LIFE PREDICTION OF AN AUTOMOBILE COMPONENT UNDER VARIABLE AMPLITUDE LOADING

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Abstract— **The present work covers the prediction of fatigue life of an automobile component. The life prediction will be carried out by using n-Code software. Very firstly the component is prepared for the scanning and then 3D scanning of component is done. Furtherly CAD model is generated. To find the critical location the simulation is carried out. For the experimental purpose strain data is acquired, the data then be processed using the tools and modules of n-Code software. The fatigue life is then predicted by using n-Code software.**

Keywords— **3D scanning, Component Preparation, CAD model generation, Life prediction**

I.   INTRODUCTION

In materials science the fatigue is the incapacitation of a material caused by cyclic loading that result in progressive and localized structural damage and the growth of cracks. Once a crack has initiated then each loading cycle will grow the crack a small amount and typically producing striations on some parts of the fracture surface. During the design and development of the component/system the fatigue is one of the most important aspect to be considered. The fatigue analysis gives us the assurance of the system durability. Life prediction of component is one of the challenging and vast field in engineering. Since practically it is not possible always that based on design calculation, manufacture and run the component till failure, so it is needed to predict the life so that it can be determined that the current design is going to meet the expectations or not. If not the engineer can redesign the component to achieve maximum life of the component/system. The present work covers the prediction of fatigue life of an automobile component. The life prediction will be carried out by using n-Code software. Very firstly the component is prepared for the scanning and then 3D scanning of component is done. Furtherly CAD model is generated. To find the critical location the simulation is carried out. For the experimental purpose strain data is acquired, the data then be processed using the tools and modules of n-Code software. The fatigue life is then predicted by using n-Code software.

II.   DESIGN, DEVELOPMENT AND SIMULATION

A.   *3D Scanning –*

3D Laser Scanning is a non-contact, non-destructive technology that digitally captures the shape of physical objects using a line of laser light. 3D laser scanners create "point clouds" of data from the surface of an object. In other words, 3D laser scanning is a way to capture a physical object's exact size and shape into the computer world as a digital 3-dimensional representation.3D laser scanners measure fine details and capture free-form shapes to quickly generate highly accurate point clouds. 3D laser scanning is ideally suited to the measurement and inspection of contoured surfaces and complex geometries which require massive amounts of data for their accurate description and where doing this is impractical with the use of traditional measurement methods. It is done by using two steps,
(i)Component preparation
(ii)Scanning procedure

Fig. 3D Scanning of component

B. *Analysis simulation work* –

For the strain gauge mounting the critical locations are needed to be determined. For that purpose the simulation work is done by using ANSYS R19 software. The steps carried out are as under.

(I) The load cases are determined by using standard procedure.
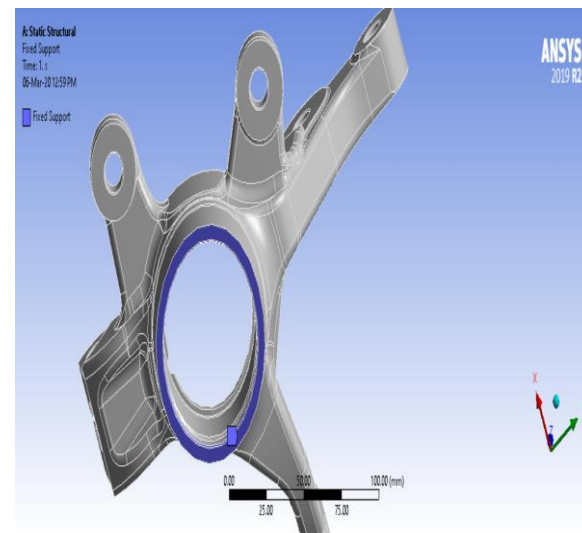
(II) The corrected orientation of CAD model is done.
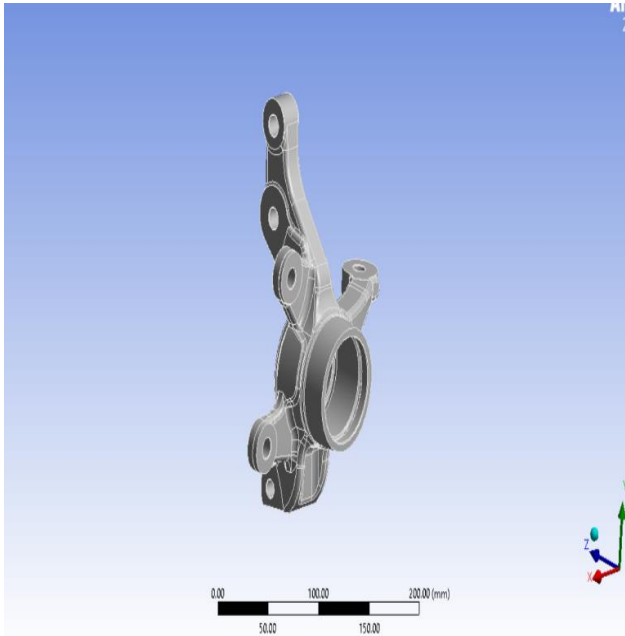
(III) The load case data is as under

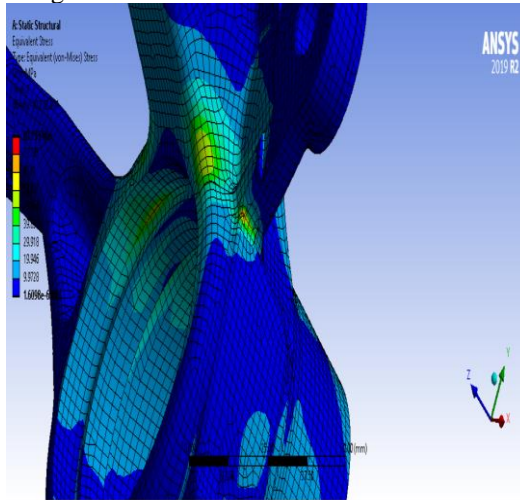|	Corrected	Orientated	Data
LOCATION	X	Y	Z
Strut Joint	70	-3140	-1080
Steering Arm	130	-90	1030
Hub	6780	-5670	-140
Lower Arm	1490	-80	30

(IV) Meshing is done on the steering knuckle. The auto meshing is generated, to make it even fine the Hex Dominant mesh is done. The element size kept is 2 mm.
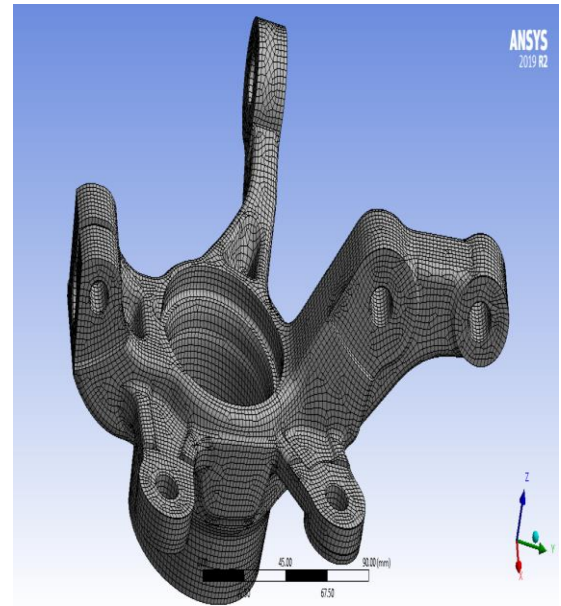
(V) Boundary conditions and the load cases are applied.

(VI)   The critical location is determined as shown in fig.

c. *Design and manufacturing of fixture for static test –*

The fixtures for static test are designed by using standard procedure.

As shown in figure the adaptor rod, sleeves, washer, guide plates are designed.

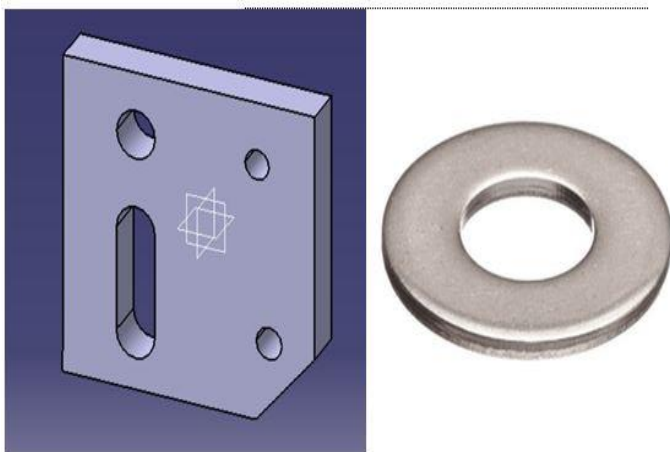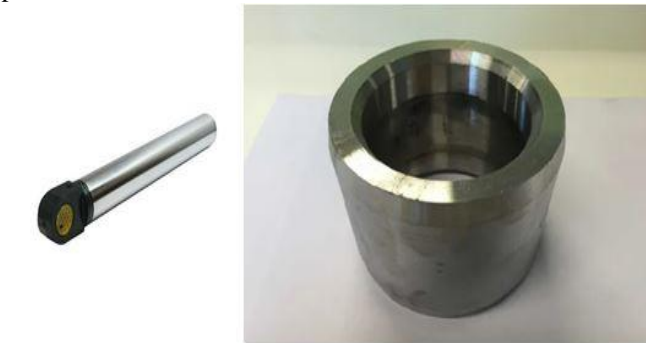**c. *Strain gauge mounting and data aquisition –***

A strain gauge can give can only give best results if it is bonded to the test piece in such a manner so that the strain experienced by the gauge grid is precisely same as that of the strain of the test specimen. To achieve this proper installation of gauge is very important. Infact the bonding technique is depended upon the type of gauges and the cement to be used which is supplied by the manufacturers. Hence the instructions given by the manufacturers catalog should be followed. In general the following steps should be followed for the bonding the strain gauges to the test specimen,

1.   Surface preparation.
2.   Gauge Preparation.
3.   Adhesive preparation.
4.   Gauge installation.
5.   Lead wire connections.
6.   Environmental protection.

As mentioned above the strain gauge is mounted.

d. Data acquisition system-
The data is acquired by using standard procedure.
The noise is removed and the filtration is done.

III.   LIFE PREDICTION AND RESULTS

The fatigue life is predicted using minors rule. The minor's rules states that Ratio of no. of cycles(n) for which a part is run at stress (σ) to the life of component at that stress (N).

$$D = \frac{n}{N}$$

Stress $\sigma 1$ for n1 cycle.
Stress $\sigma 2$ for n2 cycle.
Stress $\sigma 3$ for n3 cycle.

The damage caused at Stress $\sigma 1$ is, $D1 = \frac{n_1}{N_1}$

The damage caused at Stress $\sigma 2$ is, $D2 = \frac{n_2}{N_2}$

The damage caused at Stress $\sigma 1$ is, $D3 = \frac{n_3}{N_3}$

So the total damage caused will be equal to unity 1,
Mathematically,

$$\frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} = 1.$$

By using the principles of fatigue calculation the life is predicted.

The life predicted is 8055 repeats.

IV. CONCLUSION

1. 3D scanning is done.
2. CAD model is generated.
3. Analysis simulation is done.
4. Critical locations are determined.
5. Strain gauge data is obtained.
6. Life is predicted is 8055 repeats.

V. REFERENCE

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