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Design of Combined Fatigue Testing Machine

OmkarP.Bhatkar[#],Sameer Y. Mhatre[1], Ashish S. Pilankar[2], Vibhavari S. Desai[3], Mohsin J. Katlikar[4]
[#]Assistant Professor,[1234]Student, Department: Mechanical Engineering.
Rajendra Mane College of Engineering and Technology, Devrukh, Maharashtra India
om.bhatkar@gmail.com, sameer.mhatre238@gmail.com, ashishpilankar333@gmail.com
vibhavari.desai28@gmail.com, mohsinkatlikar@gmail.com

Abstract– Engineering machines and mechanical components are subjected to fluctuating stresses, due to which the failure of component occur below the ultimate tensile strength. This type of failure is called fatigue failure. The machine used for this purpose is fatigue testing machine. This paper describes the design, fabrication of dual fatigue testing machine. This work was undertaken considering the high cost of the presently available fatigue testing machines to design this fatigue testing machine. Specimens are subjected to repeated fluctuating stresses and the numbers of cycles are counted till the breakage of specimen and the results are plotted.

Keywords: Fatigue Test, Part Selection, S-N Curve.

1. INTRODUCTION

Fatigue failure occurs when a material is subjected to repeated loading and unloading or fluctuating stresses for some time.

Fatigue failure begins with a small crack. This crack is so minute that it cannot be seen by naked eyes. Due to the development of crack there is variation of cross section and the stress concentration increases.

Due to the increase in stress concentration the crack begins to progress rapidly. Unlike other failures, fatigue failure does not give any prediction of the failure of component, the component fails suddenly. This failure is sudden and very dangerous and can lead to fatal accidents. Thus determination of fatigue strength of material is very important which are subjected to cyclic loading.

The fatigue life of component is defined by the total number of stress cycles required to cause failure. Fatigue life can be separated into two stages before final failure of component

$$N_f = N_i + N_p$$

Crack initiation (N_i)

Cycles required for initiation of crack. Generally results from dislocation pile-ups or imperfection such as surface scratches, voids, etc.

Crack propogation (N_p)

Cycles required for growing the crack in a stable manner to a critical size. Generally controlled stress level. Since most common materials contain flaws, the prediction of crack growth is the most studied aspects of fatigue.

2. WORKING PRICIPLES:

Principle of rotating shaft fatigue testing Machine -

The fibres of the specimen are subjected to alternate tensile & compressive stresses with the help of load applied to the cantilever specimenat one end. As the specimen rotates the fibre undergoes alternate stresses & ultimately fails.

Principle of Reciprocating Bending type fatigue testing Machine-

The specimen is subjected to alternate compression & tension with the help of crank & connecting rod mechanism. The specimen is reciprocated above & below the neutral stress line of the component, finally fails due to alternate stresses.

3. MACHINEDESIGNCONSIDERATION

The machine consists of electric motor, bearings, couplings, sensors, counters, crank& connecting rod assembly, specimens (2 types). The various components will be coupled together according to the CAD model and various theoretical principles of bending which had been thoroughly studied.

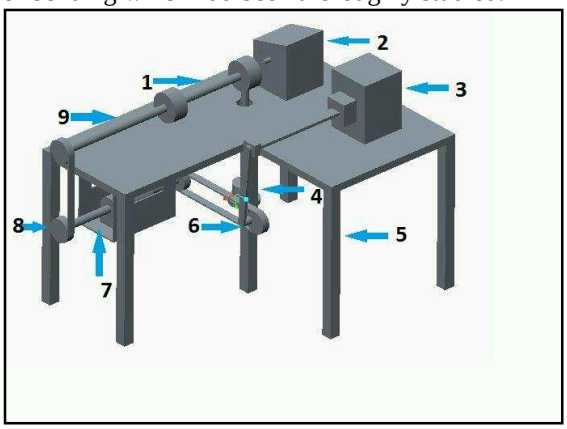

Fig.1 CAD model of combined fatigue testing machine

Part List

1. Specimen
2. Control Panel
3. Fixture

4. Dead Weight
5. Frame
6. Crank & Connecting Rod Assembly
7. Motor
8. Belt & Pulley Assembly
9. Supporting Shaft

Frame and seat of motor-
The machine is powered by 0.5 kW, 1Hp and 4200 rpm motor. It supplies the required power for the fatigue testing purpose. The frame and seat of the motor is so designed that there is an ease of adjustment of electric motor and the belt transmitting motion from the electric motor to the shaft. The overall dimensions of the seat of motor come according to the dimensions of motor.

Bearing-
The bearing selected for this machine is self-sealed spherical roller bearing due to their high load carrying capacity and property to accommodate misalignment and shaft deflection maximum of 0.5 degrees. The bearing allows the mounting of components on the shaft.

Crank and connecting rod mechanism-
This is used to hold the specimen for the reciprocating fatigue testing machine and impart reciprocating motion to the specimen. This assembly of the crank and connecting rod gives the required no. of cycles the component undergoes before the failure of the specimen.

Sensors and counters-
The sensor is used to sense the no. of revolutions before the failure of specimen. The sensor sends signals in the form of pulses to the counter which counts the no. of pulses to display on the screen. This data along with the load applied is used to plot the S-N curve.

Specimens-
The specimen selected is according to the standards. The basic dimension of both types of fatigue testing mechanism is shown in figures.

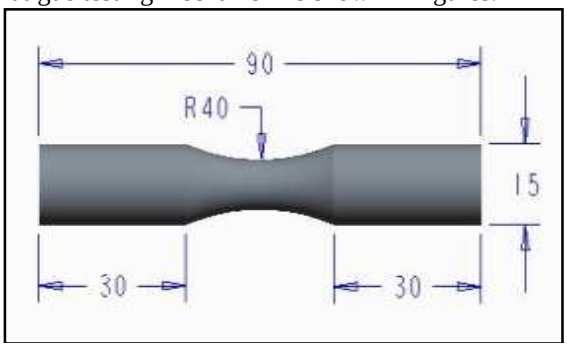

Fig.2: Rotating shaft fatigue testing specimen

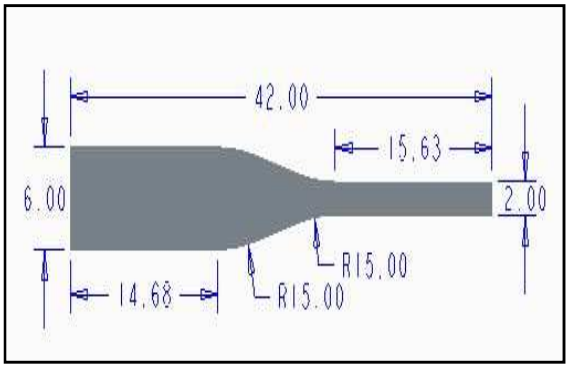

Fig.3: Bending fatigue testing machine specimen

Controls of machine:
The machine is controlled using two switches, one is to turn on the whole system and the other turns on/off the motor to start and stop the experiment. The control unit consists of the control switches and the digital counters to display the no. of revolution the specimen undergoes before failure.

4. ADVANTAGES

1. The machine designed is compact and efficient.
2. The machine utilises two types of mechanism for the fatigue testing.
3. The machine is more economical than the presently available machines in the market.

5. PLOTTINGOF RESULTS

Each test on fatigue testing machine give a point on the S-N diagram. It is also called as Wohler diagram . It is a standard way of presenting fatigue data.
The S-N curve is the graphical representation of stress amplitude versus the number of stress cycles before fatigue failure on a log-log graph paper.

REFERENCES

[1] Shreyas P, Trishul M. A., Design and fabrication of dual specimen Rotating Bending Fatigue Testing Machine, IARJSET, Vol. 2, Issue 1, January 2015, Pg. 25-27.
[2] Claude Bathias, Piezoelectric fatigue testing machines and devices, International Journal Of Fatigue, Vol. 28(11), 1438-1445.
[3] C.M.Sonsino, Fatigue testing under variable amplitude loading, International Journal Of Fatigue, Vol. 29(6), 1080-1089.
[4] I Marines, X Bin, & C Bathias, An understanding of very high cycle fatigue of metals, International Journal Of Fatigue, Vol. 25(9), 1101-1107.
[5] A Kusaba,S Okazaki, M Endo & K Yanase, Designing of a testing machine for shear-mode fatigue crack growth, International Journal of Modern Physics, Vol. 6(2012), 318-232.

[6] He Ling, Xu Cheng, Wang Yaping& Wang Yongjuan, An impact fatigue testing machine to investigate the fatigue lifetime of automatic mechanism key components, IE&EM, October 2009, 1555-1559.
[7] Jingzhong Xiang &Xin Song, study of thin-plate specimen fixture of high-frequency fatigue testing machine, EMEIT, August 2011, 3643-3645.
[8] Meng Sun,Changchun Li &Xiaodong Liu, Study on force control for fatigue testing machine based on iterative learning control, AIMSEC, August 2011, 4374-4378.
[9] V.B.Bhandari, Design of machine elements,3rd edition, pp 166-170.