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RESULTS AND COMPARISONS BETWEEN THE CAD MODEL AND THE PROTOTYPE OF A COUPLING WITH FRICTION SHOES AND ADJUSTABLE CENTRIFUGAL DRIVING.

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Abstract: This paper refers to some aspects of the researches about a new kind of centrifugal coupling - a coupling with friction shoes and adjustable centrifugal driving. A profound analyses and comparison between the numerical results of the prototype and a CAD model directed to insignificant errors at the level of mass properties for the component elements.

1. INTRODUCTION

The CAD modelling represents a major tool into the design process nowadays. It helps by offering lower costs, shorter time, higher precision and a lot of other advantages during the whole process from the idea and final product. Based on this idea, this paper presents some aspects, comparative results and conclusions provided by the analysis: Prototype vs. CAD model. The constructive and functional elements of a coupling with friction shoes and adjustable driving [3, 4] are the subject of this paper.

2. ELEMENTS OF MODELLING

A new kind of centrifugal coupling represented the subject of a profound research activity. As a result, a coupling with friction shoes and adjustable centrifugal driving was realized.

The execution and testing of a prototype were one major goal of the researches mentioned before. In respect of this, a special attention was accorded to the modelling activities based on using CAD software (Autodesk® Mechanical Desktop® 6 Power Pack [1] and Autodesk® Inventor™ 5 [2]). Thus, it could had been realised a 3D high resolution graphic model which simulate very well the prototype, according to both of dimensional and mass characteristics. In order of this, in the figures 1 to 6 are shown some screen capture views of the CAD model.

The CAD models generally help the designer to solve many problems. Particularly this one was very useful, in the previous stages to effective practical execution of the prototype, allowing:

- 3D high resolution views to each part of the coupling, the subassemblies or groups of components and to entire assembly;
- the checking of the dimensional, assembling and proximity / contact / overlap compatibilities of the coupling's parts;
- visual simulations of the movement of main parts and groups of parts which have an active role in the coupling's running (see figure 8);
- the calculation of the mass characteristics of all parts and subassemblies of the coupling etc.

Based on all these aspects a dynamic model of the coupling's operation and also a model for numerical simulations of operating performances could be created.

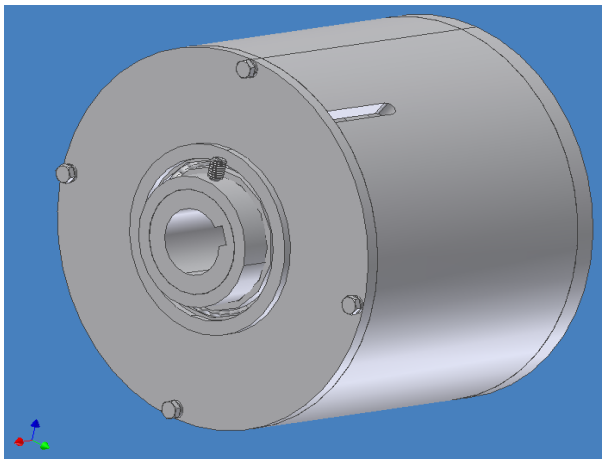

Fig. 1. Exterior view of the coupling

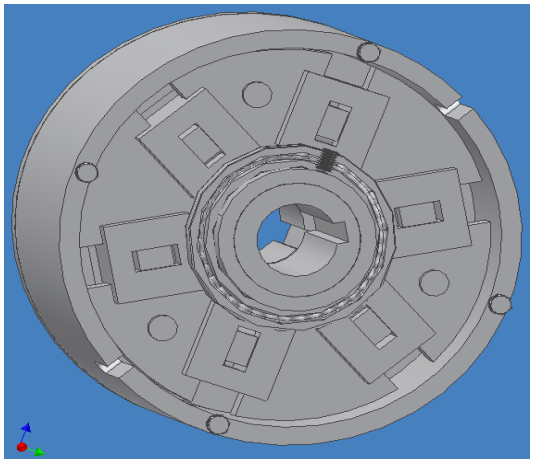

Fig. 2. Internal view of the coupling

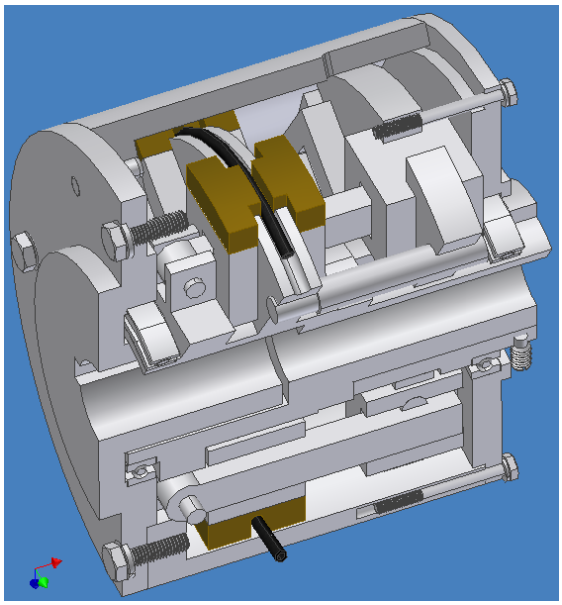

Fig. 3. Partial section

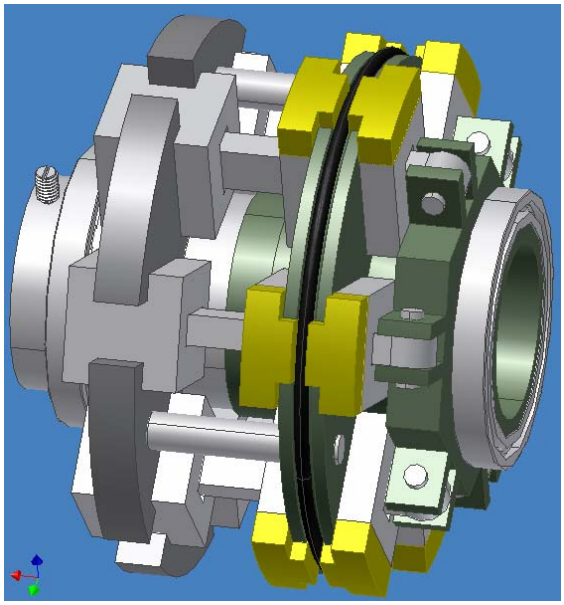

Fig. 4. The driving semi-coupling subassembly

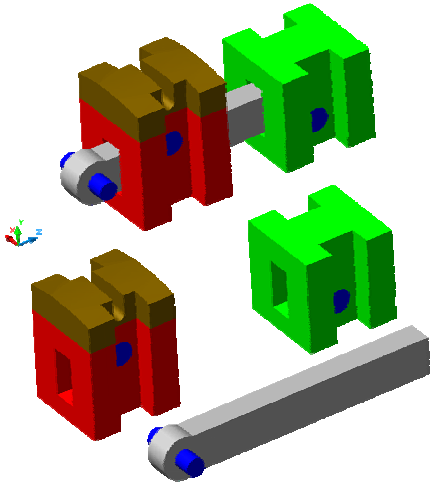

Fig. 5. The parts and group of parts of a driving mechanism

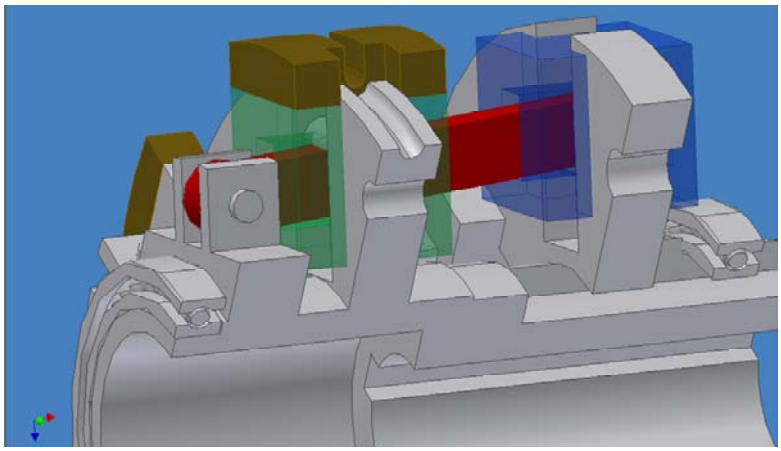

Fig. 6. A driving mechanism into its operational position

As an example of the aspects mentioned before some of the most important numerical results were the mass, the position of the mass centre (centroid) and the mass moments of inertia for the parts, group of parts, subassemblies and the assembly of the coupling. An extract of these results is presented in the table 1. These results were also used into the comparison with the experimental results provided by the analyses of the coupling's prototype (figures 7, 8 and 9). Thus, few examples are shown in the table 2 as an example of the accuracy of the CAD results. Very appropriate values and minimal differences between the mass values obtained by measuring the prototype's parts and the values provided by the CAD model can be observed.

Table 1. Mass properties for the driving parts of the coupling

Part/Subassembly: DRIVING WEIGHT + BOLT			
File: ……			
Mass properties for multiple components			
Input units: Metric (mm, kg)			
Output units: Metric (mm, kg)			
Coordinate system: User coordinate system (UCS)			
Summary: Mass	0.15159473 kg		
Volume	18242.44626947 mm^3		
Surface area	7635.63827473 mm^2		
Centroid		Principal mass moments and axes about CG	
X	0.00000000 mm	I	26.97212571 kg mm^2
Y	47.15695512 mm	Axis	
Z	-38.00000000 mm	X	1.00000000 mm
Mass moments of inertia		Y	0.00000000 mm
X	582.98799886 kg mm^2	Z	0.00000000 mm
Y	243.79268126 kg mm^2	J	24.88989331 kg mm^2
Z	361.10135923 kg mm^2	Axis	
Mass products of inertia		X	0.00000000 mm
XY	0.00000000 kg mm^2	Y	1.00000000 mm
XZ	-0.00000000 kg mm^2	Z	0.00000000 mm
YZ	-271.65234070 kg mm^2	K	23.98827404 kg mm^2
Radii of gyration		Axis	
X	62.01371622 mm	X	0.00000000 mm
Y	40.10220771 mm	Y	0.00000000 mm
Z	48.80592091 mm	Z	1.00000000 mm

Table 2. Mass values for the main coupling parts and group of parts

Part		Part weight			Difference relative to nominal weight	Relative error to nominal weight
		Real	Nominal (Theoretical)	Provided by CAD software		
Type	Mechanism index	10^{-3} [kg]			10^{-3} [kg]	[%]
Driving weight	1	153.118	152	151.59473	1.1180	0.735526316
	2	152.0874			0.0874	0.0575
	3	152.0788			0.0788	0.051842105
	4	152.6417			0.6417	0.422171053
	5	152.4837			0.4837	0.318223684
	6	151.5155			-0.4845	-0.31875

Fig. 7. Exterior view of the prototype

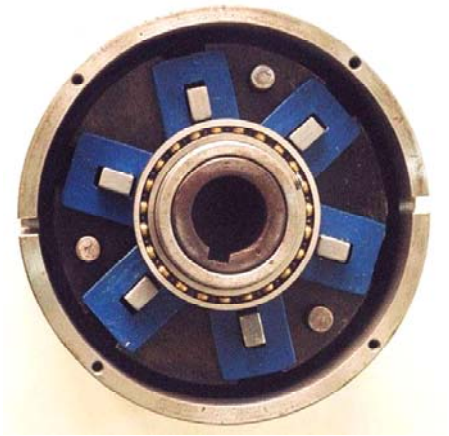

Fig. 8. Internal view of the prototype

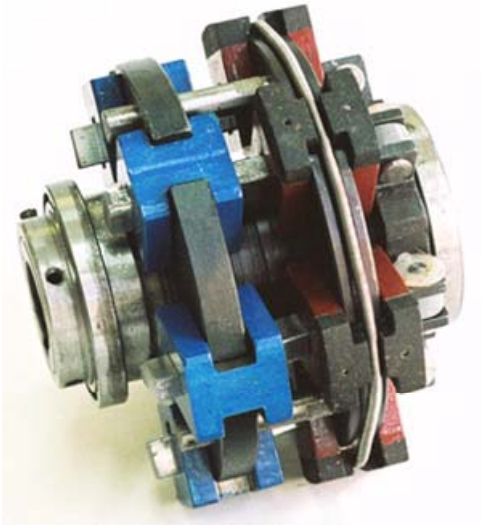

Fig. 9. The driving semi-coupling subassembly

3. CONCLUSIONS

The CAD model realised for the designed coupling allowed, first of all, the study and the check of many aspects linked to the constructive principle, dimensions, operational properties and capabilities etc. obtaining very valuable information before to start the execution of the prototype. In the same time, the CAD model helped us to estimate the mass values of the coupling's parts, group of parts and subassemblies, before to realise the prototype. These information were useful into the process of estimating the performances of the designed and studied coupling. The CAD model analyse permitted the measuring of many dimensions too, dimensions confirmed by the prototype. Another valuable way for using the CAD model was the 2D drawings used for the prototype execution. And finally, one of the most spectacular advantages offered by the CAD model was the possibilities of creating video simulations in which the coupling's way of operating could by seen and analysed.

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