Critical Analysis of Honeycomb to Actualize Building Design Appearance

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Abstract
This research was carried out to analyze honeycomb critically to actualize building design appearances. Such problems are: reduction in the load bearing capacity or the strength of the building structures, increase in the penetration of water inside the building structures, losing of grip between rods and concrete and reduction in the durability of the buildings are problems associated with honeycomb. However, these problems can be solved by addition of water within the allowable limit, using a cohesive concrete to improve on the grip on the rod, proper compaction or vibration of concrete, reduction of the pouring height, ensuring a water tight form work and placing of bars in beams and columns properly.

Keyword: *Cement, Aggregates, water, concrete, honeycomb, building*

INTRODUCTION

1.1 Background of the Study

Honeycombing in building concrete is a rough surface that contains voids or hollow cavities as a result of incomplete filling of the concrete against the formwork or where mass concrete does not reach. The surface with honeycomb defect looks extremely rough. They have voids and gaps between the concrete and the reinforcement. In some cases, it is seen that concrete has not even reached below the reinforcement. If the honeycomb is not treated properly then

the whole structure will be weak.

Honeycombing in concrete looks like the honeycomb (honey bees nest). If the honeycomb is present in the surface of the structure, then it can be detected as soon as we remove the shuttering and if the honeycomb is present inside the mass concrete, then it requires advanced techniques like ultrasonic testing for its detection. Honeycombing in concrete are of different types, which include the following; Small size honeycomb: This type of honeycomb has a depth of less than 25 mm, Medium size honeycomb: This type of honeycomb is deeper than 25 mm but in which steel bar is not exposed and Large size honeycomb: This type of honeycomb is deeper than 25 mm and in which steel bar has come out.

Honeycombs are formed in Columns, Beams, Walls, Footings and Slabs.

Fig 1: Honeycomb in Wall

Fig 2: Honeycomb in Column

CAUSES OF HONEYCOMB

- **Improper workability of concrete**

Honeycomb in column is caused by improper workability of concrete which means pouring stiff and tough concrete into formwork. This type of concrete may not reach every part of reinforcement in the structure like a beam, column, slab, etc. A slump test should be done for the proper workability of concrete.

- **Addition of water than the allowable limit**

The surplus amount of water-cement ratio will lead to the separation of aggregates from the mortar.

If the concrete is poured after the setting time of the concrete, then it will not reach at all the places resulting in honeycombs.

- **After setting time**

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- **Excessive Vibrations**

When excess vibration is applied through the frameworks, it'll lead mortar to leak through frameworks and leaves the aggregates to settle down.

- **Pouring concrete at height**

When the concrete is poured from a specific height, then the aggregates and mortar get separated. They will then partly settle down causing honeycombs in concrete.

Lack of Attention to Typical Spot

Places like beam to beam or beam to column joints should be taken extra care while placing concrete because lapping of one or more layers of reinforcements makes the concrete hard to penetrate through them.

Improper use of Aggregate sizes

When the improper bigger size of aggregates is employed within the concrete, it makes the smaller particles hard to penetrate through them leaving voids within the concrete.

- **Improper placement of bars in beams and columns**

If steel bars in beams and columns are placed horizontally and vertically in an improper manner, then it will not allow concrete to reach everywhere causing honeycombs in the concrete.

- **Non cohesion of Concrete**

If the concrete is not cohesive then honeycomb in concrete may occur. It happens due to the use of outdated cement.

Others are;

- Movement of form works also results in a honeycomb formation.
- If formwork is not water-tight, it results in a honeycomb formation.
- If reinforcement congestion is normal, then 75 mm and if congestion is more, then 150 mm slump should be maintained this helps in concrete penetration but when it is not maintained honeycombs are formed.

1.2 Problems Associated to Honeycomb

The problems exhibited by honeycomb in concrete structures are;

- It reduces the load-bearing capacity eventually affecting the strength of the structure.
- It causes water and air to penetrate inside the structure.
- Rusting and corrosion of reinforcement occur. This results in losing grip between rods and concrete, which can be very dangerous.
- Honeycombing in concrete reduces the durability of the structure. Hence resulting in great loss of lives and property.

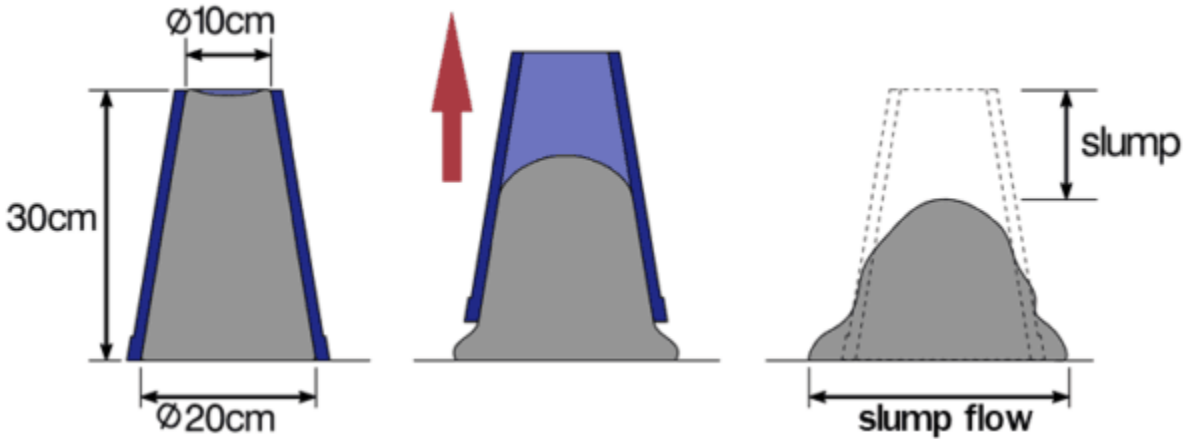
2.0 METHODOLOGY

Nowadays, concrete is the most widely used building material. Its properties greatly depend on the proportion and properties of its constituents. Cement, aggregates and water are the major component of concrete. The production of concrete is primarily based on its constituent mix ratios, physical and chemical properties to ensuring economical and safer structures. Concrete is the most commonly used material in construction works all over the country. Concrete is now produced in batch mixing plants located either at site of construction or away from the site in a location from were concrete is carried in a transit mixers to the site. The later once is commonly called Ready Mixing Concrete (RMC). The proportion of various ingredients of concrete made in batch mixing plants mentioned above is usually determined in laboratory. This process is called designing (proportioning) of concrete mix and concrete. The designing process a trial and error in which right proportion of ingredient is sought to determined so as to achieve targeted mean strength which is kept somewhat higher than the characteristics compressive strength of the concrete. The designing process most of major projects is usually carried out through reputed laboratories.

2.2 Slump Test

Slump test is carried out in the laboratory or during field work. Its main aim is to determine the consistency of the concrete with the dominant maximum size of the aggregate $\leq$ 38mm. this test was developed in the U.S.A. with mould dimensions of 100mm and 200mm for top and bottom diameters respectively with a height of 300mm. The shape is in the form of a frustum.

Shown below is the slump test apparatus for i) true slump ii) shear and iii) collapse slump



The mould is filled with fresh concrete in four layer each approximately, ¼ of the height (75mm up) and tamped with 25 strokes of the tamping rod. The strokes are distributed in a uniform manner over the cross- section and for the second and subsequent layers should penetrate into the underlying layer. The bottom layer is tamping, a trowel or the tamping rod is used to strike off the concrete level with the mould and filled completely.

The mould is then removed by raising it slowly and carefully upwards. This allows the concrete to subside and the slump measured by determining the difference between the original height of the mould and the highest point of the concrete being tested. The subsidence is recorded in mm. it should be noted that when the difference is much, then it indicates non- cohesiveness and hence poor consistency of the mix. It also shows that the cement has poor workability which is referred to as shear or collapse slump.

2.3 To Achieve the Desire Workability in Plastic State

Concrete is a construction material that consists of cement commonly Potland cement, aggregates (generally gravel and sand) and water.

Concrete solidified and hardens after mixing and placement due to a chemical process known as hydration. The water react with the cement, which bonds the other components together and eventually creating a stone like material. Therefore the water and cement paste hardens and develops strength over time. In other to ensure economical and practical solutions, both fine and coarse aggregates are utilized to make up the bulk of the concrete mixture. Sand, natural gravel and crushed stone are mainly used for this purpose. Workability (consistence, as it is known in Europe) is the ability of fresh plastic concrete mix to fill formwork and compact properly with a poker vibrator with ease. Workability depends on water contents,

chemical admixtures. Aggregate (shape and particle size distribution), cementious and age (level of hydration) raising the water content or adding chemical admixtures will increase concrete workability. Excessive water will lead to increased bleeding and/or segregation of aggregates (the separation of cement and aggregates) with the resulting concrete having reduced strength. The use of an aggregate with a required gradation can result in a very harsh mix ratio or design with a very low slump.

Workability can be measured by the slump test, a simplistic measure of the plasticity of a fresh batch of concrete following the ASTMC 143 or en 12350-z test standards. Slump normally measured by filling an "Abrams Cone" with a sample from fresh batch of concrete. The cone is placed with the wide end down onto a level of non-absorptive surface. When the cone is carefully lifted off, the enclosed material will slump to a certain amount due to gravity. A relatively dry sample will slump very little, having a slump value of one or two inches (25mm or 50mm). A relatively wet concrete sample may slump as much as six or seven inches (150mm-175mm). Slump can be increased by adding chemical admixtures such as mid-range water reducing agents (super-plasticters) without changing the water/cement ratio. It is a bad practice to add extra water at the concrete mixer. High flow concrete is tested by other flow measuring methods, includes placing the cone while it is gradually lifted.

2.4 To Achieve the Desire Minimum Strength in the Harden State.

Concrete is designed to withstand a certain maximum load per area before failing, known as compressive strength; a number of factors influence the concrete's ability to withstand the force from an applied load, such as the size, type and availability of cement and /or supplementary materials, the amount of mix water, the age or maturing of the concrete and the production practices used in placing, consolidating and curing the concrete.

Water to cement ratio, the maximum water to cement ratio may be established by the customer or authority having jurisdiction based on anticipated exposure conditions. The target w/c ratio can also be selected.

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The major problems exhibited by honey comb in concrete structure are studied to ensure that the load bearing capacity or the strength of the building structures are increased, water penetration inside the building structures are reduced, the grip between roads and concrete in building structures are improved and the durability effects of the building structure are enhanced.

Fig 3: Remedies of Honeycomb

If you see honeycomb on concrete, don't hide it with cement paste as it won't rectify the problem. Rather after years, it starts to deteriorate. Therefore, proper advice should be taken from the designer regarding the problem.

Therefore, in achieving the objectives of the study, it was proven that:

- The addition of water than the allowable limit can cause reduction of the load bearing capacity of the building structure
- If the concrete is not cohesive, it can reduce the grip between the rod and concrete in a building structure.
- Improper compaction or vibration of concrete reduces the durability of the effect in building structures
- Pouring concrete from a height can affect the load bearing capacity of building structures.
- If form work is not water tight, it will result in the exposure of the reinforcement in the building structure
- The improper placement of bars in beams and columns can affect structural durability of structures.

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