BTL ALIGNMENT SCRIPT GUIDE

Arjuna Austin

1. Installation and Set-Up

The Python script utilises a software program called ‘FreeCAD’, free to download via the web: https://www.freecad.org/

The Python script contains several imported packages that are not pre-installed on FreeCAD and must be manually copied from your Python packages.
The additional packages required:

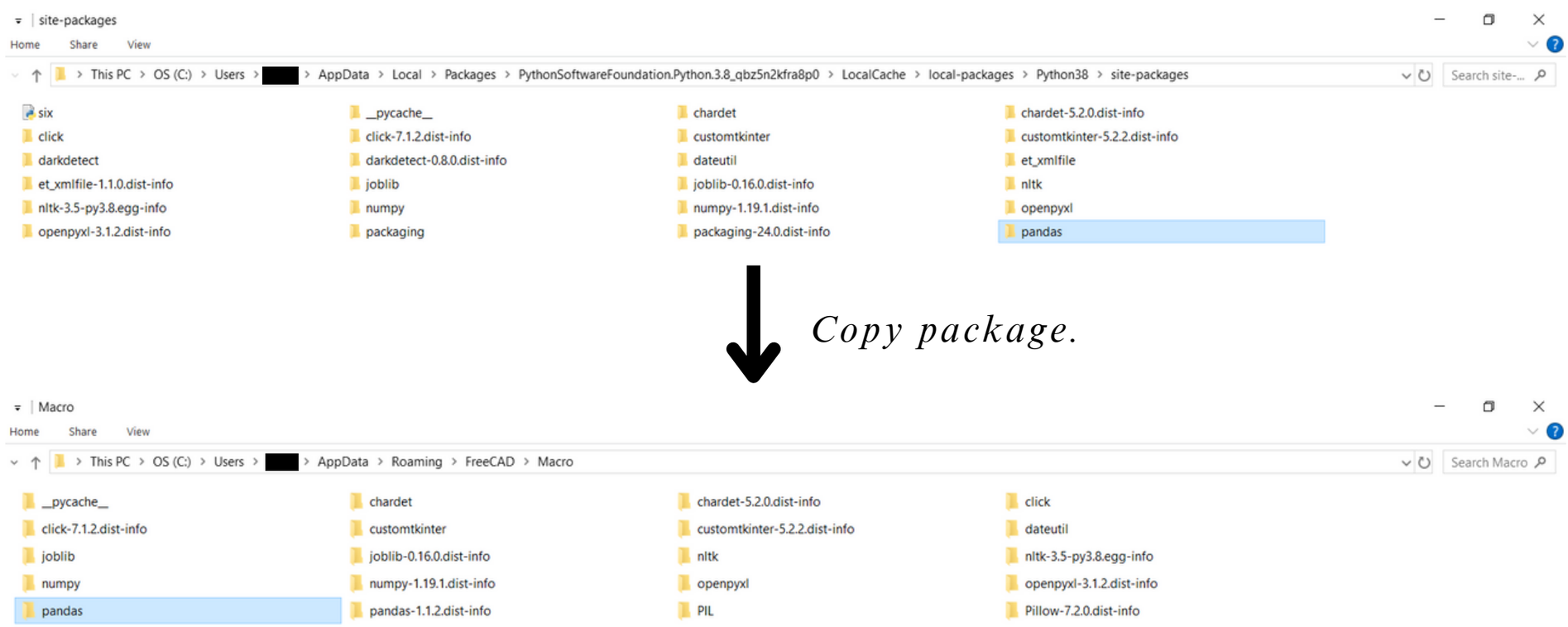
- pandas
- tkinter
- numpy

```
import FreeCAD as App ; import Draft
import FreeCADGui as Gui ; import Part
from scipy.optimize import minimize
from tkinter import *
import pandas as pd
import numpy as np
import math
```

If you do not have any of these packages in your pre-existing python environment, open Command Prompt and use the following command:

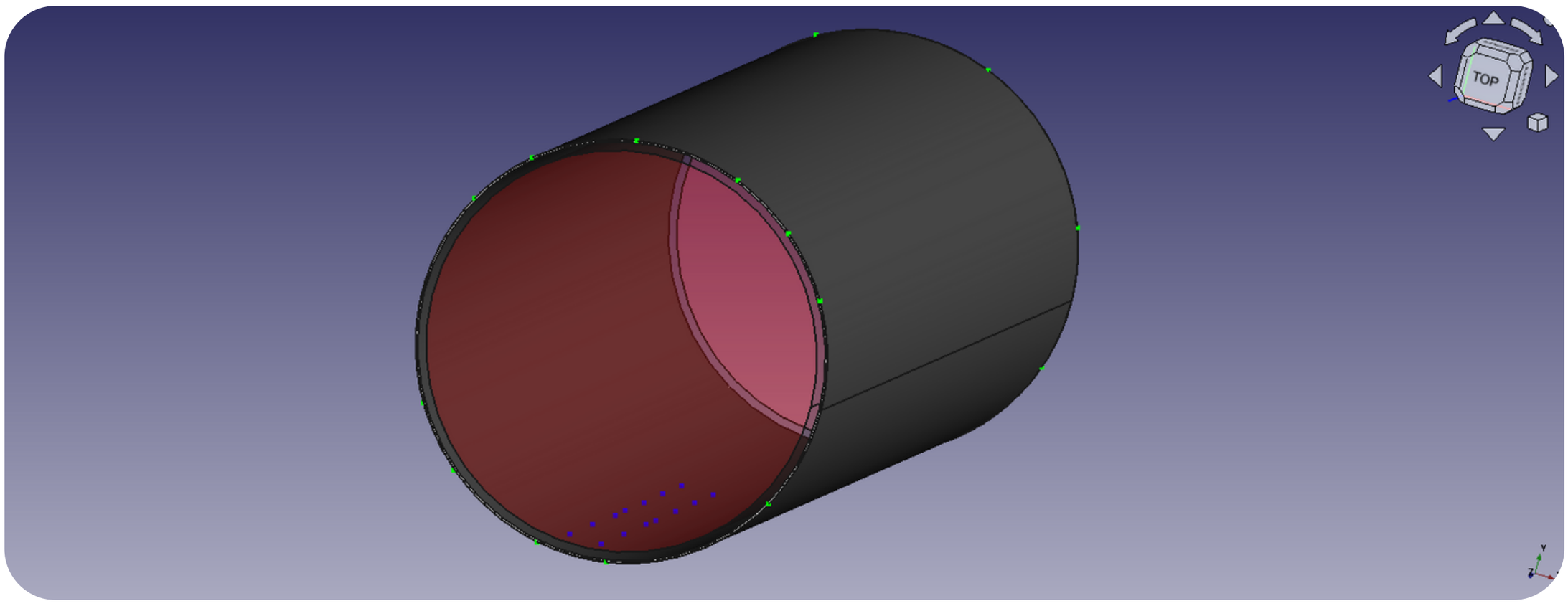
```
>pip install {package name}
```

Once you have all the required packages, copy these files into FreeCAD’s ‘Macro’ Path.



Import the Python script into FreeCAD and the code should now work without error.

Desired Output (example):



2. CMS Naming Convention

Objects within the BTL are named according to the CMS naming convention:

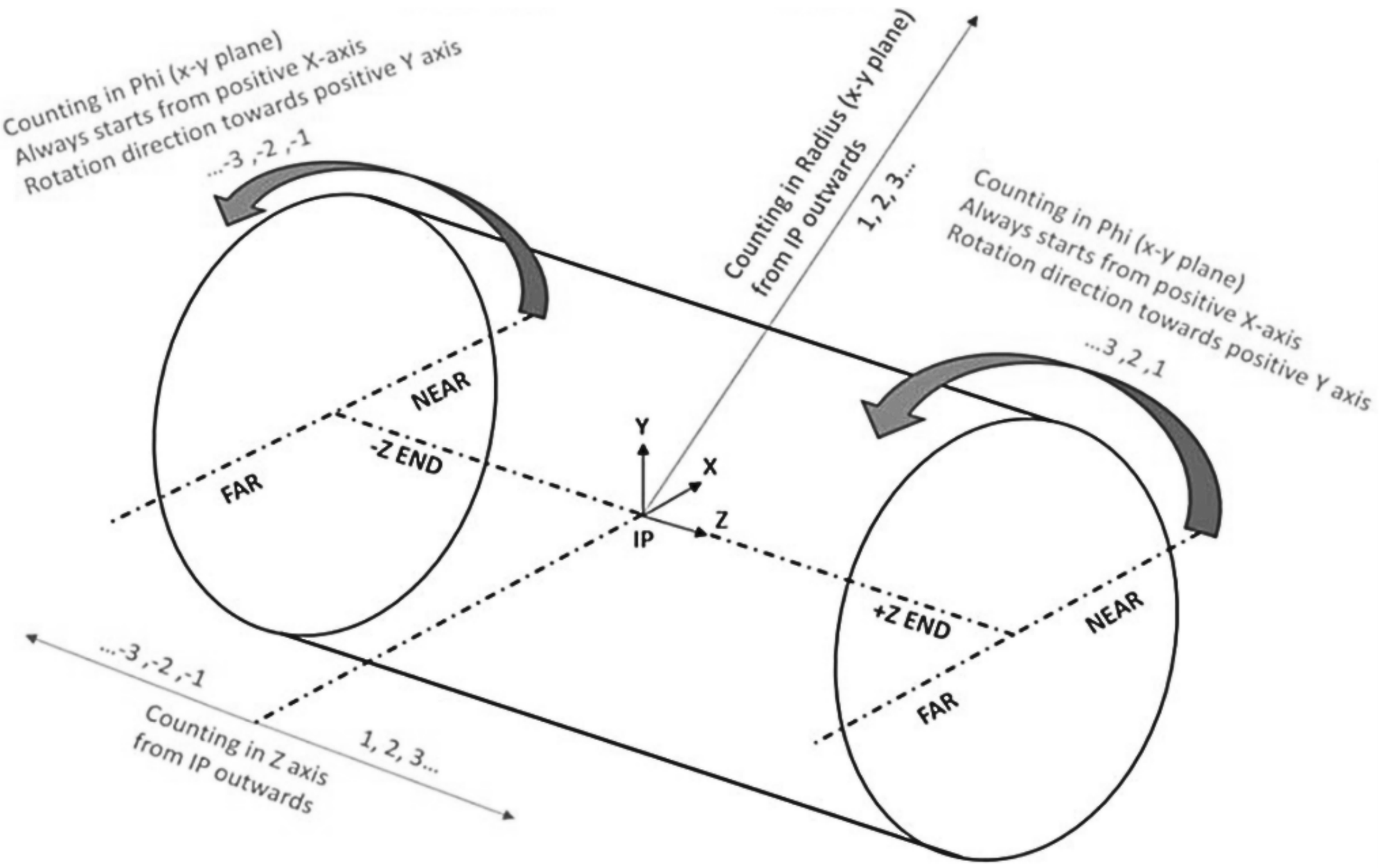
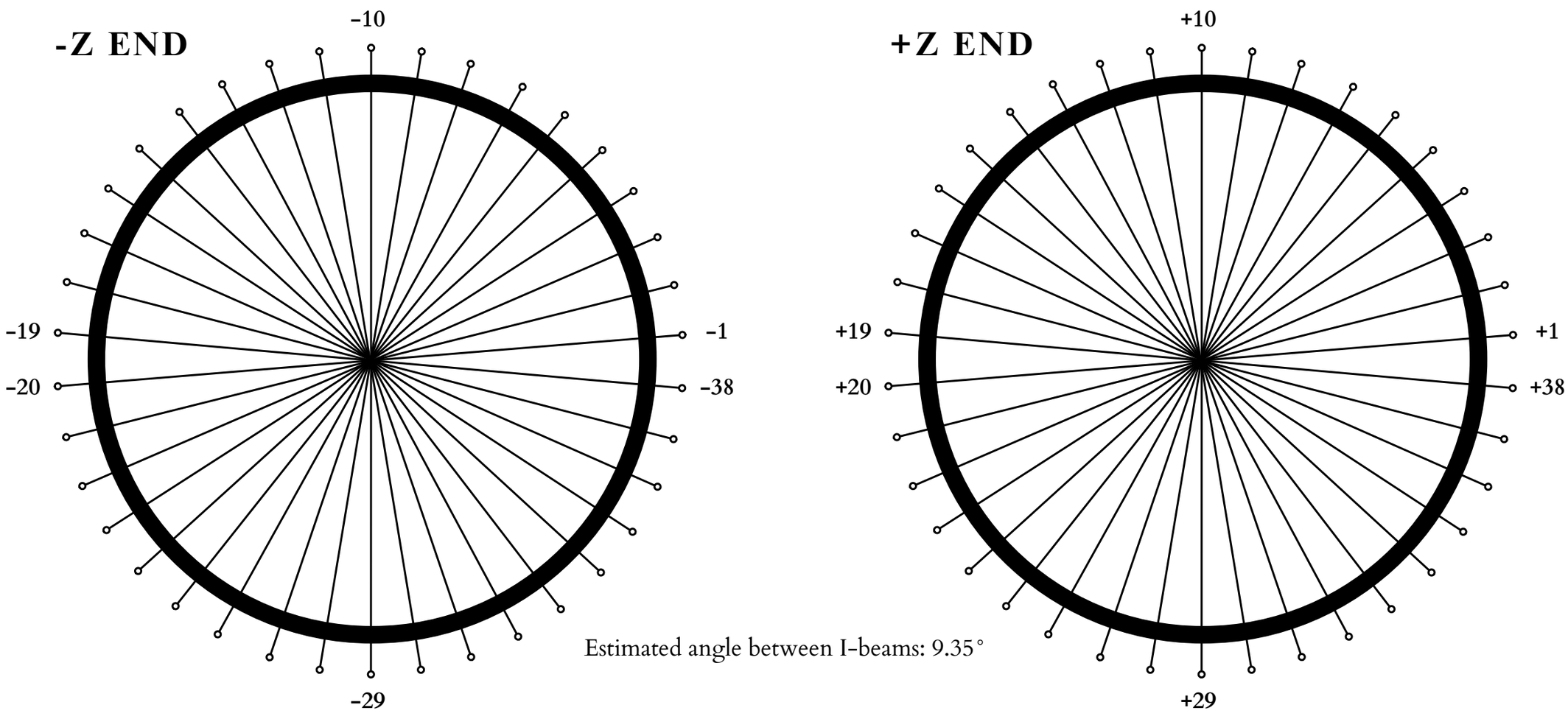


Illustration by Antti Onnela [19 July 2022]

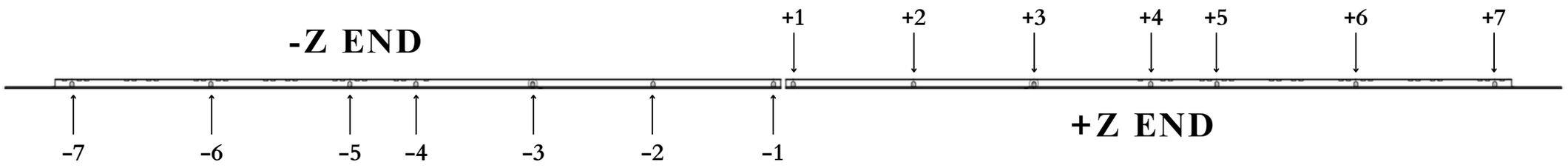
The two objects named in the script (so-far) are the ‘I-beams’ and ‘Feet’.
There are 76 I-beams in total.

Naming I-Beams



Estimated angle between I-beams: 9.35°

Naming Feet



3. Using the script & spreadsheet

Insert the correct file path for ‘BTL Alignment Spreadsheet.csv’ into the script:

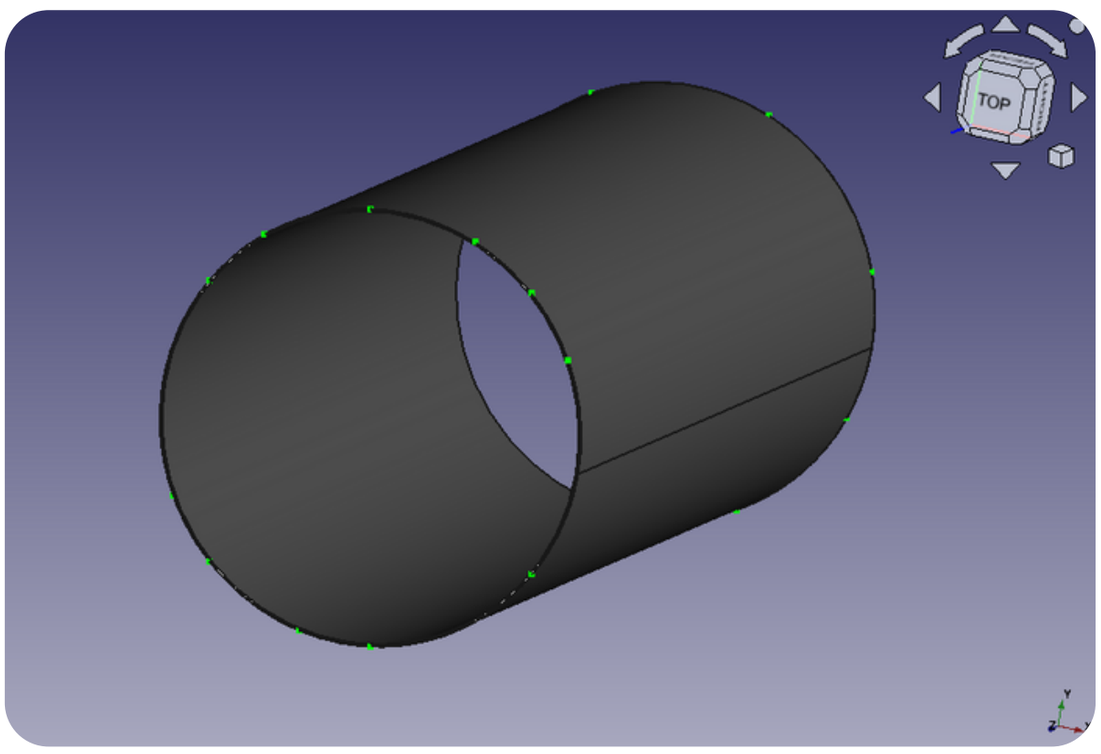
```
# Read the excel file
csv_file_path = "csv file path/BTL Alignment Spreadsheet.csv" #<- insert file path
```

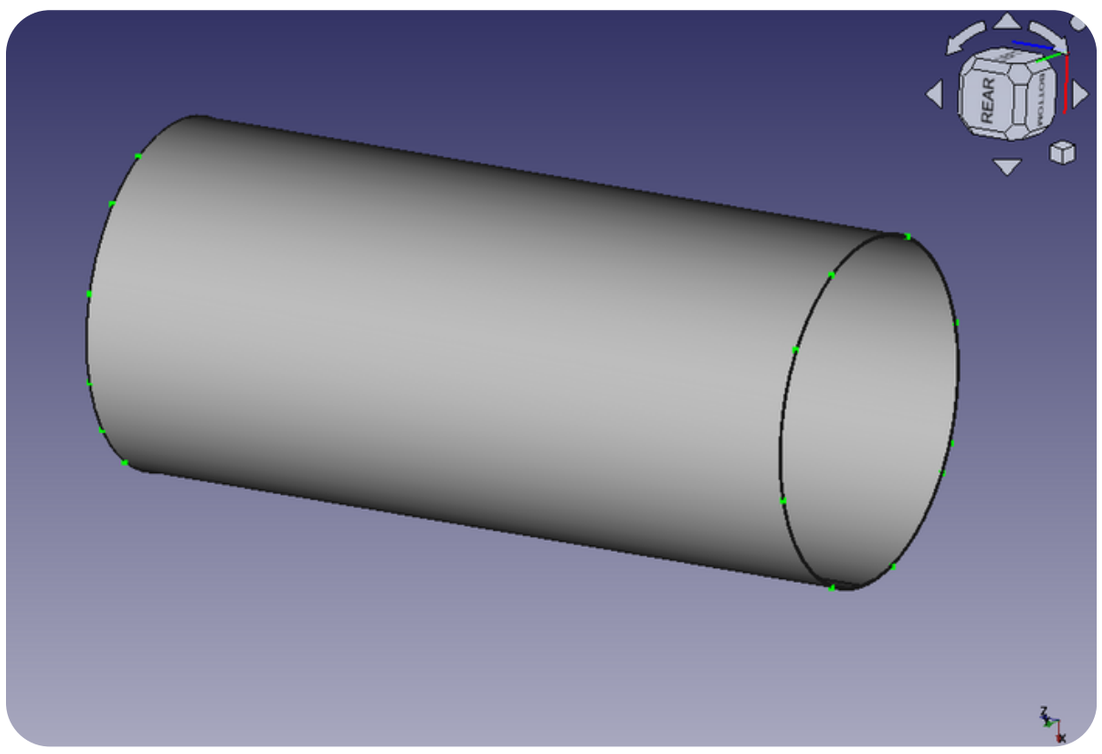
Measure points around the circumference of the BTST on both ends and record them in the following tables in ‘BTL Spreadsheet.csv’:

-Z End : Circumference			
	X	Y	Z
C1	-1.04726	0.60436	2.690384
C2	-0.7783	0.926429	2.690291
C3	-0.21091	1.192315	2.689945
C4	0.413587	1.137918	2.690137
C5	0.77646	0.926953	2.690112
C6	1.047768	0.606021	2.689917
C7	1.047164	-0.60336	2.689832
C8	0.210738	-1.19218	2.690071
C9	-0.20988	-1.1929	2.689967

+Z End : Circumference			
	X	Y	Z
C1	-1.04814	0.60647	-2.68943
C2	-0.6052	1.049041	-2.6898
C3	0.413846	1.137138	-2.6899
C4	1.136647	0.413578	-2.68971
C5	1.135634	-0.41535	-2.69101
C6	0.604865	-1.04975	-2.69039
C7	0.413931	-1.13826	-2.69028
C8	-0.41393	-1.13684	-2.68998
C9	-1.13614	-0.41206	-2.69016

This will produce the following 3D cylinder model representing the BTST.



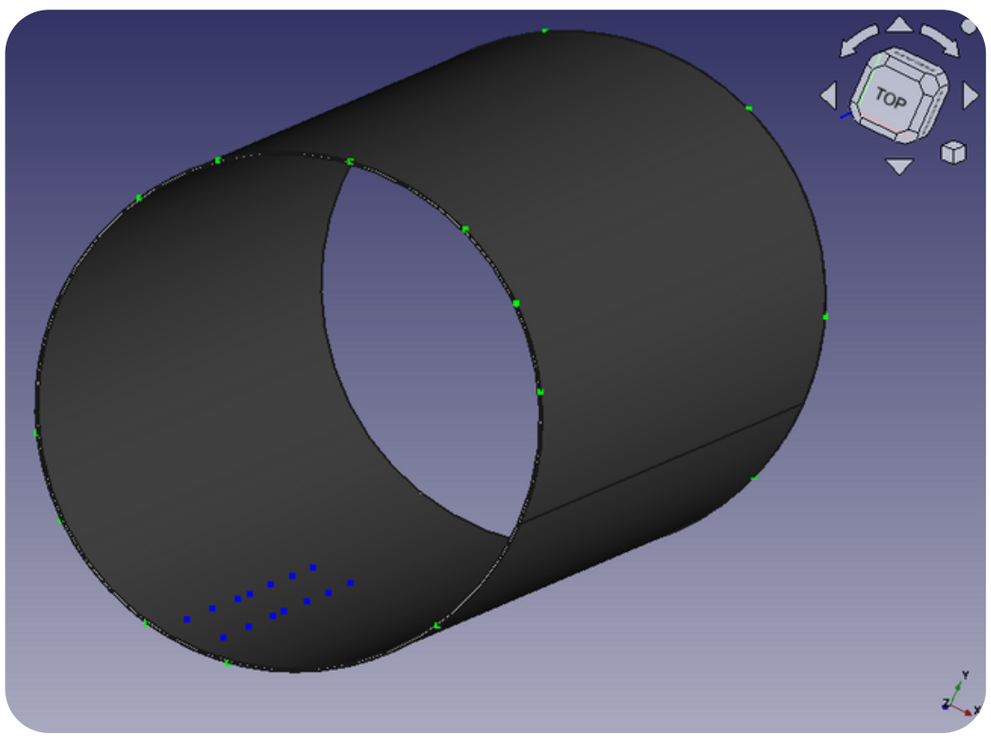


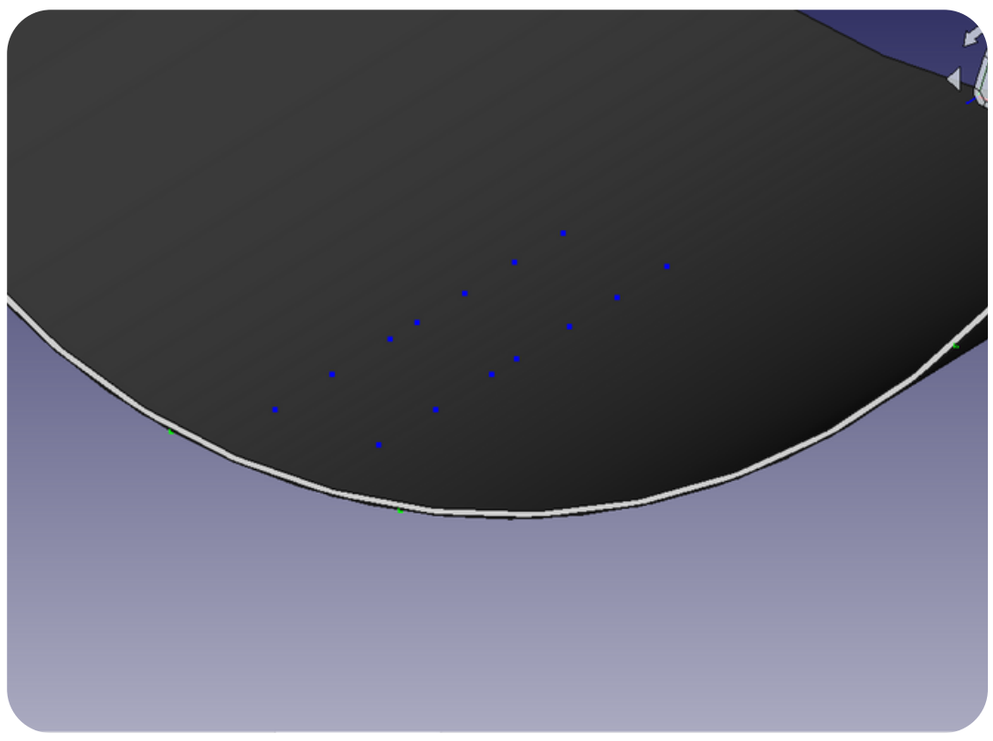
Measure points across the desired I-Beams and record them in the corresponding tables in ‘BTL Spreadsheet.csv’:

+Z End : I-Beam +29			
	X	Y	Z
I29_F1	-0.08987	-1.1367	0.027702
I29_F2	-0.0905	-1.13507	0.431703
I29_F3	-0.09039	-1.13466	0.850366
I29_F4	-0.09028	-1.13486	1.244822
I29_F5	-0.09049	-1.13488	1.467772
I29_F6	-0.09325	-1.13485	1.942864
I29_F7	-0.09415	-1.13524	2.413965

+Z End : I-Beam +30			
	X	Y	Z
I30_F1	0.09585	-1.13214	0.023186
I30_F2	0.096323	-1.13263	0.437905
I30_F3	0.095358	-1.13341	0.835736
I30_F4	0.093795	-1.13396	1.260616
I30_F5	0.093736	-1.1342	1.467684
I30_F6	0.09496	-1.13449	1.938957
I30_F7	0.095209	-1.13514	2.413422

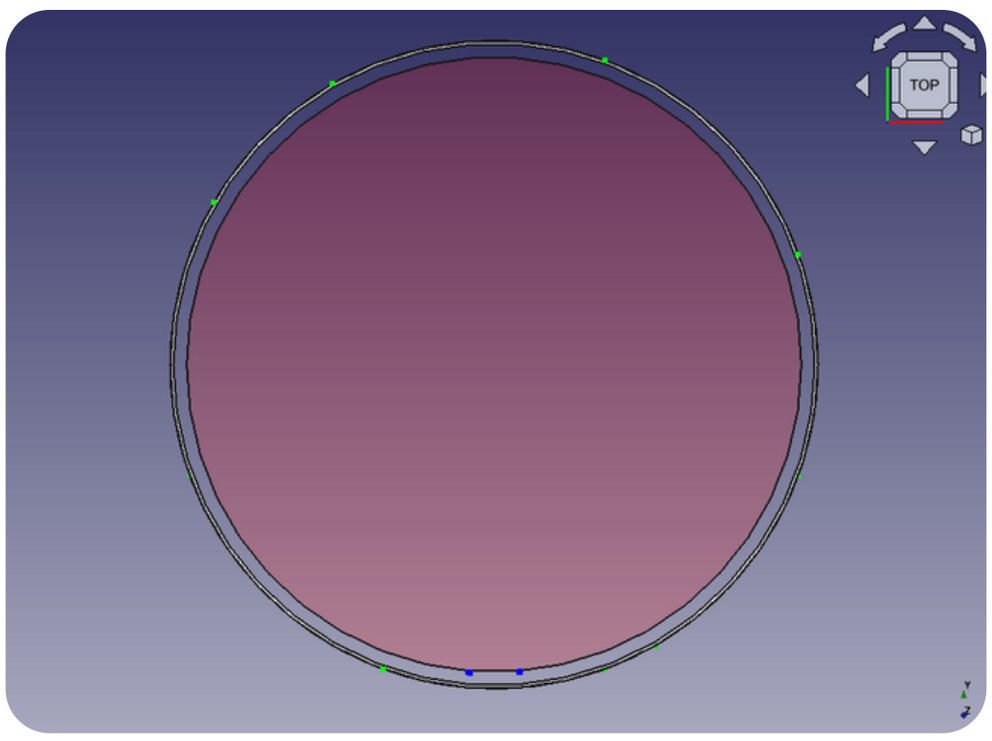
This will then mark the coordinates into the 3D visualiser (with the correct adjustment).

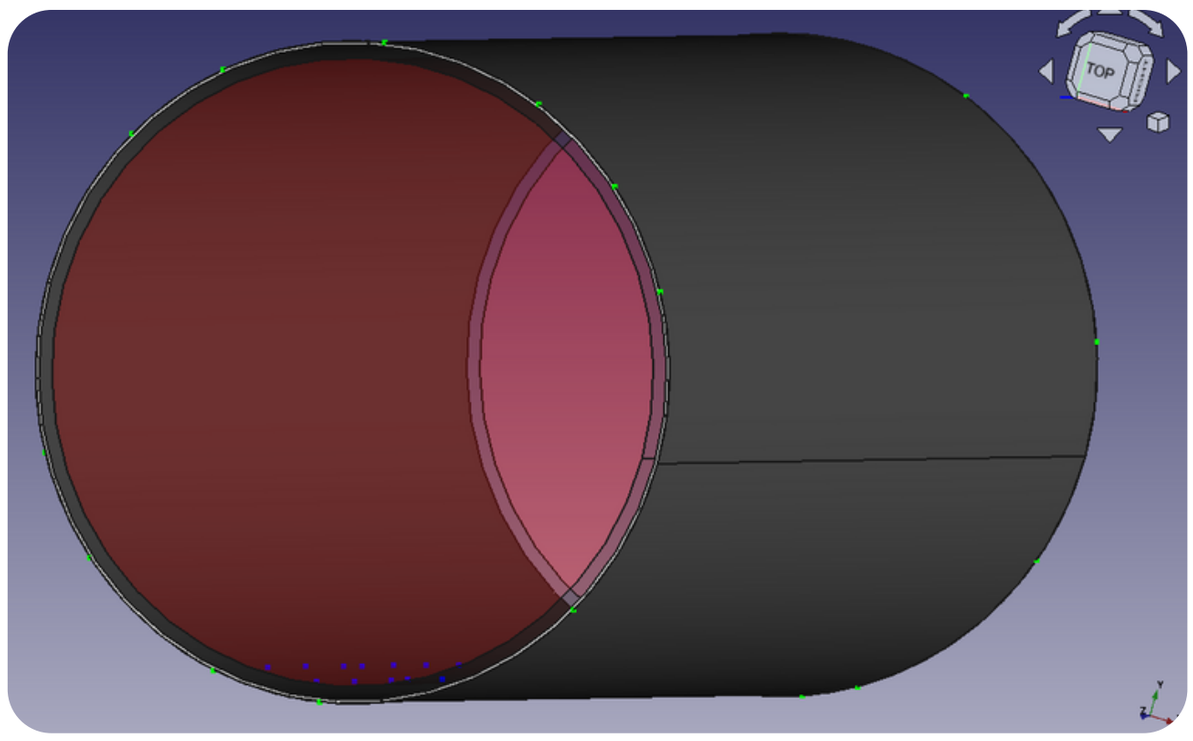




4. Adjustment Readings (Automated)

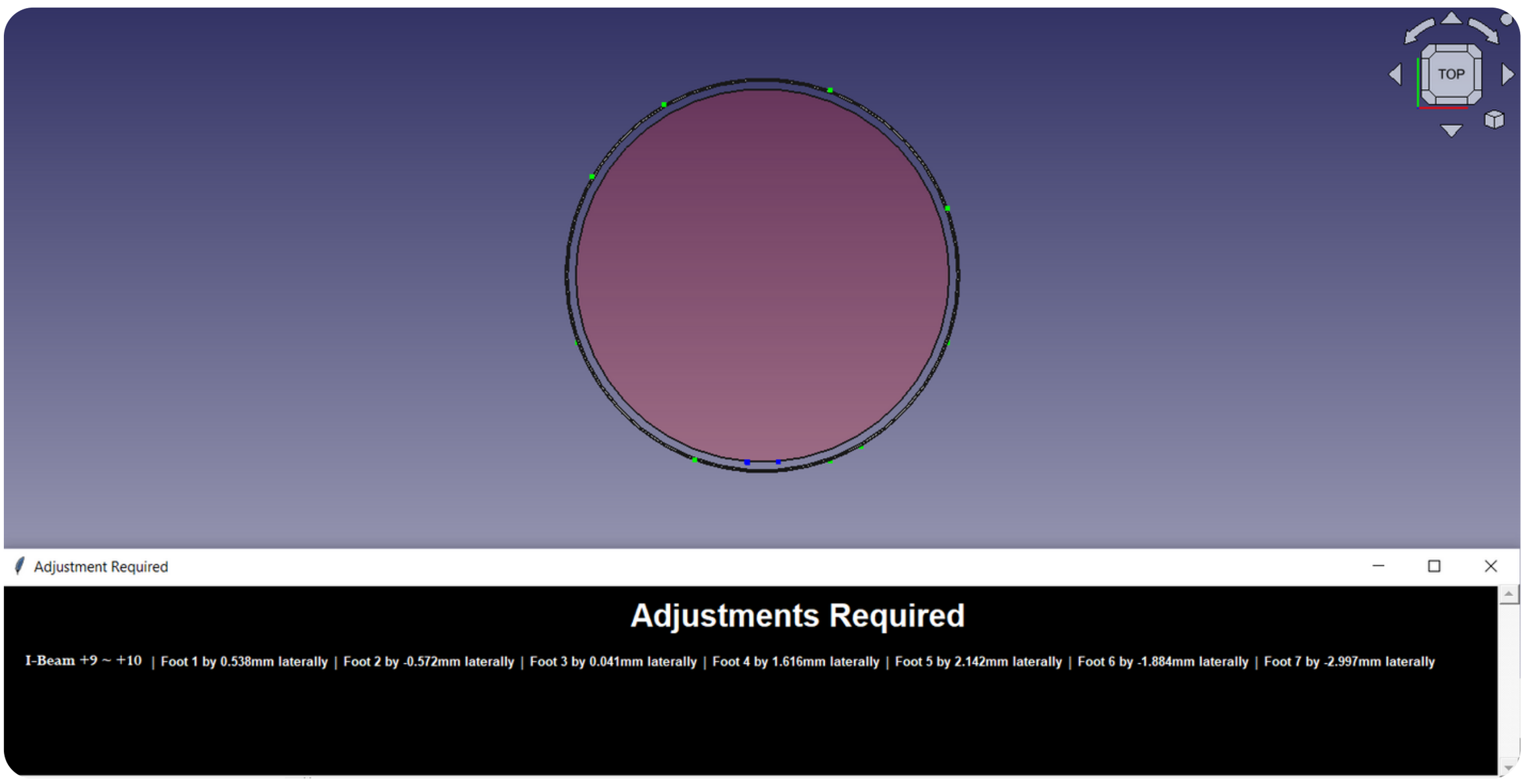
The script will produce a secondary cylinder (in red) representing a ‘No-Go-Zone’, which is the radial threshold to align BTL with Tracker:





If points measured along any of the I-beam cross into this No-Go-Zone, the user will be informed of the necessary adjustments needed to perform vertically on the feet.

Additionally if the adjacent points between I-beams do no meet a nominal separation distance, the user will be informed of the necessary adjustments needed to perform laterally on the feet.



Note: This code will likely be modified in the future. This is the initial version, ready for a laser scanning test on 20/03/2024