Research on Air-wake of Large Diameter Non-metallic High-speed Disk

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Abstract: *Good performance of intelligent power grid user equipment is the necessary condition to ensure the smooth implementation of smart grid, due to the influence of outside air damping, non-metallic of large diameter disk as the key components of the smart grid sensor will easy cause the problem of deformation and damage in the working process. At present, the usually method of researching the aspect of inspection, performance comparison and optimization design of disk are testing but not computer software. In this paper, non-metallic of large diameter disk are analyzed from the aspect of velocity, pressure and stress through the software of ANSYS WORKBENCH, which lay the foundation for the structure optimization.*
Key words: *Non-metallic of Large Diameter Disk, Ansys Workbench,Fluid Solid Coupling*

I. Introduction

The research of testing equipment of the smart grid at home and abroad is still in the initial stage at present[1]. Compared with the low detection efficiency, serious energy waste, bid random error, poor reliability and low accuracy of the original single manual detection method, intelligent detection system of proximity switch operation frequency has been greatly improved from the aspect of automation and intellectualization. But the fracture and deformation are often occurred in non-metallic of large diameter disk, which as the key components of intelligent detection system of proximity switch operation frequency. As a branch of mechanics between fluid and solid mechanics, fluid solid interaction mechanics is the kind of subject which study the all kinds of behaviors of deformation solids under the effect of flow field and its interaction[2].The interaction between two medium are the important features of fluid-structure interaction mechanics and deformation or motion will occurred on the deformation solids under the action of fluid loading. In order to find out the reason of fracture and deformation of non-metal of large diameter disk occurred frequently, the non-metal of large diameter disk has to be analyzed, although there are many software about fluid solid coupling analysis method, but restricted by all kinds of factors, the domestic in this information is scared.

II. Fluid solid coupling analysis

With the development of computer science and numerical analysis method, research the method of coupling analysis is more and more used by people, coupling analysis is the use of Computer Aided Engineering (CAE) analysis technology of multi-physical field of a single part or assembly of interaction [3]。

At this stage, the coupling effect of more and more being applied to the practical engineering problems, especially in the field of fluid dynamics, with the promotion of ANSYS Workbench, the method of analysis of fluid solid coupling has made rapid development, has received extensive attention in academic and industrial circles. The fluid mechanics (Computational Fluid Dynamics, CFD) and solid mechanics (Computational Solid Mechanics, CSM) together into system branch of mechanics, an analysis of the interaction of fluid and solid is called a solid fluid coupling, which is composed of multi subject and multi physical field derived out an important research part, wherein the solid the research can be deformed in the flow field of the force, and the deformation of solid under the action of flow field will have influence on the flow field in some extent, the two is the interaction, mutual influence.

In this paper, with a large diameter non metallic high-speed disk as the research object, the establishment of 3D model in PROE. The unidirectional fluid solid coupling in ANSYS Workbench.

III. High speed metal disc of large diameter non pretreatment

Smart grid user end by the sensor response of key parts of frequency detection system in the large diameter non metal both high speed disk as the research object[4], the geometry model refer to the actual size of the model, established in accordance with the 1:1 ratio. The turntable modeling process are completed in today's mainstream 3d modeling software Pro/Engineer, Pro/Engineer software is used for parametric design, provides a

simple and flexible solid modeling system for the user, make up the FLUENT built-in pre-processing software GAMBIT for modeling of complex   problems。
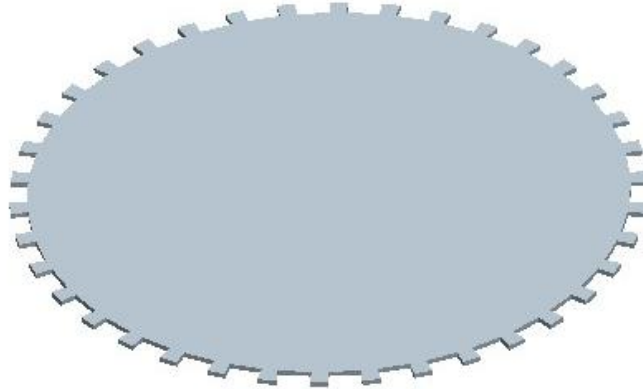

Fig.1 Large Diameter Non-metallic High-speed Disk

Use the GAMBIT software, mesh for processing the good model, get the mesh as shown below:
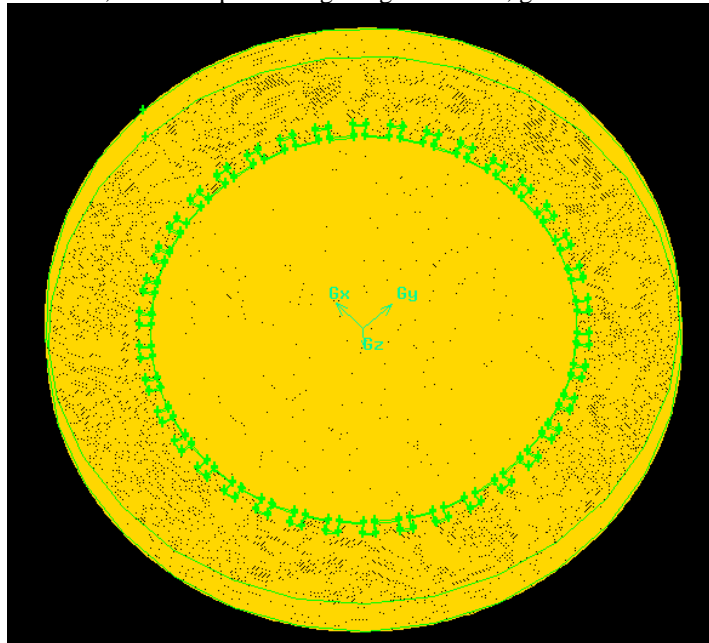

Fig.2 The mesh

IV. FLUENT analysis of flow field

In order to facilitate the analysis of late FLUENT operation and fluid solid coupling, need to be defined for each surface of the related finite element model of module [5], rotating disk model boundary region and generating coincidence, selected 154 groups of surface, defined as the fluid solid coupling interface. The upper surface of the box body structure, side, lower surface and other undefined type, wall type defaults to WALL. Define the entity region, as mentioned above will be integrated dynamic regional settings, select the reasonable calculation model, get the velocity distribution
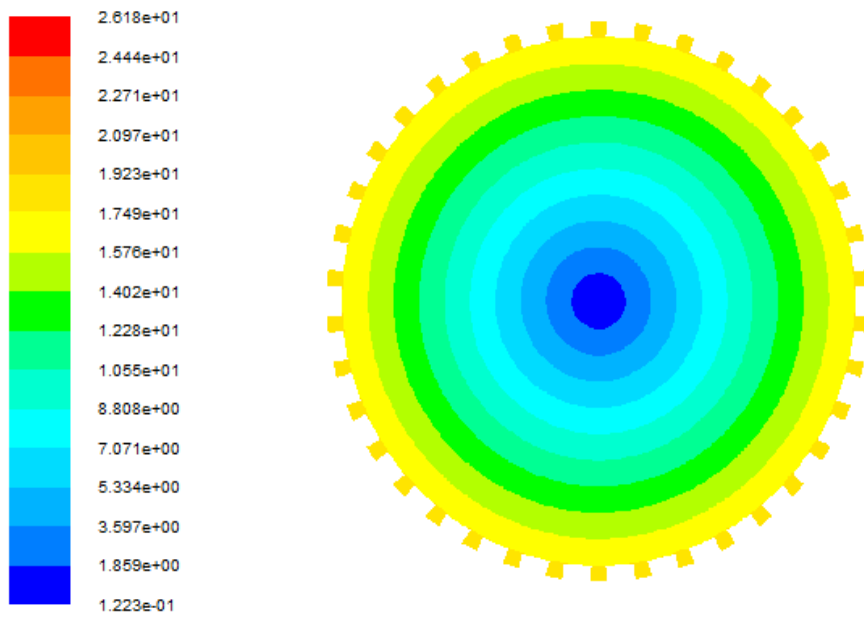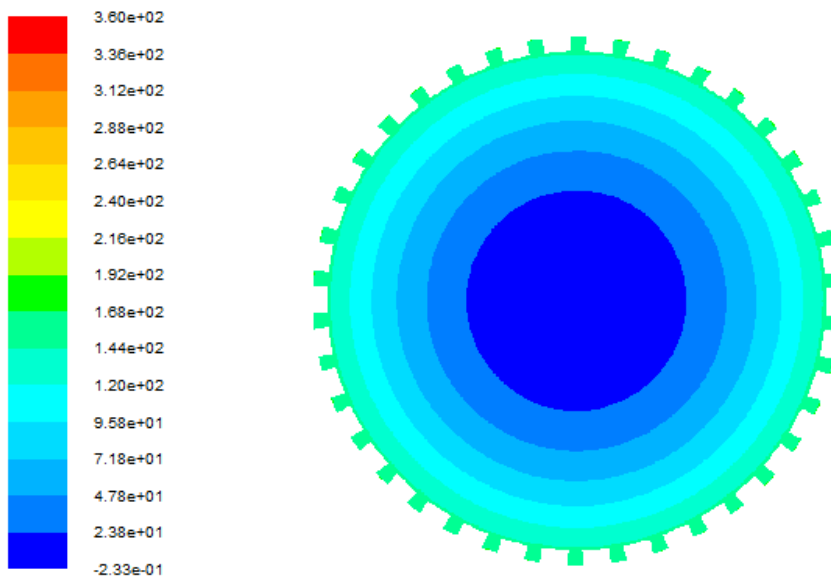
Fig.3 The velocity profile

Fig.4 The stress distribution profile

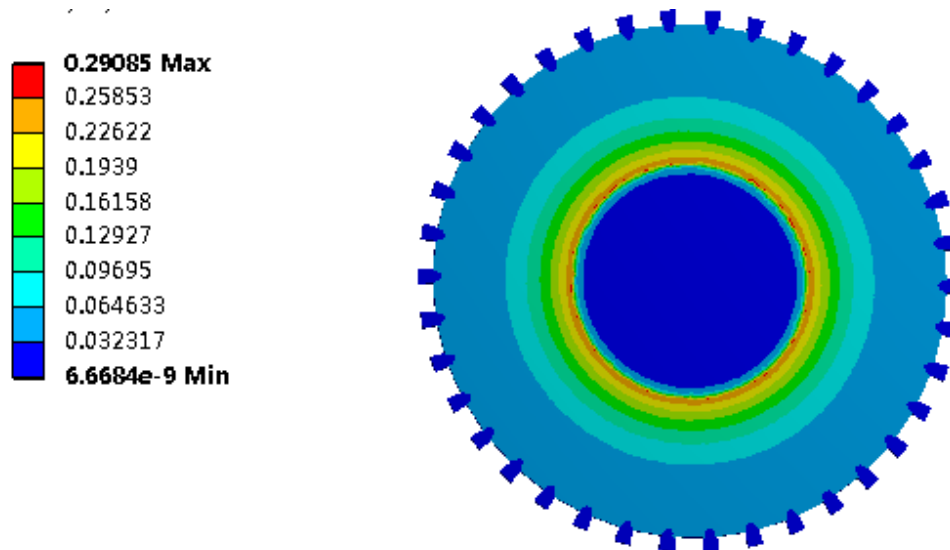## V. The structural static analysis

Fig.5 The stress distribution profile

The FLUENT simulation results obtained by the single pressure coupling loading to the static analysis module for coupling calculation, get the equivalent stress of the image as shown above, the equivalent stress of the unit is MPa, the distribution is symmetric distribution is in a circular ring shape, the minimum interval of the upper limit of 0.28e+5Pa stress, said as long as it is in the range of stress values are shown in blue, the maximum range of 2.56e+5Pa~2.91e+5Pa, and reaches the maximum value after the stress to the surrounding gradually   become   smaller.

The results of this analysis, allows us to optimize the design of large diameter non metallic high-speed disk structure, in the back of the design of the disc center position of stiffened plate, stabilize the reinforcement effect of the Large Diameter Non-metallic High-speed Disk[6] .

VI. Conclusions

In this paper, using fluent-workbench method of fluid solid coupling of large diameter non metallic high-speed disk was studied by numerical simulation, according to the stress distribution is obtained，it is recommended to do some adjustment to the key structural dimensions, reduce stress, so as to achieve the purpose of optimizing the structure.

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