

2019 Kona Process 153 AL



BENJAMIN ZIMMERMAN

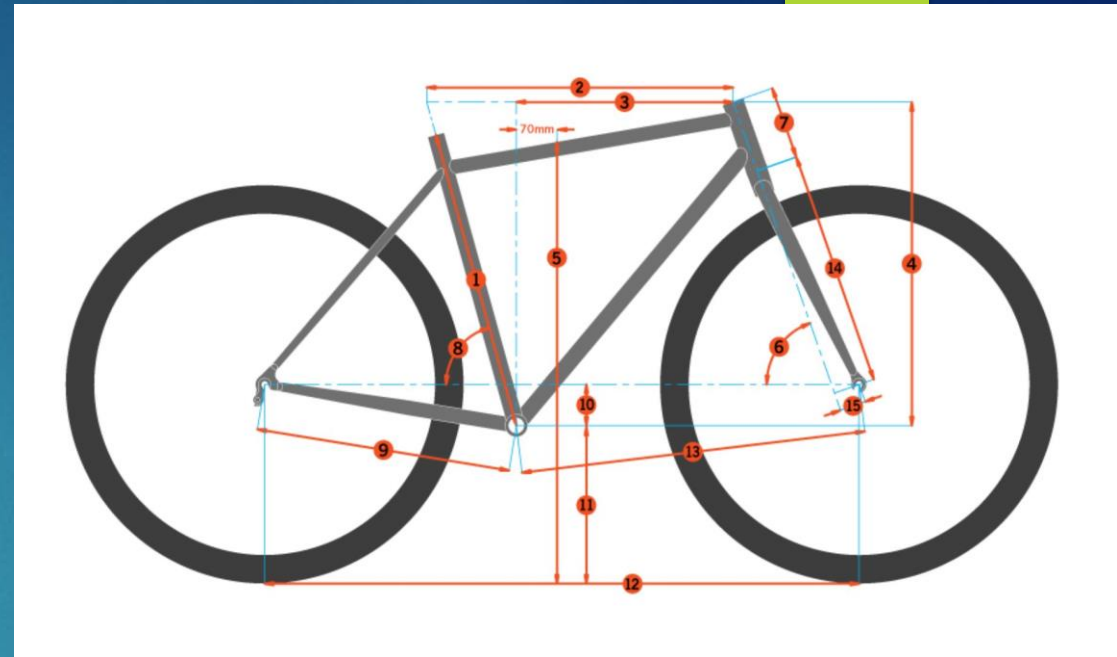


Goals

- CREATE ACCURATE MODEL OF MOUNTAIN BIKE FRAME
- CREATE DESIGN TABLE OF THE 3 DIFFERENT FRAME SIZES OFFERED
- CREATE ASSEMBLY OF FRAME AND LINKAGE

Where to start?

- ▶ Knowing where to start on a project like this can always be a little challenging, but what I chose to do was to go to my bike manufacturers website and see if I could find anything about dimensions for the bike. And since I know they have specific geometry consumers look for I knew they must have something.
- ▶ Here is what I found. So this table gave me a good baseline of dimensions that I needed to model too and the dimensions that I needed to put into my design table.

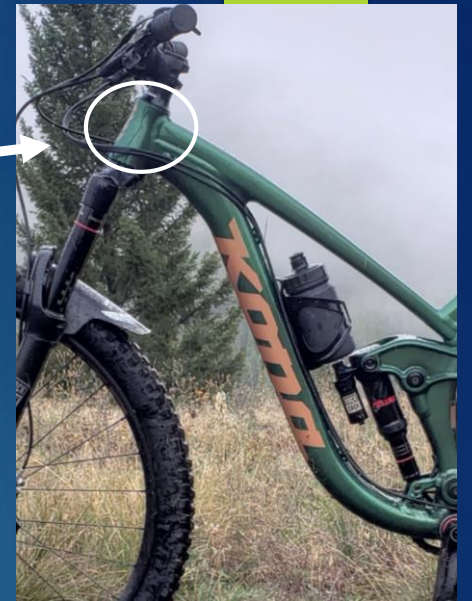


| GEOMETRY | | mm | inches | |
|----------|--------------|------|--------|------|
| SIZE | | S | M | XL |
| 1 | ST LENGTH | 16.1 | 17.7 | 19.1 |
| 2 | TT LENGTH | 23.7 | 24.9 | 26.4 |
| 3 | REACH | 17.7 | 18.7 | 20.1 |
| 4 | STACK | 24.1 | 24.4 | 24.8 |
| 5 | STANDOVER | 27.8 | 28.3 | 28.9 |
| 6 | HT ANGLE | 66.0 | 66.0 | 66.0 |
| 7 | HT LENGTH | 3.5 | 3.9 | 4.3 |
| 8 | ST ANGLE | 76.0 | 75.8 | 75.7 |
| 9 | CS LENGTH | 16.7 | 16.7 | 16.7 |
| 10 | BB DROP | 1.1 | 1.1 | 1.1 |
| 11 | BB HEIGHT | 13.6 | 13.6 | 13.6 |
| 12 | WHEELBASE | 46.8 | 48.0 | 49.5 |
| 13 | FRONT CENTER | 30.2 | 31.3 | 32.8 |
| 14 | FORK LENGTH | 22.5 | 22.5 | 22.5 |
| 15 | FORK OFFSET | 2.0 | 2.0 | 2.0 |

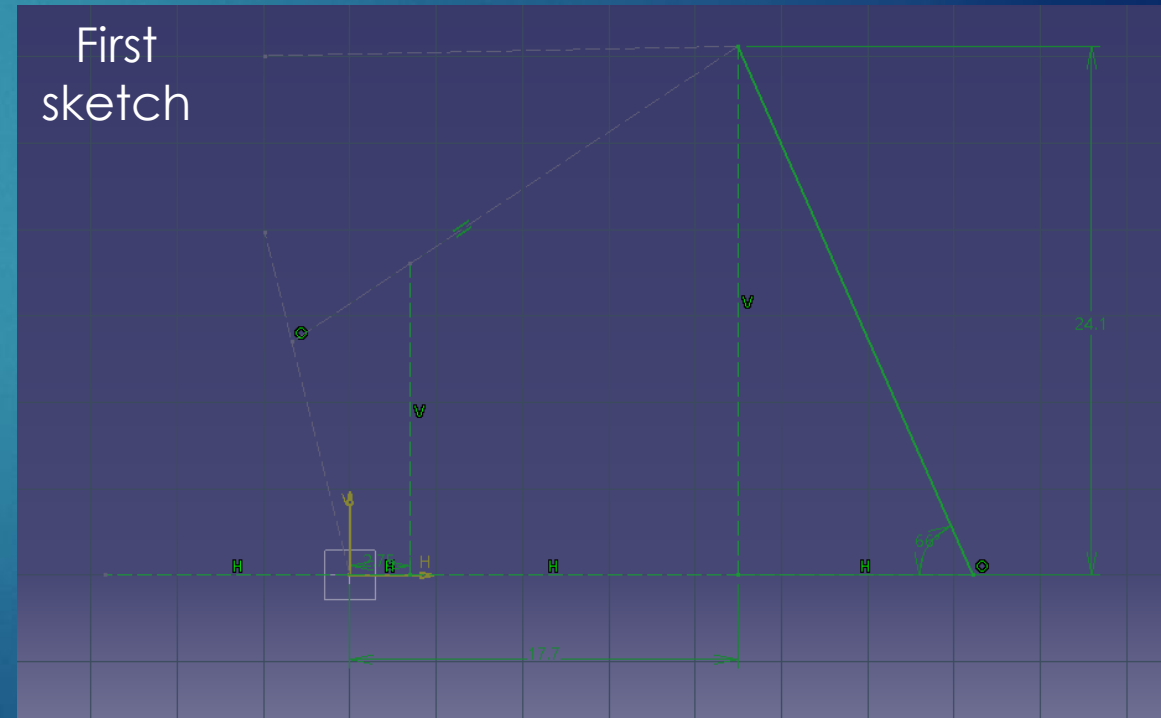
Starting modeling

- ▶ Along with the dimensions given by the manufacturer I also used a tape measure to measure anything that wasn't already given.
- ▶ So once I got some basic dimensions I started modeling and to begin with I started at the front of the frame at the head tube. And made that the basis for creating my model this is also where I introduced my first few design table variables.
- ▶ Which were my head tube angle, Stack, and Reach dimensions.

Starting point

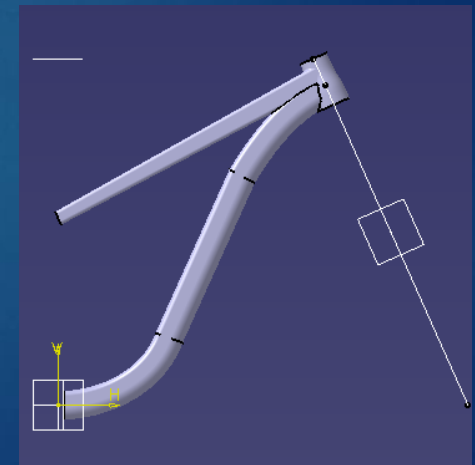
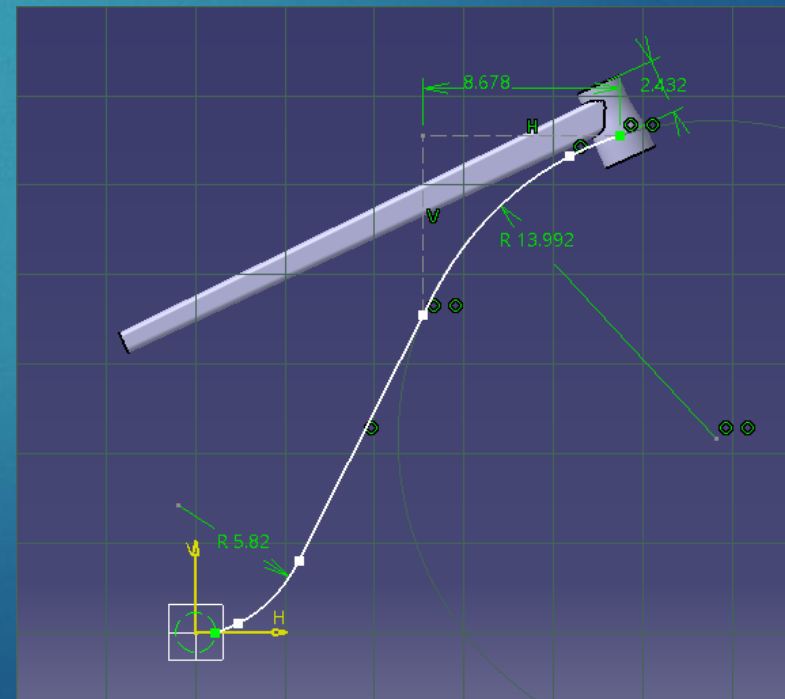
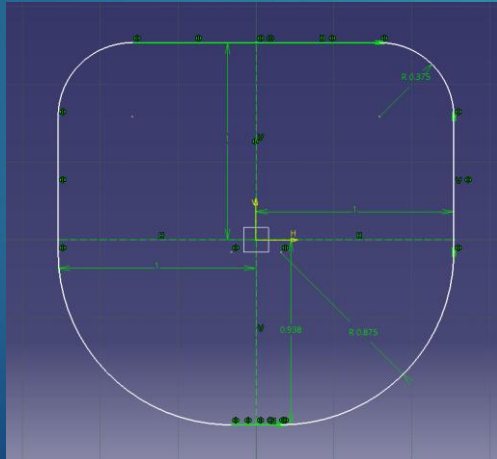
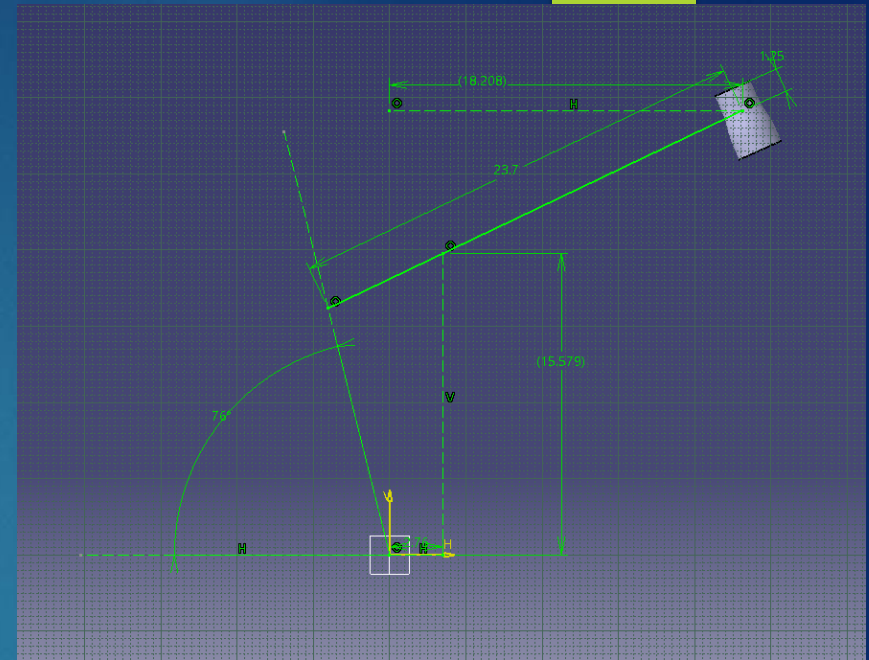
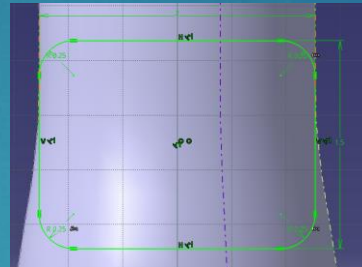
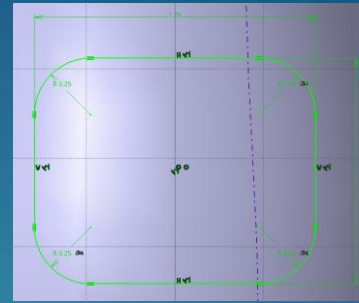


First sketch



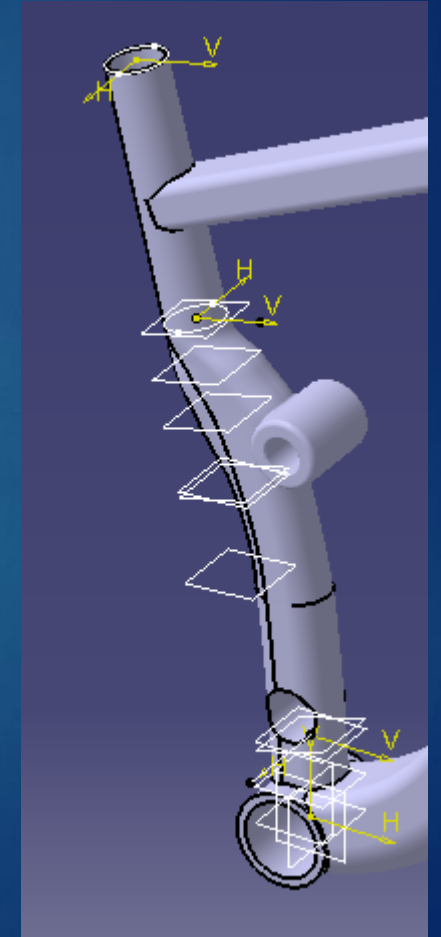
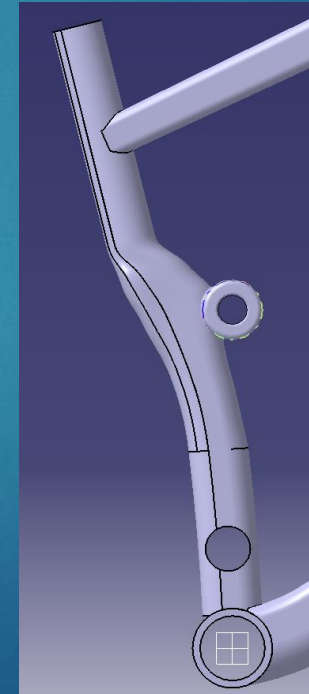
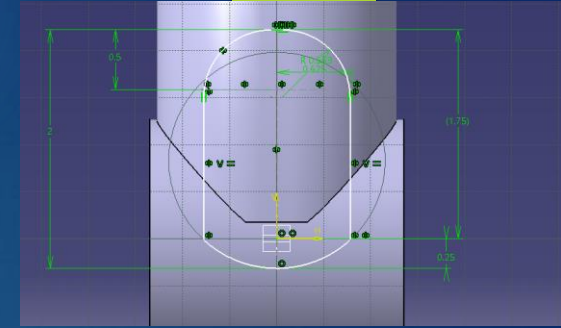
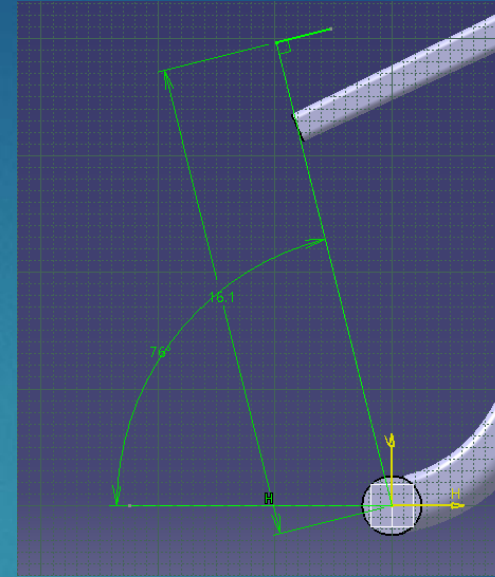
Initial Phase

- ▶ Once I got the head tube in I started modeling the top tube and the down tube.
- ▶ For the top tube since it had a tapered size along the tube I used 2 reference planes and 2 different sketches with similar geometry to create a multi-selection body, and used reference sketches to affix my length.
- ▶ And for the down tube I used a rib feature since the shape is the same throughout. I also left it unconstrained for the most part so that it can stretch with when you change to the different sizes.



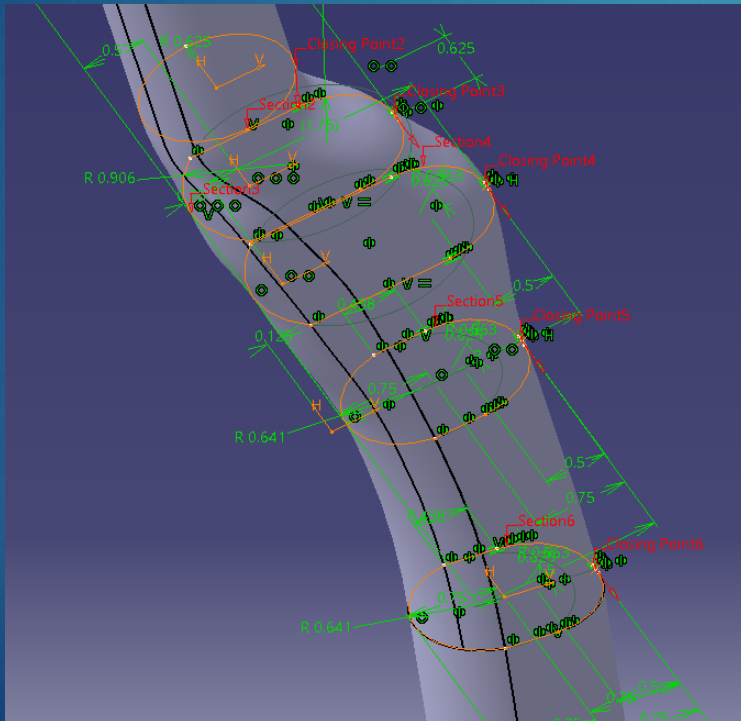
Hardest part

- ▶ This next feature the seat tube was definitely the hardest part for me. Because there was multiple different shapes and angles getting everything to be as close as possible was very difficult.
- ▶ Again I used a multi-selection body to create this last main feature. To do this I created lots of planes and sketches.
- ▶ I then could connect them all using the multi selection feature. But for some part there was too great of an arc to allow the multi-selection body to be created. So I had to do a couple less planes and make the part in two different sections.



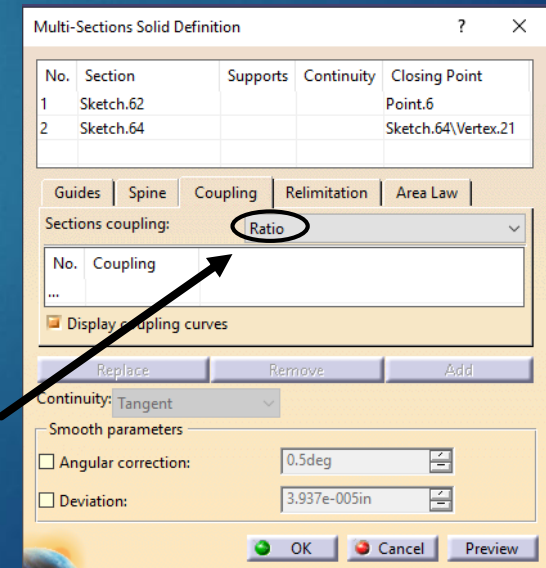
Hardest part cont.

- ▶ Another thing I had to do was to select ratio instead of tangency in the coupling tab so that the feature would work.
- ▶ I also had to change almost all of the closing points to get them to line up correctly so that there was no twist.
- ▶ I got it to look as close as possible but it was very hard when you're taking hand dimensions and you're not designing it from scratch.



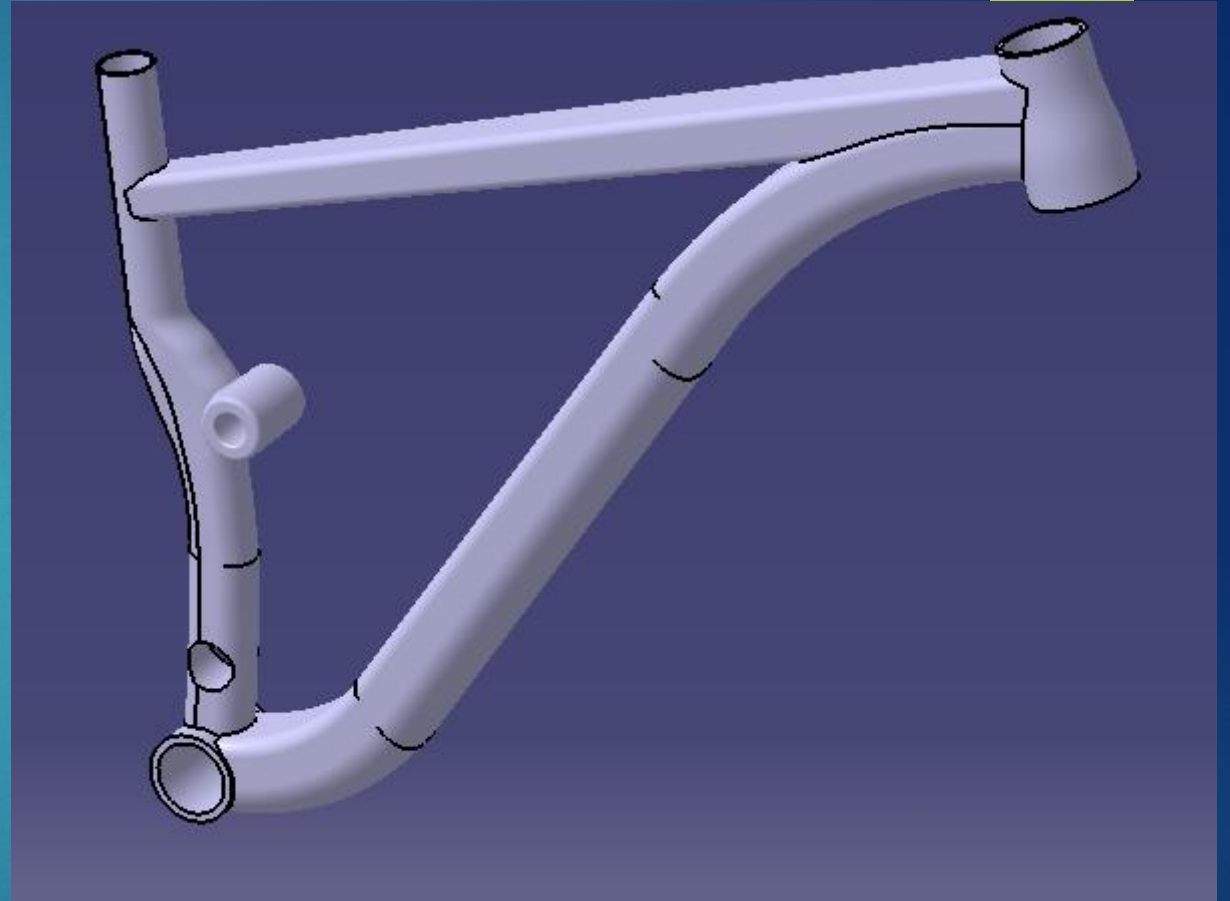
Closing points go along back spine

Changed from Tangency to Ratio



Final Frame

- ▶ After getting the seat tube finished, I added some basic holes and other features to be able to add the linkage parts once I create the assembly.
- ▶ Once I double check that all the geometry was correct I went back and renamed all of my parameters, so that I could find them easily when creating the design table.



Design Table

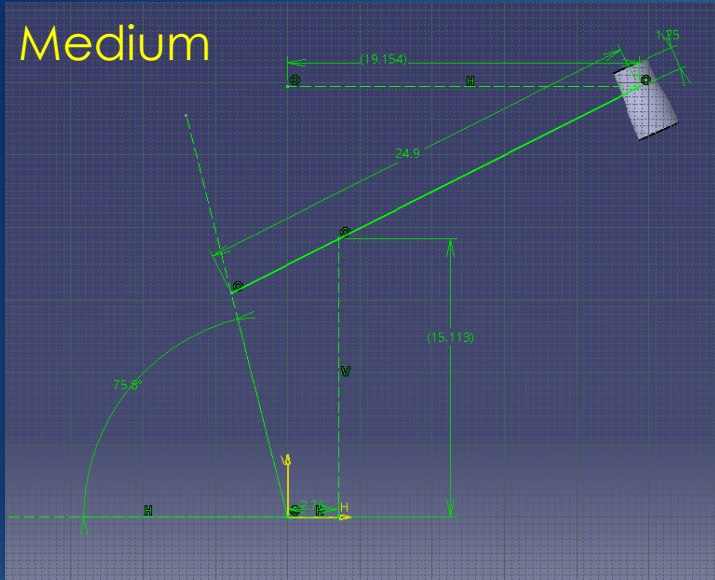
- ▶ Before this class I had never really used design tables, but I've found that they can be very useful and fun to make.
- ▶ It can make modeling parts much faster if you know that the basic geometry is going to be similar but just bigger or smaller.
- ▶ For my Design table I had 10 Variables that were defined that I used to change between the 3 frame sizes.
- ▶ As you may notice there are some double variables in my table and that is because I used multiple different sketch's and that was the only way I knew how to make sure the dimensions all stayed the same.

Actual Variables used

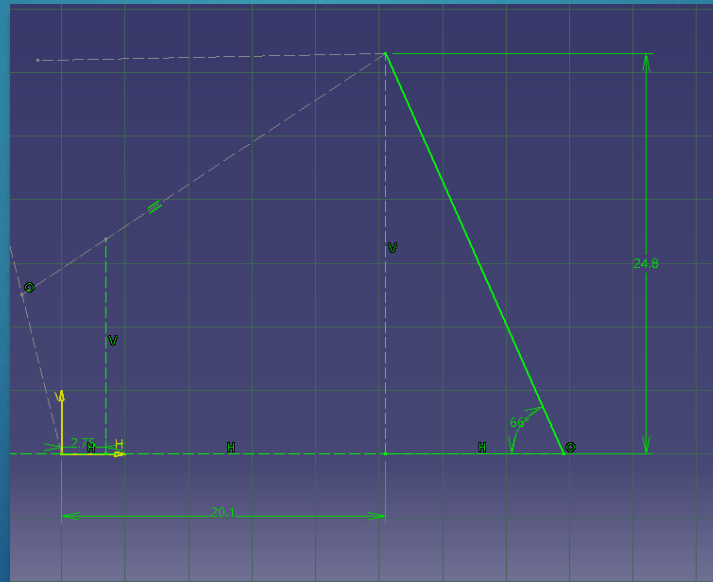
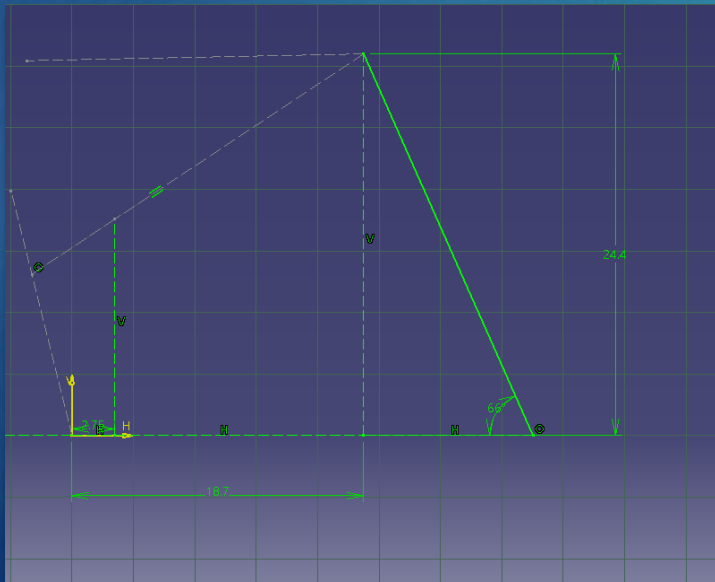
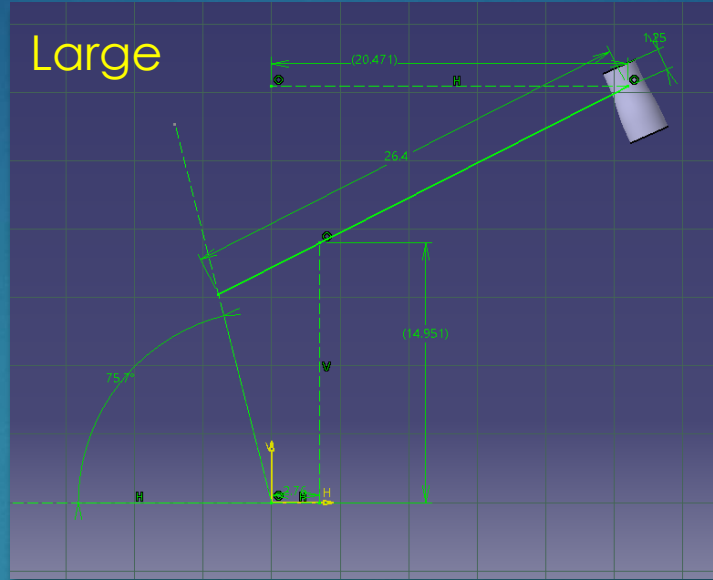
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| PartNumber | Reach (in) | Stack (in) | Head Tube | Head Tube Length` (in) | Seat Tube angle` | Top Tube Length` (in) | Down Tube offset` (in) | Seat Tube Length` (in) | Seat Tube angle` | Seat Tube angle sketch 2` (deg) |
|-------------|------------|------------|-----------|------------------------|------------------|-----------------------|------------------------|------------------------|------------------|---------------------------------|
| Small | 17.7 | 24.1 | 66 | 3.5 | 76 | 23.7 | 2.432059 | 16.1 | 76 | 76 |
| Medium | 18.7 | 24.4 | 66 | 3.9 | 75.8 | 24.9 | 2.5625 | 17.7 | 75.8 | 75.8 |
| Extra-Large | 20.1 | 24.8 | 66 | 4.3 | 75.7 | 26.4 | 2.625 | 19.1 | 75.7 | 75.7 |

Medium



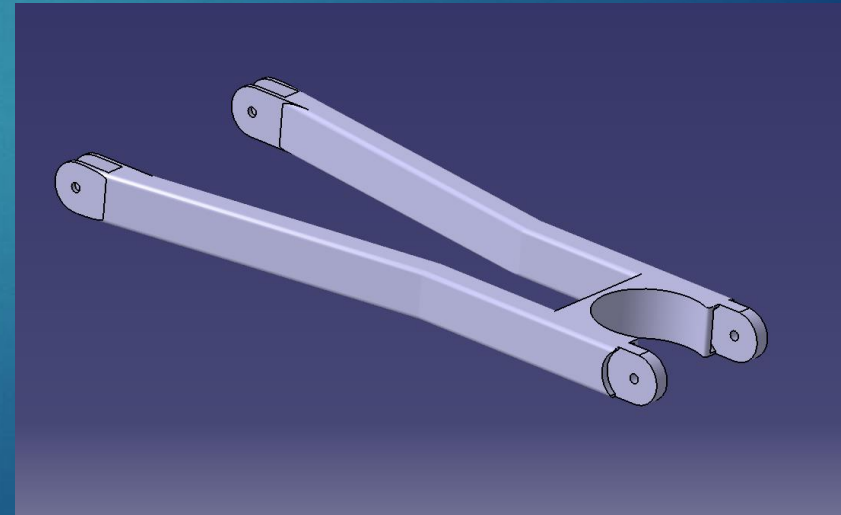
Large



Sketches
to show
design
table

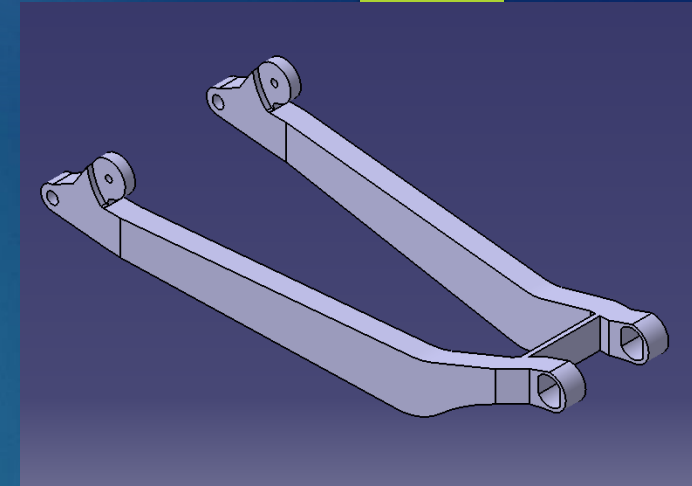
Creating Linkage parts

- ▶ After I created the design table it was time to move on to making the 3 linkage parts.
- ▶ Which consisted of the Top stay, chain stay, and rocker arm. I chose to do these separately because all the geometry was exactly the same for all the sizes, therefor I did not feel like it was necessary to include these parts in my design table.
- ▶ The first piece I modeled was the top stay, there were no dimensions given from Kona, so I took hand measurements and did my best.

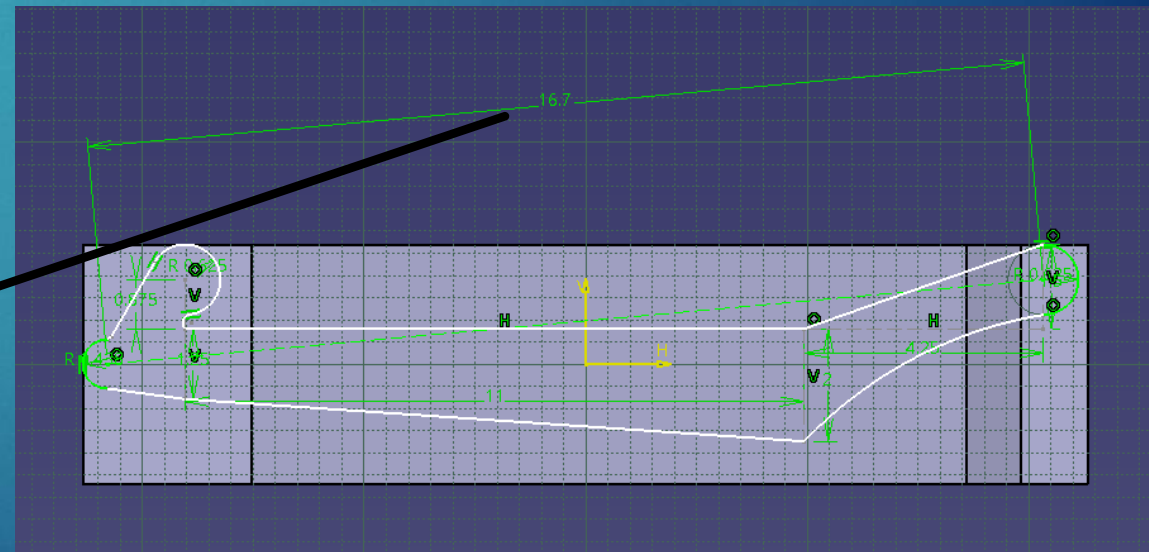


Chain stay

- ▶ The next part I created was the chain stay which is the last part that has specified dimension from my table.
- ▶ Again besides that one dimension I measured and created the model off of my own measurements.
- ▶ This part was a series of pads and pockets to create the geometry.

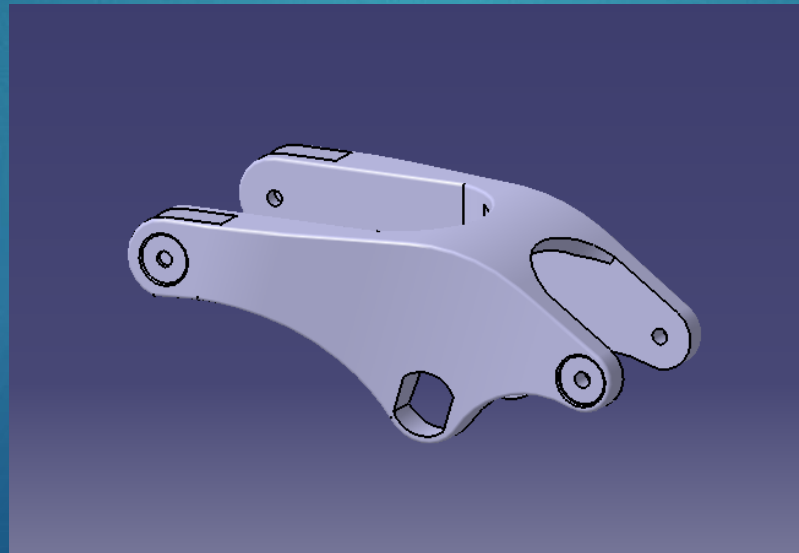


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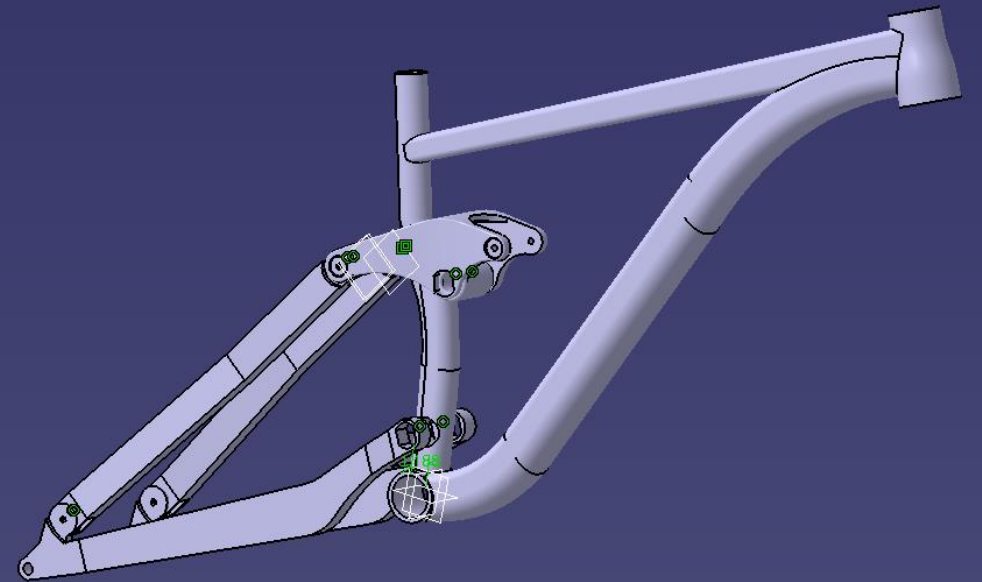
Rocker Arm

- ▶ The Final part that I created was the Rocker arm, and I felt like this was one of the harder parts to get accurate dimension of. Since it had many holes and a somewhat complicated geometry.
- ▶ All of these linkage parts I tried to make sure hole sizes and other geometry needed for the assembly were the same so everything mated up nicely.



Final Assembly

- ▶ The last step of my project was to create an assembly of my frame and linkage parts to give me my full frame.
- ▶ For this I just created a very basic assembly to show what the bike should look like.
- ▶ And as you can see it looks very similar to the real thing.



Summary

- ▶ Overall I had a lot of fun with this project. Personally I find it very gratifying to look at something with complicated geometry and recreate it with an accurate model.
- ▶ If I was do this project again I would probably choose something that I could take apart so I could get better measurements, because it was kind of hard to measure some parts when they were on the bike.
- ▶ Some advice I would also give is sometimes you try to model a part one way but it may be giving you difficulties and sometimes it will be faster and less of a headache if you restart and try another way. There was multiple times during my project I went back and modeled something completely different to make my model better.
- ▶ I am very proud of how the final product turned out and I am glad that I was able to do this project for this class.

