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Mechanical Properties of no Fines Concrete for Pathways

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Abstract:

This The runoff of the agricultural and indoors town roads is improved, water tables of those areas decreased and as current ground improvement techniques are used to beautify the secure bearing ability of ground. We often use of geo textiles for in flexible pavements in some of those areas. To improve the drainage float in to ground water levels in the ones areas I want to develop new type of roads which may be permeable and porous based definitely concrete to gain the porosity and structural electricity of concrete. No fines concrete is the pleasant alternative to reap those necessities. In many advanced nations, the usage of No fines or pervious concrete for the development of pavements, vehicle parks and driveways is turning into popular. To be able to broaden cloth specification for pervious concrete, it's miles essential to behavior testing to evaluate the overall performance of this new sort of high-overall performance concrete. The impact of the above elements on the density, compressive, and tensile strength had been studied experimentally. The permeability of no fines concrete is extra because it having more voids. The power of no-fines concrete is a good deal while compared to ordinary concrete, however enough for structural use of pathways, parking areas etc. A pavement slab appropriate for low visitors' extent roads is designed as according to IRC SP62: 2004 which permits storage of water up to 125 lit/m^3 of concrete pavement giving time for infiltration thereby decreasing the runoff and recharging the floor water or sufficient time for delivery of it. A perforated pipe can be supplied at centre of the pavement above sub-base such that it amasses the water stored in concrete and drains it to the desired treatment plant or a recharge pit. This however needs similarly research and tribulations earlier than authentic implementation.

Keywords — **No fines concrete, water-cement ratio, cement-aggregate ratio, compressive strength, split tensile strength, permeability.**

1.1 INTRODUCTION:

One of the predominant disadvantage of concrete is its increased deadweight. It has a density of the order 2400-2600 kg/m^3 [6]. Within the past tries were made to lessen the self-weight of concrete. Mild weight concrete has turn out to be greater famous in latest years because of high voids and has extra benefits than the traditional concrete. Utilization of lightweight concrete elements in building has grown widely in the latest years because of its high strength-to-weight ratio. There are exclusive methods to produce lightweight concrete either with the aid of the usage of lightweight aggregates or with the aid of omitting best aggregates or through introducing air in the mix.

Lightweight concrete produced by omitting quality particles is studied in this project. Mild in weight and additional to obtain enough energy with low value of production. Because the omission of first-rate particles in concrete ends in lower floor location of aggregates that could be coated with cement paste, much less cement content material could be used in this no-fines concrete than the traditional concrete which ultimately consequences in low value of manufacturing. Via the usage of No-fines concrete blocks in homes as masonry unit will reduce the overall lifeless weight of the structure which gives the flexibility in designing the size of basis. Using no-fines concrete in pavement reduces the runoff thereby recharging floor water. There is no segregation in no-fines concrete as mild hand compaction is given and both less and no excellent particles are utilized in no-fines concrete. Huge quantity of voids found in no-fines concrete makes it more permeable and an excellent sound absorber.

1.2 OBJECTIVE AND SCOPE

The objectives of the project have to test the performance of no fines concrete on numerous mixes of aggregates. Because of the absence of exceptional aggregate in no fines concrete, there may be a high percent of void space which ends up in high permeability.

Objectives of the no fines concrete are as follows,

- To study the mechanical property of concrete such as compressive strength, split tensile strength and permeability of concrete.
- To find the strength of no fines concrete and the effect of fine aggregate on its density.
- To find the optimum mix content based on the strength criteria.
- To reduce the production cost of concrete by reducing the fine aggregate and cement content.

The scope of the present work is to carry out a detailed analysis of the following are prescribed conditions.

1. Cement: aggregate mix by volume is taken as 1:3, 1:6 and1:9.
2. Ordinary Portland cement of 53 Grade.
3. Aggregates of sizes 20mm passing and 10mm retained are taken.
4. Water/cement ratios are limited to 0.35, 0.40 and 0.45.
5. Testing of specimens at the ages of 7, 14 and 28 days.
6. Determining the compressive strength, split tensile, and permeability of M40 Grade mix.

CHAPTER 2
LITERATURE REVIEW:

No-fines concrete having great potential in terms of research and study because the porosity nature of it is use full for water penetrate through them and increase in ground water table.

1. Improving the mechanical properties of no-fines concrete by Ammar A.M, in Journal of Babylon University/ Engineering Sciences / No. 2 / Vol.(21): 2013 This paper investigated that: No-fines concrete is, as the name indicates, concrete consisting of coarse mixture, cement and water- fines being left out absolutely. The addition of polypropylene fibres enables to maximize the intrinsic power of the concrete. Polypropylene fibres without a doubt assist inhibit the formation of cracks due to both plastic shrinkage and drying shrinkage. Polypropylene fibres used in concrete to improve blend concord and reduced bleeding of water. Mechanical residences of no-fines concrete is a feature of the combination: cement ratio and the water-cement ratio.

The density and energy houses of the investigated no- fines concrete are decrease than that of regular- weight concrete, however enough sufficient for structural use.

2. Laboratory Investigation of no fines Concrete by Md.Iftekar Alam et.al In International Conference on Civil Engineering for Sustainable Development (ICCESD-2014), 14~16 February 2014

This investigation shows that No fines concrete has excessive water permeability due the presence of interconnected air voids. The presence of high porosity relative to traditional concrete makes the pervious concrete to end up mild weight concrete with limited compressive electricity. But, pervious concrete has been substantially popular for some a long time because of its capability to lessen the incidence of flooding, and to assist in recharging the floor water level. The porosity of the pervious concrete was 0.24, in comparison to 0.08 for traditional concrete. The porosity of pervious concrete changed into no longer notably prompted with the aid of age. The compressive energy of the pervious concrete become round 11Mpa. The weight loss for pervious concrete on air drying was twice larger than that for traditional concrete. No fines concrete, despite the fact that no longer as sturdy as traditional concrete, presents an acceptable alternative when used in low volume and occasional impact areas.

3. An Experimental Study On Durability and Water Absorption Properties of Pervious Concrete by Darshan S.S et al., International Journal of Research in Engineering and Technology(IJRET), Volume-3, Issue-3, Mar-2014

This study shows that 18.75 mm size gravel with 1:10 mix proportion made with OPC has more water absorption percentage value (1.08%) compared to other and similarly 9.375 mm size gravel with 1:10 mix proportion made with OPC has more water absorption percentage (0.68%) compared to other. 18.75 mm size gravel with 1:6 proportion made with OPC is more durable (0.34 %) compared to other and similarly 9.375 mm size gravel with 1:6 mix proportion made with OPC is more durable (0.36 %) compared to other.

Such as, water absorption and durability are inversely proportional to each other means that, concrete made by 1:6 mix proportion has more durability and less water absorption and concrete made by 1:10 mix proportion has more water absorption and less durability.

4. Study and Comparison of Mechanical Properties, Durability and Permeability of M15, M20, M25 Grades of Pervious Concrete with Conventional Concrete by Sai Sindhu K et al, , in International Journal of Applied Research, 2015

This paper investigated that:

Pervious concrete has less strength than traditional concrete by using 18.2% for M15, 14.5% for M20 and 12.6% for M25.

In addition the tensile and flexural electricity values are also comparatively decrease than the conventional concrete by means of 30%. Though the pervious concrete has low compressive, tensile and flexural strength it has high coefficient of permeability hence the following conclusions are drawn based on the permeability, environmental effects and economical aspects.

It is fact from the project that no fines concrete has more coefficient of permeability. Hence, it is capable of capturing storm water and recharging the ground water. As a result, it can be ideally used at parking areas and at residential areas where the movement of vehicles is very moderate.

Further, no fines concrete is an eco friendly solution to support sustainable construction. In this project, fine aggregates as an ingredient has not been used. Presently, there is an acute shortage of natural sand all around. By making use of FA in concrete, indirectly we may have been creating environmental problems. Elimination of fines correspondingly decreases environment related problems.

In many cities diversion of runoff by proper means is complex task. Use of this concrete can effectively control the run off as well as saving the finances invested on the construction of drainage system. Hence, it can be traditional that no fines concrete is very cost effective apart from being efficient.

5. Experimental Study on Properties of No-fine Concrete by Md. Abid Alam et al, in International Journal of Informative & Futuristic Research, Volume 2 Issue 10 June 2015

This study investigated that the slump of No-fine concrete is found to be zero irrespective of 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. The relationship between compressive strength (σ_{ck}) and porosity (P) are given by the following empirical equations: For 10 mm aggregate No-fine concrete: For 20 mm aggregate No-fine concrete: For all-in aggregate No-fine concrete:

For 10 mm aggregate No-fine concrete: $\sigma_{ck}= 23.31e^{-0.045P}$

For 20 mm aggregate No-fine concrete: $\sigma_{ck} = 18.89e^{-0.033P}$

For all-in aggregate No-fine concrete: $\sigma_{ck} = 17.41e^{-0.031P}$

CHAPTER 3

3.7.1 Slump Test: Slump test is used to find the workability of fresh concrete. The slump test result is a measure of the character of a self-compacted inverted cone of concrete under the action of gravity. It is a measure of the concrete's workability or the dampness of concrete. Slump test as per IS: 1199 – 1959 is followed.

Mix portion		Slump value (mm)	Density (Kg/m3)
C/A Ratio	W/C Ratio		
	0.30	68	1738
	0.35	98	1798
1:3	0.40	128	1858
	0.30	90	1790
	0.35	120	1850
1:6	0.40	150	1900
	0.30	128	1843
	0.35	158	1893
1:9	0.40	188	1900

Fig 3.7.1 Equipment required for conduct a Slump Test

The apparatus used for doing slump test are Slump cone and tamping rod.It indicates the characteristic of concrete in addition to the slump value. If the concrete slumps evenly it is called true slump. If one half of the cone slides down, it is called shear slump. In case of a shear slump, it is measured as the difference in height between the height of the mould and the average value of the subsidence.

3.7.1.1 Apparatus:

The Slump Cone apparatus for conducting the slump test:

Metallic mould in the form of a frustum of a cone having the internal dimensions as follows:

Bottom diameter – 20 cm

Top diameter – 10 cm

Height – 30 cm

The thickness of the metallic sheet for the mould should not be thinner than 1.6 mm

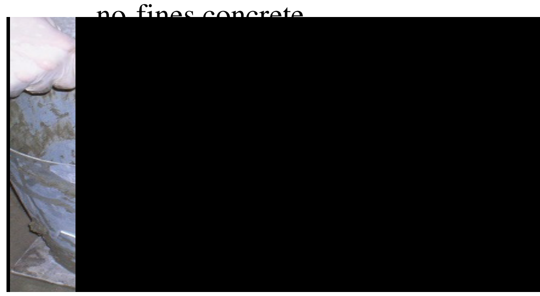
Weighing device

Tamper (16 mm in diameter and 600 mm length), Ruler, tools, Container for mixing or concrete mixer etc.

3.7.1.3 RESULTS AND ANALYSIS: This test was undertaken on each sample of concrete used for the hardened concrete tests. The slumps obtained on the concrete samples are as follows:

Table 3.7.1.3 – The Slump and density of the different concrete samples

The no-fines concrete had an extremely high slump caused by the low amount of cohesion between the aggregate particles. This particular workability test appears to be of little use when considering no fines concrete.



[redacted] used to [redacted] oncrete [redacted] per IS:

3.7.2.1 Apparatus:

Vee Bee Consistometer consist of

a) A vibrator table resting upon elastic supports

b) A metal pot

c) A sheet metal cone, open at both ends

d) A standard iron rod.

Weighing device

Tamper (16 mm in diameter and 600 mm length), Ruler, Tools and container for mixing or concrete mixer etc.

3.7.3 Compacting factor: Compacting factor test is used to determine the workability of fresh concrete as per IS: 1199 – 1959.

3.7.3.3 Results and Analysis:

The results from the compacting factor test conducted on the concrete samples are found in table 3.3.

	Partially Compacted (M1)	Fully Compacted (M2)	Compacting Factor = M1/M2
No-Fines Concrete	10.456	11.006	0.95
	10.956	11.533	0.95
	10.995	11.574	0.95
Conventional Concrete	13.365	14.527	0.92
	13.992	15.209	0.92
	14.026	15.246	0.92

Table 3.7.3 – Shows the Compacting Factor for all the samples of concrete used

No-fines concrete is a self-compacting material and this test determines its ability to compact itself dropping from a set height. No-fines concrete can be dropped from large heights and this test shows these properties by the amount of compaction obtained from simply allowing the concrete to drop. The low cohesion between the aggregate particles helps the self-compacting process of the no-fines concrete. This particular fresh concrete test is the most useful for determining the properties of no-fines concrete. The results obtained from this test will provide a method for assessing the amount of compaction required when placing a particular no-fines concrete mix.

The self-compacting properties of the conventional concrete sample were similar to that of the no-fines concrete. The only problem with conducting this test was that the conventional concrete sample required assistance to move from each of the cones to the final cylinder. This may be related to the dry nature of the concrete used in this particular situation. By helping the concrete pass through each cone, it may have affected the outcome and skewed the self-compacting factor results.

3.7.4 Summary: The slump varied dramatically between the no-fines and conventional concrete samples due to the low cohesion between the aggregate particles. The VEEBEE test showed similar results for both samples and the compacting factor test was reasonably similar for both types of concrete. The compacting factor test appeared to be the most useful workability test as it illustrates the self-compacting properties of the concrete.

The following chapter provides the details of all the hardened concrete tests undertaken along with the results and analysis.

3.8 DENSITY The density of no-fines concrete is dependent upon the void content in the concrete. Due to the high air content it is a lightweight concrete with a density of about two thirds of conventional concrete. The density of no-fines concrete typically levels among 1600 and 1900 kg/m^3. This is dependent upon the shape, length and density of the aggregate, the aggregate-cement-water ratio and the compaction exerted on the concrete.

3.9 AIR VOID CONTENT

The cement paste is simplest a skinny layer and does not include air bubbles, so the voids are received in general through the interconnected areas of the aggregate debris. The air content material is by definition the sum of the voids between the combination aggregates and any entrained or entrapped air within the cement paste.

The void content material depends upon the mixture-cement ratio and for that reason varies significantly.

The air void content of no-fines concrete levels from 13 to 28 percent of the total volume of the concrete of mixture cement/aggregate ratio between 1:3, 1:6 and 1:9.

3.10 PERMEABILITY

Permeability is defined as the property of allow the flow of fluid into a porous solid. The percentage of permeability is more in the no fines concrete compare with the conventional concrete due to its greater void ratio.

3.11 CONCRETE TESTS

The tests that were conducted had to provide a complete picture of all the characteristics of the concrete in both the wet and hardened state.

For this reason, it was proposed that the testing incorporate aggregate testing to determine the potential effect of the aggregate shape on the performance of the no-fines concrete. This was followed by conducting workability tests like the slump, VEEBEE and compacting factor tests on the wet concrete sample.

The hardened concrete tests proposed for the project were compressive strength and split tensile tests. This testing includes determining the void ratio and assessing the permeability of the no-fines concrete.

3.11.1 Conventional Concrete

Here the mix design of M-40 for comparison of compressive strength, spilt tensile and flexural strength results with the same properties of no-fines concrete, and analyzed the brief resultant values.

Cement	Fine aggregate	Coarse aggregate	Water
492.5	671.574	1079.73	197
1	1.36	2.19	0.4

Table 3.11.1 – Mix Proportions used for conventional concrete Mixes

3.11.2 No-Fines Concrete

The mix designs for no-fines concrete were obtained from printed articles. There were a large number of different mixes that are currently being used for a whole range of applications. For this reason three different mixes were trailed, with three water cement ratio are tried. The aggregate-cement-water ratio mixes were:

CEMENT	AGGREGATE	WATER
1	3	0.30
		0.35
		0.40
1	6	0.30
		0.35
		0.40
1	9	0.30
		0.35
		0.40

Table 3.11.2 – Mix Proportions used for No-fines Trial Mixes

CHAPTER-4
Experimental Investigation

4.2.2.1 Cement:

Fig 4.2.2.1 Ordinary Portland Cement of 53 Grade

Ordinary Portland cement of 53 Grade was used in the investigation. The details of tests conducted on cement are described below.

4.2.2.1.2 Fineness test on cement:

The following procedure is used to find Fineness test on cement. **Aim:** To determine the fineness of the given sample of cement by sieving. **Apparatus:** IS-90 micron sieve conforming to IS: 460-1965, standard balance, weights, and brush.

Fig 4.2.2.1.2 Sieve used for find fineness of cement

Observations:

S.No	Weight Of Sample Taken(G) W1	Weight Of Residue(G) W2	Residue (%) = (W2/W1)X100
1	100	2.15	2.15
2	100	2.16	2.16
3	100	2.16	2.16
Average percentage of residue = 2.16			

Table 4.2.2.1.2 – Observations of Fineness test on cement. Average fineness of cement =100 - 2.16 = 97.84%.

Result: Fineness of test cement: 97.84%.

4.2.2.1.3 Standard consistency test:

Observations:

No	/eight of cement aken in gms (a)	/eight of water aken in gms (b)	Plunger penetration rom bottom (mm)	Time Taken (mins)	onsistency of cement in % y weight b/a * 100
1	300	96	5	4	32
2	300	99	7	5	33
3	300	97	5	5	32.33

Table 4.2.2.1.3 – Observations of standard consistency of cement

Average of standard consistency: 32%

Result: Normal consistency for the given sample of cement is 32%.

4.2.2.2.2 Fineness Modulus of Coarse Aggregate:

Table for Sieve Analysis of Coarse Aggregate

IS SIEVE SIZE (mm)	WEIGHT RETAINED (Kgs)	CUMMULATIVE WEIGHT RETAINED (Kgs)	CUMMULATIVE % WEIGHT RETAINED(W)	CUMMULATIVE % PASSING
80	0	0	0	100
40	0	0	0	100
20	1.37	1.37	27.4	72.6
10	3.545	4.915	98.3	1.7
4.75	0.085	5.0	100	0
2.36	-	-	100	0
1.18	-	-	100	0
0.6	-	-	100	0
0.3	-	-	100	0
0.15	-	-	100	0

Fineness Modulus = W/100=725.7/100=7.257

Table 4.2.2.2.2 – Result of fineness Modulus of Coarse Aggregate

4.2.2.3 Fine Aggregate: The aggregate which is passing through 4.75mm is called as fine aggregate. The specific gravity of fine aggregate is 2.74.

4.3 MIXING PROCESS:

1. Weigh aggregate, cement and water for the mix.
2. First clean the floor surface, and make sure it is free dust.
3. Spread the coarse aggregate on the floor.
4. Spread the cement and water uniformly over the surface of the aggregate.
5. Mix the concrete until the aggregate is evenly covered with cement paste.

Fig 4.3 Mixture of no-fines aggregate

4.6 MIX PROPORTIONS FOR NO-FINES CONCRETE

The mix designs for no-fines concrete were obtained from printed articles. There were a large number of different mixes that are currently being used for a whole range of applications. For this reason three different mixes were trailed, and three water cement ratios are tried.

The aggregate-cement-water ratio mixes were:

CEMENT	AGGREGATE	WATER
1	3	0.30
		0.35
		0.40
1	6	0.30
		0.35
		0.40
1	9	0.30
		0.35
		0.40

Table 4.6 – Mix Proportions used for No-fines Trial Mixes.

4.7 Compressive Strength Test of Concrete (Is: 516-1959):

AIM: To determine the compressive strength of concrete specimens.

Apparatus:

- Compression testing machine (2000 KN)
- Curing tank.
- Balance (0-10 Kg)

Conventional concrete cube

No fines concrete cube

Fig 4.7 Concrete Cube Specimen for Compressive Strength Test

Calculation:

Compressive strength is calculate using the following formula. Compressive strength (kg/cm2) = Wf / Ap. Where, Wf = Maximum applied load just before load, (N)

Ap = Plan area of cube mould, (mm2)

TABULATION:

S.No	Mix Proportion		Area (mm^2)	Load (N)			Compressive Strength (N/mm^2)		
	C/A	W/C		7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
1	1:3	0.3	22500	145350	168750	215100	6.46	7.50	9.56
2		0.35	22500	146025	169200	215550	6.49	7.52	9.58
3		0.4	22500	167625	193500	245250	7.45	8.6	10.9
4	1:6	0.3	22500	110700	132750	176625	4.92	5.90	7.85
5		0.35	22500	111150	133200	177075	4.94	5.92	7.87
6		0.4	22500	144000	164700	205875	6.4	7.32	9.15
7	1:9	0.3	22500	49500	54450	63675	2.20	2.42	2.83
8		0.35	22500	49950	54900	64575	2.22	2.44	2.87
9		0.4	22500	76050	91800	122850	3.38	4.08	5.46

Table 4.7 (a) – The compressive strength values obtained from the trial mixes of no-fines concrete.

S.No	No of days	Area (mm^2)	Load (N)	Compressive strength (N/mm^2)
1	7	22500	618750	27.5
2	14	22500	929250	41.3
3	28	22500	1022175	45.43

Table 4.7 (b) – The compressive strength values obtained from the M40 mix of conventional concrete.

4.8 SPLITTING TENSILE STRENGTH TEST OF CONCRETE (IS-516-1959):

AIM: To determine of the splitting tensile strength of cylindrical concrete specimens.

Apparatus: Testing Machine – The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the rate specified in 5.5. The permissible error shall be not more than ± 2 percent of the maximum load. Cylinders –The cylindrical mould shall be of 150 mm diameter and 300 mm height conforming to IS: 10086-1982. Weights and weighing device, Tools and containers for mixing, Tamper (square in cross section) etc.

TABULATION:

S.No	Mix Proportion		Diameter d (mm)	LengthL (mm)	πLd (mm2)	Load (kN)			Split Tensile Strength (N/mm^2)		
	C/A	W/C				7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
1	1:3	0.3	150	300	141300	17.66	36.74	71.36	0.25	0.52	1.01
2		0.35	150	300	141300	19.78	39.56	78.42	0.28	0.56	1.11
3		0.4	150	300	141300	23.31	46.63	92.55	0.33	0.66	1.31
4	1:6	0.3	150	300	141300	16.25	36.03	68.53	0.23	0.51	0.97
5		0.35	150	300	141300	19.08	38.86	77.72	0.27	0.55	1.10
6		0.4	150	300	141300	20.49	40.27	80.54	0.29	0.57	1.14
7	1:9	0.3	150	300	141300	9.89	21.90	47.34	0.14	0.31	0.67
8		0.35	150	300	141300	12.01	24.02	48.04	0.17	0.34	0.68
9		0.4	150	300	141300	15.54	31.09	62.17	0.22	0.44	0.88

Table 4.8 (a) – The split tensile strength values obtained from the trial mixes of no-fines concrete.

S.no	No. of days	Diameter (mm)	Length (mm)	πld (mm2)	Load (KN)	Split Tensile Strength (N/mm^2)

1	7	150	300	141300	79.84	1.13
2	14	150	300	141300	144.13	2.04
3	28	150	300	141300	307.33	4.35

Table 4.8 (b) – The split tensile strength values obtained from the M40 mix of conventional concrete.

4.9 FLEXURAL STRENGTH TEST OF CONCRETE (IS: 516-1959):

AIM: TO determining the flexural strength of moulded concrete flexure test specimens. APPARATUS: Testing Machine - The testing machine may be of any reliable type, of sufficient capacity for the tests and capable of applying the load at the rate specified in 5.5. The permissible error shall be not greater than ± 2 percent of the maximum load. Beam Moulds - The beam moulds shall conform to IS: 10086-1982. The size shall be 10 × 10 × 50 cm may be used. Weights and weighing device, Tools and containers for mixing, Tamper (square in cross section) etc.

Fig 4.9: Concrete Beam Specimen for Flexural Strength Test

TABULATION:

s.no	Mix proportion		Width(mm)	Length (mm)	Measured depth (mm)	Distance between fracture line (mm)	Load (N)			Flexural strength (N/mm2)		
	C/A	W/C					7 days	14 days	28 days	7 days	14 days	28 days
1		0.30	100	400	47	133	819.38	1505.88	3343.95	0.37	0.68	1.51
2	1:3	0.35	100	400	50	133	1002.51	1979.95	3984.96	0.40	0.79	1.59
3		0.40	100	400	48	133	993.20	1986.41	3972.81	0.43	0.86	1.72
4		0.30	100	400	51	133	860.48	1825.26	3598.38	0.33	0.70	1.38
5	1:6	0.35	100	400	52	133	975.88	1978.87	3957.73	0.36	0.73	1.46
6		0.40	100	400	49	133	914.67	1853.40	3682.74	0.38	0.77	1.53
7		0.30	100	400	53	133	591.37	1210.90	2506.28	0.21	0.43	0.89
8	1:9	0.35	100	400	46	133	509.11	1018.23	2036.45	0.24	0.48	0.96
9		0.40	100	400	54	133	818.53	1607.82	3215.64	0.28	0.55	1.10

Table 4.9 (a) – The flexural strength values obtained from the trial mixes of no-fines concrete

S.No	No. of Days	Width (mm)	Length (mm)	Measured depth (mm)	Distance between fracture line (mm)	Load (N)	Flexural strength (N/mm^2)
1	7	100	400	64	133	20120.70	4.9
2	14	100	400	62	133	21002.31	5.45
3	28	100	400	63	133	26062.11	6.55

Table 4.9 (b) – The flexural strength values obtained from the M40 mix.

4.10 PERMEABILITY-One revolutionary technique to sustainable road design and creation is using permeable concrete pavements. It's been determined that the growth and unfold of impervious surfaces within urbanizing watersheds pose vast threats to the satisfactory of natural and built environments. Such threats encompass multiplied storm water runoff, reduced water best, better maximum summertime temperatures, degraded and destroyed aquatic and terrestrial habitats, and the faded aesthetic appeal of streams and landscapes. The substances used to cover such impervious surfaces might also efficiently seal surfaces, repel water and save you precipitation and different water from infiltrating soils. In addition they permit storm water to wash over them, as a consequence generating massive volumes of runoff accompanied with the aid of highly dry conditions a short time later. Permeable concrete pathways and pavement structures are claimed to assist manipulate the quantity of contaminants in waterways, through decreasing or eliminating runoff, and allowing treatment of pollution. Such treatment takes place as a result of capturing initial rainfall and allowing it to percolate into the floor, as a result permitting soil chemistry and biology to "treat" the polluted water obviously. It's also claimed that through accumulating rainfall and permitting it to infiltrate, permeable concrete allows extended groundwater and aquifer recharge, reduction of height water flow through drainage channels, and minimization of flooding. It can also permit credits to be acquired in inexperienced rating scales for sustainable construction. different claimed blessings of this material consist of much less absorption of sun radiation due to the light coloration of concrete pavements compared with darker substances, and less storage of warmth because of the extraordinarily open pore shape of permeable concrete.

4.10.1 PERMEABILITY TEST OF CONCRETE:

1. Nine specimen of concrete each of 200mm dia and 120mm height are cast.
2. After 24 hours, the middle portion of 100mm dia is roughened and the remaining portion is sealed with cement paste.
3. The specimens are cured for 28 days and then apply water pressure on the middle roughened portion so that water can penetrate inside the concrete. The water pressure is maintained as given below:
   - 1 bar (1kg/cm2) for 48 hours.
   - 3 bars for next 24 hours.
   - 7 bars for next 24 hours.
4. After this, the specimens are split to know the penetration of water. The specimen are split in compression machine by applying concentrated load at two diagonally opposite points slightly away from central axis. Calculate the average of three maximum values of penetration. The infiltration profundity of water must be under 25 mm otherwise the specimens are considered to be failed in permeability test.

MIX PROPORTION		DENSITY (Kg/mm3)	VOID (%)	PERMEABILITY (mm/s)
C/A RATIO	W/C RATIO			
1:3	0.30	1738	27.58	29.36
	0.35	1798	25.08	28.79
	0.40	1858	22.58	28.21
1:6	0.30	1790	25.42	28.87
	0.35	1850	22.92	28.29
	0.40	1910	20.42	27.71
1:9	0.30	1843	23.21	28.36
	0.35	1903	20.71	27.78
	0.40	1963	18.21	27.20

Table 4.10 – The permeability values obtained from the trial mixes of no-fines concrete

CHAPTER 5

5.1 RESULTS AND ANALYSIS: No-fines concrete mixes were tested for slump and its strength characteristics such as Compressive strength, Split Tensile strength and Flexural strength. The mix proportions selected for the study and its test results of slump and density values is represented in below Table 6.1. On testing density of no-fines concrete was found be ranging between 1738-1963kg and which is lower than that of conventional concrete. It is observed that density decreases with increase of c/a ratio. It is also observed that Slump of no-fines concrete has been increased with the addition of water in all the mix.

Mix proportion		Compressive strength (N/mm^2)			Split tensile strength (N/mm^2)			Flexural strength (N/mm^2)		
C/A	W/C	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
1:3	0.3	6.46	7.50	9.56	0.25	0.52	1.01	0.37	0.68	1.51
	0.35	6.49	7.52	9.58	0.28	0.56	1.11	0.40	0.79	1.59
	0.4	7.45	8.6	10.9	0.33	0.66	1.31	0.43	0.86	1.72
1:6	0.3	4.92	5.90	7.85	0.23	0.51	0.97	0.33	0.70	1.38
	0.35	4.94	5.92	7.87	0.27	0.55	1.10	0.36	0.73	1.46
	0.4	6.4	7.32	9.15	0.29	0.57	1.14	0.38	0.77	1.53
1:9	0.3	2.20	2.42	2.83	0.14	0.31	0.67	0.21	0.43	0.89
	0.35	2.22	2.44	2.87	0.17	0.34	0.68	0.24	0.48	0.96
	0.4	3.38	4.08	5.46	0.22	0.44	0.88	0.28	0.55	1.10

Table 5.1.1-Test Results of Compressive Strength, Split Tensile Strength and Flexural Strength of No-fines Concrete

Mix 40 with 0.40 w/c ratio	Compressive strength (N/mm^2)			Split tensile strength (N/mm^2)			Flexural strength (N/mm^2)		
	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
	27.5	41.3	45.43	1.13	2.04	4.35	4.9	5.45	6.55

Table 5.1.2 – Test Results of Compressive Strength, Split Tensile Strength and Flexural Strength of Conventional Concrete

MIX PROPORTION		DENSITY (Kg/m m3)	VOID (%)	PERMEABILITY (mm/s)
C/A RATIO	W/C RATIO			
1:3	0.30	1738	27.58	29.36
	0.35	1798	25.08	28.79
	0.40	1858	22.58	28.21
1:6	0.30	1790	25.42	28.87
	0.35	1850	22.92	28.29
	0.40	1910	20.42	27.71
1:9	0.30	1843	23.21	28.36
	0.35	1903	20.71	27.78
	0.40	1963	18.21	27.20

Table 5.1.3– The Test Results of permeability for no-fines concrete

5.3 SUMMARY:

From the 28 days testing results of no fines concrete, the cement/ aggregate and water cement ratio of 1:3 and 0.4 was chosen as the most suitable mix since it produced the highest compressive strength, split tensile strength and flexural strength. The percentage of 24 is obtained in compressive strength, percentage of 30 is obtained in spilt tensile strength and percentage of 26 is obtained in flexural strength when compared with results of M40 mix of conventional concrete. But as economically consideration, the cement/aggregate and water cement ratio of 1:6 and 0.4 is economical. The percentage of 20 is obtained in compressive strength, percentage of 26.21 is obtained in spilt tensile strength and percentage of 23 is obtained in flexural strength when compared with results of M40 mix of conventional concrete.

The average density of M40 conventional concrete is 2400 Kg/m^3, percentage of 77 is obtained for no-fine concrete at cement and aggregate, water and cement ratio at 1:3 and 0.4 that means there is decrement of 23 percent is obtained when compared with M40 Concrete.

Percentage of 80 is obtained for no-fine concrete at cement and aggregate, water and cement ratio at 1:6 and 0.4 that means there is decrement of 20 percent is obtained when compared with M40 Conventional Concrete.

As compare the results of slump, density, compressive strength, and spilt tensile strength the cement- aggregate and water cement ratio of 1:3 and 0.4 and the cement- aggregate and water cement ratio of 1:6 and 0.4 are more desirable mix proportions, for pathways in both strength and permeable considerations.

From the permeability test it is observed that at cement- aggregate ratio, water and cement ratio 1:3 and 0.3 having more permeable nature and the value is 29.36mm/s. But at cement- aggregate ratio, water and cement ratio 1:3 and 0.4 the value 28.21 and cement- aggregate ratio, water and cement ratio 1:6 and 0.4 the value 27.71mm/s, if we observe the values are very nearer so as strength criteria it observed that cement- aggregate ratio, water and cement ratio 1:6 and 0.4 the value 27.71mm/s is considered.

CHAPTER 6

6.1 CONCLUSION

The density and strength properties of the no-fines concrete are investigated at lower than that of normal weight concrete, but sufficient enough for structural use. For practical purposes mixes with cement/aggregate ratio 1:3 and 1:6 at water/ cement ratio is 0.4 were recommended.

To minimize hazard to the natural surroundings on which roads are built, in particular in city areas, permeable concrete has appropriate capability to make an advantageous contribution to sustainable street creation and life cycle control. It can meet stakeholder requirements through much less effect on the environment on which roads are constructed, and therefore can assist the development enterprise to transport in the direction of sustainable construction control. The foremost difficulty that needs interest is the need to carefully follow great control to pavement and mix design, and urban placement. Extra study is needed to higher manipulate its disadvantages, which includes the viable ability to clog below certain situations and to limit any leaching consequences into the surroundings from binder materials and it needs proper maintenance.

The previous pavement help storm water systems by slowing water during rain and melt times, Recharges local aquifers, Helps improve ground water in local area.

6.2 FUTURE SCOPE

We can further study for different cement-aggregate and water cement ratios with suitable chemical and minerals admixtures which are suitable for bonding between aggregate and cement, strength increasing by adding admixtures. By reducing the permeability capacity of no fines concrete means reducing the voids in no fines concrete will gives the more strength to no fines concrete.

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- *IS: 10262-2009 indian standard concrete mix design.*
- *IS: 516-1959 method of tests for strength of concrete.*
- *IS 3085:1965 method of test for permeability of cement mortar and concrete*

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