FABRICATION OF TWIN CELL 15x15x15cm METAL CONCRETE CUBE MOULDS by B.S STANDARD USING 4MM THICK METALLIC SHEET MATERIAL

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ABSTRACT
This research work entails the production of dual/twin cell concrete cube molds by fabrication according to the British Standards with a 4mm thick metallic sheet material (Non-absorbent) that is capable of receiving, withstanding and withholding both concrete and accessible water coming along with it without leakage or warping. The opposite faces/walls of the mold are smooth, rigid and 150cm apart, thus forming a 150x150x150cm cuboidal cell with the base of each wall dipped into a slot of equal thickness with the thickness of the plate (4mm). At the base of the mold is a vertical anchor with a threaded tip attached to the base by welding to hold the longer walls together firmly through the U-protrusion to the shorter walls. The two opposite longer walls were formed by joining two 4mm thick metal plates together to form 8mm thickness walls by making a rectangular cut on one plate and then welded together from that place the cut. Thus, each opposite angle formed between shorter cell separators and the 8mm thick longer walls are edifices of a perfect 90-degree angle, making the two cells conform by all standards. On completion, the double-cell apparatus was fed with concrete, and each cell was tamped as per 25 strokes of the tamping rod. Then, it vibrated for two minutes to test the integrity and possible leakages between joints. It was found to be of proven integrity, without leakages, easy to couple and de-molded. It was therefore recommended that practical under-field or laboratory conditions be used to determine the compressive strength of concrete cube tests; this will provide an idea of all the characteristics of concrete.

Keywords: Fabrication; Twin Cell; Metal; Concrete; Cube Moulds

1.0 INTRODUCTION

As a field of study in the civil engineering discipline, laboratory structural analysis and concrete strength tests are indispensable factors considered in the assessment of every structure to be built. The lack of laboratory tests for concrete strength tests/assessment has become a severe issue in the development of structures. The compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. Through this single test, one judges whether or not the concreting has been done correctly. Concrete compressive strength for general construction varies from 15 MPa (2200 psi) to 30 MPa (4400 psi) and is higher in commercial and industrial structures (Nura et al., 2022).

Determination of the strength of concrete becomes inevitable as far as concrete structures are concerned. The need arises to monitor the concrete properties and behaviors on a smaller scale through a series of tests of concrete cube formation, which are cured and tested for compressive strength. It therefore becomes pertinent to produce these concrete cubes as prescribed and describe B.S 1881: part 116 of 1983. Once the concrete is laid and compacted, compression tests are made on the cubes made from this concrete. For ordinary concrete, cubes are made from the concrete made at the work site. The hardened concrete must be checked for trueness in dimensions, shape, and sizes as per design specifications. The general surface appearance of concrete should also be checked. Different measurements ascertain dimensions. Concrete strength is usually ascertained from cube or cylinder samples tested at 28 days (Abubakar, 2023). Producing these cubes entails fabricating a quiet number of molds to bridge the shortage gap and make research and practical execution easier.

Furthermore, this fabrication will enable the students to carry out the practical aspect of molding and demolding concrete cubes in the Laboratory to ascertain different concrete strengths for quality assurance in concreting work. The "mold" is generally referred to in the industry as "forms" or "formwork." They are made from various materials, from wood and fiberglass on the job site to sheet steel in the casting yards.

The objectives of this project work include the following:

1- Conduct a physical survey and sort out different types of concrete molds.
2- Identify and select the best design that is easy to couple and dismantle.
3- To make a feasibility study on materials and methods for the commencement of the manufacturing process.
4- To begin manufacturing and testing molds for efficiency by casting fresh concrete into them.
5- To ease demonstrations during students' lectures and excursions.

2.0 LITERATURE REVIEW

2.1 Mould

The "mold" is generally referred to in the industry as "forms" or "formwork." They are made from various materials, from wood and fiberglass on the job site to sheet steel in the casting yards. Although, you can consider anything that will help the concrete retain its shape until it becomes a 'mold,' including earth. Commonly used mold materials are liquid latex, silicone rummer, urethane rubber, and alginates. If you want to cast concrete figures, furniture, or decorations from concrete, you need appropriate casting molds. These can be made from different materials, with sometimes more and sometimes less effort. In addition, you can also use everyday objects and perhaps not intended objects at first glance to make casting molds for concrete. This guide summarises a few possibilities, tips and tricks to help you make your concrete casting mold: https://paleo.cc>casting>materials.

Compressive Strength Test of Concrete Cubes

For the cube test, two types of specimens, either cubes of 15cmx15cmx15cm or 10cmx10cmx10cm, are used depending upon the aggregate size. For most works, cubical molds of size 15cm x 15cm x 15cm are commonly used. The concrete cube molds must be cleaned and oiled before each casting. Demoulding of the cubes will be done 24 hours after casting, and the hardened cubes will be transferred immediately into the curing tank at room temperature. The cubes are removed from the curing tank at the end of 3, 7, 14, 21 and 28 days and air-dried for about 3 hours before testing (Abdulrahman et al., 2022).

Figure 1: Twin cell 15x15x15cm plastic concrete mold

The concrete is poured into the mold and tempered correctly to avoid voids. After 24 hours, these molds are removed, and test specimens are put in water for curing. The top surface of these specimens should be made even and smooth. This is done by putting cement paste and spreading it smoothly on the whole area of the specimen. A compression testing machine tests these specimens after seven or 28 days of curing. Load should be applied gradually at 140 kg/cm^2 per minute until the Specimens fail. Load at the failure divided by the specimen's area gives the concrete's compressive strength. The compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. Through this single test, one judges whether or not the concreting has been done correctly. The compressive strength is the ratio of the crushing force and the cross-sectional area of the concrete cube sample (Uloko & Usman, 2022).

American Society for Testing and Materials (ASTM) has developed two standards for making and curing concrete specimens. ASTM C192 is intended for laboratory samples, while ASTM C31 is intended for field samples. Both documents provide standardized requirements for making, curing, protecting, and transporting concrete test specimens under field or laboratory conditions. ASTM C192 provides procedures for the evaluation of different mixtures in laboratory conditions. It is usually used in the initial stage of the project or for research purposes. ASTM C31 is used for acceptance testing and can also be used as a decision tool for form or shoring removal. The standard defines two curing regimes depending on its intended purpose: standard curing for acceptance testing and field curing for form/shoring removal. Variations in standard curing of test specimens can dramatically affect measured concrete properties.

According to the National Ready Mix Concrete Association (NRMCA), the strength of concrete air cured for one day followed by 27 days moist cured will be approximately 8 percent lower than that of concrete moist cured for the entire period. The strength reduction is 11 percent and 18 percent for concrete specimens initially cured in the air for three and seven days, respectively. For the same air/moist curing combinations but 100 degrees Fahrenheit air curing temperature, the 28-day strength will be approximately 11 percent, 22 percent, and 26 percent lower, respectively. Curing compounds should be applied immediately after final finishing. Curing compounds shall comply with ASTM C309 or ASTM C1315. Membrane-forming curing compounds are used to retard or reduce evaporation of moisture from concrete. They can be transparent or translucent and white-pigmented.

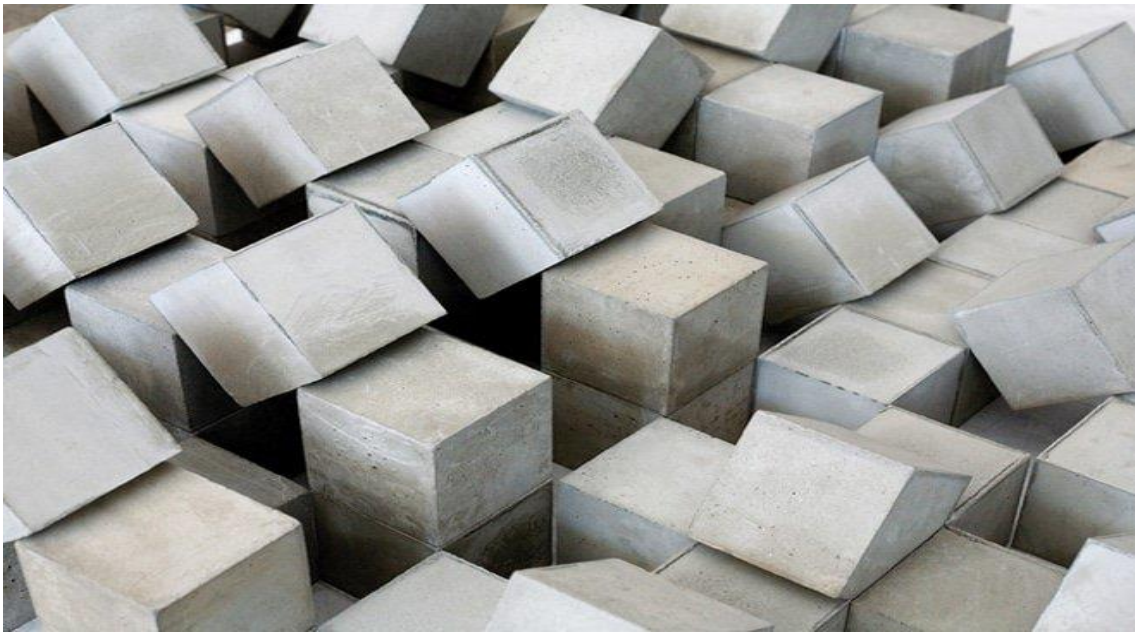

Figure: Specimen of concrete cubes

The failure load of each cube was determined using a compression testing machine. The machine applied load by compression on the cube specimens at a constant rate until a maximum load corresponding to the ultimate compressive load of the cube was reached, after which the cube specimen failed by crushing. The load corresponding to the maximum load is taken as the failure load for the cube (Abdullahi, 2016).

3.0 METHODOLOGY

Sampling and survey of related materials for fabrication were carried out. The construction commenced with parameter design and making out with tools. A 4mm thick metallic sheet material (non-absorbent) that was strong enough to receive and withhold concrete and free water from it without leakage or warping was used. Cutting of slates to assembling and welding processes were appropriately performed. Each opposite face or wall of a slate (mold) was smooth, rigid, and 150mm apart, thus forming a 150x150x150mm cuboidal cell with the base of each wall dipped into a slot of equal thickness with the thickness of the plate (4mm). At the base of the mold is a vertical anchor with a threaded tip attached to the base by welding to hold the longer walls together firmly through the U-protrusion to the shorter walls. The two opposite longer walls were formed by joining two 4mm thick metal plates to form an 8mm thick wall by making a rectangular cut on the plate and welding together from the cut. Thus, each opposite angle formed between shorter cell separators and the 8mm thick longer walls were edifices of a perfect 90-degree angle, making the two cells conform with all standards. Filing, puttying, and washing were performed, and painting was applied to the fabricated concrete molds. About 12 concrete molds were fabricated and placed in the concrete Laboratory. After construction, the twin-cell apparatus was used to see its performance and imperfections. It was found to have proven integrity, without leakages, and easy to couple and de-molded.

Below are plates that describe the processes during the fabrication of concrete molds:

Plate 1: Handles constructed to hold the mold during the molding of concrete cube.

Plate 2: Marking out of members

Plate 3: Cutting of slates.

Plate 4: Connection of member Plates (Welding)

Plate 5: Body filling (puttying) after filing a dual cell metal concrete mold.

Plate 6: A dual-cell metal concrete mold ready for smoothening after body filling.

Plate 7: A Two No. Square molds connected with their handles.

Plate 10: Compaction of concrete using a vibrator fitted with the fabricated mold to produce a cube.

Plat 11: Hand compaction of concrete with the fabricated mold to produce a cube.

4.0 RESULTS

The twin-cell concrete molds were fabricated and placed in the concrete Laboratory. On completion, the apparatus was fed with concrete, tamped each cell as per 25 strokes on the tamping rod, and rated for two minutes to test its performance and imperfections. It was found to have proven integrity, without leakages, easy to couple, and older.

4.1 CONCLUSION AND RECOMMENDATIONS

On completion, the fabrication of twin cell 15x15x15cm metal concrete molds by B.S Standard has many benefits, such as providing opportunities for staff/students in practical training and development. Provide an opportunity for in-house training and research for researchers and other nongovernmental organizations in concrete technology and develop an avenue for consultancy services. Indeed, importing what you can otherwise produce locally is unnecessary. Undoubtedly, concrete can only be mentioned when one determines its strength. Determining strength goes along with the specifications and standards for using concrete molds. Fabrication and development of concrete molds will enhance growth and development in terms of technology, thereby reducing reliance on importation to some foreign exchange.

Therefore, it was recommended that the compressive strength of concrete cubes be determined under practical field or laboratory conditions; this will provide an idea about all the characteristics of concrete.

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