Literature Review:

1. Oluokun, et. al., (1991) investigated the relationship between concrete compressive strength and its splitting tensile strength, especially at early ages as well as examination of the applicability of some of the existing relations between these properties to concrete. Analysis of test results shows that the commonly accepted 0.5 power relationship between the compressive strength and splitting was found to be inaccurate at all ages. The specimen size and shape effects on the compressive strength of High Strength Concrete were investigated by Tokyay, et. al., (1997) on different sized cylinders having constant length-to-diameter ratio (l/d), different sized cubes and cylinders with various l/d. The compressive strength was found to be significantly affected by changing l/d.

2. Zhang et al, (1995) reported that the quantity of superplasticizer required for 10% metakaolin incorporated concrete was same as that of silica fume concrete but setting times of metakaolin concrete was shorter than normal and silica fume concrete. Sabir et al, (1996) reported that although it was clear that metakaolin increased water demand, the standard workability (i.e., slump, compaction factor and Vee-bee time) was not capable of quantifying the influence on the overall flow properties of metakaolin concrete, particularly at the lower water-binder (w/b) ratios. Bai et al, (1999) observed that there was a systematic decrease in both slump and compaction factor and a systematic increase in Vee-bee time as the OPC replacement level by metakaolin in their concrete mixes increased from 0 to 15% and there were larger changes in workability of the concretes with the high water binder ratios.

3. Ramezanianpour, et. al., (1995) studied the effect of curing the compressive strength, resistance to chloride ion penetration and porosity of concretes incorporating GGBS, fly ash, and silica fume. They performed their investigations under four different curing regimes: moist curing, curing at room temperature after demoulding, curing at room temperature after two days of moist curing, and curing at 38oC and 65% relative humidity. Their results indicated that the reduction in the moist curing periods resulted in lower strength, higher porosity and more permeable concretes. The strength of concrete containing fly ash or GGBS appears to be more sensitive to poor curing than the control concrete. They also showed that the incorporation of GGBS or silica fume or high
volumes of fly ash in the concrete mixes increased the resistance to chloride ion penetration and produced concrete with low permeability.

4. Duval et al., (1998) investigated the workability and the compressive strength of silica fume concrete at low water-cementitious materials ratios with sulphonated naphthalene superplasticizer. The results show that partial cement replacement up to 10% of silica fume does not reduce the concrete workability. Jeyabalan, P (2004) reported that use of fumed silica in concrete increased the water demand. The standard workability test, i.e., slump, compacting factor and Vee-bee time, were not capable of quantifying the influence on the overall flow properties of fumed silica concrete with Recycled concrete aggregate, particularly at the lower w/b ratios (w/b=0.32).

5. Van Jaarsveld et al (1998) reported the use of the mass ratio of the solution to the powder of about 0.39. In their report, 57% fly ash was mixed with 15% kaolin or calcined kaolin. The alkaline liquid comprised 3.5% sodium silicate, 20% water and 4% sodium or potassium hydroxide. In this case, they used specimen size of 50x50x50 mm. The maximum compressive strength achieved was 75 MPa when fly ash and builders’ waste were used as the source material.

6. Palomo et al (1999) studied the Geopolymerisation of low-calcium ASTM Class F fly ash (molar Si/Al=1.81) using four different solutions with the solution-to-fly ash ratio by mass of 0.25 to .30. The molar SiO2/K2O or SiO2/Na2O of the solutions was in the range of 0.63 to 1.23. The specimens were 10x10x60 mm in size. The best compressive strength obtained was more than 60 MPa for mixtures that used a combination of sodium hydroxide and sodium silicate solution, after curing the specimens for 24 hours at 65°C.

7. Xu and Van Deventer (2000) reported that the proportion of alkaline solution to alumino-silicate powder by mass should be approximately 0.33 to allow the Geopolymeric reactions to occur. Alkaline solutions formed a thick gel instantly upon mixing with the alumino-silicate powder. The specimen size in their study was 20x20x20 mm, and the maximum compressive strength achieved was 19 MPa after 72 hours of curing at 35oC with stilbite as the source material.
8. **Mehta (2001)** suggested that they have strategies to retain concrete as a construction material for the development of infrastructure; meanwhile they have outlined an alternative eco-friendly material which can be used to manufacture concrete for the future.

9. **Mehta (2002)** suggested the use of fewer natural resources, less energy, and minimise carbon dioxide emissions, in order to produce eco-friendly concrete. He categorized these short-term efforts as ‘industrial ecology’. The unwanted by-products of industry can be attained by lowering the rate of material consumption which is his long-term goal to reduce the impact.

10. **McCaffrey (2002)** reported that by decreasing the amount of calcined material in cement, the quantity of carbon dioxide (CO2) emissions by the cement industries can be reduced, by decreasing the number of buildings using cement and by decreasing the amount of cement in concrete this problem can be sorted out.

11. **Malhotra (2002)** projected that the contribution of Portland cement production worldwide to the greenhouse gas emission is about 1.35 billion tons per annum or about 7% of the total greenhouse gas emissions to the earth’s environment. Cement is also one among the most energy-intensive construction materials, after aluminum and steel. Furthermore, Mehta and Burrows (2001) reported that the durability of ordinary Portland cement (OPC) concrete is under examination, as many concrete structures, especially those built in corrosive environments, even though they have been designed for more than 50 years of service life; start to deteriorate after 20 to 30 years.

12. **Jayabalan, (2004)** investigated the compressive strength of high performance concrete with fumed silica and reported that there were considerable increase in compressive strength of trial mixes in which cement was replaced by fumed silica at 5%, 7.5%, 10% and 15%. This result shows that, the use of fumed silica as an admixture gives ‘High Early Strength’, so as to attend the emergency repair works immediately. Mineral admixture such as fumed silica is an ideal constituent for high performance concrete, as it
has the inherent ability to contribute to continued strength development through their pozzolanic cementation reactivity.

14. **Fortune (2005)** suggested that the global warming is not only due to climate change, but also to the conflicting global dimming due to the pollution in the atmosphere. Global dimming is due to pollution particles in the air blocking the sunlight associated with the reduction of the amount of sunlight reaching the earth. However, it will increase the effect of global warming; the effect of global dimming may be reduced with the effort to reduce the air pollution that has been taken into implementation. From this point of view, the global warming phenomenon should be considered more seriously, and any action should be given more effort and concentration to reduce the effect.

15. **Ummi Kalsum et al (2008)** was studied on recycling of clay based demolition wastes for the production of concrete block. He examines the possibilities of using fired clay bricks as coarse aggregate were replaced with 20-100% of crushed FCB and strength of more than 35N/mm² was monitored. Result showed that substituting 40% of clay bricks aggregate after 28 days curing produced higher mechanical strength compared to the reference, natural aggregate.

16. **Miss. Divya Sasi (2009)** examined the impact on strength properties of concrete in replacing some portion of concrete by quarry sludge got from a nearby crusher unit. The research work did incorporated a test examination on strength properties of cement made with 2.5% to 20% substitution of cement by quarry dust of under 75 micron particle size. The tests were completed to find the compressive strength, splitting tensile strength and flexural strength on samples. Results demonstrated that up to 7.5 % substitution of cement by quarry dust there was no reduction in compressive strength, splitting tensile strength and flexural strength.

17. **Dr. R. Kumutha and, Dr .K. Vijay (2011)** studied the use of groundnut husk in paver blocks In their study the fine aggregates were partially supplanted utilizing Groundnut husk ash remains as a part of rate of 0,10, 20, 30, 40, 50, and 60. And Density, compressive strength and water absorption was found out utilizing paver blocks. Total 42 paver blocks were cast with 6 blocks for every proportion. Out of 42 paver blocks 21 blocks were used to find the average density and compressive strength. Before subjecting the samples to compression test, every specimen was weighed to find the density.
Remaining 21 blocks were utilized to get the water absorption and, give conclusions that density of paver blocks is inside of the range of 1880-2200 kg/m³. Density values declines with expansion in Groundnut husk ash remains. Groundnut husk ash is suitable in making paver blocks as the water assimilation is under 7%. The paver blocks prepared utilizing M40 grade of concrete can be utilized for light traffic, commercial vehicles like Pedestrian plazas, shopping complexes, auto parks, housing colonies, office buildings, rural streets with low volume traffic, farm houses, beach sites, traveler resorts local authority footways, residential roads, and so on.

18. **K. Gunasekaran (2011)** studied the reuse of waste steel rounded bearing from cycle shops and motorbike repairing garages. Waste steel rounded bearing can be utilized as a part of manufacturing cement paver blocks as substitution of cement in some amount. Steel has higher specific gravity and density when contrasted with coarse aggregates. As steel bearing utilized as a part of paver blocks as coarse aggregates, the density of paver blocks increases with including steel bearing. The strength of paver blocks can be increased and this is extremely noteworthy. Henceforth including steel bearing in paver blocks is beneficial as it increases the compressive strength, abrasion resistance capacity, impact value of paver blocks. In their study, they utilize different mix proportion replacing cement by waste steel @ 0%, 10%, 20%, 30% and 40% by weight.

19. **Abubakar and Muhammed Saleh Abubakar (2011)** compared the physical and mechanical properties of coconut shell and crushed granite rock also a total of 72 concrete cubes of size 150x150x150mm with different mix ratios of 1:2:4, 1:1.5 :3 and 1:3:6 were casted and tested for evaluating different properties. Aggregate crushing value (ACV) for coarse aggregate was 21.84 and 4.71 for coconut shell. Elongation and flakiness index were 58.54 and 15.69 respectively for gravels, while for coconut shell, it was 50.56 and 99.19 respectively. Compressive strength of concrete cubes in N/mm² of coconut shell at 7,14,21 and 28 days with mix ratios of 1:2:4, 1:1.5 :3, and 1:3:6 are (8.6, 8.9 ,6.4,), (9.6, 11.2, 8.7), (13.6, 13.1, 10.7) and (15.1, 16.5, 11) respectively, likewise (19.1, 18.5, 9.6), (22.5, 23.0, 10.4), (26.7, 24.9, 12.9) and (28.1, 30.0, 15) respectively for gravel. Since the concrete strength of coconut shell with mix ratio 1:1.5:3, attained 16.5 N/mm² compressive strength at 28 days it can be used in plain concrete works, cost reduction of 48% will be achieved.
20. **Satish Parihar and Hemraj R Kumavat (2012)** utilized reused plastic as aggregate as a part of paver blocks. Recycled plastic as aggregate in concrete is satisfactory there are for the making of concrete utilized coarse aggregate having size 10mm, natural river sand utilized for making a concrete and plastic aggregate utilized as a part of concrete. Test carried out on these aggregate density, and sieve analysis, water absorption, all these test conduct on Recycled plastic aggregate example routine aggregate and compressive strength of cement at 10%, 20%, 30 substitution of plastic aggregate in concrete. What's more, they infer that the solid comprise of cement, sand, aggregate and water. Out of which the aggregate rate is 60 to 70% in concrete and utilization of the 20% Recycled plastic aggregate in concrete which does not influence the properties of cement. it is conceivable to utilize the plastic in concrete mix up to 20% weight of coarse aggregate. also, utilizing the plastic as a part of solid blend to diminishes the weight of cube up to.

21. **P. Turgut and E. S. Yahlizade (2012)** conduct a parametric trial study for reducing paver blocks utilizing fine and coarse waste glass. The chemical response between the alkali in Portland cement and the silica in aggregates forms silica gel that causes crack upon development, as well as weakness the concrete and shortness its life. Ground waste glass was utilized as aggregate for mortars and no response was detected with fine particle size, consequently showing the possibility of the waste glass reuse as fine aggregate in mortars and concrete in addition, waste glass appeared to decidedly add to the mortar micro scale basic properties bringing about a clear change of its mechanical performance. He prepare seven series of mix in the lab trials as indicated by the requirements, tried that and make inference that The substitution of fine glass by fine aggregate at level of 20% by weight significantly affected the a few properties of concrete paver block specimens as contrasted and the control test. The compressive strength, the flexural strength, the splitting tensile strength and abrasion resistance of the paving block samples in the fine glass. Substitution level of 20% is 69%, 90%, 47% and 15% higher as compared with the control test, respectively. The fine glass at level of 20% could be utilized as a part of the production of paver blocks.

22. **Amarnath Yerramala Ramachandrudu C (2012)** in his experimental study, coarse aggregate was partially replaced by coconut shell and fly ash. Percentages of replacement
by coconut shell were 10%, 15%, 20% and Percentages of coconut shell replacement by fly ash were 5%, 25%. He concluded in his study that workability decreased with increase in CS replacement. Compressive and split tensile strengths of CS concretes were lower than control concrete.

23. Maninder Kaur & Manpreet Kaur (2012) published a review paper in which it is concluded that use of coconut shells in cement concrete can help in waste reduction and pollution reduction. It is also expected to serve the purpose of encouraging housing developers in investing these materials in house construction. It is also concluded that the Coconut Shells are more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production.

24. Vishwas p. Kulkarni et al (2013) studied that Aggregates provide volume at low cost, comprising 66 percent to 78 percent of the concrete. M20 Concrete is produced by 0%, 10%, 20%, 30% replacement of coarse aggregate by coconut shell. There is no need to treat the coconut shell before use as an aggregate except for water absorption. No bond failure was observed, confirming that there was adequate bonding between the coconut shell aggregate concrete and the steel bars.

25. Daniel Yaw Osei (2013) in this experimental study coarse aggregate is partially replaced by coconut shell. Percentages of replacement by coconut shell were – 0%, 20%, 30%, 40%, 50%, 100%. He concluded that CS can be used to produce lightweight concrete and 18.5% replacement of crushed granite with coconut shells can be used to produce structural concrete.

26. Tomas U. Ganiron Jr (2013) used coconut shells and fibre as substitute for aggregates in developing concrete hollow block. The study was carried out for various percentage of coconut shell content as partial replacement of conventional aggregate. Results showed that replacement of appropriate coconut shell content produces workable concrete with satisfactory strength. Integration of coconut shell enhanced the strength of concrete.

27. M. C. Nataraja & Lelin Das et al (2013) has Study on strength properties of paver blocks made from unconventional Material. In this investigation, various properties such as compressive split tensile, bending strength and water absorption of paver blocks consisting of crushed granite, unconventional materials such as Kadappa and
broken paver for various percentage replacement of coarse aggregate are studied as per IS 15658: 2006. Kadappa aggregates are better than granite aggregates in terms of water absorption limits. Broken paver aggregate is not suitable in making paver blocks as water absorption is more than 7%. However, 50% replacement of paver aggregate with natural aggregate can be used.

28. **R. Nagalakshmi, 2013** contemplated the fractional replacing of cement with marble dust powder. In his study he replaced coarse aggregate by marble dust powder at different rates and performs numerous tests on them. Marble powder were included cement in step of 5% (0%, 5%, 10%, 15%, 20%). For every percent of marble powder replacing cement, 3 cube and 3 cylinders were casted for 7 days and 28 days. Compression testing machine is utilized for testing the compressive strength of block and split tensile strength of cement. The crushing strength were noted and average compressive strength and tensile strength for three specimens is determined for each. With the consideration of marble powder the strength of cement steadily increments upto a specific point of confinement however the progressively diminishes. With the incorporation of marble powder upto 10% the initial strength quality increase in cement is high. At 10% there is 12% increase in initial compressive strength for 7 days At 10% there is 17.7% increment in starting compressive strength for 28 days.

29. **G. Navya et al (2014)** have carried out Experimental Investigation on Properties Concrete Paver Block with the Inclusion of Natural Fibers. In their experimental investigation the compressive strength, water absorption and flexural strength of paver blocks were determined by adding Coconut fibers in the top 20mm thickness. Coconut fibers were added in proportions of 0.1%, 0.2%, 0.3%, 0.4% and 0.5% in volume of concrete. The compressive strength, flexural strength and water absorption were determined at the end of 7 and 28 days. They have been concluded that indicate the addition of coconut fiber by 0.3% paver block attains maximum compressive strength, i.e. addition of coconut fiber gradually increases flexural strengths and water absorption at 7 and 28 days. They investigated at 0.3% of coconut fiber content effect of top layer thickness on compressive strength and flexural strength is also determined.

30. **Shreeshail B.H et al (2014)** have studied on the effects of coconut fibers on the properties of concrete. Study the deformation properties of concrete beams with fibers
under static loading condition and the behavior of structural components in terms of compressive strength for plain concrete (PC) and coconut fiber reinforced concrete (CFRC) has been studied. The testing of various material constituents of concrete was carried out according to the Indian Standard specifications. The suitability of CFRC as a structural material is studied, in comparison with conventional concrete. Optimum results were found when 2% of coir by weight of cement fibers was used; there was 6% and 13% increase in compressive strength as compared to normal concrete for 75AR and 125 AR respectively. Split Tensile Strength increased up to 12% for 75 aspect ratio and 29% for 125 aspect ratio with 2% fiber. Modulus of Rupture increased up to 45% for 75 aspect ratio and 50% for 125 aspect ratio with 2% fibre.

31. D.N Patil J. R. Pitroda et al (2014) has studied Development of low cost paver blocks by replacing PPC with used foundry sand. Foundry sand generated from metal casting industry is replaced in different percentages like 1.0%, 20%, 30%, 40% and 50%. Compressive strength, flexural strength has been determined at the end of 7, 14 and 28 days and water absorption test has been determined at 28 days. Even after 50% replacement of cement, they got compressive strength 23.48 N/mm² and water absorption is 2%. Cost optimization can be achieved when cement is replaced in different percentages by used foundry sand. At 50% replacement of cement, the cost of paver block is 20.13% lower than standard mixed proportion.

32. Parag S. Kambli & Sandhya R. Mathapati. (2014) prepared three different Mix Designs for M20, M35, M50 grades of concrete. Percentage replacement by coconut shell varied as 0%, 10%, 20%, 30%, 40% respectively. It is concluded in this study that for M20 grade concrete cubes with 30% replacement of CS aggregates had given strength of 23 MPa at 28 days. Concrete cubes with 30% replacement of CS aggregates had given strength of 42 MPa at 28 days for M35. For M50 grade concrete cubes with 30% replacement of CS aggregates had given strength of 51 MPa at 28 days [16].
33. **Dinesh W. Gawatre et al (2015)** have been studied on manufacture of paver block using partial replacement of construction and demolished concrete waste. In order to achieve the same conventional results they trying to replace the course aggregate and fine aggregate completely and partially up to 50% in bottom layer because of environmental considerations and growing trend in reusing waste products. Impact value and crushing value obtained for aggregates obtained from concrete waste were 14.6% and 13.25% respectively which are way better than requirements as per IS recommendations. They conclude the characteristic compression strength of interlocking paver blocks obtained was 35.63MPa which is more than design standards for M35. Minimum breaking load for a single sample out of eight samples was 6.420KN, which is still more than that required for Regularly Trafficked Roads. Average tensile splitting strength was obtained as 1.5MPa which is not satisfactory. Finally they concluded that the paver blocks prepared using M35 grade of concrete and 50% replacement of aggregates can be used for pedestrian plazas, car parks, office complexes, rural roads with low volume traffic, residential roads, housing colonies etc.

34. **Vishal Kumar et al (2016)** have studied utilized the waste material in concrete paver blocks. They have been studied paper a study for producing paver blocks utilizing waste aggregate specially in the form of rounded bearing of size 6.35mm) is introduced. Waste rounded steel bearing are introduced in concrete of paver block in different rates. Compressive strength of paver block with different rates of waste aggregates and utilizing elastic cushions is examined. Test result demonstrate that including different rates of waste steel aggregates in paver blocks gives up to 50% more strength quality than customary paver blocks. They conclude that the compressive strength of cubes are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the compressive strength decrease and split tensile strength of cylinders are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the split tensile strength decreases.

35. **Dinesh W. Gawatre 2016** concentrated on the utilization of reused coarse aggregate got by squashing of solid waste from destruction of structural component, for example, old buildings, bridges concrete pavements etc He supplant the coarse aggregate and fine
aggregate completely and partially up to half in paver blocks and tested the specimens for compressive strength, water absorption and durability and find agreeable results.

36. Mithun and et al 2016 An experimental investigation carried out on hypo sludge as a replacement for cement in terms of percentage and also replacement for fine aggregate in the casting of paver blocks for M30 grade, which suits for medium traffic as per IS standards. ICBP technology has been introduced in India in construction, a decade ago, for specific requirement namely footpaths, parking areas etc. But now being adopted extensively in different uses where the conventional construction of pavement using bituminous mix or cement concrete technology is not feasible or desirable.