

## INFLUENCE OF INFORMATION TECHNOLOGIES ON ENGINEERING GRAPHICS MODELS

Lionginas ČIUPAILA <sup>1/</sup>, Jonas ZEMKAUSKAS <sup>2/</sup>

<sup>1/</sup> Vilnius Gediminas Technical University, Sauletekio al. 11, LT10223 Vilnius, Lithuania  
email: lac@fm.vtu.lt

<sup>2/</sup> Vilnius Gediminas Technical University, Sauletekio al. 11, LT10223 Vilnius, Lithuania  
email: Jonas.Zemkauskas@fm.vtu.lt

**Abstract.** Computer methods have been used in teaching of engineering graphics in Vilnius Gediminas Technical University for two decades. Historically the way of using computerization has been formed, the peculiarity of which is that in the process of teaching commercial systems were used not directly but to solve adapted graphical problems. During the time of packed graphics already when they had to program each action, auxiliary systems were made which allowed solving with minimal efforts not informational but graphical problems. Experience of many years showed that such methods allow to be independent on constantly changing commercial graphical systems and form the problems of engineering graphics and the rational ways of solving them. Our analysis and practical results are summarized in manuals on graphics, proceedings of conferences and scientific papers. The work grounds the necessity of transition from traditional engineering graphics (TEG) into information engineering graphics (IEG). This necessity arises from more complete using of computing possibilities including the nuances of artificial intelligence. The formed IEG models show the connection between separate parts of the course and its place in engineering studies. The problems of globalization and international exchange are discussed. Modeling evidently showed the difference between IEG and TEG, problems of realization and the necessity of maximal usage of computing possibilities.

**Key Words:** Computer graphics, information engineering graphics, graphics programming, data exchange technology, extended data, drawing database, artificial intelligence, Visual LISP Application, formalization of design problems, CAD program development.

### 1. Introduction

Though computer methods have been used in graphics for some decades [1], the contents of the majority of the newest textbooks [2-5] in principle has not changed for some centuries. New technologies are adapted to old methods, so in the titles of textbooks there appear only numbers of commercial systems [6-9]. The authors believe that formation of a new standpoint and technologies is necessary and inevitable due to the following reasons:

First:

- graphics needs and solved tasks have changed in computer science. For example, an arc or tangent realized in classical graphics by dozens of techniques (Fig.1a), can be carried out by one or at least two commands using computer (Fig.1b). So, teaching by traditional methods, no matter how nice and usual they would be, is becoming senseless because it is simply unnecessary in the real life (Fig.1a).

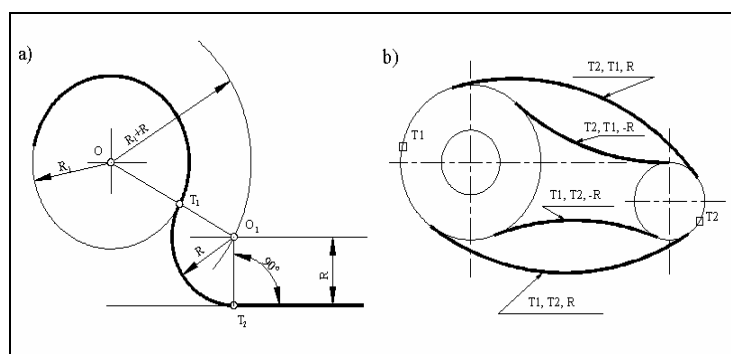


Figure 1: Graphs distinctions

Second:

- the main role in engineering graphics is assigned to a projection method allowing describing 3D objects by 2D (paper) views. But the classical Monge's technique (Fig.2a) is used neither in engineering nor in computer practice, where 3D model is visualized in 2D fields (Fig.2b).

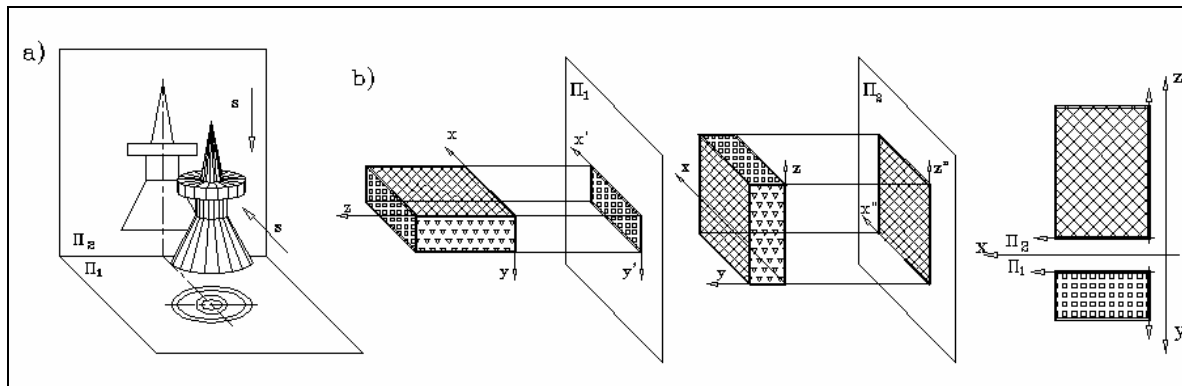


Figure 2: Graphics projections

Third:

- graphics opportunities have changed. In computer technique the automated graphical drawing analysis is possible, which was not the case with traditional technologies. Besides, computer aided drawing can contain additional information reflecting necessary engineering data. So, graphics content acquires new essential information opportunities. Unfortunately, it is not even reflected in teaching writing, though it is unjustifiable from the point of view of graphics effectiveness.

Fourth:

- the role of Graphics Departments in creation of graphical systems is unreasonably depreciated. They are becoming similar to commercial systems educational courses, and the evidence of its teaching literature titles which make up two groups of terms: Engineering Graphics plus a number of a graphical system. Unfortunately, the books with such type of titles are published in the whole world.

The above mentioned circumstances ground the necessity of a new concept in engineering graphics.

## 2. Information engineering graphics models (IEG)

Rational application of computer science and solution management of practical tasks in graphics subjects are necessary to be recreated evaluating traditional positive matters and opportunities provided by information technologies. New methods can be found in an embryonic state [10,11]. But even now there exist teaching techniques [12] guided by traditional themes [13,14], which are used mechanically, but not connected with opportunities of computer technologies and needs of practical engineering. The model of IEG is presented (Fig. 3).

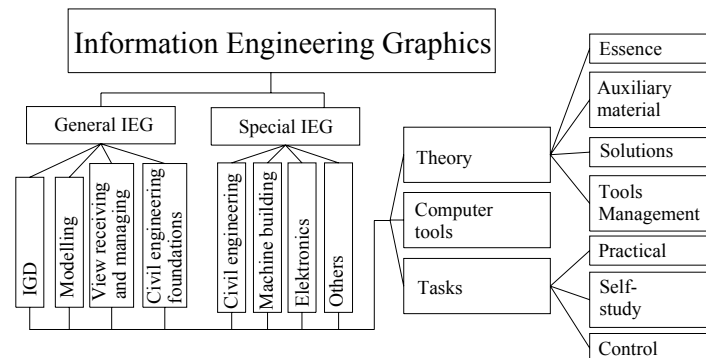


Figure 3: IEG model

Computer methods in graphics, compared with traditional technologies, have a number of peculiarities the use of which allows not only to apply commercial graphical systems effectively but also to create applied systems on the basis of commercial ones. Especially it is urgent for solving a group of tasks of a low level as specialized commercial systems of such type are usually not profitability and general systems do not exploit advantages of computer science. For such type of tasks the educational engineering graphics (EEG) can be attributed.

The main EEG problems:

- abundance and complication of commercial graphical systems;
- lack of methodology of information graphics methods (IGM);
- inadequacy of traditional methods (TM) to IGM.

The EEG problems can be rationally solved by modeling and creating applied graphical systems. In VGTU the model of such system has been functioning for some years [15-21], so it is time to generalize and improve the system theoretically, taking into consideration even the conditions of the EU joining (communication not only in Lithuanian).

Besides, during some decades the tendencies of developing commercial systems grew up, which allows to make applied systems more independent from permanent changes of systems.

The system model depends on the tasks, the content of which forms the objects of modeling. EEG is divided into 2 parts: general and special ones. The essence of general graphics is generalization and general principles, while the essence of special one is subject peculiarities and effective methods of work. It is evident, for example, in the model of civil engineering (Fig. 4), in which even basic drawing is supplemented by practical details and the commands corresponding to rational visualization technology.

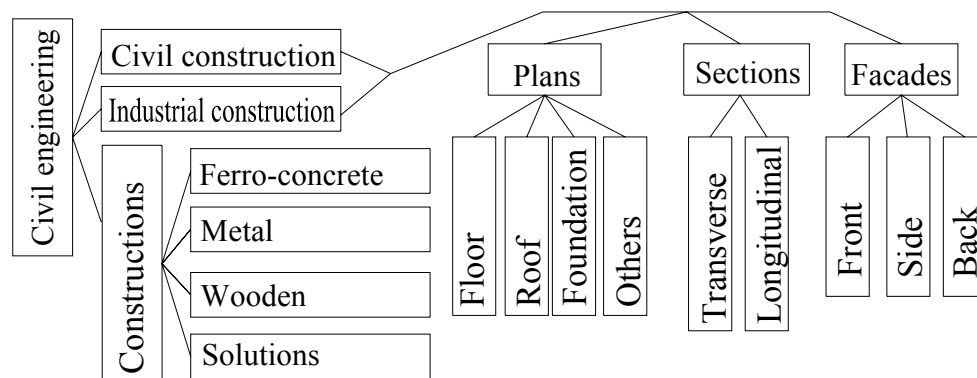


Figure 4: Information civil engineering drawing model

Generally, it is the same to all engineering professions, but the special part depends upon studies and is different for civil engineering, mechanics, electronics, etc. each part deserves separate research. Having discussed the specific features of projection technique and geometrical drawing [22, 23], we are going to carry on a wider investigation of information civil engineering drawing models.

### 3. Information civil engineering drawing models

The basis of civil engineering drawing in the course of graphics is drawing of building plans, fronts and sections. In comparison to traditional technology [24] in computer science there appear absolutely new possibilities, the most important from which are:

- drawing can be not carried out from separate lines, but composed of the corresponding view elements (windows, doors, stairs, etc.). The elements themselves can contain additional information which can influence the form of the elements nor results of drawing analysis;

- computer science allows to transfer a considerable part of work and even of knowledge for carrying out by computer, so it is useful to model and develop informational technologies as much as possible applying computer capabilities.

Then, information on civil engineering drawing (ICED) model, which includes visualization and the involved process, is formed by:

- automation of visualization element (windows, doors, etc.);
- visualization of processes (axes, walls, stairs, etc.);
- optimization of digital information control (additional data files);
- peculiarities of drawing formation (of a plan, section, façade);
- peculiarities of presentation (indicating usage of a prototyping field, etc.);
- application of intelligence.

In ICED model it is expedient to estimate the following:

- computer science allows to carry out formalized operations (preparation of drawing field, automated extraction of views using elementary parameters, etc.) automatically;
- in the process of work the corresponding software should be used, while minimal attention is paid to acquire general knowledge about computer science, the main effort is made to reach graphical results.

The analysis shows [17] that the object of ICDE can be disintegrated into the following logical-informational elements:

- component elements of a building plan (Fig. 5a);
- characteristic elements of a building section (Fig. 5b);
- component parts of a façade (Fig. 5c).

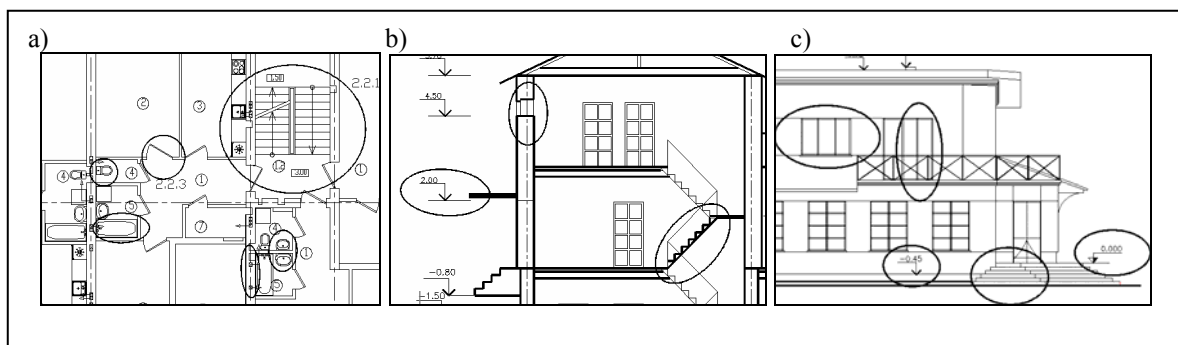


Figure 5: Information civil engineering drawing model

Such disintegration is expedient from the point of view of visualization convenience (the view is composed of different object views), informativeness (different physical meaning) and technical conformity (relatively small work field).

The view model determines the quantity and type of realizing tools, which are in addition influenced by additional factors. The number of tools depends on valid standards [3], which could be already realized in them, but, unfortunately, we, ordinary users, have to do it ourselves. On the other hand, the review of such tools itself is useful during the learning year, because it presents really existing subjects (Fig. 6a – possible door constructions).

In the models of tools it is necessary to estimate the final drawing scale, because according to the standard the same object can be represented differently in different scales (Fig. 6b).

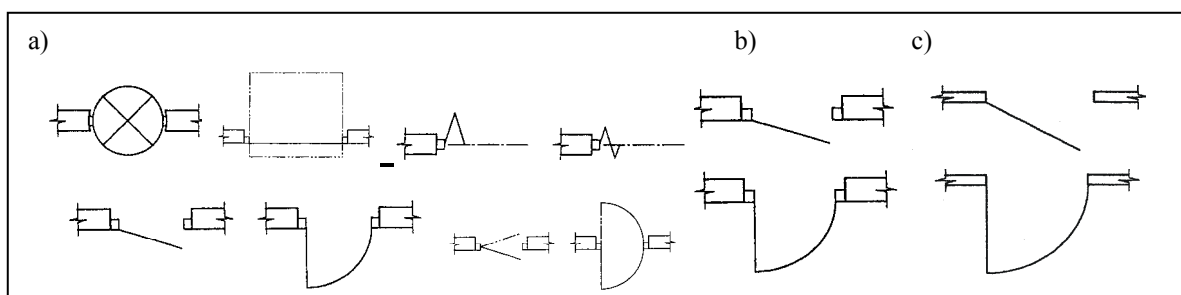


Figure 6: Information civil engineering drawing model

The size of ICED elements, capability of different scales, and type of elements influence the structure of a drawing field which can be the following:

- a) layers (AXES, WALLS, PARTITIONS, etc.), estimating that the mentioned elements can be in the plan, section or façade and it is significant for automated analysis;
- b) types of line (continuous, axial, dotted, etc.);
- c) colour of lines and screen.

As different scales will be applied, work formats should be created in modeling and prototyping fields.

ICED objects are complicated, so there is a big space for automation:

- in creation of object visualization tools it is urgent to optimize them from the point of view of operation and control;
- automated formation of field (modeling and prototyping) parameters;
- command intelligence, for example, incorporation of economical, physical and other parameters of products (windows, doors, sanitary ware, etc.) into the object itself;
- automated control of specifications and others;
- automation of dimension control, estimating different scales.

Realization of ICED needs the following:

- laboratory and control work tasks;
- preparation of automated work control is desirable;
- convenient comment of command execution and work running.

#### 4. Conclusions

- To solve the tasks of information engineering graphics it is necessary to have an applied programming system, as only advantages of information technologies at most, because of:
  - possible rational management;
  - automation of formalized stages;
  - automation of text information management.
- The experience showed that application of DG in computer graphics is pointless because:
  - software is based on mathematical expressions;
  - DG content is a problem solving by graphical methods on a plane heuristically processing 3D information which is not needed in solving by mathematical form.
- Computer possibilities can be completely used only going over from command management to process management. It requires to change graphics content, which would allow not to draw but get necessary information by using intelligence of hardware. That is why the term of the title “information” is not advertising but essential one, which reflects absolutely different IEG possibilities.
- IEG peculiarity is that there appears a resilient connection between tools and work techniques.
- Realization of ICED can be carried out only by special equipment, otherwise computer capabilities in civil engineering drawing will be not used. ICED drawings are similar to traditional technologies drawings only by sight, though they are carried out by computer. ICED rationalism lies in both, drawing making and information extraction.
- ICED element structure is unified, so its intelligence level can be very high.
- The experience showed that application of parameterization and intelligence would allow to solve conveniently many educational and practical ICED tasks, significantly increasing convenience and productivity of designing.

#### 5. Acknowledgements

The authors would like to thank Assoc Prof Dr Algirdas Čiučelis Dean of the Faculty of Fundamental Sciences at Vilnius Gediminas Technical University, for his financial help,

without which the presentation of this paper would not be possible. The authors are indebted to Professor Polozov V.A. (Novgorod, Russia) for fruitful discussions and useful comments. We also thank to Assoc Prof Dr Pranas Gerdžiūnas, Head of Department of Engineering Graphics, for his help to use our methodology in the teaching process.

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### **ZWIĄZEK TECHNOLOGII INFORMACYJNYCH Z MODELAMI GRAFIKI INŻYNIERSKIEJ**

Metody komputerowe są wykorzystywane w nauczaniu grafiki inżynierskiej w Wileńskim Uniwersytecie Technicznym Gedymina od dwudziestu lat. Analizy i praktyczne wnioski są przedstawiane w podręcznikach grafiki inżynierskiej, materiałach konferencji naukowych i artykułach. Konstruowane modele i własne pomocnicze pakiety użytkowe stanowią pomost między tradycyjną grafiką inżynierską (TEG) i komputerową grafiką inżynierską (IEG), pokazują związek między poszczególnymi częściami wykładu i ich miejscem w studiach inżynierskich. Pakiety użytkowe tworzone są tak, by były uniwersalne, niezależne od stale zmieniających się komercyjnych systemów graficznych i umożliwiały równocześnie wymianę międzynarodową. Niniejsza praca zawiera omówienie powyższej problematyki.