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## INTRODUCTION OF COMPUTER AIDED METHOD IN EDUCATION OF MECHANICS AT THE FACULTY OF ENGINEERING IN UNIVERSITY OF SZEGED

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### ABSTRACT

The spread of mass education in Hungary needs new methods in teaching of technical basic subjects. It is necessary because the quality of the education should be maintained in spite of the increase in the number of students.

Department of Mechanics and Technical Drawing (Mechanical Engineering Faculty of Szent Istvan University, Hungary) have developed and applied computer aided method for give out and correction mechanics homework in the full-time and distance education for the last fifteen years. Other Hungarian universities and colleges apply this method. The circle of such applied task types in the program package has been increasing continuously according to demand. First author applied a similar program package previously in Szolnok College. On the basis of experience of mechanics teachers using this method it is recommended to introduce it at the Faculty of Engineering in University of Szeged.

In the frame of this paper the authors present the method and the program, moreover they summarize their gained experiences connected to the applying of the program.

### 1. INTRODUCTION

The education of Mechanics has centuries-old tradition hereby the question can be reasonable: Why is necessary to deal with methodological problem in this factual field?

There is no entrance examination in certain part of faculties in Hungary (students can get in on the basis of results obtained in the secondary school). For this reason their knowledge in Mathematics and Physics are very different. Moreover the interest in technical professions is decreasing hereby the knowledge level, the basic qualification; the general erudition of students in technical higher education is very heterogeneous. Moreover the number of lectures has decreased and the freedom and independence of the students have increased in recent years.

As we can see under these circumstances the efficiency of the education and learning has been decreasing. The social background does not give the students enough motivation to get more and more knowledge. For this reason we felt it necessary to initiate so-called content compelling tools which give the possibility of independent decisions and "constrain" the student to get useful knowledge as much as possible.

These circumstances give reasons to modify the methodology of the education because the requirements cannot change. In followings it will be mainly about the full-time education. The methodology of full-time education should take into consideration the demand of distance learning as well.

As a result of spreading out of computer and the using of special programs in the field of Mechanics the content of the subject modified. Only one fundamental thing cannot

change: the user should know the theoretical ground, the conditions and methods. Therefore beside the traditional methods in calculation it should be prepared the education of different programs of mechanical content and processes in calculation.

## 2. MAIN MOMENTS OF THE METHODOLOGY OF THE EDUCATION

The construction of the process of the learning is in most cases inductive namely it goes from the knowledge of the more simple to the more complicated. In case of application the process is inverse because the general laws are to be applied in given example. For this reason the process is deductive. It should not only be taught general laws and methods but also their application. In this way inductive and deductive methods have to be applied in proper place of the educational process. Taking into consideration the above mentioned things the intention of every single educational phase has to be well determined and these series of intentions should form the methodological steps [3,4,5].

From another point of view determined the methodology of education: the connection between the role of teacher and the educational technology in the process of education. It can be declared concerning the role of the educational technological instruments: they can only be applied then the comprehension and learning are better than the traditional activity of the teacher. In order to determine the role of the teacher we summarized them in following manner. The charge of teacher

- is the personal teaching;
- is the giving the students a share in discovering of pleasure having the proper results;
- is to take lectures radiated personal magnetism moreover his/her lecture should enrapture the audience.

Beside these the students need greater freedom. They want to learn under less formal constrain.

## 3. THE APPLIED PEDAGOGICAL METHODOLOGY

Every single student has different study technique but there is a method in case of technical basic subjects which can be recommended. According to our opinion it can be summarized in the following steps:

Comprehension of principal relations and methods (lectures) → Learning of notions, fundamental laws (short tests, measurements) → Comprehension of method of application of principles, methods (practice) → Learning of methods of application (computer aided method for give out and correction mechanics homework) → Practice of methods of application (collection of examples in program package [1,2], written test) → Comprehension and learning of the relations of the whole subject-matter of instruction (examination at the end of teaching process).

Of course these steps of the process of learning cannot be separated definitely but in any case determine the general direction.

#### 4. THE COMPUTER AIDED SYSTEM FOR GIVE OUT AND CORRECTION OF MECHANICS HOMEWORK

In this paper we deal with the computer aided method for give out and correction mechanics homework. Learning of methods of application in the full-time and distance education goes on solving homework.

The examples of homework follow the syllabus of lectures and practice and they rely on the factual material learnt here. The applied task types in the program package can be collected according to demand of user staff at the faculty. The homework develops the independent activity and the creative thinking moreover gives pleasure of creation in case of successful solution.

We compile the topics of homework so that they do contain the most important parts of the subject. The number of problems is about 4-6 per semester, namely, 2-3 weeks are available for working out of one task. In case of necessity the teachers of the department consult the students.

The most frequently used task types (various types of tasks are used in the different institutions of the higher education):

- Moment of spatial force system to certain points of space;
- Stress figures of straight and broken-line beams with mixed load;
- Planar lattice mesh structures;
- Stress figures of Gerber-beams;
- Computation of characteristics of combined cross sections;
- Dimensioning of bent beams;
- Stress calculation of rotating shafts for combined load;
- Statical undefined structures;
- Kinematical investigation of simple planar mechanisms.

In every single task type thirty-forty different structures are available moreover to every single structure has one thousand different mechanical loads and geometry. The program consists of two main parts such as teacher's and student's version. Students have the student's version of course. At the beginning of the semester, they can watch their own tasks by the aid of personal code. They can check their computational results by writing in it. If the results and partial results written in and calculated by computer are the same with the accuracy of 0.1% in the display you can read „ The result is correct” or else „ The result is faulty”. In this way students can check her/his results from the beginning to the end. Having the correct results, the homework can be put in as written technical document. By the aid of the teacher's version the teacher can check the personal home works easily and quickly [6].

#### 5. AN EXAMPLE

The load of the multi-span beam (can be seen in figure below) consists of the followings: concentrated forces and evenly-distributed load.

To be carried out:

- the values of moments at supporting points;
- the values of supporting forces;
- the maximum value of shear force;
- the maximum value of bending moment and its place measured from the origin of coordinates;

- the diagrams of the different kind of load;
- the sizes of the cross section of the beam;
- the factor of safety;
- displacement of the cross section at the appointed place.

After the giving the code and the correct result the „Help” of the program the diagrams of deformation functions of beam (displacement and rotation) appear on display, moreover the student can have the values of deformation anywhere along the beam. In this way the student can draw these diagrams to scale.

By the aid of his/her code the geometrical data of the beam and the values of the different kind of loads and the permissible normal stress will be seen on display. The code is a three-figure number given out students by the teacher.

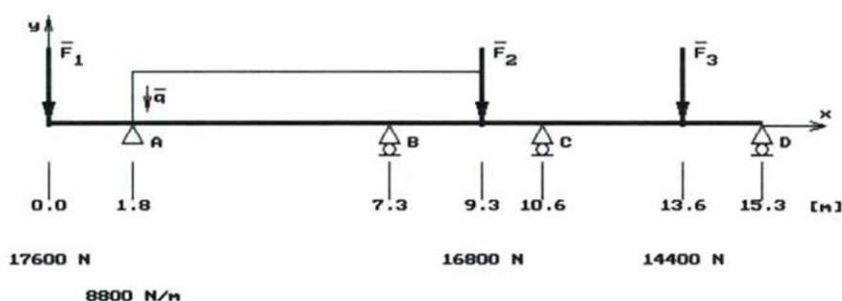


Figure 1. Geometrical model of the beam and its load

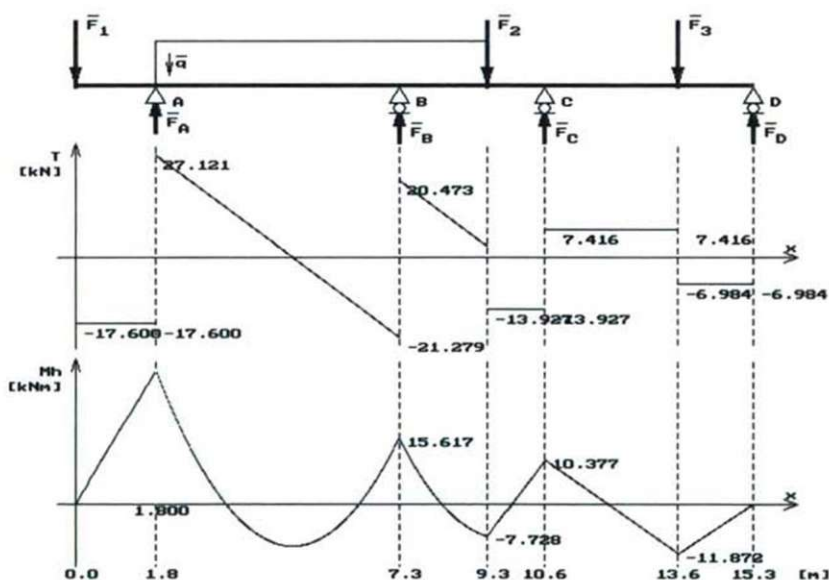


Figure 2. Stress figures of the beam

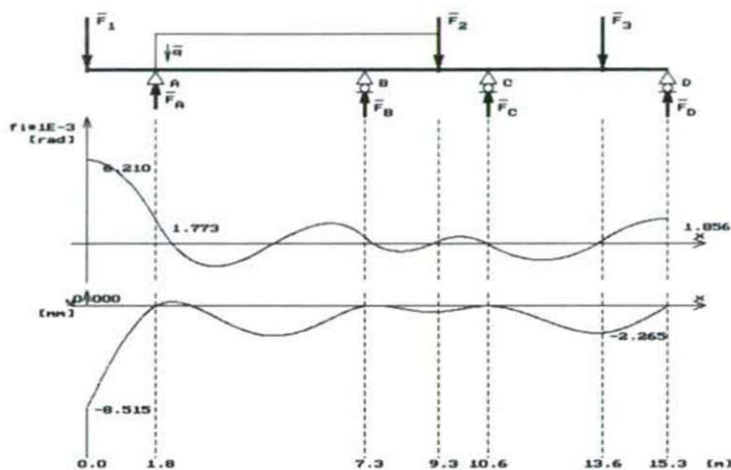


Figure 3. Deformation functions of the beam

## 6. EXPERIENCE OF THE APPLICATION OF THE SYSTEM

The system for give out and correction of mechanics homework was accepted by students with pleasure. According to opinion of students it is useful particularly because the results of calculations can be controlled. For this reason, they not only have a real sense of achievement but also they notice the mistakes so it helps to find easier the proper method.

This system is advantageous for teachers as well because the put in homework have no mistakes. By the aid of the detailed teacher's version, the homework can be checked easily. During the control the teachers have more time to check the logical construction of the solving and the exactitude of technical documentation.

This instrument is well defined part the educational process. It enables the greater freedom and independence for students because their activity is not fastened to time strictly and the „Help” of the program is anytime at their disposal. Simultaneously it has content compelling effect (only the proper solution can be accepted) for this reason it helps the better preparations to pass the exam.

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