

## TEACHING METHODOLOGY OF THE MACHINE PARTS - REPRESENTATION AND DIMENSIONING OF FLANGES

**Abstract:** This paper presents a teaching activity on the topic - Representation and dimensioning of flanges and is addressed to the teachers who teach technical drawing in technical university education, but also to the students.

The paper represents an aid both to the professor in achieving the learning objectives, but also for the students who need to understand easily the information and knowledge required by other fields.

**Key words:** flange, technical drawing, teaching, objectives, dialog boxes, AutoLISP routine.

### 1. INTRODUCTION

The learning process represents the object of pedagogical research and includes a set of actions such as: design, in which modalities for assessment and educational activities are envisioned, the actual achievement, in which the teaching project is put into practice and performance assessment for the overall training and educational activity.

Thus, the teaching designing can be defined as a step for anticipating how the educational activities will be conducted in a certain period of time.

Designing a teaching activity implies: the establishment of the objectives; the identification of resources; the establishment of teaching strategies; the building of the assessment tools [5].

### 2. THE REPRESENTATION AND DIMENSIONING OF FLANGES

The drawing of a flange is done usually by using two projections: a projection indicating the form and number of the fixing holes and another projection to indicate the thickness of the flange and how they link to the body of the part concerned; the second projection is usually a longitudinal section. There are cases in which the representation of the flange can be done in a single projection, using some conventional representations that simplify the drawing of the flange.

The flanges are objects that ensure the connection between two pieces, usually performed by connecting studs or bolts. Thus, the flanges are equipped with holes for bolts, which are considered functional elements of the flanges. The representation and dimensioning of flanges should define all holes, both in terms of size (diameter, length) and of their position.

An AutoLISP routine that works as a macro command in AutoCAD can be designed for drawing and dimensioning of various types of flanges. The macro is referred to as "FLANGES" and its creation is justified in the case of repeated drawings of flange type parts with different sizes and shapes [1].

A cylindrical flange is represented on the drawing in two projections, in one projection or simplified. If the cylindrical flange has holes disposed at  $45^{\circ}$  relative to the sectioning plane, a folding of the holes in the sectioning

plane, represented in section with thin dash dot line will be made [2].

The other types of flanges, including square, triangular, oval, rectangular are similarly represented in two projections [2].

The characteristic elements of a flange which must be represented in detail are: geometric shape (outside diameter, the edge of the square, etc.), position and number of fastening holes, thickness and diameter of the central hole. At the most types of flanges, fastening hole centers will be placed symmetrically on a circle centered at the geometric center of the flange. The flanges that have geometrical corners by the shape, must be spliced with a radius equal to the diameter of the holes [2].

The AutoLISP routine called FLANGES.LSP works as an AutoCAD command for a quick representation of the flanges. It allows the technological design of parts by flanges type, by activating certain modules of the graphic editor. These modules contain images of the following types of flanges: rectangular flange, cylindrical flange, square flange, triangular flange, oval flange [2]. The graphical data basis of the graphic editor is realized with the help of slide files.

Each module of the graphic editor has its correspondent; for each type of flanges, a dialog box is created in DCL files. Each DCL file has a correspondent AutoLISP program which loads, displays and manages the respective dialog box [1].

The main program calls the flanges library and then, based on the selection of a particular type of flange, it opens the corresponding dialog box of the flange; after inserting the input values of the elements of the flange, the design of the flange is realized.

A work session starts with the loading of the program `FLANGES.DCL`, which activates the graphic editor described by Figure 1. This graphic editor contains a number of six active images which are images of the considered types of flanges. After choosing the desired entity, the program opens another dialog box, appropriate to the type of flange which was selected. This dialog box requires the input of data needed to construct the chosen type of flange.

After entering the data for the flange, the system asks for the insertion point of the drawing of the respective flange, and then, it constructs the drawing of the flange.

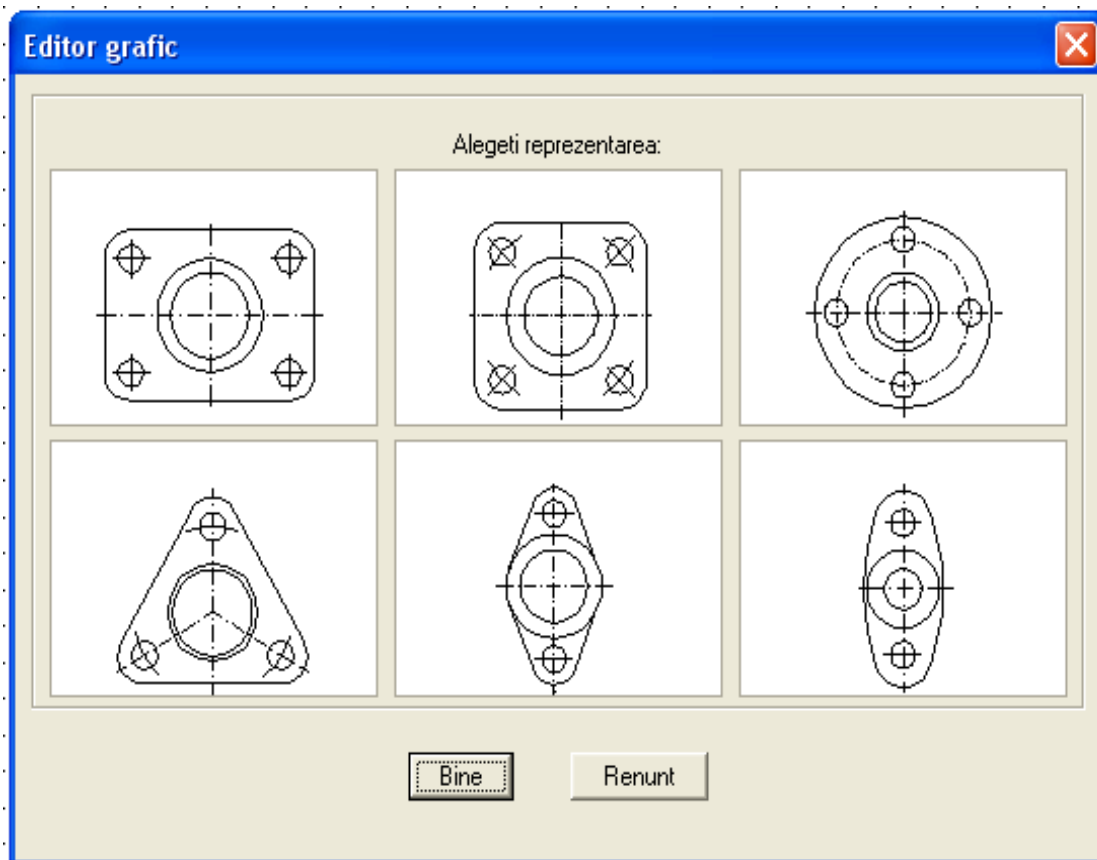


Fig. 1 Graphic editor

The drawing, as well as the 3D model of any type of flanges will be obtained according to the values of the input parameters filled in the dialog box for the considered flange.

### 3. PRESENTATION OF A TEACHING ACTIVITY IN THE TREATED AREA

The place of the training is recommended to be a technical drawing laboratory where for optimization of the teaching, it is necessary to have a minimal equipment containing of at least one computer connected to the network.

The computer configuration must allow the running of applications through which specific skills will be formed.

This specific field of discipline requires interactive teaching methods, recommending the individual practical applications, the discovery method, the demonstration method and the heuristically conversation.

In the educational process, for the specialized disciplines, one can use communication methods, the exploration methods and other methods action oriented.

At different times during the lesson, the teacher must decide which of these methods would provide the most appropriate educational potential.

Applications presented to the students, the applications that they will work with, must have as their

object concrete problems of productive activities in the field of activity to highlight the advantages of using computer systems. The assessment should aim especially the creative interpretation of the information and the ability to solve a problem.

The teaching methods, used for teaching principles in technical drawing, are presented in [3] and [4]; they allow the understanding of the representation of different types of parts.

#### 3.1 Reference objectives:

- O1 - to know the role of flanges and their characteristic features;
- O2 - to learn the rules for representation and dimensioning of the main types of flanges;
- O3 - to manifest ingenuity and initiative in carrying out works;
- O4 - to realize the use of exercise in the development of applications;
- O5 - to form the field specific language by acquiring the correct technical terms.

#### 3.2 Operational objectives:

Table 1 shows the operational objectives which are pursued at teaching representation and dimensioning of the flanges [5].

In Table 2 there are presented the content areas in representation and dimensioning of the flanges [5].

Table 1

Operational objectives				
Code	The ability to form	The behavior certifying training	Terms of achievement	The level of acceptable performance
O1	To acquire the general concepts about flanges	Teaching the general rules of flanges	- Drawing Office - Electronic computer - Software	Reproduce the definition of the flange
O2	To represent the main types of flanges	Representation of the principal types of flanges	- Drawing Office - Electronic computer - Software - Flanges of various types - Design of the main types of flanges	Represent three of the five types of flanges
O3	To achieve the main types of flanges dimensioning	Realization of the main types of flanges listing	- Drawing Office - Flanges of various types - Design of the main types of flanges	Dimensioning three of the five types of flanges
O4	To discover how to realize automatically parameterization of flanges	Discovery of the way to realize the automatic parameterization of the flange	- Drawing Office - Electronic computer - Software (AutoCAD, AutoLISP)	Identifies how to realize the parameterization of flanges using a computer

### 3.3 Content:

In Table 2 there are presented the content areas in the lesson about the representation and the dimensioning of the flanges [5].

Table 2

Content	
Code	Area of Contents
C1	General notions concerning flanges
C2	Representation of the main types of flanges and their dimensioning
C3	Automatically parameterization of the main types of flanges

### 3.4 Appropriate knowledge and skills:

Appropriate knowledge and skills are:

- Knowledge of the rules of representation in technical drawing;
- Knowledge concerning the arrangement of the projections;
- Knowledge about the representation of views and sections;
- Knowledge about dimensioning.

### 3.5 Resources used at the lesson:

In Table 3 there are presented the resources used at the lesson about the representation and dimensioning of the flanges [5].

Table 3

Resources used at the lesson	
Code	Type
R1	Drawing Office
R2	Electronic computer
R3	Software (AutoCAD, AutoLISP)
R4	Execution drawings with different types of flanges
R5	Different types of flanges

### 3.6 Learning/teaching methods:

Table 4 presents the learning/teaching methods used at the lesson about representation and dimensioning of the flanges [5].

Table 4

Learning/teaching methods	
Code	Method
M1	Heuristic conversation
M2	The exposure
M3	The explanation
M4	Learning by doing
M5	Exercise

### 3.7 Organizational form of the class:

Table 5 presents the organizational form of the class used at the lesson about representation and dimensioning of the flanges.

There is an agreement between a harmonious combination of teaching and learning/ evaluation activities. All activities, with everything involved (objectives, principles, resources, etc.) are correlated and find themselves in agreement through a permanent cooperation between them. Depending on how this cooperation is achieved, different forms of organization can be defined [5].

Table 5

Organizational form of the class	
Code	Form
F1	Frontal
F2	Individual

### 3.8 Training organization chart:

Table 6 there presents the training organization chart used for the lesson about representation and dimensioning of the flanges.

The training organization chart content areas are related to each teaching objective [5].

Table 6

Training sequence	Objective	Content	Forms of organization	Teaching methods	Resources	Evaluation Criteria
1. Arrangements		verification of the class, attendance, classroom organization	F1	M1		
2. Focusing the attention						
3. Communication of new knowledge and announcement of followed objectives	O1	C1	F1	M1 M2 M3	R1 R2 R3 R5	Formative - Cognitive - Quantitative - Qualitative
	O2	C2	F2	M1 M2 M3 M5	R1 R2 R3 R4 R5	Formative - Cognitive - Quantitative
	O3	C2	F2	M1 M2 M5	R1 R2 R3 R4 R5	Formative - Cognitive - Quantitative
	O4	C3	F1	M2 M3 M4	R1 R2 R3	Formative - Cognitive - Quantitative
	O5	C1 C2	F2	M4 M5	R1 R2 R3	Formative - Cognitive - Quantitative

### 3.9 Evaluation:

Table 7 presents the type of evaluation used at the lesson about representation and dimensioning of the flanges [5].

Table 7

Type of evaluation	The evaluated content	Scoring scale
Current	C1 C2 C3	According to the scale

## 4. CONCLUSION

This paper presents the design of a teaching activity which is a step in anticipating the objectives, contents, methods and means of learning, of evaluation instruments and relationships established between all these elements in the context of specific ways of organizing teaching activity. This type of applications helps to the development of specific skills.

The application presented is useful when the flanges present different shapes and sizes. This application can be extended to other classes of parts in case one needs repeated drawings of parts of a certain type.

The particularities of the graphical subjects allow the use of interactive teaching methods, recommending individual practical applications, demonstration, the heuristic conversation and the method of discovery.

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