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# Effect of Percentage Seeding on Strength of High Strength Concrete

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***Abstract: Seeding is one of the techniques of producing high strength concrete. There is very few research done on effect of seeding on high strength concrete. Hence, it was decided that investigation on seeding effect should be carried out. The research describes the effect of various percentage of seeding by weight of cement (i.e. 2%, 4%, 6%, 8% and 10%) on the strength of high strength concrete of M50 grade. The seeding used in this research is the powder of partially hydrated cement mortar cubes of 3 days, 7days, 14 days, 21 days, 28 days age. The relatively small percentage of seeding i.e. 4% gives good result. Due to 4% seeding powder the increase in strength is 25.41% as compared to the strength of plain M50 concrete. The seeding powder of 14 days age gives good strength as compared to other ages seeding powder.***
***Keywords: Seeding Technique, High strength Concrete, M50 Grade, Seeding powder etc.***

## I. INTRODUCTION

High-Strength Concrete (HSC) has attracted more attention from structural and civil engineers during the past few years. The life cycle cost-performance ratio and outstanding engineering qualities of this relatively new construction material, such as higher compressive and tensile strengths, higher stiffness, and better durability when compared to the conventional Normal Strength Concrete (NSC), can both be used to explain some of the growth in its commercial use. From a historical perspective, high-strength concrete was regarded in the middle of the 20th century as having a typical strength of 25 MPa. For instance, in the 1950s, concrete made with a compressive strength of 30 MPa was considered to be of excellent strength. Concretes that had compressive strengths of 40–50 MPa in the 1960s, 60–70 MPa in the 1970s, and 100–plus MPa in the 1980s gradually advanced and were employed in real constructions. Despite the recent significant advancements in concrete technology, HSC continues to be defined as concrete having a compressive strength more than 40 to 60 MPa. In more recent times, cast-in-place structures have been employed with compressive strengths around 130 MPa. HSC was mostly specified for projects as a backup design about twenty years ago. However, HSC is now being defined as a practical option for concrete construction at the early design stage. Today, concretes with compressive strengths up to roughly 120MPa are commercially accessible, and strengths far higher than that can be generated in laboratories because to advancements in high strength concrete production technology. The numerous recent construction projects where high strength concrete has been employed successfully serve as evidence of the high strength concrete's great economic advantages.

## II. PROBLEM STATEMENTS

*1)* High Stability Concrete has a very low water to cement ratio, a higher binder content, and the ideal packing density to completely remove capillary pore and give an incredibly solid matrix.
*2)* It is a high strength material made of a unique mixture of Portland cement, admixtures, fine aggregate, coarse aggregate, high-range water reducer (i.e. SP), and water as constituent ingredients.One method for creating high-strength concrete is seeding. In order to create a concrete mixture with a high strength, a little amount of finely crushed, fully or partially hydrated Portland cement is added.

## III. RESEARCH METHODOLOGY

Making high performance concrete with a 50 MPa grade and replacing 2–10% (i.e., 2%, 4%, 6%, 8%, and 10%) of the cement with seeding powder constitutes the experimental inquiry. The setup entails gathering the necessary supplies, casting the mortar cube, curing it, making cement powder from the mortar cube, casting the plain concrete cubes, casting the plain concrete cubes with seeding powder, curing the plain concrete cubes with and without seeding powder, and testing the plain concrete cubes for the strength investigation. As demonstrated in fig.1, the approach for this investigation is presented as a flow chart.

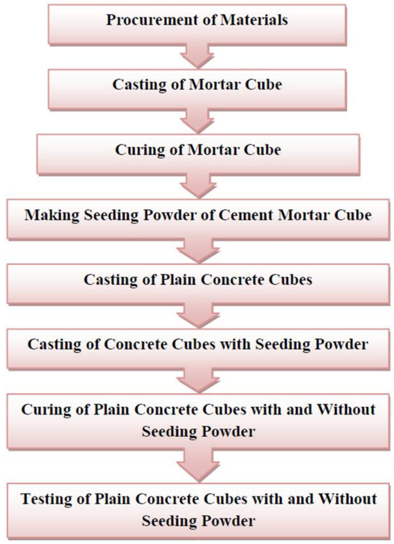



Fig. 1 : Flowchart

### A. *Procurement of Materials*

The project team purchases the materials from the market. The project requires the usage of cement, sand, and aggregate. Sand that passes through an IS sieve measuring 2.36 mm and regular Portland cement of grade M53 are purchased. The aggregate is divided into two parts: 50% of the aggregate retained on an IS sieve that is 12 mm and 16 mm wide, and 50% of the aggregate that is less than 12 mm but greater than 4,75 micron wide.

### B. *Casting of Mortar Cube*

1) Sand and one part cement.
2) Next, determine how much water is needed for this ratio in accordance with ASTM guidelines.
3) To prevent damage to the cubes during mould removal, take 10cm x 10cm x 10cm cube moulds and properly clean them from the inside out. You should also fix the cubes firmly so that compression is simple.
4) Next, combine all of the dry ingredients thoroughly. Carefully add water to create a paste.
5) After that, add mortar to the mould and compact it with a meddling rod with a 5/8-inch round end.
6) Prepare a batch of 20 cubes every 3, 7, 14, 21, or 28 days.
7) After that, condense it on a vibrator.
8) After that, leave it outside for one day, and then treat them for a total of 3, 7, 14, 21, and 28 days.

### C. *Curing of Mortar Cube*

Following the addition of water to the dry ingredients, the formed cement mortar cubes are kept unchanged for 24 hours in a room at a temperature of 27 °C and an atmosphere with at least 90% relative humidity.

The cement mortar cubes are removed from the moulds for curing after 24 hours. In the curing tank, the cement mortar cubes are dried. After removing cubes from the moulds, they are immediately immersed in clean, fresh water for curing and held there for a predetermined amount of time before being removed for testing.

### D. *Making Seeding Powder of Cement Mortar Cube*

1) Curing cement mortar cubes were removed from the curing tank after 3, 7, 14, 21, and 28 days and left to dry for 20 to 30 minutes.
2) Next, we used a hammer to smash the cubes so that we could quickly crush them in the loss angles abrasion machine.
3) Next, the crushed cubes were fed into an abrasion testing device to create seeding powder for 3, 7, 14, 21, and 28 days.
4) After that, the material was removed from the machine.
5) Crushed material was put through a 300 micron IS filter to create powder.

### *E. Casting of Plain Concrete Cubes*

1) Create a plain M50 grade concrete mixture.
2) The mix design provides an explanation of the mix and water cement ratio as well as the super plasticizer dosage.
3) To prevent damage to the cubes during mould removal, take 10cm x 10cm x 10cm cube moulds and properly clean them from the inside out. You should also fix the cubes firmly so that compression is simple.
4) Create a uniform mixture of the dry ingredients next, and carefully add water to create a paste.
5) After that, pour concrete into the mould and compact it with a 5/8-inch, round-ended tampering rod.
6) Make 9 cubes in advance for the 3, 7, and 28-day compressive tests.
7) Make 9 cubes in advance for the 3, 7, and 28-day compressive tests.
8) After that, condense it on a vibrator.
9) Then, treat them for a total of 3, 7, or 28 days by keeping them outside for one day.

### *F. Casting of Concrete Cubes with Seeding Powder*

1) Create a plain concrete mixture for M50 grade using seeding powder.
2) The mix design provides an explanation of the mix and water cement ratio as well as the super plasticizer dosage.
3) Replace 2, 4, and 6, 8, 10 percent of the cement with seeding powder every 3, 7, 28 days.
4) To prevent damage to the cubes during mould removal, take 10cm x 10cm x 10cm cube moulds and properly clean them from the inside out. You should also fix the cubes firmly so that compression is simple.
5) Next, combine all of the dry ingredients thoroughly. Carefully add water to create a paste.
6) After that, pour concrete into the mould and tamp it down with a 5/8-inch, round-ended tamping rod.
7) Prepare each of the nine cubes for testing at 3, 7, and 28 days.
8) After that, condense it on a vibrator.
9) Next, cure them for a total of 3, 7, or 28 days by placing them in the open air for one day.

### *G. Curing of Plain Concrete Cubes with and without Seeding Powder*

The prepared simple concrete cubes are kept unchanged for 24 hours after the addition of water to the dry materials in a room at a temperature of 27 °C and an atmosphere with at least 90% relative humidity.
The plain concrete cubes are removed from the moulds for curing after 24 hours. The curing tank is used to cure the plain concrete cubes. After removing cubes from the moulds, they are immediately immersed in clean, fresh water for curing and held there for a predetermined amount of time before being removed for testing.

### *H. Testing of Plain Concrete Cubes with and without Seeding Powder*

Compressive Strength Test
This is the most crucial test that was conducted on the concrete and provides information on all of its properties. One can determine whether concrete pouring was done correctly or not by using this one test. Depending on the size of the aggregate, cubes measuring 10 cm X 10 cm X 10 cm are utilised as cube test specimens. This concrete is appropriately poured into the mould and tempered to prevent any voids.
These moulds are removed after 24 hours, and test specimens are then submerged in water to cure. These specimens' top surfaces ought to be level and smooth. This is accomplished by applying cement paste and evenly spreading it across the entire specimen surface.
After 3, 7, and 28 days of curing, these specimens are evaluated using a compression testing equipment. Until the specimens fail, a load should be applied gradually at a rate of 140 kg/cm2 per minute. Concrete's compressive strength is calculated by dividing the load at failure by the area of the specimen.
On a compression testing machine with a 3000 kN capacity, the compressive loading tests on concrete were performed. According to IS 516-1959, a loading rate of 2.5 kN/s was used for the compressive strength test. A 100mm cube served as the test object. Tests were conducted after 3, 7, and 28 days. The samples were evaluated right away after the cubes were removed from the curing tank in a wet condition.

Fig. 2 : Compressive Testing Machine

## IV. RESULTS AND DISCUSSION

### *A. Compressive Strength of Plain M50 Concrete*

Table 1 shows the compressive strength result for M50 concrete.

Table 1 : Compressive Strength of plain M50 concrete with

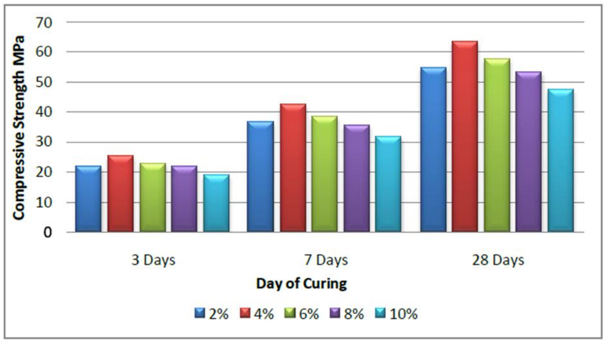
| Age | Compressive Strength (MPa) | | | Average |
|---|---|---|---|---|
| | Cube 1 | Cube 2 | Cube 3 | |
| 3 days | 18.48 | 25.09 | 23.03 | 22.20 |
| 7 days | 35.16 | 36.48 | 40.11 | 37.25 |
| 28 days | 55.93 | 54.13 | 56.50 | 55.52 |

### *B. Compressive Strength of M50 Concrete with S3 Seeding Powder*

The compressive strength of M50 concrete containing S3 seeding powder is displayed in Table 2 and Graph 1. It is evident from the graph that cement replacement with 4% seeding S3 powder exhibits greater strength after 3 days, 7 days, and 28 days. From 2% seeding to 4% sowing, the strength progressively increases. From 4% seeding to 10% seeding, the strength gradually declines.

Table 2 : Compressive Strength of M50 Concrete with S3 Seeding Powder.

| Seeding Percentage | Age | Compressive Strength (MPa) | | | Average |
|---|---|---|---|---|---|
| | | Cube 1 | Cube 2 | Cube 3 | |
| 2% | 3 days | 20.10 | 23.22 | 22.17 | 21.83 |
| | 7 days | 36.65 | 35.82 | 37.27 | 36.58 |
| | 28 days | 54.35 | 54.15 | 55.32 | 54.60 |
| 4% | 3 days | 24.32 | 27.53 | 24.21 | 25.35 |
| | 7 days | 42.72 | 45.78 | 38.75 | 42.42 |
| | 28 days | 63.84 | 62.12 | 64.11 | 63.35 |
| 6% | 3 days | 22.42 | 24.23 | 22.17 | 22.94 |
| | 7 days | 35.40 | 38.63 | 41.23 | 38.42 |
| | 28 days | 57.43 | 58.05 | 56.75 | 57.41 |
| 8% | 3 days | 23.53 | 20.21 | 20.10 | 21.28 |
| | 7 days | 36.66 | 35.23 | 35.06 | 35.65 |
| | 28 days | 53.35 | 54.10 | 52.35 | 53.27 |
| 10% | 3 days | 18.76 | 20.21 | 17.79 | 18.92 |
| | 7 days | 29.14 | 32.64 | 33.32 | 31.70 |
| | 28 days | 47.65 | 48.05 | 46.42 | 47.37 |



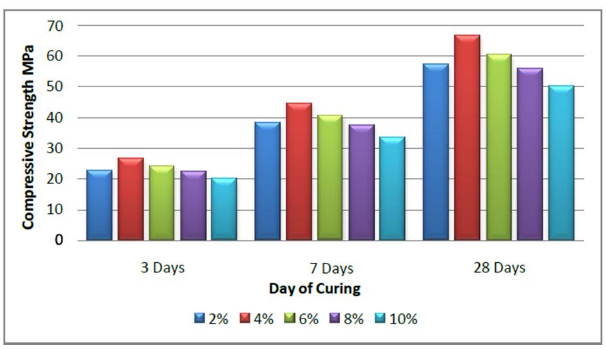

Graph 1 : S3 Seeding Powder compressive strength

### C. *Compressive Strength of M50 Concrete with S7 Seeding Powder*

The compressive strength of M50 concrete with S7 seeding powder is displayed in Table 3 and Graph 2 respectively. The outcomes of S7 seeding powder follow the same pattern. Concrete containing S7 seeding powder has more strength than Concrete strength using S3 seeding powder.

Table 3 : Compressive Strength of M50 concrete with S7 seeding powder

| Seeding Percentage | Age | Compressive Strength (MPa) | | | Average |
|---|---|---|---|---|---|
| | | Cube 1 | Cube 2 | Cube 3 | |
| 2% | 3 days | 23.76 | 23.35 | 21.51 | 22.87 |
| | 7 days | 38.23 | 39.10 | 36.97 | 38.10 |
| | 28 days | 57.35 | 56.13 | 58.15 | 57.21 |
| 4% | 3 days | 28.16 | 25.35 | 26.35 | 26.62 |
| | 7 days | 43.25 | 46.88 | 43.82 | 44.65 |
| | 28 days | 66.73 | 67.27 | 65.84 | 66.61 |
| 6% | 3 days | 25.36 | 26.10 | 21.20 | 24.22 |
| | 7 days | 39.74 | 41.70 | 39.82 | 40.42 |
| | 28 days | 60.49 | 59.22 | 61.58 | 60.43 |
| 8% | 3 days | 24.72 | 21.68 | 20.86 | 22.42 |
| | 7 days | 38.40 | 35.20 | 39.27 | 37.59 |
| | 28 days | 56.77 | 55.80 | 55.76 | 56.11 |
| 10% | 3 days | 22.24 | 19.28 | 18.76 | 20.09 |
| | 7 days | 37.78 | 35.95 | 29.73 | 33.49 |
| | 28 days | 50.33 | 49.33 | 51.01 | 50.22 |



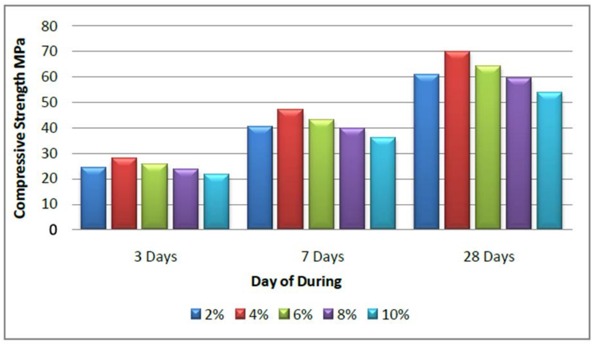

Graph 2 : S7 Seeding Powder Compressive Strength

### D. *Compressive Strength of M50 Concrete With S14 Seeding Powder*

The compressive strength of M50 concrete with S14 seeding powder is displayed in Table 4 and Graph 3 respectively. Among S3, S7, S14, S21, and S28, M50 concrete containing S14 seeding powder had the maximum compressive strength.

Table 4 : Compressive Strength of M50 concrete with S14 seeding powder

| Seeding Percentage | Age | Compressive Strength (MPa) | | | Average |
|---|---|---|---|---|---|
| | | Cube 1 | Cube 2 | Cube 3 | |
| 2% | 3 days | 25.12 | 24.42 | 23.24 | 24.26 |
| | 7 days | 39.11 | 40.45 | 41.10 | 40.22 |
| | 28 days | 60.15 | 61.25 | 59.99 | 60.46 |
| 4% | 3 days | 27.78 | 29.56 | 26.10 | 27.81 |
| | 7 days | 46.58 | 47.82 | 45.55 | 46.65 |
| | 28 days | 69.34 | 68.94 | 70.61 | 69.63 |
| 6% | 3 days | 24.23 | 24.89 | 24.23 | 25.47 |
| | 7 days | 43.36 | 41.66 | 43.38 | 42.80 |
| | 28 days | 62.99 | 61.86 | 63.77 | 63.87 |
| 8% | 3 days | 24.72 | 22.66 | 23.56 | 23.64 |
| | 7 days | 40.55 | 40.63 | 37.89 | 39.69 |
| | 28 days | 59.59 | 59.43 | 58.46 | 59.16 |
| 10% | 3 days | 23.32 | 20.25 | 20.79 | 21.45 |
| | 7 days | 35.31 | 36.75 | 35.64 | 35.90 |
| | 28 days | 53.53 | 52.86 | 53.11 | 53.50 |



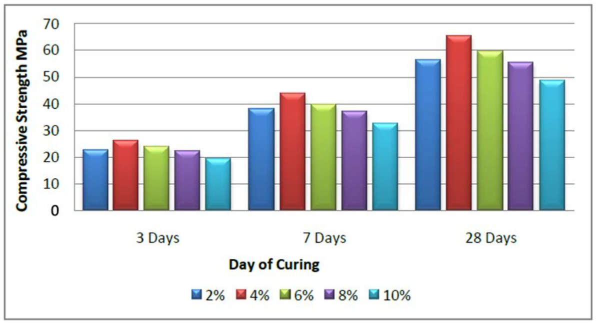

Graph 3 : S14 Seeding Powder Compressive Strength

### *E. Compressive Strength of M50 Concrete with S21 Seeding Powder*

The compressive strength of M50 concrete with S14 seeding powder is displayed in Table 5 and Graph 4 respectively. Compared to concrete with S14 seeding powder, concrete with S21 seeding powder has a lower compressive strength.

Table 5 : Compressive Strength of M50 concrete with S21 seeding powder

| Seeding Percentage | Age | Compressive Strength (mpa) | | | Average |
|---|---|---|---|---|---|
| | | Cube 1 | Cube 2 | Cube 3 | |
| 2% | 3 days | 23.62 | 22.86 | 21.35 | 22.61 |
| | 7 days | 37.88 | 38.55 | 37.24 | 37.89 |
| | 28 days | 56.56 | 57.13 | 55.99 | 56.56 |
| 4% | 3 days | 24.93 | 28.18 | 25.43 | 26.18 |
| | 7 days | 46.57 | 42.52 | 42.76 | 43.95 |
| | 28 days | 65.81 | 66.56 | 64.17 | 65.51 |
| 6% | 3 days | 26.72 | 22.83 | 21.88 | 23.81 |
| | 7 days | 38.51 | 38.52 | 41.50 | 39.51 |
| | 28 days | 59.81 | 58.96 | 59.85 | 59.54 |
| 8% | 3 days | 24.12 | 21.23 | 21.12 | 22.15 |
| | 7 days | 38.10 | 37.15 | 36.03 | 37.09 |
| | 28 days | 55.41 | 54.87 | 55.58 | 55.28 |
| 10% | 3 days | 17.23 | 20.14 | 21.07 | 19.48 |
| | 7 days | 32.56 | 31.69 | 33.25 | 32.50 |
| | 28 days | 48.89 | 49.10 | 47.55 | 48.55 |



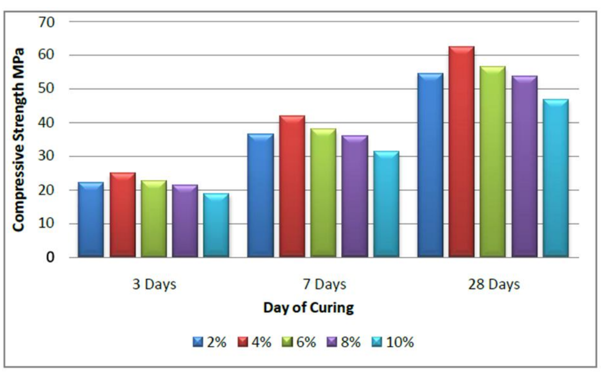

Graph 4 : S21 Seeding Powder Compressive Strength

### *F. Compressive Strength of M50 Concrete with S28 Seeding Powder*

The compressive strength of M50 concrete with S28 seeding powder is displayed in Table 6 and Graph 5 respectively. When compared to S3, S7, S14, S21, and S28 seeding powder, the compressive strength of concrete using S28 seeding powder is lower. After 28 days, the cement gets fully hydrated, and its strength decreases.

Table 6 Compressive Strength of M50 concrete with S28 seeding powder

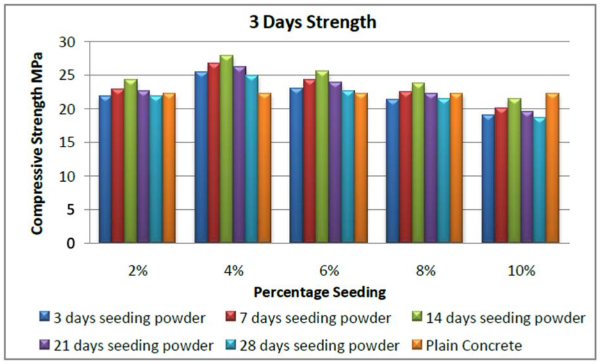
| Seeding Percentage | Age | Compressive Strength (MPa) | | | Average |
|---|---|---|---|---|---|
| | | Cube 1 | Cube 2 | Cube 3 | |
| 2% | 3 days | 21.87 | 22.65 | 20.70 | 21.74 |
| | 7 days | 36.58 | 35.89 | 36.70 | 36.39 |
| | 28 days | 54.41 | 55.23 | 54.15 | 54.41 |
| 4% | 3 days | 27.64 | 23.98 | 23.05 | 24.89 |
| | 7 days | 42.33 | 40.89 | 41.88 | 41.70 |
| | 28 days | 62.55 | 63.24 | 61.09 | 62.29 |
| 6% | 3 days | 24.32 | 21.96 | 21.31 | 22.53 |
| | 7 days | 36.10 | 39.12 | 38.00 | 37.74 |
| | 28 days | 56.48 | 55.43 | 57.24 | 56.38 |
| 8% | 3 days | 23.58 | 20.86 | 19.64 | 21.36 |
| | 7 days | 36.52 | 34.23 | 36.59 | 35.78 |
| | 28 days | 52.71 | 54.68 | 53.02 | 53.47 |
| 10% | 3 days | 18.71 | 17.78 | 19.34 | 18.61 |
| | 7 days | 29.67 | 30.75 | 33.12 | 31.18 |
| | 28 days | 45.33 | 46.57 | 47.87 | 46.59 |



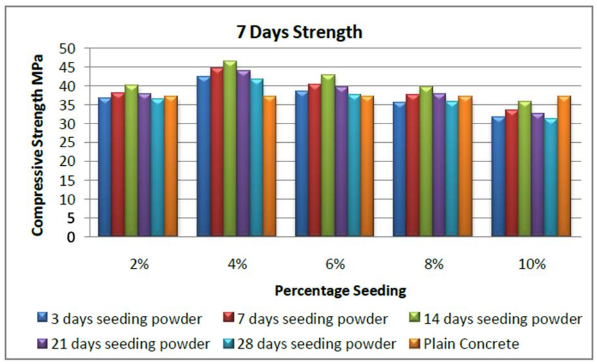

Graph 5 : S28 Seeding Powder Compressive Strength

### *G. Comparison of Plain M50 Concrete and M50 Concrete with Seeding*

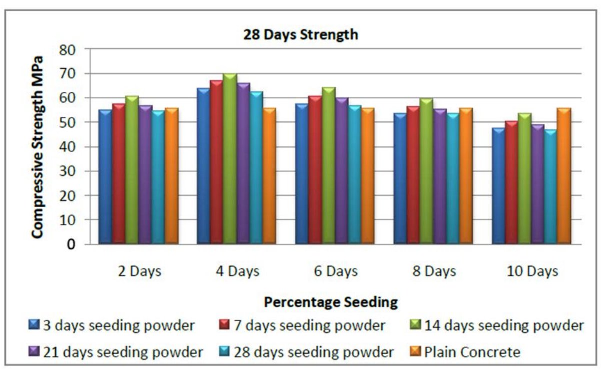
The compressive strength of plain and seeded concrete is depicted at 3, 7, and 28 days, respectively, in graphs 6.6, 6.7, and 6.8. When compared to ordinary concrete, every seeded concrete, including concrete with S3, S7, S14, S21, and S28, has higher strength thanks to the 4% seeding. Strength increases by 25.41% at 4% seeding compared to ordinary concrete.



Graph 6 : 3 Days Strength



Graph 7 : 7 Days Strength



Graph 8 : 28 Days Strength

## V. CONCLUSION

There is very few research done on effect of seeding Research on the impact of seeding on high strength concrete is few. Consequently, it was decided to conduct an inquiry into the seeding effect. The study describes the impact of different seeding percentages by cement weight. Today, concretes with compressive strengths up to roughly 120MPa are commercially accessible, and strengths far higher than that can be generated in laboratories because to advancements in high strength concrete production technology. The several recent building projects where HSC has been effectively employed are evidence of the enormous economic benefits of HSC, which are extensively established.

1) The rate of hydration is accelerated by adding a relatively modest amount of seeding powder to the high strength concrete.
2) The 14 days seeding powder has the highest strength among the seeding powders for 3 days, 7 days, 14 days, 21 days, and 28 days.
3) Specimens with 4% seeding powder replacement in place of cement exhibit higher strength results, but after that point (6%, 8%, 10%), the strength continues to decline.
4) As a result of the results above, it is best to replace cement with 4% seeding powder.

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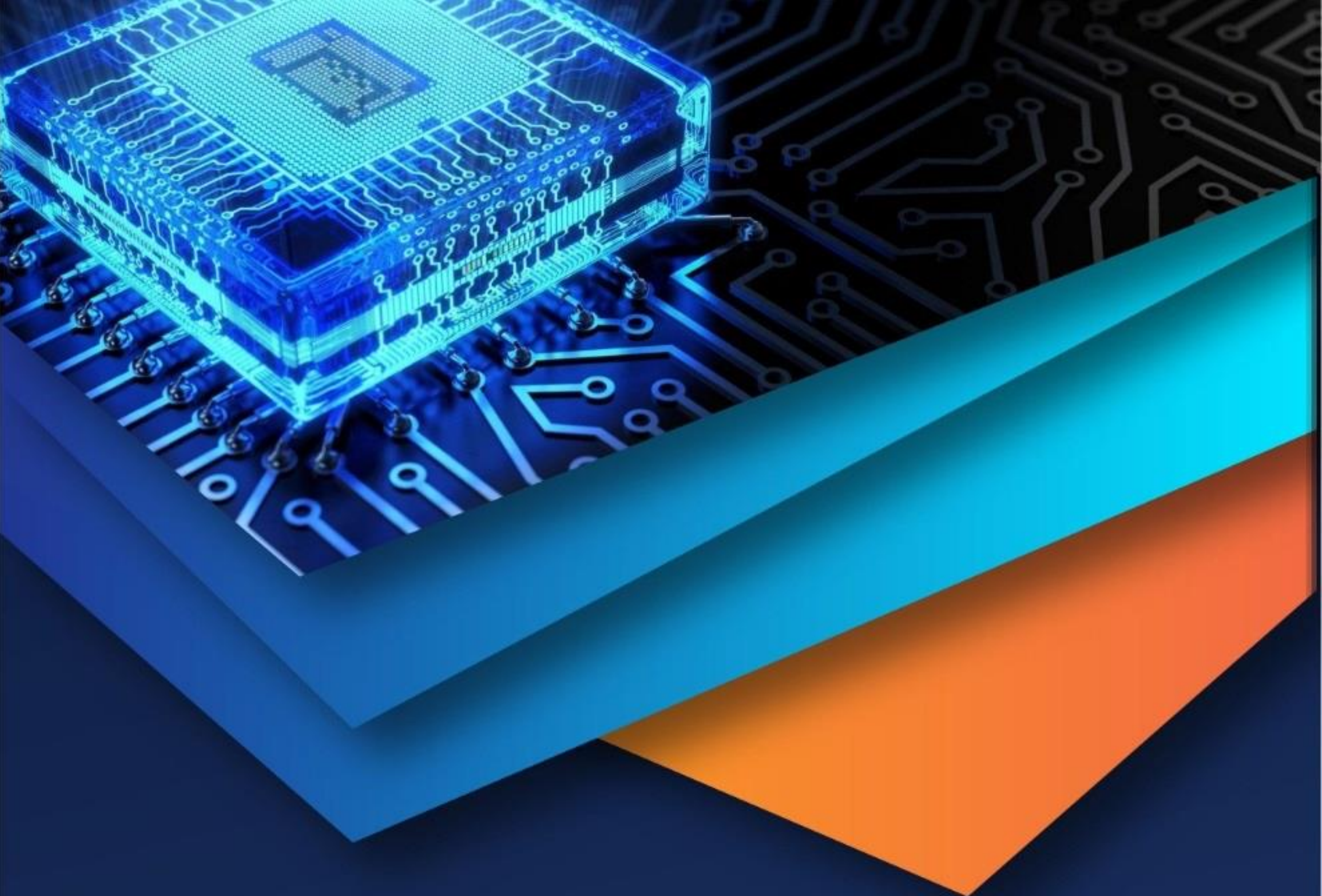


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