CASE STUDY

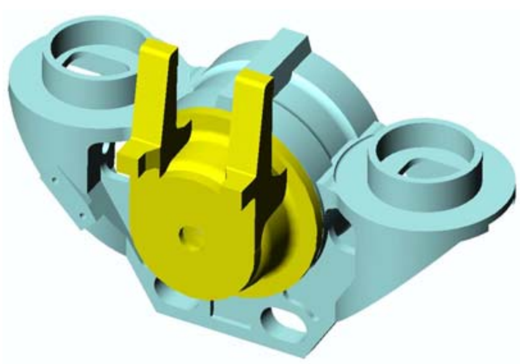
ACHIEVING EXCELLENCE IN ENGINEERING

Design Assessment of a Train Bearing Housing

The Problem

A high speed train had been designed and our client, a major international bearing company, was awarded a contract to supply the axle bearing and housing assemblies for the prototype.

Once the design of the bearing housing had been completed, it was necessary to confirm that it had sufficient strength and an infinite fatigue life. The housing assembly is subjected to loads from the suspension springs, damper and a torque reaction link. A number of load combinations needed to be considered in order to confirm that the housing assembly would withstand in-service conditions.

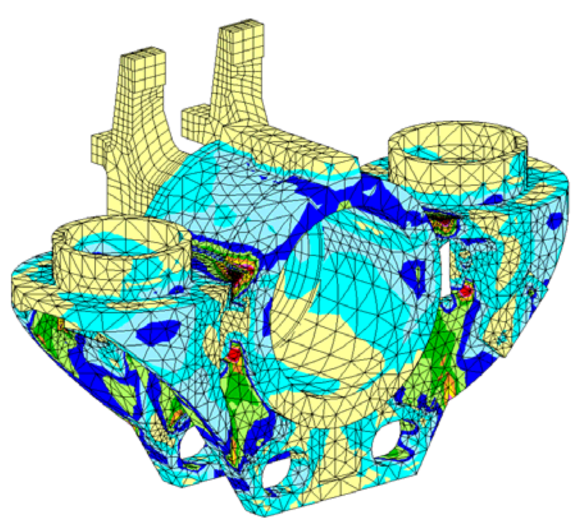


Special points of Interest:

- Design assessment of a bearing housing required
- Shown that the design was adequate for testing of prototype train
- Following successful testing, large order placed for trains
- Optimization of the design achieved the required fatigue life, without changes to the surrounding structures

The Approach

The housing is a relatively complex casting, and in order to calculate the stresses and the fatigue life to a sufficient level of accuracy, it was necessary to perform a Finite Element Analysis. To ensure the behaviour of the bearing housing was modelled accurately, it was necessary to represent the end cover plate and bearing assembly as well as the housing. When creating the FE model, it was not feasible to represent all small fillet radii and local geometry features.



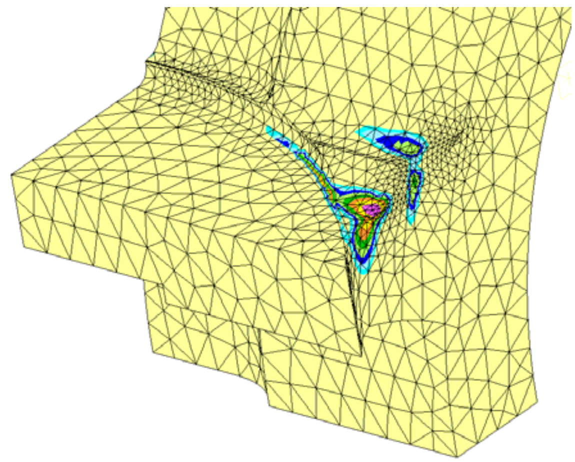
Stress levels calculated using the global model

However, these features can affect the peak stress levels, and hence must be taken into account in the analysis. To overcome this problem, sub-modelling of the most highly stressed regions was undertaken.

This involves creating a detailed FE model of each of the local regions with all geometry features modelled. By applying the displacement field, obtained from the analysis of the global model, to the edges of the sub-model, along with any other relevant loads, the accurate stress field can be calculated.

The Results

The analysis showed that the housing had sufficient strength, and the stress levels under the proof loads would not reach the yield strength of the material. However,under the fatigue loads, the calculations showed the housing could withstand a large number of cycles, but would not have an infinite life due to high stress ranges occurring at local features. On the basis of the analysis, it was decided that the housing was adequate to enable safe operation and testing of a prototype train.



Sub-model showing reserve factor for fatigue

The Outcome

A prototype of the high speed train was built and tested. Its performance exceeded the specification, and the design was considered to be successful. A large order was placed for new trains, and our client received the order for the bearing housing assemblies.

In order to achieve the required infinite fatigue life, Eatec undertook optimization of the bearing housing design. By changing fillet radii and blend angles it was possible to achieve the required fatigue life, without impacting on the designs of the surrounding structures.

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