



PASS/EQUIP Overview Webinar

Comprehensive Software for
Structural Pressure Vessels
Analysis

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PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

Webinar Agenda

- About PASS Suite
- What is PASS/EQUIP
- PASS/EQUIP Configurations
- Supported codes and standards
- PASS/EQUIP Material Database
- 3D Model Export
- Reports generation
- What's new in PASS/EQUIP 3.02
- Live demonstration of PASS/EQUIP
- Q & A session



PIPING AND EQUIPMENT
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PASS Suite

PASS Suite provides smart simulation & sizing tools for every piping and equipment engineer and designer



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Company Overview

- > 50 years history
- > 3,000 active users worldwide
- Best in class modern methods, algorithms and software libraries
- Embedded knowledge and support/training from industry experts
- User-friendly interface and flexible CAD integration
- Affordable price and flexible licensing



PASS/EQUIP

Pressure vessel strength and stability analysis for horizontal and vertical vessels, columns, storage tanks, heat exchangers, and finite element analysis of arbitrary vessel nozzles



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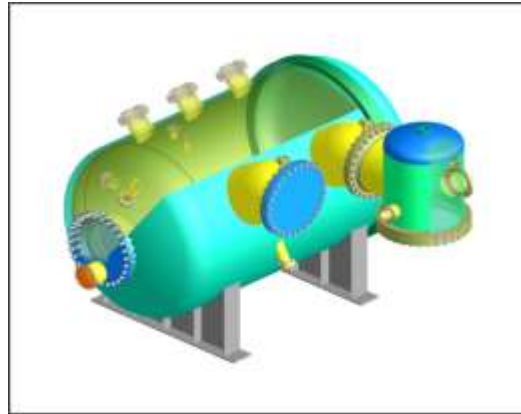
Pressure Vessel Stress Analysis

- Broad Applicability
- Unsurpassed Usability
- Powerful Capabilities
- Flexible Configurations
- Widely Used



PASS/EQUIP | Broad Applicability

- Power
- Oil Refining
- Chemical
- Petrochemical
- Natural Gas



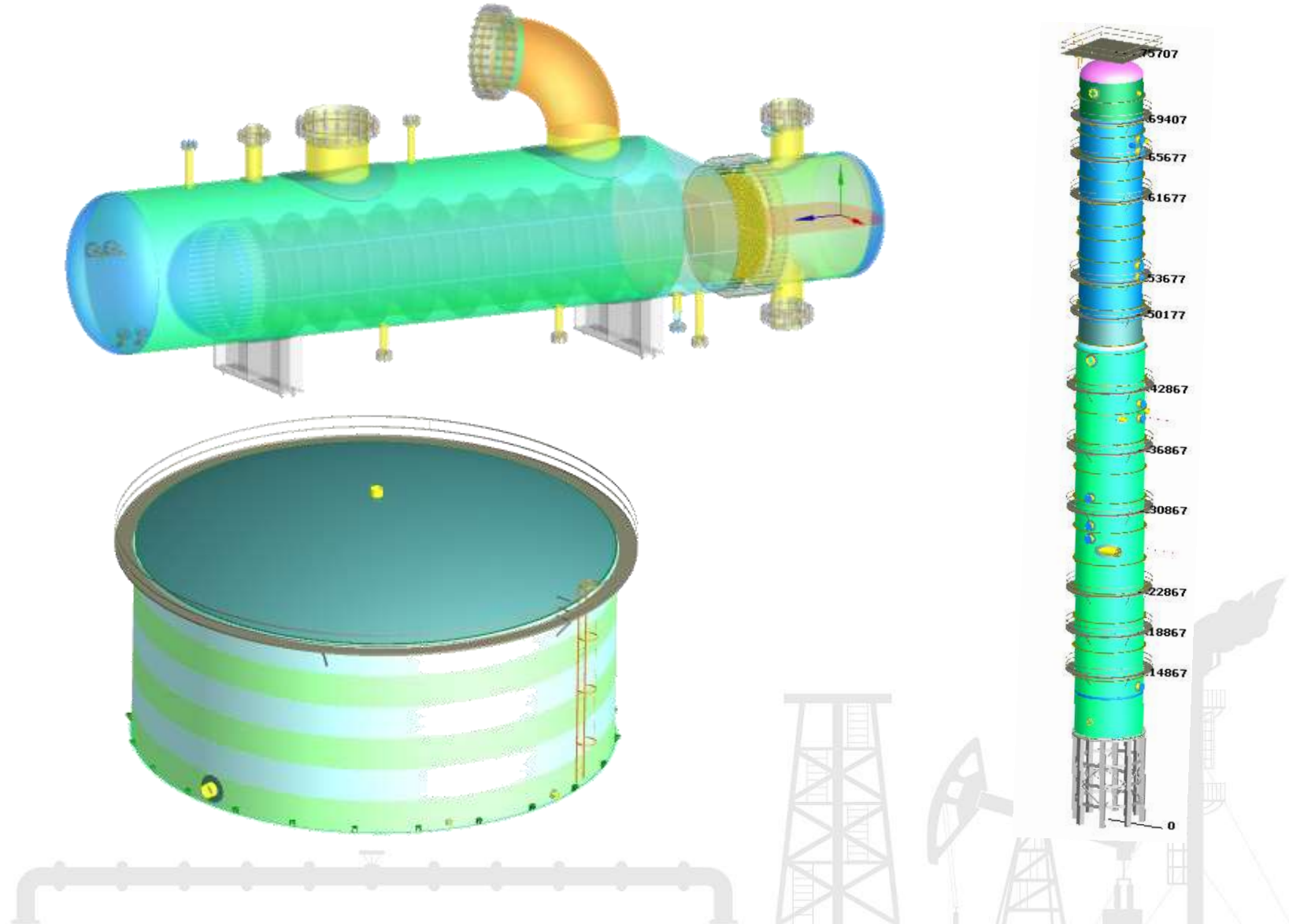
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PASS/EQUIP

Configurations

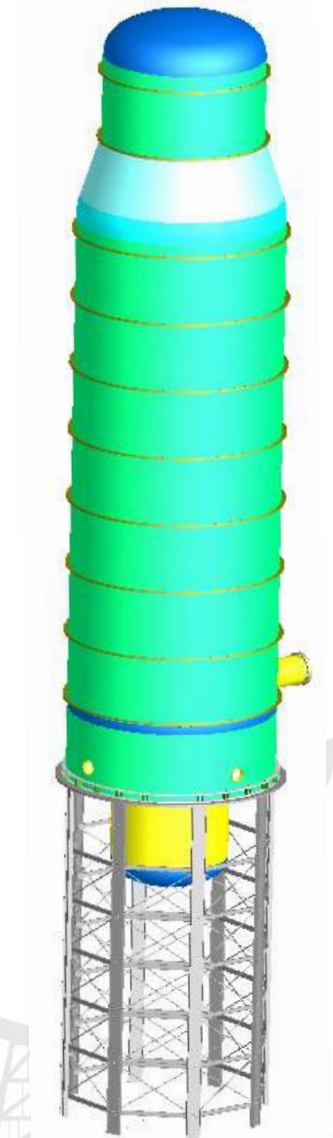
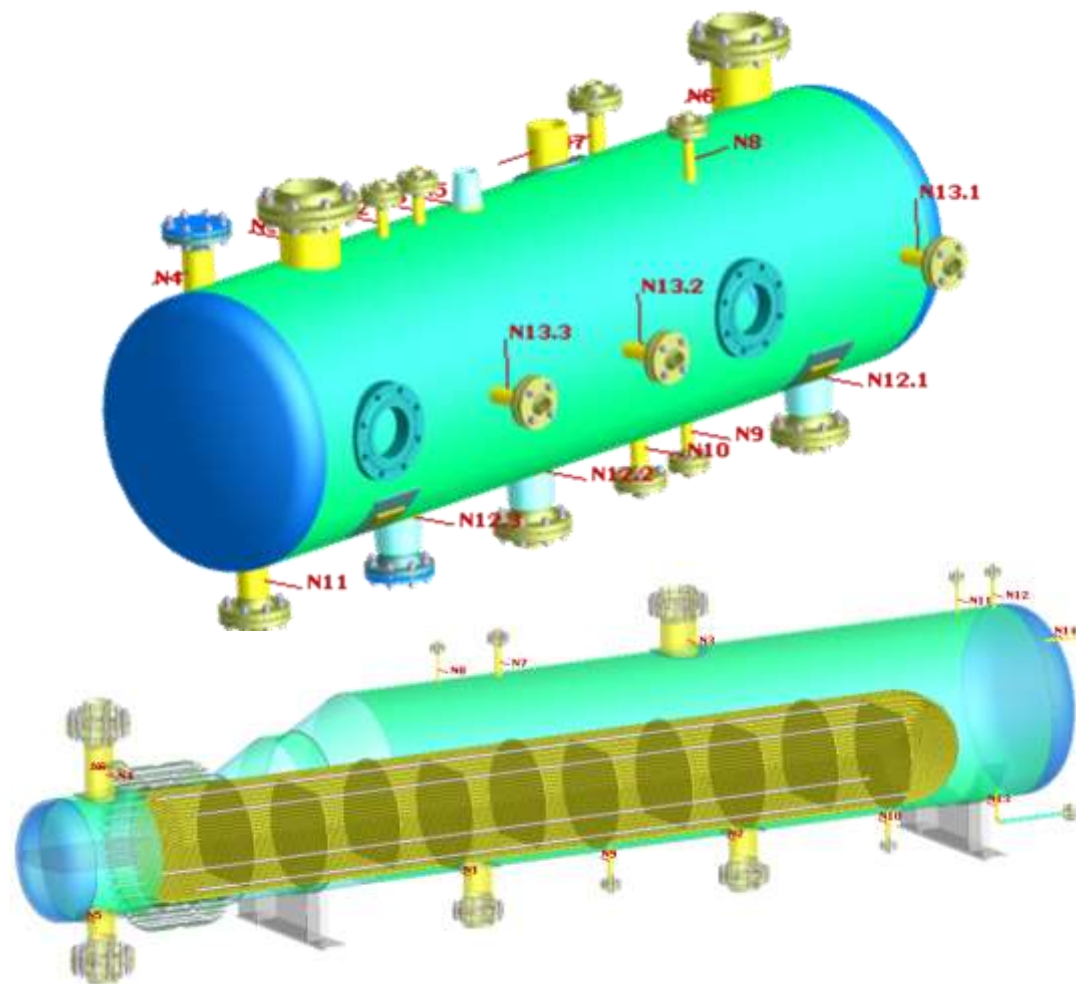
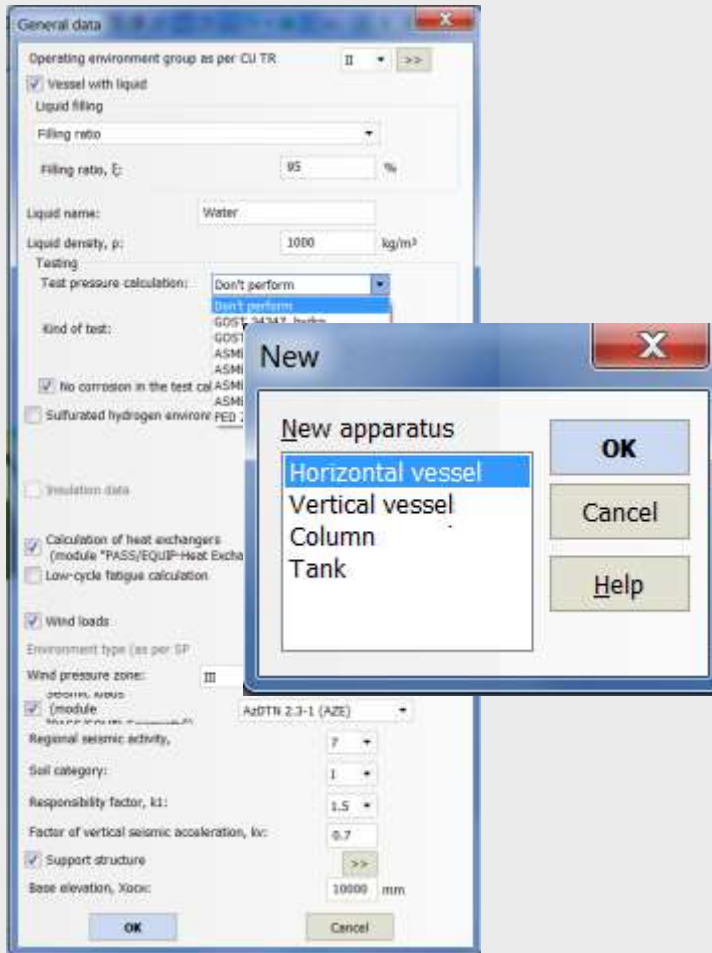
- Horizontal and vertical vessels
- Columns
- Heat Exchangers
 - shell-and-tube
 - air-cooled
- Tanks



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PASS/EQUIP

General Data



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PASS/EQUIP Features

- **Codes:**
ASME sec VII div. 1 and div.2, EN 13445, WRC and Russian GOST
- **Nozzle-shell connection:**
The stresses per WRC 537(107)/297 and GOST 34233.3-2017 codes
- **Materials and Elements Database:**
ASME, EN, GOST, JB etc., shells, heads, flanges gaskets, saddle supports, supporting legs, cylindrical and conical supports, nozzles, cross-sections of ribs, reinforcing rings, beam elements of support structure
- **Input data analysis**
Error and warning messages
- **Input of additional weight loads**
Forces and moments
- **Thickness calculation**
(Including for external pressure) and calculation of allowable pressure, forces and moments



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PASS/EQUIP | Material Database

- Selected from database (ASME II Part D, EN, GOST 34233.1, PNAE G-7-002-86, GOST R 54522-2011 etc.)
- User-defined materials

Selection of material dialog box showing material properties for GOST R 52857.1-2007. The material is Steel, Carbonic, Pipe. Properties include Allowable stresses, Yield point, Strength limit, Modulus of longitudinal elasticity, and Linear expansion coefficient.

T, °C	[Sigma]av, MPa	Re (Rp1.0, Rp0.2), MPa	Rm, MPa	E, MPa	Alpha, 1/°C
20	154	258	460	199000	0,000116
100	149	230	435	191000	0,000116
150	145	224	460	186000	
200	142	223	505	181000	0,000126
250	131	187	510	176000	
300	113	173	520	171000	0,000131
350	100	167	480	164000	
375	93	164	450		
400	80	130	411	159000	0,000130
410	64,8	142	392		
420	60	132	363		
425	56,8	123	343		
450				148000	
500					0,000141

Factor A: 80000 MPa, Factor B: 0,4, Factor C: 2300, Min. cycles number: 1000, Density: 7850 kg/m3, Poisson ratio: 0,3

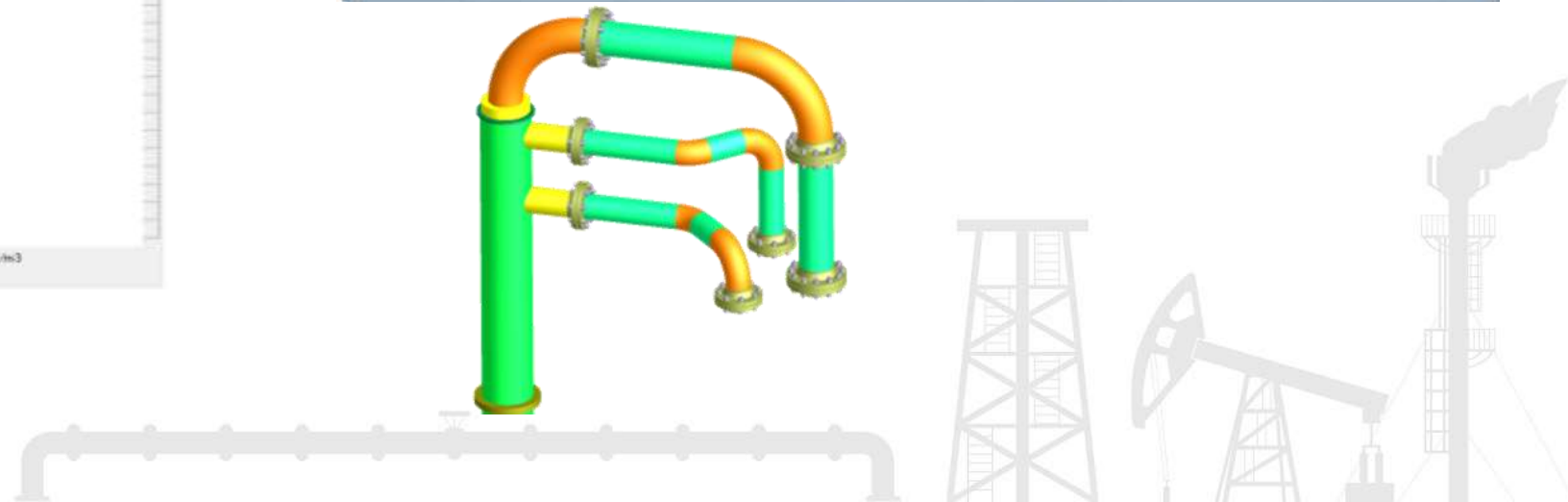
User's material dialog box showing material name: 09Г2С К1245. Material properties table includes columns for Workpiece, Type/Grade, T, Re, Rm, E, Alpha, and Rm/10^5.

Workpiece	Type/Grade	T, ...	Re (Rp1.0, Rp0.2), MPa	Rm, MPa	E, MPa	Alpha, 1...	Rm/10^5, MPa
Forging		350	161	258	164000	0,000136	0
Forging		375	152	244	164000	0,000136	0
Forging		400	138	220	155000	0,000136	0
Forging		20	245	378	199000	0,000116	0
Forging		100	210	336	191000	0,000116	0
Forging		150	202	323	186000	0,000126	0
Forging		200	194	311	181000	0,000126	0
Forging		250	190	304	176000	0,000126	0
Forging		300	176	281	171000	0,000131	0

Low-cycle strength (*) Coefficient A: 0 MPa, Coefficient B: 0, Coefficient C: 0, Minimum number of: 0. Physical properties (*) Density: 7800 kg/m3, Poisson's ratio: 0,3. (*) IF "0", substituted values for steel. (*) IF "0", defined as per GOST R 52857.6



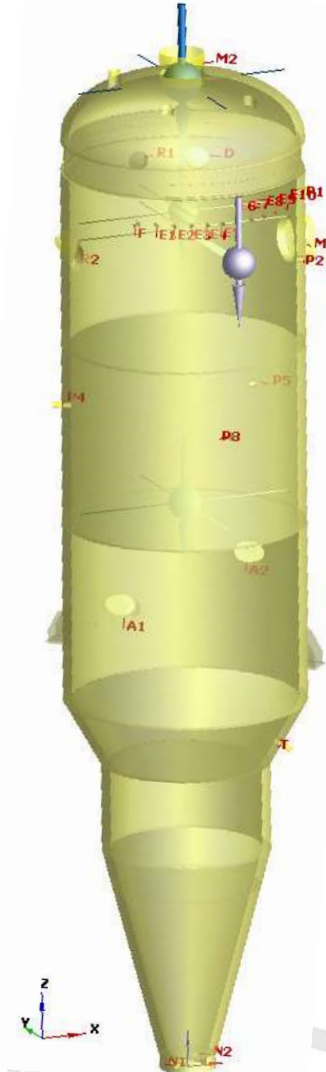
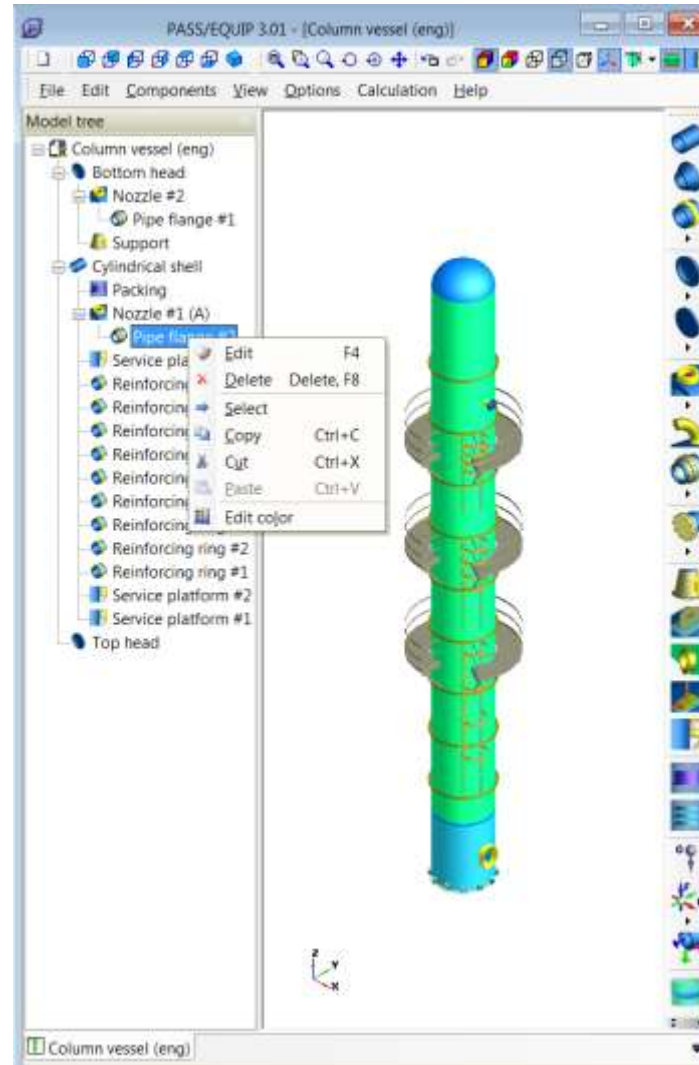
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PASS/EQUIP

- Representation of model structure as a structure tree.
- 3D graphic display: the color of selected elements and the entire model to be customized.
- "Wire-frame" and "transparent" view which allows internal elements to be seen.

Features



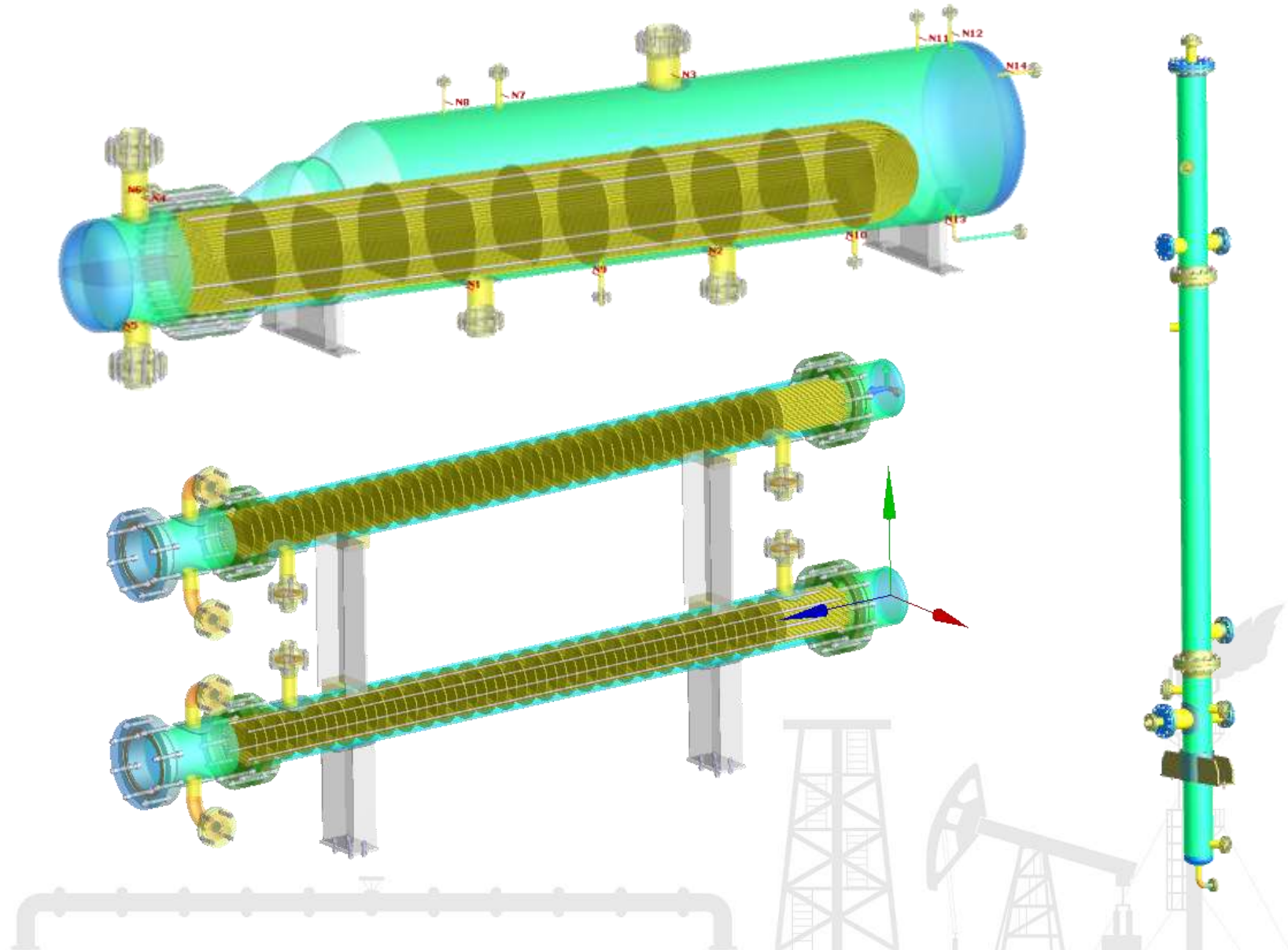
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PASS/EQUIP

Automatic calculation of:

- weight
- length
- reinforcing ring properties
(in both cylindrical shells and saddle supports)
- liquid volume, fill height, filling ratio and hydrostatic pressure

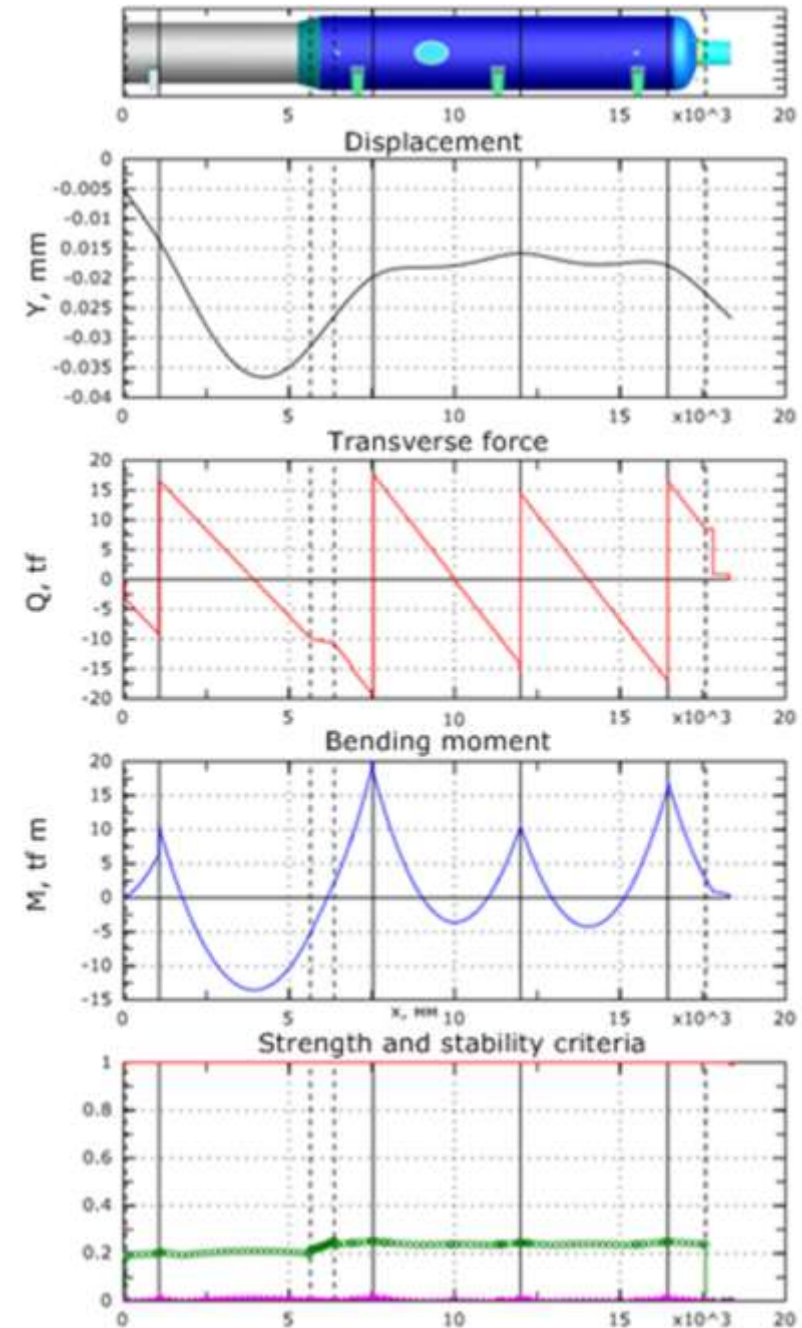
Features



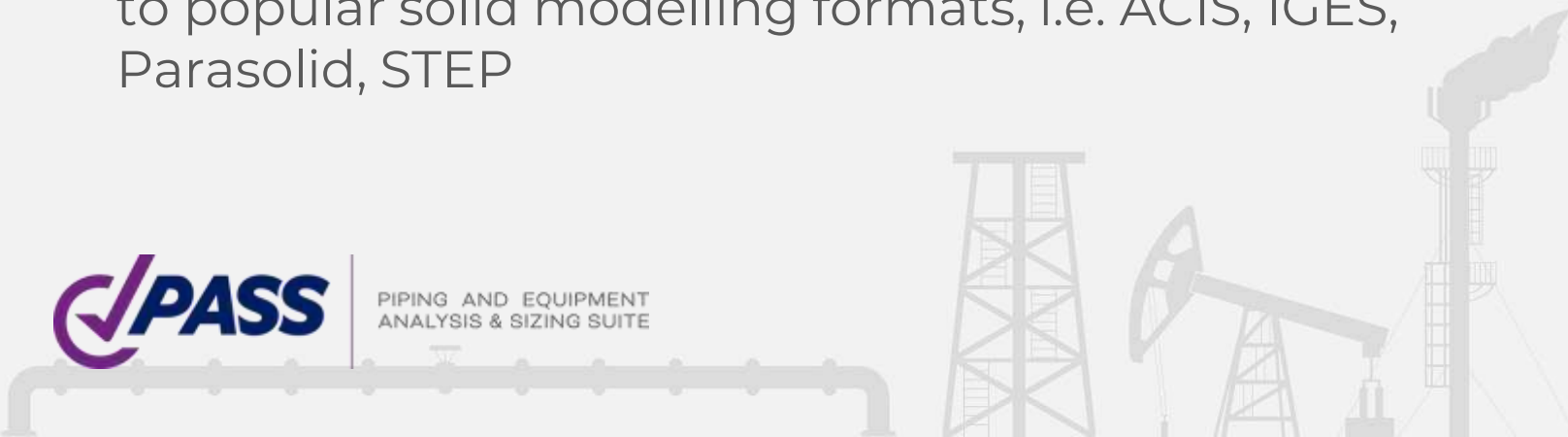
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PASS/EQUIP Features

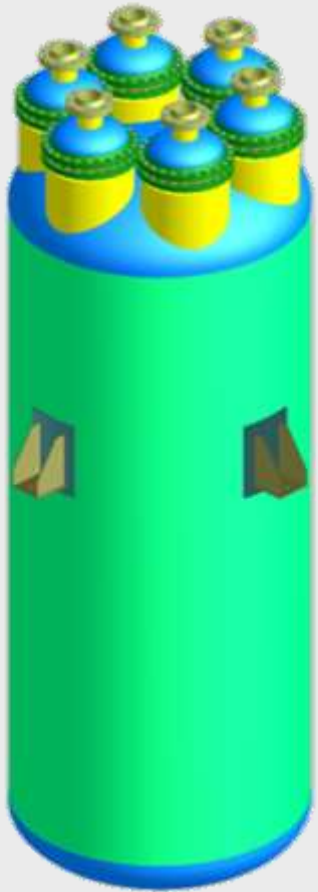
- Dependency between elements when one element changes, other linked elements change automatically
- Precise 3D solid model representation
- Units selection (US, SI, MKS)
- Analysis of horizontal vessel shells with any number (more than 2) and position of saddle supports
- Output of diagrams for deformation, bending moments, transverse forces and strength and stability allowances
- Export of the model to popular solid modelling formats, i.e. ACIS, IGES, Parasolid, STEP



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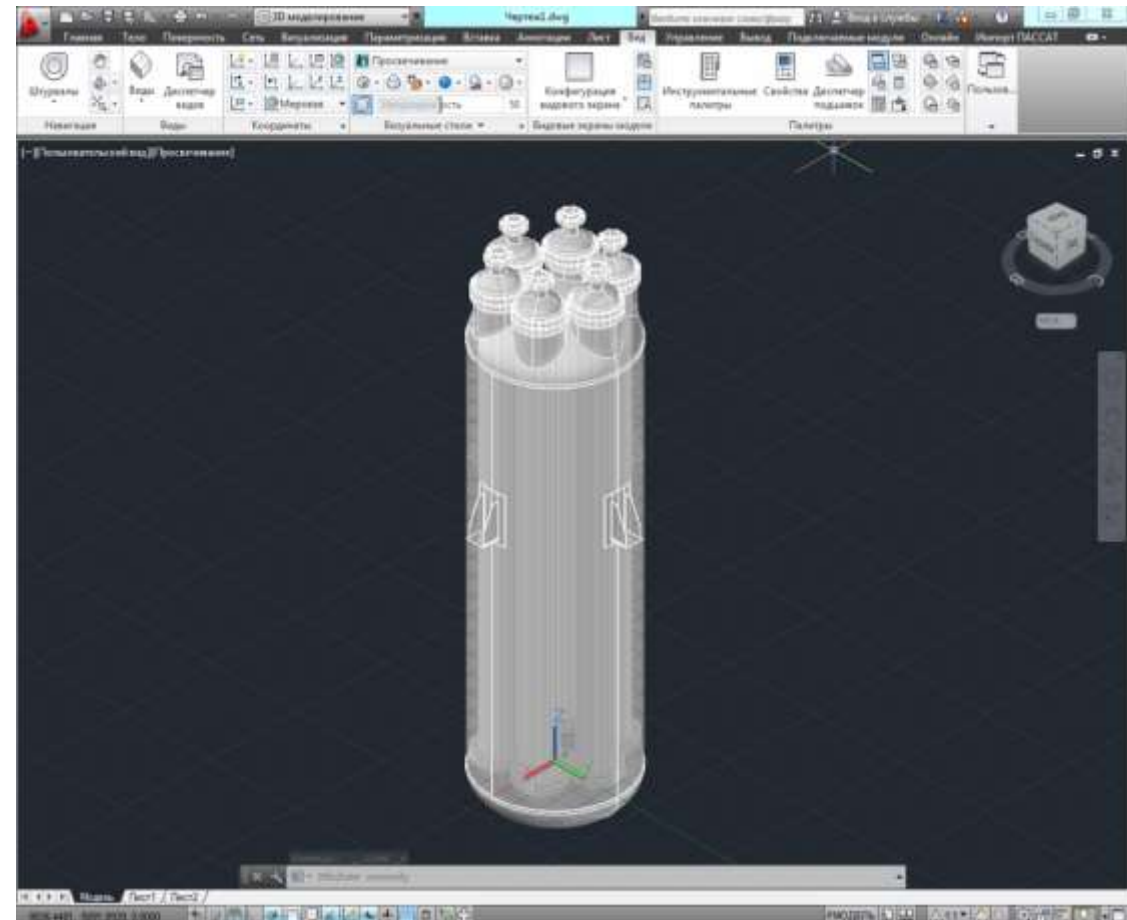
PASS/EQUIP



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3D Model Export

Export to AutoCAD and other popular CAD systems and finite element analysis software via formats IGES, STEP, ACIS, ParaSolid

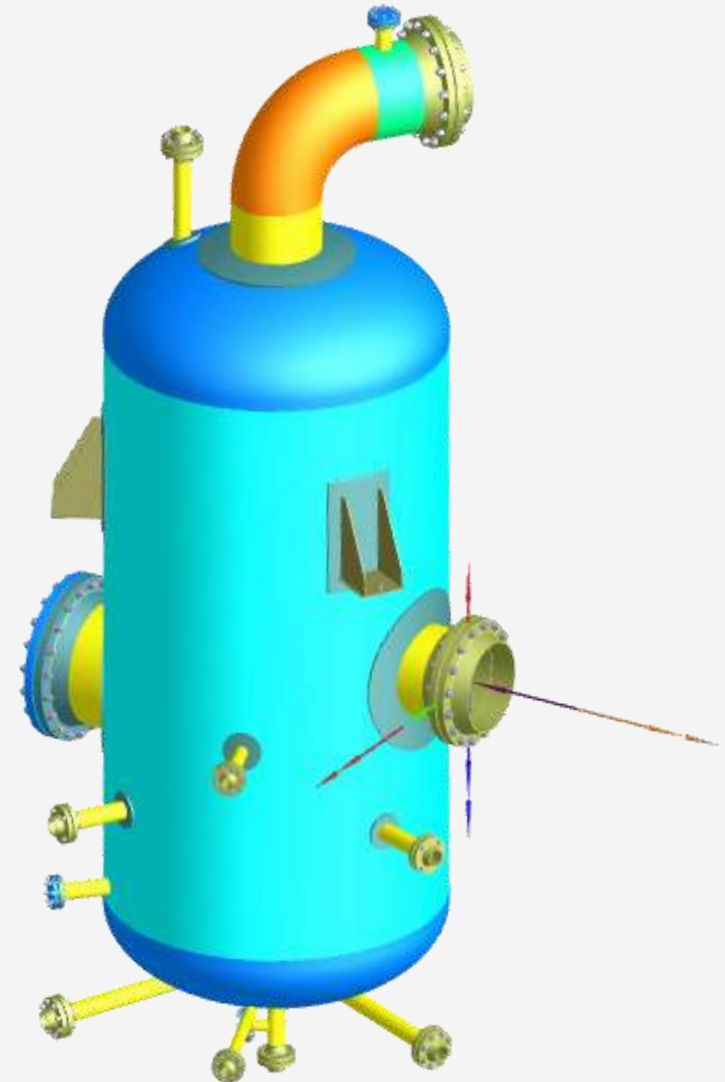


PASS/EQUIP Features

- Analysis of bolted caps
(with flange joints) as a combined analysis of flange and heads
- Calculation of low-cycle fatigue of vessel elements
- Strength analysis of shells and heads
considering displacement of weld joint edges, angularity and out-of-roundness of the shells
- Full (with intermediate analysis results) or Short reports of analysis
- Export of nozzles to PASS/EQUIP Nozzle FEM files (*.nzi)

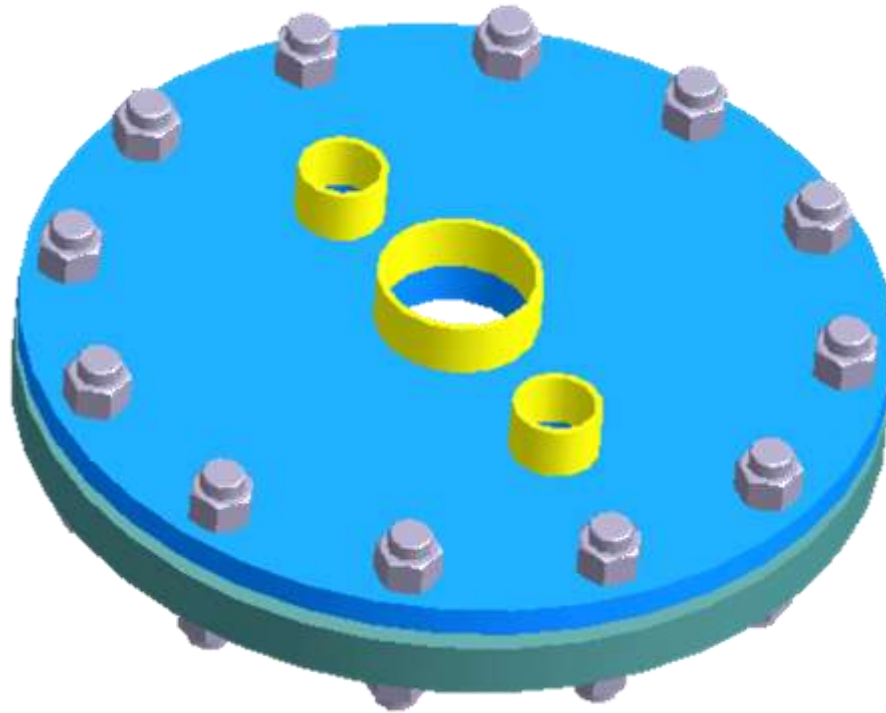


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PASS/EQUIP | Report

FLAT COVER WITH HOLES



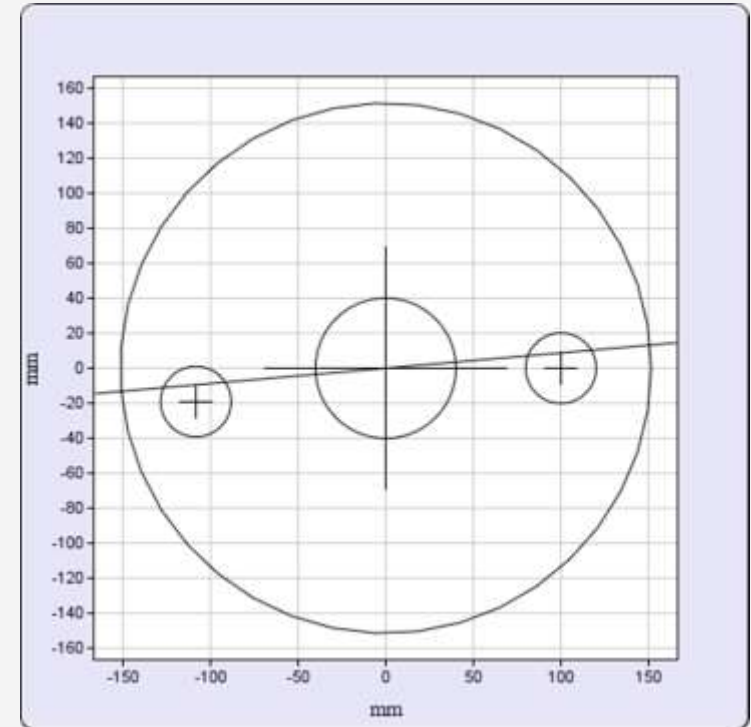
Nozzle number, i	Nozzle name	Chord, d _i , mm
1	Nozzle 1	80.3
2	Nozzle №2	36.34
3	Nozzle №3	35.45

Reduction factor for bottoms with holes (number of holes: 3) :

$$K_0 = \frac{\sqrt{1 - \left(\frac{\sum d_i}{D_p}\right)^3}}{\sqrt{1 - \left(\frac{\sum d_i}{D_p}\right)}} = 1.274$$

Position of the most hazardous section:

Angle of the most hazardous section, Φ : 5°



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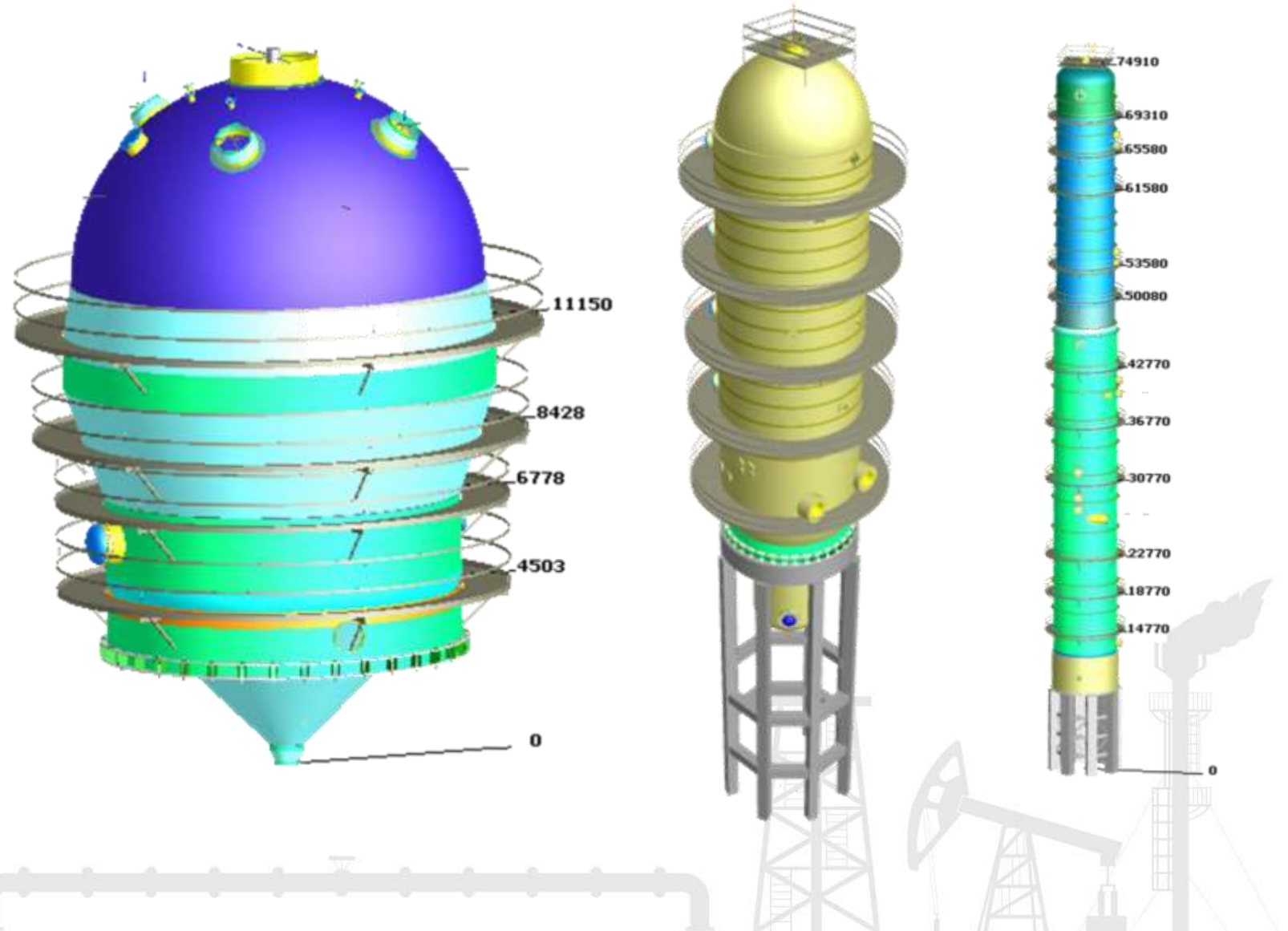
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- Lowest vibration frequency.
- Forces under wind loads (including resonance vortex excitation) and seismic loads.
- Strength and stability analysis of column elements.



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Columns



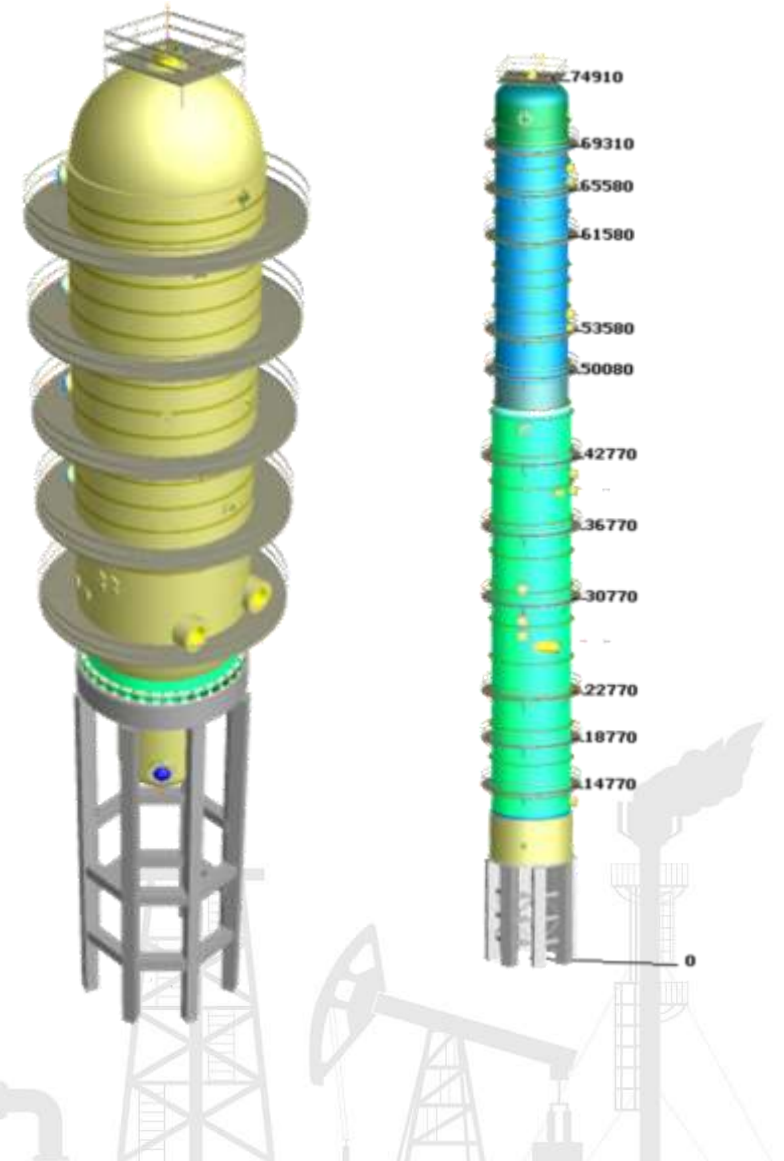
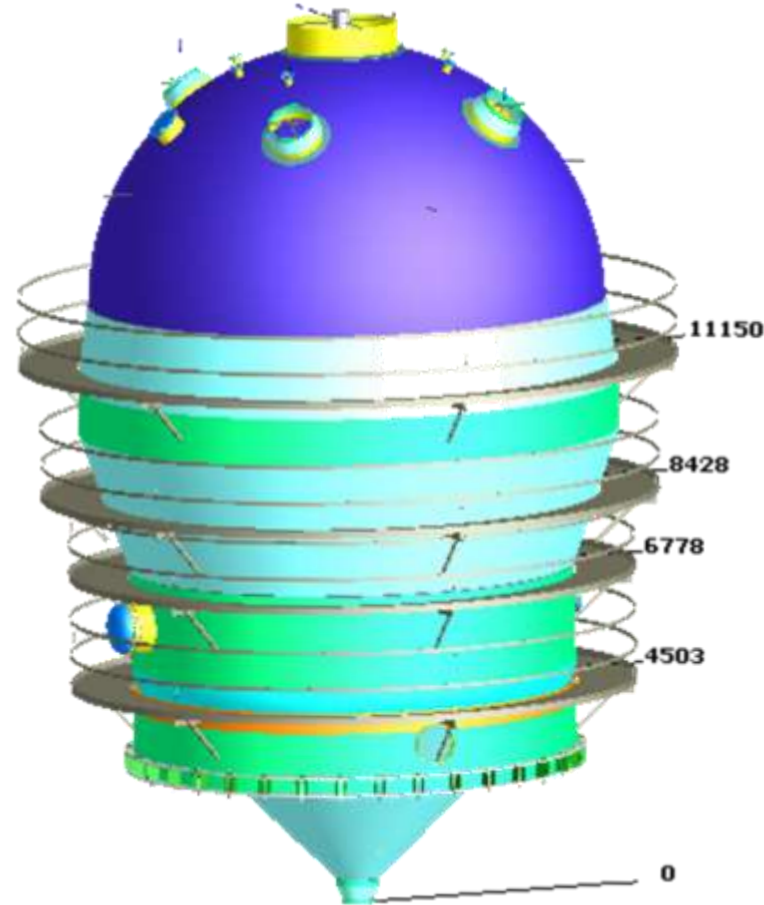
PASS/EQUIP

- Analysis of “cylinder + cone” support skirt with the option of including a transitional shell.
- Automatic determination of position and properties of most unsafe cross-section of supporting shell.
- Calculation of loads on basement and support structure.



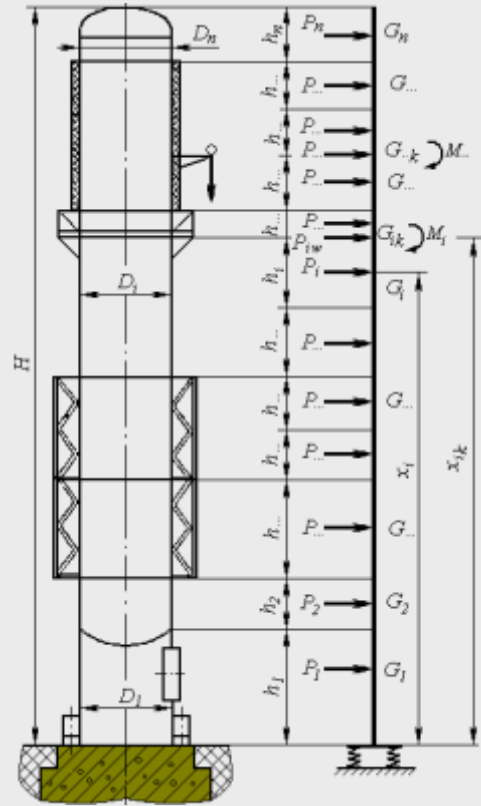
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Columns

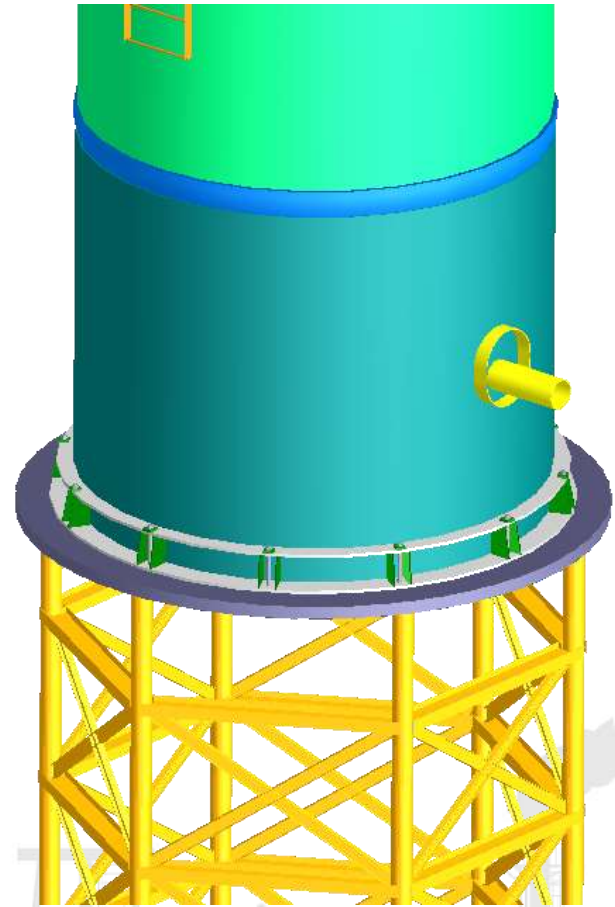
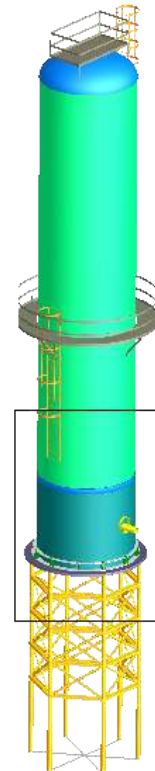
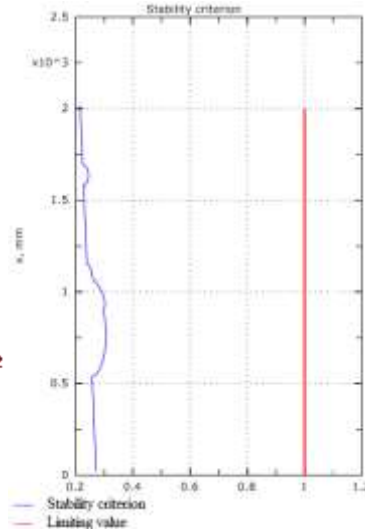
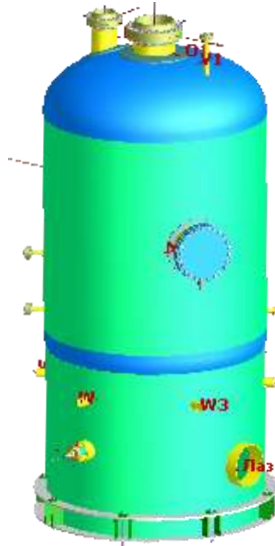


PASS/EQUIP

$$T = 2\pi \sqrt{\frac{\sum (G_i y_i^2 + G_{ik} y_{ik}^2)}{g \sum (G_i y_i + G_{ik} y_{ik})}}$$

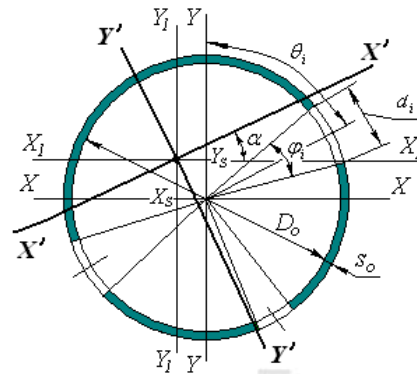


Columns



Parameters of hazardous section

Section coordinate (from the lower point of base): $x = 768.6$ mm
 Diameter in the critical cross-section: $D_2 = 2600$ mm



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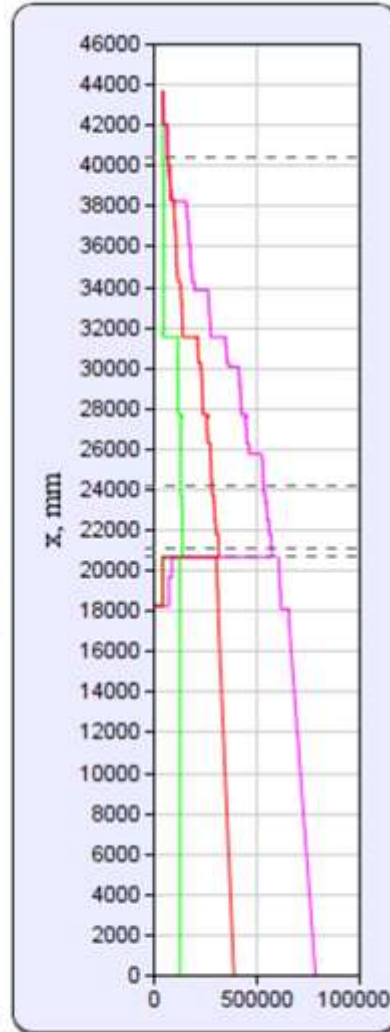
PASS/EQUIP

Columns

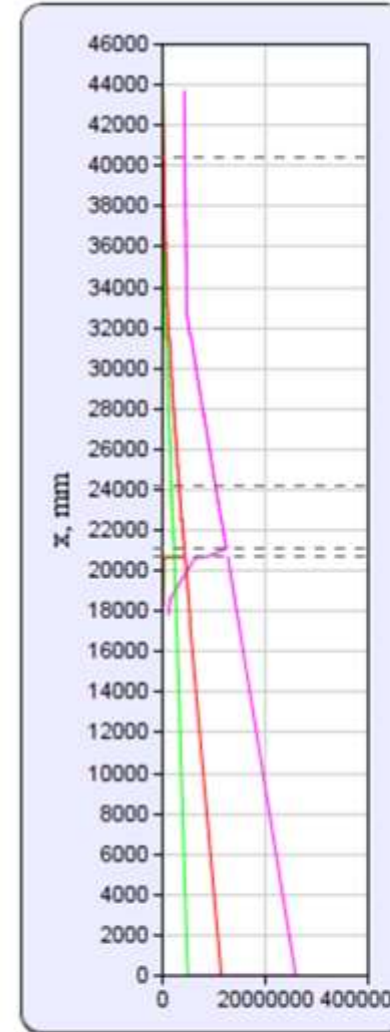
Automatic Determination of Loads, Plotting



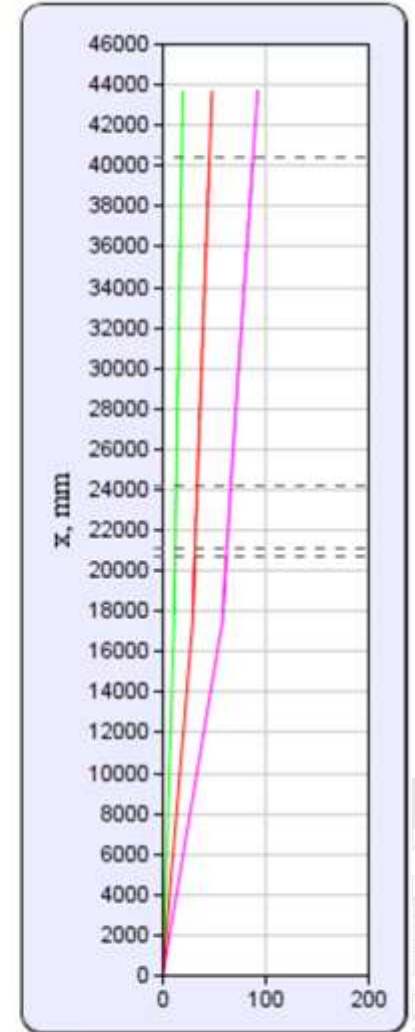
- Q_{sum}
- seism.
- wind.



Horizontal load,
 Q_{sum} , N



Bending moment,
 M_{sum} , N m



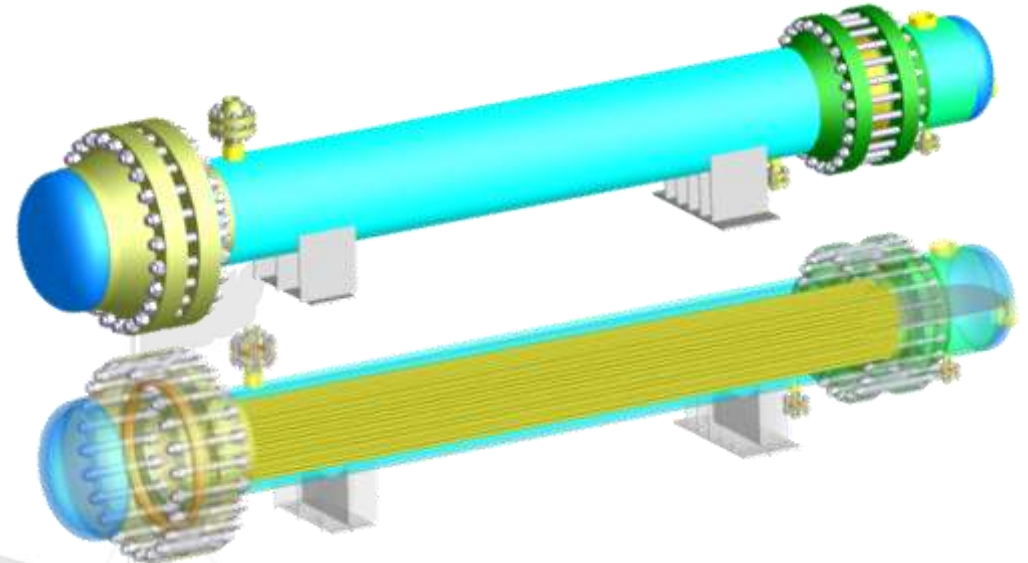
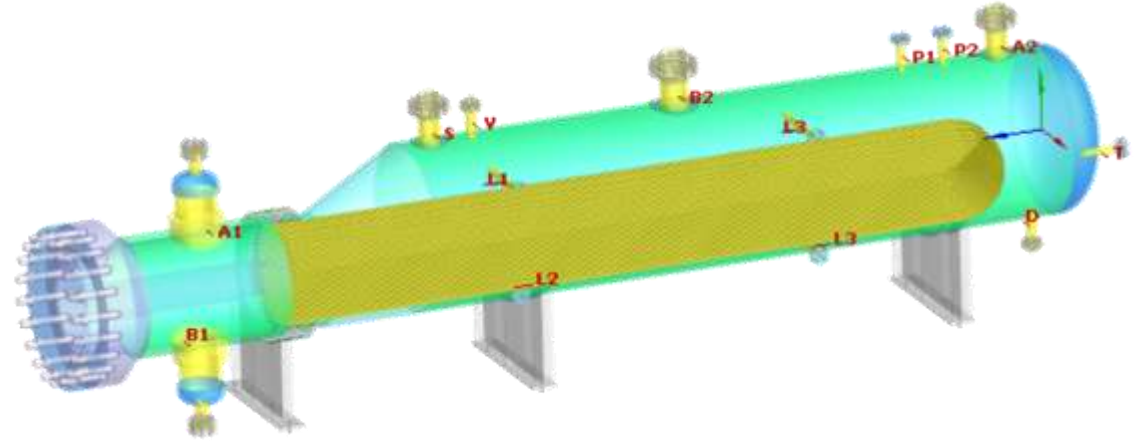
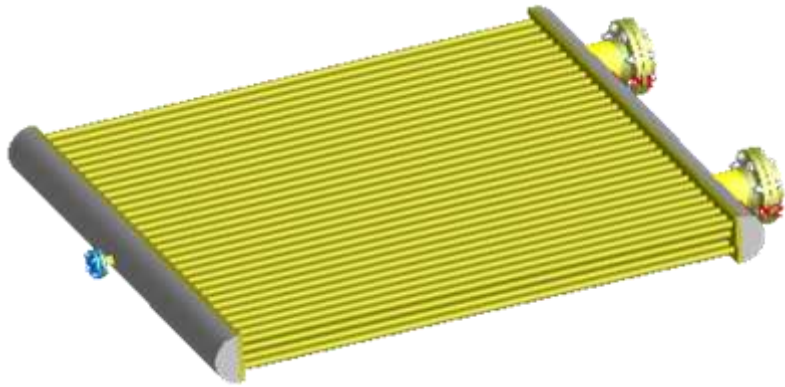
Displacements due to total
loads, y , mm



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PASS/EQUIP | Heat Exchangers

- ASME UHX and GOST 34233.7 heat exchanger mechanical design;
- Input of heat-exchange element properties within a single multi-window interface;
- Calculation of forces in tube plates, casing and tubes;
- Analysis of tube plates, casing, tubes, expansion joint, expansion vessel, floating head;
- Air cooling exchanger.



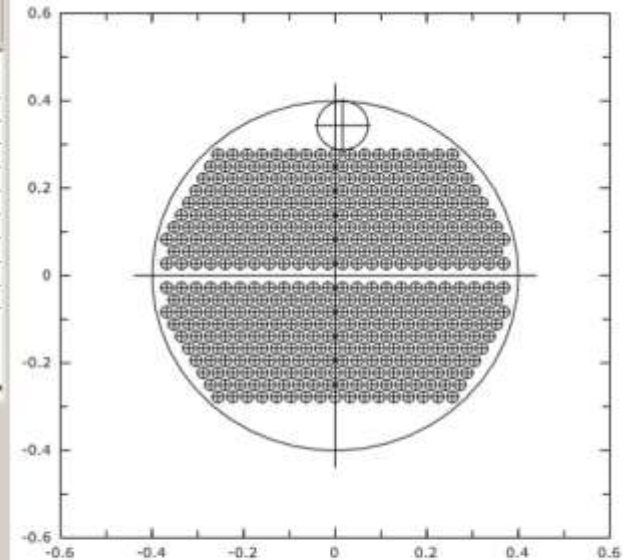
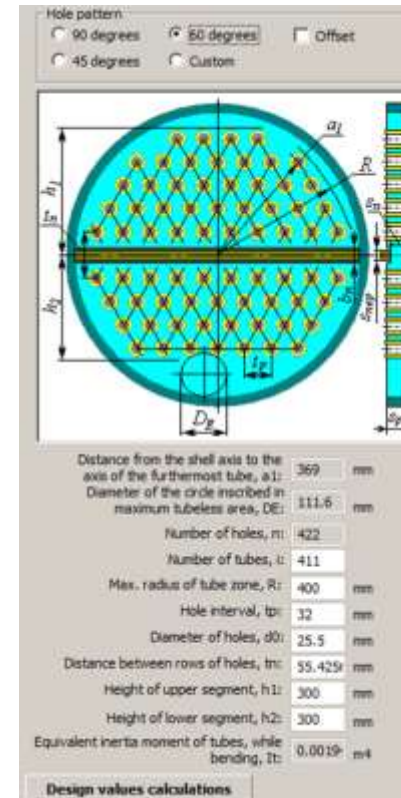
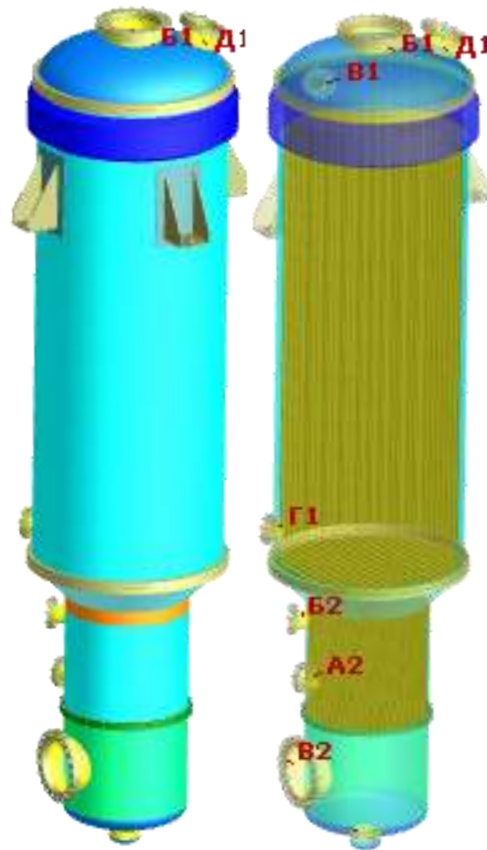
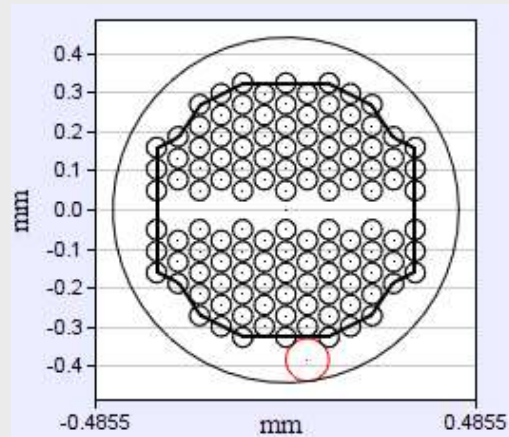
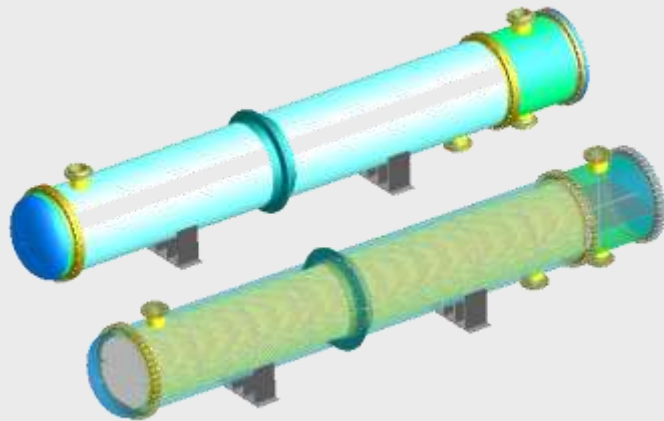
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PASS/EQUIP

Heat Exchanger

Automatic determination of tube sheet design parameters



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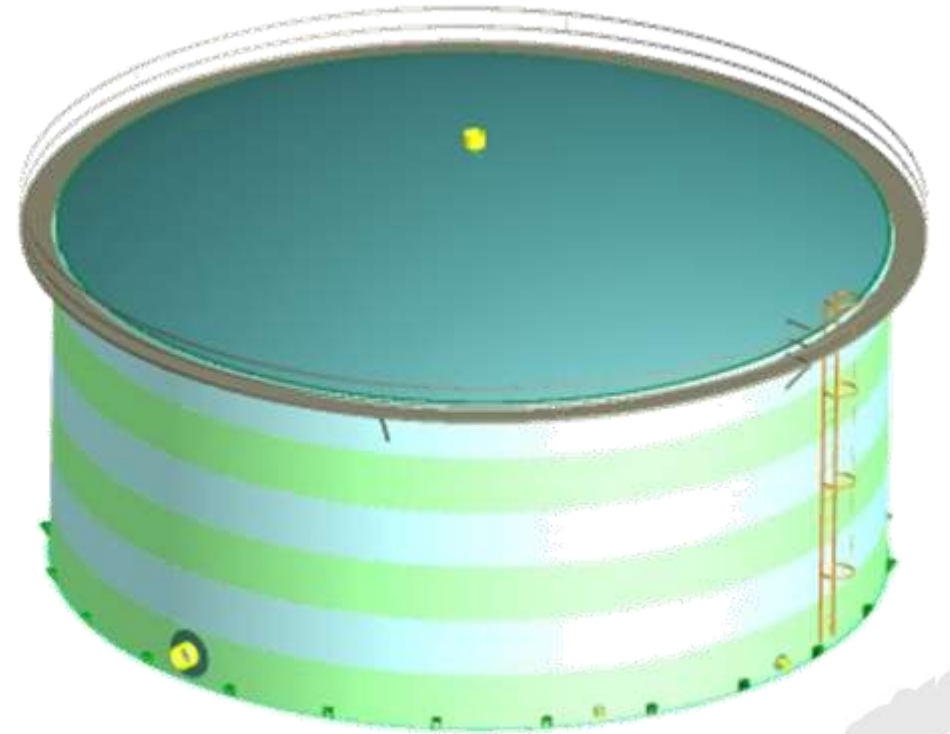
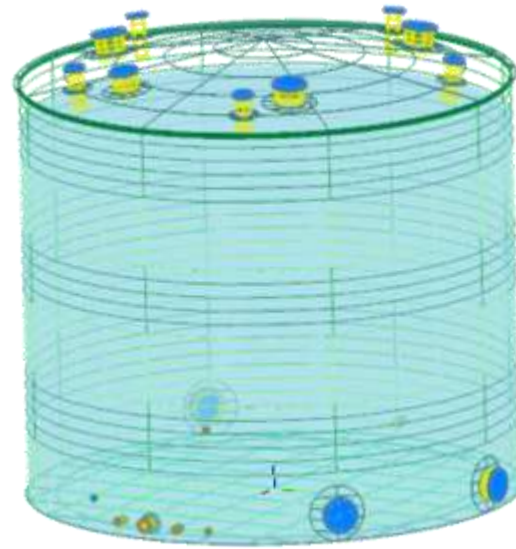
PASS/EQUIP

- Automatic weight measurement.
- Strength and stability analysis of the wall, stationary frameless roof and tank head, including wind, snow and seismic loads.
- Wall anchorage calculation.
- Calculation of loads on basement.
- Estimation of allowable stresses on the nozzles of cut-ins in the tank wall.



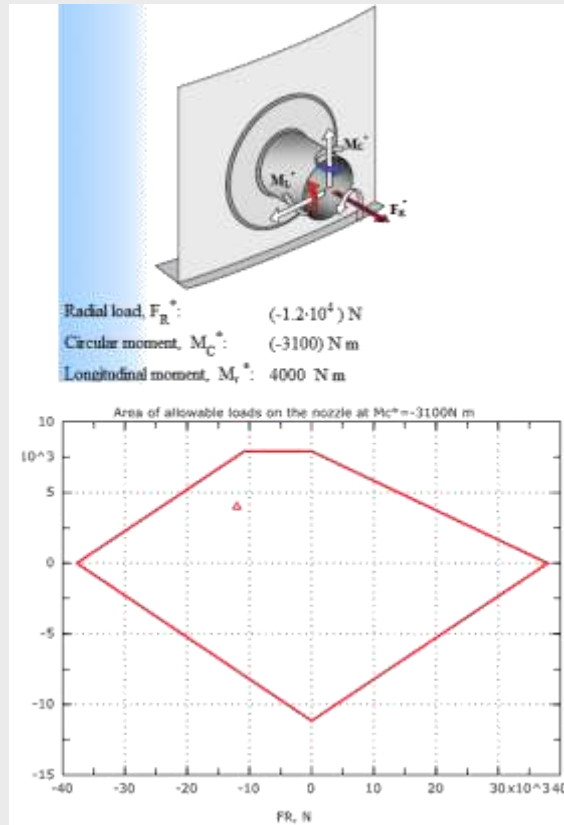
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Tanks

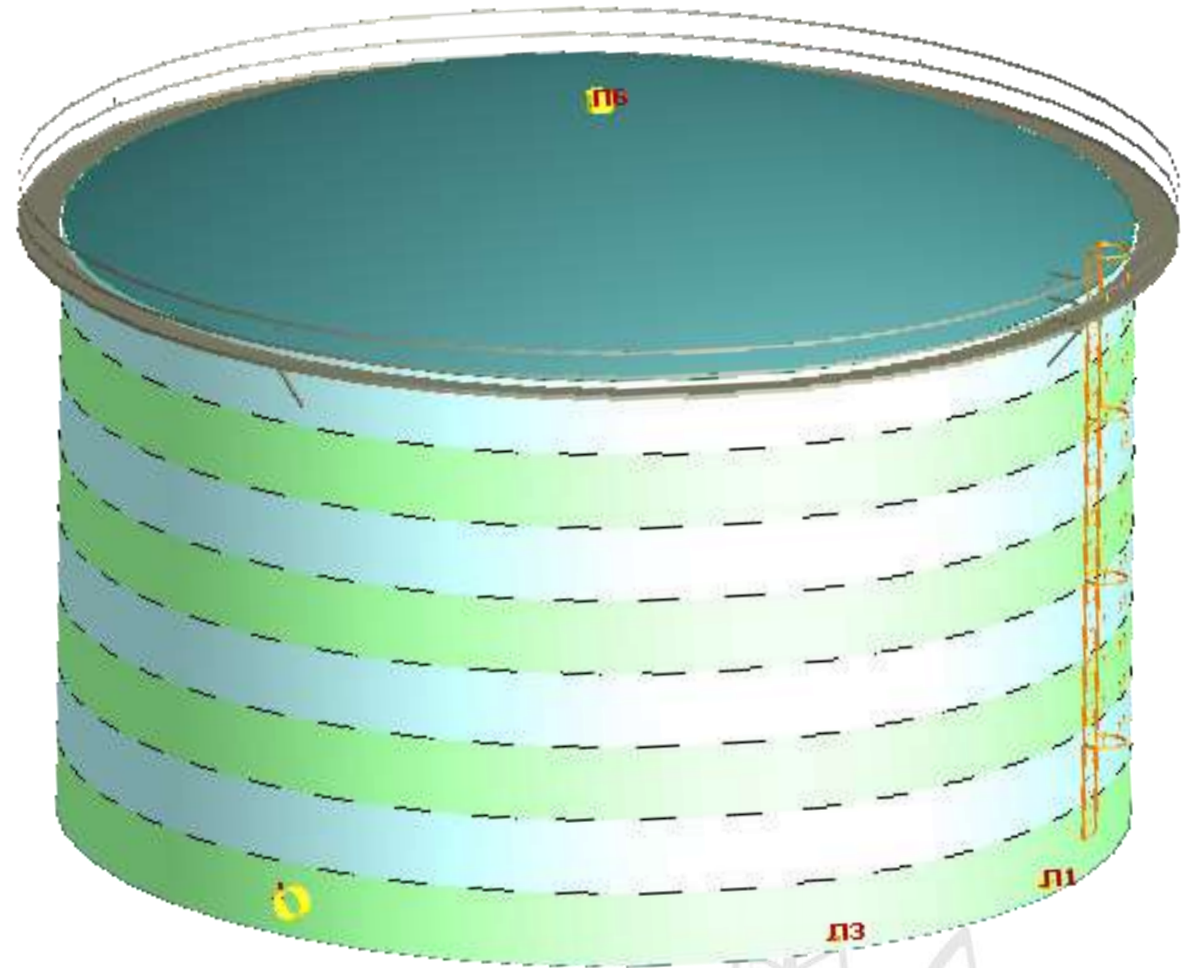


PASS/EQUIP

Area of allowable nozzle loads



Tank



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PASS/EQUIP Seismic

- Calculation of seismic loads on horizontal and vertical vessels.
- Analysis of vessel elements considering seismic loads.
- Consideration of support structure and installation height.

Calculation of seismic loads

Calculation in operating conditions (including corrosion)

Dynamic factor:

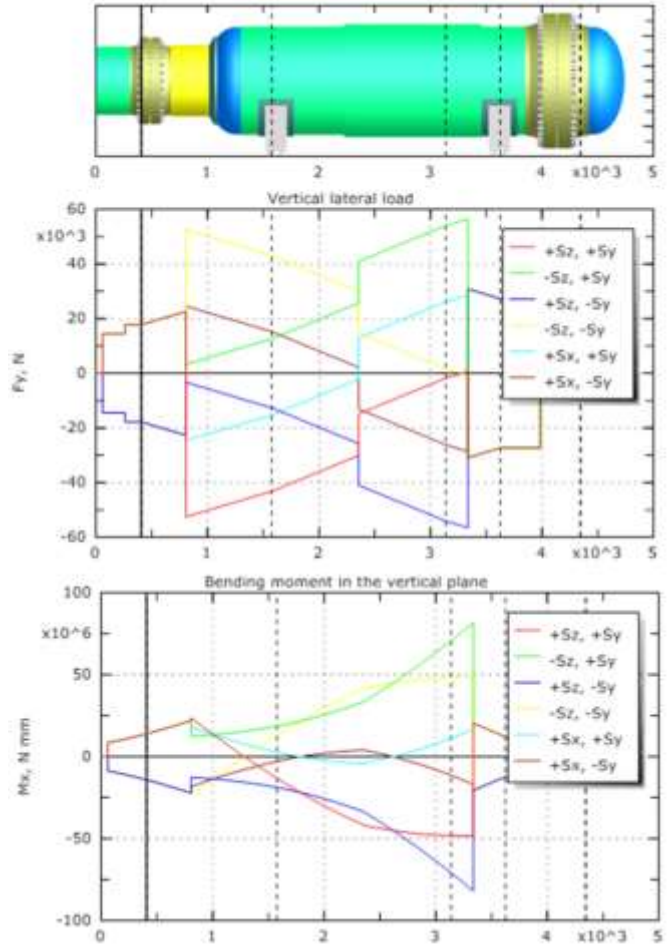
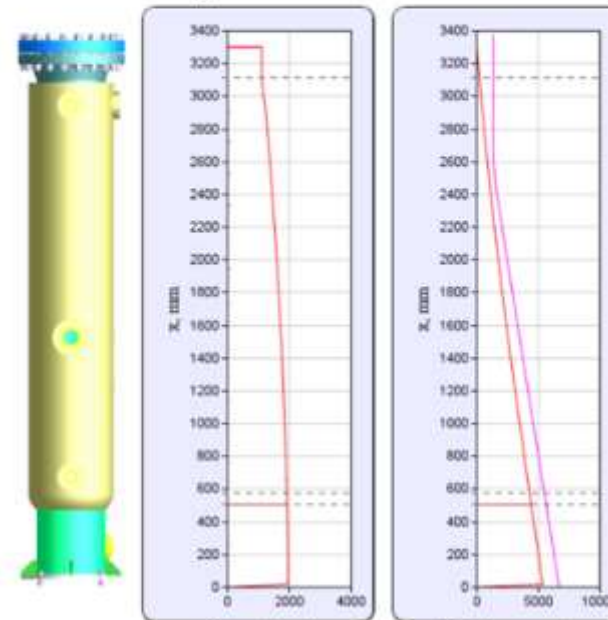
$$\beta = \max\left\{0.3; \min\left(\frac{1.9}{T}; 2.5\right)\right\} = 2.5$$

Seismic load factor:

$$K_s = 0.2$$

Seismic load applied at the center of gravity i -th element:

$$S_i = 0.375 \cdot K_s \cdot \beta \cdot G_i \cdot y_i \frac{\sum_{j=1}^n G_j \cdot y_j}{\sum_{j=1}^n G_j \cdot y_j^2}$$



Seismic loads (module "PASS/EQUIP-Seismicity")
 Regional seismic activity, magnitude: 7
 Soil category: II
 Responsibility factor, k1: 1.5
 Factor of vertical seismic acceleration, kv: 0.7
 Support structure
 Base elevation, Xочн: 10000 mm

AzDTN 2.3-1 (AZE)
 STO SA-03.003-2009 (RUS)
 AzDTN 2.3-1 (AZE)
 GOST R 55722-2013 (RUS)
 GOST 34283-2017 (RUS)
 IS 1893 (IND)



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PASS/EQUIP | Reports

Passat report

Problem components

General data

Summary tables
 Summary tables
 Nozzle summary
 Filling calculation
 Equipment category: as per TR TS 032/2013

Strength from supporting loads:
 Drawings of forces and moments
 Saddle Support №1
 Saddle Support №1

Calculation of seismic effects

Head elliptical №1

Cylindrical Shell 1

L8
 L4
 L2
 L7
 L3
 L1
 B1
 S1

Flange Dc100

Flange Dc210

Flange Dc210

N2

Flange Dc100

Flange Dc200

Cylindrical Shell 2

L3

Nozzle d

Flange Dc1600

Cylindrical Shell №1

L8

Head elliptical №3

N4

Cylindrical Shell 1

Z1

S1

Z1

Summary tables

Basic components

Input data

Component	Material	Diameter, mm	Wall thickness, mm	Length (height), mm	Total allowance, mm	Weld strength ratio
Head elliptical №1	09Г2С	4000	60	1140	15	1
Cylindrical Shell 2	09Г2С	4000	50	4940	6	1
Cylindrical Shell 3	09Г2С	4000	65	2600	6	1
Cylindrical Shell №4	20	1600	26	1043	6	1
Head elliptical №3	09Г2С КИ245	1600	30	490	10	1
Cylindrical Shell 1	09Г2С	4000	50	8540	6	1
Cap flat №1	09Г2С	600	60	218	6	1
Head elliptical №2	09Г2С	4000	60	1140	15.3	1

Calculation results

Operating conditions

Component	Calculation temperature, °C	Calculation pressure, MPa	Allowable stresses, MPa	Effective thickness including allowances, mm	Allowable pressure, MPa	Strength condition
Head elliptical №1	100	3.412	160	57.87	3.58	fulfilled
Cylindrical Shell 2	100	3.412	160	49.1	3.482	fulfilled
Cylindrical Shell 3	100	3.412	160	49.1	4.651	fulfilled
Cylindrical Shell №4	100	3.428	142	25.55	3.506	fulfilled
Head elliptical №3	100	3.433	140	29.74	3.478	fulfilled
Cylindrical Shell 1	100	3.412	160	49.1	3.482	fulfilled
Cap flat №1	100	3.4	160	50	5.121	fulfilled
Head elliptical №2	100	3.412	160	58.17	3.556	fulfilled

Test conditions

Component	Calculation pressure, MPa	Allowable stresses, MPa	Effective thickness including allowances, mm	Allowable pressure, MPa	Strength condition
Head elliptical №1	4.444	254.5	50.07	5.695	fulfilled
Cylindrical Shell 2	4.444	254.5	41.22	5.539	fulfilled
Cylindrical Shell 3	4.444	254.5	41.22	7.4	fulfilled
Cylindrical Shell №4	4.46	200	24.04	4.938	fulfilled
Head elliptical №3	4.465	222.7	26.12	5.534	fulfilled
Cylindrical Shell 1	4.444	254.5	41.22	5.539	fulfilled

Calculation of wind loads

Calculation as per GOST 34283-2017

Normative value of the average wind load on the i-th section:

$$q_{i,av} = q_0 \cdot \theta_i \cdot K,$$

where θ_i – coefficient taking into account the dependence of the wind pressure of the vessel height:

$$\theta_i = \begin{cases} 0.75, & (z_j + z_{out}) \leq 5 \text{ m} \\ \left(\frac{z_j + z_{out}}{10} \right)^{0.3}, & (z_j + z_{out}) > 5 \text{ m} \end{cases}$$

Average share of wind load on the i-th section:

$$F_{i,av} = q_{i,av} \cdot D_i \cdot h_i,$$

where D_i – outer diameter of the i-th section,

h_i – height of the i-th section.

The coefficient of the spatial correlation of the wind pressure fluctuations:

$$v = 0.968 - 0.025 \cdot \sqrt{H + z_{out}}$$

Fluctuating component of the wind load on the i-th section:

$$P_{i,fluc} = v \cdot G_i \cdot \xi \cdot \eta_i,$$

where G_i – weight of the i-th section,

ξ – dynamic factor,

η_i – relative acceleration of the center of gravity of the i-th section.

Wind load on the i-th section:

$$P_i = P_{i,av} + P_{i,fluc}$$

The bending moment in the cross-section at the height x_0 , caused by wind load on the j-th serving platform:

$$M_{ej} = 1.4 \cdot q_0 \cdot \theta_j \cdot (x_i - x_0) \left[1 + 0.75 \cdot \xi \cdot x_j \cdot m_j \right] \cdot \Sigma A_p$$

In the absence of accurate data about the shape of platform the bending moment is given by:

$$M_{ej} = 1.85 \cdot q_0 \cdot \theta_j \cdot (x_i - x_0) \left[1 + 0.75 \cdot \xi \cdot x_j \cdot m_j \right] \cdot A_j,$$

where ΣA_p – sum of the areas of all projections profiles of j-th platform in a plane perpendicular to the wind direction;

A_j – area bounded by the j-th platform;

$$x = 1.56 \cdot \left(\frac{x_j + z_{out}}{H + z_{out}} \right)^{1.6}$$

m_j – pulsation factor of the wind pressure,

$$m_j = 0.76 \cdot \left(\frac{x_j + z_{out}}{10} \right)^{-0.15}$$

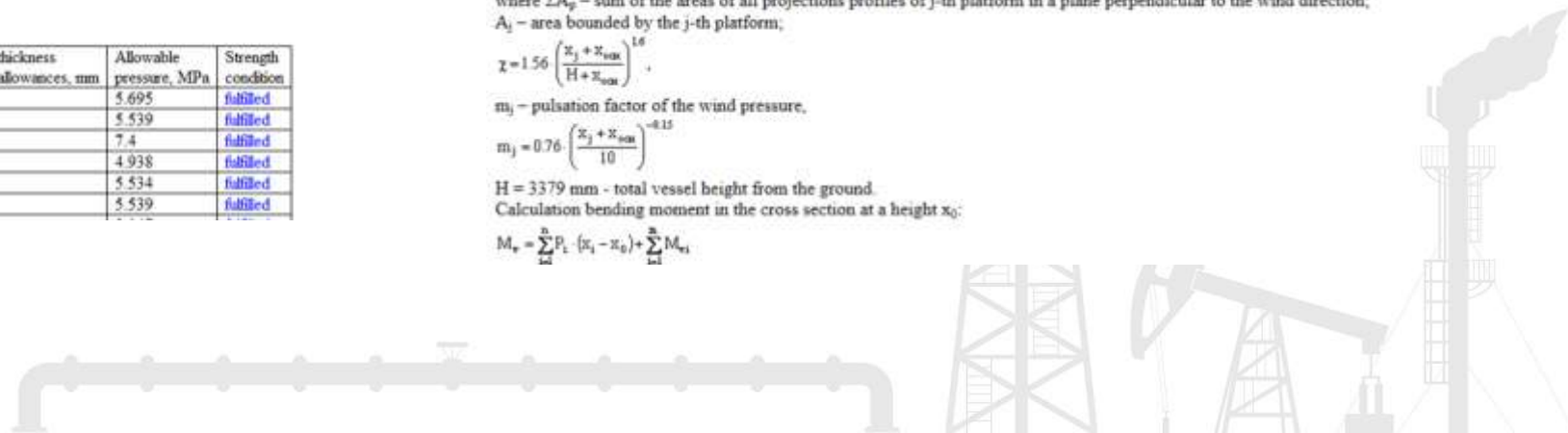
$H = 3379$ mm – total vessel height from the ground.

Calculation bending moment in the cross section at a height x_0 :

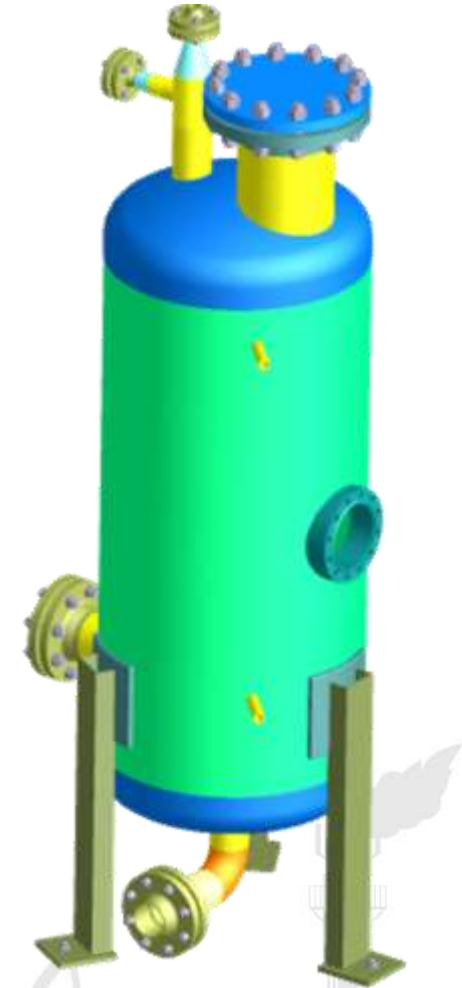
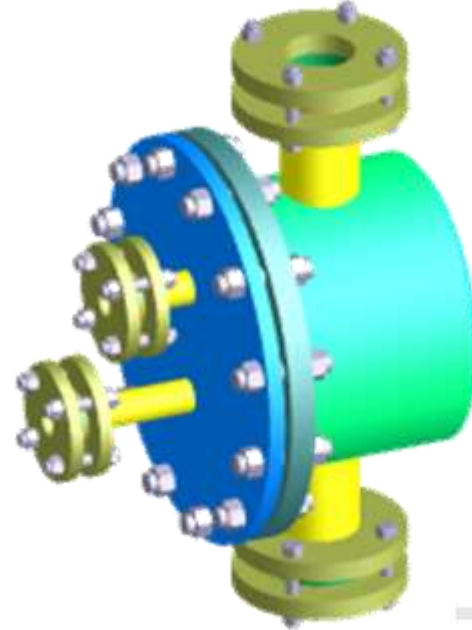
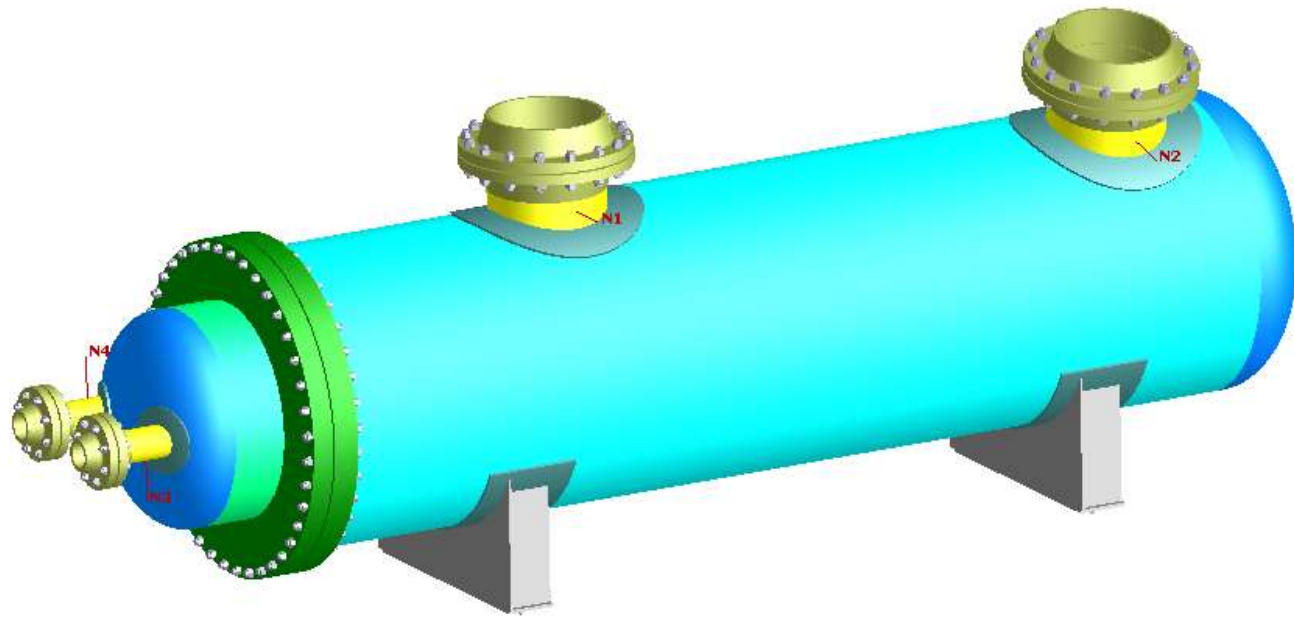
$$M_x = \sum_{i=1}^n P_i \cdot (x_i - x_0) + \sum_{i=1}^n M_{ei}$$



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



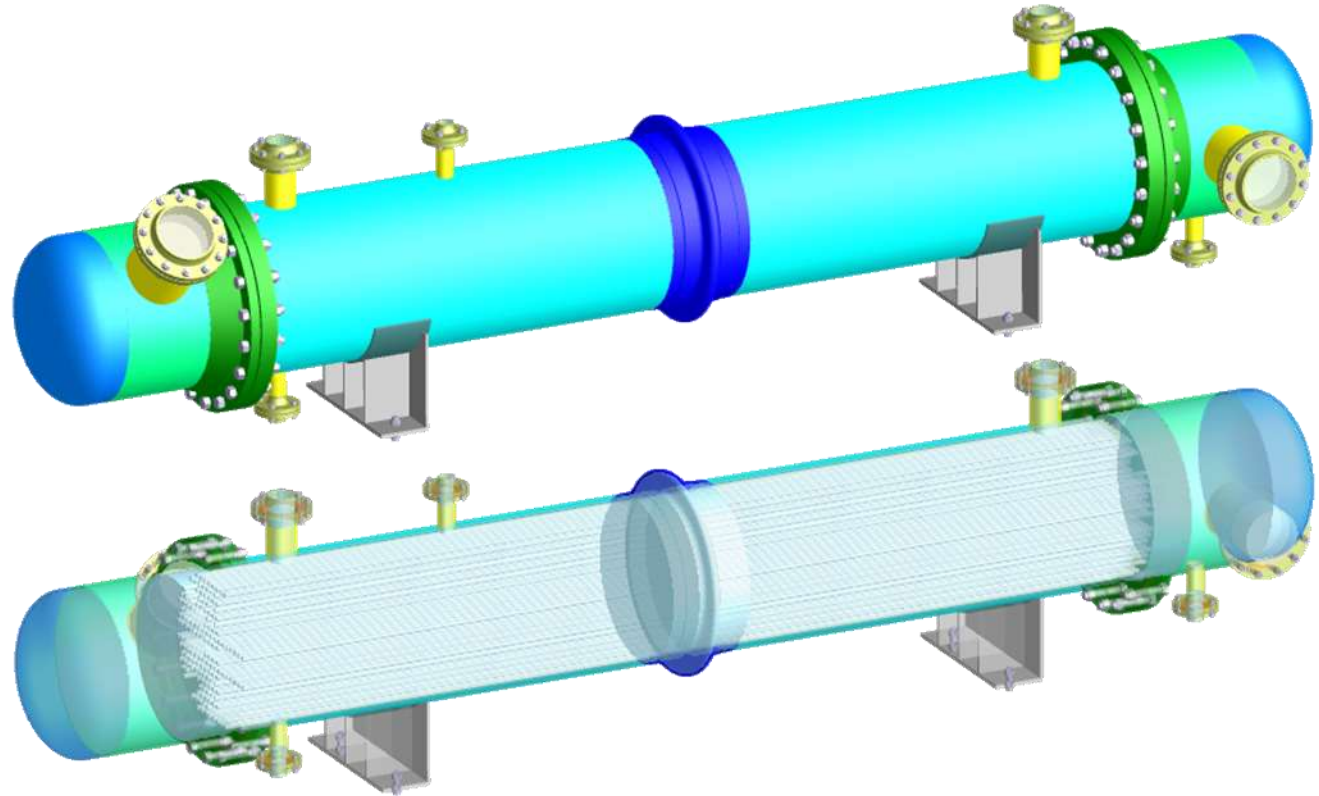
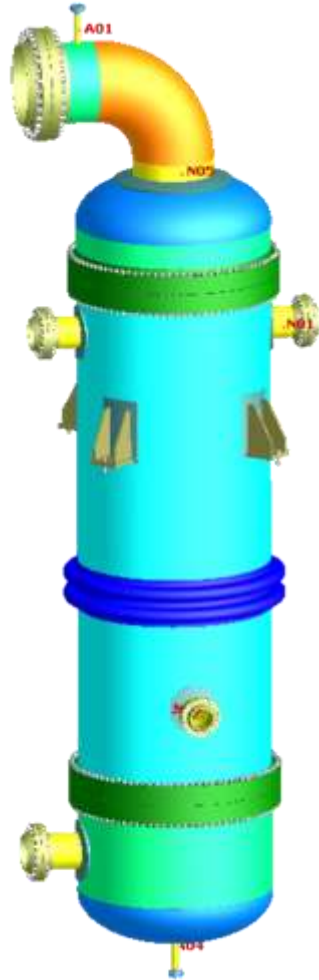
PASS/EQUIP | Examples



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



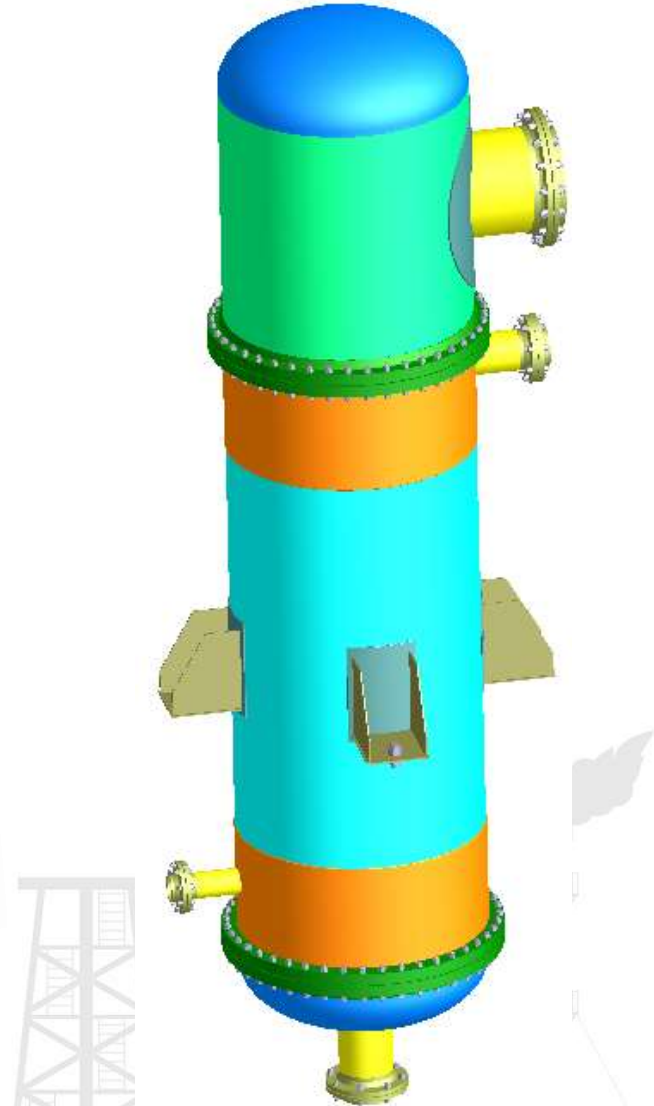
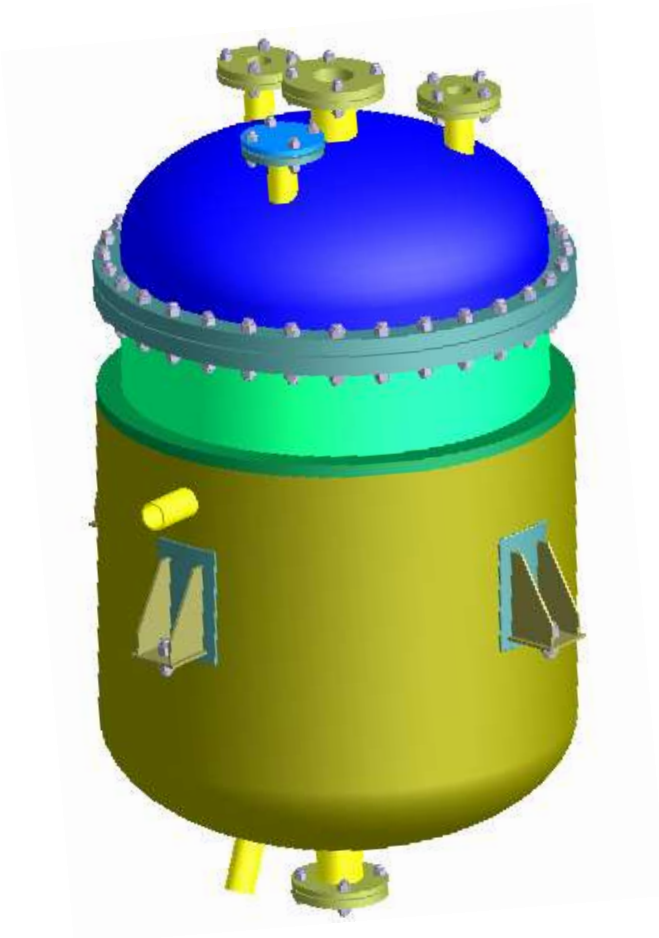
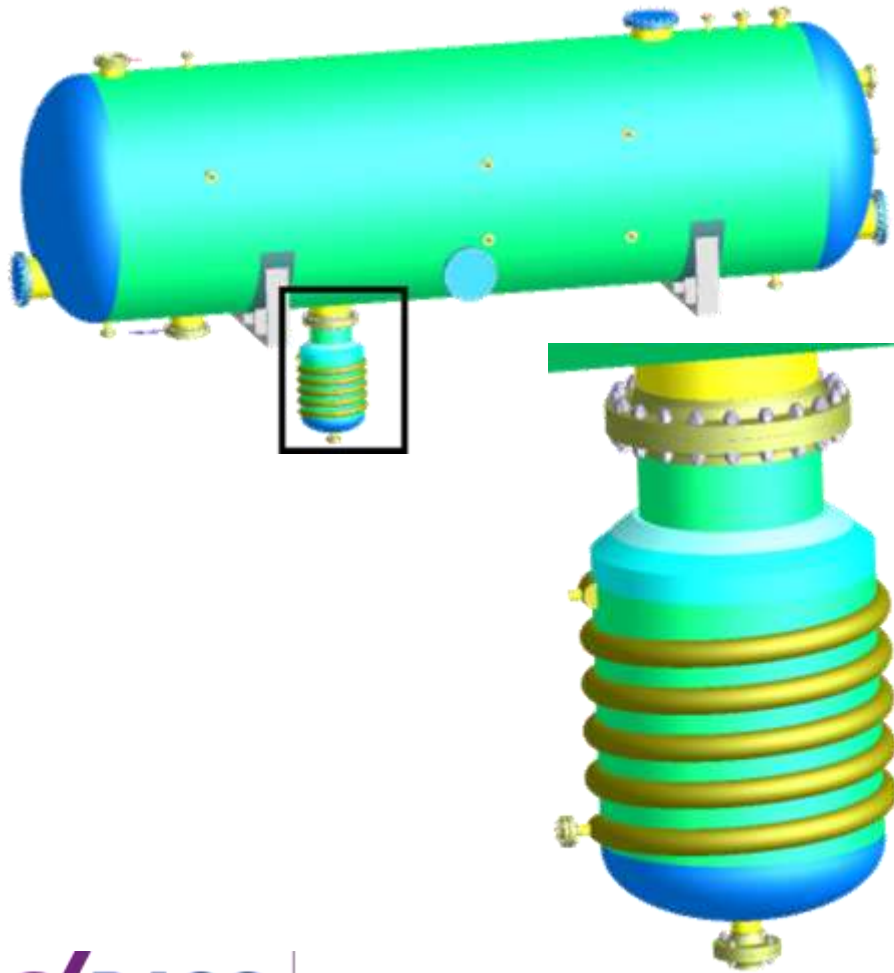
PASS/EQUIP | Examples (Heat Exchangers)



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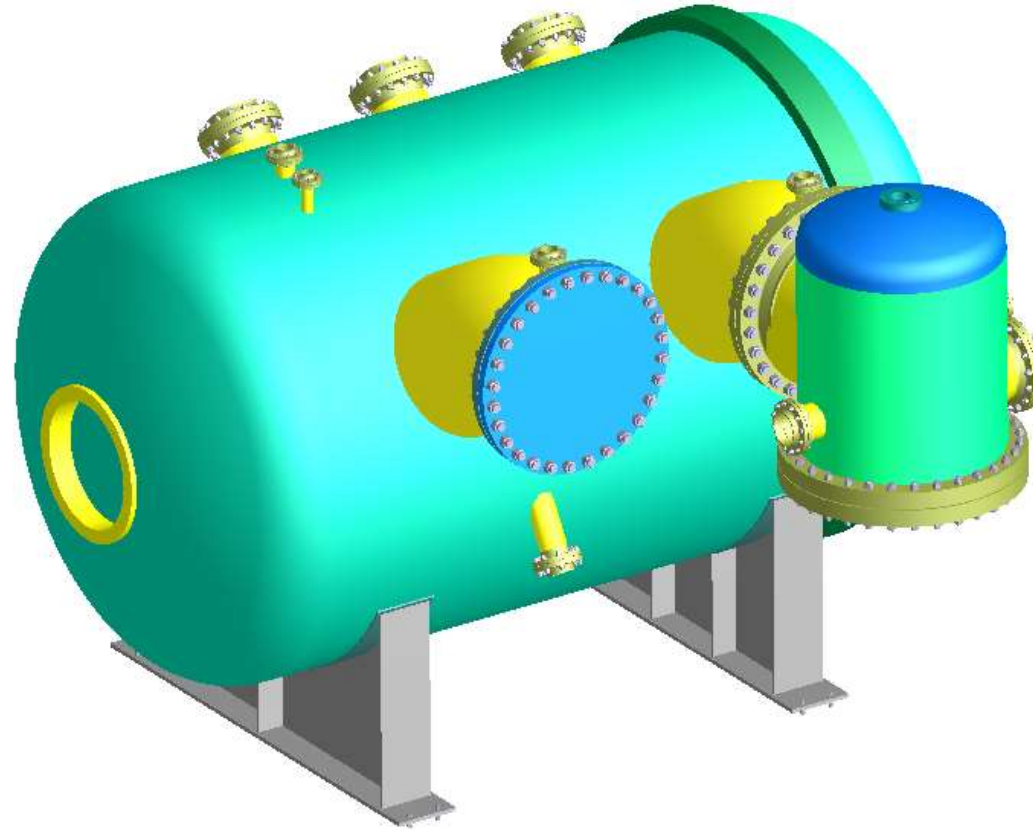
PASS/EQUIP | Examples



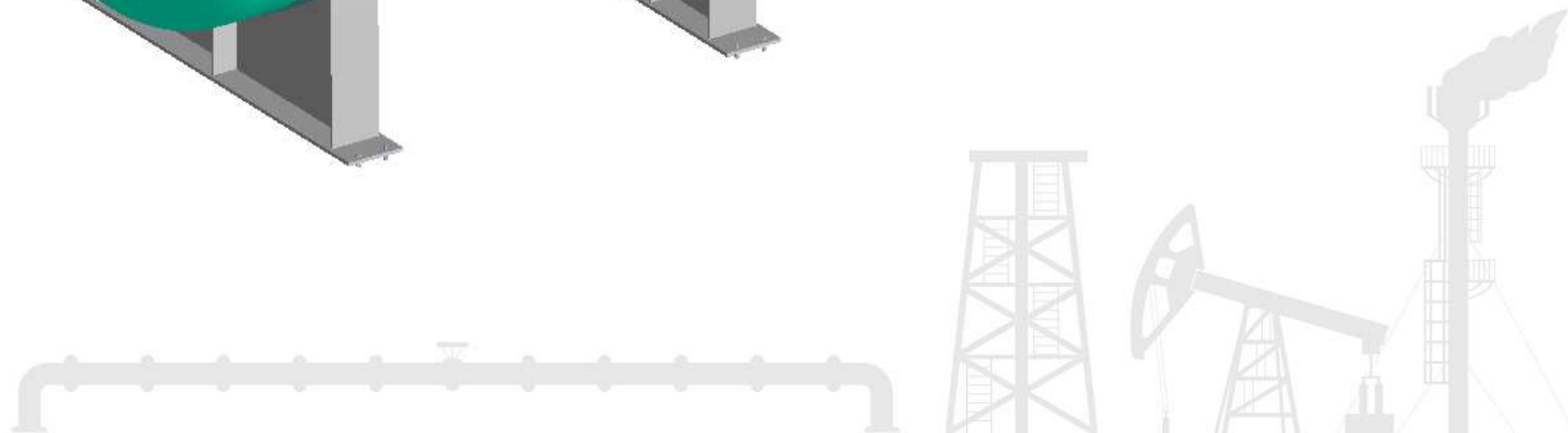
PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/EQUIP | Examples

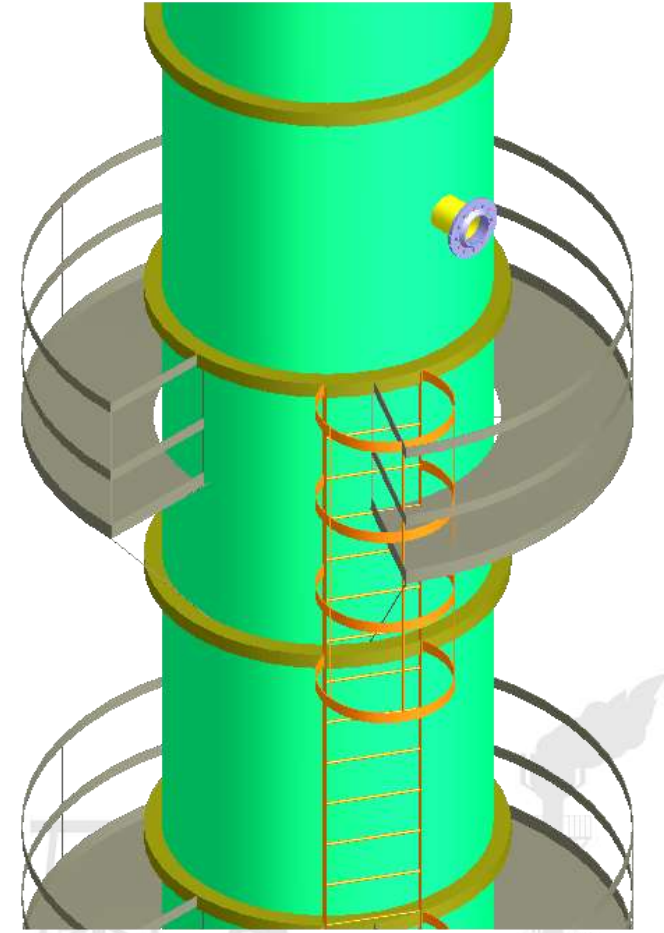
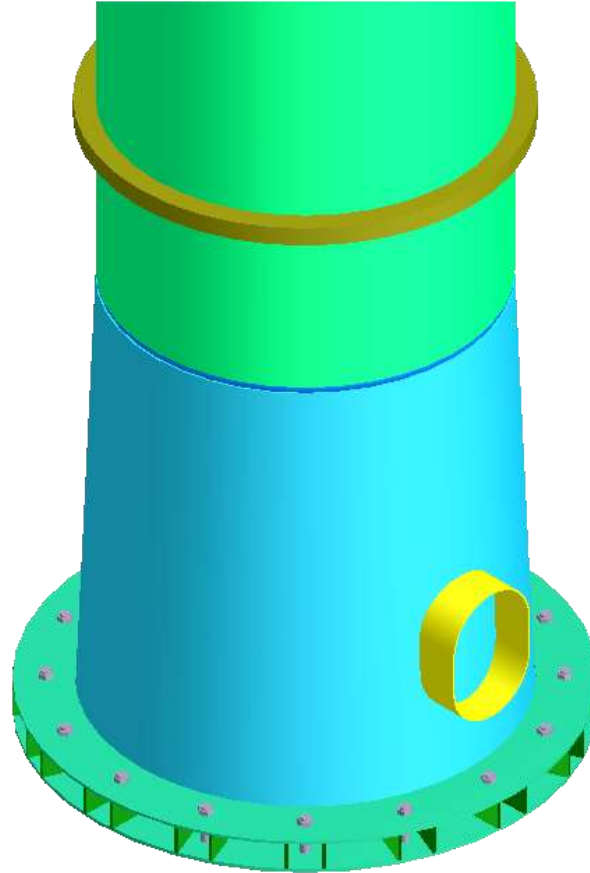
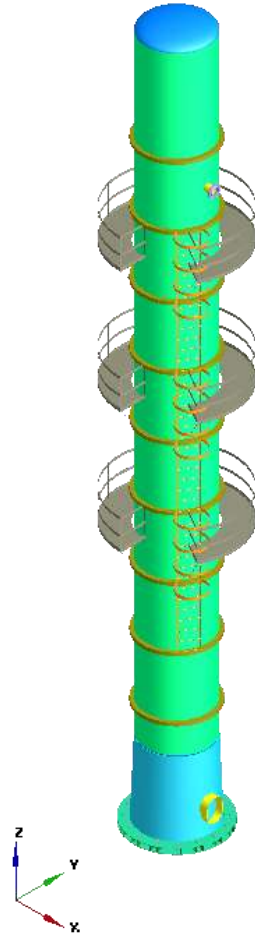
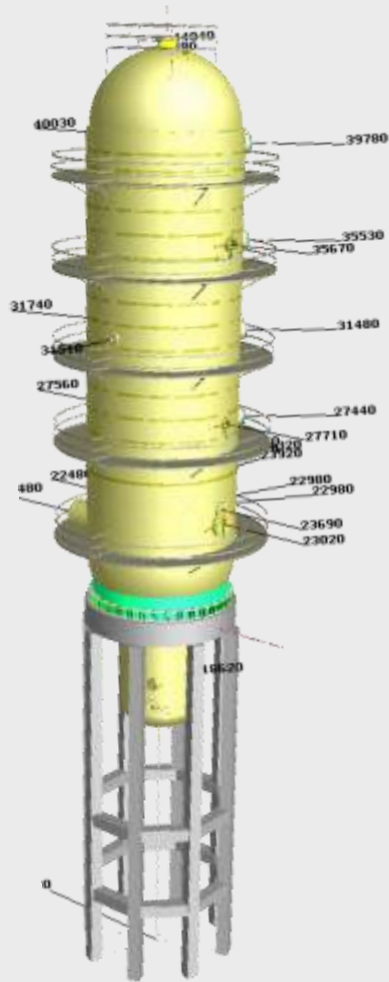


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PASS/EQUIP

Example (Columns)



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/EQUIP

Industries:

- Oil refining
- Chemical
- Petrochemical
- Oil and Gas
- Thermal power
- and others

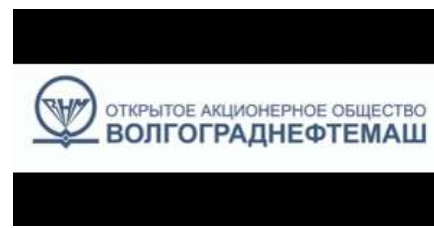


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WW Users



PASS/EQUIP | Russian Users

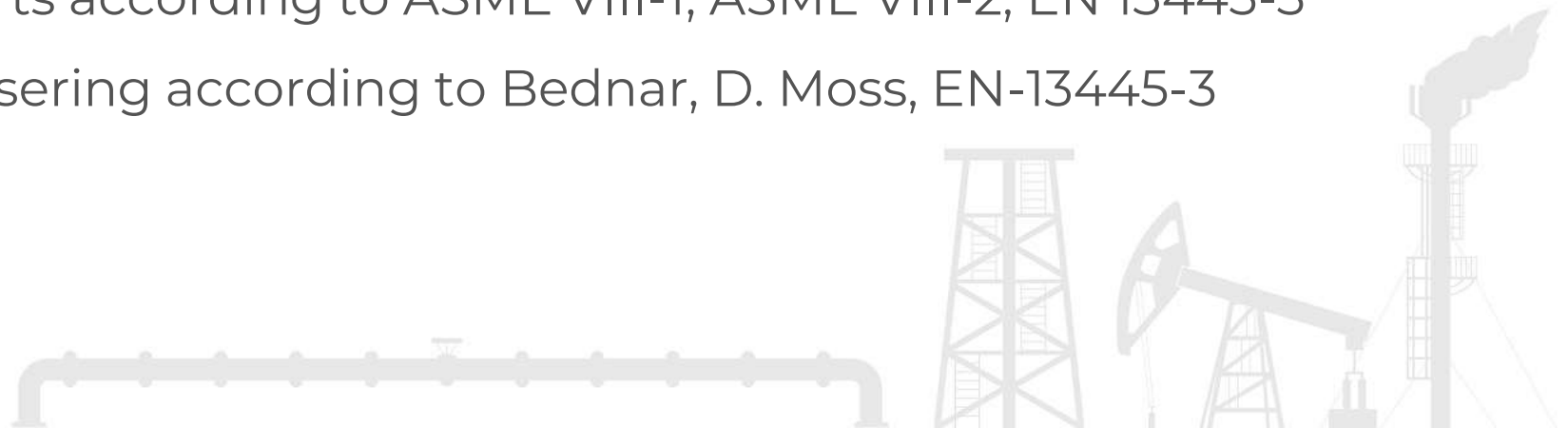


PASS/EQUIP | In the Upcoming Version 3.02

- The ability to calculate the model simultaneously for several loading cases
- Calculation of the minimum material applicability temperature (MDMT) in accordance with ASME VIII-1
- Calculation of seismic loads according to EN-1998, wind loads according to EN 19914
- Calculation of the Ring support of a vertical vessel according to EN 13445-3
- Saddle support with full coverage
- Calculation of support skirts according to ASME VIII-1, ASME VIII-2, EN 13445-3
- Calculation of the skirt basering according to Bednar, D. Moss, EN-13445-3



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE



PASS/EQUIP | In the Upcoming Version 3.02

General data

Operating environment group as per CU TR 032/2013: 1 >>

Vessel with liquid

Liquid filling
 Filling ratio: 100 %
 Filling ratio, ξ : 100 %

Loading case	Operating fluid name	Operating fluid density ρ , kg/m ³
Oper (int.press)	oil	900
Oper (ext.press)		0
steaming		0

Testing
 Test pressure calculation: ASME VIII div. 1, UG-99b
 Subtract static head
 Kind of test: Hydrotesting
 Test pressure: 1 MPa
 No corrosion in the test calculation

Seismic loads
 Seismic loads (module "PASS/EQUIP-Seismicity") EN 1998 (EUR)

Soil category: A >>
 Importance class: II >>
 Spectrum type: I

Horiz. spectrum parameters TB: 0.15 c TC: 0.4 c TD: 2 c
 Vert. spectrum parameters TB: 0.05 c TC: 0.15 c TD: 1 c

Soil factor, S: 1
 Reference peak ground acceleration, agR: 0.2 g
 Vertical design ground acceleration/design acc., avg/ag: 0.9
 Importance factor, γ_I : 1
 Behaviour factor, q: 1
 Horizontal spectrum lower boundary factor, β : 0.2

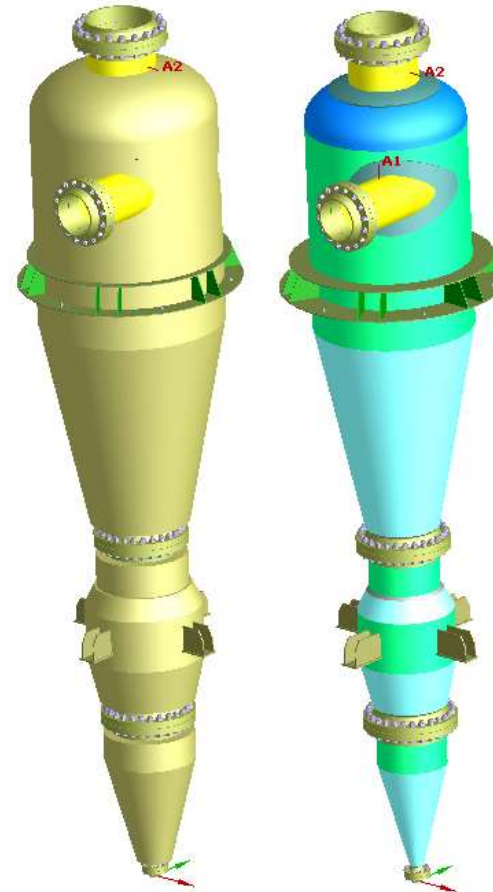
Insulation
 Insulation data

Sulfurated hydrogen environment
 Sulfurated hydrogen environment

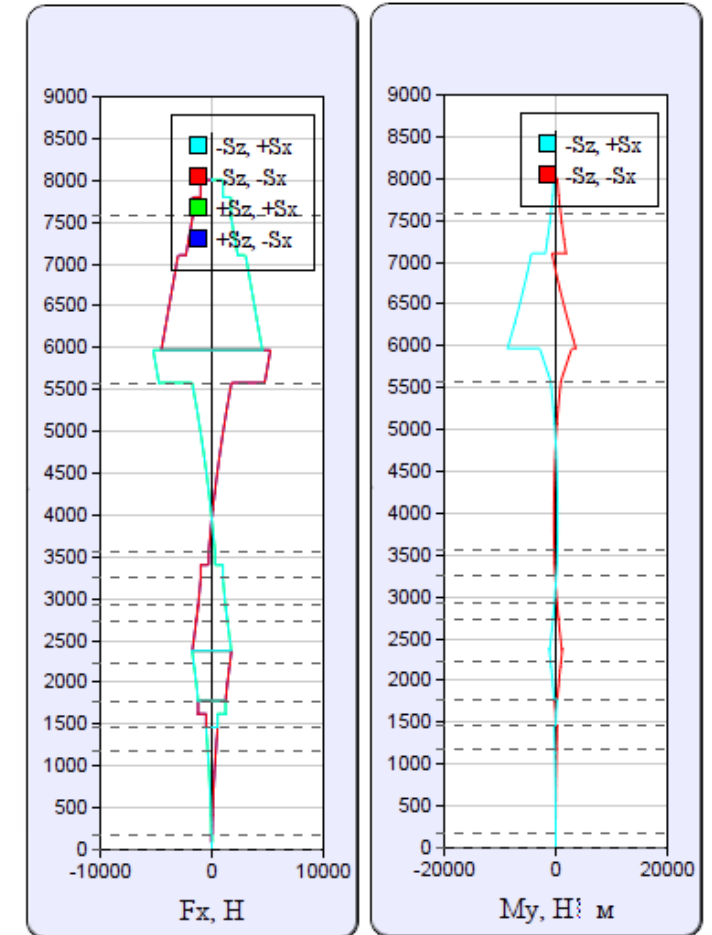
Wind loads
 Wind loads EN 1991-1-4 (EUR)
 Terrain category: 0

Basic wind velocity, Vb0: 70 m/s
 Directional factor, Cdir: 1
 Seasonal factor, Cseason: 1
 Construction factor, CsCd: 1
 Aerodynamic factor, Cf: 0.7
 Wind load during tests factor: 60 %

Low-cycle fatigue calculation
 MDMT -48 °C
 Calculation of heat exchangers (module "PASS/EQUIP-Heat Exchanger")
 Lower vibration period, (input "0", if no data): 0 s
 Support structure >> Base elevation, Xoch: 0 mm



Two supports together



PASS/EQUIP | In the Upcoming Version 3.02

The ability to calculate the model simultaneously for several loading cases

General data

Operating environment group as per CU TR 032(2013): [] >>

Vessel with liquid

Liquid filling

Filling ratio: []

Filling ratio, E : [100] %

Loading cases

Loading case	Operating fluid name	Operating fluid density ρ , kg/m ³
Oper (int.press)	oil	900
Oper (ext.press)		0
steaming		0

Add

Delete

Testing

Test pressure calculation: ASME VIII div.1, UG-99b

Subtract static head

Kind of test: Hydrotesting

Test pressure: [1] MPa

No corrosion in the test calculation

Seismic loads

Seismic loads (module "PASS/EQUIP-Seismicity")

Insulation

Cylinder

Component name: []

Code: GOST 34233.2-2017

Material: Cr3 Welded pipe >>

Standard dimensions

Inside diameter, D : 1000 mm

Outside diameter, D_o : 1020 mm

Nominal thickness, s : 10 mm

Corrosion allowance, c_1 : 2 mm

Negative tolerance, c_2 : 0.6 mm >>

Technological allowance, c_3 : 0 mm

Length, L : 2000 mm

Longitudinal welded joint efficiency, η_p : 1 >>

Circular welded joint efficiency, η_t : 1 >>

Loading case

Loading case	Pressure p , MPa	Temperature T , °C
Oper (int.press)	0.3	220
Oper (ext.press)	-0.100	250
steaming	0.6	100

Defects as per GOST 34233.11-2017 >>

OK Cancel

OK Cancel **Design values calculation**

Insulation and lining >>

Loads

Calculate automatically Define manually

Calculation axial force, F :

Design model to determine $\ln p$:

1 5

2 6

3 7

4



PIPING AND EQUIPMENT
ANALYSIS & SIZING SUITE

PASS/EQUIP | In the Upcoming Version 3.02

General data

Operating environment group as per CU TR 032/2013: [dropdown] >>

Vessel with liquid

Loading cases

Loading case	Operating fluid name
Operating conditions	

Add

Delete

MDMT -20 °F

Calculation of heat exchangers (module "PASS/EQUIP-Heat Exchanger")

Calculation of the minimum material applicability temperature (MDMT) in accordance with ASME VIII-1

Отчёт Passat

Проблемные элементы

Общие данные

Сводные таблицы

- Таблица основных элементов
- Таблица ингуверов
- Расчет заполнения
- Расчет весов и центров тяжести
- Использование материалов
- Категория оборудования по ТР ТС 032/201
- Приложенные нагрузки
- MDMT

Прочность от опорных нагрузок

- Эпюры сил и моментов

Элементы сосуда

- Обечайка цилиндрическая №1
 - Штуцер №1
- Фланцевое соединение №1
- Обечайка цилиндрическая №2
 - Штуцер №2

Список литературы

MDMT

Название элемента	Стандарт	Материал	Governing thickness, in	MDMT, °F	R _m ratio	MDMT reduction, °F	Curve	Примечание
Обечайка цилиндрическая №1	ASME VIII div.1	SA-516 Gr.70 Плита	1,81	-7,6	-	-	Curve D	Impact test required
Штуцер №1	ASME VIII div.1	SA-516 Gr.70 Плита	1,81	-7,6	-	-	Curve D	Impact test required
		SA-105 Поковки	1,81	58,97	-	-	Curve B	Impact test required
		SA-656 Gr.T7 Плита	1,81	21,17	-	-	Curve C	Impact test required
Обечайка цилиндрическая №2	ASME VIII div.1	SA-516 Gr.70 Плита	1,81	-7,6	-	-	Curve D	Impact test required
Штуцер №2	ASME VIII div.1	SA-516 Gr.70 Плита	1,81	-7,6	-	-	Curve D	Impact test required
		SA-216 Gr.WCC Отливки	1,81	58,97	-	-	Curve B	Impact test required



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PASS/EQUIP | In the Upcoming Version 3.02

Calculation of seismic loads according to EN-1998, wind loads according to EN 1991-4

General data

Operating environment group as per CU TR 032/2013: I >>

Vessel with liquid

Liquid filling

Filling ratio: 100 %

Filling ratio, ξ : 100 %

Loading cases

Loading case	Operating fluid name	Operating fluid density ρ , kg/m ³
Oper (int.press)	oil	900
Oper (ext.press)		0
steaming		0

Add
Delete

Testing

Test pressure calculation: ASME VIII div.1, UG-99b

Subtract static head

Kind of test: Hydrotesting

Test pressure: 1 MPa

No corrosion in the test calculation

Insulation

Insulation data

Sulfurated hydrogen environment

Sulfurated hydrogen environment

Seismic loads

Seismic loads (module "PASS/EQUIP-Seismicity") EN 1998 (EUR)

Soil category: A >>

Importance class: II >>

Spectrum type: I

Horiz. spectrum parameters TB: 0.15 c TC: 0.4 c TD: 2 c

Vert. spectrum parameters TB: 0.05 c TC: 0.15 c TD: 1 c

Soil factor, S: 1

Reference peak ground acceleration, agR: 0.2 g

Vertical design ground acceleration/design acc., avg/ag: 0.9

Importance factor, γ I: 1

Behaviour factor, q: 1

Horizontal spectrum lower boundary factor, β : 0.2

wind loads

Wind loads EN 1991-1-4 (EUR)

Terrain category: 0

Basic wind velocity, Vb0: 70 m/s

Directional factor, Cdir: 1

Seasonal factor, Cseason: 1

Construction factor, CsCd: 1

Aerodynamic factor, Cf: 0.7

Wind load during tests factor: 60 %

Low-cycle fatigue calculation

MDMT

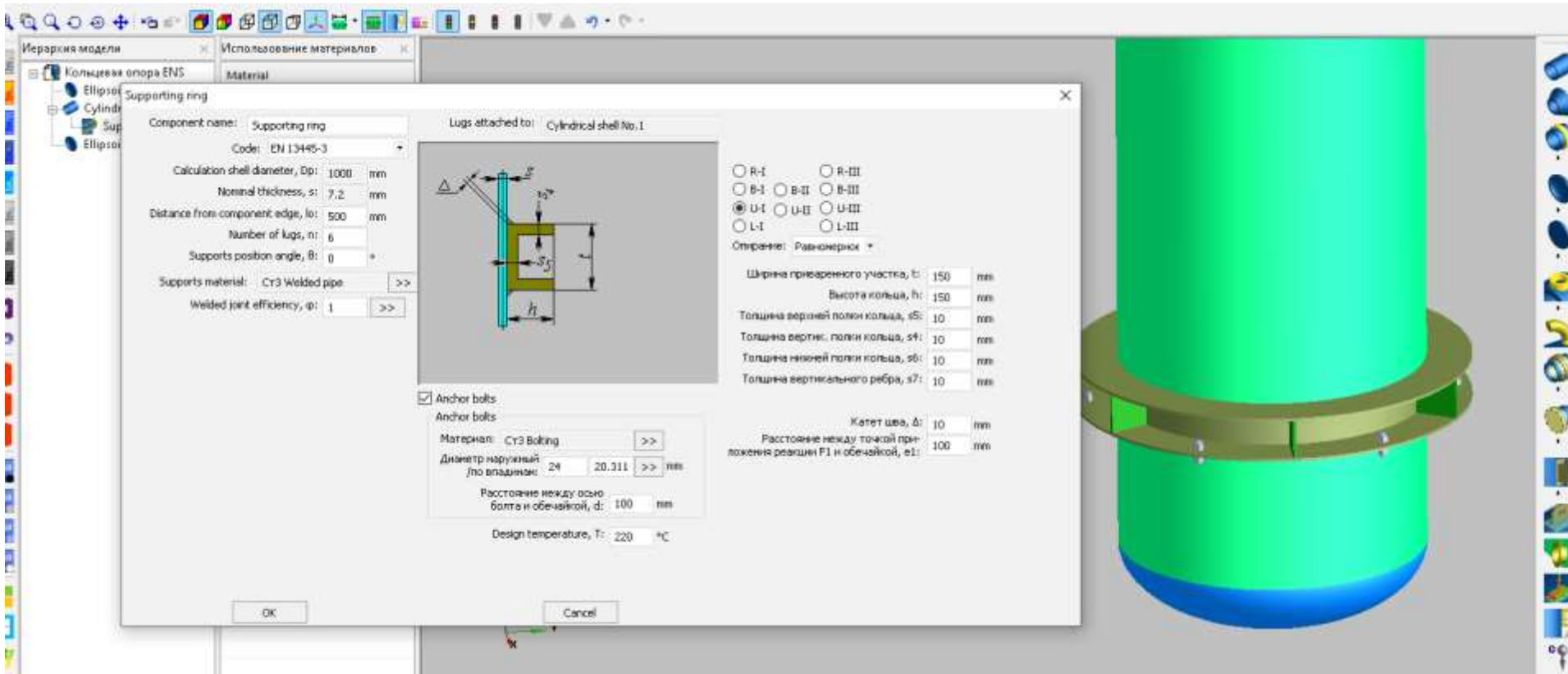
Calculation of heat exchangers (module "PASS/EQUIP-Heat Exchanger")

Lower vibration period, (input "0", if no data): 0 s



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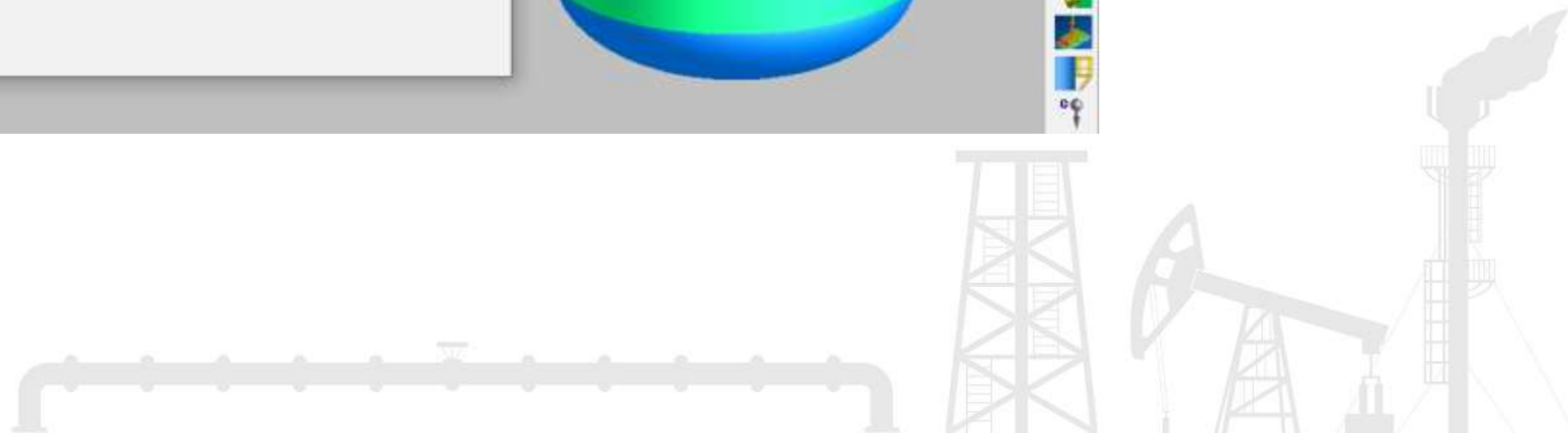
PASS/EQUIP | In the Upcoming Version 3.02



Calculation of Ring support of a vertical vessel according to EN 13445-3

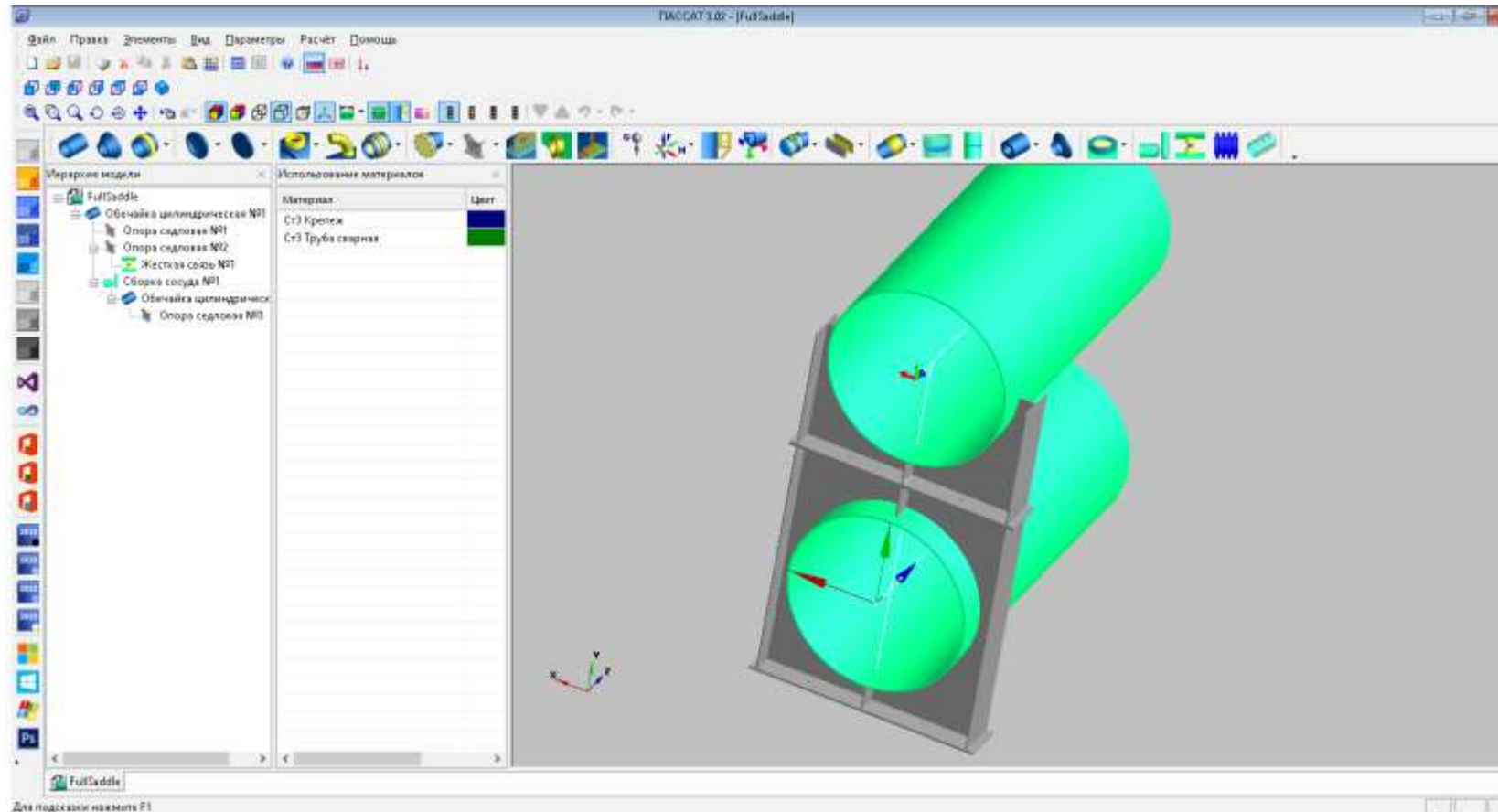


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Saddle support with full coverage

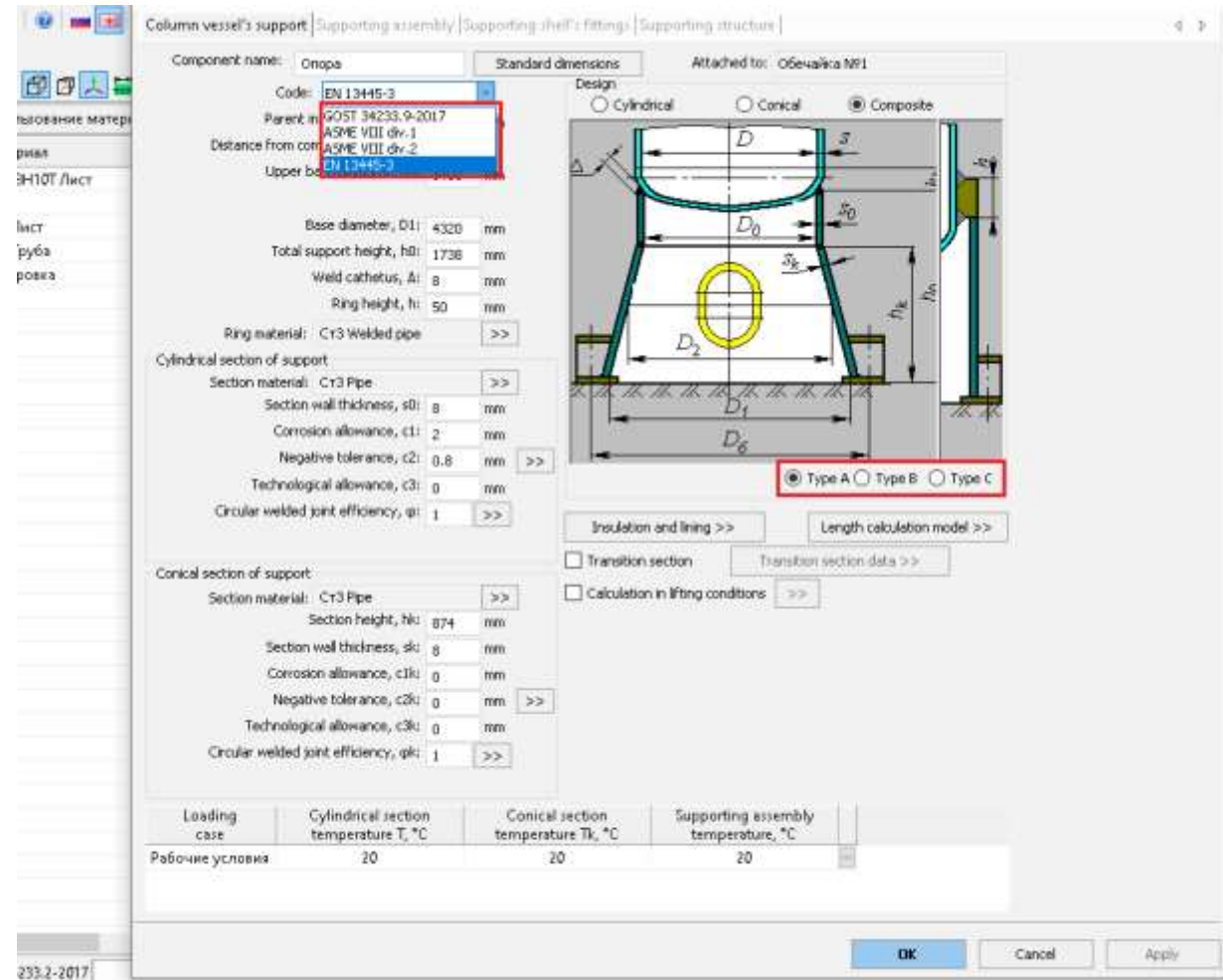


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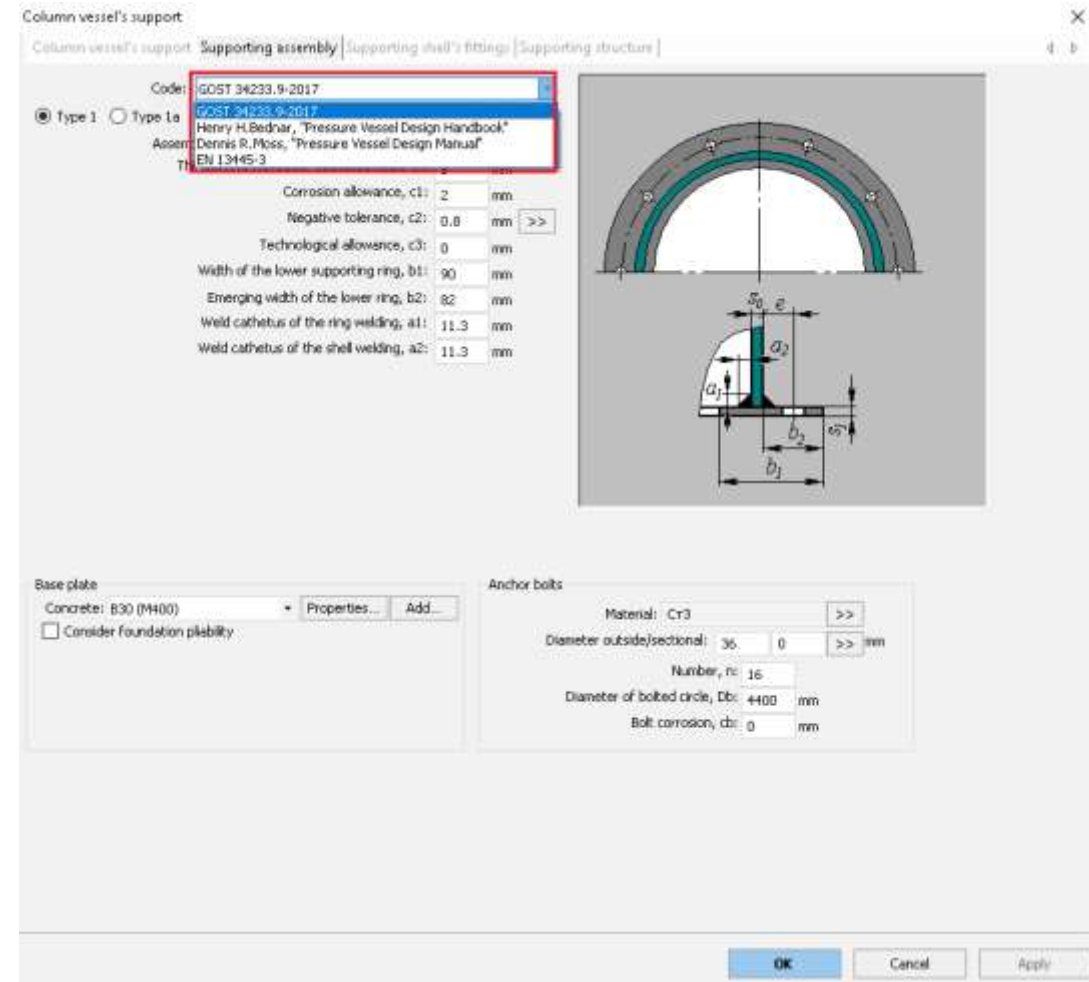
PASS/EQUIP | In the Upcoming Version 3.02

Calculation of support skirts
according to ASME VIII-1,
ASME VIII-2, EN 13445-3



PASS/EQUIP | In the Upcoming Version 3.02

Calculation of the skirt basering according to Bednar, D. Moss, EN-13445-3



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PASS/EQUIP | Development Plan for 2020

- Calculation of vessels and Heat Exchangers by ASME VIII Div.2 Code
- Other national seismic and wind load codes
- Full integration “PASS/EQUIP” with “PASS/Nozzle-FEM”
- API 650 for Tanks
- Calculation of the strength and stability of the frame tank roof using FEM
- Other customer wishes:

we are open for your suggestions!



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Q & A

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