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IMPLEMENTATION OF MS ACCESS SOFTWARE FOR CASING-CLASS MANUFACTURING FEATURES SAVING

Abstract

Manufacturing features are widely accepted as a means for the CAD, CAPP and CAM systems and their integration. Despite high number of works in this area, the investigations on the methods on manufacturing features saving are still limited and many results are not suitable for manufacturing systems design purposes. The paper presents possibility of using the MS Access software for saving and management of constructional data of casing-class parts. Therefore, the method of representation and saving casing-class constructional knowledge was developed. The proposed method is based on application of the design feature technique.

1. INTRODUCTION

The increase of global competitiveness, motivates manufacturers to realize their processes in more and more efficient way. On the other hand individualization and complexity of manufactured products caused the complexity of production preparation and management. In consequence, these challenges are the main cause of permanent development in such areas as production preparation processes and realization of production processes. The manufacturing process planning is one of the most important action in the domain of both technical production preparation [1,2] and manufacturing systems design [3,4].

Manufacturing feature technology is the subject of many works. Especially high number of works deals with the algorithm for feature recognition [5,6,7]. Despite underlining the significance of the manufacturing features in CAD/CAPP integration [8,9,10] or detailed descriptions of applications

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of manufacturing features in different manufacturing process planning activities [11,12,13], there are only works about the logic structure of the database used for a the storage and processing of manufacturing features [14,15].

Databases significantly influence the application of computer techniques. To make database software useful for manufacturing features storage the proper method of representation and saving constructional data is necessary. This paper presents the conception of method of representation and saving constructional knowledge about casing-class parts using the MS Access system. This solution was successfully implemented for computer aided machine-tool selection for flexible manufacturing systems [16-21].

2. METHOD OF REPRESENTATION OF CONSTURCTIONAL FEATURES

In this work the concept of '*construction*' word is understood in accordance with definition presented by J. Dietrych [22]. Following to this definition, '*construction is a configuration of features and different states of a part*'. Determination of construction depends on assigning of part's states. Construction is determined by defined constructional features. Identification of constructional feature depends on selection of constructional structure and configuration of dimensions what can be presented as below:

$$C = f(\Pi; Y), \quad (1)$$

where: C – constructional feature,
 Π – constructional shape of part,
 Y – configuration of dimensions.

According to J. Dietrych's definition, constructional shape of part is quality constructional property, while configuration of dimensions is a way of identification constructional features. Simultaneously, only construction determines permissible decomposition identified using a configuration of dimensions. Formal representation of W dimension as an element of configuration of dimensions can be submitted as below:

$$W = N + T, \quad (2)$$

where:
 N – rated dimension,
 T – tolerance of dimension.

After analyzing traditional constructional and technological documentation of casing-class parts and also available in literature solutions concerning with designing of technological data base and data management, the method of representation and saving constructional data was developed. This method was based on three-levels data base what was shown in fig. 1.

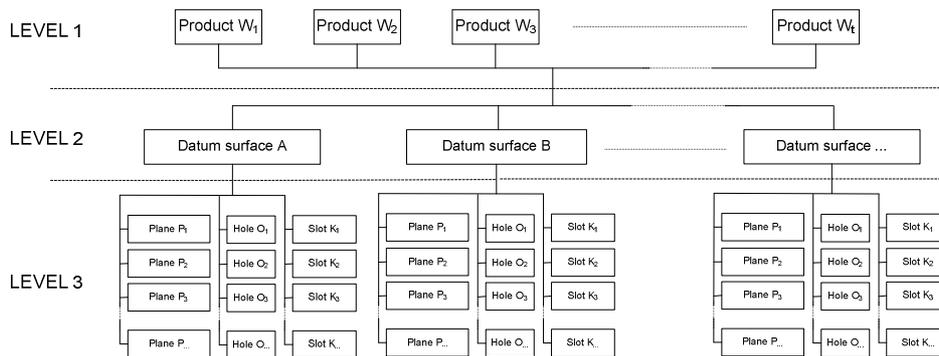


Fig. 1. Structure of database for saving data on casing-class products to be machined in a FMS [source: own study]

From Level 1 the user can input data of informative character and define the product to be machined in the FMS. In particular, the input data will include such items as:

- the name of the product,
- product's symbol,
- overall dimensions of the semi-finished product (including distances required for fixing the product on a machining palette or in a fixture),
- weight of the semi-finished product,
- assumed annual production program for the part.

Level 2 is used to define the datum surfaces for the machining of the part. The datum surface is taken as an actual or a virtual plane within the machining space, defined in terms of position, permitting precise parameterization of coordinates of features involved in the machining process of a specific product. A uniform system of classification of machining datum has been developed for the purposes of description of datum surfaces when machining parts.

Level 3 of the database is used to define the consecutive features to be machined, with relation to specific products from the casing class. In particular, there is a possibility to define three basic types of machined features – planes, holes, or slots.

2.1. Classification of the basic datum surfaces for the machining of the casing-class part

To make an automatic verification of machining specified part on specified machine tool possible it is necessary to simultaneously define both the position of the part and position of all objects to be machined in the machining space of the machine tool. But it is also important to define not only position but also side from with the machining process will be realized.

Casing-class parts are objects which have three-dimensional character, and machining process for these parts can be realized in flexible manufacturing system after fixing them on the technological (or machining) pallet. In order to realize proper description of basic datum surface for the machining of the part the literal-numerical system was taken. This system allows for determination of datum surface and coordinates of basic point which is characteristic for the position of basic datum surface for the machining (fig. 2).

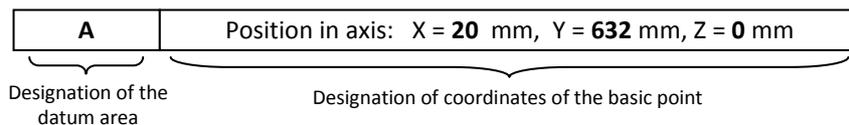


Fig. 2. An example of designation of basic datum surface for machining [source: own study]

The system of classification of datum surface for machining was based on five basic datum surfaces for machining designated using the symbols as below (fig. 3):

- A – basic datum surface for machining (cutting plane) parallel to the surface of technological pallet,
- B – basic datum surface for machining (cutting plane) perpendicular to the surface and parallel to one of longer edge of technological pallet
- C,D,E – basic datum surface for machining (cutting plane) perpendicular to the surface of technological pallet turned in accordance with the direction of clock-hand moving adequately for an angle 90°, 180° and 270° in relation to defined B basic datum surface.

In case of existing additional datum surfaces for machining placed into specified angle in accordance with the location of basic datum surface for machining the destination has the literal-numerical character. Letters indicate basic datum surfaces which are the basis for determination of placement and number which determines the angle of cutting-plane location in accordance with basic surfaces (for example: designation AE 30 determines basic datum surface placed between cutting planes A and E slanting into angle 30° in according to basic datum surface for machining A – fig. 4).

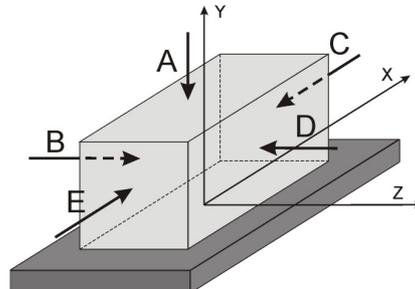


Fig. 3. Literal denotation of basic datum surface for machining [source: own study]

In order to define in an unequivocal way the basic datum surface for machining in machine-tool's machining space it is needed to define coordinates of location any basic point on the plane in according to co-ordinate system with origin of coordinates in the middle of front plane of technological pallet on which the object to be machined is fixed (fig. 4).

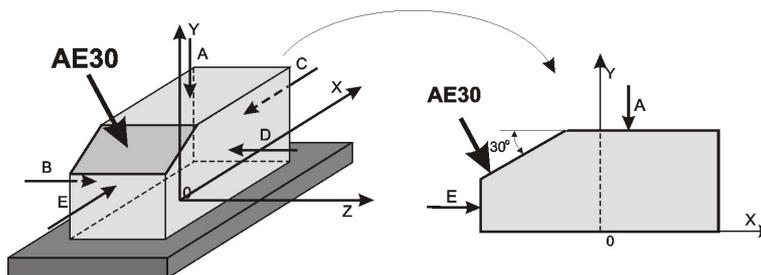


Fig. 4. An example of indicating the basic datum surface for machining located with the angle 30° in relation to A and B basic datum surface [source: own study]

2.2. Saving constructional knowledge about parts to be machined

Defining the basic datum surface for machining according to the classification gives possibility to define datum surface for machining in machine tool's machining space and determines the cutting plane of reference for each object intended to be machined in specified part. Analysis of features of casing class parts allows to specificate three elementary objects which are machined in this type of parts:

- Planes,
- Holes,
- Slots.

Planes are the most often machined to obtain surface's roughness or flatness imposed by the constructor. It is possible to distinguish two types of planes: internal (grooves) or external (shelves), for which are defined: coordinates of machining range in X and Y axis (in local co-ordinate system on the basic datum surface for machining in relation to placement of basic point), value of withdrawal from basic datum surface for machining, roughness of butting and/or lateral face (for grooves) and also different information concerning with the machined surface (for example: flatness deviation).

Holes can be divided in cylindrical hole (straight forward) and conical (convergent). In case of holes defined parameters are: coordinates of hole centre, its dimensions (diameter or diameters, angle of inclination), roughness parameters, deviations of position and dimension, information about its materiality, thread, machining depth and others.

The characteristic type of object which can be found in casing-class parts are slots completed for fixing with using o-rings. These objects, performed most often by the milling or reaming are some kind a special type of "cut-outs" performed in machined earlier holes. For slot-type objects defined parameters are: coordinates of slot centre, width and diameter of slot, value of withdrawal from basic datum surface for machining, value of roughness of cylindrical and frontal surfaces of slot and other values connected with the object (for example: deviations of position and dimension).

All of presented above objects are defined individually and independently apart from each other and each of these is identified using the unrepeatable symbol given by the user in the moment of input the object into database. In case of complex holes (with cylindrical or conical spot facing) they are decomposed into elementary elements (cylindrical or conical hole) where each one is defined separately.

For unequivocal determination of orientation in machine tools machining space, it is necessary to define coordinates in relation to connected with the object basic datum surface for machining. Coordinates of position of characteristic point (or characteristic points) – i.e. center of the hole or the slot are determined in two-dimensional local co-ordinate systems. One is the plane which is overlapping with basic datum surface for machining where its center is overlapping with the basic point of datum surface for machining (fig. 5).

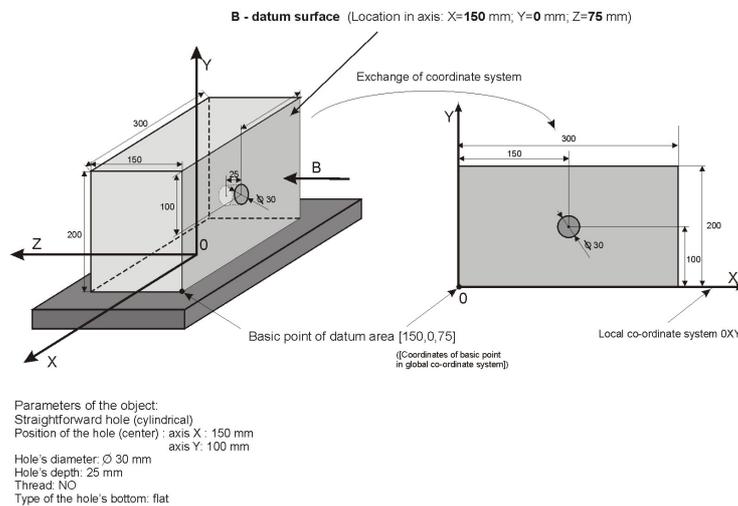


Fig. 5. An example saving data about location and parameters of selected cylindrical hole-type object [source: own study]

3. SAVING CONSTRUCTIONAL DATA ABOUT CASING-CLASS PARTS USING MS ACCESS SOFTWARE

The database where manufacturing features of parts intended to be machined in FMS are gathered using MS Access system and in this article the database is presented as a part of the system <<OPTSELECT>> which allows for computer aided machine tools selection for casing-class flexible manufacturing system. Its starting, which allows to input constructional data, is realized from the main form of program by trusting the bottom “Data input about parts to be machined in FMS” – fig. 6.

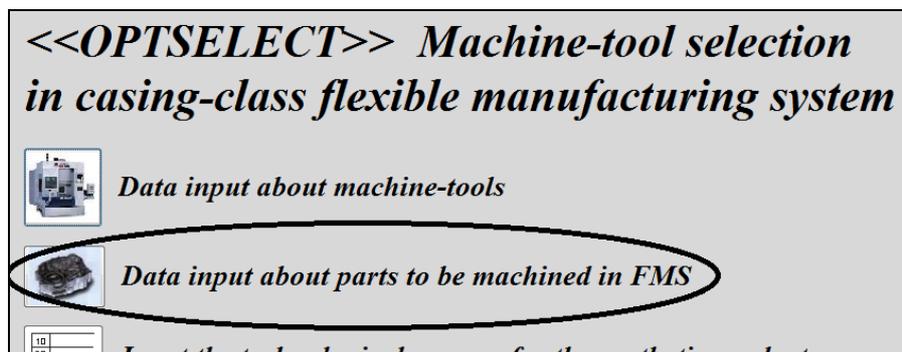


Fig. 6. Starting the constructional features database [source: own study]

Database where the saving process of constructional features of parts to be machined in flexible manufacturing system has three-levels structure according to brief foredesign presented in section 2 (fig. 1). Starting the database causes opening the main form of data base, which gives possibility to input data of informational sense which define the part to be machined in FMS – fig. 7.

Catalogue of casing-class parts to be machined in FMS

Identification number: 1

Part's catalogue number: 419-40-1002

Name of the part: Cylinder block

Overall dimensions of semi-finished product

Length (L): 712 mm

Width (B): 243 mm

Height (H): 712 mm

Distance needed to fix a semi-finished product

In axis of the product's length: 76 mm

In axis of the product's width: 307 mm

In axis of the product's height: 178 mm

Weight of semi-finished product: 91 kg

Annual production programme: 760 pieces

Fig. 7. Main form to input data about parts to be machined in FMS [source: own study]

Using the form presented above, the user has also possibility to define all necessary basic datum surfaces for machining in case of consecutive parts moved into system – fig. 8.

Catalogue of casing-class parts to be machined in FMS

Weight of semi-finished product: 91 kg

Annual production programme: 760 pieces

Basic datum surfaces of the part:

Symbol of datum surface: A

Location of basic point: (in relation to the center of the pallet)

Symbol of datum surface	In X axis:	In Y axis:	In Z axis:
A	0 mm	832 mm	0 mm
AB45	0 mm	476 mm	0 mm
B	167 mm	476 mm	0 mm

Go to the datum surface form

Remarks:

Fig. 8. The form for defining datum surfaces for machining [source: own study]

Defining individual objects intended to be machined into a part is possible after opening the datum surface for machining form (button “Go to the datum surface form”) and pressing the button “Add a new machining object” – fig. 9.

Datum surface

Identifier of the basic datum surface
(Generated automatically)

Symbol of the datum surface:

Position of basic point
(In relation to the center of the pallet)

In X axis: mm
 In Y axis: mm
 In Z axis: mm

Add a new machining object
 Save and exit
 Exit without saving
 Close

Fig. 9. Adding a new machining object [source: own study]

When choose the defined object (fig. 10) the user takes advantage of proper appearing form (which is characteristic for particular object) input parameters connected with defined object. The fragment of an example object (cylindrical hole) was presented in fig. 11.

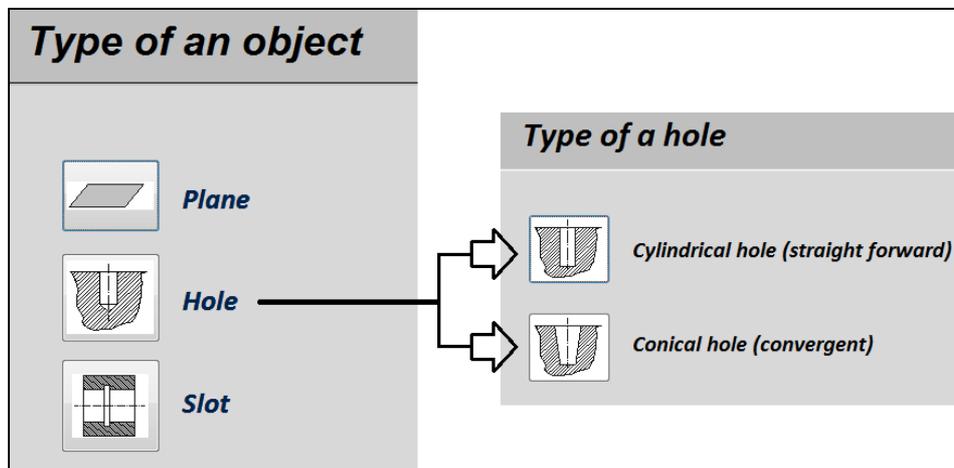


Fig. 10. Following steps in defining the object to be machined [source: own study]

Cylindrical hole

Define the basic datum surface for the hole:
(choice from the list):
B; Location in axes: X: 0 mm, Y: 476 mm, Z: 0 mm

Symbol of the hole: **O3**

Coordinates of the hole's location:

In X axis: 66,25 mm

In Y axis: 333,2 mm

Input tolerance for hole's location

Hole's diameter: \varnothing 13,50 mm

Input tolerance for hole's diameter

Type of a hole:

Arterial

With defined depth

Głębokość otworu (L): 17 mm
(from the datum surface)

Type of the hole's bottom:

Flat

Conical An angle of the hole's bottom: 112 °

Is the hole threaded?:

YES

NO

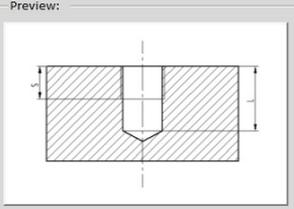
Type of a thread 3/4" - 10UNC - 2B

Thread's depth (S):

The same as the hole's depth

Defined depth: 48 mm

Preview:



Roughness designation:

Roughness of forehead surface: Ra

Roughness of cylindrical surface: Ra

Roughness of a thread: Ra

**Fig. 11. The form of saving data about the object
(an example of cylindrical hole) [source: own study]**

Information about loaded parts, basic datum surfaces for machining and objects can be chosen both from the level of form and the table, where the data are saved. Passing between separate forms is possible thanks to navigational buttons located on each of the form. From the level of particular form it is possible to check each time all connected objects (for example: part and defined basic datum surfaces, or the basic datum surface for machining and connected objects).

All constructional data about parts to be machined are saved in 10 connected tables. Detailed specification and relation between them were presented in fig. 12.

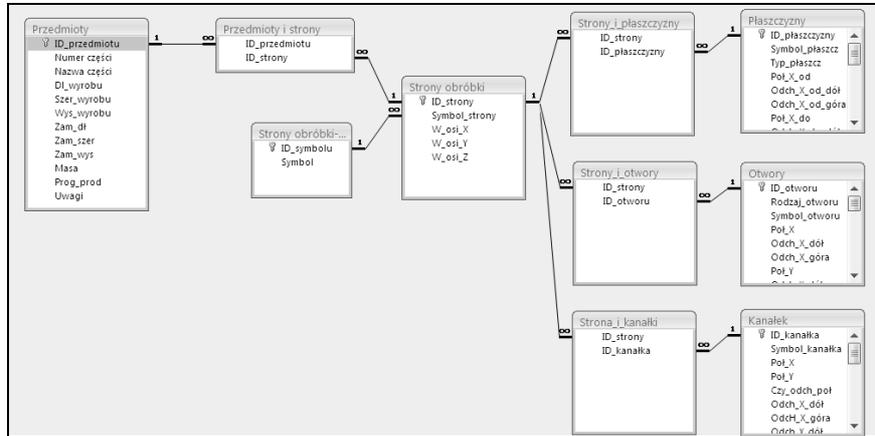


Fig. 11. Tables and relations between tables in database about parts [source: own study]

4. CONCLUSIONS

One of the fundamental tasks when design and develop software which helps the human to realize any activity is to guarantee possibility of simple and fast input appropriate data and in such way that it would be possible to select, look over and verify them. In order to make it possible one often has to develop the conception of gathering information is structuralized way, that gives further possibility to fast access to their source and fast processing of them.

This kind of problem is possibility of saving technical knowledge (constructional and technological) about parts to be machined in manufacturing system in such way to make possible the optimal selection of machine tools used for their processing. In this article the method of representation and saving constructional data about casing-class parts was presented. This method was submitted in context of problem of machine tools selection in flexible manufacturing system. The presented method allows for relatively fast and simple “transfer” data recorded as traditional constructional and technological documentation to computer software which helps the designer to select the FMS machine tools subsystem.

The presented method was based on three-levels data base which allows for saving constructional parameters and in different module – technological knowledge. This conception was implemented in the surface of MS Access database software and is an integral module of <<OPTSELECT>> program which is dedicated for casing-class flexible manufacturing system machine tool subsystem selection. The method can be moreover used in an independent way both for different task where the computer saving and registering technical documentation is necessary and also in different user applications.

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