

SUPPORTS FOR INJECTOR FEED CAP AND END CAP



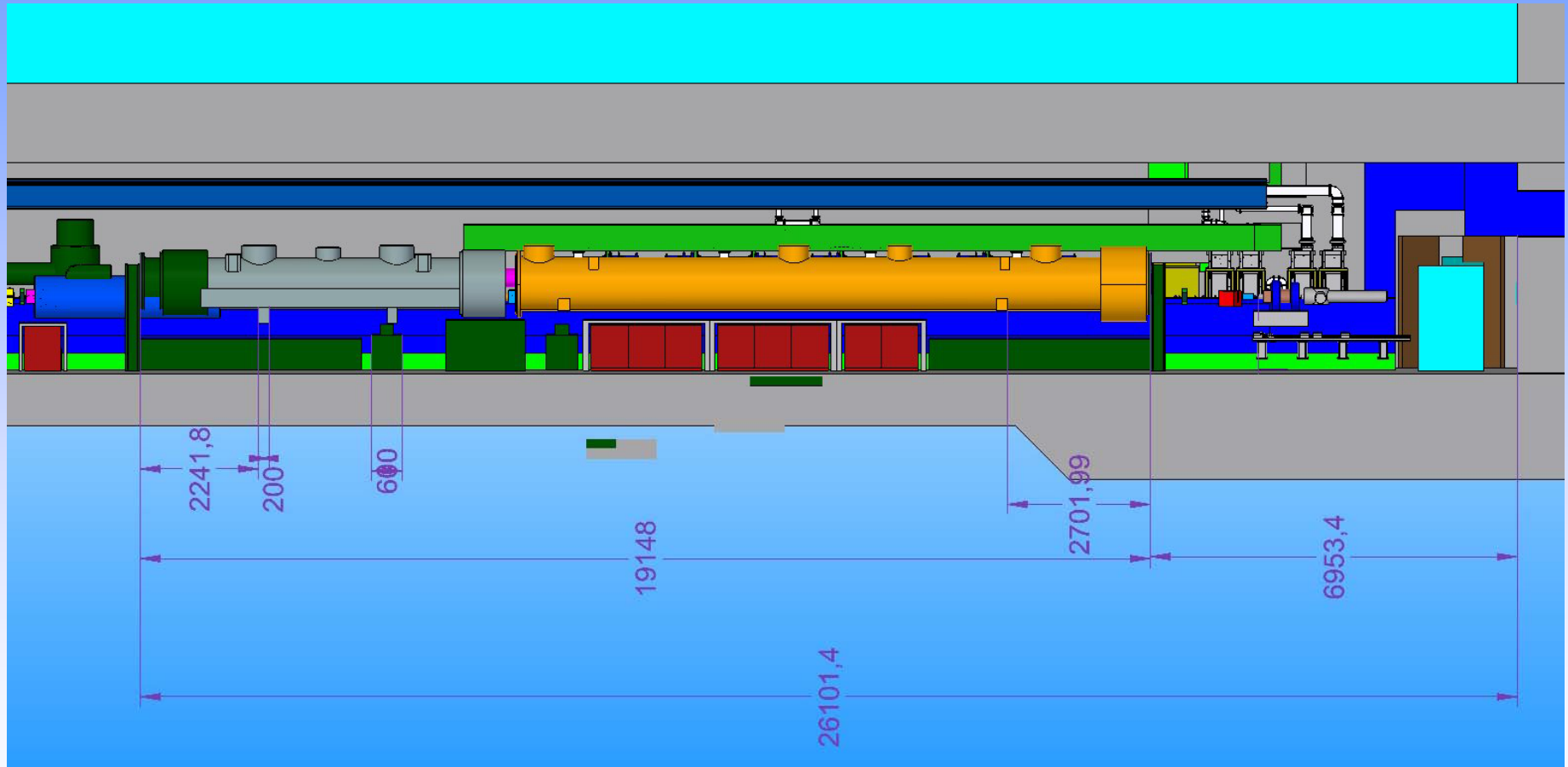
**The Budker Institute
of Nuclear Physics**
Novosibirsk, RUSSIA

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12.04.2012

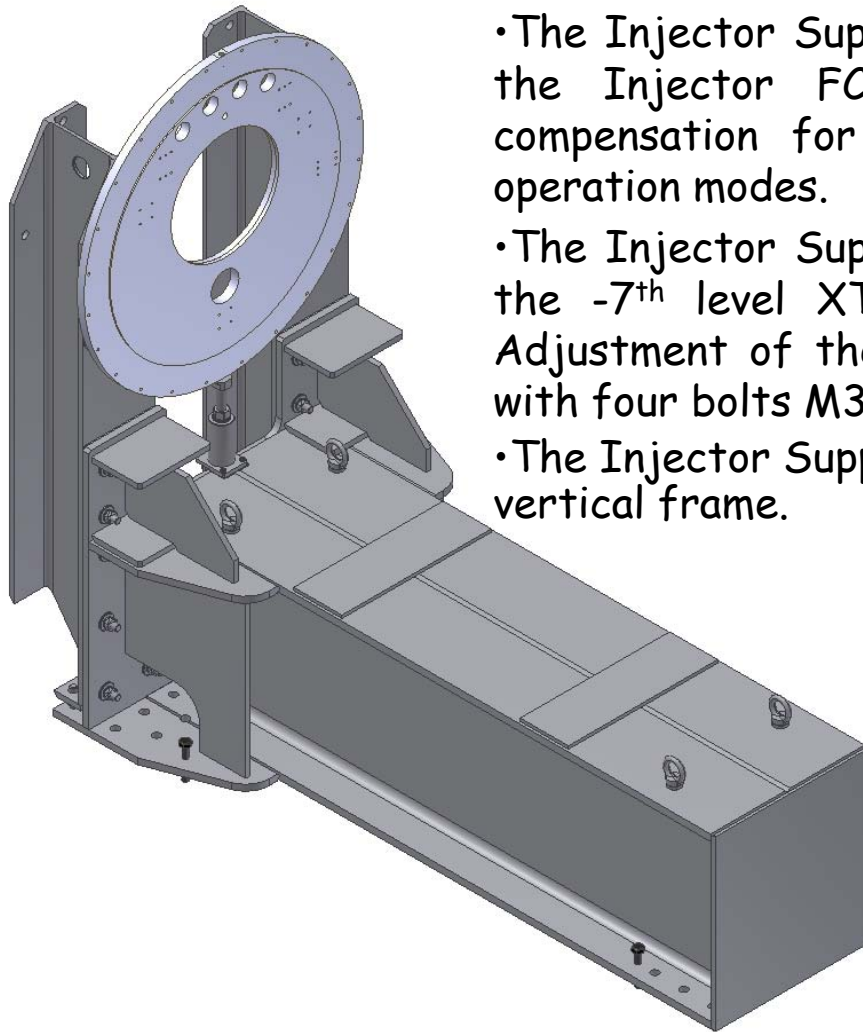
Mr. Konstantinov designed the mobile and fixed supports for XATB



Layout equipment in Injector complex of the XTIN building



3D model of support for injector feed cap and end cap



- The Injector Support is designed for placing and fixing the Injector FC/EC. The Support design provides compensation for all the forces occurred in various operation modes.
- The Injector Support is fixed to the concrete floor of the -7th level XTIN hall with 16 anchor bolts M24. Adjustment of the Fixed Support in height is achieved with four bolts M30.
- The Injector Support consists from base and two vertical frame.

Technical data

Weight - 2.16t

Dimensions:

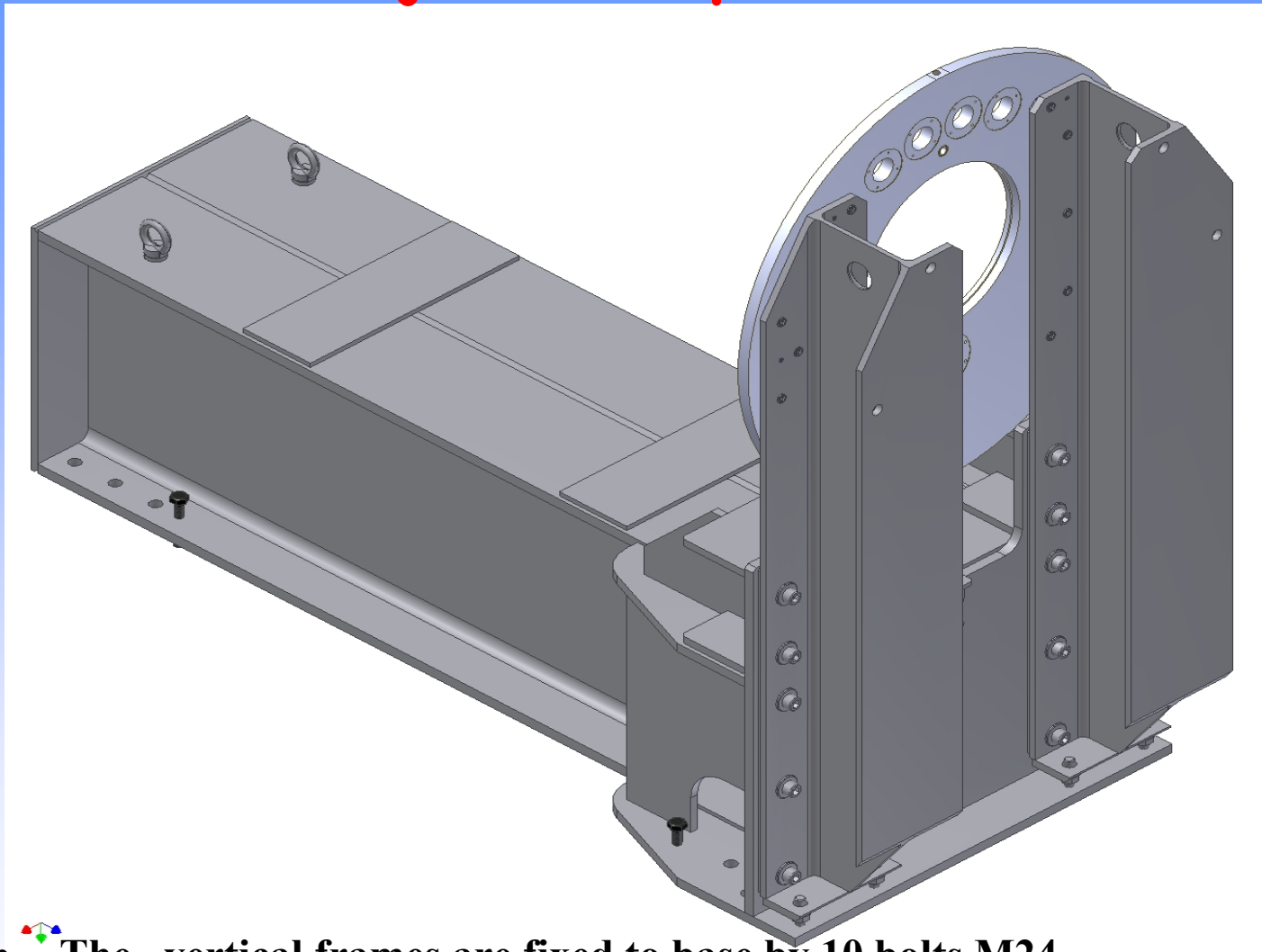
Length - 2200mm

Height - 2035mm

Width - 1120mm

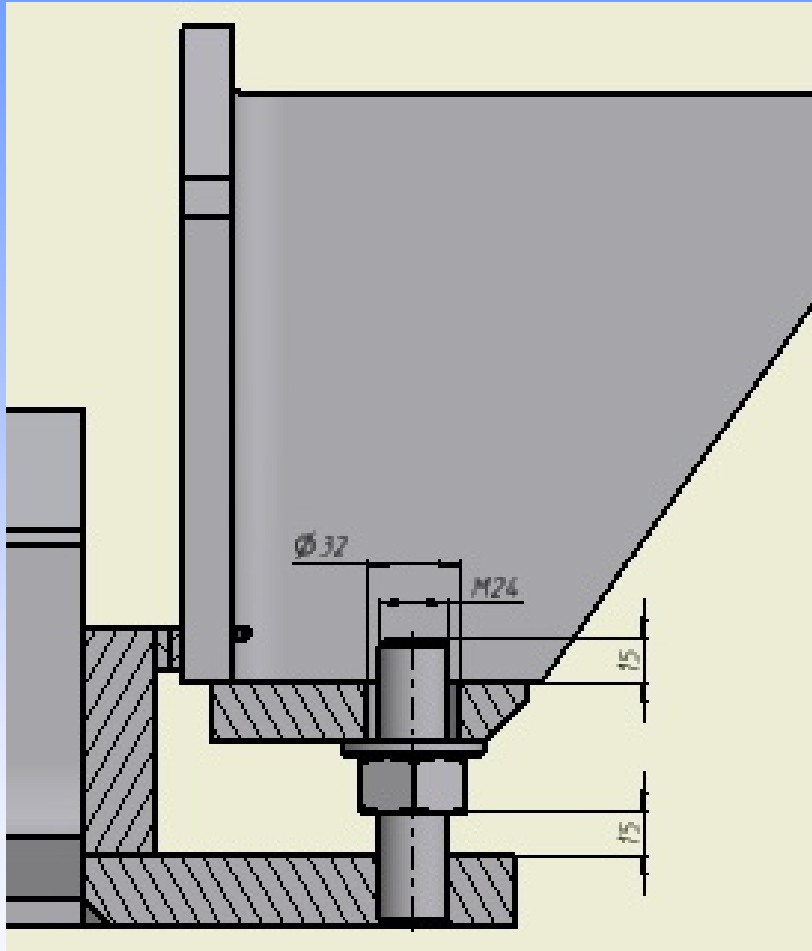


Adjustment possibilities



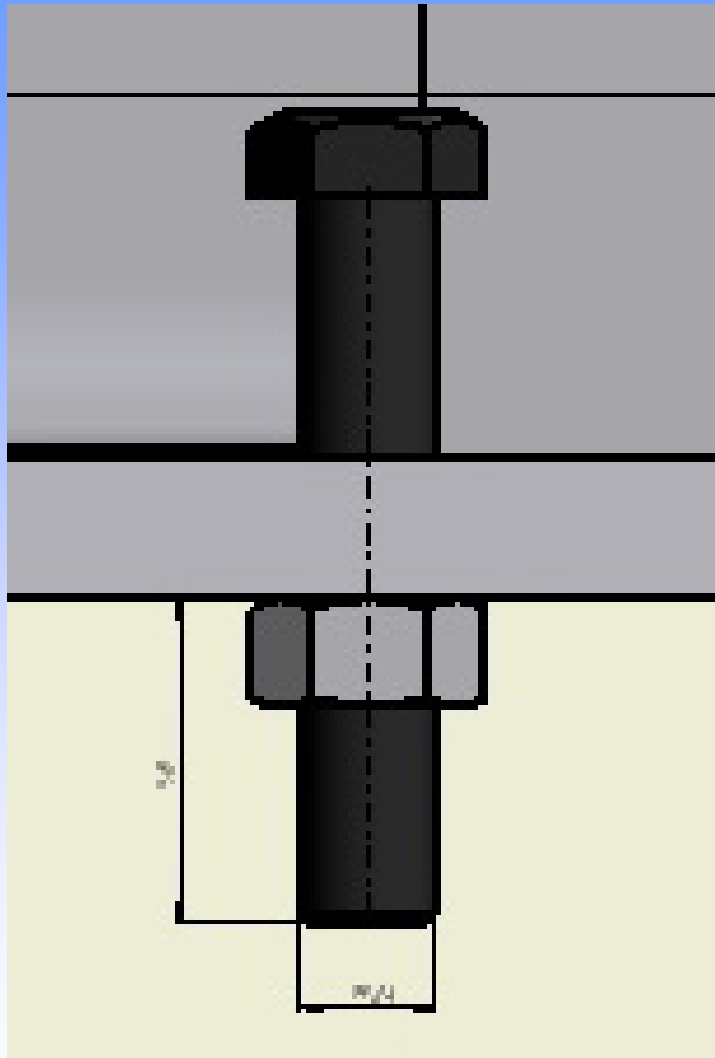
- The vertical frames are fixed to base by 10 bolts M24.
- Injector End Cap / Feed Cap - $\pm 8\text{mm}$ both in vertical and in transversal directions





- The vertical frame is based on the base's foot by two stud bolts M24x120mm.
- The stud bolts provide an additional adjustment for vertical and angle position of the each frame.

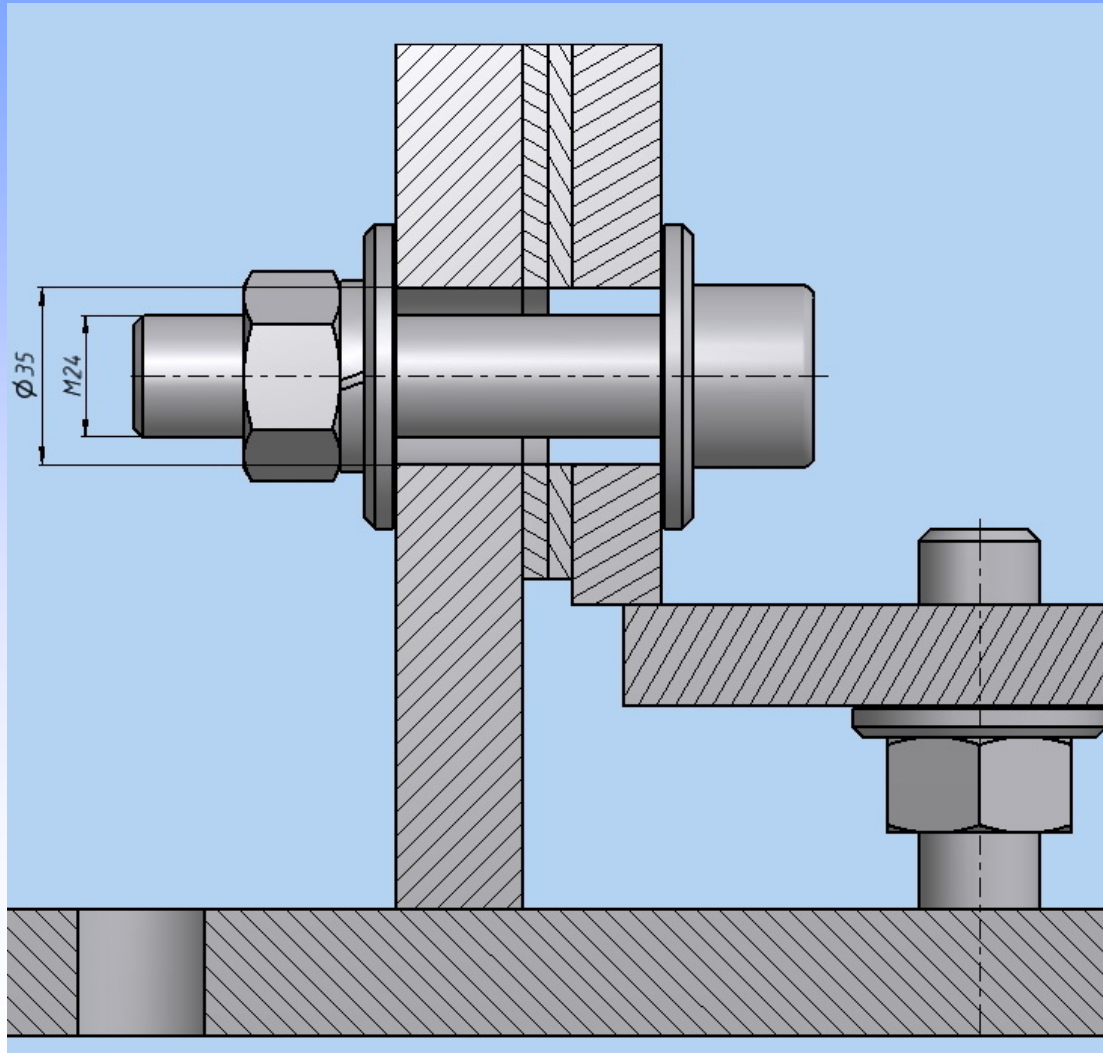




- The Injector support is based on floor by four bolts M24x140mm.
- The nominal gap between support and floor is 48 mm.

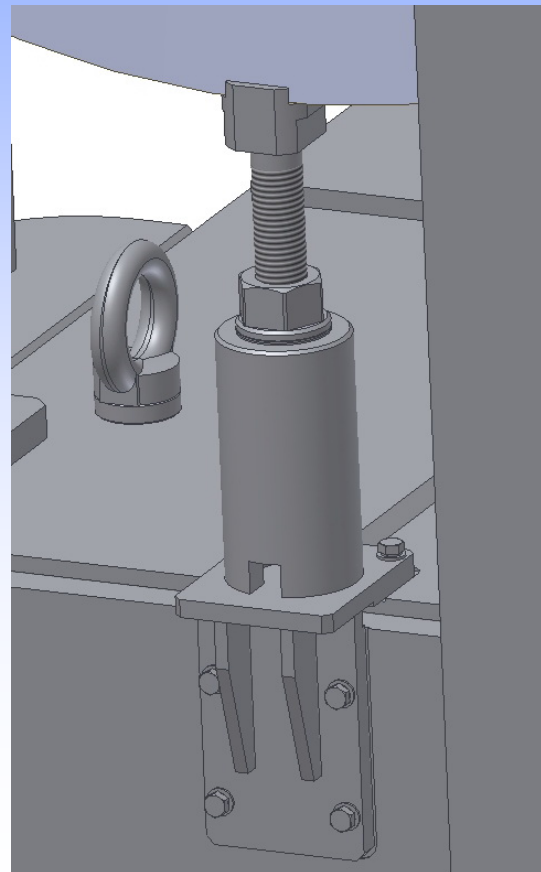
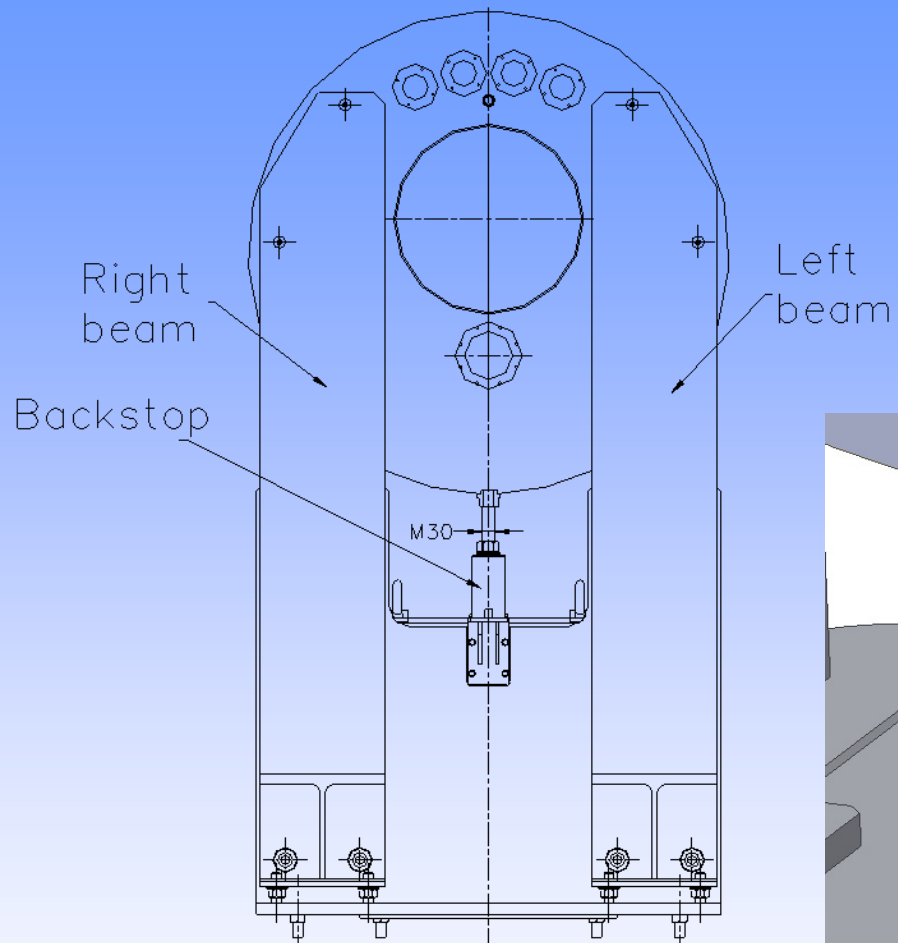


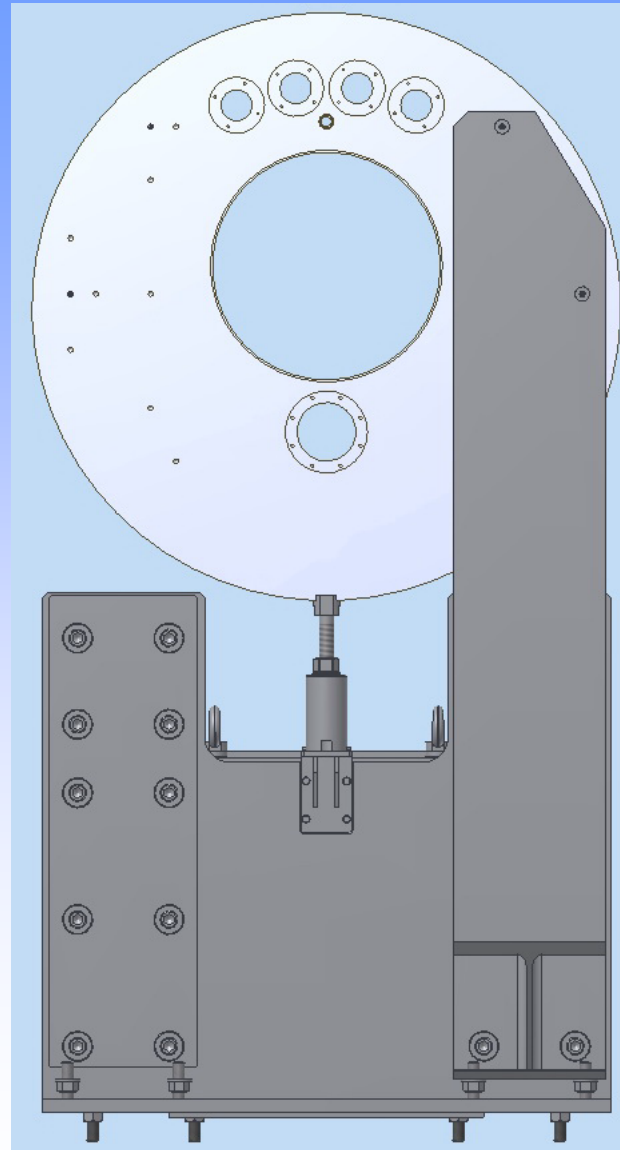
- The adjustment of the vertical frames provides by a holes $\varnothing 35\text{mm}$.



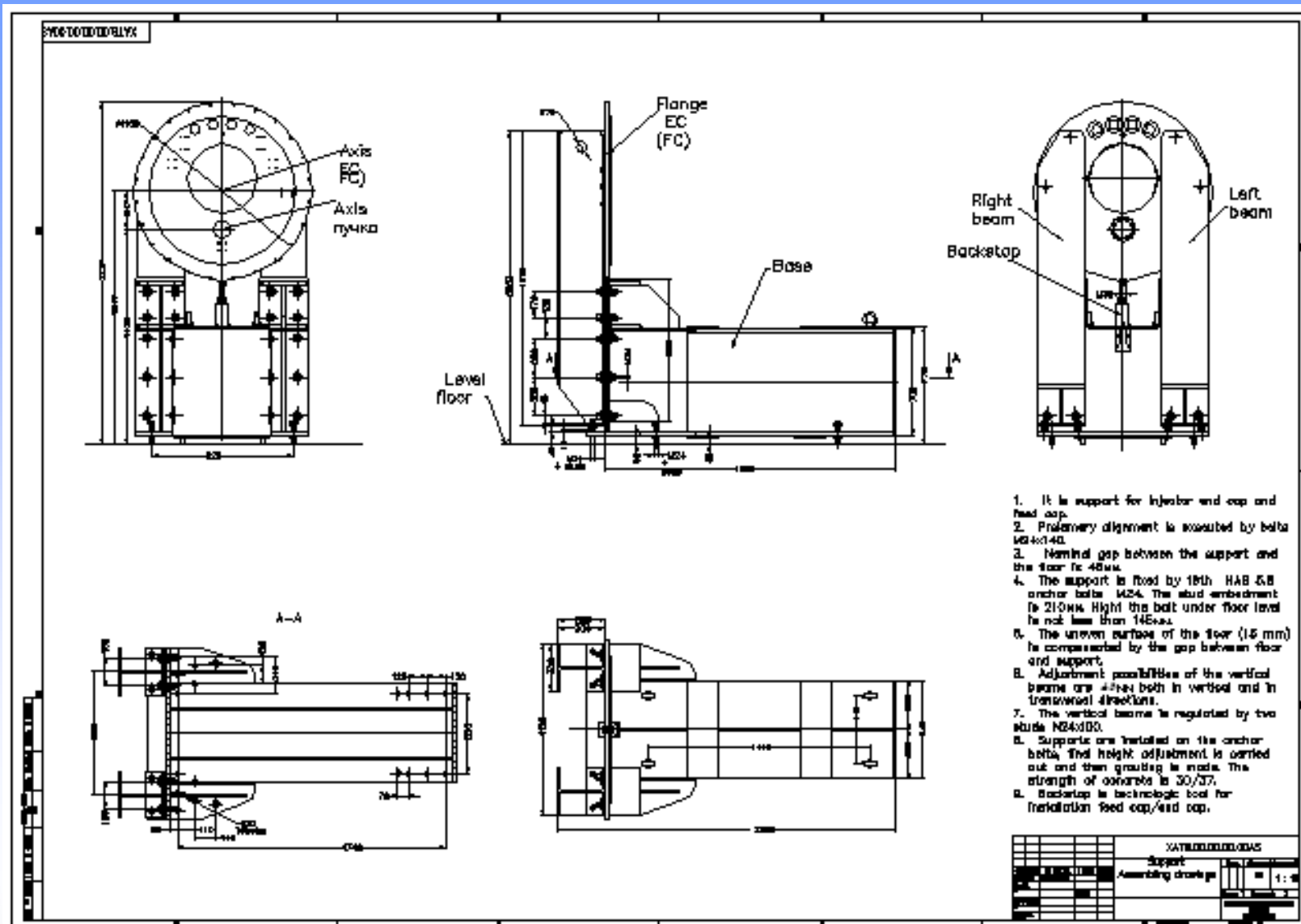
- The Backstop provides an additional support of the Feed Cap flange during alignment of equipment and assembling works.

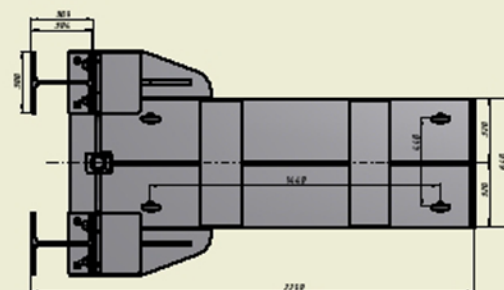
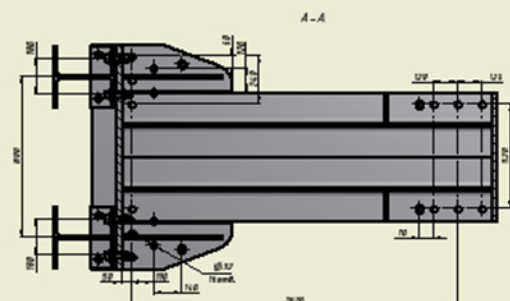
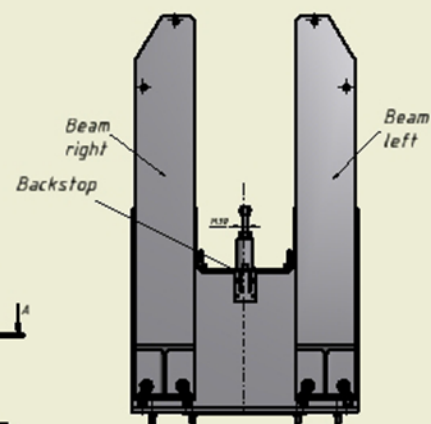
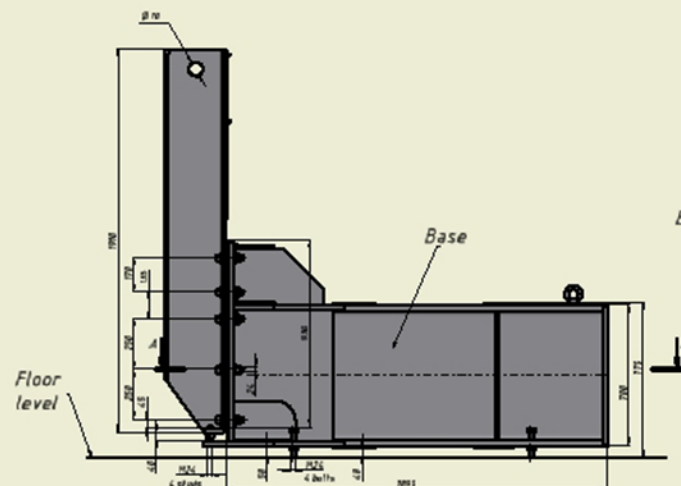
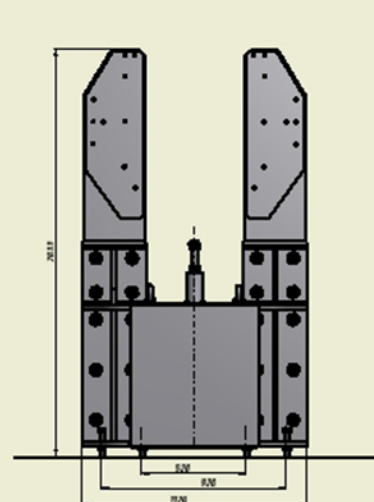
- The thread diameter of the backstop is M30.





Support drawing

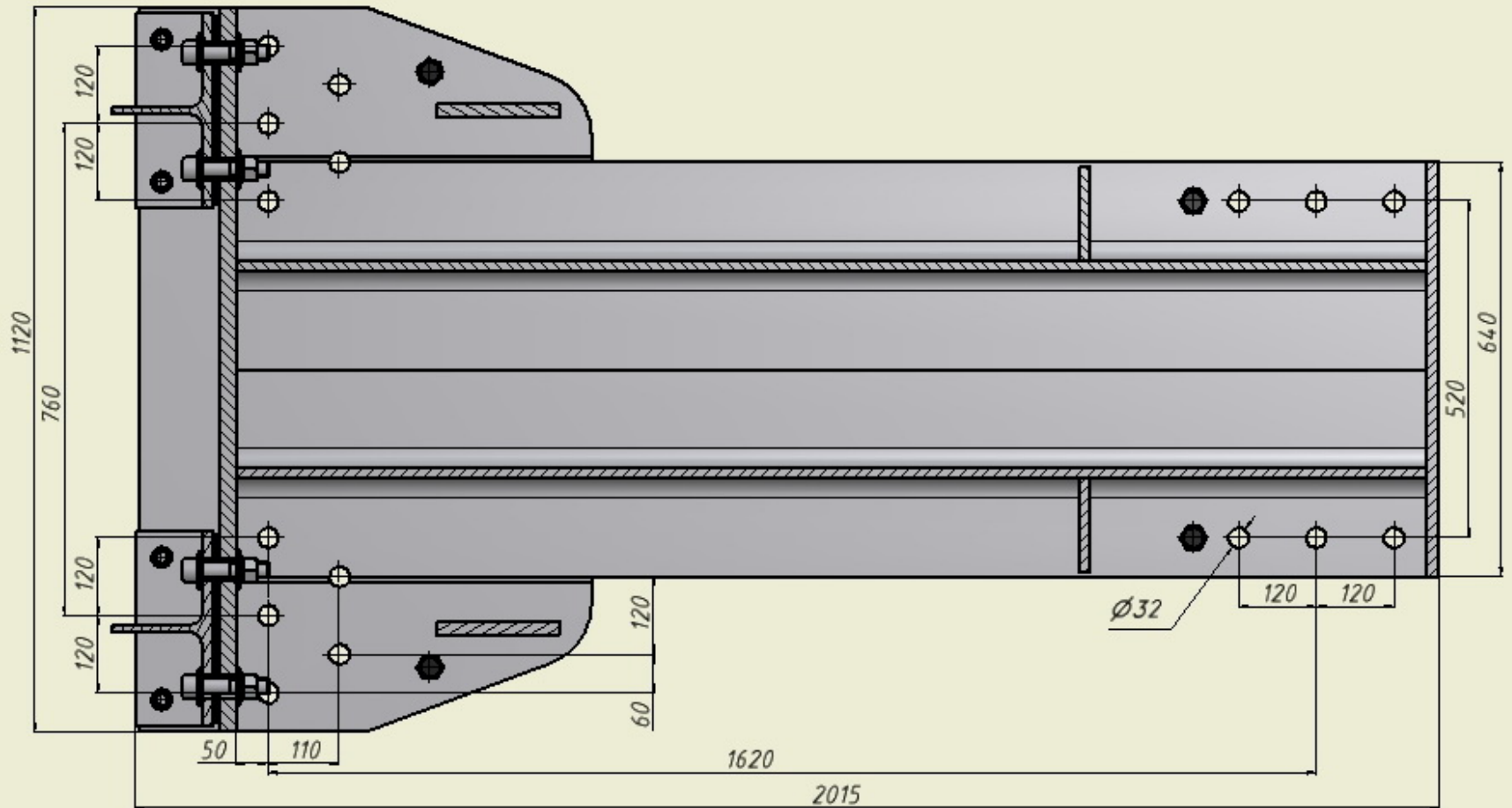




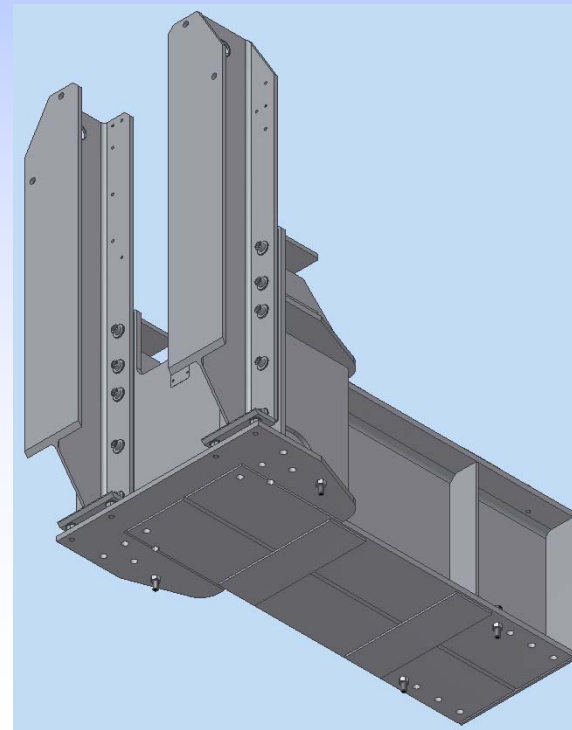
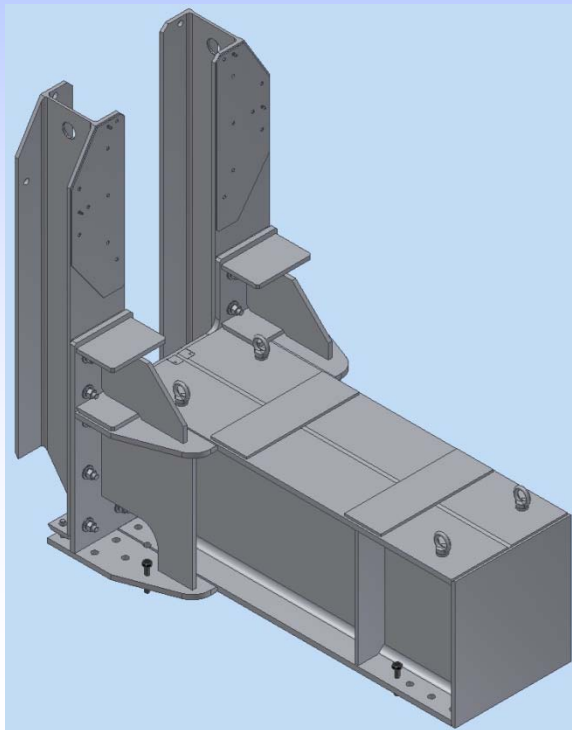
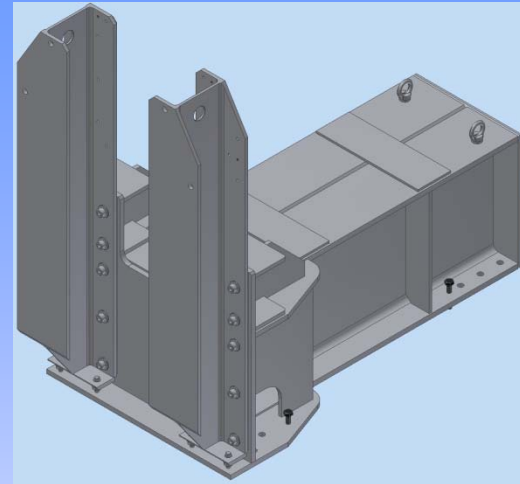
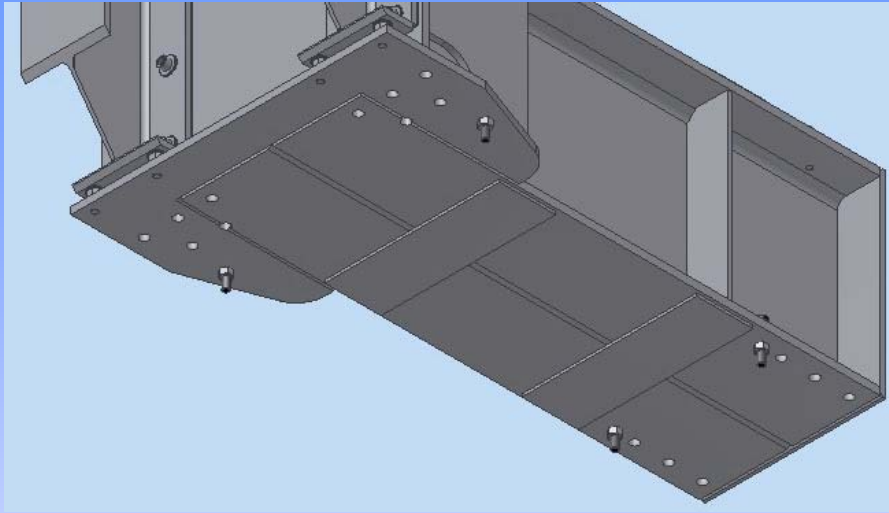
1. It is support for injector end cap and feed cap.
2. Preliminary alignment is executed by bolts M24x130.
3. Nominal gap between the support and the floor is 48mm.
4. The support is fixed by 16th HAS 5.8 anchor bolts M24. The stud embedded is 210mm. Height the bolt under floor level is not less than 345mm.
5. The uneven surface of the floor (15 mm) is compensated by the gap between floor and support.
6. Adjustment possibilities of the vertical beams are given both in vertical and in transversal directions.
7. The vertical beams is regulated by two studs M24x100.
8. Supports are installed on the anchor bolts, final height adjustment is carried out and then grouting is made. The strength of concrete is 30/37.
9. Backstop is technologic tool for installation feed cap/end cap.

[illegible]

Top view



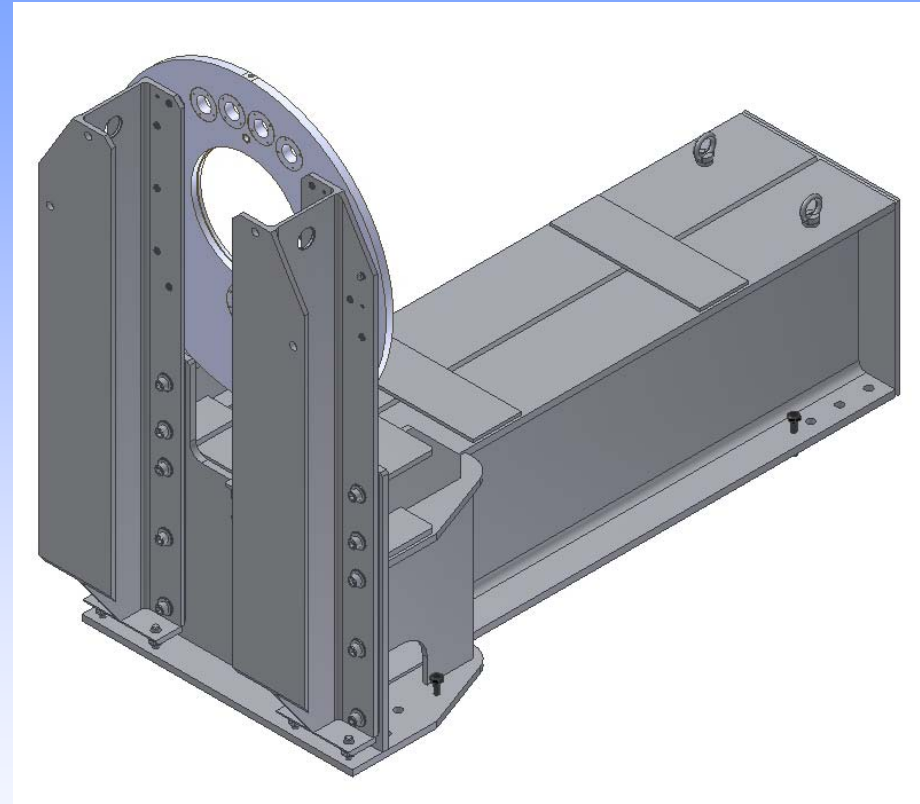
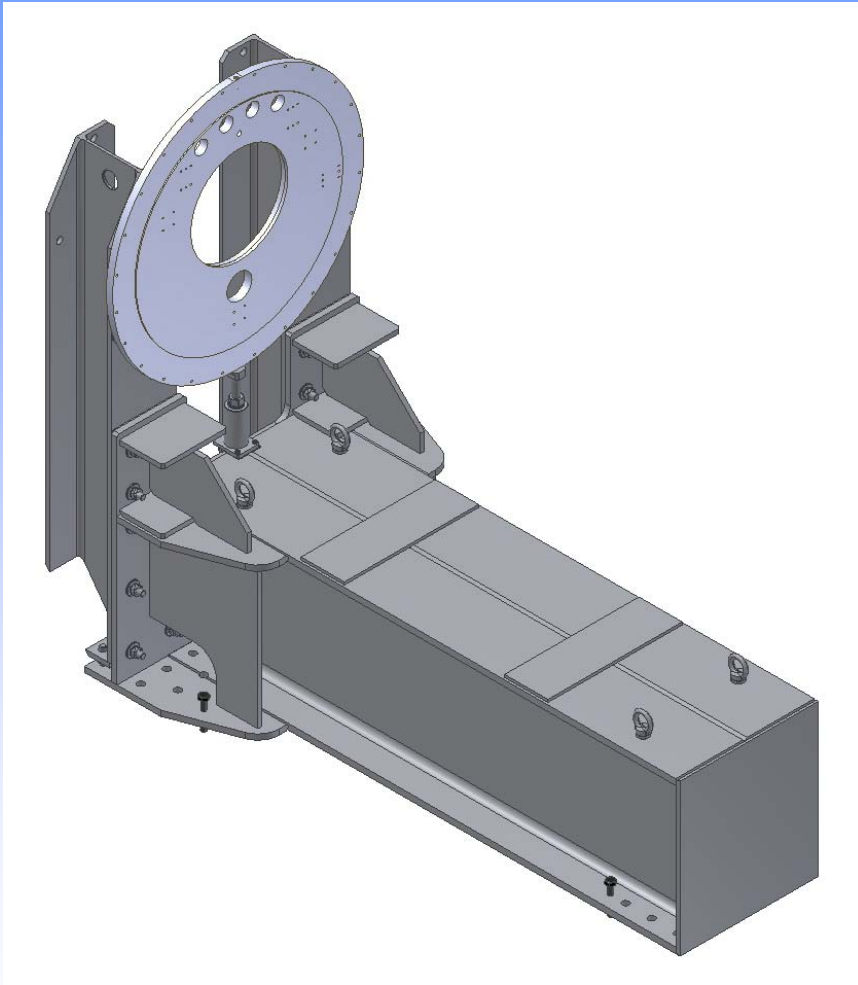
Support views



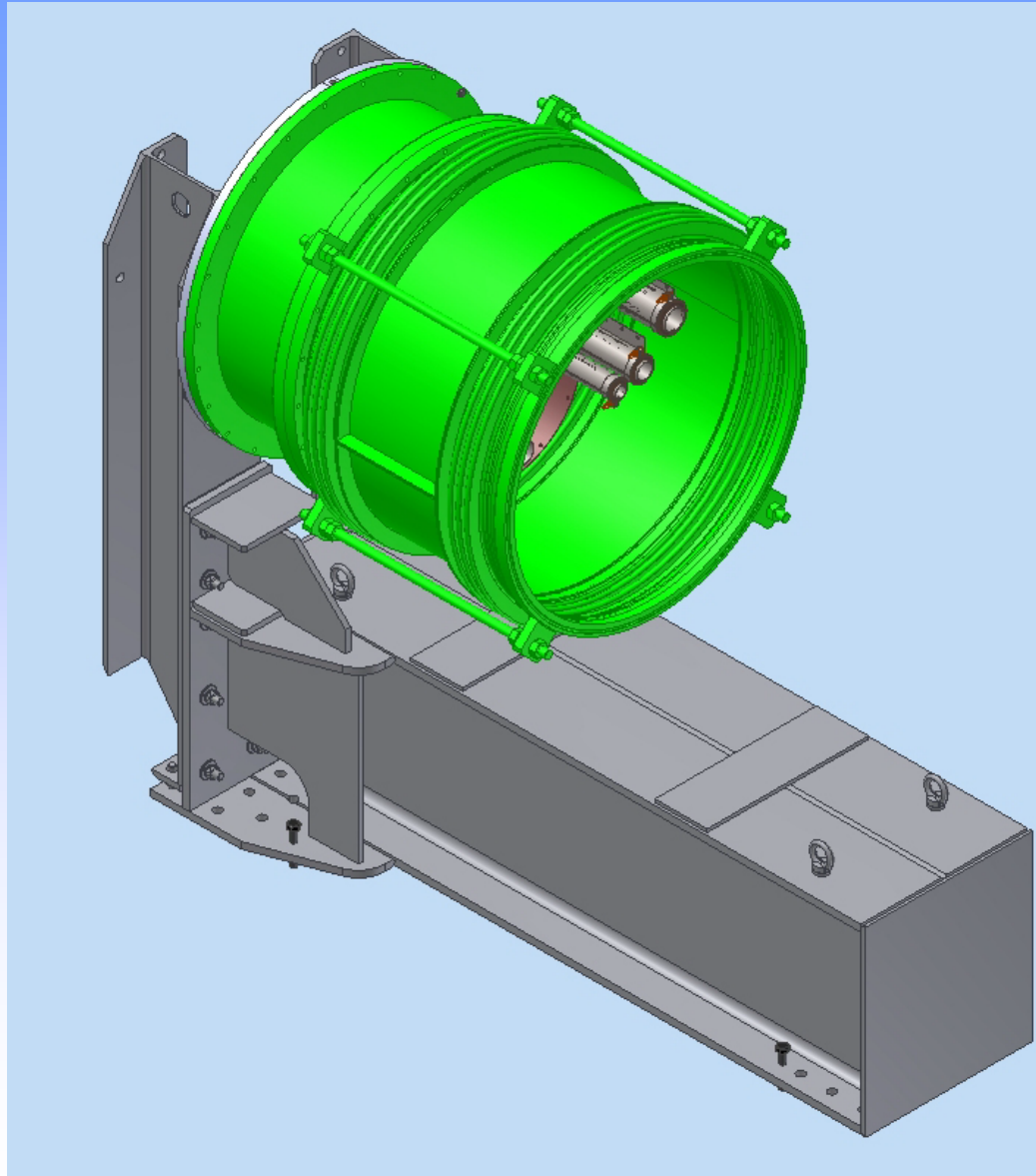
Injector supports with cryogenic equipment



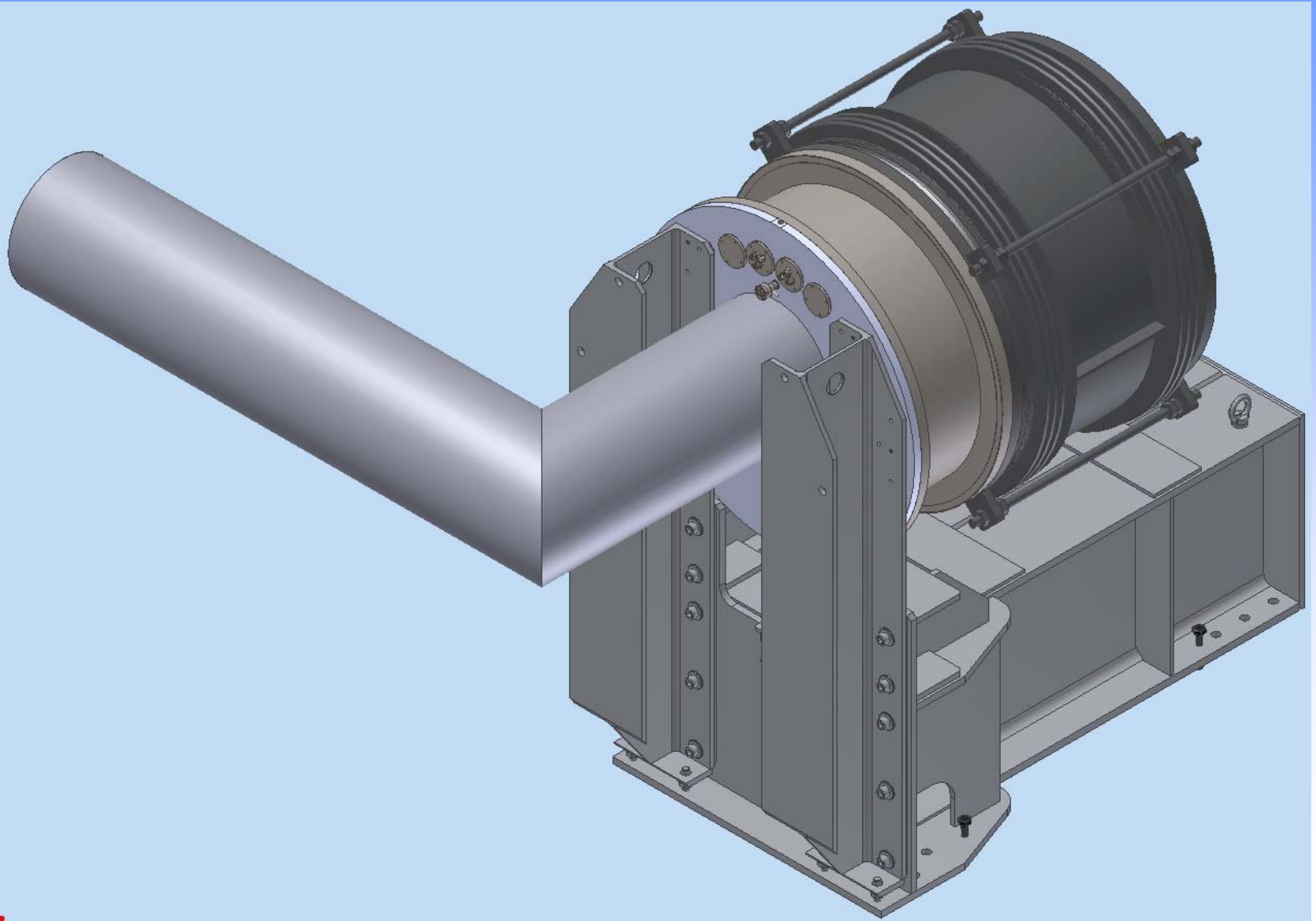
Feed cap flange



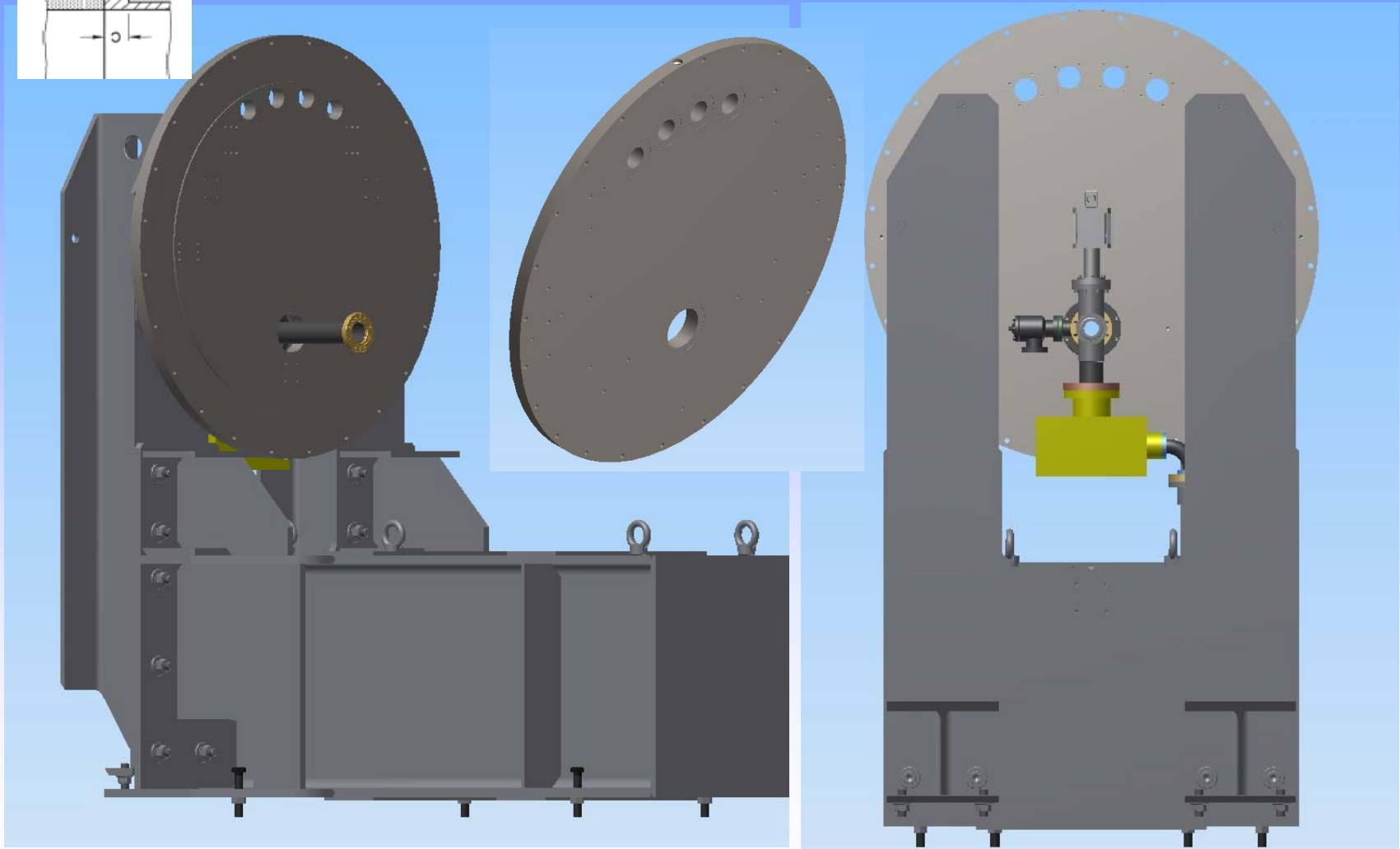
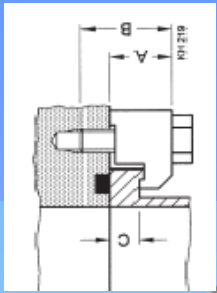
Injector feed cap



Injector feed cap with L-shape transfer line



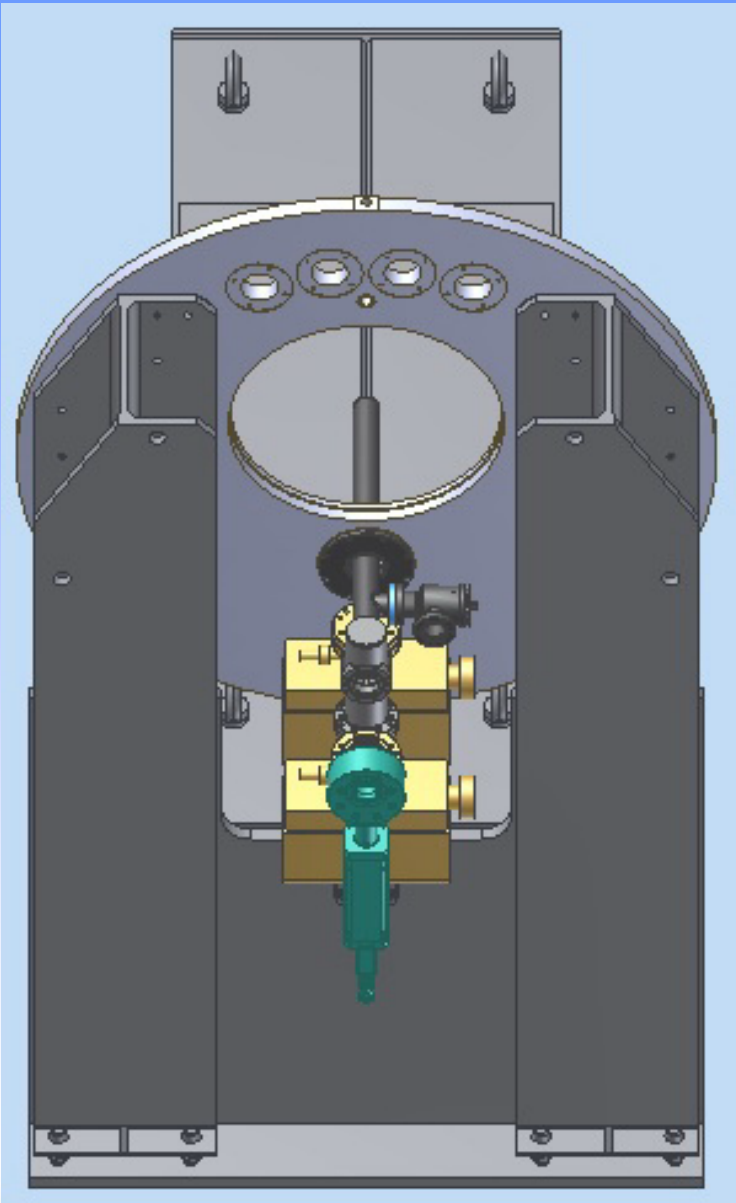
End cap flange.



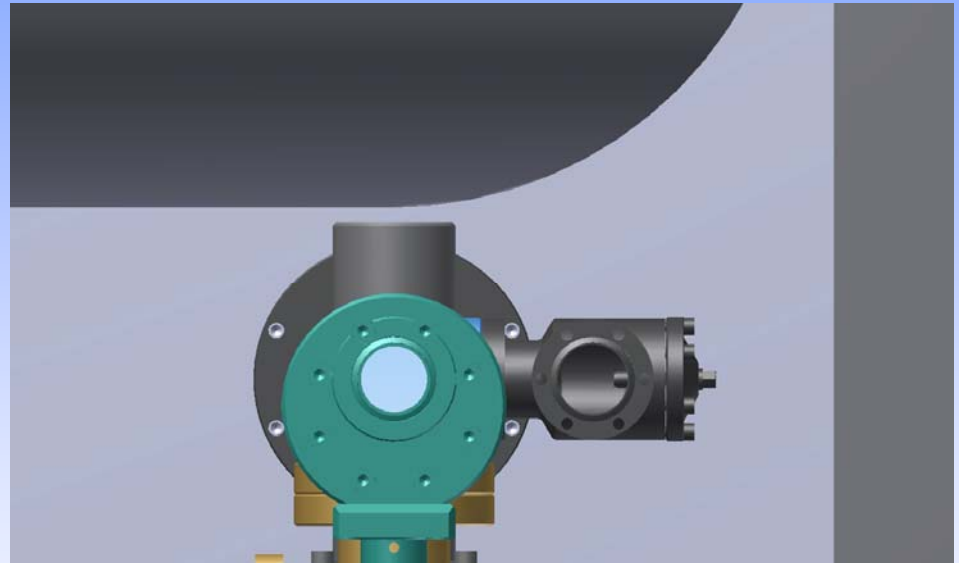
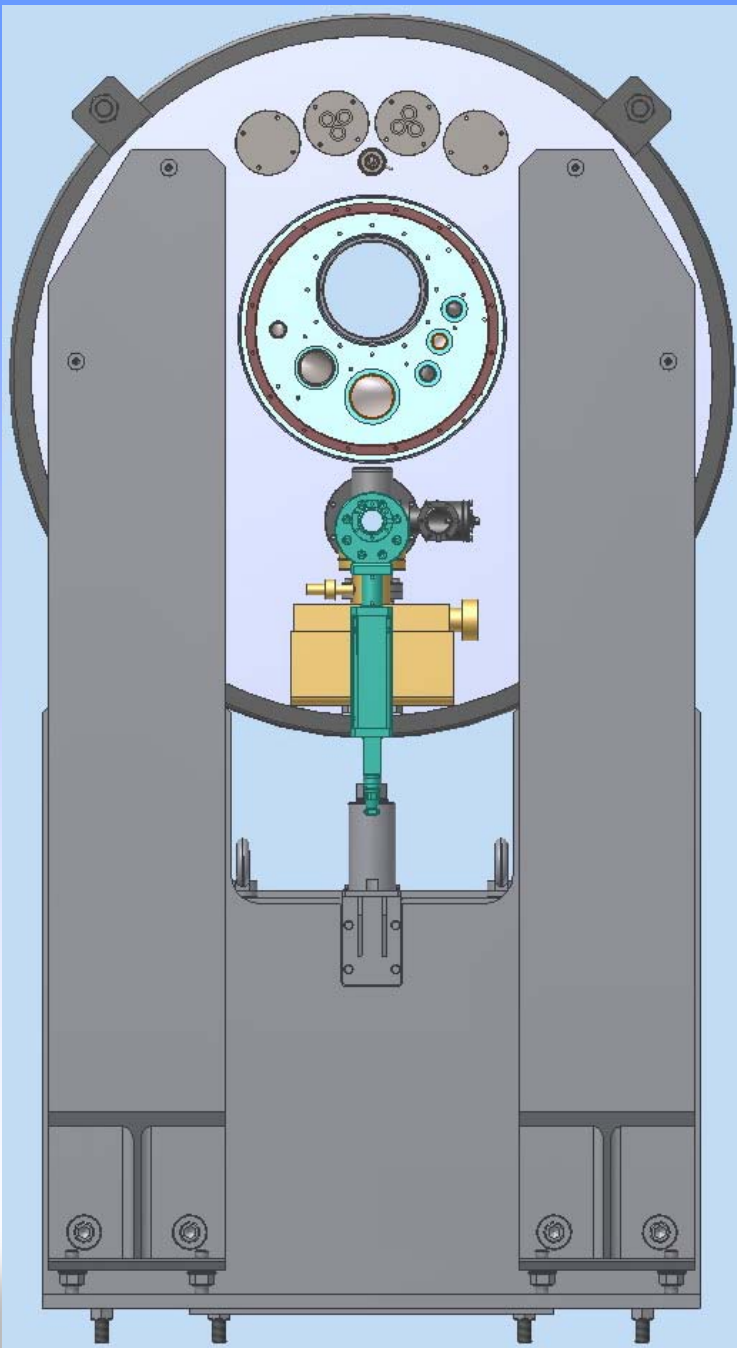
**Vacuum equipment
location relative to the
supports with cryogenic parts**



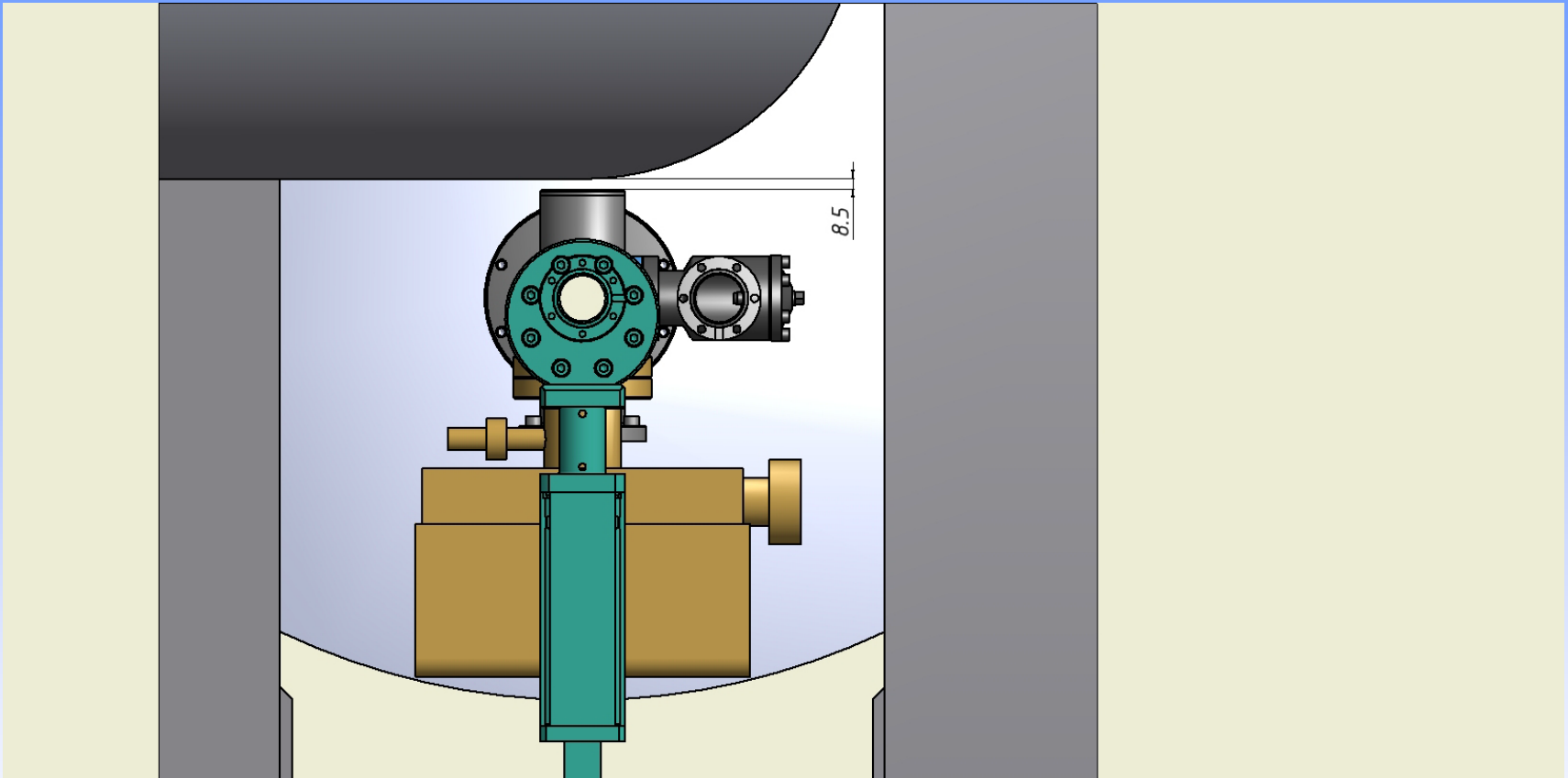
Support and vacuum
equipment. Feed cap side.



Linac side view



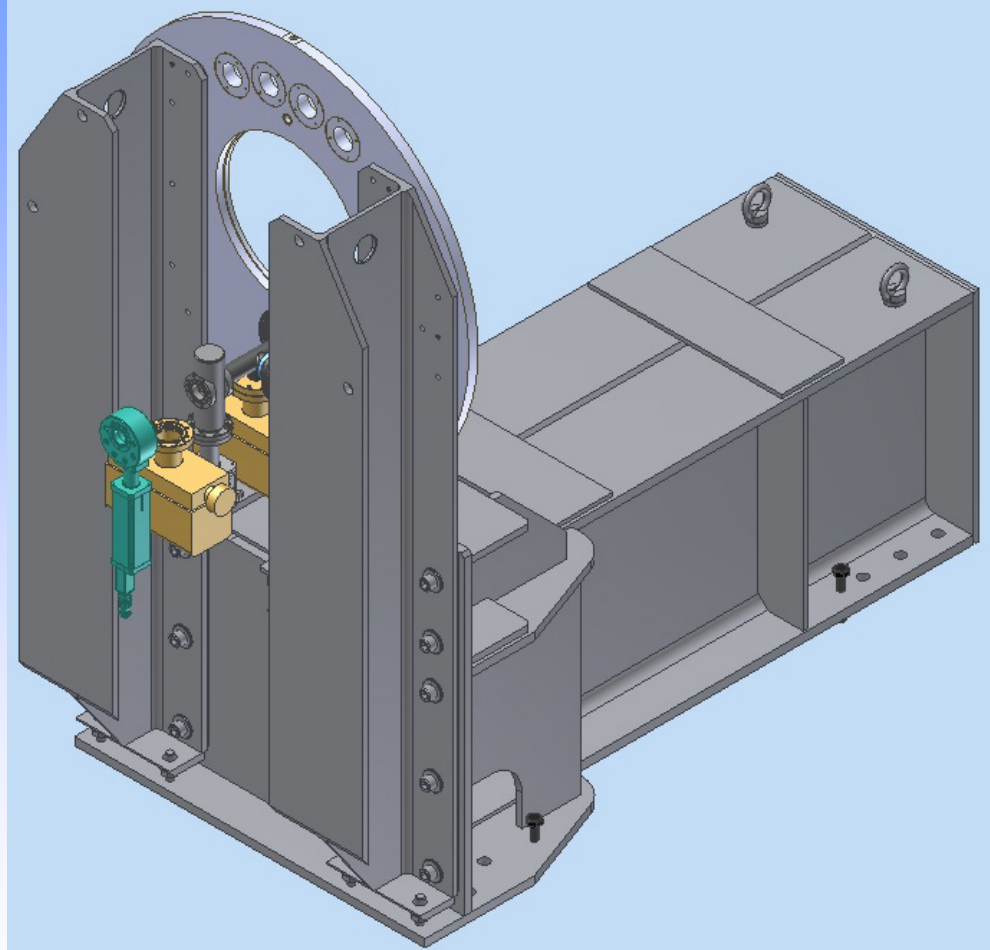
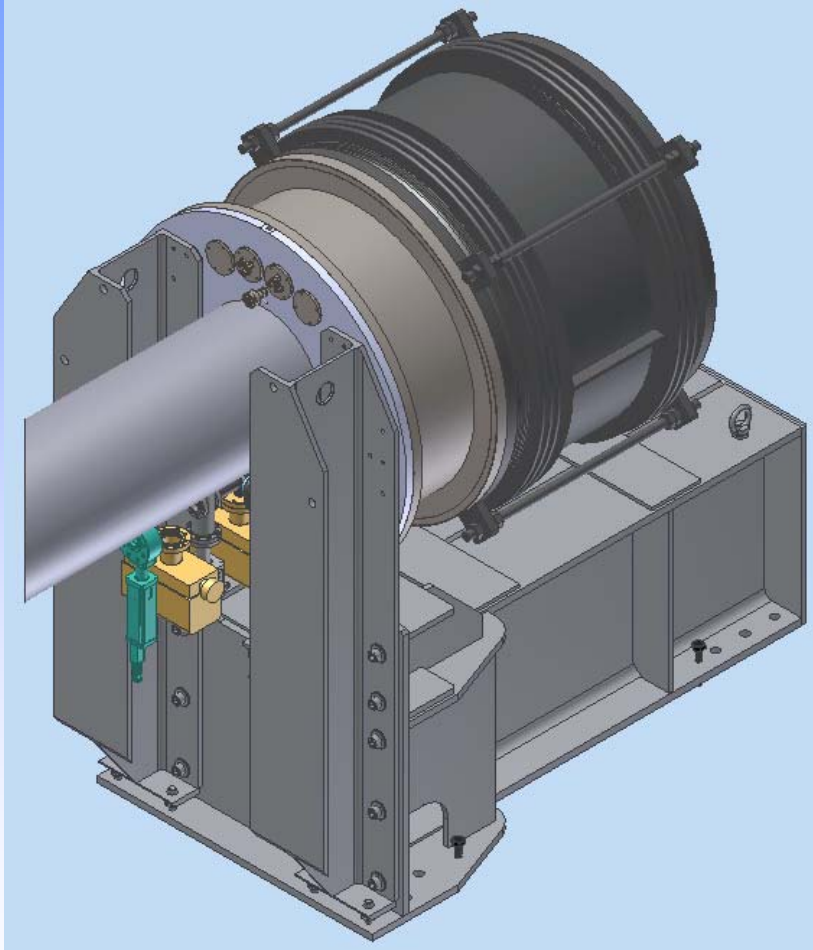
Linac side view



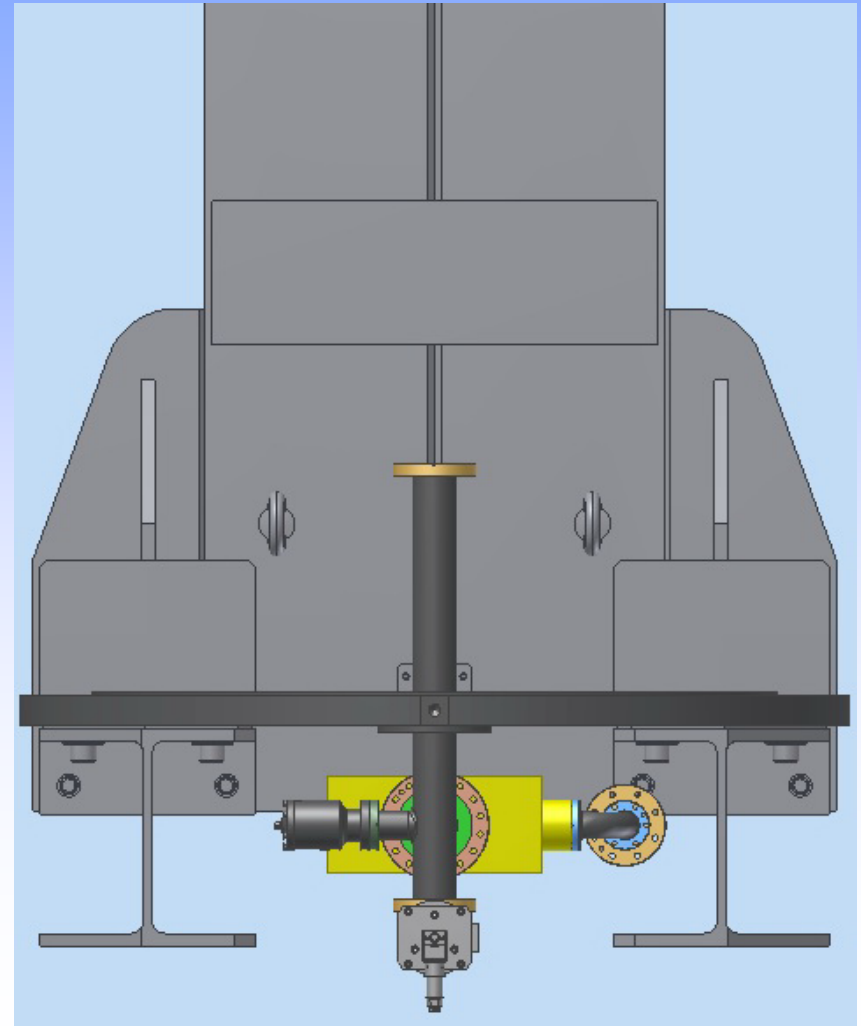
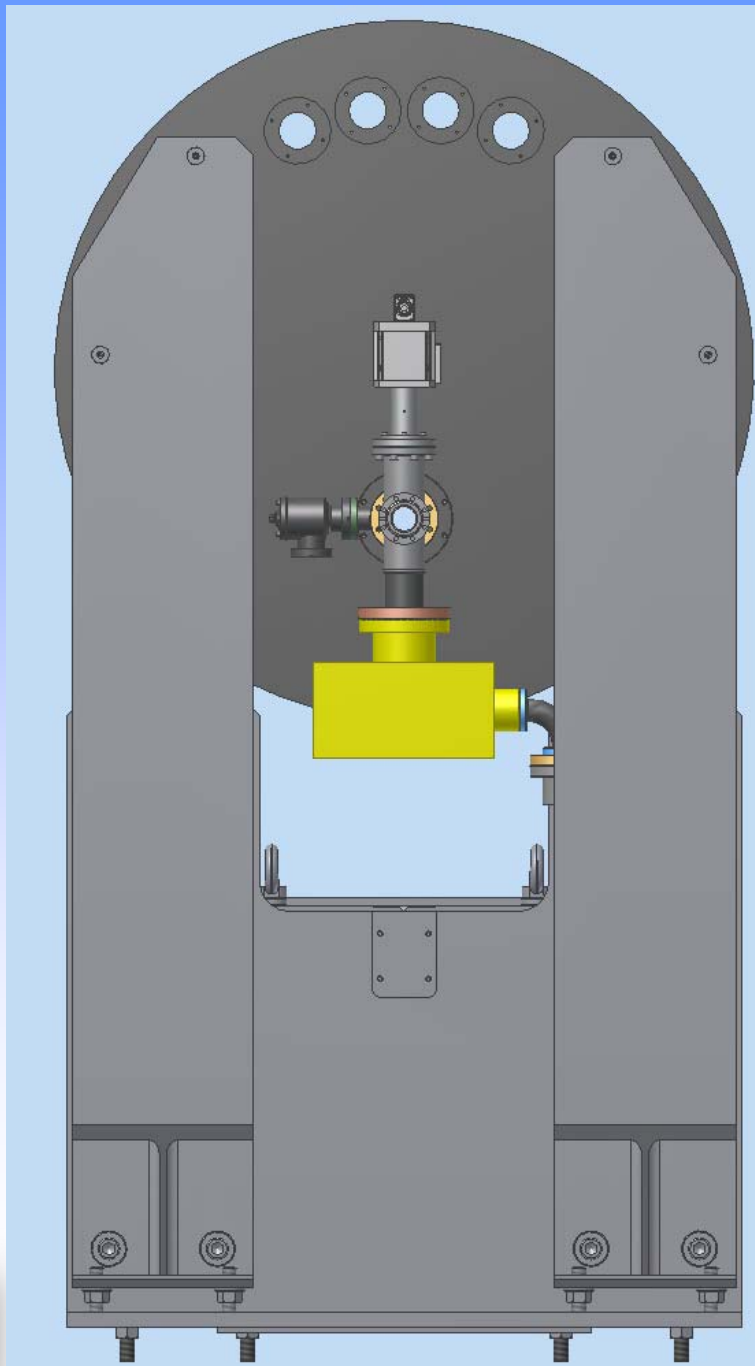
The gap between vacuum vessel of TL and the top of vacuum equipment is 8.5 mm.



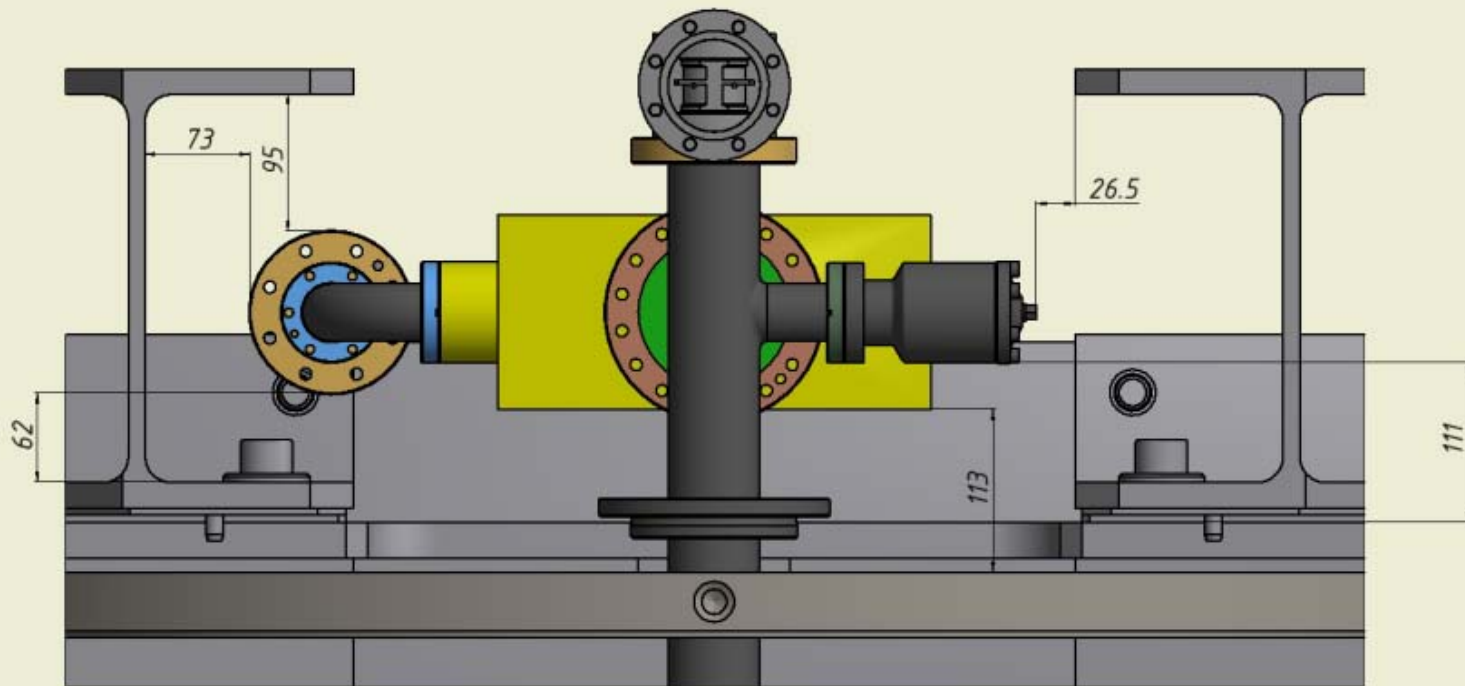
3D model



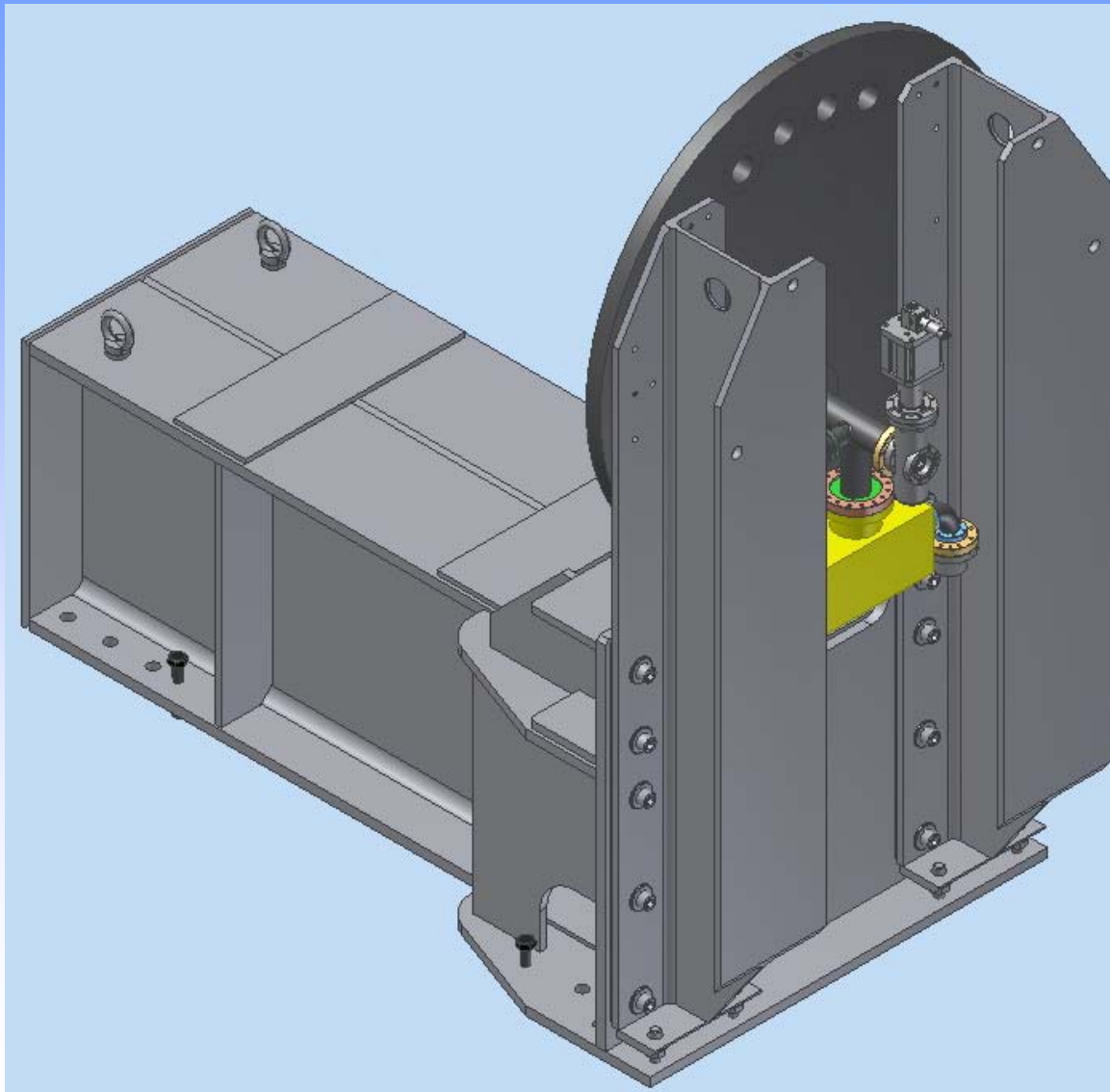
Support and vacuum
equipment. End cap side.



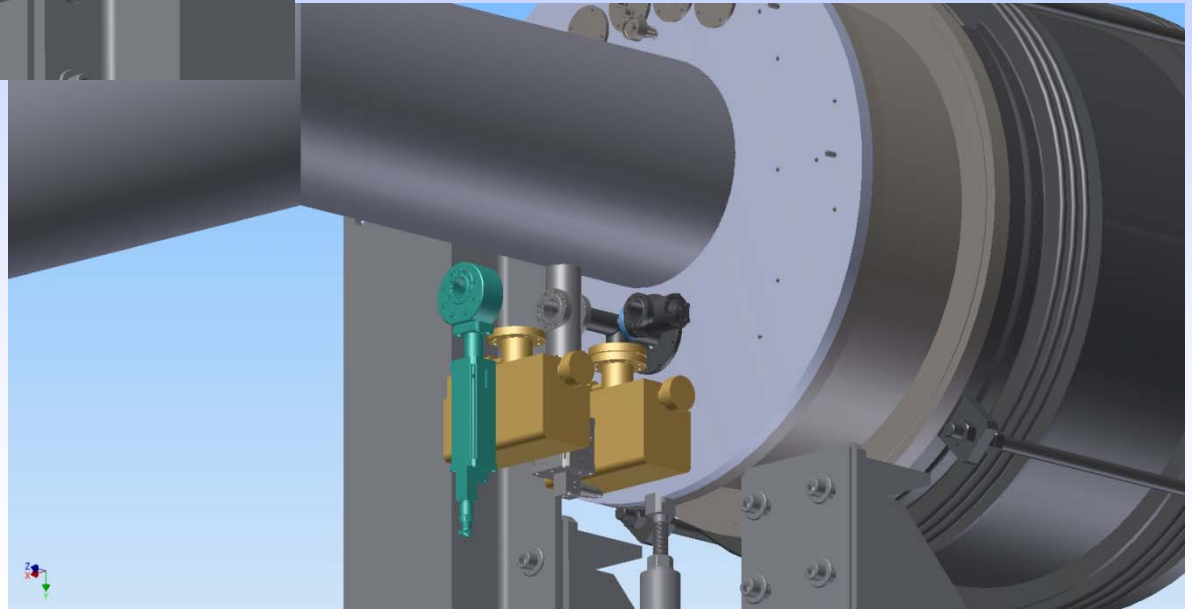
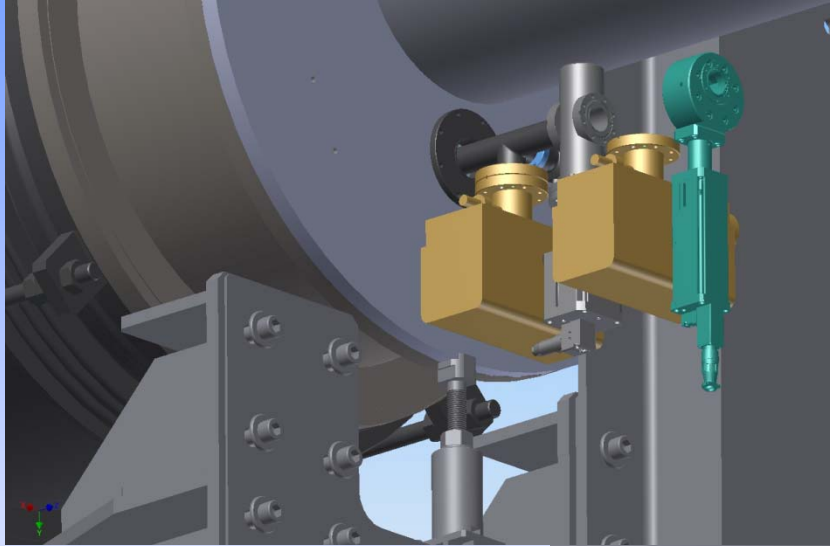
Support and vacuum equipment. End cap side. Critical dimensions.



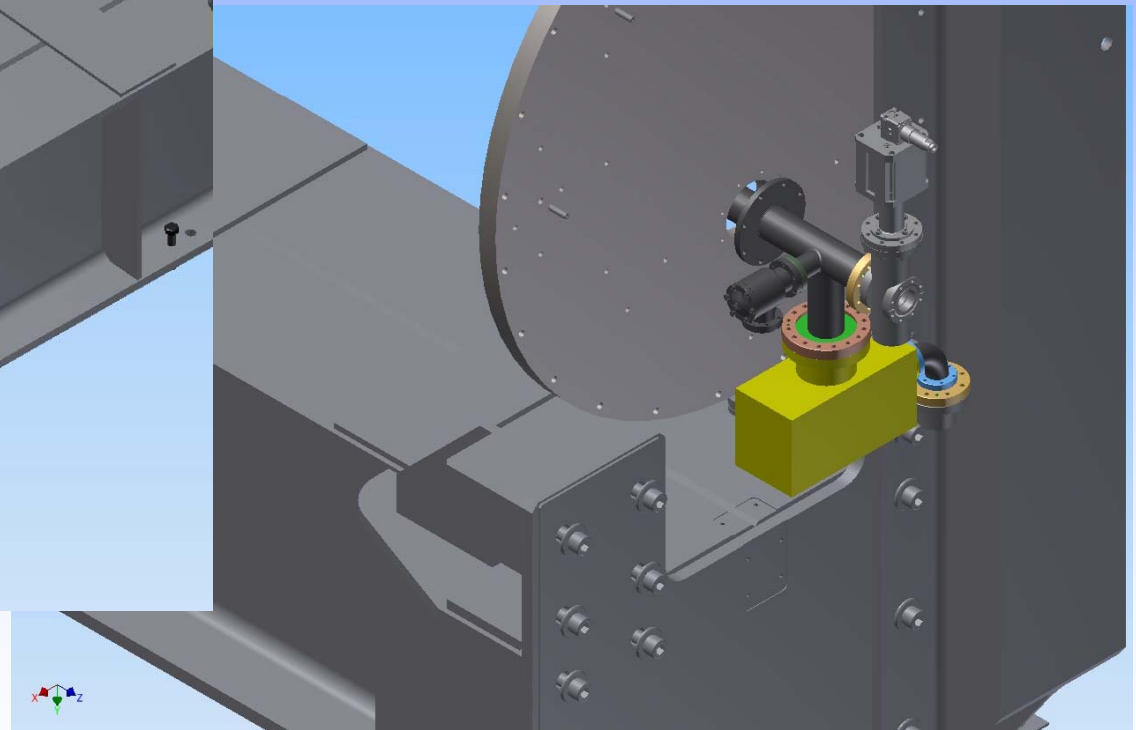
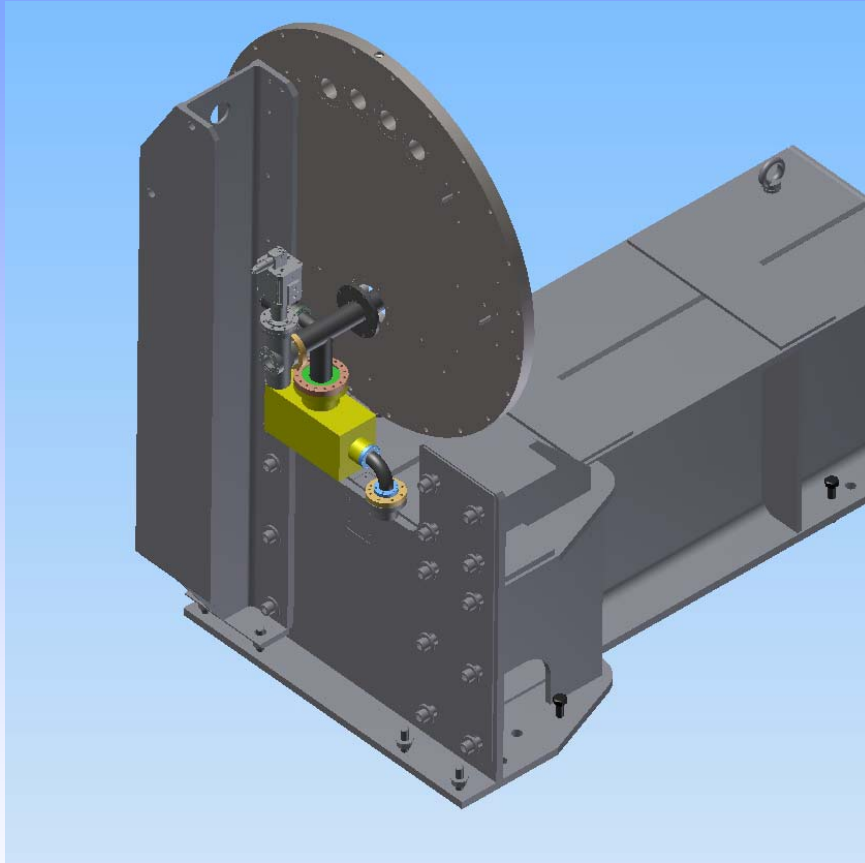
Support and vacuum equipment. End cap side.



Possibilities for vacuum equipment installation. Feed cap side



Possibilities for vacuum equipment installation. End cap side



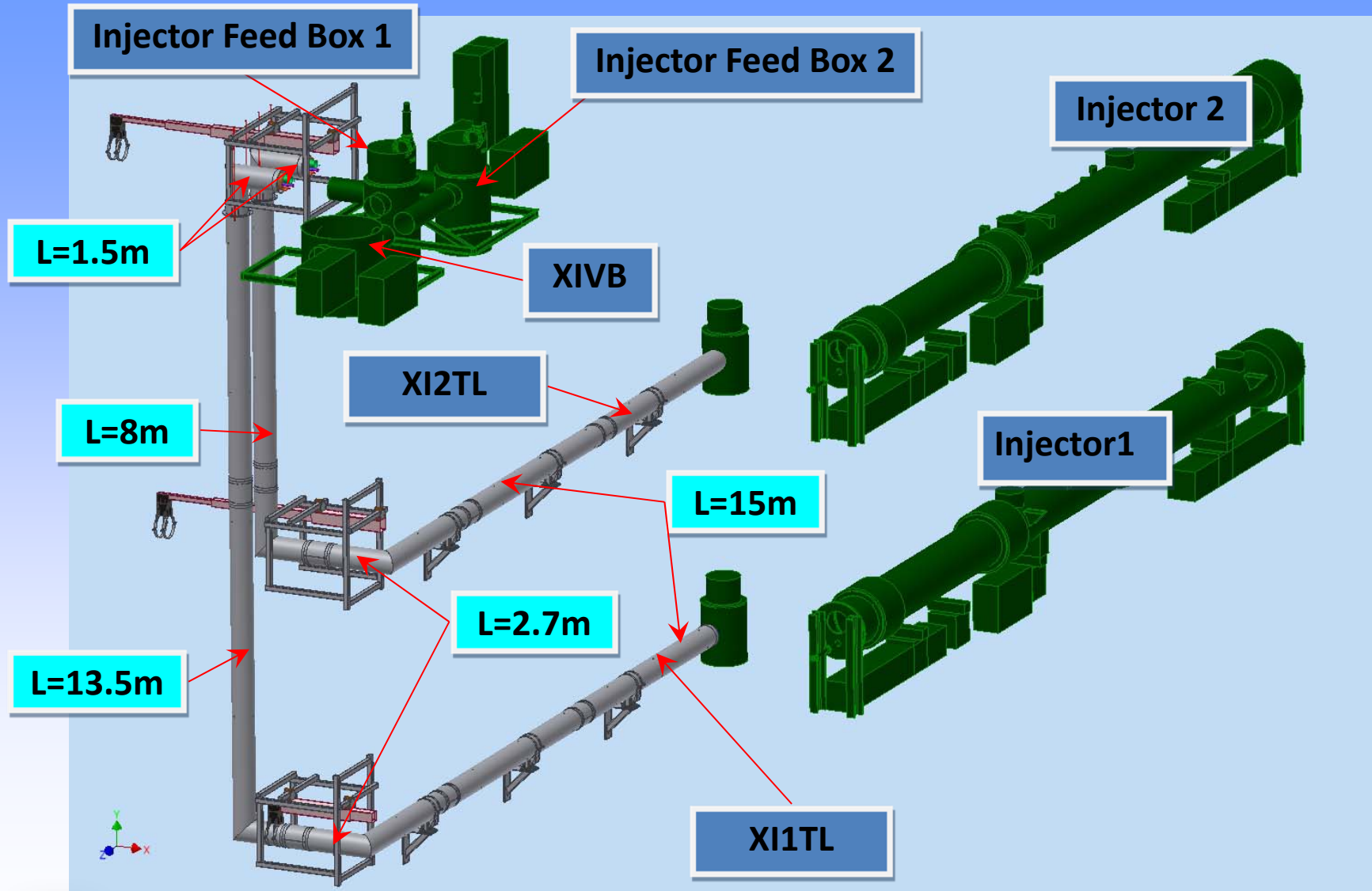
Calculations. Loads and deviations.

The following assumptions are taken for the calculations:

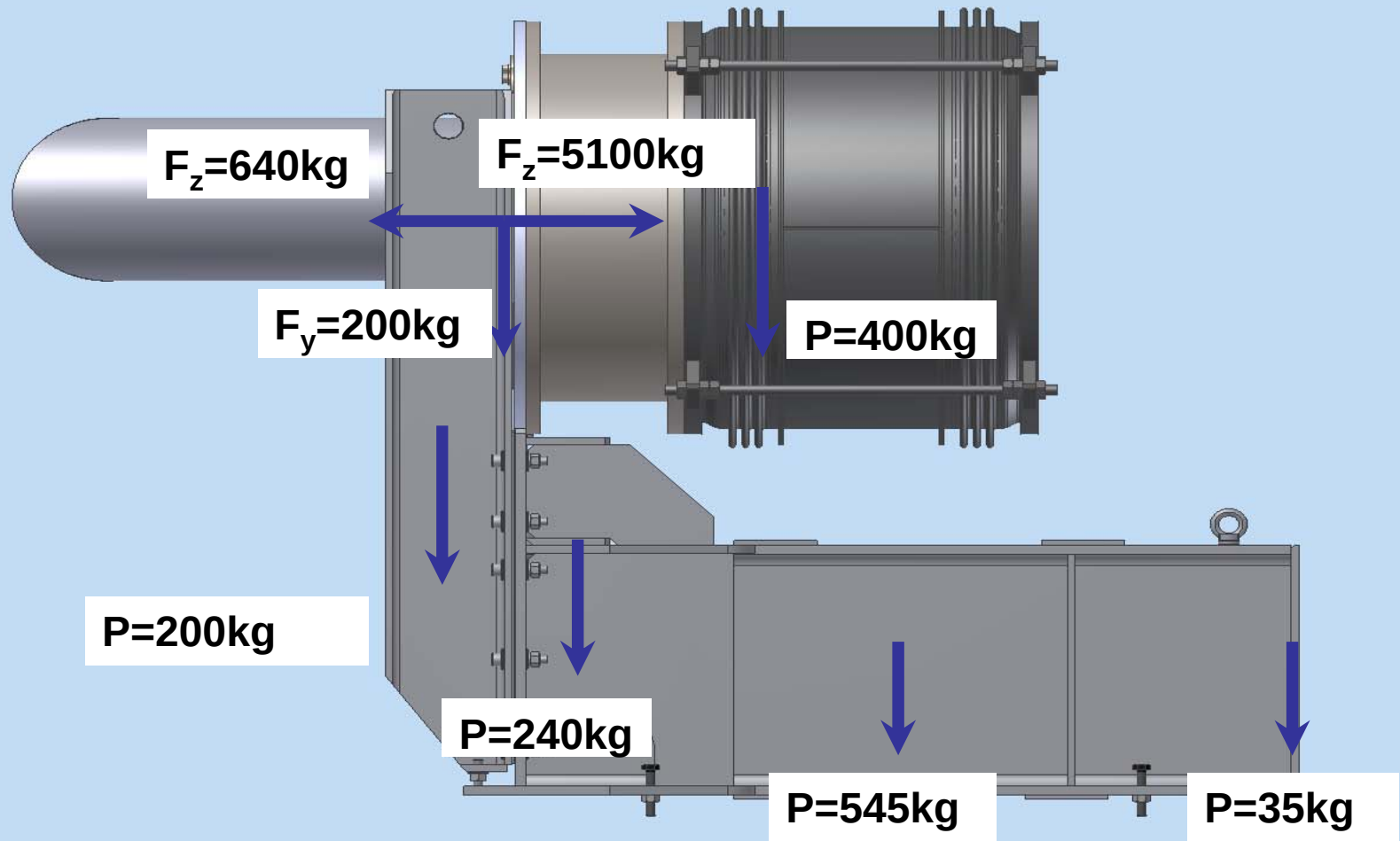
- The corresponding frames are rigidly fixed to the injector supports;
- The Feed Cap/End Cap vacuum vessels are rigidly fixed to the Injector Supports;
- Additional loads from XI1TL are taken account for the calculation of the Feed Cap support for all working conditions;
- Since the Injector Support with Feed Cap has a more loads than the Injector Support with End Cap the calculations were made for the Feed Cap Support;
- For the sake of simplicity, a half cross-section (one I-beam instead of two) was taken in the design scheme (all the loads are twice lower).



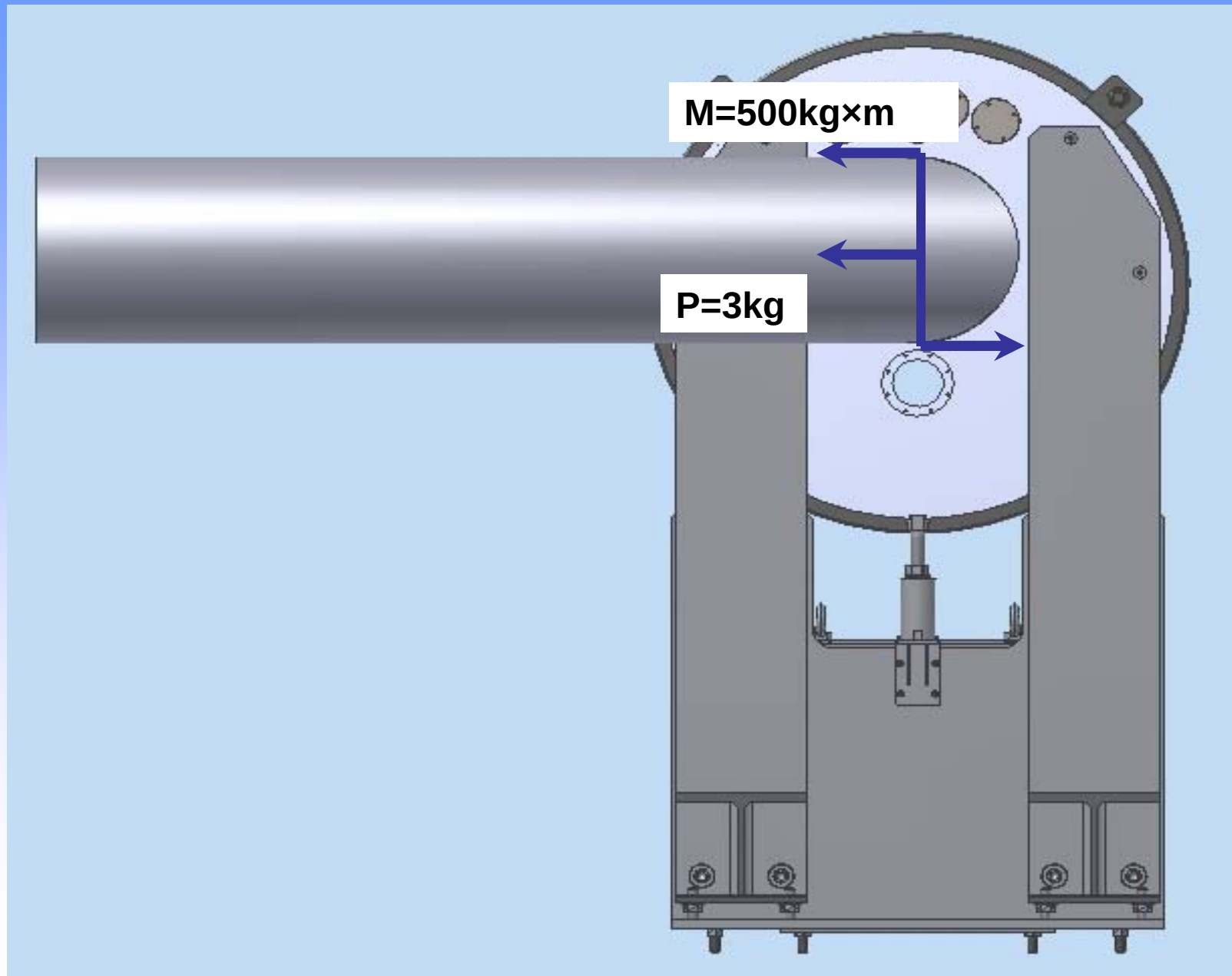
Transfer lines arrangement



Distribution of forces for operation condition



Moment of forces from weight, operation condition



Distribution of forces for operation condition

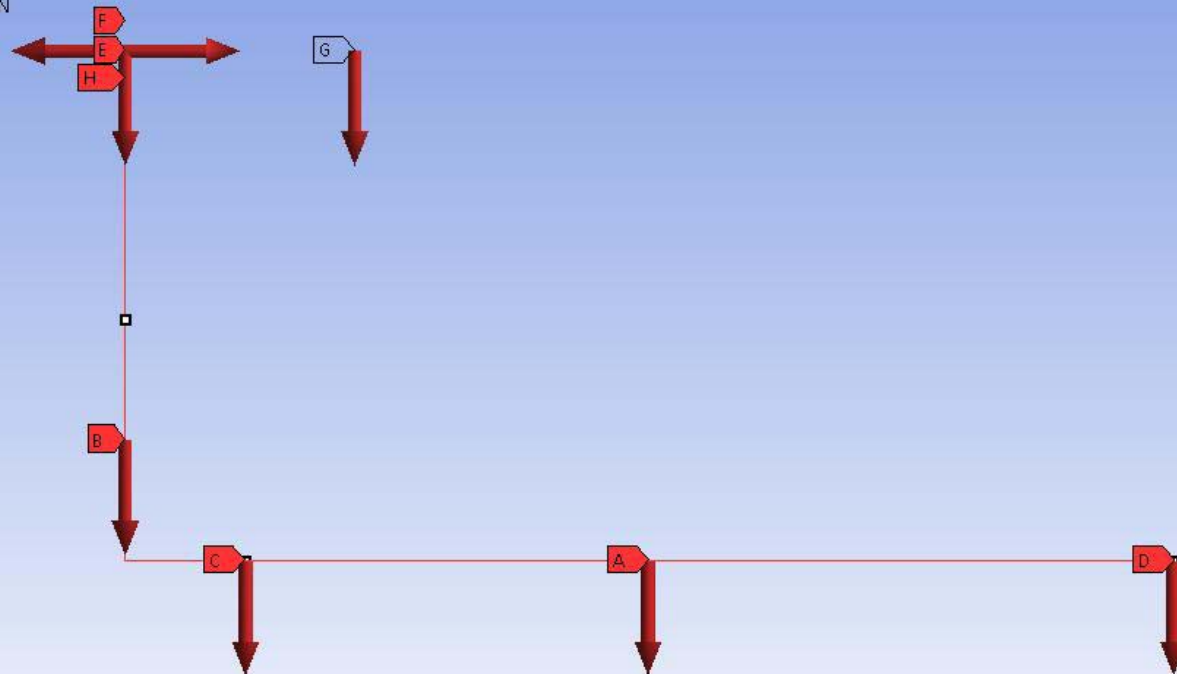
A: Normal

TL vertical (normal)

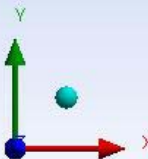
Time: 1, s

28.03.2012 15:50

- A** Selfweight 70sh3: 5450, N
- B** Selfweight 30k3: 2000, N
- C** Panel weight: 2400, N
- D** Plate weight: 350, N
- E** Vacuum (normal): 51000 N
- F** TL horizontal (normal): 6400, N
- G** FC Weight: 4000, N
- H** TL vertical (normal): 2000, N



0,00 250,00 500,00 750,00 1000,00 (mm)



Deviation along the X-axis

E: Normal Displacement

X Axis - Directional Deformation - All Line Bodies

Type: Directional Deformation(X Axis)

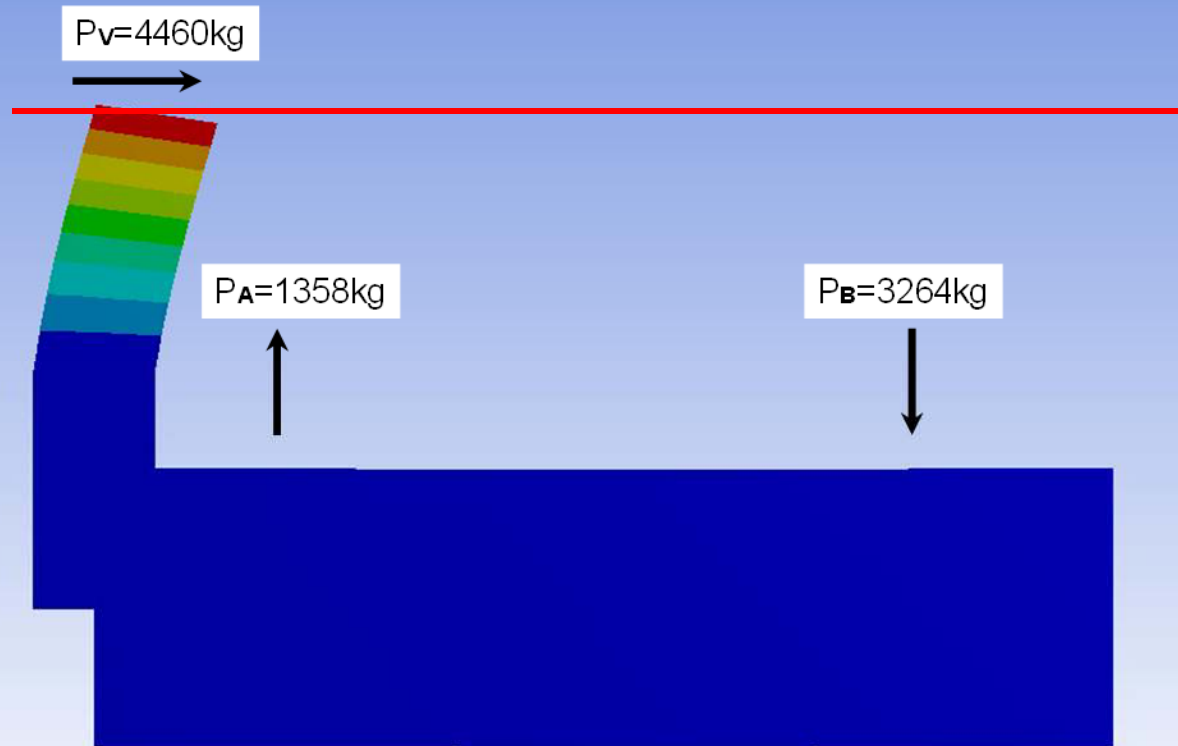
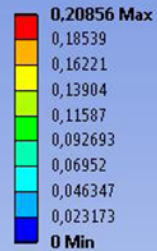
Unit: mm

Global Coordinate System

Time: 1

28.03.2012 15:42

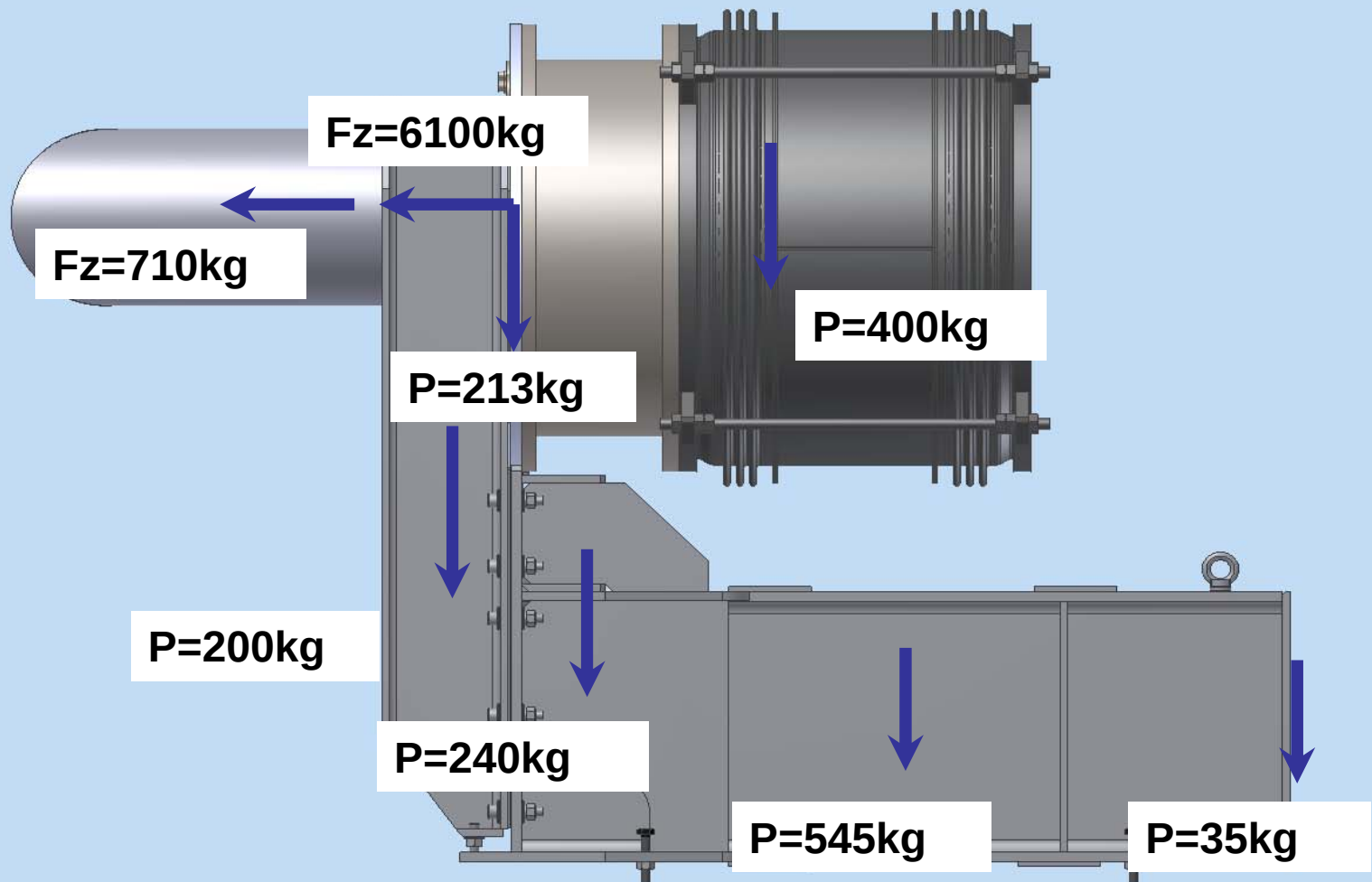
ANSYS
14.0



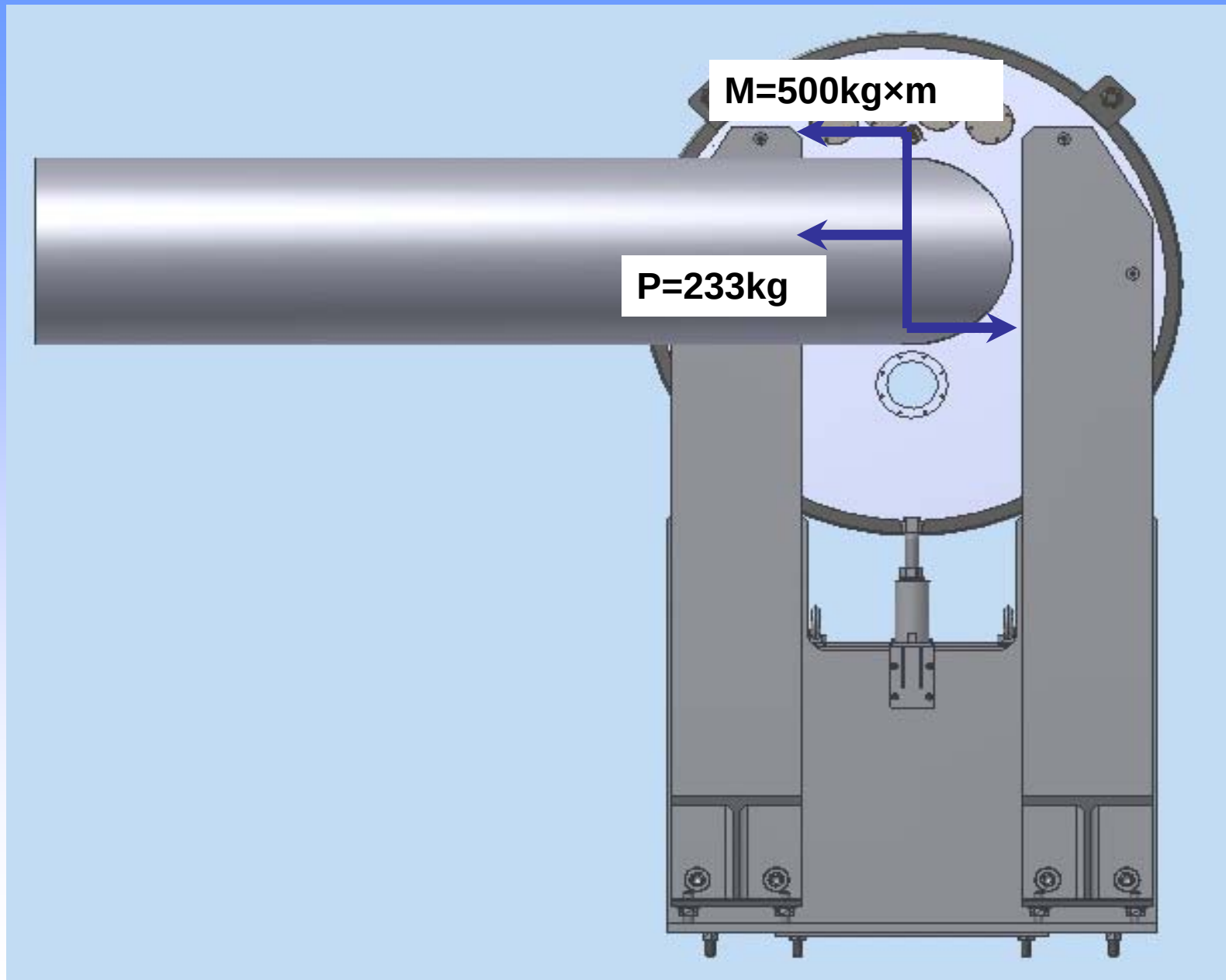
The upper line of the rectangular showing Feed Cap is the **real** Feed Cap axis.



Distribution of forces for breakdown case $P=2.2$ bar



Moment of forces from weight, breakdown case



C: Crash

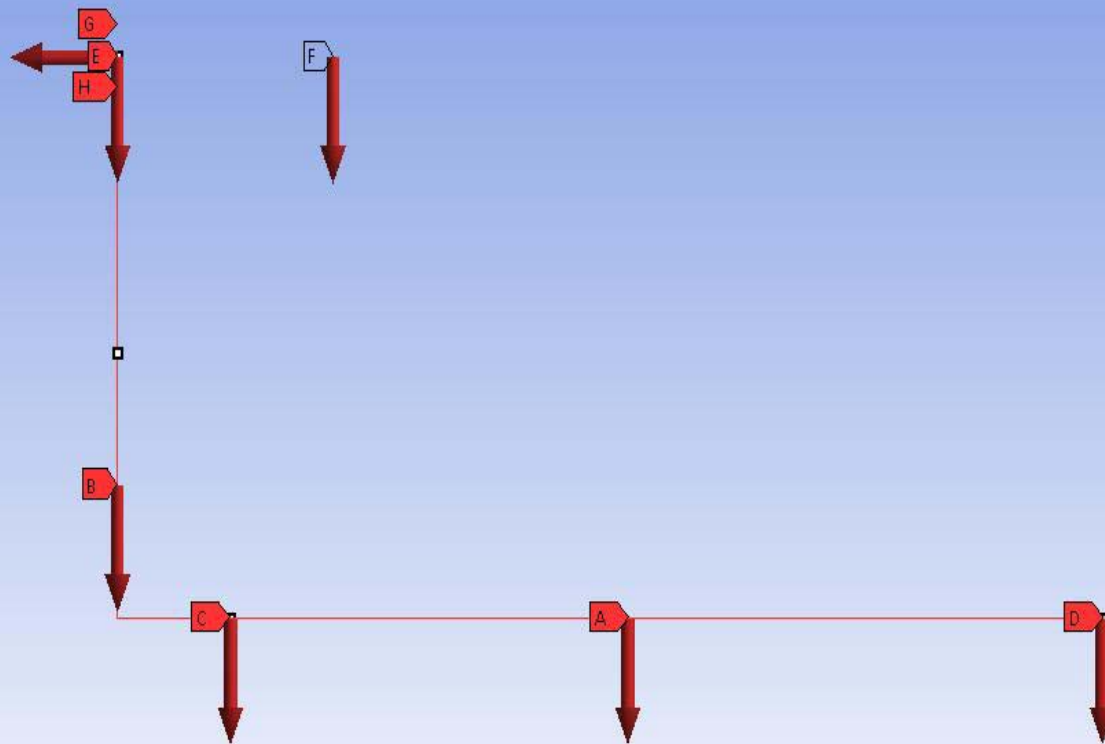
TL vertical (crash)

Time: 1, s

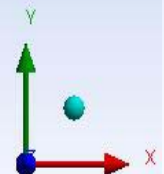
28.03.2012 16:23

- A** Selfweight 70sh3: 5450, N
- B** Selfweight 30k3: 2000, N
- C** Panel weight: 2400, N
- D** Plate weight: 350, N
- E** Pressure (crash): 61000 N
- F** FC Weight: 4000, N
- G** TL horizontal (crash): 7100, N
- H** TL vertical (crash): 2130, N

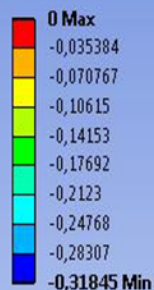
Distribution of forces for breakdown case P=2.2 bar



0,00 250,00 500,00 750,00 1000,00 (mm)



Deviation along the X-axis, case of breakdown P=2.2 bar

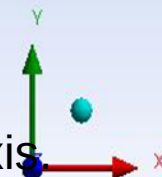


$P_{Cr}=6810\text{kg}$

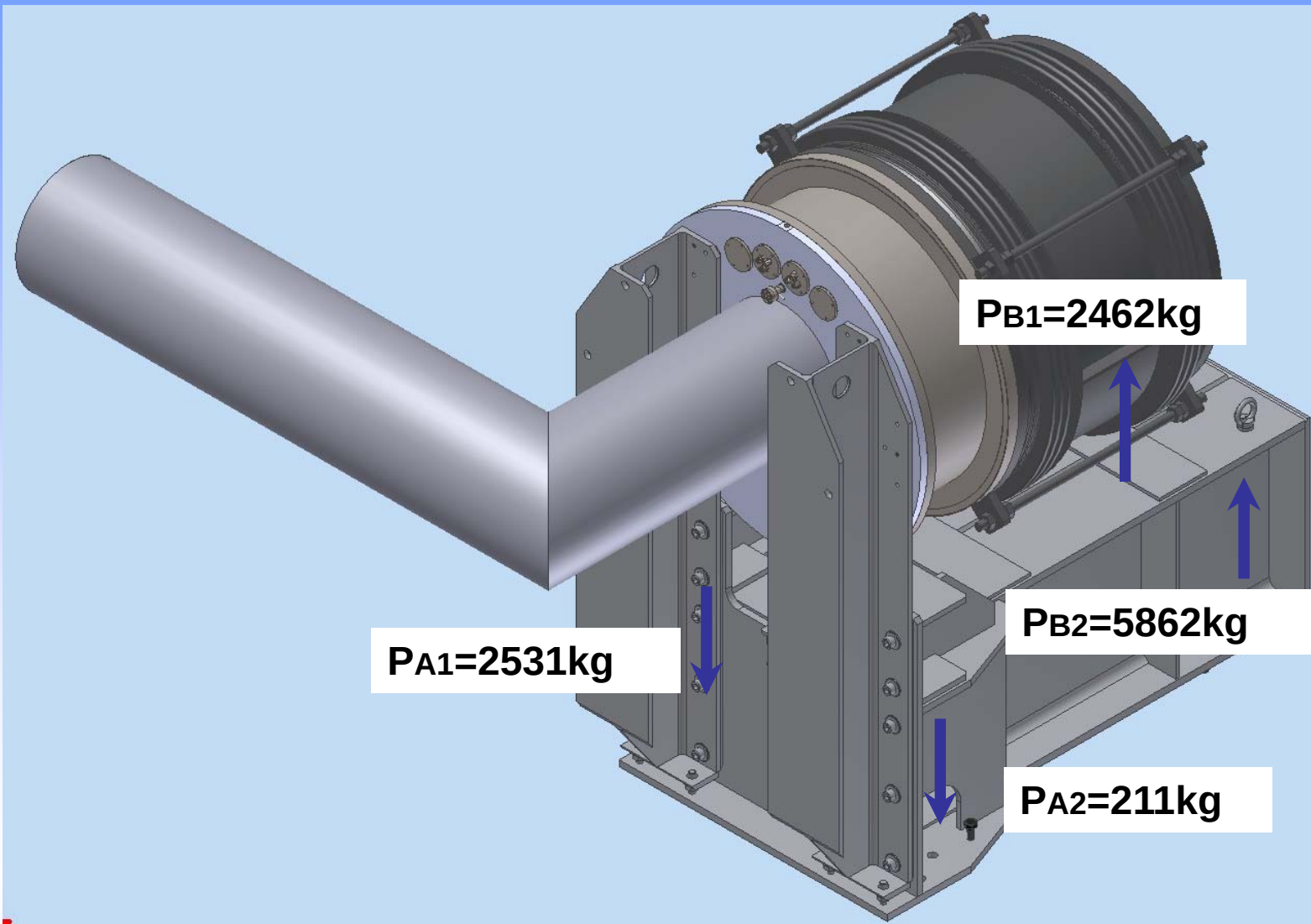
$P_A=1371\text{kg}$

$P_B=4162\text{kg}$

The upper line of the rectangular showing Feed Cap is the **real** Feed Cap axis



Anchor bolts loads, breakdown case



Calculation of the anchor bolts.

- Maxima forces acting to the anchor bolts are :
 - At a maximum resulting compression force on 3 bolts - 3264kg;
 - At a maximum resulting tension force on 3 bolts - 5862 kg.
- One anchor bolt M24 (HAS-M24x210/54) withstands the pull up force from the concrete floor - 6000 kg/piece, shearing force – 7800 kg/piece.
- Calculated loads are acting on group of three anchor bolts. The resulting force which they can withstand for shearing and pulling up exceeds the design force occurred at any operational conditions of the support system.

Thank you for your attention!



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