SMART STRUCTURAL MATERIALS

TYPES OF CONCRETES USED

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Abstract

Concrete is the most important and essential material for constructing any structure. High strength and durable concrete is ideal. Advance technologies and materials keep bringing out something new. Self compacting concrete is made such that it gives a great amount of strength to the structure. Self healing concrete gives a longer life span and durability to a building. Thus, both these concrete are a blessing to civil engineers for construction of structures.

Keywords: *self compacting concrete, self healing concrete*

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1. SELF COMPACTING CONCRETE

Free flow concrete or self compacting concrete is designed such that it flows under its own weight and does not require external vibrator for compaction. It is one of the most important developments in building industry. It contributes to high improvement of quality of concrete structures.

1.1 REQUIREMENT

Self compacting concrete is used n such situations where there is no other option than to use free flow concrete. Conditions where the reinforcement is so much that the concrete with its aggregates cannot reach all the corners for the structure, self compacting concrete is used. Also, this concrete compacts itself and does not require compaction by vibrator.

The concrete has high segregation and bleeding resistance. It remains homogeneous in its composition.

The concrete is widely used due to its flowability, filling ability, passing ability and resistance to segregation.

1.2 MATERIAL

The ingredients used in SCC are chosen such that they give a high performance.

- Cement- Ordinary Portland Cement
- Coarse Aggregate- size is less than 12.5mm
- Fine Aggregate- zone II sand
  Crushed sand (50%) + River sand (50%)
- Fly ash
- Water
- Chemical admixtures- Superplasticiser and VMA

1.3 TESTS CONDUCTED

Tests are conducted over self compacting concrete so as to know particular details. Following tests are conducted.

- Slump flow- used to determine flow ability of SCC
- V-funnel test- used to determine viscosity or segregation resistance
- J-ring test-used to determine passing ability
- L-Box test
- Sieve segregation resistance

1.4 DISADVANTAGES

There are not much disadvantages of self compacting concrete. It is 10-15% costlier than normal concrete but this concrete is brought in use only when the normal concrete cannot fulfill the needs.

Figure-1: Slump test

Figure-2: Pouring of SCC on slab

2. SELF HEALING CONCRETE

Self healing concrete is also called Bacterial Concrete. Micro cracking in the concrete can be healed by mineral producing bacteria. If the concrete has a flaw and is subjected to tension, it cracks. Concrete can withstand only compressive forces. To seal these cracks, bacteria in the self healing concrete converts nutrients into limestone.

2.1 REQUIREMENT

Concrete is the most important building material, but concrete structures are prone to cracking. When these tiny cracks appear, water seeps in and degrades the concrete. It also corrodes the steel reinforcement used. This results in the loss of strength of structure and reduces its lifespan.
Reinforcement takes the tensile strength, whereas concrete takes the compressive strength. Concrete cracks when subjected to tensile forces. This may happen within short period of construction. When damages occur, steps have to be taken to repair it. Repairs are expensive and time consuming.

At such times, self healing concrete makes the job simpler. It helps us increase the life and durability of concrete structure by self healing action of that concrete.

2.2 WORKING

Self healing concrete biologically produces limestone and heals cracks which occur. Selected types of bacteria genus, Bacillus along with calcium based nutrient, called calcium lactate. Nitrogen and phosphorus are added to the ingredients of concrete and are mixed well. These bacteria are introduced in porous clay pellets (2-4mm). This ensures that the bacteria would not get activated during mixing. When a crack appears on the surface of concrete, water starts to seep in. the pellets crack open and the bacteria germinate. This activates the bacteria which then feed on calcium lactate. When this bacteria feeds, it consumes oxygen. This reduces the possibility of corrosion of steel and hence increases the durability of the reinforcement. The process turns soluble calcium lactate to insoluble limestone. Limestone solidifies on the cracked surface and hence seals the crack.

2.3 BACTERIA USED

The bacterium that is used is chosen such that it is capable of surviving in extremely alkaline environment as the pH of cement and water is 13. Most of the bacteria belongs to genus Bacillus are fulfilling the required criteria. The most suitable chemical is calcium lactate- $Ca(C_3H_5O_2)_2$.

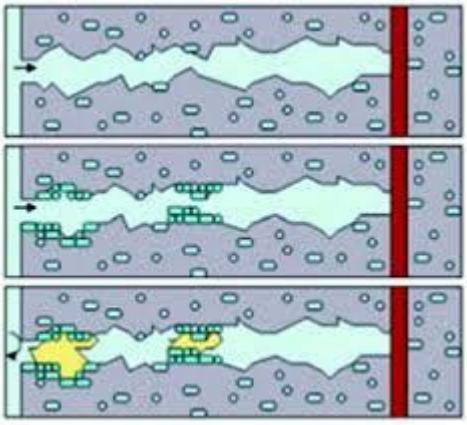

Figure-3: Bacteria sealing cracks.

Figure-4: Before and after pictures of SHC's work

2.4 DISADVANTAGES

The pellets used consume 20% volume of the concrete. This is usually taken up by harder aggregate such as gravel, which is also stronger than clay. This reduces the strength of concrete by 25% and reduces its compressive strength. So in case of high rise buildings, the compressive strength is more and hence, this is not recommended.

The cost of self healing concrete is double the cost of normal concrete, but where safety is more essential, money is secondary, like in the case of tunnel lining or marine structures. Bacterial concrete is also a great help in the structures where there is a limited access for repairing.

CONCLUSIONS

According to the use different concretes are used and above mentioned are some new trends and advance materials that have been taken up by civil engineering.

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