Determination of Some Dimensioning Characteristics in the Computer Assisted Drawings Case in the Civil Engineering

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Abstract: Starting from the fact that the laying operation of the values of the dimensioning variables in AutoCAD is very laborious, she claiming, among others, and a practice rich experience, the authors present a study on the identification of the key dimensioning variables and suggest methods to determining the values for some of these variables.
Keywords: AutoCAD, technical drawing, civil engineering drawing.

1. INTRODUCTION

At a first analysis, dimensioning a civil engineering drawing seems to be not a big deal, but the multitude of situations that arise in day-to-day, requires to the engineer a thorough theoretical knowledge of the rules of dimensioning for technical civil engineering drawing.

In the same time he must mastering the AutoCAD program to achieve, depending on the drawing type, the unit measure used for realizing the drawing, the chosen layout and the representation scale, the changing the values of some dimension variables.

2. FEATURES ANALYSED AND PROPOSED SOLUTIONS

In general, the accomplishment of a construction supposed, among other, the existence of some drawings that may be grouped in four categories, as follows (Fig. 1):
- architectural plans (development site plans, general site plans, plans, sections and facade);
- plans regarding the site organization;
- structural plans (structural plans for wood, metal, reinforced concrete, precast reinforced concrete and so on);
- equipment plans (gas installations, electrical installation, sanitary installation).

Depending on the type and surface representation (general and property layout plans, general construction drawing, structural plans for wood, concrete, reinforced concrete, metal and so on) unit or units of measure used for achieving the drawings, the standardised formats, the usual used representation scales, is determined the print format, the used scale or scales representation and, finally, the height of the dimension text and the size of the delimiters of the dimension lines, Fig. 2.
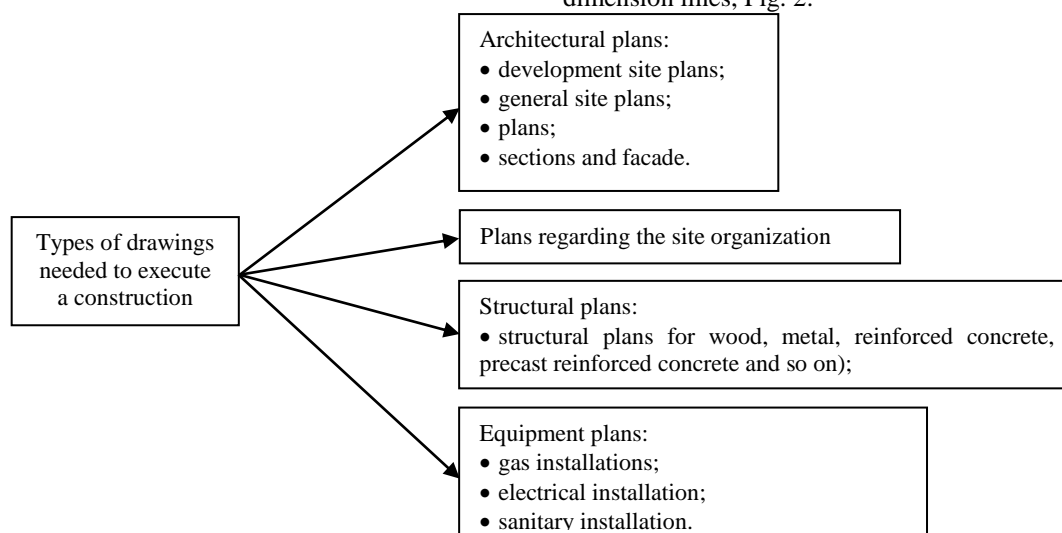

Fig. 1 Types of drawings needed to execute a construction

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The type of drawing (general and property layout plans, general construction drawings, structural plans for wood, concrete, reinforced concrete, metal and so on)

Unit or units used for the drawing representation (millimetre - mm, centimetre - cm meter - m)

Standardised layouts (normal drawing sheet – the series ISO - A, Special elongate drawing sheet)

The usual scales of representation (1:1, 1:2, 1:5, 1:10, etc.)

It makes the following

The format of the drawing printing

Scale or scales of representation

The height of the dimension text

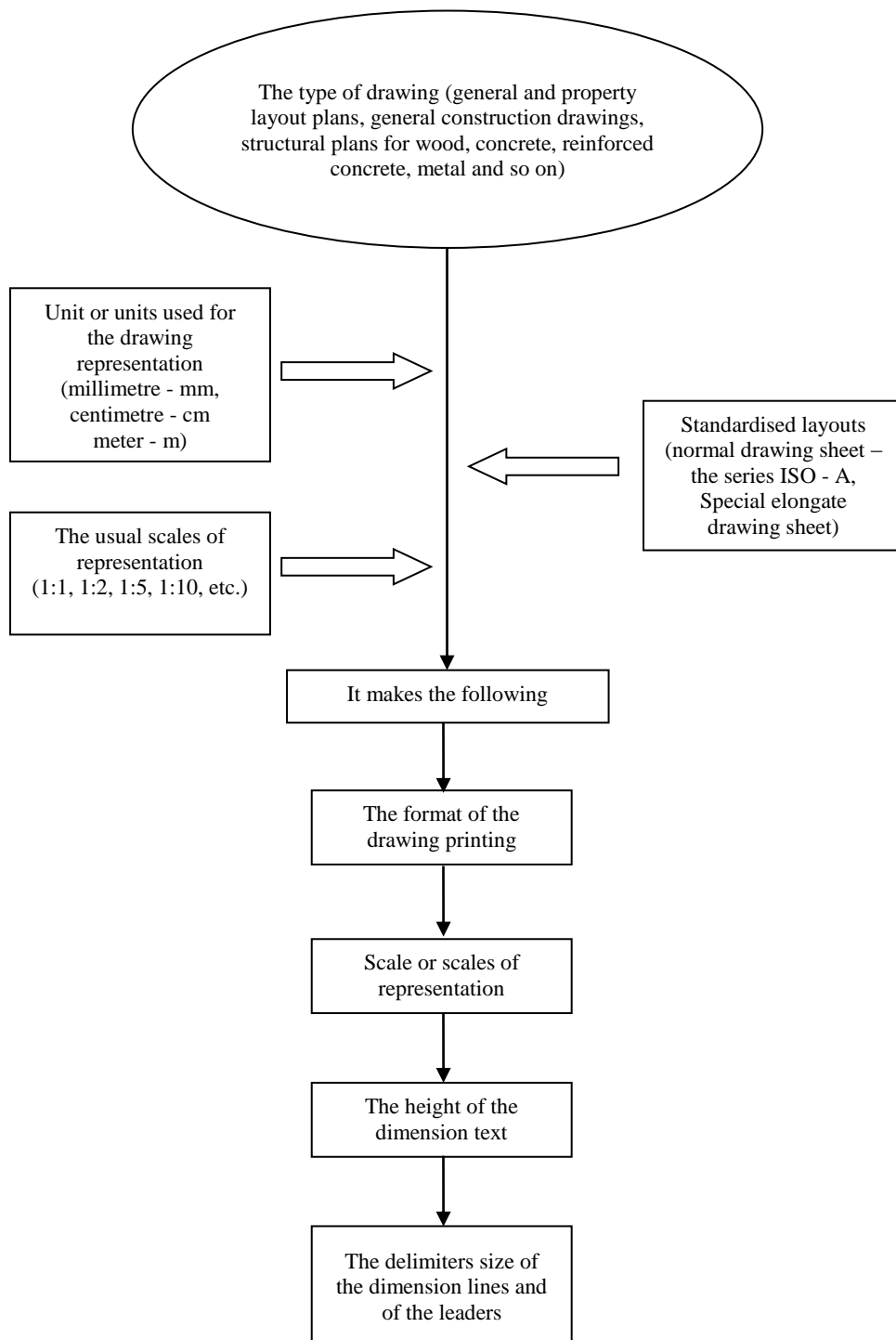The delimiters size of the dimension lines and of the leaders

Fig. 2 The steps that must follow for determining
the height of the dimension text and for the delimiters size of the
dimension lines and of the leaders

The correct setting of the units of measure used for achieving and printing the drawing it is very important whereas, according to it, are set the dimensions of printing layout of the drawing, the height of the dimensioning text and the size of the delimiters of the dimension lines. The importance lies in the recommendation that in any graphic representation to be used measurement units specified in the rules governing the technical drawing.

In practice with students, the authors noted the difficulty that they meet her when is necessary that after completion of the graphical representation, to determine a print format for drawing and the scale or scales of representation to be used. It was also observed that the degree of difficulty increases with the use of multiple units of measure for plotting drawings.

Given the above, the authors proposed, regardless of the unit of measure used for plotting (millimetre, centimetre, meter), a variant of work that determines the format and the scale representation, method that has proven very useful.

Working version proposed by the authors is structured in three tables, each table being allocated one unit (Fig. 3, Fig. 4 and Fig. 5).

To properly use these tables is recommended that the unit of measure, used to achieve the design, to be identical to the unit specified at the beginning of each table.

For a representation scale and a format chosen, the table specifies the sizes that must have the format of the drawing printing.

Using the tables shown in Figures 6, 7 and 8 students determine, for the size and scale of representation that was adopted in the previous step, the size of the title block.

UNIT OF MEASURE ADOPTED - millimetre (MM)															
SCALE REPRESENTATION															
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
THE DIMENSION OF THE LISTING LAYOUT OF THE DRAWING															
A4	210	297	420	594	1050	1485	2100	2970	4200	5940	10500	14850	21000	29700	42000	59400
A3	420	297	840	594	2100	1485	4200	2970	8400	5940	21000	14850	42000	29700	84000	59400
A2	594	420	1188	840	2970	2100	5940	4200	11880	8400	29700	21000	59400	42000	118800	84000
A1	841	594	1682	1188	4205	2970	8410	5940	16820	11880	42050	29700	84100	59400	168200	118800
A0	1189	841	2378	1682	5945	4205	11890	8410	23780	16820	59450	42050	118900	84100	237800	168200

Fig. 3 The dimension of the listing layout. The values refers to the layouts and scale shown
(calculated for millimetres (MM) - unit of measure that was adopted)

UNIT OF MEASURE ADOPTED - centimetre (CM)															
SCALE REPRESENTATION															
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
THE DIMENSION OF THE LISTING LAYOUT OF THE DRAWING															
A4	21	29,7	42	59,4	105	148,5	210	297	420	594	1050	1485	2100	2970	4200	5940
A3	42	29,7	84	59,4	210	148,5	420	297	840	594	2100	1485	4200	2970	8400	5940
A2	59,4	42	118,8	84	297	210	594	420	1188	840	2970	2100	5940	4200	11880	8400
A1	84,1	59,4	168,2	118,8	420,5	297	841	594	1682	1188	4205	2970	8410	5940	16820	11880
A0	118,9	84,1	237,8	168,2	594,5	420,5	1189	841	2378	1682	5945	4205	11890	8410	23780	16820

Fig. 4 The dimension of the listing layout. The values refers to the layouts and scale shown
(calculated for centimetres (CM) - unit of measure that was adopted)

UNIT OF MEASURE ADOPTED - meter (M)															
SCALE REPRESENTATION															
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
THE DIMENSION OF THE LISTING LAYOUT OF THE DRAWING															
A4	0,21	0,297	0,42	0,594	1,05	1,485	2,1	2,97	4,2	5,94	10,5	14,85	21	29,7	42	59,4
A3	0,42	0,297	0,84	0,594	2,1	1,485	4,2	2,97	8,4	5,94	21	14,85	42	29,7	84	59,4
A2	0,594	0,42	1,188	0,84	2,97	2,1	5,94	4,2	11,88	8,4	29,7	21	59,4	42	118,8	84
A1	0,841	0,594	1,682	1,188	4,205	2,97	8,41	5,94	16,82	11,88	42,05	29,7	84,1	59,4	168,2	118,8
A0	1,189	0,841	2,378	1,682	5,945	4,205	11,89	8,41	23,78	16,82	59,45	42,05	118,9	84,1	237,8	168,2

Fig. 5 The dimension of the listing layout. The values refers to the layouts and scale shown
(calculated for meters (M) - unit of measure that was adopted)

UNIT OF MEASURE ADOPTED - millimetre (MM)															
SCALE REPRESENTATION															
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
THE TITLE BLOCK DIMENSIONS															
A4	185	50	370	100	925	250	1850	500	3700	1000	9250	2500	18500	5000	37000	10000
A3	185	50	370	100	925	250	1850	500	3700	1000	9250	2500	18500	5000	37000	10000
A2	185	50	370	100	925	250	1850	500	3700	1000	9250	2500	18500	5000	37000	10000
A1	185	50	370	100	925	250	1850	500	3700	1000	9250	2500	18500	5000	37000	10000
A0	185	50	370	100	925	250	1850	500	3700	1000	9250	2500	18500	5000	37000	10000

Fig. 6 Table that specifies the title block dimensions for the layout and scale that are shown
(calculated for millimetres (MM) – unit of measure adopted)

	UNIT OF MEASURE ADOPTED - centimetre (CM)														
	SCALE REPRESENTATION														
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
	THE TITLE BLOCK DIMENSIONS														
A4	18,5	5	37	10	92,5	25	185	50	370	100	925	250	1850	500	3700	1000
A3	18,5	5	37	10	92,5	25	185	50	370	100	925	250	1850	500	3700	1000
A2	18,5	5	37	10	92,5	25	185	50	370	100	925	250	1850	500	3700	1000
A1	18,5	5	37	10	92,5	25	185	50	370	100	925	250	1850	500	3700	1000
A0	18,5	5	37	10	92,5	25	185	50	370	100	925	250	1850	500	3700	1000

Fig. 7 Table that specifies the title block dimensions for the layout and scale that are shown
(calculated for centimetres (CM) – unit of measure adopted)

	UNIT OF MEASURE ADOPTED - meter (M)														
	SCALE REPRESENTATION														
Layout	1/1		1/2		1/5		1/10		1/20		1/50		1/100		1/200	
	THE TITLE BLOCK DIMENSIONS														
A4	0,185	0,05	0,37	0,1	0,925	0,25	1,85	0,5	3,7	1	9,25	2,5	18,5	5	37	10
A3	0,185	0,05	0,37	0,1	0,925	0,25	1,85	0,5	3,7	1	9,25	2,5	18,5	5	37	10
A2	0,185	0,05	0,37	0,1	0,925	0,25	1,85	0,5	3,7	1	9,25	2,5	18,5	5	37	10
A1	0,185	0,05	0,37	0,1	0,925	0,25	1,85	0,5	3,7	1	9,25	2,5	18,5	5	37	10
A0	0,185	0,05	0,37	0,1	0,925	0,25	1,85	0,5	3,7	1	9,25	2,5	18,5	5	37	10

Fig. 8 Table that specifies the title block dimensions for the layout and scale that are shown
(calculated for meters (M) – unit of measure adopted)

As required, the tables shown in Figure 3 ... 8 can be adapted to any size and scale of representation.

With the layout and title block sizes, specified in the tables, the user goes in AutoCAD and represents the two elements. In case that the layout contains optimal representation means that the size and scale of representation have been correctly chosen. Otherwise it must go back in the table to choose another layout and / or another scale of representation.

The next stage is to establish the height of the dimension text, size and shape of the delimiters of the dimension line and of the leaders. And this step is particularly important because:

- if the height of the dimension text and size of the delimiters is too small (Fig. 9) cannot "read" the dimension or the portion that is accurately determined by the dimension;

- if the height of the dimension text is too big (Fig. 10), the representation is disproportionate and there are situations where a number of dimensions cannot be positioned or in that they overlap;
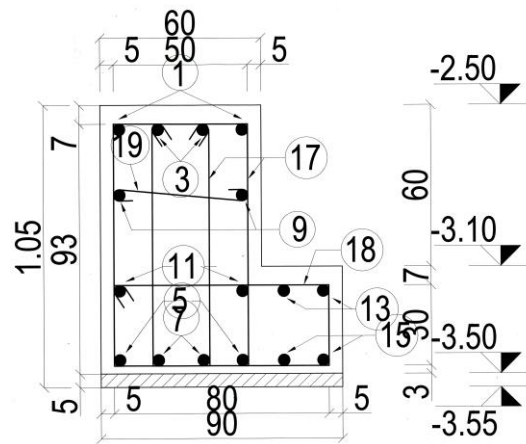

Fig. 10 The height of the dimension text is too large and the graphical representation is disproportionate

- if the height of the dimension line delimiters is too big (Fig. 11), also the graphic representation is disproportionate;
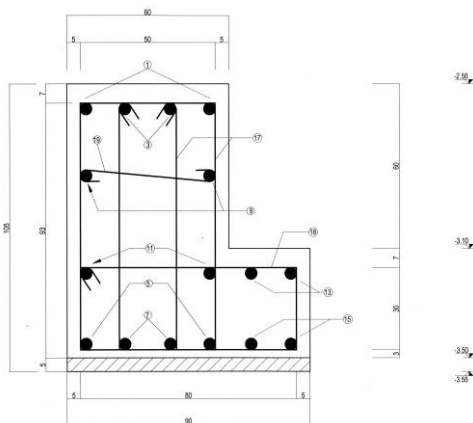

Fig. 9 The height of the dimension text and the delimiters size of the dimension lines and of the leaders is too low
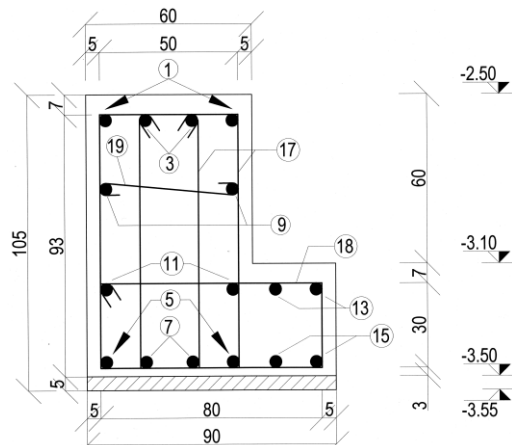

Fig. 11 The delimiters size of the dimension line and of leaders is too high and the graphical representation is disproportionate

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- if the shape of the dimension line delimiters is chosen randomly (Fig. 12), may appear many situations in which are not respected the technical drawing rules referring how to use of the dimension line delimiters, thus:

✓ the use of dimension line delimiters in shape of point to the dimension lines;
✓ the use of dimension line delimiters in shape of architectural tick inclined to 45 degrees;
✓ the use of dimension line delimiters in shape of arrow that ends on a surface;
✓ the use of dimension line delimiters in shape of point that ends on a contour line.
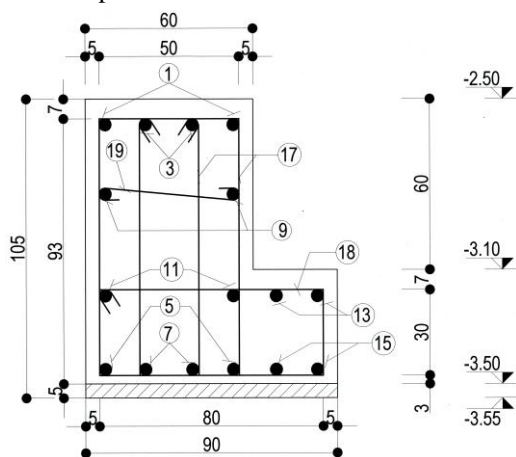

Fig. 12 The shape of the delimiters is chosen randomly

In Fig. 13 can be seen the correctly and clearly the way of dimensioning of the detail represented in Fig. 9.
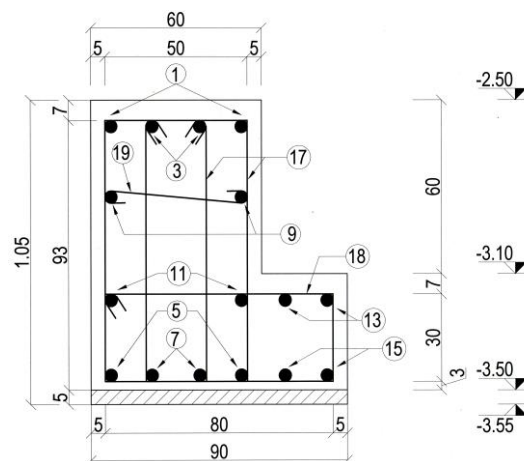

Fig. 13 The height of the dimension text, the delimiters size and shape of the dimension line are properly made and proportioned indicated

And this step was accomplished by the help of three tables (Fig. 14, Fig. 15, Fig. 16, Fig. 17, Fig. 18 and Fig. 19), one table for each unit, millimetre, centimetre, and meter.

Depending on the layout and scale of representation adopted in one of the previous tables is determined the height dimension text and the dimension line delimiters size and leaders, values that go into specific dialog boxes of the AutoCAD computer program.

The height of the dimension text was chosen so that the text fits best in title block boxes: *Project leader, Projected* and *Drawn*.

Also, these tables can be adapted, as needed, for any type of layout and representation scale.

UNIT OF MEASURE ADOPTED - millimetre (MM)							
SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
THE DELIMITERS SIZE OF THE DIMENSION LINES AND OF THE LEADERS							
A4	3	6	15	30	60	150	300	600
A3	3	6	15	30	60	150	300	600
A2	3	6	15	30	60	150	300	600
A1	3	6	15	30	60	150	300	600
A0	3	6	15	30	60	150	300	600

Fig. 14 Table that specifies the size of the delimiters of the dimension lines and of the leaders relative with the layout and scales adopted
(Calculated for millimetres (MM) – unit of measure adopted)

UNIT OF MEASURE ADOPTED - centimetre (CM)							
SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
THE DELIMITERS SIZE OF THE DIMENSION LINES AND OF THE LEADERS							
A4	0.3	0.6	1.5	3	6	15	30	60
A3	0.3	0.6	1.5	3	6	15	30	60
A2	0.3	0.6	1.5	3	6	15	30	60
A1	0.3	0.6	1.5	3	6	15	30	60
A0	0.3	0.6	1.5	3	6	15	30	60

Fig. 15 Table that specifies the size of the delimiters of the dimension lines and of the leaders relative with the layout and scales adopted
(Calculated for centimetres (CM) – unit of measure adopted)

UNIT OF MEASURE ADOPTED - meter (M)								
	SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
	THE DELIMITERS SIZE OF THE DIMENSION LINES AND OF THE LEADERS							
A4	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A3	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A2	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A1	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A0	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6

Fig. 16 Table that specifies the size of the delimiters of the dimension lines and of the leaders
relative with the layout and scales adopted
(Calculated for meters (M) – unit of measure adopted)

UNIT OF MEASURE ADOPTED - millimetre (MM)								
	SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
	HEIGHT TEXT FOR DIMENSIONS							
A4	3	6	15	30	60	150	300	600
A3	3	6	15	30	60	150	300	600
A2	3	6	15	30	60	150	300	600
A1	3	6	15	30	60	150	300	600
A0	3	6	15	30	60	150	300	600

Fig. 17 Table that specifies the height text for dimensions relative with the layout and scales adopted
(Calculated for millimetres (MM) – unit of measure adopted)

UNIT OF MEASURE ADOPTED - centimetre (CM)								
	SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
	HEIGHT TEXT FOR DIMENSIONS							
A4	0.3	0.6	1.5	3	6	15	30	60
A3	0.3	0.6	1.5	3	6	15	30	60
A2	0.3	0.6	1.5	3	6	15	30	60
A1	0.3	0.6	1.5	3	6	15	30	60
A0	0.3	0.6	1.5	3	6	15	30	60

Fig. 18 Table that specifies the height text for dimensions relative with the layout and scales adopted
(Calculated for centimetres (CM) – unit of measure adopted)

UNIT OF MEASURE ADOPTED - meter (M)								
	SCALE REPRESENTATION							
Layout	1/1	1/2	1/5	1/10	1/20	1/50	1/100	1/200
	HEIGHT TEXT FOR DIMENSIONS							
A4	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A3	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A2	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A1	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6
A0	0.003	0.006	0.015	0.03	0.06	0.15	0.3	0.6

Fig. 19 Table that specifies the height text for dimensions relative with the layout and scales adopted
(Calculated for meters (M) – unit of measure adopted)

3. CONCLUSION

When it comes to using AutoCAD software in civil engineering, knowledge and the efficient use of settings on the dimensioning activity of technical drawings becomes crucial. Ignoring or superficial treatment of this problem may cause display errors such as, display an incorrect value for dimension, the mismatch between the height of the dimension text and the delimiters size of the dimension lines with the representing scale of the drawing. Knowledge the size of the printing layout, the unit used for achieving the drawing and the scale of representation, has a specially importance because, without it, cannot be properly determined height dimension text and the delimiters size of the dimension lines and of the leaders.

The authors propose a method with a low degree of difficulty that allows, to the students, setting correct values of the variables mentioned above.

The method proved very effective and, at the same time, it was found that it favours the understanding of the logical sequence of phases that are taking place before the dimensioning operation.

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