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Analysis of Gas Turbine Blade for Different Materials

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Abstract: The word turbine was coined in 1828 by Claude Burdin (1788-1873) to describe the subject of an 1826 engineering competition for a water power source. It comes from Latin turbo, turbines, meaning a "whirling" or a "vortex," and by extension a child's top or a spindle. Defining a turbine as a rotating machine for deriving power from water is not quite exact. The precise definition is a machine in which the water moves relatively to the surfaces of the machine, as distinguished from machines in which such motion is secondary, as with a cylinder and piston. Consider a gas turbine blade foe modeling using PRO-E software. After developing a model import into the ANSYS software for stress analysis with different materials. To study the variation of stresses for gas turbine blade for graphite and titanium materials.

Keywords: Gas Turbine.

I. INTRODUCTION

The common overshot water wheel is a rotating machine, but not a turbine, while an undershot wheel is an impulse turbine, but not generally considered as one. We shall discuss many types of water-driven prime movers in this article, but mainly turbines, for which we will explain the fundamental theory. We shall also discuss steam turbines and gas turbines and their applications.

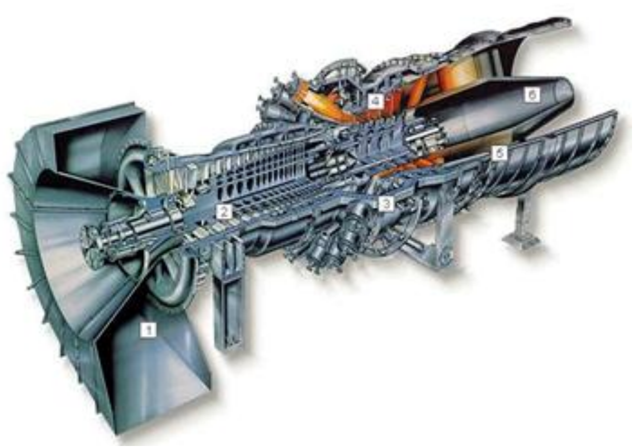

Fig.1. gas turbine.

II. GAS TURBINES

Gas turbines on the other hand rotate directly in the hot combustion gases. With temperatures up to 1500 °C, these gases are much hotter than those in steam turbines. For this reason the blades are cooled with air that flows out of small openings and creates a "protective film" between the exhaust gases and the blades. Without cooling, the blade material would quickly wear out. The working fluid in a gas turbine is a permanent gas, in contrast with a condensable vapour in the steam turbine, produced in a gas generator at high pressure by continuous combustion in a combustion chamber. The combustion chamber is supplied with air for combustion by a compressor, normally driven by a turbine using the gas produced. This gas contains much more energy than is required for the compressor. A gas turbine requires neither a boiler nor a condenser, so it can be made very compact and light as shown in Fig.1. The thermodynamic cycle is called a Brayton cycle in this case, which like the Rankine cycle has two isobars and two isentropes.

A. Versions of Pro-Engineer

S.NO	NAME\VERSION	BUILD NUMBER	YEAR
1	Pro\ENGINEER(Auto fact 1987 premier)	R 1.0	1987
2	Pro\ENGINEER	R 8.0	1991
3	Pro\ENGINEER	R 9.0	1992
4	Pro\ENGINEER	R 10.0	1993
5	Pro\ENGINEER	R 11.0	1993
6	Pro\ENGINEER	R 12.0	1994
7	Pro\ENGINEER	R 13.0	1994
8	Pro\ENGINEER	R 14.0	1994
9	Pro\ENGINEER	R 15.0	1995
10	Pro\ENGINEER	R 16.0	1996
11	Pro\ENGINEER	R 17.0	1997
12	Pro\ENGINEER	R 18.0	1997
13	Pro\ENGINEER	R 19.0	1998
14	Pro\ENGINEER	R 20.0	1998
15	Pro\ENGINEER	R 2000i	1999
16	Pro\ENGINEER	R 2000i2	2000
17	Pro\ENGINEER	R 2001	2001
18	Pro\ENGINEER WILDFIRE	R 1.0	2002
19	Pro\ENGINEERWILDFIRE	R 2.0	2004
20	Pro\ENGINEER WILDFIRE	R 3.0	2006
21	Pro\ENGINEER WILDFIRE	R 4.0	2008
22	Pro\ENGINEER WILDFIRE	R 5.0	2009
23	CREO ELEMENTS\PRO	R 5.0	2010

B. Pro-E Modules

- Sketcher (2D)
- Part (3D)
- Assembly
- Drawing and Drafting
- Sheet Metal
- Rendering

For this particular design, retaining rings specifications are from shiv sagar industries tables, with the following specifications:

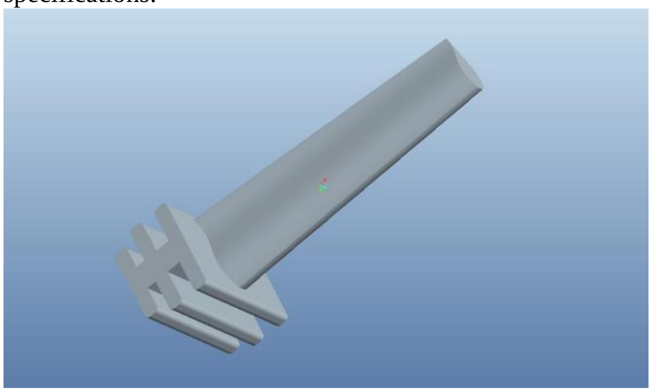

Fig.2. pro-e model.

C. Meshing Model Of Gas Turbine Blade

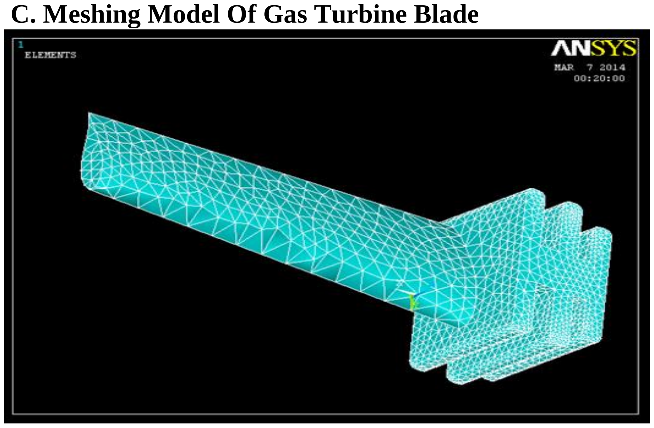

Fig.3. mesh model.

III. ANALYSIS

A. Material Type: Graphite

Deformed Shape Of Gas Turbine Blade

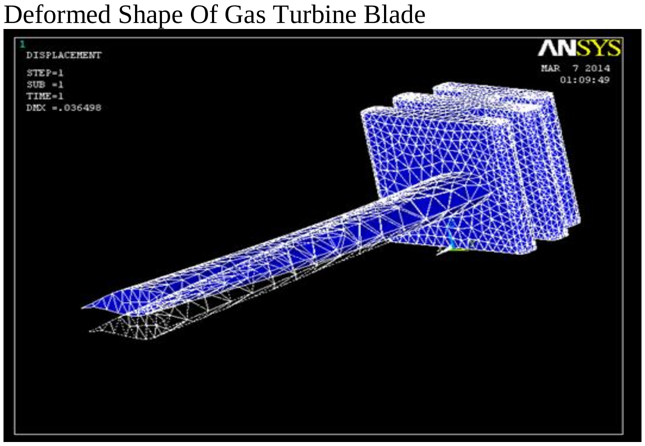

Fig.4.

B. Displacement Vector Sum Model Of Gas Turbine Blade

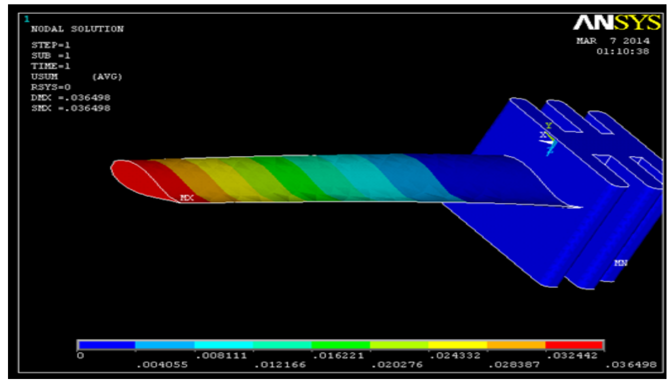

Fig.5.

Maximum Absolute Values:

NODE 10977 10493 10493 10493

VALUE -0.18949E-02-0.45726E-02 0.36208E-01 0.36498E-01.

C. Vonmises Stress Model Of Gas Turbine Blade

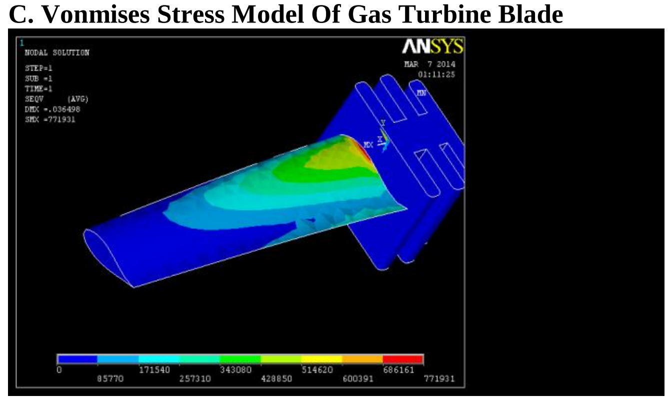

Fig.6.

Minimum Values:

NODE 3262 3258 11178 10 10

VALUE -26475. -78062. -0.54572E+06 0.0000 0.0000

Maximum Values:

NODE 11895 3281 3277 11895 11895

VALUE 0.56145E+06 81961. 16478. 0.55976E+06 0.53345E+06

D. Vonmises Strain Model Of Gas Turbine Blade

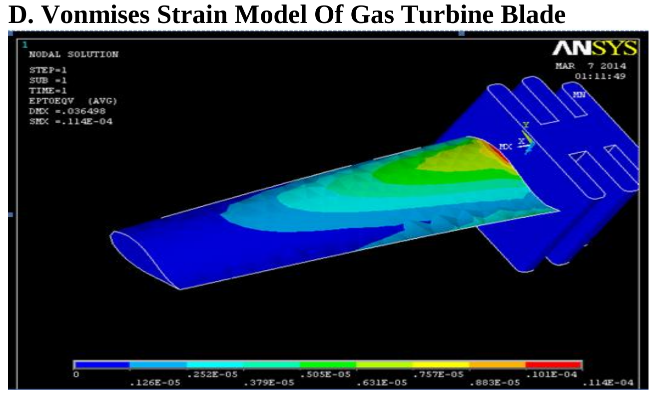

Fig.7.

Minimum Values:
NODE 10 11945 11178 10 10
VALUE 0.0000 -0.12665E-05-0.78410E-05 0.0000 0.0000

Maximum Values:
NODE 11895 11219 10 11895 11895
VALUE 0.80872E-05 0.11910E-05 0.0000 0.97959E-05 0.78515E-05

E. Modal Analysis

SET	TIME/FREQ	LOAD STEP	SUBSTEP	CUMULATIVE
1	0.12271E-03	1	1	1
2	0.36295E-03	1	2	2
3	0.63689E-03	1	3	3
4	0.10820E-02	1	4	4
5	0.16383E-02	1	5	5

F. Displacement At First Set

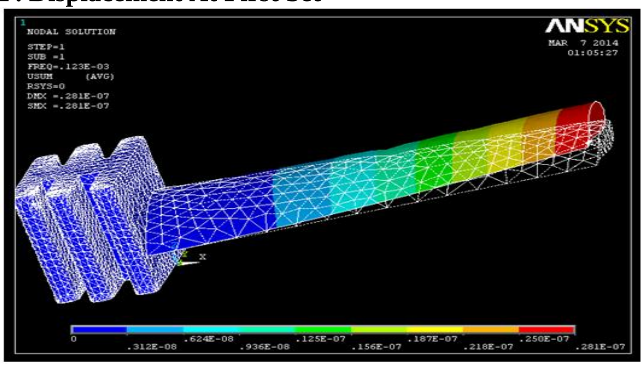

Fig.8.

G. Displacement At Second Set

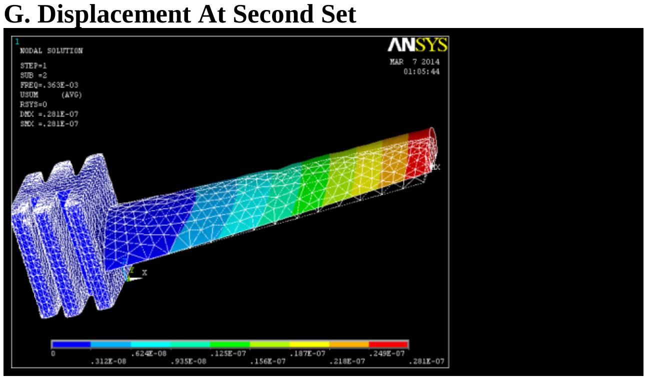

Fig.9.

H. Displacement At Third Set

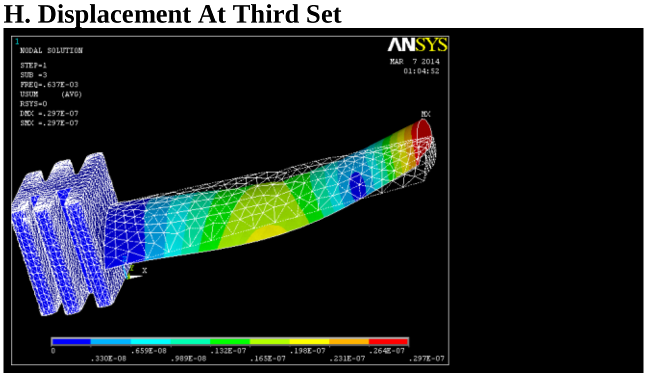

Fig.10.

I. Displacement At Fourth Set

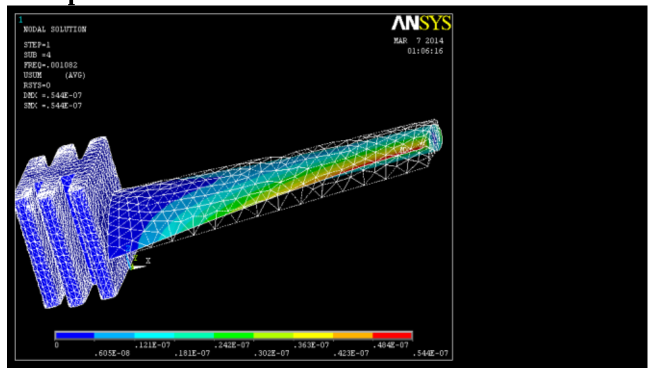

Fig.11.

J. Displacement At Fifth Set

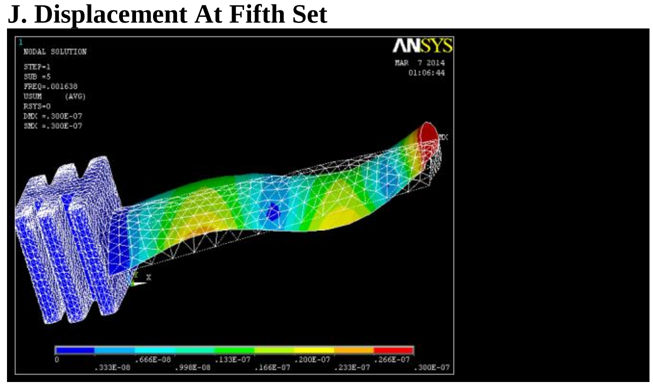

Fig.12.

K. Material Type Titanium

Deformed Shape Of Gas Turbine Blade:

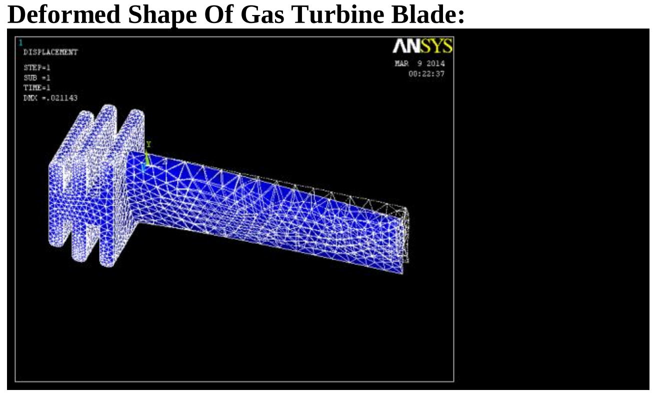

Fig.13.

Displacement Vector Sum Model Of Gas Turbine Blade:

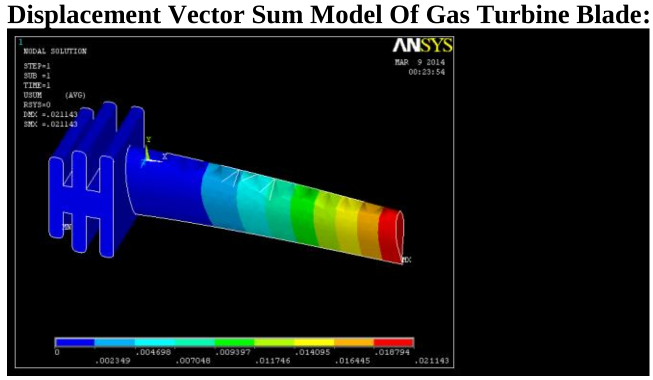

Fig.14.

Maximum Absolute Values:

NODE 11001 10493 10493 10493

VALUE -0.10987E-02 -0.26465E-02 0.20976E-01 0.21143E-01

Vonmises Stress Model Of Gas Turbine Blade:

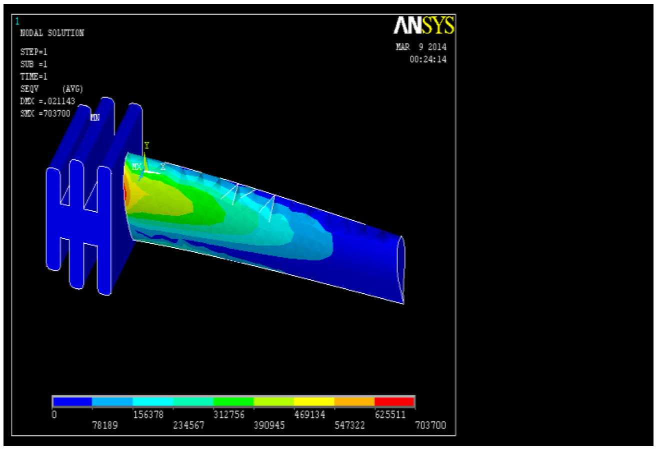

Fig.15.

Minimum Values:

NODE 3260 3258 11177 10 10

VALUE -76988. -0.16158E+06-0.55062E+06 0.0000 0.0000

Maximum Values:

NODE 11897 3281 3283 11895 11895

VALUE 0.56561E+06 0.16308E+06 64866. 0.58244E+06 0.53841E+06

Vonmises Strain Model Of Gas Turbine Blade:

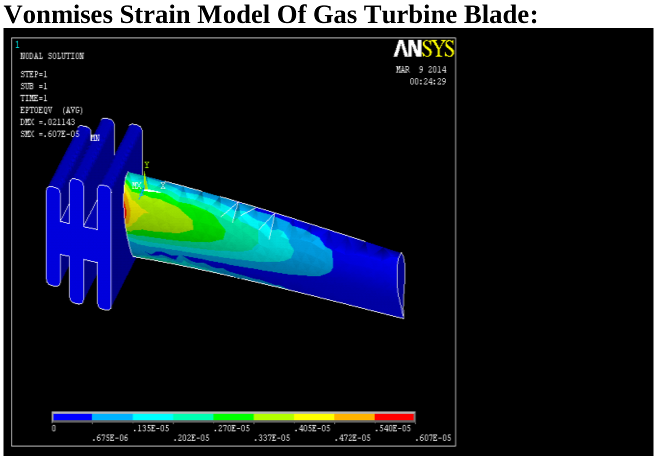

Fig.16.

Minimum Values:

NODE 10 11945 11178 10 10

VALUE 0.0000 -0.12433E-05-0.45469E-05 0.0000 0.0000

Maximum Values:

NODE 11895 11219 10 11895 11895

VALUE 0.46685E-05 0.11726E-05 0.0000 0.66278E-05 0.46486E-05

IV. MODAL ANALYSIS

A. Mode Frequencies

SET	TIME/FREQ	LOAD STEP	SUBSTEP	CUMULATIVE
1	0.11416	1	1	1
2	0.33637	1	2	2
3	0.59121	1	3	3
4	0.95177	1	4	4
5	1.5145	1	5	5

B. Displacement At First Set

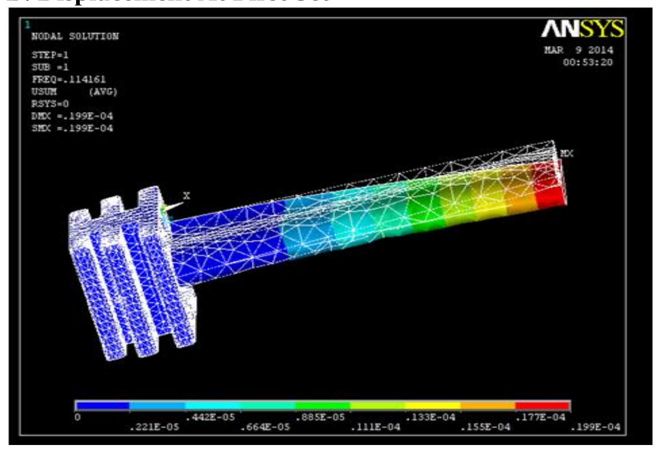

Fig.17.

C. Displacement At Second Set

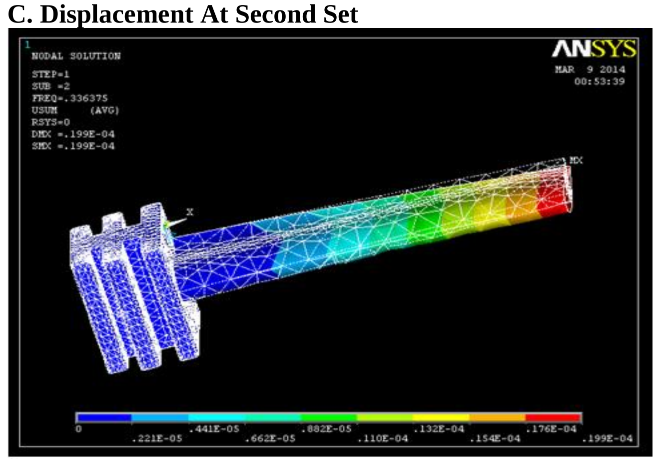

Fig.18.

D. Displacement At Third Set

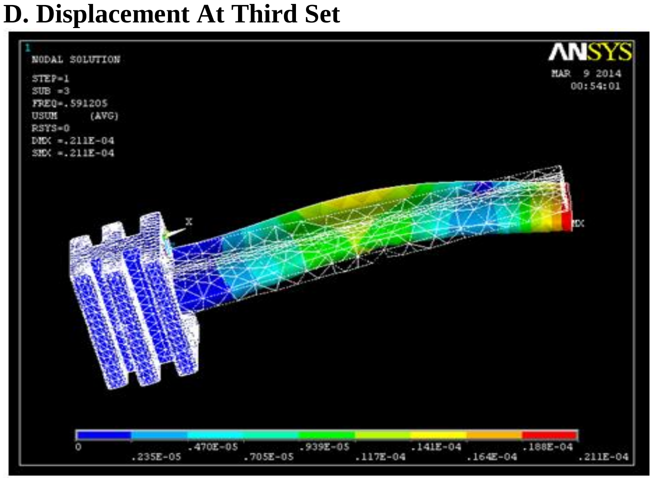

Fig.19.

E. Displacement At Fourth Set

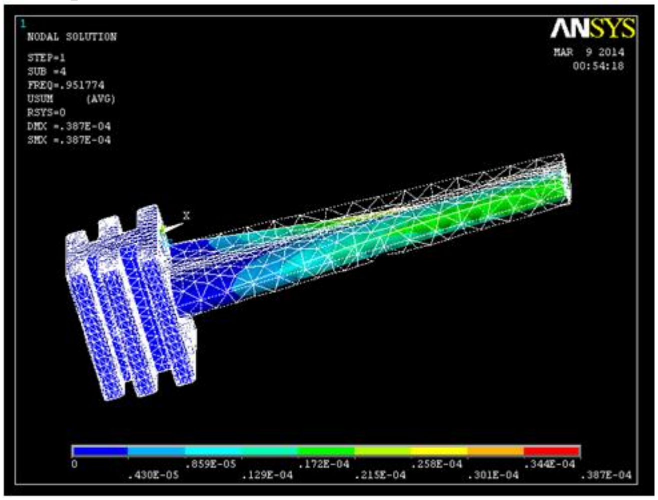

Fig.20.

F. Displacement At Fifth Set

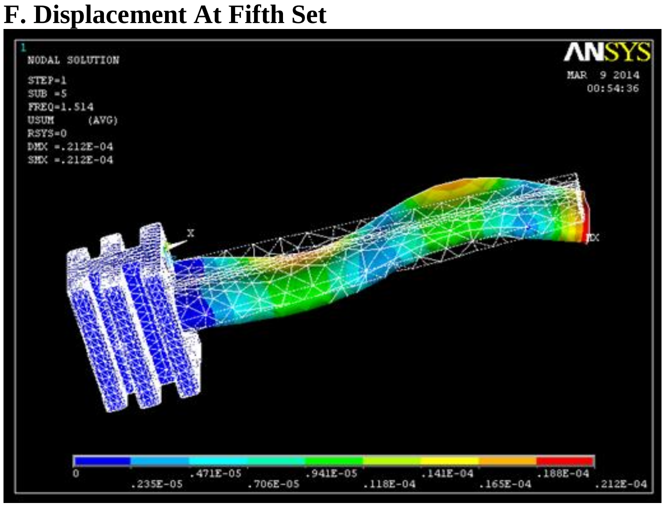

Fig.21.

V. CONCLUSION

In this paper we have analyzed previous designs and generals of turbine blade to do further optimization, Finite element results for free standing blades give a complete picture of structural characteristics, which can utilized for the improvement in the design and optimization of the operating conditions.

- In the first step we have designed turbine blade using pro\Engineering from existing model.
- In the second step we have done the study on different materials which are suitable for the improvement of turbine blade.
- In the third step we have validated our design using existing materials.
- In the next step we have applied different materials for turbine blade to suggest best material.

From the above results we can conclude that using nickel alloys with TITANIUM and GRAPHITE with partially stabilized cobalt coating is more beneficial than previous materials, due to low stress displacement, low cost and easy to manufacture.

VI. ACKNOWLEDGMENT

This paper is based on M. Tech. project carried out by the student of Chirala College of engineering, CHIRALA studying M.Tech (CAD/CAM).The project had been completed by Ms. N.SURESH bearing H.T.no:12E91D0413 under the guidance of MR.T.L.RAKESH BABU. I take this opportunity to record our obligations to Mr. MOHAN, Design engineer for his encouragement and in valuable guidance for the development of this project.

Future Blade Pro Enhancements:

The Blade Pro product is constantly being updated to provide support for additional geometric features and customer-requested enhancements. One such ongoing effort is the interfacing with solid models generated by other third-party software. The ANSYS Connection product has proven to be an effective method of transferring solid models from various CAD systems into the ANSYS environment. Additional analysis features that exploit ANSYS capabilities (e.g., contact analysis) are planned for future releases.

VII. REFERENCES

[1] S.Gowreesh, N.Sreenivasalu Reddy and N.V.Yogananda Murthy. "Convective Heat Transfer Analysis of a Aero Gas Turbine Blade Using Ansys", International journal of Mechanics of solids, vol4, No.1, March 2009(ppt55-62).

[2] P.Kauthalkar, Mr.Devendra S.Shikarwar, and Dr.Pushapendra Kumar Sharma. "Anlysis Of thermal Streses Distribution pattern On Gas Turbine Blade using Ansys", International journal of Engineering Education and technology, Vol.2, No.3, Nov 2010.

[3] John's, T.Ramakrishna. "THE DESIGN ANDANALYSIS OF GAS TURBINE BLADE", International Journal of Advanced Research and Studies, Vol 2, No.1, Dec 2012.

[4] V.Raga Deepu, R.P.Kumar Ropichrla."Design And Coupled Field Analysis Of First Stage Gas Turbine Rotor Blades", International journal of Mathematics and Engineering, Vol 13, No.2, Pages: 1603-1612.

[5] S.S.Rao,"The Finite Element method in Engineering", BH Publications New Delhi, 3rd.

[6] V.Ganesan "Gas Turbines"TMH Publications.