2400 kg/m³).

Nevile, A.M., (11) 1995, stated that Pumice is a natural light weight material used in concrete as coarse aggregate where it is locally available or easily imported.

Moira A.Harding, (12) 1995, had studied on "Structural Light weight aggregate concrete". Terence, C.Holland et. al., (13) 1995, had studied on" Use of silica fume in concrete". Both are reveals that the effects of silica fume on strengths.

J.Alduaij, et.al., (14) 1999, studied on light weight concrete by using different unit weight aggregates without using of natural fine aggregate (no-fines concrete). They obtained a light weight concrete with 22 MPa cylinder compressive strength and 1520 kg/m³ dry unit weight at 28 days.

Ali R. Khaloo, and Nakseok Kim., (15) 1999, conducted tests and studied the effect of different curing periods and different temperatures on concrete. It results that the influence of various curing conditions on the major mechanical strength properties of light weight high strength concrete (LWHSC) is in considerable limits.

Prakash Desayi, et.al., (16,17,18,19,20,21, and 22) 1993, 1993, 1999, 1999, 1999, 2000, and 2000, studied about Mode-II fracture studies using DCN specimen geometry which fails in predominant Mode-II failure, They have also made finite element analysis to arrive at stress intensity factor. Using this DCN
geometry lot of experimental investigation using cement paste, mortar, plain concrete have been studied. Details of this geometry are presented in fig 2.1.

Fig.2.1. Details of DCN test specimen geometry

L.Calaveri, et.al., (23) 2003, proved that the pumice aggregate is no way inferior than natural granite aggregate by taking into account the loading tests carried out on structural systems made of LWPSC.

L.Cavaleri, et.al., (24) 2003, had investigated on light weight pumice stone, and stated that the use of pumice aggregate in concrete, shows that the light weight pumice stone concrete is an alternative material in the construction industry.

Khandaker M.Anwar Hossain, (25) 2003, reported about the suitability of using volcanic pumice as cement replacement, and coarse aggregate in light weight concrete production. It is also observed that the volcanic pumice concrete has lower modulus of elasticity, more permeability, and initial surface absorption.

Kevin J. Folliard, et.al., (26) 2003, had studied on the effects of curing period on strength development of controlled specimens. From their studies it is concluded that the strengths are increased slightly with increasing curing periods.

Albert N.Noumowe, (27) 2003, investigated on the thermal effects on high strength fiber (polypropylene) reinforced concrete and light weight aggregate concrete, and drawn conclusions about thermal stability at high temperature and the residual mechanical properties of the tested specimens.
Santanu Bhanja, and Bratish Sengupta., (28) 2003, had studied on contribution of silica fume on concrete and determined its optimum content. The results revealed that the optimum replacement percentage is not constant, but depends on w/c ratio, and also observed that both the mechanisms significantly contribute to the concrete strength.

M.N.Haque, et.al., (29) 2004, conducted tests on the "Strength and durability of light weight concrete". The results were indicated that the water penetrability and carbonation depth of SLWC are almost identical to those of the corresponding strength and much less than those made with both fine and coarse LWA.

D.Sari, and A.G.Pasamehmetoglu., (30) 2005, studied about the influence of pumice as admixture on pumice light weight aggregate concrete, and its effect on gradation. It is observed that there is a significant influence on the strength and density of light weight pumice concrete.

G.Batis, et.al., (31) 2005, had investigated on "Corrosion protection of steel in pumice light weight mortar by coatings".

Oguz Akin Duzgun, et.al., (32) 2005, had investigated on the effect of steel fibers on the mechanical properties of natural light weight aggregate concrete. Detailed investigations were conducted on the effect of steel fibers on the mechanical properties of pumice aggregate concrete. Modulus of elasticity and deformation capability was decreased with increasing the pumice aggregate and steel fiber ratio in the mixture.

Sarah Jo Grotheer (33) 2006, had studied on "Evaluation of Light Weight Concrete mixture for bridge deck and pre-stressed bridge Girder applications ".

Fouad M. Khalaf, (34) 2006, had reported that due to high porosity and roughness of the surfaces of crushed clay brick aggregate there is a tendency of the ability to absorb more bitumen, and provide good bonding on asphalt concrete. By using this recycled brick aggregate it has many uses, such as friendly environs, and suitable for road construction as alternative.

Harikrishnan, K.I., and Ramamurthy., (35) 2006, studied on manufacturing of fly ash pellets. They concluded that the efficiency of production of pellets depends on
speed of revolution of pelletizer disc, moisture content, angle of pelletizer disc and duration of Pelletization.

Harun Tanyildizi et al (36) 2007, reported on the "Performance of light weight concrete with silica fume at high temperature".

L.Gunduz, (37) 2007, studied on the effects of pumice aggregate/cement ratios on the low-strength properties of concrete, and also discussed about thermal insulation using different A/C ratios in mixture.

L.Gunduz, (38) 2007 investigated the suitability of quartet blended concrete which contains fly ash, scoria, pumice and cement. By using this mixture he produced cellular hollow light weight masonary blocks. These blocks are suitable and have adequate strengths for their use in general building construction.

Farid Debieb et.al., (39) 2007, had studied on the use of crushed brick as fine and coarse aggregate in making light weight concrete. The study throws some light on the possibility of using this crushed brick as coarse and fine aggregate for preparation of concrete.

Ivana kesegic et.al., (40) 2008, had studied on "Recycled clay brick as an aggregate for making fresh concrete". An overview of this study reported that this concrete has better thermal conductivity.

V.BhaskarDesai, et.al., (41,42) 2008, and 2011, evaluated the mechanical strength properties like compressive strength, split tensile strength, mode-II fracture by using DCN specimen and the fracture toughness values in Mode-II (K_{IIc}) from the theoretical equations suggested by the earlier researchers and are compared with those obtained from load verses deflection (p-δ) diagrams.

Xuemei Liu et.al., (43) 2010, had studied on “Development of light weight concrete with high resistance to water and chloride-ion penetration”.

R. Kumutha, and K.Vijai, et.al., (44) 2010, had studied on “strength of concrete incorporating aggregates recycled from demolition waste”. It consists of either crushed concrete (CC) or crushed bricks (CB) from the demolition wastes available locally.
K.BalajiRao, et.al., (45) 2012, evaluated the mechanical strength properties and the fracture toughness from the theoretical equations.

P.S.Raghuprasad, et.al., (46) stated that the pollution levels and scarcity of naturally available materials have reached the peak due to rapid industrialization. Hence it is necessary to study an alternative to the conventional aggregate, and one possible way is replacement of conventional aggregate with cinder.

Various laboratory trials were conducted to investigate the possibility of using pelletized cold bonded light weight aggregate as the replacement of natural coarse aggregates in concrete. A series of tests were carried out to determine the density, compressive strength, split tensile strength, flexural strength, in-plane shear strength (Mode-II) and young’s modulus of concrete with and without replacement of cold bonded pelletized light weight aggregate with conventional coarse aggregate in concrete was replaced with 0%, 25%, 50%, 75% and 100%. For strength properties, the results shows a measurable decrease in all strengths as the percentage of cold bonded pelletized light weight aggregate used in the specimens increased.

2.2 OBJECT & SCOPE OF INVESTIGATION

From the past available literature it is known that much less attention has been paid towards study of artificial cold bonded pelletized aggregate concrete. Light weight pelletized aggregate concrete has been considered in the present investigation and normal aggregate has been replaced by artificially prepared light weight aggregate.

Hence present investigation has been undertaken for the study of mechanical strength properties along with in-plane shear strength with an addition of light weight artificial aggregates. The objectives of the present investigation are as listed below.

To carry out the possibility of study of producing pelletized cold bonded light weight aggregate concrete by using industrial by products such as pozzolanas.

To investigate the mechanical strength properties of modified light weight aggregate concrete, such as compressive strength, flexural strength, split tensile strength, modulus of elasticity, and density etc.
To examine the Mode-II fracture properties of artificial light weight aggregate concrete.

To know the strength properties of fiber reinforced light weight aggregate concrete with steel fibers.

To know the durability and temperature studies of modified artificial light weight aggregate concrete.

And also to know the XRD, SEM analysis of modified light weight aggregate concrete with cold bonded pelletized aggregate.

From the past literature, test specimen geometry proposed by Prakash Desai et.al. (16) for Mode-II fracture of cementitious materials i.e., Double Centered Notched (DCN) specimen is considered, in the present investigation since this gives predominant shear failure. In this experimental work the effect of replacing the conventional aggregate by lightweight aggregate i.e., pelletized aggregate (Fly ash, Metakaoline and Silica fume) in different percentages and the effect of addition of different percentages of crimped steel fiber is also studied. This has resulted in casting and testing of DCN specimens with various a/w ratios (a=depth of the notch, w=width of the specimen) along with plain cubes, cylinders and flexure beams etc. Further the durability studies on fly ash aggregate concrete and silica fume aggregate concrete are also reported. Present investigation is expected to throw some light on the better understanding of behaviour of artificial pelletized light weight aggregate concrete with and without an addition of steel fiber. This may help for better utilization of industrial wastes and solve disposal problems.