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Investigation of Concrete to Concrete Bonding Between Different Grades Under Shear Test

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***Abstract* - The main Aim is that finding a strength of repaired bonded structure by Epoxy performing Slant Shear Test. Our structure is damaged due to some natural and manmade events after all we need to rehabilited and repaired the old structure or a damaged structure. There are many Research and study that focuses on repairing concrete structure by using epoxy based resin as a binding material. Our Focus is make use of concrete is very less and instead of these we use a binding material that is Epoxy resin to make a construction faster and easier and having a strength as like as concrete mix. The slant shear test strength is conducted for block of repaired concrete are based on concrete grade of substrate and thickness of epoxy. Casting of different grades of cylindrical slants and cured up to 28 days. After that taking these cylindrical slants and bonded them with epoxy using different thickness and test using specification of ASTM C882. It is observed that increase in thickness the strength of concrete is also increase and also observed that failure of bonding is occur when two substrate of different material is bonded and fails the substrate whichever is low grade.**

Keywords: Concrete, Rehabilitation, Epoxy Resin, Slant Shear Test, Grades of Concete, Concrete Block, Bond Failure, Cylindrical Slant.

I. INTRODUCTION

We are familiar about Concrete is known about its strength and durability as it used widely as a construction material. Weathering, Corrosion, impact is such process which affects on concrete and deteriorates the concrete structure. There is main and important aspect is that bonding between new and existing concrete. Our Project investigates the strength of repaired concrete using epoxy resin to increase the compressive strength and structural integrity for a repaired crack.

1.1 Concrete

It is used to make a buildings, bridges, dams and roads which is crucial for normal civilian functioning Proper design, construction, and maintenance practices can help to maximize the desirable properties of concrete and ensure the safety and durability of concrete structures. These are the properties of concrete:

Consistency: it is the degree of wetness or fluidity of concrete or the ability of the concrete to flow.

Segregation: it is the tendency of separation of the various components, such as cement, sand, and aggregate, which happens when the mixture is not proportioned properly or when it is handled inappropriately during usage.

Bleeding: it is a condition where water rises on top of a freshly laid concrete. Bleeding can take place due to the difference in specific gravities of solid and liquid particles

Workability: it is vital for the concrete to have consistency such that it can be easily transported, placed and finished sufficiently without any segregation, bleeding, or excessive resistance to deformation. A concrete is said to be workable if it satisfies these conditions.

Setting time: there are two setting time initial setting time and final setting time. Initial setting time is the time when the concrete starts losing its plasticity i.e. concrete starts to solidify. Final setting time is the time at which concrete turns solid and holds its shape.

Strength: Concrete is strong and can endure huge loads and resist deformation thanks to its high compressive strength. The use of reinforcement, such as steel bars or fibers, can strengthen concrete even further.

Durability: Concrete is a resilient substance that can withstand erosion, abrasion, and weathering. Concrete constructions that are built properly can survive for decades or even centuries.

1.2 Failure in Concrete Structure

Corrosion: Concrete reinforcement can corrode when exposed to moisture and air, especially in humid climates or near coastlines. Corrosion can cause the reinforcing and concrete structure to lose strength, which can cause fissures and eventually collapse.

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Fatigue: When a concrete structure is repeatedly loaded and unloaded over an extended period of time, fatigue failure happens. Due to this, tiny fractures may start to appear and spread over time, eventually resulting in the building failing.

Shear failure: Shear failure occurs when the concrete structure fails due to lateral forces that exceed the shear strength of the concrete or the reinforcement. Shear failure can occur in beams, slabs, or other structural elements.

Concrete repair materials: These materials are used to fix cracked, spalled, and potholed concrete structures. Examples include cementitious grouts, epoxy resins, and concrete repair chemicals.

Asphalt repair materials: To maintain and repair asphalt pavements, including potholes, Cracks, and surface imperfections, asphalt repair materials are utilized. Examples include hotmix asphalt, asphalt emulsion, and cold patching materials.

II. LITERATURE REVIEW

Santos et al., (5) carried out investigated how differences in shrinkage and stiffness affect the bond strength of new and old concrete surfaces. He claims that in the literature he studies two types of failure: cohesive failure and cohesive failure. He also notes that as the surface roughness increases, the failure rate increases under cohesion conditions. Furthermore, he concluded that as the stiffness difference increased, the collapse of the cohesive state increased.

Rashmi R Pattnaik (6) examined how the compressive strength of substrate mortar and repair material affects the failure pattern of the composite cylinders. It was discovered that the bond strength and failure pattern of repair materials are influenced by the compressive strength of the repair material. The bonding and testing of substrate mortar and repair mortar with varying strengths. It was found that substrate mortar would fail if the repair material's compressive strength was higher. A repair material that showed compressive strength comparable to that of collapsed subsoil mortar.

Issa and Debs (5) used 15 concrete cubes to study epoxy repair of concrete cracks. Six of the cubes had unhealed cracks, six had scratches that were healed with gravity filled epoxy, and three had no cracks at all. The compressive strength was measured and found to drop by up to 40.93% due to global cracking, but when the cracked cubes were fixed with epoxy, the compressive strength recovered and dropped by 8.23%.

Dawood and Ganim (6), hybrid fiber reinforced high-performance mortars perform best. In their tests, they also found that the use of epoxy provided the strongest bond strength, but fibers reinforced with high-performance mortars were more likely to fail. Since he used only two concrete substrates in their experiments, it was hypothesized that epoxy would provide the optimum strength we were looking for.

2.1 Hypothesis

The bond between the repaired structure and the epoxy resin has a gradient shear strength much higher than that of the original, unrepaired structure. This is because epoxy resin, which is known for its high adhesion quality, can efficiently transfer stress between the substrate and repair material during adhesion, resulting in stronger adhesion. Moreover, the oblique shear test method has been used effectively in previous studies and is a reliable and accurate means of measuring the bond strength of repaired structures.

III. RESULTS AND DISCUSSIONS

1. Objective: To see the bond strength between two specimen bonded by epoxy.
2. Result: Bond strength of two similar grade of concrete cured for longer days were found to have higher bond strength that of those cured for lesser days.
3. Objective: To see if the grade of concrete has any effect on the bond strength of the material.
4. Result: When concrete of same grade were bonded together by epoxy, there was a bond failure. When concrete of different grades were bonded together, the concrete having lower grade of strength failed first.
5. Objective: To see if the thickness of the binding material (epoxy) has any effect on the bond strength of two old concrete.
6. Result: Two concrete specimens bonded with epoxy showed higher bond strength when the thickness of the epoxy was higher.

IV. CONCLUSION

A total of 108 cylindrical specimens were casted and cured for 28 days. On the 28th day the specimens were taken out one hour prior to applying epoxy. The surfaces were roughened by sand blasting. The specimens were bonded together and kept for another 7 days. On the 7th day it was tested. It was found that specimens with similar graded of concrete experienced bond failure (adhesive failure). The bond strength obtained was true bond strength. The specimens with different grade of concrete experienced material failure (cohesive failure) and. the bond strength obtained were apparent or minimum bond strength. When different grade of concrete was used the concrete with lower strength failed. The

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thickness of the epoxy also affects the bond strength. Greater the thickness, greater was the bond strength

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