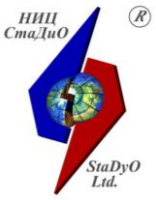


StaDyO Research & Engineering Centre

Quality Assurance

Moscow, 2018

Contents

1. Introduction

Research & Engineering Centre StaDyO was founded in Moscow in 1991 as one of the Russian pioneers offering and performing computer-oriented computation services for industrial purposes. We concentrated our efforts on problems such as effects of static, temperature and dynamic loads on complex buildings, equipment and pipelines of nuclear and hydro power plants, wind structures, offshore structures etc.

StaDyO develops and distributes computer-aided design systems as well as the respective specialized software. StaDyO distributes technical software in the area of structural mechanics and other related areas.

During twenty five years our specialists successfully worked in the field of design and numerical analysis of structures, equipment and pipe systems of nuclear power plants, hydro power stations and dam constructions, offshore structures and other complicated systems. There were designed several programs.

Among them are:
STADYO^{TM} – the universal software package for solving the linear and non-linear problems of the theory of field, statics, stability, dynamics, fracture mechanics and optimization of arbitrary space systems by the finite element method and other modern schemes.

ASTRA-NOVA^{TM} – the software package for nuclear power plants, fuel power plants, petroleum&gas pipelines stress-strain analysis according to existing Russian and international codes.

SyMonEx^{TM} **–** informational & diagnostic computer system of monitoring and expert safety evaluation of complicated power energetic structures.

The mentioned software has been developed during several years and includes great experience in research of the reliability of power plants as well as the strength and reliability of pipelines and platforms. This software was used for the analysis of systems of such objects as Novovoronezhskaya, Kolskaya, Smolenskaya, Kurskaya, Beloyarskaya (Russia), Paksh (Hungary), Timelin (Chekoslovakia), Kozlodui (Bulgaria), Loviza (Finland), Kudankulam (Indya) nuclear power plants, Zagorsk, Katun (Russia), Hudoni, Ingury (Georgia), Kapanda (Angola) hydropower stations, the projects of offshore structures on shelf of Sakhalin, unique civil buildings, structures of aerospace engineering etc.

The programs have powerful pre- and postprocessors, which allow to prepare input data and interpret the results, correspond to world standards and are oriented to the analysis of complicated structures. This is provided by the using of different modern CAD/CAM systems, data bases, graphical interpretation of results. These programs provide static, dynamic, temperature analysis of physical and geometrical nonlinear systems too.

2. The company

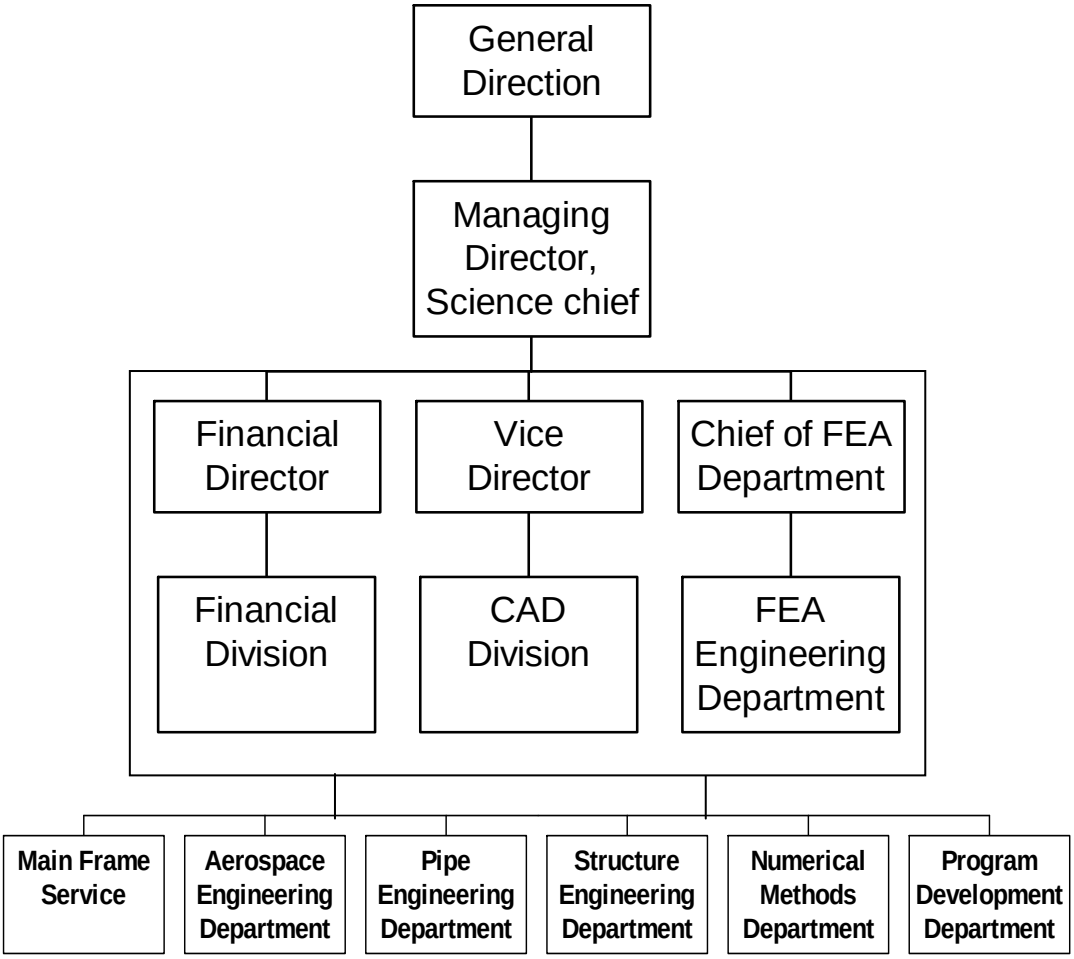
2.1. The Founders of StaDyO

Founders of our firm are leading Russian scientists.

2.2. The Portrait of StaDyO

Research & Engineering Centre StaDyO was founded in Moscow in 1991 as one the Russian pioneers offering and performing computer-oriented computation services for industrial purposes.
Altogether the staff consists of 25 experienced persons (among them 3 professors and 8 philosophy doctors), all prepared to solve your problems. Capability, efficiency and flexibility of a medium sized engineering company will be your advantage.

ORGANIZATION CHART



2.4. Software Products

During twenty nine years our specialists successfully worked in the field of design and numerical analysis of structures, equipment and pipe systems of nuclear power stations, hydro power stations and dam constructions, offshore structures, wind structures, typical and unique structures of civil engineering and other complicated systems. There were designed several problem and object oriented programs.

Among them are:

STADYO^{TM} - the universal software package ***STADYO^{TM}*** provides temperature fields, static, stability and dynamic analysis (including response spectra and accelerations definition) as well as fracture mechanics and strength analysis and optimization of arbitrary combined 2-D and 3-D solid, shell, plate and beam mechanical systems by the finite elements, superelement and other modern numerical methods:

- STADYO-FIELD - stationary field (thermoconduction, filtration, fluid flow, etc) problems;
- STADYO-STAT - linear-elastic static stress-strain analysis;
- STADYO-EIG - solving the eigenvalue problems (natural frequencies and modes, loads and forms of buckling);
- STADYO-SEISM - "normative" spectral analysis of seismic responce under exitations, defined by acceleration spectra;
- STADYO-VIBR - evaluation of system stationary vibration parameters;
- STADYO-SPEC - linear spectral (modern superposition) dynamic analysis;
- STADYO-DYN -direct step-by-step integration of dynamic equations;
- STADYO-NFIELD - solving the non-stationary field problems;
- STADYO-FRAC - solving the linear problems of fracture mechanics, including intensivity ratio coefficients and J-integral definitions$
- STADYO-NLIN - solving the nonlinear static and dynamic problems of motion equations (large displacement, plasticity and viscoplasticity of metals, concrete and ground, opening cracks and joints etc.);
- STADYO-WIND - object-oriented code for 3D static and dynamic analysis of typical wind units;
- STADYO-ASTRA - object-oriented cod for 3D static analysis of typical pipe elements (elbows, tees, weld connections, etc);
- STADYO-INTER - object-oriented code for 3D static and dynamic analysis of combined "soil-structure" systems.

The software package ***STADYO^{TM}*** is verificated and certificated in Gosatomnadzor RF (State Nuclear Safety Commission) and is applied in the leading design and research institutes and plants. Among them: Atomenergoproject, Hydroporoject, Teploenergoproject (Russia), Energoproject (Bulgaria), Siemens AG (Germany), etc.

ASTRA-NOVA^{TM} – the software package for nuclear power plants, fuel power plants, petroleum, heating network, main oil/gas pipelines static, temperature and dynamic stress analysis according to existing ex- and post-USSR and international codes.

SyMonEx^{TM} – informational & diagnostic computer system of monitoring and expert safety evaluation of complicated power energetic structures.

The mentioned software has been developed during several years and includes great experience in research of the reliability and strength of NPP components (systems "foundation-structure", equipment and pipelines) as well as dam and underground structures and platforms. The software was used for the analysis of foundations, structures, equipment and pipeline systems of such objects as Leningradskaya, Smolenskaya, Kurskaya, Novovoronezhskaya, Kolskaya, Volgodonskaya, Balakovskaya, Beloyarskaya, Bilibinskaya (Russia), Kozloduy and Belene (Bulgaria), Paksh (Hungary), Timelin (Czech), Mochovice (Slovakia), Loviza (Finland), Kudankulam (India), Tianwan (China), Akkuyu (Turkey) nuclear power plants, new generation NPP (NP-500, NP-1000, WWER-TOI), Zagorsk, Katun (Russia), Hudony, Ingury (Georgia), Kapanda (Angola), Tery (India), Hoabin (Vietnam) hydropower stations, offshore platform project on shelf of Sakhalin, windmill structures (capacities 50, 300, 2000 kWt).

The programs have powerful pre- and postprocessors, which allows to prepare input data and interpret the results. The programs are provided by the using of different CAD/CAM systems, data bases, graphical interpretation of results.

3. Activities

3.1. Field of Activities

- Structural engineering
- Floor response
- Mechanical equipment
- Piping
- Electrotechnical equipment
- Hydropower stations and dam structures
- Underground structures
- Offshore structures
- Civil engineering structures
- Airspace & submarine structures

Load cases:

- Earthquake
- Wind
- Airplane crash, blast
- Dead load, pressure, temperature
- Operating vibrations induced by hydrodynamic loads
- Pressure hammer
- Test loads

3.1.1. Structural engineering

Operation conditions, hazardous external events (earthquake, blast, airplane crash) and internal dynamic loads.

Choice of appropriate plane, axisymmetric and 3D structural models:

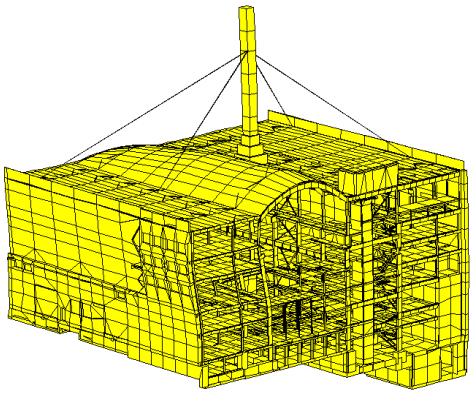
- Beam models
- Shell models
- Solid models
- Rigid bodies
- Fluid models
- Combined models
- Superelement (substructure) models
- Aggregate models

Non-stationary and Dynamic Analysis:

- Spectral methods
- Time history analysis
- Response spectra method
- Probabilistic method

Results as deflections, forces, strain and stresses, natural frequencies and modes in tabular form, x-y-plots, coloured graphics and animated presentation. Proof of stability, feasibility studies.

f_5 = 1,8376 Гц



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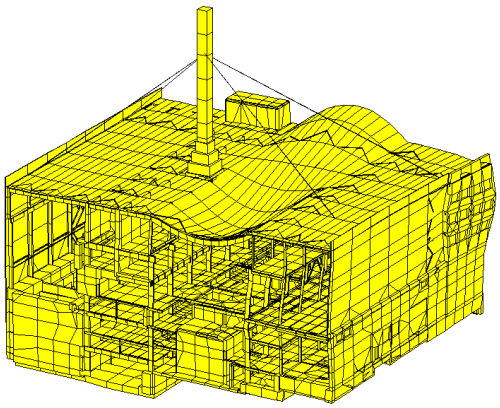

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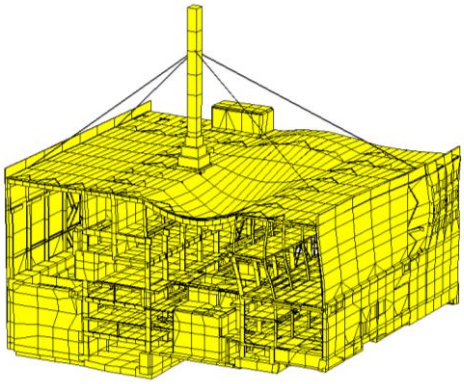

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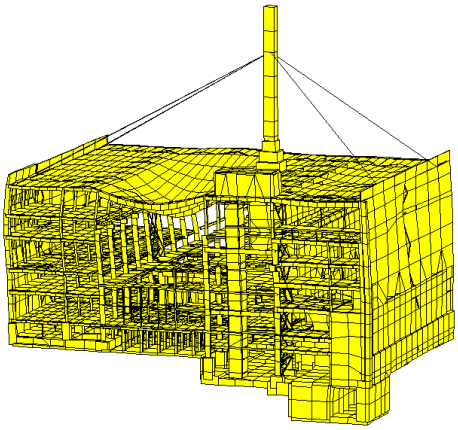

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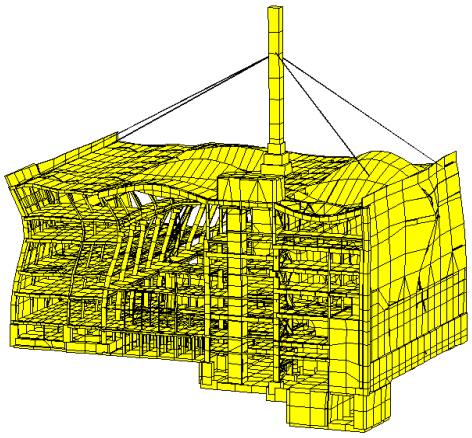
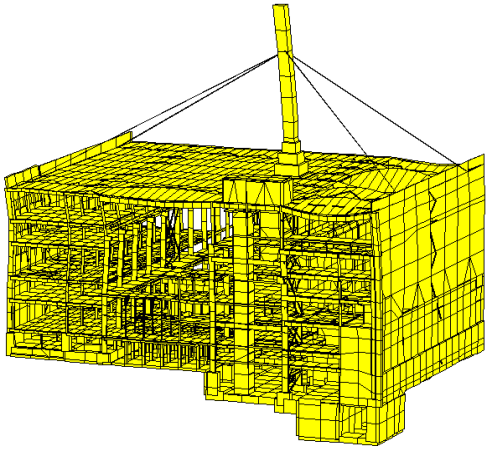
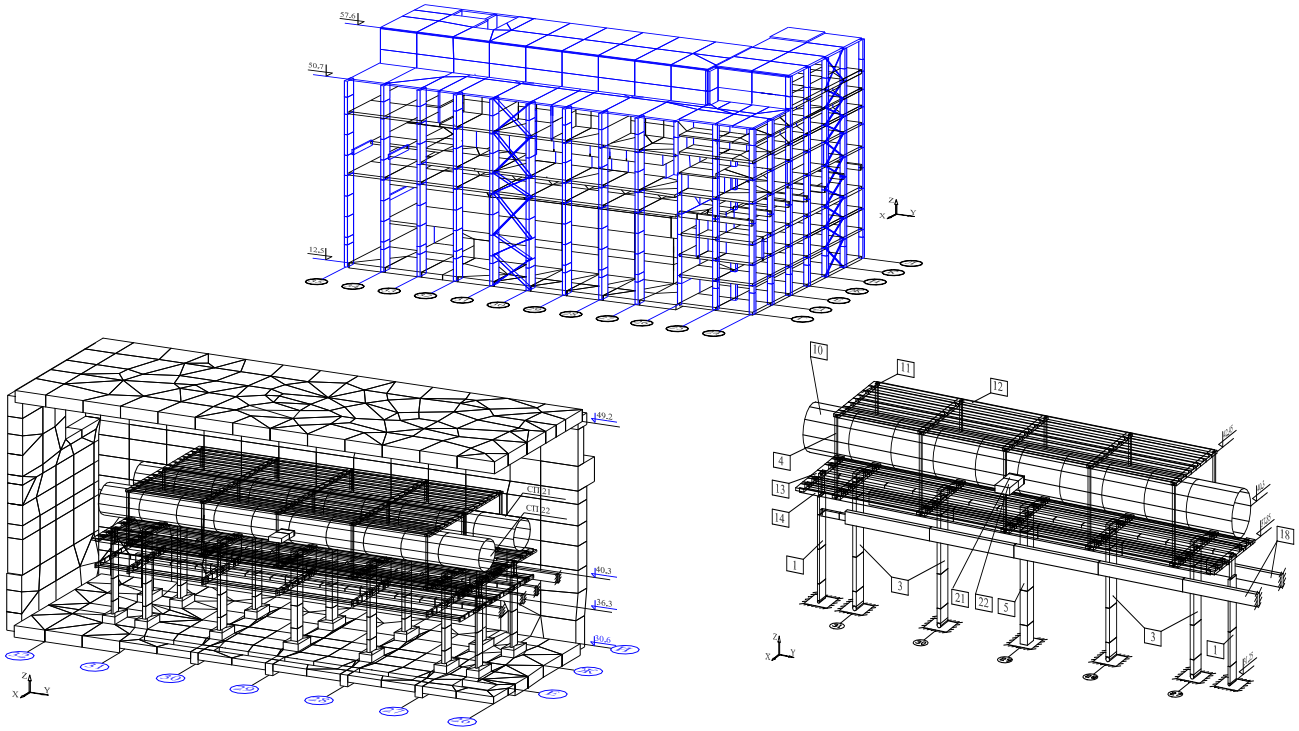


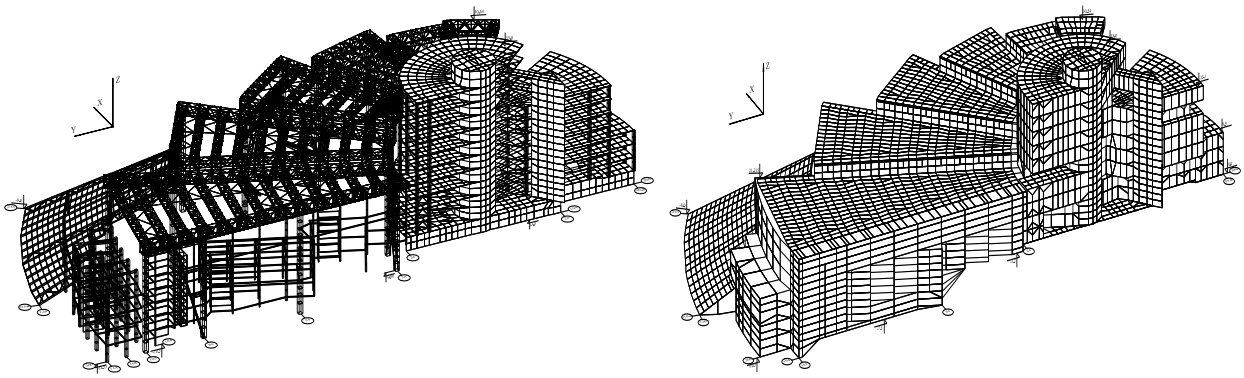
f_{22} = 3,3364 Гц



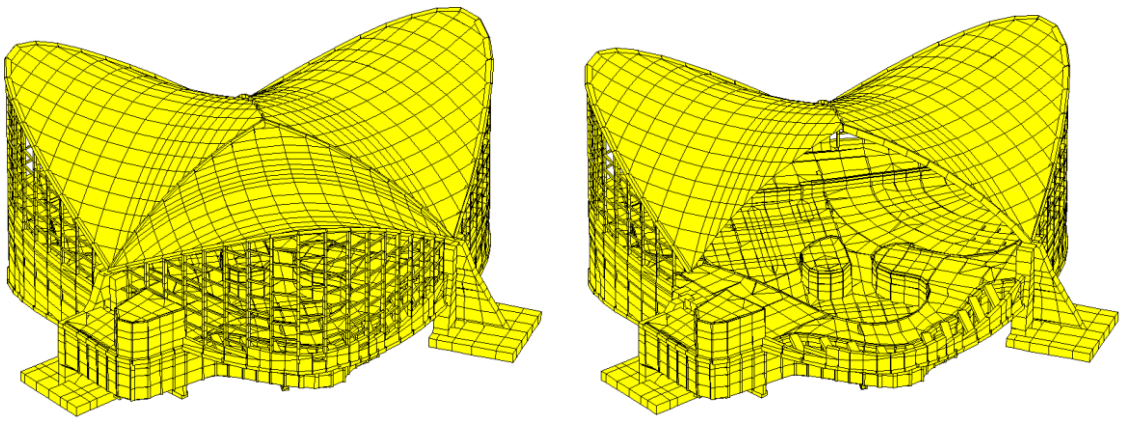
Calculated natural frequencies & modes of Bilibinskaya NPP structure. ***STADYO***^{TM}



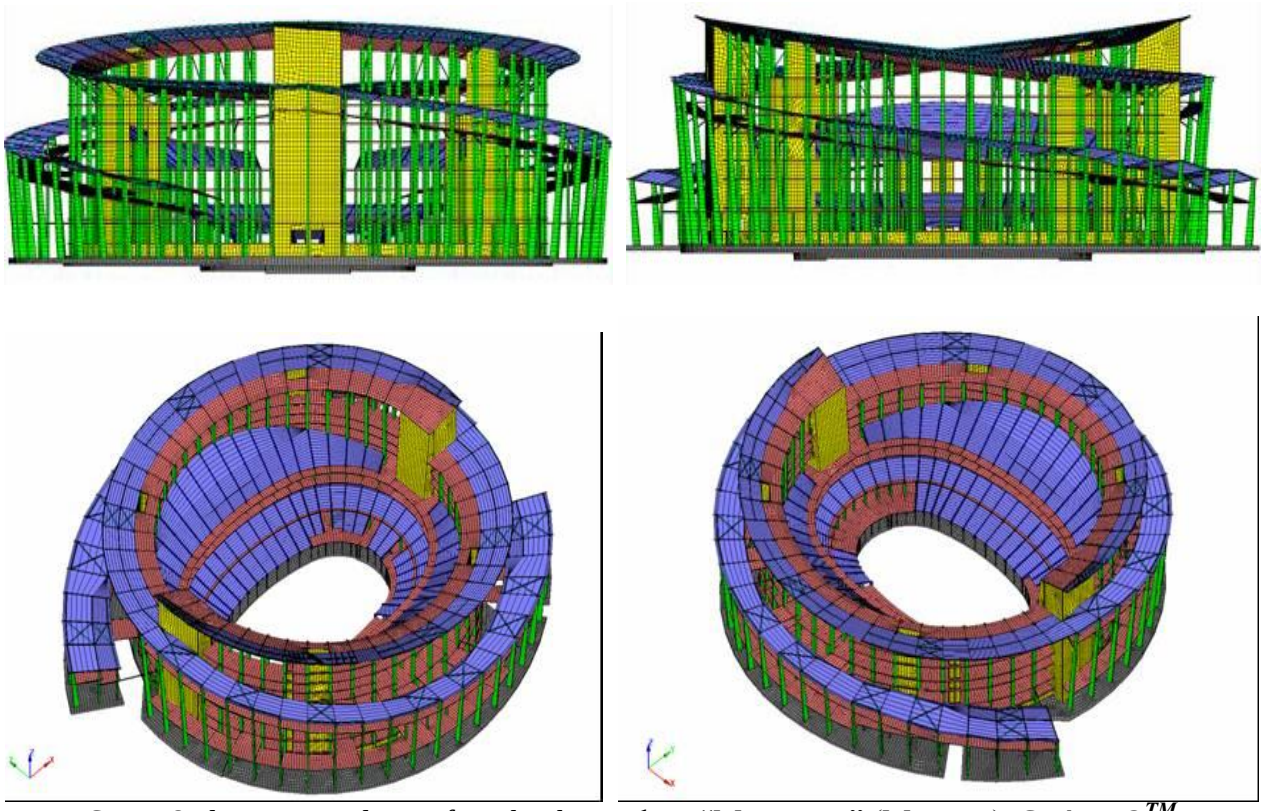
Static & seismic analysis of system “structure-equipment” of Kurskaya NPP. ***STADYO^{TM}***



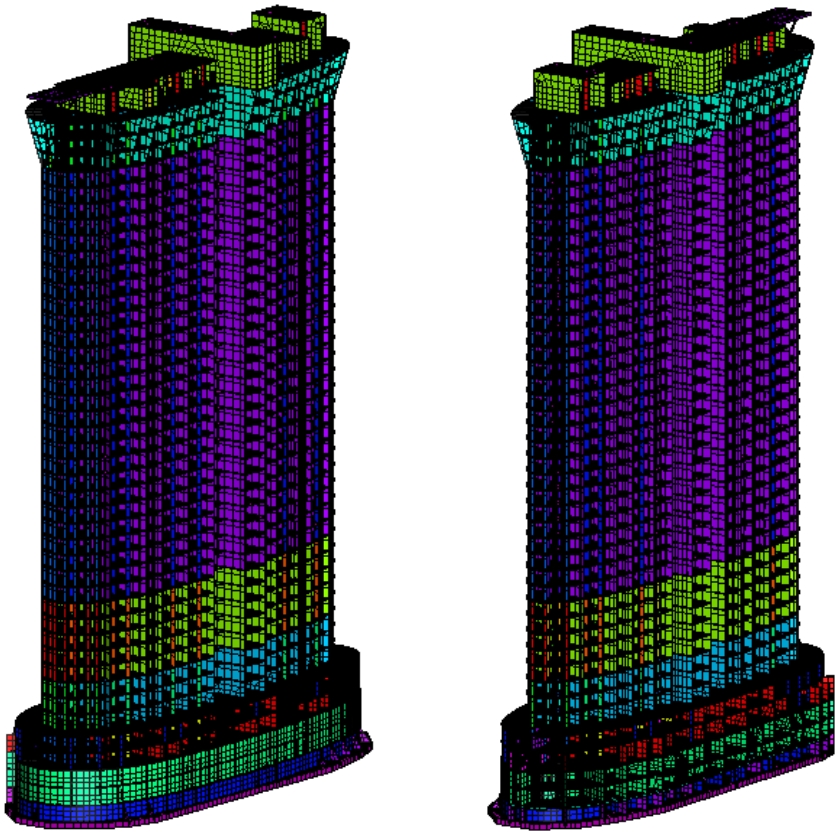
Static & wind analysis of sporting & recreating complex “Aquadrom” (Moscow). ***STADYO^{TM}***



Static & wind & seismic analysis of sporting complex “Iskra” (Sochi). ***STADYO^{TM}***



Static & dynamic analysis of ice-hockey palace “Megasport” (Moscow). ***STADYO***^{TM}



Static & dynamic analysis of skyscraper “Airship” (Moscow). ***STADYO***^{TM}

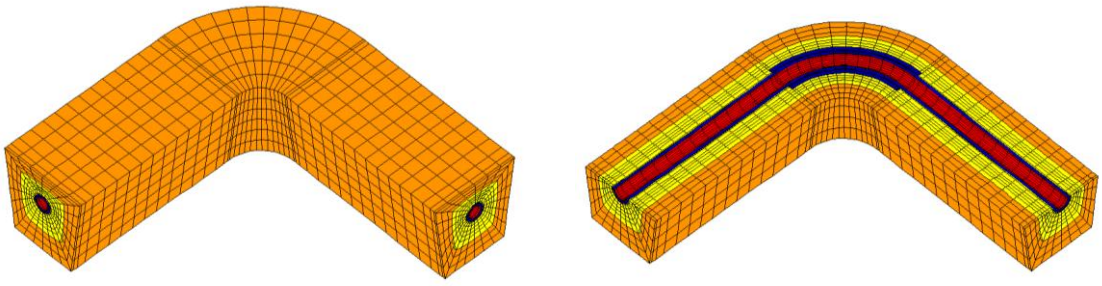
3.1.2. Floor response spectra

Numerical simulation of soil-structure interaction with different complexity:
- Spring-Dashpot Models
- Continuum models
- Finite-Element and Substructure Models

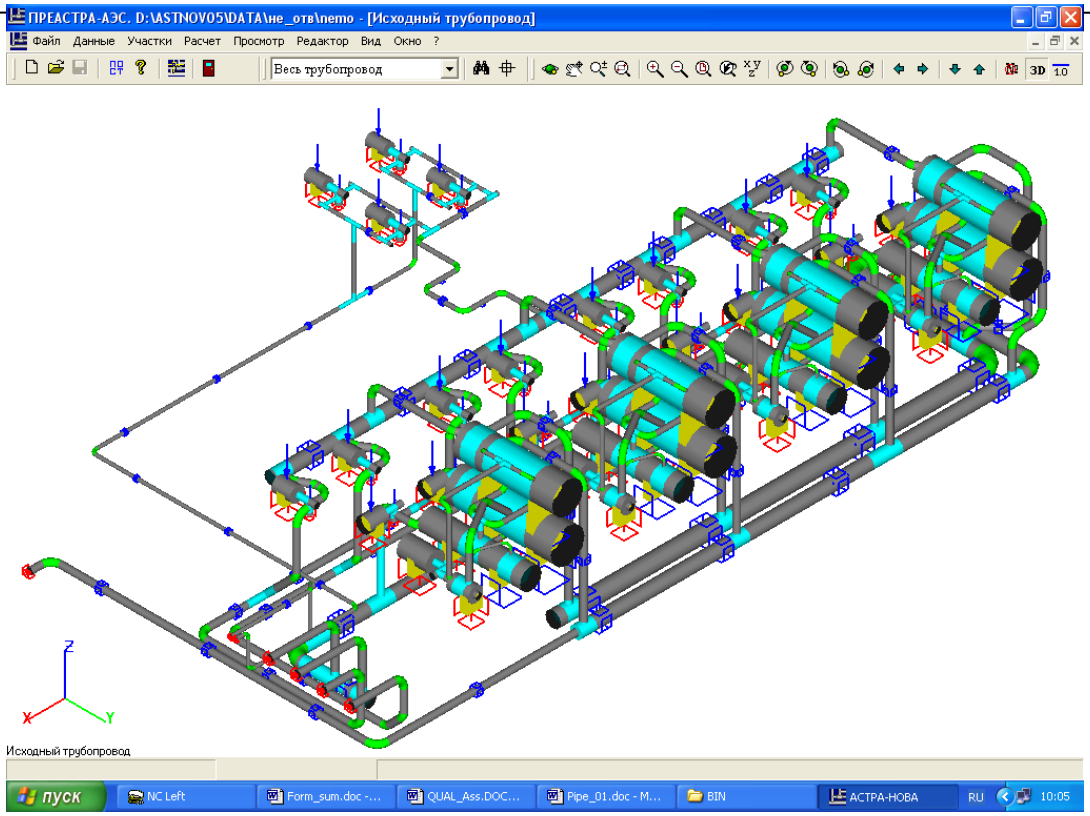
Floor response spectra and design spectra for all dynamic load cases as well as for all types of building and main components as primary system, reactor pressure vessel. Consideration of damping and ductility.

3.1.3. Piping

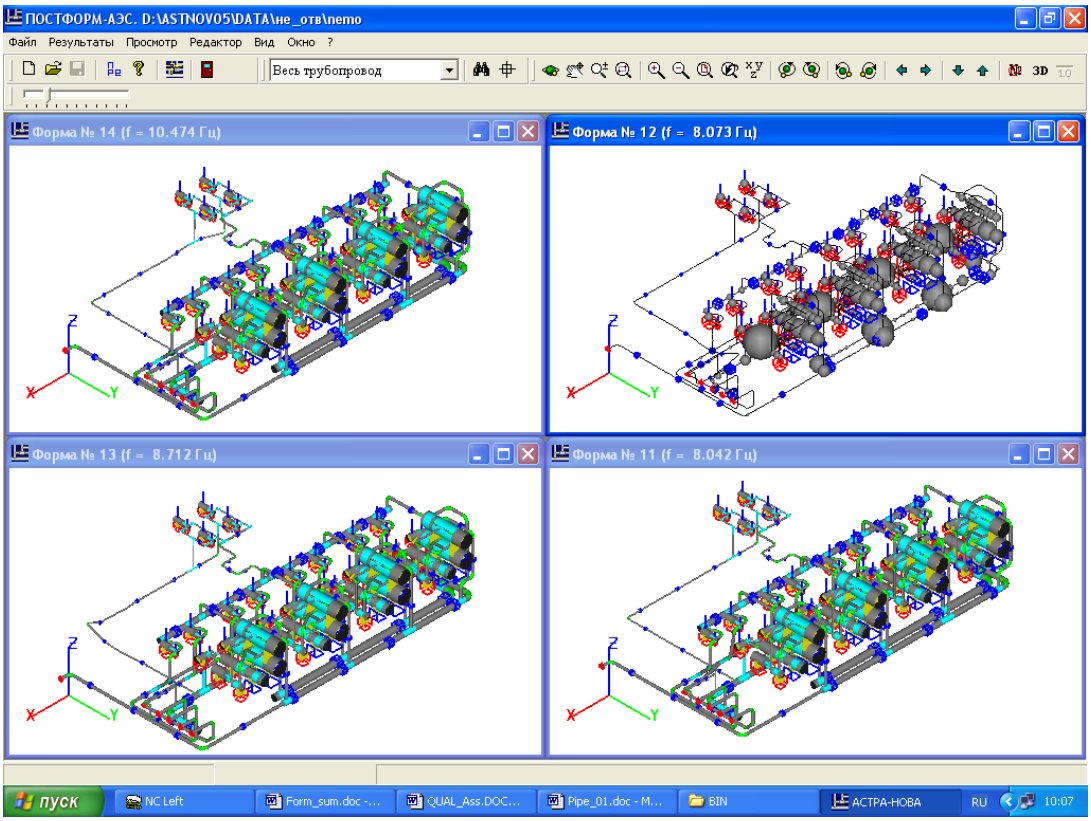
Design and analysis of piping systems (nuclear & fuel power plants, oil & gas industry) for static and dynamic operational and faulted conditions:
–Static analysis:
♦ pressure ♦ thermal
♦ weight
♦ wind
♦ applied loads
♦ cold springs
♦ support movements
♦ differential settlement
♦ static equivalent
♦ dynamic acceleration
– Dynamic analysis:
♦ uniform or mutilevel seismic response spectrum analysis
♦ time history analysis for applied force or support movement
♦ left-out-force included
- Thermal transient analysis
- Fatigue analysis, include wipe consequensies.
- LBB analysis
- Fracture mechanic analysis
- Nuclear & fuel power plants, oil & gas codes checks
–"Precise" FE stress analysis of pipe elements (tees, elbows, nozzles, weld connections, etc)
– Underground pipelines/



3-D nonlinear FE model o system "steel pipe – PU isolation – PE shell ground "



FE (superelement) model of NPP system “equipments-pipes-supports” (***ASTRA-NOVA***^{TM})



Animation of calculated natural modes (***ASTRA-NOVA***^{TM})

3.1.4. Electrotechnical equipment

Design of electrotechnical equipment against induced vibrations and external load cases
- Stability
- Operability

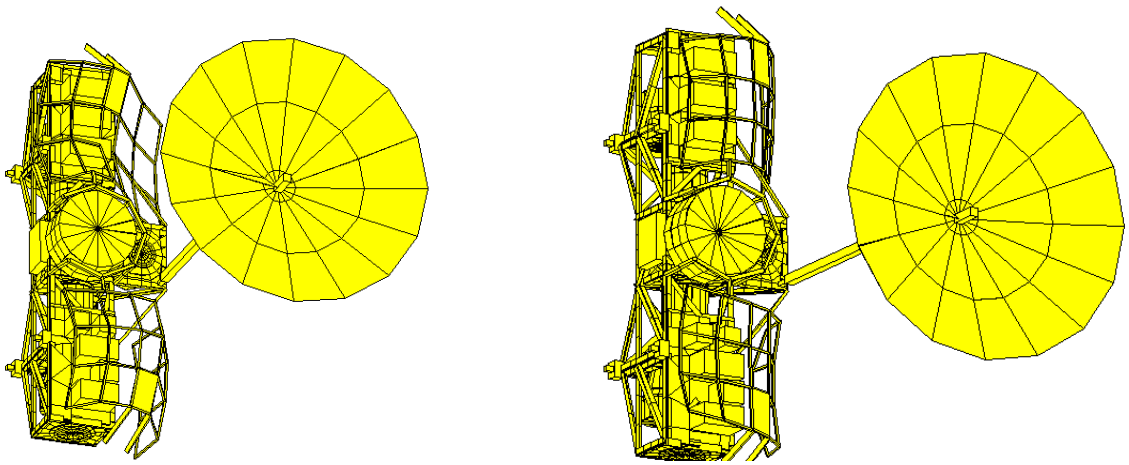
Battery racks, cable supports, switch gear cabinets, emergency power supply. Design of swing platforms in steel or concrete for shock isolation. Evaluation of functionality by dynamic shaker tests of E-equipment as governor, rectifier, relay. Backfitting for dynamic load cases.

3.1.5. Hydropower stations and dam structures

Concrete arch and gravity, soil and rock-fill dams with foundation massive, underground structures, station buildings. Effects of static, temperature and dynamic loads.

3.1.6. Aerospace engineering

Complex static & dynamic analysis of "Alpha" international space station subsystems.



"Alpha" space station fragment. Calculated natural vibration forms. ***STADYO***^{TM}

4. Team experience

4.1. The List of Clients

Our clientele in the energetics includes the leading design and research institutes and plants in the area of power supply, planning and constructions. Among them: Atomenergoproject, Hydroproject, Teploenergoproject, Mosenergoproject, Energosetproject, Hydropress, Mosproject etc (Russia), Energoproject (Bulgaria), Siemens AG, Nemetchek AG (Germany), Robot (France), COADE (USA) etc.

4.2. The List of Projects & Applications

- stress-strain analysis of pipe systems and equipment of nuclear power plants under static, temperature, hydrodynamic, seismic and hazardous excitations (Smolenskaya, Kurskaya, Novovoronehzskaya, Kolskaya, etc, projects of plants with high safety);
- static, temperature and dynamic analysis of complex nuclear power plant systems "foundation-structure" and subsystems (Armjanskaya, Smolenskaya, Kurskaya. Bilibinskaya, Ignalinskaya, Kozlodui, etc.);
- static, temperature, seismic and vibration analysis of hydro power station systems "foundation-dam" (Katun, Ingury, Hudony, Gehy, Kapanda, Tery, etc.);
- static and dynamic analysis of windmill structures (capacities 50, 300, 2000 KWt);
- complex analysis of offshore structures (Chaivo-1, Sakhalin);
- complex static & dynamic analysis of "Alpha" international space station subsystems.
- proposals to ex-USSR codes "ПНАЭ-Г-7-002-86".
- participation in projects and programs expertise in State Power Inspection (Gosatomnadzor) of Russia.

4.3. The List of Consulting & Courses Items

- Numerical methods in Engineering
- FEA Engineering
- Pipe Engineering
- FEA Packages
- Main PC Applications
- Main AutoCAD Applications
- Design Technology in AutoCAD Environment
- Data Bases Managing Systems - Main Applications
- NetWork Operation Systems
- Desktop Systems and Scanning Technology in MS Windows Environment
- Programming in C++
- Programming in Fortran

5. Quality Guarantee

The reliability of our software and structural analysis results is provided by the following actions:
– the verifying of the algorithms and programs using a wide range of practical problems;
– the great (more than 29 years) experience of installation and support of our software on the leading enterprises of the ex-USSR (Atomenergoproject, NICIET, OCB “Hydropress”, Hydroproject, etc.) and Bulgaria (“Energoproect”) for the strength and reliability analysis of the complicated objects;
– developed diagnostics of the errors in the input data and informative interpretation of the results including pre- and postprocessor interactive modes of visualization of models, displacement fields, temperatures, stresses, vibration shapes etc.;
– attestation of our software packages (STADYO, ASTRA, SyMonEx, IRBIS, etc.) in State Power Inspection (Gosatomnadzor) of Russia for using in design and static, thermal and dynamic analysis of complex NPP structures, equipment and pipelines;
– purchasing and using of licensed software (Windows, FORTRAN, AutoCAD, etc.);
– multilevel supervision (engineer, senior engineer, chief of department) of the problem formulation correctness, reliability of results and their interpretation;
– learning and attestation of the specialists of the company.

6. Address

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E-mail: *stadyo@stadyo.ru*
Web-site: *www.stadyo.ru*

7. Curriculum vitae

Name:

Belostotsky, Alexander

Date of Birth:

3 June, 1952

Languages:

Russian/native language, English/fluent

Educational degree:

MscTech, 1976, Moscow Power Engineering Institute,

Ph.D (Tech), 1980, Mechanical Engineering Research Institute of the Academy of Sciences of the USSR,

Doctor of Technical Science, 1998, Moscow State University of Environmental Engineering,

Professor of Moscow State University of Civil Engineering (MSUCE), 1999,

Professor of Perm Technical State University (PNIPU), 2012

Position in firm:

Managing Director, Science Manager

Total Experience:

41 years

Specialization in Firm:

Managing StaDyO scope of work and integration of software development FEA engineering Scope

Professional training and experience:

– Engineer from 1976, senior engineer from 1977, leading engineer from 1978, senior research scientist from 1981 to 1987, at Hydro Power Design Institute "Hydroproject".

– Chief of laboratory from 1987 to 1991 at the Science Department of Design and Research Institute "Atomenergoproject".

Development of FEA software kit including ***ASTRA-NOVA*** (the software package for nuclear power plants, fuel power plants, petroleum etc. pipelines stress-strain analysis according to existing Russian and international rules) and ***STADYO*** (the universal software package for solving linear and non-linear problems of the theory of field, statics, stability, dynamics, fracture mechanics and optimization of arbitrary 3D mechanical systems by the finite elements method). ***SyMonEx^{TM}*** development - informational & diagnostic computer system of monitoring and expert safety evaluation of complicated power energetic structures.

Numerical analysis of complex mechanical systems for nuclear power plants: Novovoronezhskaya, Kolskaya, Smolenskaya, Kurskaya, Beloyarskaya (Russia), Paksh (Hungary), Timelin (Chehoslovakia), Loviza (Finland) etc., hydro power stations: Katun (Russia), Hudony, Ingury (Georgia), Kapanda (Angola), offshore platform near Sakhalin (Russia), unique civil engineering structures, airspace structures etc. under thermal, static, dynamic and accidental loads. Development of Russian codes for strength analysis of nuclear & hydro power structures, equipment and pipelines, unique civil engineering structures.

Present places of work:

Managing director, Science manager, StaDyO Ltd.

Scientific Chief, Research & Educational Center of Computational Simulation, MSUCE

Professor of Moscow State University of Civil Engineering (MSUCE)

Professor of Perm Technical State University (PNIPU)

Corresponding Member of the Russian Academy of Architecture and Construction Sciences