

3S Trailer Suspension

Meeting # 4

Start Date & Time: Monday, 6/22/2020, 1:00pm

Members Present: Robert, Caitlin, Anson, Kirk

End Time: 2:15pm

Last Meeting:

- Questions for Client meeting Monday 6/21/2020 @ 1pm
 - What do you want for the deliverables?
 - Do you want a working prototype?
 - Read for production drawings for 2000 35000 6000lb trailer
 - Single axle trailer
 - Only prototyping the portion that goes onto an existing trailer
 - What are Georges concerns and thoughts?
 - What is your overall vision for this project?
 - Is this for paved road? Off road?
 - How can we make this an off-road edition?
 - Lock out the spring?
 - Slower over bumpy terrain - versatility
 - Improvement in Design or gas mileage?
 - Do you have any test results for it being better?

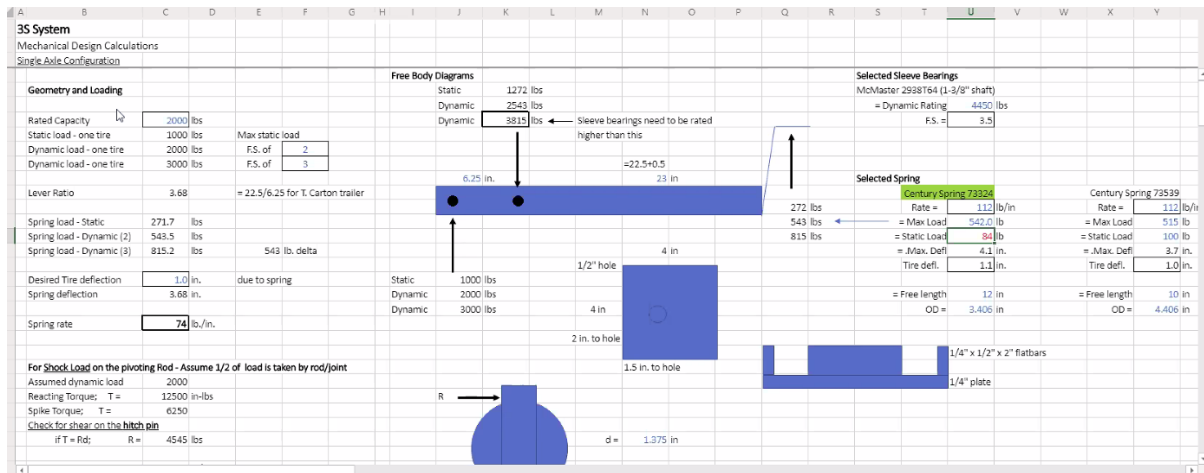
Today's Objectives:

- Meet with Client
- Get all questions asked and answered
- Come up with any concerns that we have for the future

Notes:

- We couldn't find the calculations at first – Swenson found it in a different location
- What do you want for the deliverables?
- 2000 35000 6000lb version of a system to attach onto a preexisting trailer
- 2000lb - make a working prototype small scale
- Production ready drawings for all 3 suspension for 3 different weight
- Stick with the Single axle trailer for each different weight classes
- Only prototyping the portion that goes onto an existing trailer

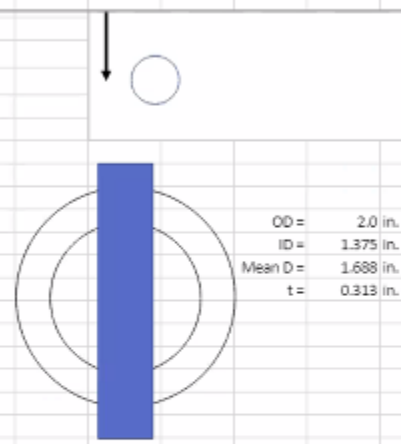
- Is this for paved road? Off road?
- 2 joint suspensions might be super hard if it's off road
- Can we do dependent and independent suspensions? Or both?
- High speeds or low speeds?
- Trying to make it a middle of the road product?
- If we talked to ted - he would say - the new concept of linked suspension provides better stability off-road. By personal experience
- As a result - design that we have created - we need to add 1 thing from independent too dependent by simply pulling out a pin - will help us from switching back and forth - from off road to not
- Allows us to test back to back conditions - of the same thing and physically see the difference
- If you hit a bump on 1 tire and not on the other its putting a torque on the axle
- Proof of concept - split the difference between co-dependent of deflection of axle
- If you have an offset load - both sides of the suspension will still depress but not as much as the other way
- 50/50 split -



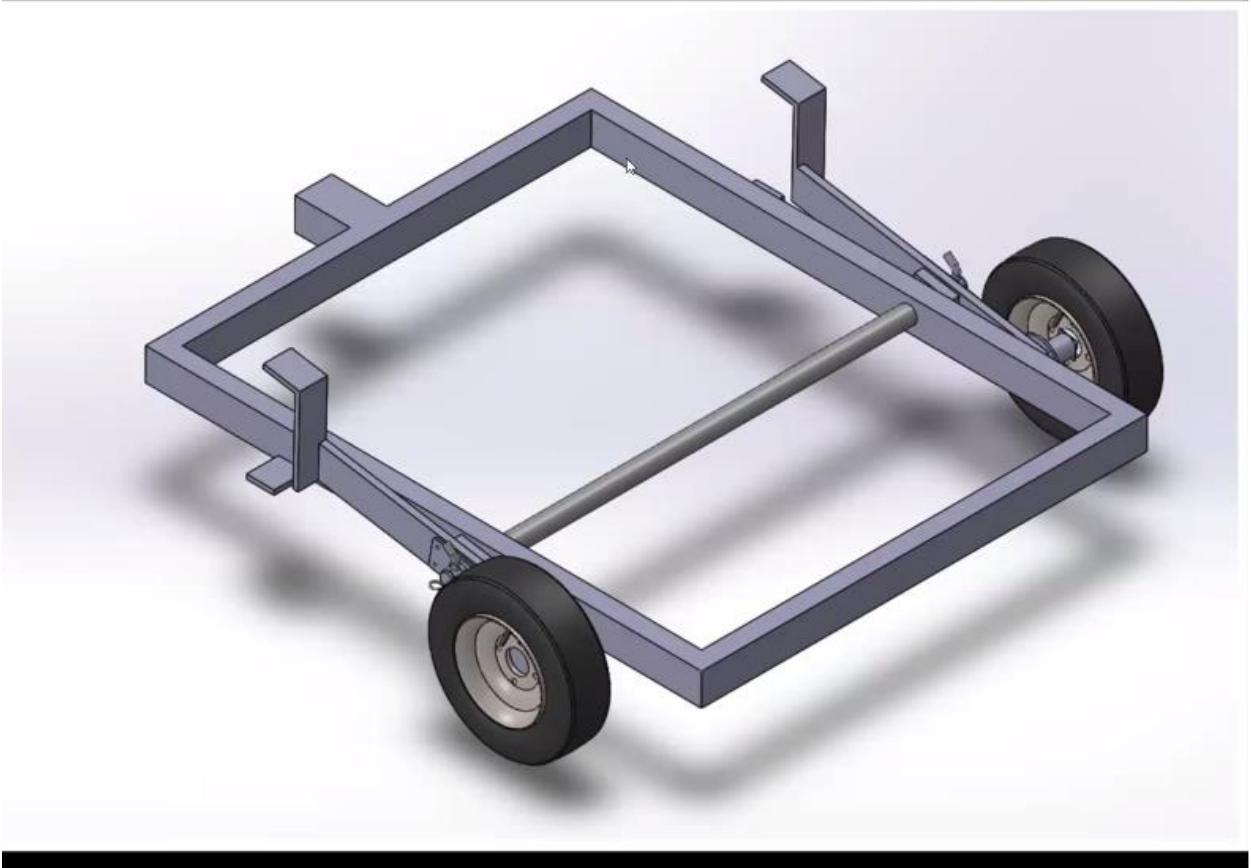
3S System											
Mechanical Design Calculations											
Single Axle Configuration											
Steel yield strength		36000	lb/in ²								
F.S. =		3.04	incl. 2x static load								
Check: The other half of shock is taken by the rod angular deflection											
Geometry of the rod											
Length; L =		54	in								
d =		1.375	in	r =		0.6875	in.				
J =		0.351	in ⁴								
Tao = Tr/J		24489	lb/in ²								
If using A36 steel											
Steel yield strength		36000	lb/in ²								
F.S. =		2.94	incl. 2x static load								
Angle of rotation											
Assume		G =	11500000	lb/in ²							
Theta = TL/JG											
Theta =		0.167	radians								
		9.6	degrees								
At the wheel											
Deflection		1.04	in.	1.0	Compare to above for spring						
within		4.1%	difference								

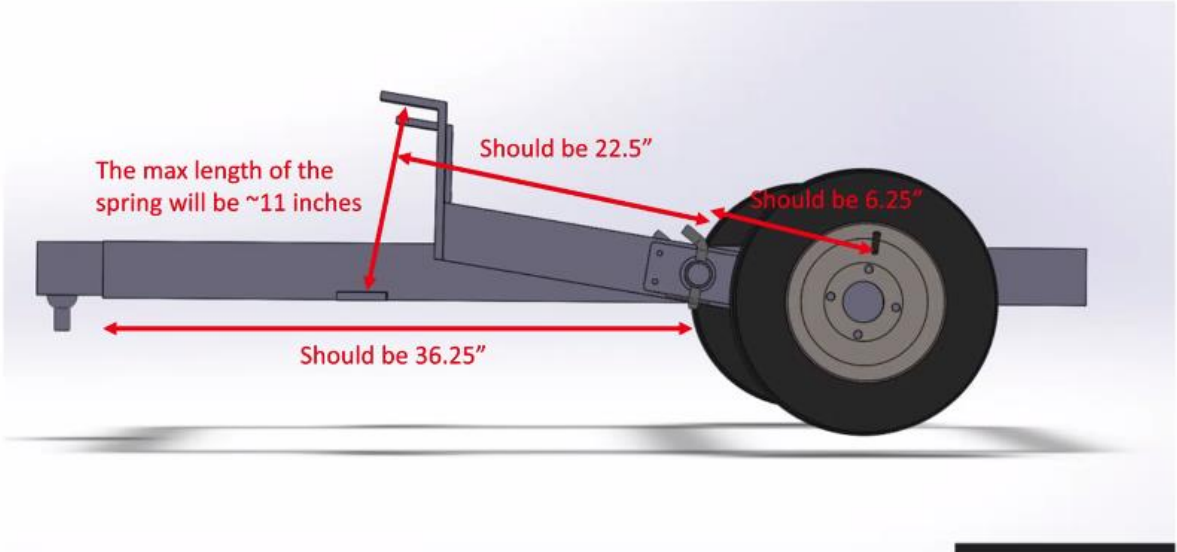


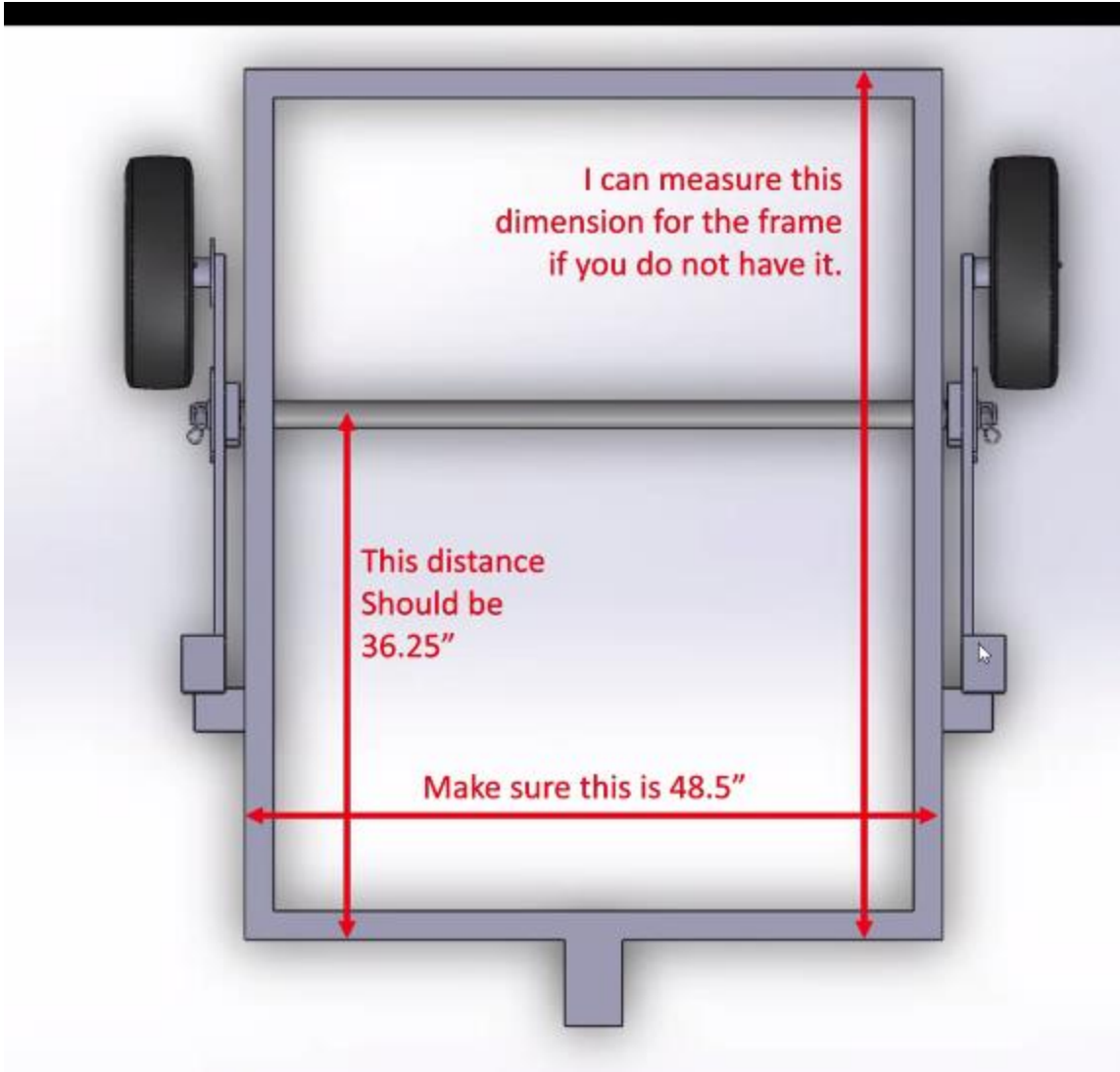
3S System											
Mechanical Design Calculations											
Single Axle Configuration											
Shear Stress, Tao max		48000 = 0.5 Sy		27500							
Shear Stress, Tao = R/A _s											
Min. A _s =		0.027756	in ²	0.046428	in ²						
Min. Size =		1/4	in.	5/16	in.						
Plan to use 3/8" bolts											
Check bearing load on the tubing											
Spike T =		6250	in-lbs								
Reaction; R =		3704	lbs								
A = D _{pin} * t		0.15625	in ²								
Stress - Sigma = R/A =		23704	lbs/in ²								
If using A36 steel											
Steel yield strength		36000	lb/in ²								
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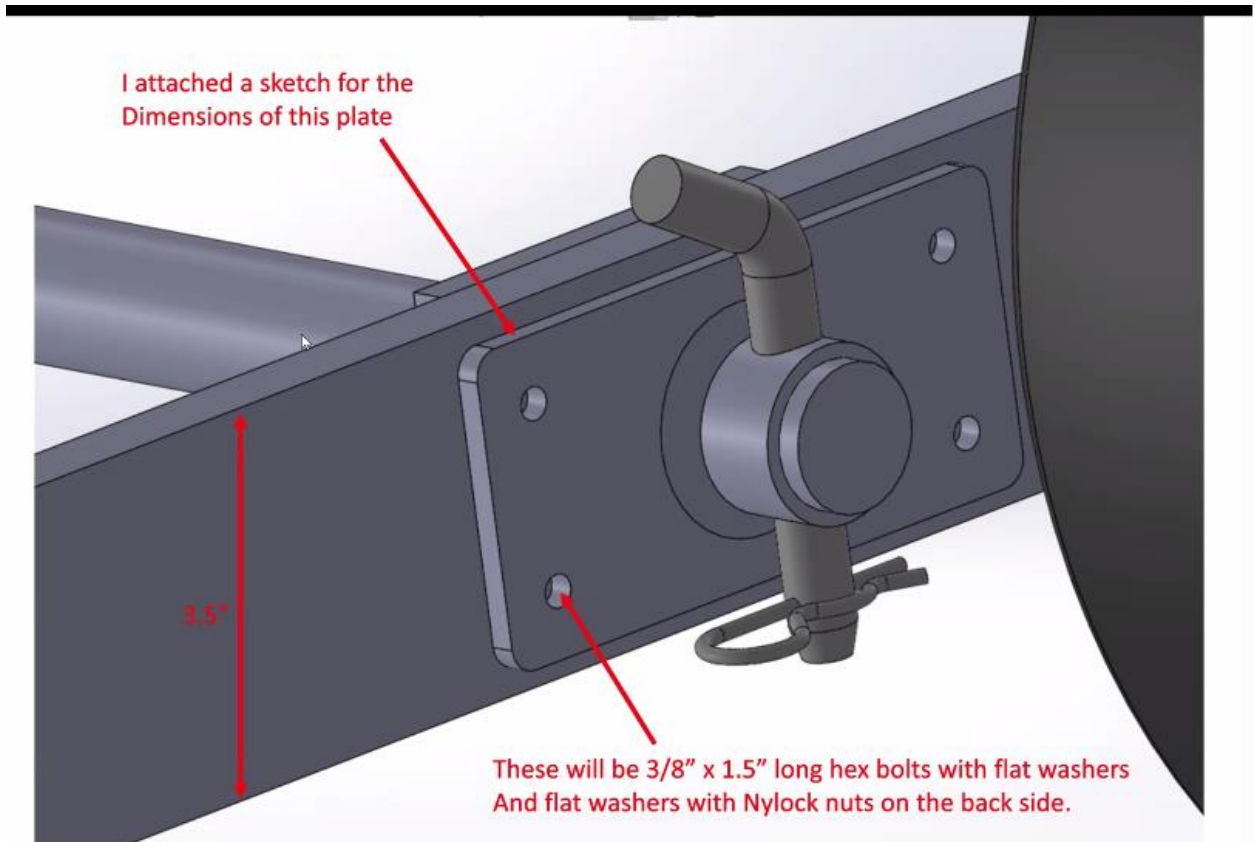
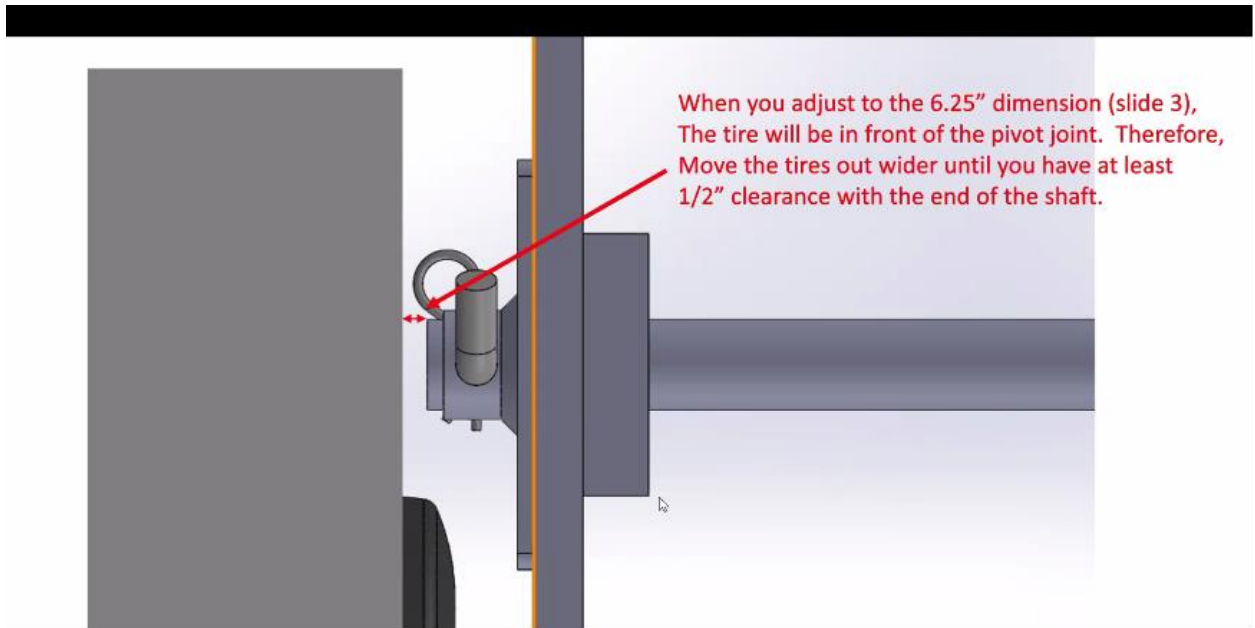


- The axle and spring are both 50/50 of the deflection
- FOS = 2 (Factor of Safety)
- No altering the design at all - just changing the spring and tire and bearing capacities
- Explore things that may make it better but don't reinvent anything
- These designs are for the proof of concept calculations
- Different lever ratio? So maybe we could have a new spring size
- Make lever arm out of one piece?? Not so many parts? Bends?









- Pin goes through tubing and axle
- For independent suspension - just remove the pin
- Would you only need the pin on one side? - yes - one side has end cap

- Independent? - holes won't always be perfectly fit - but only if there is 2 pins - You could just rotate it till it fits
- We are getting the best of both worlds - dependency - helping with cornering

Lock out the spring?

- Just basically pulling out the pin
- Pin - connect pin with metal wire
- All on the left side

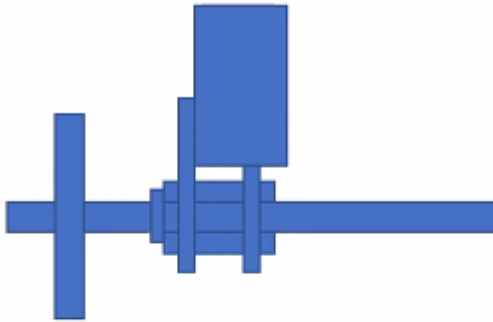
Improvement in Design or gas mileage?

- Aesthetic? How do we want it to look like? Is it a concern?
- Not a concern
- Gas mileage - depends on how you are towing it
- Air resistance is very minute
- Spring sitting out in the open, is it going to drag for air flow?
- Spring = pinch point?
- Shield for a spring? - if we do - make it aerodynamic
- WE are just going to start out with a spring
- If we have time left in the project - try a new spring design
- Different solutions for suspension

Notes

- Did you add the plate? What other design changes did you make to the design from the original
 - Axle was welding into the frame
 - Lever arm could pivot on the axle
 - A pin was still on the outside
 - Purely independent suspension system with a solid axle
 - Bushing was also in a different place
-
- Welding the suspension on an existing frame
 - Develop a bracket that you could weld to the frame
 - 2 plates that weld on bottom of frame - one could weld on outside of frame tubing - 3D welds

- One comes up on the bottom of the frame
- Piece of pipe that fits inside those plates and put a sleeve bushing on the outside that runs inside that pipe
- Do the same thing on the other side
- Sleeve bearing - pre lubricated and high bearing strength
- Flange bearing - can pivot in there according
- Wheels and tires same place as existing trailer
- Stopper on the spring so that it doesn't go above a certain height
- Welded not bolted? Explore bolt on kits?
- Open to bolt on kit!
- You would have to cut through a weld and cut off hangers
- What could bolt on to existing hangers?





- Technical readiness level
- Rating where a new tech or design is at
- Look up graphs online
- We are starting at level 3
- Hopefully we can go to level 6 in this class

For Next Time:

What to work on Next?

- Work on Requirement documents
- Pulling up models and trying to make sense of those
- Email the excel sheet with all the data
- Reach out to George – email meeting minutes
- Copy excel sheet with updated capacity - in order to accomplish the same things but at a higher load
- Finite element analysis - stress concentrations
- Find a time to Go out and look at the trailer

Comments/Concerns/Reflections from Today:

- George couldn't make it to the meeting
- This meeting gave us great insight for further progress on the project

Next Meeting Time & Date: Tuesday, 6/23/2020, 12:00pm