ME-573 Project 1

(Total project is worth 200 points with each section weighted equally. Project time is 2 weeks)

Overview:

In this individual project a 'real' engineering design will be analyzed using:

1) Classical (deterministic) methods
2) Nouveau (probabilistic) methods

The results will be compared and discussed in light of the track record of the design and the potential for improvement in engineering efficiency.

Project:

The engineering design is a case study of a failure analysis problem. You will analyze the design using your present (or readily achievable) grasp of deterministic or probabilistic design methods and determine whether this device should have been expected to fail. Note that of particular interest are the hook at the location of maximum tension and the shank at the transition to the threaded section. At a minimum, determine FS and R at each of these locations. Be sure to state all assumptions.

In conducting this project you will need to determine tolerances for the nominal dimensions. In addition, you will need to determine statistics (actual or estimated) for dimensions, loads and material properties of interest. The sources of your information should be credible and easily referenced.

The formal report required at the end of this project should be written for a technical manager. However, it should also contain a management summary at the beginning and targeted for upper management. The bulk of the report should be written for an engineering manager who will appreciate technical content. Where appropriate, explanatory charts, figures, and plots should be included in the text. Appendices should contain all useful and appropriate information not directly required for the text.

1) Deterministic:

In conducting the deterministic analysis you will need to determine a factor of safety for the engineering design as implemented. You will also need to comment on the appropriateness of this factor of safety for the particular application and whether the design and associated analysis is appropriate for the application. Simplifications of the loading, geometry, etc. for the analysis is acceptable if the assumptions are explained and well documented. Keep in mind that the basis of the analysis will be used in the probabilistic analysis.

2) Probabilistic:

In conducting the probabilistic analysis you will need to determine reliability for the engineering design as implemented. You will also need to use the statistics (determined or estimated) for dimensions, loads and material properties of interest. Where necessary and appropriate, confidence bounds (justified by you) should be implemented for the particular application. Comment on whether the design and associated analysis is appropriate for the application.

3) Comparison/Evaluation:

In comparing the two approaches to mechanical design (deterministic vs. probabilistic), compare the results of the two methods. Comment on the appropriateness of each method to your chosen engineering design. What are the specific advantages and disadvantage of each approach? Which approach is more realistic? Which is "safer"? Which would you use in engineering practice?

Given that this component was observed to have failed under the loading conditions provided, which of the analysis "admits" that the failure could have occurred?

Crane Hook

Standard working load was 15 tonnes (1 tonne=2210 lb), however, the safe working load varied from a minimum of 7.5 tonnes to a maximum of 20 tonnes. Loading is assumed to be vertical in the hook, collinear with the centerline of the threaded shank. The hook was as-cast with some deburring. Material was cast steel with 0.16% C and 0.53% Mn as major alloys. As-received Brinell hardness was 150 kg/mm^2. All dimensions are shown in Figure 1.

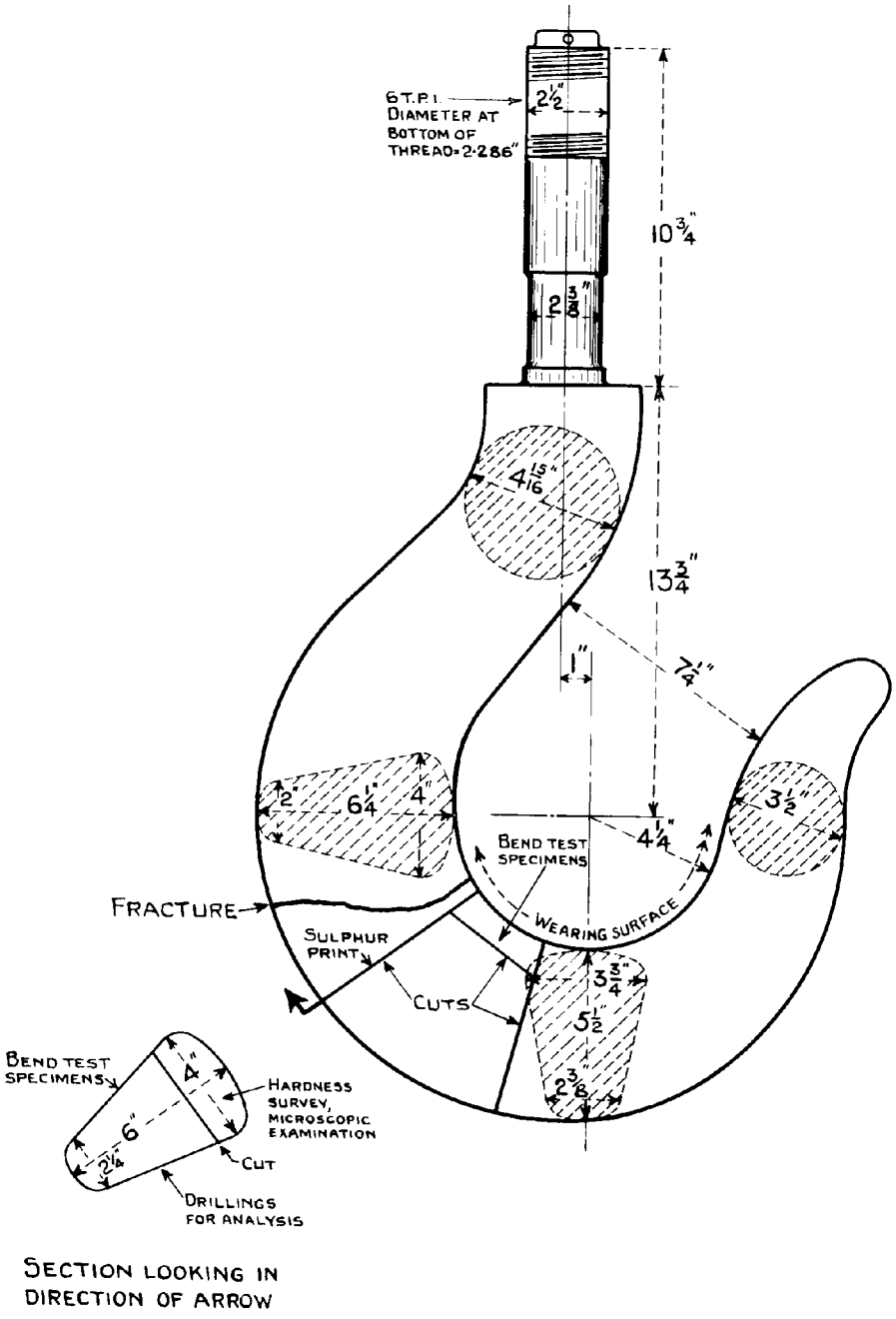

Figure 1 Dimensions in hook