Demonstrating and Analysis of Turbine Blade

Harshit Sharma, Hrishikesh Mishra, Madhav Gupta, Neelam Baghel

Abstract*: A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. The steam turbine gives the better thermodynamic efficiency by using multiple stages in the expansion of steam. The stages are characterized by the way of energy extraction from them is considered as impulse or reaction turbines. In this work the parameters of steam turbine blade varied and analysis is done for strength, life and heat transfer rates. The varied parameters are the ratio of X-axis distance of blade profile by chord length and ratio of maximum height of blade profile in Y-direction to the chord length. The 3D modeling is done by using SOLIDWORKS software. The ANSYS software is used for static, thermal analysis finally concluded the suitable design and material (titanium alloy, manganese bronze, tungsten -1) for steam turbine blade.

Keyword*: Steam turbine, thermal energy, impulse turbine, reaction turbine, static analysis, thermal analysi.

I. INTRODUCTION

A turbine (from the Latin turbo, a vortex, identified with the Greek, signifying "disturbance") is a rotating mechanical gadget that removes vitality from a liquid stream and changes over it into valuable work. The work delivered by a turbine can be utilized for creating electrical power when joined with a generator or creating push, as on account of stream motors. A turbine is a turbo machine with no less than one moving part called a rotor get together, which is a pole or drum with edges joined. Moving liquid follows up on the edges with the goal that they move and give rotational vitality to the rotor. Early turbine precedents are windmills and waterwheels.

II. LITERATURE REVIEW

Numerous examiners have recommended different strategies to clarify the impact of pressure and stacking on turbine edge, rotor and investigation the different parameters. A paper on structure and examination of Gas turbine edge uses to get the characteristic frequencies and mode state of the turbine cutting edge. In this paper we have broke down past plans and officers of turbine cutting edge to do encourage enhancement, Finite component results for unattached edges give a total picture of auxiliary attributes, which can used for the improvement in the structure and advancement of the working conditions. Plan of high weight steam turbine edge tends to the issue of steam turbine proficiency had a particular spotlight on airfoil profile for high-weight turbine cutting edge, and it assesses the adequacy of certain Chromium and Nickel in opposing jerk and crack in turbine sharp edges. The productivity of the steam turbine is a key factor in both the natural and monetary effect of any coal-terminated power station. In view of the exploration introduced changes to high-weight steam turbine sharp edges can made to build turbine proficiency of the turbine. The outcomes and determinations are introduced for a concerning the sturdiness issues experienced with steam turbine edges. The most extreme operational Von Misses Stresses are inside the yield quality of the material yet the distortion is relatively better for material CA-6 NM (Chromium Nickel). Altered answers for Steam turbine sharp edge esteems to machines to amplify their diminish life cycle costs, effectiveness, and improve unwavering quality Sanjay Kumar was explored on drag life of turbine cutting edge. Latency load is the consistent burden that will cause creep disappointment. Creep is a rate subordinate material nonlinearity in which material keeps on disfiguring in nonlinear style even under steady burden. The principle objective is to anticipate the drag life of the straightforward motivation steam turbine sharp edge, and to give the FEM approach for wet blanket investigation. The examination of turbine cutting edge for various burdens, which demonstrates that the most extreme anxieties, instigated for each situation. These burdens are inside yield point of confinement of the material and won't experience plastic misshapening amid activity result is discovered that, creep life diminishes as the pressure esteem increments. Thus, by diminishing the pressure an incentive in the segment we can expand its drag life. This was be accomplished by altering the edge structure.

III. OBJECTIVE

The goal of this work is to make a Steam turbine sharp edge with 3D display, To think about the static - warm conduct of the steam turbine cutting edge with various materials by playing out the limited component analysis.3D demonstrating programming (catia v5) was utilized for planning and examination programming (ANSYS) was utilized for investigation.

Revised Manuscript Received on 30 May 2019.
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IV. METHODOLOGY

The technique followed in the work is as per the following:
A. Make a 3D model of the distinctive Steam turbine sharp edges utilizing parametric programming SOLIDWORKS.
B. Convert the surface model into IGS and import the model into ANSYS to do investigation.

C. Perform static and warm examination on the steam turbine edge.

D. At last it was finished up which material is the reasonable for steam turbine sharp edge on these three materials.

V. LOAD CALCULATION

M = Mass of stream flowing through turbine
V = velocity of steam in m/s [1310 m/s]
M = 1000 kg / hr
F = 362.87N

VI. MATERIAL PROPERTIES

Material	Titanium Alloy
Density	4620
Poisson's Ratio	0.36
Young Modulus	960 gpa
Thermal Conductivity	21.9 w/mk
Tensile yield strength	930 mpa
Tensile ultimate strength	107 mpa

Table 1: Titanium Alloy Properties

Material	Tungsten -1
Density	15000
Poisson's Ratio	0.29
Young Modulus	250 gpa
Thermal Conductivity	60 w/mk

Table 2: Tungsten -1properties

Material	Manganese bronze
Density	8730
Poisson's Ratio	0.34
Young Modulus	117 gpa
Thermal Conductivity	35.5 w/mk
Tensile yield strength	758 mpa
Tensile ultimate strength	427 mpa

Table 3: Manganese Bronze Properties

VII. ANALYSIS PROCEDURE IN ANSYS

Designed component in SOLIDWORKS after imported into ANSYS workbench now select the steady state thermal analysis.

1. Material Properties
2. Create or import geometry.
3. Model (apply meshing).
4. Setup (boundary conditions)
5. Solution
6. Results

Static Structural Analysis

The static basic examination ascertains the burdens, removals, strains, and powers in structures brought about by a heap that does not actuate critical dormancy and damping impacts. Relentless stacking and reaction conditions are accepted; that the heaps and the structure's reaction are expected to change gradually as for time. A static auxiliary burden can be performed utilizing the ANSYS WORKBENCH solver. The sorts of stacking that can be connected in a static investigation incorporate .

Steady State Thermal Analysis

A consistent state warm investigation computes the impact of unfaltering warm burden on a framework or part, expert were additionally doing the relentless state examination before playing out the transient examination. An unfaltering state investigation can be the last advance of transient warm examination. We can utilize enduring state warm investigation to decide temperature, warm angle, heat stream rates and warmth motion in an item that don't differ with time Nodes 11860, components 6074.

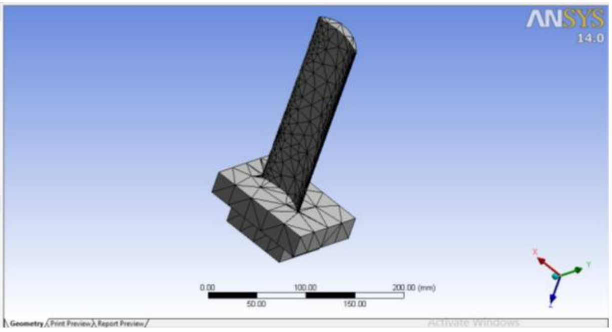

Figure 1: Meshing

Boundary Condition in Static Analysis

In static analysis fixed the bottom side after apply pressure on blade face.

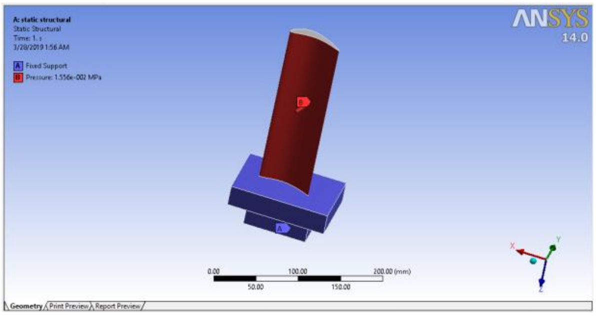

Figure 4: Boundary Condition in Static Analysis

Boundary condition in steady state thermal analysis

Apply temperature 2290C, apply convection 220C film coefficient is 0.0025w/mm2'c.

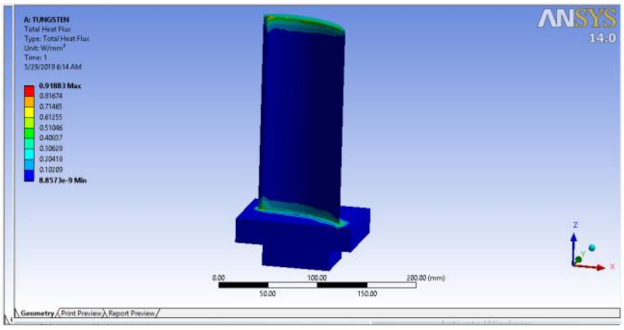

Figure 5: Boundary Condition in Thermal Analysis

VIII. RESULTS AND DISCUSSION

Static Analysis

This analysis is performed to find Structural parameters such as Stresses, shear stress, deformation. Here we observed results on three materials namely Zirconium Diboride, Titanium Alloy, and Manganese Bronze as shown below figures.

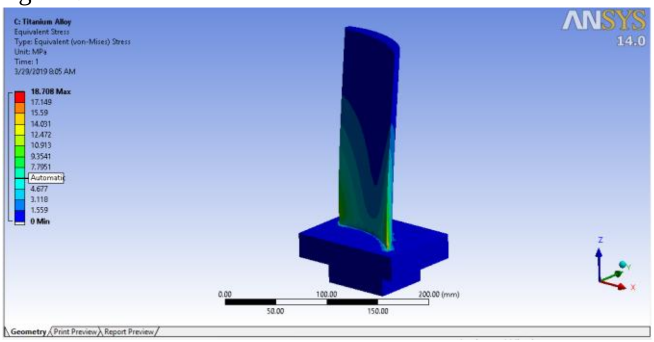

Figure 6: Stresses on Titanium Alloy

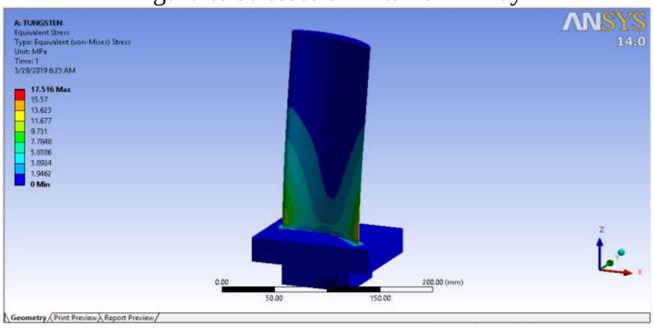

Figure 7: Stress on Tungsten -1

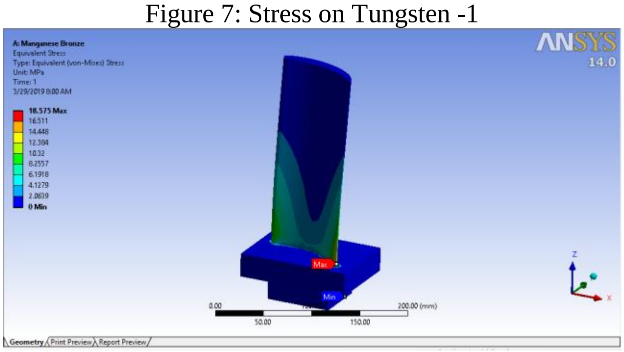

Figure 8: Stresses on Manganese Bronze

IX. THERMAL ANALYSIS

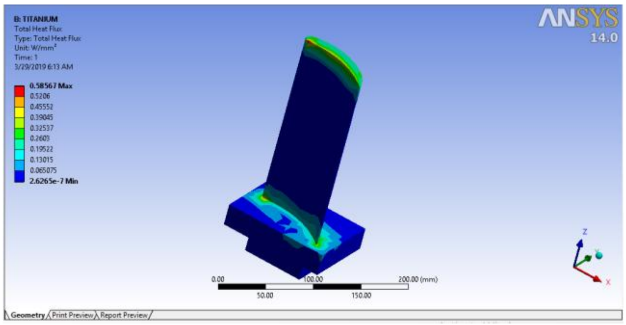

Figure 9: Heat Flux on Titanium Alloy

Figure 10: Heat Flux on Tungsten -1

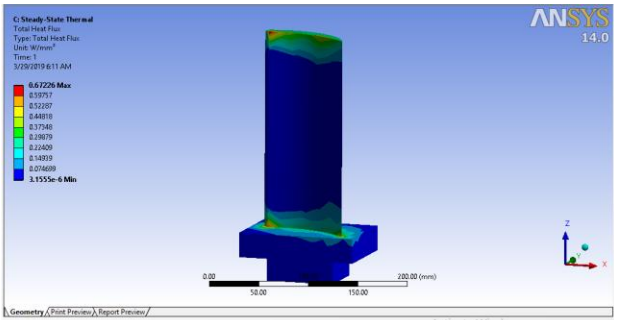

Figure 11: Heat Flux on Manganese Bronze

X. GRAPHS

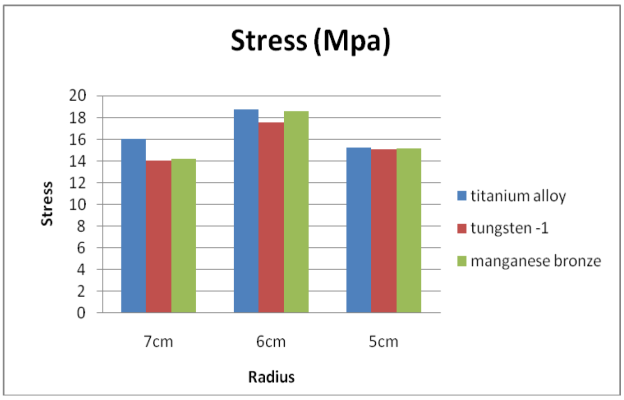

Figure 12: Comparison between stress and different radius of different materials.

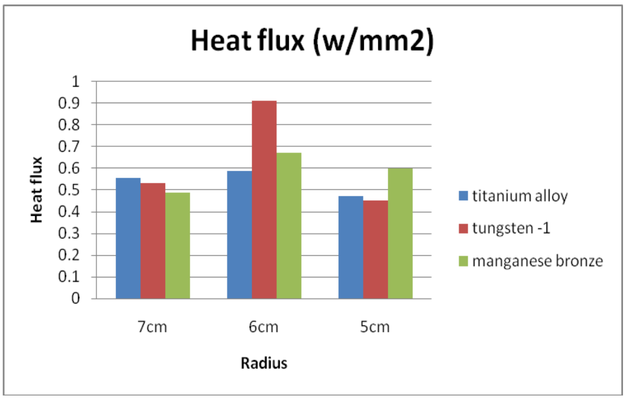

Figure 13: Comparison between heat flux and different radius of different materials.

XI. CONCLUSION

Demonstrating and investigation of steam turbine sharp edge is finished by utilizing SOLIDWORKS Software and after that the model is brought into ANSYS Software for Structural examination on the steam turbine cutting edge to check the nature of materials, for example, titanium compound, tungsten-1,manganese bronze. From the acquired Von-misses stresses, shear pressure, misshapening, temperature dissemination and warmth transition for the materials, individually Compared with all materials tungsten-1material have less burdens, distortions, and High temperature dispersion and warmth motion esteems. At last from auxiliary examination and warm investigation dependent on results it is inferred that tungsten-1material is reasonable material for stream turbine. Furthermore, we have done analysis on different radius of turbine blade to obtain the most efficient radius on which the properties such as stress, deformation are low and temperature distribution, heat flux are high. Finally from structural analysis and thermal analysis based on results it is concluded that tungsten -1 material of 6cm radius is best suitable for stream turbine.

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