DECLARATION BY THE CANDIDATE

Date:___________

I hereby declare that the work presented in this dissertation entitled **COMPUTATIONAL STUDY OF TURBINE CASCADE"** has been carried out by me under the guidance of Dr. Samsher, Professor, Department of Mechanical Engineering, Delhi College of Engineering, Delhi and hereby submitted for the partial fulfilment for the award of degree of Master of Engineering in Mechanical Engineering (THERMAL) at Delhi College of Engineering (Delhi university), Delhi.

I further undertake that the work embodied in this major project has not been submitted for the award of any other degree elsewhere.

CERTIFICATE

It is to certify that the above statement made by the candidate is true to the best of my knowledge and belief.

Dated:-------------------

Dr. SAMSHER

Professor

Mechanical Engineering Department

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Acknowledgement

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DEVENDRA SINGH

ABSTRACT

Roughness over the turbine blade is mainly caused by erosion corrosion and deposition. The roughness varies along the blade height and also over different stage of blade. To see the effect of roughness, three profiles have been taken and were checked for different roughness over only pressure surface, only suction surface and over both the surfaces together. The study has been carried out using Fluent software. It has been concluded that the loss coefficient increases with roughness. Roughness over pressure surface is more detrimental than suction surface. Study also reveals that roughness over reaction profile is more detrimental than that of impulse profile.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX -1

NOMENCLATURE

Nomenclature

E	Both suction and pressure surface of blade rough
PE	Entire pressure surface of blade rough
PL	$1/3^{rd}$ of pressure surface of blade rough at leading edge
PM	$1/3^{rd}$ of pressure surface of blade rough at mid chord
PT	$1/3^{rd}$ of pressure surface of blade rough at trailing edge
RKE	Realizable k-ε model
RNG	Renormalized group model
S	Both suction and pressure surface of blade smooth
SE	Entire suction surface of blade rough
SL	$1/3^{rd}$ of suction surface of blade rough at leading edge
SM	$1/3^{rd}$ of suction surface of blade rough at mid chord
ST	$1/3^{rd}$ of suction surface of blade rough at trailing edge

Symbols

a	Local velocity of sound
c	Chord length of blade
C_p	Specific heat at constant pressure
D_H	Hydraulic diameter
E	Energy of the system
F_i	External body force in 'i' direction
g_i	Acceleration due to gravity in i direction

k_s	Equivalent sand grain roughness
K_{adm}	Admissible surface roughness
l	Length /span of blade
L	Characteristic length
m	Mass flow of the system
M	Mach number
P	Pressure of system
R_e	Reynolds number
S	Pitch
S_m	Source term
T	Temperature of the system
u_i	Velocity component in i direction
$\overline{u_i}$	Average velocity in turbulent flow in i direction
V	Velocity of fluid
C_{x1}	Inlet velocity
Cx_2	outlet velocity
α_1	Inlet angle (air angle)
α_2	Exit angle, Blade angle

Greek symbols

ρ	Density of air
μ	Dynamic viscosity
κ	Turbulent kinetic energy
ε	Rate of dissipation of turbulent kinetic energy
γ	Ratio of specific heats
ϕ	Scalar variable
η	Efficiency
σ_k	Prandtl number for turbulent kinetic energy
σ_ε	Prandtl number for dissipation

τ_{ω}	Wall shear stress
ζ	Mass averaged value of profile loss coefficient
ζ_{y}	Local profile loss coefficient
β_{2y}	Local exit flow angle
δ_{1k}	Boundary layer thickness
δ_{ij}	Kronecker's delta
τ_{ij}	Stress tensor

Subscripts

1	Inlet to cascade
2	Outlet to cascade
o	Total value
s	Static value
y	Local value in pitch-wise direction