TPC Support and Constraint

TPC Support

- Baseline support system (Assumes “gravity” constraint)
- Loading
- APA support detail
- CPA support detail
- End wall support concept
- Some comments on contraction

TPC Constraint

- Effect of pressure on TPC position
- Alternative #1 – Springs
- Alternative #2 – Rails?
- Alternative #3a &3b – Rigid support for center rail

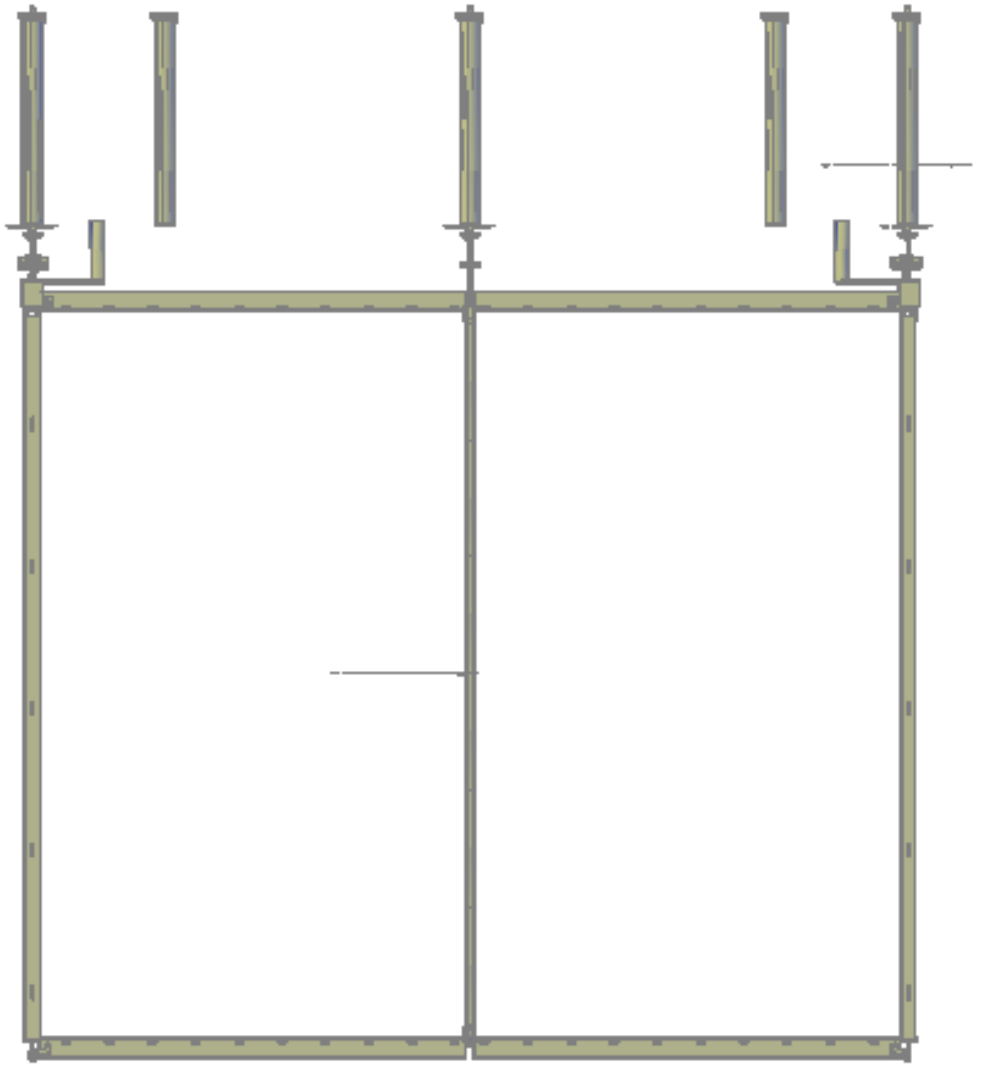
Installation

Questions

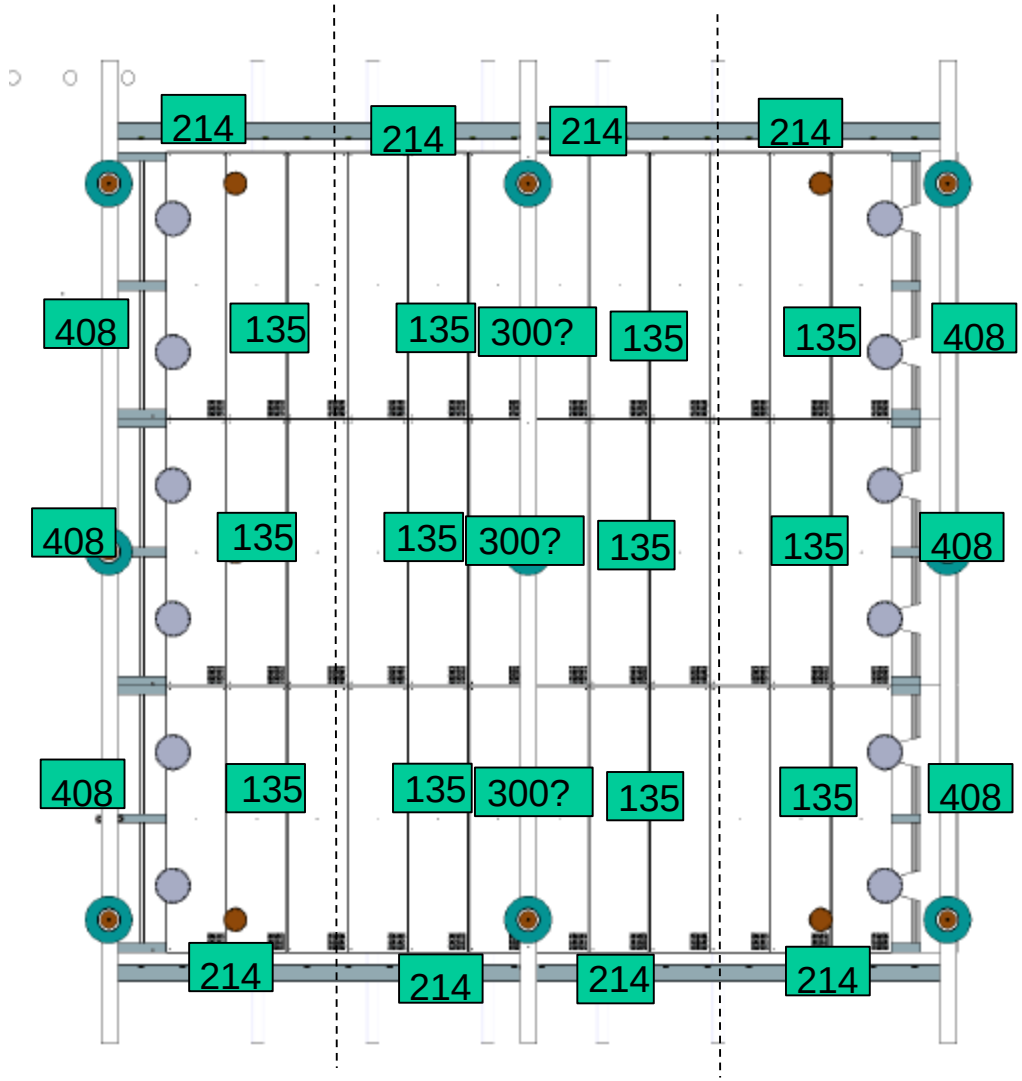
Baseline support system (Assumes “gravity” constraint)

Minimum constraint – Safest for accommodating CTE

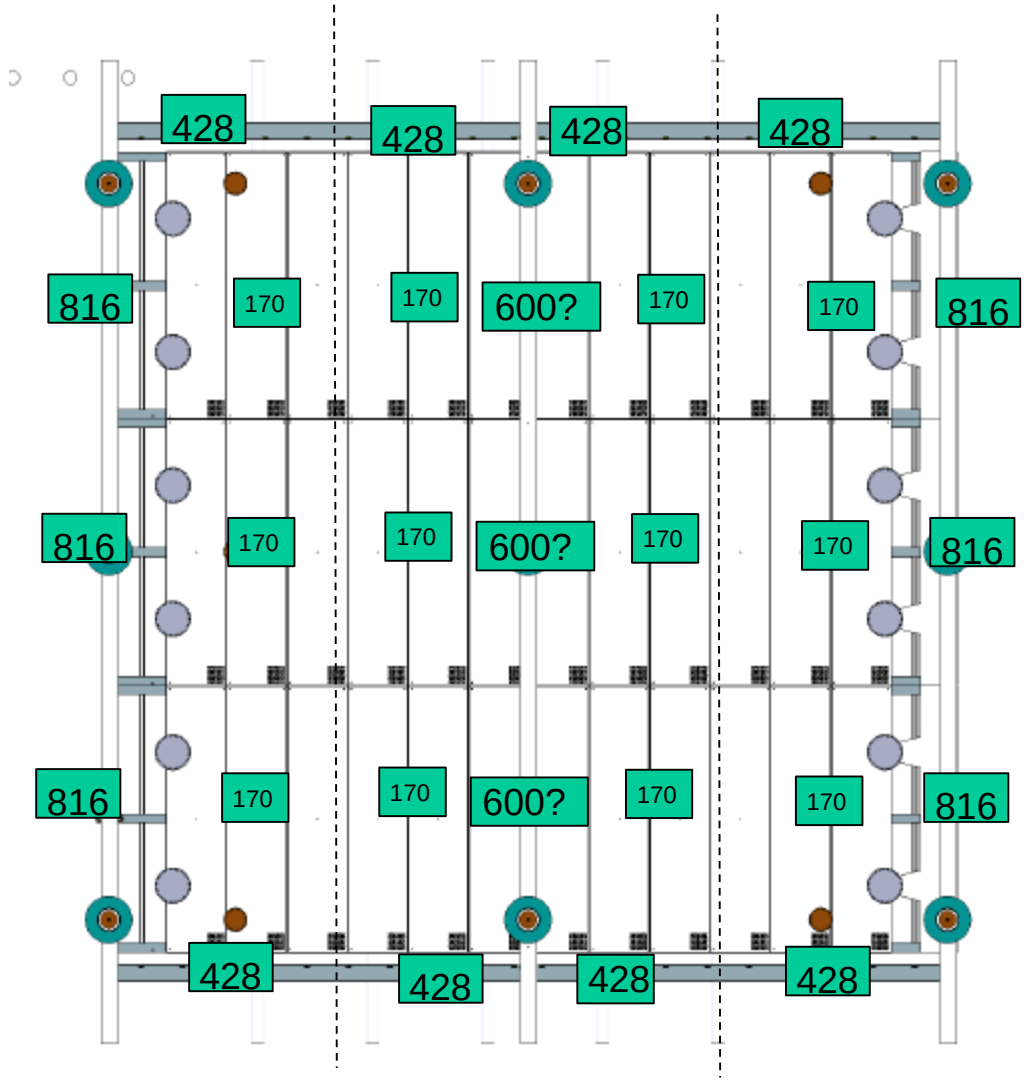
- If supporting cryo pipes, minimal horizontal loads can be transferred to structure
- Also strain in cables could affect TPC position if not careful



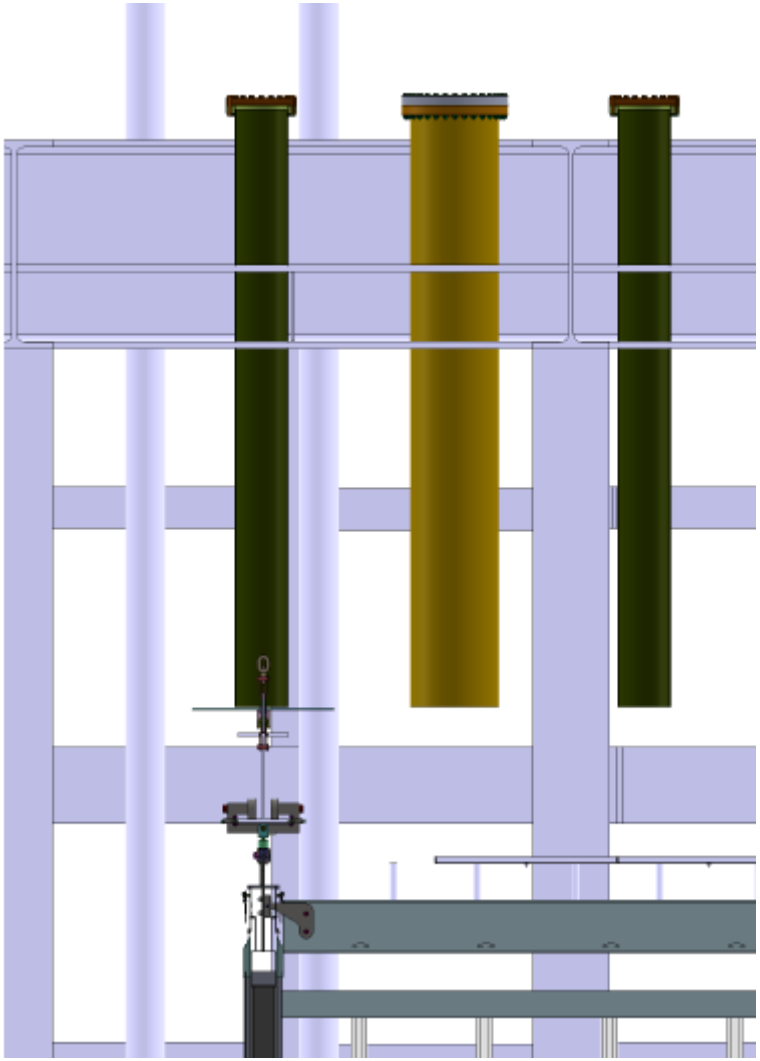
Loading – protoDUNE (kg)
Assumes no ground plane on bottom

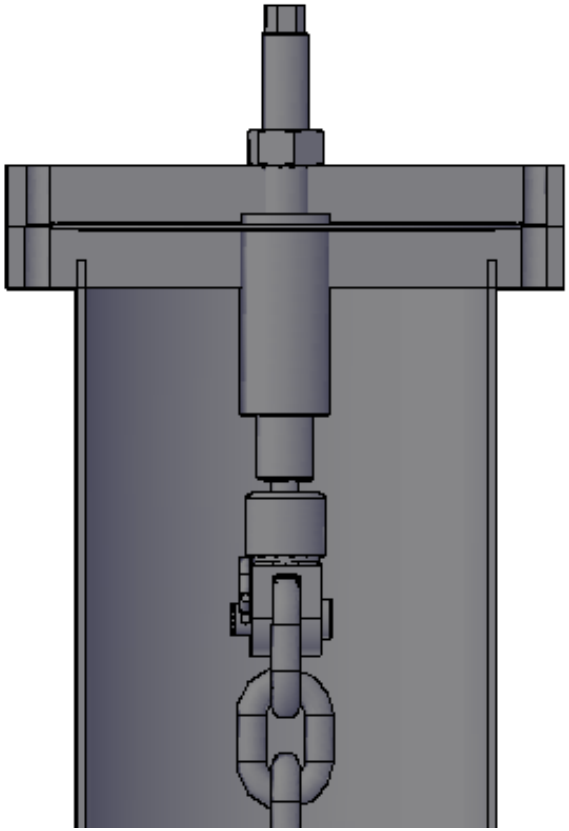


Loading for DUNE shown on protoDUNE footprint (kg)
With ground plane at the bottom



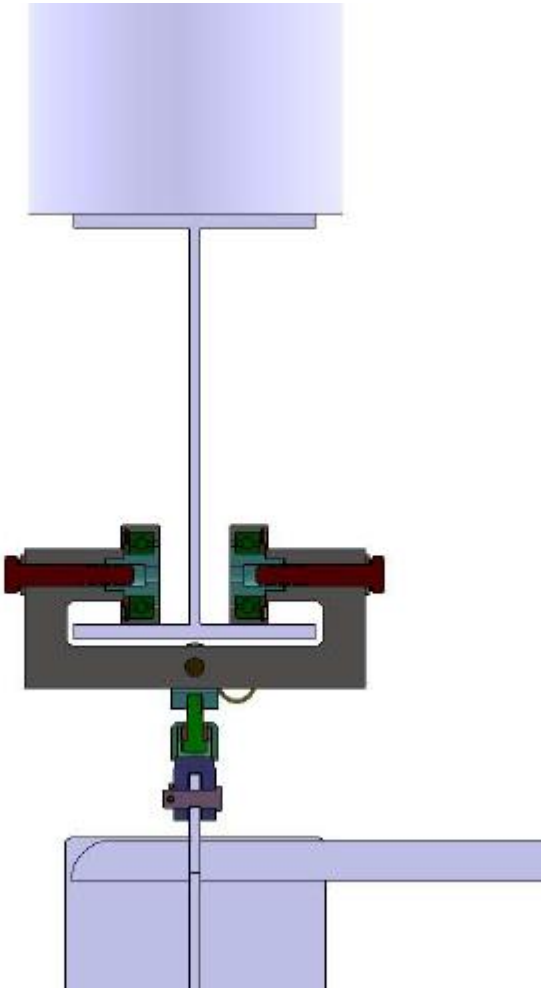
APA Support Detail

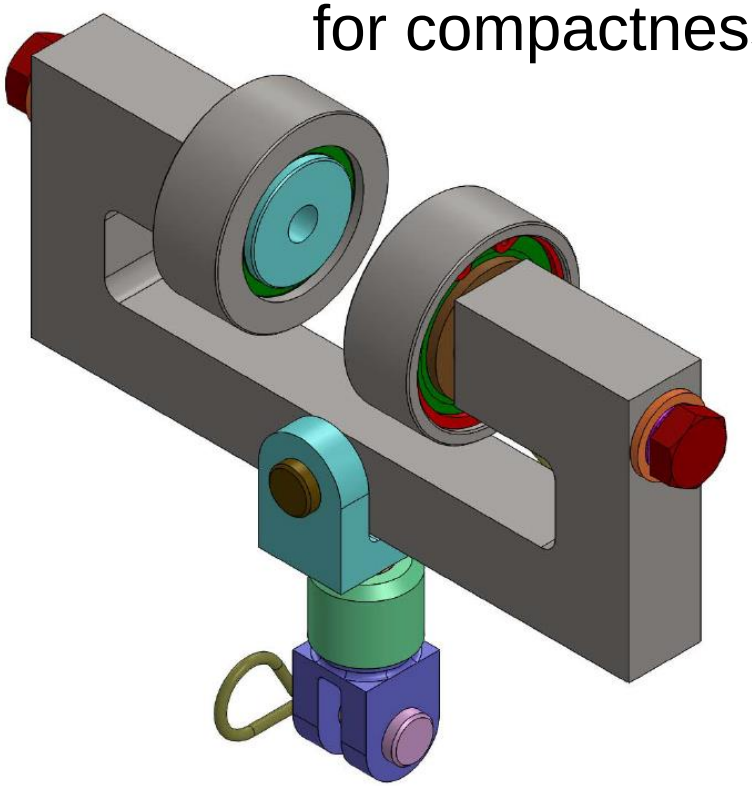




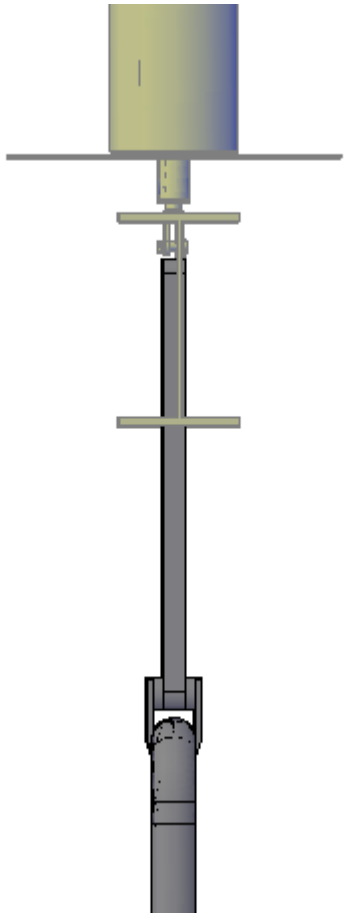
APA support detail

Simple but custom trolley with swivel for compactness.



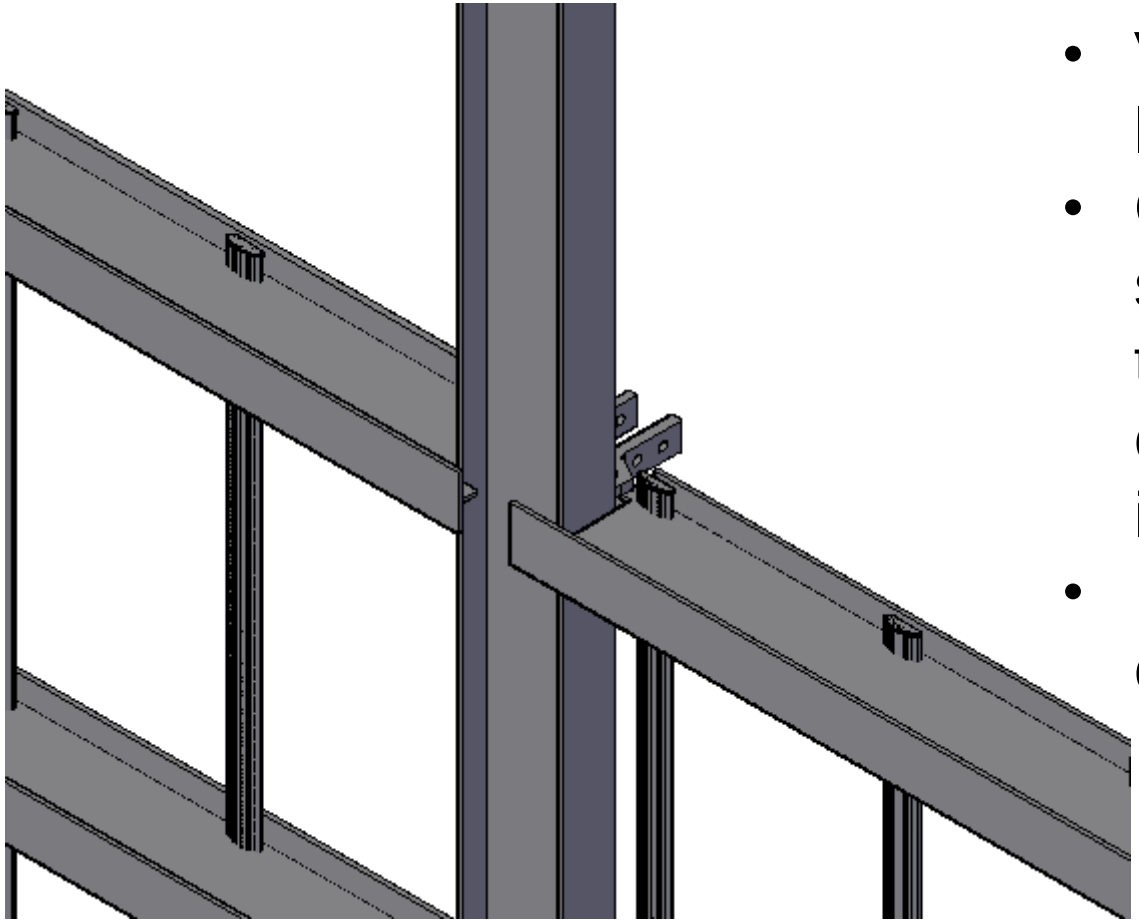


CPA Support Detail



- CPA to beam needs definition.
- Need to finalize plane locations. (parameter drawing is needed.)
- Support to CPA as designed will accommodate differential CTE.
- Two point support may cause tipping in x-z plane.

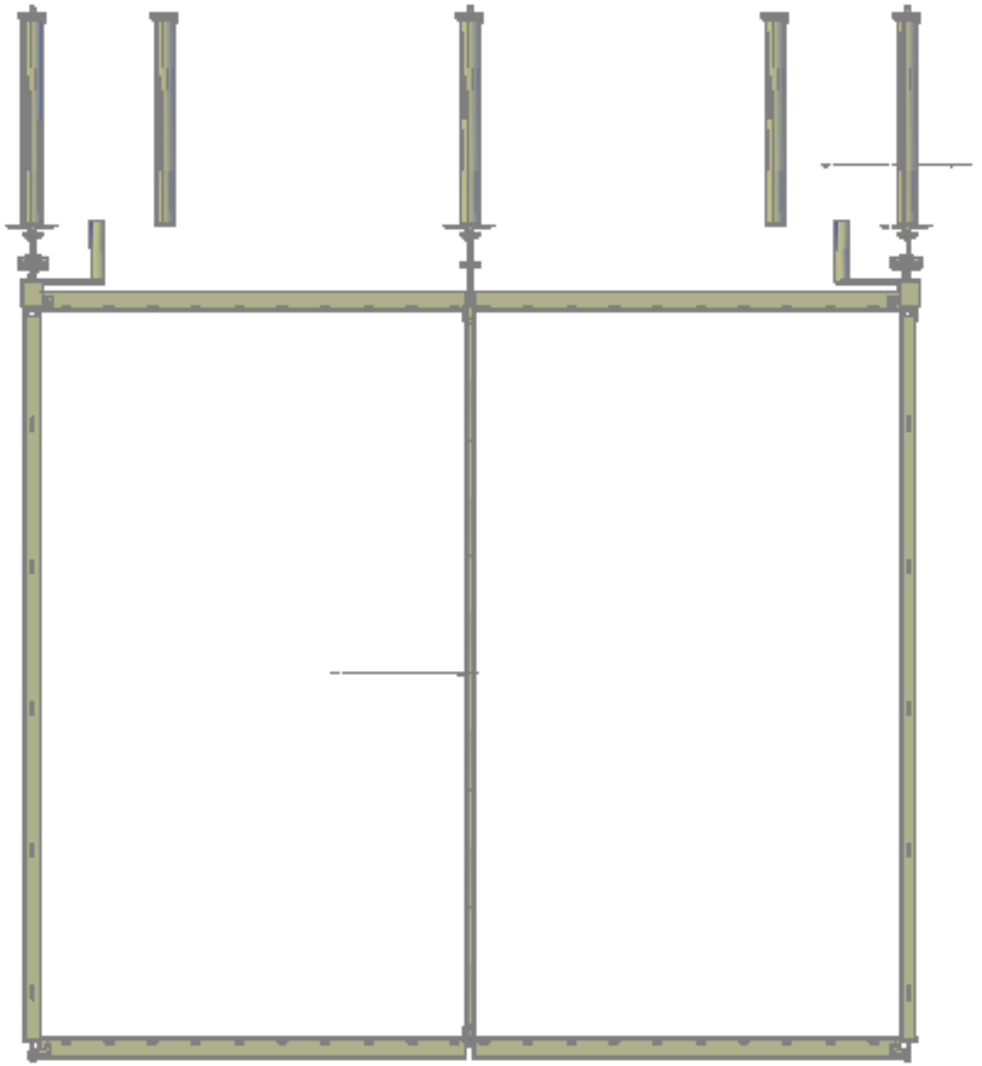
Endwall Support Concept



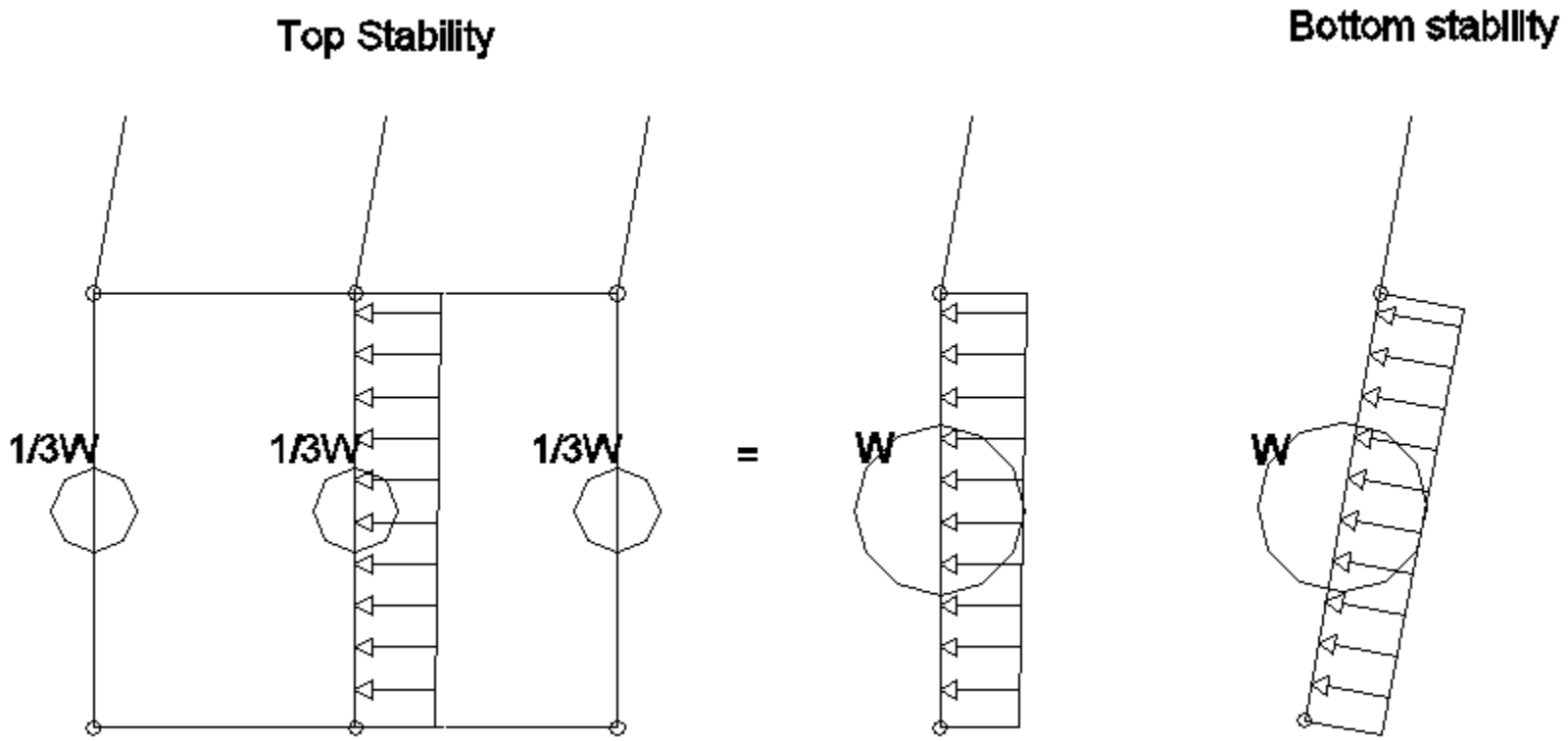
- Vertical beam takes load to rail
- Connection to CPA is slotted and probably travels with wall and is connected to CPA from inside
- FC to beam connection not shown

Some comments on contraction

- APA plane contraction requires 150mm “nozzle” in FD. Maybe larger depending on true position.
- Anticipate CPA to beam differential CTE?
- Start with gap between CPAs?
- FC from slight trapezoid to rectangle?
- Must manage differential CTE of GP to FC.



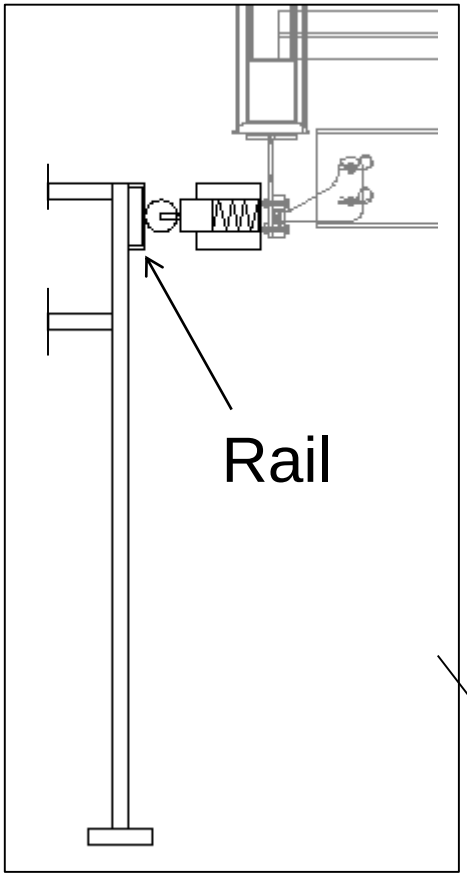
Effect of pressure on position – Equivalent system with all mass at the TPC c.g.. Analysis based on one APA length of TPC

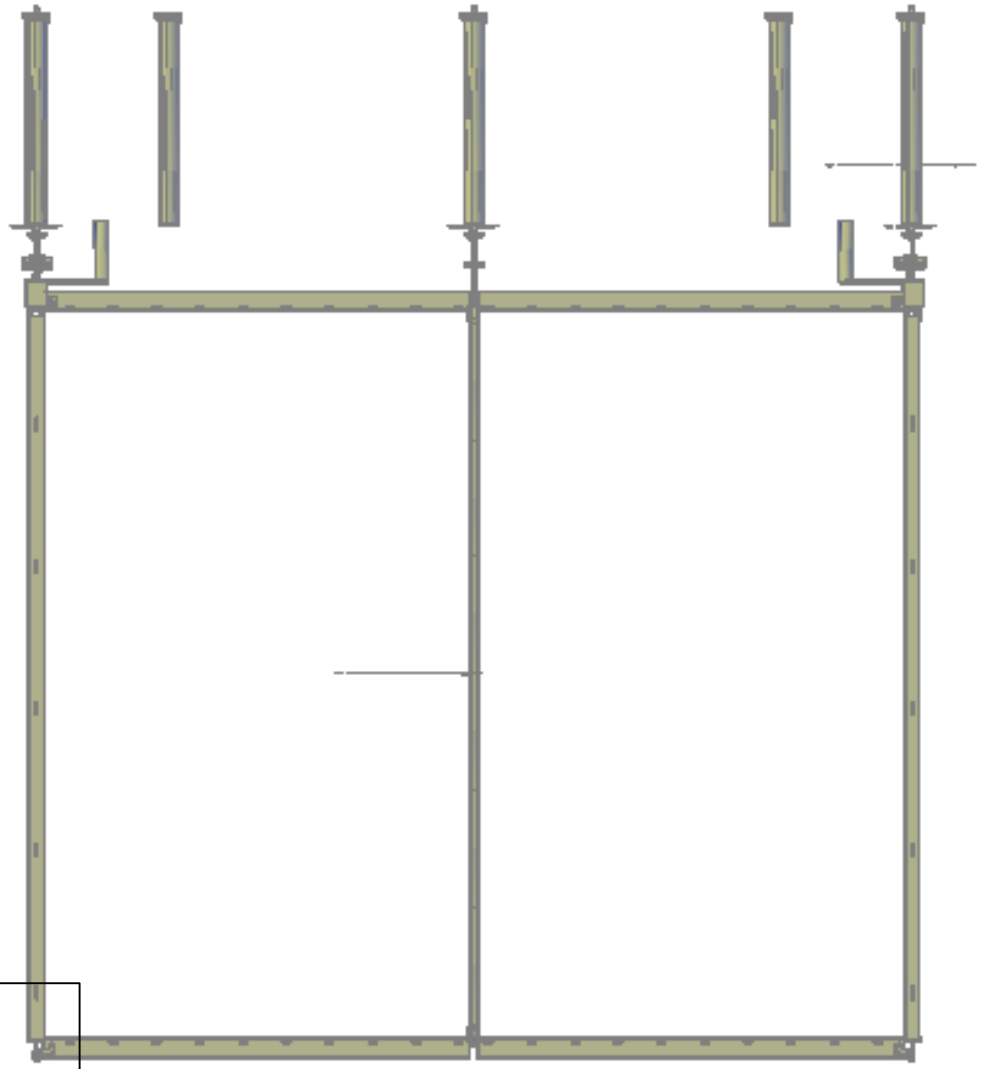


Effect of pressure on position – Equivalent system with all mass at the TPC c.g.. Analysis based on one APA length of TPC. All values are based on 1Pa differential pressure on 1 CPA panel

Top stability protoDUNE 2mm
Bottom stability protoDUNE 8mm
Top stability DUNE 1mm
Bottom stability DUNE 9mm

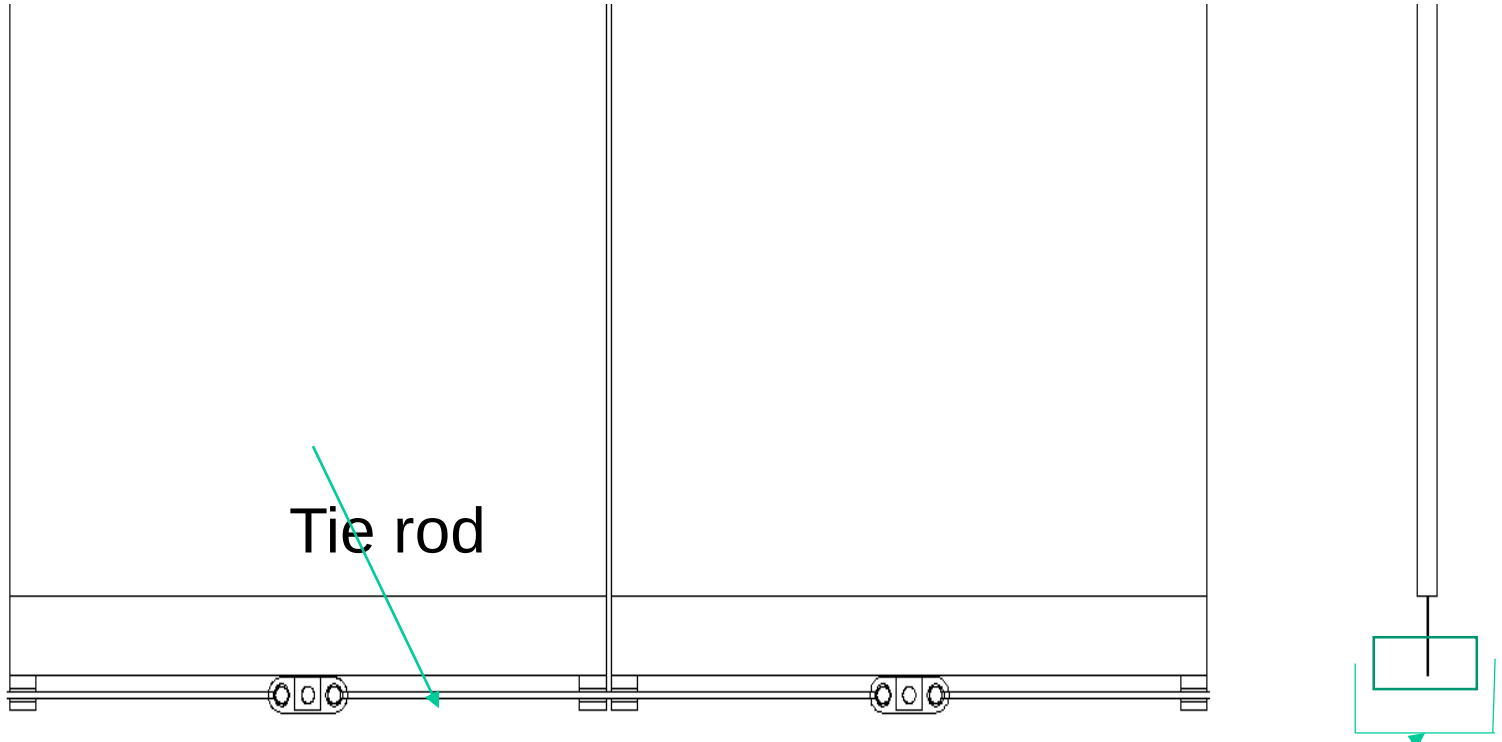
Alternative #1 - springs



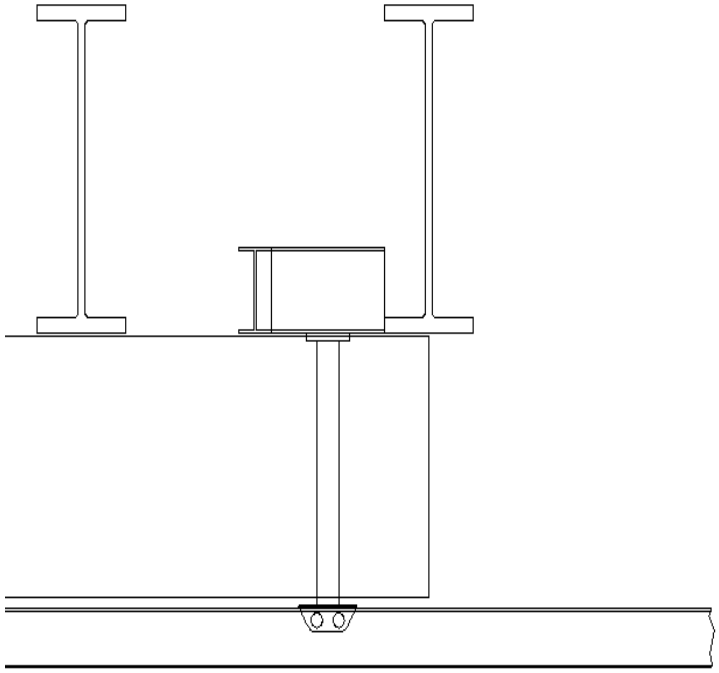


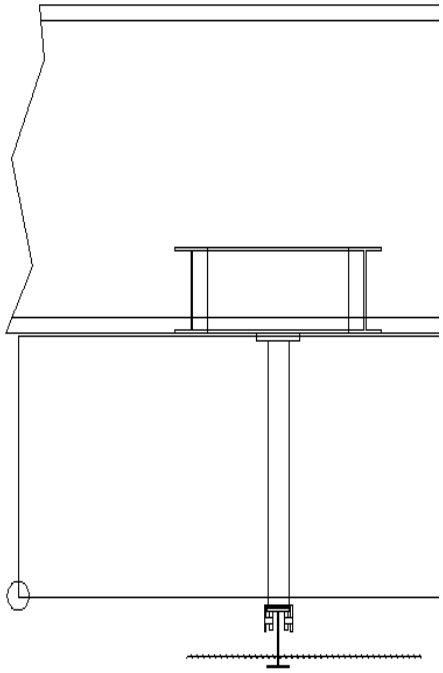
Very conceptual

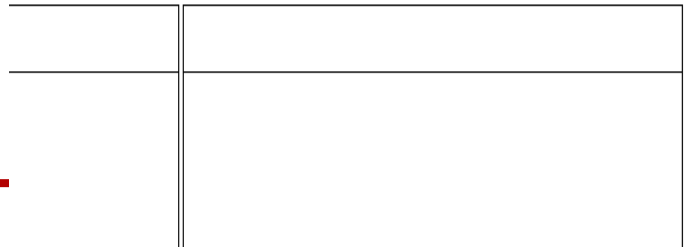
Alternative #2 – Rails?



Alternative 3a and 3b rigid support to center rail







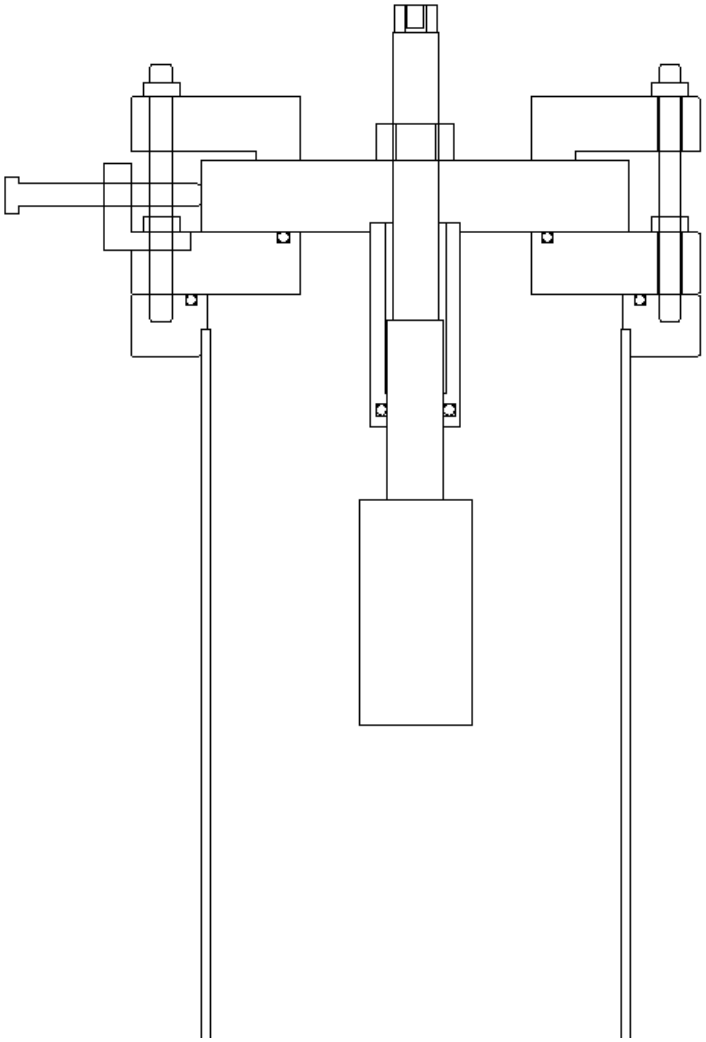
Installation

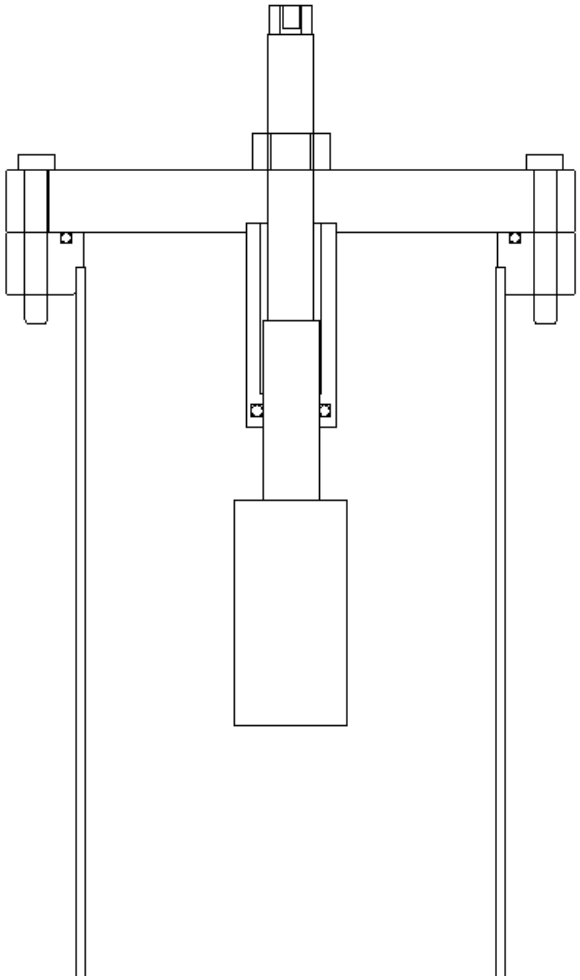
- Compatibility with Installation needs verification
- “Toaster” installation concept has advantages may change things

Questions

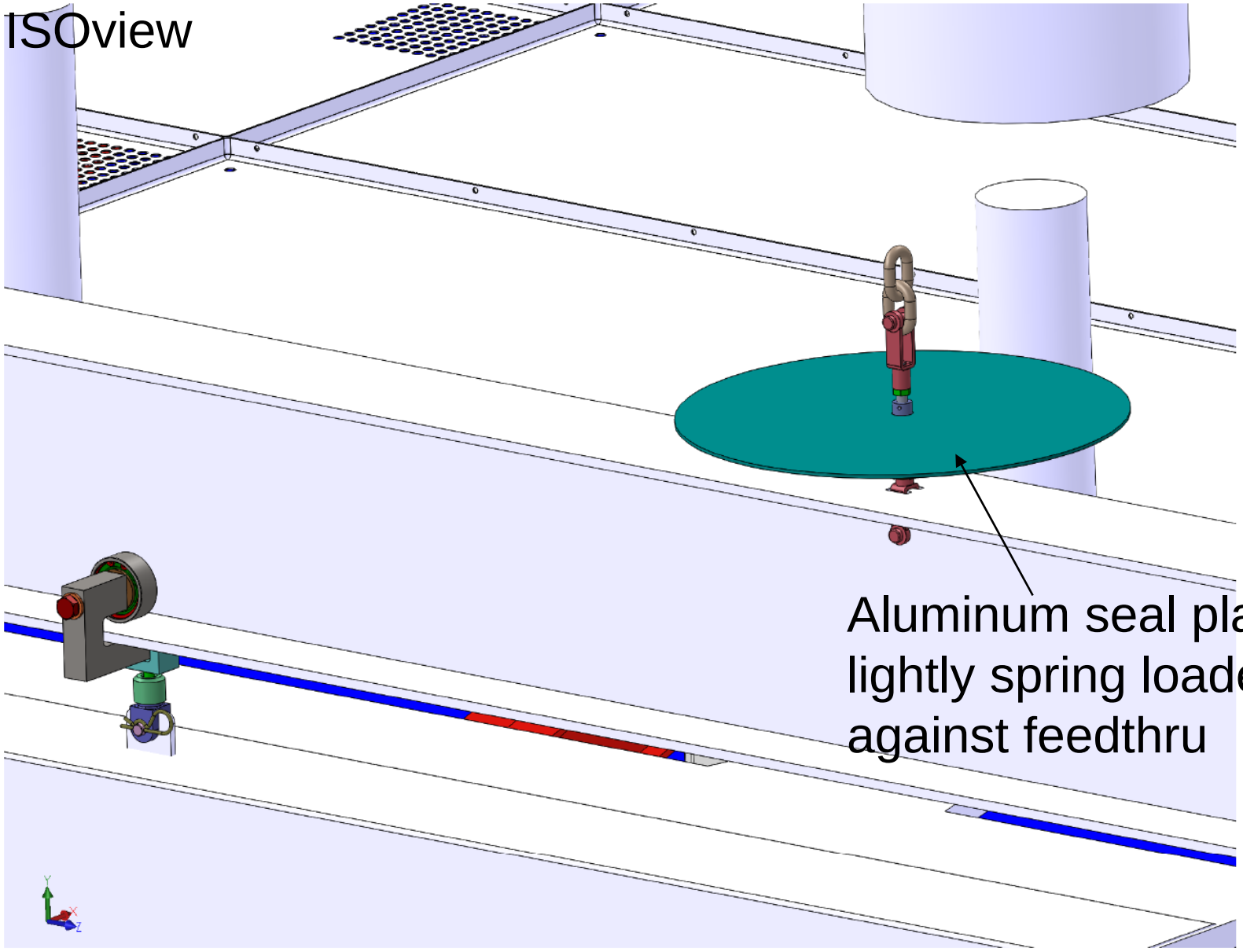
- What are practical positional tolerances for support feedthrough locations?
- Are there any issues with the beam pipe (or HV) if we shrink towards the center?
- Where are cryo pipes? How to support? Will they be vibrating?
- Corrugation pitch vs Roof belt pitch?
- Max cool down rate to design for?
- Max temperature gradient?
- Roof deflection for protoDUNE?
- Ullage temperature?
- Fabrication locational tolerance for feed-thrus?

Back up slides

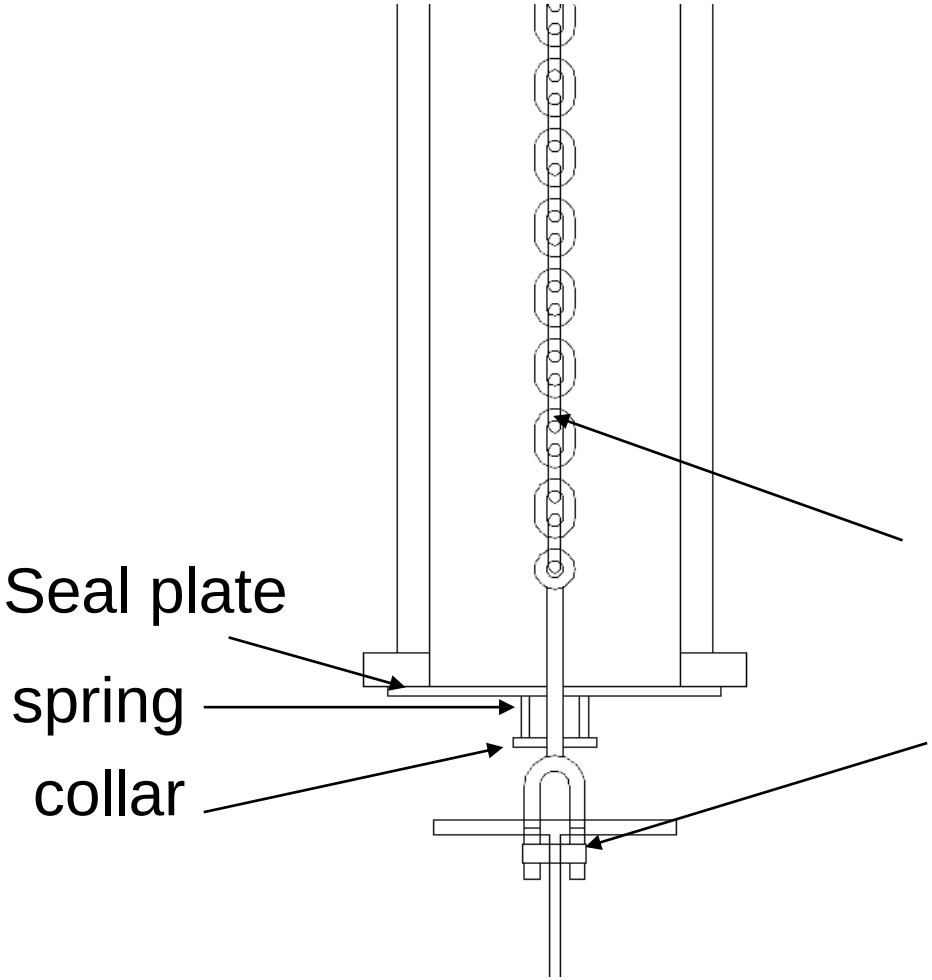




APA Rail mounting ISOview



Rail mounting

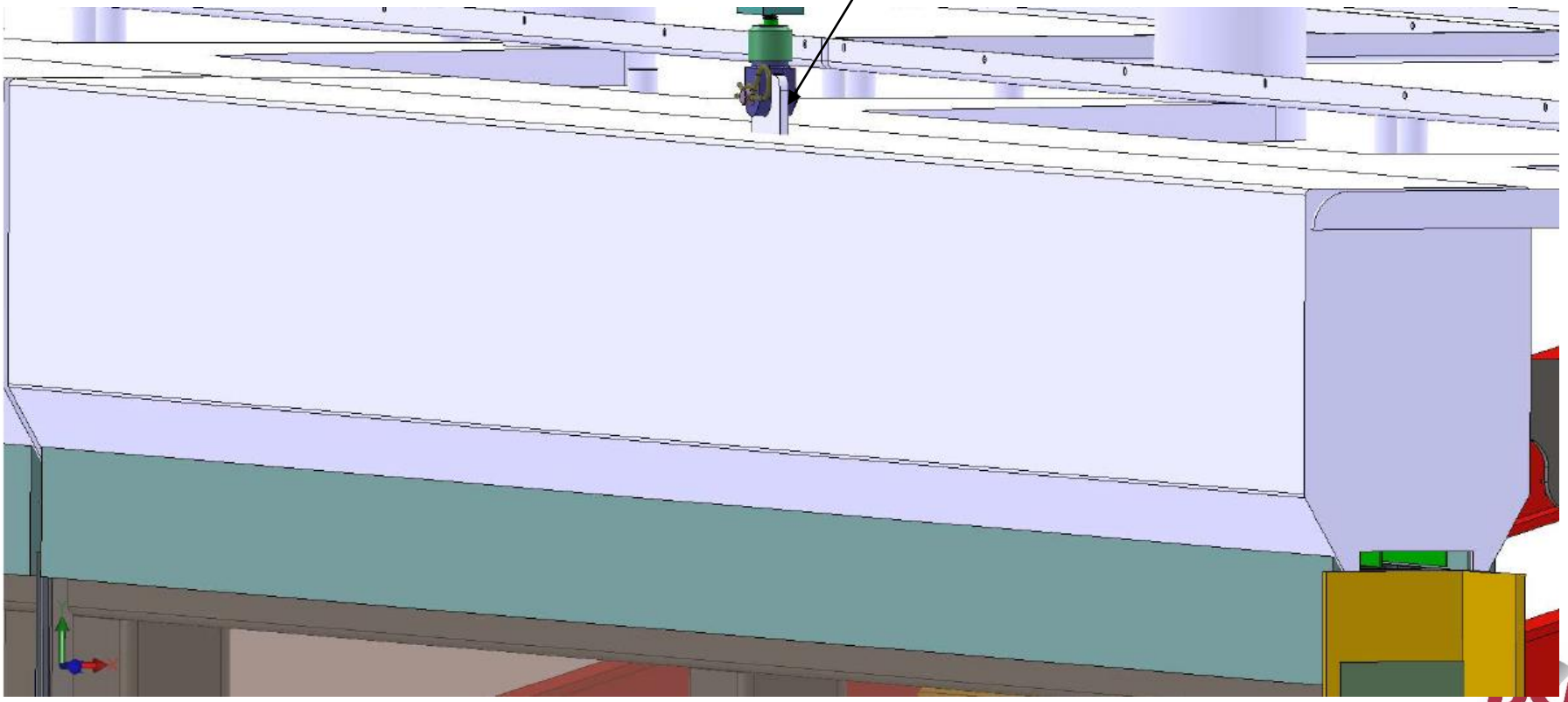


Chain for connection to adjustable mount point above roof.

Yoke and clevis connection through slots in beam flange

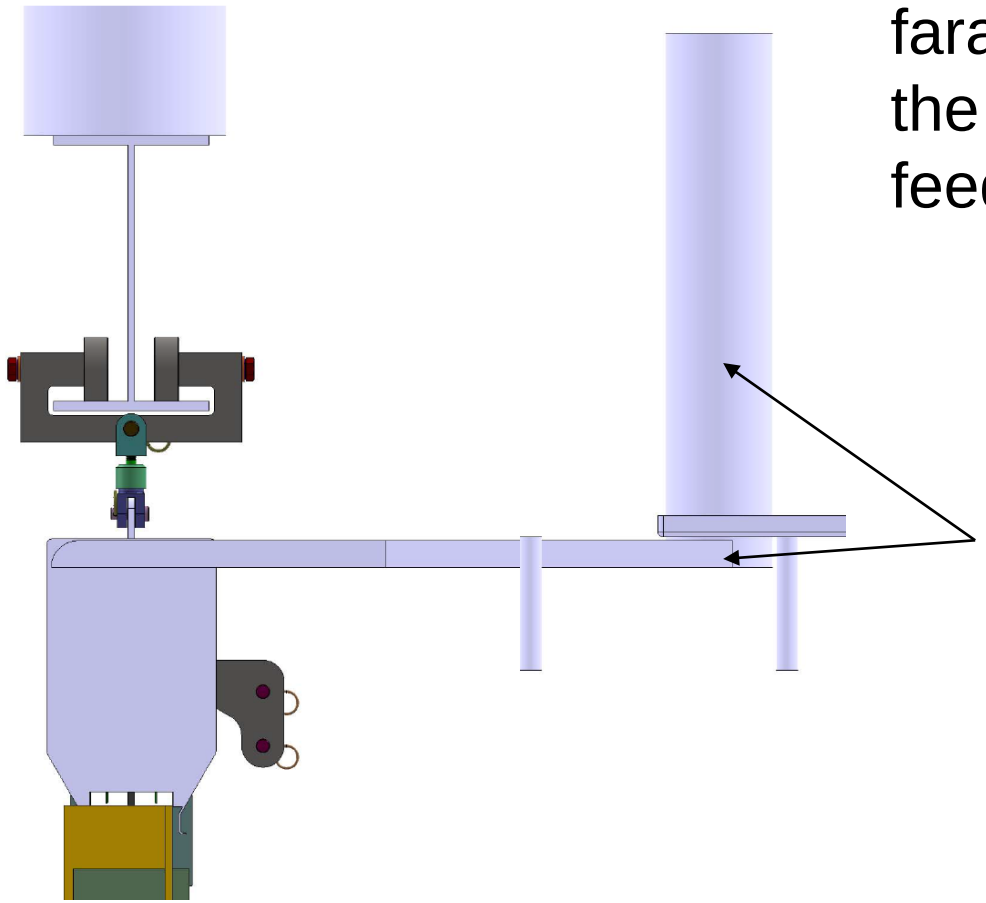
Fin dimensions

Tab to be added to e-plate



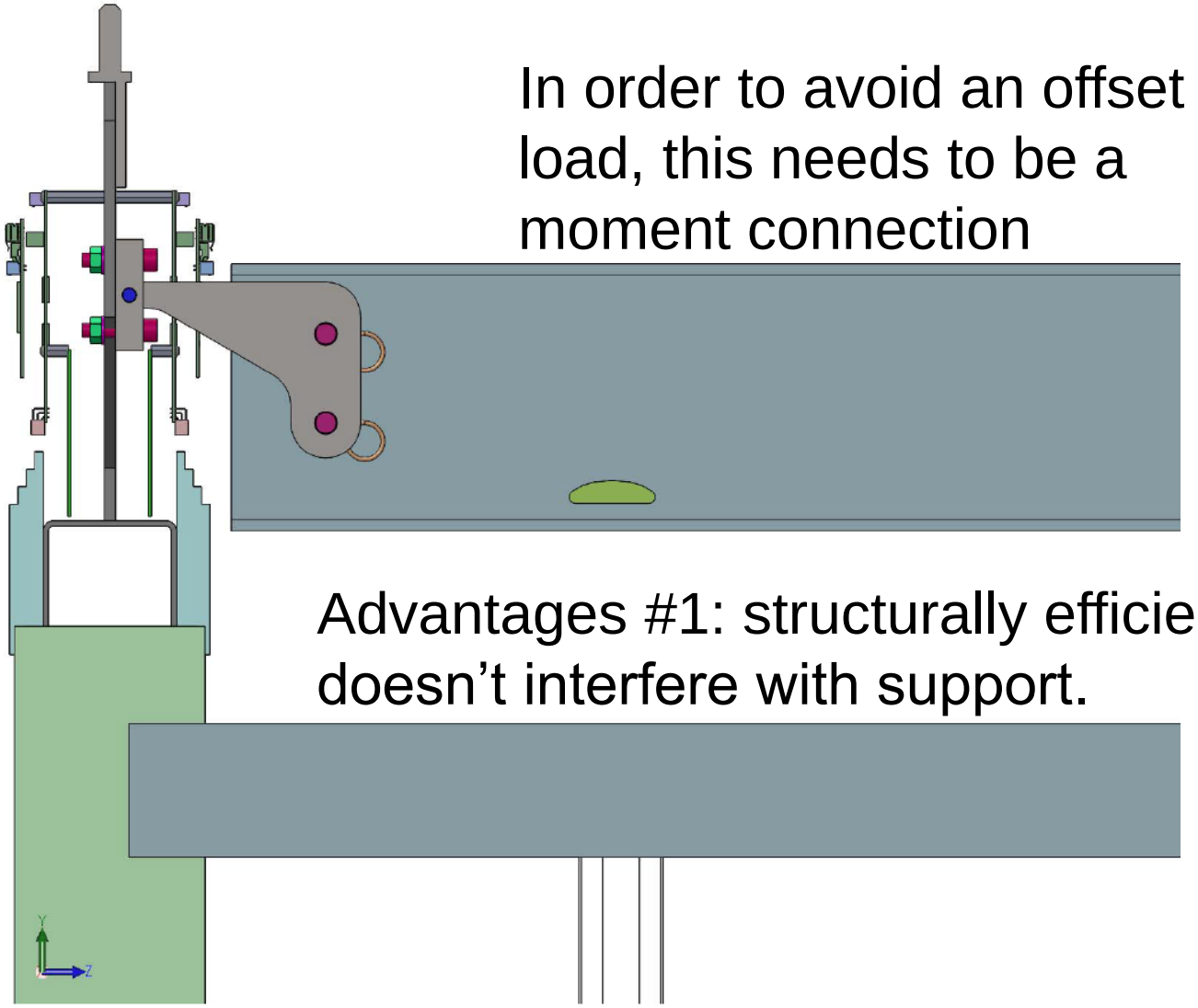
Cable Routing

Cable route over top of e-plate and out the front of the faraday cage to the cable feedthrough.



Cable envelope (need to adjust to miss GP).

APA to FC interface

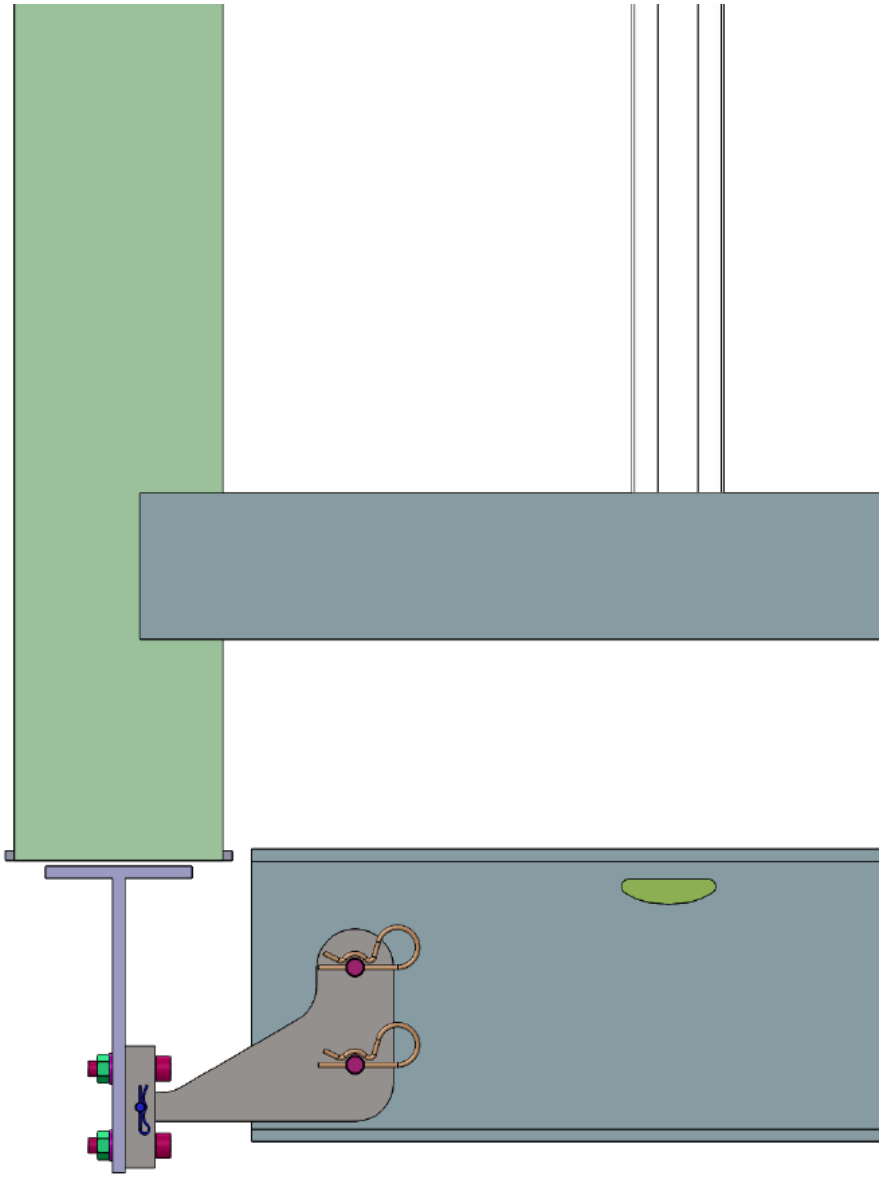


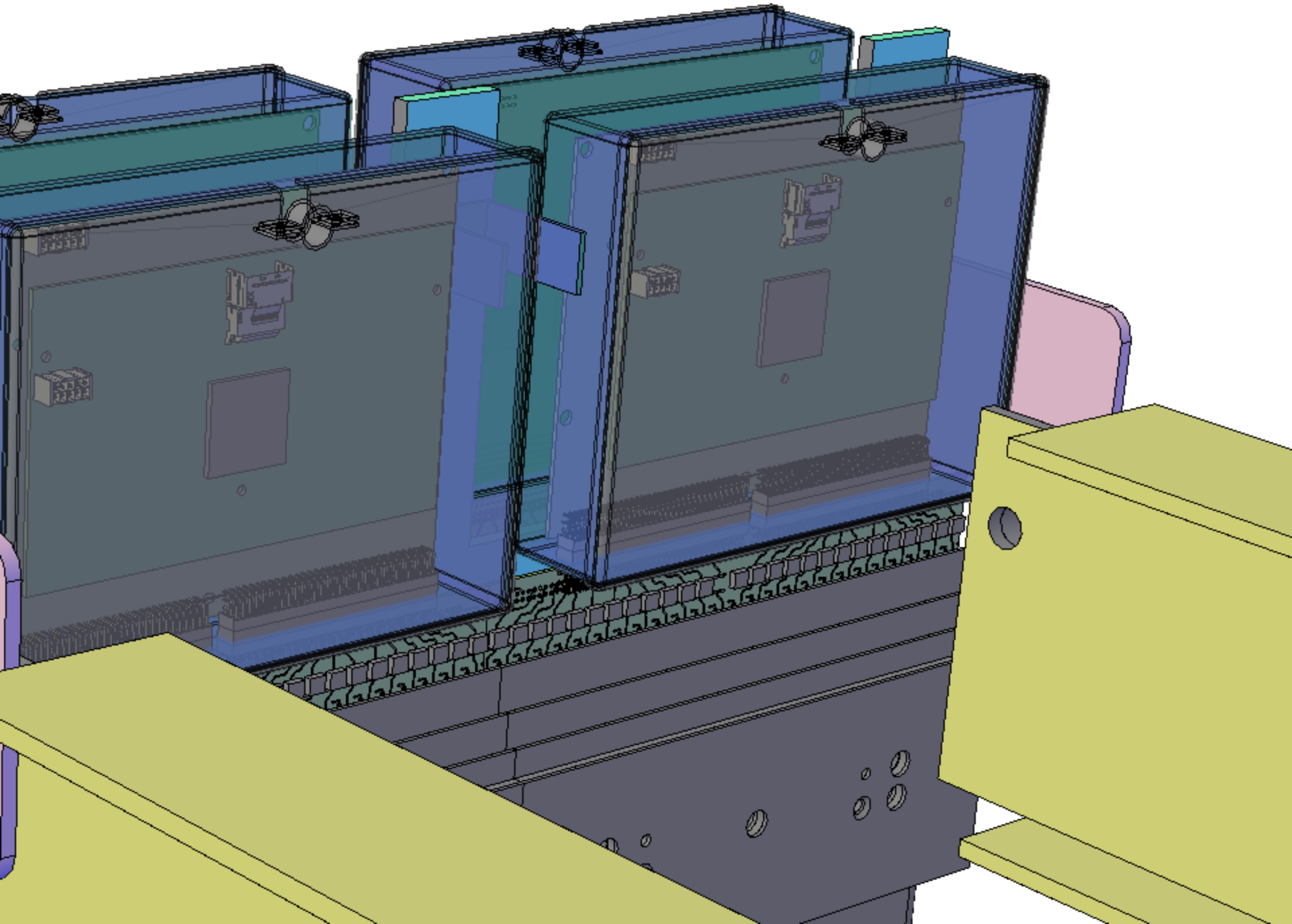
In order to avoid an offset load, this needs to be a moment connection

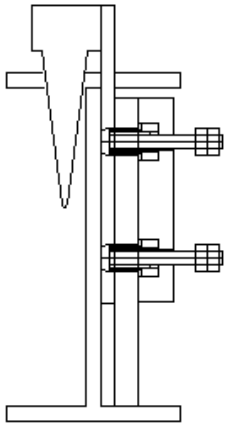
Advantages #1: structurally efficient, doesn't interfere with support.

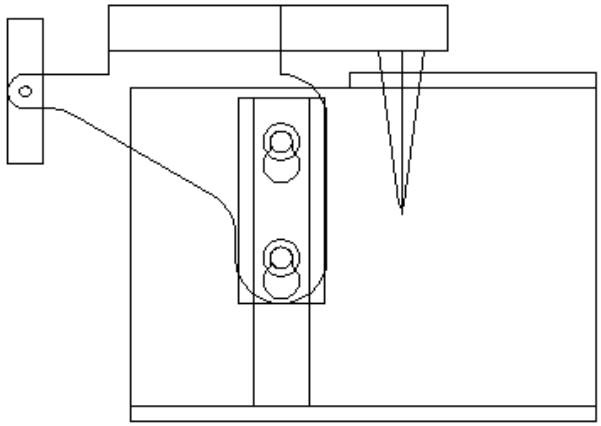
End view of bottom connection

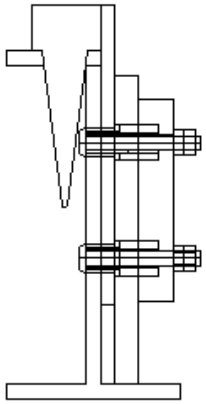
Tee profile mounted to bottom of APA using spacers and frame rivnuts

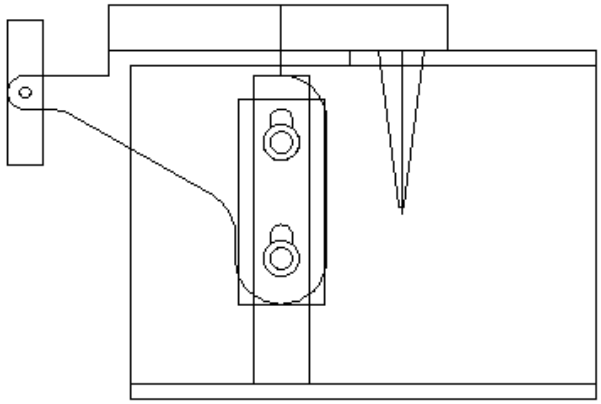




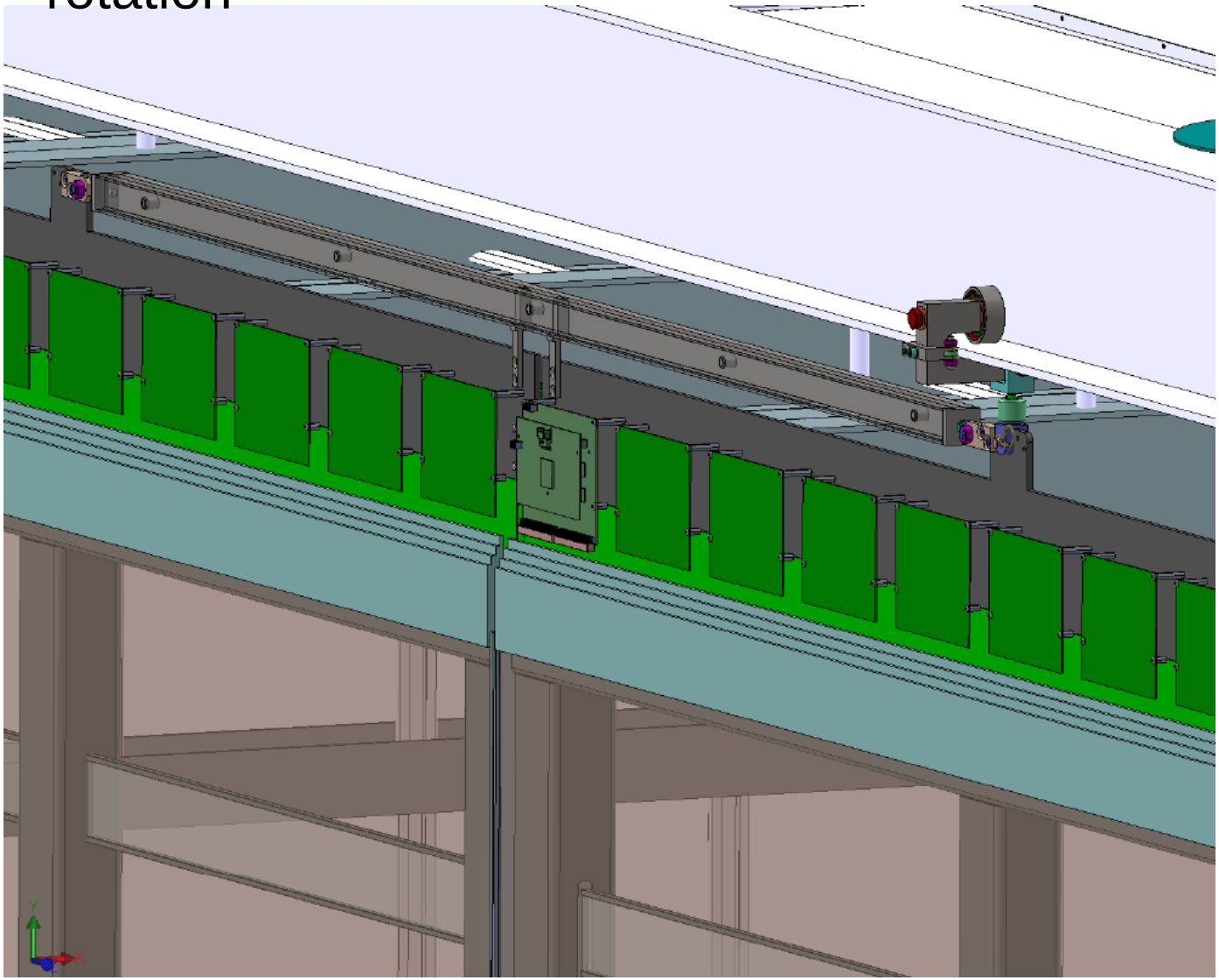




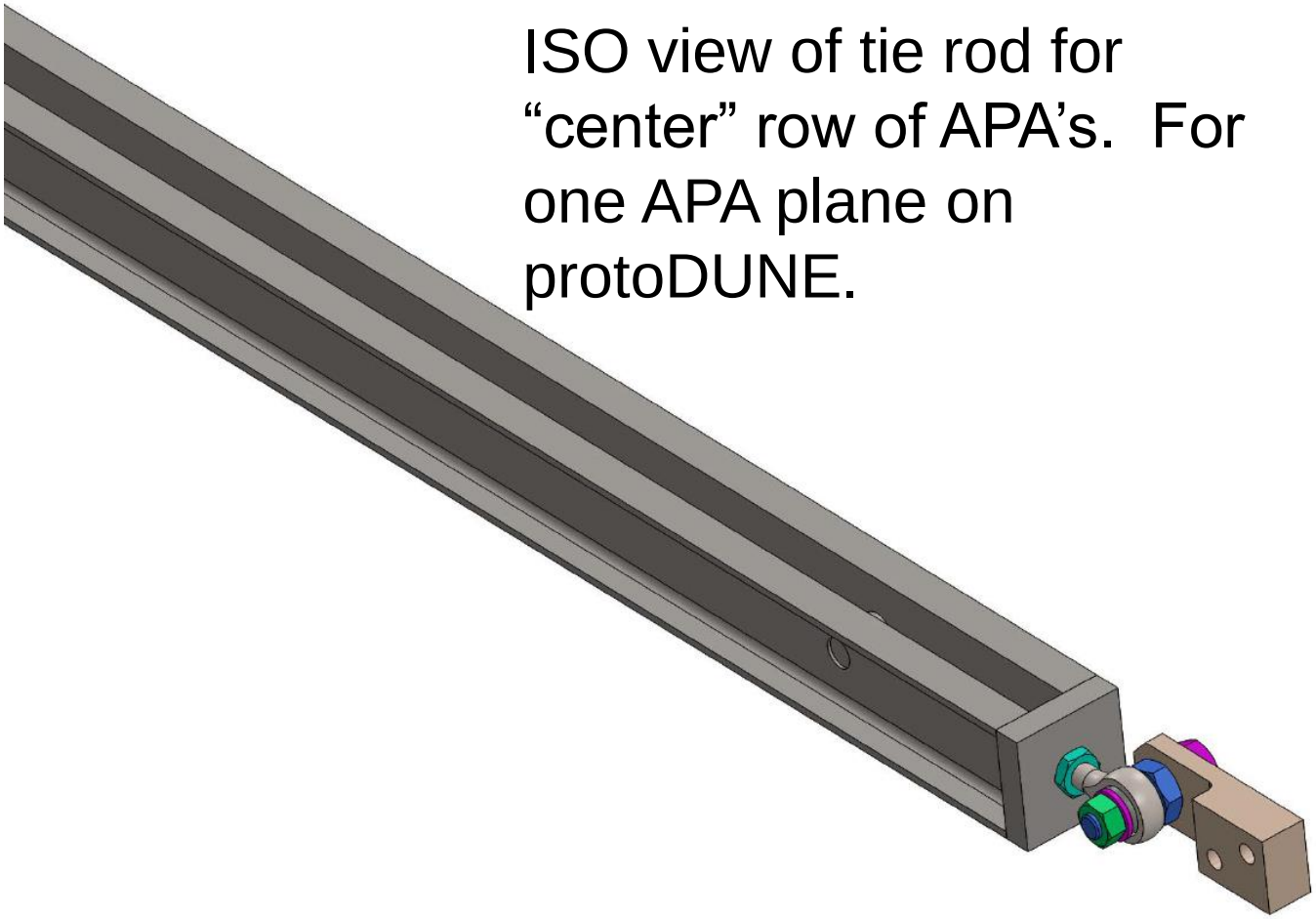


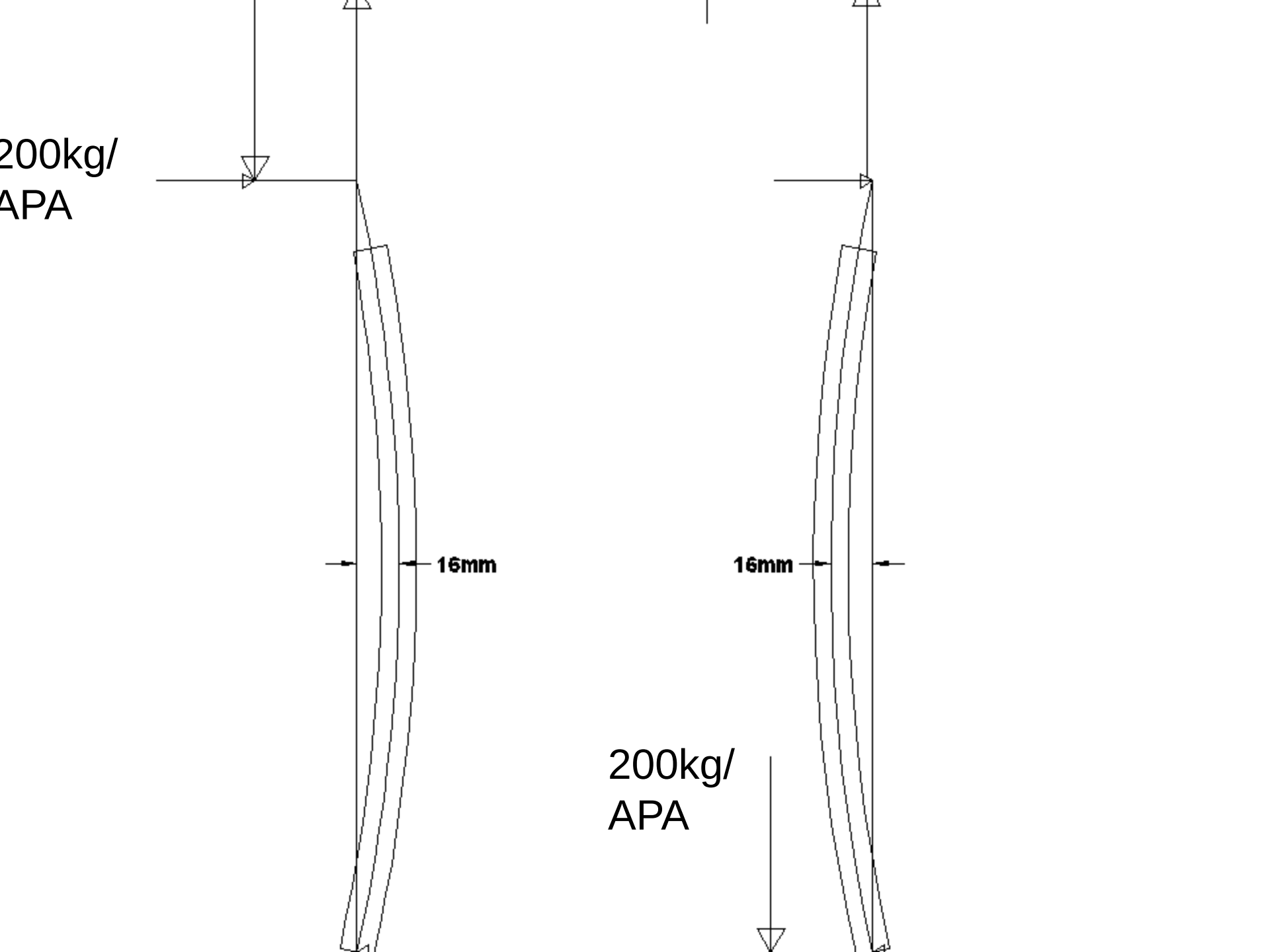


Tie rod between APA's to keep spacing and prevent rotation



ISO view of tie rod for “center” row of APA’s. For one APA plane on protoDUNE.




200kg/
APA
16mm
16mm
200kg/
APA

CTE info

- 304 SS 2.8mm/m
- G-10 warp = 2.1mm/m
- Fiberglass axial = 1.65mm/m