Classification of Design Errors in Mechanical Engineering

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ABSTRACT

This article analyses the errors made in making design documentation, lists most important errors of design documentation, and distinguishes them into different classes depending on the type of error.

Keywords: drawings, design, error, classification, calculations, dimensions.

The reasons for errors are inherent in the essence of the design process. The creative process of designing is the ideal process in the designer's imagination. Based on the data of the technical specification, the conducted research, information materials and practical experience, the designer creates a mental image of the product, which is reflected in the drawings. But there is an error between the designer's idea and its actual implementation, even with the most subtle insight into the problem. In the design process, the designer has to take into account a number of requirements and restrictions. These factors are often contradictory and do not allow you to create the sample that the designer wanted. Any design can be considered as imperfect, lagging behind the imaginary ideal design-the standard. The standard embodies all the best that scientific and technical achievements give. The removal of the real quality of the product from the standard serves as a criterion for the perfection of the design. If the removal is greater than the average engineering level of a given time, then the design can be considered erroneous.

An error is a deviation of the design result from the accepted norms laid down in advance in the technical conditions and restrictions, a deviation from the standard or objective law that exists in nature. There are obvious (obvious) and hidden errors.

Obvious (obvious) errors are easily detected when comparing the design with the standard or when checking it according to the objective laws of mathematics, physics, mechanics and other laws that are known to an ordinary engineer. Obvious errors include errors in dimensional circuits, strength, deviations of parameters (force, speed, pressure, etc.). Obvious errors are detected when checking technical documentation by analytical or graphical methods known to an ordinary engineer. Hidden errors are not detected by verification and appear, as a rule, in new developments where a working principle that has not been tested in practice is applied or there is not enough information to implement an already known principle. In such structures, ordinary methods of control and analysis do not give an answer or give an incorrect, distorted answer to the question of the operability and suitability of the design. [4].

Hidden errors are identified after performing special calculations or developing expert opinions of major specialists. In such cases, it is advantageous to build an experimental model, when testing it, most of the hidden errors will be revealed.

The reasons for errors in technical documentation can be very diverse: ignorance, erroneous judgment, inability to cover all the issues of the problem, negligence, indifference, etc. Errors in design documentation are classified into the following groups: Group I- design errors; II - errors in calculations; III - errors in dimensions.

Errors caused by the wrong direction of development. These errors are already embedded in the technical specification for the development and arise from a wrong understanding of the work that the product should perform, or the processes for which it is created. Such errors should be disclosed already in the initial stages of development: in the technical proposal, draft design. The developer is given the right to critically analyze the terms of reference and identify all inaccuracies and errors in it. A significant role in this process is played by the heads of groups, bureaus, and chief project engineers, who are responsible for the correct direction of design developments. Errors in the wrong direction of development are hidden errors and are not always detected when checking the design documentation and checking its compliance with the requirements of the technical specification

Classification of errors detected in drawings

Table 1.

Class	Class characteristics	Errors
I	Errors that do not affect the quality and performance of the product	Violation of the rules of drawing A unified System of Design Documentation, rules for the placement of dimensions, designations, etc., as well as the rules of standardization and normalization. It is not an economic choice of the accuracy of the processing of the elements of the parts. Errors in calculations (calculation of mass, calculation of technical parameters, etc.), in the final size consisting of several calculations of parts; in the shape of the product (the desired shape cannot be obtained by economic means), of a legal nature, as a result of which a non-patentable product is created; of an economic nature
II	Errors that impair the performance and management of the product	In the choice of material, its heat treatment, durability, strength. The absence or insufficient availability of technical requirements for the accuracy of manufacturing and assembly. Errors in the choice of permissible deviations in the size of the interfaces of surfaces; in the choice of the roughness of the surfaces of the rubbing parts or interfaces; of an ergonomic nature: the controls are not adapted to the physiological and anthropometric data of the human

		operator; of an aesthetic nature (reducing the dignity of the design): the product has an ugly appearance; its shape does not correspond to its functional purpose
III	Errors that cause correctable Defective parts, assembly units, or products	In dimensional chains or in individual dimensions; in the choice of permissible deviations of dimensions or interfaces of surfaces; in the orientation of individual geometric and structural elements of the part; in the choice of components or general-purpose products; in the manufacturability of parts
IV	Errors that cause the final product failure	Non-compliance of the product with the purpose and requirements of the technical specification. Errors in the choice of a particular mechanism, its principle of operation, or the physical process underlying the work. An error that causes the failure of the intended functions of individual mechanisms or the entire product; in compliance with the assembly conditions (the product is not assembled); in size and in dimensional chains; in calculations; in the choice of material, heat treatment, etc.
*Correctable is a defect, the elimination of which is economically feasible without the manufacture of new parts or assembly units. Fixing it does not reduce the quality and performance of the product.		

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