# Applications Assessment -

Introduction: This assessment's objective is to design a life sized chess piece for a 4m by 4m board. As each square is 500mmx500mm I decided on a 420mmx420mm base. I have a height of approx. 80cm. This is to allow children and adults to play with it with relative ease. My piece is constructed of relatively smooth and round shapes to reduce it getting banged up. It is symmetrical around the entire thing meaning an equal weight distribution and also an overall more complete look. I designed a Queen. However if scales down could be an appropriate rook.
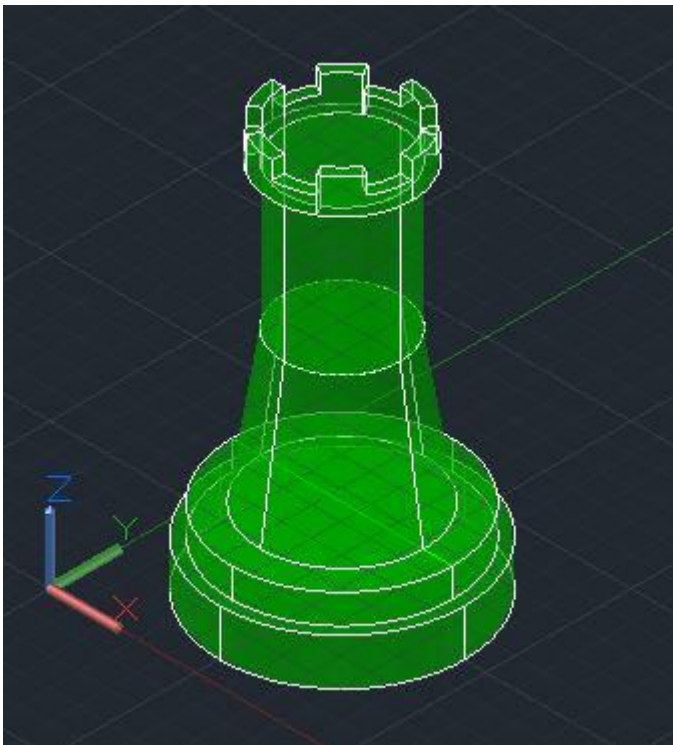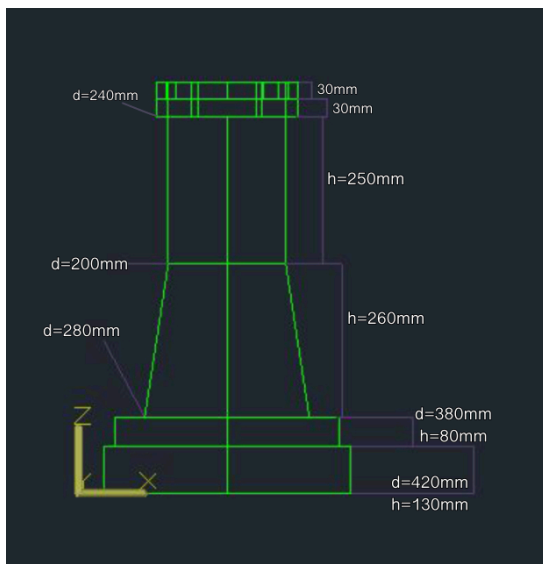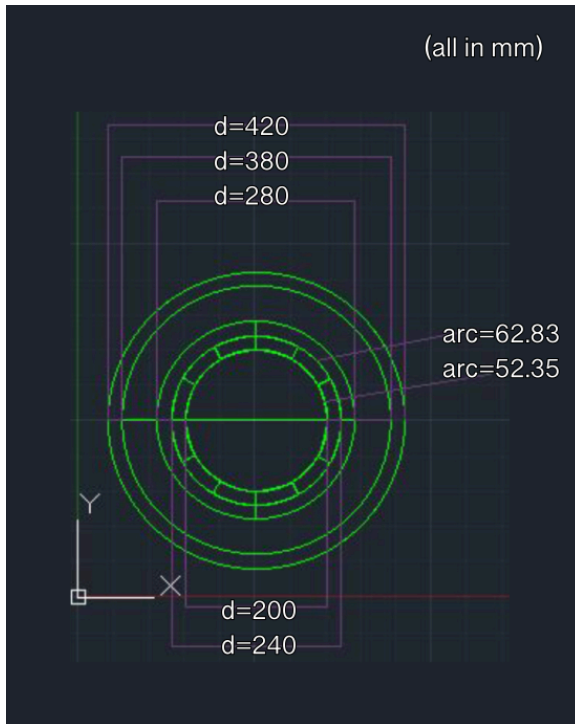

This image is my "3D sketch" in X-Ray isometric view
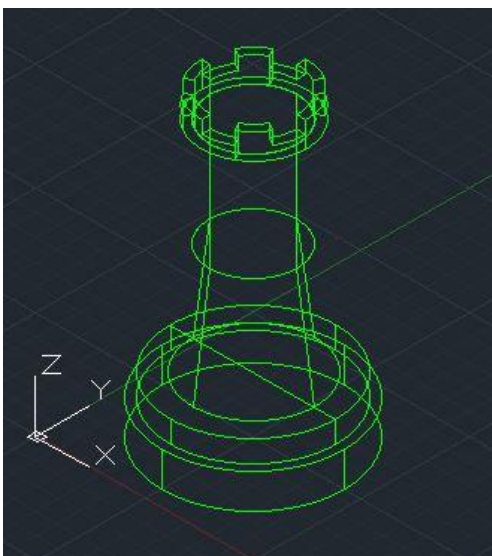
Extra cute wireframe image

The following are dimensioned sketches in mm - I have no side view as my shape looks the same all the way round.

BASE CYLINDER 1 $= 18,010.75 cm^3 = (\pi 21^2) \times 13$
BASE CYLINDER 2 $= 9,072.92 cm^3 = (\pi 19^2) \times 8$
BIG CONE A $= 18,677.82 cm^3 = (\pi \times 14^2) \times (91 \div 3)$
LITTLE CONE B $= 6,806.78 cm^3 = (\pi \times 10^2) \times (65 \div 3)$
MIDDLE CYLINDER 3 $= 7,853.98 cm^2 = (\pi 10^2) \times 25$
CONE VOLUME $= 18,677.82 - 6806.78 = 11871.04 cm^3$

CROWN VOLUME $(\pi 12^2) - (\pi 10^2) \times \frac{3}{4}$
$= 33\pi$
$= 103.67 cm^3$

TOTAL VOLUME $= 18,010.75 + 9072.92 + 7853.98 + 11871.04 + 103.67$
$= 46912.16 cm^3$

Average Cylinder
$r = 14 cm \quad h = 78 cm$
$\pi 14^2 \times 78 = 15288\pi$
$15288\pi = 48028.67 cm^3$

My Total Volume was 46912.67cm/cubed and my Average Shapes volume was 48028.67cm/cubed. The process I used to do this was to obtain my cylindrical diameters of 42, 38, 28, 24, 20 and 20 centimetres. I then divided this by 6 to get 28.66, averaged it to a 28cm diameter and got an average radius for my shape of 14cm. The height of 78cm is relevant to the height of my chess piece. This is relatively similar to the total volume of my accurate shape (1116cm/cubed off). A potential way I could make it more accurate is to separate the top piece and make two calculations as the top piece is hollow and therefore less volume than if it was solid. I could also have used a perfect radius/diameter rather than a rounded one. I didn't do this, to keep the shape as simplistic as possible (with integers.)

SURFACE AREA
FORMULA $2\pi r h + 2\pi r^2$
CYLINDER 1 $(2\pi \times 21 \times 13 + 2\pi 21^2) - (2\pi 19^2)$
$= 4486.19 - 1134.12$
$= 3352.08 cm^2$

CYLINDER 2 $= (2\pi \times 19 \times 8) + (\pi 19^2) - (\pi 14^2)$
$= 1473.41 cm^2$

BIG CONE A $= \pi r l$
$= \pi \times 14 \times 92.07$
$= 4049.45 cm^2$

LITTLE CONE B $= \pi r l$
$= \pi \times 10 \times 65.76$
$= 2065.91 cm^2$

PRODUCT CONE SLOPE $= 4049.45 cm^2 - 2065.91 cm^2$
$= 1983.54 cm^2$

CYLINDER 3 $= 2\pi 10 \times 25 + \pi 10^2$
$= 1884.96 cm^2$

CROWN PIECE $= (\pi 12^2) - (\pi 10^2) = 44\pi$
$\pi 24 \times 6 \times 0.75 = 339.29 cm^2$
$\pi 20 \times 6 \times 0.75 = 282.74 cm^2$
$44\pi \div 2 = 22\pi$
$(2 \times 3) \times 12 = 72$

$= 66\pi + 694.03 = 901.38 cm^2$

TOTAL SURFACE AREAS $= 3352.08 cm^2$
$+ 4049.45 cm^2$
$+ 1473.41 cm^2$
$+ 2065.91 cm^2$
$+ 1983.54 cm^2$
$+ 1884.96 cm^2$
$+ 901.38 cm^2$
$= 15710.73 cm^2$

PAINT REQUIRED $= 15710.73 cm^2 \div 7500 cm^2$
$= 4.39$
$= 5 \times \$27.25 = \$136.25$

My Total Surface Area is 15710.73cm/squared and the cost to produce it is $136.25 (which is honestly too much for one chess piece so I got this wrong or its hella not affordable.) Even though I only need 4.38 tins, 5 tins is an appropriate amount to buy to account for the loss of paint from the tin and indirect transfer of paint onto other stuff (brush or walls) if hand painted. If not and dipped - from dripped paint/excess on the chess piece. I don't believe it needs "protective paint" as is being 3D printed and the coloured paint is merely for looks.

Cost to 3D Print.

WEIGHT $46912,16cm^3 \times 0.124g$
           $= 5817.12$

SPOOLS $5817.12 \div 500g$
           $= 11.63$ SPOOLS

COST $12 \times \$34.95$
           $= \$419.40$
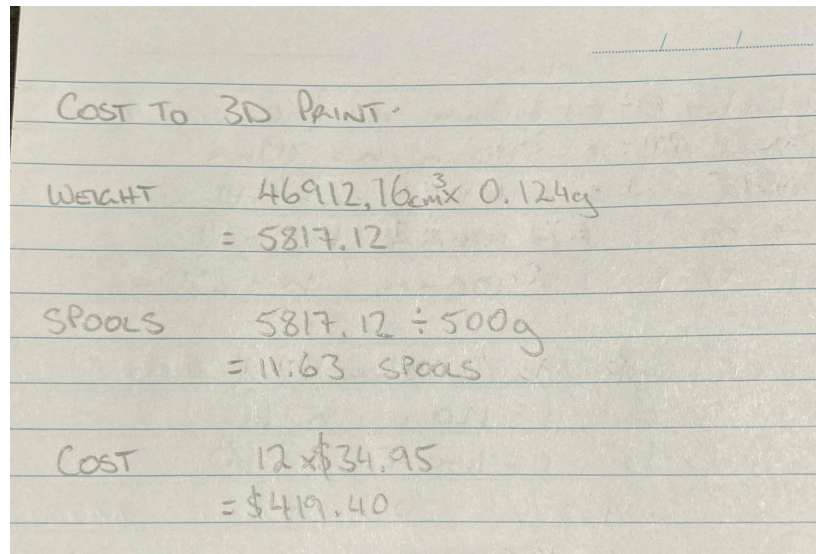
This is the cost to 3D print my Chess piece, I,ve rounded up to 12 spools as sometimes filament has a bad start or your spool could fail mid print, this allows some minor leeway. If you wanted to be super safe you could get 13 spools for $454.35 instead.

Conclusion: The total cost for producing my Chess piece is $555.65. For a life size chess piece it could be worse but I would suggest producing it out of super thin plastic and letting it get trashed, I feel like it would be cheaper. The duration of time it would take to print the chess piece (especially a whole set) is also a factor that is less desirable in production and would inevitably add to your costs for the ability to run a 3D printer.

Evaluation: Although my measurements are accurate, a potential future improvement could be including more decimal places than two before my final answer instead of rounding as I went through. This would allow a slightly more accurate end result. Although it isn't significant enough to change any major things.

Assumptions:
- Assume the appropriate chess piece size.
- Assume an average shape.
- There would be extra paint not used - needed to be accounted for.
- Potential failure with a 3D print/shitty first part of the coil - needs to be accounted for.
- I have assumed square/sharp edges in the printing process.
- I assume these people are rich cos a whole chess set would be about 18 grand 💀

Limitations:
- Dimension 50cm x 50cm
- A catering to people of all ages - having to find a middle ground
- Amount/types of shapes were quite small - had to focus on simplistic shapes that still got the point across, and the amount of shapes needed to be simple (4-8 sections) for appearance and also ease of production and handling.

Appendix: A.K.A. link for shit

- https://grabcad.com/library/chess-pieces-31
- https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.alamy.com%2Fstock-image-black-bishop-chess-piece-isolated-on-a-white-background-165032374.html&psig=AOvVaw1Qfx-F3k-FWlPQXZjl4MmM&ust=1652617036829000&source=images&cd=vfe&ved=0CAwQjRxqFwoTClit1K383vcCFQAAAAAdAAAAABAD
- https://grabcad.com/library/chess-piece-queen-5
- https://www.barewalls.com/posters-art-prints/queen-chess-piece.html