Evaluation & Optimization Of Pervious Concrete

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Abstract- *Pervious concrete is a special type of concrete, which consists of cement, coarse aggregates, water and if required, admixtures and other cementitious material. As there are no fine aggregates used in the concrete matrix, the void content is more which allows the water to flow through its body. So the pervious concrete is also called as Permeable concrete ad Porous concrete. There is lot of research work is going in the field of pervious concrete. The compressive strength of pervious concrete is less when compared to the conventional concrete due to is porosity and voids. Hence, the usage of pervious concrete is limited even though it has lot of advantages. If the compressive strength and flexural strength of pervious concrete is increased, then it can be used for more number of applications. For now, the usage of pervious concrete s mostly limited to light traffic roads only if the properties are improved, then it can also be used for medium and heavy traffic rigid pavements also. Along with that, the pervious concrete eliminates surface runoff of storm water, facilitates the ground water recharge and makes the effective usage of available land. The main aim of our seminar is to improve the strength characteristics of pervious concrete. But it can be noted that with increase in strength, the permeability of pervious concrete will be reduced. Hence, the improvement of strength should not affect the permeability property because it is the property which serves its purpose.*

Keywords- cement, coarse aggregates, roads, concrete etc.

I. INTRODUCTION

Pervious concrete pavement is a unique and effective means to meet growing environmental demands. By capturing rainwater and allowing it to seep into the ground, pervious concrete is instrumental in recharging groundwater, reducing storm- water runoff, and meeting U.S. Environmental Protection Agency (EPA) storm-water regulations. In fact, the use of pervious concrete is among the Best Management Practices (BMP) recommended by the EPA and by other agency and geotechnical engineers across the country for the management of storm-water runoff on a regional and local bass. This pavement technology creates more efficient land use by eliminating the need for retention ponds, swales, and other storm-water management devices. In doing so, pervious concrete has the ability to lower overall project costs on a first-cost basis. In pervious concrete, carefully controlled amounts of water and cementations materials are used to create a paste that forms a thick coating around aggregate particles. A pervious concrete mixture contains little or no sand, creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable enter-connected voids that drains quickly. Typically, between 15% and 25% voids are achieved in the hardened concrete, and flow rates for water through pervious con create typically are around 480 in/hr. (0.34 cm/s. which is 5 gal/ft2/ mm or 200 L/m2/min), although they can be much higher. Both the low mortar content and high porosity also reduce strength compared to conventional concrete mixtures, but sufficient strength for many applications is readily achieved. While pervious concrete can be used for a surprising number of applications, its primary use is in pavement. This report will focus on the pavement applications of the material, which also has been referred to as porous concrete, permeable concrete, no- fines concrete, gap-graded concrete, and enhanced-porosity concrete.

1.1 APPLICATIONS

Although not a new technology pervious concrete is receiving renewed interest, partly because of federal clean water legislation. The high flow rate of water through a pervious concrete pavement allows rainfall to be captured and to percolate into the ground, reducing storm-water runoff, recharging groundwater, supporting sustainable construction, providing a solution for construction that is sensitive to environmental concerns, and helping owners comply with EPA storm-water regulations. This unique ability of pervious concrete offers advantages to the environment, public agencies, and building owners by controlling rainwater on-site and address storm-water runoff issues. This can be of particular interest in urban areas or where land is very expensive. Depending on local regulations and environment, a pervious concrete pavement and its sub base may provide enough water storage capacity to eliminate the need for retention on ponds, swales and other precipitation runoff containment strategies. This provides for more efficient land use and is one factor that has to a renewed interest in pervious concrete. Other applications that take advantage of the high flow rate through pervious concrete include drainage media for hydraulic structures, parking lots, tennis courts, greenhouses, and pervious base layers under heavy duty pavements.

II. LITERATURE REVIEW

- **Balaji and Amarnaath (2015)** carried out research on Design of eco-friendly pervious concrete. From the test results it was concluded that the mix design with aggregate and cement ratio of 3 has the maximum strength, This mix design gives us the required strength of M20 grade concrete and this mix design has the required void ratio for the water seepage.
- **Meininger (1988)** studied the effect of different aggregate sizes (10mm and 19mm) on hardened properties of non-fine concretes and the results showed that compressive strength reduces with increase in aggregates size. It claimed the decrease of aggregate size led to higher pervious concrete strength, resulting from the increase of the interface strength between the aggregate and cement paste.
- **Paul (2004)** studied the replicated simples of pervious concrete formed from two rock sources for coarse aggregates and different size fractions to determine hydrologic relationships. Linear relationships were found between porosity and density. Permeability and density, porosity and permeability, porosity and specific yield. The results suggest that properties such as permeability, porosity and specific yield are not significantly affected by different aggregate types.
- **Kevern, Schaefer (2008)** et al. studied the current methods of curing pervious concrete is to cover with plastic for 7 days, although no studies have been performed to determine if that is sufficient or even required. They presented results of combinations of four different pervious concrete mixtures cured using six common curing methods. The surface abrasion of the concrete was tested using a rotary cutter device. The results show that the concrete abrasion resistance was improved with a majority surface-applied curing compounds; however the surfaces covered with plastic sheets produced the lowest abrasion levels. The best abrasion resistance and higher strength overall was obtained with the mixture containing fly ash and cured under plastic for 28 days.
- **Deo, Neithalath (2011)** studied that the properties of pervious concrete are strongly dependent on its pore structure features, porosity being an important one among them. Different pore structure for pervious concrete was proposed and subjected to static compression tests. The compressive stress-strain response of pervious concretes, a model to predict the stress-strain response and its relationship to several of the pore structure features are outlined. A statistical model was used to relate the compressive strength to the relevant pore structure features. It was observed that a proper understanding of the influence of pore structure features on compressive response can lead to optimized material design for the desired properties.
- **Rajah (2010)** et al. investigated the properties of pervious concrete by replacing 20% and 50% of cement with fly ash. He found out that pervious concrete with high porosity shows low compressive strength and high permeability. The results of their investigation described that the permeability of pervious concrete was not notably affected when 50% of cement was replaced by fly ash and compressive strength will decrease with increase of the fly ash content.
- **Na Jin (2010)** worked on ―fly ash applicability in pervious concrete‖ using 2% and 32% fly ash in pervious concrete. He found out that using 2% fly ash pervious concrete can achieve higher compressive strength than that of using 32% fly ash in pervious concrete. He also indicated that fly ash helps to increase long term compressive strength of pervious concrete.
- **Vijayakumar (2015)** found out that replacement of cement by 20 per cent, 30 per cent and 40 percent glass powder increases the compressive strength by 19.60 per cent, 25.3 % and 33.7 % respectively whereas replacement of cement by 40 per cent glass powder increases the split- tensile strength by 4.4 per cent respectively and replacement of cement by 20 per cent, 30 per cent and 40 per cent glass powder

III. ENGINEERING PROPERTIES

3.1 Fresh Properties

The plastic pervious concrete mixture is stiff compared to traditional concrete. Slumps, when measured, are generally less than ¾ in. (20 mm), although slumps as high as 2 in. (50 mm) have been used. When placed and compacted, the aggregates are tightly adhered to one another and exhibit the characteristic open matrix. For quality control or quality assurance, unit weight or bulk density is the preferred measurement because some fresh concrete properties, such as slump, are not meaningful for pervious concrete. Conventional cast cylinder strength tests also are of little value, because the field consolidation of pervious concrete is difficult to reproduce in cylindrical test specimens, and strengths are heavily dependent on the void content. Unit weights of pervious concrete mixtures are approximately 70% of traditional concrete mixtures. Concrete working time typically is reduced for pervious concrete mixtures. Usually one hour between mixing and placing is all that is recommended. However this can be controlled using retarders and hydration stabilizers that extend the working time by as much as 1 .5 hours, depending on the dosage.

3.2 Hardened Properties

3.2.1 Density and Prosperity

The density of pervious concrete depends on the properties and proportions of the materials used, and on the compaction procedures used in placement. In-place densities on the order of 1600 kg/m3 to 2000 kg/m3 are common, which is in the upper range of lightweight concretes. A pavement 5 in. (125 mm) thick with 20% voids will be able to store 1 in. (25 mm) of a sustained rainstorm in its voids, which covers the vast majority of rainfall events and the U S. When placed on a 6-in. (150-mm) thick layer of open-graded grave or crushed rock sub-base, the storage capacity increases to as much as 3 in. (75 mm) of precipitation.

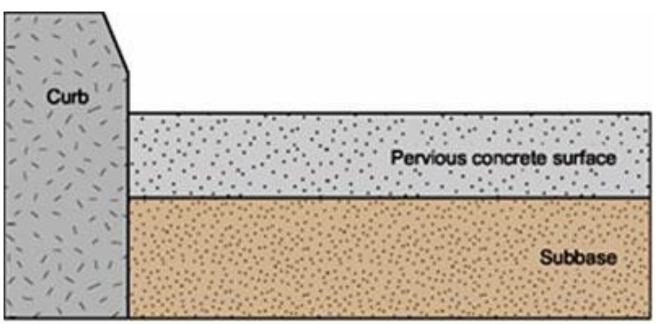

Fig 3.1: Typical cross section of pervious concrete pavement.

3.2.2 Permeability

The flow rate through pervious concrete depends on the materials and placing operations. Typical flow rates for water through pervious concrete are 3 gal/ft2/min (288 in./hr., 120 L/m2/min, or 0.2 cm/s) to 8 gal/ft2/min (770 in/hr., 320 L/m2/min, or 0.54 cm/s), with rates up to 17 gal/ft2/min (1650 n/hr., 700 L/m2/min, 1 .2 cm/s) and higher having been measured in the laboratory.

3.2.3 Compressive Strength

Pervious concrete mixtures can develop compressive strengths in the range of 500 psi to 4000 psi (3.5 MPa to 28 MPa), which is suitable for a wide range of applications. Typical values are about 2500 psi (17 MPa). As with any concrete, the properties and combinations of specific materials, as well as placement techniques and environmental conditions, will dictate the actual in-place strength as compaction differences make cast cylinders less representative of field concrete.

3.2.4 Flexural Strength

Flexural strength in pervious concretes generally ranges between about 150 psi (1 MPa) and 550 psi (3.8 MPa). Many factors influence the flexural strength, particularly degree of compaction, porosity, and the aggregate: cement (NC) ratio. However the typical application constructed with pervious concrete does not require the measurement of flexural strength for design

3.2.5 Shrinkage

Drying shrinkage of pervious concrete develops sooner but is much less than conventional concrete. Specific values will depend on the mixtures and materials used, roughly half that of conventional concrete mixtures. The material’s low paste and mortar content is a possible explanation. Roughly 50% to 80% of shrinkage occurs in the first 10 days, compared to 20% to 30% in the same period for conventional concrete, Because of this lower shrinkage and the surface texture; many pervious concretes are made without control joints and allowed to crack randomly.

3.3 Durability

3.3.1 Freeze-thaw Resistance

Freeze-thaw resistance of pervious concrete in the field appears to depend on the saturation level of the voids in the concrete at the time of freezing. In the field, it appears that the rapid draining characteristics of pervious concrete prevent saturation from occurring. Anecdotal evidence also suggests that snow covered pervious concrete clears quicker, possibly because its voids allow the snow to thaw more quickly than it would on conventional pavements. In fact, several pervious concrete placements in North Carolina and Tennessee have been in service for more than 10 years.

3.3.2 Sulfate Resistance

Aggressive chemicals in soils or water, such as acids and sulfates, are a concern to conventional concrete and pervious concrete alike, and the mechanisms for attack are similar. However, the open structure of pervious concrete may make it more susceptible to attack over a larger area. Pervious concretes can be used in areas of high-sulfate soils and ground waters if isolated from them. Placing the pervious concrete over a 6-in. (150-mm) layer of 1-in. (25-mm) maximum top size aggregate provides a pavement base, storm-water storage, and isolation for the pervious concrete. Unless these precautions are taken, in aggressive environments, recommendations of ACI 201 on water: cement ratio, and material types and proportions should be followed strictly.

3.3.3 Abrasion Resistance.

Because of the rougher surface texture and open structure of pervious concrete, abrasion and raveling of aggregate particles can be a problem, particularly where snowplows are used to clear pavements. This is one reason why applications such as highways generally are not suitable for pervious concretes. However, anecdotal evidence indicates that pervious concrete pavements allow snow to melt faster, requiring less plowing. Most pervious concrete pavements will have a few loose aggregates on the surface in the early weeks after opening to traffic. These rocks were loosely bound to the surface initially, and popped out because of traffic loading. After the first few weeks, the rate of surface raveling is reduced considerably and the pavement surface becomes much more stable.

IV. MIX DESIGN

4.1 Material

Materials Pervious concrete uses the same materials as conventional concrete, with the exceptions that the fine aggregate typically is eliminated entirely, and the size distribution (grading) of the coarse aggregate is kept narrow, allowing for relatively little particle packing. This provides the useful hardened properties, but also results in a mix that re quires different considerations in mixing, placing, compaction, and curing. The mixture proportions are somewhat less for giving than conventional concrete mixtures—tight controls on batching of all of the ingredients are necessary to provide the desired results. Often, local concrete producers will be able to best determine the mix proportions for locally available materials based on trial batching and experience. Table 3 provides typical ranges of materials proportions in pervious concrete, and ACI 211.3 provides a procedure for producing pervious concrete mixture proportions.

4.2 Cementitious Materials

As in traditional concreting, port-land cements (ASTM C150, C157) and blended cements (ASTM C595, Cl57) may be used in pervious concrete as per IS Code 1489:1991. In addition, supplementary cementitious materials (SCM5), such as fly ash and pozzolanas (ASTM C618) and ground-granulated blast furnace slag (ASTM C989), may be used. Testing materials beforehand through trial batching is strongly recommended so that properties that can be important to performance (setting time, rate of strength development, porosity, and permeability, among others) can be determined. The water cementitious material ratio (w/cm) is an important consideration for obtaining desired strength and void structure in pervious concrete. A high w/cm reduces the adhesion of the paste to the aggregate and causes the paste to flow and fill the voids even when lightly compacted. A low w/cm will prevent good mixing and tend to cause baling in the mixer, prevent an even distribution of cement paste, and therefore reduce the ultimate strength and durability of the concrete. W/cm in the range of 0.26 to 0.40 provides the best aggregate coating and paste stability. The conventional w/cm-versus-compressive strength relationship for normal concrete does not apply to pervious concrete. Careful control of aggregate moisture and w/cm is important to produce consistent pervious concrete.

4.3 Aggregate

Fine aggregate content is limited in pervious concrete and coarse aggregate is kept to a narrow gradation. Commonly used gradations of coarse aggregate as per IS code 10262:2009 include ASTM C33 No.67 (¾ in. to No. 4), No. 8 (¾ in. to No. 16), or No. 89 (¾ in. to No. 50) sieves [in metric units: No. 67 (19.0 to 4.75 mm), No. 8 (9.5 to 2.36 mm), or No. 89 (9.5 to1.18 mm), respectively]. Single-sized aggregate up to 1 in. (25 mm) also has been used. ASTM D448 also may be used for defining grading. A narrow grading is the important characteristic. Larger aggregates provide a rougher surface. Recent uses for pervious concrete have focused on parking lots, low- traffic pavements, and pedestrian walkways. For these applications, the smallest sized aggregate feasible is used for aesthetic reasons. Coarse aggregate size 89 (¾-in. or 9.5-mm top size) has been used extensively for parking to and pedestrian applications, dating back 20 years or more in Florida. Generally, NC ratios are in the range of 4.0 to 4.5 by mass. These NC ratios lead to aggregate contents of between about 1300 kg/rn3 to 1800kg/rn3. Higher NC ratios have been used in laboratory studies but significant reduce tons strength result.

4.4 Water

Water to cementitious materials ratio is 0.27 to 0.30 and is used routinely with proper inclusion of chemical admixtures, and those as high as 0.34 and 0.40 have been used successfully. The relation between strength and water to cementitious materials ratio is not clear for pervious concrete because unlike conventional concrete, the paste content is less than the voids content between the aggregate. Therefore, making the paste stronger may not always lead to increased overall strength. Water content should be tightly controlled. The correct water content has been described as giving the mixture sheen, without flowing off of the aggregate. A handful of pervious concrete formed into a ball will not crumble or lose its void structure as the paste flows into the spaces between the aggregates. Water quality is discussed in ACI 301. As a general rule, water that is drinkable is suitable for use in concrete. Re cycled water from concrete production operations may be used as well, if it meets provisions of ASTM C94 or AASHTO M 157. If there is a question as to the suitability of a water source, trial batching with job materials is recommended.

4.5 Admixtures

Chemical admixtures are used in pervious concrete to obtain special properties, as in conventional concrete. Because of the rapid setting time associated with pervious concrete, retarders or hydration-stabilizing admixtures are used commonly. Use of chemical admixtures should closely follow manufacturer's recommendations. A reentering admixture can reduce freeze-thaw damage in pervious concrete and are used where freeze-thaw is a concern. ASTM C494 governs chemical admixtures, and ASTM C260 governs air reentering admixtures. Proprietary admixture products that facilitate placement and protection of pervious pavements are also used.

Table 4.1Typical Mix Design for Pervious Concrete

Material	Proportion (Kg/m³)
Cement (OPC or blended)	270 to 4165
Aggregate	1190 to 1480
Water: Cement ratio (by mass)	0.27 to 0.34
Fine coarse aggregate	0 to 1:1
Chemical admixture are commonly used and addition of fine aggregate will decrease the void content and strength	

Fig 4.1 Mix Design

4.6 Samples of Mix Design

In this paper the effect of fine aggregate in strength and durability properties of pervious concrete is mentioned. 42 specimens were cast cured and tested for compressive strength, flexural strength, and void ratio. Applications of Pervious Concrete are mentioned as well as, Benefits of Pervious Concrete Pavement; Environmental Benefits Economic Benefits Structural benefits are given in this study. Materials are cement, fine aggregates, coarse aggregates and water. The properties of these materials are given in detail. Cement properties such as Sp. Gravity of Cement Consistency, Initial Setting Time, Final Setting Time, Fineness Test and Soundness are found out. Aggregates properties such as Sp. Gravity, Water Absorption, Crushing Value, and Flakiness Index are explained. Water properties such as Chloride, Sulphate, Organic Solids, Inorganic Solids, Suspended Matter, pH Value are calculated. As per the ACI mix design procedure followed and explained in detail.

Table 4.2: Mix Proportions for Different Mixes

Mix	Cement in Kg	Fine Aggregate in kg		Fine Aggregate in kg	
		River sand	Crushed Stone sand	20mm	12mm
M1	330	-	-	1447	-
M2	330	-	-	-	1447
M3	330	145	-	1447	-
M4	330	145	-	-	1447
M5	330	-	-	724	724
M6	330	-	145	1447	-
M7	330	-	145	-	1447

Compressive Strength, Flexural Strength, Void Ratio of all mixes M1, M2, M3, M4, M5, M6, M7 are compared with each other. By comparing it is found that increase in void ratio give reduction in Compressive Strength and Flexural Strength. The strength of pervious concrete with 12mm aggregates is more than 20 mm aggregates. Mix M4 has the high value of Compressive Strength, Flexural Strength, and Void Ratio as compared to other. Mix M4 can be used as M10 grade of pervious concrete from both strength and void ratio properties.

V. CONSTRUCTION

5.1 Sub-grade and Sub-base Preparation

Uniformity of sub-grade support is a key criterion for placing pervious pavement. As in other types of pavements, truck ruts and other irregularities must be smoothed and compacted prior to placement. Since sub-grade and sub-base preparation are critical components of pervious concrete pavement performance, refer to ―Hydrological Design Considerations‖ and ―Structural Design Considerations‖

elsewhere in this document for more information. Compaction to a minimum density of 90% to 95% of theoretical density per AASHTO T 180 often is recommended for consistent sub-grade support; however, increasing the sub-grade density decreases its permeability. Local geotechnical engineers may be the best source of knowledge regarding the proper fess of sub-grade soils. Since pervious pavements contain minima water and high porosity, care must be taken to ensure that the pavement does not dry out prematurely. The sub-grade must be moist (without free-standing water) or to placement to prevent water from being removed from the lower portion of the pavement too soon. The recommended practice for conventional concrete pavement placement if conditions for high evaporation rates are present, but are even more important in pervious concrete placement because the high voids can allow more rapid drying, with subsequent decrease in strength and durability, under less extreme conditions.

5.2 Batching and Mixing

The special properties of pervious concrete require tighter control of mixture proportioning. In particular, the water content of pervious concrete is limited to a narrow range to provide adequate strength and permeability, and prevent the paste from flowing off the aggregates and closing of the open structure. A limited paste content means that added water will have more drastic impact than that experienced in conventional concrete applications. Aggregate moisture level should be monitored carefully and accounted for, as both water absorbed by the aggregate and excess moisture supplied with the aggregate can be detrimental. Contractors and producers must work together to ensure a proper mixture prior to delivery at the job site. On some occasions, slight adjustments to the water content may be necessary at the job site to achieve proper consistency; however, this should be done with care because job site additions of water can be difficult to control. The correct water content will provide a mix with sheen. A unit weight test is necessary to provide assurance of Consistent mixture proportions. Unit weights between 1600 kg/m3 and 2000kg/rn3 are typical, and on-site measured values typically are required to be within 5% of the design unit weight.

5.3 Transportation

Because pervious concrete has a low water content, special attention is required during transportation and placement. It's very low slumps may make discharge from transit mixers slower than for conventional concrete; transit mixers with large discharge openings or paving mixers tend to provide a faster unloading time. A pervious pavement mixture should be discharged completely within one hour after initial mixing. The use of retarding chemical admixtures or hydration stabilizing admixtures may extend discharge times to 11½ hours or more. High ambient temperatures and windy conditions will have more pronounced effects relative to conventional pavements and should be taken into account.

5.4 Placement and Consolidation

A variety of placement techniques can be used for constructing pervious concrete pavements; as with conventional concrete, placement techniques are developed to fit the specific job site conditions. It should be noted that pervious concrete mixtures cannot be pumped, making site access an important planning consideration. Prior to placement, the sub-base preparation and forms should be double-checked. Any irregularities, rutting, or misalignment should be corrected. Each load of concrete should be inspected visually for consistency and aggregate coating. The stiff consistency of pervious concrete means that slump testing is not a useful method of quality control. Unit weight tests provide the best routine test for monitoring quality and are recommended for each load of pervious concrete.

Fig 5.1 Placement And Consolidation

5.5 Finishing

Pervious concrete pavements are not finished in the same way as conventional concrete pavements. Normal floating and troweling operations tend to close up the top surface of the voids, which defeats the purpose (for most applications) of pervious concrete. For the majority of pervious pavements, the ―finishing‖ step is the compaction. This leaves a rougher surface, but can improve traction.

5.6 Joint Placement

Control joints should be placed if prevention of random cracking of the pavement is desired, although the joint spacing is usually larger than for conventional concrete pavements because pervious concretes tend to shrink much less.Saw cutting joints also is possible, but s not preferred because slurry from sawing operations may block some of the voids, and excessive raveling of the joints often results. Removing covers to allow sawing also slows curing, and it is recommended that the surfaces be re-wet before the covering is replaced.

Fig 5.2 Joint Placement

5.7 Curing and Protection

The open structure and relatively rough surface of pervious concrete exposes more surface area of the Cement paste to evaporation, make curing even more essential than a conventional concreting. Water is needed for the chemical reactions of the cement and it is critical for pervious concrete to be cured promptly. In some regions, it is common to apply an evaporation retarder before compact on to minimize any potential for surface water loss.Because pervious concrete pavements do not b need, they can have a high propensity for plastic shrinkage cracking in fact, ―curing‖ for pervious slabs and pavements begins be more the concrete is paced: the sub-grade must be moistened to prevent it from absorbing moisture from the concrete. After placement, fog misting followed by plastic sheeting is the recommended curing procedure, and sheeting should remain place for at least seven days. Using sand or dirt to hold plastic sheeting in place is not recommended because clogging of the voids could result from spillage on removal. Instead, securing plastic sheeting with number or other methods is recommended. Curing should be started as soon as practical after p acing, compacting, and punting. Best practice call for curing to begin with in a max mum of 20 minutes after these procedures. High ambient temperatures and windy conditions we I have more pronounced effects relative to conventional pavements and should be taken into account.

Fig 5.3 CURING AND PROTECTION

VII. CONCLUSION

The following conclusion comes through the study of pervious concrete pavement in rural areas becomes more suitable to meet the rural area requirement such as:

- Cities with pervious pavements would be safer for traffic, be cleaner and less pollution.
- It cannot be used for heavy or medium traffic pavements due to less compressive strength of the pervious concrete block.
- To reduce the storm water runoff.
- To increase the ground water level.
- To eliminate costly storm water management practices.
- It is crystal clear that the utilization of these waste materials is beneficial from the environmental as well as economical point of view.
- It is exceptionally good method to improve sustainability of construction.
- As no fines concrete contains no sand and consequently requires considerably less cement per cubic yard of concrete, there is direct saving in material.
- Fly ash results in higher infiltration rate due to more voids as compared to alccofine which results in lower infiltration rate.
- Overall, it is expected that the present research will help to understand the pore network characteristics of pervious concrete using non-destructive evaluation and digital image processing.
- From review it is studied that the strength of pervious concrete get decreases as compared to conventional concrete. And also can be concluded that the 12 mm size aggregate is appropriate for preparing pervious concrete.

- For mix design of pervious concrete, the IS code method can be used but a definite method is not available and it is found that the pervious concrete gives better results imparting super plasticizer. For the best result it can be suggested that to keep cement to aggregate ratio as 1:3.

REFERENCES

[1] AC PA, WinPAS, Pavement Analysis Software, Computer software, MCO16, American Concrete Pavement Association, Skokie, llinois, 2000b.

[2] ACPA, Cement-Treated Permeable Base for Heavy-Traffic Concrete Pavements 1S404, American Concrete Pavement Association, Skokie, I no s, 1994, 6 pages

[3] AC PA, Design of Concrete Pavement for City Streets~ 1S184, American Concrete Pavement Assoc at on, Skokie, II no s, 1993,8 pages.

[4] ACPA, Street Pave, Computer Software, MCOO3, American Concrete Pavement Association, Skokie, Illinois, 2005. Bonnin, G. M.; Todd, D.; Lin, B.; Parzybok, T.; Yekta, M.; and Riley, D., ―Precipitation-Frequency Atlas of the United States,‖ NOAA Atlas 14, Volume 2, Version 2, NOAA, National Weather Service, Silver Spring, Maryland, 2004.Available on-line at: http:llhdsc.nws noaa.gov/hdsclpfds/ Accessed July 20, 2004.

[5] CCPC, Pervious Concrete Driveway on 25°o Scope‖ Impressions, Vo. 49, Ca fornia Cement Promotion Council June 2003, pages 5 to 6.