Digitisation of Standard Penetration Test

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***Abstract*— Standard Penetration Test (SPT) is available for determining the Safe Bearing Capacity of soil. This equipment confirms to IS 2131-1981. During the test 65kg hammer is lifted and dropped at an height of 75cm for more than 50 times. Atleast 8 persons are required. It is very difficult to handle the equipment and also balancing the tripod is very difficult.Electric motor is used for lifting and dropping the hammer. The motor is connected to the gear box and engine. It is operated by the microcontroller. The no of blows is recorded in the digital format.In this project it can save the time, manpower, and cost of labors and also the accurate results can received. The tripod of the equipment is made up of Mild steel (Fe250),and other parts are made up of hardened steel(EN 8).In our institution the SPT equipment is available and it is manually operated. It is very difficult for the operation. In slight modification the equipment is modified to fulfill this project.**

***Index Terms*—standard Penetration Test-IS 2131-1981-Electricmotor-microcontroller-digitalformat-clutch actuator**

I. Introduction

India is one of the fastest growing economy in the world due to rapid urbanization, industrialization and infrastructure development we need more automated and digitalized equipments to full fill our dream. So, Digitisation of standard penetration test is help for finding safe bearing capacity. On tha basis of results of standard penetration tests, terzaghi and peck in 1948 proposed correlations in the form of curves. In this project 65kg weight is dropped and lifted for more than 50 times depends upon the soil condition. The blow should be applied till the sampler reaches 450mm depth in to the soil. 0.5HP motor with 1440 RPM is used to lift the 65kg hammer. The timing for upward and downward movement of weight is adjusted using gearbox in the ratio of 1:4. Clutch is provided to the gear box to drop the hammer and limit switches are fixed in the sampler to count the blows applied on the sampler. And the blows are displayed on the LED displayed automatically using c programming. The rope length is corrected for the requirement of soilpit. To alert buzzer is provided. Before starting the experiment the drop hammer timing is noted based on that drop hammer lifts and drops automatically. It is already programmed in micro controller.

II. Standard Penetration Test

AS PER BUREAU OF INDIAN STANDARDS IS-2131 (For Standard Penetration Test), the test uses a thick-walled sample tube, with an outside diameter of 50.8 mm and an inside diameter of 35 mm, and a length of around 650 mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a mass of 63.5 kg (140 lb) falling through a distance of 750 mm (30 in).The number of blows needed for the tube to penetrate each 150 mm (6 in) up to a depth of 450 mm (18 in) is recorded After that the "N" value is determined by above details**.**

III. Digitalisation of SPT

In this project the test is done automatically, the result will be given in display, number of blows required to reach a depth of 300mm is obtained by using limit switch, At the end of the test the buzzer is provided to indicate us, this technique can be easily applied in existing SPT.

IV. Working

Electric motor is used to drive the whole system it is controlled by using relay and micro-controller, The power from the motor is transmitted to gearbox by using coupling, in the gearbox the speed is reduced and the torque is increased,

The output from the gearbox is connected to clutch and the output from the clutch is connected to roller drum

In roller drum heavy rope is provided, the end of the rope holds the weight in the tripod assembly, the 65kg weight is placed in guide pipe and it is connected to drill rod, this setup of electrical motor is shown in Fig. 1.

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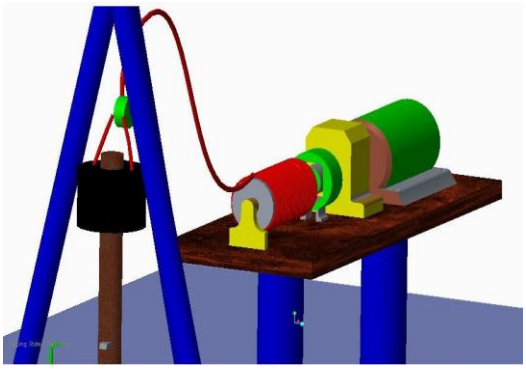

Figure 1. Electric motor is used to drive the whole system

Assembling of Motor, Gear Box and Clutch are shown in Fig. 2, 3, 4

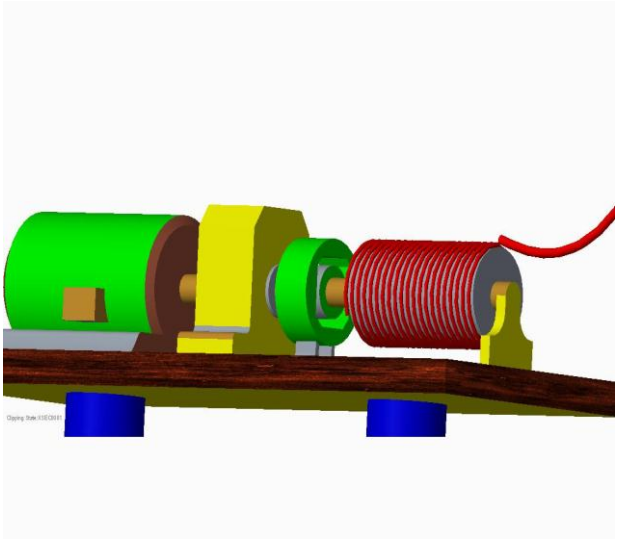

Figure 2. Electric motor is used to drive the whole system it is controlled by using relay and micro-controller

V. EQUIPMENTS USED

This system includes the following equipments

- ❖ Motor-0.5HP-1440rpm,
- ❖ Gear box(1:4),
- ❖ Clutch,
- ❖ Clutch actuator,
- ❖ Limit switch,
- ❖ Micro controller,
- ❖ Relay,

shown in Fig. 6.

Other electrical and electronic equipments

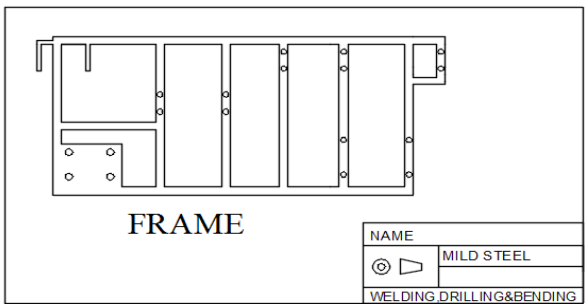

Figure 3. Frame

A. Motor

P=mgh/t,

P=65*9.81*0.75/(15),

P=31.88wt

Where,

P = power,

M = mass,

g = gravity,

h = height,

t = time.

The motor is used to operate the whole project,It gives drive and power to this system,AC-motor is used in this project which is 0.5HP The current direction is periodically reversed during each rotation by means of the commutator.

B. Gear Box

Gear box plays an important role in this project,Motor cannot able to lift a 65kg weight directly, so we use gear box to get extra torque,According to the motor speed and required torque the gear box ratio is selected

C. Clutch

In this project the clutch is used to give get an impact at gravity level, THE clutch actuater is provided to activate the clutch at the proper time.When the clutch is activated it releases the load from gearbox and makes the weight to fall freely. Clutch in SPT is shown in Fig. 5.

D. Clutch Actuator

It is provided to activate the clutch at regular interval,

When the weight reaches the top level it engage the clutch, when the weight reaches the bottom level disengage the clutch, clutch actuator shown in Fig. 7.

E. Power Supply Units

Step down transformer

- Rectifier unit
- Input filter
- Regulator unit
- Output filter

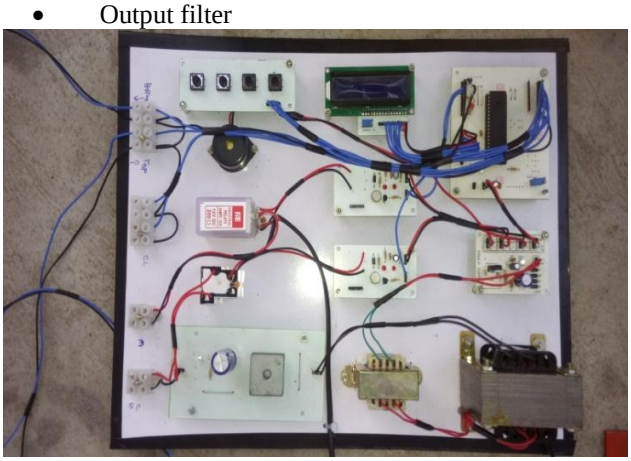

Figure 4. Electric kit

F. *Microcontroller Pic16f877a*

By using of this micro controller we control the whole machine, we can programmed in microcontroller. Micrio controller unit is shown in Fig. 4. If users do care about the chip that drives their product, they are probably seeking to surpass its intended use. The 8-bit microcontrollers are not as programmer-friendly as 32-bit processors.

VI. Design and Drawings

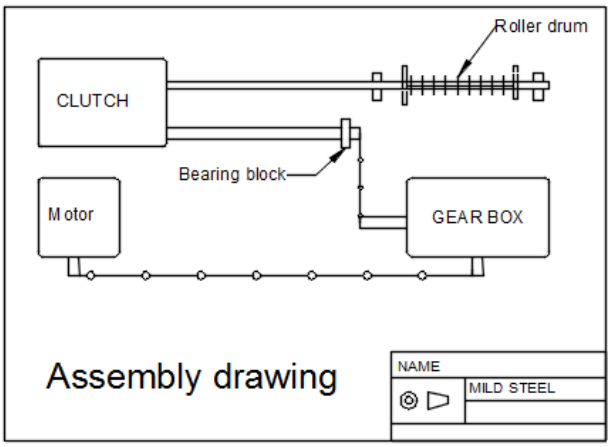

Figure 5. Assembly drawing

VII. Pictures

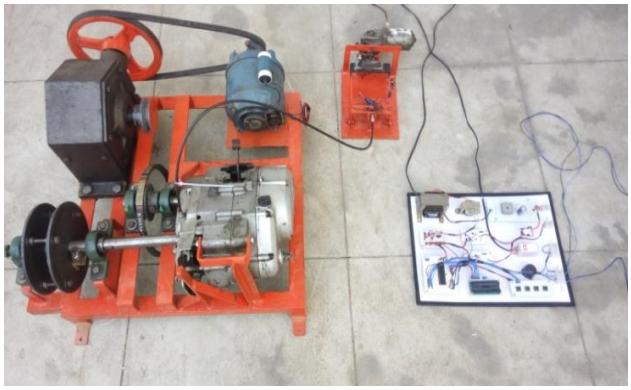

Figure 6. SPT-EQUIPMENT

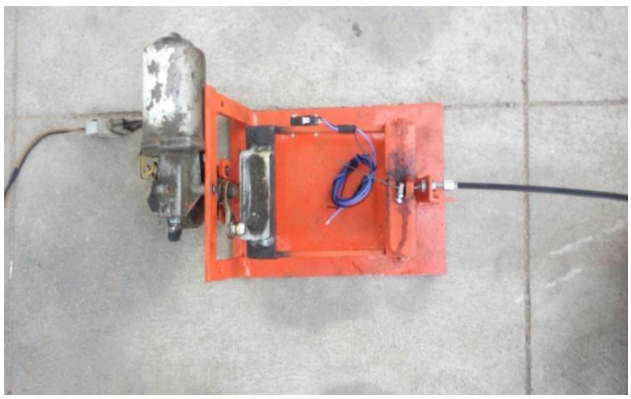

Figure 7. Clutch actuater

VIII. Test

Q=35(N-3)(B+0.3/(2B)) ŦRw2Fd KN/m ²
Q=5.54(N-3)(B+0.3/(2B))^2*R
Q=Safe Bearing Capacity of Soil,
N=Number of blows,
B=Breath of the footing,
R=Water table correction factor.
Q=41.88ton/m^2

IX. Application and Merits

- In this project the whole system will run automatically, we can save time, manpower and cost of labours,
- In this project accurate results can received,
- It reduces the manual error,
- It can be applicable for all existing Standard Penetration Testing machine.

X. Conclusion

A strong multidiscipline team with a good engineering base is necessary for the development and refinement of computer programming, assembling the machines, connection of circuits, editing techniques, diagnostic software, and algorithms for the dynamic exchange of informational different levels of hierarchy. Simulation techniques are suitable for solving calculation. But good quantitative model and a setup will help to understand the system. This project work has provided us as excellent opportunities and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling, and machining while doing this project work. We feel that the project work is good solution to bridge the gates between institutions and industries.

We are proud that we have completed the work with the limited time successfully. The **DIGITAZATION OF STANDARD PENETRATION TEST MACHINE** is working with good conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making. . In conclusion remarks of our project work, let we add a few more lines about our impression project work. Thus we have developed **DIGITIZATION OF STANDARD PENETRATION TEST** which helps to know how to achieve low cost of labors and man power. By using more techniques, they can be modified and developed according to the application.

Conflict Of Interest

"The authors declare no conflict of interest"

Authors Contribution

Author 1(Gnadhimathi.A) is a guide for project,
Author 2 (Vigneshkumar.P) execute and take the results of the Project,
Auhor 3 (Palanisamy.P) helps to write the paper.

REFERENCES

[1] K. Zurell, "Complete guide to pic microcontroller-e-bookC programming for embedded systems," *R&D Books CMP Media*, Inc. USA, Suite 200 Lawrence, KS 66046, ch. 3, pp. 29.
[2] S. Giblisco, *Teach Yourself Electricity and Electronics*, 6th ed. McGraw, Uttar Pradesh, B-4, Sector 63, Noida, 1993, Part-2, ch-9, pp. 167.
[3] P. P. Raj, *Soil Mechanics and Foundation Engineering*, Dorling Kindersley Pvt. Ltd, India, Part-14, Ch-14.8, pp. 515.
[4] V. N. S. Murthy, *Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors Pvt. Ltd, India, Ch-18, PART-A, pp. 667.