Modern Information Technologies in System Architecture—Urban Planning—Building Constructions

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Abstract The toolkit of modern versions of SAPFIR-3D and LIRA-SAPR allows to carry out the idea of an architect through a detailed analysis of a tense deformed state and verification of the bearing capacity of building structures in the software complex LIRA-SAPR to produce design documentation with the requirements of the necessary regulatory documents in the SAPFIR-3D program.

Keywords Information technology · Geometry · Form · Architecture · Urban planning · Building constructions · Designing

1 Introduction

One of the most important areas of implementation of modern information technologies is construction. Computer-integrated design leads to enhanced quality and speed of work, financial control, communication and access to shared data and productivity. Unfortunately, many firms in the third world countries are yet to understand this essential value and its importance to the development of their construction sector [1].

Design of products which satisfy the consumer not only in operational, but also esthetic qualities which are broadcast in requirements to creation of certain forms of objects of design is the purpose of the modern designer of any direction. The form, in turn, first of all, is inseparable from its geometrical characteristics. Achievements in the field of geometry, construction mechanics, physics and other sciences enable to create optimum constructive forms which meet obviously set requirements.

Understanding these geometrical images, different behind plastic character, bear in themselves harmonious coherence, special behind tectonics, which in synthesis with composition and graphic means gives the opportunity to receive samples with high esthetic rates [2], has to be the basic component in the course of computer design of objects of graphic design.

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2 Analysis of Publications and Problem Statement

The architecture, by Patrik Schumacher definition, is coded by the double code: usefulness (functionality) and beauty (the formal decision), and one-sided aspiration only to formal aspects is valid anomaly [3]. The social functionality of the built-in environment keeps in its communicative potential. Development of space complexes as systems of importance is a key to modernization of the main competence of architecture.

The Council on Tall Buildings and Urban Habitat (CTBUH) UK Chapter hosted presentations and panel discussion at the RIBA London, supported by Zaha Hadid Architects and ABB Group [4].

Reflecting on the lessons learned from the past 50 years, the presentations and panel discussion explored the future of our built environment in cities designed to be sustainable and smart, socially responsive and self-learning: the main discoveries of the past 50 years that have influenced our built environment; how artificial intelligence and big data inform the city of the future; how smart technologies can improve social, environmental and economic balance of our cities; improving the integration of research into smart tall buildings and smart cities.

The panel of speakers presented their latest research with a focus on how greater collaboration can be implemented across the disciplines shaping our urban environment: Peter Murray of New London Architecture, Simon Giles of Tyrens London, Carolyn Dwyer of City of London Corporation, David Nicholl of ABB, Patrik Schumacher of Zaha Hadid Architects. Organized by Viviana Muscettola and Katrin Förster.

Striking example of parametrical design of the city residential district is the project for developing a part of Admiral Serebryakov Embankment by Novorossiysk consortium led by Zaha Hadid Architects (Fig. 1). The team has suggested to arrange on the embankment dynamic composition from nine buildings which at the different levels are connected among themselves by passes, the areas and podiums and also have continuation in the form of the moorings going to the sea. The configuration which fits into the available urban development and, at the same time, can become modern architectural symbol of the city has as a result turned out. The project integrates business, ecological, cultural and recreational functions, creating unique consecutive agglomeration and creatively programming the territory [5].

Currently, one of recognized and available in Ukraine and neighboring countries is the LIRA-SAPR program complex [6]. It includes such modules as SAPFIR-3D, MONOMAKH-SAPR and ESPRI (Fig. 2).

The SAPFIR-3D module enables to carry out: design of various construction objects—a lot of floor residential and public buildings, constructions of any assignment of superstructures, small architectural forms; preparation of analytical models of construction objects for the subsequent strength calculation and the analysis of design in the LIRA-SAPR program complex; search of versions of volume decisions and rational constructive schemes on the basis of parametrical modeling and interactive space shaping.

Fig. 1 Concept of developing a part of Admiral Serebryakov Embankment by Novorossiysk consortium led by Zaha Hadid Architects
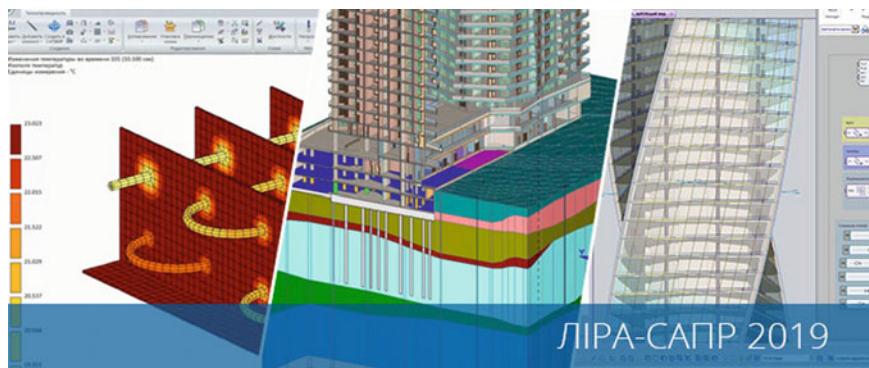

Fig. 2 LIRA-SAPR program complex

Fig. 3 New version of software LIRA-SAPR

The MONOMAKH-SAPR module is intended for calculation and structural design of buildings from monolithic steel concrete, with brick walls. In the course of work calculation of the building and its separate parts with forming working drawings and schemes of reinforcing structural components has been made.

The LIRA-SAPR program complex is constantly updated (Fig. 3): releases include new opportunities and corrections [7].

## 3 The Purpose of the Research

Application of modern construction program complexes in system architecture—urban planning—building constructions at training of specialists of the higher school with the solution of practical tasks of the enterprises.

4 Results of the Research

Long-term experience of the use of modern information technologies in educational process at Donbass State Technical University (DonSTU) and effective research cooperation with the LIRA-SAPR company under the direction of the D. Sc., the Professor Gorodetsky O.S. [8] have provided an opportunity to receive in the fall of 2018 for Volodymyr Dahl East Ukrainian National University (V. Dahl EUNU) the license sets of training programs of ACADEMIC set 2018 and to begin the process of implementation in educational process at the departments "Architecture and Urban Planning" and "Constructions, Urbanistic and Space Planning" this modern construction program complexes LIRA-SAPR FULL 2018, MONOMAKH-SAPR PRO 2016 and ESPRI 2018.

The use of scientifically capacious tools of modern versions of the SAPFIR-3D and LIRA-SAPR programs allows:

- To fulfill the original idea of the architect on the basis of geometrical premises of art shaping by means of parametrical shaping when developing the concept of the residential district of the city (Fig. 4) and project of the building (Fig. 5);
- To carry out the detailed analysis of tensely state of strain and check of bearing capacity of building constructions in the LIRA-SAPR program complex (Fig. 6);
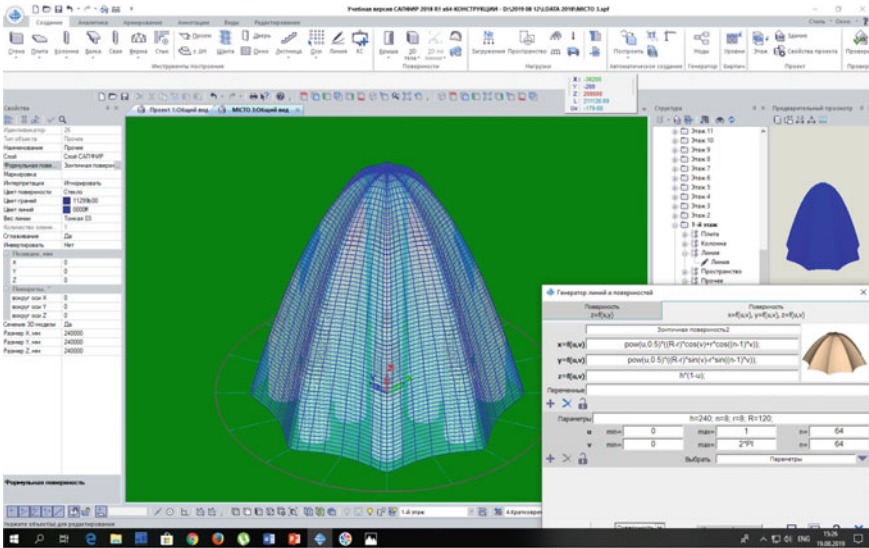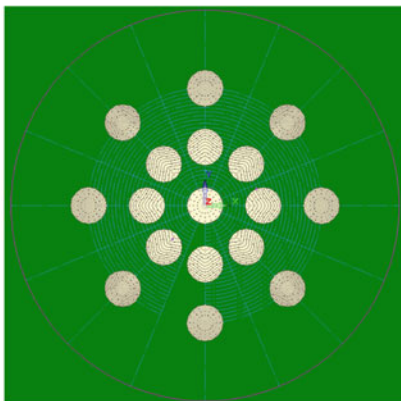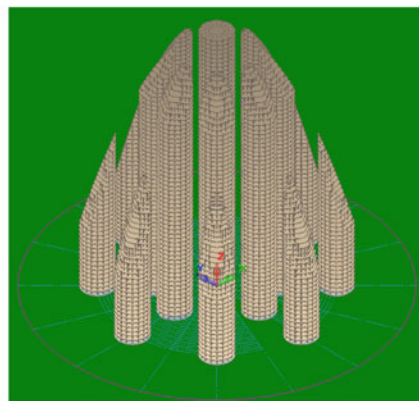
Fig. 4 Creation of conceptual architectural model of the residential district of the city in the SAPFIR-3D program: **a** parametrical shaping, **b** bottom view, **c** look in isometry
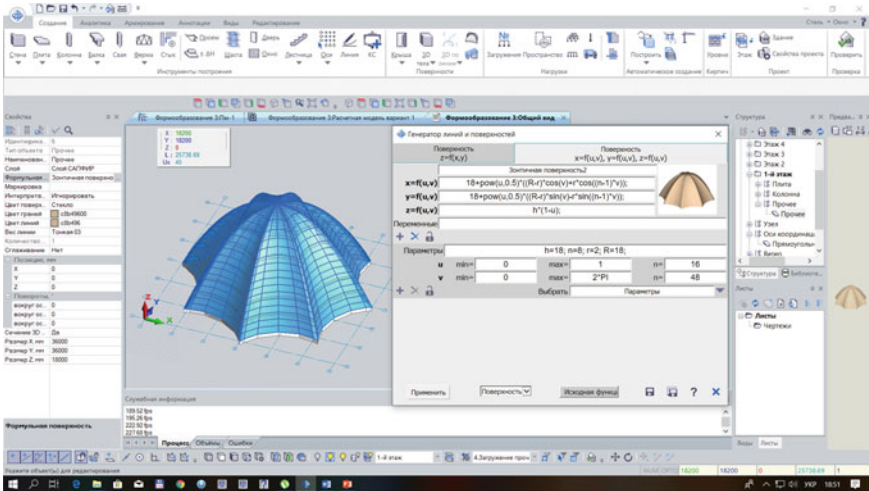
Fig. 5 Creation of architectural model of the building in the SAPFIR-3D program
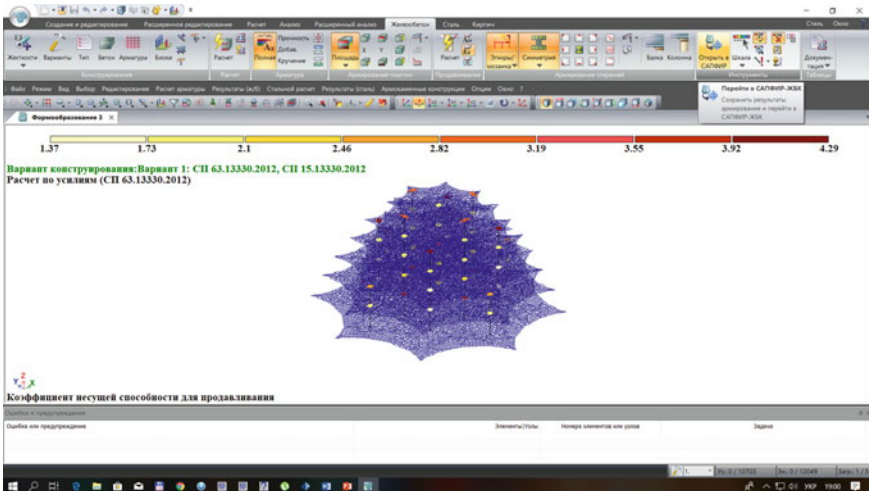

Fig. 6 Check of bearing capacity of building constructions in the LIRA-SAPR program complex

- To prepare the project documentation in the SAPFIR-3D program (Fig. 7) with observance of requirements, relevant state normative documents depending on the country of construction.

It is especially necessary to emphasize the role of the LIRA-SAPR company in assistance on implementation of modern programs in educational process in institutions of higher education of the construction direction for training specialists. On the official site of the LIRA-SAPR company [9], there is provided different information
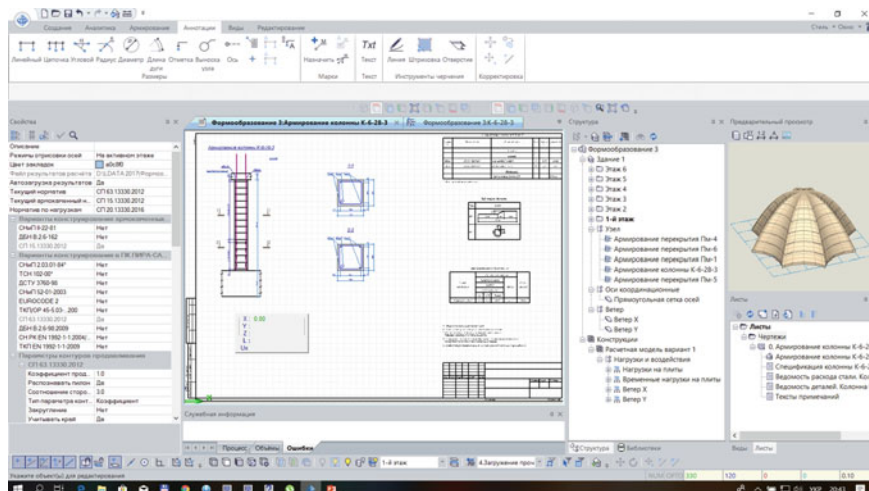
Fig. 7 Creation of the operating documentation in the SAPFIR-3D program

on modern software products. Students have opportunity free of charge to load educational versions of programs and to obtain exhaustive information for its use [10] both in educational process and during the work in construction companies.

5 Conclusions

Attraction of the accumulated international experience in the field of architecture, use of modern construction information technologies, effective research cooperation with the LIRA-SAPR company, design organizations and industrial enterprises give all opportunities for effective implementation in educational process of dual technique of training future specialists capable to solve complex problems of creating projects of reliable buildings and constructions with high esthetic rates.

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