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DESIGN & FABRICATION OF VIBRATING TABLE FOR CONCRETE MOLDS

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ABSTRACT— In this project the proposed concept is to replace the manual work of removing air bubble from concrete block by providing vibrations to the concrete block with the help of cam and motor arrangement. Concrete is a composite mixture of aggregate, water and cement. When mixed together in specific ratios, they form a mass fluid which can be easily moulded into different shapes for various functions. In order to attain the specific required strengths, concrete needs to be free of entrapped air and voids. This is done by consolidation of concrete. Consolidation is the process of removing entrapped air from concrete mould. Removal of these voids improves the outside surface of the moulded concrete that allows the use of a lower water with cement that allowing a much stronger finished product and that was achieved by providing vibrations to it with the help of vibrating table.
Keywords-. Concrete, Consolidation, Vibration, Concrete Vibrating Table Design, Concrete Molds, etc.

1. INTRODUCTION

Concrete vibrating tables has used to reduce the porosity of concrete and enhancing their bond to the reinforcement. Concrete quality was directly dependent on the consolidation of the concrete. A freshly prepared batch of concrete was honeycombed, with entrapped air. If allowed to harden in that condition, the concrete will be non-uniform, weak, porous, and poorly bonded to the reinforcement. It would also had a poor appearance. The mixture must be consolidated if it have the properties normally desired and expected of concrete. Consolidation is the process of inducing a closer arrangement of the solid particles in freshly mixed concrete or mortar during placement by the reduction of voids, usually by vibration, centrifugation, rodding, tamping, or some combination of these action. it is also applicable to similar manipulation of other cementitious mixtures, soils, aggregates. By using some kind of chemical admixtures, consistencies requiring reduced consolidation effort can be achieved at lower water content. As the water content of the concrete is reduced, concrete quality (strength, durability, and other properties) improves, provided it is properly consolidated. Alternatively, the cement content can be lowered, reducing the cost while maintaining the same quality. Vibration also improves outside surface finish, which allows the product to look better. Concrete is mixture of course particle of sand, cement and water used for construction, also sometimes chemical and /or Additives were used in concrete. Concrete that used in prefabricated material in construction should have some properties such as strength and durability. Their initial research consisted of finding existing vibration tables that might perform the task of that consolidating concrete.

2. EASE OF USE

Vibrating table has reduced labour's work and improves the quality of concrete that is strength. Vibrating table system had overcome the existing problems caused due to air trapped in mould. Vibration required for the system also can be achieved from the various sources where vibrations produced during some other operation or vibrations are associated with any kind of operation.

3. LITURATURE REVIEW

J. Manikandan et al., 2017 in studied on design and fabrication of vibrating table for separating nuts using different sizes mesh [1].Osamu Furuya, et al., 2008 studied on research and development of vibrating attenuation technique for light weight structure [2].Waluyo Adi Siswanto, et al., 2011 studied the shaker table design for electronic device vibration test system. A general purpose vibration test system has been developed to provide a testing platform for electronic devices [3].Igor Ovchinnikova, et al., 2017 studied, attempt has been made to test the vibrations caused by the vibrating table. The requirements for test results on vibration authenticity and reproducibility are discussed[4].Ercan yozgat, et al., 2011 studied concrete is composite material commonly used in construction defined as composed of aggregate (coarse and fine), water, cement and sometimes chemical and/or additives[5].Aditya Pawar, et al., 2016 studied a vibration exciter is a machine which produces mechanical vibratory motion to provide forced vibration to a specimen on which modal analysis and testing is to be performed[6].Afework Achalu, et al., 2017 studied Concrete material is the most common building material relatively low maintenance requirements add to its popularity[7].Sudarshan N.M., et al., 2017 studied the strength and durability of conventional concrete depends on number, shape and size of air voids in a concrete[8]. Y Ito, T. Uomoto., 1997 studied the sound induced by hammering the surface of the concrete has often been used for detecting defects such as voids and delamination in actual structure [9].

4. LITERATURE STUDY

After reading and study all these research paper we discussed that the flaws seen in conventional compaction process can be overcome by vibration which is the major motive behind our project.

5. NOMENCLATURE

Table no. 1. Nomenclature

Sr. No.	Symbol	Description
1	V	velocity
2	T	Time
3	F	Force
4	ω	Angular velocity
5	R_n	Normal reaction
6	d_o	Outer diameter
7	d_i	Inner diameter
8	μ	Coefficient of friction
9	M	Bending moment
10	T_{max}	max. torque transmission capacity
11	N_{crt}	Critical natural frequency
12	T	torsion
13	K	stiffness

6. PROPOSED BLOCK DIGRAM

The function of vibrating table is to generate the vibration. The block diagram of setup is as shown in below. The spring concept design will feature four springs mounted in the contact points. In order to predict the required spring rate needed to match the frequency (3900±200 RPM) and amplitudes (0.3 to 0.4 mm) desired for our system design, spring constant, damping, load, frequency of rotation, and m*e are all variables.

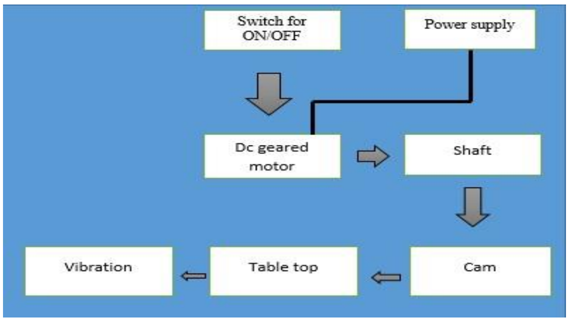

Fig .1: Block diagram of setup

We considered to create a more efficient design. Additionally, we assumed a very low damping value to model a system with springs only. At low spring rate values, k, the natural frequency of the system is greatly reduced from the 3800±300 RPM requirement but with larger values of k, the natural frequency matches the input frequency of the motor. In this situation there is a secondary/ beat frequency that emerges; this frequency is undesirable. Therefore in order to obtain the desired output of the system, a damper must be present. With a damper, the secondary frequency disappears and the system has constant amplitude with a frequency equal to that of the drive shaft. However, the damper does directly affect the amplitude of vibration and therefore, for the same amplitude, a different eccentricity is required so we are using eccentric load coupled with motor.

6.1 Design of table top

The design of rigid table top that had a cam directly attached to the motor shaft is important. That design has beneficial for keeping constant amplitude of vibration for any load size. After refining our background research they found that the amplitudes of the table top should be between 0.3 to 0.4 mm. Since the amplitudes are so small. To accomplish this required rigidity and to minimize cost, we decided to keep the existing table top thickness of 4 mm.

6.2 Vibrating table system

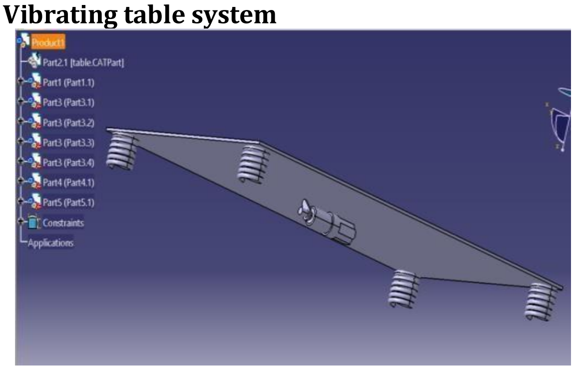

Fig. 2: Assembly of System

6.3 Calculations

D = Mean diameter of spring.
d = Wire diameter of spring.
Lo = Free length of spring.
Torque acting on spring

$$T = F \times \frac{D}{2}$$

d is diameter of wire and I is the polar moment of inertia,

$$I = \frac{\pi d^4}{32}$$

Shear stress in spring is,

$$\tau_{\mathcal{F}} = \frac{4F}{\pi d^4}$$

And due to torsion

$$\tau_T = \frac{8FD}{\pi d^3}$$

Maximum shears tress

$$\tau_T + \tau_F = \frac{8FD}{\pi d^3}\left(1 + \frac{1}{2 * \frac{D}{d}}\right)$$

$$\tau_{max} = \frac{8FD}{\pi d^3}\left(1 + \frac{1}{2 * c}\right)$$

Deflection of spring

$$\delta = \frac{8FD^3N}{Gd^4}$$

Assuming approximate weight of concrete to be 20kg to 30 kg load=200N to 300 N over an area of 600 mm×600 mm

Total load on spring =300+weight of unloaded table top =300+110=410N

Considering spring wire diameter as 6mm and spring index c is 6,

$$\text{load taken by each spring} = \frac{410}{4} = 102.5\ N$$

So

$$\tau_{max} = \frac{8 \times 102.5 \times 36}{\pi \times 6^3}\left(1 + \frac{1}{2 \times 6}\right) = 47.127\text{MPa}$$

Maximum deflection of table top is restricted to 2mm.

i.e. $$\delta = \frac{8FD^3N}{Gd^4} = \frac{8 \times 102.5 \times 36^3 \times N}{G \times 6^4} = 2.471 \times N$$

G of spring is 84000 MPa (or) approximately 80000Mpa (AISI 1095 steel spring)

N=2.471×2=5.420≈6

Net torque acting (or) motor selection for providing torque

Dead weight of system =410N

This weight is vibrated by cam which is connected to motor i.e.

m×e=torque

Mass is net mass of system including cam

$$\frac{410 + 10}{9.81} = 42\text{Kg}\,(420\text{N})$$

i.e. Radius of the cam is around 3cm i.e.30 mm

Net torque required

$$420 \times \frac{30}{100} = 12.6\text{Nm}$$

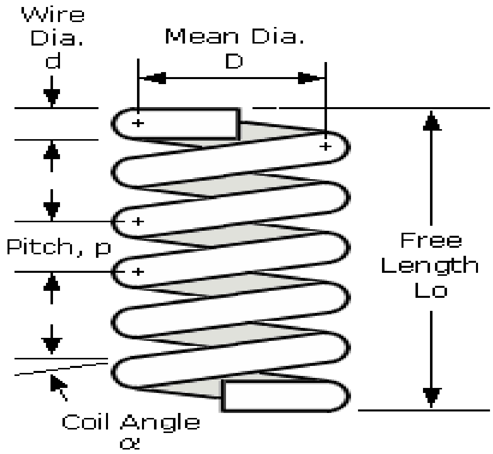

Fig. 3: Helical compression spring

Cam has selected on the basis of eccentric radius that radius taken is equal to 3 mm.

DC geared motor has selected on the basis of net torque required and number of revolution i.e. RPM

7. CONCLUSION

We concluded that the compactness of concrete mould has increased by providing the vibration to mould, due to that the strength of mould has increased.

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