

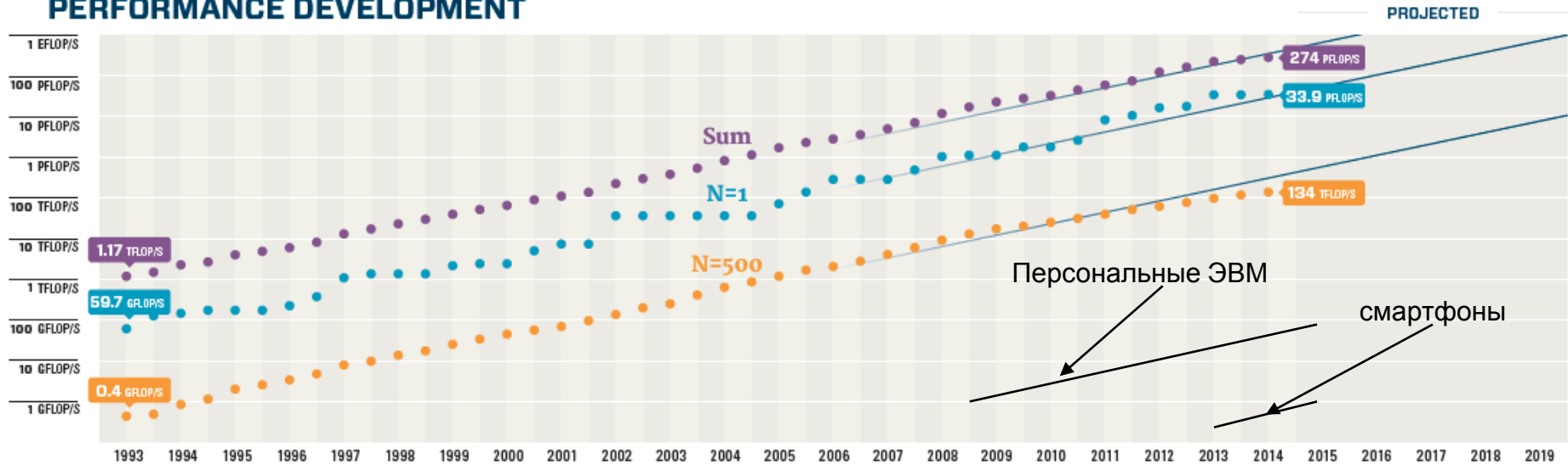
Многопроцессорные и многоядерные вычислительные системы в инженерных расчетах



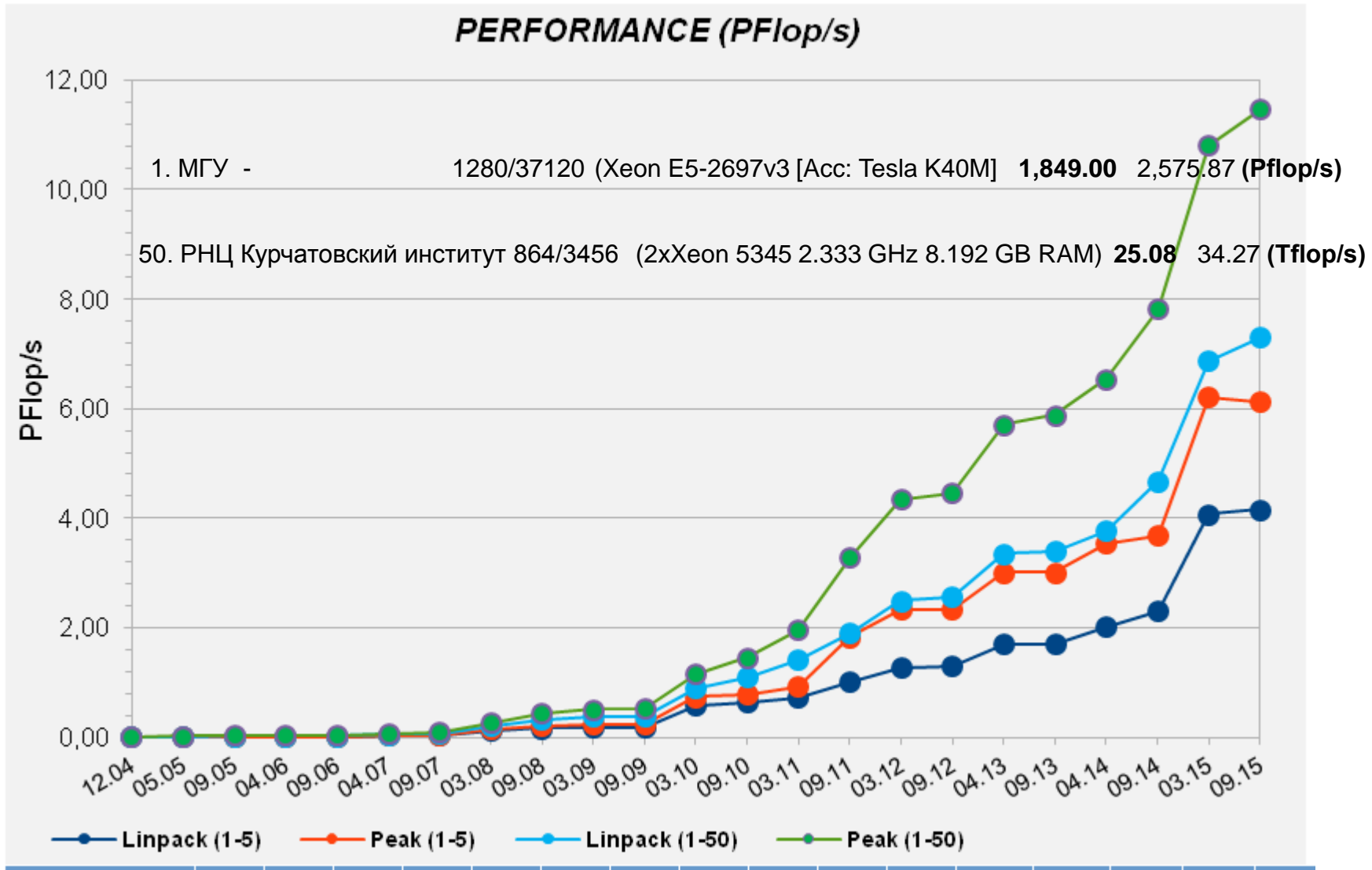
TOP 500

	NAME	SPECS	SITE	COUNTRY	CORES	R _{MAX} PFLOP/S	POWER MW
1	Tianhe-2 (Milkyway-2)	NUDT, Intel Ivy Bridge (12C, 2.2 GHz) & Xeon Phi (57C, 1.1 GHz), Custom interconnect	NSCC Guangzhou	China	3,120,000	33.9	17.8
2	Titan	Cray XK7, Operon 6274 (16C 2.2 GHz) + Nvidia Kepler GPU, Custom interconnect	DOE/SC/ORNL	USA	560,640	17.6	8.2
3	Sequoia	IBM BlueGene/Q, Power BQC (16C 1.60 GHz), Custom interconnect	DOE/NNSA/LLNL	USA	1,572,864	17.2	7.9
4	K computer	Fujitsu SPARC64 VIIIfx (8C, 2.0GHz), Custom interconnect	RIKEN AICS	Japan	705,024	10.5	12.7
5	Mira	IBM BlueGene/Q, Power BQC (16C, 1.60 GHz), Custom interconnect	DOE/SC/ANL	USA	786,432	8.59	3.95

PERFORMANCE DEVELOPMENT



TOP 50



Хайльбронн электостанция

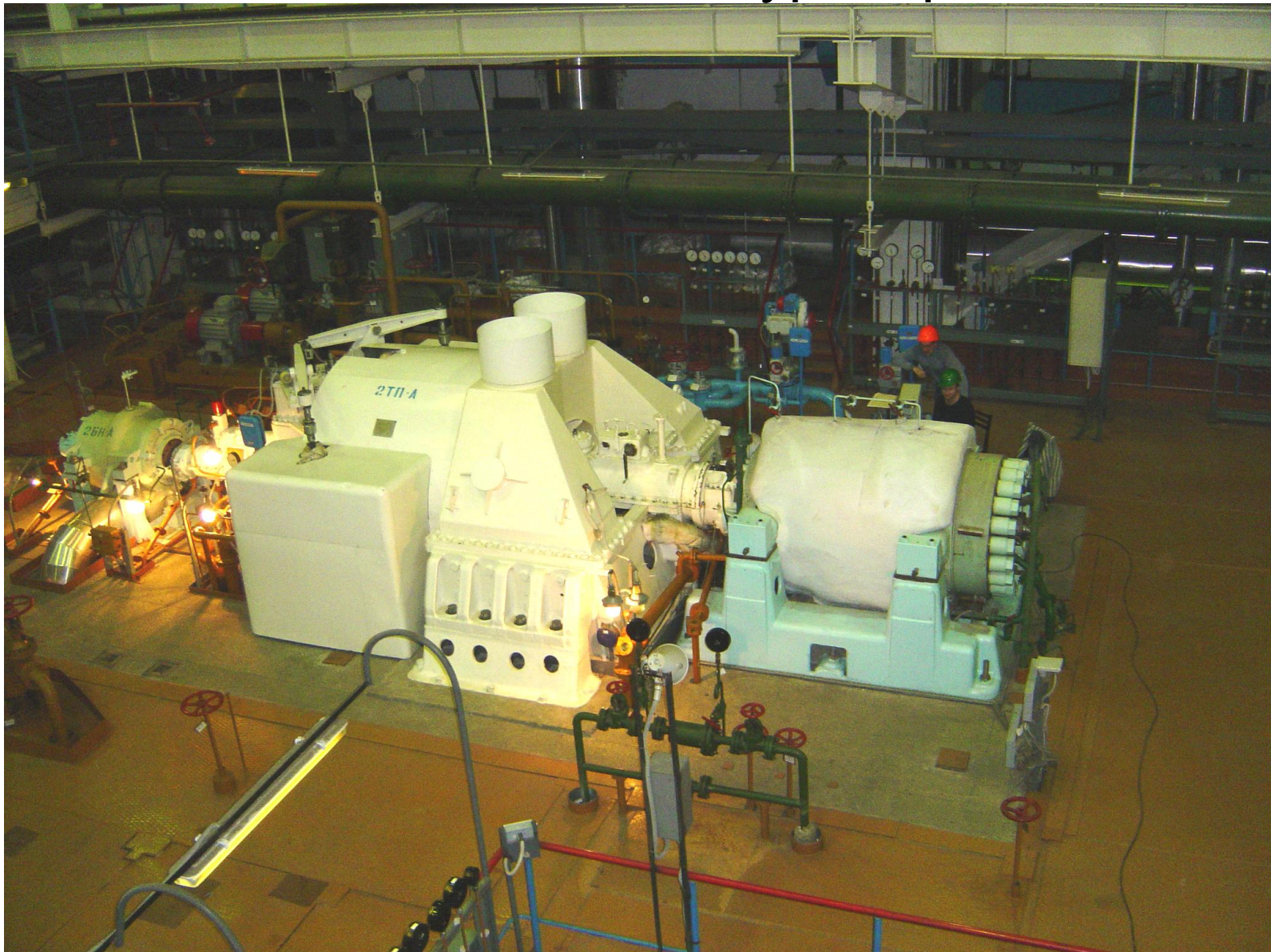




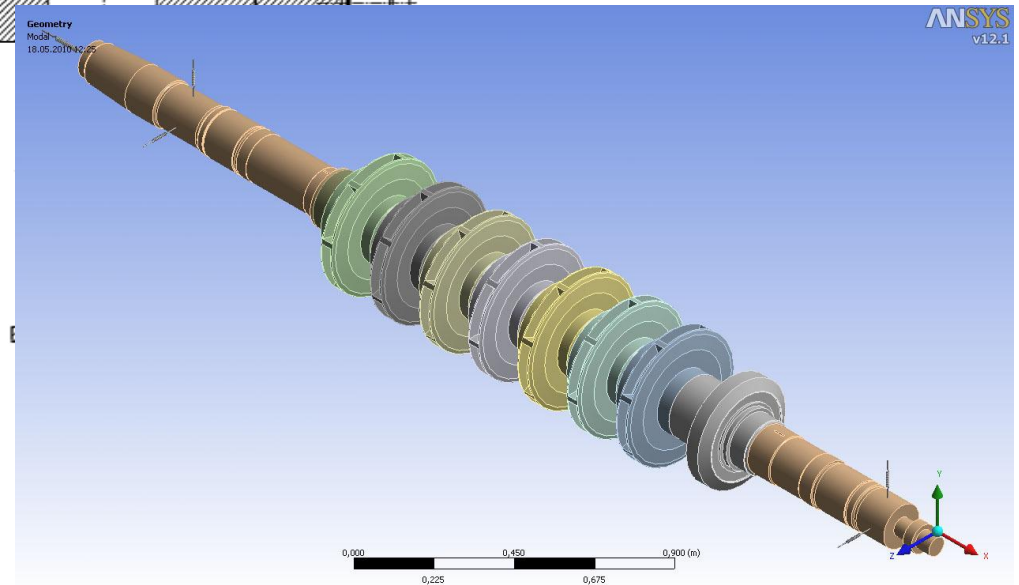
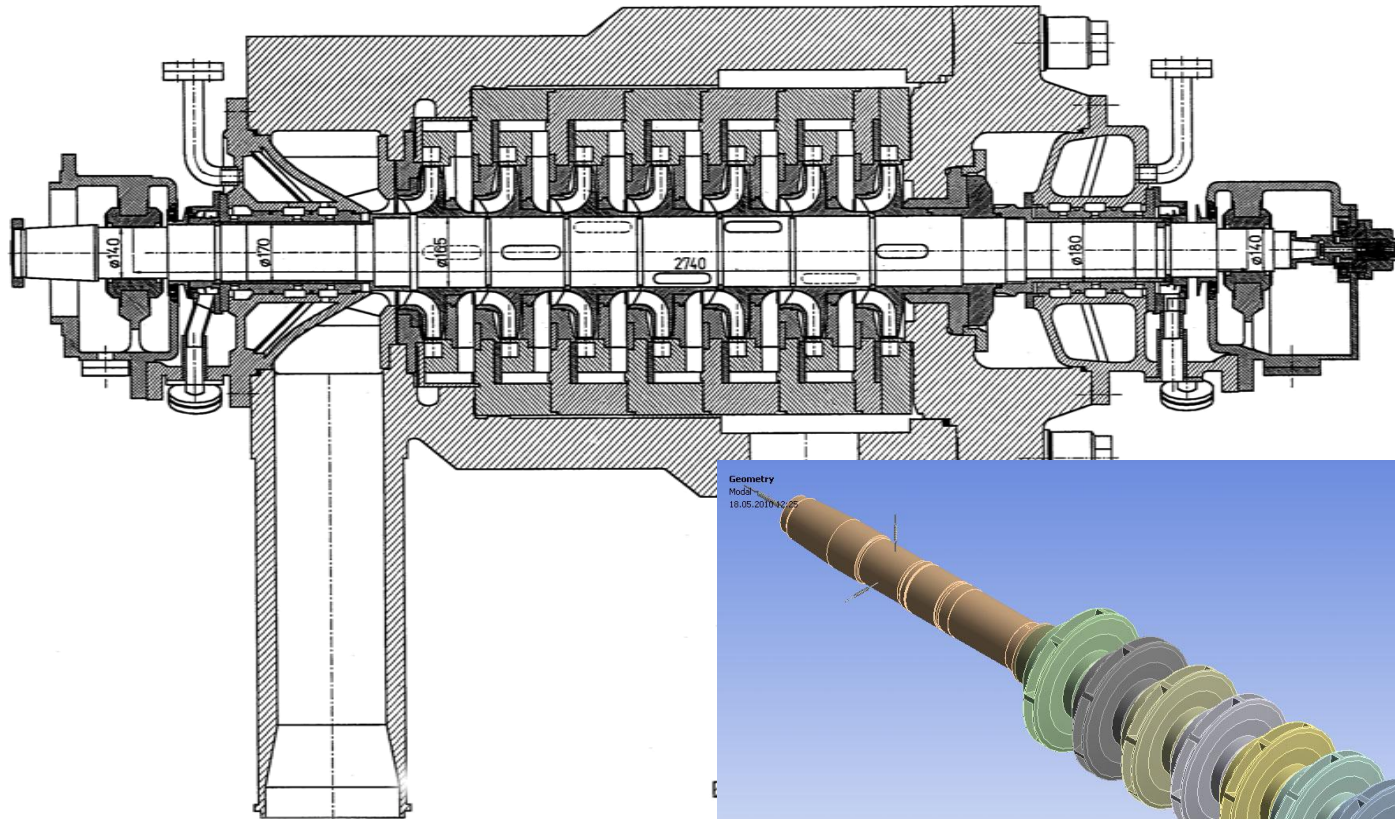
Турбопитательная установка блока 800 МВт. Нижневартовская ГРЭС



Питательный насос ПН 1500-350-4. Общий вид насоса и турбопривода



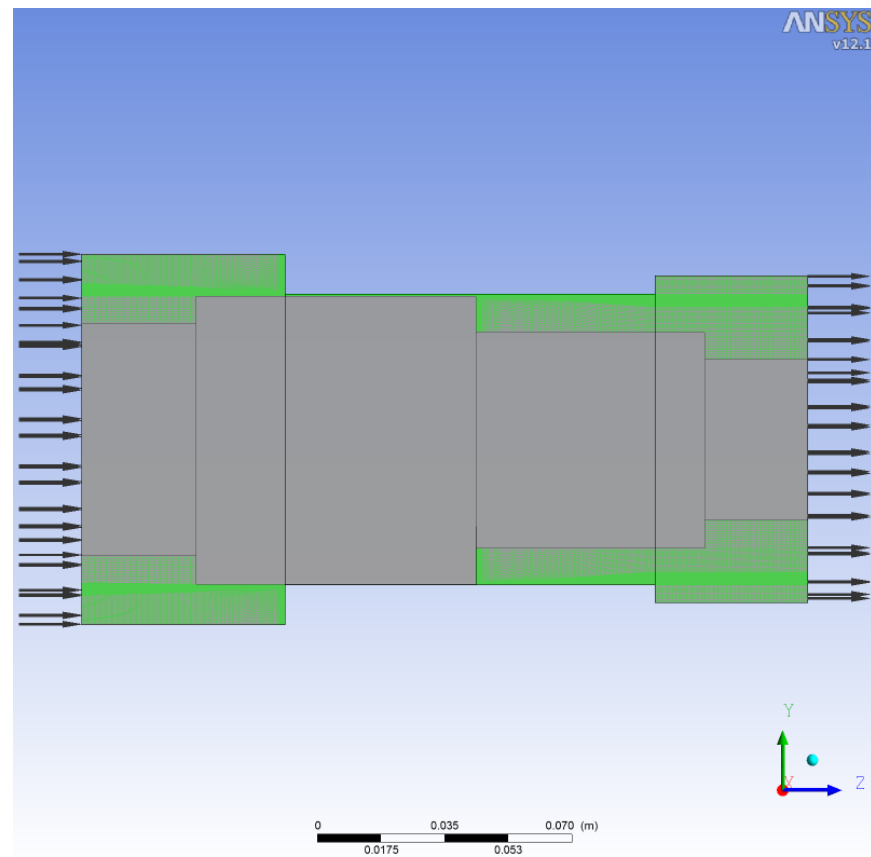
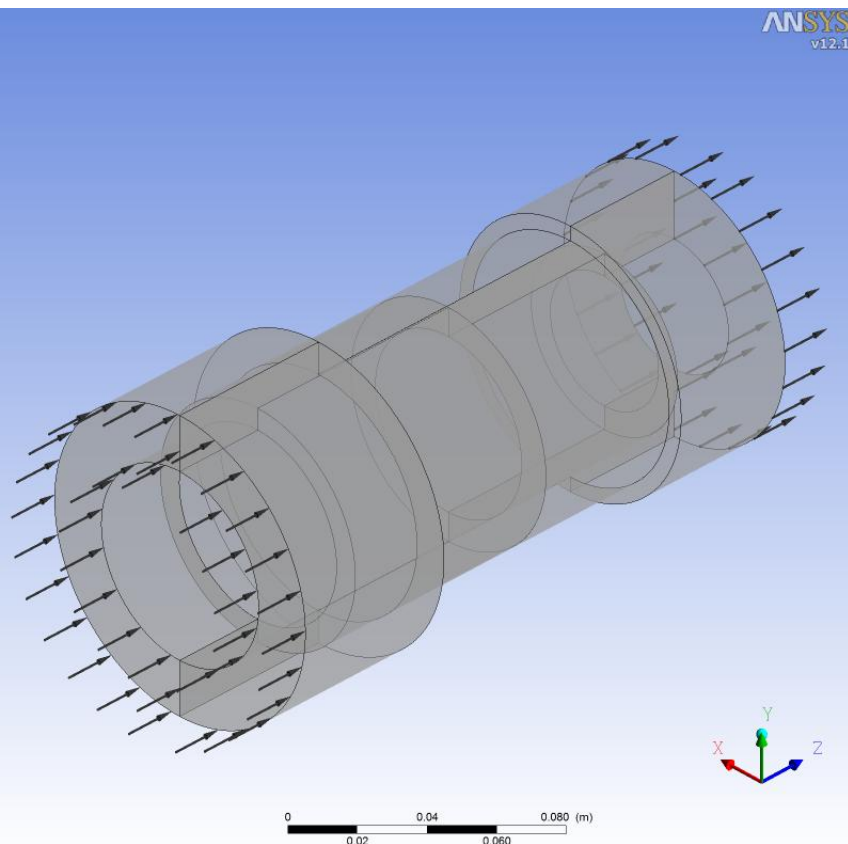
Питательный насос ПН 1500-350 «ЛО ПЗ» Сургутская ГРЭС блок 800 МВт



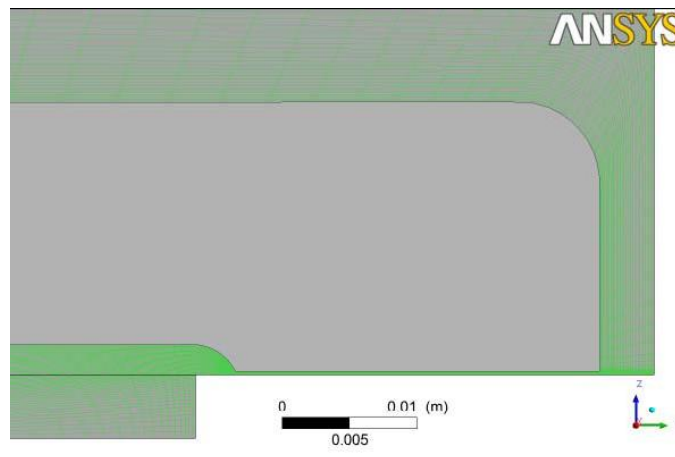
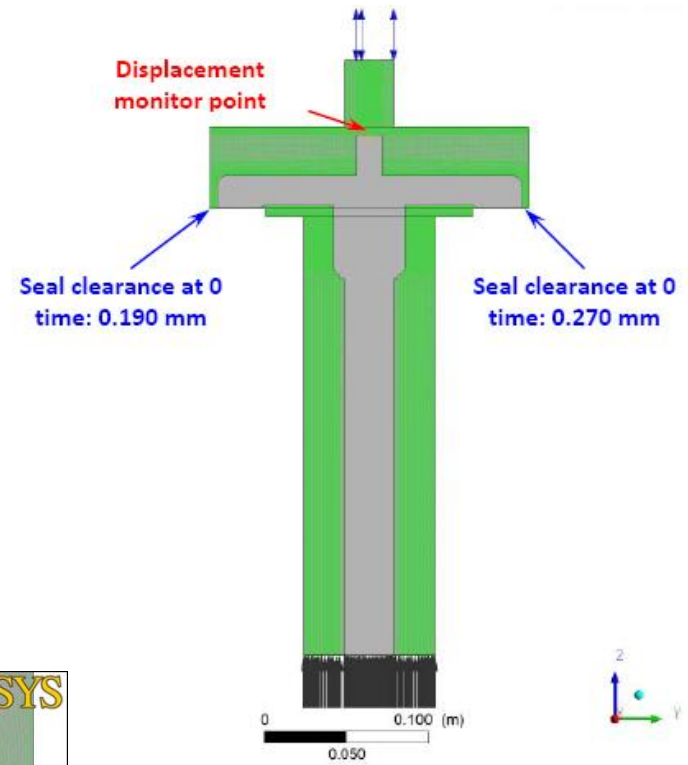
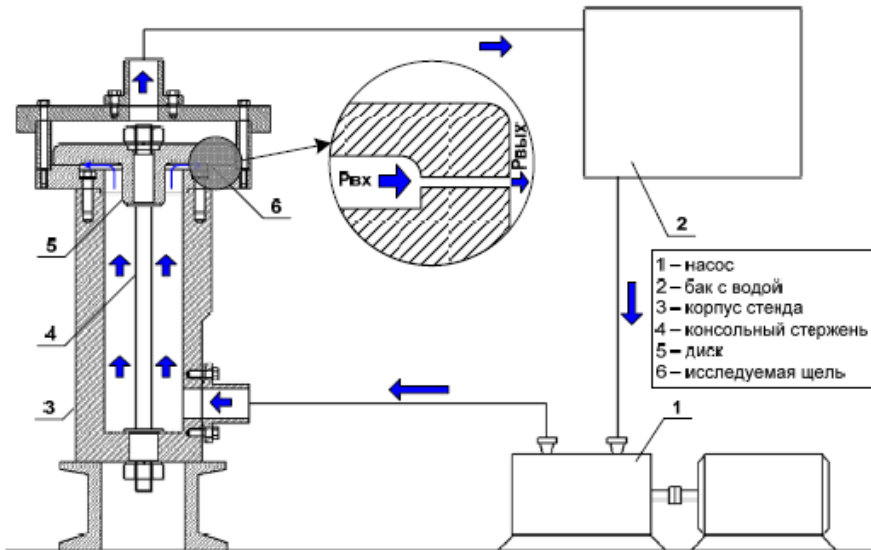




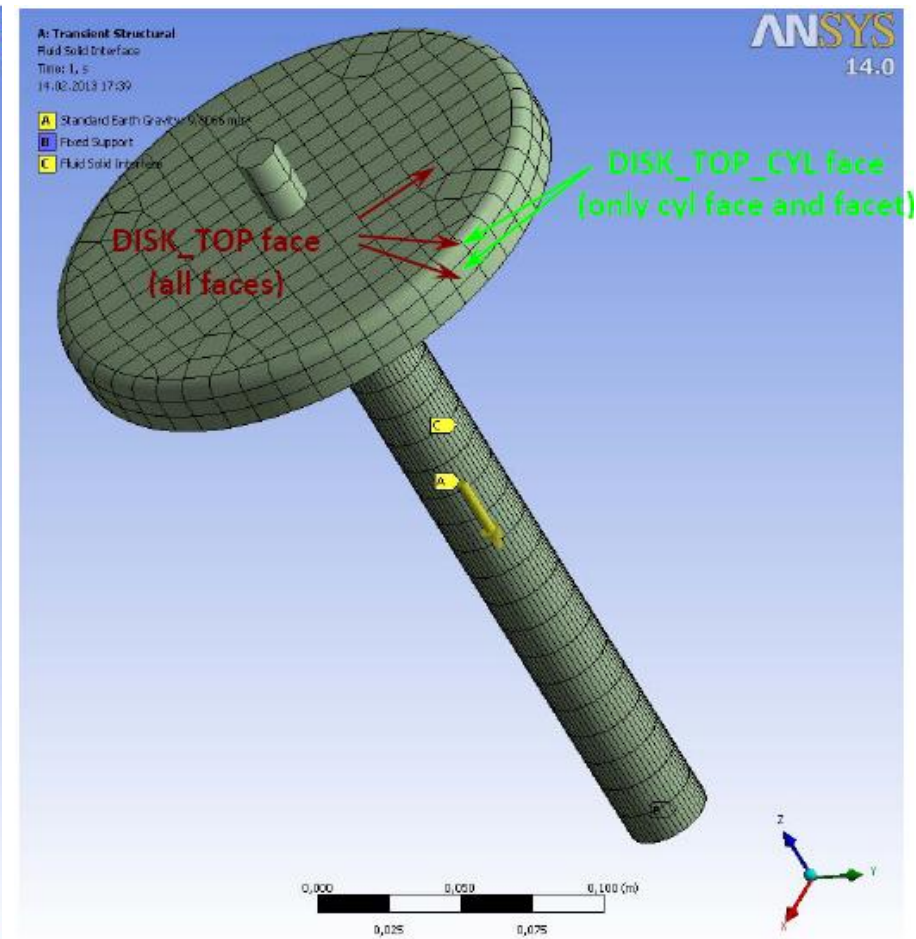
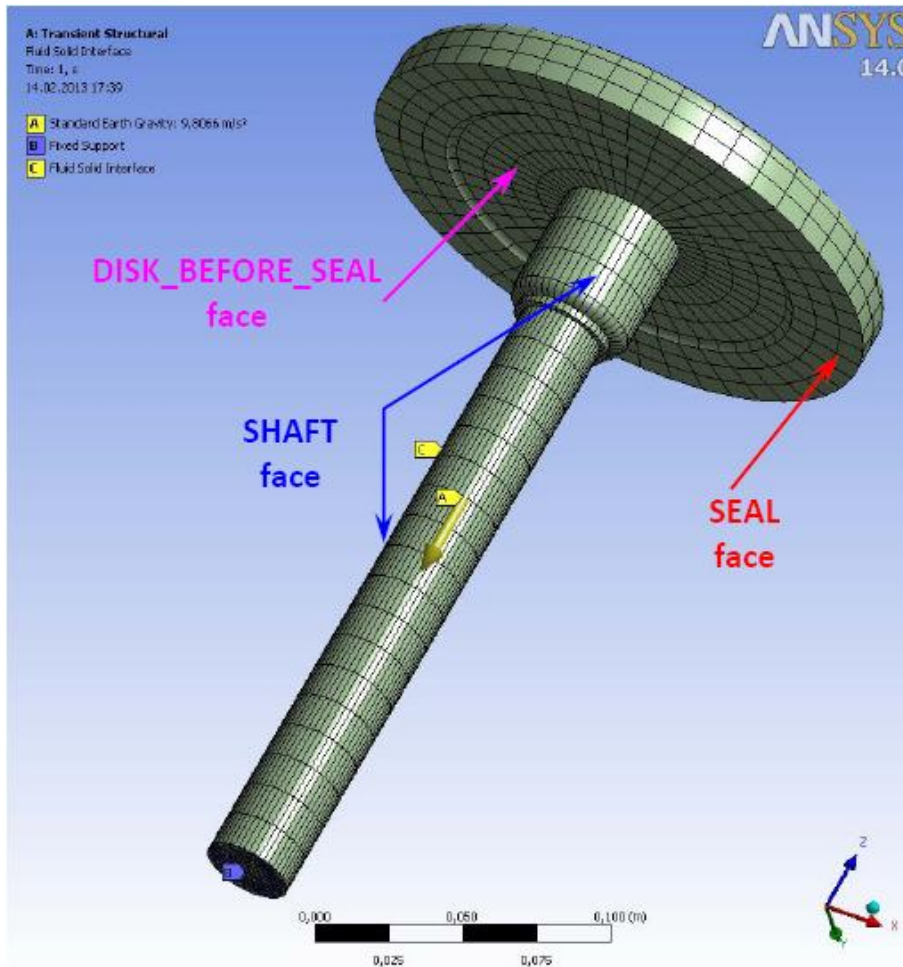
Геометрия и расчетная сетка



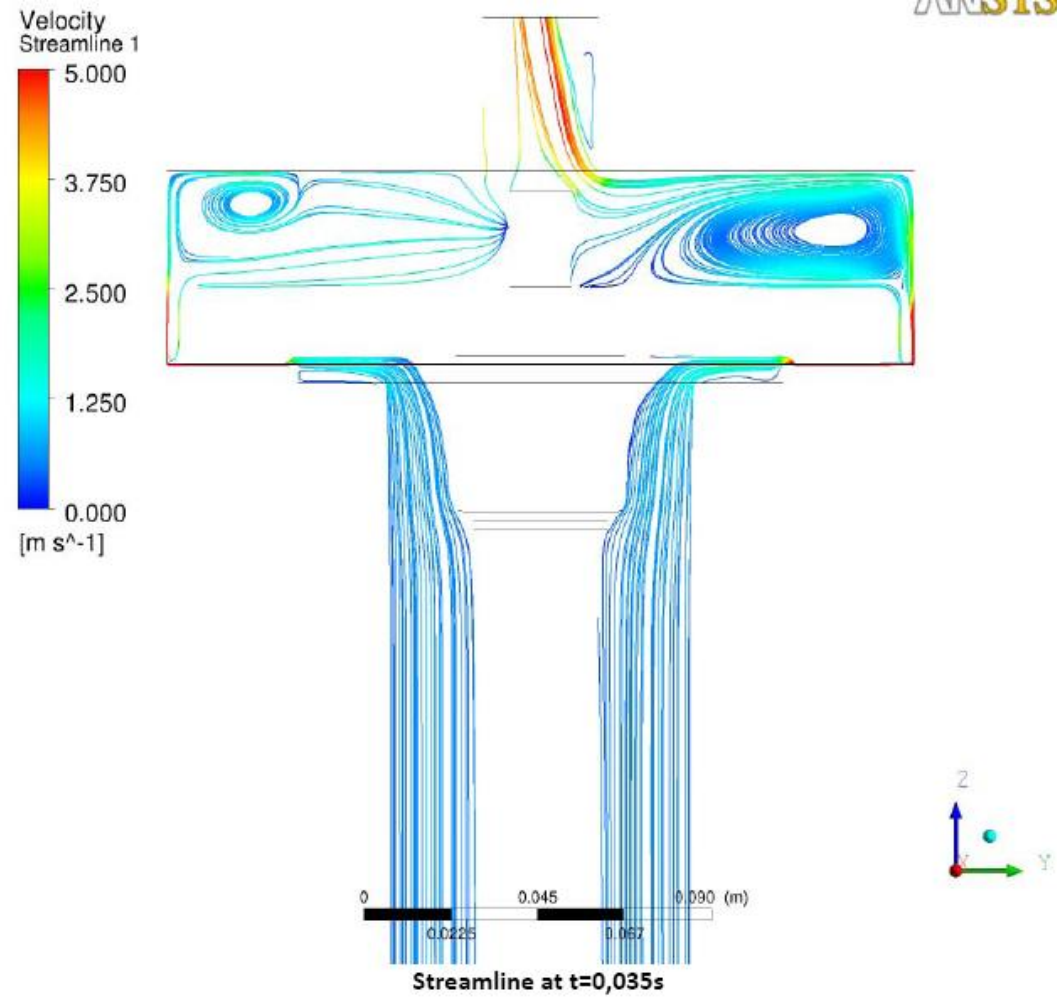
Автоколебания



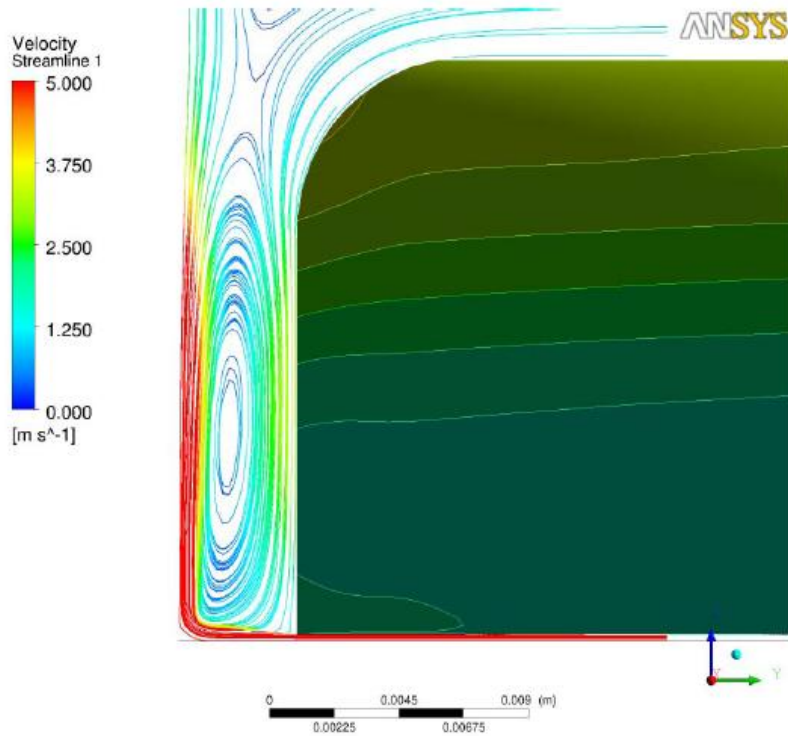
Консоль и поверхности



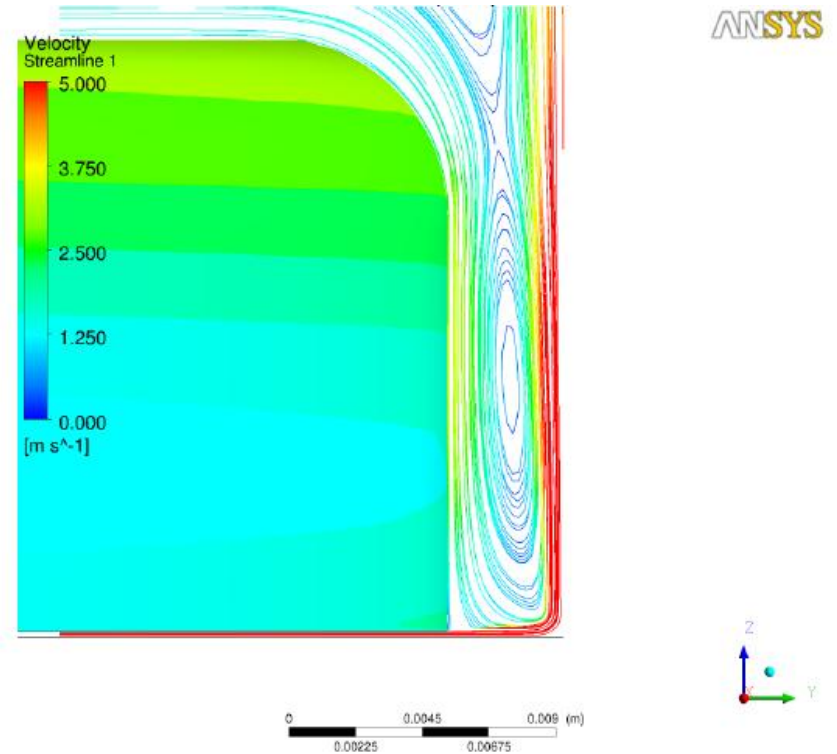
Линии тока



Линии тока (t=0,031s.)



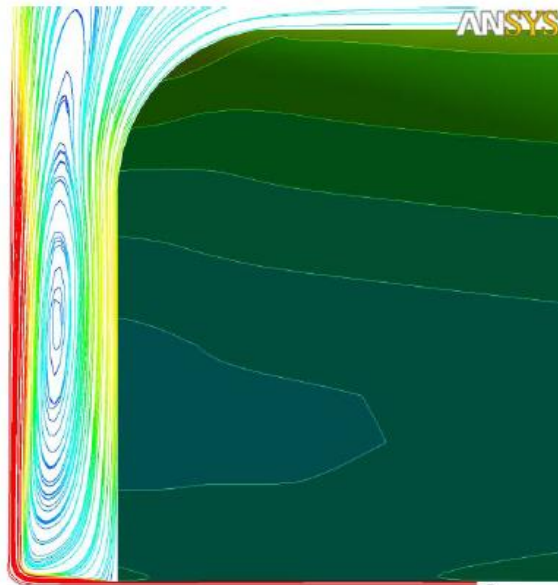
Streamline at t=0,031s, left side



Streamline at t=0,031s, right side

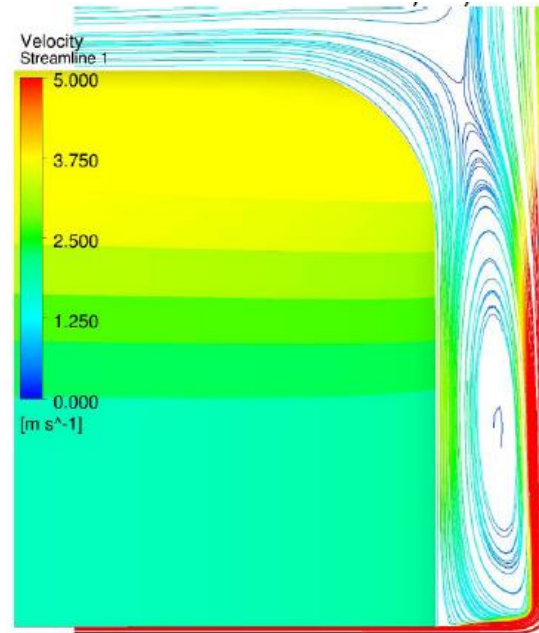
Линии тока (t=0,035s.)

Pressure
Contour 1
0.700
0.679
0.657
0.636
0.614
0.593
0.571
0.550
0.529
0.507
0.486
0.464
0.443
0.421
0.400
[bar]



0 0.00225 0.0045 0.00675 0.009 (m)

Streamline at t=0,035s, left side



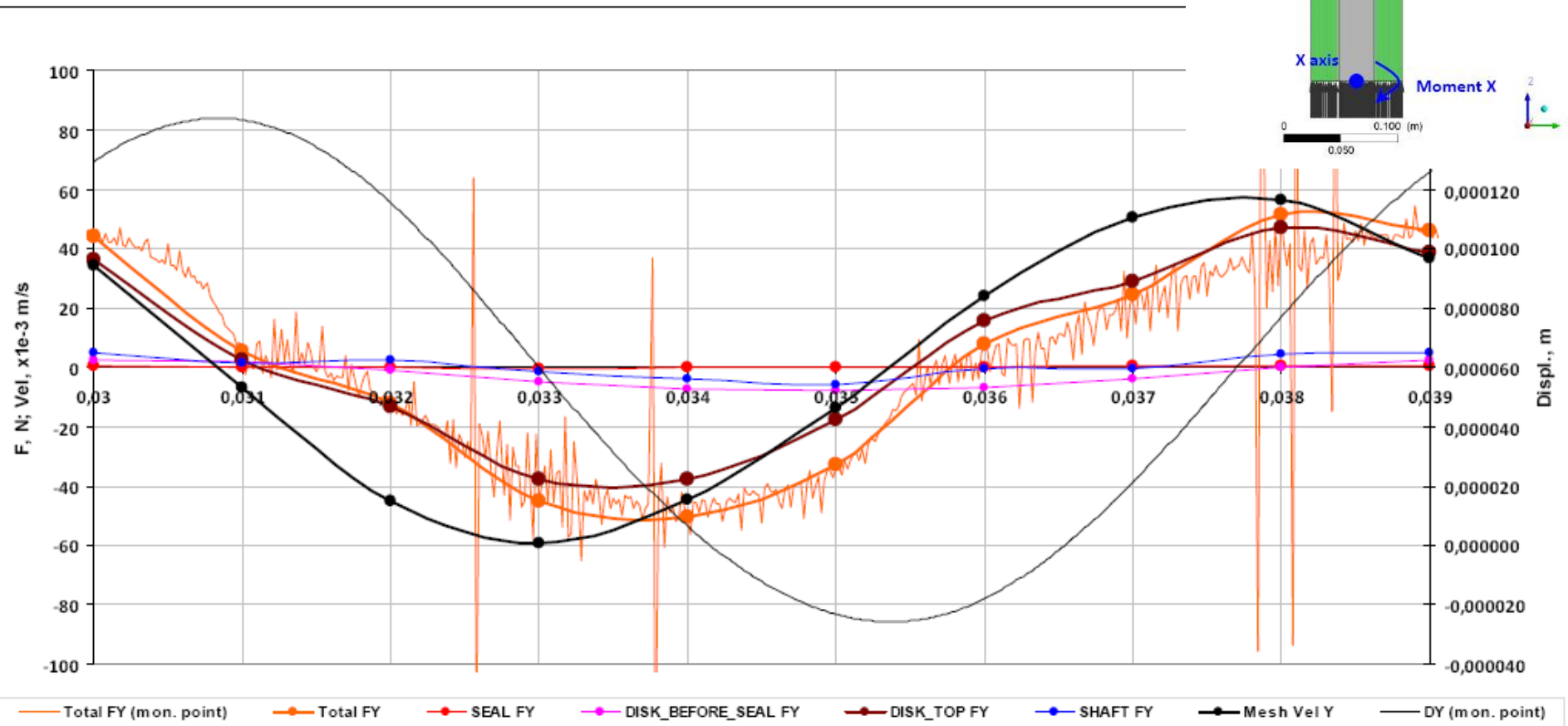
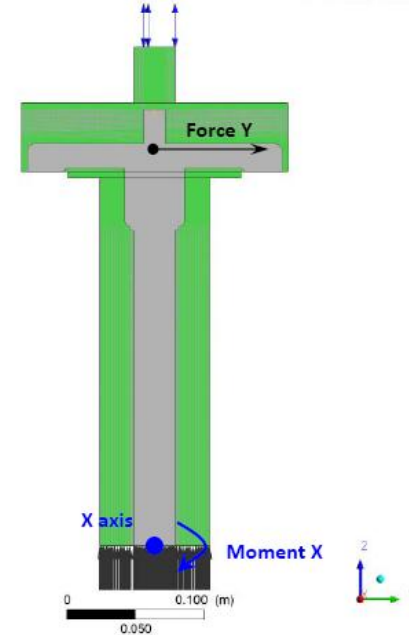
0 0.00225 0.0045 0.00675 0.009 (m)

Streamline at t=0,035s, right side

ANSYS

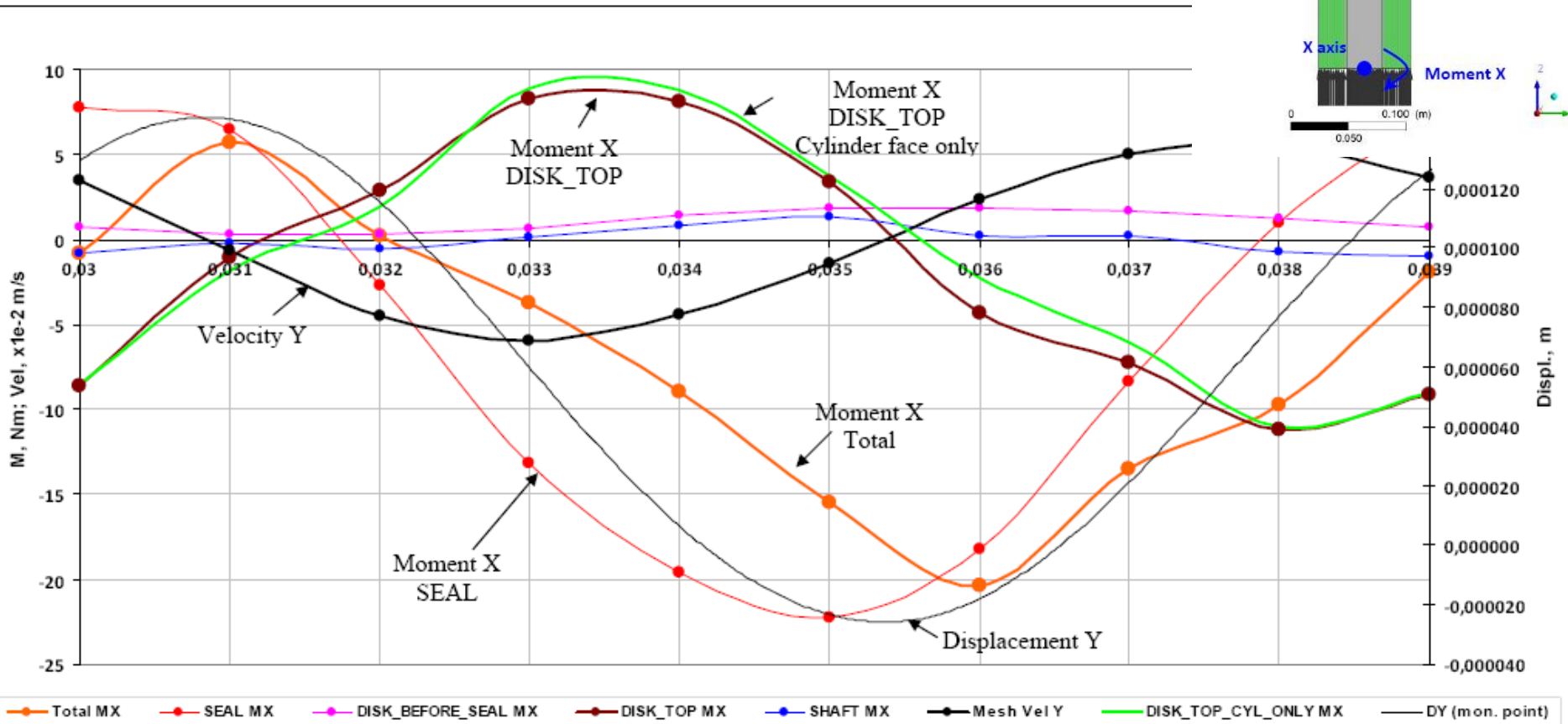
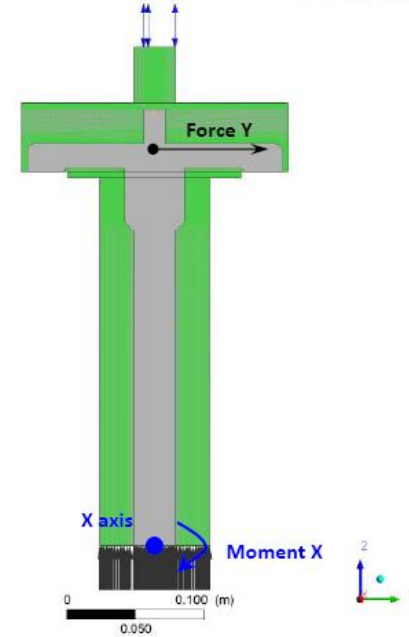


Силы



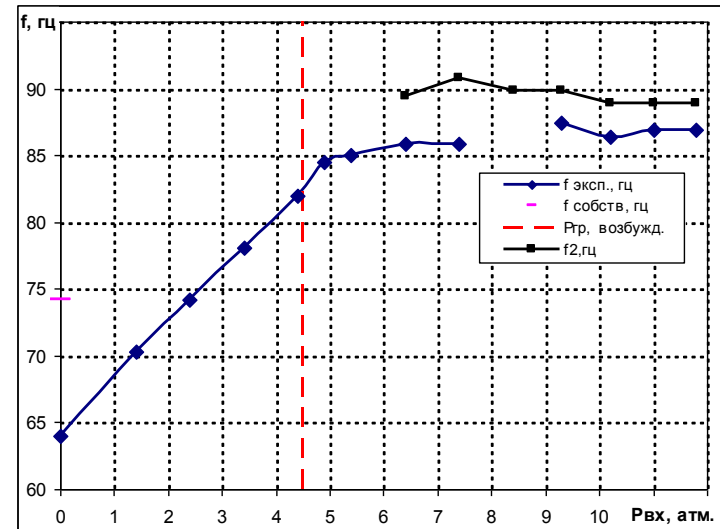
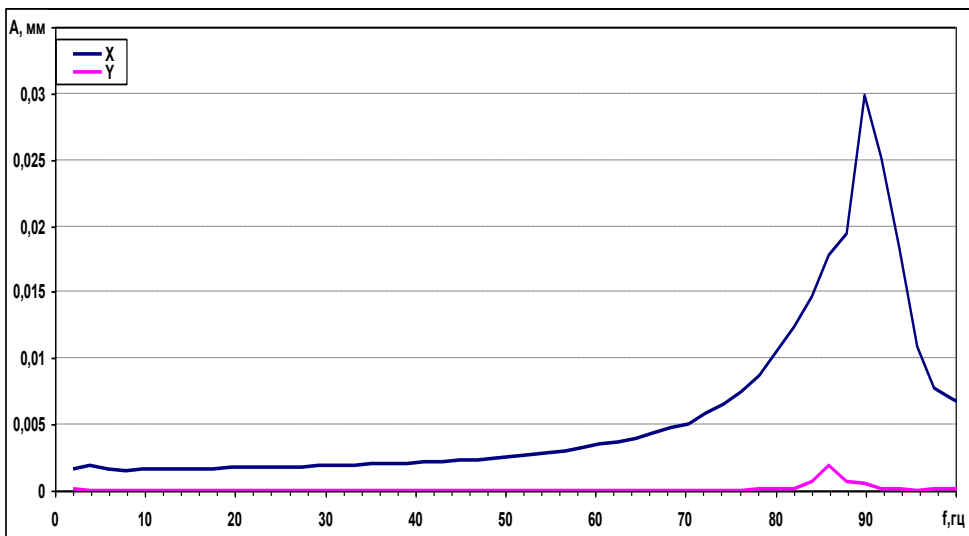
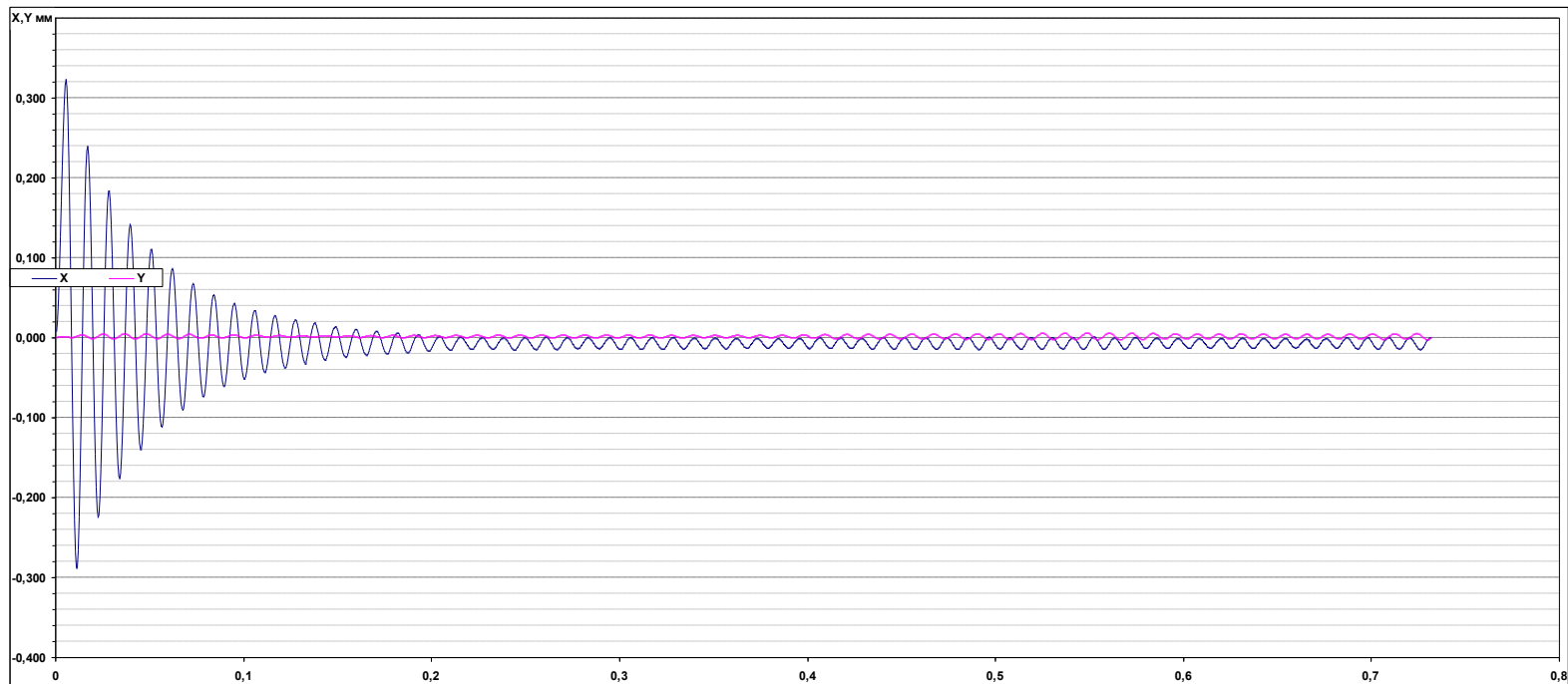
Dei Kräfte Y

Моменты

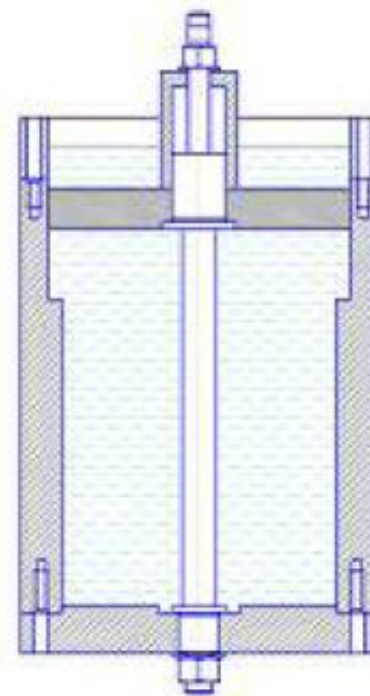
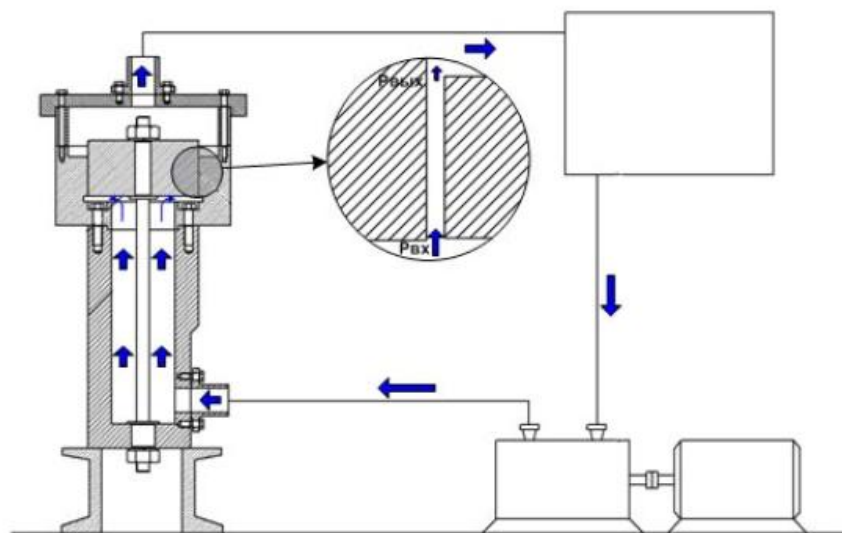


Die Momente X (negative moment correspond to positive Force Y)

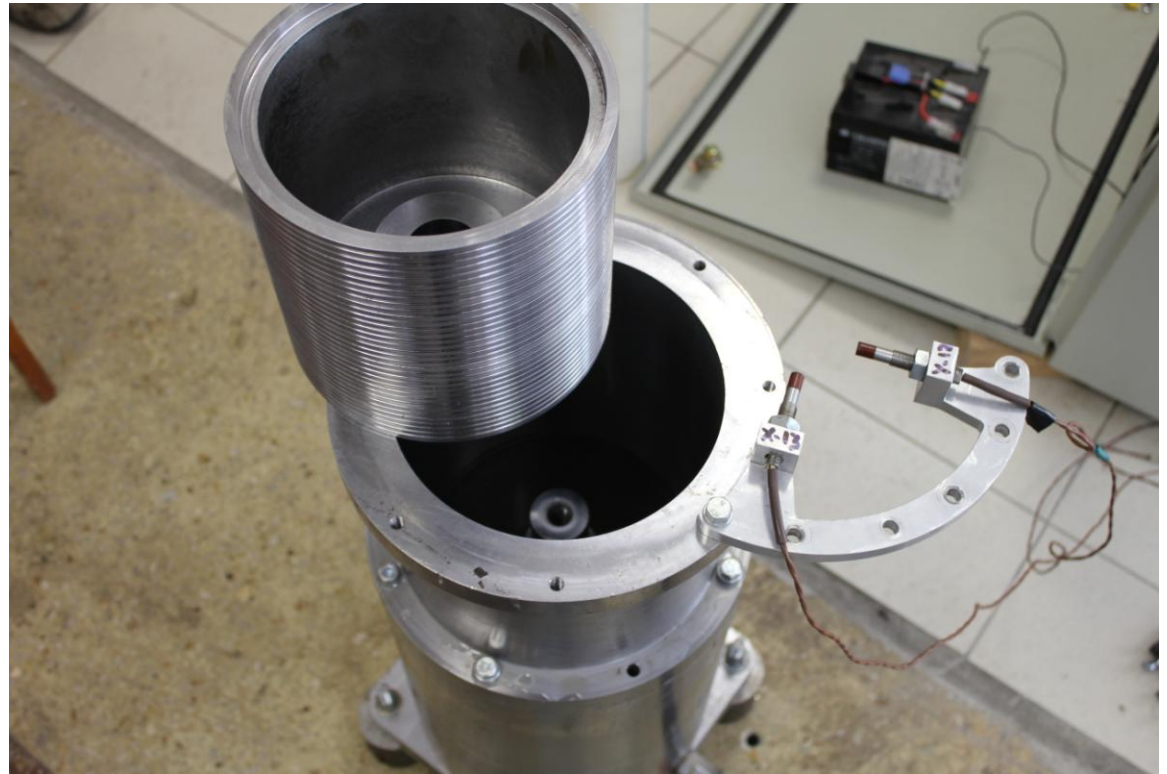
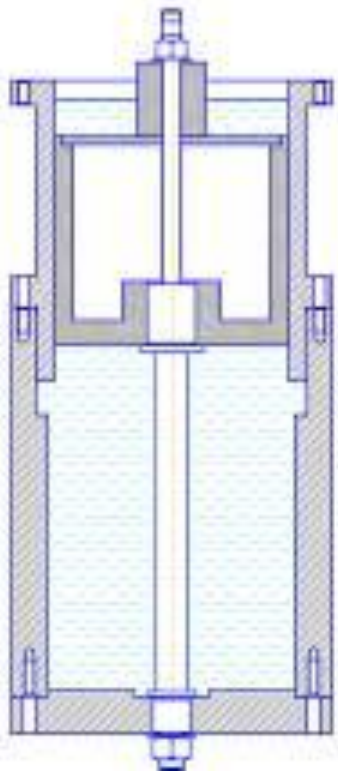
Расчет FSI Ansys CFX. 6 атм



Стенд по определению присоединенных масс



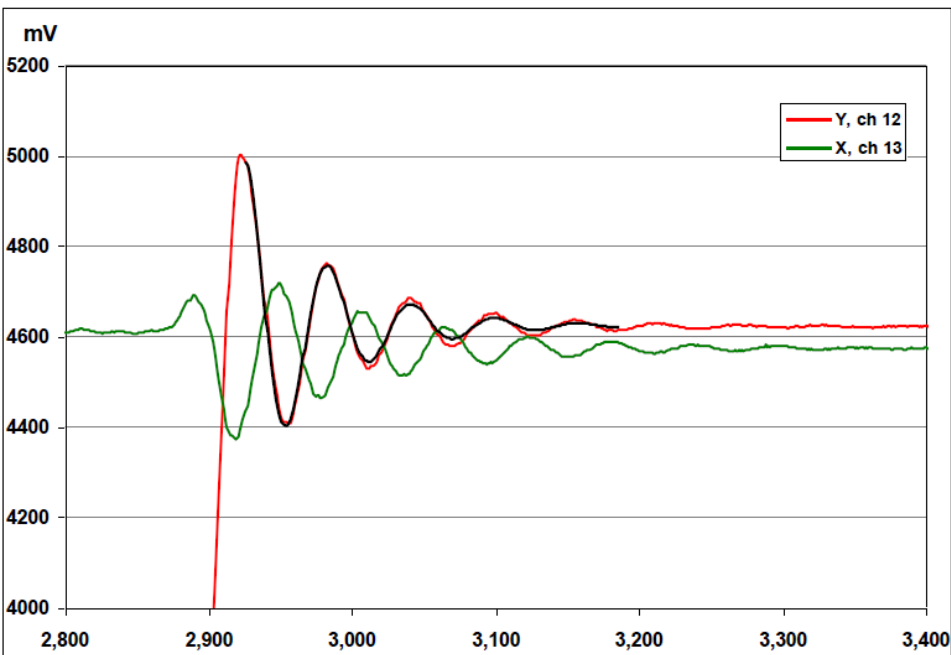
Стенд с диаметром $D=189\text{mm}$



Колебания уплотнения с гладкой щелью L169.5 D189.7 H400, Воздух

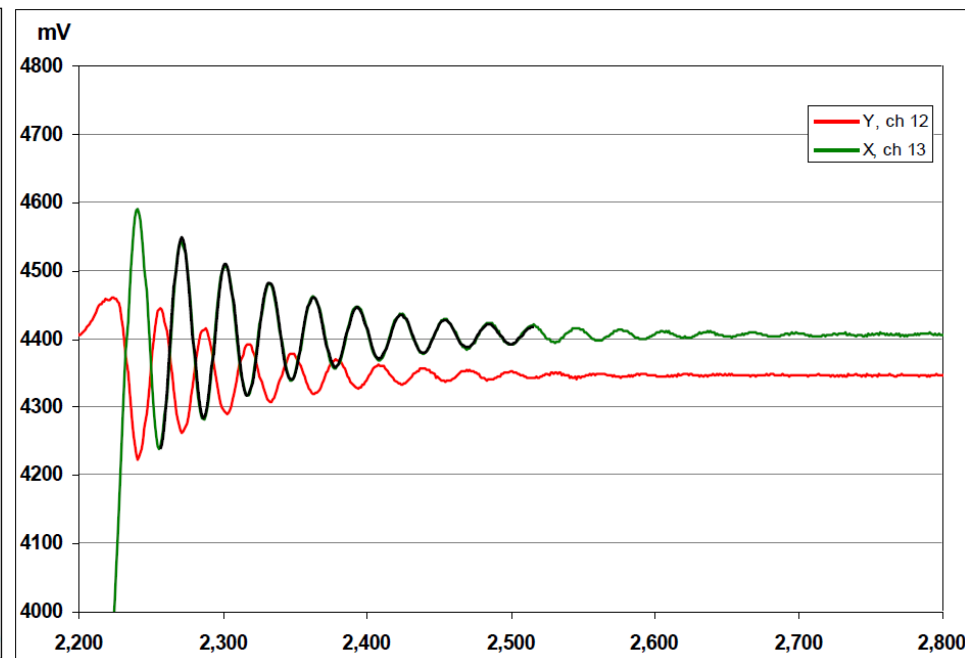
•Диаметр консоли 25 mm

•Частота 17 Hz



•Диаметр консоли 35 mm

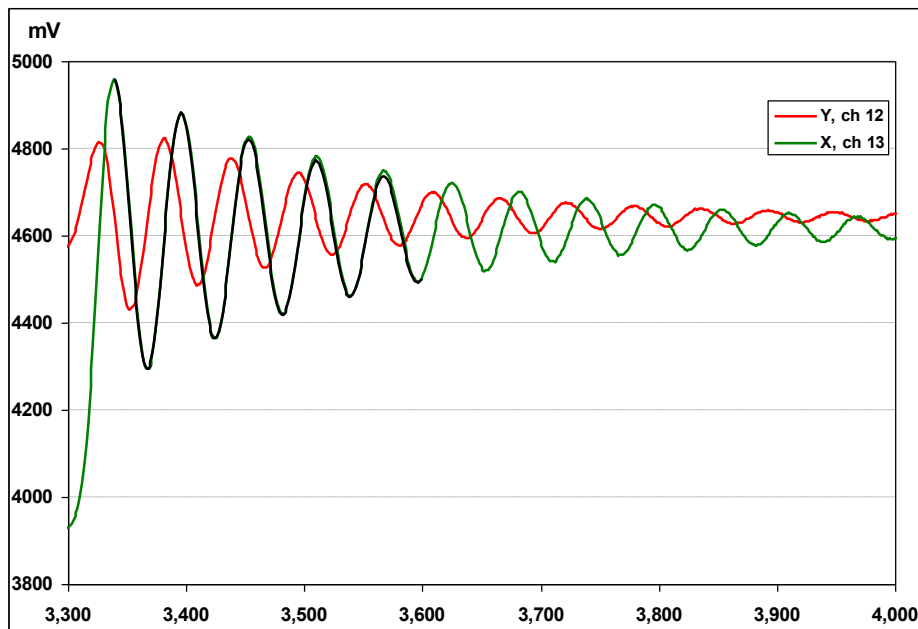
•Частота 33 Hz



Колебания уплотнения с нарезкой L169.5 D189.7 H400, Luft

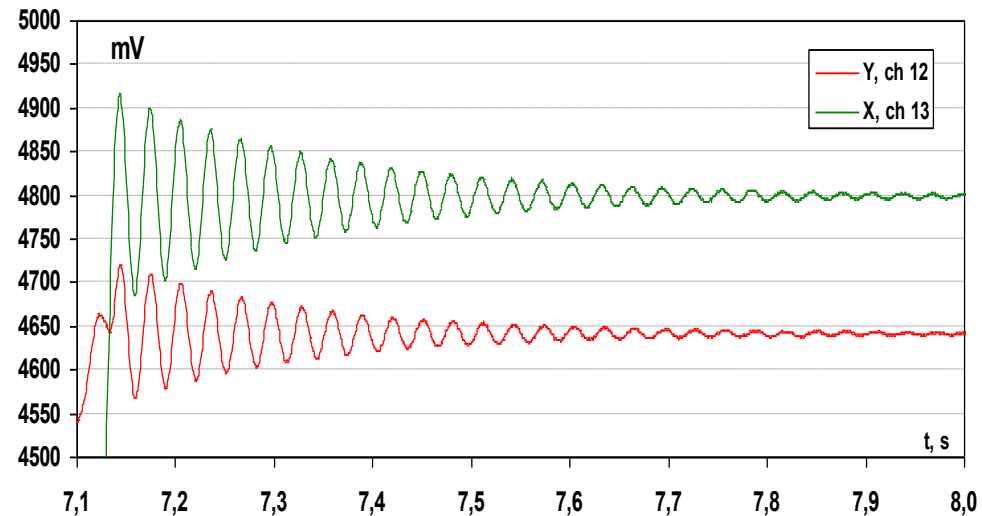
•Диаметр консоли 25 mm

•Частота 17 Hz



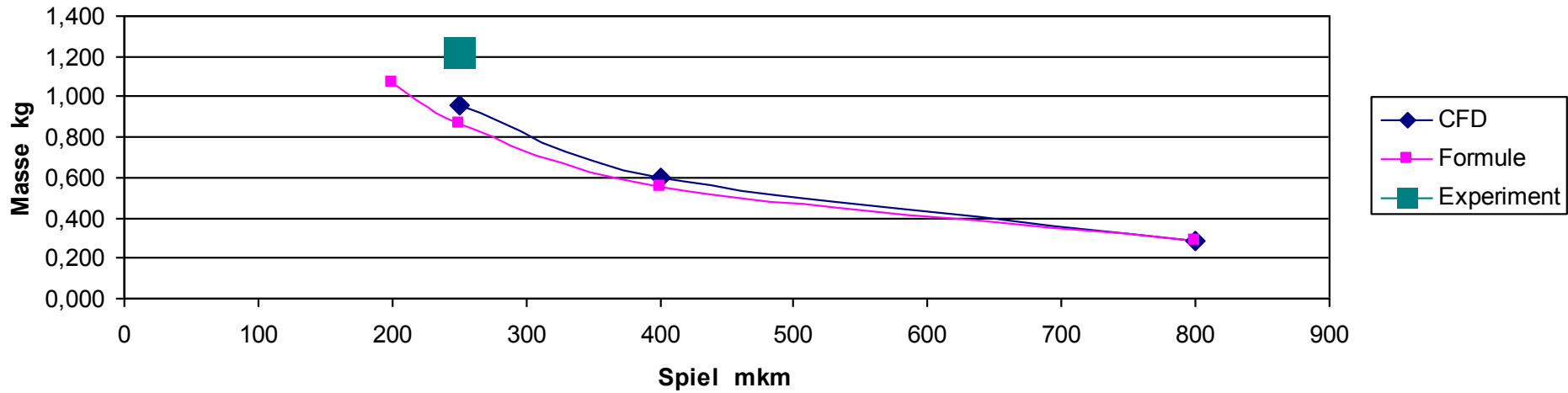
•Диаметр консоли 35 mm

•Частота 33 Hz



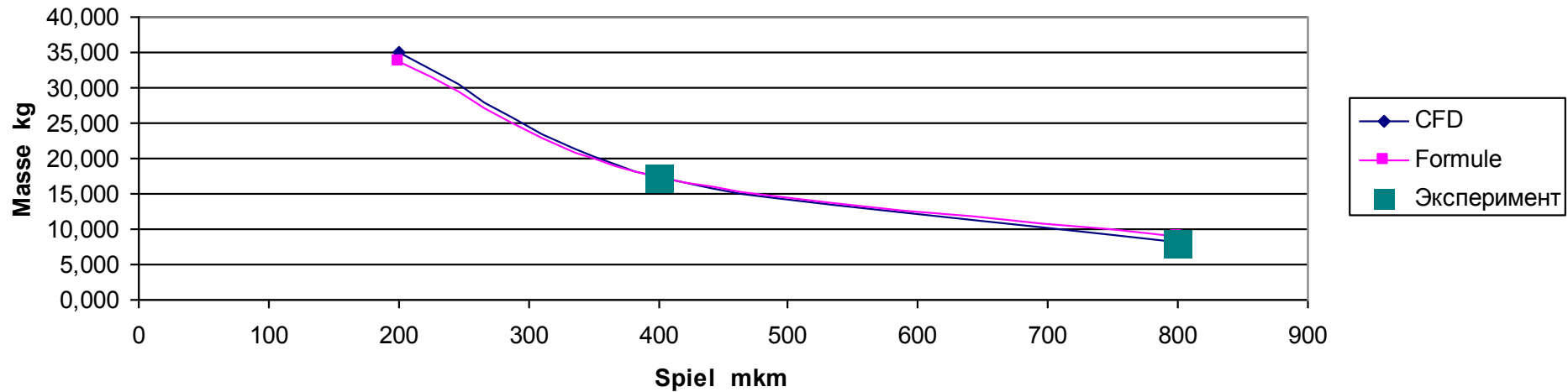
Сравнение эксперимента, расчета CFD и укороченной модели

Kurze Spalte D=140



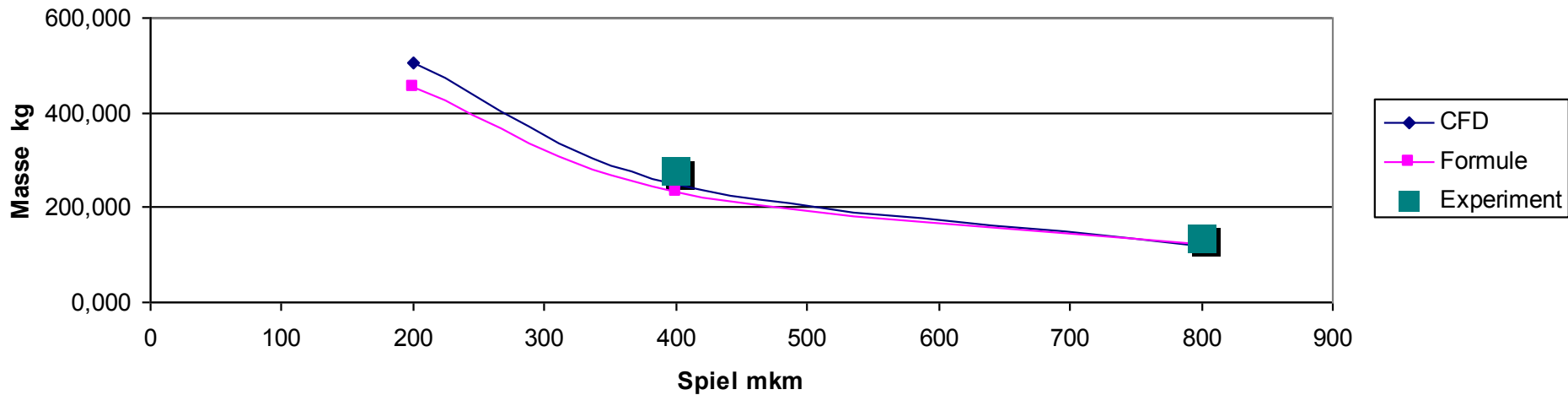
Сравнение эксперимента, расчета CFD и укороченной модели

Lange Spalte D=80



Сравнение эксперимента, расчета CFD и укороченной модели

Lange Spalte D=189



Формула расчета динамических коэффициентов

$$K = 2517 \cdot \frac{(D/1000) \cdot (\Delta P)^{0,98}}{(L/1000)^{0,4} \cdot (h/1000)^{0,699}}$$

$$C = 1252,5 \cdot \frac{(D/1000)^{1,46} \cdot (L/1000)^{1,23} \cdot (\Delta P)^{0,55}}{(h/1000)^{1,05}}$$

•Black [1979], C – Spiel h

$$K = k_{yy} = k_{zz} = -\frac{1}{4} \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \frac{R}{C} \cdot \Omega^2$$

$$k_{yz} = -k_{zy} = \frac{1}{2} 0,2193 \cdot \lambda \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \left(\frac{R}{C}\right)^2 \cdot \Omega^2$$

$$C = d_{yy} = -d_{zz} = \rho \cdot \pi \cdot R^2 \cdot L \cdot \frac{R}{C} \cdot \Omega$$

$$d_{yz} = d_{zy} = 0,2193 \cdot \lambda \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \left(\frac{R}{C}\right)^2 \cdot \Omega$$

Viskosität $\eta_{eff} = 0,0053 \cdot \text{Re}_r^{0,75} \cdot \eta$

•Fritz [1970], C – Spiel h

$$K = k_{yy} = k_{zz} = -\frac{1}{4} \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \frac{R}{C} \cdot \Omega^2$$

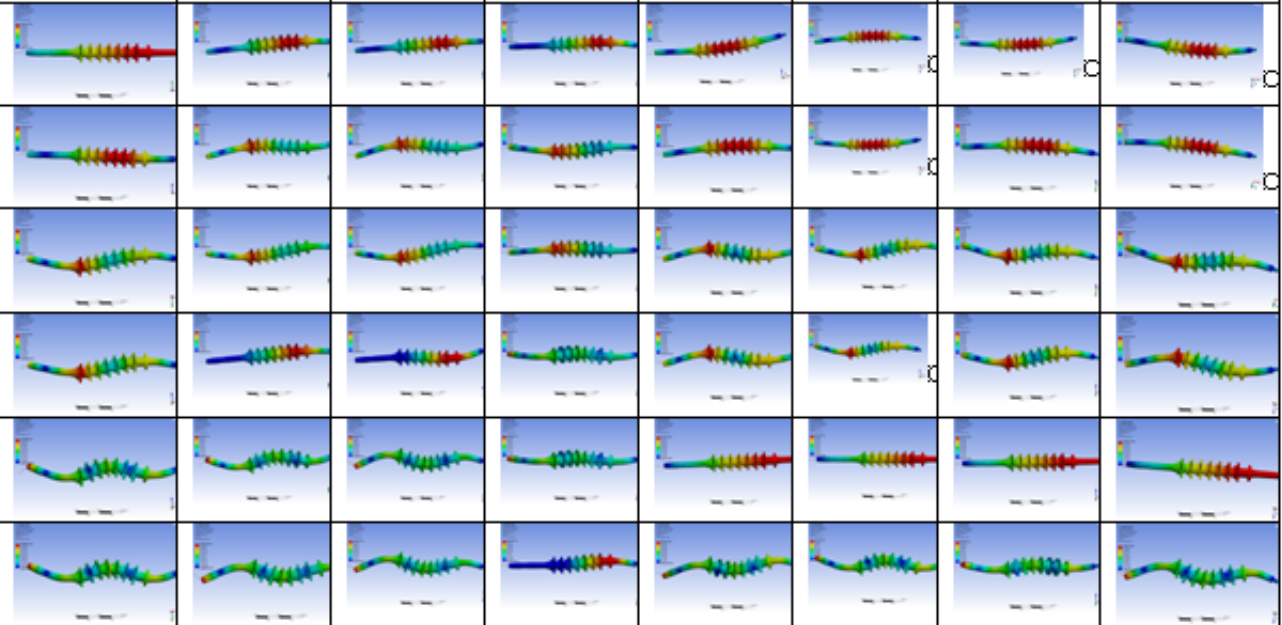
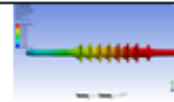
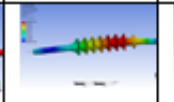
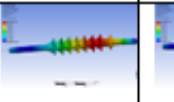
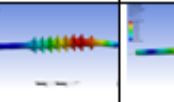
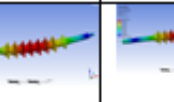
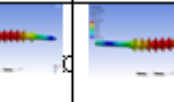
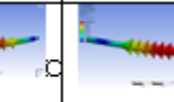
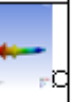
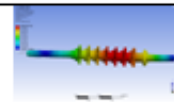
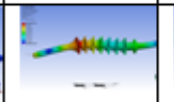
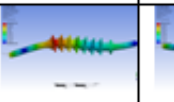
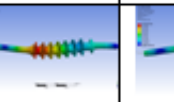
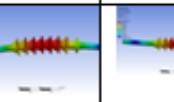
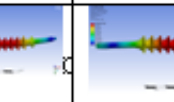
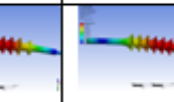
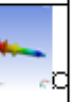
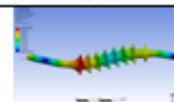
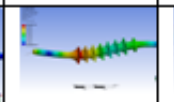
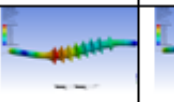
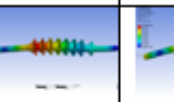
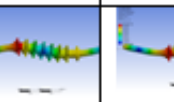
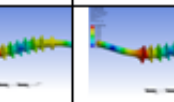
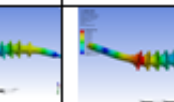
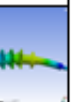
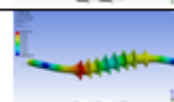
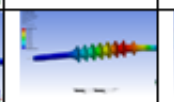
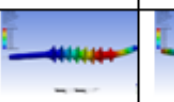
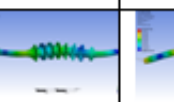
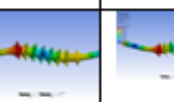
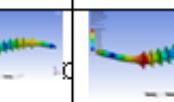
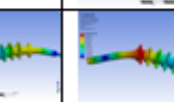
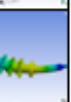
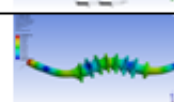
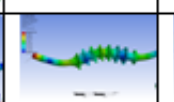
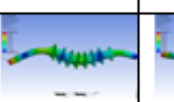
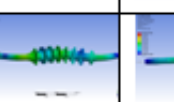
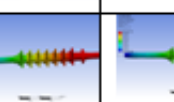
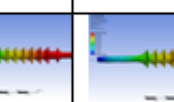
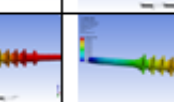
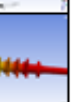
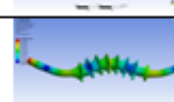
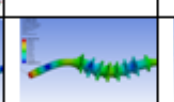
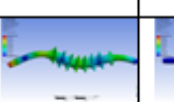
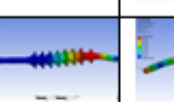
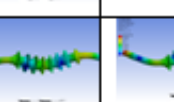
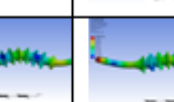
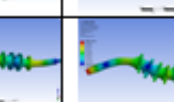
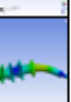
$$k_{yz} = -k_{zy} = \frac{1}{2} 0,2193 \cdot \lambda \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \left(\frac{R}{C}\right)^2 \cdot \Omega^2$$

$$C = d_{yy} = -d_{zz} = \rho \cdot \pi \cdot R^2 \cdot L \cdot \frac{R}{C} \cdot \Omega$$

$$d_{yz} = d_{zy} = 0,2193 \cdot \lambda \cdot \rho \cdot \pi \cdot R^2 \cdot L \cdot \left(\frac{R}{C}\right)^2 \cdot \Omega$$

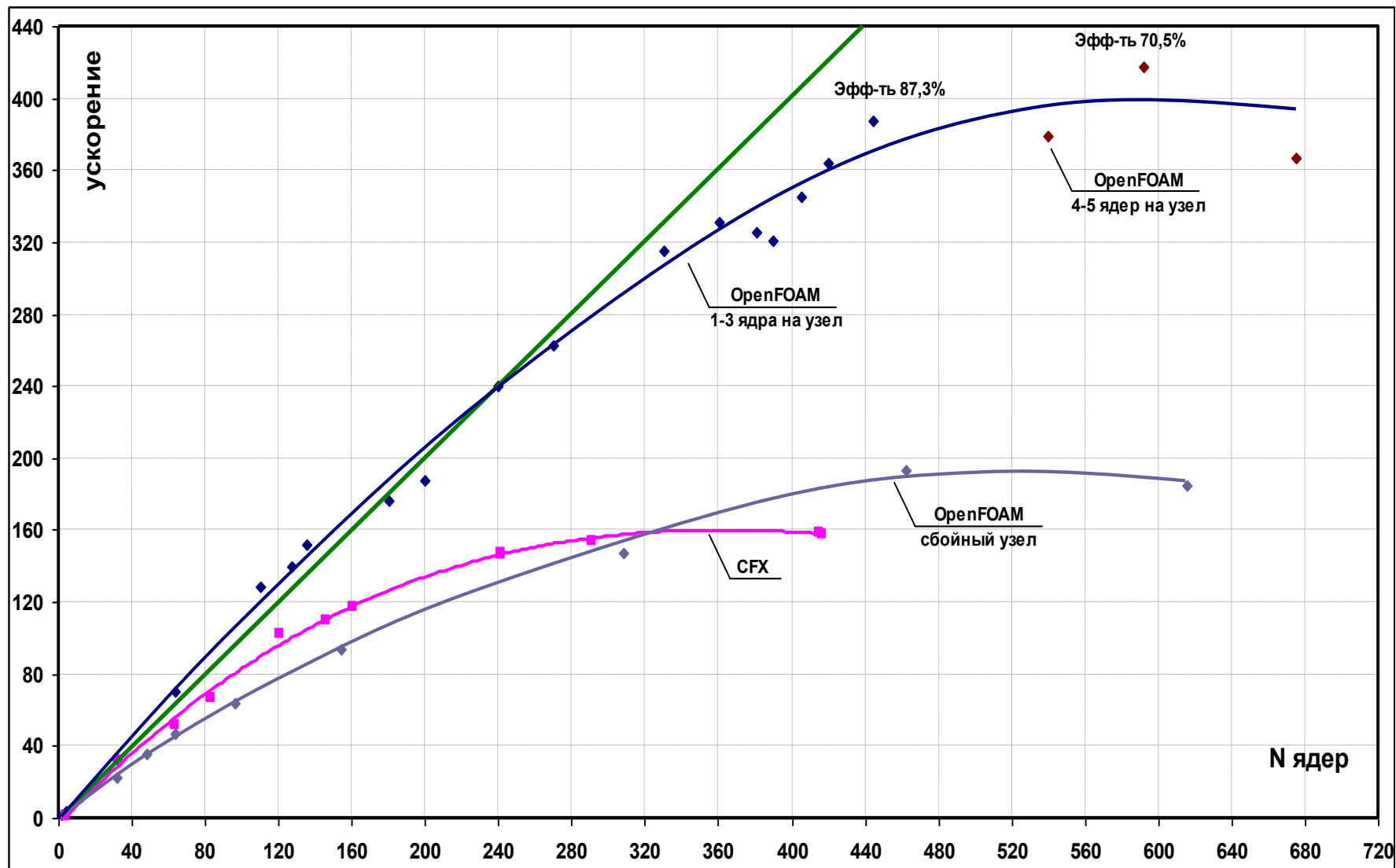
Reibungskoeffizienten $\frac{1}{\sqrt{\lambda}} = 2,0 \cdot \log\left(\frac{1}{2} \cdot \text{Re}_r \cdot \sqrt{\lambda}\right) - 0,8$

Формы колебаний ротора для различных режимов

вариант	01а	02а	03а	04а	05а	06а	07а	08а
h, mm	0,35а				0,75а			
ω, rpm	1600а	2800а	3700а	4665а	1600а	2800а	3700а	4665а
$K \cdot v$	26,91а	3,6967а	1,3198а	0,55207а	45,936а	57,321а	66,984а	75,301а
опорах	33,892а	110,9а	112,41а	114,53а	47,818а	60,491а	71,133а	80,639а
$E9а$	116,59а	116,12а	118,61а	121,94а	127,2а	129,88а	132,78а	135,26а
	121,65а	17,833а	19,305а	253,98а	129,47а	133,47а	137,06а	139,93а
	259,35а	256,26а	255,55а	259,07а	264,67а	264,67а	264,67а	264,67а
	263,65а	260,67а	260,67а	20,61а	264,2а	265,12а	266,19а	267,07а
								
								
								
								
								
								

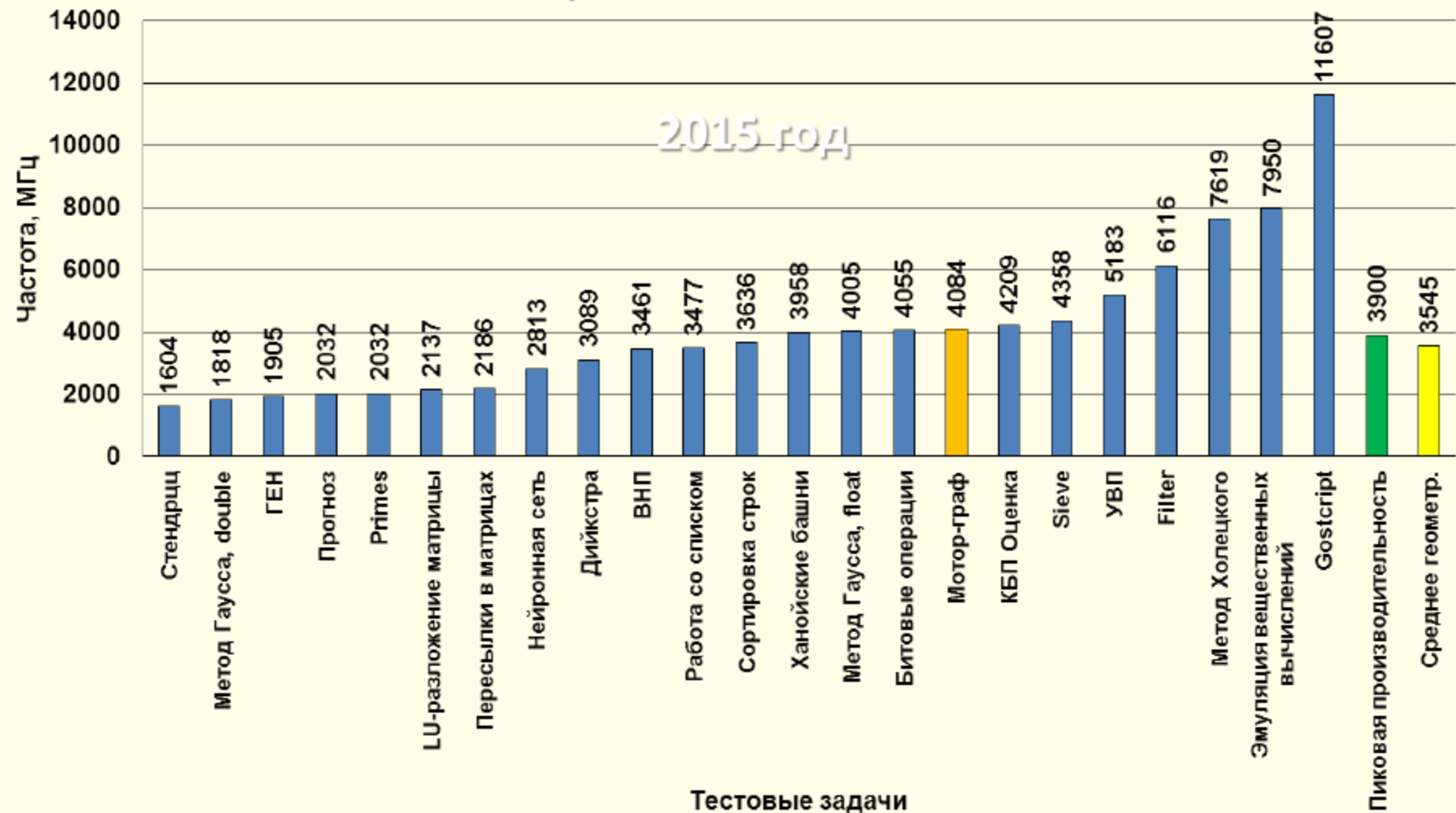
Масштабирование OpenFoam на кластере «Скиф Урал»

на задаче с сеткой 8 000 000 узлов
(600 вычислительных ядер - ускорение 390)



Сравнительные характеристики реальной производительности одного ядра микропроцессоров Эльбрус и Intel Core (предоставлено разработчиками концерна «Моринформсистема-Агат»)

Тактовая частота одного ядра процессора Core i7, соответствующего по
производительности одному ядру процессора Эльбрус-8С 1300 МГц
на различных тестовых задачах



Решение дифференциальных уравнений на АВМ

