DESIGN AND ANALYSIS OF TURBINE BLADE A REVIEW

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ABSTRACT

A steam turbine is mechanical tool which converts thermal power in steam into mechanical work. The steam turbine gives the better thermodynamic performance by way of using more than one stages within the growth of steam. The stages are characterised via the manner of power extraction from them is taken into consideration as impulse or response mills. in this thesis the parameters of steam turbine blade numerous and analysis is carried out for power, life and heat transfer quotes. The various parameters are the ratio of X-axis distance of blade profile by way of chord duration and ratio of most height of blade profile in Y-route to the chord duration. The three-D modelling is done through using catia software program . The ANSYS software is used for static, thermal evaluation, finally concluded an appropriate layout and cloth for steam turbine blade.
KEY WORDS: *Steam Turbine, Thermal Energy, Impulse Turbine, Reaction Turbine, Static Analysis, Thermal Analysis*

Introduction

A turbine (from the Latin faster, a vortex, associated with the Greek τύρβη, tyrbē, which means "turbulence") is a rotary mechanical tool that extracts strength from a fluid flow and converts it into beneficial paintings. The paintings produced by means of a turbine can be used for producing electric power when blended with a generator or producing thrust, as inside the case of jet engines. A turbine is a turbo system with as a minimum one transferring part referred to as a rotor assembly, that's a shaft or drum with blades connected. transferring fluid acts at the blades so that they circulate and impart rotational electricity to the rotor. Early turbine examples are windmills and waterwheels.

gasoline, steam, and water generators have a casing around the blades that contains and controls the operating fluid. credit for invention of the steam turbine is given each to British engineer Sir Charles Parsons (1854–1931) for invention of the reaction turbine, and to Swedish engineer Gustaf de Laval (1845–1913) for invention of the impulse turbine. cutting-edge steam turbines regularly appoint each response and impulse within the equal unit, usually various the diploma of response and impulse from the blade root to its periphery.

The word "turbine" became coined in 1822 via the French mining engineer Claude Burdin from the Latin turbo, or vortex, in a memo, "Des turbines hydrauliques ou machines rotatoires à grande vitesse", which he submitted to the Académie royale des sciences in Paris. Benoit Fourneyron, a former scholar of Claude Burdin, constructed the first realistic water turbine

FIG 1 - TURBINE

USES OF TURBINES

almost all electric strength on the earth is generated with a turbine of a few kind. Very excessive performance steam turbines harness around 40% of the thermal strength, with the rest exhausted as waste warmth.

maximum jet engines rely on turbines to supply mechanical paintings from their running fluid and gas as do all nuclear ships and electricity flowers.

generators are frequently a part of a larger gadget. A fuel turbine, as an instance, may additionally talk to an inner combustion machine that carries a turbine, ducts, compressor, combustor, heat-exchanger, fan and (inside the case of one designed to supply power) an alternator. Combustion generators and steam generators may be linked to machinery which include pumps and compressors, or may be used for propulsion of ships, generally through an intermediate gearbox to lessen rotary velocity. Reciprocating piston engines along with plane engines can use a turbine powered through their exhaust to drive an intake-air compressor, a configuration acknowledged asa turbocharger (turbine supercharger) or, colloquially, a "faster".

Back Pressure Steam Turbine

• Steam exits the turbine at a higher pressure that the atmospheric HP Steam

Advantages& Disadvantages:

Advantages

Simple configuration –

Low capital cost Boiler Turbine

-Low need of cooling water –

High total efficiency Fuel

Disadvantages:

Condensate LP Process Steam –

Larger steam turbine

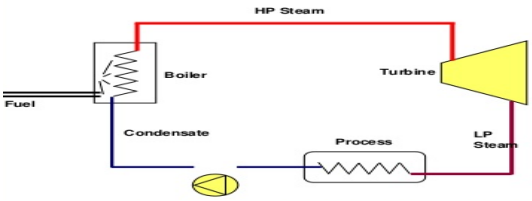

FIG 2 BACK PRESSURE STEAM TURBINE

PROBLEM DEFINITION:

All mordern steam strength plants use impluse-response mills as their blading performance is higher than that of impulse mills. ultimate stage of steam turbine impluse-reaction blade are very plenty directly affect efficiency of plant.With the records that an understanding of the forces and stresses performing on the turbine blades is essential importance, on this work we will compute this kind of pressure performing on a ultimate level Low strain (LP) blade of a large steam turbine rotating at 3000 rpm as a way to estimate the material stresses on the blade root. One such LP steam turbine blade is show in determine 1. We studied structural and themal evaluation of blade the use of FEA for this paintings and by use of the operational statistics have accomplished by using the use of FEA (ANSYS) and This study paintings worried the examine bldde and take a look at FEA information of std. blade with various matirial.

OBJECTIVE

The objective of this project is to make a Steam turbine blade different 3D models of the steam turbine blade with holes and without holes we are taking two designs and study the static - thermal behaviour of the steam turbine blade with different

materials by performing the finite element analysis.3D modelling software (catia v5) was used for designing and analysis software (ANSYS) was used for analysis.

METHODOLOGY

THE METHODOLOGY FOLLOWED IN THE PROJECT IS AS FOLLOWS:

- Create a 3D model of the different Steam turbine blades using parametric software catia v5.
- Convert the surface model into IGS and import the model into ANSYS to do analysis.
- Perform static thermal analysis on the steam turbine blade.
- Finally it was concluded which material is the suitable for steam turbine blade on these two materials(Nimonic 80A,Chrome steel)

SCOPE OF THE PROJECT :

The scopes of this proposed project are:

1. To generate 3-dimensional geometry model in catia workbench of the steam turbine blade

2. To perform structural analysis on the model to determine the stress, deformation, of the component under the static- thermal load conditions

3. To compare analysis between two different designs and materials of steam turbine blade

LOAD CALCULATION :

$F = M \times Vm$

M=Mass of stream flowing through turbine

Vm=velocity of steam in m/s

M=1000kg/hr

Vm=1310m/s

F=362.87N

Blade area=23319.1mm^2

Pressure =F/A

P=0.01556N/mm^2

MATERIAL PROPERTIES

TAB 1CHROME STEEL PROPERTIES

Material	Chrome steel
Density	7.70 g/cc
Young's modulus	200Gpa
Poisson's ratio	0.32
Tensile strength ultimate	325000psi
Tensile strength yield	295000psi
Melting point	1400^{0}c
Thermal conductivity	33.5W/m/K
Specific heat capacity	0.448J/g-^{0}C

TAB 2 NIMONIC80A PROPERTIES

Material	Nimonic80a
Density	8.19 g/cc
Young's modulus	222Kn/mm^2
Poisson's ratio	0.35
Tensile strength ultimate	1250Mpa
Tensile strength yield	800MPa
Melting point	1365^{0}c
Thermal conductivity	11.2W/m/K
Specific heat capacity	0.448J/g-^{0}C

ANALYSIS PROCEDURE IN ANSYS:

Designed component in catia workbench after imported into ansys workbench now select the steady state thermal analysis .

1.ENGINEEERING MATERIALS (MATERIAL PROPERTIES).

2.CREATE OR IMPORT GEOMENTRY.

3.MODEL(APPLY MESHING).

4.SET UP(BOUNDARY CONDITIONS)

5.SOLUTION

6.RESULTS

STATIC ANALYSIS:

This analysis is performed to find Structural parameters such as Stresses, Deformation, Here we observed results on two materials namely chrome steel and Nimonic as shown below figures

2 Nimonic 80a material

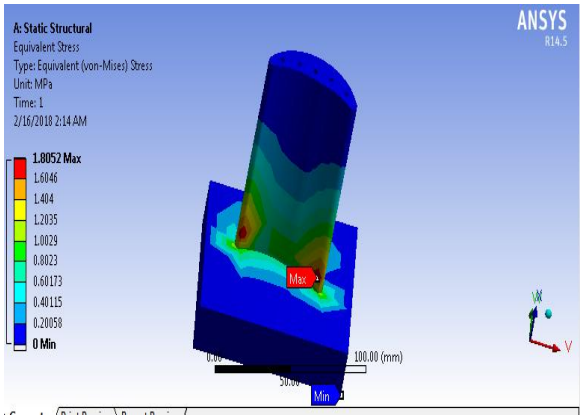

FIG 3 STRESS ON NIMONIC 80A

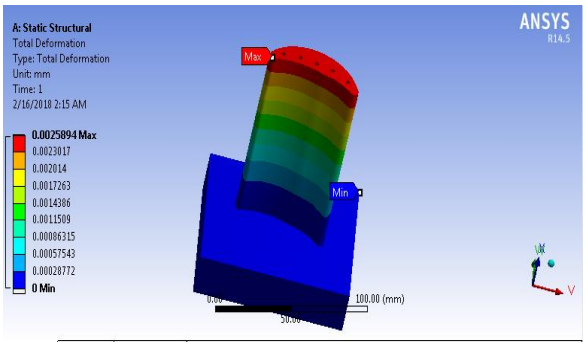

FIG 4 DEFORMATION NIMONIC 80A

CONCLUSION

Modeling of steam turbine blade is completed with the aid of using CATIAV5 software program and then the model is imported into ANSYS software for Structural analysis at the steam turbine blade to test the fine of materials consisting of, Nimonic80A, and chrome steel. From the acquired Von-misses stresses, , deformation, temperature distribution and heat flux for the substances, respectively compared with all materials Nimonic80A cloth have much less stresses, deformations, and high temperature distribution and heat flux values .finally from structural analysis and thermal evaluation based on effects it's miles concluded that Nimonic80A material is suitable material for stream turbine .

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