Sborník prací ke konferenci

1. Mezinárodní konference

STRUCTURA 2011
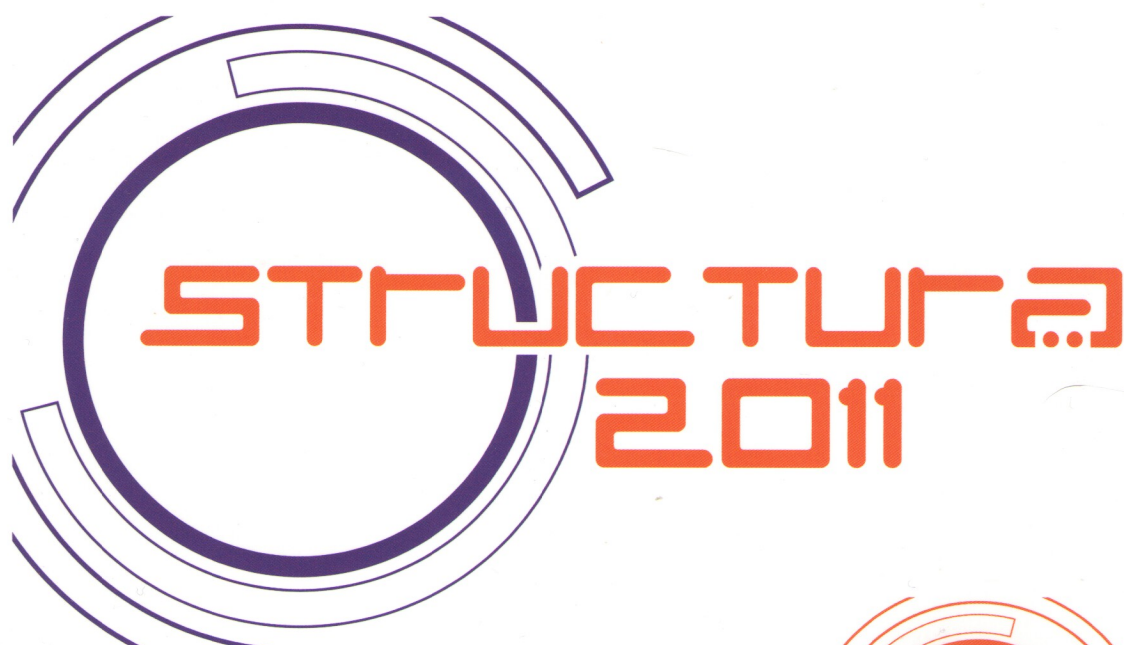
Konstrukce, materiály a technologie ve stavebnictví

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Ostrava 8. - 9. 12. 2011

1. Mezinárodní stavební konference konaná v rámci projektu „Tvorba a internacionalizace špičkových vědeckých týmů a zvyšování jejich excelence na Fakultě stavební VŠB-TU Ostrava"

COMPUTER AIDING AS AN INDISPENSABLE TOOL OF MODERN ENGINEER

Mariusz CZABAK[1], Adrian CHOLEWA[2]

Summary:

This article presents an influence of polish building engineering on computerization of engineers` work. It also presents two examples showing that using aiding programs brings benefits.

1.   INTRODUCTION

The necessity of improvement and acceleration of work rises with the increase of life`s speed. It makes our life harder, but it also causes continuous development . Thanks to this development we invent newer and newer working methods. In civil engineering, particularly in design of building structures, we can observe technology and new calculation methodologies that affect the architecture. This influence makes constructions more complicated.

The origins of the design were mainly based on two-dimensional systems that had to be separated from the three-dimensional whole. This approach is still used in design practice, but in the case of objects with ambiguous layout design there is a problem with influences caused by the work space of the building. In consequence there is a risk of oversizing of the items.

1.1.   Polish contribution to the field of computer aiding

In Poland there is a research carried out in the field of construction, both in laboratories and in the field. Poland is also the country where software CAD (Computer Accelerating Design) develops. In some difficult cases CAD is an indispensable tool for ensuring stability and trouble-free existence of the structure. In Poland there was also invented software that has been sold and now it is developed by foreign companies.

Additionally designers can optimize the work by reading publications produced by research institutes, for example the book of prof. Assoc. Eng. W. Starosolski "Wybrane zagadnienie komputerowego modelowania konstrukcji inżynierskich" or prof. Assoc. Eng. J. Sieczkowski's "Podstawy komputerowego modelowania konstrukcji budowlanych ". In addition, there are many articles about the creating a model structure. There are also some works related to specific programs such as Dr. Eng. Stefan Dominikowski's " Procedury projektowania konstrukcji przy wykorzystaniu programu robot millennium i robot ekspert ".

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1.1.1 Robobat

„Autodesk Robot Structural Analysis Professional" is one of the best known analysis programs. It has it's origins in early 80's, when the owner and director Andrzej Niżnik (Pole) created the first program for the calculation of building structures. It was in 1983 and the program was a part of his academic work at INSA (Institut National des Sciences Appliquées) in Toulouse. Currently, Autodesk has bought the whole program "Robot Millennium" and it sells this program under its own label.
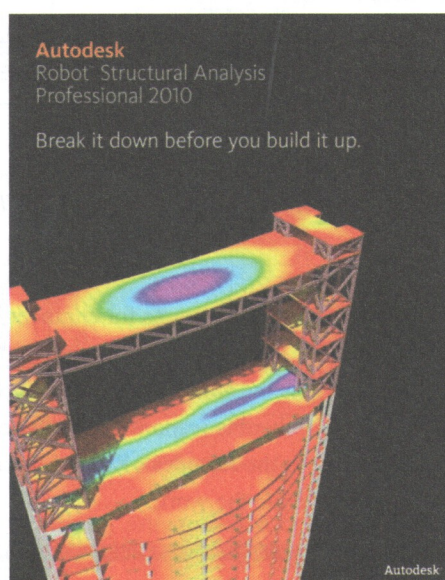

Fig. 1 The logo of ARSAP 2010 [I1]

1.1.2 CadSiS

Another fast developing project is RM-3D program by CadSiS. It was created by Dr. Eng. Tadeusz Smoleń and M. Sc. Jaroslaw Szczesny. They both have special training in the theory of the structure. Before the activity in the Company they worked at the College of Engineering in Opole (now Technical University of Opole) as the academic teachers, dealing with the strength of materials and elasticity theory. The program has its origins in 1988, when there was created MR program under MS-DOS.
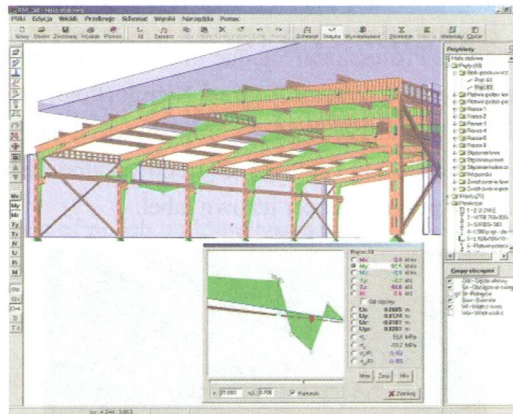
Fig. 2 Screenshot of program RM-3D by CadSiS [I2]

1.1.3 PRO soft

The third of Polish companies offering a full suite of programs for engineers is PRO Soft. The company was founded by Dr. Eng. Krzysztof Grajek. Software is created by the owner of the company, in cooperation with prof. Assoc. Eng. Włodzimierz Starosolski. He is the authority in the field of reinforced concrete structures. The package is divided into 4 modules. Each of them is responsible for other type of structure (plate, frame, shield and 3D object), acting in a similar way as the Autodesk Robot Structural Analysis Professional, Nemetschek or Plato 4, which facilitate and accelerate the work.
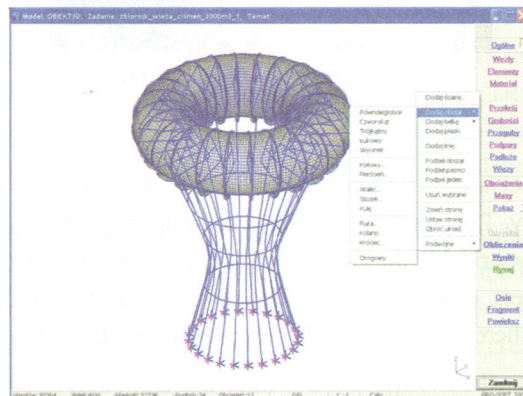
Fig. 3 Screenshot of the program's ABC PRO 3D object soft [I3]

1.2. Other programs

In addition to the Polish programs, the market offers a wide range of programs for constructors, such as (ANSYS, Nemetschek SCIA, Autodesk Robot Structural Analysis Professional, SAFI 3D). Everyone can find software that fully meets his expectations. The biggest barrier may be the price of these programs.

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2.   THE USE OF PROGRAMS IN THE DESIGN

In the next part of this article there are presented examples of situations, when the program was used to assist the engineer in the calculation. In this case, there was used "Autodesk Robot Structural Analysis Professional".

2.1.   Example 1

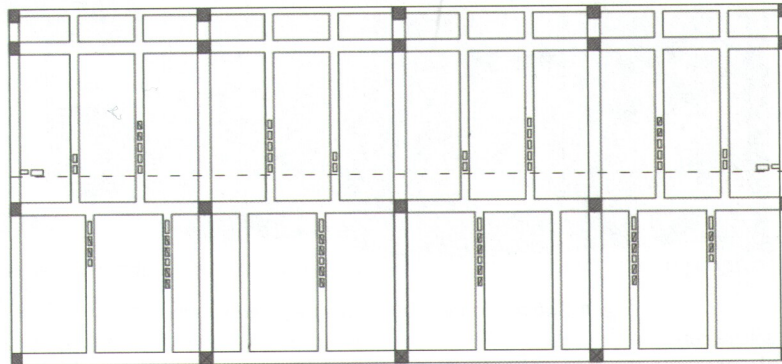Example of the model of slab-beam ceiling in the hotel facility.

Fig. 4 Projection of the ceiling

In accordance with accepted engineering principles the ceiling should be calculated and reinforced as a unidirectionally reinforced concrete plate (based on secondary beams). On the map below we cannot see any changes in the values of bending moments in the locations of secondary beams. Noticing of that is only possible using computational programs such as CAD.

This construction's work is the result of putting of heavy walls of hollow concrete on the beams (for ensuring adequate sound insulation). Weight pressing on the beam was big enough to change the work schedule, so the ceiling slab should be reinforced in two directions.
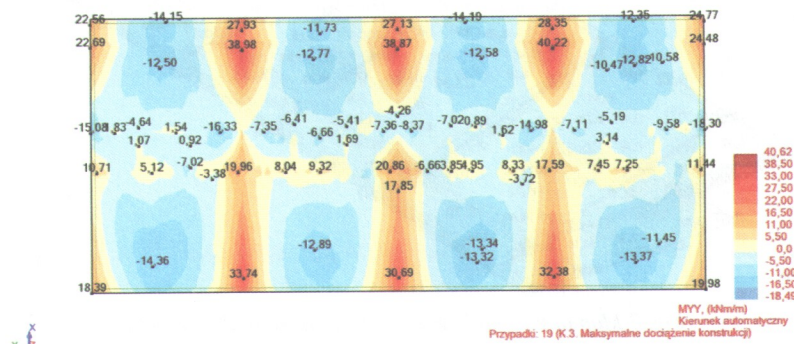

Fig. 5 Map of the bending moments

2.2. Example 2

The office and the service facility with modern architecture.
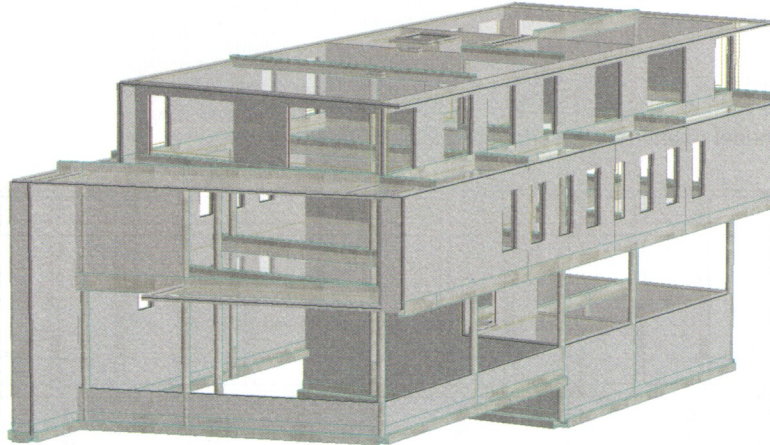

Fig. 6 Calculation model of the office and service

The second example presents the floor of a modern office and service building, which has a complicated construction. Separation of the plate belt is the most difficult, because there are different span lengths and different stiffness of beams. Listing of the burden and the choice of most unfavorable combination could also cause many difficulties. Using of design analysis programs helps to understand the work of such as constructions.
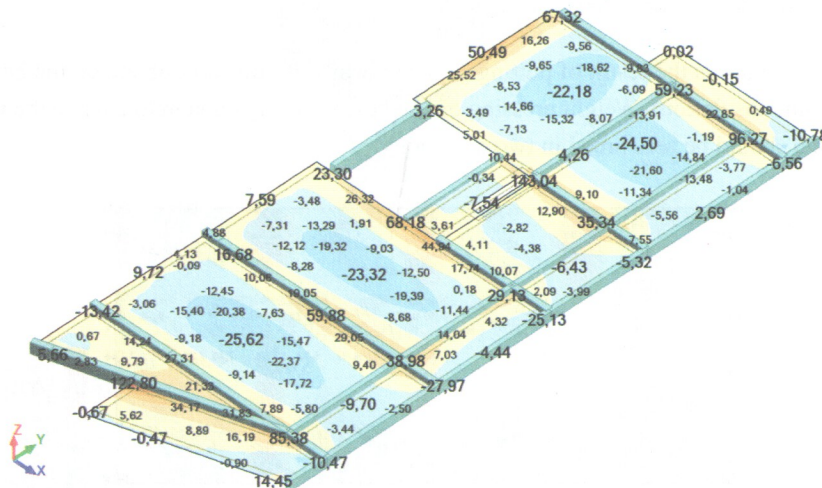

Fig. 7 Map of the bending moments relative to the axis OX

On the map we can see that the distribution of bending moments is consistent with the expectations.

3.   THE CONCLUSIONS

The opportunities of work with the computer increase with the development of technologies. In recent times we can see a big progress of programs for engineers. There are programs aiding the design of buildings (CAD), but there is also a software helping with mechanisms (CAM). The speed of life grows, so we need the solutions that facilitate and accelerate the design. There are some programs in the market, which have been sold for years. "Autodesk Robot Structural Analysis Professional" is one of them.

One of the biggest advantages of programs helping with calculations is duration of the work and effort. There is also the probability of accounting errors – it is higher in case of hand calculations.

However, there is still needed a qualified engineer in the process of model and analysis of the results. He is able to interpret the results in proper way. And then the knowledge in the field of structural mechanics or strength of materials is very useful.

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