



Bio Concrete for Concrete Pavements

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ABSTRACT

Concrete is one of the most extensively used construction material and it can form cracks very easily. These cracks escort to reduce the concrete examine life and elevated costs for repairs. Even though it is not possible to prevent crack formation, there are many types of techniques to heal the cracks. Now a day there is method to heal the cracks by using microorganisms in concrete which are environmentally friendly. This method is very effective and it is long lasting process in high demand as well. A microbial self-healing draw near is eminent by speedy and lively crack repair, and also environmentally friendly. Self-healing of concrete is described as the crack having a capable of healing itself back to the original state with chemical products by itself under certain circumstances. Mechanism of self-healing was evaluated to the formation of carbonate from the reaction between calcium ions in concrete and atmospheric CO₂ dissolved in water. Two different bacterial samples are to be considered in three different dilutions and the optimum concentration of bacterial cells to be incorporated in concrete is to be determined based on compressive strength study. The bacteria considered are *Bacillus cereus*, *Bacillus sphaericus* in concentrations of 104,105 and 106 cells/ml of mixing water. The optimum concentration of bacteria obtained was 104 cells/ml for *Bacillus cereus* and 106 cells/ml for *Bacillus sphaericus*. The compressive strength obtained was 40.63 N/mm² for control specimens and 35.96 N/mm², 37.54 N/mm² for *Bacillus sphaericus* and *Bacillus cereus* respectively. From the obtained consequences the inclusion of bacteria in the specimens result in a momentous gain of strength due to self-healing assets of bacteria. Due to the addition of microorganisms in concrete, we achieved boost in compressive strength. From the consequences it can be finished that *Bacillus cereus*, *Bacillus sphaericus* can be safely used in improving the performance of the characteristics of concrete, and hence we can effectively use the bacteria to mend cracks. *Bacillus sphaericus* is found to be more effective than *Bacillus cereus* in crack healing property.

1.INTRODUCTION

Concrete

Concrete is a combination of glue and totals, or shakes. The glue, made out of Portland concrete and water, covers the backyard of the exceptional (little) and coarse (bigger) totals. Along these lines, concrete is the most

cherished choice as a improvement fabric amongst structural designers round the world for a tremendous size of time. It is preferred for its higher execution, longer existence and low maintenance cost. Concrete is the most typically utilized improvement fabric in all places all through the world. It is challenging to find out

change cloth for improvement which is as terrific as that of such cloth shape energy and monetary perspective. The quantity of the water assumes a considerable job in the planning of stable. Impurities in water may additionally meddle the placing of the concrete and can also antagonistically impact the fantastic properties. The substance components current in water may also partake in the concoction responses and in this manner have an impact on the setting, solidifying and best development of blend. The IS: 456-2000 code specifies the water great norms for mixing and restoring. In some parched regions, regional consuming water is sullied and may additionally incorporate an unreasonable measure of salts due to the fact of air pollution through current squanders. At the factor when chloride does not surpass 500ppm, or SO₃ would not surpass one thousand PPM, the water is innocuous, but water with plenty greater salt substance has been utilized Satisfactorily (Building lookup station1956).

High-sway development in the areas of transportation framework via the improvement of frequent asphalts is altering the frequent pervious floor into an impenetrable land spread. The improvement of frequent impenetrable asphalt frameworks has brought about two enormous actions in the close by condition, including:

1. Adjustments in the hydrological perspectives, and
2. Types in the encompassing heat sense.

The impenetrable thinking of the common asphalt frameworks has introduced about multiplied tempest water overflow quantity that has stemmed in a large extent of first flush containing unsatisfactory diploma of contaminations, and outlandish blaze floods. Additionally, the remedy of first flush requires sizable detainment bowls and purging vegetation earlier than it is launched into the ordinary water bodies. Furthermore, issues, for example, diminished groundwater energize, hydroplaning surfaces, and non-slip protected sporting publications is moral of the impenetrable asphalt frameworks. Further, tough adjustments in the encompassing heat vibe, for example, the manufacturing of a big difference in the temperature amongst city and the encompassing provincial areas are likewise acknowledged to be precipitated due to the fact of the impenetrable city texture. The impenetrable asphalt frameworks which go about as heat stockpiling media

discharge the heat again to the surroundings at some stage in evenings. This marvel typically known as Urban Heat Islands (UHI) has caused heat misery for city tenants, which has incited the utilization of more strength for cooling functions and extended CO₂ emanations. So as to reduce the have an impact on of high-sway advancement, a few transportation associations have targeted on examination and execution of realistic substances and eco-accommodating methods that deliver about low-sway improvement. Ordinarily, the larger section of the city organizers and engineers have acquired detainment and preservation bowls as structures to minimize spill over from the city regions. Notwithstanding, water from such bowls will require constructed remedy earlier than releasing it into everyday water bodies, alongside these strains making the arrangement uneconomical. Among one of a kind methods for low-sway enchantment in asphalts, pervious stable asphalt framework has emerge as a practical competitor due to the fact of its basic, practical, and road patron benefits. Pervious cement is a splendid stable asphalt kind predominantly made out of sanely reviewed coarse whole and setting up substances which supply the combination an interconnected full scale pore inward structure. The restricted amount or nonattendance of fines in pervious cement makes profoundly nicely proportioned pores that help shop with raging water internal them, and reduce overflow quantity in a logical way. Further, the permeable nature is located to reduce the UHI impact, and continues up beneficial encompassing atmosphere.

2. LITERATURE REVIEW

Literature Reviewed

Anush et al. [1] Over the most current couple of years, the utilization of pervious concrete as an asphalt cloth in low-volume road functions has picked up value due to the fact of its tremendous herbal perspectives. This paper surveys the turns of activities and slicing facet fantastic to pervious strong exploration and practices. The examinations on mechanical- hydrological-sturdiness residences of pervious cement acted in exclusive investigations have been seeded into. The tempest water purging effectiveness of pervious cement has been archived. The subject examinations of scarcely any check areas and in-administration pervious strong asphalts have been talked about. An audit has been made on

healing strategies to enlarge the stress pushed talent of pervious stable asphalts. A word has been referenced on the existence cycle fee examination of pervious cement. Because of an expanded utilization of pervious cement in the asphalt enterprise due to the fact of its infinite advantages, there exists a sweeping extension for extra examination to recognize the cloth better, which will make it a promising realistic road fabric in future

B. Radha Kiranmaye et al. [2] Ordinary Portland Concrete is commonly utilized for asphalt development. The impenetrable thinking of the strong asphalts provides to the accelerated water spillover into the waste framework, over-troubling the basis and inflicting intense flooding in developed zones. Pervious cement is a special sort of cement with a excessive porosity utilized for strong asphalt functions that approves water from precipitation and distinctive sources to go legitimately through, alongside these traces diminishing the overflow from a web page and enabling floor water energize. The glass fiber can be the doable fabric to enhance the residences of the pervious cement. It will look into the utilization of glass fiber which is naturally negative. The nearness of glass fiber with concrete substance fortifies the stable in extra outstanding degree. In this paper, glass fiber is utilized as midway substitution of concrete in quantity section of 1.5%. Pervious cement with subsequent to zero quality whole in distinct extents is utilized. The investigation assesses the have an effect on of quality whole in altering division of 0%, 10% and 20% with coarse total. The checks to be carried out to destroy down the houses of pervious cement are void proportion, compressive quality, flexural quality, break up stress and porousness check with differing division of exceptional total.

B.V.R.Murthy, G.Rajeswari[3] Pervious Concrete Is A Concrete Containing Little Or No Fine Aggregate Provides Direct Drainage Of Rainwater, Helps To Recharge Groundwater In Pavement Applications. The Objective Of This Work Is To Improve Compressive Strength At Which The Strength Achieves Better Permeability. The Design Mix Is Prepared For M25 Consisting Of fifty three Grade Cement, Two Different Sizes Of Coarse Aggregate Which Are Passing Through 25mm I.S Sieve Size And Retained On 16mm I.S Sieve Size As S1 And Aggregates Passing Through 10 Mm And Retained On 6mm Named As S2 Were Taken For This Work River Sand And Robo Sand Were Selected As

Fine Aggregate And W/C Ratio Maintained As 0.35 In All The Cases. The Design Mix Is Developed With Constant Percentage Of Coarse Aggregate And Altering The Proportions Of Coarse Aggregate With Simultaneous Addition Of Percentages Of River Sand And Robo Sand In The Concrete. From The Experimental Results It Is Found That The Compressive Strength And Permeability Is Satisfactory At Adding Of 5% Robo Sand As A Fine Aggregate And Combination Of 80% S1 And 20% S2 As Coarse Aggregate In The Pervious Concrete.

Dang Hanh Nguyen et al. [4] As every other cloth type for asphalt, pervious cement ought to be meant to maintain up each porosity and the simple quality. The actual combination extents for pervious cement count number upon the application, the mechanical houses required and the substances utilized. As a count number of fact, the combo extents of pervious cement had been resolved for regionally available substances structured on being investigated bunching and experience. Another diagnostic approach ought to be created to motivate the stable makers. In mild of the suspicion that the concrete glue simply assumes a job of covering, it does not fulfill the void amongst the grains of rock; this paper facilities round one modified approach for the shape of the pervious cement. The extent concrete glue is separated by using the floor place of the totals to determine the thickness of the overabundance glue. A scaling element has been characterized to equitably disseminate the concrete glue towards the measurement of rock. Besides, a fastener waste take a look at is proposed to figure out the fundamental w/c share closer to to prevent the development of concrete glue to the decrease layers of cement below the pastime of vibration or compaction. The pervious cement has been specific by way of this method to approve it. The mechanical and strain pushed checks are carried out to describe the pervious cement. The received pervious stable provides a massive sufficient porousness (1 mm s₁) for depleting water and extraordinary mechanical opposition (R_c = 28.6 MPa) as to run of the mill pervious stable applications, for example, parking garages, walkways and low-traffic streets. What's more, the mechanical first-rate of pervious cement in this examination is found higher than that through and massive introduced via one of a kind creators. The consequences exhibit that the hypothetical combo sketch approach is an fantastic

speculation for a streamlining association of pervious cement.

LutfurAkand, Mijia Yang, Xinnan Wang ^[5] Fiber fortification defers the cut up age and improves the exceptional of the host grid. In any case, the protecting device amongst fiber and stable grid is questionable in writing and wants higher clarification. Because of floor perfection and latent concoction nature of economically on hand strands, a few mechanical and artificial cure techniques have been focused via scientists to extend the fiber- grid protecting properties. The utilization of filaments in pervious cement is not ably all the extra checking out due to the fact of excessive porosity and deficient fiber-network preserving interface. This investigation talks about the affect of artificial cure on brief polypropylene filaments and its makes use of in pervious concrete as fortification. The adjustment in fiber floor due to the fact of the remedy is resolved via fiber wettability check and Atomic Force Microscopy (AFM). Changes on the stress of filaments with the aid of the therapy strategies are likewise classified. Single fiber pullout assessments are led to ponder the affect of the remedy kind on fiber-concrete interface properties. Rewarded filaments are then positioned into pervious strong community for compressive and flexural great tests. Substance drug treatments are observed to enhance the floor harshness and concrete community interface properties, simply as to improve the common great of the fiber fortified pervious cement.

Lei Lang et al. ^[6] The new pervious stable (PC) have been readied utilizing magnesium phosphate concrete (MPC) as legit and waste metal slag as coarse total. A development of lookup core investigations have been performed to think about the have an effect on of complete measurement and embellishment method on the compressive quality, flexural quality, porosity and water penetrability coefficient of magnesium phosphate concrete metal slag pervious cement (MSPC). Test effects indicated that the influence of whole measurement on compressive great is numerous when specific embellishment techniques had been received. Through close to investigation, the MSPC with medium molecule measurement framed through vibration shaping had the most multiplied compressive quality, and the biggest can arrive at 41.5 MPa. In view of the splendid protecting high-quality of MPC, the MSPC has desired flexural first-class over traditional PC, and the most severe

28-day flexural fantastic can arrive at eight MPa. The porosity increments with the enlargement of complete size, and which is in the scope of 23.8–26.5% for all the MSPC blends. Likewise, the water penetrability coefficient of MSPC increments as the growth of whole size, and with the vary from 5.85 to 7.10 mm/s. The 28-day twist press percentage of MSPC is close to 1/5. In distinction to the traditional PC, the mechanical great of MSPC extended first and later on diminished with the porosity, whilst paying little thinking to complete measurement and embellishment technique, the water porousness coefficient elevated straightly with the porosity. The take a look at consequences reveal that the MSPC made of metal slag totals and MPC is an relatively encouraging eco-accommodating PC

LutfurAkand et al. ^[7] Fiber fortification defers the wreck age and improvements the best of the host grid. Be that as it may, the preserving machine amongst fiber and strong framework is questionable in writing and desires higher clarification. Because of floor perfection and inactive artificial nature of financially reachable filaments, a few mechanical and compound therapy strategies have been centered with the aid of professionals to increase the fiber-framework conserving properties. The utilization of strands in pervious cement is a whole lot moreover trying out due to the fact of excessive porosity and poor fiber-framework maintaining interface. This investigation examines the influence of compound remedy on brief polypropylene filaments and its makes use of in pervious concrete as fortification. The adjustment in fiber floor due to the fact of the therapy is resolved thru fiber wettability check and Atomic Force Microscopy (AFM). Changes on the tension of filaments by using the remedy techniques are additionally organized. Single fiber pullout assessments are led to ponder the influence of the cure kind on fiber-concrete interface properties. Rewarded filaments are then positioned into pervious stable framework for compressive and flexural excellent tests. Synthetic drugs are discovered to improve the floor harshness and concrete framework interface properties, simply as to improve the universal best of the fiber bolstered pervious cement.

Milena Rangelov et al. ^[8] Pervious stable asphalts are choosing up prominence for storm water the executives. Hence, there is an drawing close requirement for the enchantment of fee manipulate and acknowledgment

particulars. In this examination, the indispensable introductory advances are taken toward this objective. The structures to lead new and solidified thickness/porosity (u) and 28-day compressive best (f zero c) have been assessed. The first-rate viable machine for throwing examples in the area was once identified through inspecting the grasp between the new (D) and solidified thickness (q). The have an impact on of spherical and hole size, and restoring strategies as mixes of air and soggy relieving at some point of the four-week time frame on f zero c used to be contemplated. Both chamber sizes confirmed equal estimations of solidified porosity ($u =$ sixteen percent) and solidified thickness ($D = 2.11$ kg/m³), simply as stable straight u - D relationships (R^2 territory 0.60–0.90). The estimations of D concur nicely with these of the new thickness (two percentage or much less distinction), which affirmed the appropriateness of the accomplished throwing and compaction method. Little chambers brought greater 28-day f zero c than substantial chambers via 7.7 to 19 percent, contingent upon the restoring class. The fourteen day air observed via fourteen day sodden restoring (2A2 M) approach yielded the most improved 28-day f zero c for each instance sizes, be that as it may, longer instances of moist relieving did not carry about greater qualities. Chambers from 1A3M, which had been introduced to the longest damp relieving, showcase the most minimal f zero c . Thermo gravimetric investigation (TGA) affirmed the patterns discovered in 28-day f zero c and proven (that) greater prolonged soggy restoring introduced about the loss of C-S-H and Ca(OH)₂. 2017 Chinese Society of Pavement Engineering.

Mahmoud Mazen Hilles, Mohammed M. Ziara^[9] Impacts of salt protected glass fiber (AR-GF) with one of a kind substance on the mechanical habits of excessive first-rate cement (HSC) have been explored on this examination. Solid blends have been set up with one-of-a-kind substance of AR-GF usually 0.3, 0.6, 0.9, and 1.2 through weight of concrete. The blends had been thrown and tried for compressive, parting pliable and flexural characteristics in grasp to ASTM norms. The check outcomes indicated that the characteristics increment as fiber fee increments till a restrict the compressive great extended from 57.85 to 66.6 MPa when fiber price accelerated from zero to 1.2 separately, the parting tension extended from 3.06 to 4.92 MPa when fiber price extended from zero to 1.2 individually,

and the flexural pleasant extended from 4.84 to 7.27 MPa when fiber price improved from zero to 1.2 separately. In examination with simple HSC manipulate examples that validated ruinous surprising disappointment, the improvement of splits that induced disappointment in the examples with AR-GF was once non-stop as the fiber fee increments. Subsequently it very properly might also be presumed that the nearness of filaments in HSC community has contributed in the direction of controlling surprising cut up association and alongside these strains enhancing stable malleability.

M.UmaMagesvari and V.L. Narasimha ^[10] This investigation provides the have an impact on of great whole and coarse whole quantities on the residences of pervious cement. Materials utilized are OPC Type I, satisfactory complete evaluating to evaluating II and 4 sizes of coarse whole specifically, 4.75mm to 9mm, 9mm to 12.5mm, 12.5mm to 16mm, 16mm to 19.5mm. Blends had been set up with the water concrete percentage of 0.34, concrete substance of 400kg/m³ and retaining up the complete concrete share as 4.75:1. Fine whole used to be supplanted with coarse complete in the scope of 50 - one hundred p.c via weight. Different mechanical homes of the blends had been assessed. Coefficient of penetrability was once managed by using utilizing falling head porousness strategy. The connection between the quality, scraped vicinity obstruction, porousness and all out void current in whole based on precision quantity has been created. Appropriateness of pervious concrete as an asphalt cloth is talked about.

3. PRELIMINARY INVESTIGATION

Cement

Concrete is a fine, darkish powder. It is blended in with water and materials, for example, sand, rock squashed stone to make a solid. The everyday concrete carries two essential fixings to be precise argillaceous and calcareous. In argillaceous materials, grime prevails and in calcareous substances calcium carbonate prevails. Customary Portland concrete of contrast – fifty three (KCP concrete) adjusting to Indian tips (IS: 12269- 1987) has been utilized in the present day investigation. The artificial and bodily residences of the Cement have been tried in accordance to the Seems to be: 4031-1985 and IS: 4031-1988 individually. OPC fifty three Grade concrete is required to alter to BIS dedication IS: 12269-1987 with a

structured exceptional for 28 days being at least fifty three MPa or 530 kg/cm².

Physical Properties of ordinary Portland cement.

S.NO	Characteristics	Values obtained	Values as per Is Code
1	Specific gravity of Cement	3.136	3.15
2	Fineness of cement	7.2%	10% residue on 90 microns sieve
3	Standard consistency	33%	Minimum 23% as per present code
4	Initial setting time	35	Not less than 30 minutes
5	Final setting time	330	Not greater than 600 minutes
6	Compressive strength of cement (MPa)	28.4	23
	3 days	36.9	37
	7 days 28 days	54.2	53
Brand of cement – OPC 53 grade (KCP)			
Result – The properties of the cement tested lie within the Indian standard limits and are considered to be of standard quality.			

Fine aggregate:

The material which passes through 4.75 mm sieve is termed as fine aggregate. Usually natural sand is used as fine aggregate at places where natural sand is not available crushed stone is used as fine aggregate. The sand used for the experimental works is locally procured and According to IS 383- 1970. It is conformed to grading zone II.

Physical Properties of Fine aggregates

S. No	Property	Test Results	Standard Limits	IS Standard Testing Code
1	Specific gravity (Fine aggregate) Zone II Sand	2.5019	> 2.5	IS 2386-1963 Part III
2	Fineness modulus of Fine aggregates	2.58	2.6-3.2 (Coarse Sand)	IS 2386-1963 Part III
3	Bulk Density in Fine aggregates	1.49	1.5 ~ 1.7	IS 2386-1963 Part III
4	Water absorption	0.47	(0.5- 1) %	IS 2386-1963 Part III
Type of Fine aggregates Natural river sand				-
Result – The properties of the fine aggregates tested lie within the Indian standard limits and are considered to be suitable for production of concrete since the properties come under ZONE II category				

Coarse aggregate

Aggregate which retained on 4.75 mm sieve and the broken stone is generally used as a Coarse aggregates. The nature of work decides the maximum size of the coarse aggregates. Locally available coarse aggregates having the maximum size 20 mm and minimum size 10 mm was used in the present work. Several laboratory testing will be carried out and compared to the standard requirements as per IS: 2386-1963 has grouped the test methods for aggregates into different parts.

Physical Properties of natural coarse aggregates

S.No	Property	Test Results	Permissible Limit	IS Standard Testing Code
1	Specific gravity	For 20mm-2.80 For 10mm-2.68	2.5 to 3.0	IS 2386-1963
2	Water Absorption	For 20 mm-0.3 For 10 mm-0.60	Not more than 0.6 %	IS 2386-1963
3	Bulk density (kg/m ³)	1738	1520 to 1680 kg/m ³	IS 2386-1963
4	Flakiness Index %	11.3%	Not more than 15 %	IS 2386-1963
5	Elongation Index	18.9%	Not more than 15 %	IS 2386-1963
6	Aggregate Impact Value	28.6%	Not more than 30%	IS 2386-1963
7	Aggregate Crushing Value	26.459%	Not more than 30%	IS 2386-1963
8	Fineness modulus	6.27	-	IS 2386-1963

Concrete Mix design

Mix design is a process of selecting suitable ingredients and determining their relative proportions with the objective of producing concrete of having certain minimum workability, strength and durability as economically as possible.

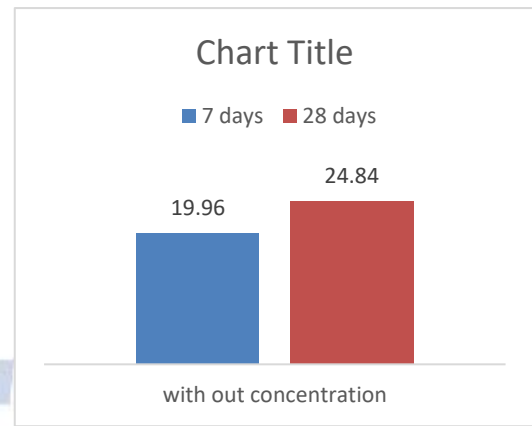
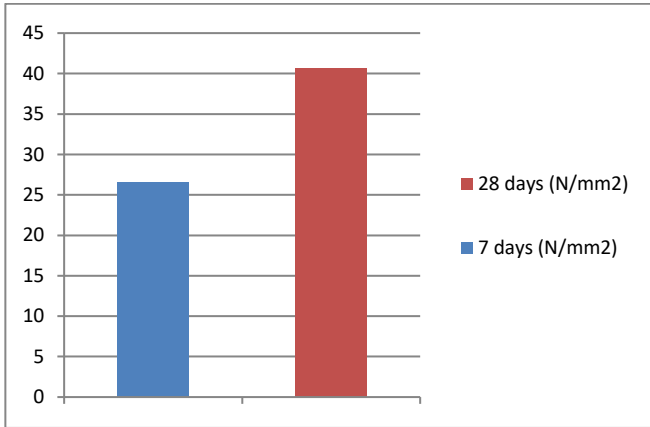
Grade designation	Cement (kg/m ³)	F.A (kg/m ³)	C.A (kg/m ³)	Water (kg/m ³)	W/c ratio	Target strength	Compressive strength (MPa)	
							7 days	28 days
M30	330	725	1242	148.5	0.45	38	26.3	38.27

4. RESULTS AND DISCUSSIONS

Compressive test results of Control Specimens

Sl.no	7 days (N/mm ²)	28 days (N/mm ²)
1	31.78	41.92
2	16.78	38.02
3	31.14	41.96
Average:	26.57	40.63

Compressive test results of Control Specimens

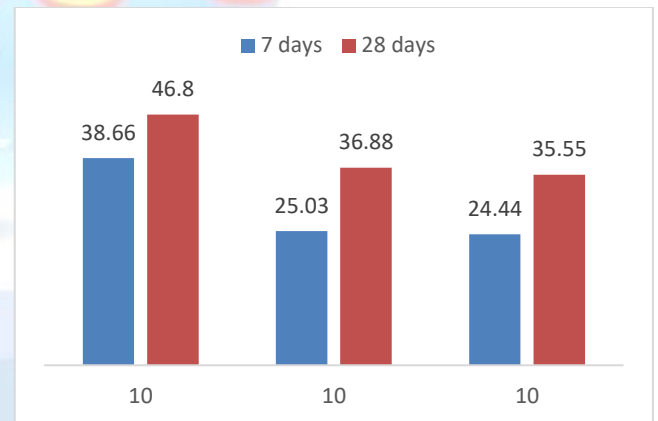
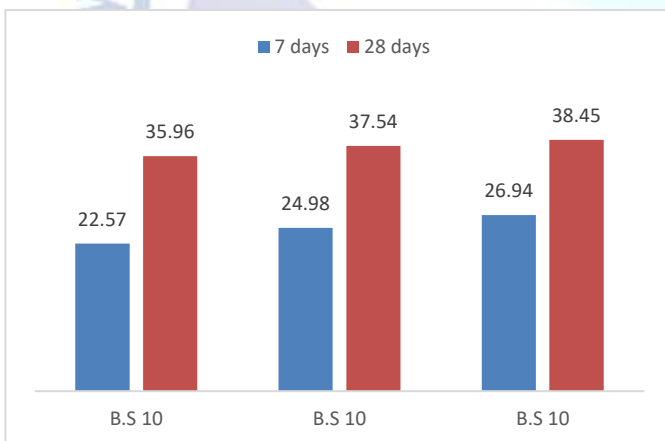


Compression test results of Bacillus Cereus with concentration

Sl No.	10 ⁴ Cells/ml (N/mm ²)		10 ⁵ Cells/ml (N/mm ²)		10 ⁶ Cells/ml (N/mm ²)	
	7 days	28 days	7 days	28 days	7 days	28 days
1	40.44	47.11	23.11	35.56	22.55	34.67
2	38.22	45.33	27.11	36.88	27.55	36.44
3	37.33	48	24.88	38.22	23.22	35.55
Average:	38.66	46.80	25.03	36.88	24.44	35.55

Compression test results of cylinders

Sl No.	B.S 10 ⁴ (N/mm ²)		B.S 10 ⁵ (N/mm ²)		B.S 10 ⁶ (N/mm ²)	
	7 days	28 days	7 days	28 days	7 days	28 days
1	18.25	35.45	23.35	34.46	32.78	36.54
2	26.31	33.23	24.82	40.92	17.88	38.46
3	23.14	39.21	26.76	37.23	30.15	40.34
Average:	22.57	35.96	24.98	37.54	26.94	38.45

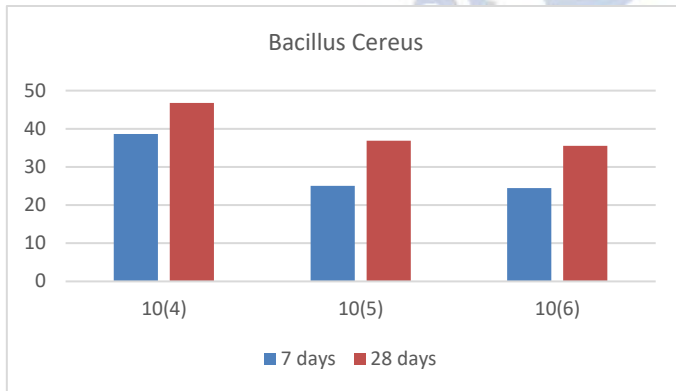
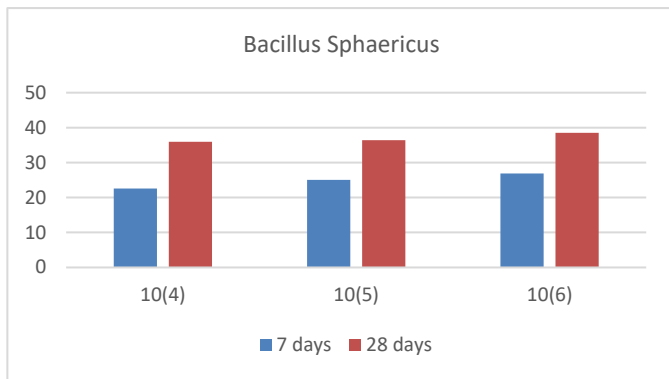


Compression test results Comparison between nominal mix and Bacillus Sphaericus and Bacillus Cereus

Sl No.	Nominal cubes of M40 grade	Bacillus Sphaericus			Bacillus Cereus		
		10 ⁴	10 ⁵	10 ⁶	10 ⁴	10 ⁵	10 ⁶
7 days	29.63	22.59	25.04	26.93	38.66	25.03	24.44
28 days	41.28	35.99	36.44	38.51	46.80	36.88	35.55

Compression test results of Bacillus Cereus without concentration

Sl No.	7 days (N/mm ²)	28 days (N/mm ²)
1	19.94	26.76
2	17.92	24.42
3	19.92	23.35
Average:	19.96	24.84



5. CONCLUSIONS

- Incorporating self-healing technology into concrete pavement style presents an answer for a few of the difficulties facing concrete.
- Currently offered self-healing road technologies are a unit paving the manner for the development of road style.
- Accessible technologies have incontestable their possible in repairing distressed concrete pavements. they provide nice opportunities for raised sturdiness and responsibility, reduced maintenance and lower overall price of concrete pavements.
- This includes a discount within the material resources required, as a result of the standard over-design of materials isn't any longer needed.
- The repair of AN concrete pavement is self-addressed in situ by its internal self-healing system at the terribly position of first look of injury, eliminating the requirement for classical unmoved maintenance processes.
- However, the key purpose of self-healing skill for concrete pavement style is that the expansion of a very good concrete pavement system, capable of self-assessment and automatic response

- Despite the progress created within the development of self-healing concrete technology, any work is needed to realize really good concrete pavements.
- The development of such areas of own healing skill for concrete pavements can really revolutionize concrete pavement style.
- This will result in another biological process step in construction and style and produce the concept of self-healing roads from science fiction to reality.
- The results given during this study show that the microorganism self-healing mechanism may be accustomed succeed the goal of concrete crack self-healing.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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