

## ABOUT TECHNICAL DRAWING COMPOSITION

Janīna Osnovina

Daugavpils University, Faculty of Music and Art, Arts Department  
jandau@inbox.lv

**Abstract.** The effectiveness of pedagogical work depends on the teacher's investment into perfection of the teaching and educational process and the methods of improvement of the teaching quality. Modern market relations in the field of intellectual work affected the purposes and tasks of higher education that postulated new demands on the quality of the future engineers' professional training. The present article is devoted to the problem of improvement of the quality of technical drawing design from the point of view of its compositional design regardless of the kind of the technique's design: by hand or Computer Aided Design.

**Key words:** quality of professional engineers' training, technical drawing, composition.

### Introduction

In the present global market, engineers and technologists must be more and more visually literate to successfully face the increasing use of graphical communication in the manufacturing industry. Technical drawing is a globally standardized graphical language for technical communication in all engineering fields. In this context, technical product documentation (including technical drawings) is the only established means of communication and serves as a basis for interpretation of contracts.

The concrete competence of the future engineer is formed in the process of teaching not only technical study subjects and special engineering subjects, but also general, social and humanitarian subjects. However, research of the problems of higher professional education shows that not much attention is paid to those study subjects which develop spatial thinking, skills of graphical design of engineering idea and its logical completion.

Analysis of students' graphical tasks and projects shows the disadvantages which reduce the quality of the future specialists' professional training. Technical drawings are intended for manufacture and control of mechanical parts. Therefore, the technical drawing's content and design should meet the requirements of standards. Besides, the integral part of a technical drawing is its composition. The process of reading a technical drawing, the mechanical part's manufacture and control can be difficult if the rules of composition are not observed. The rules of composition are shown in all kinds of arts, as well as in engineering. But the problem of technical drawing's composition practically is not described in textbooks.

### The basic data

The theory of composition in engineering gradually gets a more precise character; however, its structure does not represent quite a developed system. It also concerns terminology which is used in this sphere of activity, though it is gradually specified, too.

Composition in engineering includes such important sections as bases of composition, ergonomics in mechanical engineering, design of industrial machines and equipment, etc. There is not enough information about composition of engineering specifications.

Certainly, use of appropriate standards provides competent performance of graphic and text documents. But it is advisable to consider the problem of a technical drawing's composition, which basic requirements, on the one hand, do not contrast with the content of the standards, but, on the other hand, essentially improve the quality of a drawing.

Composition (*Latin compositio*) in the standard meaning is drawing up, connection and combination of various parts in a unity according to any idea. The rules of composition are based on the rules of perception which work on a subconscious level.

The basic requirements of composition are the following: its content, balance, scale, weight, colour, etc.

Composition of the drawing is a competent arrangement of images of the mechanical part, its dimensions and other data on the paper format, their combination in a unity.

What is composition for?

Based on the rules of psychological and visual perception it provides an optimum arrangement of all the components of the drawing, rational use of formats; makes the drawing and its content clear and its perception comfortable, creating a certain “route” for an eye, which should be passed without missing anything important. Correctly constructed composition does the process of work interesting and attractive, improves the quality of teaching and learning.

The design of any technical drawing consists of three main stages: 1) creation of a composition; 2) execution of the technical drawing on a format; 3) final graphic drawing up.

Finishing the drawing it is necessary to check up the correctness of performance of all components of the drawing.

### Basic stages of the technical drawing’s composition

The basic stages of creation of the technical drawing’s composition are as follows:

- analysis of the initial data;
- choice of the main image and other necessary images;
- choice of the size of a format;
- arrangement of views on a format;
- dimensioning;
- drawing up the other data about the mechanical part.

### Results

According to the results of the research carried out the following main rules for technical drawing’s composition were distinguished.

At the beginning it is necessary to analyse the form, purpose and name of the mechanical part. Two factors influence the choice of the main (front) view. They are: the form of the part and manufacturing techniques. The main (front) view should give the best representation of the form and the dimensions of the part [1, 2]. The part of the turning group is represented horizontally (Fig. 1, a), the part of the case group – according to its arrangement at operation (Fig. 1, b).

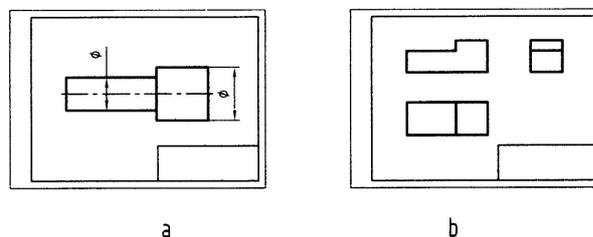


Fig. 1. **Correct arrangement of mechanical parts on the main view:**  
a - turning mechanical part; b - case mechanical part

Figure 2 shows the examples of wrong arrangement of mechanical parts on the main view.

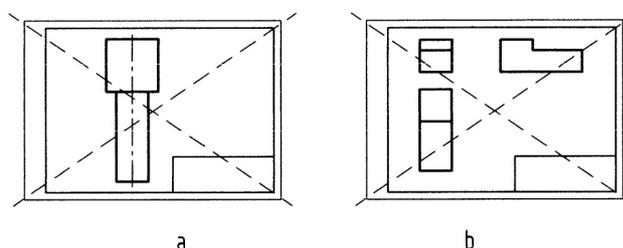


Fig. 2. **Wrong arrangement of mechanical parts on the main view:**  
a - turning mechanical part; b - case mechanical part

At the choice of a format it is necessary to consider the number of views, their arrangements, scale and rationality. Thus the useful area of a format should be filled on 75-80 % (Fig. 3).

Placing views on a format it is better to have them in projective connection and according to the European system of projection.

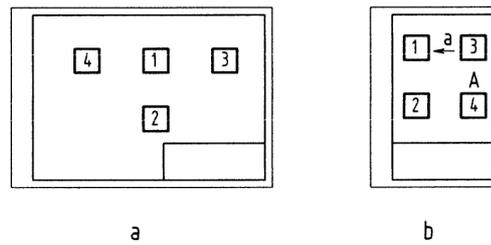


Fig. 3. Arrangement of views of a mechanical part of uniform scale on formats A3 and A4:  
a – irrational; b – rational

A big influence on the composition of the technical drawing renders the scale of the image. Figure 4 evidently proves that. Too small scale (Fig. 4a) and too big scale (Fig. 4c) negatively influence visual perception of the drawing. In the first case it is too much empty space, the images are grouped non-uniformly in one place. In the second case too big images do not leave any space for dimensioning and other data.

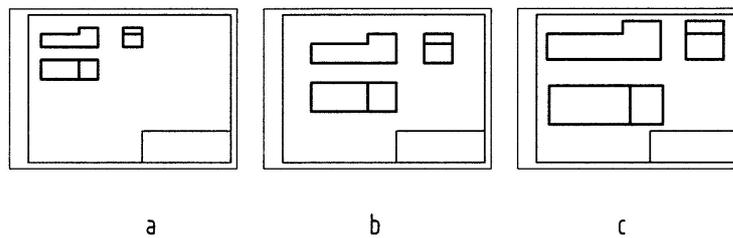


Fig. 4. Arrangement of views of a mechanical part of different scale:  
a, c – wrong; b – correct

The minimal distance between the views should be 25...30 mm. It is necessary to have in regular interval views of the part on the length and height of the format (Fig. 4, 5). The distances *A* and *B* for formats A3 and A4 are calculated according to the formulae [1]:

$$A3: A = (390 - (l + b))/3; B = (277 * -(h + b))/3; \tag{1}$$

$$A4: A = (180 - (l + b))/3; B = (277 * -(h + b))/3. \tag{2}$$

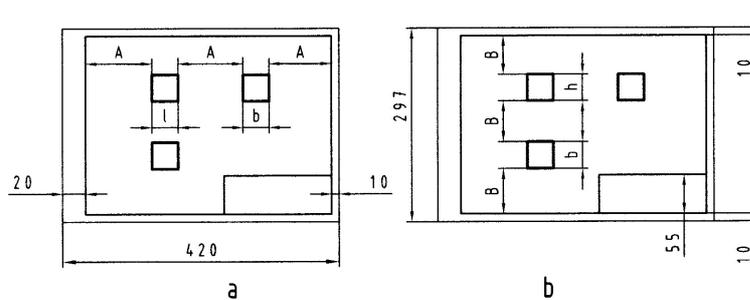


Fig. 5. Uniform arrangement of views of a mechanical part on format A3:  
a – horizontally; b – vertically

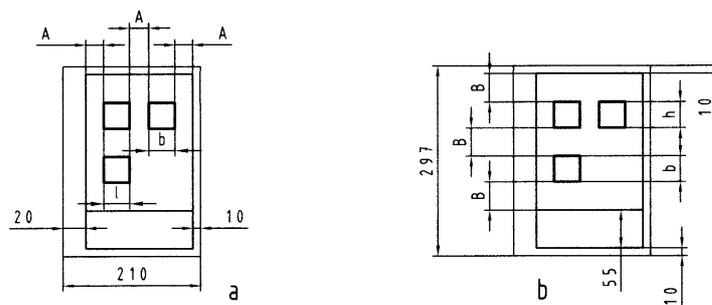


Fig. 6. Uniform arrangement of views of a mechanical part on format A4:  
a – horizontally; b – vertically

It is necessary to consider the features of visual perception. If the part is long, its useful height 277\* mm in the formula should be reduced by 55 mm.

If the part, such as cylinder or axle, is long and it is located horizontally, its axis of symmetry is symmetrized not strictly, but it should be a little displaced upward (Fig. 7).

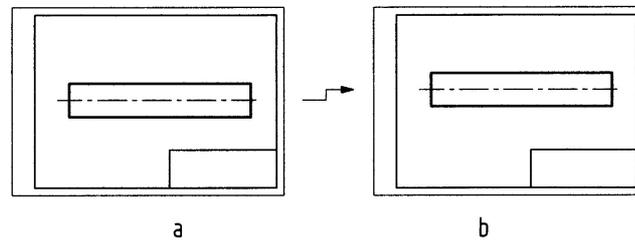


Fig. 7. Arrangement of the main (front) view of a long mechanical part on format A3:  
a – wrong; b – correct

Observance of the standard “Dimensioning” is an obligatory condition of the execution of the technical drawing. Values of the height of dimensional text and the length of arrows should be coordinated with the size of the image and be equal among them (Fig. 8).

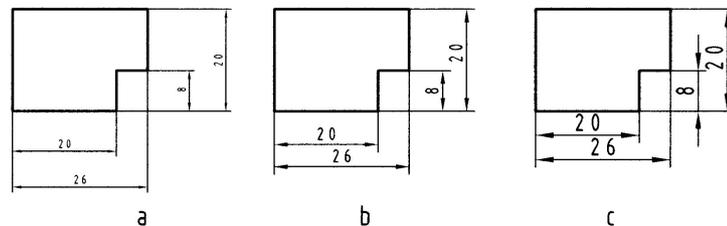


Fig. 8. Composition of the dimensions:  
a, c – wrong; b – correct

The considered requirements to the composition of a technical drawing evidently prove to be true images of a black circle on a white square (Fig. 9).

It is evident from Fig. 9 that the perception of left and right variants is not comfortable. Too small circle is lost on the big square and it is perceived to be located outside the plane of the square. But too big circle renders pressing influence on the observer as it seems that it is located in front of the plane of the square.

Analogous impression of discomfort is caused by incorrectly executed technical drawings presented on Fig. 4, Fig. 8.

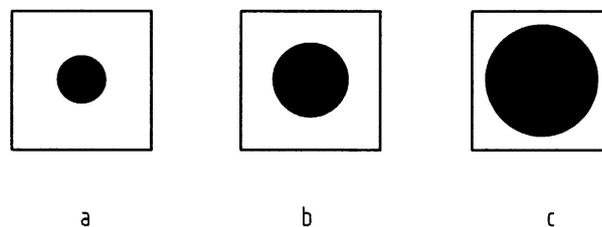


Fig. 9. Visual perception of black-and-white various in size objects:  
a, c – uncomfortable; b – comfortable

So, in the present article the basic rules for the composition of a technical drawing which observance provides clearness of execution and reading a mechanical part's working drawing and comfort of visual perception are analyzed. The results of the research were successfully approved in the educational process in the Daugavpils University in 2007, 2008 and 2009.

## Conclusions

1. The basic rules of the technical drawing's composition were considered and systematized.
2. In order to improve the quality of the technical drawing some methodical materials were developed. The use of them will be able to improve development of the content of Technical Graphics and the quality of the future engineers' training.
3. Technical skills acquired in the drawing's composition are important for disciplines like Mechanical Engineering Drawing, Computer Aided Design and Manufacturing and Introduction to Machine Design.

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