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Design and Fabrication of Portable Motor DrivenConcrete Mixing Machine: Final

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ABSTRACT

The aim of our paper is design and fabrication of portable concrete mixture machine. Mixer widely usedto make a concrete mixture which used to building construction and other industrial application such as concreteblock, pipe, sheets, etc. As for all materials, the performance of concrete is determined by its microstructure. To determine the mixing method best suited for a specific application, factors to be considered include: location of theconstruction site. the concrete mixture machines which are currently available in the market is heavy and having big capacity of concrete mixing. Continuously and easy handling, we have fabricated this concrete mixture machine. The construction and building industries are expanding on a daily basis as a result of increase in humanpopulation and continually demand for shelter. Concrete which comprises mainly of sand, cement and gravel is animportant component required for construction of houses and roads. However, most operation of mixing concretein Nigeria is done manually as a result of lack of insufficient machinery and high importation cost. In this research,I carried out the design of a low-cost concrete mixing machine. The materials used in this research work are as follow; sand, gravel, water, mild steel, hopper, electric motor, shaft, bearing, V-belt, angle bar, mild steel plate, bolts and nuts, etc. In other to achieve a good design, feasibility studies, and preliminary tests were carried out. The materials selected for this design were justified.

Keywords: portable mixer, design model, mixing volume, power, torque, belt tension

1. INTRODUCTION

Concrete is a structural material widely used in the construction industry. It consists essentially of cement, fine aggregate (sand) and coarse aggregate (natural gravels or chippings). These constituent materials proportioned are properly mixed together with water to form the concrete. The cement serves as the binder to the aggregates while theaggregates serve as the filler materials that give strength to concrete. Concrete has the unique distinction of being theonly construction material manufactured on the site, whereas other materials are merely shaped to use at the work site[1].

A concrete mixer machine is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete [2]. A typical concrete machine mixer uses a revolving drum to mix the components. The compressive strength of concrete depends on the aggregate grading, aggregate/cement ratio as well as the water/cement ratio. The freshly mixed concrete should be workable to be properly placed and the hardened concrete needs to be durable and attain a specific compressive strength [3].

The aim of concrete mixer machine design is to achieve concrete that meets a specified strength. Concrete can be produced by employing either mechanical or manual mixing methods. In Nigeria like every other developing country,hand mixing which involves turning over the mixture of the concrete materials from one end of the mixing tray or platform to the other is a popular method of producing concrete. However, the end product obtained from manual mixing method possesses weak compressive strength. The compressive strength of concrete depends so much on theconsistency achieved through mixing [4].

Based on the above-mentioned requirements, this review paper discussed design and fabrication of portable concreatemixer machine, we were planning for design and fabrication of a concrete mixer. This project brought advantages over manual mixing and expensive mechanized concrete mixer.

2. WORKING PRINCIPLE OF CONCRETE MIXING MACHINE

A portable concrete mixer is a device that homogeneously combine concrete, aggregate such as sand or gravel, and water to form concrete a powered device that mixer concrete with water and aggregate, such as sand or pea gravel, to make concrete. A concrete mixer is comprised primary of motor, a rotating drum, and the materials used to make concrete spin around, mixing together evenly and remaining soft for application and forming. The stopper is fabricatedto the main frame for operator or labour, here to this machine the inclination arrangement to concrete drum is providedso that raw material will get come outside.

3. DESIGN OF CONCRETE MIXING MACHINE

Components Used: Components are chosen to maximize the product's output. The following are the components thatare employed as follows.

- **Drum**

A concrete mixer is a device that homogeneously combines cement, conglomeration such as sand or gravel, and waterto form concrete. A typical concrete mixer uses a revolving drum to mix the components. Cement, sand and other aggregates are loaded in a hydraulically operated hopper and then poured in the mixing drum for final mixing and then can be unloaded by tilting the drum.

- **Motor specification**

motor is used to rotate drum. The specification of motor are as follows:

  - Voltage= 12V
  - RPM of motor =55 Rpm
  - Stall Current= 10A
  - Shaft diameter: 10mm
  - Shaft dimension: 29mm
  - Weight:1280gm

- Shaft: Shaft of concrete mixer is mounted concentrically at the centre of the Drum. Electric Motor, Metal Bucket/ the mixing trough, Shaft Pulley, Motor Pulley mounted on the shaft, Bearings, Shaft.
- Pulley: A pulley is wheel on axle or shaft that is design to support moment and change of direction. A pulley isa simple machine that is used to lift heavy objects.
  specification:
  Parameter= Pulley Quantity=2 Material type=MS
- Wall mounted bearing: A square bore ball bearing is used which is fastened to the drum. A square bore ball bearing is the specialty product that exhibit all of the characteristics of standard single row ball bearing except fact the inner ring has a square interior design for square shaft as oppose to a round one. The main purpose of bearing is to rotate the drum.

4. DESIGN AND CALCULATION OF CONCRETE MIXING MACHINE

- **Determination of Mixing Force of the Concrete**

The mixing force of the concrete was calculated as follow:
$W = MT \times g$ (1)where,
MT = Total Mass = Mass of concrete + Mass of mixing drumg = Acceleration due to gravity = 10m/sec2
But, Maximum mass of concrete the mixing drum can take = 40kg (Measured)Mass of drum = 5kg (Measured)
Therefore,
Total Mass MT =$40kg + 5kg = 45kg$
Therefore,
Weight required by the grating machine $W = MT \times g = F$ [8]

- **Determination of Volume of Mixing**

The volume of the mixing chamber is calculated as follows:
$VmC = \pi r\ 2h$ (2)
were,
Vmc= Volume of mixing chamber
r = Radius of cylinder
h = Height of cylinder

- **Determination of Torque**

The torque is obtained from the equation as follow:
$T = Fl$ (4)
where;
T = Torque
F = Force
L = Length of the paddle
Therefore,
T = 450*0.376
T =169.2 N.m

- **Design of Shaft**

we know that
T/J =Tm/r
Where,
T=Toque
J= Polar moment of Inertia
J = π * d4 /32
Tm= maximum shear stress for cast iron take Tm=100MPa =100* 10 6 N/m2
r =d/2
Therefore,
equation becomes
T= π * d 3 * Tm /16 187.5 *16
= π * d 3 *100* 10 6 d
=0.02121 mm =21.21 mm for safety factor let d =25 mmtherefore, the diameter of shaft is 25 mm

5. RESULTS AND DISCUSSION

The results of the detailed design show that for a proper mixing of the concrete, a minimum force of 450N is requiredis required. This force was used to evaluate the power and torque required by the concrete mixer machine. a torque of
169.2 Nm was designed for. The torque generated by concrete mixer machine is 187.5 Nm. The mixing volume of theconcrete mixer machine was obtained as 0.486 m3 . Thus, the machine is portable enough to be moved around especially in area of frequent usage that distance is a factor. The distance between the driver and driven pulley is obtain as 0.965 m. the diameter of rotating shaft is calculated 25mm. the number of cycles done per hour is range between 11 to 14 and discharge per hour is between 440 kg to 560 kg.

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