Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium, Volume 21, No. 1, ISSN 1726-9679
ISBN 978-3-901509-73-5, Editor B. Katalinic, Published by DAAAM International, Vienna, Austria, EU, 2010
Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
Annals of DAAAM International

AUTOMATION OF THE PRODUCTION PROCESS FOR METALLIC FLEXIBLE DIAPHRAGM WITH CAD/CAM SYSTEM CATIA V5R19 SUPPORT

MAJERIK, J[ozef]; BAJCIK, S[tefan] & JAMBOR, J[aroslav]

Abstract: *This article deals with the heavy membrane couplings for special applications. Part of that study is devoted to the creation of a CAD model of a steel membrane using CATIA V5R19 description and other parts of the diaphragm-type clutch. The same system strength analysis is carried out using finite element method for finding critical points of greatest stress during operational conditions. At the end of the documented optimized manufacturing process of steel membrane generated NC code for Heidenhain control system.*
Key words: *diaphragm couplings, automation, machining, membranes, stress*

1. INTRODUCTION

Shaft couplings are used for several decades, whenever the requirement to transfer torque from one job to another facility. Currently, the market still appear new and improved clutch, which can in addition to the primary functions of power transmission and provide secondary benefits such as balancing shaft alignment, vibration damping and protection devices against definite loss of stability. For optimal performance flexible couplings began experimenting with the design of flexible steel elements. The important aspects that directly affects the ability to transfer irregularities and extreme operating shock and the mechanical properties of the material of flexible members. Find a compromise between these properties and the ability to bear the extreme loads while maintaining a relatively low cost help to modern information systems to support design (CAD) and manufacturing (CAM), or sophisticated computing software using the method of finite elements (CAE) to simulate the stress. In terms of production design, these innovative solutions are certain risks with respect to the deteriorated machinability of materials and complexity of their shape (Majerik & Bajcik, 2008).

2. BASIC SITUATION OF STEEL FLEXIBLE MEMBRANES

Steel membranes are constantly expanding group of flexible elements that provide flexibility in coupling membrane. Torque transmission is carried out in the radial direction from outer to inner edge of a steel membrane or vice versa, and this area is distorted by variations alignment and drive the driven shaft. Angle alignment spinning outer edge view of the inner membrane resulting in the amount of pressure and tensile stress due to deformation, leading to a complex shape. When thrust movements, rigid membrane is a combination of strength proportional to the extension and bending. (Gorny & Majerik, 2010). Membranes must also bear a large burden in terms of shear stress from operating torque. As the material for the manufacture of steel membranes are mainly used in high strength and high quality high tensile steel, which are often adjusted to the surface better anti-corrosion properties. These materials must also have very good elastic properties. To achieve the least possible stress on the membrane deformation required by the critical event may result in loss of stability is a key requirement for evenly distributed tension throughout the volume profile. Profile means the area between the inner and outer edge of the steel membrane. During operation of this section is subject to static as well as cyclical strain. Static stress is the rule generated torque, centrifugal forces or axial deviations. Cyclic stress is mainly driven angular deviation of the alignment. In special cases, is considering the temperature gradient. By the axial stress of the membrane voltage there is a complex condition and the resulting shape known as "umbrella". This distortion arises between two effects. First is a move in the radial direction thereby increasing the distance between the inner and outer edges and the second bend.

3. NEW DESIGN OF STEEL MEMBRANES

Optimal contour profile (see Fig. 1) of the proposed aid of sophisticated computer systems using FEA methods is essential for maintaining the least possible tension arising during deformation of the membrane while the ability to transfer torque. The contouring profile steel membrane is a new generation to a minimum thickness profile without affecting the torque capacity. By adjusting the thickness profile of a steel membrane in special-purpose devices, achieves the desired compromise between size and torque that provided flexibility. Thicker sections provide more power, but fail to settle uncertainty over the connection, and in very thin sections is to provide high flexibility at the expense of performance. The proper distribution of voltage profile in the membrane also contribute to the smooth rounded shaped flexible part and the outer or inner edge of the membrane through which it is connected to other parts of the coupling. When designing the steel membrane in CATIA and I use modules SKETCHER and PART DESIGN. The advantage of modeling and supporting the creation of sketches based on the simplification of control, because all the functions and icons used are mostly single-level, creating a much better idea to work, unlike some other CAD systems (Danisova & Zvolensky, 2006).

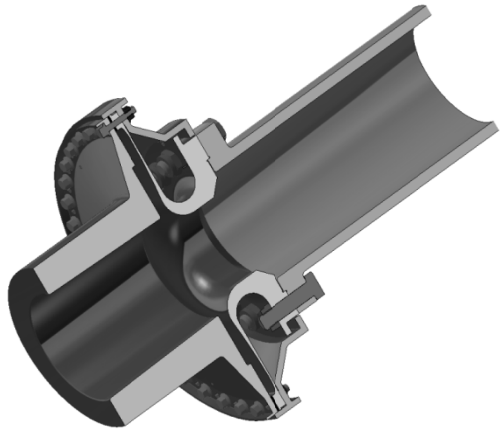

Fig. 1. Membrane-type coupling in the 3D MS-section

4. STRENGTH ANALYSIS IN CATIA V5R19 AND AUTOMATION OF PRODUCTION PROCESS

This chapter focuses on the fortification control steel membrane type I and also describes the automation of production process and its improvement in qualitative and productivity aspects. The analysis is carried out using finite element method (FEA) in CATIA V5 Analysis & Simulation module. Membrane itself is rigid during the operation of many components of the load. It should be noted that during operation receives the load in such extremes as the superposition of all components. In accordance with this fact, perform a detailed inspection fortification especially for all components load. Model membranes are made of steel with the actual dimensions of the size 4.0 and it also correctly assigned material properties of steel 15-5 PH.

The distribution model for the individual elements (discretization) is not clear in any case, so try to resize to specific locations (see Fig. 2). At the expected voltage profile, such as membrane softens network. By contrast at the edges of the membrane is not necessary to tame because working conditions are screwed onto the surface of the other members of the coupling membrane and therefore cannot expect a significant tension here (Gorny & Majerik, 2010). In developing the boundary conditions in the CATIA Analysis & Simulation interface for individual components of loads based on the knowledge structure coupling membrane as a whole. We use particular features for creating virtual objects attached to the model membranes and remove degrees of freedom so that the resulting kinetic characteristics correspond to actual conditions in operation. The parameters are transmitted in particular the maximum torque, maximum speed, clutch mass, moment of inertia, torsional stiffness, maximum axial displacement in both directions for the entire clutch and the maximum angular deviation of the alignment to an end. Figure 3, it is evident that the tension is greatest in the transitional area between large and small part of the membrane and moves to the profile. The largest displacement generated at the outer edge of the membrane. The results of the analysis indicate the strength values of lawful τ stress = 375 MPa, below 93.80 MPa maximum stress and maximum displacement of

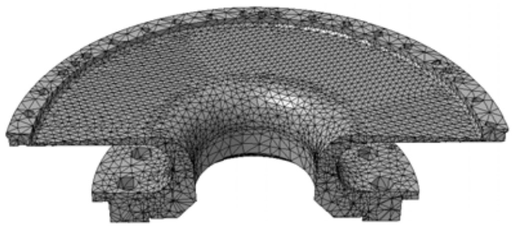

Fig. 2. Discretization model of the steel membrane

Fig. 3. Stress map of the membrane at the load maximum torque moment

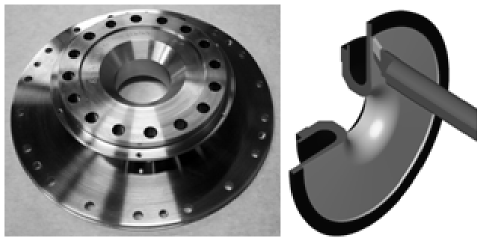

Fig. 4. Created part and machining process simulation

0.178 mm. In the process, NC program creation and automation technology throughout the manufacturing process for CNC turning centers MASS S80 Prim with control system HEIDENHAIN module was used CATIA NC Manufacturing - Lathe Machining. The process of choice consisted of CNC machine parameters, work origin, the correct determination axis system-defined properties, types and parameters of cutting tools (Majerik & Sandora, 2008). Consequently, an appropriate strategy is selected for each machining operation, the generated tool path, and eventually was transferred to the machining process simulation of parts with identifying bottlenecks and potential collisions. Fig. 4 illustrates the simulation process of finish turning on the surface shape as a substitute for finish operation e.g. grinding or superfinishing (Liska et. al., 2009).

5. CONCLUSION

This article solves the optimization of manufacturing process of steel membranes for high-performance clutch. In the theoretical part of the article is processed shaft coupling theory, with emphasis on flexible coupling. Article important chapter is the construction type selected steel membrane and its CAD model creation using CATIA V5R19. The uniqueness of this membrane coupling member is also evidenced by special anti-corrosion steel, in which produces. Very high cost and difficult availability of this material on the European market led to an equivalent solution and research strength analysis of membrane material, as well as research on automation of the production process. Another chapter is devoted to analyzing the strength of steel membrane as well as optimizing the production process using CATIA V5R19 Analysis and simulation respectively NC Manufacturing. Use the appropriate postprocessor is generated NC program in ISO format. Thus, an optimized production process of steel membrane type I and size 2.5 is an effective compromise between the costs incurred in production and quality of completed treatment. The methods used and results obtained open the possibility for further research activities in this area, particularly in the manufacture of complex mechanical parts.

6. REFERENCES

Danisova, N. & Zvolensky, R. (2006). The automated flexible manufacturing systems. *Proceedings of international conference of manufacturing,* pp. 253-256, ISBN86-85211-92-1, Palic, 05/2006, Faculty of Technology, Novi Sad

Gorny, A. & Majerik, J. (2010). Optimization of manufacturing process for metallic flexible diaphragm, *Available from:* http://www.fst.tnuni.sk *Accessed:* 2010-05-11

Liska, J. et.al. (2009). Superfinishing theory. *Proceedings of the 20th International DAAAM Symposium Intelligent Manufacturing & Automation,* pp.1297-1298, ISSN1726-9679, Vienna, 11/2009, Vienna University of Technology

Majerik, J. & Bajcik, S. (2008). Automation of turning process in Manual Guide-i. A*I Magazine,* Vol.I, No.3 (12/2008), pp. 44-45, ISSN 1337-7612

Majerik, J. & Sandora, J. (2009). New trends in cutting tools. *Mechanical Engineering Journal,* Vol.XIII, No.3 (03/ 2009), pp. 30-31, ISSN1335-2938