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Life expectancy of structural component

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ABSTRACT

Continuously monitoring the actual load acting on the components in real-time leads to the determination of the actual range of loads acting on that components in that particular environment, based on which the component can be designed on both materials and structurally for that concern environment which leads to avoiding overestimation of loads and additional weight built up. This project concentrates on determining the life expectancy of the strut in shock absorber by placing a piezoelectric sensor in the strut of the vehicle and the real-time loads acting on the vehicle is obtained with ARDUINO UNO microprocessor board and is connected to the Display/computer unit to save the load value with respect to time and creation of structural component done by using design software CREO, now the values are imported to Ansys workbench for fatigue analysis to calculate the life of the shock absorber. In this project also depends on not only the life, but it also includes the stress, stress, total deformation for on-road condition

Keywords— *Piezo sensor, ARDUINO UNO, CREO, ANSYS, Fatigue analysis, Life expectancy*

1. INTRODUCTION

The main aim of this project is to identify the life expectancy of a structural component. Life expectancy is a product's service life of its period of usage in service. Determining a product's expected service-life as a part of business policy involves using tools and calculations from maintainability and reliability analysis**.** To identify the load value in the structural component for different road condition. After that to design, the structural component using CREO software and also load value is imported to ANSYS WORKBENCH. In Ansys, the analysis of fatigue test is used to identifyy the life expectancy.

For analyzing the life expectancy, the components which used are Piezoelectric sensor, ARDUNIO UNO microprocessor, CREO Design software, and ANSYS WORKBENCH analysis software, the combination of these things will help to do the project, and the components were explained. The structural component in our project is Shock absorber since the shock absorber also works with fatigue conditions for the road conditions.

2. LITERATURE SURVEY

Christopher J [2] et. al had published a journal, which describes a general survey of the research activities in Structural Health Monitoring (SHM) in the field of mechanical and civil and thus got the successful result on SHM. Now, there is research in process in the aeronautical field. Dorel Dumitru Valcea [3] et. al have published a journal which explains the way of optimizing a component using Ansys Workbench which aims to determine the deformation, stress, strain and fatigue life of the component. Sridhar Krishnaswamy [10] had published a journal that gives basic details of a structural health monitoring system and its significant research that are present on the health monitoring system and the way of detecting damage. K Suresh [11] et. al have published a journal, which describes basic info of piezoelectric sensor the application and the rare availability on SHM.

3. METHODOLOGY

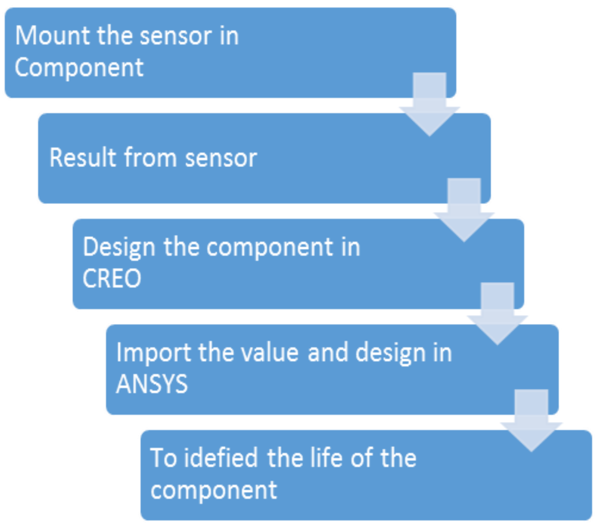

Fig. 1: Methodology

4. WORKING OF SHM

The main working of SHM is to sense the value using the piezoelectric sensor. We selected the shock absorber as a structural component. The sensing device we used here is a piezoelectric sensor and it is connected to ARDUINO UNO microprocessor board to receiver the analog input and it is transferred to digital output for displaying the load value with respect to time in the display unit as a computer. Finally, after identifying the load value of shock absorber with respect to time for certain damage and clear road condition. After that, we design the shock absorber using CREO software. Finally, the load value and design is imported to the ANSYS WORKBENCH software to analyze the fatigue analysis of the shock absorber for identifying the stress, strain, total deformation, and the main thing is the life expectancy of the shock absorber

5. MOUNT THE SENSOR

The first step is to fix the piezoelectric sensor in the strut of shock absorber to identify the load value with respect to time for the road condition. Figure 2 shows the piezo sensor placed in the shock absorber

Fig. 2: To mount the sensor in the shock absorber

6. RESULT FROM SENSOR

After that, the sensor is connected to AURDINO UNO board and the computer displays the load value with respect to time The graph Figure 3 shows the graph between pressure (bar) and time(s) which is generated with the help of a piezo sensor for the road condition.

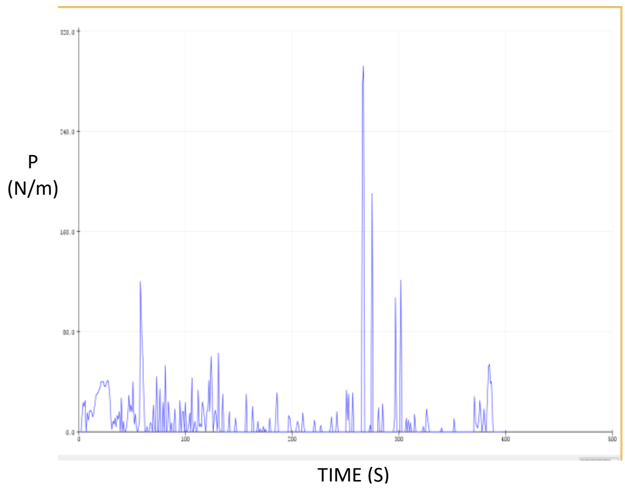

Fig. 3: Pressure vs time graph

7. PROGRAM

A part of a computer program that performs a well-defined task is known as an algorithm. A collection of computer programs, libraries, and related data are referred to as software. Computer programs may be categorized along functional lines, such as application software or system software.

```
Void loop () {
// read the sensor and store it in the variable sensorReading:
sensorReading = analogRead(SensorReading);
// if the sensor reading is greater than the threshold:
if (sensorReading >= threshold)
{
// send the string "SensorReading!" back to the computer, followed by newline
Serial.println(sensorReading);
}

if (sensorReading >= maxm)
{
// toggle the status of the ledPin:
ledState = !ledState;
// update the LED pin itself:
digitalWrite(ledPin, HIGH);
}

if (sensorReading <maxm)
{
digitalWrite(ledPin, LOW);
}
```

8. DESIGN USING CREO

The design of the component in CREO is very important to avoid real-time manufacturing of the component. Design the shock absorber using CREO software. Figure 4 shows the design of the shock absorber with top, bottom, and spring assembled by using CREO software.

Fig. 4: Shock absorber

9. ANALYSIS USING ANSYS WORKBENCH

Import the design and load value in the Ansys and the fatigue analysis of the shock absorber helps to identify the results are,

- Equivalent Stress
- Equivalent Elastic Strain
- Total Deformation
- Safety factory
- Life

9.1 Equivalent Stress

The first result is the equivalent stress of the shock absorber in the fatigue analysis using ANSYS WORKBENCH. Figure 5 shows the Equivalent stress of the shock absorber using ANSYS WORKBENCH.

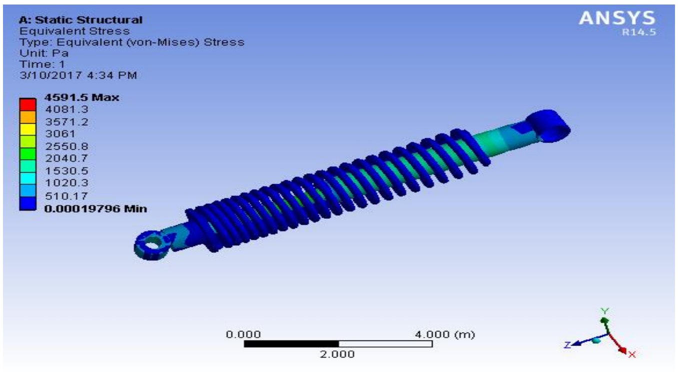

Fig. 5: Equivalent Stress

9.2. Equivalent Elastic Strain

The Second thing is the equivalent Elastic strain of the shock absorber in the fatigue analysis using ANSYS WORKBENCH. Figure 6 shows the Equivalent Elastic Strain of the shock absorber using ANSYS WORKBENCH.

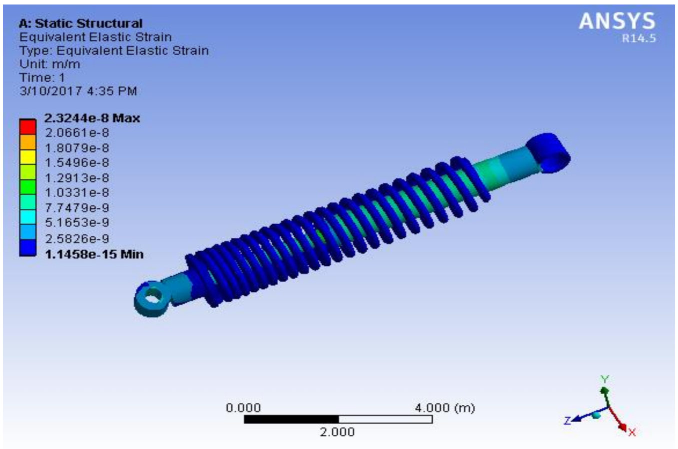

Fig. 6: Equivalent Elastic Strain

9.3 Total Deformation

The Next thing is the Total Deformation of the shock absorber in the fatigue analysis using ANSYS WORKBENCH. Figure 7 shows the Total Deformation of the shock absorber using ANSYS WORKBENCH.

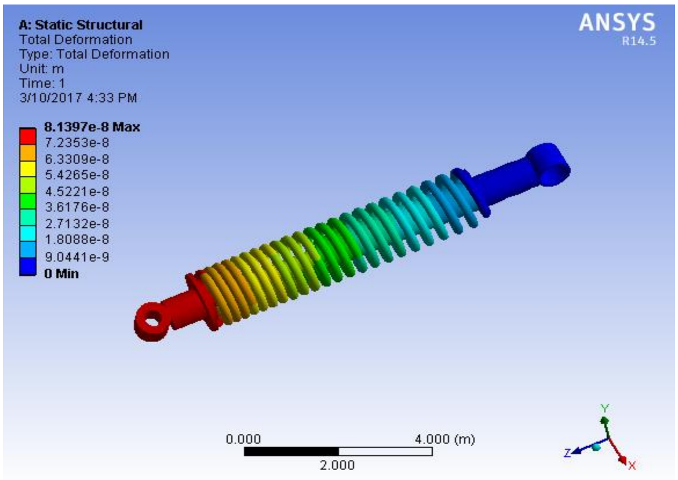

Fig. 7: Total Deformation

9.4 Safety factory

The next thing is the Safety Factor of the shock absorber in the fatigue analysis using ANSYS WORKBENCH. Figure 8 shows the Safety Factory of the Shock Absorber using ANSYS WORKBENCH.

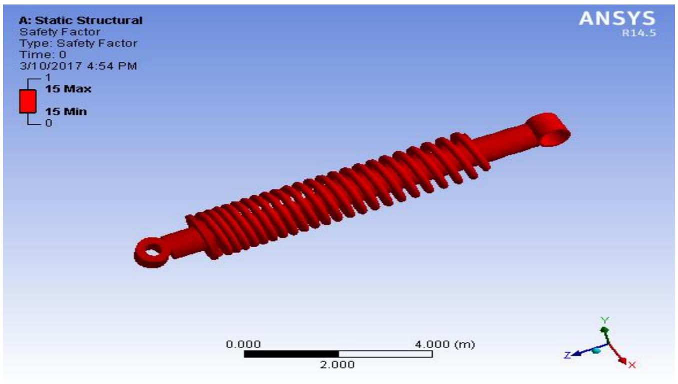

Fig. 8: Safety factor

9.5 Life

The main thing is the life of the shock absorber in the fatigue analysis using ANSYS WORKBENCH. Figure 9 shows the Life of the Shock Absorber using ANSYS WORKBENCH.

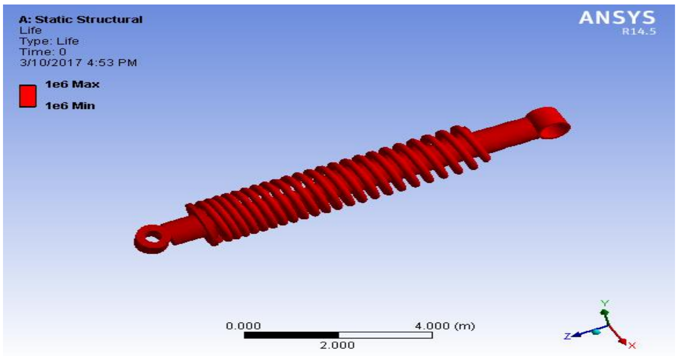

Fig. 9: Life of the shock absorber

10. APPLICATION

(a) It can be fixed one time on small vehicles like bike, car, bus
(b) It can be fixed permanently in the large vehicles like aircraft, ship, truck
(c) This will be useful for all the mechanical, automobile, aeronautical, etc.

11. CONCLUSION

Thus the condition monitoring was carried out on the shock absorber and the loads were obtained using piezoelectric sensors connected to Arduino board, structural analysis is done using Ansys by using the real-time loads and the values obtained for Equivalent Stress value is 510.17pa, Strain value is $2.58e^{-9}$, Total max deformation is 8.13^{e-8} m, Safety Factor is 15 and Life Expectancy of the component was found to be 1^{e6} cycles, so by using this approach one can determine the exact loads acting on the components in its period of life. Based on the components It can be designed or modified according to the work of the environment on both material and structural, which leads to an efficient and economically design

12. ACKNOWLEDGMENT

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13. REFERENCES

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