BILL OF MATERIALS

1. 128 M5 stainless steel bolts
2. 128 M5 stainless steel nuts
3. 4 Vertical beams (T-slot 20x20 aluminum profile - Length 2000mm)
4. 4 Z coils beams (T-slot 20x20 aluminum profile - Length 1790mm)
5. 4 X coils beams (T-slot 20x40 aluminum profile - Length 840mm)
6. 4 Y coils beams (T-slot 20x40 aluminum profile - Length 810mm)
7. 1 Testing table (Aluminum sheet 2x840x810mm)
8. 2 ±X table beams (T-slot 20x20 aluminum profile - Length 840mm)
9. 2 ±Y table beams (T-slot 20x20 aluminum profile - Length 810mm)
10. 16 Double profile brackets (20x40 aluminum brackets (4 bolt holes))
11. 16 Square profile brackets (20x20 aluminum brackets (2 bolt holes))
12. 8 Z coils brackets
13. 16 X-Y coils brackets
14. 2 X coils (side length 1650mm)
15. 2 Y coils (side length 1700mm)
16. 2 Z coils (side length 1750mm)
17. 16 support brackets

For the assembler’s convenience, the following parts shall be renamed:

Item number, from BoM	Initial name, from BoM	Final name, referred as in document
3	Vertical beams (T-slot 20x20 aluminum profile - Length 2000mm)	XL
4	Z coils beams (T-slot 20x20 aluminum profile - Length 1790mm)	L
5	X coils beams (T-slot 20x40 aluminum profile - Length 840mm)	x2/84
6	Y coils beams (T-slot 20x40 aluminum profile - Length 810mm)	x2/81
8	±X table beams (T-slot 20x20 aluminum profile - Length 840mm)	TBL X
9	±Y table beams (T-slot 20x20 aluminum profile - Length 810mm)	TBL Y
10	Double profile brackets (20x40 aluminum brackets (4 bolt holes))	Double brackets
11	Square profile brackets (20x20 aluminum brackets (2 bolt holes))	Single brackets

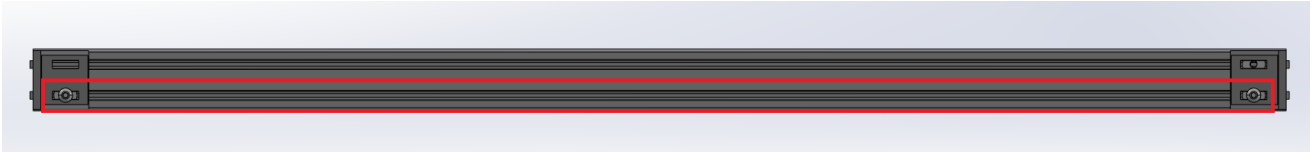
PRELIMINARY WORK

Brackets preparation

We take a screw, pass it through a hole of our choice from a double bracket and screw a nut on the other side, making sure that the flat surface of the nut faces the double bracket. We repeat this procedure for all the double brackets, and work similarly for the single brackets. It is important that half of the double brackets have the screw in the left hole, and the other half have it in the right, like they are projections on a mirror.

Preparation of x2/84 and x2/81 supports

We assemble all the x2/84 and x2/81 supports. On the 40mm wide surface (big surface), and channel of our choice, we insert a double bracket with the blank back facing outwards and align the back of the double bracket with the edge of the support, then tighten the screw. We repeat the process on the other side of the support. CAUTION!!! At this point, the screws from the two double brackets should be in the same channel of the big surface of the x2/84 and x2/81 supports.



Preparation of the TBL X and TBL Y supports

We assemble all of the TBL X and TBL Y supports. Using the single brackets, we work similarly to the preparation of the x2/84 and x2/81 supports.

Preparation of the L supports

We assemble all the L supports. At a distance equal to 47.1cm from each side, we mark the point. For the input of a single bracket, we insert it in the channel with the back with the empty hole facing outside of the L support (at 90 degrees). We align the single bracket's flat surface, which is facing towards the side it was inserted from, with the 47,1cm mark and tighten the screw. We repeat this procedure for the other side of this L support. We repeat this procedure for all the L supoorts. CAUTION!!! The surface with the empty hole of all the single brackets must be facing the same way.

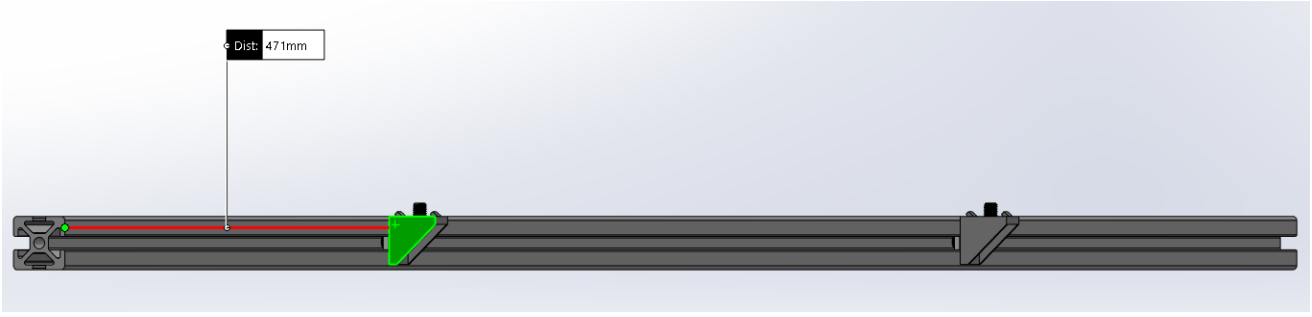


Figure 1. Single brackets distance and placing

At this point, the 4 L supports should have 8 single brackets mounted on them, in total, which will all be in the same channel, and the empty hole of all the single brackets will be facing the same way.

ASSEMBLY

COALESCENCE OF THE 4 XL BEAMS

For the assembler's convenience, the bottom of the XL beams will be called the (-) side, whereas the top will be called the (+) side.

We take 2 XL beams and at a distance of 26cm from the bottom (-), we mark the spot. We take one x2/81 support and insert it in the channel of an XL beam with its blank side facing the top (+) of the cage, while the side which bears the double bracket faces the bottom (-). We align the blank surface with the 26cm mark, and tighten the screw. We repeat this process for the other XL beam. Finally, we repeat all the above steps with the other 2 XL beams and 1 x2/81 support. CAUTION!!! The protruding part of the x2/81 support MUST be towards the outside area of the cage.

At this point, we have joined together the 4 XL beams in pairs of 2.

Next, at a distance of 28.7cm from the bottom (-) of the XL beams, we mark the spot. Using one of the two pairs of XL beams, we insert a x2/84 bracket into the channel of an XL bracket with the blank surface facing the top (+) and the side with the double brackets facing the base (-). Align the blank surface with the 28.7cm mark, and tighten the screws to stabilize the support. We are now able to join the 2 pairs by inserting the other end of this x2/84 support into the channel of the other XL pair. Finally, we insert another x2/84 from the other side and work in a similar way to close the loop. CAUTION!!! At this point the 4 XL brackets should be joined together, and the side of x2/81 and x2/84 that protrudes from the frame should be OUTSIDE the cage.

At this point, the cage should look like this.

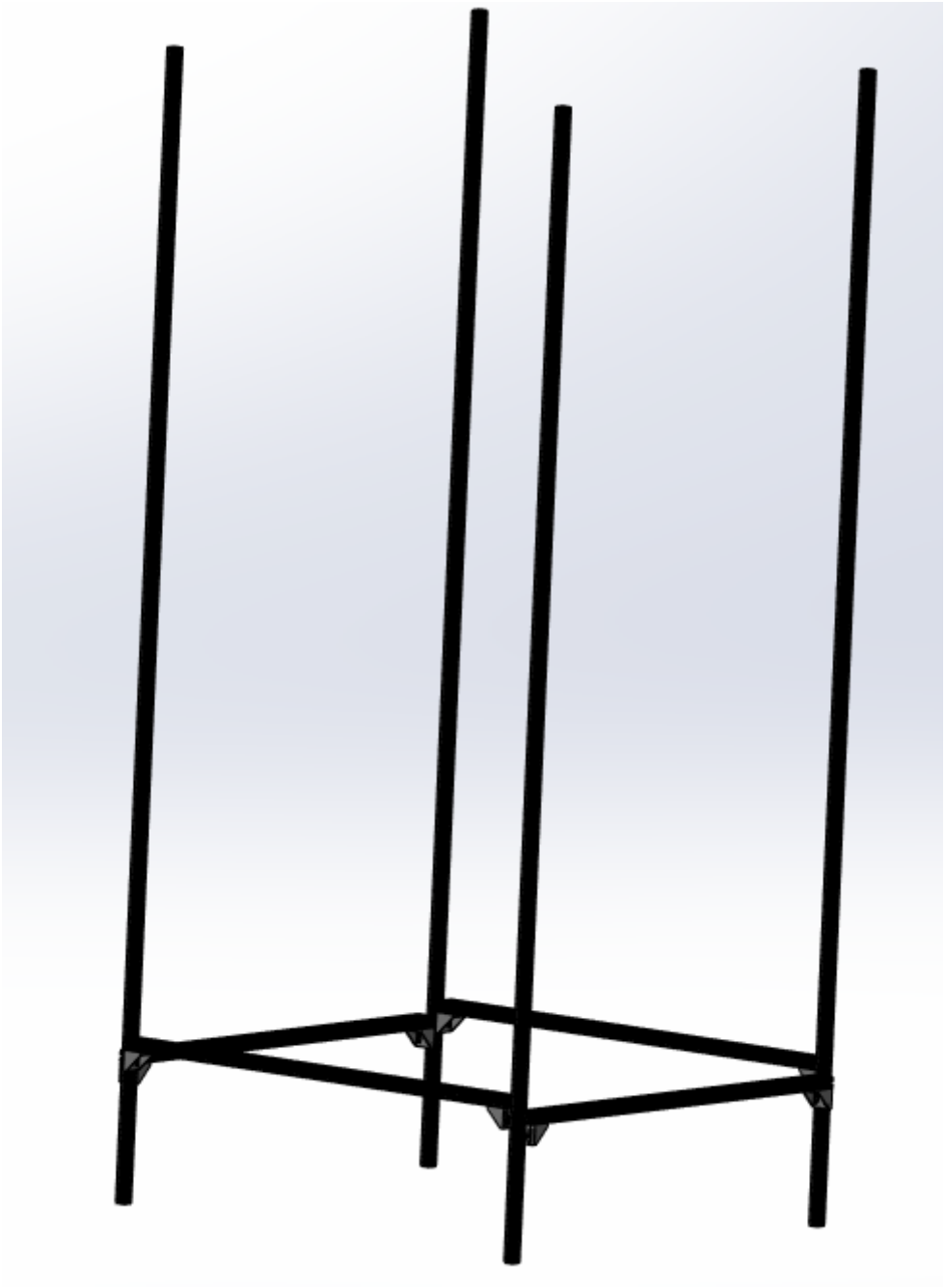


Figure 2. Coalescence of the XL supports

LOWER Z SUPPORTS PLACEMENT

At a distance equal to 60.9cm from the base (-) we mark the spot. The L supports MUST be inserted on the same sides as the x2/81 supports. The L supports MUST be facing the inside area of the cage. We align the blank surface with the 60.9cm mark, facing the top (+), and tighen the screw.

At this point, the cage should look like this.

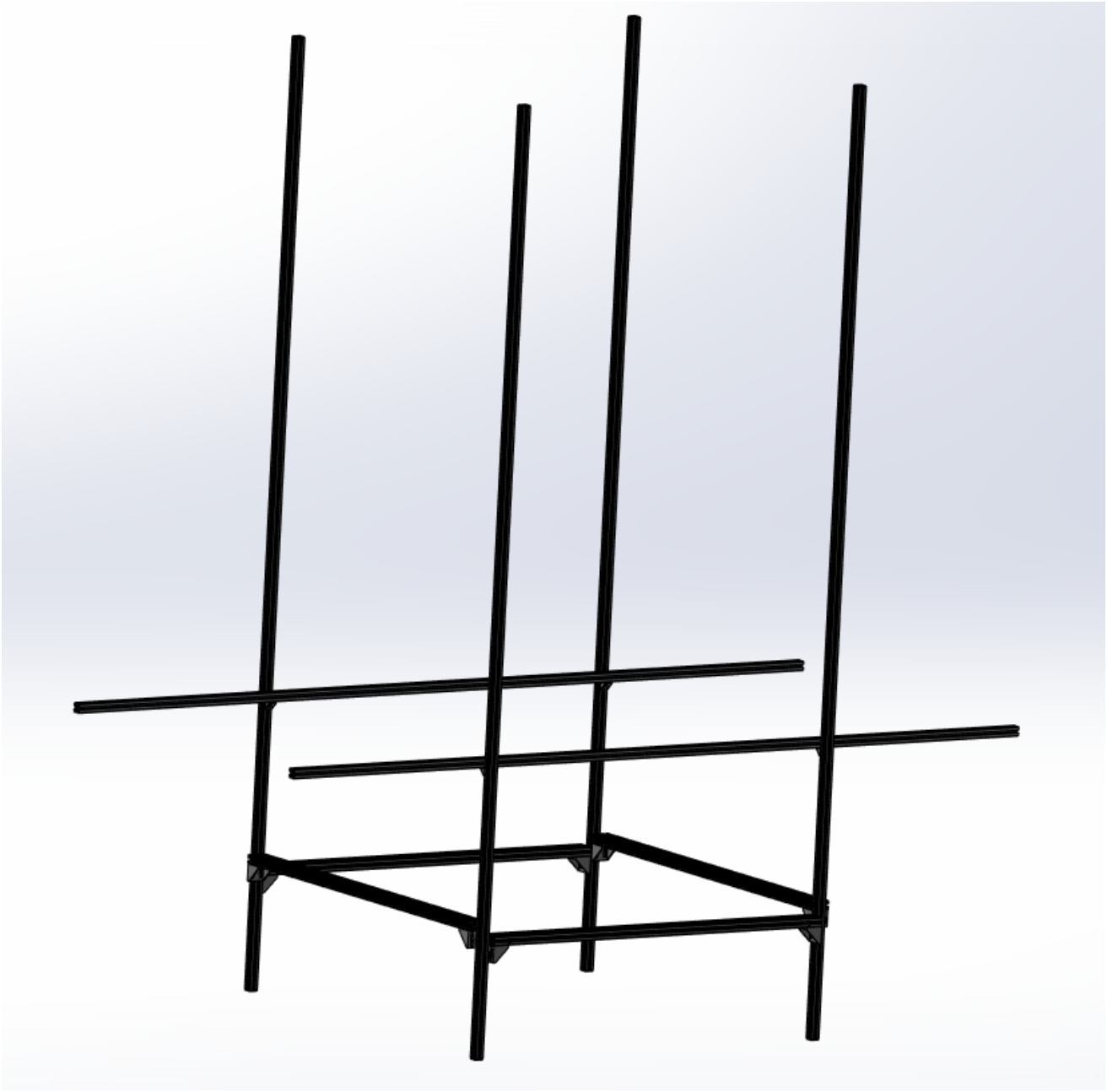


Figure 3. Lower Z supports

TABLE PLACEMENT

At a distance equal to 113cm from the base (-) we mark the spot.

To mount the TBL X supports, we insert them from the same sides as the x2/84 supports. To install the first TBL X, insert the bracket with the single bracket side facing the base (-). Align the blank surface of the TBL X with the 113cm mark, and tighten the screw. Repeat the procedure for the other TBL X support. In a similar way, we insert the TBL Y brackets from the sides of the x2/81 brackets, and repeat the procedure.

At this point, we have the 4 table brackets TBL X and TBL Y with their blank surface aligned with the 113cm mark, and with the single bracket facing the base (-). Also, the TBL X are parallel to the x2/84, while the TBL Y are parallel to the x2/81.

We place the table on top of its supports, with the longer side (840mm) on the TBL X supports and the shorter side (810mm) on the TBL Y supports.

At this point, the cage should look like this.

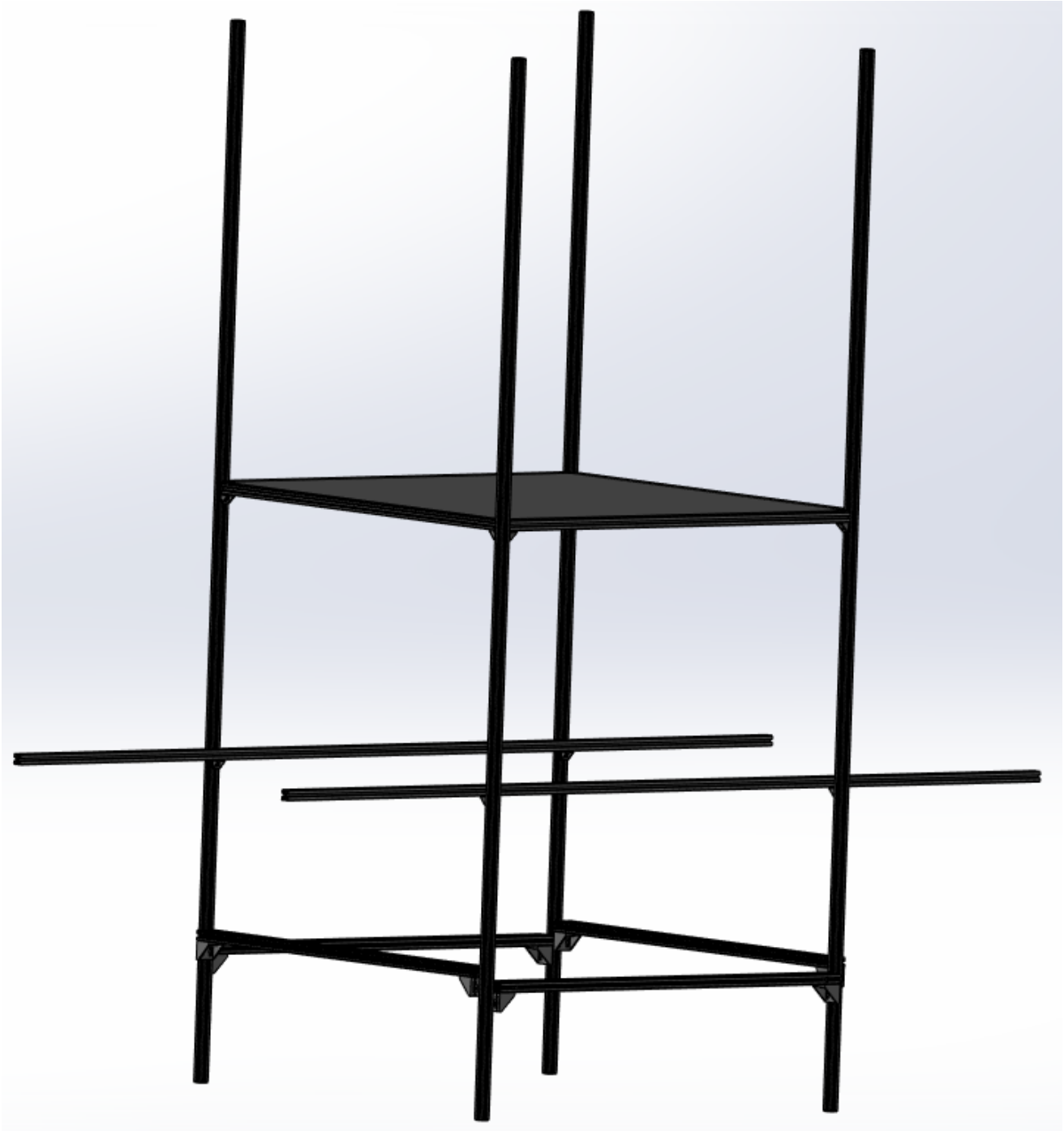


Figure 4. Table and its supports

UPPER Z SUPPORTS PLACEMENT

At a distance equal to 156.1cm from the base (-) we mark the spot. The L supports MUST be inserted on the same sides as the x2/81 and TBL Y supports. The L supports MUST be facing the inside area of the cage. We align the blank surface with the 156.1cm mark, facing the top (+), and tighen the screw.

At this point we have placed the 4 L supports, facing towards the inside are of the cage, and parallel to the x2/81 and TBL Y supports.

At this point, the cage should look like this.

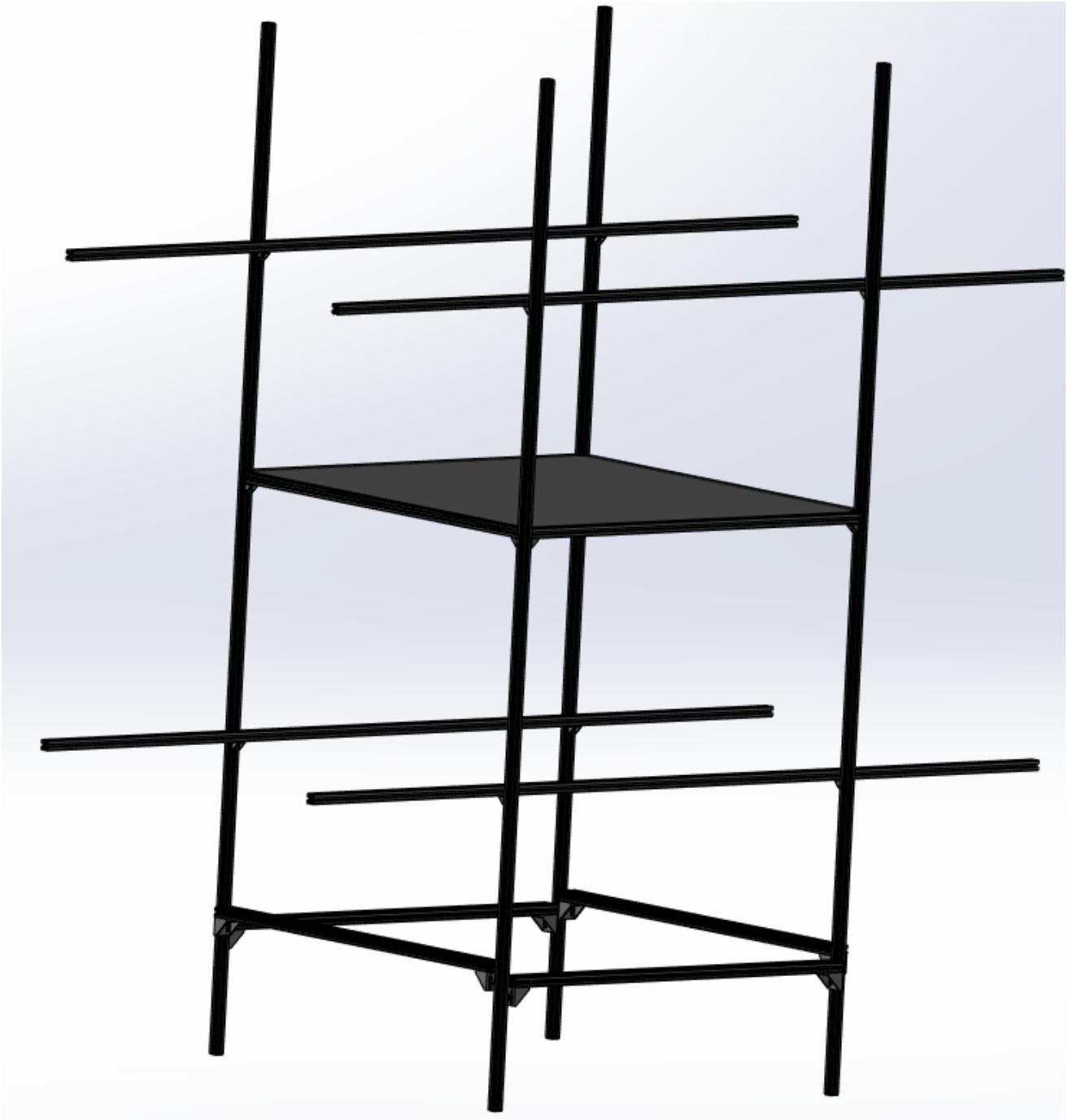


Figure 5. Upper Z supports

TOP SUPPORTS PLACEMENT

At a distance of 2cm and 4.35cm from the top (+), we mark the spot.

For the placement of the final 2 x2/81 supports, we insert them from the top (+) of the sides that have the other 2 x2/81 and TBL Y supports mounted. We insert them with the brackets facing towards the base (-), align the blank surface with the 2cm mark, and tighten the screws.

Similarly, we mount the final 2 x2/84 supports to the top (+) of the sides that have the other 2 x2/84 and TBL X supports. We align the blank surface with the 4.35cm mark, and tighten the bolts.

At this point, we have set up the main frame infrastructure, alongside all the internal supports. The cage should look like this.

Figure 6. Top supports

COILS PLACEMENT

The first coils to be mounted are the X coils (side length 165cm) atop the x2/84 supports. Next, the Y coils are placed (side length 170cm) atop the x2/81 supports. During the Y coils' installation, we mount them outside of the X coils.

Finally, we place the Z coils (side length 175cm) outside of the other 2, and mount them atop the L supports.

At this point, the cage should look like this.

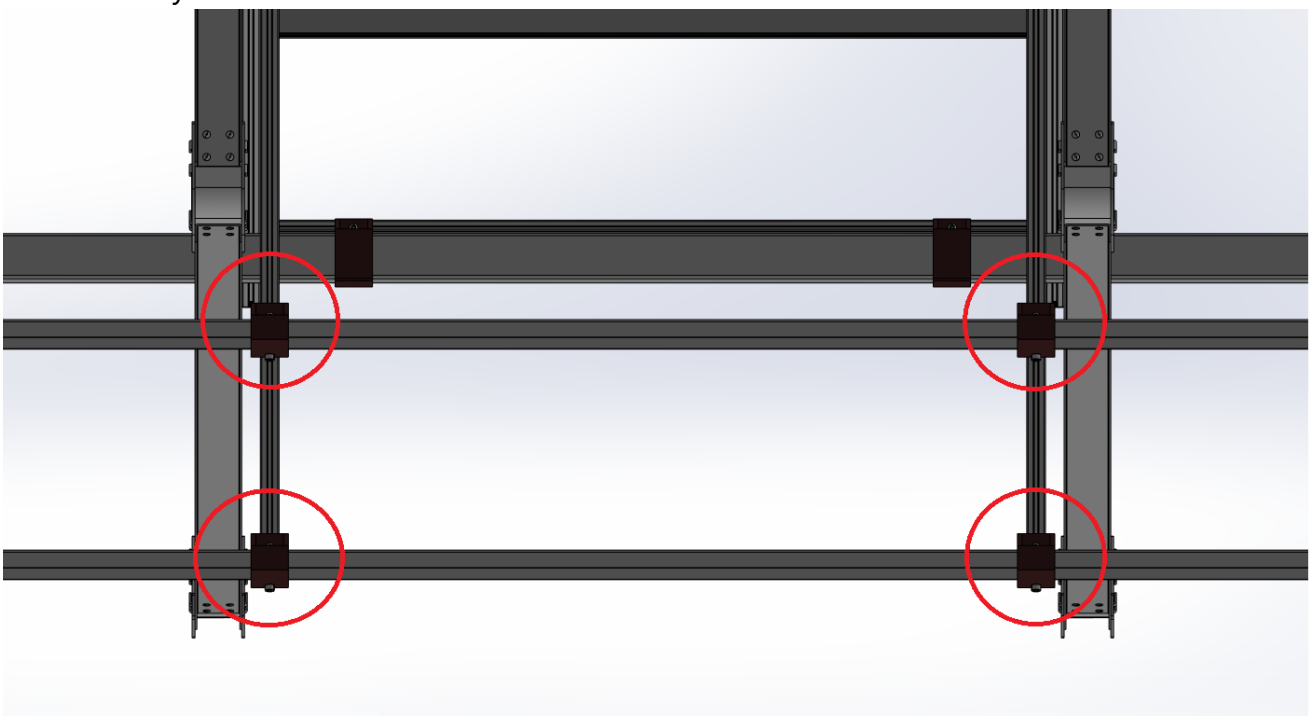
Figure 7. Assembled Helmholtz cage, with frame and coils

SUPPORT BRACKETS

In order ot further improve the overall stability of the assembly, 3D printed brackets are being utilized.
There are 3 types of brackets:
- X-Y brackets for the X-Y coils
- Z brackets for the Z coils
- Support brackets for the x2/81 and x2/84 beams

The X-Y brackets keep the X and Y coils in place atop the x2/81 and x2/84 beams. There is no fixed position for them to be screwed. It's up to the assembler.

The Z brackets keep the Z coils in place at the edges of the L beams.
If the inside of the beam is threaded, an additional screw may be used to further stabilize the assembly.



The support brackets further stabilize the x2/81 and x2/84 beams, keeping them from rotating due to the coils' weight.