MEC-E1070 Selection of Engineering Materials

Review Task

Instructions: The task is to select the material for one of the following load-bearing components:

- hoist cables for an elevator, which need to withstand tension and bend over the hoist pulley
- the tower of the wind turbine
- a ladder
- a playground seesaw

Review your reports on the weekly tasks along with the feedback you received. Decide which subtasks to do. You can only do the corresponding subtask if your final grade is less than 4 for the weekly task. You will probably need to do subtask R1 as context for the other tasks. For the relevant weekly tasks, also review the published model answers, questions, and answers in the general discussion forum on MyCourses, and the course textbook. The exercises may require the use of the GRANTA EduPack software.

Write a short report based on the subtasks below. Upload your report to the MyCourses "review task submission" assignment. Up to 20 points might be earned from this review task if you did not earn any points at all from the weekly tasks. These points will be marked as extra credit in MyCourses. You will only earn extra points for those criteria where you earn more for the review task than you earned for the corresponding weekly task.

Subtask R1: Selection basics

Explain the design load case that limits the maximum load in this application. Derive the corresponding material performance index for supporting a given load with minimum mass. (2 points)

Construct a chart that illustrates the general performance of different classes of materials for this performance index. Choose three different materials that would be suitable considering only this performance index for this load case. (2 points)

Subtask R2: Multiple objectives

Explain the difference between constraints and objectives. Consider some common-sense constraints for this application, explain what changes on the chart you constructed for subtask R1. Devise a penalty function that combines the objectives of minimizing mass and minimizing material cost. Explain how it would be used to rank the three materials you selected in subtask R1. (2 points)

Construct a chart illustrating the trade-off between "budget" mass-produced items and high-performance gear, relative to a typical choice. (2 points)

Subtask R3: Shape

Explain how different cross-sections perform better or worse in this application. (2 points)

Define a shape factor for this application and explain how it is used in material selection. (2 points)

Subtask R4: Hybrid materials

Explain some of the potential advantages of using a hybrid solution in this application. (2 points)

Design a hybrid solution (2 points)

Subtask R5: Environmental impact and manufacturing

Estimate the CO2 footprint and discuss recycling of this component. (2 points)

Explain one suitable manufacturing process for this component. Discuss which materials and shapes this manufacturing process is suitable for. (2 points)

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