THE USAGE OF COMPUTER GRAPHICS TEACHING THE SUBJECTS OF MECHANICS

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Abstract. Teaching mechanical subjects in Lithuanian University of Agriculture the faculty of engineering, computers are used both for graphic work and calculations. It is generally accepted that only a successive deepening of knowledge semester after semester ensures the mastering for a long time.

Key words: mechanical subject, computer graphics, machinery element

1. Computer graphics

Descriptive geometry is studied in the first semester of the first year when students get introduced with the principles of projection drawing. In the second semester learners master how to draw sections and cuts as well as get acquainted with drawing of machine elements, mechanic gears (transmitters), their kinematics schemes and assembling drawings. In addition, students are introduced with the software of computer graphics, work methodologies, the main principles of drawing and editing commands of AutoCAD program pack. While making a detail's drawing, students find out how to identify and change the qualities of drawn objects, use layers, create blocks, put measurements, and edit a text.

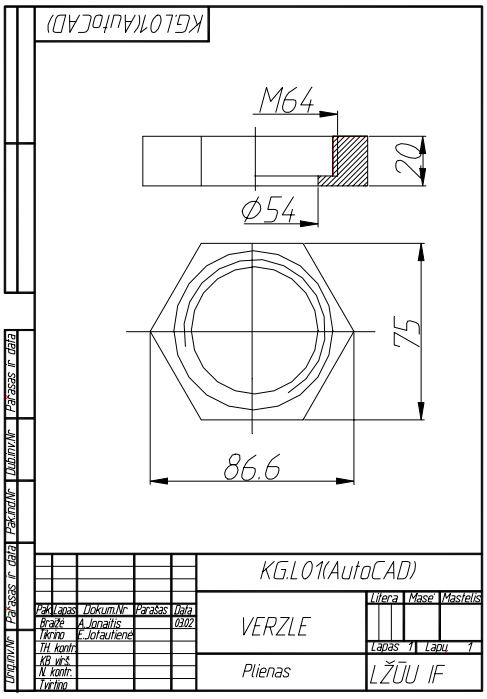

Fig. 1. A task example

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Moreover, making drafts of simple details (Fig. 1), general practical skills of applying a concrete graphic system are acquired.

2. Teaching of replacement and standardization

Studying replacement and standardization subject in the third semester, learners are taught to calculate and choose joints, deviations of surface forms and interstate as well as roughness. In a given assembling drawing they choose standard mechanical elements, their joints and prepare a draft of a detail. Later a student redraws the draft using a computer and applying AutoCAD software pack in a chosen subject of computer graphics. Figure 2 presents one of such drawings.

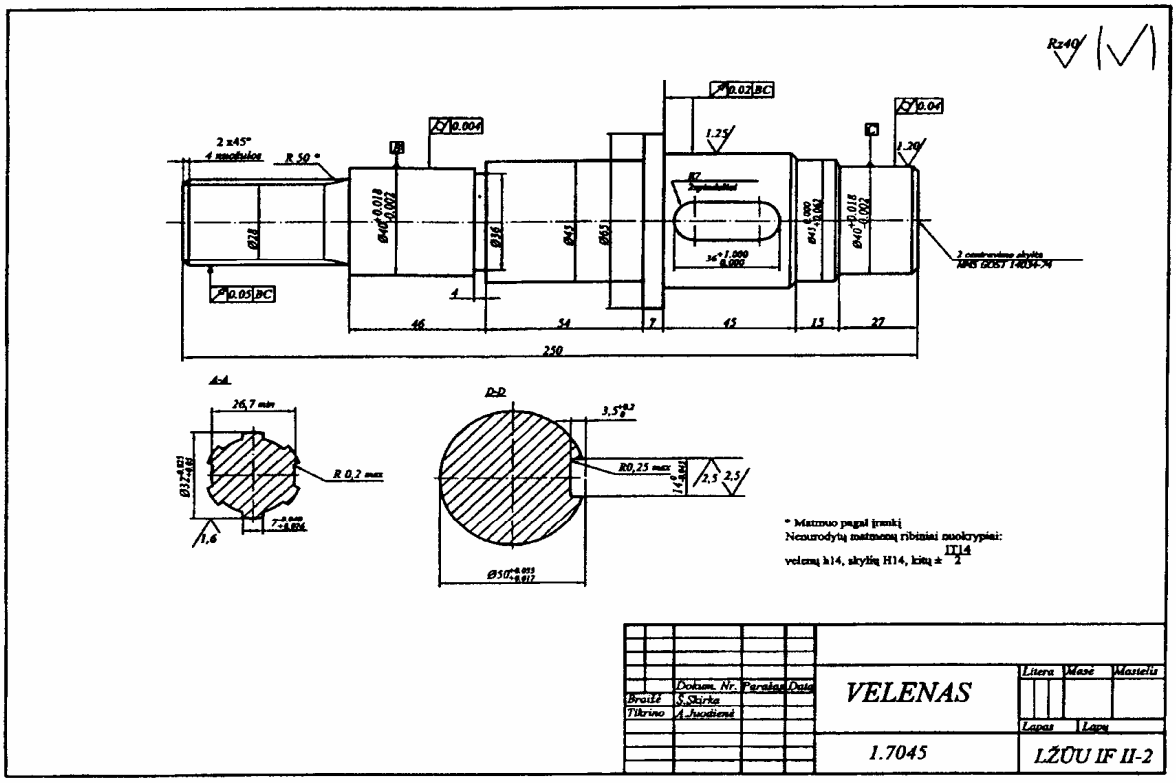

Fig. 2. A draft prepared by a student.

3. Course of machinery elements

Preparing a project course paper of machinery elements, it is besides the purpose to use continuous work programs. For a better acquisition of calculating algorithms, a student, applying general methods, rates one variant, while for other versions compute-aided methods are employed. Several variants are usually calculated. Training programs for calculating parameters of spur gears and bevel pinions, worm-gear parameters and measures of shafts as well as the selection of bearings are arranged. Preparing for calculations a special from with the most important primary data such as the number of transmissions, torques, the angular velocity of rotation, the resource of transmission, the material of a product and heat-treatment is filled in. Other parameters can be given as well. The program is designed to work using a dialogue regime. A student has an opportunity to change his decisions, adjust the obtained results of parameters with standard parameters as well as correct the course of further sums.

Two schemes of shaft algorithm calculation are presented (Figures 3 and 4). While projecting shafts, external loads, the places of gear detail erection and distances between bearings must be known in advance. On the basis of such data the scheme of shaft load is composed. In addition to this, operating moments and shaft diameters in characteristic cuts are

counted as well. Bending moments in vertical and horizontal planes, total bending and reciprocal moments and shaft diameters are calculated in characteristic cuts.

A possibility to rate the parameters of a shaft in the presence of various load combinations is provided during the course of the program. Changing the obliquity or the direction of rotation of a gearwheel, only the direction of active powers in mesh changes while their absolute value remains the same. Calculating the parameters of the shaft repeatedly only the significant numbers, determining the changes of load directions in comparison with the former, are installed.

Analyzing the results of the calculation, shaft bending and turning diagrams of the most unfavorable cases are drawn. Besides, chosen shaft diameters in different segments are combined with linear measurement line R_a40.

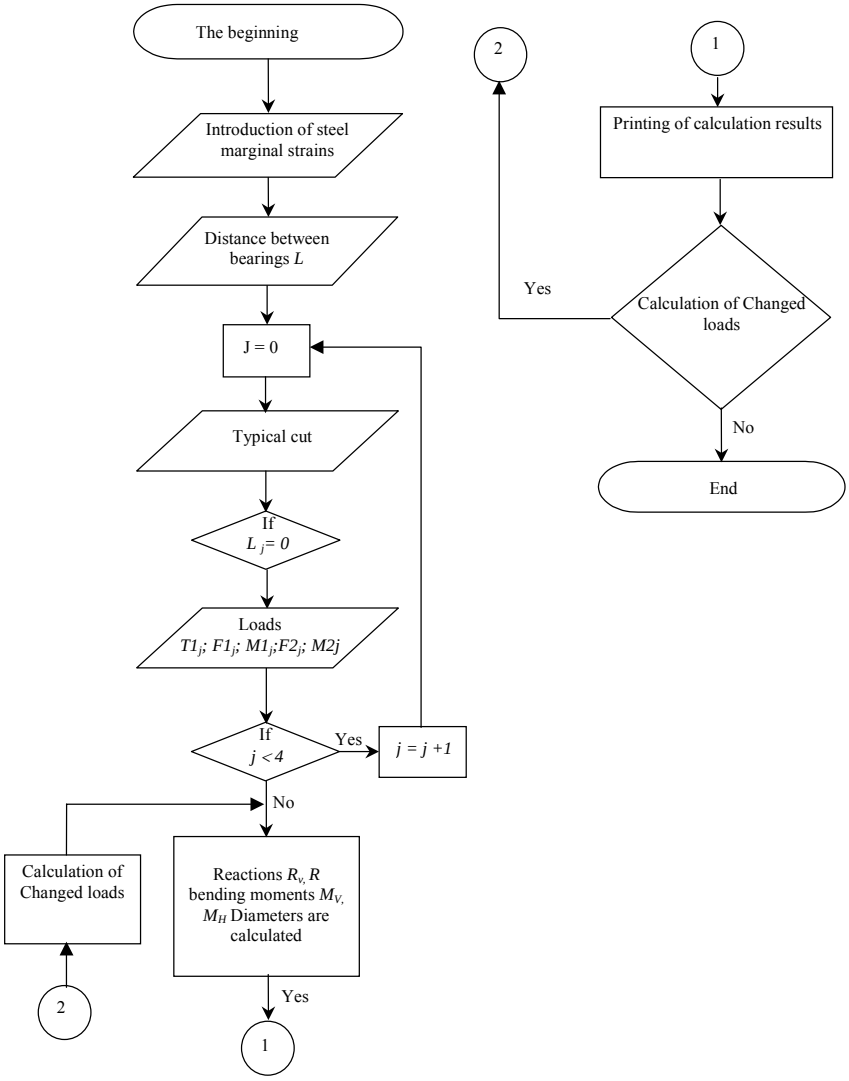

Fig. 3. The algorithm scheme of shaft bending and turning diagrams

Bearing in mind the structure, measures of the shaft, load character, and the value of powers and the duration of gear work, the fatigue of the shaft can be assessed (Fig. 4). It is advisable to count the fatigue of the shaft in cuts with the biggest load where strain concentration is possible. Therefore, the diameter of the shaft in a chosen cut together with the value of bending moments M_v, M_h, turning moment T and pivotal power are indicated. The subject of strain concentration in the analyzed cut is pointed when counting the fatigue of the shaft. When sev-

eral subjects of the strain concentration are operating, usually only one, with the biggest value of strain concentration coefficient, is shown.

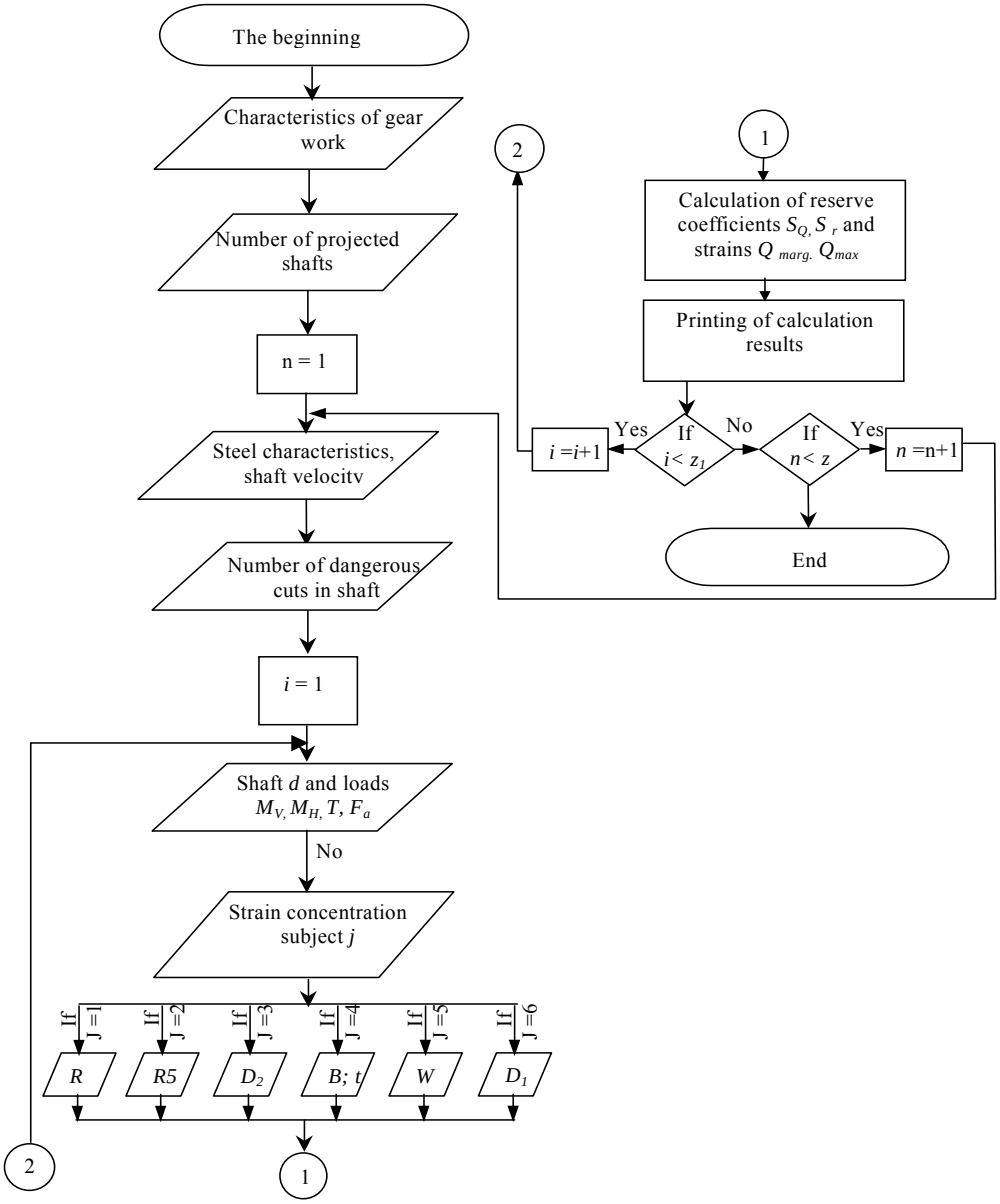

Fig. 4. The Scheme of shaft fatigue calculation

On the basis of a composed program the following calculations are done: the reserve coefficients of shaft strength K_q and K_r, total strength coefficient, maximum reciprocal and marginal strains that can be used to load the shaft during the course of momentary overloads. The possibility to assess strength reserve coefficients in different chosen cuts, providing additional information about the load of the shaft and strain concentration in the cuts is scheduled in the program. After the calculations of one shaft of a projected gear, the other is counted. The results are used for the calculations of gear element fits.

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