THE ANNALS OF „DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICAL ENGINEERING, ISSN 1224-5615
2009

SPECIFIC ASPECTS OF MODELLING AND DESIGNING GEAR PUMPS

Assoc. ec. dr. eng. Adrian Mihai GOANTA
University "Dunarea de Jos" of Galati,
Research Center for Mechanics of the Machines
and Technological Equipments

ABSTRACT

The paper intends to highlight, in the context of general geometrical modelling, the specific aspects of design and modelling of a gear pump. In practice in such situations containing toothed gear it is recommended to use specific subroutines that are able to access library data bases.

KEYWORDS: CAD/CAE, Autodesk Mechanical Desktop 2008

1. Introduction

CAD - Computer Aided Design is now increasingly used in the various fields of mechanical engineering, architecture or product design, being a rapidly developing field. The modern design assistance is no longer limited only to the systems simple drawings using the computer, followed by placement of sizes and shades, but have evolved by adding features and new instruments for 3D modelling, with the possibility of creating solid models and geometric surfaces, based on the parameters specified by the design engineer.

The design is an iterative process and consists of several phases, some wider, some more diminished. These phases are:

- **Comparative study** –allows to identify the shortcomings of the already designed products and it is carried out by an experienced engineer that concludes whether launching a new product is convenient
- **Defining functions** refer to determining both the main function and the secondary ones the and grouping them into a specification of the product to be designed. Specification includes the physical and functional features , cost, quantity and operating performance
- **Synthesis and analysis** are relatively interlinked and are contained into an iterative process. A particular component of a comprehensive system is conceived by the designer, analyzed, and improved through analysis and redesign. This process is repeated until the project is optimized under the constraints imposed by the designer. Components and subsystems are summarized in the global system in a similar way
- **Evaluation** refers to the degree of meeting the conditions set out in the specification established in the problem definition phase. This assessment often requires the manufacture and testing of a prototype model to obtain data on performance, quality and profitability;
- **Presentation** is the final phase of the project and includes the necessary documentation, namely the project execution drawings, specifications of materials, parts lists, etc..

With this type of pump and engines the transmission of pressurized fluid between suction and discharge is performed by the gaps between the pin teeth, the housing and side covers, the fluid circulation in the pump, between suction and discharge taking place as shown by the arrows in Figure 1.

Aspiration is determined by the depression that arises at the gear teeth outlet in the suction area, fluid is discharged at the gear teeth inlet in area R. The efficiency of transport is influenced by the radial clearance between the teeth and the outer housing, as well as by the axial clearance on the front surface between gears and side covers. Transmission is provided by the upper pins, which, through the gear, causes the bottom gear to move as well.

Due to the existence of two zones with different pressures, low pressure suction A and high pressure discharge R, a strong imbalance of forces in the static pump (and engine) occurs the resultant being directed from R to A

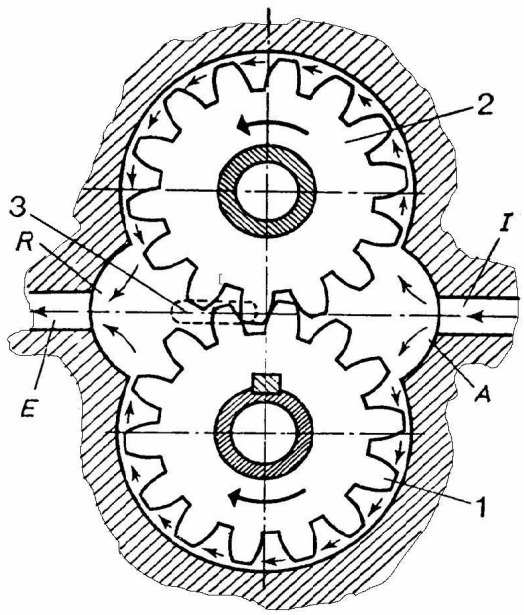

Figure 1. Sketch of the external oil gear : 1- leading gear ; 2-led gear ; 3-lathing ; A-suction space; R-discharge space

2. Theoretical Aspects of Mechanical Desktop Design

Three-dimensional modelling of the oil pump from Dacia 1310 underlines the benefits of 3D design using one of the most used software packages produced by Autodesk Inc. namely: Autodesk Mechanical Desktop 2008. Assembly generating starts from the creation of each item of the pump, namely: pins, lower body containing pin box and oil propulsion groove/channel , the upper body or sieve , shaft, arch and ball, holding screws, nuts and the sieve which draws the oil from the bath oil.

Parameterization of each item is based on the working plan "*Work features / Work Plan*" in the "Part Modelling menu , drawing the profile sketch, add profile to the work plan, applying the constraints and sizing the profile by introducing the actual dimensions. Perhaps the biggest advantage of parameterized modelling is to save precious time to generate views and sections. Thus, for the three projections of a particular item, open the "Drawing layout, select the" Multi-views", then choose the type of view you want to do , select the plan from which we look, return to format layout and using the mouse position the 3 projections, and the axonometric view . Autodesk Mechanical Desktop 2008 includes tools for sizing pieces (which can be parameterized and defining a size can be done by equation) and also for the drawing annotations, tables etc. for holes, all these being changed automatically according to changes made in the part geometry.

Automatic generation of design and execution and bidirectional association along with the 3D model is one of the most important features of the software used. Projections are generated in "Paper Space" and can be of the following types: *base, orthographic, isometric, auxiliary, partially sectional, full sectional, sectional offset, iso-sectional, detail, user-defined*.

Any change in the three-dimensional model will be reflected in the design and execution, as any change of size will lead to changes in the model

3. Generating Gears Teeth

The gear teeth can be generated by the following two methods:

- **Manual method,** which involves defining an involutes arc with the size resulted from an engineering calculation, corresponding to the tooth flank, an arc which multiplied polar around an axis of rotation and completed with circle arcs delimiting the head and foot of the tooth lead to a final sketch of the front tooth, by extrusion this further generating the 3D model of the gear. Mention must be made that this method is recommended for experts in designing and generation, who master very well the technique of engineering calculation and subroutines AutoLISP for the generation of involutes type curves.

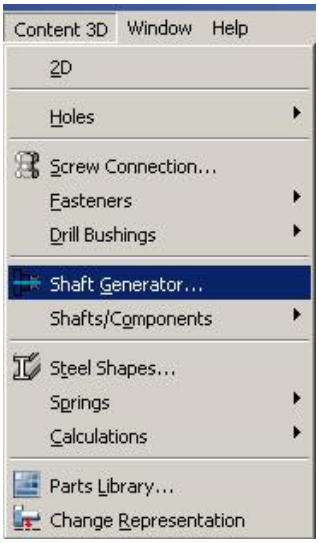

Figure 2. Launching command "Shaft Generator"

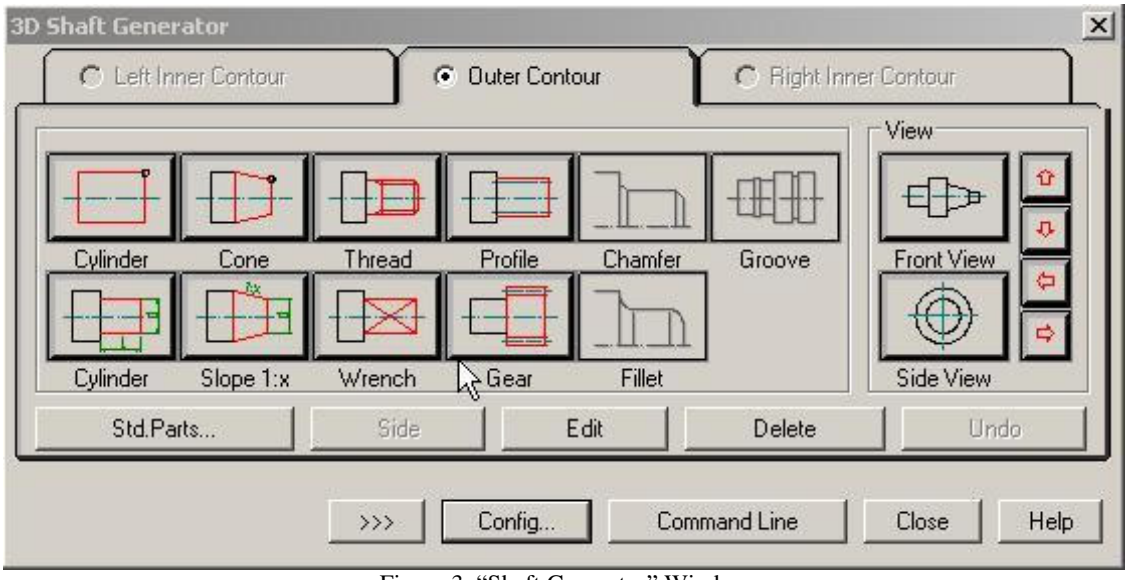

Figure 3. "Shaft Generator" Window

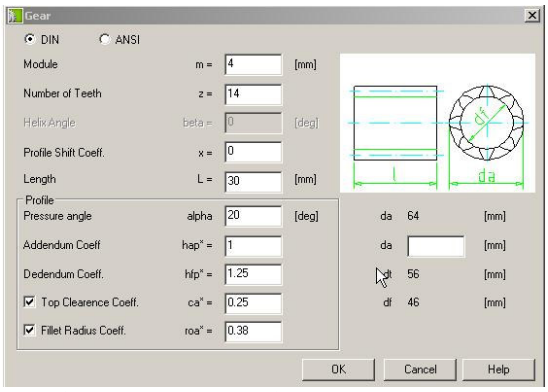

Figure 4. Gear generating parameter window

- **Automatic method** of generating gears by command "Shaft Generator" from "Content 3D" menu - as shown in Figure 2, which involves opening a generating window title " 3D Shaft Generator " - Figure 3 where option "Gear" generation" will be chosen.

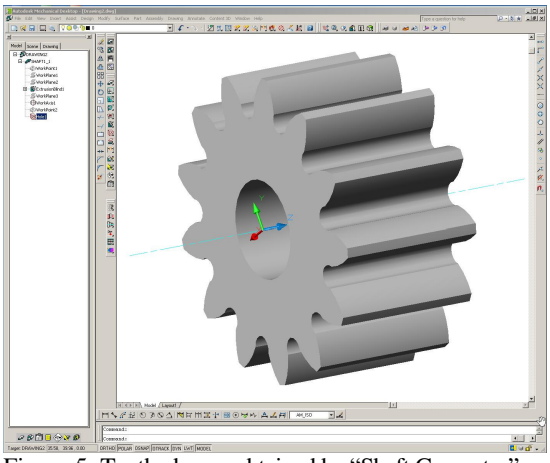

Figure 5. Toothed gear obtained by "Shaft Generator"

This option will open a new window shown in Figure 4, where the designer must define all the numerical values of the requested geometric parameters. The result of the gear generation subroutine is presented in Figure 5.

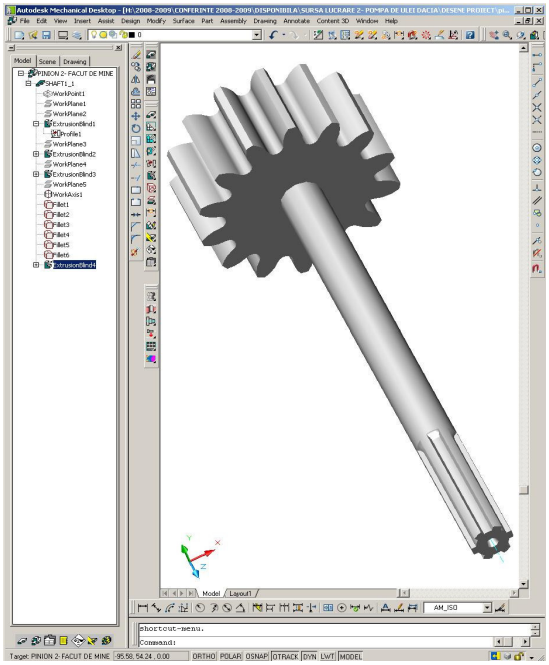

Figure 6. Leading shaft

Similarly, the pair of toothed gear was made, having the role of a leading wheel. It should be noted that it must be keep in mind that both toothed gears have the same module and their external diameter should be taken as a parameter in the pump body design draft/sketch, for the cell generation where the pair wheels would spin. Also in case of the leading gear , by means of command "Shaft Generator" it

was generated the cylindrical portion of the rod and the groove at the rod end which takes the rotation torque. The groove library contains both grooves as such and various profiles, standardized or not, that can be used by the designer to complete the end of a shaft.

4. Generating the Toothed Gear Pump

After the two toothed gears were modelled, each item can be modelled and in the end the related model can be generated taking into account the 3D restrictions of the adjoining pieces. For a better visualization, in Figure 7 there were assigned glass properties to those components that cover the gear. It should be noted that the items of body and cover types are characterized by a remarkable complexity of geometric forms.

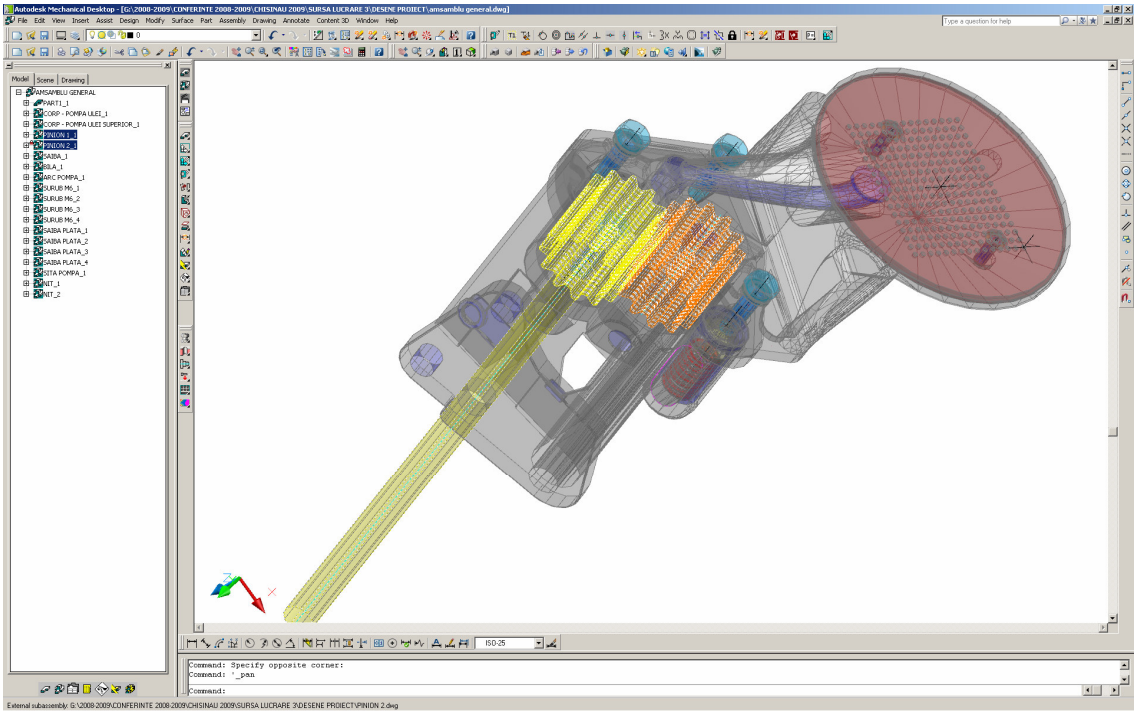

Figura 7. Model related to the gear pump assembly

5. Conclusions

After completion of the design process, it is important to transmit accurately the design parts information to the teams responsible to order and manufacture the product. If a general software design is used, this operation often involves the manual creation of tables and lists of materials (BOMs). Even in the case of the smallest changes in design, the manual methods can introduce critical errors that could lead to delays in its delivery to the customer. To prevent errors and costly delays, Autodesk Mechanical Desktop 2008 offers the possibility of making up a list of materials (BOM) integrated into normal work flow so that the component table and the BOM contain information on the component parts, the whole information being updated as soon as a change in design is made. These accurate data allow designers to work more effectively with other departments and suppliers.

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