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COMPUTER PROGRAMS FOR DESIGNING BUILDING STRUCTURES

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Abstract
The article discusses in detail the possibilities of automating the process of processing projects and structural documents of buildings and construction structures, methods of design using modern computer technologies, computer design of construction structures, structural mechanics and construction structures.

Keywords: Construction Construction construction, finite elements, computing system, robustness, dynamics, geometric shape, vibration frequency, stagnation, deformation, ANSYS, COSMOS, PLAXIS dynamics, FLOWSTAR, SCAD, LIRA.

Introduction

PK Robot Millenium is the only system that combines all stages of construction design in one unique package - from the creation of the calculation scheme to the creation of reports and drawings. PK allows to perform the analysis of the state of constructions based on the finite element method, and the following operations are performed by means of it: perform linear and non-linear calculations, determine the state of stress and deformation caused by static and dynamic loads in the structure, stabilize the entire scheme and its individual elements. analysis of the loss of strength, inspection of rigid constructions made of various materials in accordance with international design standards, automatic generation of design documents and drawings for some elements.

In SCAD, an advanced library of finite elements for modeling rod, plate, solid and mixed-combination structures is compiled, in addition, a variant procedure of joint analysis models of several variants of the computational scheme is included.

SCAD office is a new generation of software that allows calculation and design of steel and reinforced concrete structures. It includes the universal finite element analysis program SCAD and functionally independent design-calculation and utility programs. The SCAD program is designed for the complete calculation of the structure. Other calculation and design programs are designed to calculate and check load-bearing structures (individual beams, columns, plates) in accordance with existing standards. [1]

The complex includes the following calculation modules: STAR - linear static calculation; DSTAR – calculation of stability, frequency of oscillations and forms; FSTAR – endurance calculation; ASTAR - dynamic calculation of forced vibrations; OPTSTAR – optimization of construction form and dimensions; HSTAR - solving heat engineering issues; NSTAR –

non-linear statics and dynamics; FLOWSTAR – analysis of laminar fluid motion; FLOWPLUS – two- and three-dimensional analysis of fluid turbulent movement; ESTAR - low-frequency analysis of electromagnetism problem; HFESTAR is a high-frequency analysis of the problem of electromagnetism.

Lira is a software product that allows for numerical research of strength and stability of constructions and to perform a number of construction processes in an automated manner.

PK ―Lira‖ allows research of many types of constructions: space-steering and shell systems, mixed systems - frame-connecting constructions in high-rise buildings, ground-base slabs, rib slabs, multi-layer constructions, among them. STAAD Pro is a program designed for calculation and design of building structures. This program consists of an integrated complex of calculation, analysis and design of construction structures, buildings and structures. STAAD Pro provides detailed information about the stress-strain state of the structure and its individual elements. The main emphasis is on the simplicity and ease of creating a computational model, taking into account all the latest methods of analysis and design, productivity. STAAD Pro is recognized as a relatively successful development in today's computing market, and is the industry standard for this class of software. Calculation results are used in the design of metal, reinforced concrete and wooden structures in accordance with the requirements of many popular standards and codes, including SNiP. PLAXIS 8.0 is a calculation complex, which includes a set of practical calculation programs that analyze the stress-deformation state of the ―soil-foundation-structure‖ system using the finite element method. The complex includes additional modules: PLAXIS DYNAMICS – analyzes the impact of vibrations caused by pile driving, road traffic. PLAXIS 3D TUNNEL – provides a possibility of three-dimensional analysis of stagnation and deformations in the design of tunnels constructed using the shell method. [2]

PLAXFLOW is a filtration calculation of water-saturated and unsaturated soil arrays using finite elements in flat problem conditions (for solving flat problems using finite elements).

PLAXIS 3D FOUNDATION – finite element analysis of stress-deformation state of the ―soil-foundation-structure‖ system in the conditions of a three-dimensional problem.

The program is used in all areas of traditional geotechnical engineering: from it in the design of dams and reservoirs, ground and foundation structures, construction of embankments, trenches and retaining walls, embankment strengthening, road expansion, dam displacement, infiltration issues. it is used in solving, designing tunnels, building metro stations.

FEM models are 21st century computing equipment designed for calculation of complex constructions using the finite element method. FEM models consist of a model that describes the above-ground structures of the building and the complex nonlinear behavior of the soil. FEM models allow calculation taking into account the interaction of the building floor and above-ground structures, as a result of which, the need to calculate the joint settlement of a complex of buildings with different floors built on piled ground allows to perform in practice on the basis of normative requirements.

ANSYS is the world's most widely used multipurpose finite element calculation system. It includes stability and dynamics, temperature fields, hydrogas dynamics, electrostatics,

electromagnetism, modules of optimization calculations, probability calculations, highly nonlinear calculations carried out according to the exact integration scheme, etc.

This system has a unique ability to simultaneously or alternately calculate several different physical fields within a single problem. COSMOS/M is based on the GEOSTAR software system, which includes a preprocessor, computational finite element modules, and a postprocessor. GEOSTAR allows the user to create a geometric shape of the calculated model, fill it with elements, quickly make the necessary changes, perform the required types of calculations, view the results, take a screenshot and publish. The GEOSTAR software system manages the work of various calculation modules of COSMOS/M, creating an interactive environment for their mutual cooperation.[3]

The SCAD complex is an integrated system of designing and analyzing the strength of structures based on the finite element method. It includes solving large-scale problems (with hundreds of thousands of degrees of freedom) in linear and non-linear conditions with high performance, modules of stability analysis, formation of calculation summations of stresses, stress state of structural elements according to various strength theories. includes a processor that allows checking, determining the stresses generated when a single fragment of the structure works together with the structure, building amplitude-frequency characteristics, selecting modules for reinforcement for elements of reinforced concrete structures, checking and selecting modules for metal structures. In addition to static calculations, the system has the ability to consider various dynamic effects - seismicity, pulsation of wind load, harmonic vibrations, impulse, impact.

The graphical tools for the formation of computational schemes include a set of options similar to the dimensions of structures, which have the ability to automatically represent the mesh of finite elements in space, to define the physicomechanical properties of materials, support and connection conditions, and loads. Compilation of computational models from different schemes, scheme options for choosing a large number of tools for graphical control of all descriptions are provided. Calculation results can be exported to an editor or a spreadsheet and the values of deformation and bending schemes, displacements in nodes, displacement isofields and isolines of plate-like and volumetric elements can be expressed in color and number.

In the process of analyzing the table, it is necessary to pay great attention to the application of the program complex by country, construction norms and rules. From this point of view, the list is reduced even more. [4]

STRAP (Israel), STAAD, NASTRAN, STRUDL, ANSIS, COSMOS, ADINA (SSHA), DIANA (Netherlands), ROBOT (France), STARK (Russia), LIRA (Ukraine). US and Canadian standards and regulations are implemented in American program complexes. In the STARK and LIRA program complexes, the norms and rules of the CIS have been introduced, based on this, we consider LIRA PK to be the most suitable for us.

Lira PK is a multifunctional software complex designed to compute and design constructs for various purposes. Lira PK is widely used to carry out computational work in mechanical engineering, structure-building construction, bridging, nuclear power, oil industry and a

number of industries where methods of construction mechanics are important. Lira PK automates series design processes:
Determination of loading and voltages in relation;
Selection of elements in constructions;
Choosing a cross section on steel and reinforced concrete structures and checking them, creating working drawings of columns and beams based on the result of this process;
Lira PK is based on the use of the finite element method (CHEU), which is recognized as the main instrument throughout the world, in the numerical analysis of the strength and priority of construction structures, in the form of displacements.
The main functions of the Lira program complex are:
An advanced intuitive graphical environment of the user is created;
embodied the set of multifunctional processors; any optional constructions in practice: schemes with flat and spatial sterjen, shells, plates, beams-walls, membranes, awnings (closures), and at the same time an extended Bibliotheca of finite elements, which makes it possible to build a computer model of combined systems consisting of finite elements of various sizes;
Computations can be performed on different types of dynamic effects (vibration loads, momentum, shock, response-spectrum; [5]
The CIS, European, African, Asian and US countries have been able to perform calculations on wind and seismic impacts, mainly taking into account wind gusts;
It is made up of systems that design reinforced concrete and steel elements based on the criteria of the CIS, European and US states;
the possibility of editing the base of steel sortaments is created;
To implement file-based linkage with other graphics and documentation systems such as DXF, MDB, IFC, etc (AutoCAD, AllPlan, Stark, ArchiCAD, MS Word, HyperSteel, AdvanceSteel, Bocad, Revit, etc.
Enhanced provisioning; support and documentation systems performance
the possibilities of changing the interface language at any stage and documenting the process at any stage are created;
There is a system of different size units and their combinations.
Systems of the Lira software complex
The lira PK of the lira is made up of the following information systems related to the lira PK:
LIR-VIZOR; processors; Lir-ARM (armature);
Lir-LARM (local armature;
Lir-STK (design of steel structures;
Lir-RS.;
Lir-KS (cross-sectional constructor;
Lir-KTS (thin-walled cross-sectional constructor;
Lir-KM (metal lir constructions;
Beat the GRUNT;
CUSTOM PROCESSORS;

VARIATING THE MODELS IN A ROW.

LIR-VIZOR is the user's only intuitive graphical environment, a system designed to create computer models of current optional constructs and analyze them (Figure 1).

The reason why it is said to be the only one is that the user performs all the steps of counting in a situation where he does not leave this environment. In this environment, there are opportunities where you can view and use data from any stage, switch to any mode and view several Mode Windows at the same time (for example, you can also see the initial data at the same time in the process of analyzing the results).

Intuitive-because it corresponds to the requirements of the Windows operating system interface in terms of the composition and filling of the interface. The user is familiar with this interface, and he can easily communicate with a computer in this system.

When describing a graph – project, the graphic form of information performs a leading function (whole or partial representation of an object, an image of the results in the form of a deformed scheme, epyura, isolinia (ISO lines), animation of dynamic processes, etc. k.).

The LIR-VIZOR is the core system of the Lira software complex and performs the following core functions:

Implementation of their visualization at all stages of synthesis and analysis of computational schemes;

Making it possible to detect errors;

Ensuring accurate instructions;

Ensuring the availability of text-linked information;

the presence of methods for creating multiple and variant mathematical models;

Providing a large number of methods in the analysis of results (construction of voltages, displacement isomaydon, isochisics, power epics, vibration animations, construction and imaging of deformed circuits, image scale control);

Representation of the image of the transition idiocy in the processor on the screen; the presence of an extended documentation system.

The LIR-viewfinder interface is a configurable interface, since it contains indicators of a number of settings-modifications, the main ones being: equipment panels;

Color schemes (working window background color, color of structural elements and objects of the calculation scheme, palette of results isomaydoni).

Type and sizes of fonts;

Pointers to the main directories for storing initial data and results file;

Units of measurement;

Interface and documentation languages; 3D graphics indicators.

The LIR-VIZOR system employed the principle of multiple issues. According to this, the user is offered a number of scenarios for communicating with the software complex. The user can implement a single command through the main menu line, using the equipment panel button, the context menu line, or the ―goryachiye keyboard‖.

Lira PK is made up of the following set of processors and modules that perform basic computations:

Linear processor-calculates linearly deformed constructions to static and dynamic effects. The finite element method (CHEU) in displacements has been introduced. There are more than 50 types of finite element Bibliotheca: optional cross-sectional surface sterjen elements, including Elastic ground elements,

Triangular, rectangular and rectangular plate elements (balkadevor, shell, plate, including in the elastic floor); three – dimensional elements in the form of a tetrahedron, parallelepiped, triangular and rectangular prisms, irregular convex Hexagonal and octagonal, special elements-with a finite BICR bond, node beryllibility, grunt-ground bounded elements, etc.k. Static calculation is performed on the effects of loads (distributed and accumulated) and deformations (given displacement, temperature). The calculation for dynamic effects is solved on the basis of the spectral analysis (analysis) method, and the system of linear equations is solved on the basis of the Gaussian method. Minimization of the calculation is carried out on the basis of the algorithm —factor derevyev va and —minimalnaya stepen‖.

The linear processor embodies a number of the following additional modules:

The module calculates the effect of the aggregate of computational stresses generated from given loadings (specific gravity, payload, snow, wind, seismic, etc.;

the priority module provides an opportunity to perform a general priority inspection of the facility being calculated by determining the Reserve coefficient and the form of loss of priority;

LITERA module-performs the calculation of head and equivalent voltages based on various strength theories;

HYUJ (aggregate of numerical loads) module-performs the calculation of displacements and voltages from linear combinations of loads based on the main requirements;

FRAGMENT module-performs the calculation of the load generated by the impact of one fragment of the calculating structure on the other. In particular, it is possible to determine the loads that are transmitted from the bottom of the structure to the base.

The technological chain of automatic design of a construction based on a linear processor in LIRA PK can be built as follows - HZJ or Hyujloyihal system-sketch of working drawings. [6]

Conclusion: The issues of design of construction structures are widely covered in QMC, field-specific educational publications and monographs. But the calculations presented in these sources are performed separately for the elements of the plate, fence, column. Constructive connections between them are not fully quoted, which cannot fully represent the idea of the work performed by a holistic construction.

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