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Engineering drawing as a visual channel in communication medium

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Abstract. Engineering Graphics is an important technical basic course known as the language of engineering and technology (design language) 'in two dialects': the First-angle orthogonal projection (earlier referred to as method E) and the Third-angle orthogonal projection (earlier referred to as method A). This course for engineering students is essential for introducing engineering to their further studies and it involves several disciplines (e.g. Machine Design, Engineering Measurements, Mechanical Engineering Projects). Engineering Graphics serves to create a graphic model (engineering drawing) according to which machine parts can be manufactured and machines and buildings can be assembled. Graphic models can also be considered in the aspect of semiotic principles. The tools of expression of Engineering Graphics are graphic representation, figure (image) and drawing specification, which are perceived by the visual and auditory organs (in the case of verbal contact between the writer of a drawing and the reader of a drawing, i. e. oral form), and represent the means of communication for engineering practice. The requisite elements for communication are: sender (writer of a drawing), receiver (reader of a drawing), channel, medium and at least a partially overlapping sign repertoire of sender and receiver. In order for overlapping to be complete and unambiguous, the Engineering Graphics course begins with learning the design language which is based on graphic conventions.

Key words: Engineering Graphics, representation, drawing, visual channel, communication.

INTRODUCTION

Engineering Graphics may been seen as a formal language using visual signs for transferring the data of the design object. It appears to be the only intercultural (to a certain extent) universal language in two dialects: the First-angle orthogonal projection and the Third-angle orthogonal projection used by the engineering community. In other words, it serves to record images (ideas) and to convey them unambiguously to others.

The object of semiotics is a sign system. As Deely remarks 'The proper effect of a sign, of course, is to signify, i.e., to make present an object other than itself' (Deely, 2005). When training technical (design) engineers we have dealt briefly with the semiotic aspects of graphic thinking within the course of Engineering Graphics as it is a complex semiotic system. We reflect on the role of semiotic representations in constructing (visualising) and communicating engineering images (ideas) in the teaching and learning processes. In semiotics the model is an analogue of the object and replaces the object in the cognition process. This model in our case may depend on the stage of the design: the engineering drawing (graphic model), the prototype or the model (in natural size). Signification of engineering imagination (non-existing structure) occurs in the encoding and decoding processes within the framework of the communication model, as data carrying information must be coded in some way (ISO Standards Handbook, 2002). In this study we focus on the engineering drawing differently from designers who use images for communication (communication as a form of social interaction) where the object is not a piece of news (in the sense of ordinary communication) but represents a transferred model. The engineering drawing is an expressive reflection in the design process; it is a visual presentation on surface: canvas (tape-recording), sheet of paper, computer screen, etc., which means creation of 2D or 3D records of a three- dimensional object. Similarly, in Engineering Graphics some drawings with alphanumerical data are arranged in a way to achieve a better communication of the initial technical ideas and images of future objects.

Engineering drawing of the design object and the triadic model of representation

Students are faced with a plethora of design process to produce a product (real object) and they need to be able to navigate within these environments, as well as to decode them, in order to obtain knowledge. Engineering Graphics may been seen as a formal language using visual signs for transferring the data of the design object (Suzuki et al., 2003; Penna, 2012). Therefore, we may also consider the visual sign applying the semiotic aspects of graphic thinking within the course of Engineering Graphics.

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 realises a combination of particular characteristics from three dimensions (Fig. 1a) (Bense, 1983).

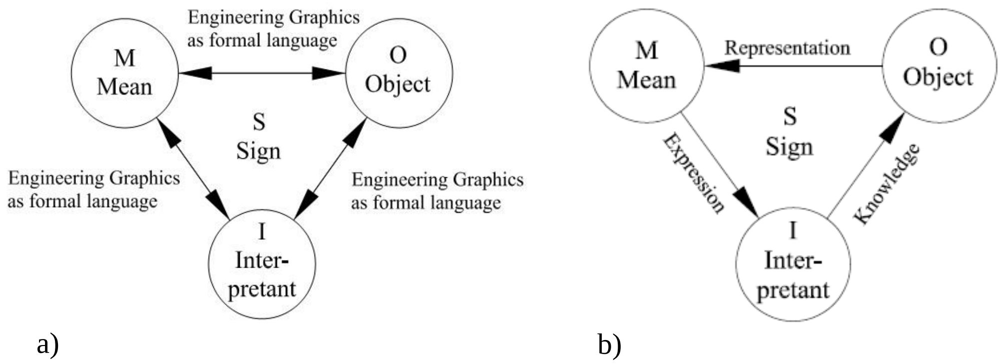

Figure 1. Bense's triadic model (the model is editorially modified by Tasheva, (Tasheva, 2012) (a); Nadin's triadic model for transferring the data of the design object (Nadin, 1990) (b).

If we cite Deely 'The object always involve a 'relation to an observer', so to speak, or, more exactly, to an organism experiencing' (Deely, 2005). And further on: 'In order to deal with object, the mind must first form an idea (image) of that object while the mind forms a concept (mean) of the object too is formed and made present as the term of the sign relation'. According to Peirce, the interpretant is a key idea introduced for the purpose of explaining the process of semiosis, in other, words the action of the sign. As Deely states: ‘An interpretant, accordingly, is the reason for the sign’s being seen as related to something else’s as signified’ (Deely, 2005).The unity between the three components represents the sign. Signs are identified only through their representation (in our case, visual representation). In the teaching and learning process, we can treat the relation between the sign and the object, which the sign conveys, and the relation between the sign and the user (the graphic model of an object is communicated to the manufacturer). Undoubtedly, the process of representation and interpretation are crucial. In this context the interpretant is the sensibly triggered training of engineers (having the knowledge of engineering). As problem solving is a general principle of design, certain semiotic aspects (characteristic of engineering or of the graphic design) should be specified in order to better understand this type of design before attempting to propose a model for it; solving of problems requires knowledge, skills, resources, and the ability to communicate within a team.

The sign (engineering drawing) can be understood as the interaction between the interpretant and the object. The functions of the sign are presented in Fig. 1b: semiotics as a science of representation; semiotics as a science of expression; and semiotics as a science of knowledge (Nadin, 1990). Therefore, the problem of graphic design is not only to transmit information at an optimal rate (in the sense of information theory) but also to find correct correlation between the graphic means of expression and the impressions engendered by them. It is supposed that the impressions associated with a simple three-dimensional form are similar to the impressions associated with their two-dimensional projections.

Peirce divided the system of signs into icons, indexes and symbols. The steps in the sign processes with growing abstraction justify the didactic approach in the Engineering Graphics course, where we should follow the sign process of growing abstraction, which was briefly dealt with in our presentation (Lille et.al, 2010). There are three different references to the object in the sign: iconical, indexical, and symbolical (Interpretant (I) should be located symmetrically Object (O) and Mean (M)), see Fig. 3.

COMMUNICATION MODEL

The ability to decode and to understand signification is based on competence to use a sign system with which one gets familiarised through performing engineering drawings within the course of Engineering Graphics and the completion of which takes several academic terms and involves several disciplines (e.g. Machine Design, Engineering Measurements, Mechanical Engineering Projects). This helps develop engineering imagination which is highly essential for creating a successful design and for composing the working drawing as the model of a future product.

Signification of engineering imagination (non-existing structure) occurs in the encoding and decoding process within the framework of the communication model (Fig. 2) as data carrying information must be coded in some way. The code, in short, belongs to the object experienced and idea to the organism experiencing. (Deely, 2005). In our case sensory experiences involve visual imagination as well as visual perception. The central aspect of the concept of perception as well as of knowledge is factuality, i.e. when we perceive or know something; it means that it really exists as such.

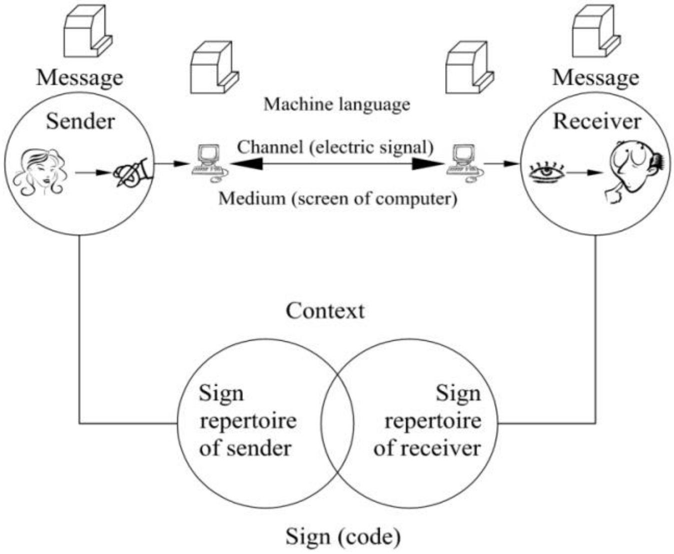

Figure 2. A communication model involving the use of computers (the model is editorially modified by Tasheva (Tasheva, 2012).

The engineering drawing can be seen as a monomodel in which the visual representation is given in a highly conventional way, expressing the meaning exactly and systematically. Engineering drawings are prepared using the same design standard, instructions, databases and other documentation. Engineering drawings introduce the Engineering Graphics course and are followed by the other engineering subjects, thus, irrespective of the language, engineering drawings are unambiguously understood by all people living, e.g. in the Western culture space. It should be mentioned, that engineering drawings are not created as pictures for enjoyment but they may reveal the aesthetic qualities of material things.

Example of application, 3-D modelling for engineering graphics

A solid modelling software can visualise a 3D object created by designers, although traditional sketching is often more efficient in the early stages of the concept design. To convey design ideas for graphic communication, the student starts with a pencil-and–paper sketch of his or her idea and generates an engineering drawing for final communication. Even physical 3-D prototypes that can be held in one`s hand and felt with the fingers, can be printed out rapidly (Fig. 3). In addition to visual perception, there arises tactile perception originating from the design object. Now there appears an iconic relation between the interpretant and the object (prime interpretant). The iconicity (the icon as likeness to the object) of drawings makes them vivid, intuitive and comprehensive.

Fig. 3 presents a concurrent engineering paradigm for graphic communication is presented after Barr (Barr, 2012).

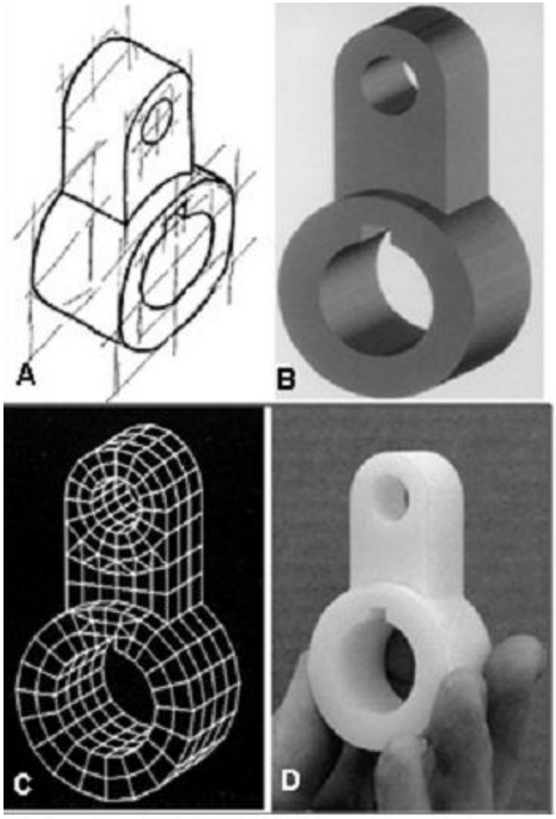

Figure 3. The modern engineering graphics process (Barr, 2012).

The design process starts with a sketch idea (A) which is transformed into a solid computer model (B). The model geometry can be analysed for certain properties, e.g., creating a mesh and performing a finite element study for obtaining the values of loading or thermal stress (C) and a 3-D prototype can be printed (D).

It is necessary to take into consideration expectations and experienced possibilities in order that the design parts planned assembled and interacting with other parts would create future conditions which are different from what is presently obtained or projected (Deely, 2005).

CONCLUSION

The Engineering Graphics course for engineering students is an essential introduction to further engineering studies and serves to create a graphic model (engineering drawing).

The engineering drawing is a graphic representation and the graphic model is a medium through which visual images in the mind of the designer are finally converted into the real object.

Engineering graphics is presented here as a formal language using visual signs (semiotic tools). The signs are explained with the help of Bense´s triadic model of the sign.

A communication model is presented involving the use of computers, in the framework of which forwarding of information occurs by the visual signs (3D solid object) encoded by the sender (writer of drawing) and decoded by the receiver (reader of the drawing), where conventional connections between the object and the means are established according to the design standard or the code.

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