

## COMPUTER PROGRAM WHICH PROVIDES AUTOMATIC DETERMINATION OF SOME CHARACTERISTIC NECESSARY FOR CORRECT DIMENSIONING AND PRINTING OF THE TECHNICAL DRAWING FOR CONSTRUCTION

**Abstract:** *In the steps preceding the dimensioning and printing of a technical drawing for construction, a series of settings must be made which, if not done correctly, make that the printed drawing and the elements represented in that drawing not comply with the rules of the technical drawing for constructions and the representations made are not correctly understood. Bearing in mind these elements, the authors have developed an original computing program that works on the AutoCAD software interface, which helps users make the necessary settings so that the sheets will finally respect the technical drawing rules regarding the correct use of the print format, of choosing of the title block, of the scale of representation, and the optimal view of delimiters and quota values.*

**Key words:** *technical drawing, layouts, scales, format, dimensioning, CAD*

### 1. INTRODUCTION

From the experience gained, the authors know that the steps that put students, but also users with little experience in using AutoCAD, in the stages of dimensioning and formatting some representations, are related to:

- choosing the dimensions of printing layout of the sheets;
- setting the units of measure in which they are displayed the dimensions on printed sheet:
  - o meter;
  - o centimeter;
  - o millimeter.
- setting values for some dimension variable [2]:
  - o *length* (length of the extension line);
  - o *extend beyond dim lines* and *offset from origin* (settings for establishment of the start and ending points of the extension lines);
  - o *arrow size* (the delimiters' size of the dimension lines);
  - o *text height* (the size of the dimension text);
  - o *offset from dim line* (the distance from the dimension text to the dimension line);
  - o *precision* (the unit format and his precision);
  - o *scale factor* (the scale factor for the dimension text).

It is known the fact that according to the type of the representations:

- In the civil engineering drawings, the dimensions are displayed in meters, centimeters or millimeters;
- Drawings are made on various scales at values 2, 5 or 10:
  - o 1:1;
  - o 1:2;
  - o 1:5;
  - o 1:10;
  - o 1:20;
  - o 1:50;
  - o 1:100, etc.

- for printing the drawing can be used any drawing format (A<sub>4</sub>, A<sub>3</sub>, A<sub>2</sub>, A<sub>1</sub>, A<sub>0</sub>) [1], [3].

Taking into account the fact that for getting the optimal version of the drawing there are many variables that influence each other, the authors have designed a computer program which according to a series of elements specified by the user:

- sets the dimensioning variables;
- represents the title block and the format of the drawing to the scale chosen by the user and to the measure unit desired by him.

### 2. MATERIAL AND METHOD

At the start, the authors focused on the units of measure analysis, used by the students for draw of the current level plane of a residential building.

It can be seen that if it is recommended that the centimeter (1 cm) to be the measure unit for draw the drawing, the students arbitrarily establish different units of measure, thus:

- one meter (1 m);
- one decimeter (1 dm);
- one centimeter (1 cm);
- one millimeter (1 mm).

This is disadvantageous because according to the used measure unit for draw the drawing must be done the other settings for:

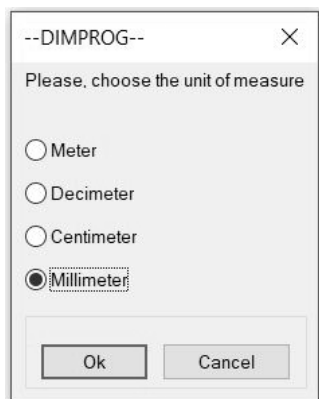
- the dimensioning variables;
- the drawing format dimensions;
- the title block dimensions.

Thus, if one user chose the meter (1 m) as measure unit for draw the drawing and another user chose the centimeter (1 cm), the values of the dimensioning variables, of the title block dimensions and drawing format dimensions differs from one user to another because these chose different units of measure for making the drawings.

## Computer Program Which Provides Automatic Determination of Some Characteristic Necessary for Correct Dimensioning and Printing of the Technical Drawing for Construction

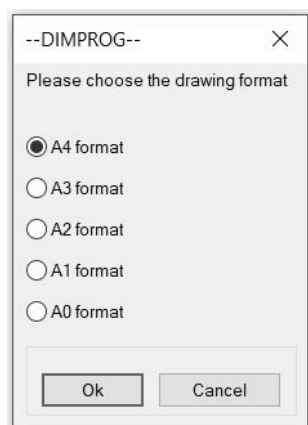
For run the computer program made by the authors, in the command line his name *DIMPROG* must be typed and after that the *ENTER* key must be pressed.

Further the computer program asks the user to specify the unit of measure choose for drawing the drawing (meter, decimeter, centimeter or millimeter) (Figure 1).



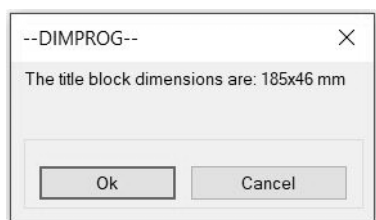
**Fig. 1** Choosing the units of measure

After the desired unit of measure was choose, the computer program displays the dialog box shown in figure 2 in which the user sets the drawing format. It can be noticed that in this example the A4 format was choose.



**Fig. 2** Selecting the drawing format

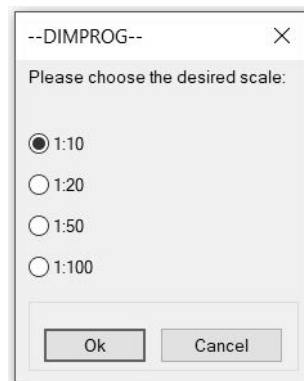
By pressing the OK button, the computer program runs further and displays the dialog box shown in figure 3. Here are displayed the title block dimensions in the units of measure previous adopted (figure 1).



**Fig. 3** The computer program displays the title block dimensions

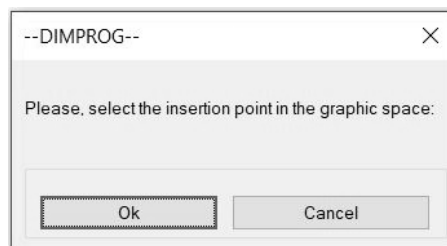
Pressing the *OK* button from the dialog box shown in fig.3 the computer program displays another dialog box

shown in fig.4. Now the user has to choose the representation scale. It can be seen from this figure that the selected scale is 1:10, between the common scales displayed by the computer program.



**Fig. 4** The computer program displays the common scales

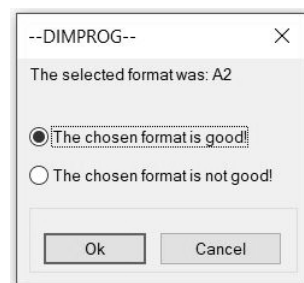
Next the computer program requests the user to specify an insertion point (*Please select the insertion point in the graphic space*). This point is necessary for the insertion of the drawing format and for the title block (Figure 5).



**Fig. 5** The computer program asks to be specified the insertion point for the drawing format and for the title block

Once this point has been specified, the computer program displays the drawing space bordered by the outline of the monitor, the entire drawing format and the title block, at the scale previously selected by the user.

In the next dialog box (figure 6) the computer program requires the user to specify whether previously selected drawing format is good.



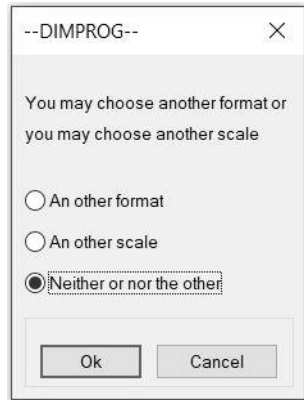
**Fig. 6** The computer program requires the user to specify whether the selected format is good.

If the first option is selected, the computer program sets and then displays the values of the dimension

variables taking to account the unit of measure adopted by the user in the first stage.

Instead, if the second option is selected, the computer program displays the dialog box shown in figure 7 and the user is able to:

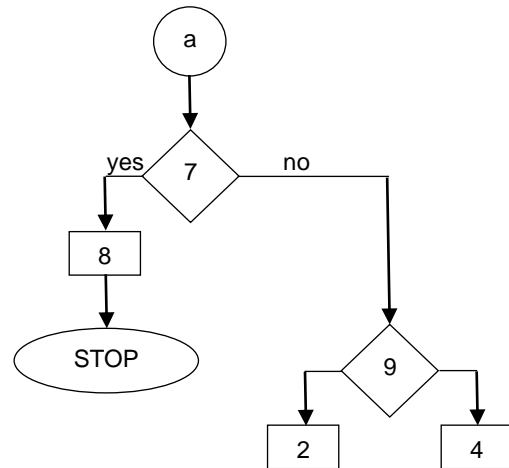
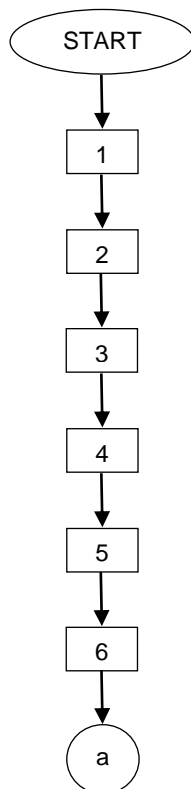
- select another drawing format;
- select another scale;
- not to make any changes.



**Fig. 7** The computer program allows the user to change the drawing format, the representation scale or to go further.

If the drawing format change option is selected, the computer program resumes from the dialog box shown in figure 2. But, if the user selects the option which refers to the changing of the value of the representation scale, the computer program reopens the dialog box shown in figure 4.

The logical schema of the computer program called *DIMPROG* is shown in figure 8.



**Fig. 8** The logical schema of the computer program *DIMPROG* (continuation)

The dialog boxes 1 to 8 are identified with the following steps of the computer program:

- 1 – the user specifies unit of measure;
- 2 – the user specifies the drawing format;
- 3 – the user specifies the title block dimensions in the choose unit of measure selected in the first step;
- 4 – the user selects the desired representation scale;
- 5 – the user specifies an insertion point for the title block and for the drawing format;
- 6 – the computer program represents the drawing format and the title block in the units specified by the user;
- 7 – the computer program requests the user to say if the drawing format and the title block are correct;
- 8 – the computer program sets and displays the values of the dimensioning variables;
- 9 – the user has the possibility to change the drawing format and the representation scale.

### 3. RESULTS AND DISCUSSIONS

To verify the utility of the *DIMPROG* computer program, it was tested in a classroom of 30 students. Students were invited to bring each one two dwg files containing a civil engineering drawing without telling them what type of representation they should contain, what representation scale should have, and what unit of measure either used.

Prior to the start of the test, it was noted that from those 60 drawing:

- 27 contained ground floor plans or current floor of certain buildings;
- 6 contained facades of certain buildings;
- 1 contained roof covering plan of a roof;
- 2 contained structural roof plans of certain buildings;
- 2 contained transverse sections of buildings;
- 11 contained details of metal structures;
- 3 contained foundation plans;
- 2 contained formwork plans for reinforcing reinforced concrete plates;

**Fig. 8** The logical schema of the computer program *DIMPROG*

- 4 contained formwork plans for reinforcing certain reinforced concrete beams;
- 2 contained formwork plans for reinforcing certain reinforced concrete columns.

It has also been observed that:

- in the case of ground floor plans or current floor, facades, transverse sections, roof covering plans or structural roofs, as measure unit was adopted, depending on the user, the meter, decimeter, centimeter or millimeter;
- all the details of metal structures were made in millimeters;
- for the foundation plans also was adopted, depending on the user, the meter, decimeter, centimeter or millimeter;
- for the drawings which contained elements from reinforced concrete was choose as unit of measure the centimeter or millimeter.

Prior to the start of the test, the aim and how to use the computer program was briefly explained to the students.

During the test, 7 students (23.33%) have needed guidance on cases where the chosen drawing format or scale did not allow optimal framing and visualization of existing graphical representations.

At the end of the test:

- 23 students (76,67%) have correctly choose the drawing format and the representation scale without any guidance and specified the fact that the computer program is very useful;
- 7 students (23,33%) have correctly choose the representation scale but the adopted drawing format and the title block for one or both graphical representations were bigger or smaller than optimal, in which case they received guidance;
- from those 23 students that have correctly choose the drawing format and the representation scale, 6 (26,09%) they wanted to know if:
  - two or more representation scale can be set on the same drawing format;
  - multiple dimension styles can be automatically set in which some variables have same values and other have different values with the aim:
    - dimensioning of the representations on the same drawing to different representation scales;
    - the use of several types of delimiters for the dimension lines in the case of little distances or for leaders;
    - the use multiple heights for the dimension text;
    - the use many more precision modes to displaying the quotes;
    - the use of multiple scaling factors for the values of the quotes.

Analyzing the requirements listed by the students, the authors stated that the way in that the computer program was designed does not allow at this time to perform any of the elements specified by them, the only possibility being the subsequent creation of styles by the users, starting from the one created by the program.

#### 4. CONCLUSION

The *DIMPROG* computer program allows, in accordance with a set of variables adopted by the user, to determine the drawing format, the title block and of some values for some dimensioning variables which allow the correct dimensioning of graphical representations from the civil engineering field.

The computer program was built to run under the AutoCAD graphical interface. It may be used by anyone that does not have enough knowledge to achieve the required settings which permit that the drawings or the printed sheets to respect the technical drawing's rules regarding to the adopting the optimum drawing format, choose the representation scale for the represented elements and the values of the dimensioning variables.

To verify the utility of the program, it was tested on a group of 30 students where a large proportion (76.67%) considered the program useful.

At this point the program does not have the possibility of adopting two or more representation scales on the same format, nor to the automatic creation of two or more dimensioning styles, which was requested by 6 students (26.09%), elements to be studied and implemented in the next version of the program.

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#### Authors:

**Sen. Lect. Eng., Ph.D Andrei SLONOVSKI**, "Gheorghe Asachi" Technical University of Iasi, Faculty of Civil Engineering and Building Services, Department of Engineering Graphics, Email: andreislonovski@yahoo.com

**Assoc. Prof. Eng., Ph.D. Liviu PRUNA**, Director of Department, Technical University of Iasi, Faculty of Civil Engineering and Building Services, Department of Engineering Graphics, Email: liviu.pruna@tuiasi.ro, lpruna2004@yahoo.com