ME 360L Project – Spring 2008
Bicycle Frame

You work for a bicycle manufacture. The marketing department in your company wants you to create a new bicycle for road racing that will be the premier bike in their line of products. Your company designs and manufactures bicycle frames but purchases all other components from other suppliers.

You will design the frame to be used for this new bicycle.

1. The frame may be made of any material you choose. But it must be competitive in cost with the materials used by other manufactures.
2. It must be very light weight so that it will appeal to competitive cyclists. Your chief competitor's frame weighs 1150 grams.
3. Several different sizes will be sold but you will do all of your analysis on a frame with a 56 cm center tube length.
4 The frame must accommodate readily available high-end components but is not restricted to typical or traditional frame geometry.

Structural Specifications

Your company has two structural requirements that all of its bicycles adhere to. They are.

1. The bicycle will be able to sustain a vertical drop of 650 mm with an 80 kg rider without surpassing its maximum design stress limit (yield stress divided by the safety factor).
2. The frame shall be relatively stiff and the side to side deflection at the crank hub shall not exceed 50 mm under the maximum peddling force of an 80 kg rider.

Other structural requirements will be developed by your team. These requirements involve.

3. The safety factor you will use in the design of the bicycle frame.
4. The maximum allowable deflection at the handle bars under heavy peddling by an 80 kg rider. You will specify the maximum deflection in your design specifications.
5. The maximum allowable deflection at the seat when the 80 kg rider is peddling hard and sitting on the seat. You will specify the maximum deflection in your design specifications.
6. Frames must also withstand crashes so you frame be able to withstand the load imposed by an 80 kg rider falling on the center tube of a bicycle that is lying on its side. The bicycle will be supported by the seat, the pedal-crank assembly, and the handlebars. You will specify the height the rider will fall in your design specifications.
7. Other loads you feel are important.

Specifications

The first phase of the design process is to develop the design specifications. This report is due April 7, 2008. It shall include:

1. The material you will use in the design of your bicycle. You will be using Mechanica for the analysis so the material must have a linear stress/strain curve and the stress/strain curve must be the same for all directions. If you plan to use several different materials, you must specify the materials and in which parts of the frame they will be used.
2. The yield stress of the material(s) you have chosen and the safety factor you will use in the design. The safety factor times the maximum allowable design stress equals the yield stress of the material.
3. In addition to the tests listed above, other structural tests you feel are necessary in the design of the frame. These tests should assure the integrity of the frame under reasonable normal and unexpected conditions. These conditions along with the others already specified should define the maximum envelope of operations for the frame. You will supply a minimum of two additional tests.
4. The procedures you will use in performing this structural analysis. Include hand drawn diagrams where necessary.
5. Justification for the safety factor you have chosen.

Final Project

This project will culminate in both written and oral reports. The reports will contain:

1. Detailed dimensioned drawings of the bicycle frame. These should be drawn at a scale that allows them to be easily seen and understood.
2. A discussion and justification for the stress and deflection limits you used in the design.
3. The results of each load case explaining:
    a. How the loads were derived. Show any necessary computations.
    b. The loads and how they were applied. Illustrate with a drawing or diagram showing the magnitude, direction, and area of application for the loads. A Mechanica fringe plot is not sufficient for this diagram.
    c. The constrains used in the analysis and how they were applied. Illustrate with a drawing or diagram (this can be the same drawing or diagram as used for the loads).
    d. Fringe plots showing both the stresses and the deflection of the frame. These plots should be reasonably large so that stress details can be easily seen. The maximum stress should be shown on the fringe plot. The maximum value in the fringe plot legend should be set to the maximum design stress of the material.
    e. A comparison of the load and deflection limits you set for the problem with those computed in the analysis.

The written report for the project is due May 8, 2008