

For each of the following sets of photographs (SEM), describe as much as you can. For example, “brittle fracture propagating in the direction shown” (*then include an arrow on the photo indicating fracture direction*). If possible, offer an explanation about what caused the failure.

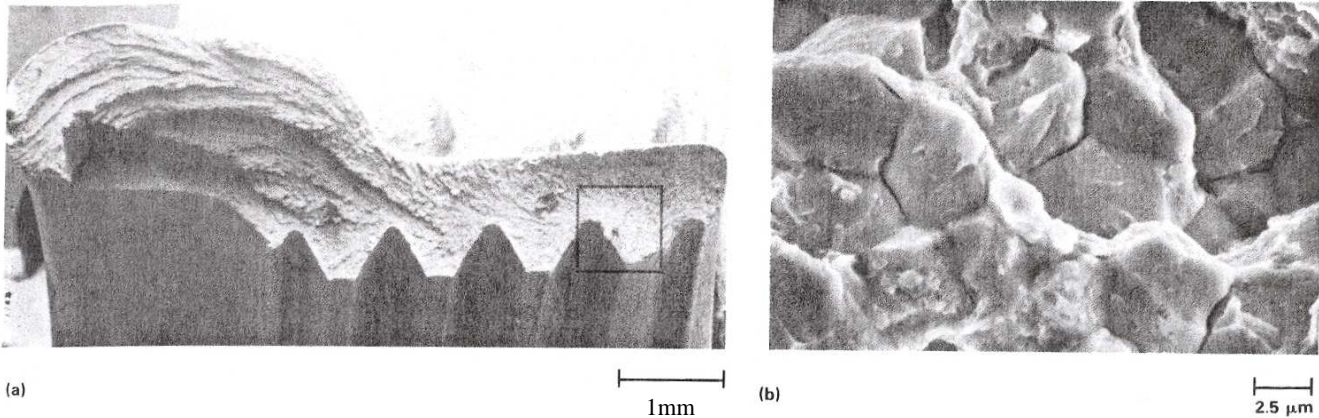


Figure 1 – AISI 8740 steel nut failure with cadmium plating. Image (b) is a high magnification image taken from near the thread.

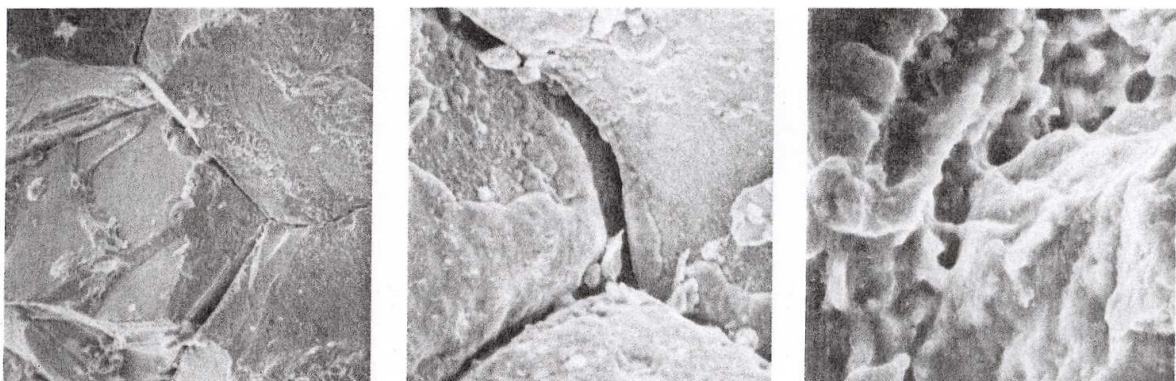


Figure 2 – images of three different metals, but all showing the same failure mechanism.

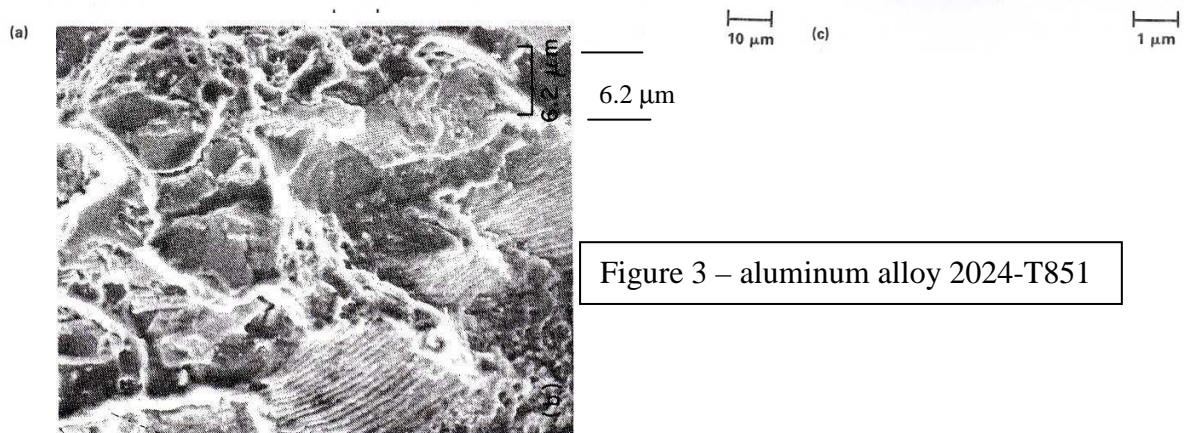


Figure 3 – aluminum alloy 2024-T851

TO: Students, ME 421
FROM: Dr. K. Lulay
DATE: November 2, 2011
REF: Due November 9, 2011

The purpose of this memo is to inform you of your job reassignment. As you may know, our company is involved with designing a 3-lane bridge for Highway 99 in California. One of our designers (Mr. Smite) has taken a position at another company. You have been assigned to this project as his replacement. Mr. Smite was responsible for designing the hanger joints. He had completed the concept phase of the design, but had not completed any details. In this memo, I will describe the overall bridge design as well as Mr. Smite's concepts. At the end of this memo, I am requesting specific work from you.

This bridge is supported from pillars beneath the decking. It consists of three sections: left, center and right (see Figure 1). The left and right sides are each supported by two sets of pillars. The left and right sides support the center section. The center section will be 88 feet long. The loads from the center section are transferred to the left and right sections through hanger joints. The joints consist of a hanger plate bolted to both the right side and center side (and left side and center side). There is one hanger joint per section, per side of the bridge (four total hanger joints). The center section is supported in this manner to allow for thermal contraction and expansion. Steel girders (I-Beams) support the bridge decking.

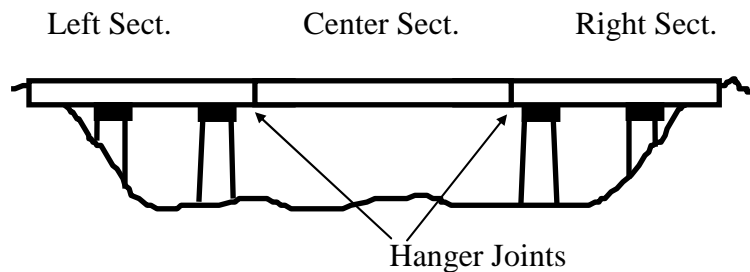


Figure 1 - Overall bridge design.

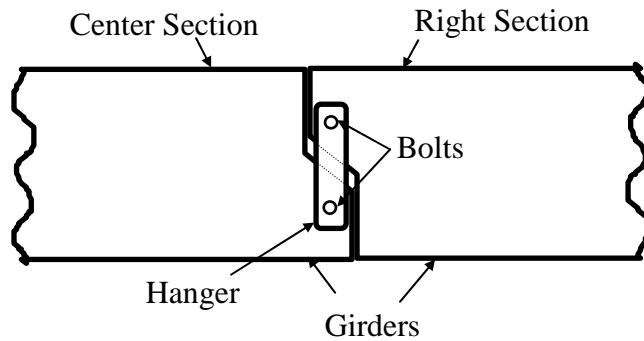


Figure 2 - Details of the hanger joint for the Center/Right Section joint (the Center/Left Section is similar)

The hanger joints that you will need to design consist of the hanger and the bolts (as shown in Figure 2). At a later date, I will provide you with loading information so that you may conduct detailed design.

Your job for now is to evaluate the design. Describe your top two concerns you may have with this design, and discuss what should be done to mitigate your concerns. i.e., “I am concerned about fatigue of the hangers at the bolt holes – a complete fracture mechanics and stress analysis should be conducted to determine the expected fatigue life of the hangers and bolts, as well as determine an appropriate inspection plan.” Note, I am not asking you to conduct any analysis – other than qualitative evaluation of the design.