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Modeling and CFD Analysis on Boiler Feed Pump

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Abstract:

A boiler feed water pump is a specific type of pump used to pump feed water into a steam boiler. The water may be freshly supplied or returning condensate produced as a result of the condensation of the steam produced by the boiler. These pumps are normally high-pressure units that take suction from a condensate return system and can be of the centrifugal pump type or positive displacement type. Feed water pumps range in size up to many kilowatts and the electric motor is usually separated from the pump body by some form of mechanical coupling.Design the model of boiler feed pump single stage After completion of the design do the Computational Fluid Dynamics(CDF) analysis by using NX (Nastero).After the completion of the CFD analysis, find the pressure which are action on compressor by using those input we will do the structural analysis on the compressor by varying the blade number. Then we will conclude in which geometry it is more suitablethanexistinggeometry.

Keywords:CDF Analysis, NX CFD Analysis, Structural Analysis.

INTRODUCTION

The provision of sufficient pumping capacity to meet flow requirements under all operational circumstances. It is normal practice to include a flow margin to accommodate additional demand by the turbine above its design rating during transient flow disturbances. A margin on pump generated head is also appropriate to cover for deterioration resulting from internal wear during periods between overhaul. In the interests of keeping pump set sizes and powers to a reasonable minimum, consistent with maintaining the pump best efficiency close to the duty point operation, these margins have been optimized as 5% on flow and 3% on generated head. The design and arrangement of boiler feed pumps has a significant impact on overall unit availability, In determining the optimum arrangement of feed- pumping plant, the economic assessment needs to take account of capital costs, capitalized running costs, repair and maintenance costs, and the likely effects of loss of availability.

DESIGN OF MODULES IN NX 11

1. Design (parametric and direct solid/surface modeling)
2. Engineering analysis (static; dynamic; electro-magnetic; thermal, using the finite element method; and fluid, using the finite volume method).
3. Manufacturing finished design by using included machining modules.

NX is a directcompetitor to Topside, CATIA,Creo, Autodesk Inventor, and SolidWorks.

NX for Design is an integrated product design solution that streamlines and accelerates the product development process for engineers who need to deliver innovative products in a collaborative environment.

NX 11 for Design

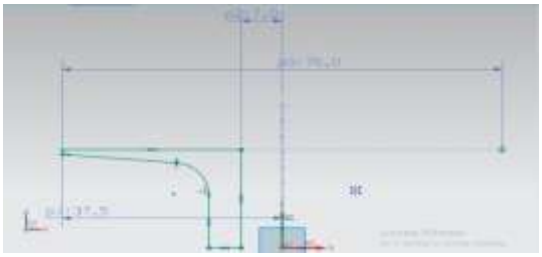

Fig.1: Simcenter 3D model in NX

Fig.2: Manufacturing model in NX

Simcenter 3D now powers all of Siemens' simulation capabilities for predicting product performance. You have all of the capabilities of NX CAE, along with new ones for acoustics, motion tire models, advanced report writing, and more. Simcenter 3D delivers a unified, scalable, and open environment for 3D CAE with connections to design, 1D simulation, test and data management. Speed your simulation process with Simcenter 3D.

NX 11 for Manufacturing: Digitalize Production

The new robotics machining and groundbreaking hybrid additive manufacturing capabilities in NX CAM let you produce new categories of parts. With Line Designer you can easily compare the physical plant with the virtual layout model by using the cloud data. NX CAM provides a new-level of efficiency to program any job, reduce machining cycle and improve quality. NX CMM now lets you create high-speed inspection methods. NX Tooling Design provides increased productivity when designing molds and progressive dies.

Advantages of Uni Graphics

1. Fast, Flexible, Efficient Product Design
2. Work Seamlessly with Data from Other CAD Systems
3. Power and Capacity for Complex Products
4. Integrated Design Validation
5. Visual Analytics Improve Decision-Making
6. Reduce Development Time by More than 30 Percent
7. Increase the Number of New Products Introduced Each Year
8. Reduce Delivery Cycle Time by 35 percent

MODELING OF BOILER FEED PUMP

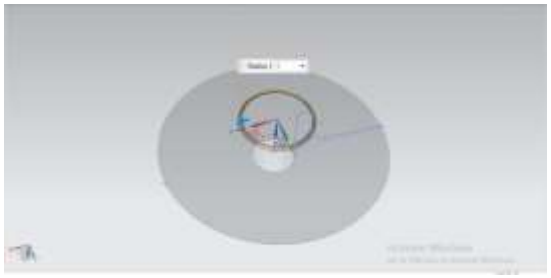

Fig.3: Edge blend: Using edge soften the edge of the body

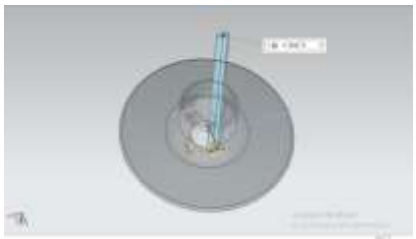

Fig.4: Extrude 1: Draw an arch on the body

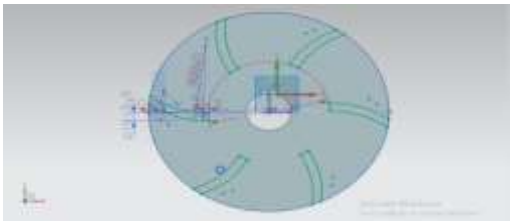

Fig.5: Then using array (polar) increase the blades around the body

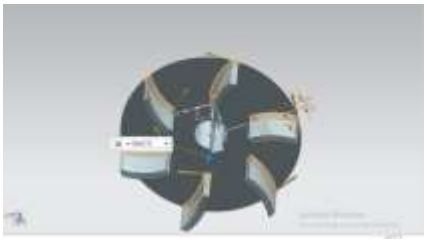

Fig.6: Using of extrude command

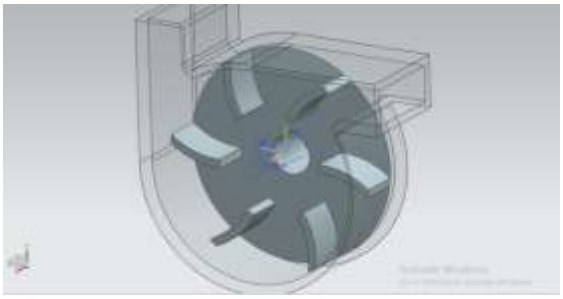

Fig.**7**: Assembly

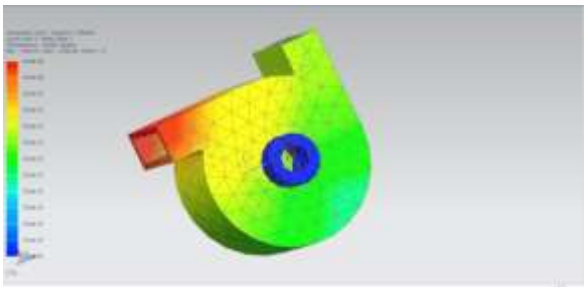

Fig.8: Thermal flow analysis Nodal

ANALYSIS

Computationalfluiddynamics (**CFD**)isabranchof fluidmechanics that uses numerical analysis and data structures to analyze andsolve problems that involve fluid flows. Computers are used to perform thecalculations required to simulate the free-stream flow of the fluid, and theinteractionofthefluid(liquidsandgases)with surfaces defined by boundaryconditions. With high-speed supercomputers, better solutions can be achieved, and are often required to solve the largest and most complex problems. Ongoing research yields software that improves the accuracy and speed of complex simulation scenarios such as transonic or turbulent flows. Initial validation of such software is typically performed using experimental apparatus such as wind tunnels. In addition, previously performed analytical or empirical analysis of a particular problem can be used for comparison. A final validation is often performed using full-scale testing, such as flight tests.

Temperature and Pressure Analysis of Boiler Feed Pump

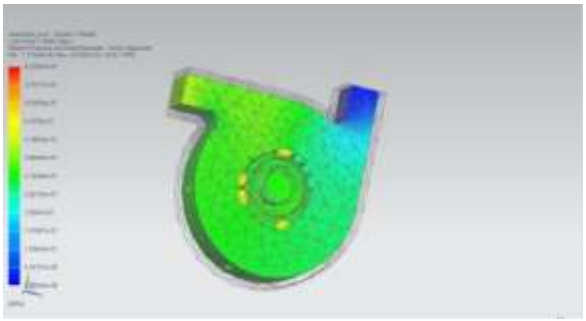

Fig.9: Relative Pressure and Shear Resultant

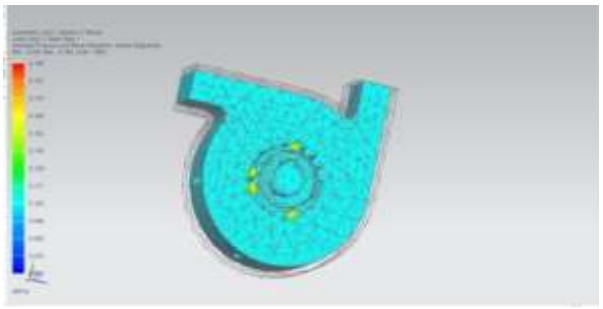

Fig.10: Absolute Pressure and Shear Resultant

RESULTS AND DICUSSIONS

From the above analysis of the boiler feed pump in NX software. The pressure and temperature analysis is collected for two different numbers of blades on the impeller.

Noticed a slight change in pressure and temperature between 6 and 7 blade impeller.

S No	Impeller Blade Count	Temperature Deg C		Pressure MPa		Velocity mm/s	
		Min	Max	Min	Max	Min	Max
1	6	1034.01	1034.02	-1.48e-08	5.39e-07	0.06	1163.98
2	7	1036.02	1036.04	-1.52e-08	5.8e-07	0.18	1175.56

CONCLUSIONS

To design and perform CFDanalysis of the boiler feed pump by differing number of blades on the impeller.

Designed an impeller and casing of boiler feed pump using the NX software in part module and assembled in the same NX assembly module. After finishing the models we meshed the model and have done temperature and pressure analysis on the boiler feed pump model in the same NX software.

Observed that there is some slight change in the temperature, pressure and velocity when the blades on the impeller are increased.

The use of the impeller with various number of blades does not necessarily contribute in the performance of the boiler feed pump.

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