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CONCEPTION OF PRE- AND POST-PROCESSING FOR PC BASED CAD SYSTEMS

Summary. The paper presents a conception of pre- and post-processing for CAD systems, and a shaft designer system based on this concept.

1. Introduction

When designing constructions which can be built from standard elements, it is practical to complete the general purpose graphic designer systems (e.g. AutoCAD, *CADdy*, CADKEY) on the one hand with a variety of elements that contains shape characteristics (e.g. hole, groove, profile, etc.) and with ones on the other hand with which the geometry need by a mechanical model can automatically be produced for a given calculation of strength. The conception of forming a variety of elements will be shown through designing shafts.

2. Modelling Levels and Methods of CAD/CAM Systems

Principles of model-making used in CAD/CAM systems of our days are shown in *Fig.1.*

In general purpose graphic designer systems a User carries out the designing of a particular component at geometrical level, by means of geometrical objects and applying geometrical rules.

For a general purpose program system doing the stress (technical) analysis of a designed component (e.g. FEM) the geometrical data should certainly be completed with technical, mechanical and physical parameters and data.

An expert program system for instance applies all these methods and functional levels.

method classes / modelling level	object based methods	rule based methods	recognition based methods
functional modelling	functional objects	functional rules and associations	analysis of functional objects
technical modelling	technical objects	technical rules and associations	analysis of technical objects
geometrical modelling	geometrical objects	geometrical rules and associations	analysis of geometry

Fig.1.

3. Designing of Shafts

The shape and sizes of shafts are defined on the basis of the shape, sizes and operation conditions of components carried, exposition to loads of shaft as well as of assembling and manufacturing requirements. Accordingly the designing of shaft is a designing-calculating operation by which we approach the final geometry of a shaft in an iterative way.

During the designing process data and suggestions in different standards must be taken into consideration. This requirement can be met by forming appropriate data-base and ensuring its use from the program.

3.1. Designing by Means of Building Units

A shaft can always be divided into sections the surfaces of which can be classified as follows

- cylindrical
- conical
- cross-sectional with transition
- chamfering, rounded edges
- threaded
- with drilled holes
- with cutting
- with flattening
- grilled
- splined.

To apply all these in designing it is practical to use menu-technics with pictogramme and treat geometrical and technical data of the selected menu elements together. Thus the time for the purely geometrical designing can significantly be reduced as against the application of general purpose drawing systems.

3.2. Analytical and Building Unit Designing

The geometry of components mounted on the shaft and their connection to the shaft define the geometry of shaft section (e.g. shaft hub-joint). The program systems for analytical designing of carried machine elements (e.g. shaft joints, geared couple) should be made capable for the geometrical representation of the appropriate elements. The shaft sections obtained this way can be joined into one shaft by means of the above mentioned building elements or of the general purpose drawing system.

On the basis of the available geometry the stresses and supporting forces can be defined at a "pre-designing" level. The geometrical data for the program system used to carry out the analysis must - according to calculation model (e.g. section-matrix method) - be produced automatically, other data (e.g. modulus of torsional shear, support model etc.) must be entered manually.

With the knowledge of supporting forces the designing of bearing support can be effected and in the case of rolling bearing support for instance - making use of the data base - the bearing section can automatically be represented on the drawing of a shaft.

For the fixing on the shaft of components mounted on the shaft (e.g. distance ring, ring fastener, bearing nut, etc.) also a menu with pictogramme is applicable by which the geometry of the designed shaft can be made more precise.

For the creation of cross-sectional transitions it is also practical to use menu technics. This way it will be possible for us to dispose of the parameters necessary for definition of safety against fatigue.

4. Application of this Concept with the CADKEY System

By starting the shaft designing program a distance must be given that refers to the length of the shaft to be designed. This can later be altered. On the display a centre line will appear followed by the main menu of the system. See *Fig.2.*

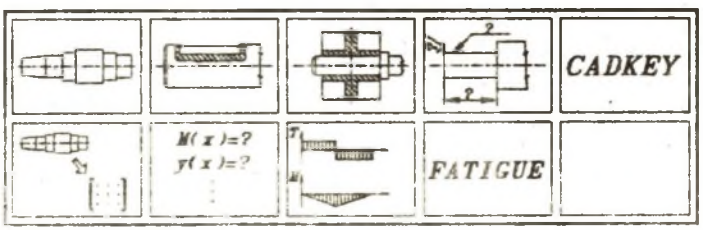

Fig.2.

Choosing the field of the menu (1,1) the menu of the type-elements *(Fig.3)* will appear from which we choose the appropriate element and can draw it on the specified point on the centre line after supplying the suitable sizes.

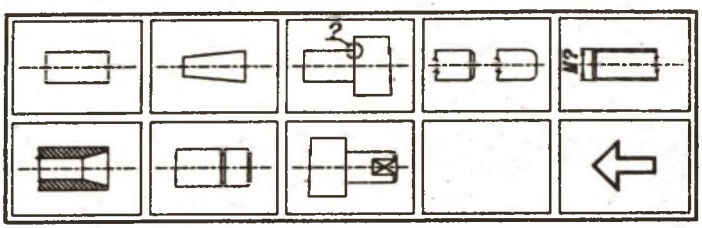

Fig.3.

When selecting field (1,3) in *Fig.3* the menu in *Fig.4* will appear and the cross-sectional transition can be drawn.

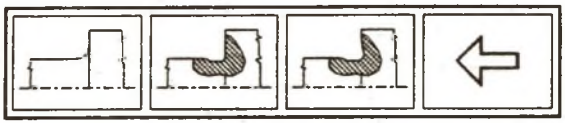

Fig.4.

Selecting field (1,5) in *Fig.3* we can produce a threaded surface on an external cylindrical surface making use of the menu in *Fig.5.*

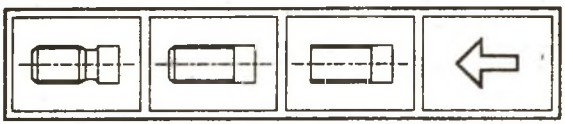

Fig.5.

Selecting field (2,1) of the menu in *Fig.3* the geometry of holes can be drawn on the basis of menu in *Fig.6* while with the selection of field (2,2) a cutting can be made for the safety ring by applying data from data-base.

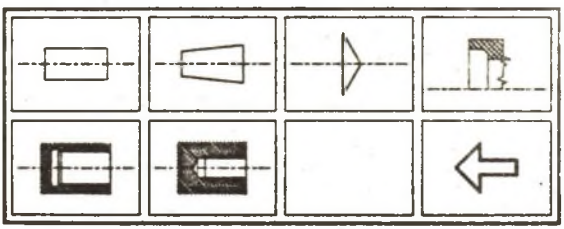

Fig.6.

Selecting field (2,3) in *Fig.3* we can carry out flattening or cutting on a cylindrical section with the help of menu in *Fig.7.*

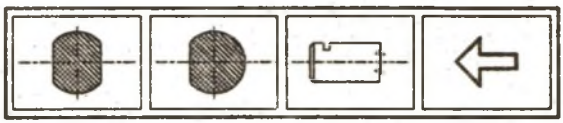

Fig.7.

Selecting field (1,2) of main menu in *Fig.2* shaft couplings can be designed and drawn according to the menu in *Fig.8.*

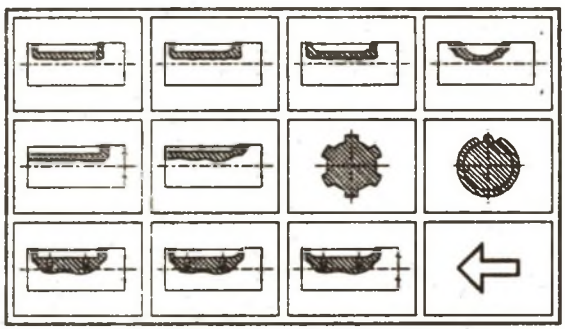

Fig.8.

After the selection of joint type and providing its location on the centre line, the design program - which operates in an interactive way - begins offering an alphanumeric display of the data in relevant standards.

By selecting field (1,3) of main menu in *Fig.2* the menu in *Fig.9* will appear.

Fig.9.

Field (1,1) of the menu is hub-type, field (2,2) serves for drawing of distance element carried. Field (1,3) is suitable for representation of the crown of the saw-toothed element. By making use of the possibilities offered by CADKEY an optional connection can certainly be drawn between hub and crown.

With the application of field (2,1) of main menu in *Fig.2* a pre-processing necessary for calculations of strength for shafts can be made. For the program system operating on the method of transitional matrixes the shaft is modelled by cylindrical sections of permanent cross-section or conical ones and chamfering applied in cross-sectional transitions and cutting are not considered. As a result of processing the drawing of shaft-model appears on the graphic screen on which loading points, sing true components and supporting points must be given. The support model can be solid or flexible. In the case of solid support the possibility of supporting force (axial, radial, axial and radial) must be given while with flexible support a suitable solidity. In addition to these the rotation axis and the angle included by gravity acceleration, gravity acceleration, the modulus of torsional shear of shaft material, Poisson factor and density should be provided.

With the selection of field (2,2) of main menu in *Fig.2* the calculation can be started and the graphic display of calculation results is ensured by the selection of field (2,3).

With the knowledge of supporting forces the designing of roller bearings can be effected which can be started on the basis of field (1,4) of menu in *Fig.9.* The program system designing bearings is based on procedures and bearing types in SKF 8200 and FAG bearing catalogues. The representation of sectional drawings of bearings designed for service life may results in the alteration of the geometry of shafts designed so far. The alteration can be done by means of sub-functions of CADKEY. For the calculation of strength of altered shaft a geometric pre-processing can again be conducted.

When selecting field (1,4) of main menu in *Fig.2* the menu in *Fig.10* will appear and it offers help for production of the shop-drawing.

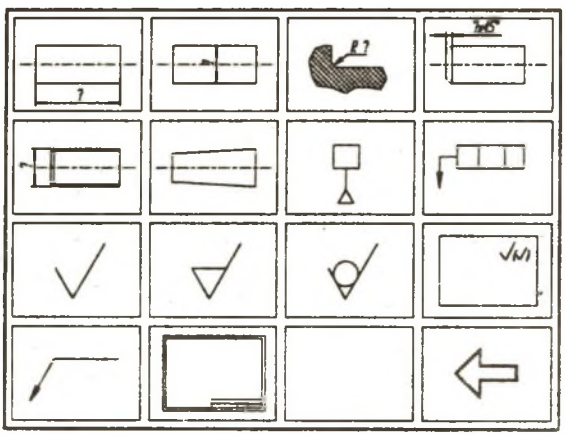

Fig.10.

It is of particular importance when calculating safety against fatigue that the values of surface roughness should be given for cross-sectional changes.

By selecting field (2,4) of the main menu the program for calculation of safety against fatigue can be started which is based on TGL 19340-84. The interactive operation of the program provides accessibility to data which are not yet available for the given calculation.

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DIE KONZEPTION DER PRÄ- UND POST-PROCESSES ZUM PC BASIERENDEN CAD SYSTEMS

Zuzammenfassung

Die Arbeit demonstriert eine konzeption und ihre Anwendung für Prä- und Post-processes zum Konstruktionssystem von Wellen auf einen PC.

KONCAPCJA PRE- I POST- PRZETWARZANIA PODSTAWOWYCH SYSTEMÓW CAD NA KOMPUTERY PC.

Streszczenie

W artykule opisano system projektowania wałków, który nie tylko skraca czas pracy urządzenia rysującego w porównaniu z głównym celem graficznego systemu projektowania, ale zapewnia bezpieczny transfer danych i szybkie wykonanie wersji alternatywnych.

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