WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Partial Replacement of Fly Ash, GGBS, Silica Fumes with Cement by Adding Glass Fiber in Pervious Concrete

Challapalli Pavani*[a] *, Dr. N. Victor Babu*[b]*

[a]Civil Engineering, M.Tech Student, Baba Institute of Technology and Sciences, Visakhapatnam
[b]Civil Engineering, Professor, Baba Institute of Technology and Sciences, Visakhapatnam

A B S T R A C T

Concrete is a combination of different materials due to its versatility, durability, sustainability, and economy it is used as a construction material. As concrete is prepared by using enormous amount of natural resources which turns to produces significant quantity of construction and demolition waste (CDW). The impervious nature of the conventional pavement systems has resulted in increased storm water runoff quantity that has stemmed in a large volume of first flush containing unacceptable level of pollutants, and unwarranted flash floods. Moreover, the treatment of first flush requires large detention basins and purification plants before it is discharged into the natural water bodies. In addition, problems such as decreased groundwater recharge, hydroplaning surfaces, and non-skid resistant wearing courses is virtuous of the impervious pavement systems.

Keywords: Concrete, Fly ash, Ggbs, Glass fiber.

1. INTRODUCTION

This chapter discusses about the sustainable of pervious concrete which means how fibers are used as an addition of cement and how they improve the properties and strength of pervious concrete by using pozzolanic materials with different fine aggregate and glass fiber ratio.

1.1. Concrete:

Concrete is a mixture of paste and aggregates, or rocks. The paste, composed of Portland cement and water, coats the surface of the fine (small) and coarse (larger) aggregates. So, concrete is the favorite choice as a construction material among civil engineers around the world for a long time. It is preferred for its better performance, longer life and low maintenance cost. It is difficult to find an alternate material for construction which is as suitable as that of such material form durability and economic point of view. The quantity of the water plays an important role in the preparation of concrete. Impurities in water may interfere the setting of the cement and may adversely affect the strength properties.

Acknowledgements, References, Appendix. Collate acknowledgements in a separate section at the end of the article and do not include them on the title page, as a footnote to the title or otherwise.

1.2 Sustainable concrete

Sustainable concrete is a concrete capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage. With the wave of sustainability also impacting the construction industry, scientist and engineers throughout the world are looking for sustainable and reusable construction materials. One such material is pervious concrete (PC). Pervious concrete is composited of cement, coarse aggregates, pozzolanic materials and fibers and small ratio of fine aggregates.

1.3 Pozzolanic materials

Pozzolanas are materials containing reactive silica which in themselves possess little or no cementitious value but which combine with lime in finely divided form in the presence of water to produce cementing compounds. Some of the pozzolanic materials that are used in this study.

1.3.1 Fly Ash

Fly ash is finely divided ash resulting from the burning of pulverized coal or lignite in boilers. The fly ash obtained from lignite isconsidered superior because of its higher lime content. Fly ash is a waste product and today, it is available in all parts of India.

1.3.2 GGBS

To produce GGBS, this granulated blast furnace slag is dried and ground to a fineness similar to that of Portland cement. Civil and marine operates five slag grinding plants, located across England and Wales. Each is a sophisticated production facility, capable of processing up to half a million tonnes a year, to accurately controlled fineness. GGBS is normally used in combination with Portland cement. The GGBS and cement are added into the concrete mixer as separate constituents.

1.3.3 Silica fume

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolan. Concrete containing silica fume can have very high strength and can be very durable

1.4 Fibers

The concept of using fibres as reinforcement is not new. In ancient times horsehair was used in mortar and straw in mud bricks. In 1900s asbestos fibres were used in concrete. But asbestos was discouraged due to detection of health risk. In 1963 Romualdi and Botson published their classic paper on FRC. After that new material like steel, glass and synthetic fibres replaced asbestos in concrete. Research is still in progress on this technology. FRC is considered one of the greatest advancement in the construction engineering.

1.4.1. DIFFERENT TYPES OF FIBRES

1. SFRC - Steel Fiber Reinforced Concrete
2. GFRC - Glass Fiber Reinforced Concrete
3.SNFRC-Synthetic Fiber Reinforced Concrete
4. NFRC - Natural Fiber Reinforced Concrete

II.LITERATURE REVIEW

Anush et al. [1] In the last few years, the use of pervious concrete as a pavement material in low-volume road applications has gained significance due to its encouraging environmental aspects. This paper reviews the state-of-the-art relevant to pervious concrete research and practices. The investigations on mechanical-hydrological-durability properties of pervious concrete performed in various studies have been reviewed. The storm water purification efficiency of pervious concrete has been documented.

B. Radha Kiranmaye et al. [2] Conventional Portland cement Concrete is commonly used for pavement construction. The impervious nature of the concrete pavements contributes to the increased water runoff into the drainage system, over-burdening the infrastructure and causing excessive flooding in built-up areas. Pervious concrete is a special type of concrete with a high porosity used for concrete pavement applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing ground water recharge.

Pankaj R. Teware1, Shrikant M. Harle[3] Now a days the concrete industry is constantly looking for supplementary cementious material with the objective of reducing the solid waste disposal problem and economic in cost. The Fly ash and Ground granulated blast furnace slag (GGBS) are among the solid wastes generated by Thermal power plant and iron manufacturing industry. To overcome from this crisis, partial replacement of cement with Fly ash and GGBS can be an economic alternative. And the cement is partially replaced with Fly ash and GGBS by 10%, 20% up to 30%.

III.EXPERIMENTAL INVESTIGATION

The details of preliminary program in terms of material properties, and its testing procedures, mix design discussed in this chapter

3.1 Cement

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel crushed stone to make a concrete. The ordinary cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous materials, clay predominates and in calcareous materials calcium carbonate predominates. Ordinary Portland cement of grade – 53 (KCP cement) conforming to Indian standards (IS: 12269-1987) has been used in the present study.

S.NO Description of test IS codes

1 Specific Gravity IS 4031-1988(part-11)

2 Fineness IS 4031-1996(part-1)

3 Standard consistency IS 4031-1988 (part-4)
4 Initial Setting time IS 4031-1988 (part-5)
5 Final setting time IS 4031-1988 (part-5)
6 Compressive strength IS 4031-1988 (part-6)

Fly Ash: - Fly ash, a finely divided ash emitting from the burning of pulverized coal or lignite in boilers, is considered to be superior because of its higher lime content. Fly ash a waste product of coal industry is available in plenty in India.

GGBS:- GGBS (granulated blast furnace slag) is dried and ground to a fine powder like OPC and then it is mixed with OPC. The appropriate mixture of GGBS and cement treated as another constituent is added to the concrete mixture to meet the technical necessity for any desired application

Silicafume:- "Silica fume, a byproduct of producing silicon metal or ferrosilicon alloys, is very useful in concrete due to its chemical and physical properties. The concrete consisting of silica fume can posses high strength and durability as silica fume is a very reactive pozzolan"

Fine Coarse aggregate: Fine aggregate used in this study is locally available river sand of Zone II compiling to IS 383:1970. "The specific gravity, water absorption and fineness modulus of fine aggregate used have been 2.55, 0.806% and 2.58 respectively." Locally obtained coarse aggregate from local quarry has been used in this study. The specific gravity, Bulk density and Water absorption used have been 2.9, 1738 kg/m3 (compacted), 1512 kg/m3 (loosely packed) and 0.502% respectively.

Water: The chief ingredient in the manufacture of concrete is water which chemically reacts with NaOH (Sodium Hydroxide) pellets in this study. As the binding strength of concrete mainly depends upon the quality and quantity of water, the water without impurities has to be used to get the desired results.

Super Plasticizer In order to enhance the workability of the pervious concrete, conplast SP 430 super plasticizer obtained from FOSROC Constructive Solution Company is used in this study. The use of super plasticizer in pervious concrete considerably reduces the quantity of water required. In this study, 3% of conplast, a brown liquid, is added to the total binder material.

Glass fiber Glass fiber, a modern introduction in the making of fiber concrete, is found in fiber glass insulation, so as to reinforce the concrete. The adding of glass fiber helps concrete insulate, strengthen, "prevent the concrete from cracking over time because of mechanical or thermal stress. Besides these, the glass fiber does not interfere with radio signals as the steel fiber reinforcement does."

Test details

A. Compressive Strength Test

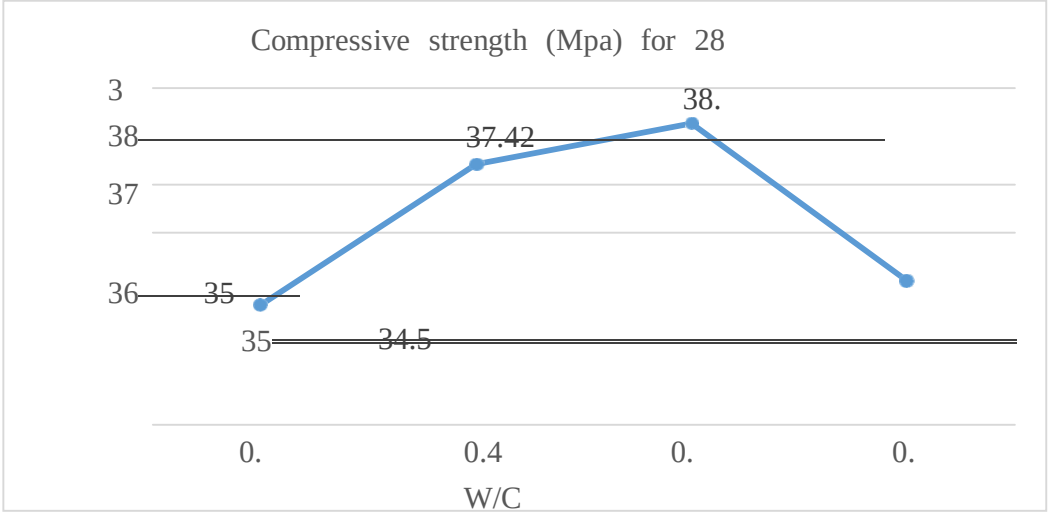
Compressive strength of hardened concrete is the very important among all properties. The compressive strength test was carried out using 200 tons CTM. Testing procedure followed as per IS 516:1959.

B. Split tensile Strength Test

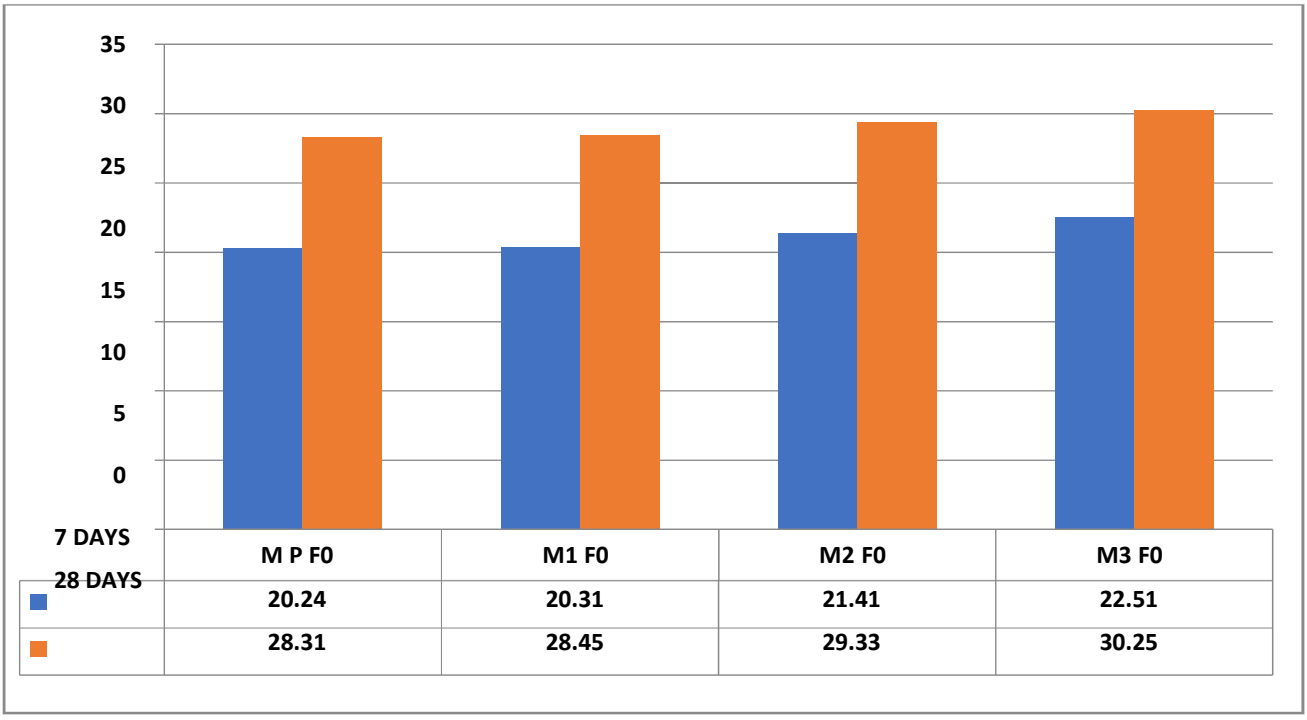
"The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete member may crack.

IV. RESULTS AND DISCUSSION

Compressive strength values for different W/C.

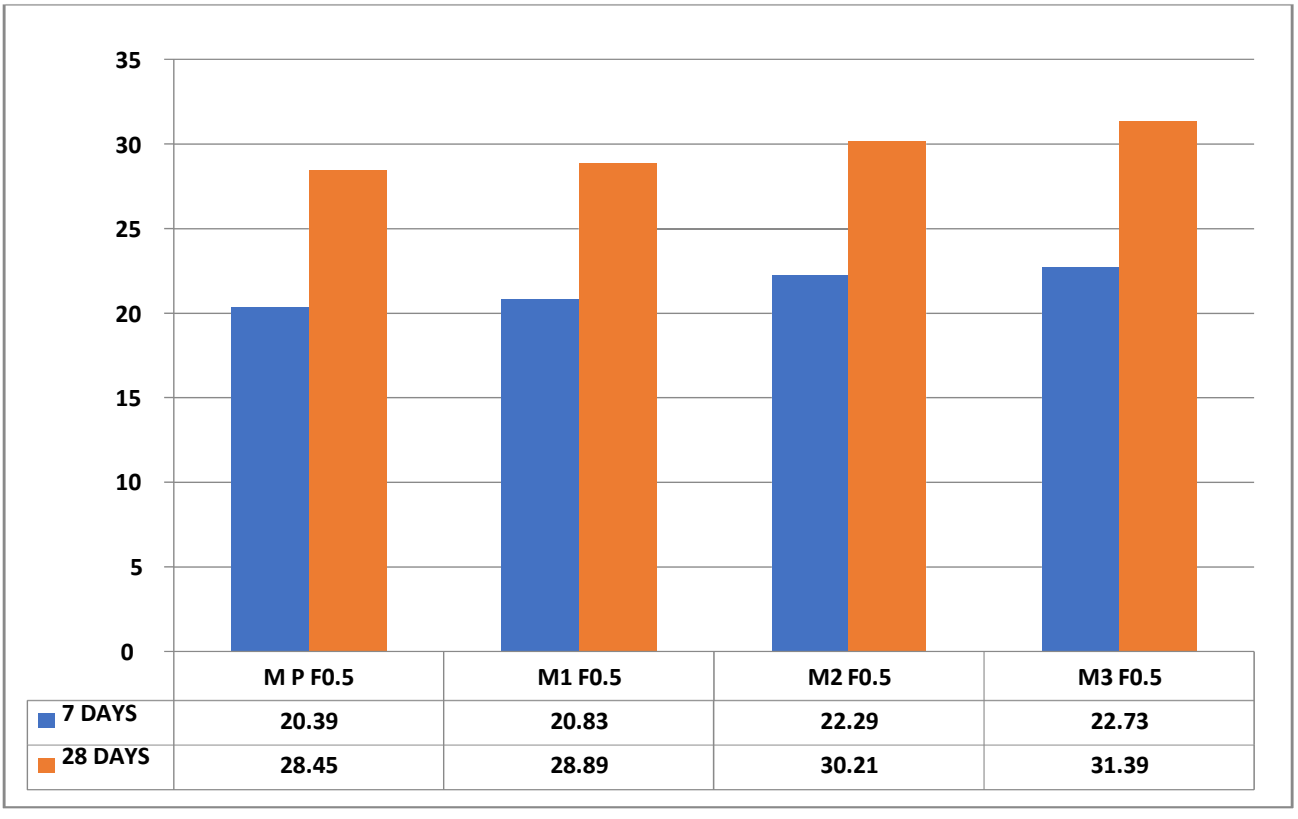


COMPRESSIVE STRENGTH OF PERVIOUS CONCRETE; VARIOUS PECETAGE REPLACEMENTS OF CEMENT WITH OTHER CEMENTATIOUS MATERIAL AND DIFFERENT PERCENATGE OF FINE AGGREGATE AND ADDITION WITH 0.5% GLASS FIBERS

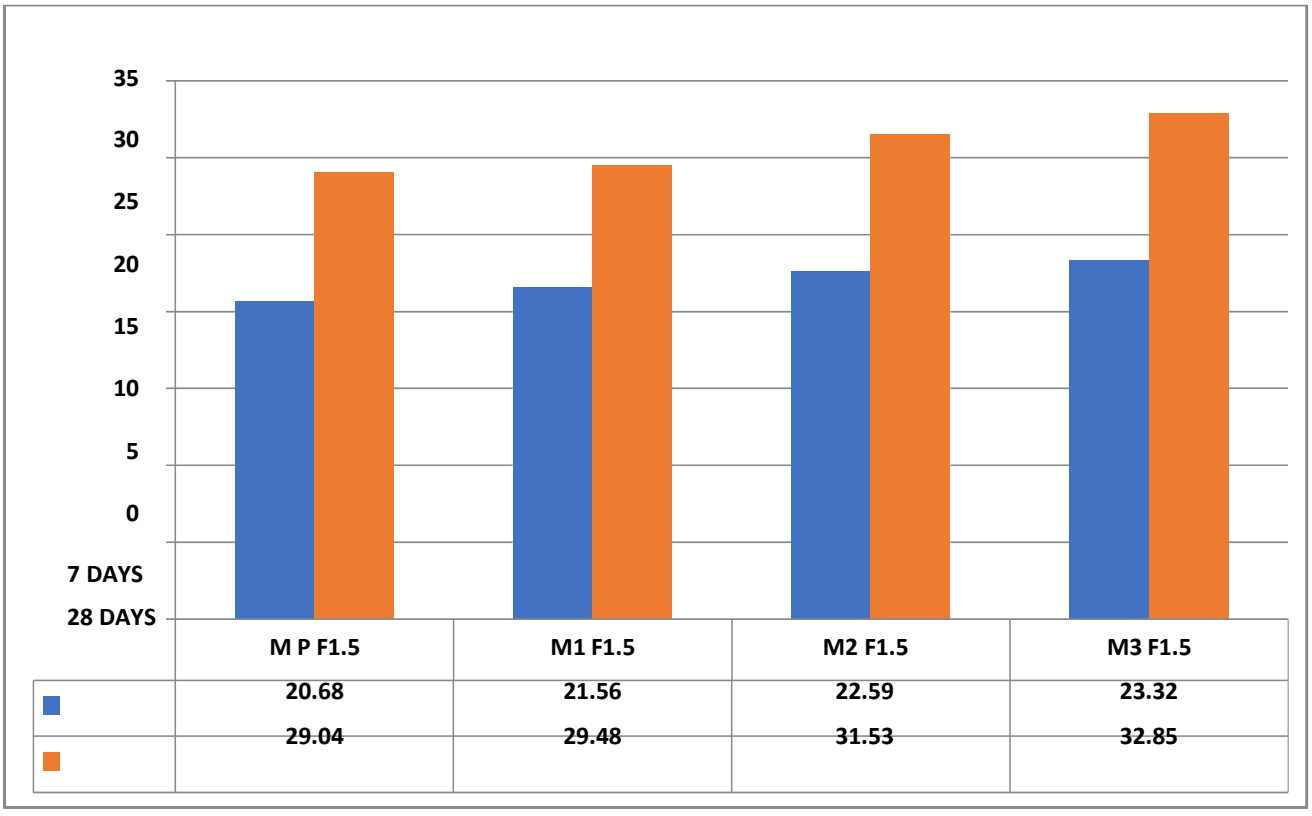


	M P F0	M1 F0	M2 F0	M3 F0
7 DAYS	20.24	20.31	21.41	22.51
28 DAYS	28.31	28.45	29.33	30.25

COMPRESSIVE STRENGTH OF PERVIOUS CONCRETE; VARIOUS PECETAGE REPLACEMENTS OF CEMENT WITH OTHER CEMENTATIOUS MATERIAL AND DIFFERENT PERCENATGE OF FINE AGGREGATE AND ADDITION WITH 1%GLASS FIBERS



	M P F0.5	M1 F0.5	M2 F0.5	M3 F0.5
7 DAYS	20.39	20.83	22.29	22.73
28 DAYS	28.45	28.89	30.21	31.39



COMPRESSIVE STRENGTH OF PERVIOUS CONCRETE; VARIOUS PECETAGE REPLACEMENTS OF CEMENT WITH OTHER CEMENTATIOUS MATERIAL AND DIFFERENT PERCENATGE OF FINE AGGREGATE AND ADDITION WITH 1.5% GLASS FIBERS

CONCLUSIONS

The results from a wide experimental campaign carried out for evaluating the most important physical and mechanical properties like split tensile, compressive strength of PC30 with and without pozzolanic materials for different replacement of fine aggregates with coarse aggregates. The main test variables of concrete have been produced by replacing (0%, 5%, 10%and 15%) given amounts of fine aggregates with coarse aggregate concrete and by adding fly ash and Silica fume and GGBS in partial replacement of Cement.

Based on results and discussions following conclusions were made.

- A significant reduction of workability.
- A progressive addition in both split tensile and compressive strength by increasing the percentage of fine aggregates and pozzolanic materials in mix. The inclusion of fine aggregate content in the specimen
- Increases the density and increase the pozzolanic materials addition. The addition of fly ash and silica fume and GGBS in the¬ mixtures enhances the split tensile strength and compressive strength performance of the concrete.
- The addition of Fly ash and silica fume and GGBS in the mixtures improves strength.
- The split tensile strength and compressive strength increases even after adding pozzolanic materials.
- Due to increase of fine aggregate content. For all replacement levels of PC with other mixes goes on decreasing in strength when compared with parent grade ofM30. Compressive and split tensile strength slightly increased by adding glass fibers to the all mixes.

REFERENCES

1. Pervious concrete as a sustainable pavement material – Research findings and future prospects: A state-of-the-art review Anush K. Chandrappa, Krishna Prapoorna Biligiri

2. D. Cree, M. Green, A. Noumowe, Residual strength of concrete containing recycled materials after exposure to fire: a review, Constr. Build. Mater. 44 (2013) 208–223 (Elsevier).

3. J. Yang, G. Jiang, Experimental study on properties of pervious concrete pavement materials, Cem. Concr. Res. 33 (2002) 381–386 (Elsevier).

4. L.M. Haselbach, S. Valavala, F. Montes, Permeability predictions for sandclogged Portland cement pervious concrete pavement systems, J. Environ. Manage. 81 (2005) 42–49 (Elsevier).

5. A. Volder, T. Watson, B. Viswanathan, Potential use of pervious concrete for maintaining existing mature trees during and after urban development, Urban For. Urban Greening 8 (2009) 249–256 (Elsevier).

6. H. Takebayashi, M. Moriyama, Study on surface heat budget of various pavements for urban heat island mitigation, Adv. Mater. Sci. Eng. 42 (2012) 2971–2979 (Hindawi Publishing Corporation).

7. K. C´ osic´, L. Korat, V. Ducman, I. Netinger, Influence of aggregate type and size on properties of pervious concrete, Constr. Build. Mater. 78 (2015) 69–76.

8. A. Ibrahim, E. Mahmoud, M. Yamin, V.C. Patibandla, Experimental study on Portland cement pervious concrete mechanical and hydrological properties, Constr. Build. Mater. 50 (2014) 524–529.

9. T.C. Fu, W. Yeih, J.J. Chang, R. Huang, The influence of aggregate size and binder material on the properties of pervious concrete, Adv. Mater. Sci. Eng. (2014)

10. B. Rehder, K. Banh, N. Neithalath, Fracture behavior of pervious concretes: The effects of pore structure and fibers, Eng. Fract. Mech. 118 (2014) 1–16.

11. J.T. Kevern, D. Biddle, Q. Cao, Effects of macrosynthetic fibers on pervious concrete properties, J. Mater. Civ. Eng. 27 (9) (2014) 06014031.

12. Q. Dong, H. Wu, B. Huang, X. Shu, K. Wang, Investigation into laboratory abrasion test methods for pervious concrete, J. Mater. Civ. Eng. 25 (7) (2012) 886–892.

13. Yu Chen,Kejin Wang,Xuhao Wang &Wenfang Zhou. (2013). Strength, fracture and fatigue of pervious concrete. Construction and Building Materials, 42, 97-104.

14. M. Aamer Rafique Bhutta , K. Tsuruta & J. Mirza. (2012). Evaluation of high-performance porous concrete properties. Construction and Building Materials , 31 , 67 73.

15. G.Girish&R.Manjunath Rao. (2011). A step towards mix proportioning guidelines for pervious concrete . International Journal of Earth Sciences and Engineering, 4, 768 -771.

16. Milani S. Sumanasooriya & Narayanan Neithalath. (2011). Pore structure features of pervious concretes proportioned for desired porosities and their performance prediction. Cement & Concrete Composites, 33, 778-787.

17. Xiang Shu , Baoshan Huang, Hao Wu, Qiao Dong & Edwin G. Burdette. (2011). Performance comparison of laboratory and field produced pervious concrete mixtures. Construction and Building Materials, 25 ,3187 3192.

18. C. Lian, Y. Zhuge & S. Beecham. (2011). The relationship between porosity and strength for porous concrete. Construction and Building Materials, 25 , 4294 4298.

19. An Cheng, Hui-Mi Hsu, Sao-Jeng Chao & Kae-Long Lin. (2011). Experimental Study on Properties of Pervious Concrete Made with Recycled Aggregate. Internal Journal of Pavement Research and Technology , 4 ,N0.2,104-110.

20. Bradley J. Putman & Andrew I. Neptune. (2011). Comparison of test specimen preparation techniques for pervious concrete pavements. Construction and Building Materials, 25, 3480 3485.

21. H.K. Kim & H.K. Lee. (2010) . Influence of cement flow and aggregate type on the mechanical and acoustic. Applied Acoustics ,71,607 615.

22. Narayanan Neithalath, Milani S. Sumanasooriya & Omkar Deo. (2010) . Characterizing pore volume, sizes, and connectivity in pervious concretes for permeability prediction. Materials Characterization , 61, 802 813