# SDSU ME314 Project 1: 3d printer axis structure

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## 1 Deadline

Sunday April 26, 11:59pm turned in to TurnItIn link on blackboard, digital copy PDF or .DOCX format. Remember we started the project Apr. 13, and this is a short project even if you have not started yet.

## 2 Introduction

You are participating as an engineer to design a 3d printer, and are in charge of the x-axis movement. This design is based on the open source 'reprap' project (www.reprap.org), and follows the prusa mendel i3 design, similar to what is shown in Figure (1). If you choose a different design, it must be open source and have a moving platform supported by bars or a simple mechanism easy to analyze. You will also be turning in drawings and files associated with your models.

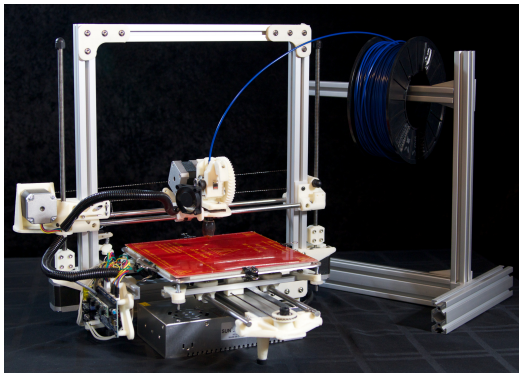

Figure 1: A reprap similar to what you are designing.

The axes are all orthogonal to each other (independent). ABS plastic which you are printing with has a high density. Printing a potentially full volume of material would end

up deflecting the bars supporting the x-axis, thereby affecting the z-axis accuracy of the part. We are going to optimize the design to maintain the accuracy stated, and then do a cost reduction to see what is the cheapest method for keeping accuracy, low parts count, and manufacturability. This project will make use of the stress-strain design work you have done up till now, and you will have extra credit to model and analyze with FEA in SolidWorks to determine max deflections as well.

## 3 Groups

This is a group project, so find a group - they must be 3-5 people. You will turn in a single report as a group, and your grade will be connected. A percentage of your grade will be peer-based.

## 4 Questions/analysis

1. Determine the worst case location of the bearing on the shaft. Given that location, compute the maximum bending stress in the shaft supporting the platform.
2. Determine, given that stress and an assumed material (ie stainless steel of a particular alloy), what the maximum deflection is in the Z direction.
3. Is the deflection at worst case greater than the printer's stated accuracy?
4. Determine the required minimum thickness of the bar to remain within the stated machine tolerance for the z axis.
5. What is the cost of the current design's plate-moving axis assembly, approximately (include major components, neglect fasteners if you wish)?
6. What is the cost of a minimum thickness design using the existing configuration?
7. Create an alternative design for the x-axis that costs less than or equal to the current design, but improves stiffness of the plate-moving axis so the deflection in z is minimized. Analyze this design for stress, strain, and deflection, and list all parts needed (search for minimum cost parts from comparable suppliers to the parts for the existing open source design - search amazon.com, google, mcmaster.com, grainger, or other locations).
8. Create a cost-thickness-deflection 3d plot, and mark on the plot the location of the current design, the minimum thickness design, and your updated design
9. (Extra credit) Use FEA to calculate the locations of major (if any) stress concentrations. Use the result to gain insight as to what areas may be lightened or beefed up to increase stiffness.

# 5 Report format

Prepare a brief report consisting of the following sections. Include calculations and figures. The report will only be turned in digitally preferably as a pdf file, but docx is acceptable as well, no print copies are required (let's save paper!).

## 5.1 Title page

Include the project, school, department, course, your names, and instructor name, as well as the date.

## 5.2 Introduction to project/project description

A brief description of the project and goals of the project, as well as your approach.

## 5.3 Drawing of the system

Please include an assembly drawing with front, side, top, and isometric projections of the x-axis. Make sure the plate support mechanism is visible. Also include in your turn in folder a zip of all parts in the assembly. You can use the SolidWorks installations for modeling in the computer labs if needed.

## 5.4 Question responses

Detail your responses to the questions here. Include plots, description, and results. Show calculation work, code, and proper SolidWorks or other drawings (no screencaptures - consider this a professional communication).

## 5.5 Conclusion

Summarize the result and project in a few sentences. What did you learn?