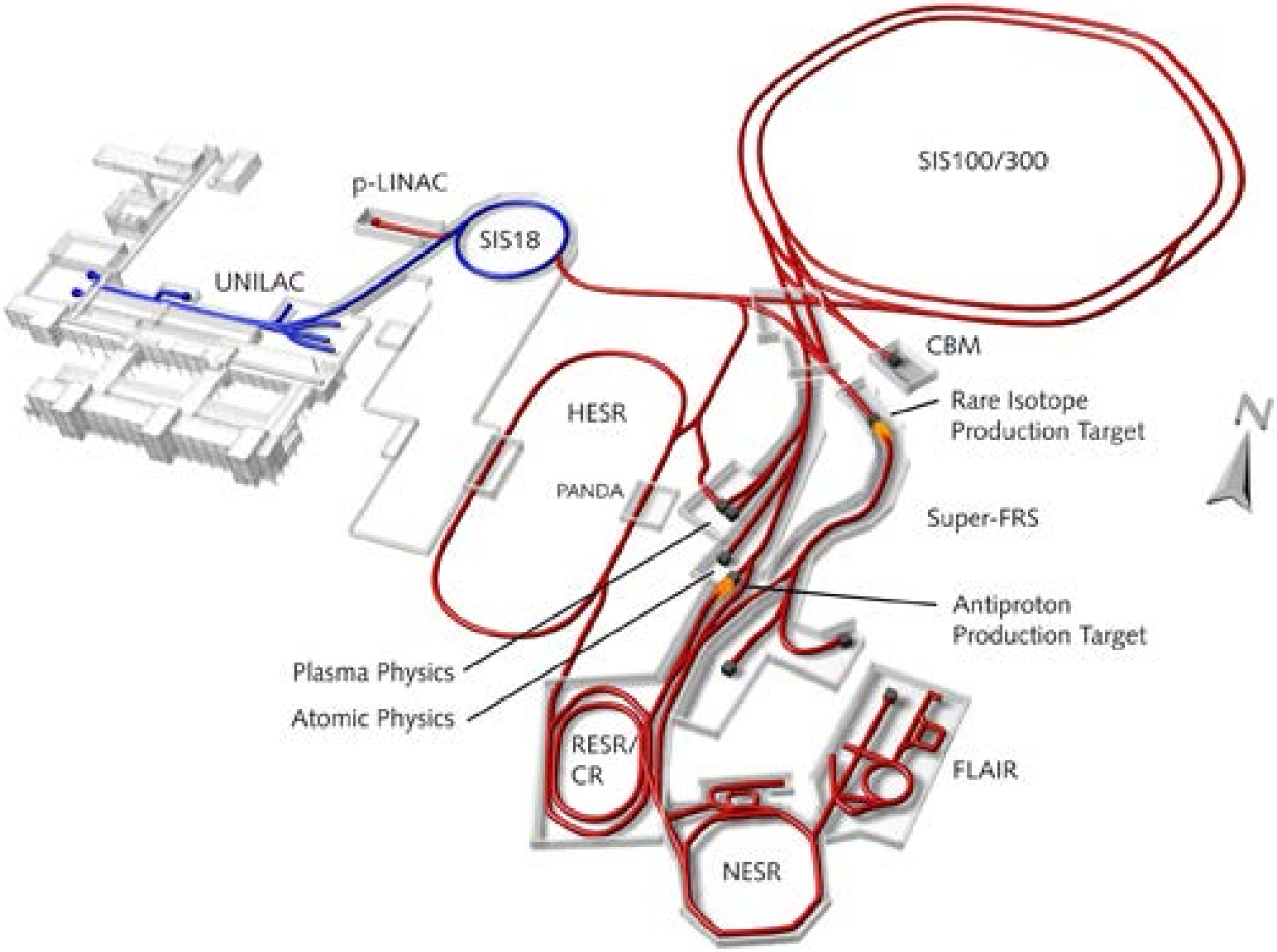
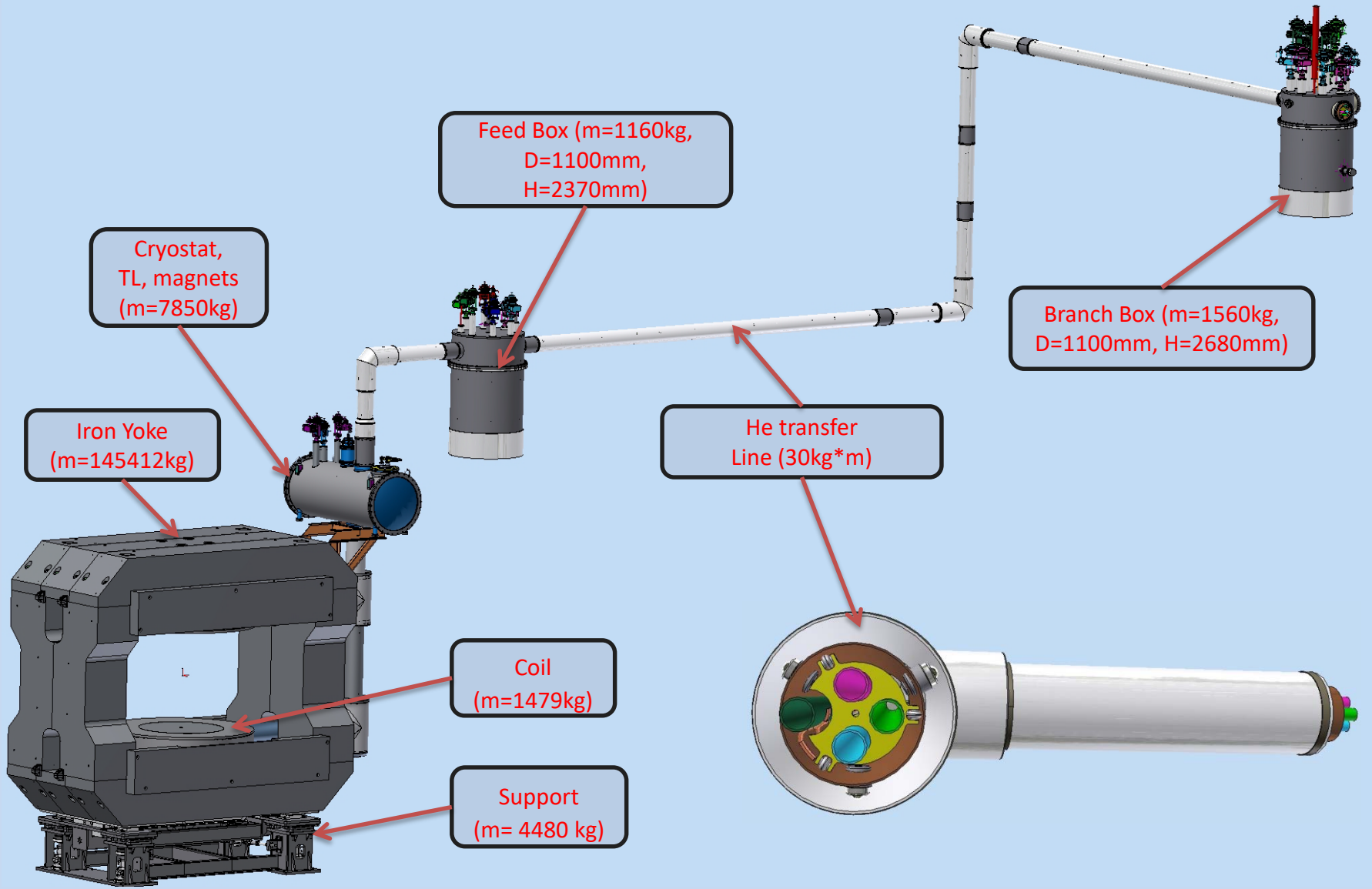
CBM Iron yoke and support design

11 2019, BINP, M.Kholopov, A.Bragin, S. Pivovarov.

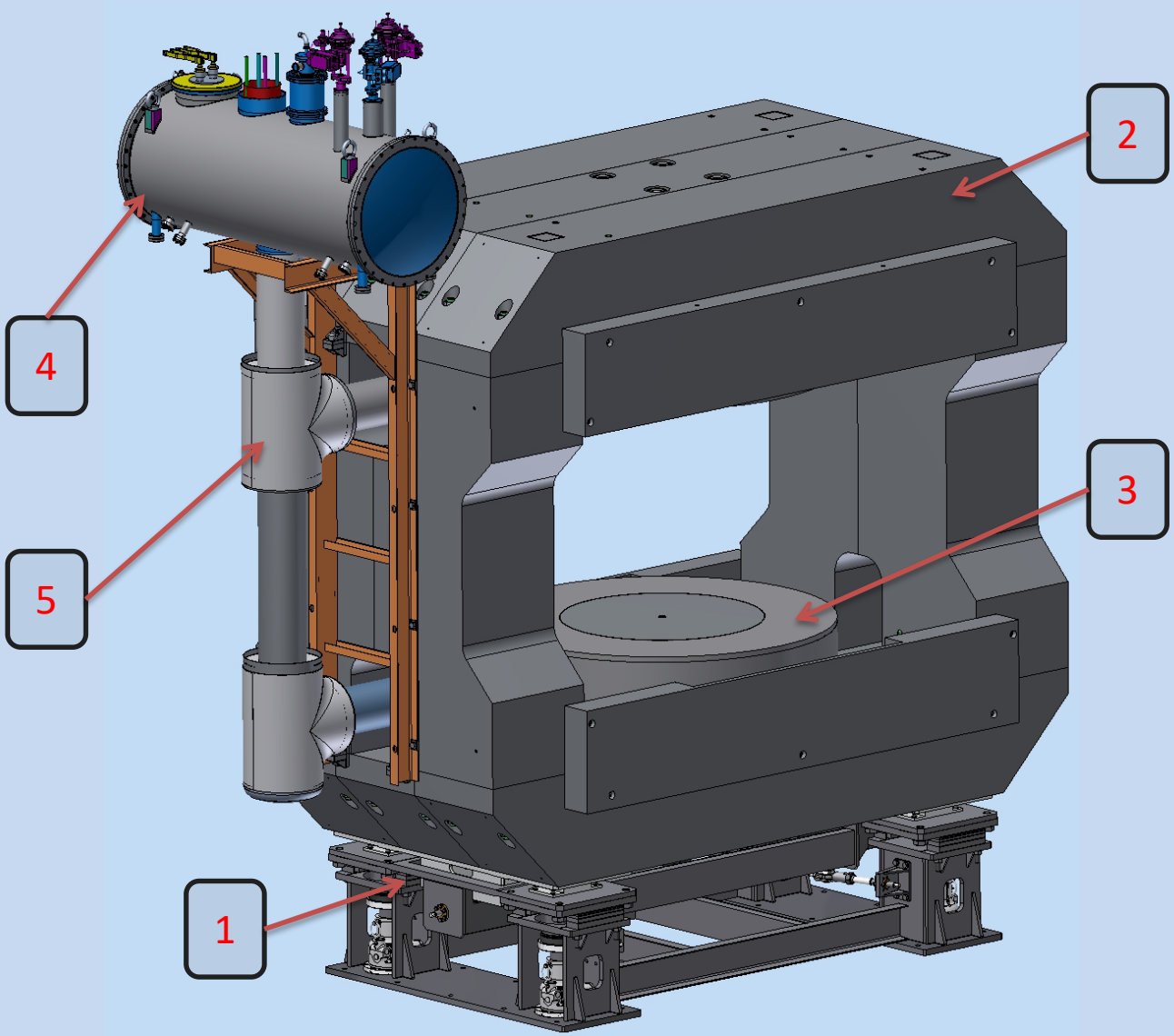
FAIR


SIS100/300
p-LINAC
SIS18
UNILAC
CBM
HESR
Rare Isotope
Production Target
PANDA
Super-FRS
N
Antiproton
Production Target
Plasma Physics
Atomic Physics
RESR/
CR
FLAIR
NESR

3D Model of CBM Magnet and cryosystem



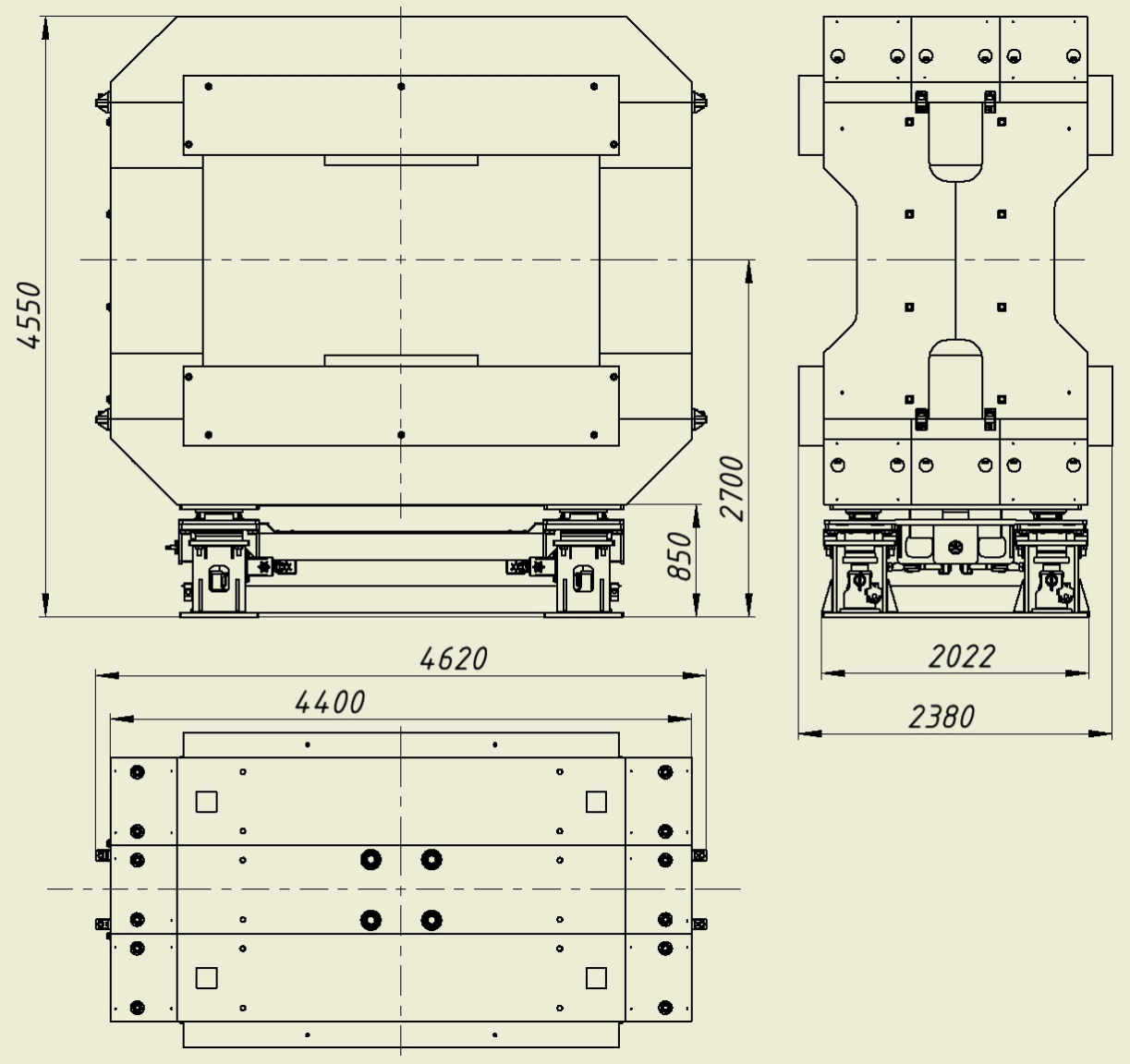
3D Model of CBM Magnet (new design)



1. Support m= 4480 kg
2. Iron Yoke m=145412kg
3. Coils m=3100kg
4. Cryostat m=940kg
5. Cryostats TL m=710kg

The support's load – 154 tons

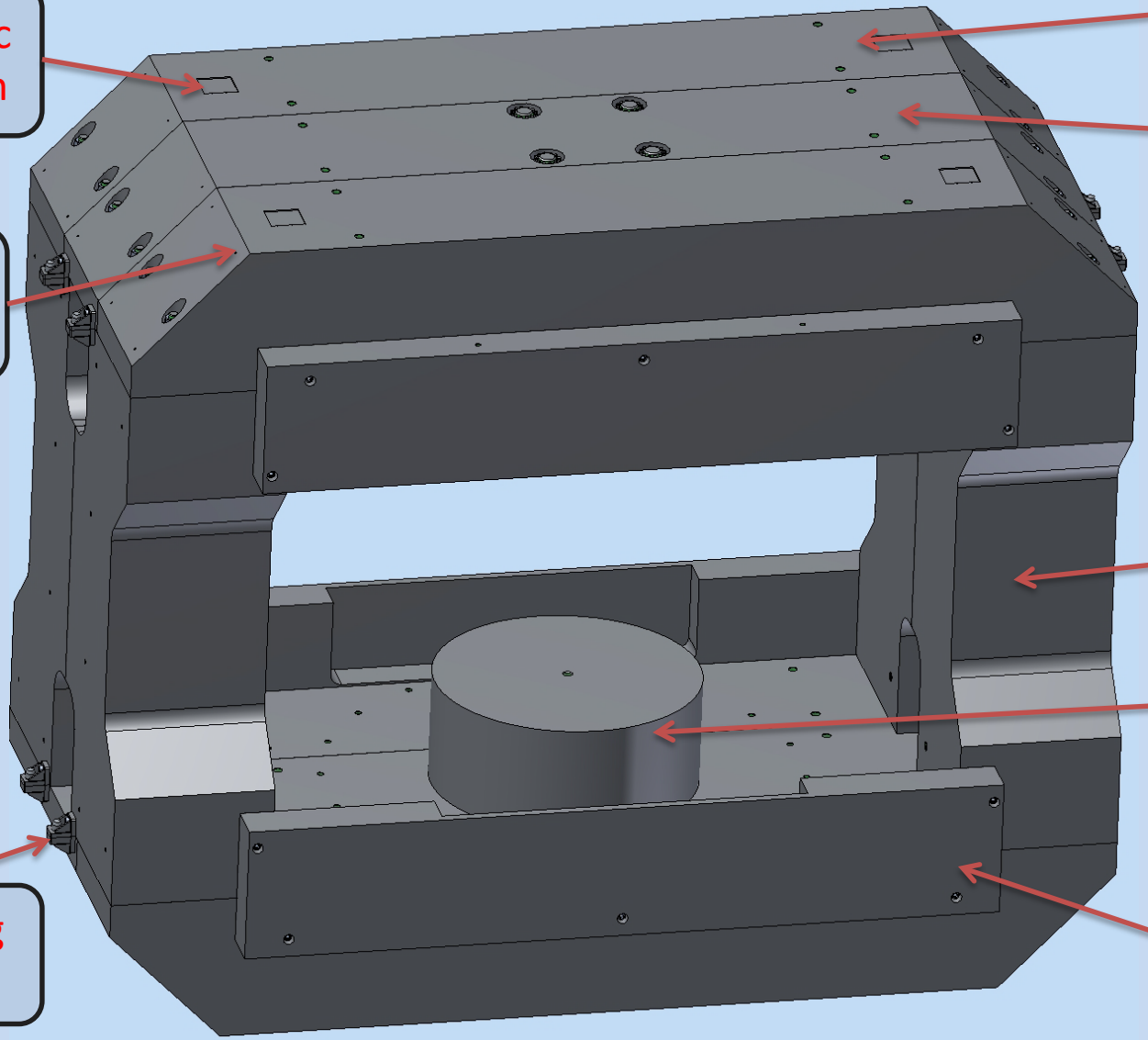
Iron Yoke and supports drawing



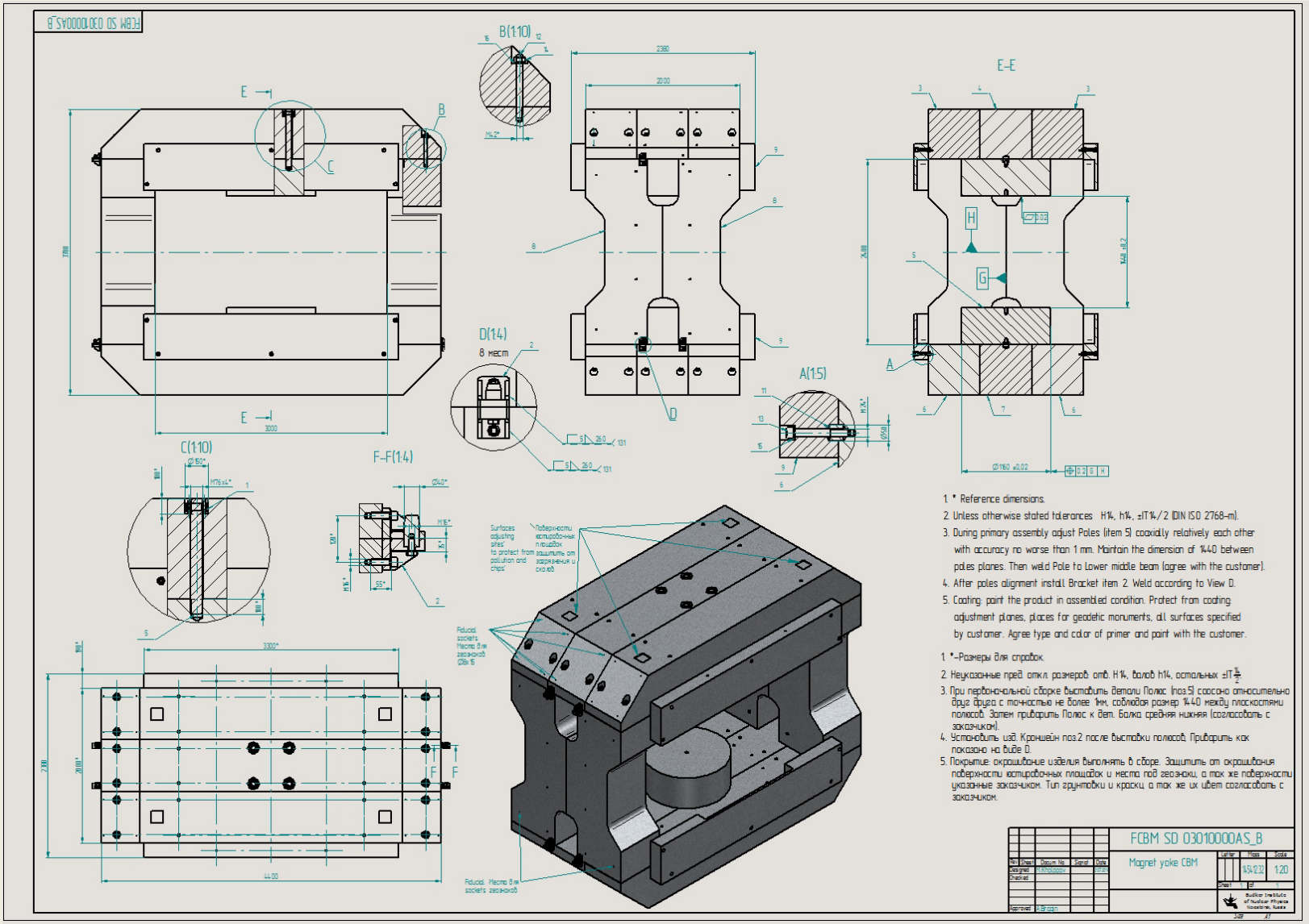
Weight and size

- m= 150000 kg
- L=4620mm
- W=2380mm
- H=4550mm

Iron Yoke 3D Model



Iron Yoke and supports drawing



Weight and size

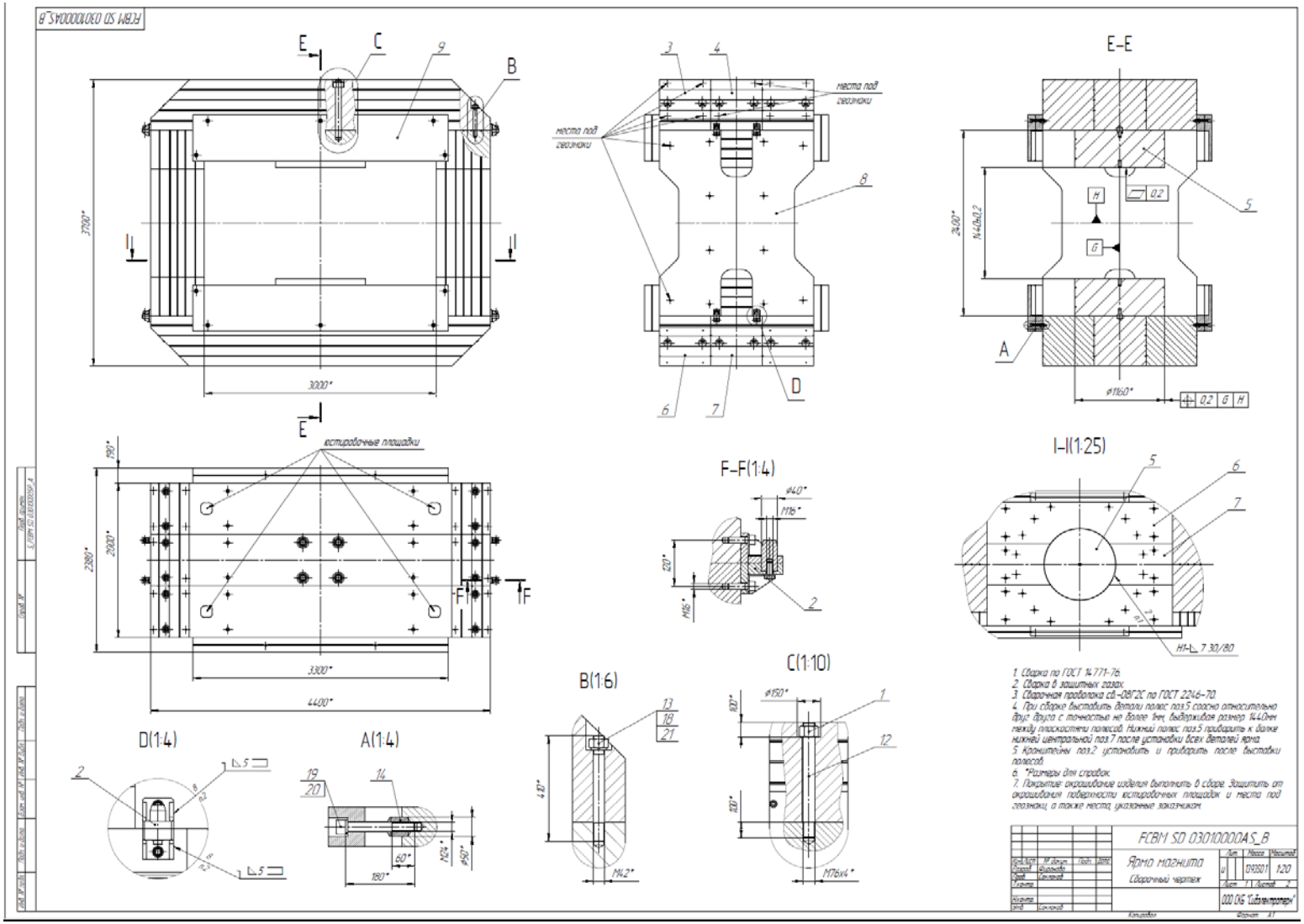
-m= 145412 kg

-L=4440mm

-W=2380mm

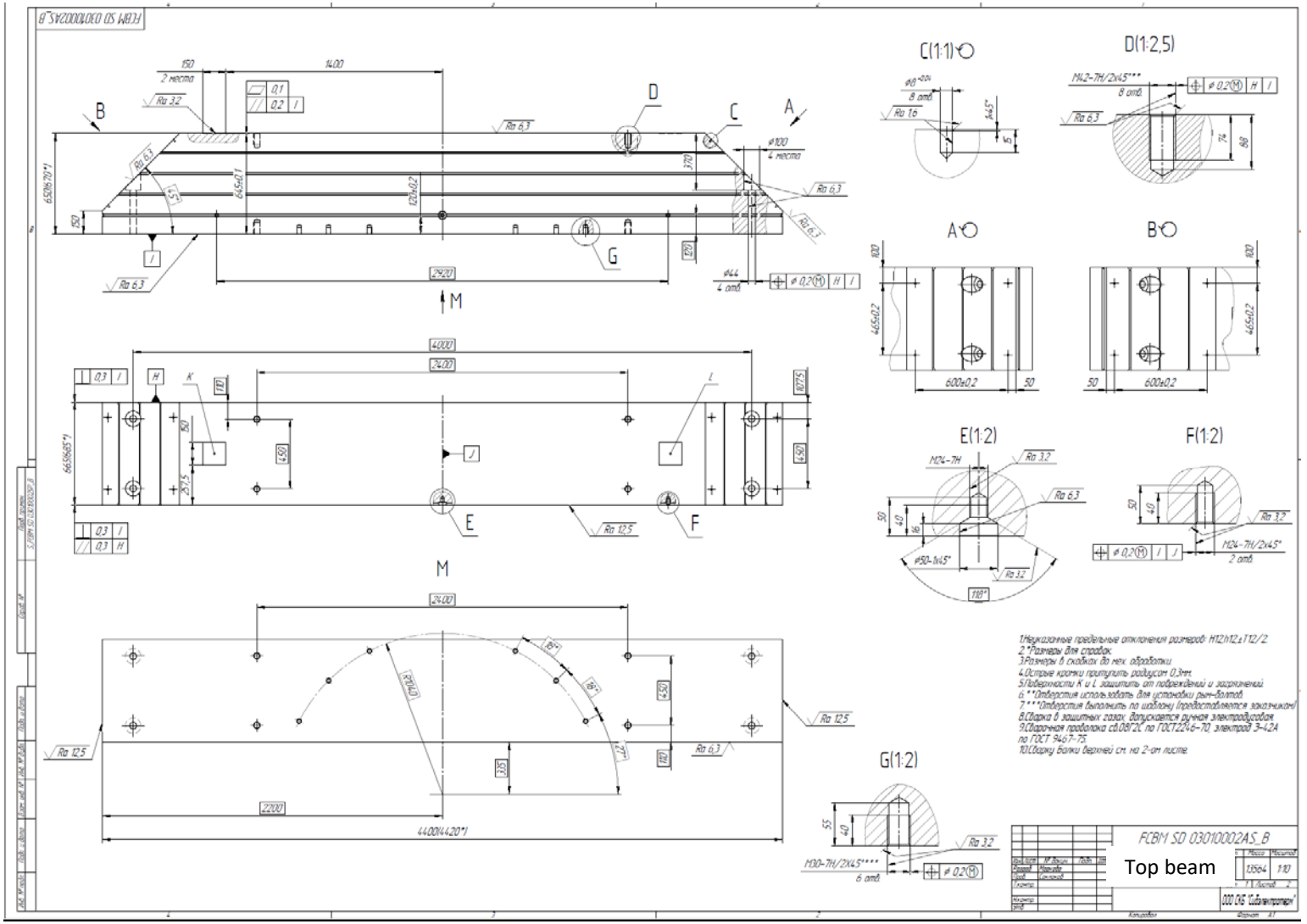
-H=3700mm

Iron Yoke production drawing



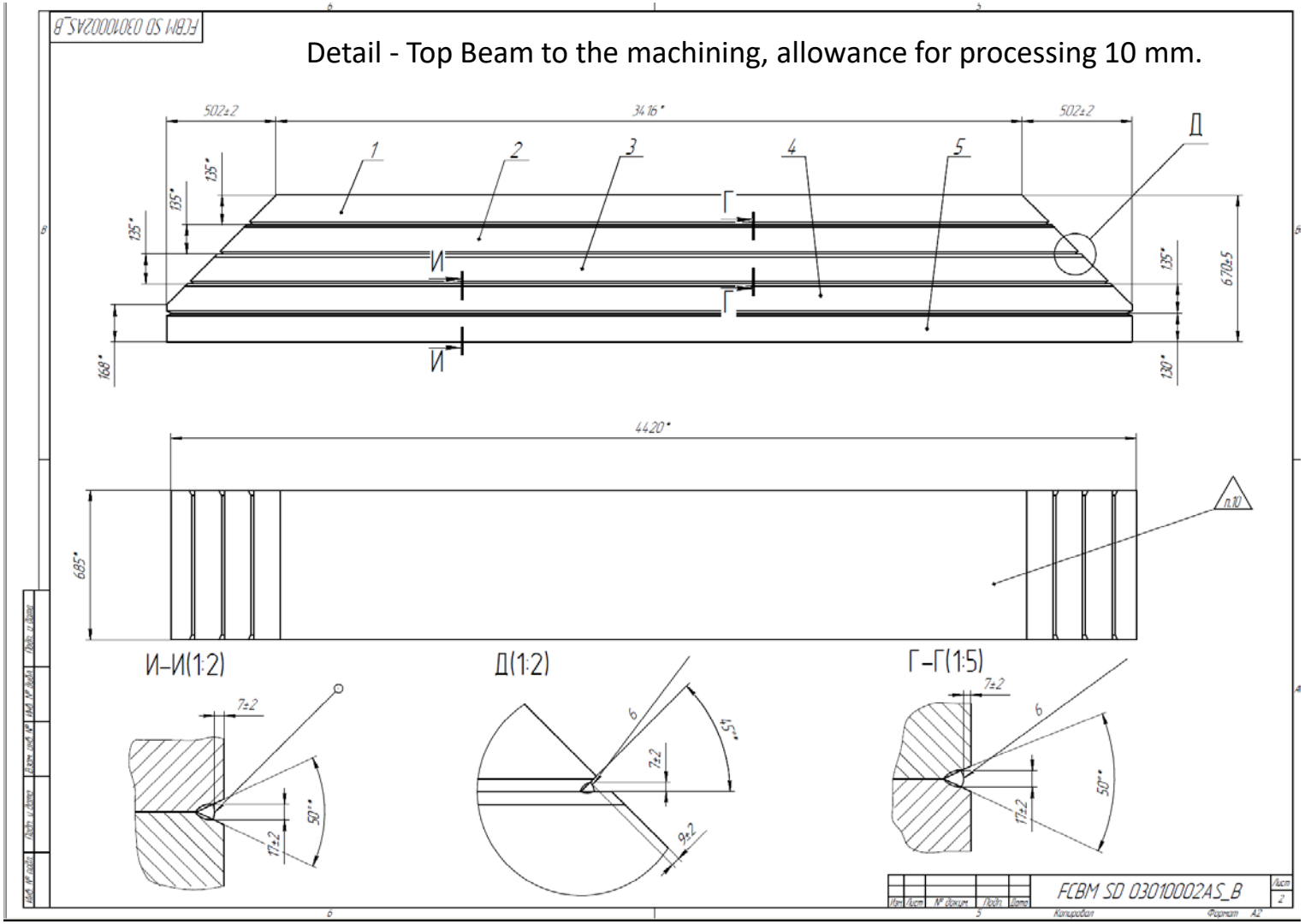
Drawings are processed in technologists and prepared for translation.

Iron Yoke production drawing



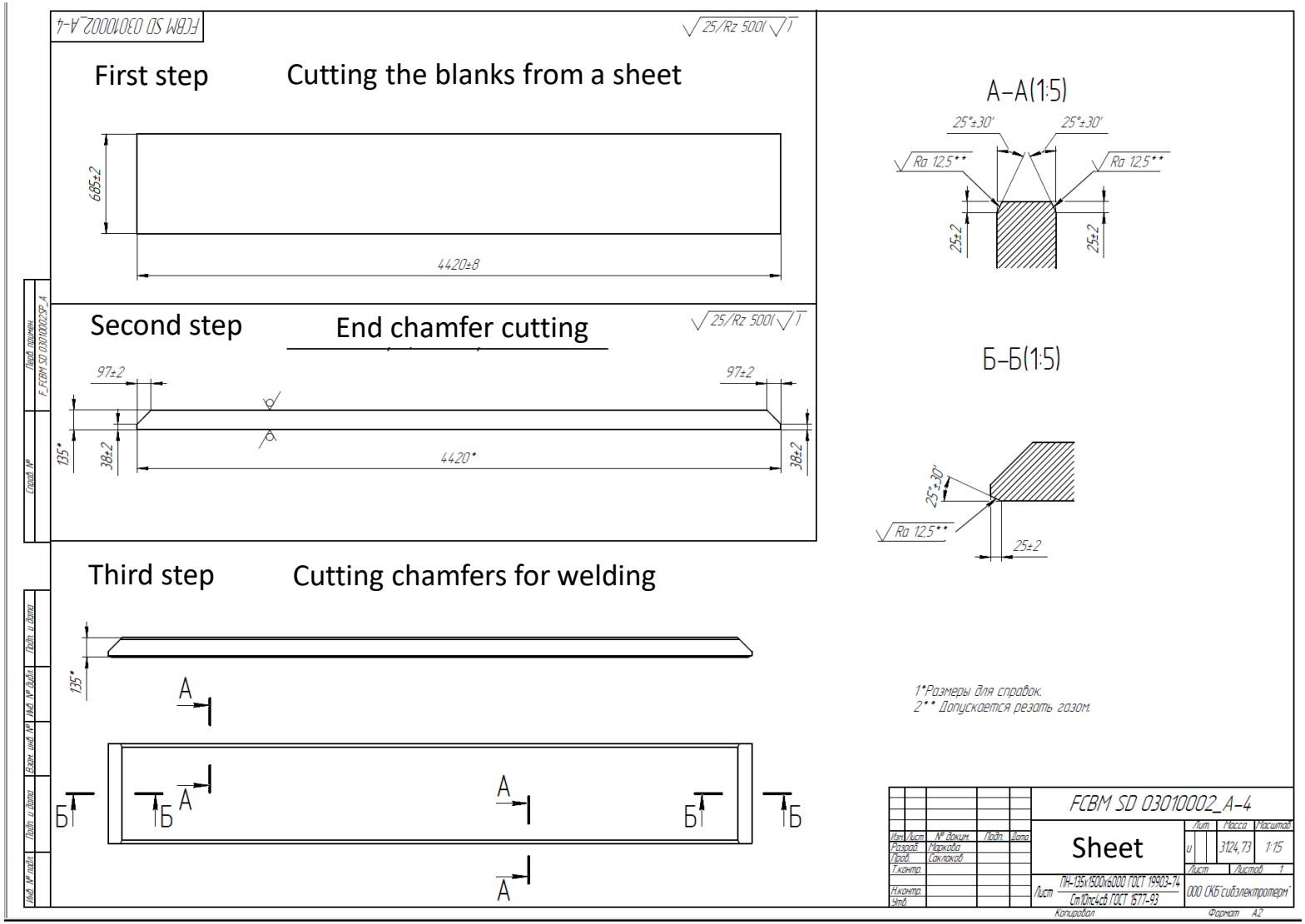
An example of the implementation of the yoke of sheet material.

Iron Yoke production drawing



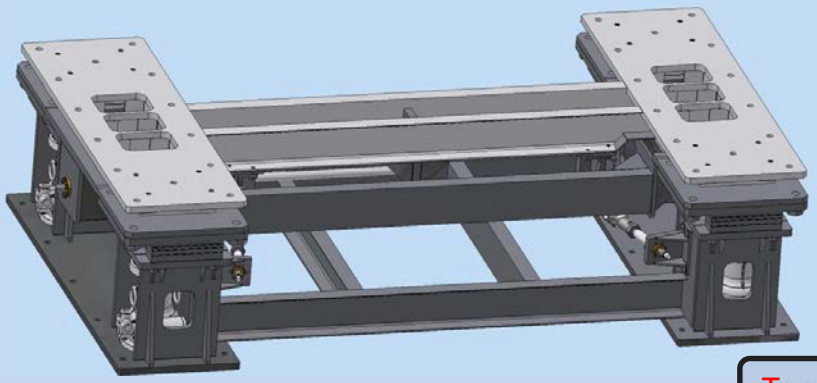
An example of the implementation of the yoke of sheet material.

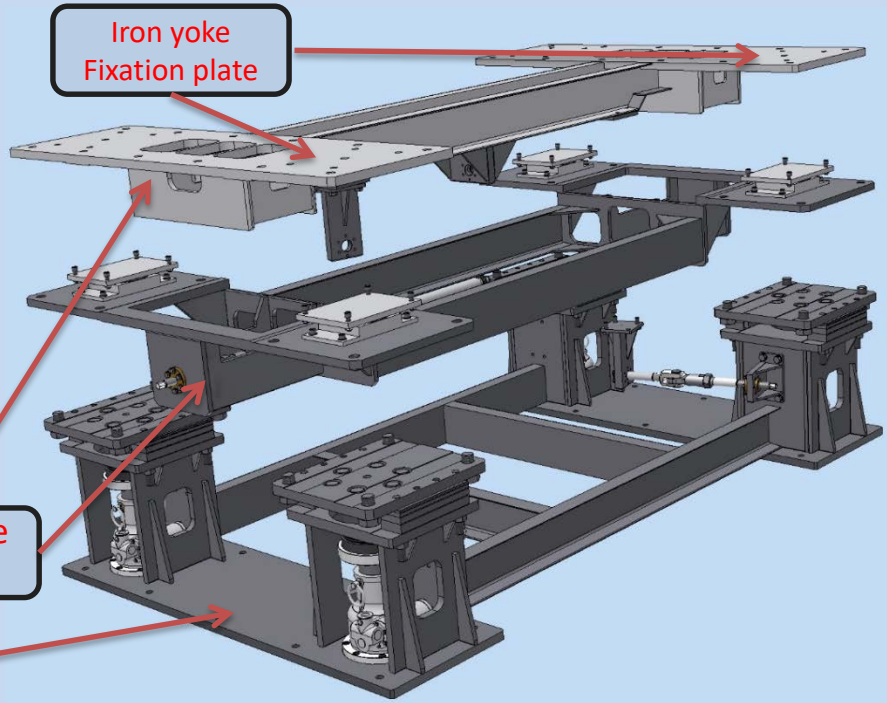
Iron Yoke production drawing



An example of the implementation of the yoke of sheet material.

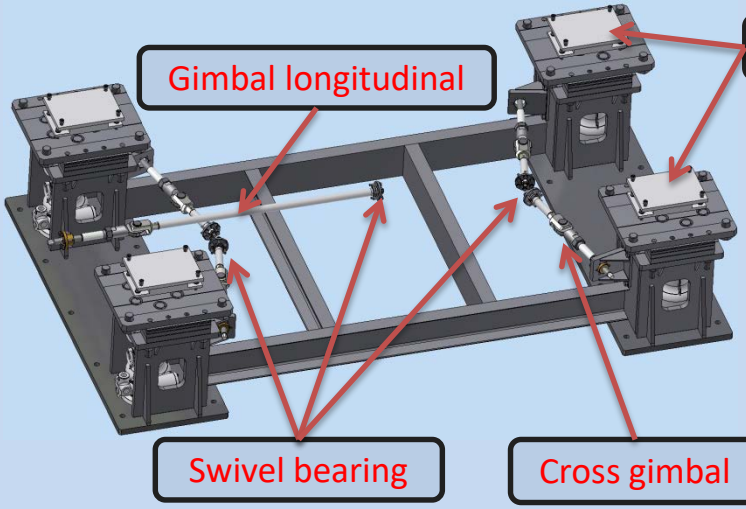
CBM Magnet support

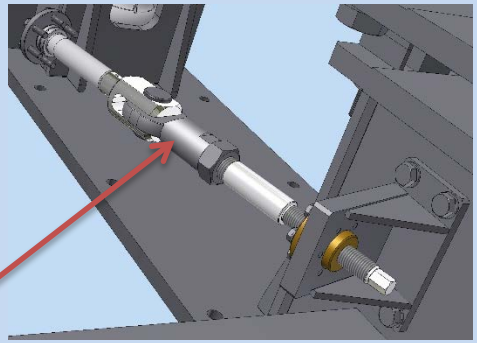




Magnet supports alignment tools

- Position accuracy: ± 0.5 mm (meeting in December 2018)
- Orientation accuracy (roll): ± 0.5 mrad
-Also, this design allows rotation around vertical axis ± 0.5 º
-The gimbals has a fixation and alignment tool

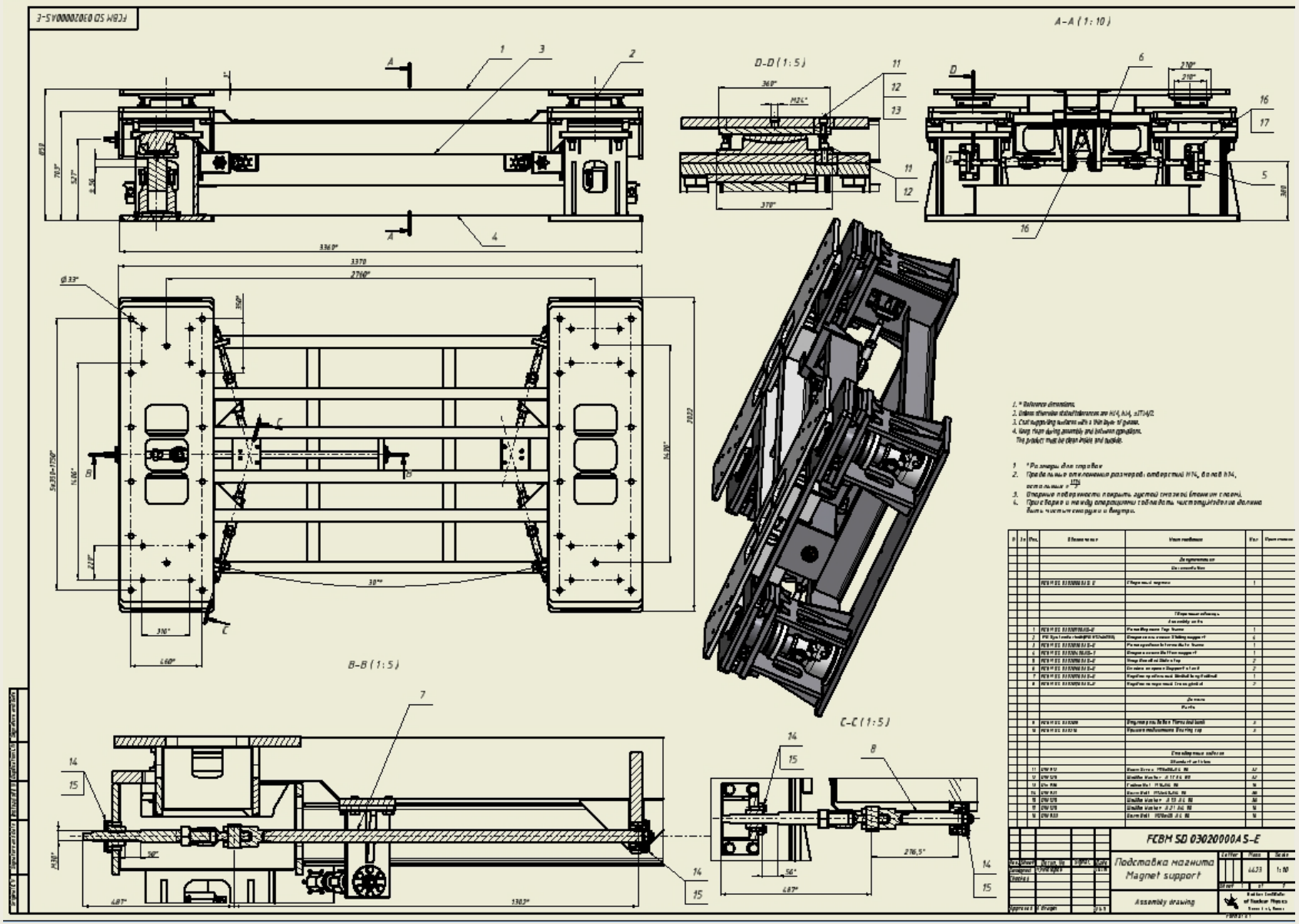




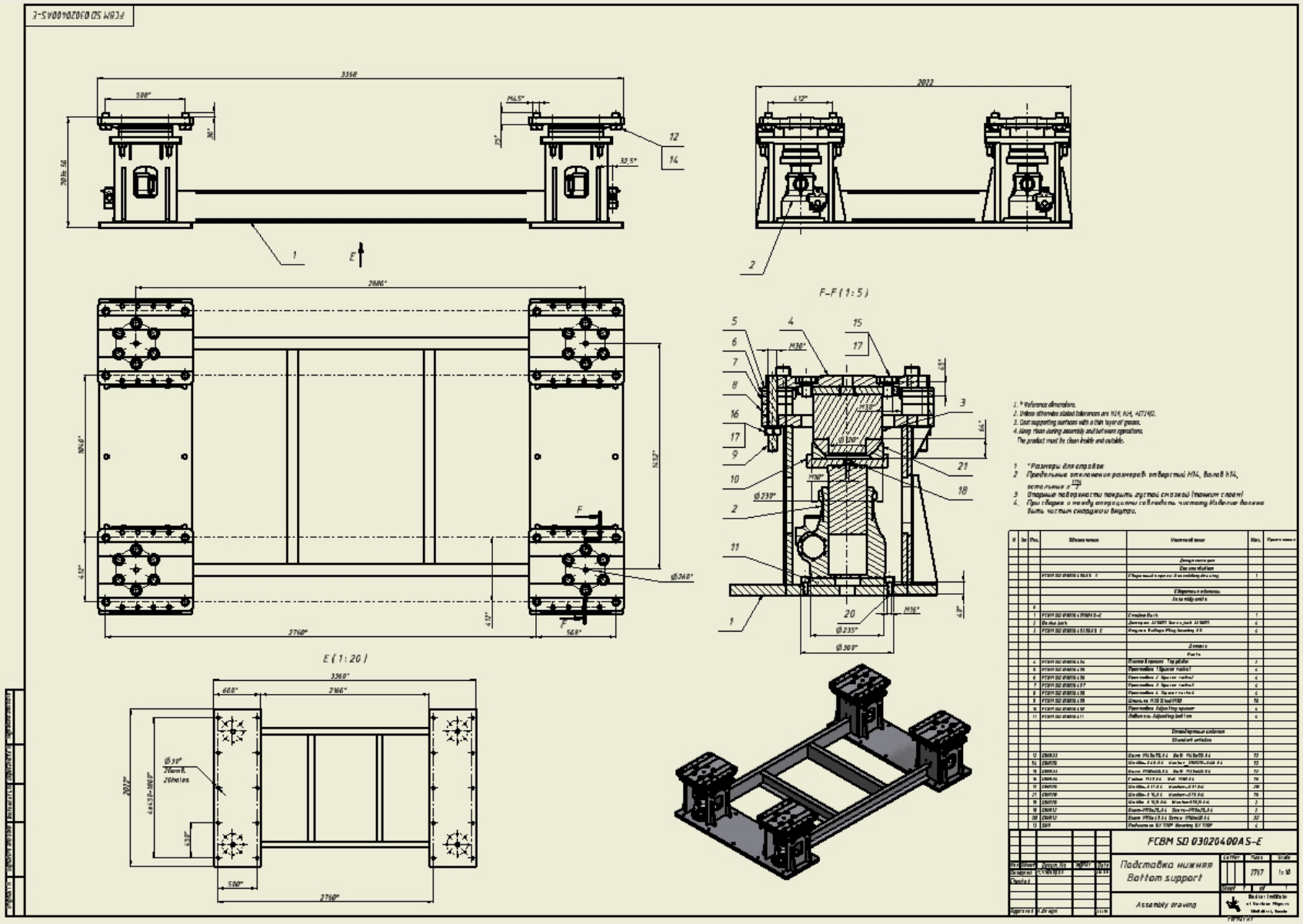
Weight and size

- m= 4480 kg
- 2022x3470x850mm
- move in 3D ±40mm
- Rotation top frame ±4º
- Loading capacity 200000 kg
- strength class of fasteners - 8.8

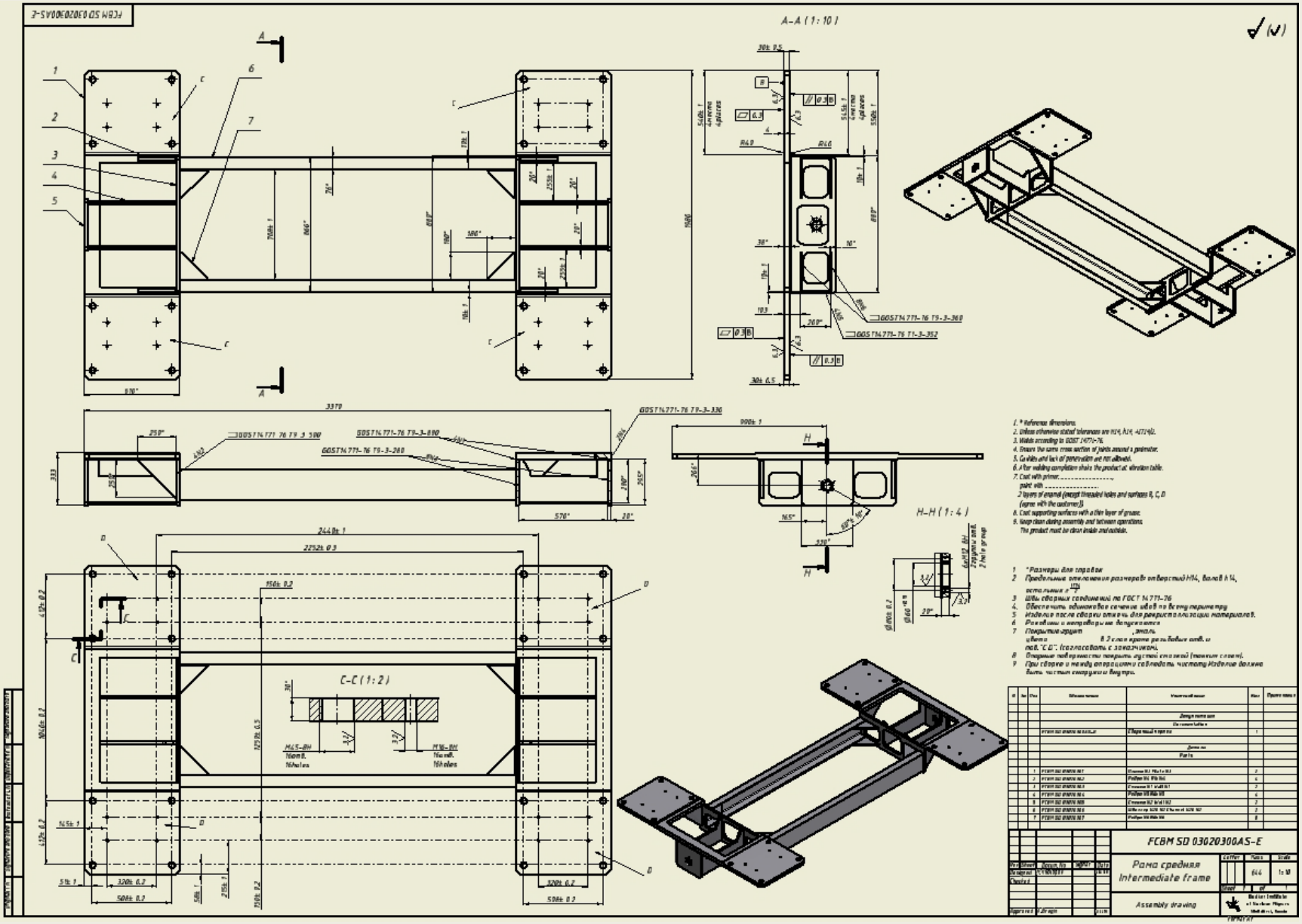
Magnet supports drawing



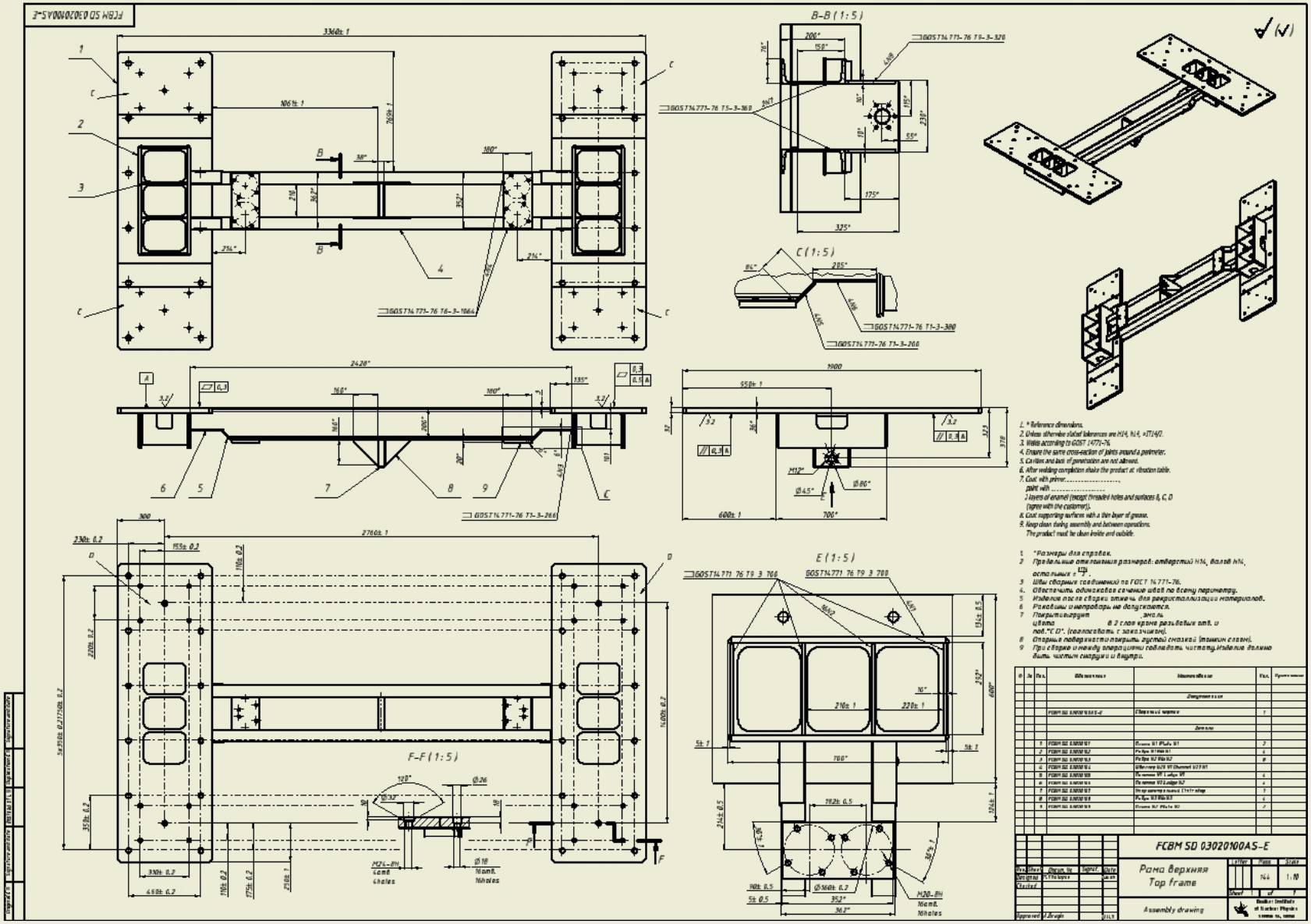
Bottom supports drawing



Intermediate frame drawing

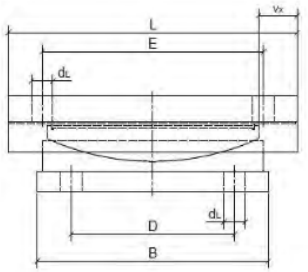


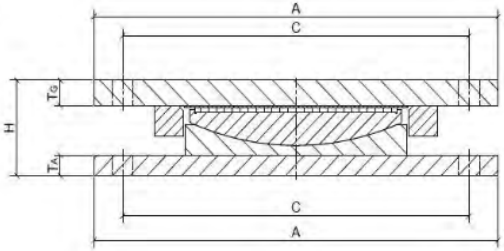
Top frame drawing

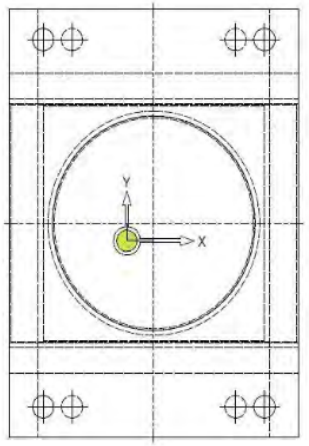


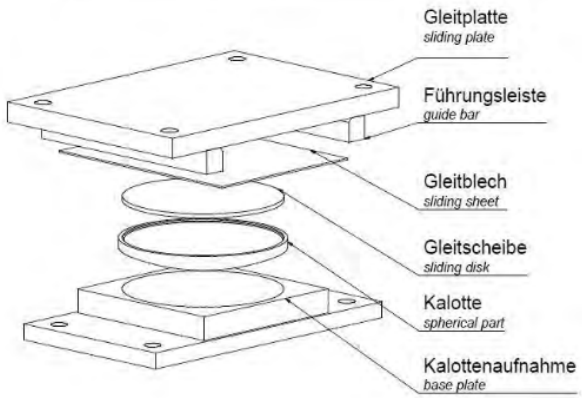
PGslide® Kalotten- Gleitlager mit 1 PTFE- Gleitelement, geführt
PGslide® spherical slide bearing with 1 PTFE pad, guided

K11sb









Typ / type	Lasten / loads max. NS,d [kN]	Lasten / loads Vy,sd [kN]	Abmessungen / dimensions [mm] A	B	C	D	T_A	T_G	H	d_L	L ± 20	L ± 40	L ± 80	E ± 20	E ± 40	E ± 80
K 11sb	**100**	20	200	100	160	60	10	10	**55**	14	120	160	240	80	120	200
K 11sb	**250**	50	250	140	210	100	10	15	**65**	14	160	200	280	120	160	240
K 11sb	**500**	100	330	180	280	120	15	20	**77**	18	200	240	320	150	190	270
K 11sb	**750**	150	370	210	320	150	15	20	**85**	18	230	270	350	180	220	300
K 11sb	**1.000**	200	420	240	360	170	20	25	**95**	22	260	300	380	190	230	310
K 11sb	**1.500**	300	520	290	440	200	20	25	**100**	26	310	350	430	230	270	350
K 11sb	**2.000**	400	620	330	520	230	30	30	**117**	32	350	390	470	250	290	370
K 11sb	**2.500**	500	670	370	570	270	30	40	**133**	32	390	430	510	290	330	410
K 11sb	**3.000**	600	700	400	600	300	30	40	**133**	32	420	460	540	320	360	440
K 11sb	**3.500**	700	760	430	660	330	30	50	**150**	32	450	490	570	350	390	470
K 11sb	**4.000**	800	810	450	690	330	35	55	**158**	38	470	510	590	350	390	470
K 11sb	**4.500**	900	870	480	750	360	35	55	**165**	38	500	540	620	380	420	500
K 11sb	**5.000**	1.000	890	500	770	380	35	55	**164**	38	520	560	640	400	440	520

PTFE plate can be replaced with radiation resistant material. For example bronze with lubrication.

PTFE bearings are maintenance-free, this also applies to lubricated PTFE bearings;

Very Low Friction Constant

For the sake of simplicity, the following friction constants may be assumed under optimum installation conditions:

PTFE bearing, not lubricated about max. $\mu = 0.1$

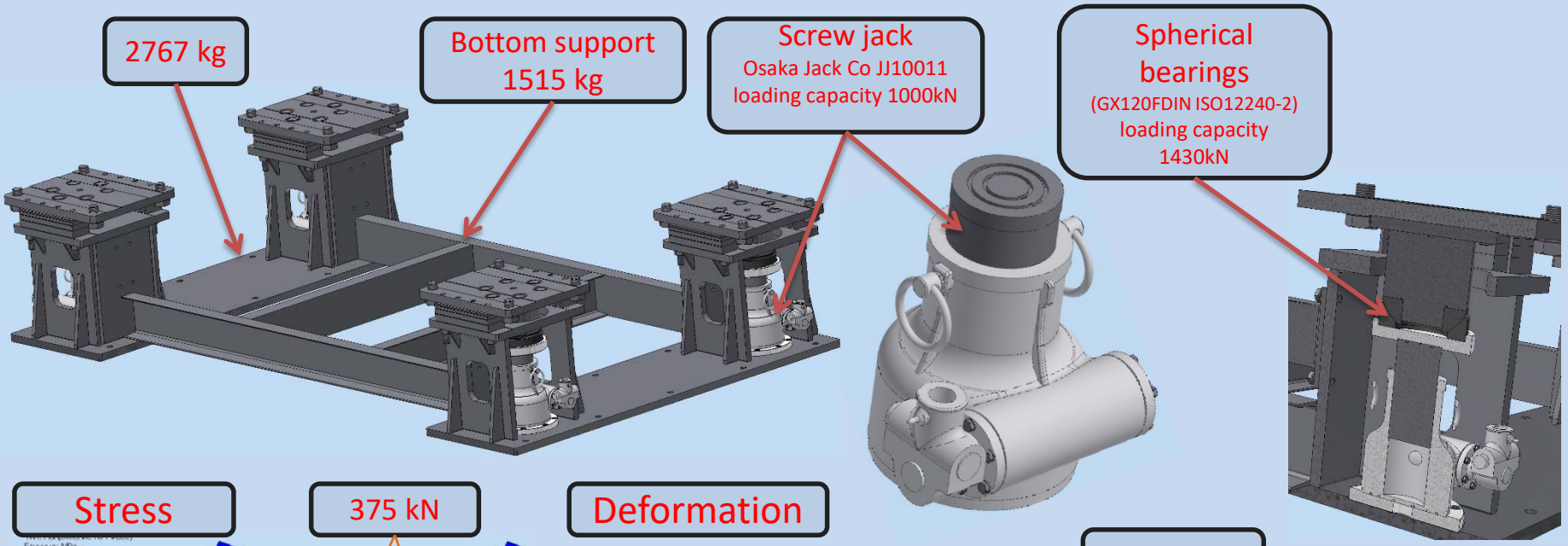
PTFE bearing, lubricated about max. $\mu = 0.04$

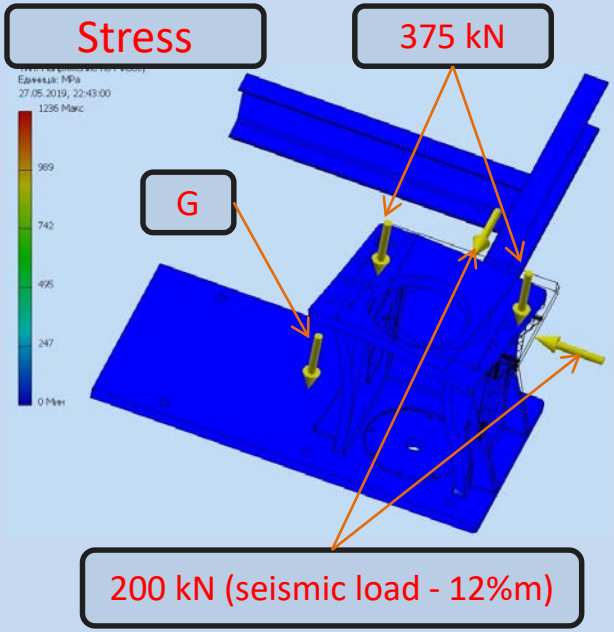
The PTFE slidingplates are absolutely corrosion resistant, re-sistant against chemicals and aging. The steel parts of the bearings are by standard sandblasted and provided with a zinc phosphate coating. Upon request, all usual corrosion protection processes are of-fered, including hot galvanizing. Versions made of special steel alloys or stainless steel on request

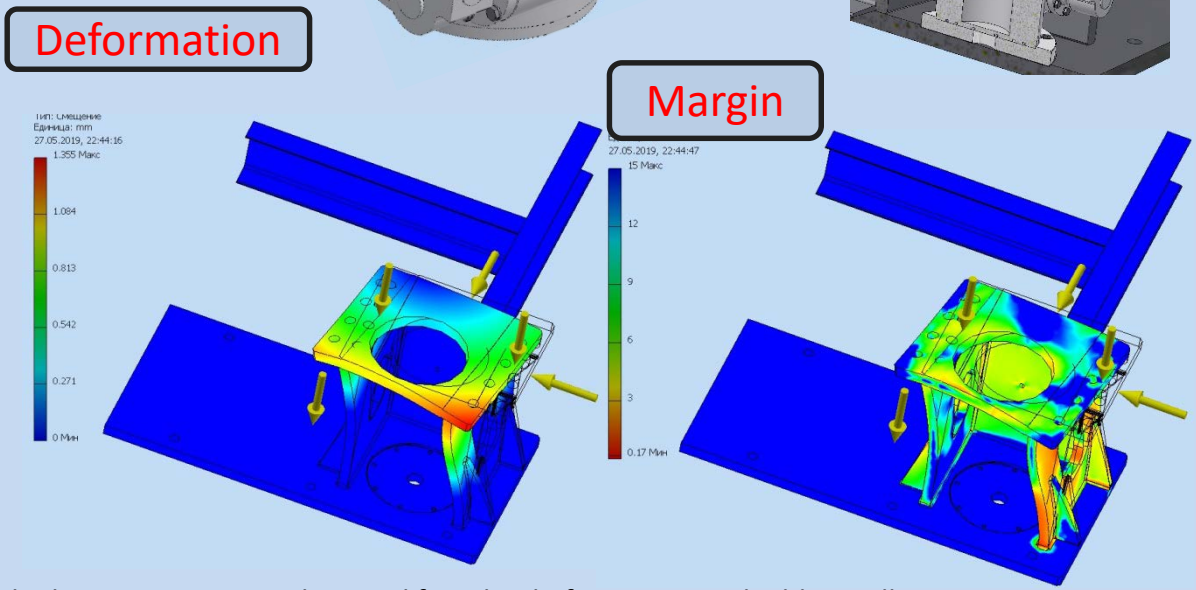
Fastener strength tablet

class of fasteners			ST-4.6		ST-8.8		A2-70		A4-80	
Thread	d2, мм	Площадь по d2, mm2	MAX load, N	Work load, kg	MAX load, N	Work load, kg	MAX load, N	Work load, kg	MAX load, N	Work load, kg
M 1	0,8	0,5	121	0	322	10	126	0	151	0
M 2	1,7	2,27	544	20	1 452	70	567	20	681	30
M 3	2,6	5,31	1 274	60	3 396	160	1 327	60	1 592	70
M 4	3,5	9,62	2 308	110	6 154	300	2 404	120	2 885	140
M 5	4,4	15,2	3 647	180	9 726	480	3 799	180	4 559	220
M 6	5,3	22,05	5 292	260	14 112	700	5 513	270	6 615	330
M 8	7,1	39,57	9 497	470	25 326	1 260	9 893	490	11 872	590
M10	8,9	62,18	14 923	740	39 795	1 980	15 545	770	18 654	930
M12	**10,7**	**89,87**	**21 570**	**1 070**	**57 520**	**2 870**	**22 469**	**1 120**	**26 962**	**1 340**
M14	12,6	124,63	29 910	1 490	79 761	3 980	31 157	1 550	37 388	1 860
M16	14,6	167,33	40 159	2 000	107 092	5 350	41 833	2 090	50 199	2 500
M20	18,3	262,89	63 093	3 150	168 249	8 410	65 722	3 280	78 867	3 940
M24	21,9	376,49	90 359	4 510	240 956	12 040	94 123	4 700	112 948	5 640
M27	24,9	486,71	116 810	5 840	311 493	15 570	121 677	6 080	146 012	7 300
M30	27,6	597,98	143 516	7 170	382 708	19 130	149 495	7 470	179 394	8 960

Screw jack Rack : design and calculation

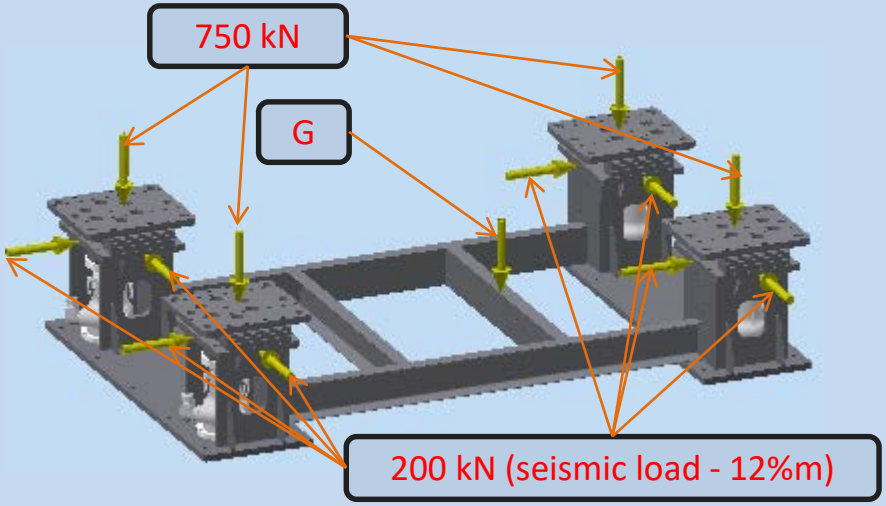


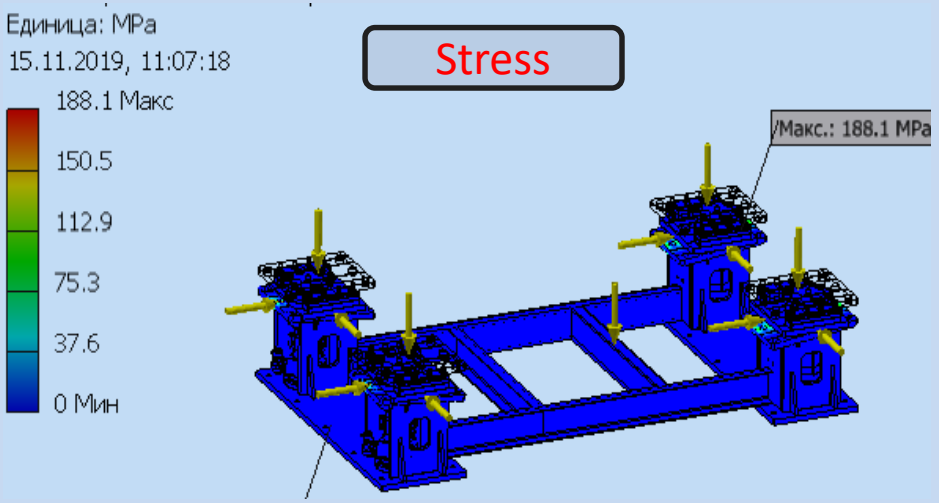


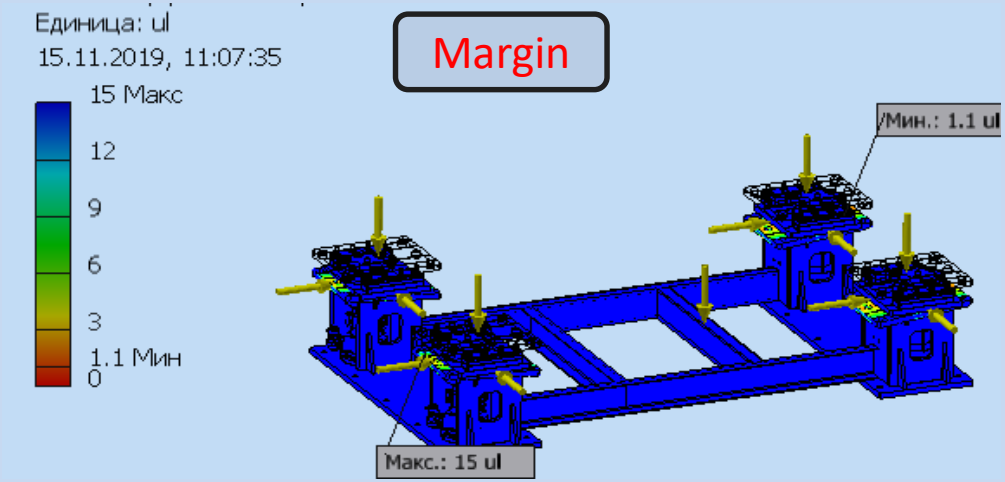


The bottom support is designed for a load of 200 tons and additionally added seismic hazar (20 tons)

Screw jack Rack : design and calculation



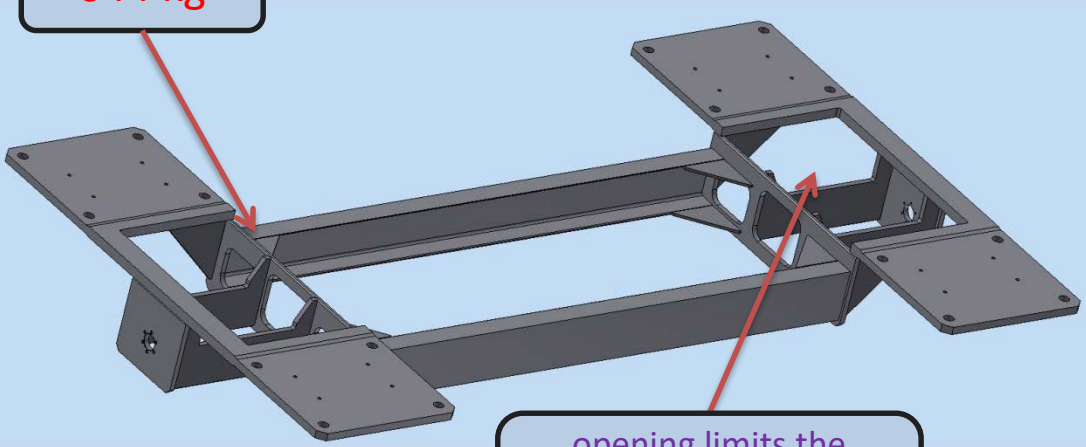




The bottom support is designed for a load of 200 tons and additionally added seismic hazar (20 tons)

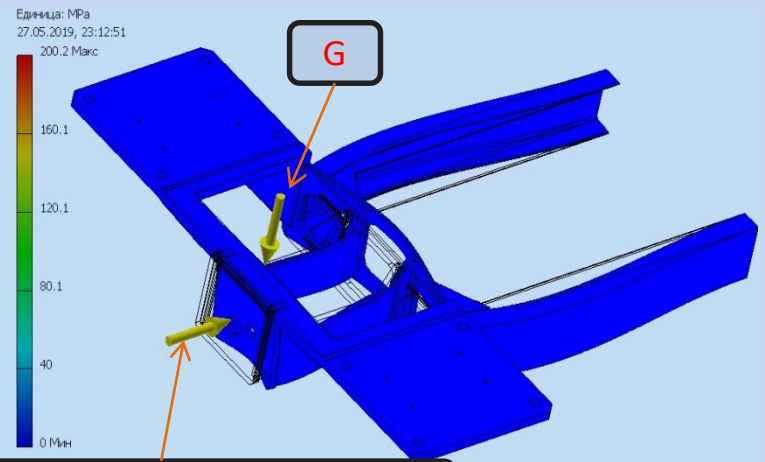
Intermediate frame : design and calculation

644 kg



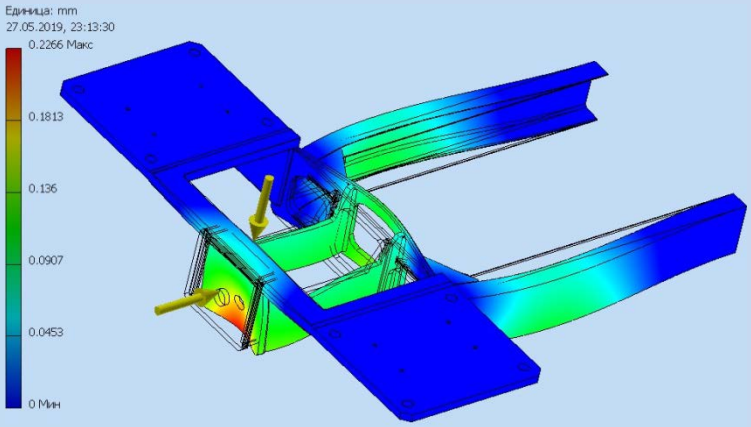
opening limits the movement of the Top frame

Stress

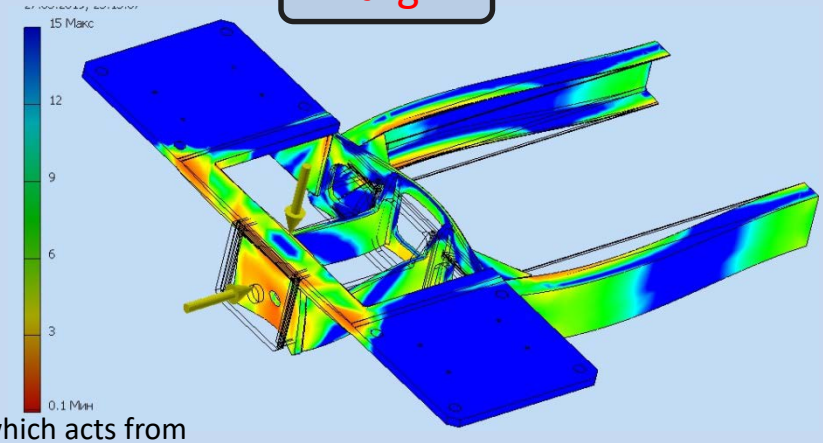


200 kN (seismic load - 12%m)

Deformation



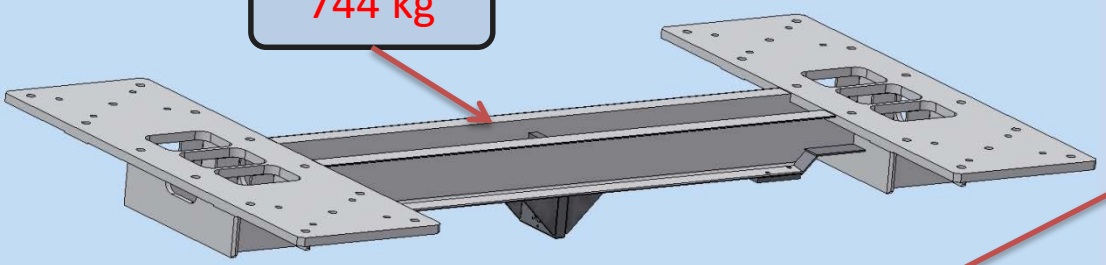
Margin

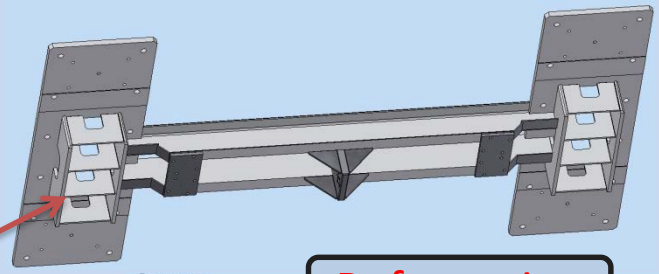


The intermediate frame is designed for seismic load which acts from the gimbal longitudinal (20 tons)

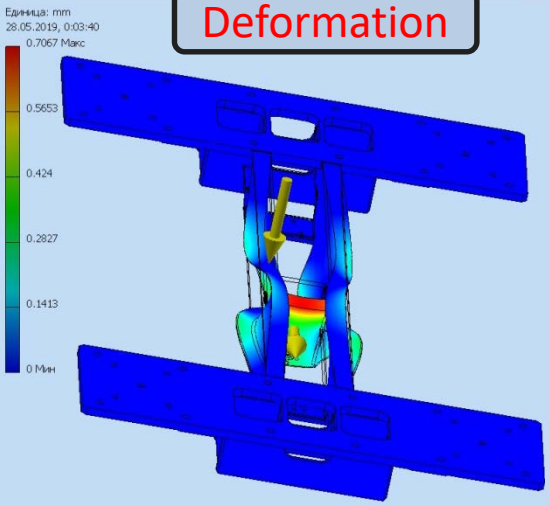
Top frame : design and calculation

744 kg



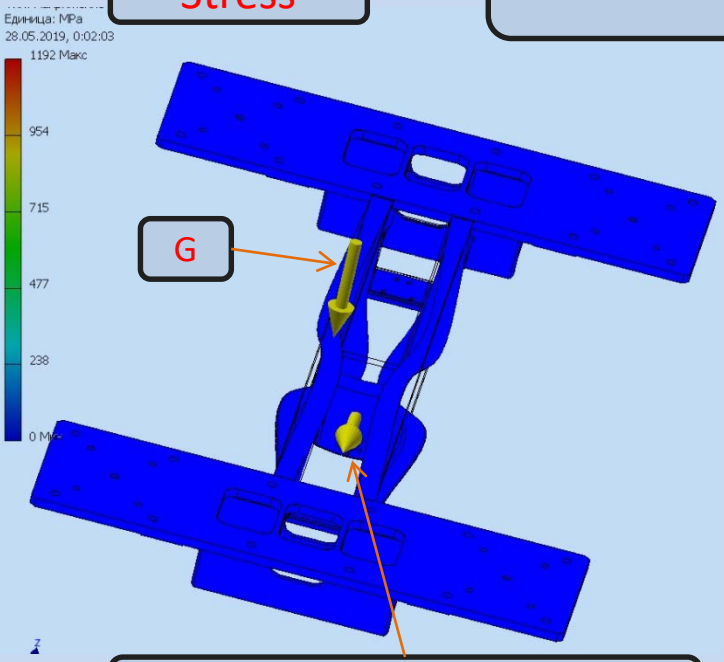


Deformation



Box limiting the movement of the Top frame in the opening of the Intermediate frame

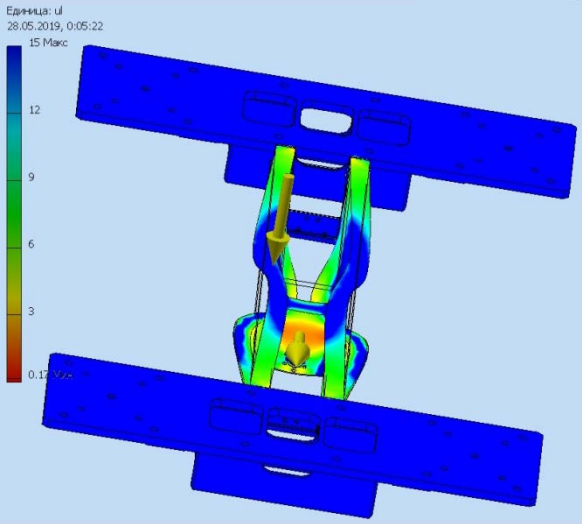
Stress



G

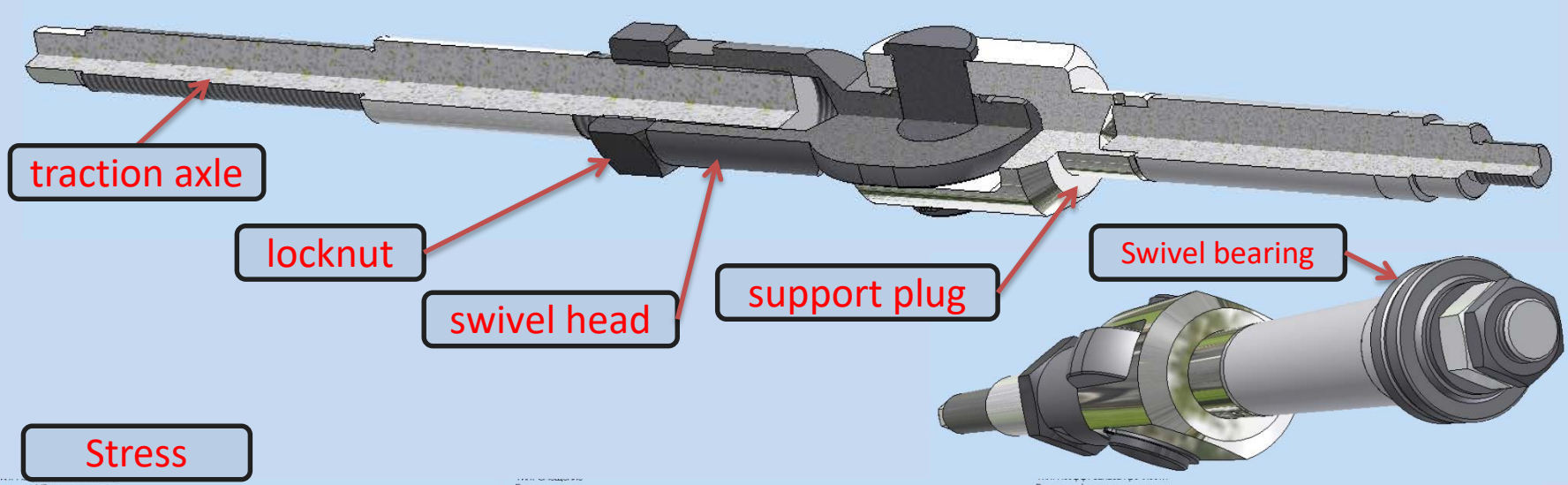
200 kN (seismic load - 12%m)

Margin

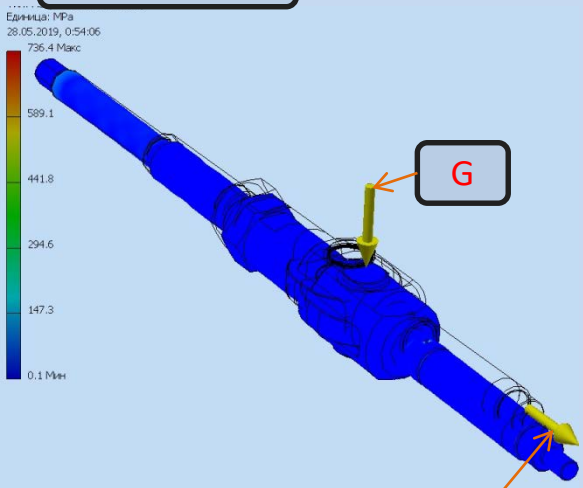


The top frame is designed for seismic load which acts from the gimbal longitudinal (20 tons)

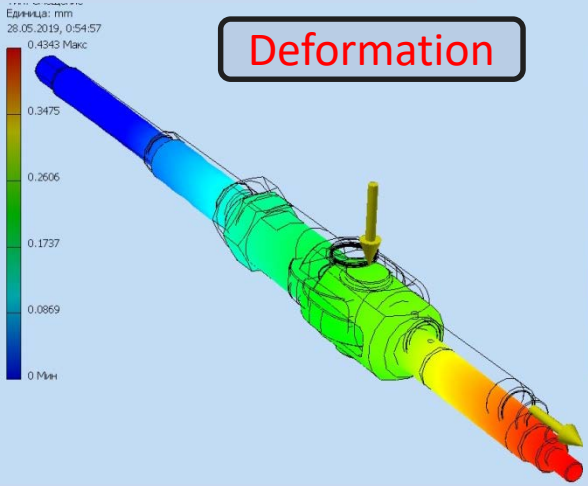
Gimbals : design and calculation



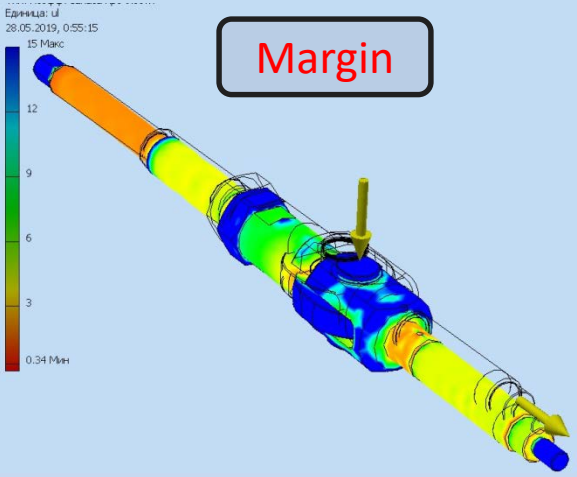
Stress



Deformation



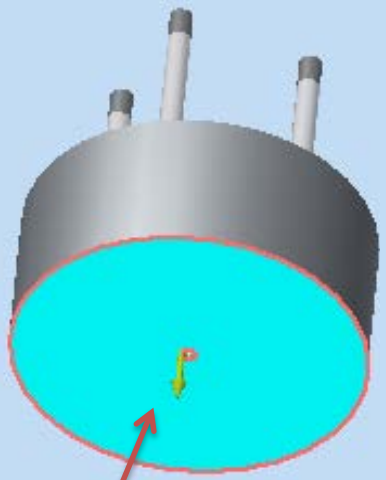
Margin



200 kN (seismic load - 12%m)

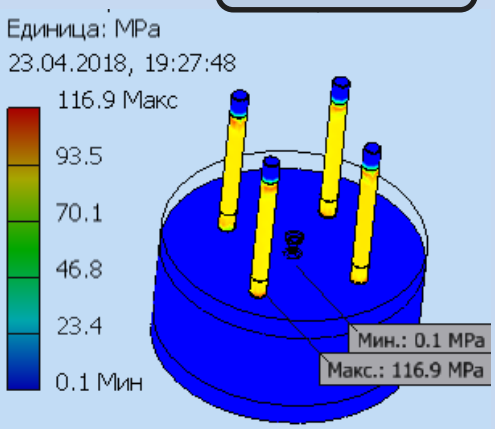
- workload : 50kN
- design load: 200kN

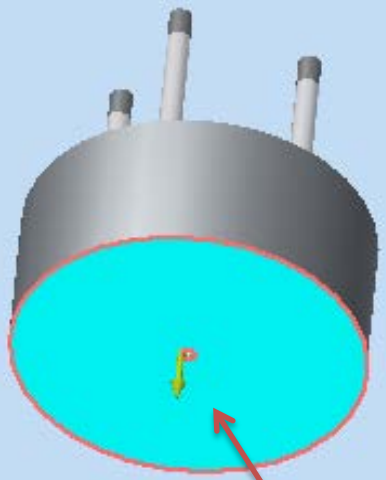
Calculation of studs for Pole CBM magnet



1500000N

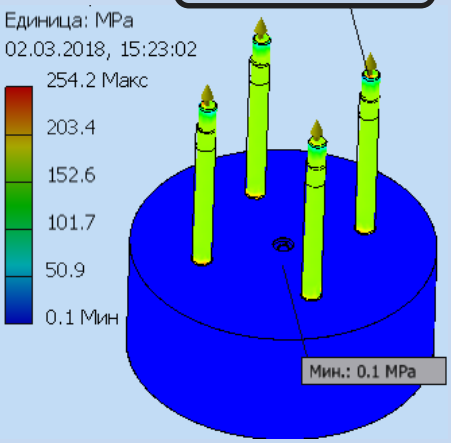
Stress



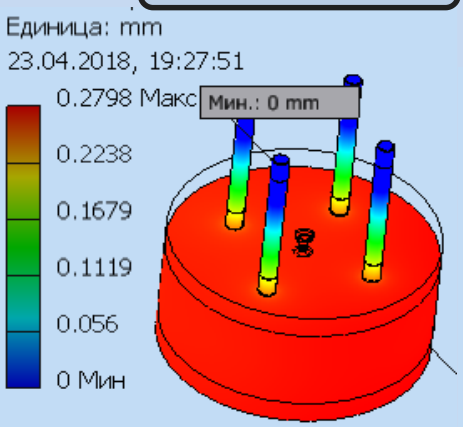


3000000N

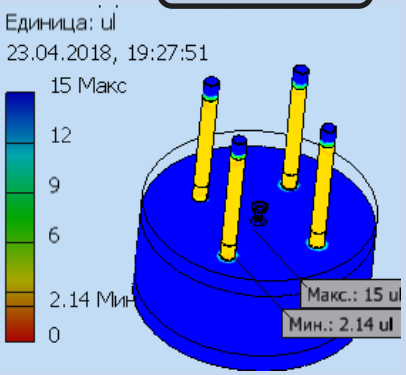
Stress



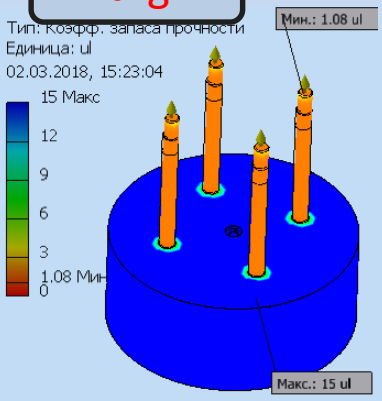
Deformation



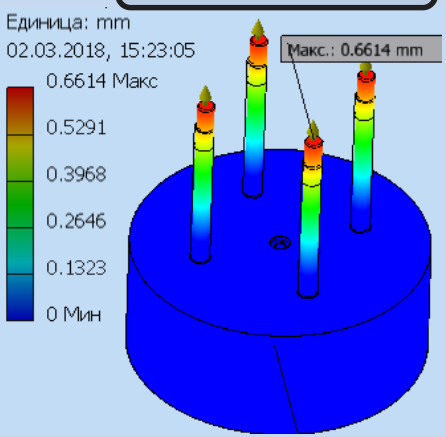
Margin



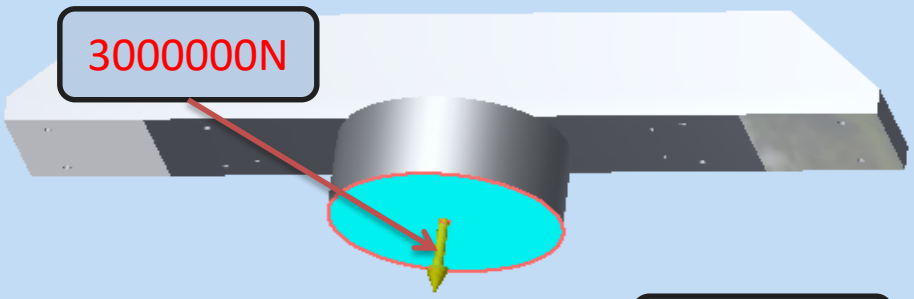
Margin



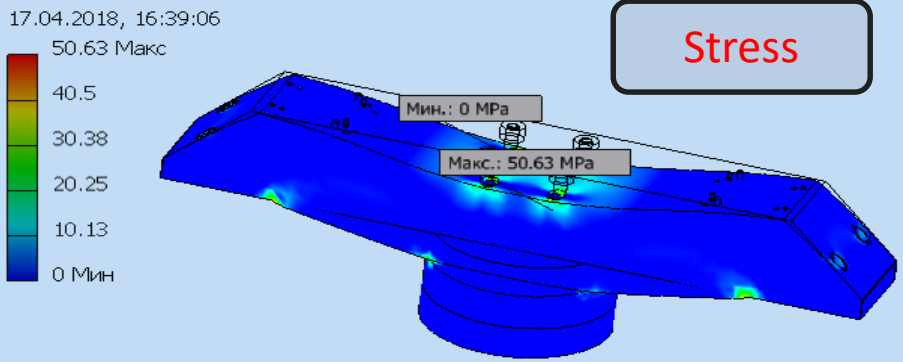
Deformation

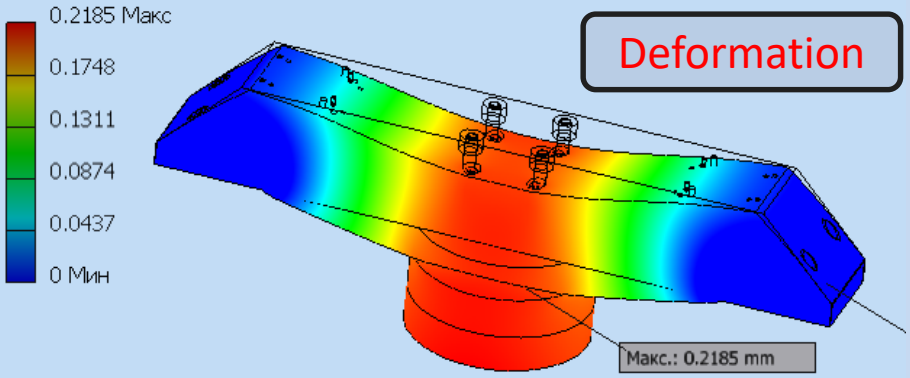


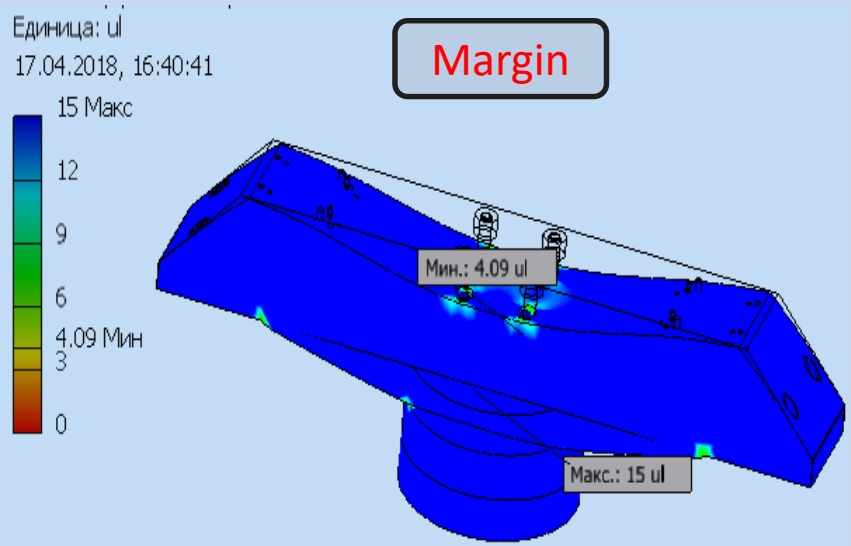
Calculation of Pole & crossbar CBM magnet



Имя	Low carbon steel	
General	Mass density	7.86 г/см^3
	Yield strength	207 МПа
	Ultimate tensile strength	345 МПа
stress	young modulus	220 ГПа
	poisson ratio	0.275 бр
	Shear modulus of elasticity	86.2745 ГПа







Thank you for your attention!