4.1 Puzzle Design Challenge

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October 31, 2014
Intro to Engineering and Design
Mrs. Laing - 401
4th Period

Autobiography

My name is Rehnuma Riana. I am a junior at Southeast Raleigh Magnet High school. I am currently enrolled in the Biotech academy, as I am interested in the biomedical field. My goal is

to become a cardiologist, and being a part of the academy only adds to my interests. I am originally from Bangladesh, a small country nestled in-between India. I moved to America with my family when I was 7 years old. Part of the reason as to why I moved was because of gaining an opportunity for a better education. I feel that by being a part of IED PLTW class, I can better explore my talents and interests, while challenging myself in ways I never thought possible.

Puzzle Design Challenge Brief

Problem Statement

- A local office furniture manufacturing company throws away tens of thousands of scrap ¾” hardwood cubes that result from its furniture construction processes. The material is expensive, and the scrap represents a sizeable loss of profit.

Design Statement

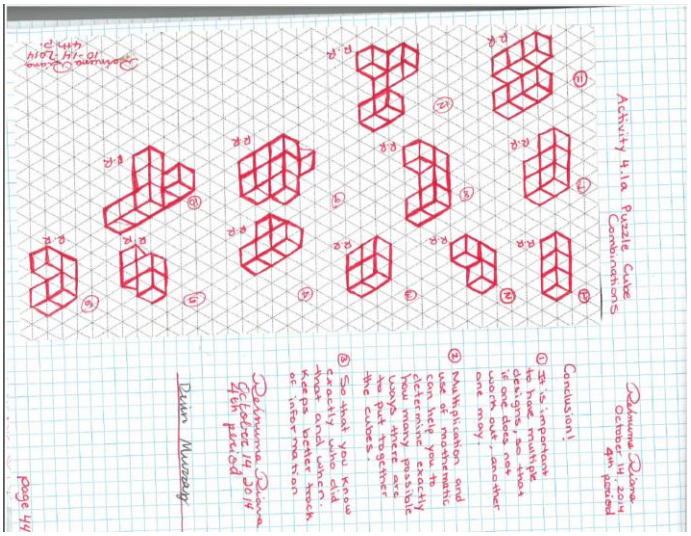
- Fine Office Furniture, Inc. would like to return value to its waste product by using it as the raw material for desktop novelty items that will be sold on the showroom floor. Design, build, test, document, and present a three-dimensional puzzle system that is made from the scrap hardwood

- cubes. The puzzle system must provide an appropriate degree of challenge to high school students.

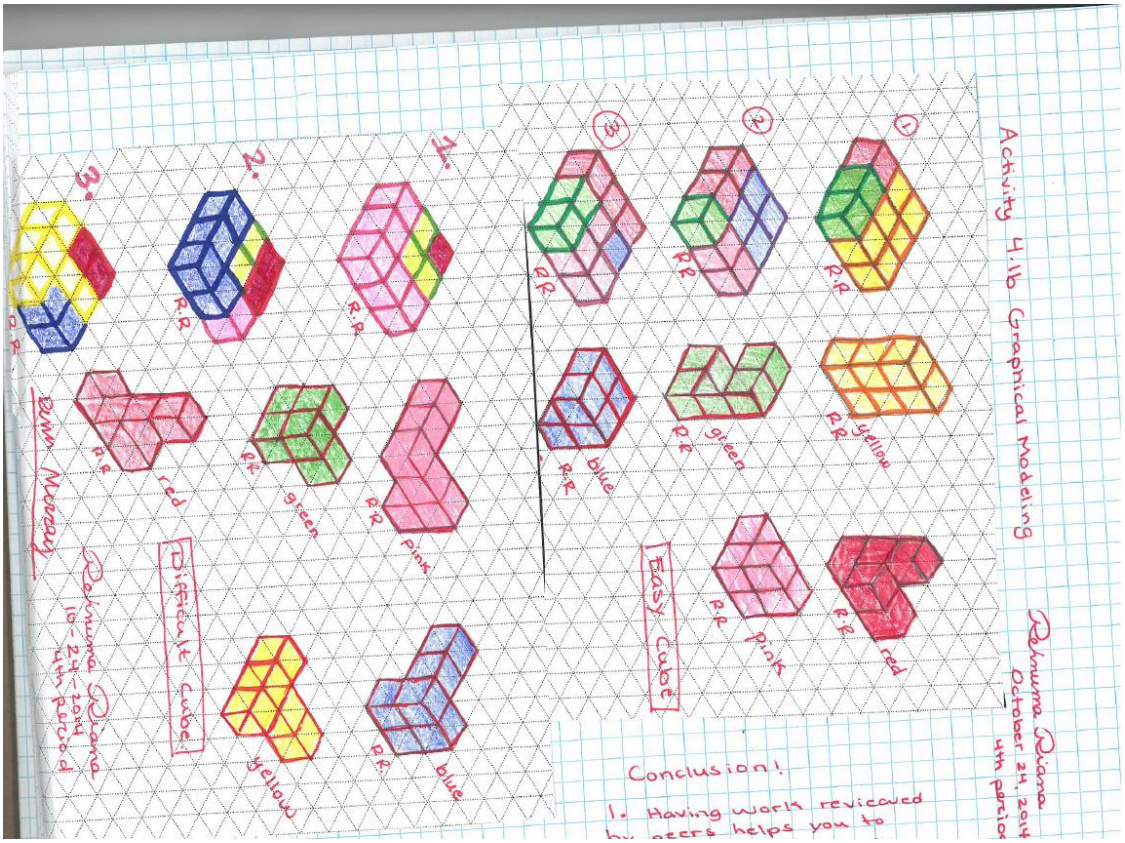
Criteria

1. The puzzle must be fabricated from 27 – ¾″ hardwood cubes.
2. The puzzle system must contain exactly five puzzle parts.
3. Each individual puzzle part must consist of at least four, but no more than six hardwood cubes that are permanently attached to each other.
4. No two puzzle parts can be the same.
5. The five puzzle parts must assemble to form a 2 ¼″ cube.
6. Some puzzle parts should interlock.
7. The puzzle should require high school students an average of 7 minutes/seconds to solve.

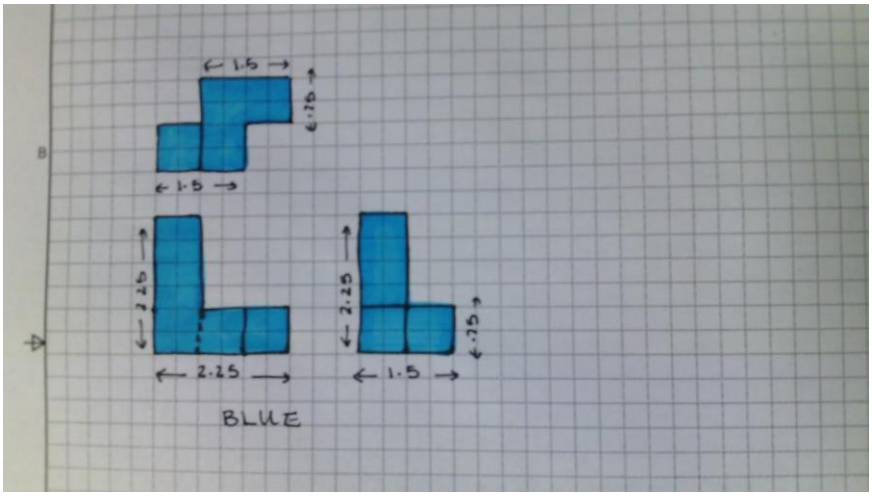
Brainstorming Possible Part Combinations!

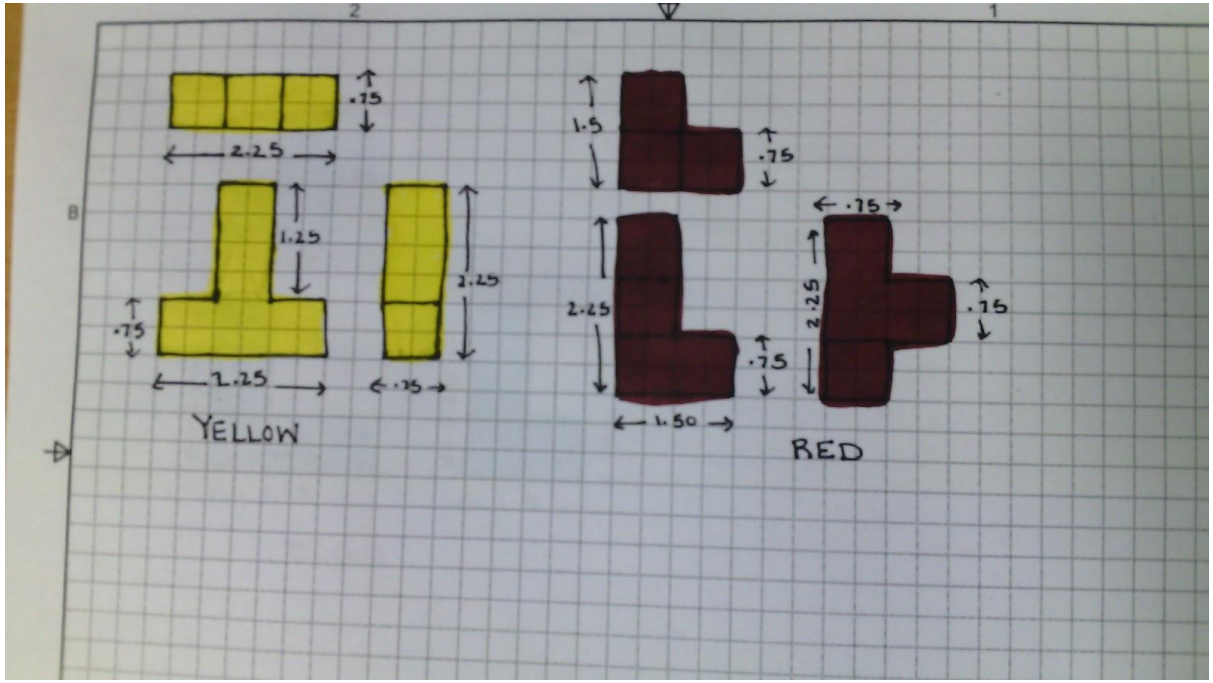


Isometric sketches of two possible complete Puzzle Cube Designs



Multiview Drawings

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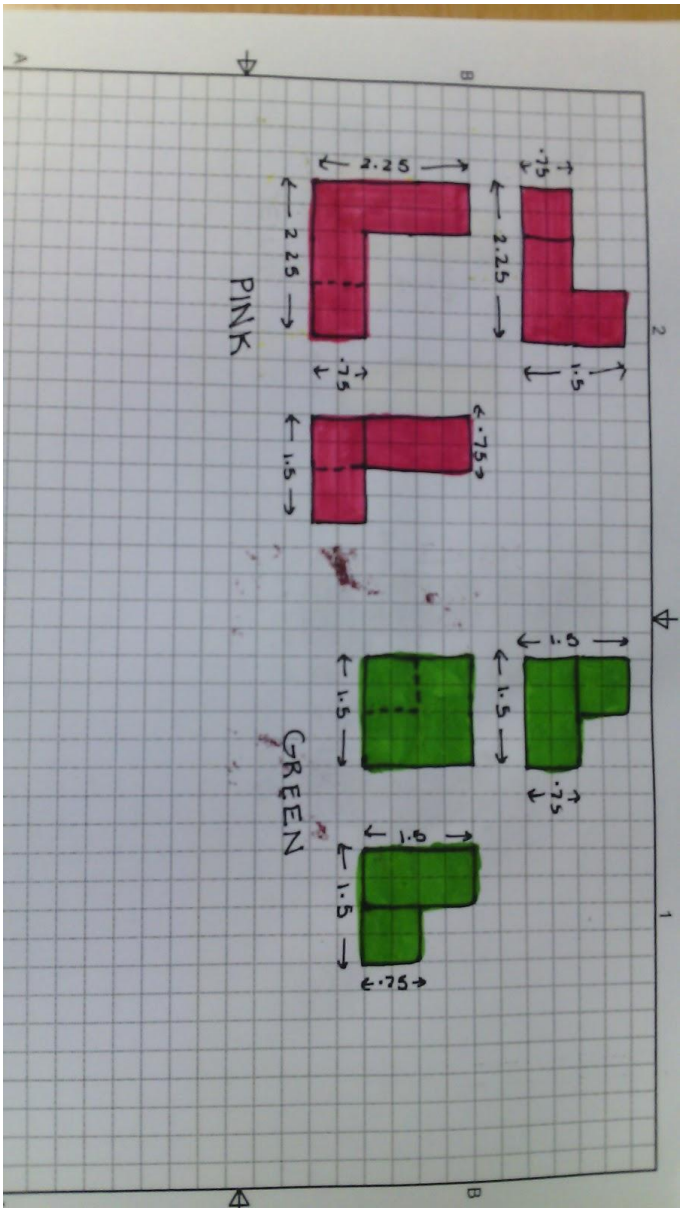
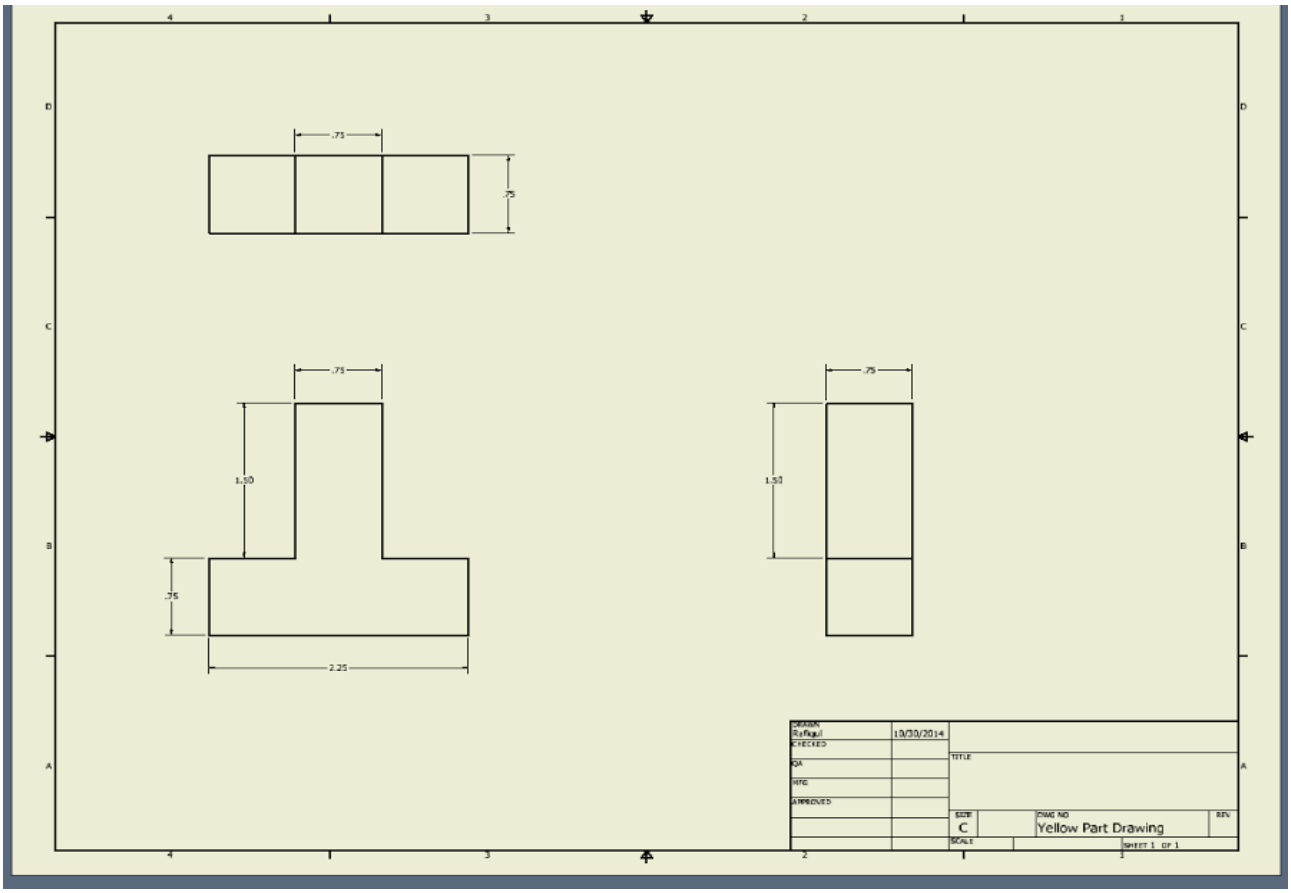


Why did I choose my design?

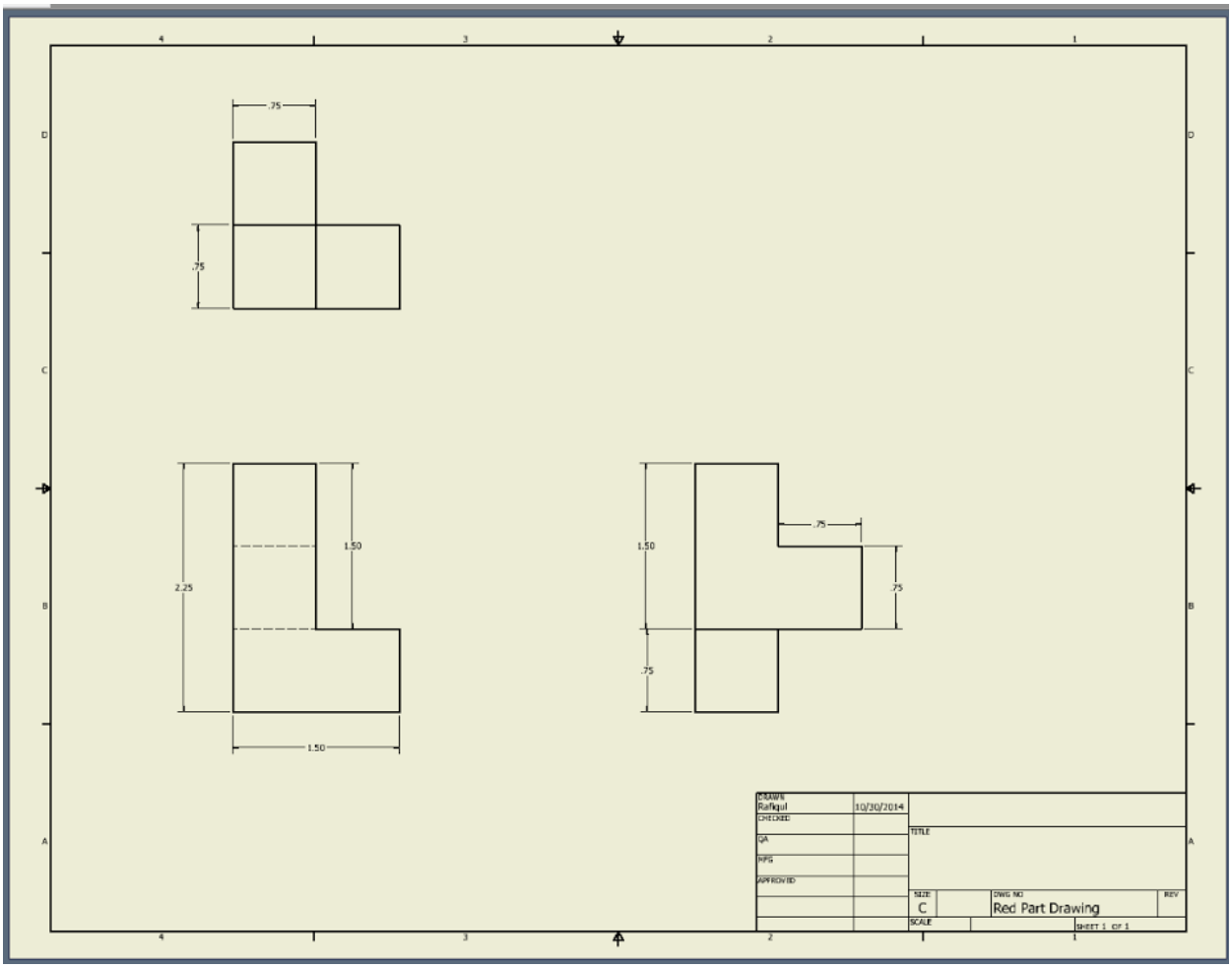
I chose this specific design for my puzzle cube, because it provides a challenge to the person trying to solve it. My design includes a variety of complex shapes, which in the beginning may not look like it will fit together. All of the individual pieces are unique and placed in a creative way. Another main reason as to why I chose this design for my puzzle cube is because, many of my pieces look like that they will fit together, however they do not. This gives an illusion that the cube will be easy to solve, though it is not. It is my personal hidden challenge within the cube.

The cube is also visually appealing, which adds to why consumers would want to purchase my puzzle cube.

Multi View Sketch:



Yellow Part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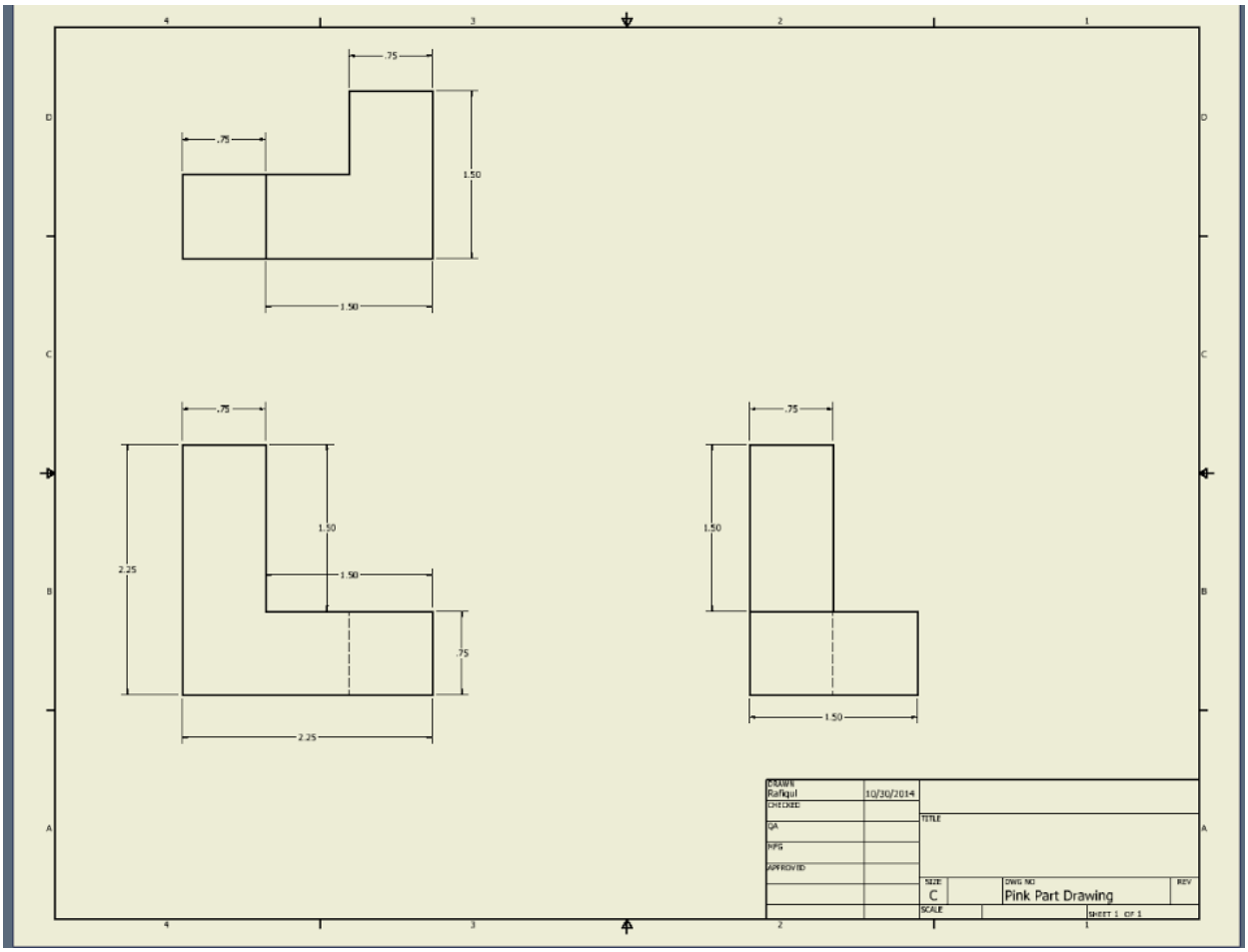
Red Part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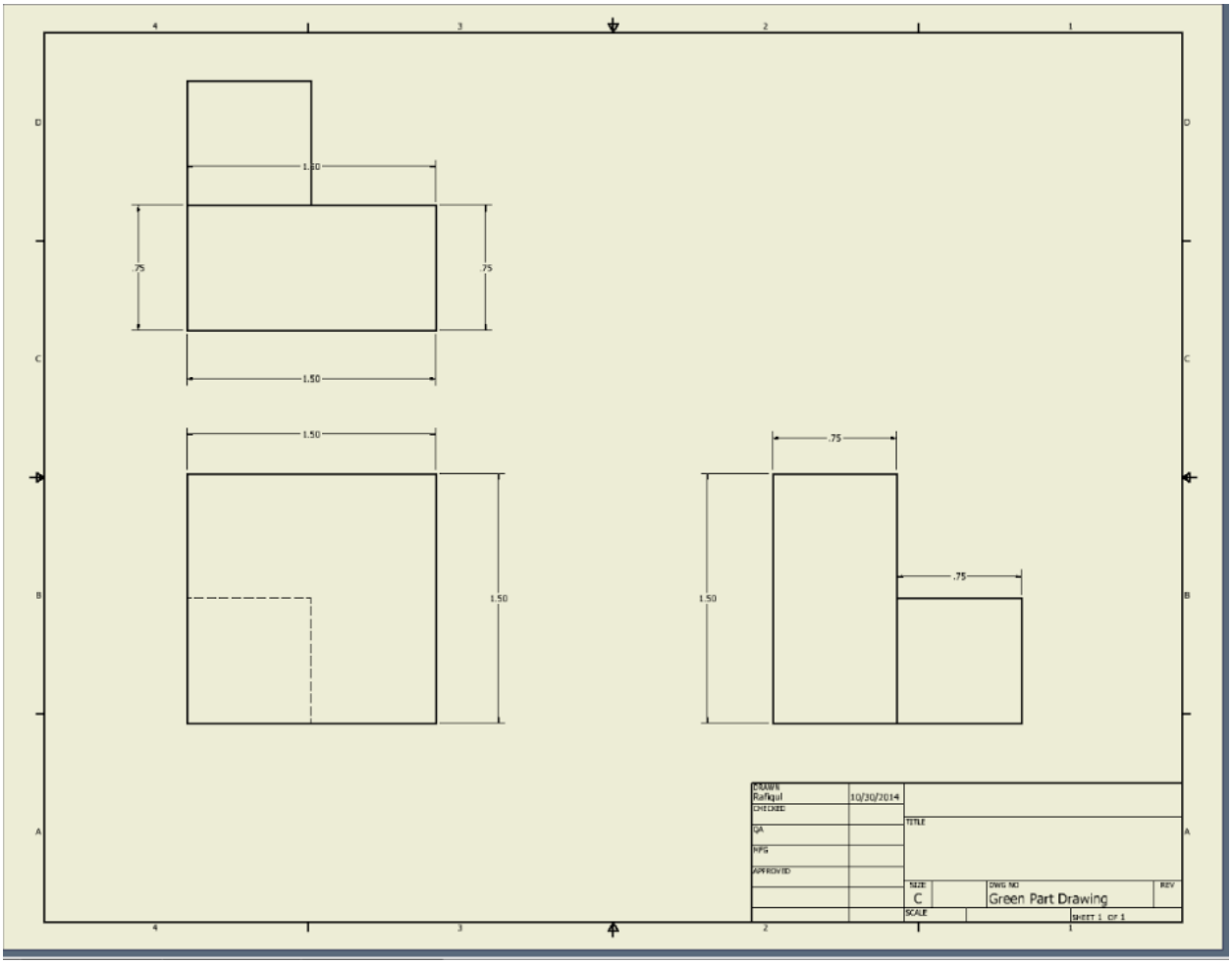
Pink Part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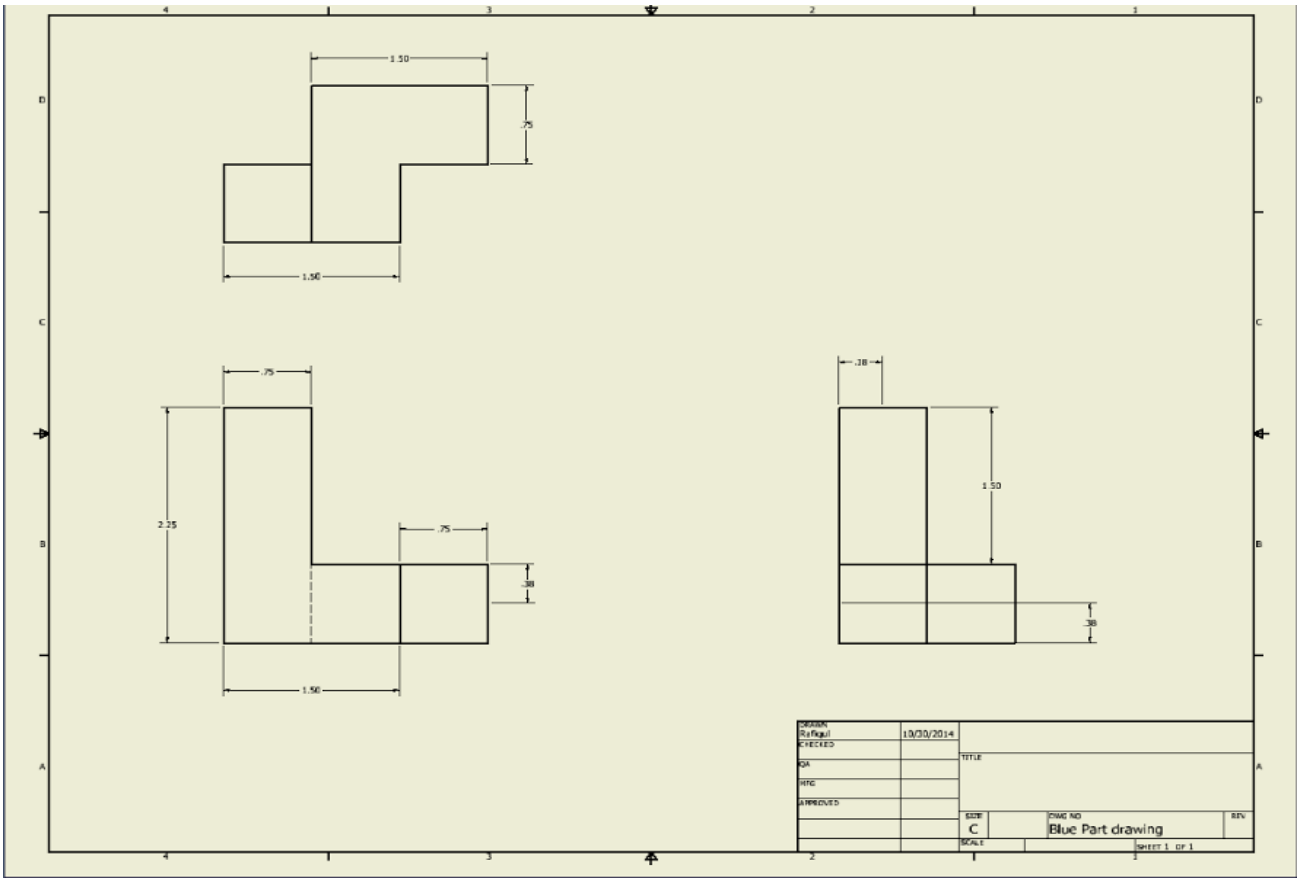
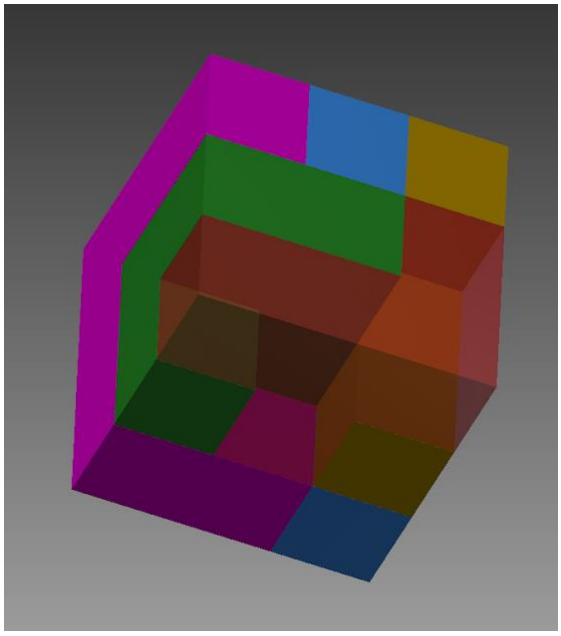
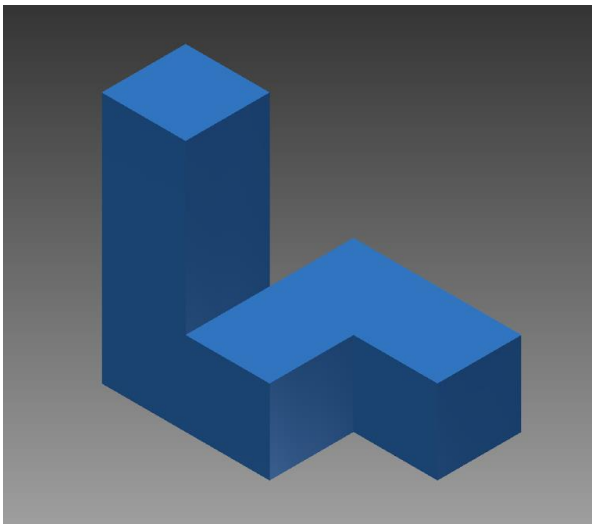
Green Part

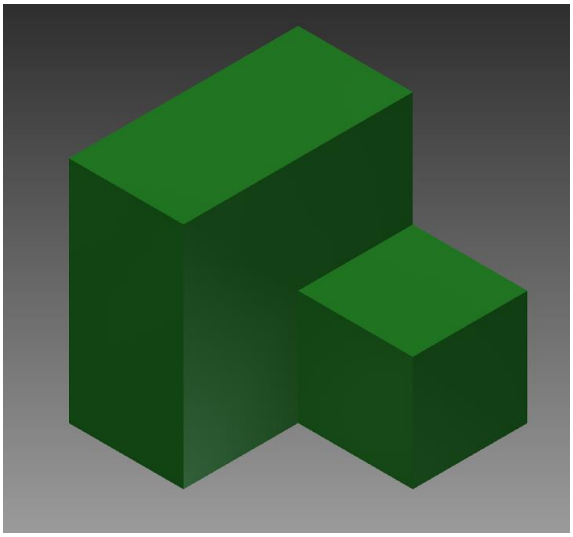


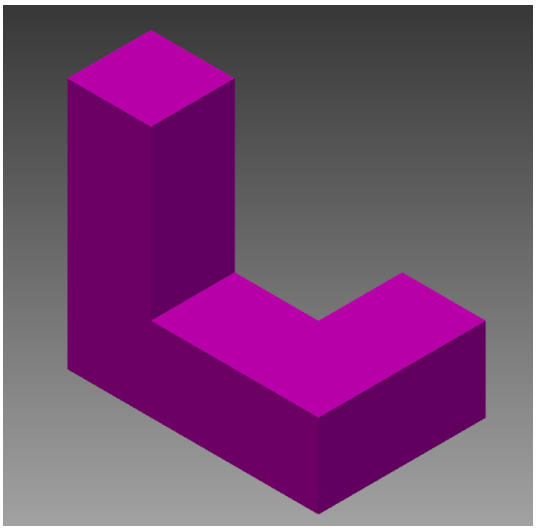
Blue Part

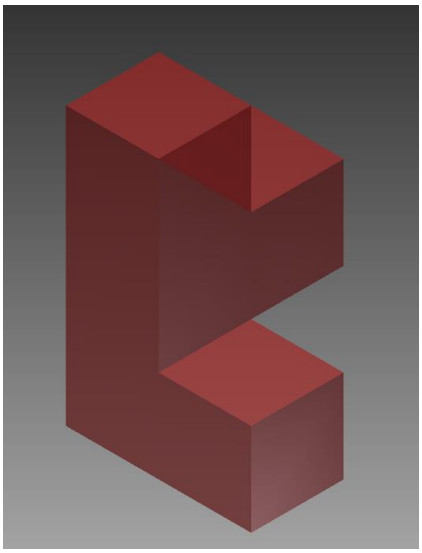
CAD Drawings

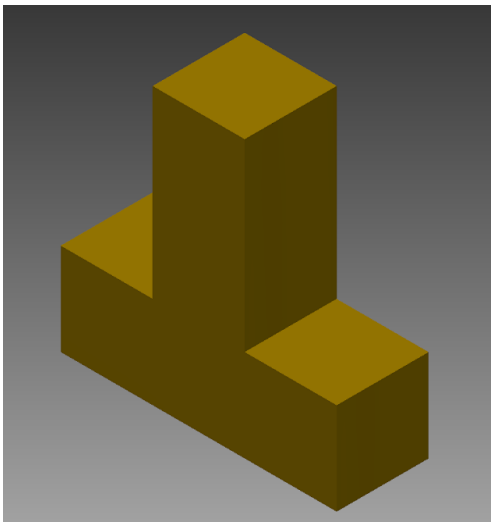








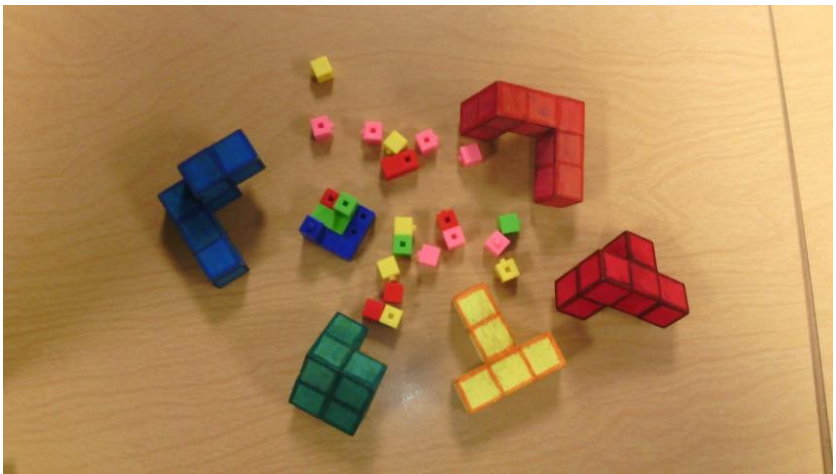




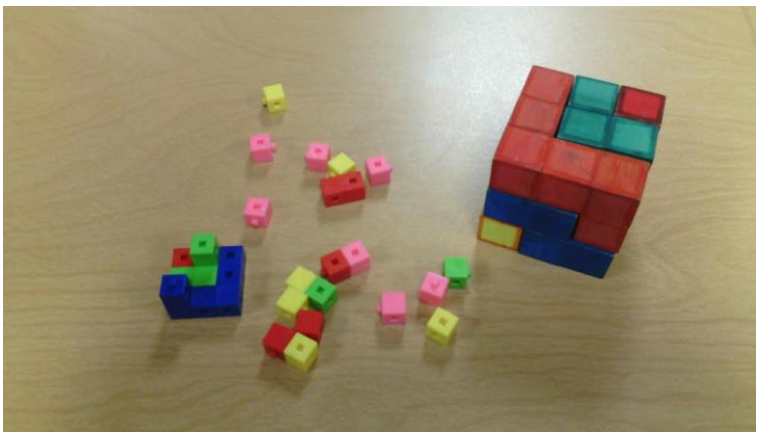
Drawing Review From a classmate:

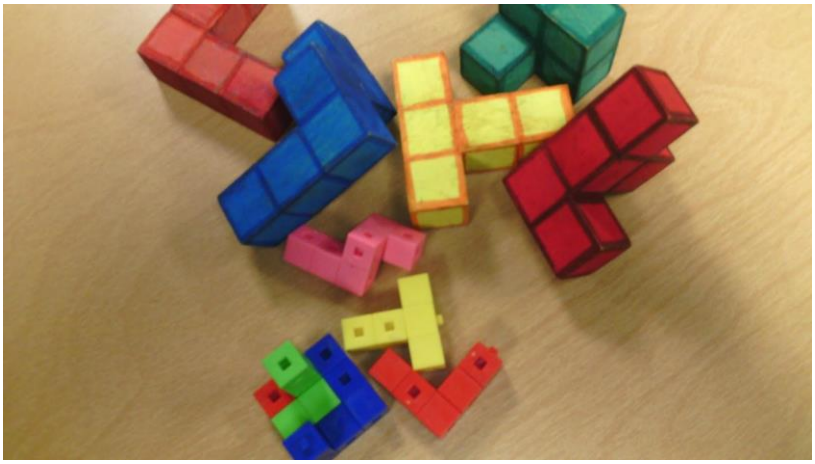
Kiara: “It is great, I like the idea of it, and it is very neat.”

Devin: “The drawings are good”.



Building Process





Changes to be made in the puzzle cube: If I had to make changes to my puzzle cube, I would probably try to make the pieces more complex, so that it is harder to solve. I would also change some of the colors and materials of my puzzle cube, so that it is more visually appealing. I would also make sure that my design was constructed in a more neat way. However, the major change

that I would make to my design would probably be that I would make my cube bigger. My original design is a 3 by 3 cube. I would change this, so that it can become a 4 by 4, or maybe even 5 by 5 cube. This would make the puzzle cube harder to solve and more fun as well.

Conclusion!

1. Why is it important to model an idea before making a final prototype?

- It is important to make a model before creating a prototype because, then you can make sure that your design is functional, practical and will fit into the criterias that are set for you. This will help you to not make mistakes when making the actual prototype.

2. Which assembly constraint(s) did you use to constrain the parts of the puzzle to the assembly such that it did not move? Describe each of the constraint types used and explain the degrees of freedom that are removed when each is applied between two parts. You may wish to create a sketch to help explain your description.

- I used the mate and flush commands to constraint the parts of the pieces together. The three types of freedom that were used in this project were Transitional on the X, Y and Z axis and the Rotational on the X, Y, and Z. This helped me to put my pieces together and fit them into my assembly piece. This made sure that my pieces did not move and that they were able to come together as my final puzzle cube design.

3. Based on your experiences during the completion of the Puzzle Design Challenge, what is meant when someone says, “I used a design process to solve the problem at hand”? Explain your answer using the work that you completed for this project.

- When the design process is used to complete a design or problem, then I know that they used specific steps to help them along the way of solving the problem. First, they brainstormed, and came up with some ideas. Then they used those ideas to come up with some sketches, and moved on to build mock-ups. Then they used mathematical modeling to dimension and start putting the pieces together. Then they used graphical modeling and computer software designs to make a model of the design. Last, they would build their design and create a final prototype.

4. How does the gender of the puzzle solver affect solution time? Be specific and provide evidence to support your answer.

- Depending on the gender, you may be able to solve the puzzle piece faster or slower because of your intellectual level, interest in the challenge etc. However, I believe that

actual gender has little to do with how long it takes for you to solve the puzzle, because the two gender contains a very broad group of people. Solving time should include more specific groups of people, for example age or experience.

5. How does the age of the puzzle solver affect solution time?

a. Make a specific statement related to the rate of increase or decrease of solution time with respect to age. Provide evidence that supports your statement.

- The younger you are it becomes harder for you to solve the puzzle. Ex: a 3 year old may not be able to solve it, but a 13 year old would. However, the exception is that people below the age of age 8 will not be able to solve.
- However after the age of 25, it becomes harder for you to solve the puzzle.

b. Write an equation using function notation that represents **puzzle solution time** in terms of **age**. Be sure to define your variables and identify units.

- y= 7x y= time it would take to solve the puzzle x= age 7= average time

c. Predict the solution time on the first attempt of a child who is 3 years of age. Show your work.

- 21 minutes. However, because it is not in the range of ages. This does not apply.

d. Predict the solution time on the first attempt of a person who is 95 years of age. Show your work.

- 665 minutes.

e. Do these predictions make sense? Why or why not?

- No, because you can not put a specific function that will meet the needs of all participants. All people are different.!

f. What is a realistic domain for the function?

- 8- 25 age group