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Design and Finite Element Analysis of Gear Housing Assembly Gauging System

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Abstract: ***Objective to checked bearing to bearing distance in four wheeler gear housing and distance of hypoid pinion gear shaft. To reduce or minimize the gearing housing assembly end play, for that we have to calculate and put standard shim at the end of shaft while assembly. For that requirement of customer to give customized gauging system which gives precise measurement, Effort less, easy process, Time saving and productivity improvement. Therefore the work on design and customized gauging system for shim selection method through design calculation and finite element analysis. The system will fully reliable and strong with the help of Finite element analysis of multi-gauging system for future aspect. As study of system Locator and Sliding plate have more load and forces while gauging condition. For that we study the design and complete FEA analysis. Also to ensure the reliability of the gear housing measurement system, the researcher was required to verify the precision and accuracy of the measurement system by repeatability trials. In the gear housing bearing to bearing distance measurement and inspection procedure, operator and the indirect gauging mechanism are the two key elements.***

I. INTRODUCTION

The measurement system had three components and three inspection stations. This measurement system appears to be allowing defective product to not be shipped to the customer. Measure the accurate and precise measurement of gear housing bearing to bearing face distance. To reduce the error in Production and Manufacturing. It's very difficult to find out is the exact type of shims which will fit in assembly. This type of complicated gauging system is difficult to Design and Manufacturing. Also this Gauging systems are to be reliable, because they use year and year with continuous mass production. The given parameter of the component and actual value of component that result co-relation and gauge proven is difficult.

II. CONCEPT CREATION AND PARAMETER STUDY

Concept creation for the three fixture so at every station below three parameters are to be checked. So as per customer requirement there is manual loading on fixture assembly but automatic cycle with rotation are considered in gauging system.
Gauging Fixture:-

a) STATION "B"- Measure Distance from Top Bearing Face to Bottom Bearing Face.
b) STATION "A"- Measure Distance from Groove Face to Upper Resting Face.
C) SHIM STATION – To Measure required Shim Thickness.

III. DESIGN OF FIXTURE

The design of gauging system total three fixture assembly system at three station. For checking bearing to bearing distance checking required in the system, but bearing to bearing required the force on top face of taper roller bearing. Also while assembly taper roller bearing required to settle down with the help of gearing housing carrier rotation. With the top force and rotation we will calculate the bearing distance, so gearing housing assembly fixture design considered with pneumatic cylinder and timing belt pulley assembly by motor rotation. For checking hypoid pinion height pneumatic clamp and spring loaded assembly are used in hypoid pinion distance fixture assembly. For shim confirmation the single cylinder used to check the spacer height checking fixture design.

IV. CONSIDERATION OF LOAD AND SUPPORT CALCULATION

Above fixture design and manufacturing multiple material used as per requirement and application. Mainly Mild steel, OHNS, EN-31 steel, brass are used. But as per study the mainly load and forces are acting on bearing to bearing face distance due to

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pneumatic cylinder force and component self-weight. The maximum load and forces are generated on main locator and sliding plate whether all assembly are rested, also cylinder forces are acting on it. Fixed support are bottom face of locator which rested on sliding plate. Fixed support of sliding plate are bolted with rail block. So for locator EN- Steel material used and mild steel used for sliding plate.

Table. 1 FEA Parameter of Locator and Sliding Plate

Sr. No.	Element type	FEA Parameter	Element type	FEA Parameter
1	Locator Material type	EN-31 Steel	Sliding Plate Material type	Mild Steel
2	Tensile Strength	750 N/mm²	Tensile Strength	440 Mpa
3	Yield Stress	450 N/mm²	Yield Stress	370 Mpa
4	Reduction of Area	0.45	Reduction of Area	0.40
5	Elongation	0.3	Elongation	0.29
6	Force on Top Face of Locator (F)	1277 N	Force of Assm. Resting Face on Sliding Plate (F)	1522 N
7	Force on Top Face of Locator (F)	1446 N	-	-

V. FINITE ELEMENT ANALYSIS

In finite element analysis we are observed the output results of locator. Locator have 25 mm thickness and material is EN – 31 Steel. On top face of locator 1277 N force generating due to top pneumatic cylinder and self weight of component. Also 1442 N force generating on bottom face of locator due to overall assembly located on bottom face of locator.

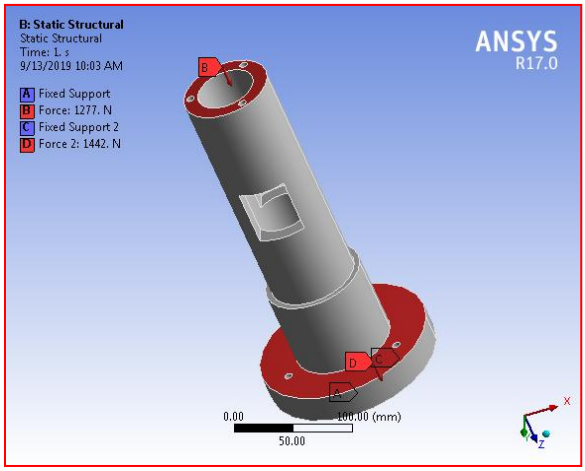
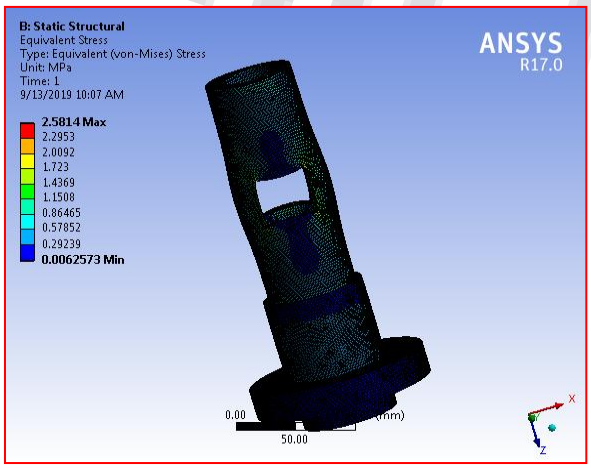


Fig. 1 (a) Fixed Support and Forces



(b) Stress Distribution of Locator

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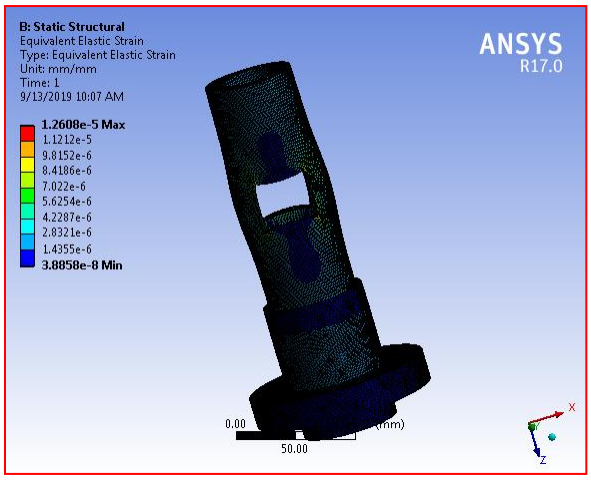


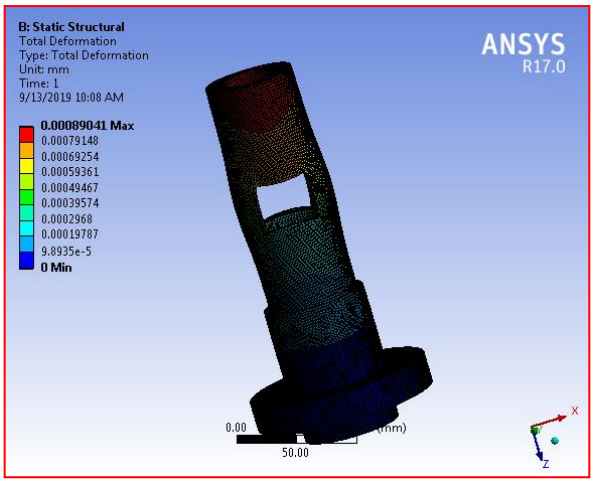
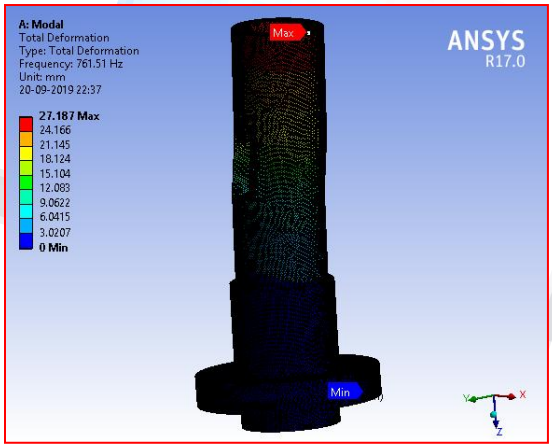


Fig. 2 (a) Strain Distribution of Locator **(b)** Total Deformation of Locator

The modal frequencies are:



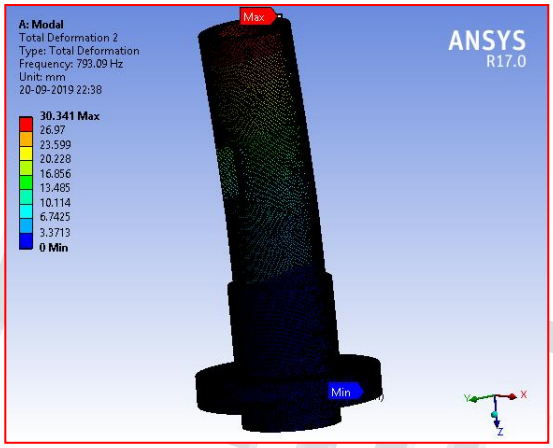


Fig. 3 (a) Model Phase 1 of Locator **(b)** Model Phase 2 of Locator

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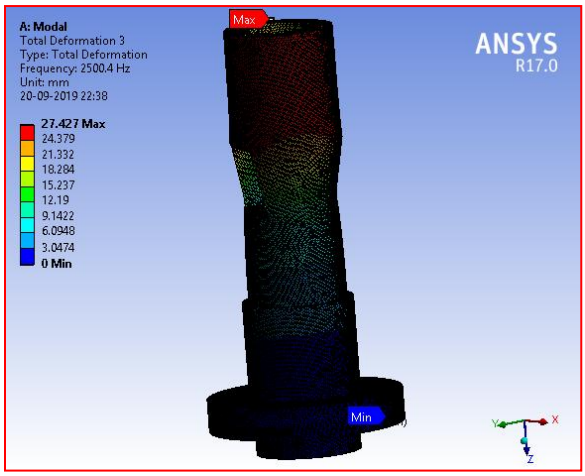


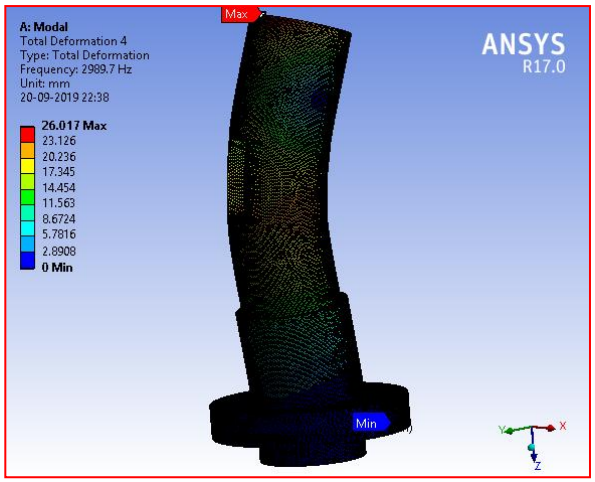
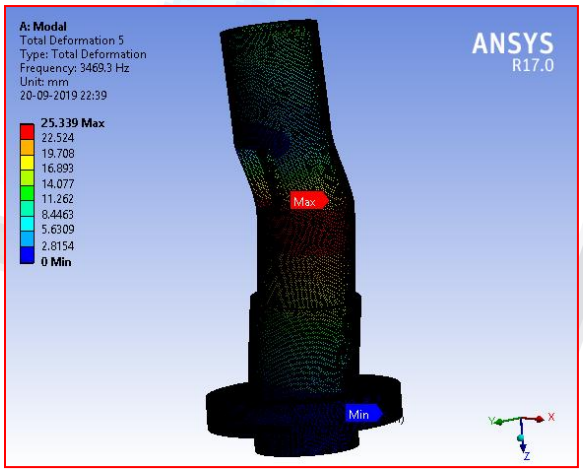


Fig. 4 (a) Model Phase 3 of Locator **(b)** Model Phase 4 of Locator



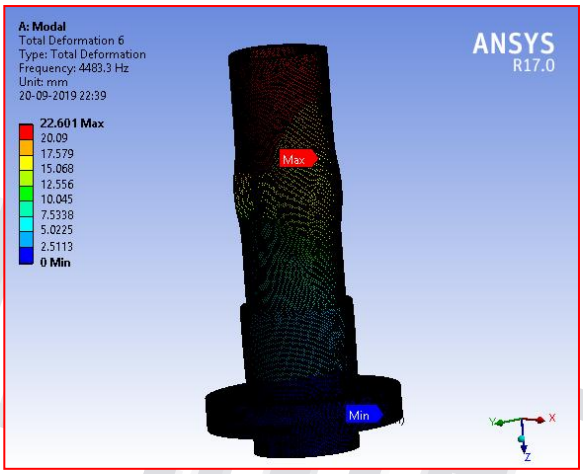


Fig. 5 (a) Model Phase 5 of Locator **(b)** Model Phase 6 of Locator

In model analysis of locator have first natural frequency of locator is 781.56 Hz. It is taken as the natural frequency of system. The value of the natural frequency is higher than excitation frequency of 60 Hz. So system is safe.

In finite element analysis we are observed the output results of sliding plate. Sliding plate have 25 mm thickness and material is mild steel. 1552 N force generating on upper face of sliding plate due to overall assembly rested on upper face of sliding plate.

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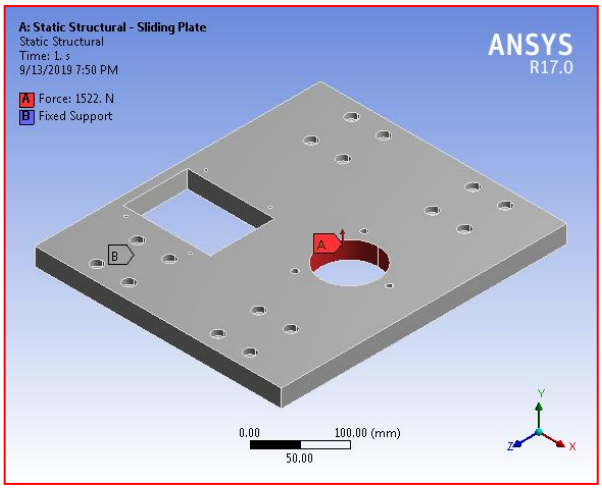


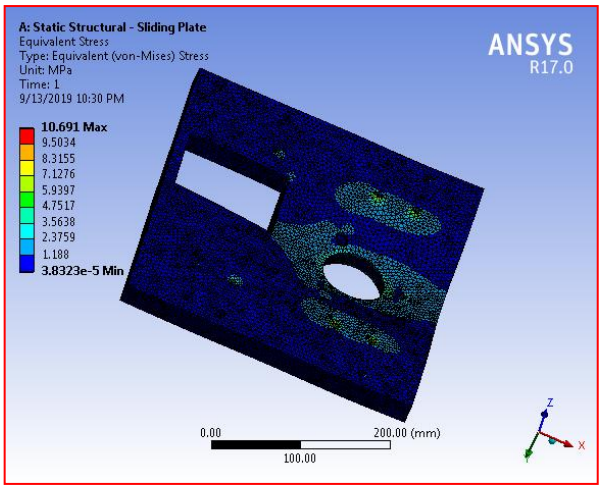
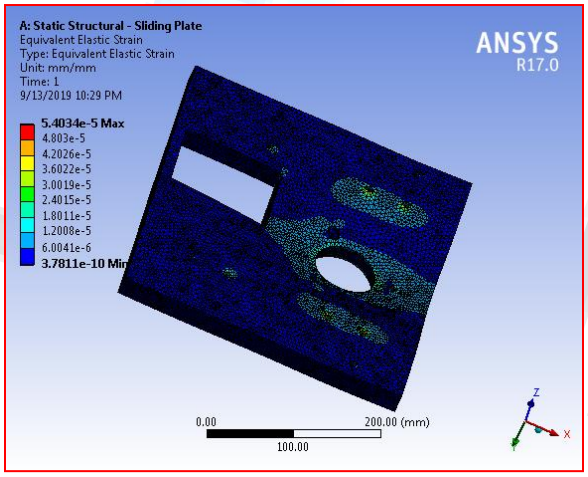


Fig. 6 (a) Fixed Support and Forces on Sliding Plate **(b)** Stress Distribution of Sliding Plate



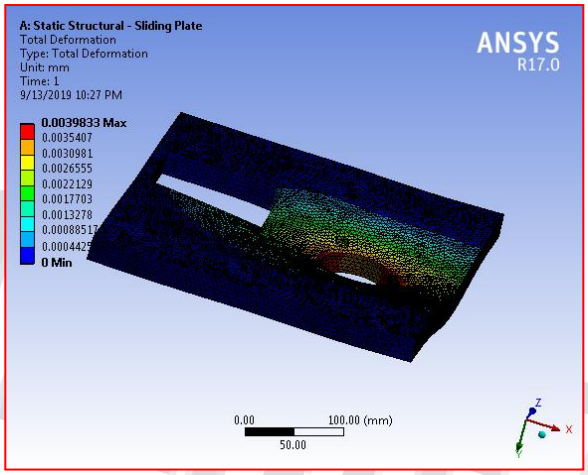


Fig. 7 (a) Stress Distribution of Sliding Plate **(b)** Total Deformation of Sliding Plate

The modal frequencies are:

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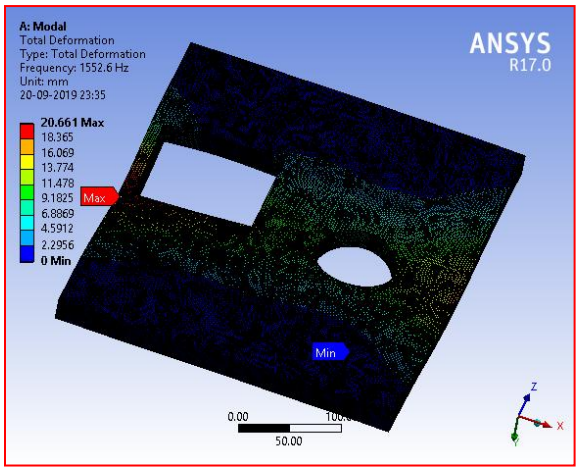
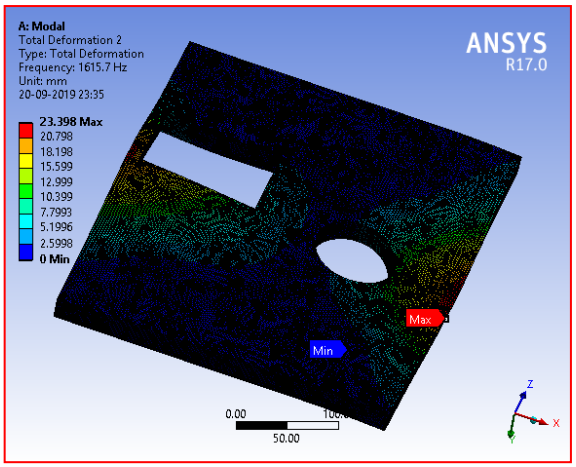


Fig. 8 (a) Model Phase 1 of Sliding Plate



(b) Model Phase 2 of Sliding Plate

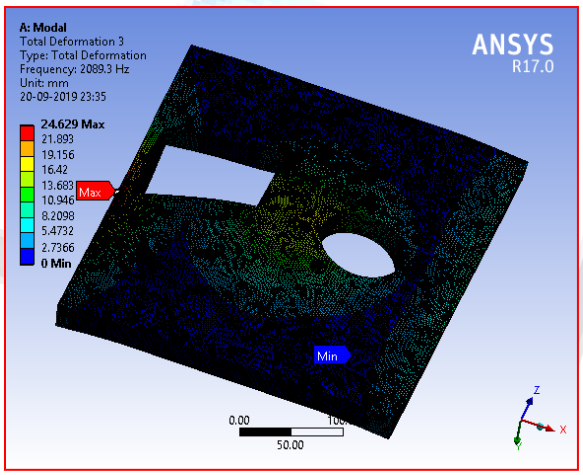
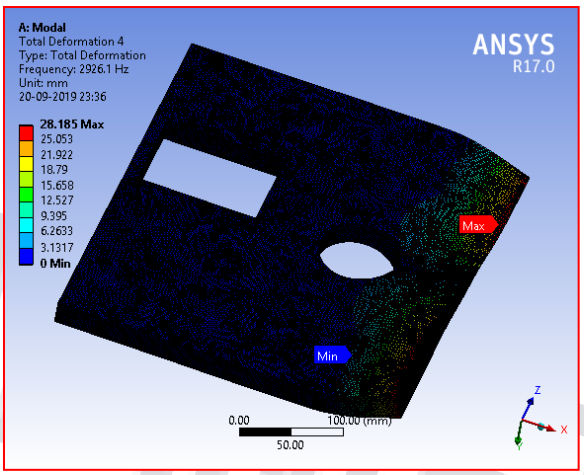
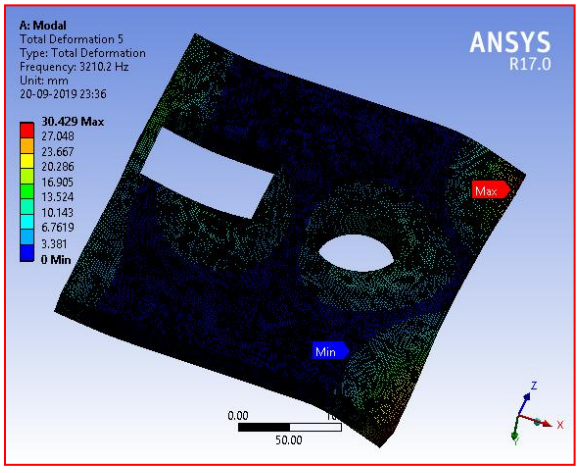


Fig. 9 (a) Model Phase 3 of Sliding Plate



(b) Model Phase 4 of Sliding Plate



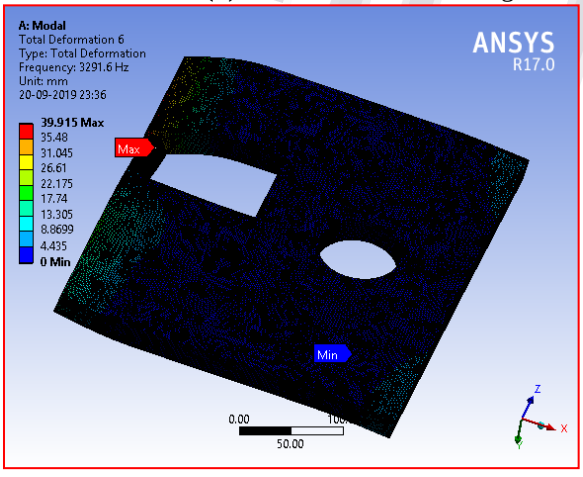


Fig. 10 (a) Model Phase 5 of Sliding Plate **(b)** Model Phase 6 of Sliding Plate

In model analysis of sliding plate have first natural frequency of sliding plate is 1552.6 Hz. It is taken as the natural frequency of system. The value of the natural frequency is higher than excitation frequency of 60 Hz. So system is safe.

VI. RESULTS

As above figure shows, Main locator and sliding plate in finite element analysis results shows the locator in static structural analysis not reach ultimate level, also model analysis locator ensured resonance avoided. Sliding plate static structural analysis shows that sliding plate not reach ultimate level, also in modal analysis of sliding plate resonance is avoided. As FEA results shows, design and manufacturing of gearing housing assembly system completed which gives accurate results by repeatability, GRR and SPC analysis.

Conclusion

In this study, we have focuses on the design and finite element analysis of a Gear housing assembly gauging system. Gear Housing assembly gives results as below following:-

1. Automatic system for checking
2. Accurate and Precise results
3. Productivity Improved
4. Time saving.
5. One System for Multiple parameter.
6. SPC analysis and Database saving.

The above research is depend on basic principles of design, finite element analysis and checking of gear housing assembly gauging system, so from above method we can design and finite element analysis for any component or part.

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