“Revolution” – Progress Update

AST AGM MARCH 2020

Introduction

- What's been happening?
- Organisation
- Design Process
- Performance Objectives
- Boiler Design
- Locomotive Design Progress

What's been happening?

- Kick off meeting – Doncaster
- Engineering meetings – Stapleford
- Boiler meeting - Edinburgh

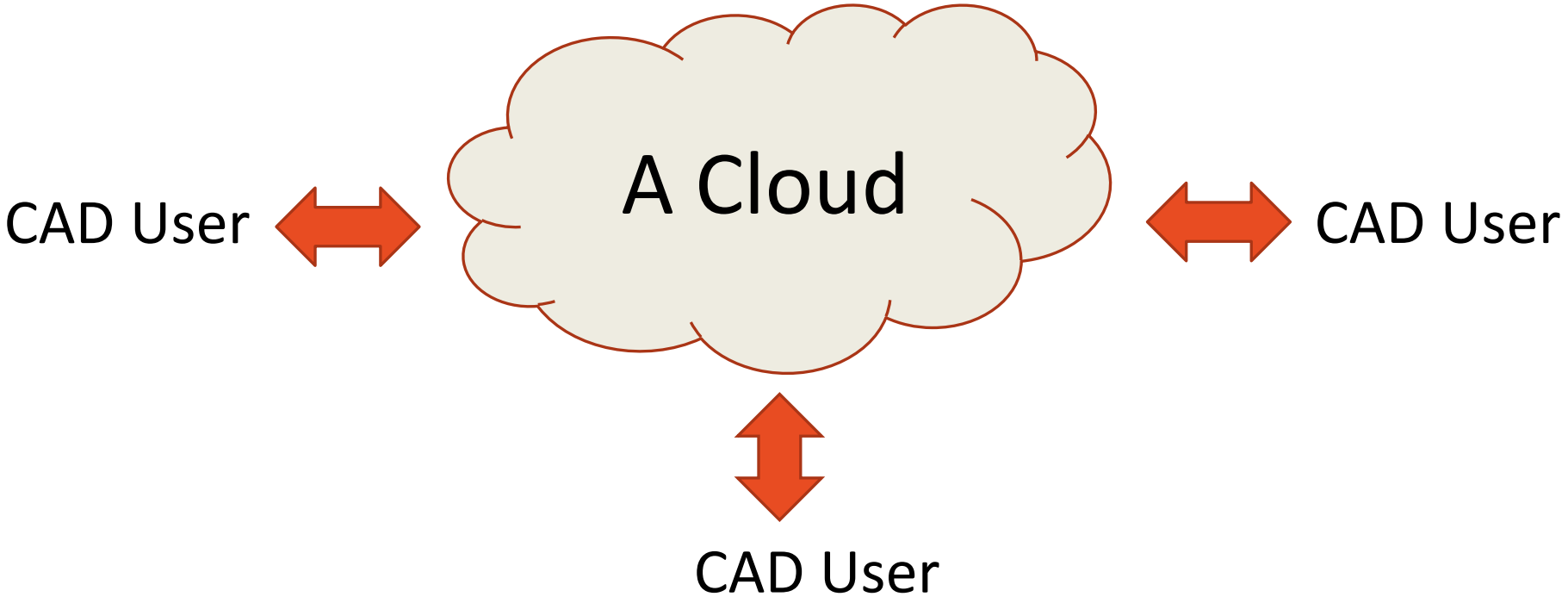
Backroom activities

- Draft Requirement Specification
  - Top level
  - Defined what it is you are doing
  - Not much detail
- Cloud based storage folders
- Drawing/part register and numbering system
- Structured calculations

Organisational Challenges

- Not everyone gets what they want
  - Everyone's got good (and different) ideas
  - It's a bit like herding cats!
  - The DRS is important!
- Co-ordinate design effort
  - Remote locations
  - Different CAD
- Demands on time

The ideal – Cloud Based CAD

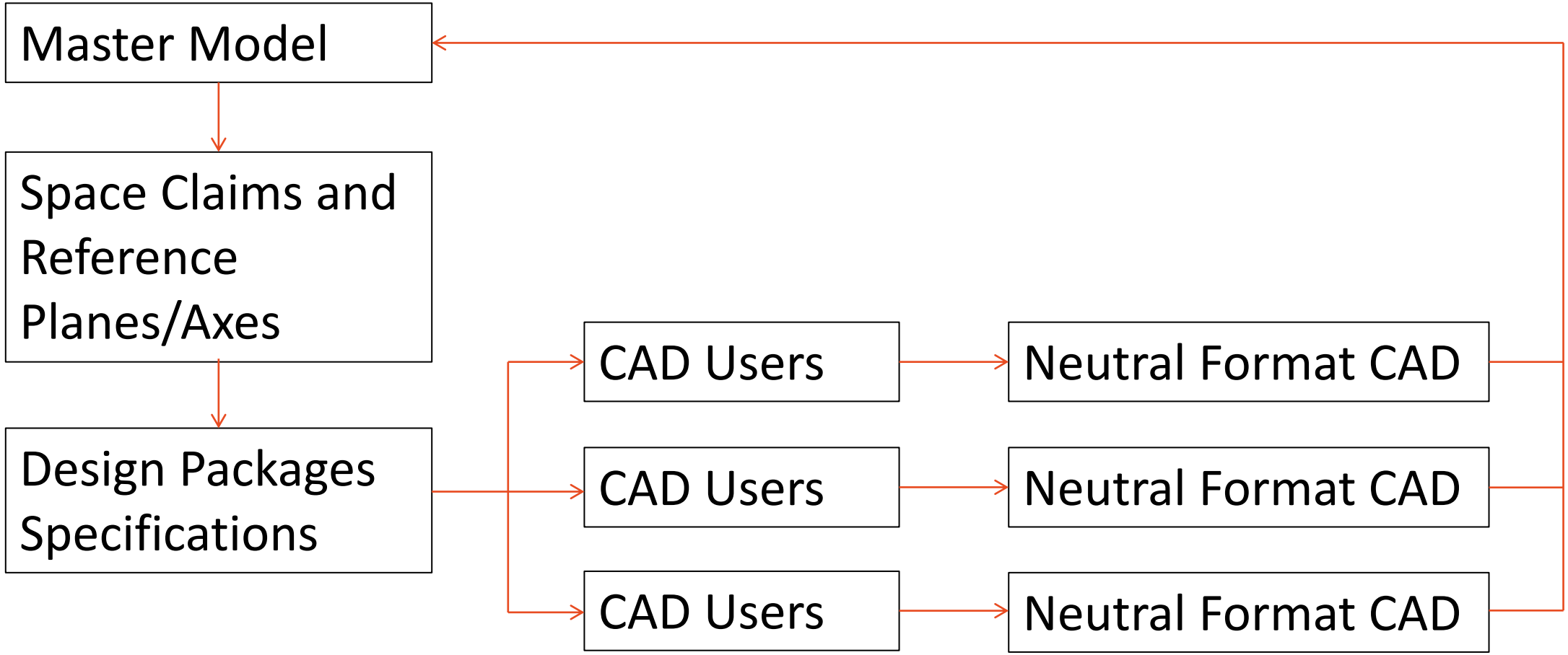


Free – limited functionality

Licenced - fee per seat ££££!

Many of us already use other systems - Solidworks

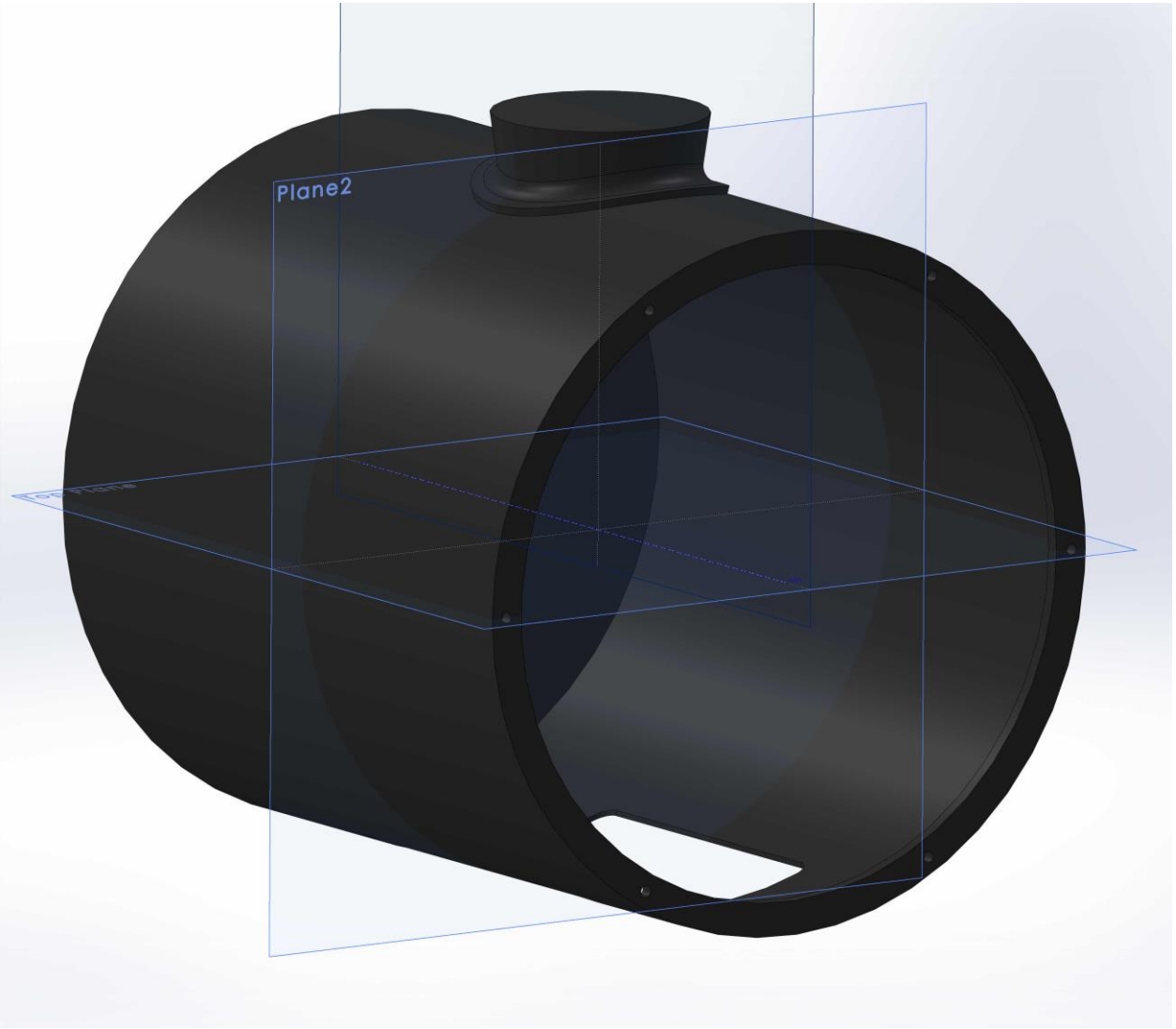
The Other Way



An Example…… Smokebox

Design Package

- Space Claim (Neutral Format)
- Reference Drawings
- Mechanical Interfaces
- Performance Data
- Design Interfaces
- Outputs
  - CAD Models
  - Detail Drawings
  - Calculations



Performance Objectives

General Concept:

- Big enough to do the job
- No bigger than necessary
- Be a “Really Useful Engine”
- Comparable to the Curwen Atlantic

Performance Objectives

The Line: Stapleford Miniature Railway

- Ruling Gradient 1 in 40, sections of 1 in 60 and 1 in 80
- Line speed 10 mph (12 mph max)

The Train:

- 9 Cars, 400kg tare, roller bearings
- 6 passengers/car (83kg x 6 = 500 kg): 900 kg laden
- Loco: 1500 kg + 500 kg tender = 2000 kg

Performance Objectives

1. Start a fully laden train on 1 in 40
   - Defines Adhesion
2. Maintain line speed on 1 in 60
   - At a sensible working cut off
   - Defines steaming requirements

Assumptions:

- 85% boiler pressure at the steam chest.

Performance Requirements

Whole Train Resistance (TR) = Wheel Rim TE (WRTE)

Resistance Calculator Spreadsheet

- Not quite sure how Standard Gauge methods apply to 10.25”!
- Some limited testing to be done to establish rolling resistance
- Overcoming gravity – the big one.

Starting on 1 in 40: TR = 3208 N

- Implies minimum adhesive weight of 1235 kg (c.400 kg/axle)

10 mph on 1 in 60: TR = 2252 N, TP = 10.0 kW

Leading Dimensions

Driving Wheel Diameter: 330 mm (13”)

- Standard SMR Practice

Stroke: 150 mm

- Longest stroke which permits Big End clearance.

Bore: 85mm

- After a great deal of messing about!

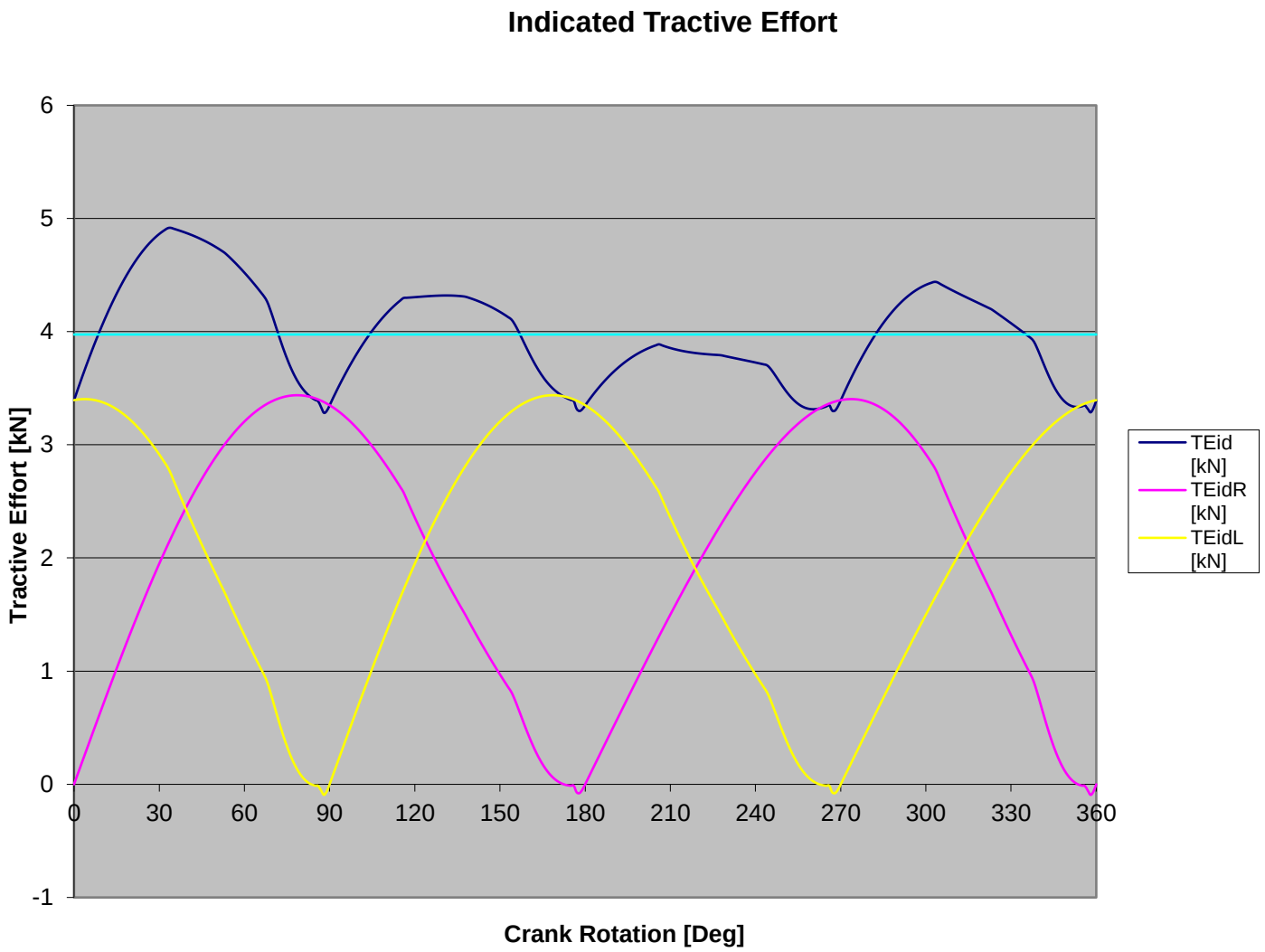
Boiler Pressure: 200 psi or 14.62 bar(a)

- Practical level. No point in it being too high.

Loading Gauge: 850 x 600 (sort of Continental 1/5 scale!)

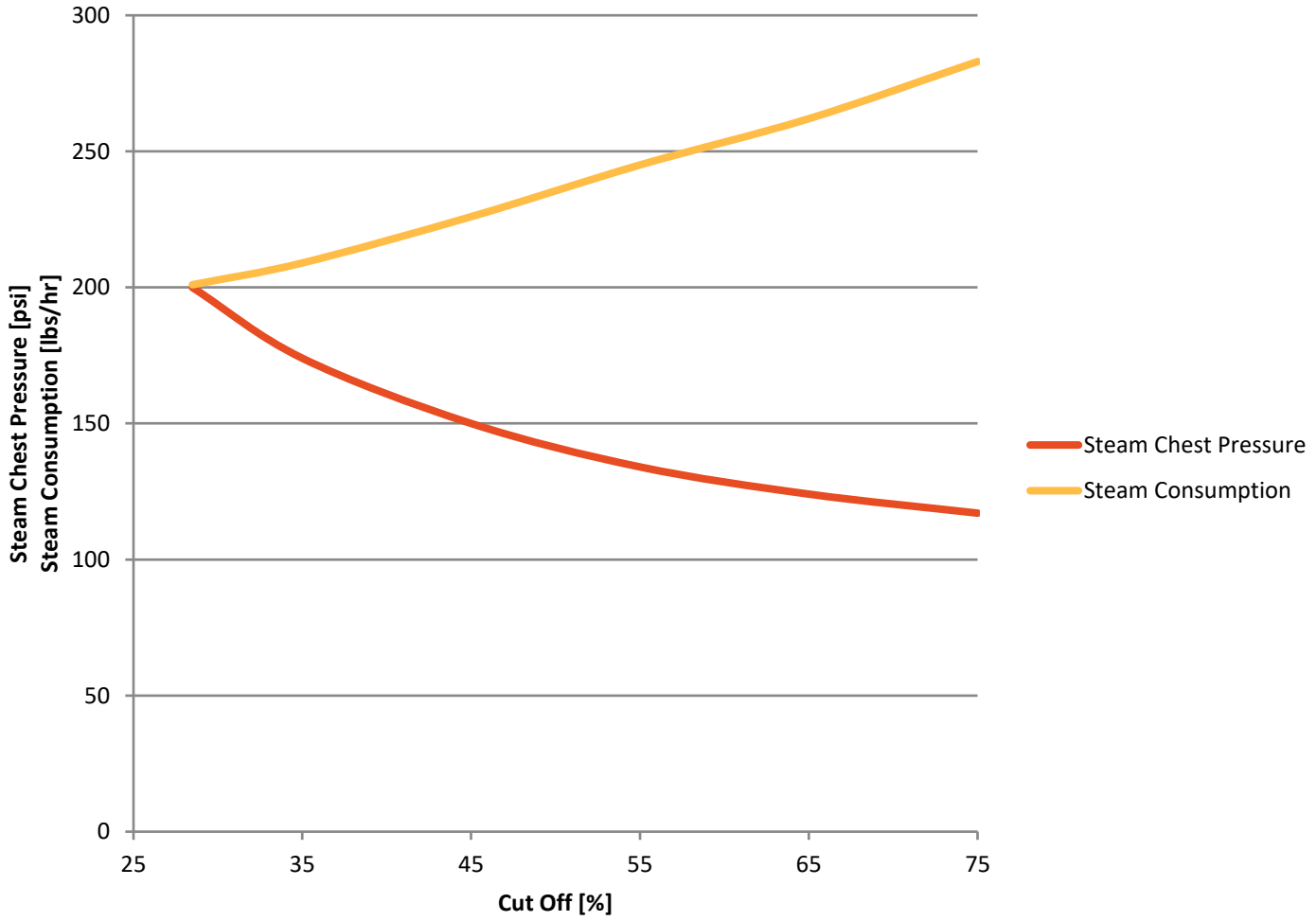
Starting Tractive Effort (85 mm Bore, 75% C/O)

Steam Chest		Min TE	Mean TE
psi	bar (a)	kN	kN
60	5.08	0.96	1.2
70	5.76	1.13	1.4
80	6.44	1.31	1.62
90	7.12	1.46	1.81
100	7.8	1.63	2.01
110	8.49	1.8	2.22
120	9.17	1.96	2.42
130	9.85	2.13	2.63
140	10.53	2.29	2.83
150	11.21	2.46	**3.04**
160	11.89	2.62	3.24
170	12.57	2.78	3.44
180	13.26	2.95	3.65
190	13.94	**3.11**	3.85
200	14.62	3.28	4.06



Constant WR Power – 10 kW, 10 mph, 350°C S/H

Cut Off	Steam Chest Press		Steam Consumption	
%	bar(a)	psi	kg/s	lbs/hr
28.5	14.62	200	0.02541	201
35	13	174	0.02635	209
45	11.33	150	0.02844	226
55	10.24	134	0.03082	245
65	9.52	124	0.03304	262
75	9.04	117	0.0357	283



Steam Consumption

At Design Point (10mph, 1 in 60, 45% Cut-Off):

0.02844 kg/s (226 lbs/hr).

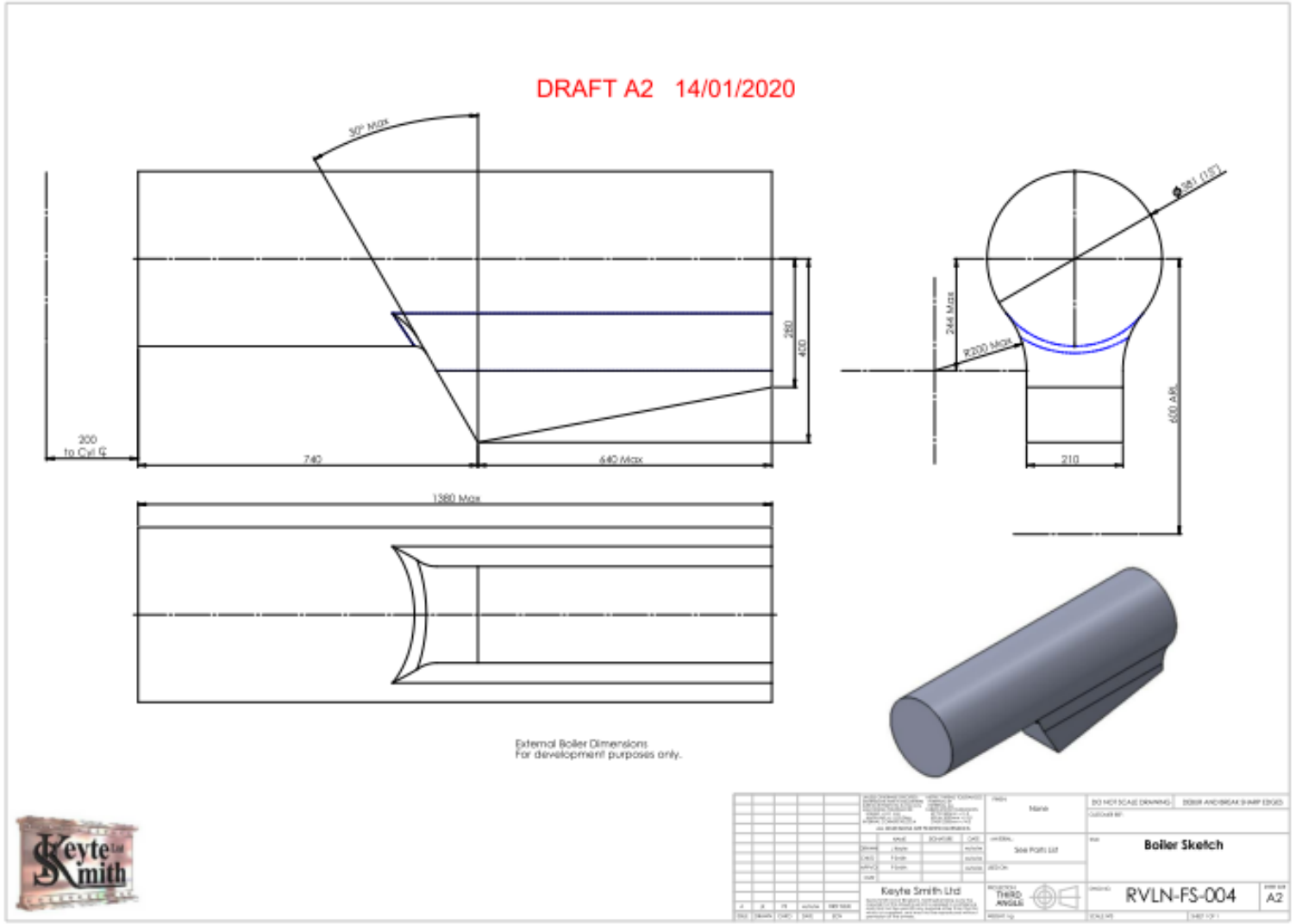
But……

- Assumes Superheat of 350°C
- No Leakage
- No Condensation
- No Thermal Losses

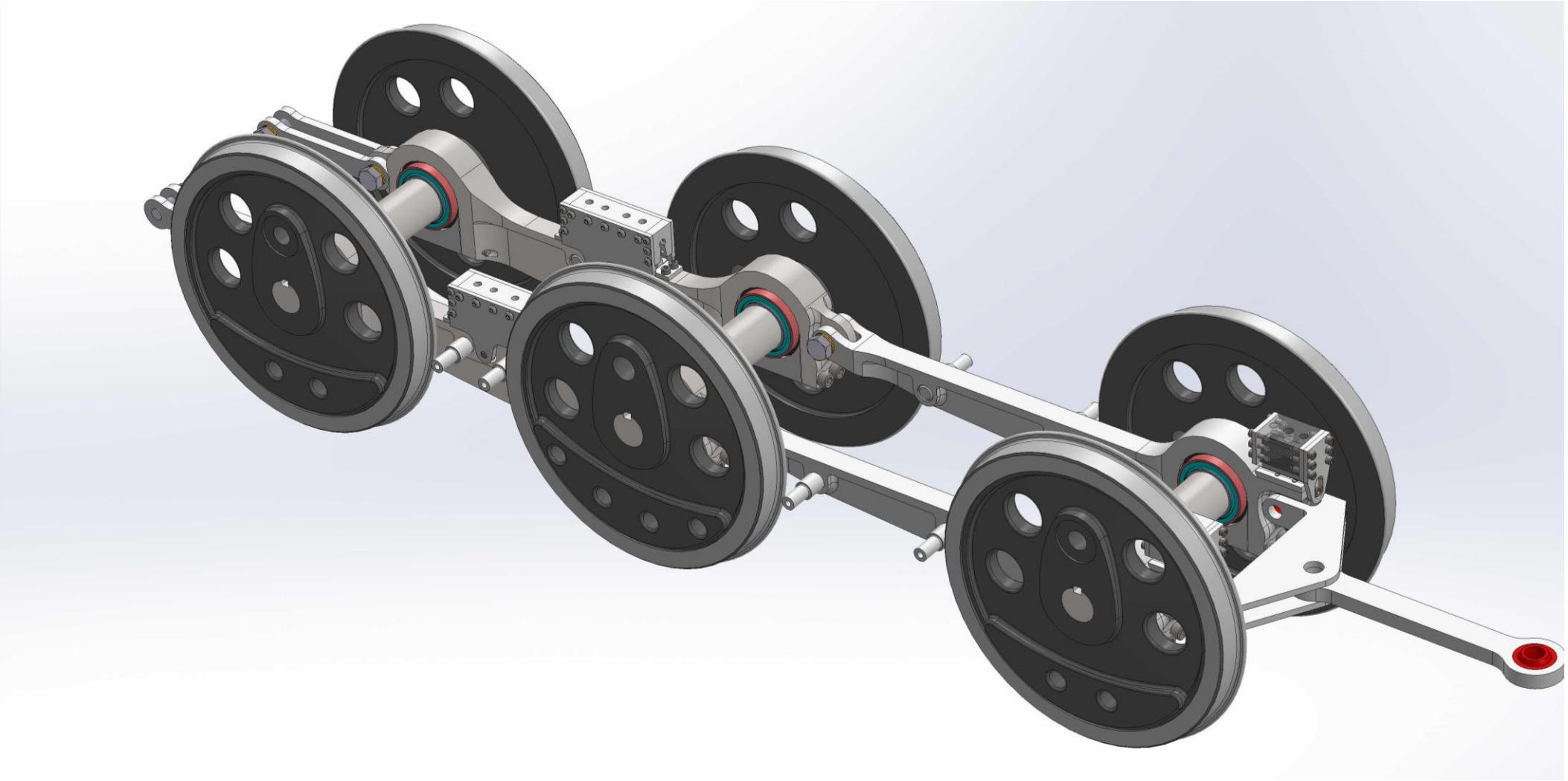
Boiler Development

- Round top box
- Narrow grate
- Martin Johnson's boiler analysis programme
  - Validated from 5" to 4' 8.5"
  - Grate area will be a challenge
- Leakage Tests on Curwen Atlantic SMR

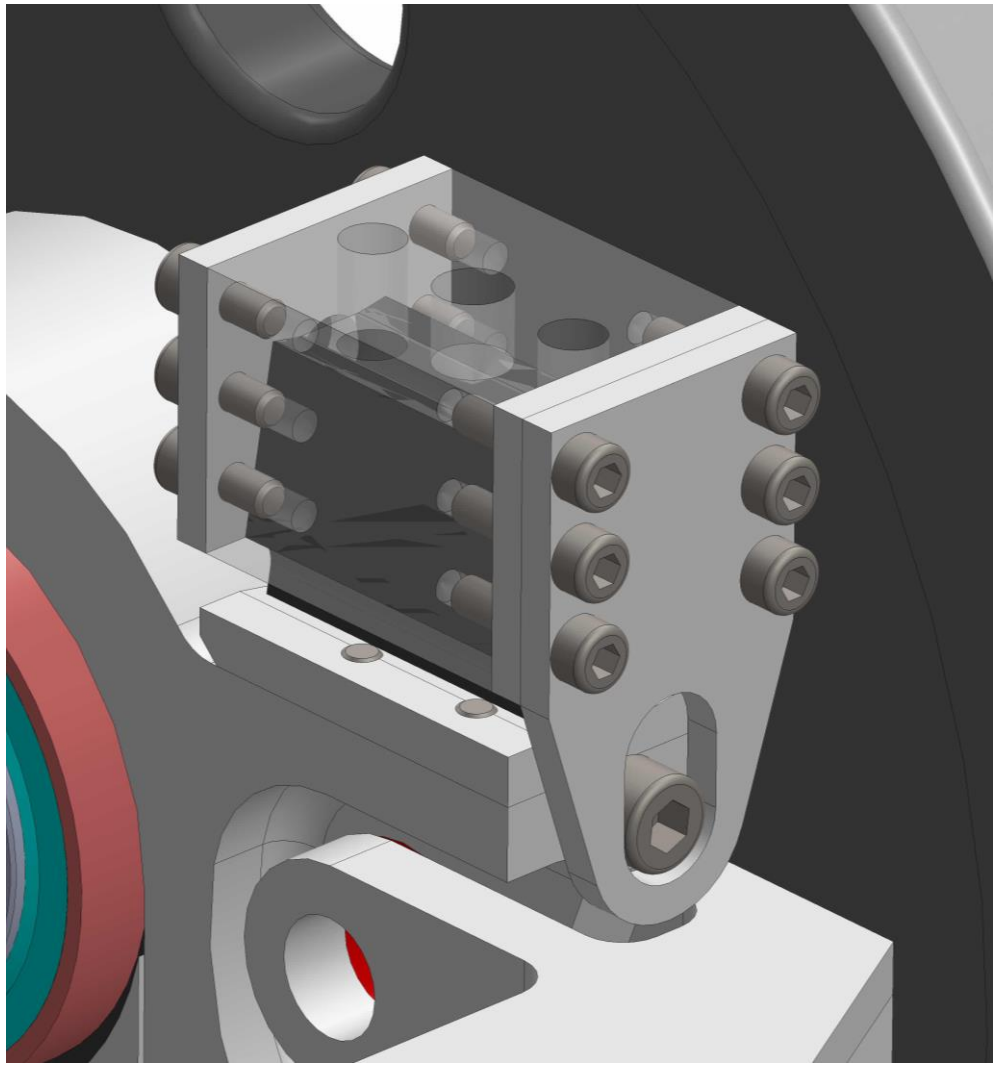
Boiler Space Claim

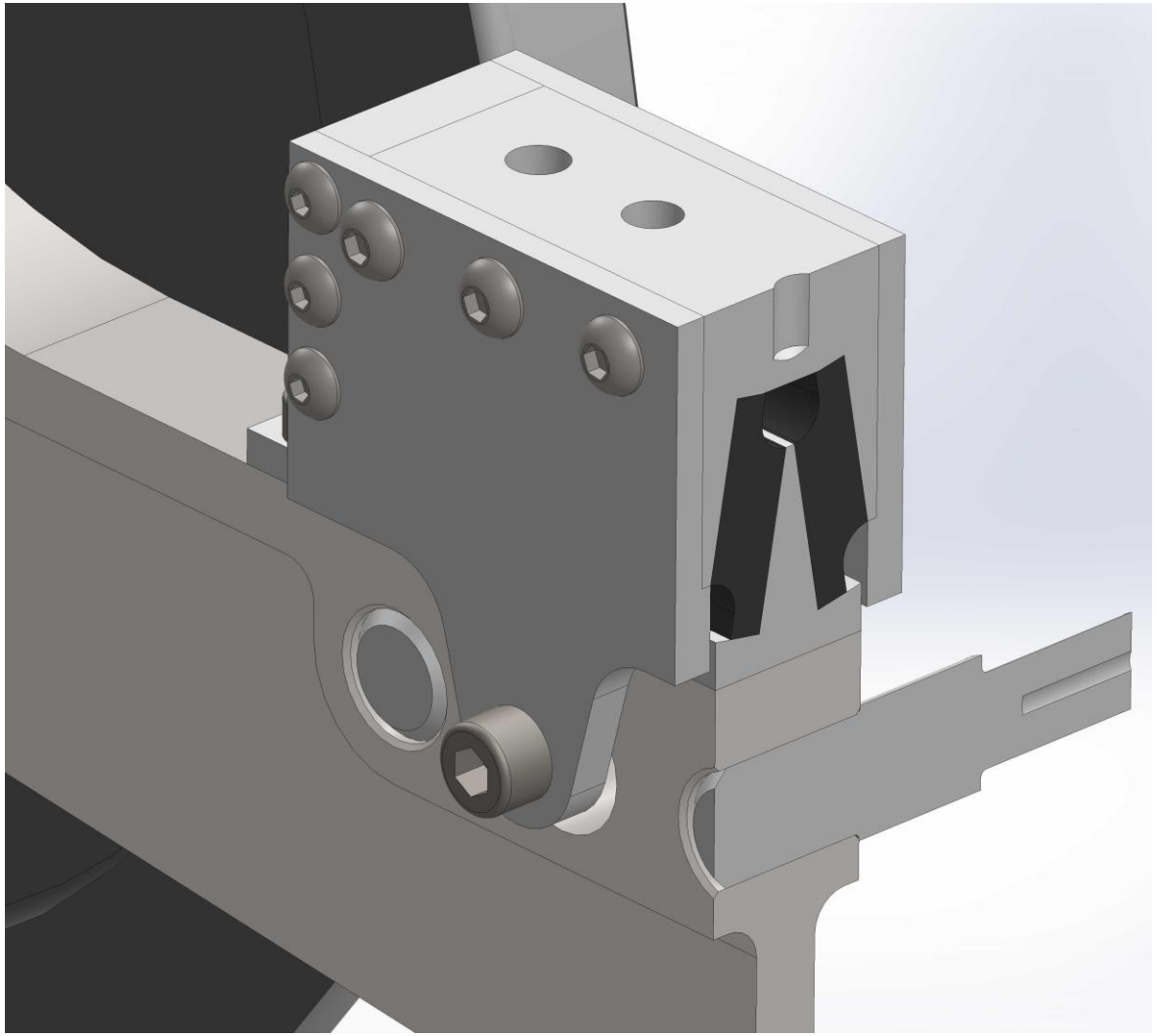


Progress - Suspension

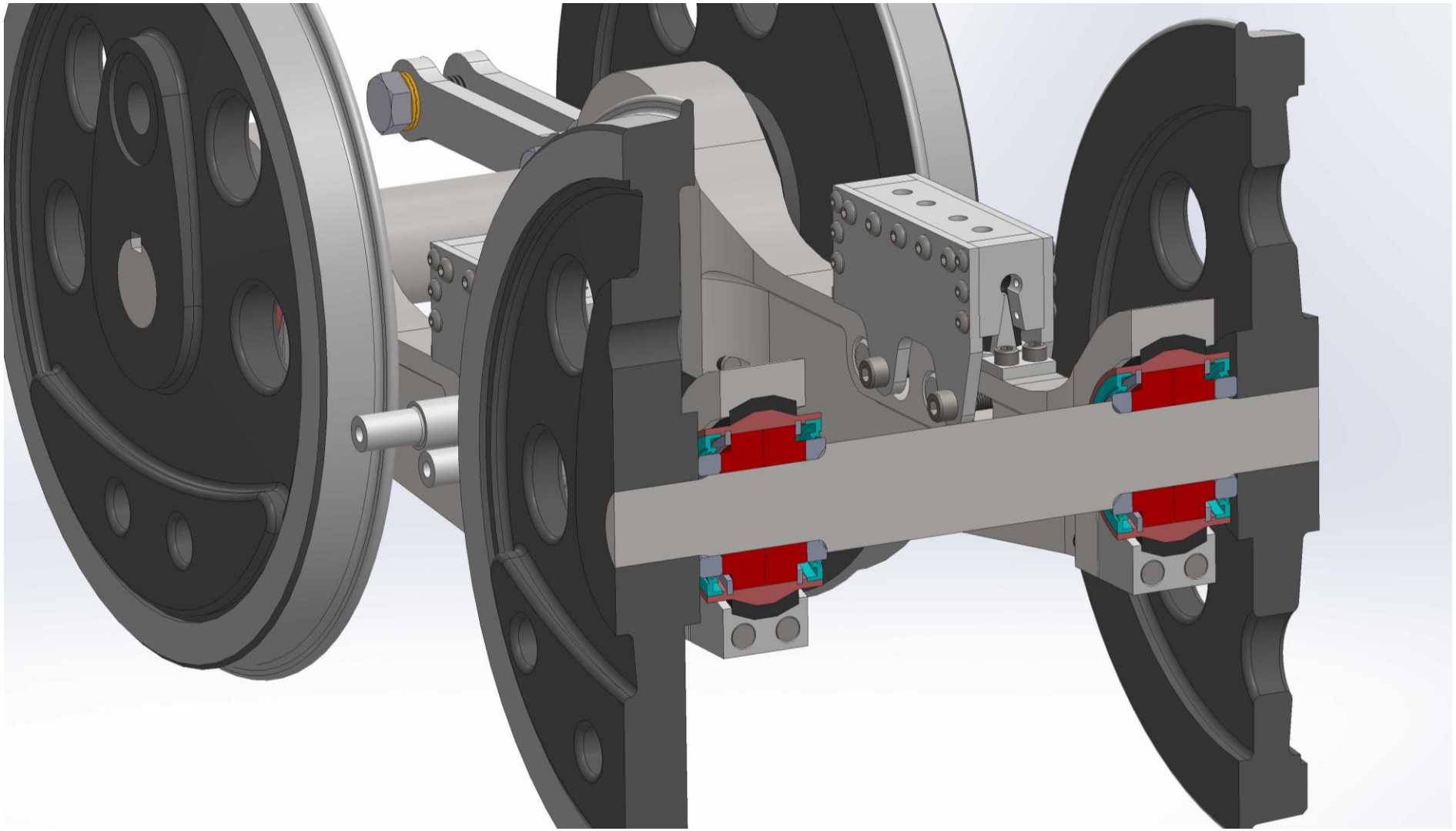


Progress - Spring Unit

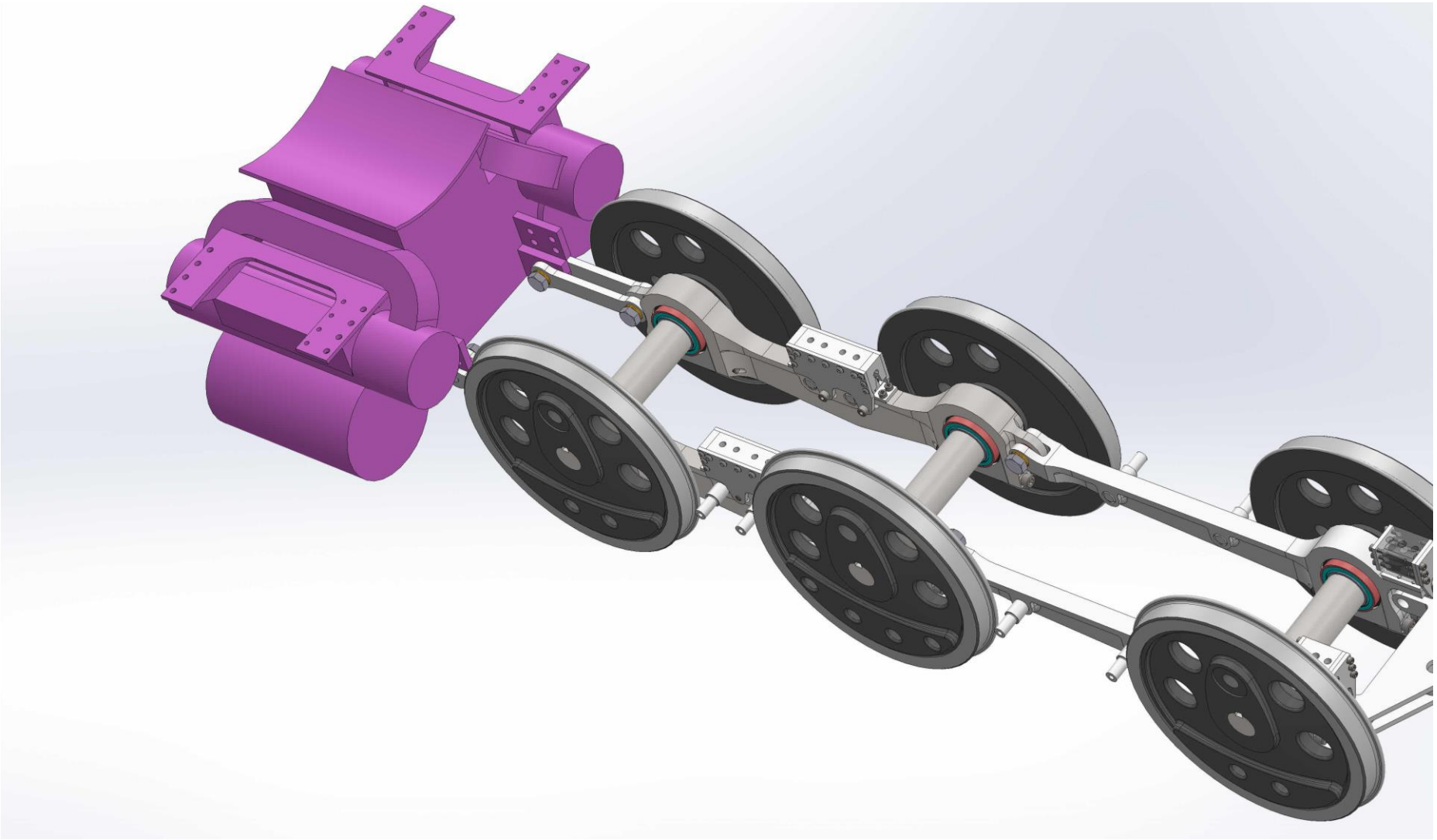




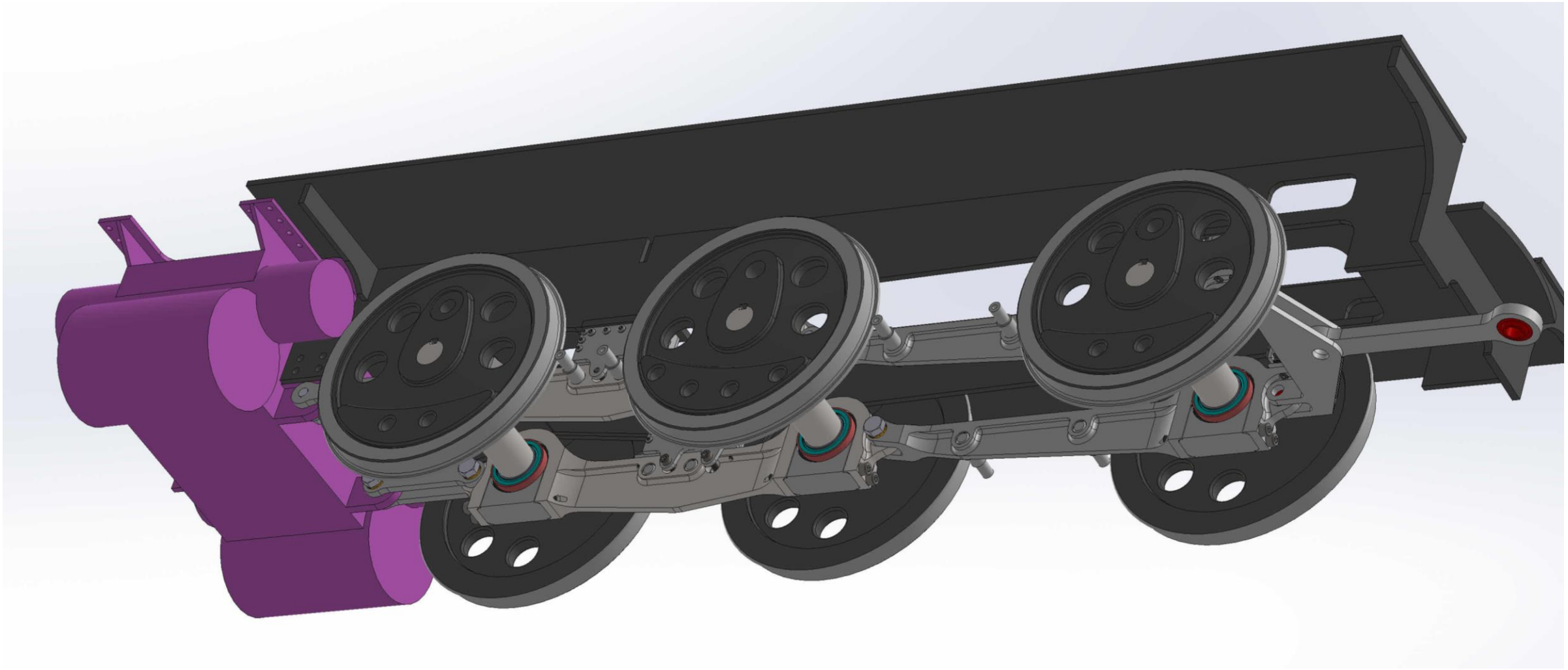
Progress – Driving Axles and Bearings



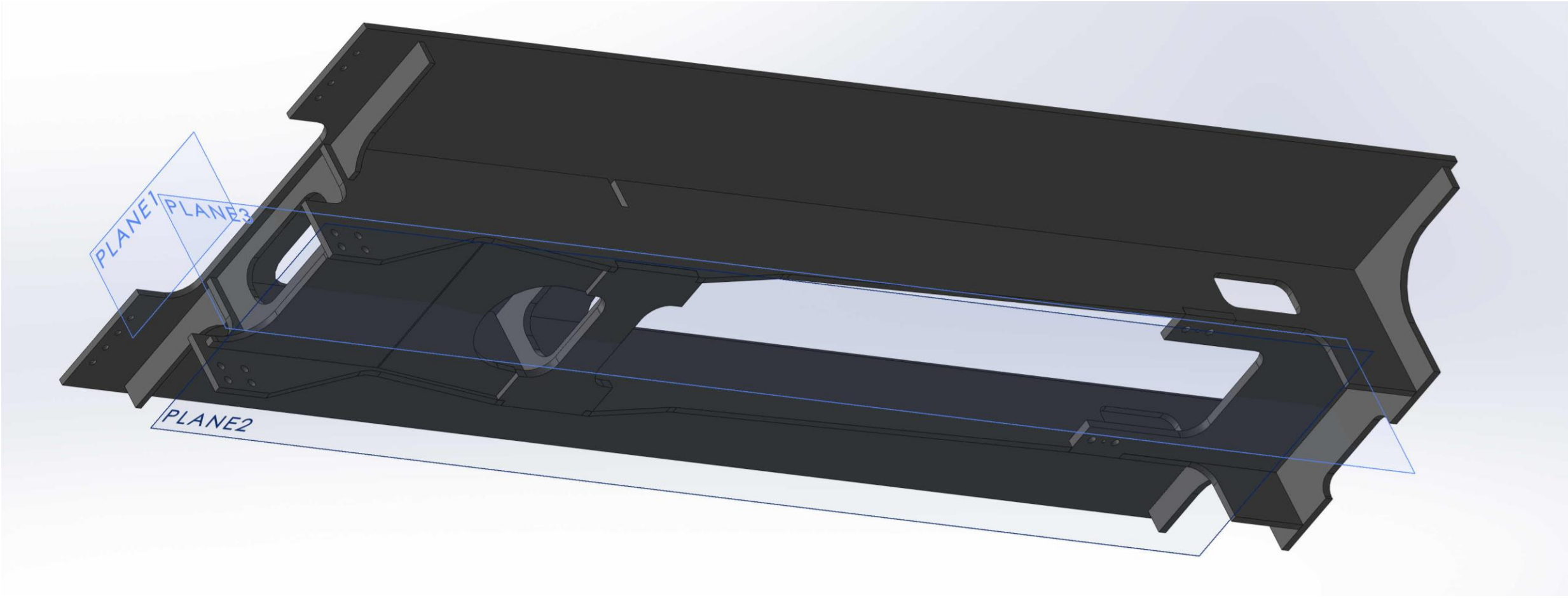
Progress – Cylinders



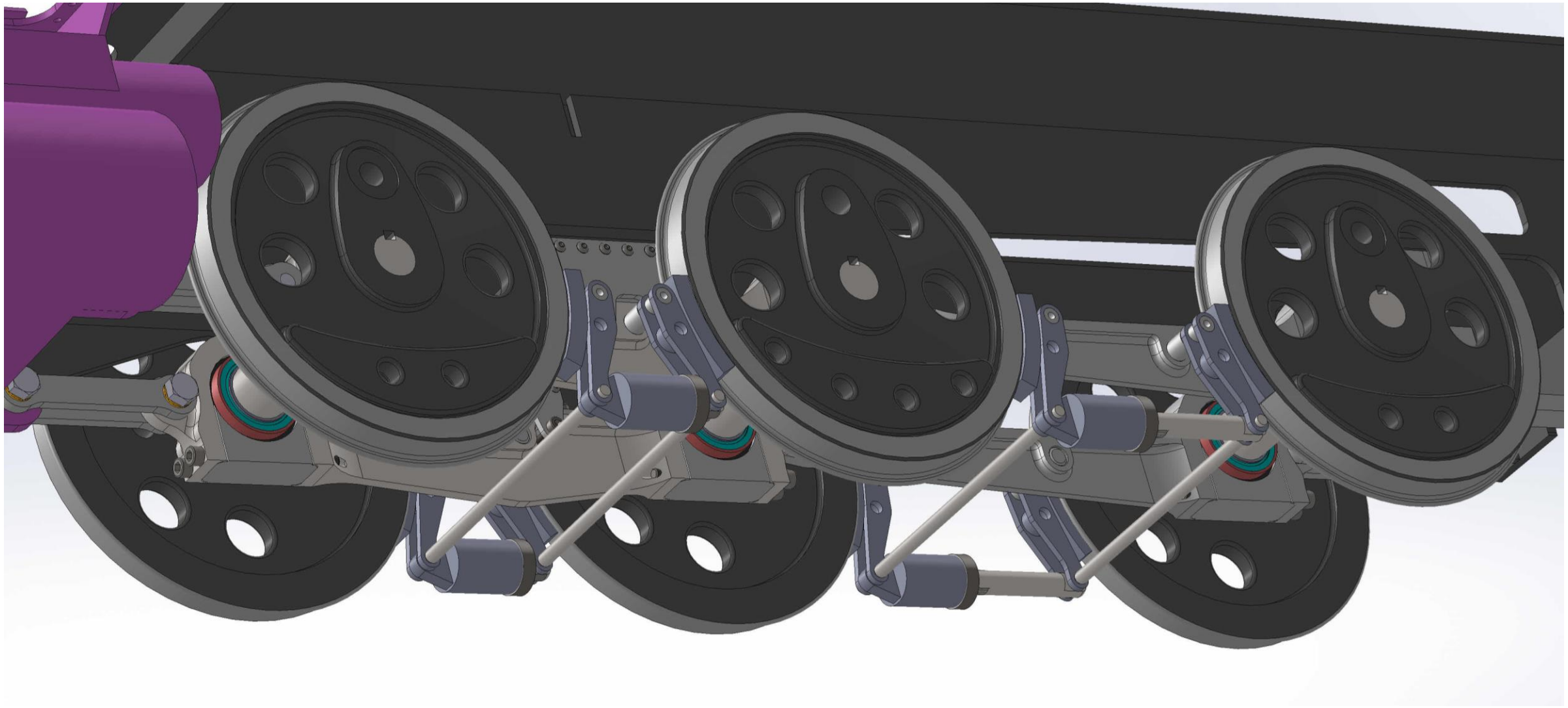
Progress - Frame



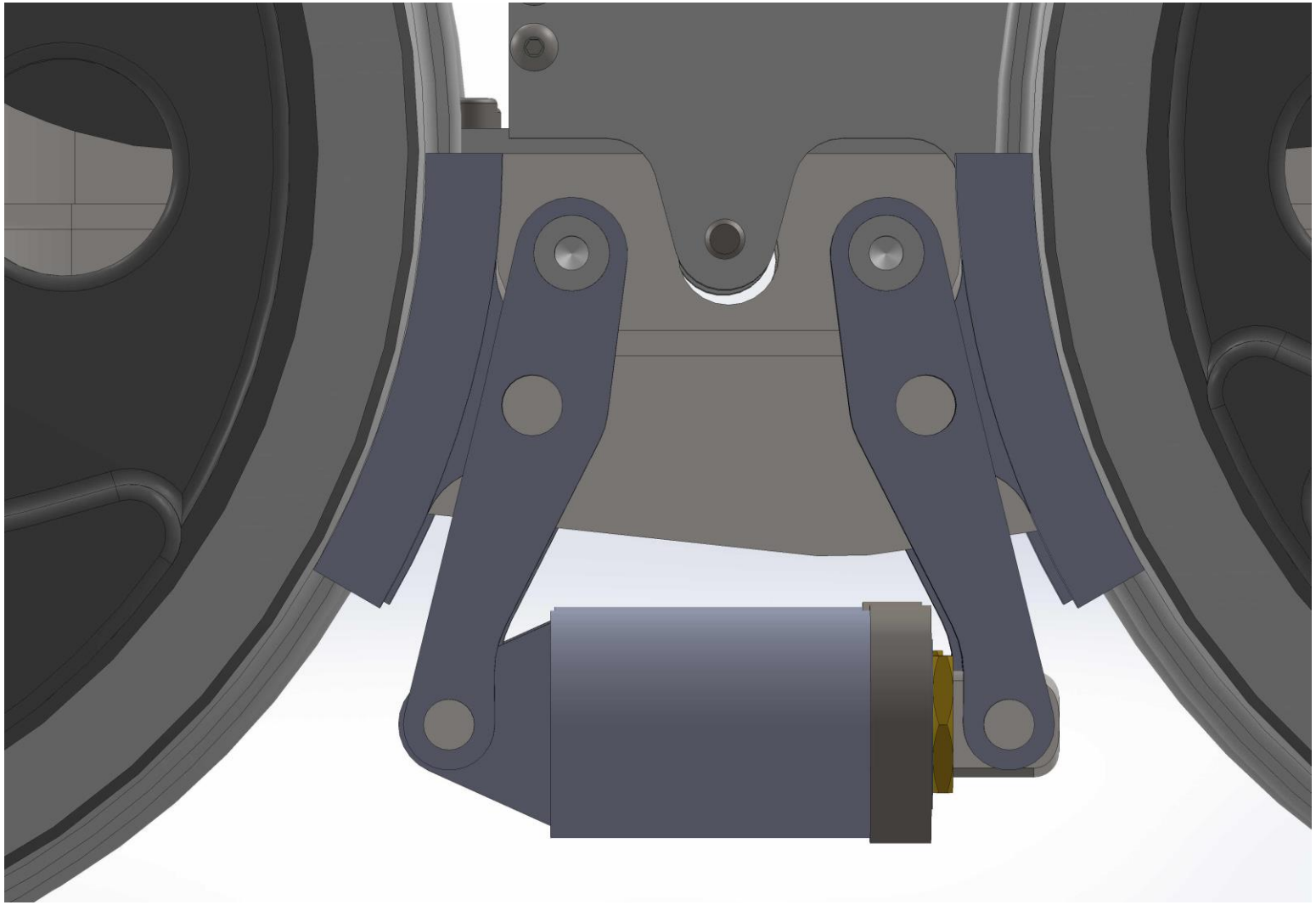
Progress – Frame (Work in Progress!)



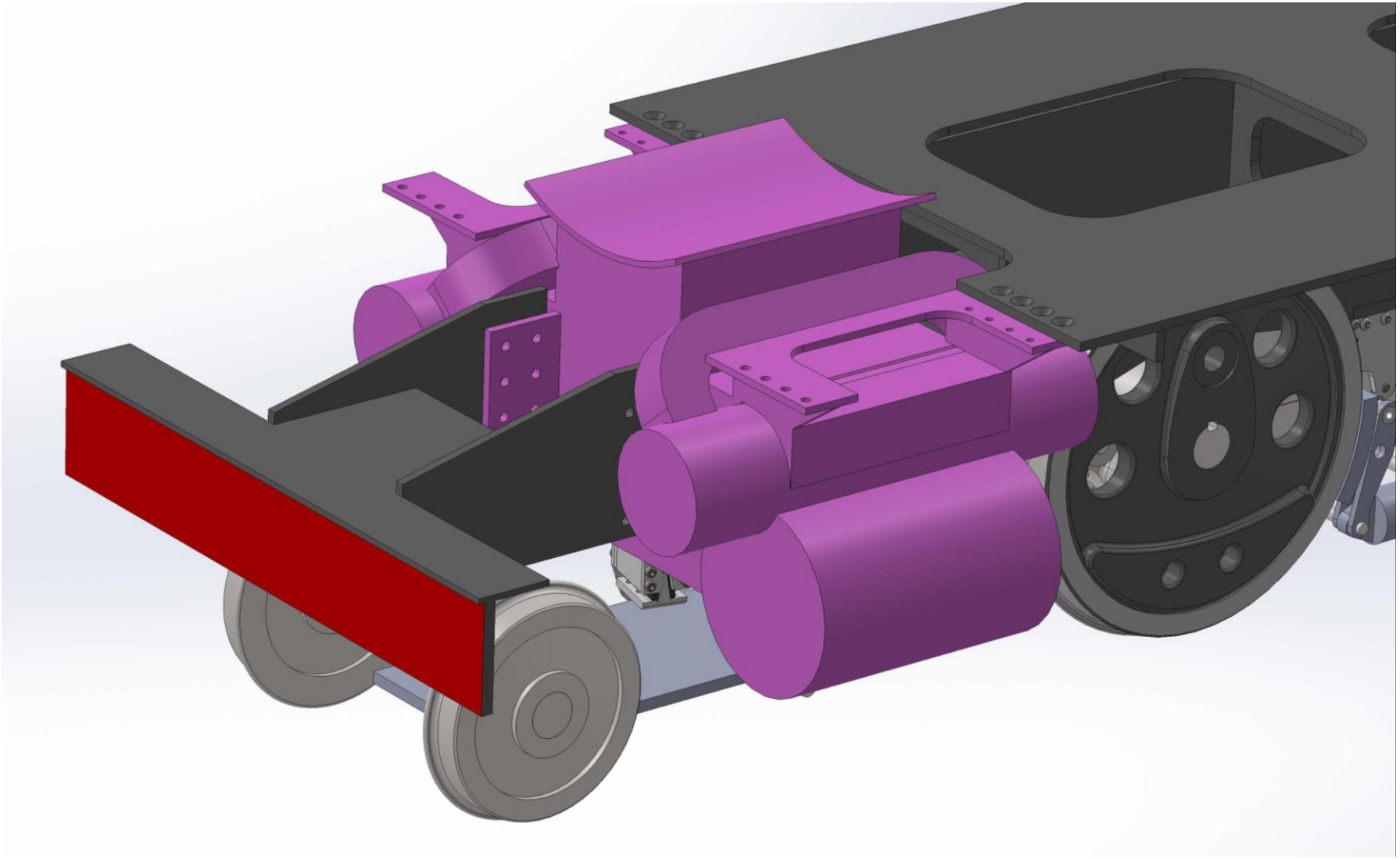
Progress - Brake Actuators



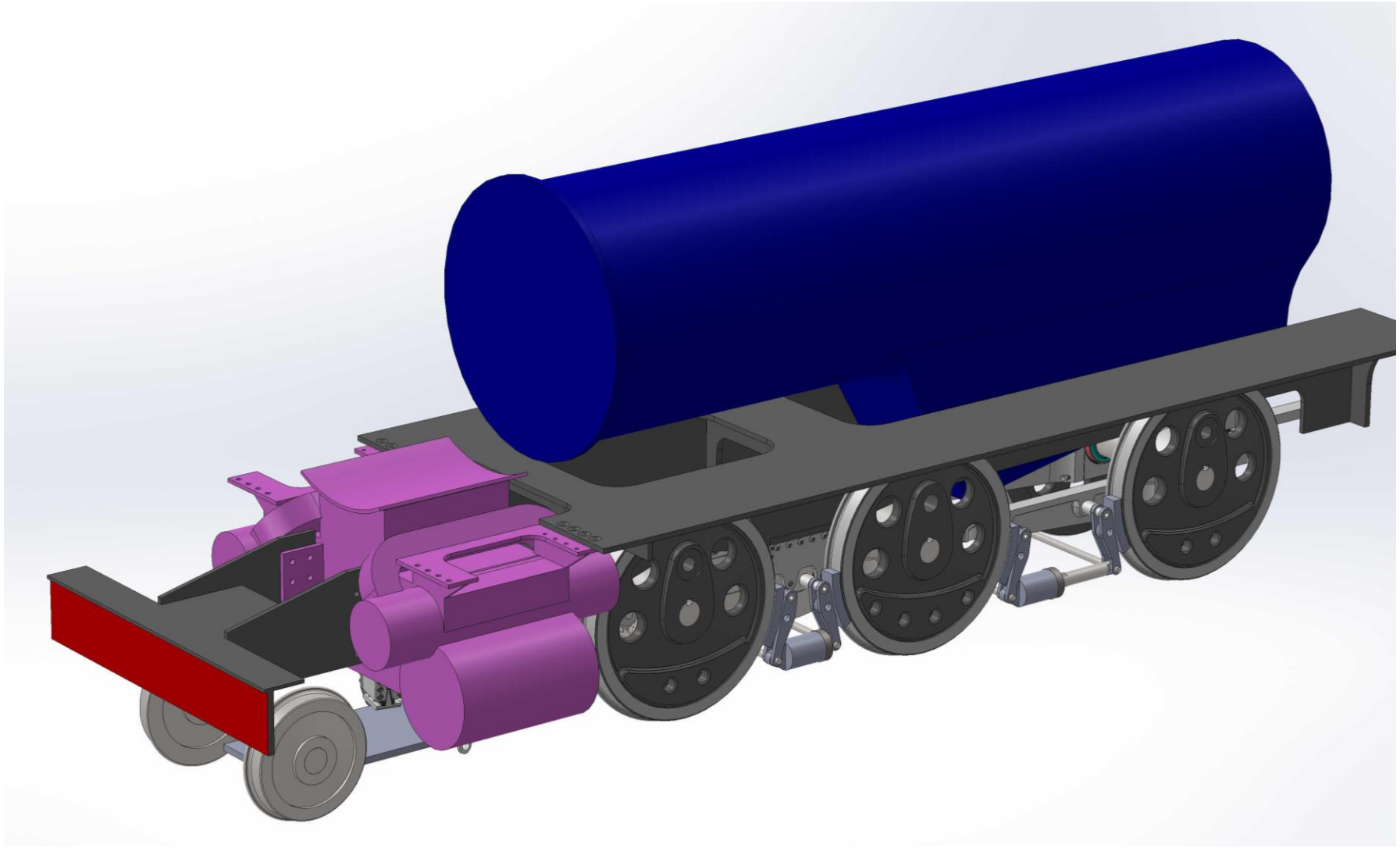
Progress - Brake Cylinder



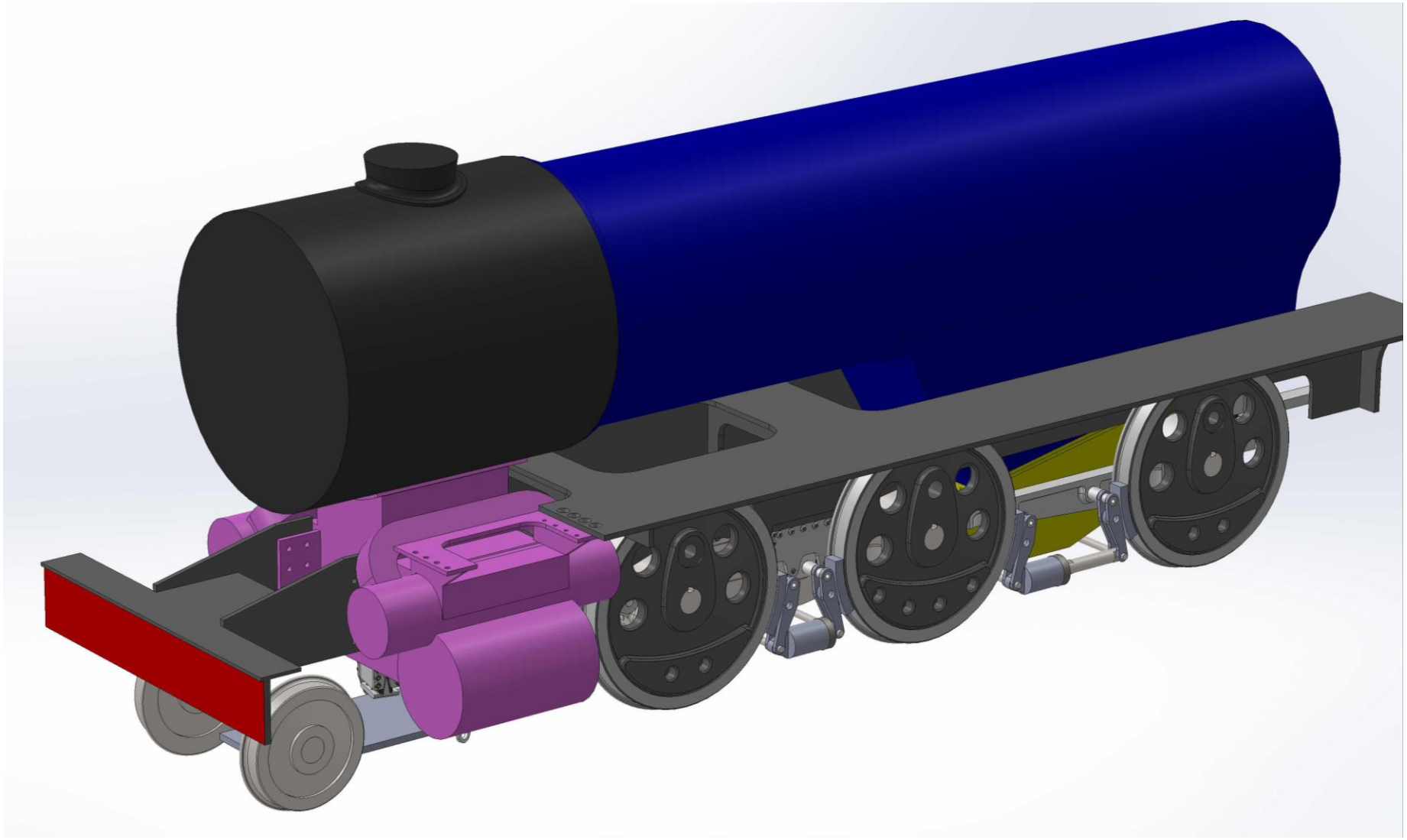
Progress – Front End & Pony Truck Space Claim



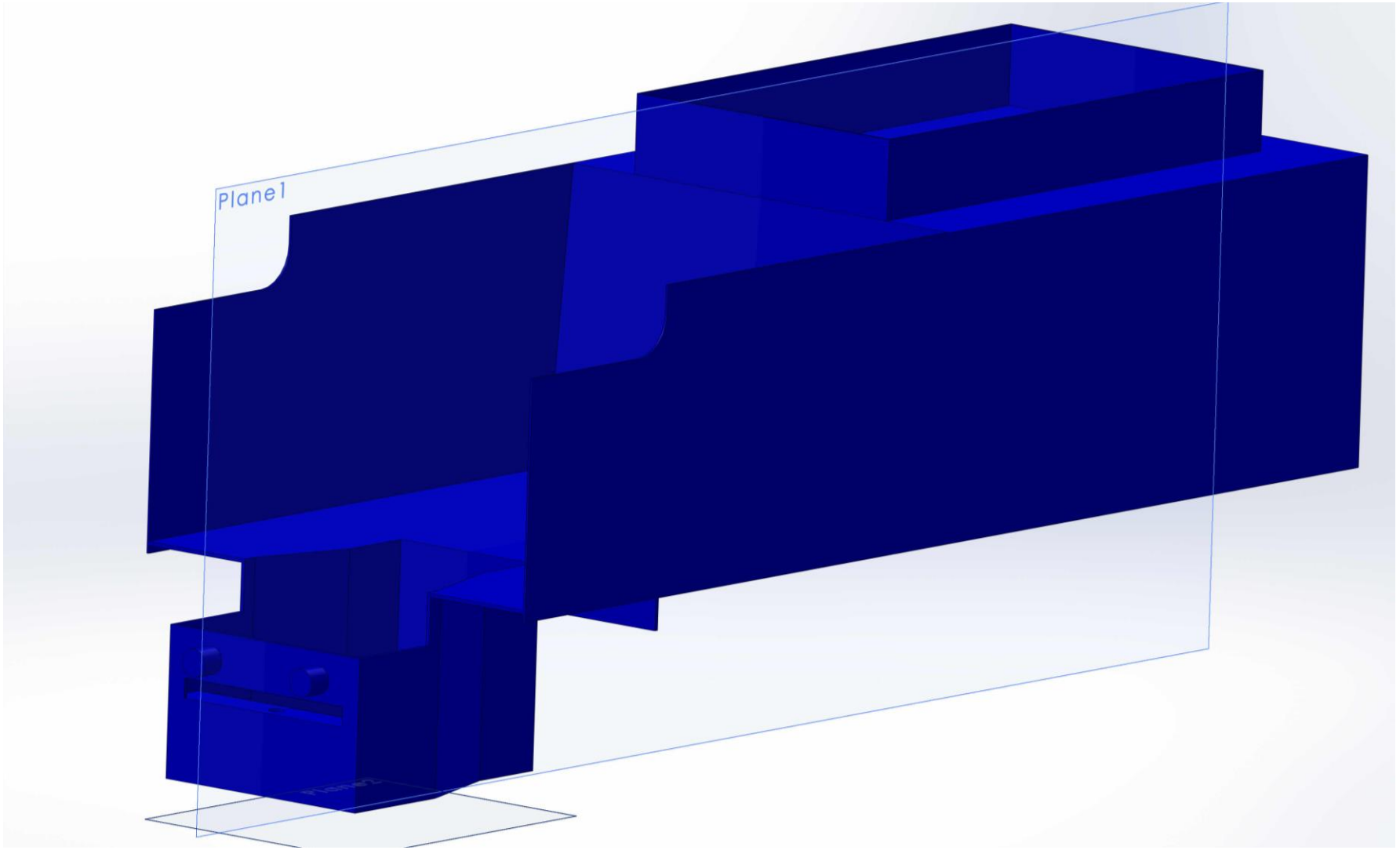
Progress – Boiler Space Claim



Progress – Amokebox and Ashpan Space Claim



Progress – Tender Space Claim



Revolution….