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FATIGUE ANALYSIS AND OPTIMISATION OF CONNECTING ROD USING FEA

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ABSTRACT

Fatigue strength was the most significant factor (design driving factor) in the optimization of connecting rod. The main aim of present research paper is fatigue analysis and optimization of connecting rod. It is estimated that 50-90% of structural failure is due to fatigue, thus there is a need for quality fatigue design tools. The focus of fatigue in ANSYS is to provide useful information to the design engineer when fatigue failure may be a concern. Fatigue results can have a convergence attached. A stress-life approach has been adopted for conducting a fatigue analysis. Several options such as accounting for mean stress and loading conditions are available. The Optimization carried out in analysis gives deep insight by considering optimum parameter for suggestion of modification in the existing connecting rod. Optimization was performed to reduce weight. Weight can be reduced by changing the material of the current forged steel connecting rod to crack able forged steel (C-70). The optimized geometry is 20% lighter than the current connecting rod.

Keyword: *FATIGUE ANALYSIS, OPTIMISATION, CONNECTING ROD, FEA*

Tool sets required

Software/Hardware requirements:

Pro/E Wildfire 3.0 :For Solid Modeling

ANSYS WORKBENCH 9.0 :For Finite Element Analysis

Fatigue Analysis:

A fatigue analysis can be separated into 3 areas: materials, analysis, and results evaluation. A large part of a fatigue analysis is getting an accurate description of the fatigue material properties. Since fatigue is so empirical, sample fatigue curves are included only for structural steel and aluminum materials. Several results for evaluating fatigue are available to the user. Some are contour plots of a specific result over the model while others give information about the most damaged point in the model. Outputs include fatigue life, damage, factor of safety, stress biaxiality, fatigue sensitivity

Stress-life Data Options/Features

• Fatigue material data stored as tabular alternating stress vs. life points.

• The ability to define mean stress dependent or multiple r-ratio curves if the data is available.

• Options to have log-log, semi-log, or linear interpolation.

• Ability to graphically view the fatigue material data

• The fatigue data is saved in XML format along with the other static material data.

• Fig. 1 shows a user editing SN curves in ANSYS.

• Table 1 is a screen shot showing a user editing fatigue data in ANSYS

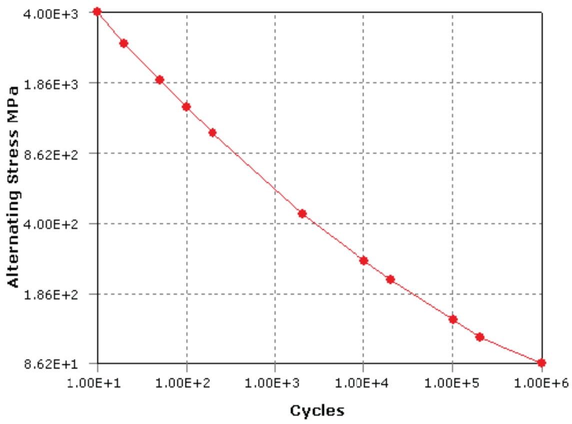

Fig. 1 User Editing SN curves in ANSYS

Table 1 User Editing Fatigue Data in ANSYS

Cycles	Alternating Stress
10.0	3,999.0 MPa
20.0	2,827.0 MPa
50.0	1,896.0 MPa
100.0	1,413.0 MPa
200.0	1,069.0 MPa
2,000.0	441.0 MPa
10,000.0	262.0 MPa
20,000.0	214.0 MPa
100,000.0	138.0 MPa
200,000.0	114.0 MPa
1,000,000.0	86.2 MPa

Optimization

Objective of the optimization task was to minimize the mass of the connecting rod under the effect of a load range comprising the two extreme loads, the peak compressive gas load, such that the maximum, minimum, and the equivalent stress amplitude are within the limits of the allowable stresses. The production cost of the connecting rod was also to be minimized. Furthermore, the buckling load factor under the peak gas load has to be permissible.

Mathematically stated, the optimization statement would appear as follows:

Objective: Minimize Mass and Cost

Subject to:

- Compressive load = peak compressive gas load.
- Maximum stress < Allowable stress.
- Side constraints (Component dimensions).
- Manufacturing constraints.
- Buckling load > Factor of safety x the maximum gas load

Shape Results

Table 2 Values

Name	Figure	Scope	Target Reduction	Predicted Reduction
"Shape Finder"	5.33	"Model"	20.0%	9.24% to 9.51%

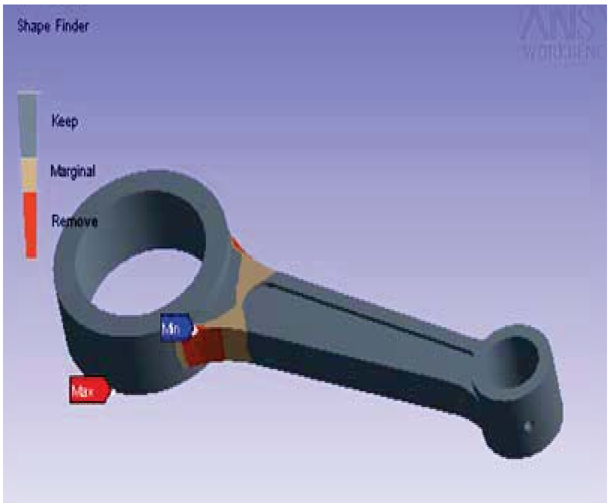

Fig. 2 Shape Finder

CONCLUSIONS

1) There is considerable difference in the structural behavior of the connecting rod between axial

fatigues loading. The result obtained with the analysis tool is quite comfortable and can be used to optimize the model

2) Fatigue strength was the most significant factor (design driving factor) in the optimization of this connecting rod.
3) The parameter consideration for optimization are its 20 % reduction in weight of connecting rod, while reducing the weight, the static strength, fatigue strength, and the buckling load factor were taken into account.
4) The optimized geometry is 20% lighter than the current connecting rod. PM connecting rods can be replaced by fracture split able steel forged connecting rods with an expected weight reduction of about higher than existing connecting rod, with similar or better fatigue behavior
5) The structural Finite Element Analysis of connecting rod using ANSYS 9.0 gives the approximate results. These results are compared with the experimental results. The experimental results are nearly similar to software results. So that Finite Element Analysis results using ANSYS9.0 is valid results
6) Optimization was performed to reduce weight. Weight can be reduced by changing the material of the current forged steel connecting rod to crack able forged steel

REFERENCES

1) Serag, S., Sevien, L. Sheha, G. and El-Beshtawi, I., 1989, "Optimal design of the connecting-rod", *Modeling, Simulation and Control, B, AMSE Press*, Vol.24, No.3, pp. 49-63.
2) Sarihan, V. and Song, J., 1990, "Optimization of the Wrist Pin End of an Automobile Engine Connecting Rod with an Interference Fit," *Journal of Mechanical Design*, Transactions of the ASME, Vol. 112, pp. 406-412.
3) El-Sayed, M. E. M., and Lund, E. H., 1990, "Structural optimization with fatigue life constraints," *Engineering Fracture Mechanics*, Vol. 37, No. 6, pp. 1149-1156.
4) Balasubramaniam, B., Svoboda, M., and Bauer, W., 1991, "Structural optimization of I.C. engines subjected to mechanical and thermal loads," *Computer Methods in Applied Mechanics and Engineering*, Vol. 89, pp. 337-360.
5) Pai, C. L., 1996, "The shape optimization of a connecting rod with fatigue life constraint," *Int. J. of Materials and Product Technology*, Vol. 11, No. 5-6, pp. 357-370.
6) Ali Fatemi and Mehrdad Zoroufi, "Fatigue Performance Evaluation of Forged Versus Competing Process Technologies: A Comparative Study", 24th Forging Industry Technical Conference, Cleveland, Ohio, 2002