

Design process:

1. Find out all requirements
2. Look into reference designs
3. Refer to Formula SAE rulebook
4. Make hand-drawing of design
5. Make sure drawing meets requirements
6. Find dimensions of everything (map it out on CAD software)
7. Find quick-release mod for Logitech G920
8. Find sequential mod for Logitech shifter (optional)
9. Find way to mount Logitech pedals (inversely mounted?)
10. Reference parts on McMaster-Carr and Fastenal, and find total approximate price to build rig.
11. Build and Test final product.

Requirements:

(Check Ergo Rig document for project requirements)

Deadline: Rig must be built and tested by JANUARY 1ST.

Update (As of December 28th, 2018): Due date moved up to February 1st.

Timeline:

October 26th, 2018: Our first meeting. Me, Ariel, and Ahmed, discussed the purpose of this project, requirements, and what is to be expected from the final product.

October 26th, 2018: I looked at reference designs, such as DIY-built custom sim rigs from forums, as well as wheel stands available on the market. I also read the FSAE rulebook from 2017/2018 that showed the optimal driving positions.

October 27th, 2018: I did some brainstorming for steering wheel mounts and adjustability, making some hand sketches, and researching possible designs. I also put out a message on Slack notifying everyone working on this project to set up a potential first meeting.

October 29th, 2018: I got no response to my initial message to set up a meeting. I put out another message today around 4:00pm. I got a reply from one of the members, Puria Pezeshki, saying that they were free, to which I responded by asking if they were free tomorrow, at Tuesday, October 30th, after 5pm. I also did some brainstorming for pedal mounts and adjustability, with a sketch for a potential idea, based on some online research.

October 30th, 2018: I got no further response from any of the new members regarding who was free today. I instead asked Ariel if he could look at my designs, to which he said yes. I also finished doing research on possible designs and ideas for seat adjustment.

October 31st, 2018: I met up with Ariel and Ahmed, who messaged me earlier saying that he would join us. I pitched my ideas to him, to which he gave constructive feedback. He specifically mentioned that for all parts of the rig, the wheel, the pedals, and the seat, each adjustable feature must not affect any other measurement, meaning that for example, changing the steering wheel angle must not affect the height or the distance of the wheel. He also said that he wants individual adjustability for angle, height and distance, for each the wheel, pedals, and the

seat. After the meeting, me and Ahmed decided to meet up together tomorrow at 11am-12pm to discuss any further ideas, now that we got some feedback. Also, we decided to split up the work- he would work on the pedals, and I would work on the wheel, and we would both work together on the seat.

November 5th, 2018: I met with Ahmed and Ariel and discussed any requirement concerns. Upon meeting, I learnt that Ariel prefers to adjust the angle about the axis that is placed on the wheel, instead of behind the wheel, as I imagined it to be before. Me and Ahmed decided to work on it a little further, and meet up on Wednesday again at 4pm. I put out a message on Slack for the other remaining members to join us if they wish to do so, to discuss ideas, as we haven't heard from them for a while. Furthermore, Sienna decided to join the Ergo Rig Project, so we gave her a quick briefing on the requirements and enlisted her to work on the driving seat.

November 7th, 2018: I met with Ahmed and Maaz and discussed any further ideas. We decided not to disassemble the pedals, as it would be time consuming and complex, with little gain. I then talked to Ariel, who suggested to use MDF plates on either side, as part of the frame itself, and then cut grooves into the MDF, and use those grooves as adjustment for the rest of the parts of the rig: wheel, seat and pedals.

November 8th, 2018: I drew up a basic sketch of an idea, built on what Ariel told me, and I showed Ariel the sketch. He seemed to like it, and told me to come up with a few more for comparison. I also showed it to Maaz, and he seemed to like it as well.

November 9th, 2018: I came up with a few more ideas, and first showed them to Maaz. He was impressed by them, and he told me to figure out a few details, concerning the adjustability of the design. I asked Ariel about any possible ideas regarding the adjustability, and he recommended some ideas, and told me to try to make a CAD drawing of the steering wheel assembly, and try to find any potential issues.

November 15th, 2018: I met with Ahmed and Maaz, and confirmed our designs. We decided to assign the design of the seat to Maaz, since Sienna would not be able to handle the seat and the headrest. I talked to Ariel on how to finish the design of the wheel plate, and he decided that he wants to put the wheel upside down on the plate. He asked me to figure out a way to be able to use the wheel the right way up, while the wheel base itself is clamped upside down, by recentering and reconfiguring the wheel, so that the center is upside down.

November 17th, 2018: After trying to find ways to recenter the wheel upside down, and coming up unsuccessful, I asked Ariel if I could disassemble the wheel off the base, and then reassemble the wheel upside down on the base. He agreed.

November 27th, 2018: The whole group met up to decide and finalize our ideas. Maaz had a concern with the knob not being strong enough to provide adequate resistance against the MDF, even when fully tightened, to support the weight of the person sitting in the ergo rig.

November 28th, 2018: Me and Maaz met again with Ariel, who told us that the MDF is pretty strong, and as long as we use a big enough knob to tighten it, it should hold together, and not slide through.

December 13th, 2018: I met with Maaz, who helped me finish off a majority of the CAD drawing for the steering wheel mount.

December 14th, 2018: I met with Ahmed, who showed me his design, and he told me he talked with Ariel about how he needed two bolts instead of one, for the movement of the pedals, otherwise the pedals would want to rotate about the bolt as well, which is something that he wants to avoid. Then I spent the rest of the day working on the wheel mount.

Friday, December 14th, 2018: I set a due date and a meeting for everyone involved in design to complete their CAD and their bill of materials, by Tuesday December 17th.

Monday, December 17th, 2018: I finish the design of the steering wheel mount, along with the bill of materials. I decide to meet with Sienna at 9am Tuesday, and Ahmed 4:30pm same day, as they both have work, and cannot meet at the same time. Sienna lets me know that she won't be able to contribute to the project anymore, as she wants to focus on her academics.

Tuesday, December 18th, 2018: I meet with Sienna at 9am. However, I find out that her headrest design is incomplete and is done on AutoCAD, not Solidworks. So using her dimensions, I am able to make a model of the headrest in Solidworks. I then meet with Maaz and we try to start the assembly together, but we are unable to continue, as we Ahmed has not finished his design of the pedal mounts. I meet with Ahmed at 6:30pm, as he was late, and I ask him to finish the design by the end of the day. He is unable to, and lets me know that he will work on it tomorrow.

Wednesday, December 19th, 2018: Ahmed still has not submitted his designs, so I decided to finish the design. I spend the night in the shop working on the CAD assembly of the pedals, along with the whole ergo rig.

Friday, January 11th, 2018: Our first design review with Ariel. Me, Maaz and Ahmed talked with Ariel and presented our design to him, and showed our bill of materials (we had prepared one to give to Ariel so that he could make the order, all from Fastenal). He gave us advice to each of our systems, regarding the hardware being used and any design changes he desired.

Monday, January 15th, 2018: I double checked and reserved the amount of MDF and plywood we had in the materials storage room. I then made CAD drawings of the MDF we had, and compared it to the amount we needed, and came to the conclusion that we had more than enough material to build the ergo rig, not including hardware.

Thursday, January 17th, 2018: I was able to finish the second iteration of the design, to Ariel's advice, and also adjusted the bill of materials to fit our new design.

Friday, January 18, 2018: Our second design review. Ariel looked over our second iteration of our design, and was overall happy with it. He gave us a few more things to adjust on the design, such as adding pilot holes for the screws, moving the front reinforcement plate farther back (just below the driver's ankles), do tolerancing for all bolts, using 1 groove instead of 2 for the height adjustment of the steering wheel, and adding more space between the two bolts for the height adjustment, bigger gussets for the steering wheel base, and the height of the side sheets. I split the work between me, Maaz and Ahmed. I later asked on Slack if anyone would be able to check and update the bill of materials.

Monday, January 21st, 2018: I was able to add pilot holes to the steering wheel base for the screws. I also went over the bill of materials again, however it was incomplete, so I planned a meeting the next day with Ahmed to get it fixed. Then, I looked at places in the GTA that do laser cutting for MDF, and I made a list of possible places we could use.

Tuesday, January 22nd, 2018: I was unable to discuss with Ahmed about the bill of materials, as I was working on the sensor enclosures. I decided to meet with him the next day at 1:30pm.

Wednesday, January 23rd, 2018: I met with Ahmed and made good progress on the bill of materials. However, the prices for the Fastenal Canada website were unknown, and needed a login to access.

Thursday, January 24th, 2018: I find the screws needed to hardmount the G29 pedals (M6X1-14mm). With this, I find the prices of them on Fastenal, and with that, I am able to finish the bill of materials. I finished my first draft of a sponsorship proposal, for laser cutting. I informed Ariel of my progress, and shared both the bill of materials, and the sponsorship proposal with him. Upon meeting him in the evening, he told me that he was impressed with the email, and that he wanted it to be a bit shorter, and to also ask for a quote at the beginning.

Reference Designs

Finding reference designs similar to what we needed was challenging. However, there were a few cool ideas online, based on Formula 1 simulator rigs:

FIRST DESIGN

<https://www.isrtv.com/forums/topic/19504-classic-diy-f1-sim/>



This design is apparently based on F1 cars from the 60's. Construction is made from MDF (thickness unknown). Looks fairly simple and minimal. And the base of the seat is mounted on rails, so it can be adjusted (shown in picture). However, I would need to account for adjustability for pedals and steering wheel. Also, this design does not show a way to mount pedals, as the legroom doesn't look sufficient.

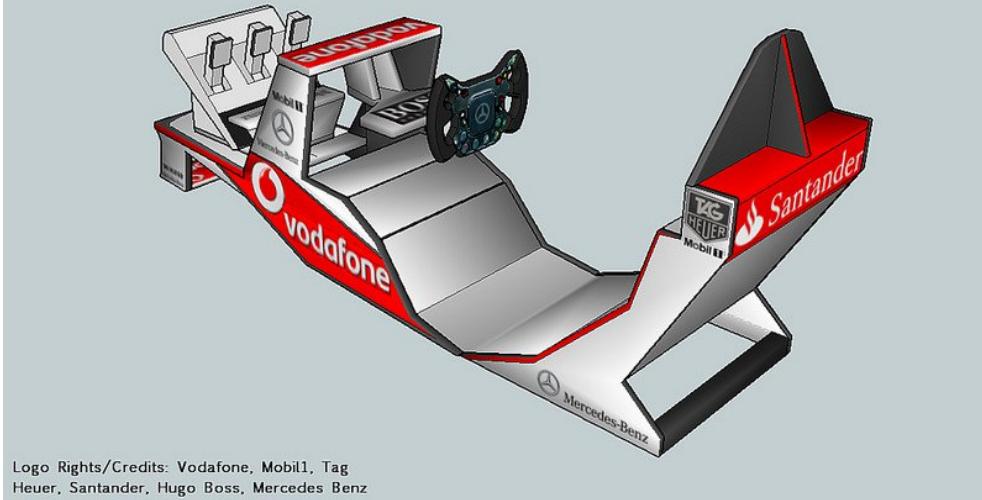
SECOND DESIGN

<https://www.gtplanet.net/forum/threads/project-simulation-diy-cockpits-plans-gt-and-f1-style.285002/>

(c) 2013 - www.ProjectSimulation.webs.com



(c) 2013 - www.ProjectSimulation.webs.com



This design was quite interesting as the seat itself was a part of the structure. The construction of this is MDF and aluminum. Also, the pedal base is tilted, putting the pedals itself at a vertical angle at a horizontal, which is a good idea to consider. However, the fixed seat will raise an issue with regards to adjustability. Also, the design might be too complex to build.

THIRD DESIGN

<https://www.gtplanet.net/forum/threads/project-simulation-diy-cockpits-plans-gt-and-f1-style.285002/>





This design would not be useful for our requirements, however, it does give ideas on potential adjustability for the steering wheel, as well as a mount for the monitor.

FOURTH DESIGN

<https://www.isrtv.com/forums/topic/19158-simple-mdf-f1-rig-build/>



This design is made from a combination of 18mm MDF as well as 22mm MDF. Similar to previous design. This reference design is mainly to provide ideas of adjustability for steering wheel.

FIFTH DESIGN

<https://opensimracing.com/products/super-sport-f1-gt-wood-plans>

Super Sport - F1/GT

OpenSimRigs.com
Designer - Steve Spencely
Copyright 2018 - Sim Racing Engineering

Wood Plans

- 3/4" MDF or Plywood
- 8020 Extrusion Adjustment
- Ikea Poang Seat optional



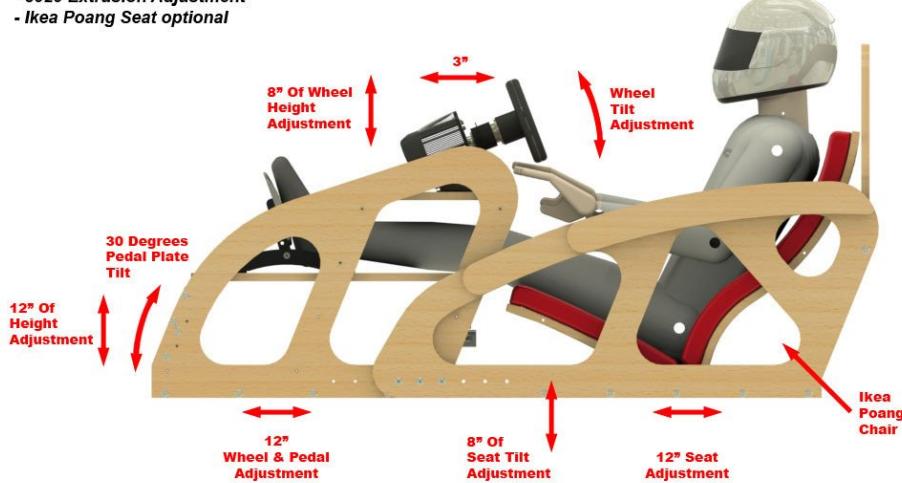
This design is intended to be built from $\frac{3}{4}$ inch MDF or plywood. These are only plans, not a built model. Design provides adjustability for steering wheel, pedals and seat. However, it looks very complex to build. It does provide good ideas for mounting wheel, pedals and seat.

Super Sport - F1/GT

OpenSimRigs.com
Designer - Steve Spencely
Copyright 2016 - Sim Racing Engineering

Wood Plans

- 3/4" MDF or Plywood
- 8020 Extrusion Adjustment
- Ikea Poang Seat optional



- I also looked at other designs for adjustability of wheels, using options from current products on the market, such as wheel stands, like the Next Level Racing Wheel Stand, which provides adjustability for pedals, as well as the OpenWheeler Racing Simulator

cockpit, which provides excellent adjustment for the steering wheel, in longitudinal and lateral directions, as well as angle.



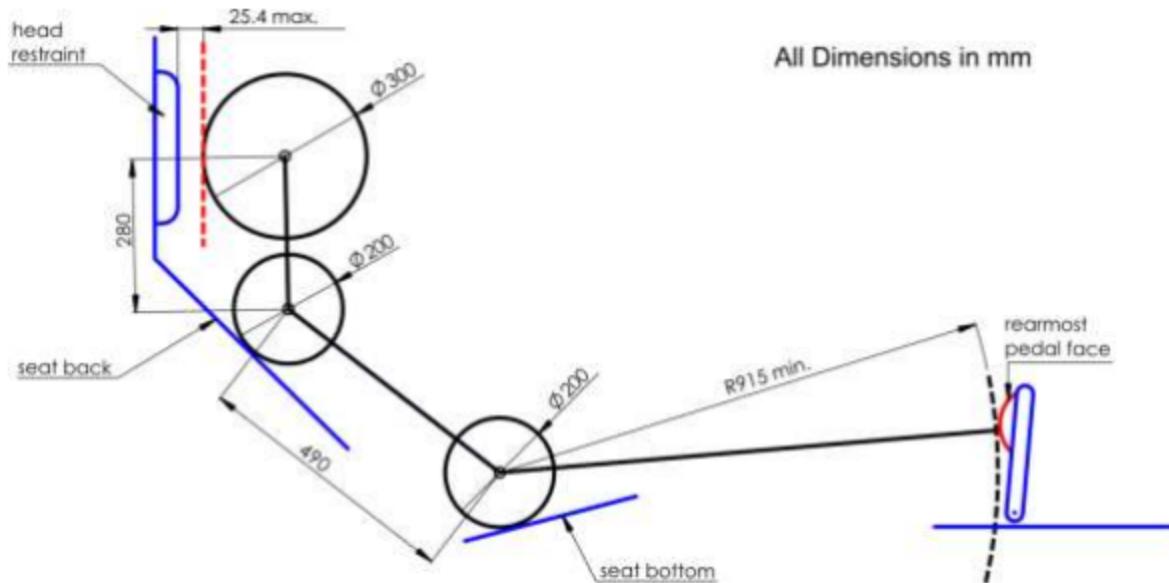
This is the Next Level Racing Wheel Stand. Note the movable pedal stand.



This is the OpenWheeler Racing Simulator cockpit. Note the adjustable steering wheel mount.

Rulebook statements:

- Should be able to fit 5th percentile female, and 95th percentile male.
- Should follow below template:



Important Decisions:

- I decided against providing an option to adjust lateral seat movement, as I found it quite redundant, since there already is adjustment for such in the pedals and the wheel. If the user found themselves a bit too far from the wheel and pedals, they could adjust those two, instead of moving the seat.
- Ariel decided to use tools to adjust all of the parts of the rig, due to budget reasons, which means that we were able to use regular lock-nuts, instead of more expensive wingnuts.(Update(January 11th, 2018): Ariel changed his mind, and he decided to use tools instead, as he was concerned that hand-tightening the wingnuts would not guarantee that the bolts would stay in place.)