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DESIGN FOR SAFETY IN COMPUTER AIDED DESIGN OF ALL-TERRAIN CRANES

Summary. In the paper the basic problems of the design for safety in the computer aided design of all-terrain cranes are presented and considered. The general idea of CAD system for all-terrain cranes is formulated and next the safety criteria for this type of machines are introduced. The initial logical structure for the data base oriented into safety problems in all-terrain cranes design is proposed.

1. INTRODUCTION

Problems of the design for safety in machinery design but specially design of all-terrain cranes are becoming more and more important. Many safety criteria are formalized in a hierarchical way. In European Standard [7] EN 292-1 "Safety of machinery; basic concepts, general principles for design", some general ideas for design for safety and general safety criteria are formulated. On a lower level particular standards or regulations are formulated for a certain type of machines or particular assemblies. As an example, procedures and safety criteria for design for safety for a steering system for vehicles and all-terrain cranes are presented in regulations ECEONZ no 79 [6], or in directives EEC 70/311/EEC [1]. During last years computer systems supporting designers in different stages of the design process have appeared. These systems can help with geometric modeling, finite element analysis, simulation and optimization with safety criteria. The

industry (also all-terrain cranes companies) began to use their commercial versions in the design offices. Computer codes are available which can support the designer in nearly every field which is connected with the design process. Quite often one design office uses many different systems. This situation creates a number of new problems. Systems made in different software firms can have different data bases, processing and dialogue organizations.

2. THE DATA BASE FOR CAD SYSTEMS

Fig. 1 illustrates the central role of the data base in CAD/CAM systems. The data base is the heart of any CAD/CAM system feeding information to all the activities in the production process.

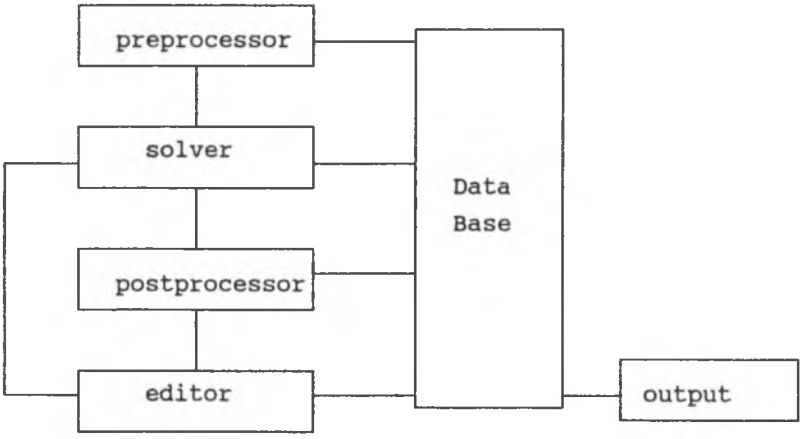

Fig. 1. Position of data base in CAD system

The efficient structuring of the data is critical to both storage needs and execution speed. Different users (designers) should be able to access the same data base and pick out the data they need and don't be disturbed by the remaining data.

The data base consists of the logical data base (as a application programmer sees the data) and the physical data base

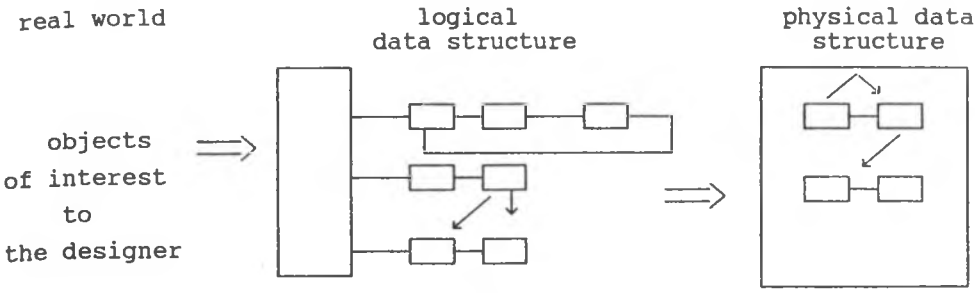

Fig. 3. The logical and physical data base

(as the data actually is stored in the computer). Fig.2 illustrates difference between logical and physical data base [8]. Fig. 3 present hierarchical data base structure in network model.

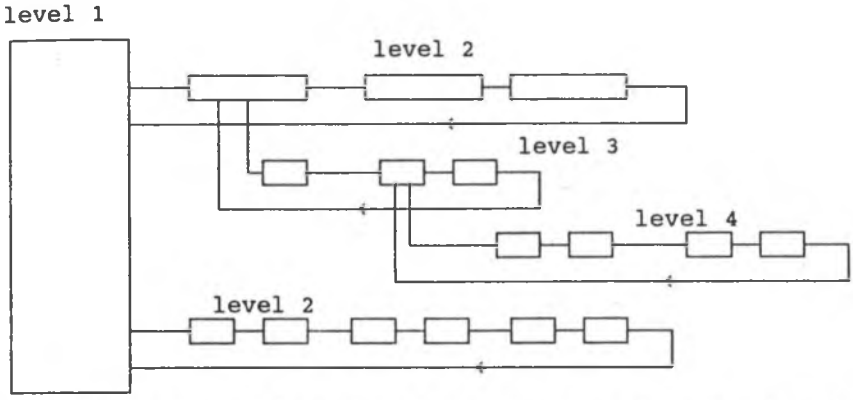

Fig 3. Hierachical data base structure in network model

The hierarchical data base structure for design of all-terrain cranes is presented in fig. 4.

The most important feature of the design process is its complexity. The whole design process consists of a number of mutually interconnected subprocesses. The results of one subprocess can be input data of another one. According to that the use of many different computer systems on different stages of the design process needs their integration.

The integration can be done in one of the following ways [5]:

a) via a system of interface's which link different computer systems,

b) via an integrated data base,

c) via a two-level intelligent data base with a knowledge level.

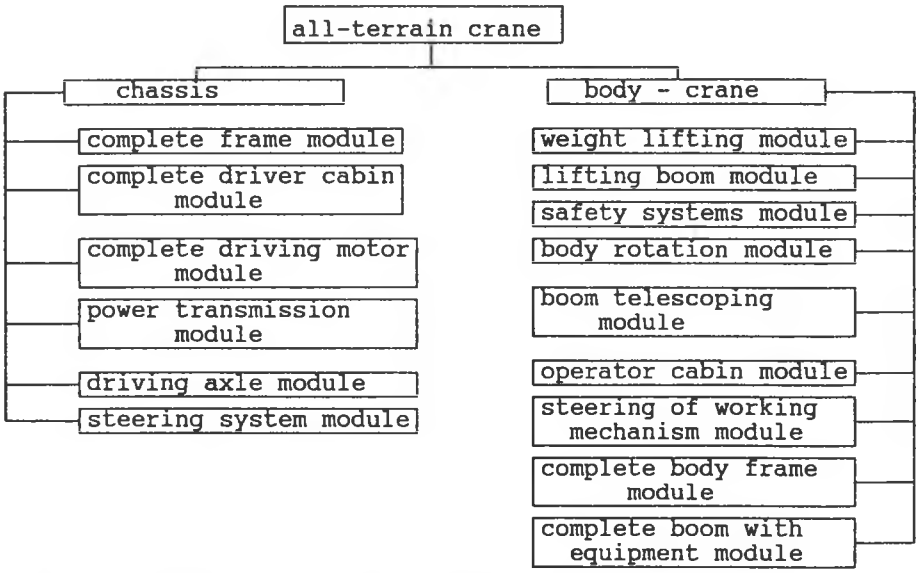

Fig. 4. The hierachical data base structure for design of all-terrain cranes

The first approach is quite often used in practice. And it is very efficient in the case of little problems. Using it we should remember that this can be the beginning of a never finishing system of inter-system links. And every improvement causes with big changes in the software. This type of structure has little flexibility and is very dangerous if it achieves large dimensions which are difficult to understand.

The use of integrated data base is very popular. The connection of information about geometric and physical features of the model in one data base is natural. Commercial data bases of this type, together with data base management systems, are available on the computer software market.

The logical structure of integrated data bases is very difficult for fast and proper designing. Very often there are no flexible results, or "over flexible " results. We should remember that the integrated system is permanently developed and improved. Every change in the idea of storing information can cost a lot of work. Except for that this solution is very popular in practice.

The third idea seems to be especially interesting for a future applications.

The most important part of the integrated design environment is the data base. The data base should integrate all computer codes used in the design process. The structure of a data base

should be open and allow to add new components. As mentioned before several solutions for the data base design are possible. The best solution seems to be a data base with knowledge level.

This kind of data base can be treated as an intelligent data base. Let's now consider a compulsory set of functions which should be offered by the data base.

The data base should allow to create connections between models which can be used by different computer systems. It should not allow to store redundant data and it should offer possibilities to reflect process aspects of design. It should be possible to archive older versions of some projects. It is very important to have the possibility of an intelligent searching in such archive or archive of standards. The archive should be equipped with functions which allow to store all development of some constructions but without redundant information.

The design process has its own dynamic structure. Some things should be done earlier, some later, some can be initiated after having done some others. A network can model it well. The design process of a new product is connected with many activities done by different people. The basic problem is how to exploit in optimal way the effort of single designers and how to coordinate their work globally. The data base should allow cooperation between different design sub-processes and store current state of them.

Intelligent solutions are needed because such a structure of a data base is not only a system for storing some information in some formal way. The data base should be equipped with different expert systems supporting nearly all activities.

5. FINAL CONCLUSIONS

Problems of the design for safety in the computer aided design of all-terrain cranes are becoming more and more important. The general idea of CAD system, with safety criteria for all-terrain cranes has been formulated. The proper logical structure for the data base oriented into safety problems in all-terrain cranes design is a first step in CAD system creation.

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Revised by: Jan Szadkowski