International Journal of Scientific Research & Engineering Trends
Volume 4, Issue 2, Mar-Apr -2018, ISSN (Online): 2395-566X

Mechanical Properties of No-Fines Concrete

Asst.prof.Saravanan.N
Department of Civil Engineering, Roever College of Engineering and Technology, Perambalur,India

Parthiban.S
Department of Civil Engineering, Roever College of Engineering and Technology, Perambalur,India

Silambarasan.S
Department of Civil Engineering, Roever College of Engineering and Technology, Perambalur,India

Vignesh.T
Department of Civil Engineering, Roever College of Engineering and Technology, Perambalur,India

Tamil Selvan.R
Department of Civil Engineering, Roever College of Engineering and Technology, Perambalur,India

Abstract **– No – Fines concrete is the type of small light weight concrete .which is obtained by eliminating the fine material sand, from the normal concrete mix, the single–sized coarse aggregates are surrounded and it is held together by a thin layer of cement paste giving strength of concrete .the main objective is high inter connected voids in a concrete allow the water to seep through concrete which is an advantages in terms of ground water recharge. It is generally made with the aggregate/cement ratio from 1:6 to 1:10,aggregates generally used are normally of size passing through 20mm and retained on 10mm.The water cement ratio varies between narrow range of 0.38 and 0.52. Properties of no fines concrete are compressive strength, and split tensile strength were performed.**

Keywords: **concrete, cement, compressive, tensile ,flexural strength.**

I. INTRODUCTION

Today in the present world we are very much fond of the sustainable and eco-friendly means of construction. Particularly in a country like India where flooding and water logging problems are the major environmental issues sustainable development has become a necessity. Various sustainable and eco-friendly means being implemented to tackle these problems .

Working on rain-drain‟ concept No-fine concrete allows a significant amount of storm water to seep into the ground, there by recharging the groundwater and reducing the storm water runoff. No-Fines Concrete is light-weight concrete produced by omitting the fines from conventional concrete.

No-fines concrete (sometimes it referred to as porous or open textured concrete) is concrete consisting of cement coarse aggregate and water. It has its origin in late 1940s and now been widely used in United States, Japan and Europe because of its various environmental benefits such as controlling storm water runoff, restoring groundwater supplies and reducing water and soil pollution.

Apart from this it has the potential to reduce urban heat island effects and can be used to reduce acoustic noise in road No-fines concrete is generally made with aggregate/binder ratio of 6:1 to 10:1.Coarse aggregates used are normally of size passing through 20mm and retained on 10 mm. The water/cement ratio for satisfactory consistency varies between a narrow range of 0.27 and 0.43.

1. Objective and Research Significance

The main objectives of the project are as follow:

- To identify the strength of no-fines concrete specimen.
- To identify the most economical mix for blocks.
- To study the durability of these concrete blocks.

2. Scope of No fines concrete in Buildings:

- Reduction in dead loads making savings in foundations and reinforcement.
- Improved thermal properties.
- Improved fire resistance.
- Savings in transporting and handling precast units on site.
- Reduction in formwork and propping.

3. Research Significance:

After identification of problem and setting the objectives of research, the research methodology has been carefully design to achieve these objectives. Collection and study of literature pertaining to the Dissertation work. Determine the engineering properties of pervious concrete and compare them with conventional concrete. Cast various trial mixes with the varying percentages of pervious concrete and compare for the compressive strength. Prepare test samples with the percentage value and test these samples for the various pavements properties.

To comment on the suitability and limitations of pervious concrete with conventional concrete in construction of pavements.

4. Applications and Benefits

Applications:

- Pervious concrete as a road pavement.
- Low volume pavement.
- Side walk and pathways.
- Tennis courts.
- Slop stabilization.
- Parking lots.

Benefits:

- It reduces the runoff water on the pavement
- Recharge the Aquifers and ground water table
- Allow more efficient land development.
- Prevent water for getting more pollute.
- Ease surface runoff.
- Also prevent water to runoff into the stream

II. LITERATURE SURVEY

Krishna Raju et al (1975) focused on the optimum water content for no-fines concrete. It was determined that for particular aggregate- cement ratio there is a narrow range for optimum water-cement ratio. This water- cement ratio was imperative to gain the maximum possible compressive strength. A higher than ideal water-cement ratio would cause cement paste to drain from the aggregate particles.

Malhotra (1976) found that the density of no-fines concrete is generally about 70percent of conventional concrete when made with similar constituents. The density of no-fines concrete using conventional aggregates varies from 1602 to1922 kg/m3.[1] A clinker aggregate was trialled and the no-fines concrete produced A density of 961 kg/m3. No-fines concrete has very low cohesiveness and formwork should remain until the cement paste has hardened sufficiently to hold the aggregate particles together.

Govind Ravish (2015) Investigated there was a considerable difference in the compressive strength between the concrete samples but this does not affect the outcome as it [5] was the relationships between the characteristics that were assessed. The relationships showed that no-fines concrete acts in a manner similar to what was found in the conventional concrete sample.

Md. Abid Alam (2015) The porosity varies as the aggregate size increases but shows a decreasing trend when some fines were added to it. The concrete has zero slump value as the concrete completely collapse when t he mould of frustum of cone is raised vertically. Similar variations in the concrete strength [10] were obtained when tested after 28-days.

III . METHODOLOGY

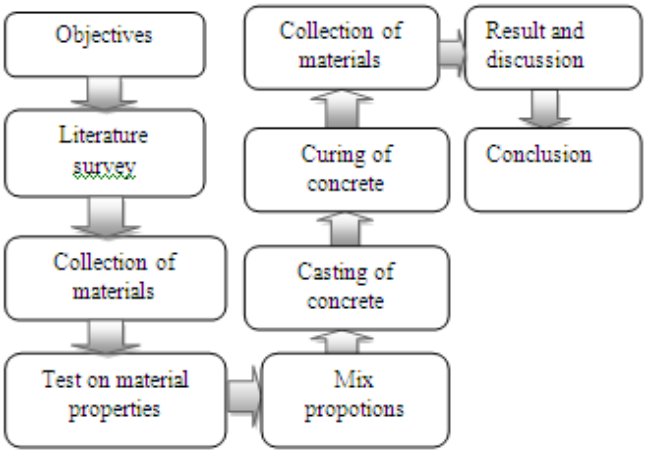


Fig.1 Block diagram of methodology

IV. MATERIAL USED AND PROPERTIES

1. Cement

Cement is a material generally in powder form that can be made into paste usually by the addition of water and, when molded or poured, will set into solid mass. Numerous organic compounds are used for the adhering, or fastening the materials, are called cements, but these are classified as adhesives, and the term cement alone means a construction material. The most widely used of the construction cements is Portland cement.

It is a bluish-gray powder obtained by finely grinding the clinker made by strongly heating an intimate mixture of calcareous and argillaceous minerals.The chief raw materials are a mixture of high-calcium limestone, known as cement rock, and clay or shale. Ordinary Portland cement (OPC) is by far the most important type of cement.

The OPC is classified into three grades, namely 33 grade, 43grade, and 53 grade depending upon the strength of the cement at 28 days when tested as per IS 4031-1988. It has been possible to upgrade the qualities of cement by using high quality limestone, modern equipments, and closer on line control of constituents, maintaining better packing.

4.1 Fineness Test of Cement:

Weight of cement (W1) = 100g

Weight of retained (W2) = 7g

(W2/W1)*100 = 7%

Fineness of Cement = 7%

2. Coarse Aggregate

Coarse aggregate are the crushed stone is used for making concrete. The commercial is quarried, crushed and graded. Much of the crushed stone used is granite, limestone and trap rock. Graded crushed stone usually consist of only one kind of rock and is broken with sharp edged. The sizes of aggregates are passing through 20mm and retained on 10mm The maximum size of coarse aggregate was12.5mm and specific gravity of 2.66.

Table.1 Specific Gravity of Course Aggregate

S.No.	Empty Weight Of Container (W1) G	Weight Of Container And Dry Solid Weight (W2) G	Weight Of Container +Dry Sample And Water (W3) G	Weight Of Container And Water(W4) G	Specific Gravity Of Coarse Aggregate=(W2-W1)/((W2-W1)-(W3-W4))
1.	894	1332	2288	2013	2.68
2.	894	1340	2278	2010	2.50
3.	894	1336	2280	2018	2.45

3. Impact Test

The test sample shall consist of aggregate the whole of which passes a 12.5mm IS Sieve and is retained on a 10 mm IS Sieve. The measure shall be filled about one-third full with the aggregate and tamped with 25 strokes of rounded end of the tamping rod.

The net weight of aggregate in the measure shall be determined to 35 the nearest gram The impact machine shall rest on floor, and the whole of the test sample placed in it and compacted by a single tamping of 25 Strokes of the tamping rod..The crushed‘ aggregate shall then be removed from the cup and the whole of it sieved on the 2.36 mm IS Sieve.

Table. 2 Impact Test on Course Aggregate

S.No	Details of sample	trail-1	trail-2
1	total weight of aggregate sampling cylinder (w1)	400g	400g
2	weight of aggregate retained 2.36mm sieve test (w2)	86g	92g
3	weight of aggregate retained 2.36mm sieve after the test (w3)	314g	308g
4	(w1-w2)+w3	628g	616g
5	(w2/w1) * 100	21.5%	23%

Average = 22.25%

4. Crushing Strength Test

The material for the standard test shall consist of aggregate passing a 12.5 mm IS Sieve and retained on a 10 mm IS Sieve, and shall be thoroughly separated on these sieves before testing. The aggregate shall be tested in a surface-dry condition. If dried by heating the period of drying shall Department of Civil Engineering Sanjay Ghodawat Group of Institutions, Atigre, Kolhapur not exceed four hours , the temperature shall be 100 to 110°C and the aggregate shall be cooled to 33 room temperature before testing.

The appropriate quantity may be found conveniently by filling the cylindrical measure in three layers of approximately equal depth, each layer being tamped 25 times with the rounded end of the tamping rod and finally leveled off, using the tamping rod as a straight-edge. The weight of material comprising the test sample shall be determined (Weight A) and the same weight of sample shall be taken for the repeat test.

The apparatus, with the test sample and plunger in position, shall then be placed between the platens of the testing machine and loaded at as uniform a rate as possible so that the total load is reached in 10 minutes. The total load shall be 40 kN.

Observation

Weight of sample retain in 12.5mm sieve (W1) = 3400g

Weight of sample passing in 2.36mm sieve(w2) = 800g

(W2/W1)*100 = 23.52%.

5. Water

Water fit for drinking is generally considered fit for making concrete. Water should be from as acid, oils, alkalis, vegetables or other organic impurities. Soft water also produced weaker concrete. Water has two functions in a concrete mix. Firstly, it reacts chemically with the cement to form a cement paste in which the Inert aggregates are held in the suspension until the cement paste has hardened. Secondly, it serves as a vehicle or lubricant in the mixture of fine aggregate and Cement.

V. MIX PROPOTIONS

The mix proportions which is used to form no-fines concrete depends predominantly on the final application of concrete. The aggregate-cement ratio used in buildings is, usually ranging from 6:1 to 10:1. This proportional mixensures that the void ratio is high and prevents capillary transport of water. In pavement applications the strength of concrete is more critical and aggregate-cement mixes as low as 4:1 is used. This ratio will help to improve the bonding between the aggregate and cement which will improve the strength.

Table.4 Mix Proportions Of Concrete

Cement/Aggregate Ratio	Water/Cement Ratio
1:4	0.40
1:6	0.40
1:8	0.40
1.10	0.40

VI. EXPERIMENTAL PROGRAM

1. Stages Involved In Making Concrete

6.1 Mixing

6.1.1 Hand Mixing

Sand and cement in appropriate proportions are mixed first in a dry state. Then coarse aggregate is added and whole mixture is mixed thoroughly with the help of shovels. The amount of water is then sprinkled over the mix. This operation is continued till such a time a good uniform and homogenous concrete is obtained.

6.1.2 Hand mixing should be done on a smooth, clean and water tight platform of suitable size in the following manner

- Measured quantity of sand is spread evenly.
- The required quantity of cement is dumped on the coarse aggregate and spread evenly.
- The coarse aggregate and cement is then mixed intimately with spade, turning the mixture over and over again until it is of even colour throughout and free from streaks.
- The coarse aggregates cement mixture is then spread out and measured quantity of coarse aggregate is spread on its top. Alternatively, the measured quantity of coarse aggregate is spread out and the sand cement mixture is then spread on its top.
- The whole mass should be mixed at least three times by shovelling and turning over by twist from centre to side, then back to the centre and again to the sides.
- A hollow is made in the middle of the mixed pile.
- Three quarters of the total quantity of water required should be added while the materials are turned in towards the centre with spades.

Fig.1 Mixing of Concrete

6.1.3. Casting of Concrete

Placing of concrete is almost important that the concrete must be placed in a systematic manner to yield optimum results. Concrete should be placed in horizontal layer not thicker than 30 to 45cm for mass concrete and 15 to 30cm for RCC. Concrete should not be laid continuously to avoid irregular and unsightly Lines.

Concrete should not be placed in heavy rains unless suitable shelter is provided.. Working on freshly laid concrete should be avoided. The fresh concrete was filled in the mould

Fig.3 casting of concrete.

6.1.4 Compaction of Concrete

The compaction of concrete is adopted in case of unimportant concrete works of the Small magnitude. Sometimes this is the method also applied of reinforcement is used which cannot be normally compacted by mechanical means, Hand compaction consists of rodding, ramming or damping. When hand compaction is adopted at a higher level the thickness of the layer of concrete is limited to about 15 to20cm. Concrete should be the thoroughly compacted during the operation of casting and thoroughly worked. Concrete may be compacted manually by rodding,damping or hammering for thin vertical member – rodding.For slabs, temping's done for compacting concrete.

Fig.2 Compaction Of Concrete

6.1.5 Curing of Concrete

Curing can be described as keeping the concrete moist and warm enough so that the hydration of cement can continue. More elaborately, it can be described as the process of maintaining satisfactory moisture content and a favorable the temperature in concrete during the period immediately following placement, so that hydration of cement may continue until the desired properties are developed to a sufficient degree to meet the requirement of service.

The remaining water is added by a water-can fitted with rose head, slowly turning the whole mixture over and over again until uniform colour and consistency is obtained throughout pile.

Fig.4 Curing Of Concrete

6.2 Testing of Fresh Concrete

Concrete slump test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction.

6.2.1 Equipment Required for Concrete Slum Test

Mould for slump test, non-porous base plate, measuring scale, temping rod. The mould for the test is in the form of the frustum of a cone having height 30cm, bottom diameter 20 cm and top diameter 10 cm. The tamping rod is of steel16 mm diameter and 60cm long and rounded at one end.

6.2.2 Sampling of Materials for Slump Test

A concrete mix (M15 or other) by weight with suitable water/ cement ratio is prepaid in the laboratory similar to that explained in 5.9 and required for casting 6 cubes after conducting Slump test.

6.2.3 Procedure for Concrete Slump Test

- Clean the internal surface of the mould and apply oil.
- Place the mould on a smooth horizontal non- porous base plate.
- Fill the mould with the prepared concrete mix in 4 approximately equal layers.
- Tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mould. For the subsequent layers, the tamping should penetrate into the underlying layer.
- Remove the excess concrete and level the surface with a trowel.
- Clean away the mortar or water leaked out between the mould and the base plate.
- Raise the mould from the concrete immediately and slowly in vertical direction.
- Measure the slump as the difference between the height of the mould and that of height point of the specimen being tested.

6.3 Tests performed on hardened concrete are

- Compressive strength test (most common).
- Split-tension test.

6.3.1 Compressive Strength Test (fc')

Out of many test applied to the concrete, this is the almost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

For cube test two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10 cm x 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15cm x15 cm are commonly used.

This concrete is poured in the mould and tempered properly so as not have any voids.

After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of these specimen should be made even and smooth.

This is done by putting cement paste and spreading smoothly on whole area of specimen These specimens are tested by compression testing machine after 7,14, 28 days

curing. Load should be applied gradually at the rate of 140 kg/cm² per minute till the Specimens fails.

Load at the failure divided by area of specimen gives the compressive strength of concrete.

Sometimes this method is also applied of reinforcement is used which cannot be normally compacted by the mechanical means, Hand compaction consists of Roding, ramming or damping.

Fig.5 Compressive Strength of Concrete.

Fig.6 No Fines Concrete Cube.

6.3.2 Split tensile strength test

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete.

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.

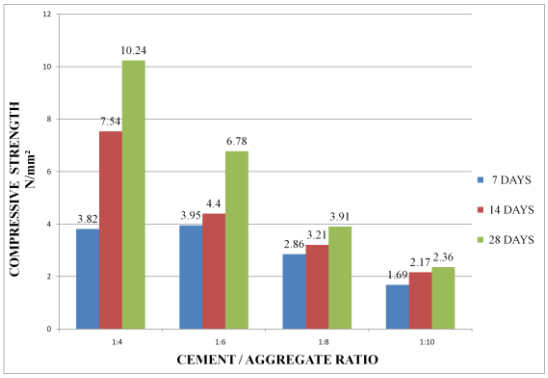
Table.5 Compression Test on Cube Ratio-1:4 and 1:6

S.No	cement/ aggregate ratio	days	compressive strength(n/mm²)	mean value (n/mm²)
1.	1:4	7 days	4.07	3.82
			3.56	
			3.84	
		14 days	8.23	7.54
			6.70	
			7.70	
		28 days	8.47	10.24
			10.95	
			11.30	
2.	1:6	7 days	3.97	3.95
			4.145	
			3.72	
		14 days	3.93	4.40
			4.92	
			4.36	
		28 days	5.98	6.78
			7.30	
			7.08	

Table.6 Compression Test on Cube Ratio-1:8 and 1:10

S.No	cement/aggregate ratio	days	compressive strength(n/mm²)	mean value (n/mm²)
1.	1:8	7 days	2.33	2.86
			3.25	
			3.01	
		14 days	3.46	3.21
			2.97	
			3.21	
		28 days	3.31	3.91
			3.56	
			4.86	
2..	1:10	7 days	1.45	1.69
			1.88	
			1.74	
		14 days	1.58	2.17
			2.15	
			2.78	
		28 days	2.42	2.36

Compression of 7, 14, 28 days compressive.
Strength bar chart.



Procedure of Splitting Tensile Test:

- Take the wet specimen from water after 7 days of curing
- Wipe out water from the surface of specimen
- Draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place.
- Note the weight and dimension of the specimen.
- Set the compression testing machine for the required range.
- Keep are plywood strip on the lower plate and place the specimen.
- Align the specimen so that the lines marked on the ends are vertical and centred over the bottom plate.
- Place the other plywood strip above the specimen.
- Bring down the upper plate to touch the plywood strip.
- Apply the load continuously without shock at a rate of approximately14-21kg/cm2/minute(Which corresponds to a total load of 9900kg/minute to14850kg/minute)
- Note down the breaking load(P)

Fig.7 Split Tensile Strength Test.

Fig.8 Split Tensile Test on Cylinder.

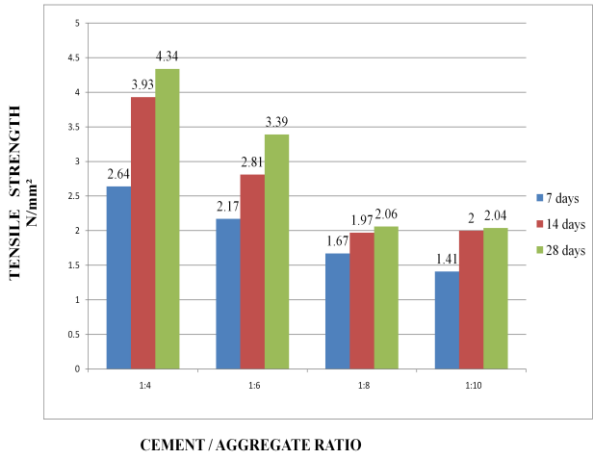
Table.7 No Fines Concrete Cylinder Ratio-1:4 and 1:6

S.No	cement/ aggregate ratio	days	compressive strength(n/mm²)	mean value (n/mm²)
1.	1:4	7 days	2.32	2.64
			2.97	
		14days	3.47	3.93
			4.40	
		28days	4.54	4.34
			4.15	
2.	1:6	7 days	2.067	2.17
			2.27	
		14days	2.38	2.81
			3.24	
		28days	2.98	3.39
			3.80	

Table.8 Split Tensile Test on Cylinder Ratio1:8 and1:10

S.No	cement/ aggregate ratio	days	compressive strength(n/mm²)	mean value (n/mm²)
1.	1:8	7 days	2.32	1.67
			2.97	
		14days	3.47	1.97
			4.40	
		28days	4.54	2.06
			4.15	
2.	1:10	7 days	2.067	1.41
			2.27	
		14days	2.38	2.00
			3.24	
		28days	2.98	2.04
			2.11	

Comparison of 7, 14, 28 Days Tensile.
Strength bar Chart.



VII. CONCLUSIONS

No-fines concrete is a viable material that has the potential to replace the use of traditional concrete pavements in situations where heavy traffic is the limited, such as car parks, residential streets and driveways. More wide spread applications may be possible if methods of reducing the travelling that occurs within the top aggregate are found. The slump of No-fine concrete is found to be zero irrespective of the aggregate size and addition of fine aggregate. The porosity of No-fine concrete is largely affected by the size of coarse aggregate used in concrete mix. Concrete mix containing 20 mm size aggregate shows higher porosity in comparison to concrete mix containing 10 mm size aggregate. The addition of fine aggregate to concrete mix lower the porosity because this fills the void spaces between the aggregate resulting in decreased porosity. . The compressive strength of No-fine concrete largely depends upon the size of coarse aggregate used in the concrete mix and the percentage of fine aggregate used in the mix. Lower value of compressive strength was obtained for 20 mm size aggregate mix. However the inclusion of fine aggregate results in comparatively good strength.

REFERENCES

[1]. Malhotra, V.M. (1976). "No- fines concrete-Its properties and applications". Journal of the American concrete institute,73(11),628-644.
[2]. Meininger,R.C. (1988). "No-fines pervious concrete forpaving".concrete international,10 (8),20-27.
[3]. Tennis.Paul.D, Michael L. Leming, David J. Akers, (2004). "Pervious concrete pavements", special publication by Portland cement association and The National Ready Mixed Concrete Association,USA,2004.
[4]. Park, S. and M. Tia. (2004). "An experimental study on the water-purification properties of porous concrete." Cement and Concrete Research 34, pp. 177–184.
[5]. Otani, T., Sato, Y., Kiyohara, C., Murakami, M., & Mitsui, Y.(2005). An equation for predicting the compressive strength of porous concrete. Journal of Structural and Construction Engineering, 590, 25–30.
[6]. Schaefer, V. R., Wang, K., Suleiman, M. T., & Kevern, J. T. (2006). Mix design development for pervious concrete in cold weather climates, Final Report, center for transportation research and education, Iowa State University, February 2006, 85p.
[7]. ACI Committee 522, (2006).Pervious concrete. Report No.522R-06, American institute.Detroit,USA,2006,25p.
[8]. Aoki, Y., Sriravindrarajah, R., & Khabbaz, H. (2008). Environmentally friendly sustainable pervious concrete. In Proceedings of the 20th Australasian conference on the mechanics of structures and materials,Toowoomba, Australia, December 2008.
[9]. Sriravindrajah.R, Wang.N.D.H and Ervin.L.J.W et al. (2012). "Mix design for pervious recycled aggregate concrete". International Journal ofconcrete structures and materials, volume-6, Number- 4,pgs 239-246,December 2012.
[10]. Alam M.A (2014) "Experimental investigation on pervious concrete for sustainable development". M.Tech Dissertation Z.H college of Engg. & Tech. A.M.U Aligarh-202002