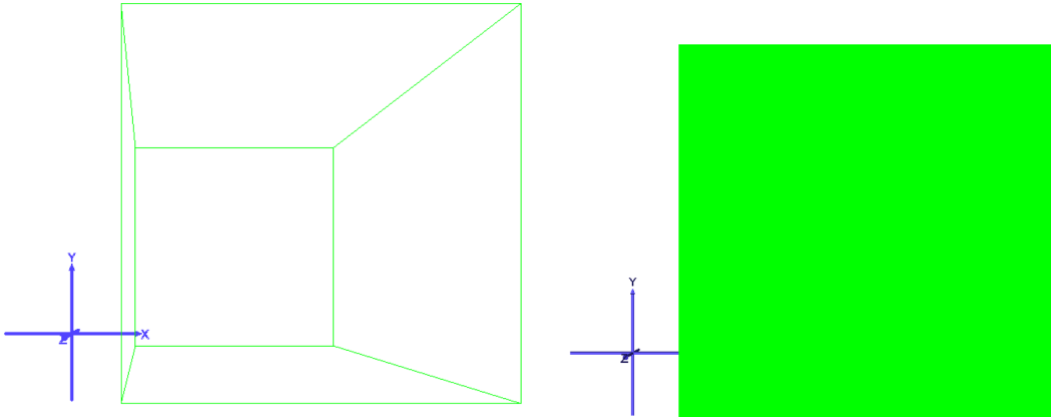


Name: YONG WEN SHIUAN

Last two digits of the matric card: 37

Q1a



A solid box with the sides parallel to the coordinate planes and has the coordinates of two opposite vertices  $(3, 0, 7)$ ,  $(10, 7, 20)$ .

$$x=3+7*u;$$

$$y=7*v;$$

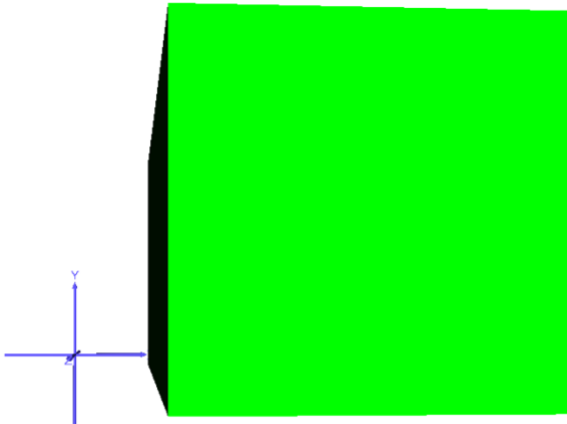
$$z=7+13*w;$$

$$u, v, w \in [0,1]$$

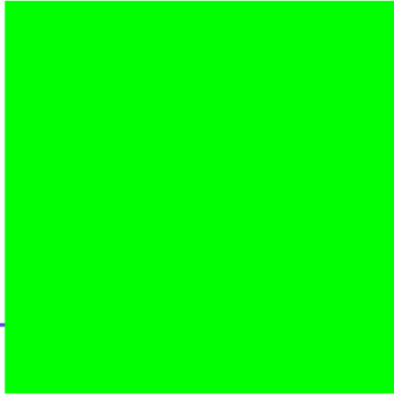
Resolution:  $[1 \ 1 \ 1]$

Name of the file: 1a.wrl

Additional screenshots explaining the selection of the sampling resolution, e.g., with a smaller and bigger resolutions. Write the tested resolutions.



Resolution:  $[5 \ 5 \ 5]$



Resolution: [2 2 2]

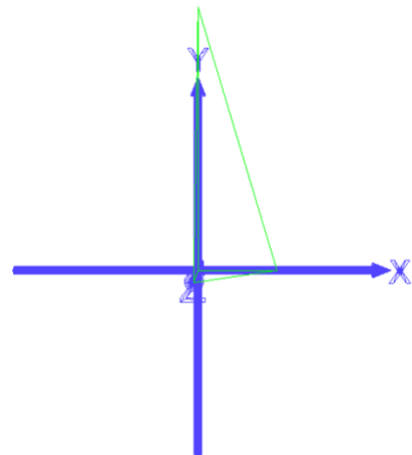
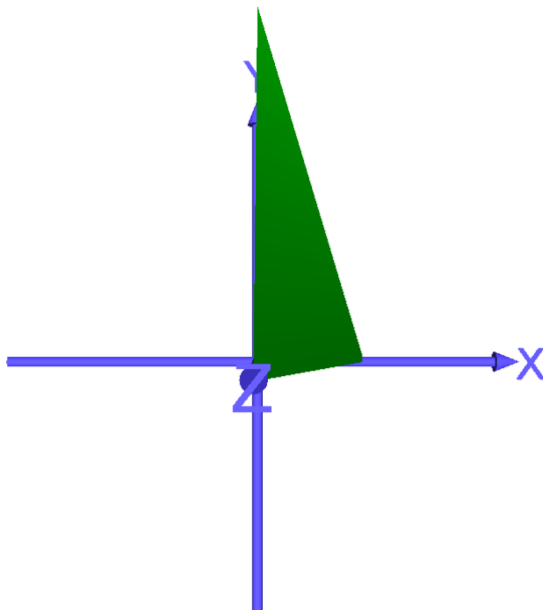
Whether divided into 1, 2 or 5 segments, since a line can be defined by 2 points, i.e. a segment, only a minimal sampling resolution of 1 is needed to display the shape bounded by straight lines

**Q1b**

Let the base alone be a 2D bilinear surface on ZX plane with  $P1 = P3 = (0,0,0)$ ,  $P2 = (3,0,0)$ ,  $P4 = (0,0,7)$ . Equation is

$$x = (3 \cdot u - 3 \cdot u \cdot v);$$

$$z = 7 \cdot u \cdot v;$$



A solid three-sided pyramid with the vertices of the base with coordinates  $(0,0,0)$ ,  $(3,0,0)$ ,  $(0,0,7)$ , and the apex at  $(0,10,0)$ .

$$x = (3 \cdot u - 3 \cdot u \cdot v) \cdot (1 - w);$$

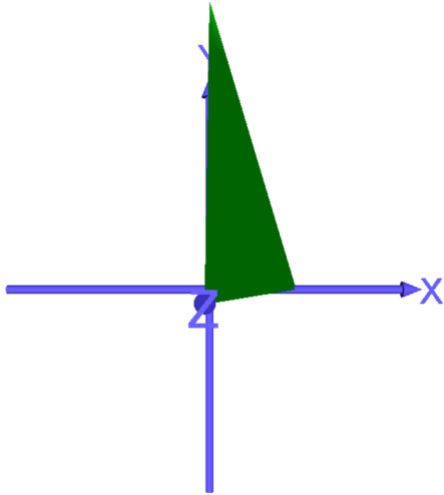
$$y = 10 \cdot w;$$

$$z = 7 \cdot u \cdot v;$$

$$u, v, w \in [0,1]$$

Resolution: [1 1 1]

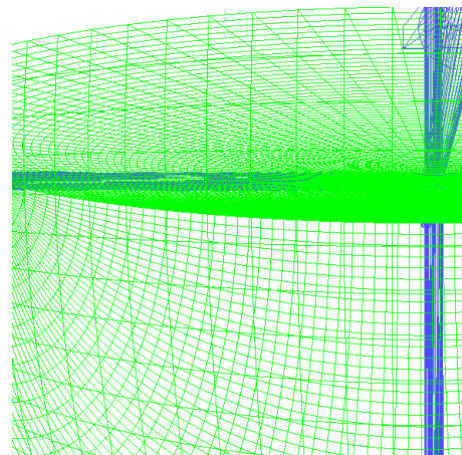
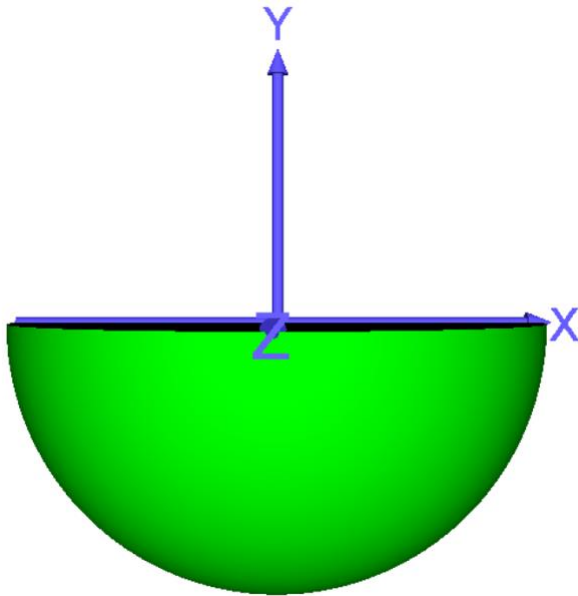
Name of the file: 1b.wrl



Resolution: [5 5 5]

Whether divided into 1 or 5 segments, since a line can simply be defined by 2 points, i.e. a segment, only a minimal sampling resolution of 1 is needed to display the shape properly.

Q1c

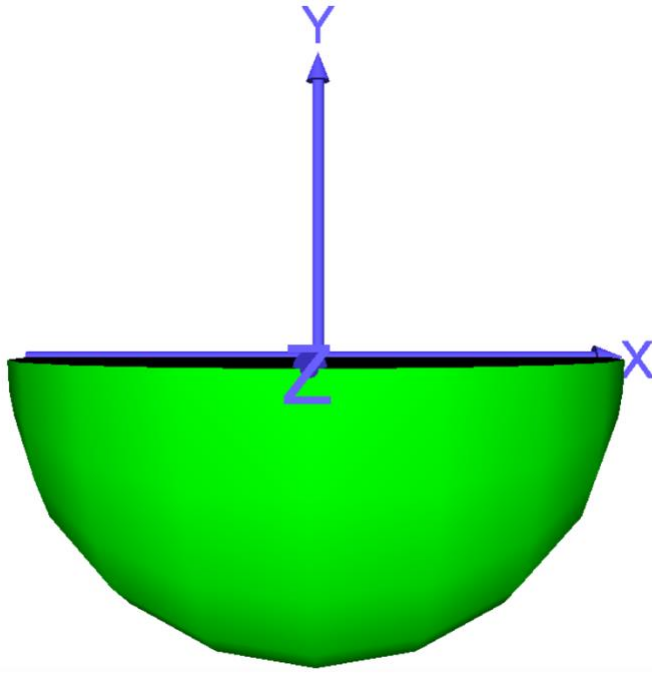


$$\begin{aligned} x &= 3*w*\cos(-\pi*u); \\ y &= 3*w*\sin(-\pi*u)*\cos(\pi/2-\pi*v); \\ z &= 3*w*\sin(-\pi*u)*\sin(\pi/2-\pi*v); \\ u, v, w &\in [0,1] \end{aligned}$$

Resolution: [75 75 75]

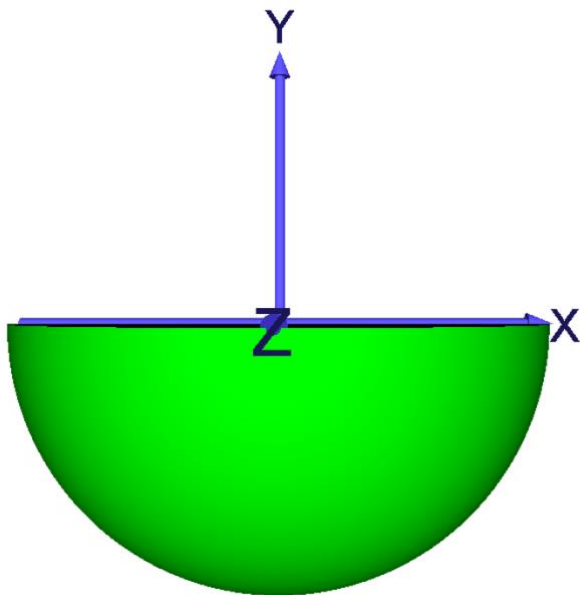
At this resolution, the polygons are not too elongated/stretched. Shape looks like it should

Name of the file: 1c.wrl



*Resolution: [10 10 10]*

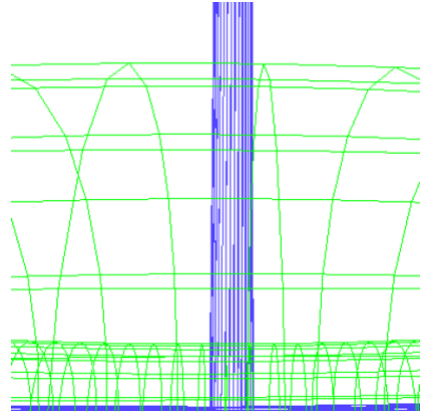
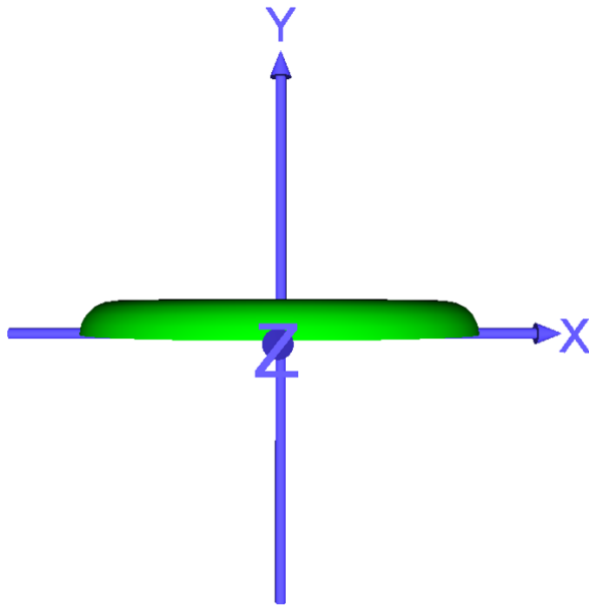
*If each parameter is divided into too few segments, e.g. 10, the polygonal interpolation can be observed and the smooth curvature is not seen.*



*Resolution: [100 100 100]*

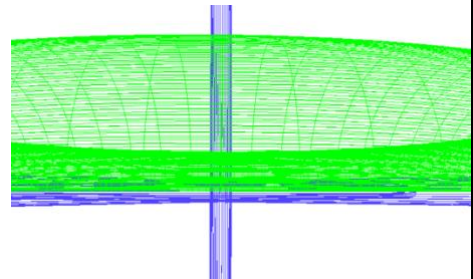
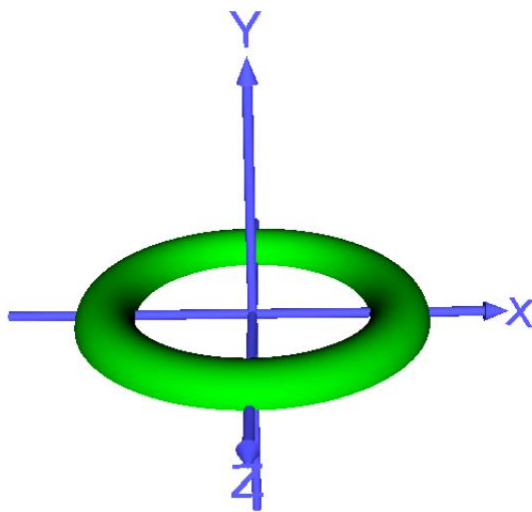
*If each parameter is divided into even more segments, e.g. 100, a smooth curvature is seen. The straight lines connecting the polygons are not as striking. But further such increases in resolution would result in minor changes to the shape curvature at the expense of additional computations*

Q1d



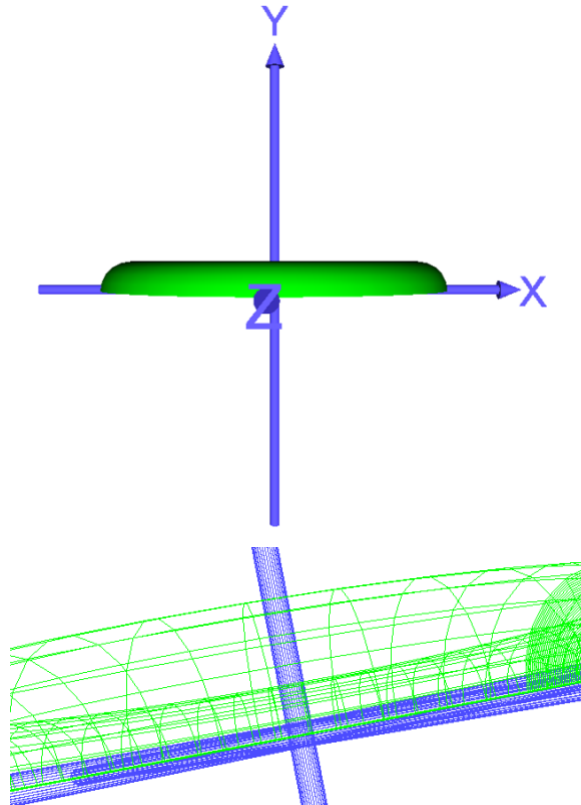
$x=(3/5*w*\cos(\pi*u)+3)*\sin(2*\pi*v);$   
 $y=3/5*w*\sin(\pi*u);$   
 $z=(3/5*w*\cos(\pi*u)+3)*\cos(2*\pi*v);$   
 $u, v, w \in [0,1]$   
*Resolution: [10 100 100]*

*Name of the file: 1d.wrl*



*Resolution: [100 100 100]*

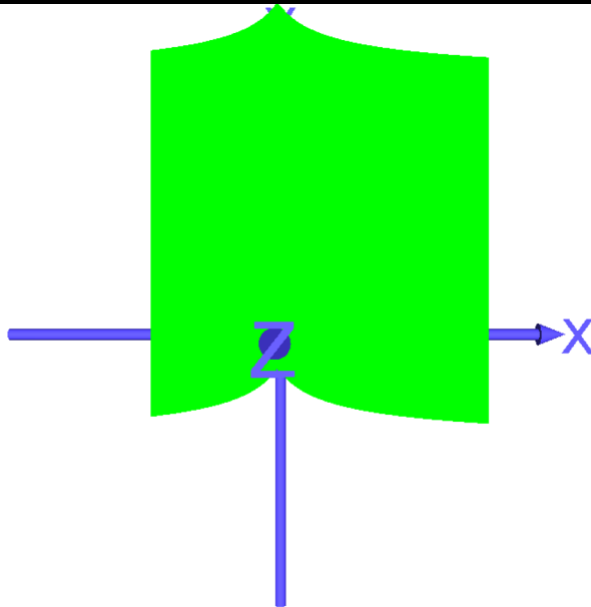
At this resolution, even though the curvature appears smooth, the polygons look rather elongated



Resolution: [10 50 50]

At this resolution, similarly, even though the curvature appears smooth, the polygons look rather elongated

Q2



resolution [75 1 1]

$x = 12 \cdot u - 4.5;$

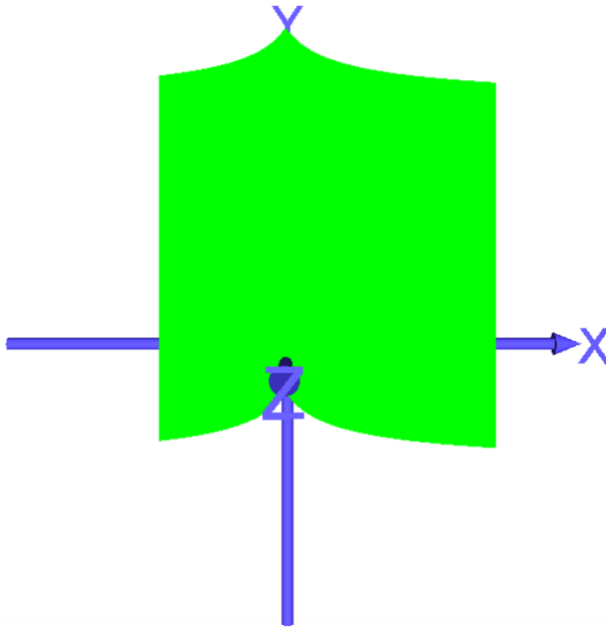
$y = 3 / (\sqrt{\text{abs}(12 \cdot u - 4.5) + 1}) - ((3 + 3 \cdot \sqrt{8.5}) / \sqrt{8.5}) + 13 \cdot w;$

$z = -3 + 10 \cdot v;$

$u, v, w \in [0, 1]$

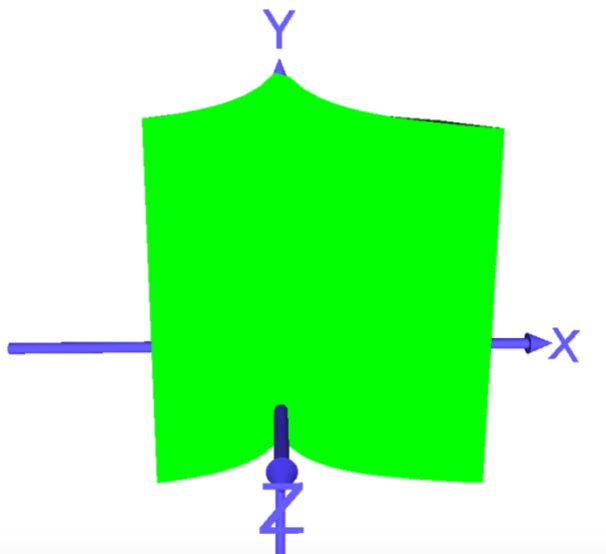
Name of the file: 2.wrl

Additional screenshots explaining the selection of the sampling resolution, e.g., with a smaller and bigger resolutions. Write the tested resolutions.



resolution [75 75 75]

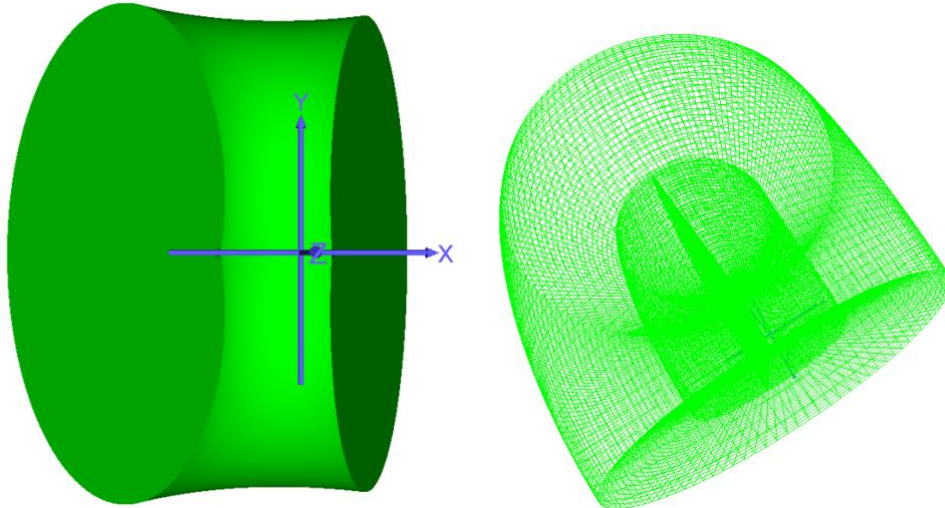
Parameters  $v$  and  $w$  are responsible for translational sweeping of the curve along  $z$  and  $y$  axes respectively, hence they need only be divided into a single segment as a straight line can be defined with 1 segment. Increasing the resolution for  $v$  and  $w$  and thus dividing them into additional segments would not make the line any straighter



resolution [25 1 1]

Resolution of parameter  $u$  determines the number of segments the curve in  $x$ - $y$  plane is divided into, so decreasing the resolution to 25 would divide it into 25 segments. However, at the peak of the shape, there is an unexpected change in the shape of the graph should look like. This is probably because that is 1 of the 25 subdivided line segments, hence the polygonal interpolation would be visible if the resolution for  $u$  is decreased to too low a value

Q3



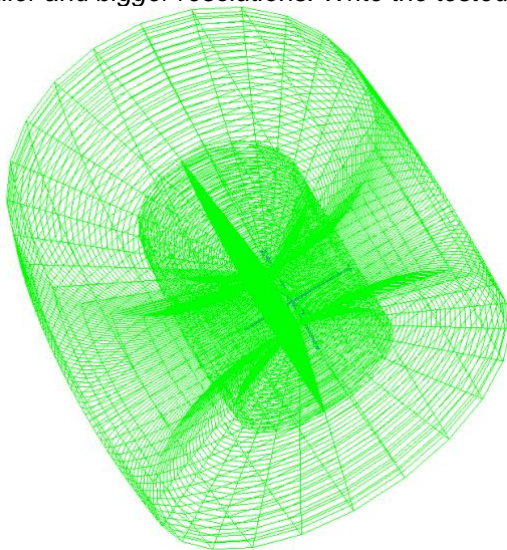
```
x=((cos(2*pi*u)*w*(3-12*cos(2*pi*u)))-3)*sin(pi*3/14-v*pi/3);  
y=(sin(2*pi*u)*w*(3-12*cos(2*pi*u)));  
z=((cos(2*pi*u)*w*(3-12*cos(2*pi*u)))-3)*cos(pi*3/14-v*pi/3);  
u, v, w ∈ [0,1]
```

resolution [250 50 50]

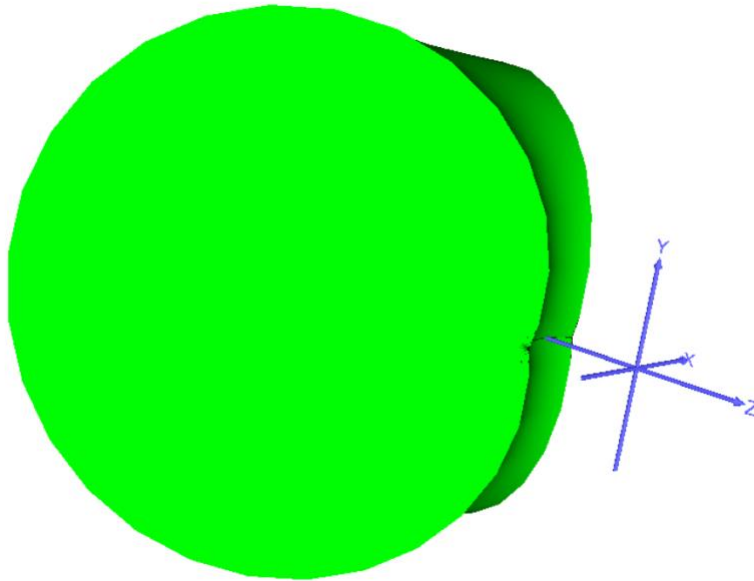
At this resolution, the polygons can be seen to be not too elongated. Curvature looks quite smooth too

3.wrl

*Additional screenshots explaining the selection of the sampling resolution, e.g., with a smaller and bigger resolutions. Write the tested resolutions.*

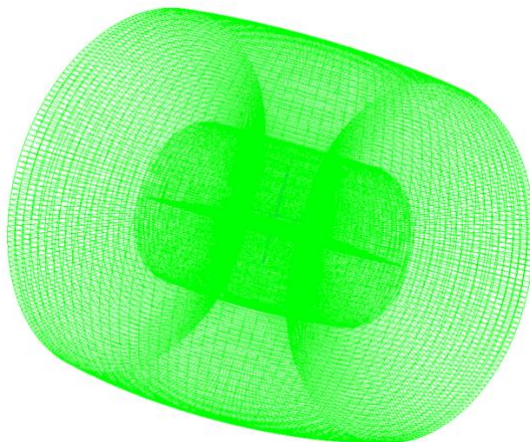
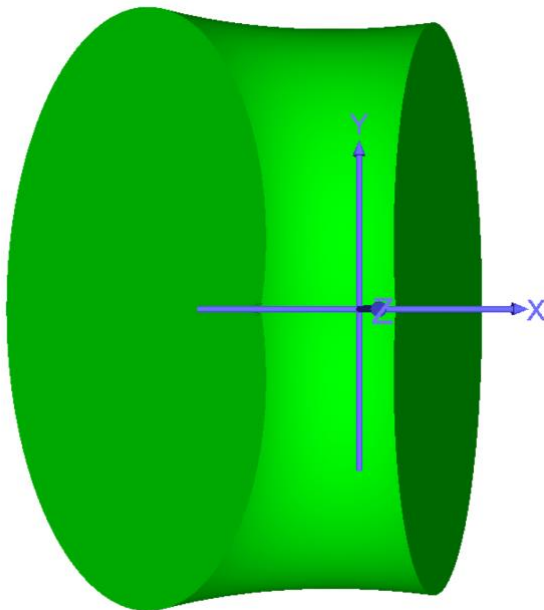






resolution [50 50 50]

At this resolution, the polyline interpolation and straight line segments joining each point may be observed at the edges and hence the curvature is not so smooth/rounded. The polygons are relatively elongated



	resolution [500 50 50]
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	At this resolution, even after doubling the resolution of $u$ , whilst curvature is smooth and there are more polygons, the polygon sides seem to not be as equal. This is possibly due to the comparative ratios in which each parameter is sampled. Also, the polygons are so small the difference is not significantly noticeable from afar, at the expense of the extra computation
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