

Mechanical Design

1678 2015 Fall Workshops
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Presentation Overview

- Design Process
- “What not to CAD”
- CAD Techniques
- Design Details



What is Mechanical Design?

- Developing and communicating a mechanically based solution toward a set of project criteria while adhering to appropriate constraints
 - Criteria are decided during the “how” and “what”
 - Do not deviate from these criteria!
 - Use only available resources
 - Know your resources before the season!
 - Involves developing AND communicating
 - Both are important
 - Which one do you think is MORE important?



Why is it important?

- Mechanical Design is the crux of FRC



Design Process

- “What” and “How”
 - Should be decided during first few days after Kickoff
 - Enables you to design to specific challenge
- Select drive base
 - What fits
 - Necessary geometry
 - How mechanisms behave together

Design Process

- Prototyping
 - 4-5 different groups
 - sometimes only one group per subsystem, sometimes several
 - constant feedback in parallel with design
 - design teams aware of prototyping progress
 - prototyping team aware of constraints set by design team

Design Process

- Transition toward CAD
 - once design sees that mechanisms can fit together
 - connect teams, continue with better data until prototype becomes no longer useful
 - design team learns that mechanism needs to do, can begin 3D design
 - details
 - how much tote sticks into robot
 - need for active clasp on tote

“What Not to CAD”

1678 known for fast iterative designs

- major part of our competition success (examples: 2013, 2015)
- much of this is not in CAD

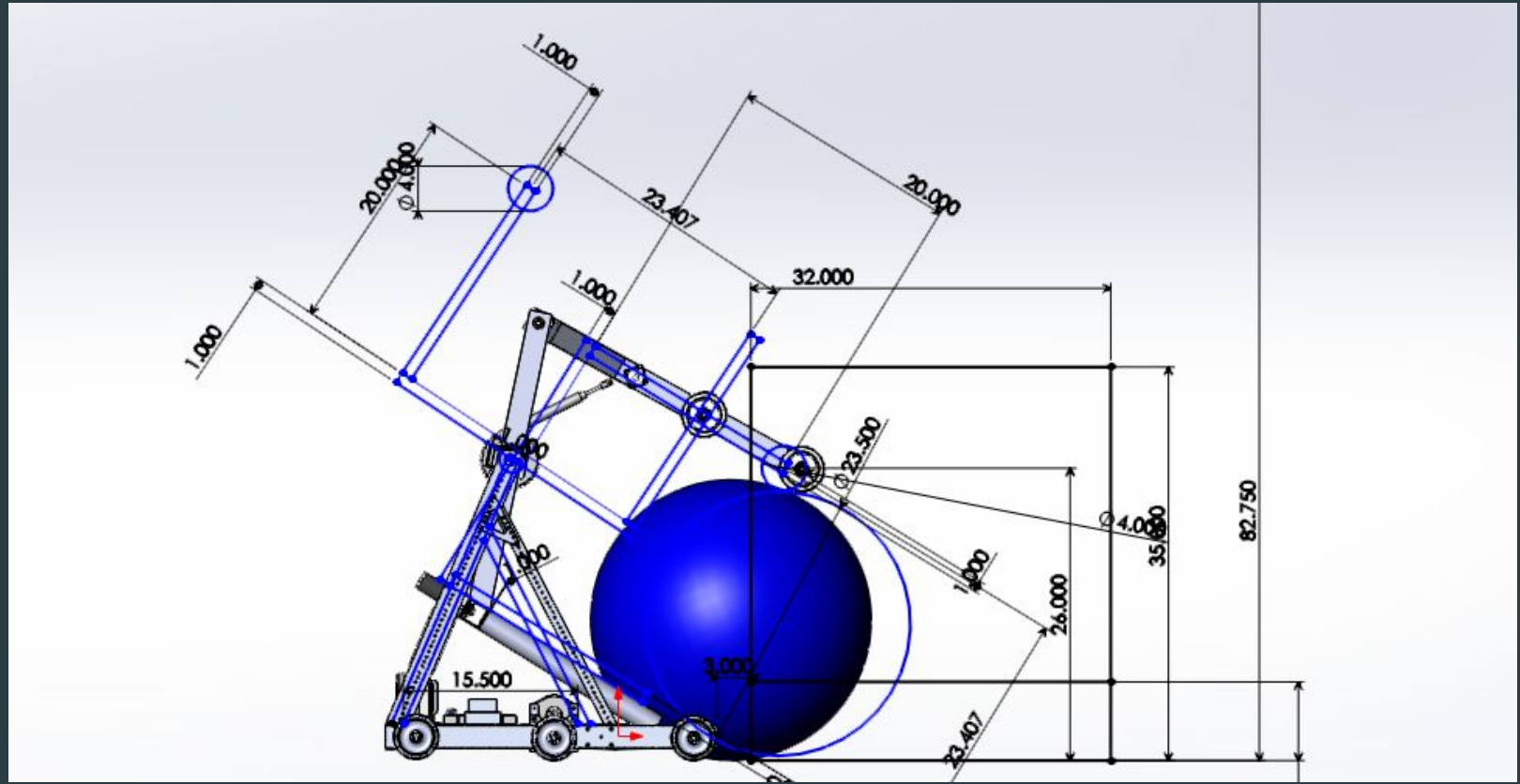


“What Not to CAD”

- Only CAD as much as we need to
 - estimations based off of space
 - Ex. only wanted to stack to 5 totes so could design tote stabilizers later on
 - what can move from prototyping to final iteration
 - Ex. carriage fingers, parts of can grabbers
- “Engineering isn’t about precision, it’s about close enough”
 - CAD gives you tools to be close enough

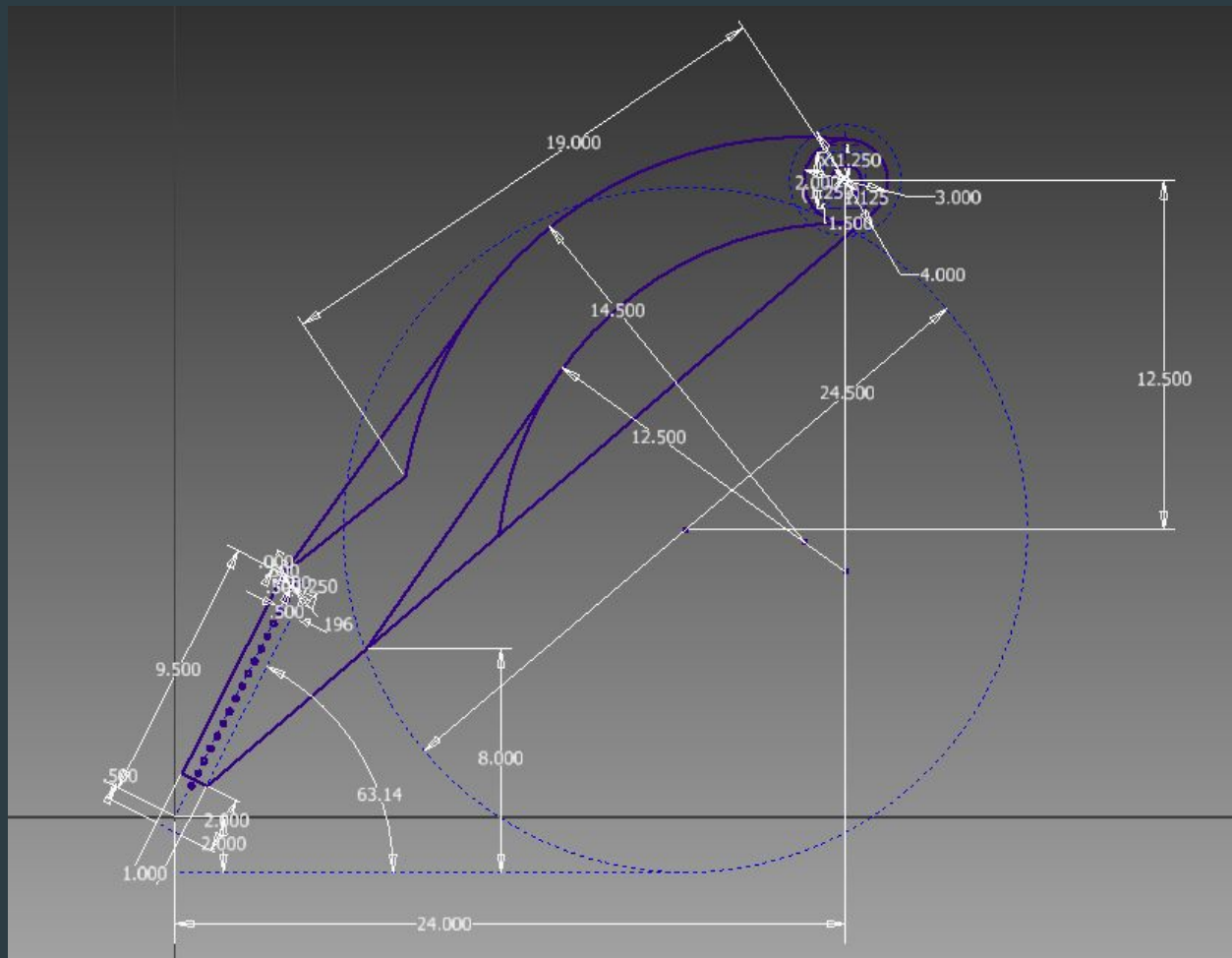
CAD Techniques

- Crayola CAD



CAD Techniques

- Crayola CAD



CAD Techniques

For when you want detailed CAD...

- Time Savers
 - 1/2" hole pattern
 - Mirrors, patterns, design everything in one sketch
 - Skip the spacers
 - Decide what actually needs to be in CAD
 - Check interferences
 - Practice!

CAD Techniques

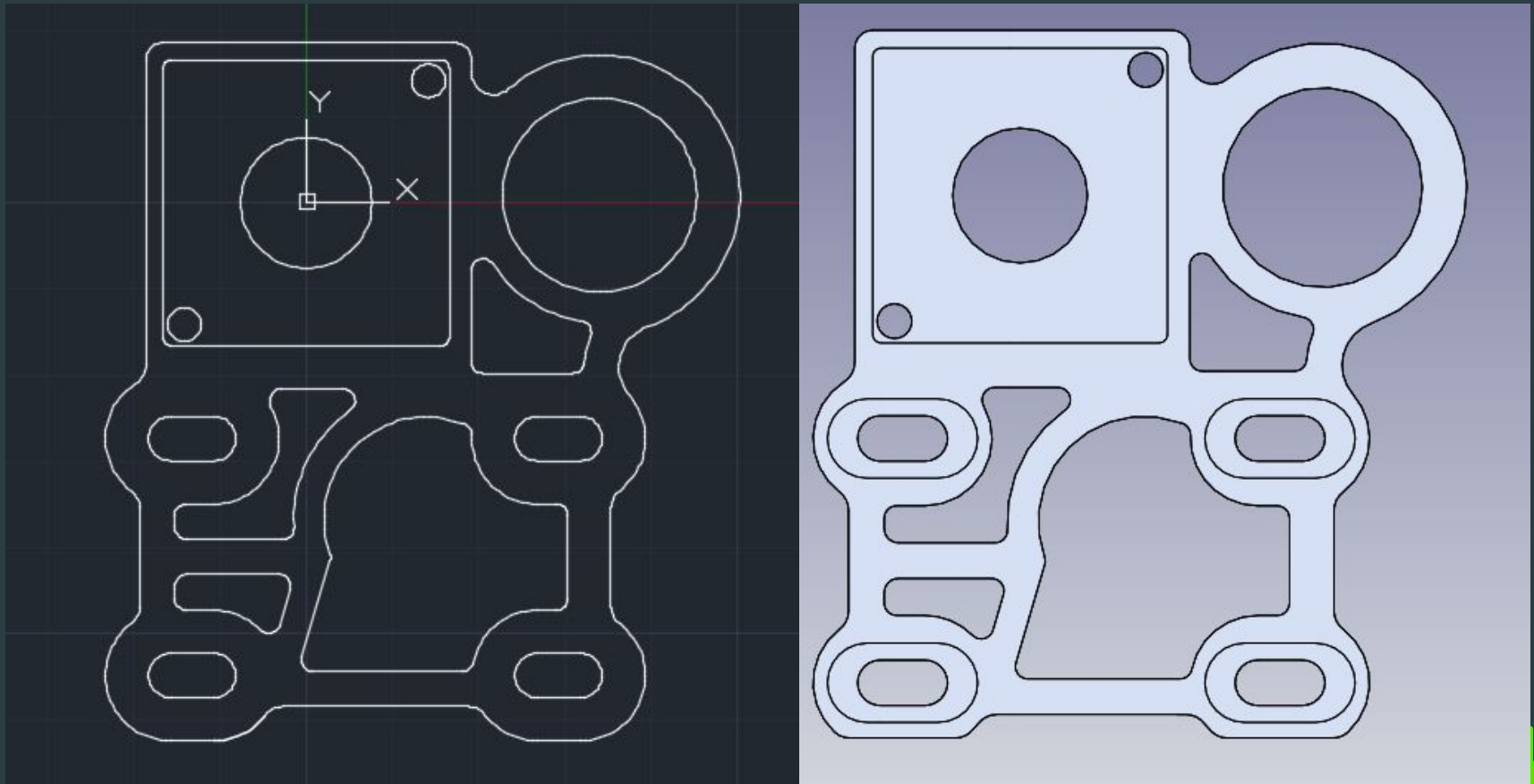
For when you want detailed CAD...

- Common difficult parts/assemblies
 - Gearbox plates and gearboxes
 - Drivetrain rails (WCD)
 - Bellyfans
 - Gussets
 - Bent sheet metal

CAD Techniques

For when you want detailed CAD...

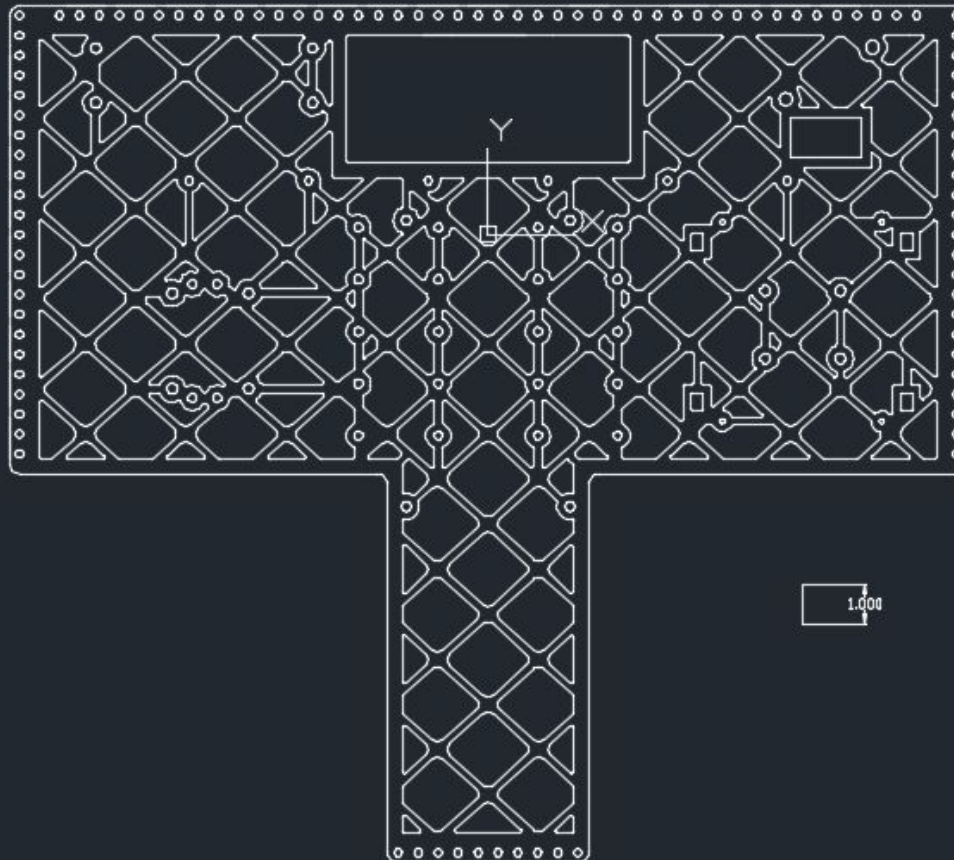
- Gearbox Plates and Gearboxes



CAD Techniques

For when you want detailed CAD...

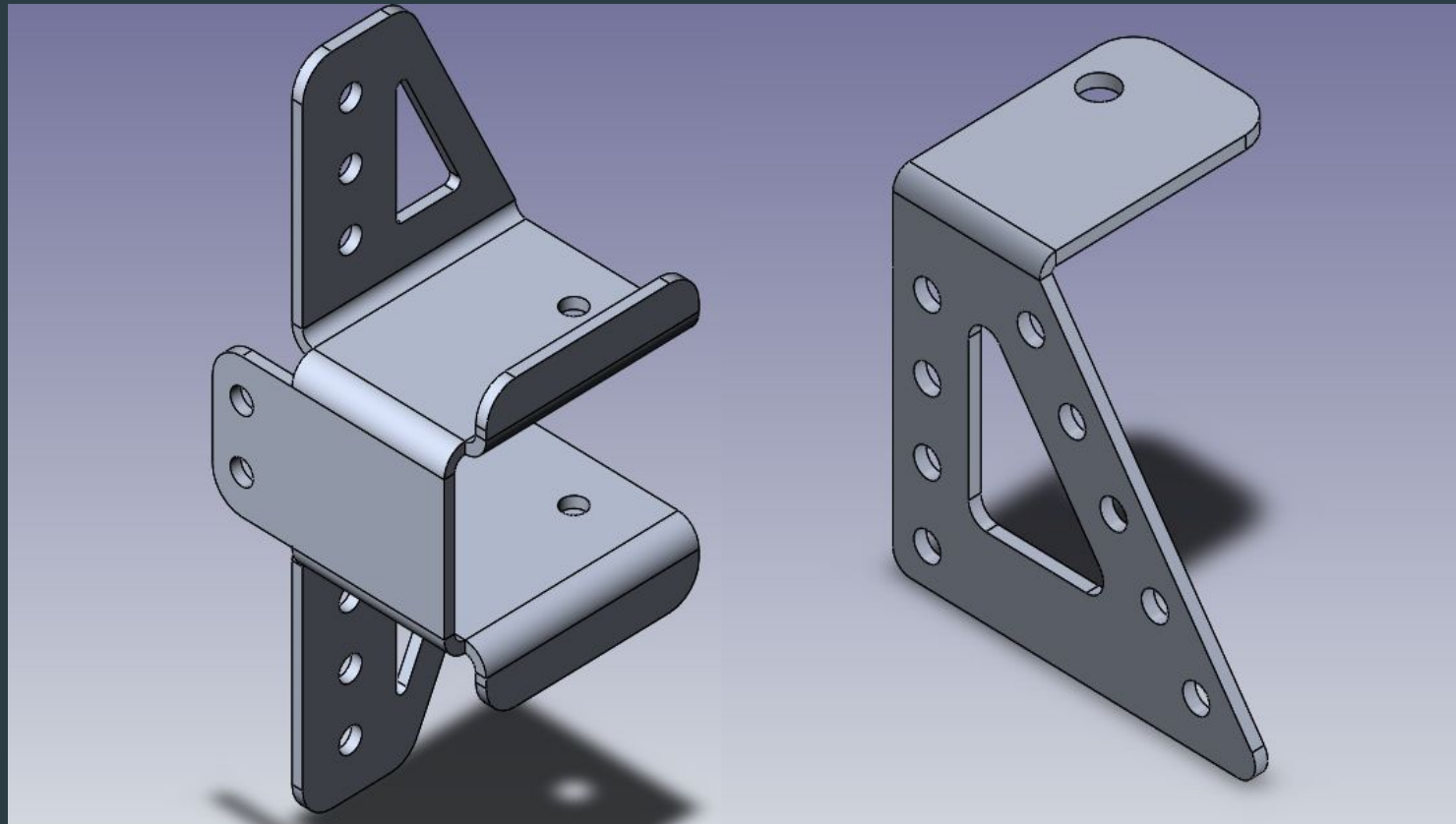
- Bellypan/Gussets



CAD Techniques

For when you want detailed CAD...

- Bent sheet metal



Design Details

“A majority of robot failures happen because there is too much material in some places and not enough material in other places”

~ Paul Copioli ~



Design Details

- WCD (West Coast Drive)
 - WCD: cantilevered, live axle
 - 1678 abides by 254's model
 - 6-wheel or 8-wheel
 - Simple design not sensitive to tolerance issues
 - WCP/VEX gearbox integration
 - Flexible design
 - Chain or belt
 - Custom gearbox
 - Consistent choice speeds up design process



Design Details

- Versa Planetaries
 - Any motor, any ratio
 - Every motor on our robot besides drive gearbox
 - Just don't put under high loads!
- Fast iteration, less need to dabble in calcs
- Easy integration
- Less time diagnosing mechanical issues



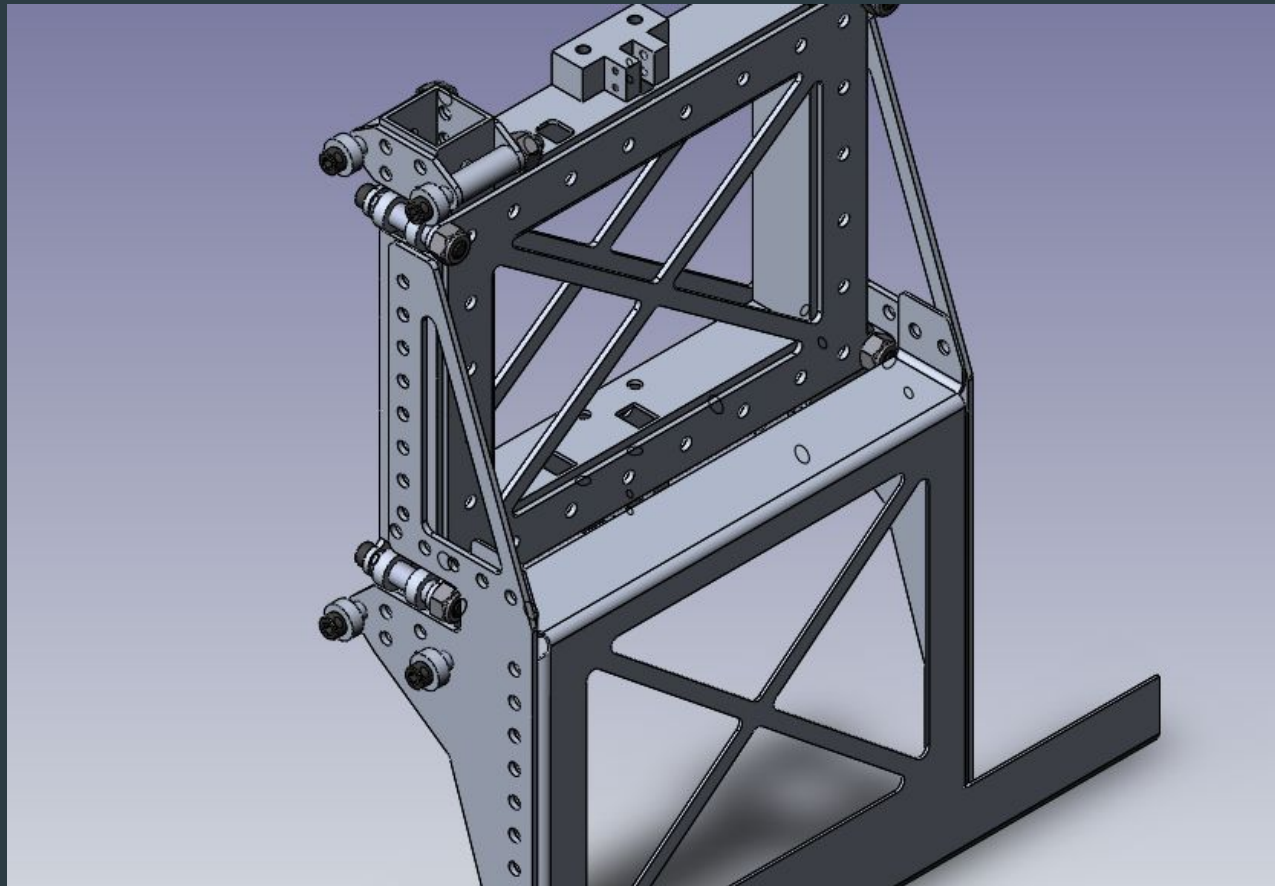
Design Details

For those with access to CNC router or laser cutter...

- 973 Tube/Gusset Design
 - Strength and weight
 - No tolerance issues
 - Fast in-house fabrication
 - Simple assembly

Design Details

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Drafting

- Effectively communicate designs to fabrication students
- Tolerancing
- Hand drawing drawings

Resources

- Download other teams' CAD files
 - 971, 1114, 973
- Adam Heard from 973's YouTube RAMP videos
 - topics from linkages to gearboxes and elevators
- JVN's or Copioli's design calculators



Q&A

- Any questions?
 - Design process, CAD techniques, design details
 - CAD demonstrations
 - Robot design walkthroughs
 - Other topics
- Please do not hesitate to contact:
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Thank you!

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