A STUDY ON STRENGTH AND STRESS STRAIN BEHAVIOUR OF SELF CURING CONCRETE

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Abstract: ***Curing cement is the process of retaining moisture in the concrete throughout its early stages, notably during the first 28 days after placement, in order to achieve the desired qualities. Relieving concrete has a significant role in the formation of the solid microstructure and pore structure. When compared to conventional cement, the goal of self-relieving is to reduce water dissipation from concrete and therefore increase the solid's water maintenance limit. Without a doubt, ill-advised restoration may degrade the quality of cement. It has been established that using water-dissolvable polymers as admixtures in solids has an influence on the qualitative features of solid relieving of cement. Solid relieving of cement plays a significant role in building up the solid small-scale structure, which improves its solidness and execution.As an inner restoring specialist, super absorbent polymer (SAP) is used.***

SAP is a collection of polymeric materials that can soak up and absorb a lot of water from their surroundings while also holding the water in their structure without causing it to dissolve. In this study, M20, M30, and M40 self-restoring concrete assessments with blending SAP0.2, 0.40, 0.6, 0.80, and 1.0 rates were used in this study.When SAP is used in self-restoring concrete, the compressive strength is not compromised. When SAP is used in self-curing concrete, the split elasticity is not reduced. The SAP can be used on the bond weight up to 0.6 percent without compromising the distinct cement quality.

Keywords: concrete, curing, evaporation, water solublepolymers, Superabsorbent polymer (SAP), self-curing concrete

I. INTRODUCTION

It is essential to guarantee that concrete buildings get proper treatment in order to achieve the necessary performance and stability criteria. In traditional construction, it is accomplished by the use of an exterior treatment following the mixing, maintenance, and finishing processes. This extremely promising technology, which may give more moisture in concrete for more efficient hydration of cement and self-destructing, has the potential to supply additional moisture in concrete. A specific treatment agent that will supply more moisture must be initiated as part of the internal treatment process. For the time being, the interior treatment of concrete may be accomplished using one of two primary approaches. A saturated light aggregate porous for the delivery of an internal water source (Eldblue) is used in the first technique, and the water that is lost by chemical contraction while the cement is being hydrated may be replaced by the water in the second way. Using superabsorbent polymers (SAP), the second way may be used since these particles in concrete can absorb significant amounts of water during mixing and can result in enormous amounts of free water holding big signals, which is also true during the hydration of cement. Stop the extinction of a species.The internal curing agent must have a high water absorption capacity as well as a high rate of water absorption in order to provide optimal performance.

This combination is formed when the availability of extra internal water cement is not included in the water. "

The traditional method of treating concrete that has not been lost from the surface of the water in such situations is believed to be the best method of treating concrete "from the inside out." In contrast, "internal curing deposits" (fine light saturated consolidation, superabsorbent polymers, or saturated wood fibres) are commonly referred to as "internal cure" or "self-healing."

A. Need For Self-Curing Concrete

1. It is possible that mineral additions will react entirely with the mixed cement system, resulting in a water demand (either external or internal) that is substantially larger than that of standard portland cement concrete. It is possible that this water will not be accessible, which will result in capillary porosity and cracking owing to the water pile (at an early age).
2. Internal treatment is the method by which cement hydration occurs as a result of the availability of extra internal water that is not included in the mixture water.
3. Extra water that is supplied in a relatively small amount using the correct total or polymer
4. the use of autopolymerization additives is very important from this point of view that water resources become more valuable on concrete basis for waterrequirements.

B. Scope And Objective

1. The investigation is aimed to evaluate the behavior of Self curing concrete by using Super Absorbent Polymer from 0% -1.0% on weight of cement.
2. The following tests are aimed to study the behaviour of Self curing concrete for M20, M30and M40 Mix grades of Concrete.
3. Compressive Strength.
4. Split Tensile Strength.
5. Stress-Strain behaviour.

Table 1 Mix Proportions

Water	Cement	FA	CA
180.42	360	584	1223.8
0.50	1.00	1.62	3.40

II. CONCRETE MIX DESIGN

Solid blend configuration is the way toward discovering right extents of bond, sand and totals for cement to accomplish target quality in structures. Thus, solid blend configuration can be expressed as Concrete Mix = Cement: Sand: Aggregates.

2.1 Concrete Mix Design – M 20 Grade Of Concrete:

REQUIREMENTS

a) Specified minimum strength = 20 N/Sq mm

b) Durability requirements

i) Exposure Moderate

ii) Minimum Cement Content = 300 Kgs/cum

c) Cement

(Refer Table No. 5 of IS:456-2000)

i) Make Chetak (Birla)

ii) Type OPC

iii) Grade 43

d) Workability

i) compacting factor = 0.7

e) Degree of quality control Good

TEST DATA FOR MATERIALS SUPPLIED

a) CEMENT

i) Specific gravity = 3.05

ii) Avg. comp. strength 7 days = 46.5 more than 33.0 OK28 days = 55.0 more than 43.0 OK

b) COARSE AGGREGATE

i) 20mm Graded

Type Crushed stone aggregateSpecific gravity = 2.68

Water absorption = 1.46 Free (surface) moisture = 0

c) FINE AGGREGATE (Coarse sand)

i) Type Natural (Ghaggar)

ii) Specific gravity = 2.60

iii) Water absorption = 0.50

iv) Free (surface) moisture = 1.40

A. Mix Design M30 grade

MIX PROPORTIONS

Cement = 288 kg/m3

GGBS = 72 kg/m3 (20% By Total weight of Cement)

Water = 158 l/m3
Fine aggregate= 798 kg/m3
Coarse aggregate 20mm = 882 kg/m3
12mm = 223 kg/m3 (20% By Total weight of Coarse Aggregate)
Chemical admixture = 1.34 kg/m3 (0.4% by the weight of cement)
Density of concrete = 2430 kg/m3
Water-cement ratio = 0.47

Mix Proportion By weight = 1:2.21:3.09

B.Mix Design M40 Grade

Cement = 400 kg

Water = 160 kg

Fine aggregate = 660 kg

Coarse aggregate 20 mm = 701 kg

Coarse aggregate 10 mm = 467 kg
Admixture = 0.6 % by weight of cement
= 2.4 kg.
Recron 3S = 900 gm
Water: cement: F.A.: C.A. = 0.4: 1: 1.65: 2.92

III.EXPERIMENTAL INVESTIGATION

The exploratory program was intended to examine the quality of Self Curing of Concrete utilizing Super Absorbent Polymer (SAP)in Natural Aggregate for the review M20, M30, M40 on compressive quality, and there push strain conduct. The program comprised of throwing and testing an aggregate number of 54 solid shapes (12 for each review) of size 150 X 150 X 150mm,54 chambers (18 for each review) of size 150x300mm. Of these 54 3D shapes and 54 cylinders,63D squares and 6 barrels relate to typical restoring concrete with 0% of SAP, 6cubes and 6 chambers compare to self relieving concrete with 0.2% of SAP, 6 3D shapes and 6 chambers relate to self restoring concrete with 0.4% of SAP , 6 3D squares and 6 chambers compare to self restoring concrete with 0.6% of SAP, 6 3D shapes and 6 chambers compare to self-restoring concrete with 0.8% of SAP,6 3D squares and 6 barrels compare to self-relieving concrete with 1.0% of SAP. Every one of the 54 solid shapes and 104 barrels compare to relieving for28days quality.

A. Cement

Ordinary Portland cement of grade-53 (source JAYPEE cement) conforming to Indian standards IS: 12269-1987 has been used in the present study.

Table 2 Properties of Cement

S.NO	Characteristics	IS-specifications (IS:12269-1987)	Test results	Remarks
1	Standard consistency		32%	
2	Setting time in minutes i. Initial setting time ii.Final setting time	 >30 <600	 112 240	 Satisfactory Satisfactory
3	Specific gravity	3.15	3.12	

B. Fine Aggregate

Locally accessible sand has been utilized as fine total. The molecule estimate conveyance and properties are given in table 3. other remote issues present in the sand has been isolated before utilize.

Table 3 Properties of Fine Aggregate

S.no	Characteristics	Test results
1.	specific gravity	2.56
2.	Fineness modulus	2.15
3.	Zone of Sand	II

C. Coarse Aggregate

Locally accessible squashed stone total of most extreme size 20 mm has been utilized. The properties are recorded in table 4. coarse total has been sieved through IS: 150-micron sifter to expel earth and other outside materials.

Table 4 Coarse Aggregate

S.no	Characteristics	Test results
1	specific gravity	2.61
2	Maximum size	10 &20mm
3	Fineness modulus	6.8

D. Water

As indicated by IS: 456-2000, water for cement ought to be of convenient quality (PH-6.8 to 8.0).

standard faucet water, which is fit for drinking has used in setting up all solid blends and relieving in this examination.

E. Super plasticizer complast SP-430

Chemical Admixture is used to diminish the frictional properties of Concrete. It is normally accessible sulphonatednapthalene formaldehyde based super plasticizer Used to improve the functionality of the solid.

F. Super Absorbent Polymer

Super Absorbent Polymer: Super Absorbent polymer is a swelling high atomic polymer containing solid hydrophilic polymer gatherings, for example, carboxy, hydroxyle et cetera and certain level of cross linked .SAP Possessed all focal points of high sub-atomic materials and polymers that can assimilate and retain extremely expansive measure of fluid relative their own particular mass and can ingest up to 500 times of its own weight of unadulterated water and discharge the consumed water under strain

Table 5 SAP

Super Absorbent Polymer	
Form	Crystalline powder
Residual Manometer	300PPM
PH Value	6.4
Density	0.61g/Cm3
Absorption rate	0.9% of Nacl .30°C at 1 Min
Whiteness	75%
Liqiud Permeability	30ml/min

IV.RESULTS AND DISCUSSIONS

A. Slump cone test

Droop test is utilized to decide the usefulness of new concrete. Droop test according to Seems to be: 1199 – 1959 is taken after. The mechanical assembly utilized for doing droop test are droop cone and packing rod. The results are appeared in Table 6.for different % of SAP for various blends M20, M30 and M40 review concrete. The results are graphically appeared infor different % of SAP for various blends M20,M30 and M40 review concrete.

Table 6 Slump cone test

S No	Percentage of SAP	Slump in MM		
		M20	M30	M40
1	Plain	118	107	96
2	0.2%	109	106	93
3	0.4%	120	113	104
4	0.6%	124	118	108
5	0.8%	121	110	103
6	1.0%	117	107	92

B. Compaction Factor Test

Compacting element of crisp cement is done to decide the usefulness of new cement by compacting factor test according to Seems to be: 1199 – 1959. The contraption utilized is Compacting factor mechanical assembly. The points of interest test results are specified in Table 5.2.for Various % of SAP of Self restoring concrete for various blends M20, M30 and M40 grades. The results are graphically appeared

Functionality test demonstrates that the expansion in up to 0.60% super permeable polymer gives better usefulness.

Table 7 compaction factor test

S No	Percentage of SAP	Compaction Factor		
		M20	M30	M40
1	Plain	0.90	0.93	0.87
2	0.2%	0.93	0.87	0.91
3	0.4%	0.85	0.84	0.85
4	0.6%	0.91	0.86	0.86
5	0.8%	0.85	0.81	0.81
6	1.0%	0.83	0.81	0.79

C. Compressive Strength

The compressive quality of self-relieving concrete has been estimated by pressure test according to May be: 516-1959. The compressive quality for plain concrete and cement blended with Super Absorbent polymer from 0%-1.0% have been condensed in table 4.1. The outcomes are appeared in Table 8 for M20 review concrete for various % of SAP included Self restoring concrete. The results graphically Shown in 1, for M20 review concrete for different % of SAP included Self relieving concrete.

There is increment of compressive quality for increment of 0.6% level of SAP and lessening of quality from 0.6% to 1.0%. The quality is expanded for including SAP without relieving than the traditional restoring concrete.

Table 8 M-20 Grade Concrete 28 days curing

S.no	Type of Concrete	Compressive strength Mpa
1	Plain	22.50
2	0.2%	23.33
3	0.4%	23.77
4	0.6%	24.12
5	0.8%	23.03
6	1.0%	22.71

Graph 1 M-20 Grade Concrete 28 days curing

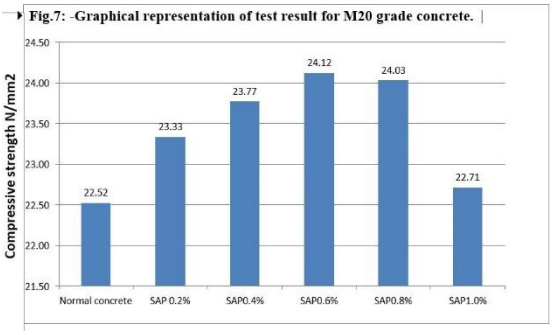


Table 9 M-30 Grade Concrete 28 days curing

S.no	Type of Concrete	Compressive strength Mpa
1	Plain	34.13
2	0.2%	34.73
3	0.4%	34.92
4	0.6%	35.15
5	0.8%	33.19
6	1.0%	33.69

The outcomes are appeared in Table 9 for M30 review concrete for different % of SAP included Self restoring concrete. The results graphically Shown 2, for M30 review concrete for different % of SAP included Self relieving concrete.

There is increment in quality with blending of SAP 0.6% and diminishes from 0.6%-1.0% of SAP.

Graph 2 M-30 Grade Concrete 28 days curing

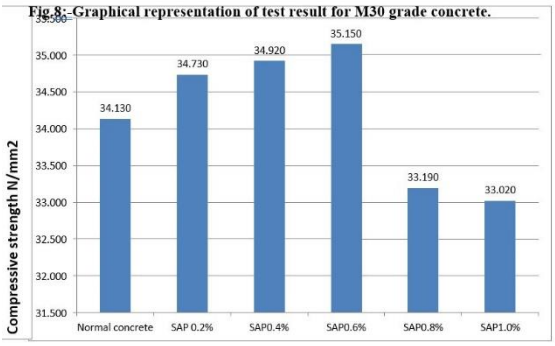


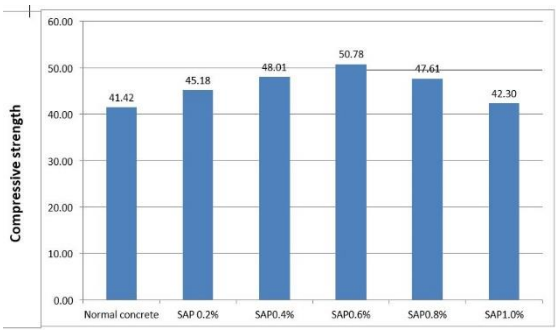
Table 10 M-40 Grade Concrete 28 days curing

S.no	Type of Mix	Compressive strength Mpa
1	Plain	41.42
2	0.2%	45.18
3	0.4%	48.01
4	0.6%	50.78
5	0.8%	47.61
6	1.0%	42.30

The outcomes are appeared in Table 10 for M40 review concrete for different % of SAP included Self restoring concrete. The results graphically Shown in 3, for M40 review concrete for different % of SAP included Self relieving concrete.

The compressive quality expanding for expanding of % of SAP contrasted with traditional blend.

Graph 3 M-40 Grade Concrete 28 days curing



D. *SPLIT TENSILE STRENGTH*

The Split rigidity of self-relieving concrete has been estimated by pressure test according to Seems to be: 5816-1999. The split elasticity for plain concrete and cement blended with Super Absorbent polymer from 0%-1.0% have been condensed in table 11.

The split elasticity results are appeared in Table 11 for M20 review concrete for different % of SAP included Self restoring concrete. The Split rigidity results graphically appeared in 4, for M20 review concrete for different % of SAP included Self relieving concrete.

The split elasticity has enhanced with expansion super permeable polymer of at different rates. The solid example with 0.60% super spongy polymer has indicated slighter increment in quality than another rate

Table 11 split tensile strength M20 grade concrete

S.no	Type of Concrete	Split Tensile strength Mpa
1	Plain	1.20
2	0.2%	1.23
3	0.4%	1.28
4	0.6%	1.35
5	0.8%	1.21
6	1.0%	1.12

Graph 4 M-20 Grade Concrete 28 days curing

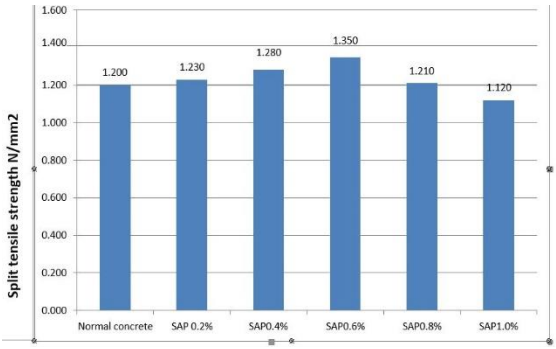


Table 12 split tensile strength M30 grade concrete

S.no	Type of concrete	Split tensile strength Mpa
1	Plain	1.81
2	0.2%	2.10
3	0.4%	2.31
4	0.6%	2.71
5	0.8%	2.35
6	1.0%	2.24

The Split rigidity results are appeared in Table 12 for M30 review concrete for different % of SAP included Self relieving concrete. The split elasticity results graphically Shown in 5, for M30 review concrete for different % of SAP included Self relieving concrete.

The split elasticity has enhanced with expansion super retentive polymer of at different rates. The solid example with 0.35 super permeable polymer has indicated slighter increment in quality than other rate without relieving. The split elasticity isn't decreased with use of SAP in self-curing concrete.

Graph 5 M-30 Grade Concrete 28 days curing

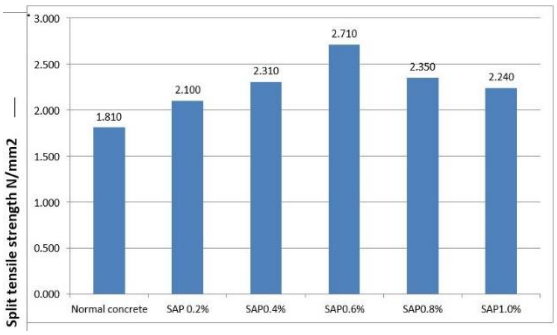


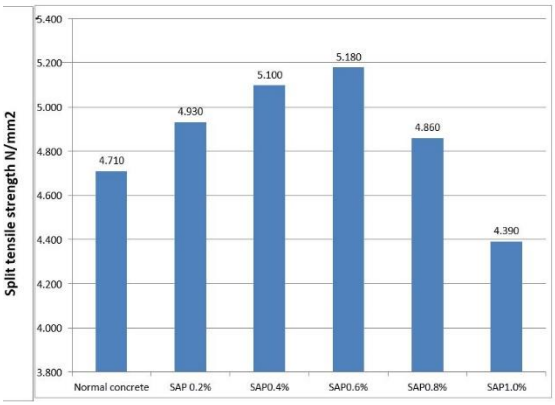
Table 13 split tensile strength M40 grade concrete

S.no	Type of Concrete	Split Tensile strength Mpa
1	Plain	4.71
2	0.2%	4.93
3	0.4%	5.10
4	0.6%	5.18
5	0.8%	4.86
6	1.0%	4.39

The split rigidity results are appeared in Table 13 for M40 review concrete for different % of SAP included self-curing concrete. The split elasticity Results Graphically Shown in 6, for M40 review concrete for different % of SAP included Self restoring concrete.

The split rigidity isn't lessened with utilization of SAP in self-curing concrete. Split ductile test will be expanded with utilization of SAP without restoring contrasted regular cement and relieving for 28 days.

Graph 6 M-40 Grade Concrete 28 days curing



E. Stress Strain Behavior

The consequences of stress – strain conduct self-relieving concrete for M20 review concrete are said in Table 14 for different % of SAP. The aftereffects of stress – strain conduct self-restoring concrete for M20 review concrete are graphically spoken to in 7 for Various % of SAP.

The strain comparing to extreme pressure (€p) of M20of concrete was expanding from 0.6% of SAP.

Table 14 Self-curing M20 grade concrete stress and strain

%of SAP	σu(MPa) Ulimate Stress	€p Strain corresponding Ultimate stree	σb(MPa) Breaking Stress	€u Ultimate Strain	fck Characteristic strength
Plain	22	0.0018	17	0.0029	22.5
0.2%	21	0.0020	19	0.0031	23.33
0.4%	19	0.0021	17	0.0031	23.77
0.6%	17	0.0023	17	0.0032	24.12
0.8%	16	0.0024	16	0.0033	24.03
1.0%	18	0.0023	15	0.0031	22.7

Graph 7 Self-curing M20 grade concrete stress and strain

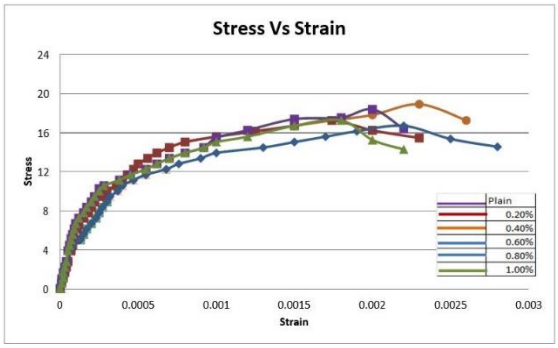


Table 15 Self-curing M30 grade concrete stress and strain

%of SAP	σu(MPa) Ultimate Stress	€p Strain corresponding Ultimate strain	σb(MPa) breaking stress	€u Ultimate Strain	fck Characteristic strength
Plain	33	0.0017	35	0.0029	34.13
0.2%	32	0.0019	33	0.0030	34.73
0.4%	34	0.0019	31	0.0030	34.92
0.6%	36	0.0020	32	0.0031	35.15
0.8%	37	0.0021	34	0.0032	33.19
1.0%	34	0.0023	31	0.0028	33.69

The aftereffects of stress – strain conduct self-restoring concrete for M30 review concrete are said in Table 15 for different % of SAP.The consequences of stress – strain conduct self-relieving concrete for M30 review concrete are graphically spoken to in Fig 8 for different % of SAP.

The braking pressure (σb) after the pinnacle pressure ofM20, M30, M40 evaluations of cement are diminishing from 0.6% of SAP to 1.0% of SAP.

Graph 8 Self-curing M30 grade concrete stress and strain

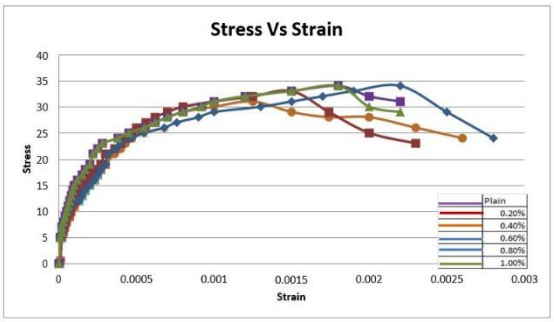


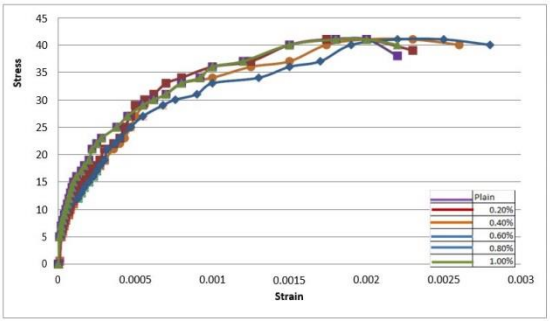
Table 16 Self-curing M40 grade concrete stress and strain

%of SAP	σu(MPa) Ulimate Stress	€p Strain corresponding Ultimate strain	σb(MPa) breaking stress	€u Ultimate Strain	fck Characteristic strength
Plain	42	0.0018	39	0.0027	41.42
0.2%	40	0.0020	37	0.0029	45.18
0.4%	36	0.0022	33	0.0030	48.01
0.6%	32	0.0024	32	0.0031	50.78
0.8%	30	0.0025	30	0.0032	47.61
1.0%	31	0.0028	31	0.0035	42.30

The consequences of stress – strain conduct self-restoring concrete for M40 review concrete are specified in Table 16 for different % of SAP. The aftereffects of stress – strain conduct self-relieving concrete for M40 review concrete are graphically spoken to in Fig 9 for different % ofSAP.

It is seen that a definitive worry for different evaluations of cement is marginally lessened with is increment in the SAP. There is increment in strain with increment % of SAP in concrete.

Graph 9 Self-curing M40 grade concrete stress and strain



V. CONCLUSIONS

1. The compressive quality isn't diminished with the utilization of SAP in self- restoringconcrete.
2. The split elasticity isn't decreased with

utilization of SAP in self-relieving concrete.

3. The SAP can be utilized upto 0.6% on weight of bond without trading off the differentquality of cement.
4. It is seen that a definitive worry for different evaluations of cement is somewhatdiminished with is increment in the SAP.
5. There is slight increment in the strain with increments in the SAP Dosages.
6. Water maintenance for the solid blends joining Self restoring operator is higher contrasted with customary cement.

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