NASA Human Exploration ROVER CHALLENGE

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Team Introductions

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Project Engineer

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Mechanical Engineer

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Design Engineer

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Quality Engineer

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Manufacturing Engineer

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A statewide network of colleges and universities supporting the expansion and diversification of Florida's space industry through grants, scholarships, and fellowships to students and educators in Florida.

Objective

To produce a functional rover capable of completing challenge course obstacles and tasks while being able to traverse on various terrains and adhere to the rules set forth by the 2020 guidebook.

Phillip Dimacali

Project Background

Competition Dates:

April 17-18, 2020

Location:

Huntsville, Al

- 14 Obstacles
- 5 Tasks
- 2 excursion attempts
- 8:00 minute time limit per excursion attempted
- 114 Total Points Possible

Phillip Dimacalir

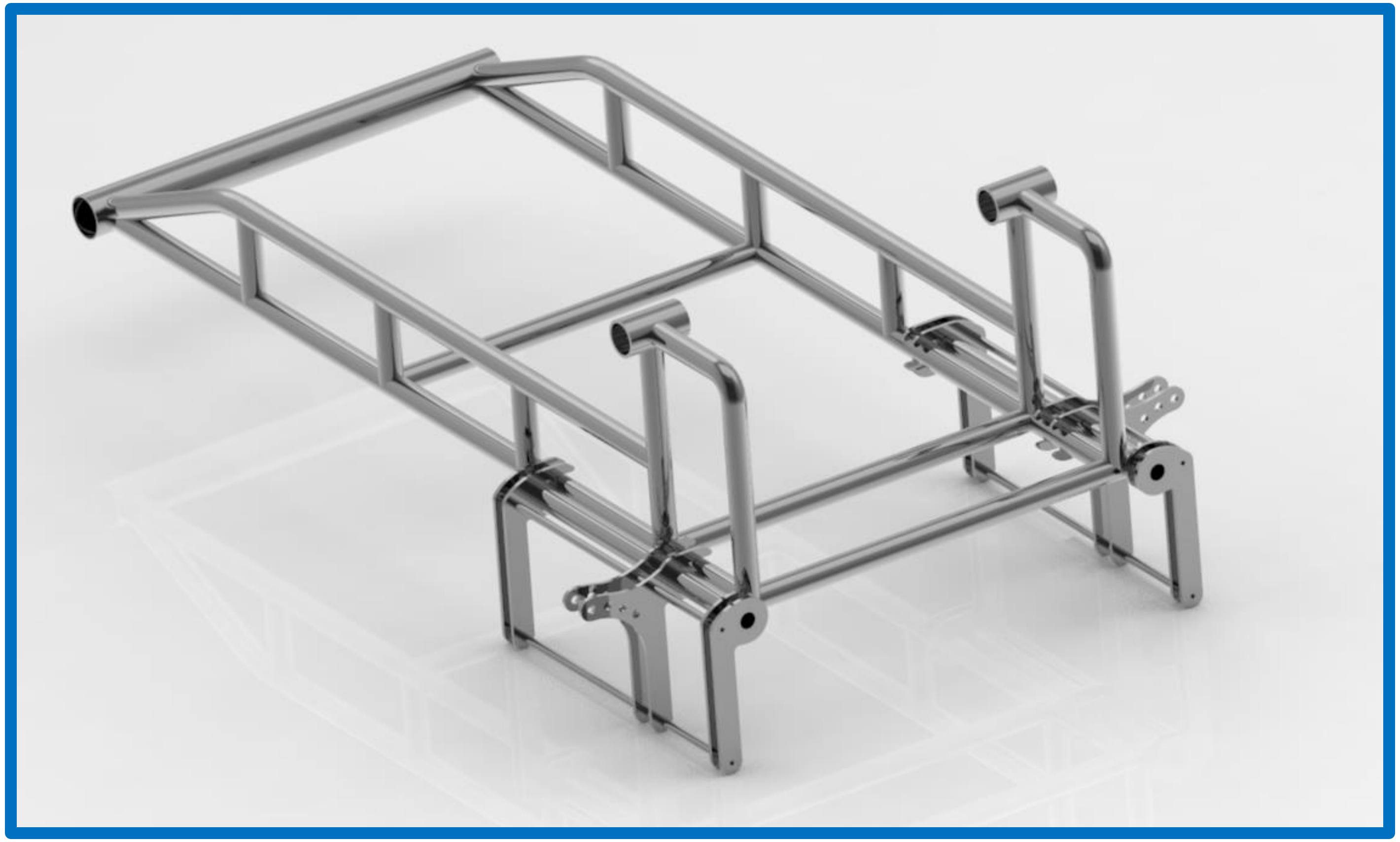
Frame

<u>Objective:</u>

- Provide stability and protection
- Robustly secure drivers
- Allow simplified manufacturing and assembly

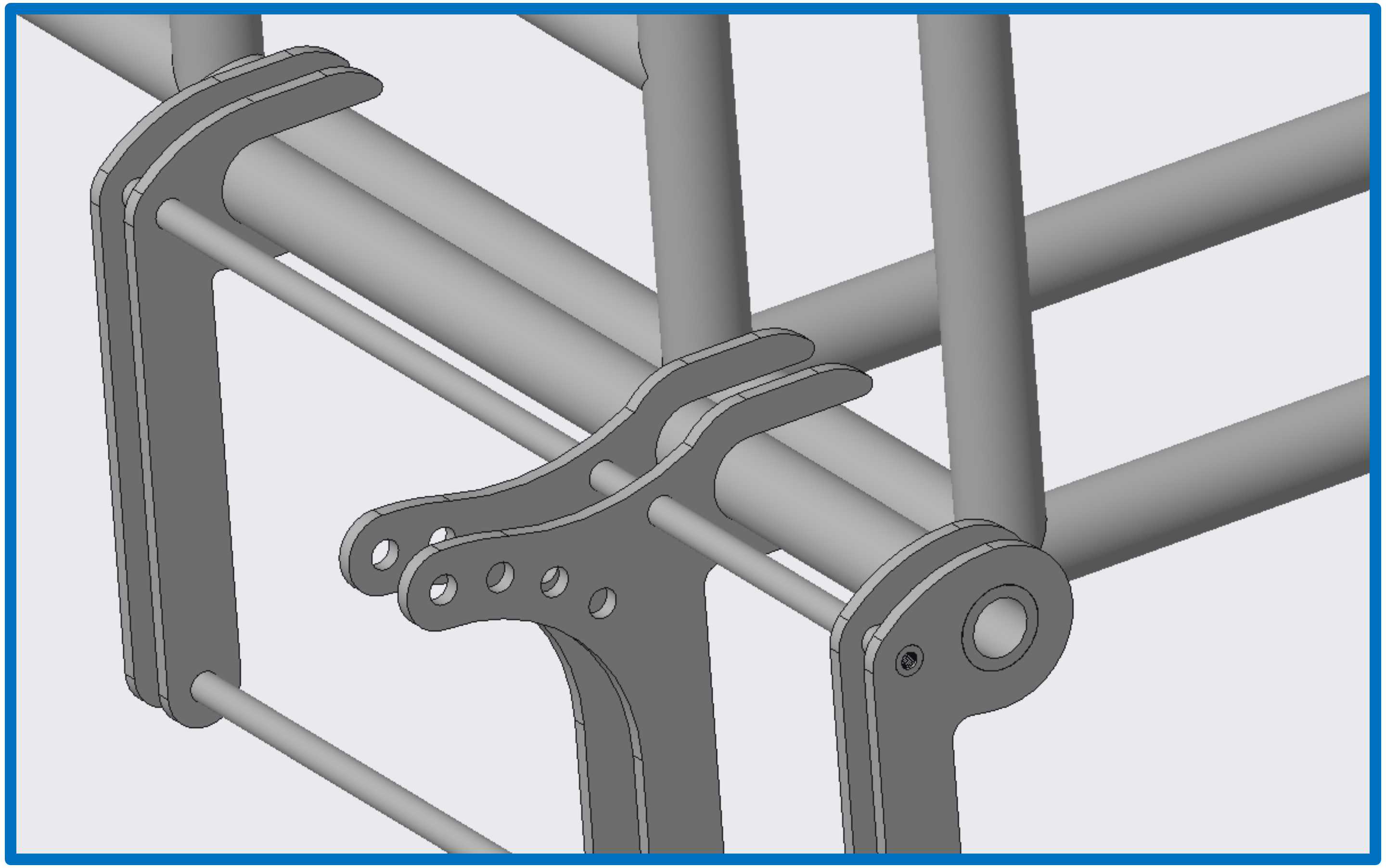
<u>Features:</u>

- 1.05" Outer Diameter (OD), 0.154" wall thickness, chrome-moly pipe framing
- 3/16" thick low carbon steel, water-jetted, components



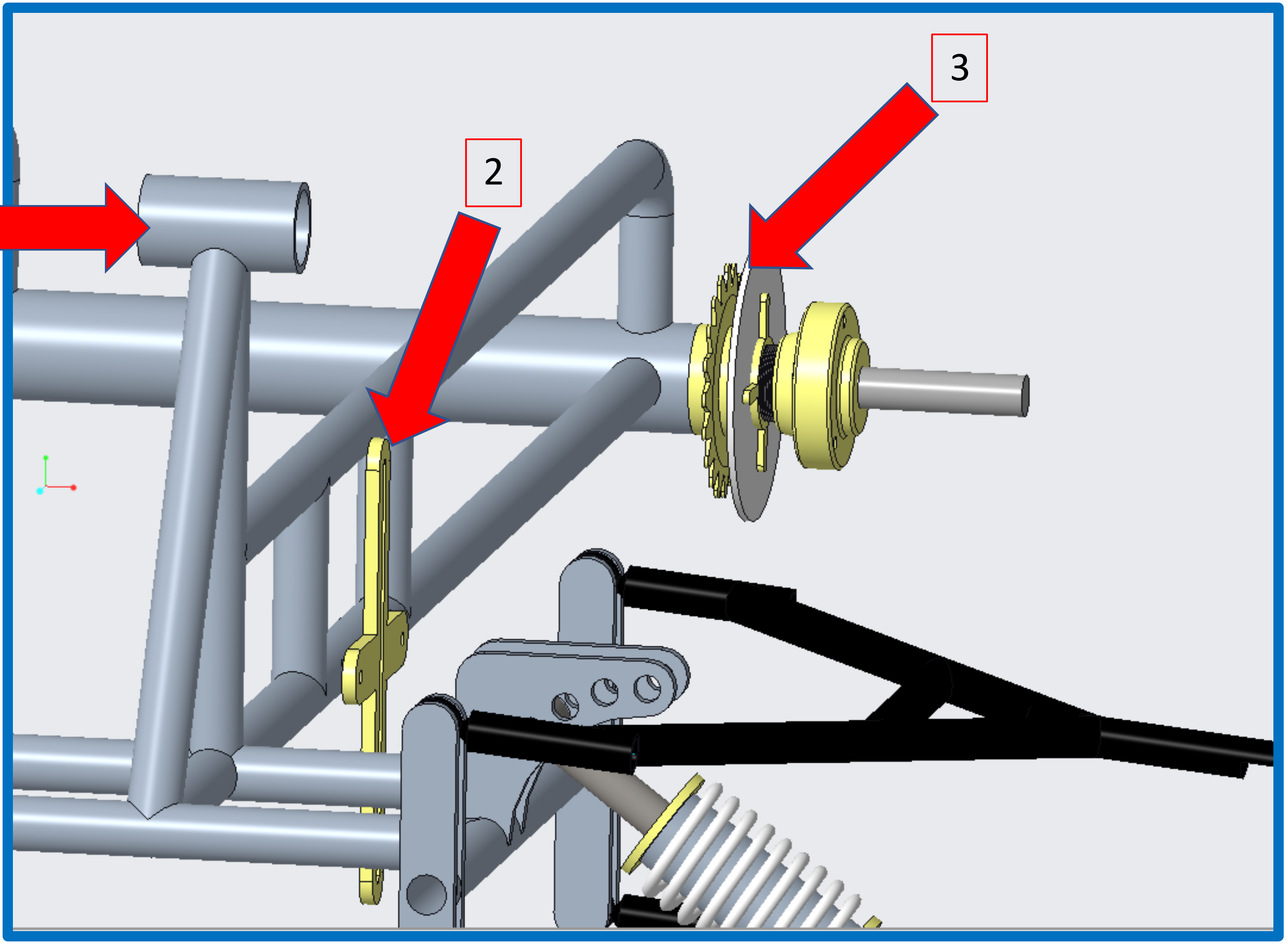
Frame Design for Manufacturing and Assembly

- Designing for ease of manufacturing and assembly considering a large amount of welding required .
- Simplified frame design for straightforward pipe bending and notching
- Water-jetted brackets and flanges for easy assembly



Drivetrain

1. Bottom bracket housing; OD = 1-21/32”, 1.375 x 24 Threads per inch (TPI)
2. Spring loaded chain tensioner (still being developed)
3. 20 Tooth freewheel fixed to axel shaft for use with 1/8” bicycle chain.



Drivetrain Components

32 tooth crankset
Fixed to bottom
bracket spindle

Torque is
transferred to axel
shaft through a 20
tooth freewheel

Transmit torque
through single
speed 1/8” bicycle
chain

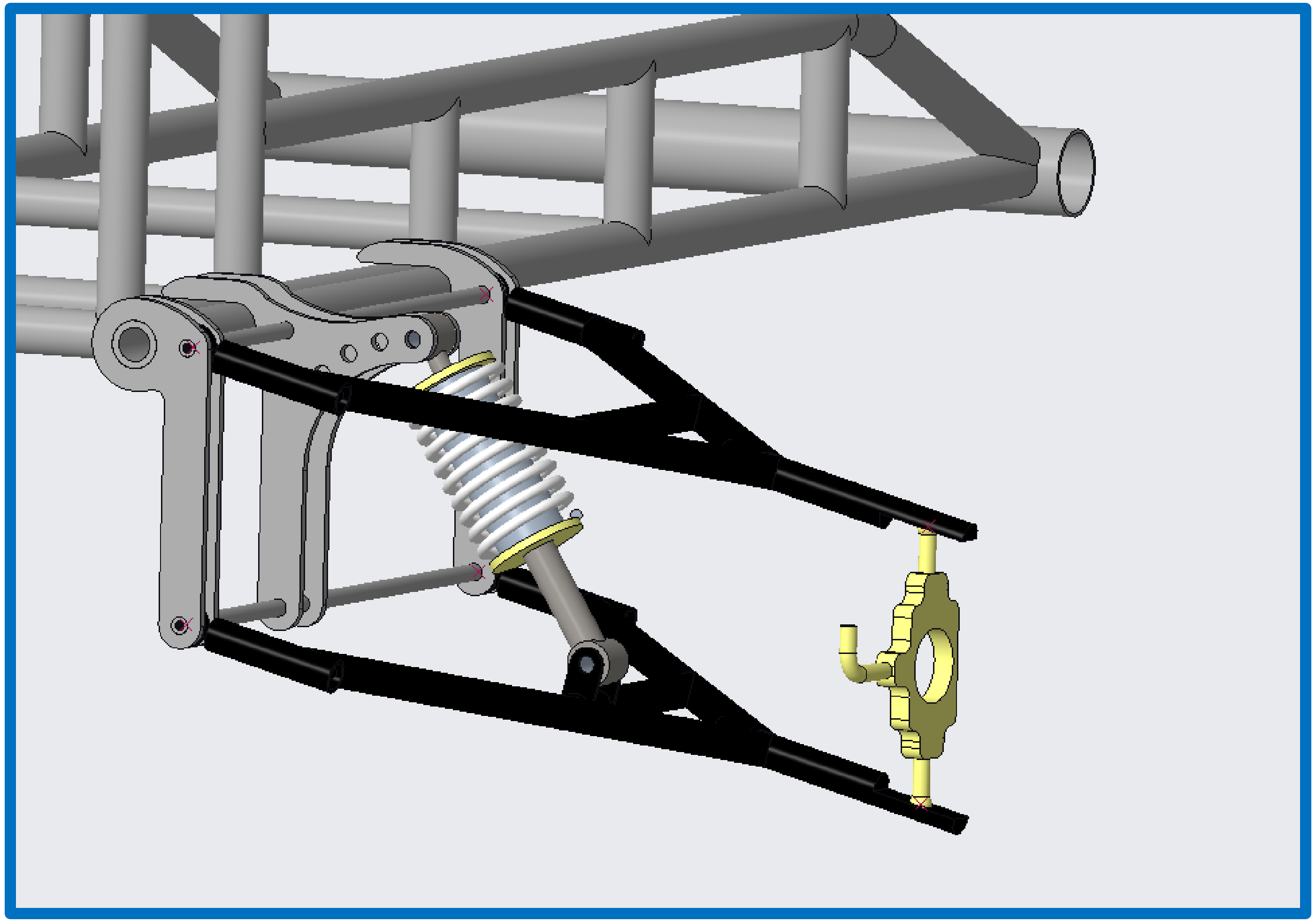
Tension
maintained with
spring loaded
tensioner with
idling sprockets

NOTE: Nothing is to scale

Suspension

Double wishbone suspension

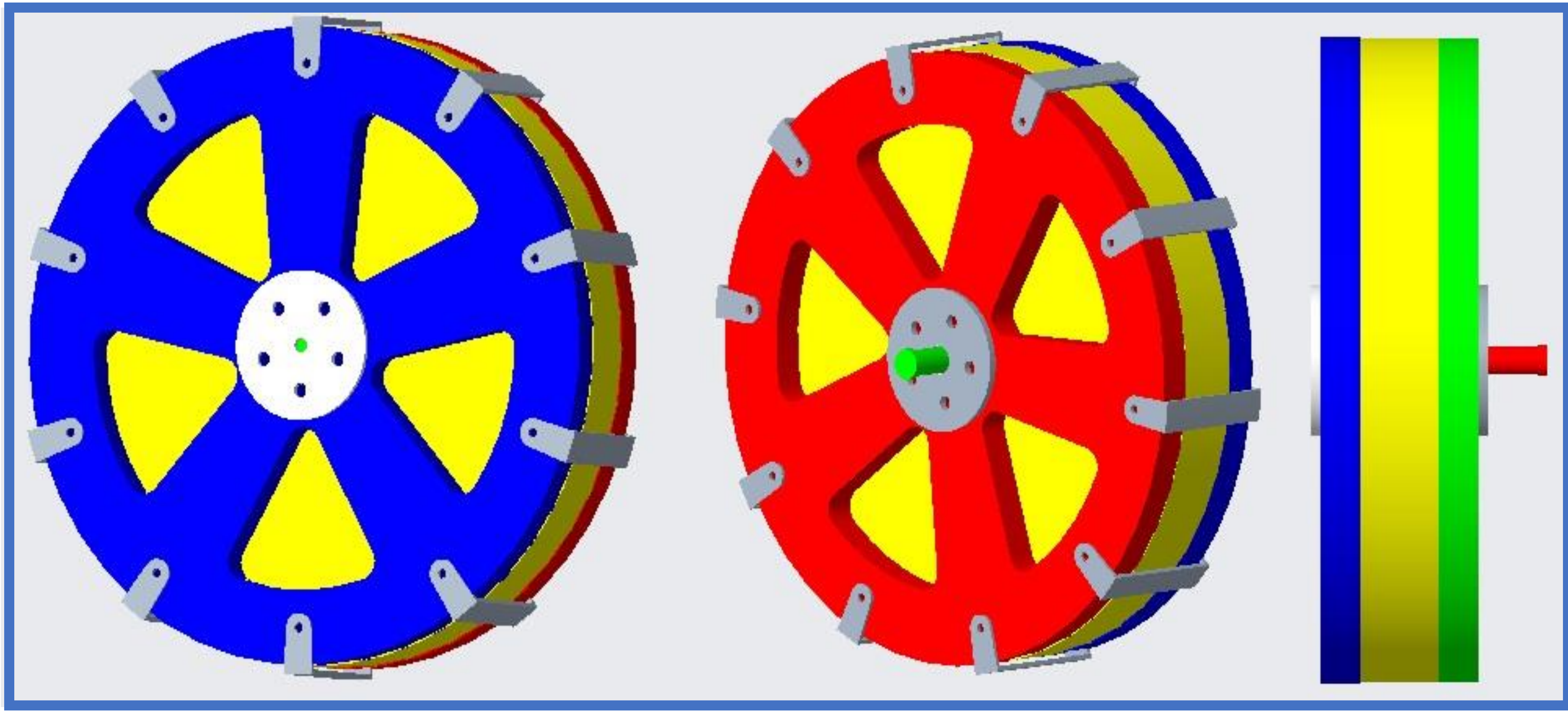
- Providing desired ground clearance
- Adjustable strut position allows for adaptive clearance control



Front Wheels

Objective:

- Help provide clearance
- Survive rugged terrain
- Free-spinning shaft allows forward and backwards maneuvering.



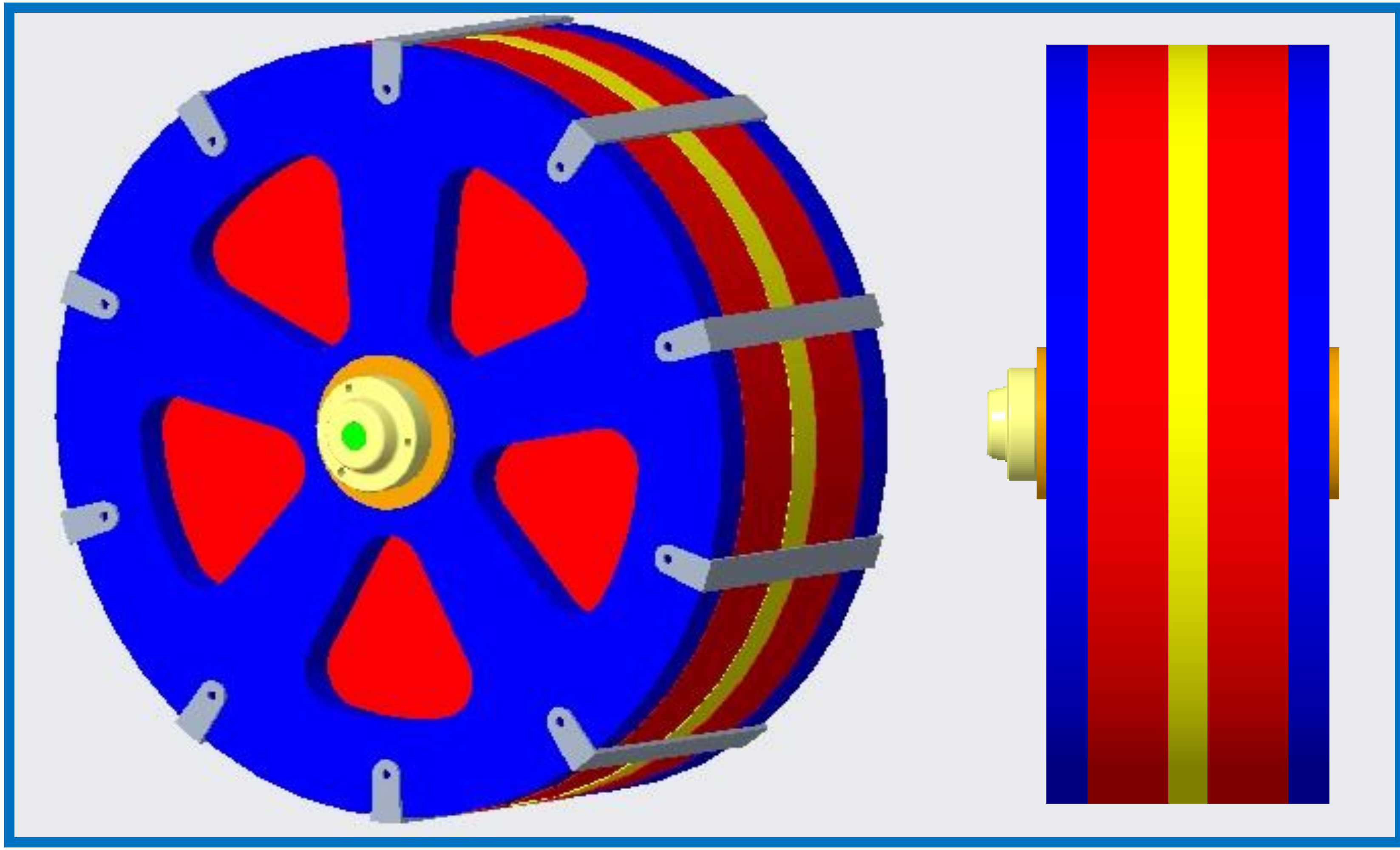
Features:

- Thin composite rims to provide support
- Thick EPS construction foam to reduce weight and inertia while providing structure.

Back Wheels

Triple Supported Wheel

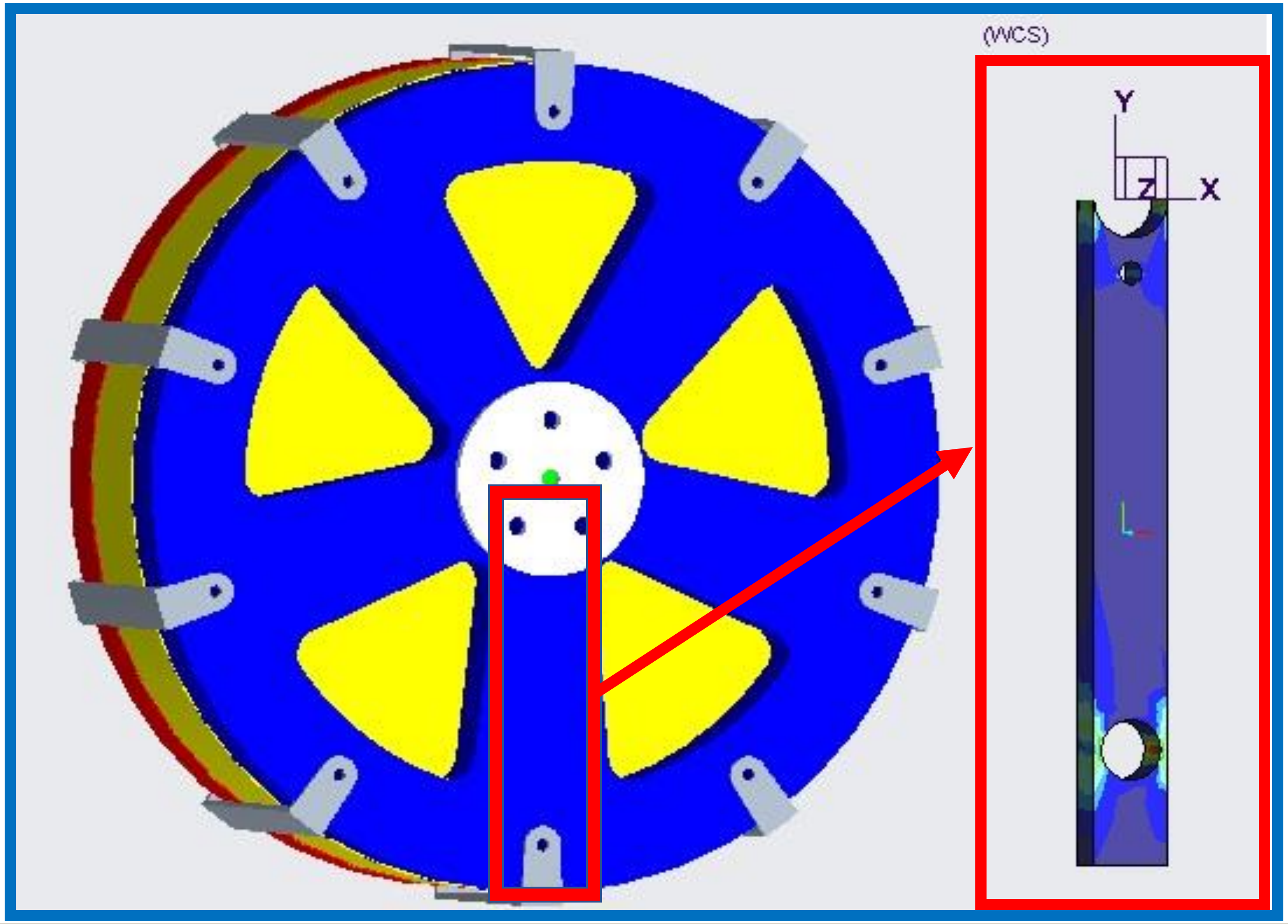
- Like the front wheels but contains a third sheet of composite in the middle of the wheel.
- Wider wheel provides more surface area to displace load and prevent digging into loose terrain.
- Rigid connection to rear axle allows for free spinning with free wheel mechanism.



Assumptions for FEA

Wheels as beams

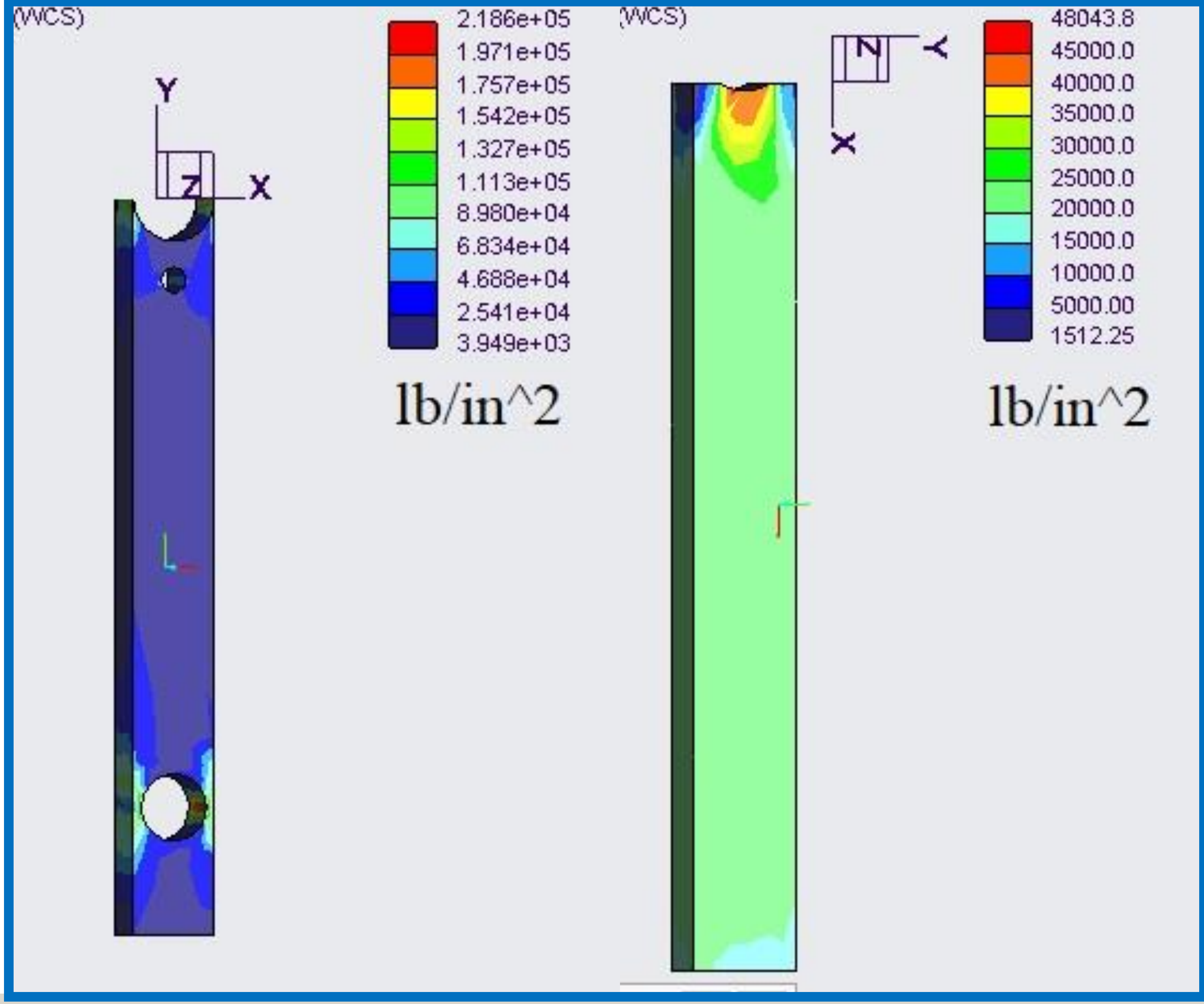
- Discs are difficult to accurately model
- Traditional pneumatic wheels allow for standard assumptions, but these are not valid in our case.
- Considering the wheel as a beam at its worst-case scenarios are the most reliable way to model wheels



FEA

Wheels as beams

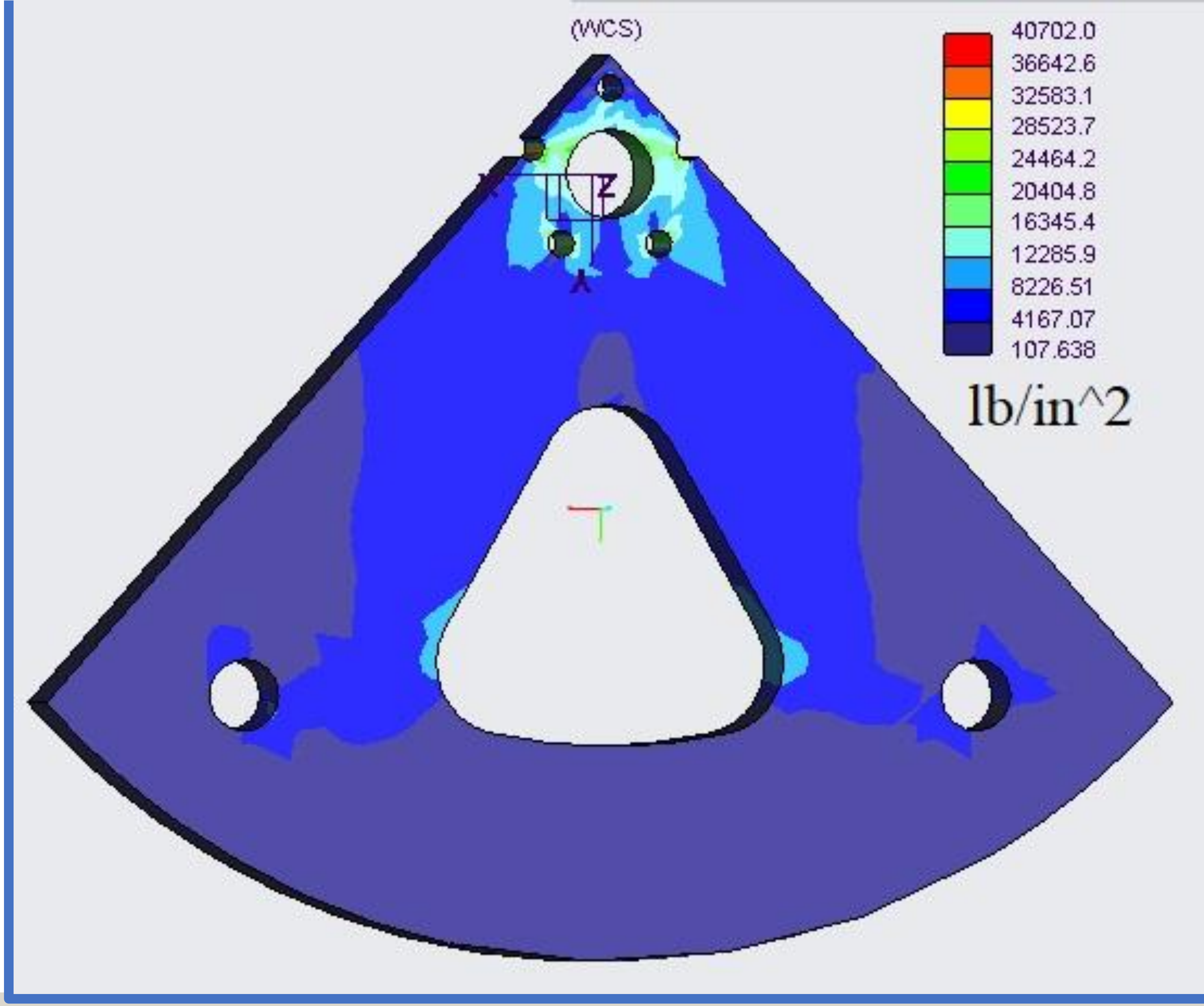
- For the solid portions of the rims, two cases are looked at.
- The first case (left) looks at the stress in a beam portion of the rim when the structural holes are in line with the ground.
- The second case (right) occurs when there is only material between the axle and the ground.



FEA

Best case scenario

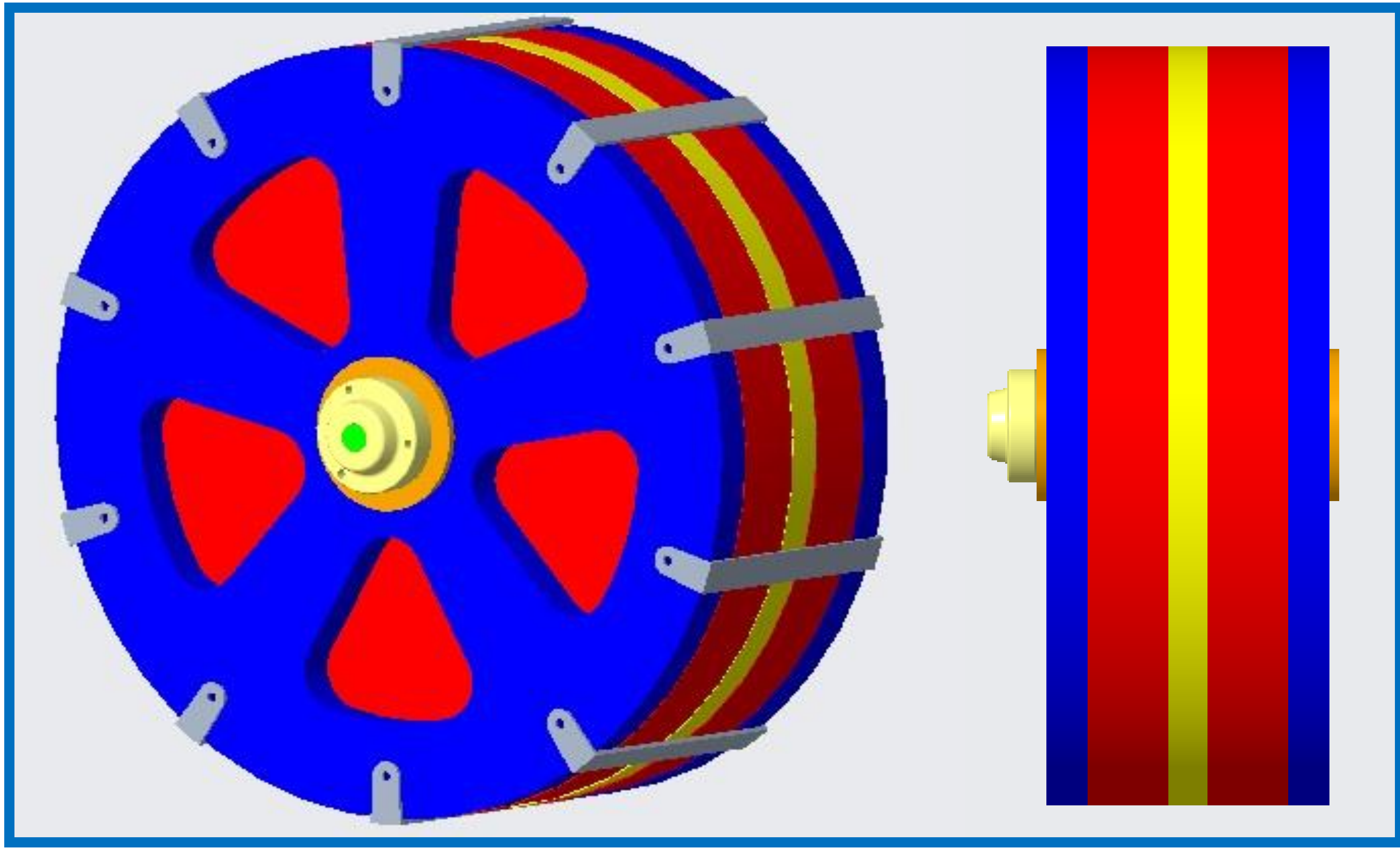
- The best displacement of stress occurs when then supports for the wheel can work as a truss structure to distribute the load



FEA results

Staggering orientation

- Comparing the best-case and worst-case scenario lead to the decision to stagger the orientation to the rims such that a truss structure will always be in contact with the ground.



Imminent Development

- Integrate rack and pinion assembly into current platform
- Begin manufacturing
- Lightweighting structural components
    - Optimize geometries to provide desired factor of safety and reduce weight
- Integrate remaining components and systems into platform

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If I have seen further than others, it is by standing upon the shoulders of giants. ~ Sir Isaac Newton

References

National Aeronautics and Space Administration. (2020). Human Exploration Rover Challenge: 2020 Guidebook. *NASA Human Exploration Rover Challenge: 2020 Guidebook*. Alabama , United States of America.