



Ansys Granta EduPack Exercises

Select the materials for an oar using a Jupyter Notebook

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Based on Projects in Materials Selection for Mechanical Design by M.F. Ashby, Engineering Department, University of Cambridge. For more information, please see: Ashby, M. F. (2017) 'Chapter 9 - Selection of Material and Shape', Ed. Ashby, M. F., Materials Selection in Mechanical Design (Fifth Edition), Amsterdam, Butterworth-Heinemann

Overview

This virtual exercise walks through the process of selecting the material for a rowing oar using the Ashby Selection Methodology in a Jupyter Notebook. Utilizing Python allows for interaction with Ashby Charts created with Ansys Granta EduPack.

Learning Objectives

Upon completion of this exercise, students will be able to:

1. Follow the Ashby Selection Methodology through a simple materials selection problem
2. Explain the value visualizing material properties in Ashby charts provides to engineers
3. Describe each step of the Ashby Selection Methodology
4. Have an awareness of how material performance indices are derived

Student Knowledge Prerequisites

This lab is written assuming that students have already been introduced to common material properties such as Young's modulus and density and understand that selecting a material is part of the design process.

Familiarity with a Jupyter Notebook interface and the Ashby Selection Methodology will make this exercise easier, but are not required.

Jupyter Notebooks

This resources utilizes Python coding in a Jupyter Notebook to allow students to interact with Ashby charts outside of the Ansys Granta EduPack software. The notebook has been set up such that students do not need to code to interact with it.

System/Library Requirements

In order to run, the following Python libraries must be installed on the computer. (The version numbers listed below in brackets are those which were used to create this resource; while it may run successfully with other versions, this has not been tested.)

1. Jupyter Notebook (version 7.0.6)
2. The following Python libraries
 - IPython (version 8.11.0)
 - ipywidgets (version 8.0.6)
 - plotly (version 5.15.0)
 - PIL/Pillow (version 9.5.0)

If you are unfamiliar with installing Python packages, guidance can be found on the [Python website](#) or elsewhere online.

Jupyter Lab First Time Setup

1. Open the zip file and extract its contents to a single location. The exercise is contained in the file titled “Material for Oar Material Selection.ipynb”. The function of this activity relies on the .py files, Figures folder, and the screeningRv.mp4 file to all be in the **same folder** as the .ipynb file.
2. Before giving the exercise to students, we recommend running it yourself to understand how long it will take and where you may want to provide additional context (depending on the level of the students).
 - a. Use the fast forward button in Jupyter Notebook to run all cells.
 - b. Check all buttons to ensure a response pops up
3. Once you are happy that the lab runs successfully, it may then be used with students. All the instructions and information need are contained within the .ipynb file.
4. Depending on how students wish to engage with the Python code, you may let them know about the function files (.py) within the folder.

Additional Educator Resources

Here are additional some educator resources that can support teaching with this Jupyter Notebook:

- [Materials Intelligence: the Card Game](#)
- [Lecture: Materials Selection](#)
- [Materials Selection White Paper](#)
- [Materials Selection in Mechanical Design](#)

And some self-learning free online courses for students:

- [Materials Selection with Ashby Charts Ansys Innovation Course](#)
- [Basic Systematic Materials Selection Ansys Innovation Course](#)
- [Intro to Performance Indices Ansys Innovation Course](#)

Optional Extensions

Additional extension could include exploring more materials selection case studies on the [Ansys Education Resources website](#). A few examples are linked here:

- [Interactive Case Study: Materials for an Elastic Hinge](#)
- [Exploration of Materials for Scuba Fin Design using Ansys Granta EduPack](#)
- [Materials Selection for a Longboard Deck](#)

As for expansion with Python, students are welcome to change any part of the code to try and optimize it. A suggestion is looking into the ipywidgets capabilities and determining if there is a different way to display the questions.

Python Support

Documentation for Jupyter and ipywidgets can be easily found online.

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Document Information

This case study is part of a set of teaching resources to help introduce students to materials, processes and rational selections.

Ansys Education Resources

To access more undergraduate education resources, including lecture presentations with notes, exercises with worked solutions, microprojects, real life examples and more, visit www.ansys.com/education-resources.

Feedback

If you notice any errors in this resource or need to get in contact with the authors, please email us at education@ansys.com.

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