THE APPLICATION OF COMPUTER IN THE DESIGN OF THE TWO-STAGE REDUCTION GEARBOX

Mr.sc. Azemi F.[1], Mr.sc. Pllan G.[2]
Technical Secondary School "Lutfi Musiqi" – Vushtrri, Republic of Kosova[1]
Faculty of Mechanical Engineering – University of Prishtina, Republic of Ksoava[2]

Abstract: The realization of a product or a mechanical system must be passed through several stages starting from the idea to create the new product until the prototype testing. In between these phases, including these, there are a lot of activities and a great deal of work. The application of computer in this field has enabled a higher efficiency and more rational usage of time. In this paper we have presented practical applications of computer in the design of machines and the formation of their families, specifically in the design of the two-stage reduction gearbox.
All elements of the product or of the mechanical system have to be constructed detailed, where we have created a software which calculates all gauge sizes of the reduction gearbox, while other members may be obtained on the basis of geometric similarity of products with the application of this software.

Keywords: DESIGN, MACHINE, COMPUTER, SOFTWARE, TWO-STAGE REDUCTION GEARBOX.

1. Introduction

In the process of constructing, computer plays a very important role, serving as a powerful tool which drastically shorts the time from initial process to final product. Besides the major benefit in time, the application of computers in the process of construction has also other positive effects such as: processing and accurate calculations of data, easier access to improve the errors, can be simulated processes, analysis and optimization processes, etc. There are many different software which today are used in the construction process of mechanical parts, to calculate the dimensions and all characteristics gauge sizes of the two-stage reduction gearbox we have created software which also is used to create their families. Task of the user of the program is to provide some data and the program makes all the calculations and creations other members with the same features but with different dimensions

2. PREREQUISITES AND MEANS FOR SOLVING THE PROBLEM

From the geometric similarity it's possible design of the family of products of the same construction (shape and characteristics) but with different size and loads.

Details should be calculated construction of one member of family, while other members of family gained with the application of geometric similarity (Cauchy's) and geometric progression of Standard Numbers (Renard-it).

In this paper we have created software that calculates all the characteristics of the two-stage reduction gearbox, and with applying geometric similarity and geometric progression series of standard numbers, the software creates other members of family of two-stage reduction gearbox. Software is created with the help of C + + programming language.
Now we will present some formulas which are used in this program.
Calculation of the axial distance of two-stage reduction gearbox:

$$a = a_{12} + a_{34},$$

$$a_{12} = \frac{m_n}{\cos\beta}\left(\frac{z_1 + z_2}{2}\right),$$

$$a_{34} = \frac{m_n}{\cos\beta}\left(\frac{z_3 + z_4}{2}\right),$$

Where are:
$m_n[mm]$- module of teeth,
z_1, z_2, z_3, z_4- number of gear teeth corresponding,
β- inclined angle of teeth.

General report of transmission of two-stage reduction gearbox is:

$i=n_h/n_d$,
where are:
$n_h[r/min]$ – number of rotations at the entrance of two-stage reduction gearbox,
$n_d[r/min]$- number of rotations at the exit of two-stage reduction gearbox.

Partial reports of transmission of two-stage reduction gearbox by the scales:

$$i_{12} = 0.8 \cdot (i \cdot k_I)^{2/3}, \quad i_{34} = i / i_{12},$$

$$k_I = \sigma_{H\lim I} / \sigma_{H\lim II},$$

Where are:

$\sigma_{H\lim I}, \sigma_{H\lim II}$ - dynamic resistance of the sides of the teeth of scale I and II.

3. SOLUTION OF THE EXAMINED PROBLEM

3.1. DESIGN AND FORMATION OF FAMILY MEMBERS OF TWO-STAGE REDUCTION GEARBOX

For designing and forming members of two-stage reduction gearbox is created software that calculates the size of a member of two-stage reduction gearbox, and other members earned on the basis of geometric similarity and geometric progression of Standard Numbers. Now we will present a performance piece of software, the results obtained will present in the table, as well as 3D views and projections of two-stage reduction gearbox.

Part of the program after executing:

Design of two-stage reduction gearbox:
Input values:

Number of rotations in output: n_o(r/min) =400
Number of teeth: z1=11
Angle beta in scale: beta=9
Module of teeth: mn (mm) =4
Number of teeth: z3=14
Minimum power: Pmin (kW) =2.5
Maximum power: Pmax (kW) =63
Number of family members: mem=10

4. RESULTS AND DISCUSSION

After that the program is executed, are required input values so the program will be done calculations and we obtained results for the number of teeth, the general report of transmission, axle distances, and other sizes that will be presented in detail through tables and diagrams.

Number of teeth z2=34.8326
Number of teeth z4=34.8165
Take on the number of teeth, the nearest integer number z2=35
Take on the number of teeth, the nearest integer number z4=35
****
****
General report of transmission i=7.875
Report of transmission for the first pair i12=3.1666
Report of transmission for the second pair i34=2.48689
Center distance a=192.368
Center distance of the first pair a12=93.1467
Center distance of the second pair a34=99.2215

****
****
Increase factor for power fp=1.6
Increase factor for length fL=1.25
Decrease factor for number of rotations fw=1.25

==========

Basic values of family members of two-stage reduction gearbox earned from program are given in table 4.1.

Table 4.1 Basic values of family members of two-stage reduction with parallel axles

Member	n[r/min]	P[kW]	m_n[mm]	a[mm]	B[mm]	B1[mm]	H[mm]	H1[mm]	h[mm]
1.	2500	4	2.5	112	210	98	237	126	25
2.	2000	6.3	3.15	140	262	122	297	157	31
3.	1600	10	4	175	328	153	371	197	39
4.	1250	16	5	219	410	191	464	246	49
5.	1000	25	6.3	273	513	239	580	308	61
6.	800	40	8	342	642	299	725	385	77
7.	630	63	10	428	802	374	907	481	96
8.	500	100	12.5	535	1003	468	1134	601	120
9.	400	160	16	668	1254	585	1417	752	150
10.	315	250	20	836	1567	731	1772	940	188

Continuation of table 4.1

Member	L[mm]	L1[mm]	M[mm]	N[mm]	d1[mm]	l1[mm]	d2[mm]	l2[mm]
1.	350	350	126	133	35	69	44	88
2.	438	438	157	166	43	86	56	110
3.	547	547	197	208	54	108	70	137
4.	684	684	246	260	68	135	87	172
5.	856	856	308	325	85	169	109	215
6.	1070	1070	385	406	106	212	136	269
7.	1337	1337	481	508	133	265	171	336
8.	1672	1672	601	635	166	331	214	421
9.	2090	2090	752	793	208	414	267	526
10.	2612	2612	940	992	260	518	334	657

In figure 4.1 are presented projections of two-stage reduction gearbox, while in figure 4.2 is presented solid model.

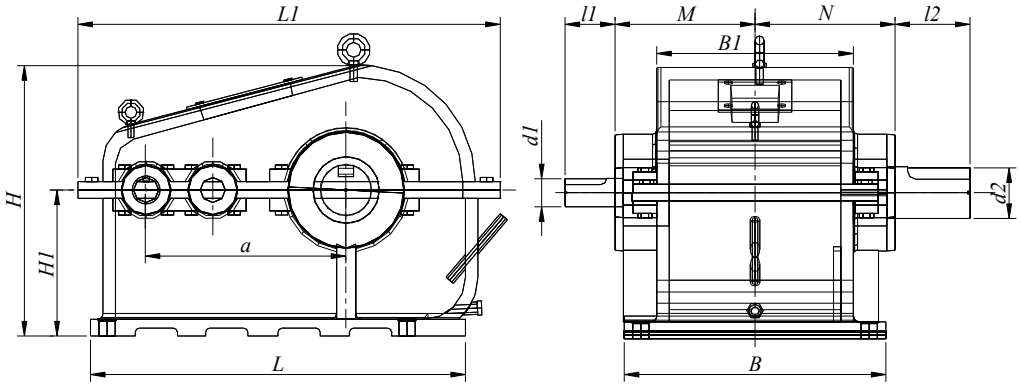

Figure 4.1 Projections of two-stage reduction gearbox

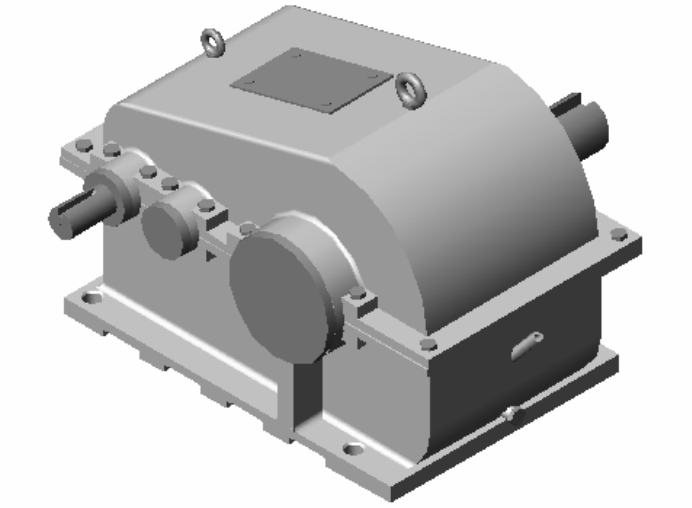

Figure 4.2 Solid model of two-stage reduction gearbox

In Figure 4.3 is presented graphically diagram of change of power and the axial distance of family members of two-stage reduction gearbox, while in figure 4.4 diagram for basic sizes.

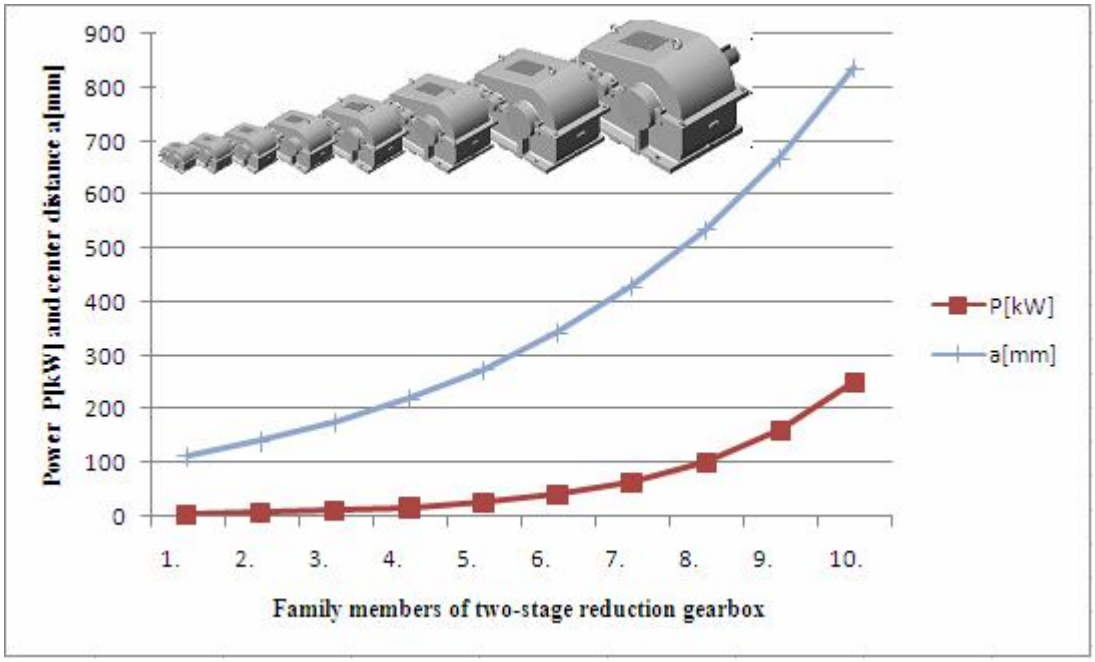

Figure 4.3 Change diagram of power and distance axle by family members of two-stage reduction gearbox

From the diagram that is shown in figure 4.3, we can see that increasing axial distance also increases the power that should carry the two-stage reduction gearbox.

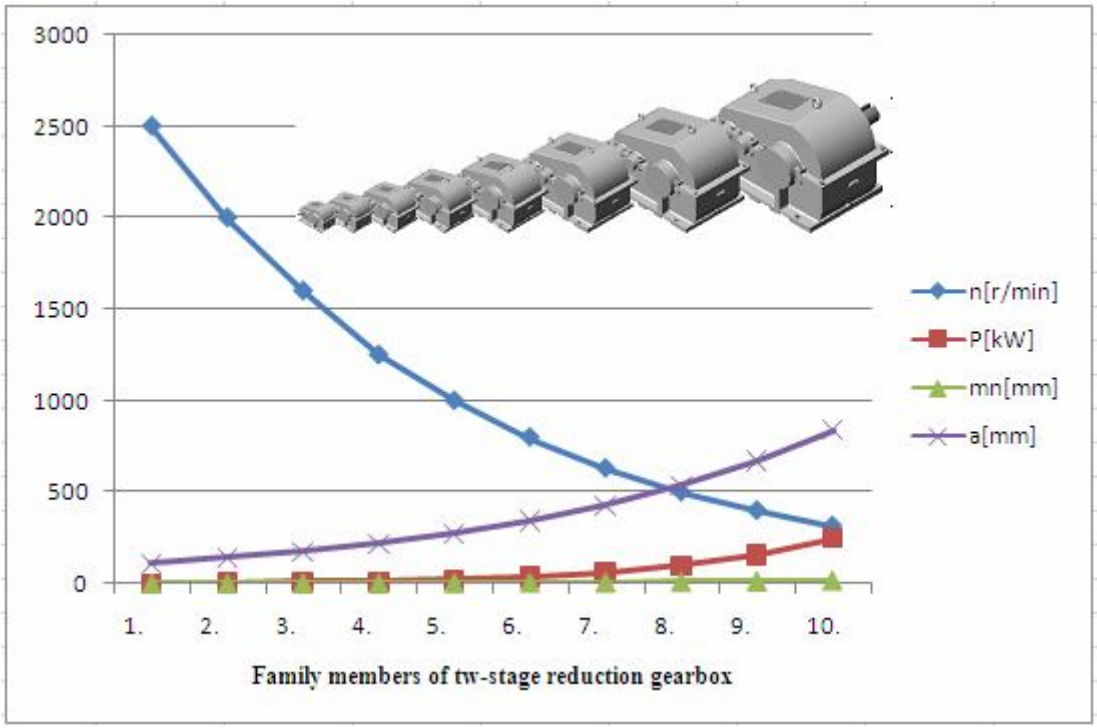

Figure 4.4 Change diagram of number rotations n[r/min], power [kW], module m_n[mm] and centre distance a[mm] by family members of two-stage reduction gearbox

From the diagram in figure 4.4 we can see that increasing the power, reduce the number of rotations from entry to exit of two-stage reduction of gearbox, while other dimensions are increased by factor of growth.

5. CONCLUSION

From the many products designed required that dimensions and their characteristics to be of different size. Market requirements stipulated that the product needed to be with different size that it fit the circumstances and conditions where it will be used, therefore required that product to be with different size that can meet the market demand. Therefore must be created members of a family of same products but with different dimensions and characteristics. Usage of computer in the design of these members as well as, usage of computer in creation of construction of a member of family has considerable effect in shortening the time of product and cost and in increase efficiency and quality of product.

6. REFERENCES

[1] Azemi F.,dipl. Ing., The analysis and optimization of the factors that indication in the construction of machines with the aid of computer, Prishtine 2004
[2] Ibrahimi N.,Dr.sc., Detalet e makinave, Prishtine 1996
[3] Pllana G., Mr.sc., Jashari I., Mr.sc., Detalet e makinave, Prishtine 1994
[4] Dika A., Dr.sc., Bazat e programimit ne C++, Prishtine 2004
[5] Stroustrup B., C++ Programming Language, Massachusetts 1997
[6] Yarwood A., AutoCAD 2006 2D and 3D design, Great Britain 2006