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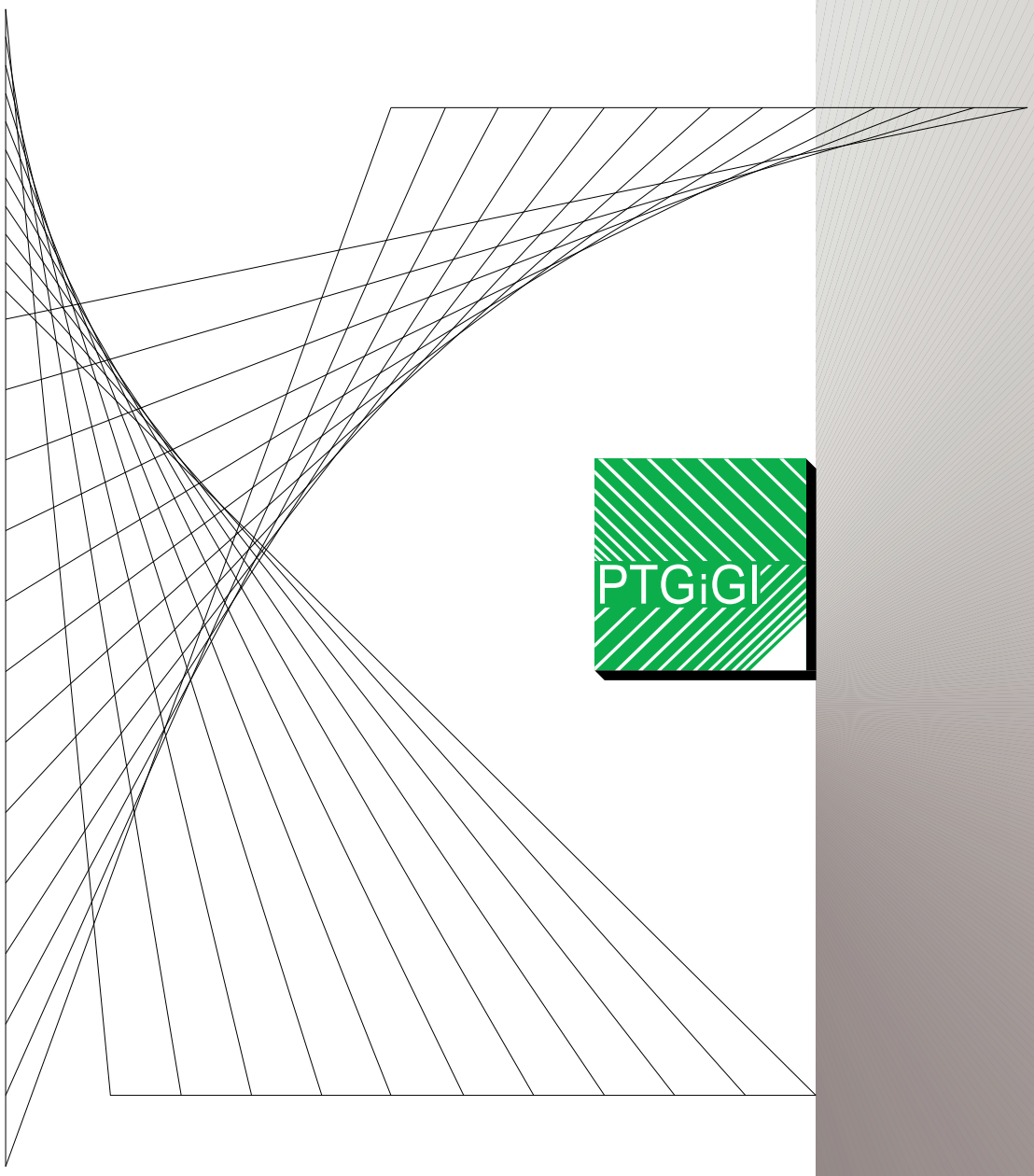

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A STUDY OF ENGINEERING DRAWING AS DESIGN LANGUAGE TEACHING

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Abstract. The drawing is the oldest language and the only universal language (here belongs also the co-called engineering or technology language – the design language). The tools of expression of engineering drawings are graphic representations. The drawing is written in form that represents the shape, size and specifications of the design object. The drawing is read so that the product can be manufactured exactly as it was originally conceived by the designer. The engineering drawing is based on descriptive geometry as the grammar of graphics, i.e. the logic of sight, and graphic variables as the words of graphics, i.e. semiotics tools – visual signs (e.g. geometric primitives, colours). The signs are explained with the help of Bense's triadic model of the sign. It assumes that each design object can be built from certain primitives according to geometric variables. The Engineering Drawing course begins with learning the design language which is based on graphic conventions and regularities.

Keywords: engineering drawing, design language, geometric variable, graphic variable, semiotics tools, communication

1 Introduction

The goal of teaching engineering drawings is thinking in images. It expresses and delivers one´s technical ideas through the medium of the engineering drawing that is the sign of the design of the object. It is committed to the pursuit of processing the existing image, in order to obtain the output of a new image of the product. On the other hand, product oriented engineering drawings can transmit messages across natural languages and cultures [1]. The Engineering Drawing course deals with geometric variables and graphic variables as semiotics tools [2, 3]. As the engineering drawing is a visual sign, it can be considered in the aspect of semiotics. A brief definition of the term 'semiotics' is the following: semiotics is the study of sign system and of communication [4]. Bense's version of the Semiotic Triangle, based on the triadic model of Peirce, is used for the engineering drawing as a special type of sign [5]. Images enable people rapidly and intuitively to recognize objects and to use them for provision of technical information, when the designer creates communication (as a form of social interaction) where the object represents a transferred model [6]. Therefore, effective use of visual images in drawings is not simply a subject of the Engineering Drawings course, it is something that must be trained and practised (visual literacy). Consequently, the design language should be taught as any other language which is not a native language but a foreign language [1, 7]. Learners feel that the elementary principles and rules of composition should be learned step by step before composing an engineering (working) drawing.

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2 Engineering drawing as a design language based on geometric and graphic variables

Engineering Drawing is an important technical fundamental course, and the engineering drawing is known as the 'engineering or technology language'. Some authors believe that, in addition to natural and artificial languages (based on natural languages), there stands also the 'pillar' of the design language (see Fig. 1). It is technical documentation for designers, manufacturers and users, as well as tool for development of technology and for exchanging science information.

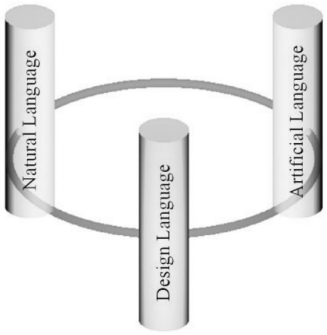
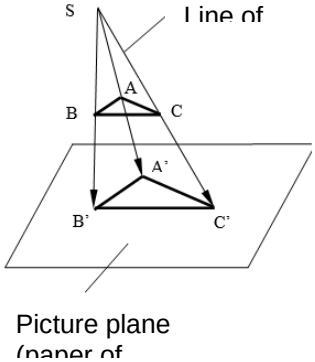
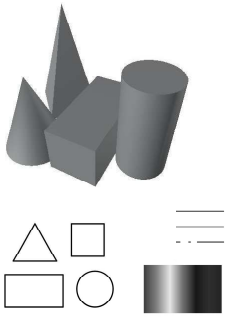


Figure 1: Three pillars of literacy education [1]



Geometric variables



Graphic variables

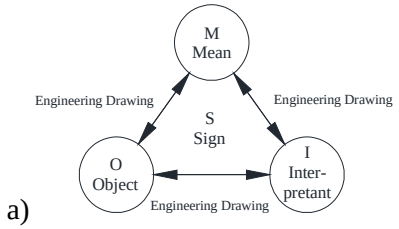
Figure 2: Geometric and graphic variables of the design object [2], edited by Lille [3]

The drawing is based on descriptive geometry as the grammar of graphics, i.e. the logic of sight, and graphic variables as the words of graphics, i.e. semiotics tools (e.g. geometric primitives, colours), see Fig. 2.

Geometry as multiview projection relation based on the orthographic projection method. The graphic variables (geometric primitives) used in 2D drawings are: point, line, plane, circle, triangle etc.; and in 3D drawings: box, cylinder, cone, pyramid, sphere, etc. It is assumed that each 3D object can be built from certain primitives in a hierarchical manner. Recognition of Semiotic tools and their relationships are connected with the dimensions and orientation of figurations, as well as with the dimensions of diameter, radius, angle, screw thread, etc.

3 Graphic representation of the design object and the triadic model of representation

Bense's version of the triadic model (Semiotic Triangle), based on the triadic model of Peirce, defines the design object as a special type of sign in that it realizes a combination of particular characteristics from three dimensions (see Fig. 3).



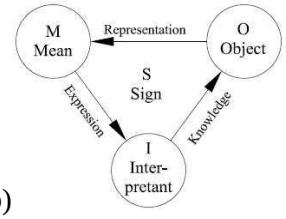


Figure 3: Bense's version of the triadic model for transferring the data of the design object a) [5], the model was modified by Nadin, b) [8]

According to Liu, the tools and means of expression are relationships between views, simplified, abbreviatory and prescriptive [6]. Knowledge is based on the orthographic projection method, depending on image thinking, logical thinking, graphic conventions, regularities and perceptions.

4 Reading of the engineering drawing and recognition of primitives

In Engineering Drawing it is assumed that each design object can be built from certain primitives according to the relationship between geometric variables. As an example of reading drawings we examine a 2D drawing of a detail and decomposition of its views [6]. Although three views are usually required to describe an ordinary object, more complicated details may require a sectional or auxiliary view in addition. Figure 4 shows three of principal views of a detail, the front, top, and side images.

Figure 5 shows an orderly analysis of the reading of the 2D drawings of an object. We begin with dividing the detail into two components. Component 1 is a solid form with a hollow, which is removed and described as component 2.

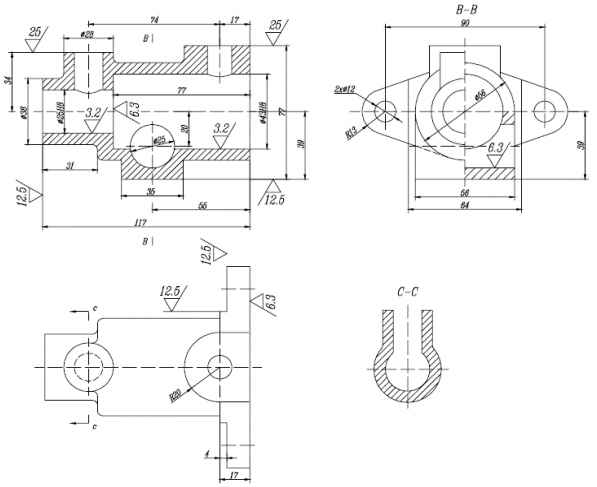


Figure 4: The three views 2D engineering drawings of an example detail [6]

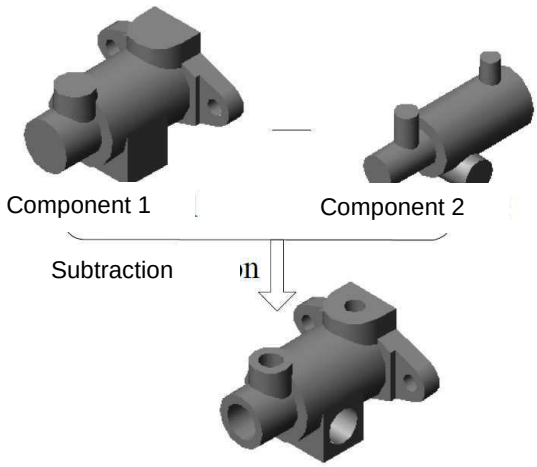


Figure 5: 3-D reconstruction of a model detail [6]

The components are divided into primitives (see Fig. 6). Component 1 consists of three cylinders, half-cylinders and boxes; and Component 2 consists of five cylinders with various diameters, which are placed according to their geometrical coordinates.

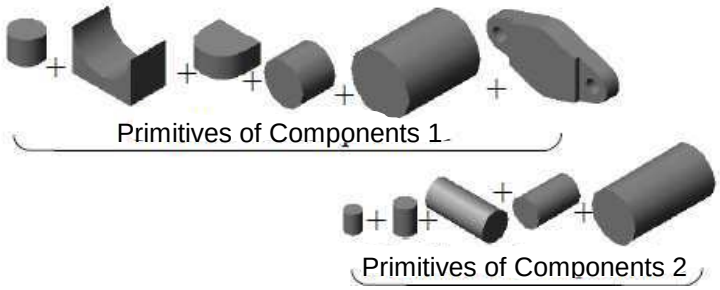


Figure 6: Primitives of Component 1 and Component 2 [6]

5 Conclusions

Engineering Drawing is an important technical fundamental course and the engineering drawing known as the 'engineering or technology language', which serves as an in addition to natural and artificial languages.

One the other hand, compared with natural languages the design language degenerates into a great number of signs.

The Engineering drawing represents graphically the design object and can be deal with as the sign. Engineering drawings are based on geometric variables and graphic variables – the grammar and the words (primitives) of the design language.

Reading of 2D drawings is presented as an example of application, where a detail is divided into two components and the components are divided into primitives.

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RYSUNEK TECHNICZNY JAKO JĘZYK NAUCZANIA PROJEKTOWANIA

Rysunek jest najstarszym i jedynym językiem uniwersalnym (dotyczy to także języka inżynierskiego i technicznego stanowiącego język projektowania). Narzędziami wyrażania rysunków technicznych są reprezentacje graficzne. Rysunek zapisywany jest w formie, która reprezentuje kształt, rozmiar i specyfikacje przedmiotu projektowania. Powinien być odczytywany tak, by dany produkt mógł być wytworzony zgodnie z pierwotnym opracowaniem przez projektanta. Podstawą teoretyczną rysunku technicznego jest geometria wykreślna, jako gramatyka grafiki, czyli logika widzenia i zmiennych (znaków) graficznych (prymitywów geometrycznych, kolorów, ...). Znaki te mogą być opisane za pomocą tzw. triadycznego modelu Bense'a. Zakłada się, że każdy projektowany obiekt może być zbudowany z elementów pewnego zbioru pierwotnych zmiennych geometrycznych. Kurs rysunku technicznego rozpoczyna się od nauki języka projektowania opartego się na przyjętych konwencjach graficznych i regułach.