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Pitch Propeller Design

Steam Turbine Components

Highlights

Design for Low Subsonic Airplane

Importance of Lathe Machine

Discovering Thoughts, Inventing Future

VOLUME 14 ISSUE 6 VERSION 1.0

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Damage Informatics for Steam Turbine Components

By Kazunari Fujiyama
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Abstract- Statistical data analyses were conducted on the variety of damage modes occurred in steam turbine major components such as high pressure turbine blades/nozzles, casings and low pressure turbine rotors and blades. The data were fitted using log-normal distribution function of operation time and number of starts. Two dimensional distribution functions were constituted by combining the marginal distribution functions of operation time and number of starts. Time-cycle mapping for various events indicated that apparent order of event occurrence and the equi-probability loci representing the time or cycle dependency and data distribution range. The best fit line for mean values of time and cycles of each event was adopted to evaluate the probability function of operation time and used to calculate resultant risk function along the line. The rational results were obtained to determine optimum maintenance periods from the risk functions established for respective turbine sections. The entire procedure including time-cycle mapping expression has been proved to be a quite useful tool for damage assessment, causality assessment and resultant risk assessment to improve the maintenance technology and can be categorized in the brand-new "Damage Informatics" concept.

Keywords: damage, steam turbine, two-dimensional probability, log-normal distribution, time and cycle mapping.

GJRE-A Classification : FOR Code: 290501

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Damage Informatics for Steam Turbine Components

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I. Introduction

Fossil power plants still play important roles for providing electric power supply on demands all over the world. Although combined cycle plants coupling gas turbines and steam turbines have become more popular due to their higher efficiency, the conventional steam turbine plants still occupy the large part of power stations and have become aged by long term service, requiring cost-effective maintenance application. To make optimum maintenance planning, risk-based maintenance[1]-[5] procedures have been established and applied to actual plants but the objective parts have been restricted and comprehensive evaluations of turbine major sections have been required. However the systematic lists of events to be considered have not been provided according to the wide variety of events and the lack of rational scenario making procedures. The fundamentals of manipulating damage information are statistical data processing and causality inference [6] from the observed event items but the latter term has not been explicitly recognized in the maintenance technology development. As the damage events may dependent on two operational parameters such as operation time and number of starts, the two parameters are used as the variables for evaluating probability functions. To provide rational maintenance decision making, risk functions are introduced based on the two-parameter distribution functions and used as the comprehensive measures for synthesizing various damage events occurred in major turbine sections. The examples of some detailed damage scenarios are also presented here to understand the synthetic evaluation of total risks for optimum maintenance planning. This approach could be called as "Damage Informatics" for Steam Turbine Components as a new investigation field of plant integrity.

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II. A General Description of Damage Events Observed at Steam Turbine Major Components

Figure 4 shows typical damage modes in steam turbine components [4]. For high-pressure (HP) and intermediate-pressure (IP) turbine rotors, creep damage is accumulated in the bore and wheel hooks. In the dovetail hook contacted area, high cycle or fretting fatigue occurs due to vibratory stress. In the strain concentrations region of casings and valves, cracks initiate due to thermo mechanical fatigue (TMF) during cyclic operations and then grow under internal pressure. For nozzles, downstream deflection of nozzle diaphragm due to steam force occurs at high temperature portion. Solid particle or droplet erosion is sometimes observed in nozzle plates at HP/IP steam inlet portion and wet steam section of LP turbine. For steam pipe weldments, creep damage is accumulated and resulted in the creep void formation. For low pressure turbine rotors, corrosion fatigue or SCC under centrifugal and vibratory stress are typical damage modes.

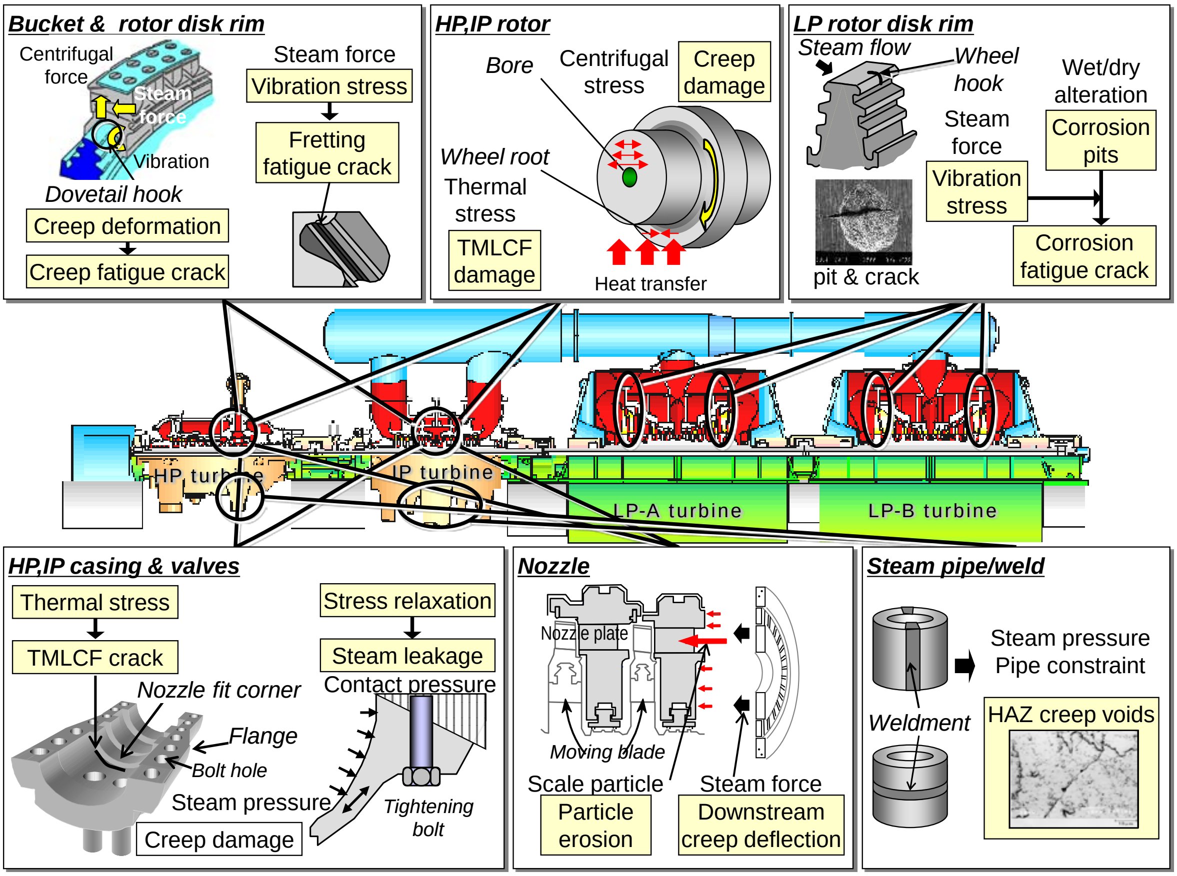

Fig.1 : Damage modes of steam turbine components

III. Statistical Analysis Procedure

Two dimensional log-normal probability distribution function F(Q) is expressed as the following equation and the ellipse locus is obtained by setting Q as a value corresponding to the constant probability[7].

$$F(Q) = 1 - \exp\left(-\frac{Q}{2}\right) \tag{1}$$

$$Q = \frac{1}{1-\rho^2}\left\{\frac{(\ln t - \mu_{Let})^2}{\sigma_{Let}^2} - 2\rho\frac{(\ln t - \mu_{Let})(\ln N - \mu_{LeN})}{\sigma_{Let}\sigma_{LeN}} + \frac{(\ln N - \mu_{Let})^2}{\sigma_{LeN}^2}\right\} \tag{2}$$

$$\rho = \frac{E\{(\ln t - \mu_{Let})(\ln N - \mu_{LeN})\}}{\sigma_{Let}\sigma_{LeN}} \tag{3}$$

Where, μ_{Let}: time based log-normal mean, μ_{LeN}: cycle based log-normal mean, σ^2_{Let}: time based log-normal variance, σ^2_{LeN}: cycle based log-normal variance, ρ: correlation coefficient of $\ln t$ and $\ln N$.

In this article, the value of F is assumed as 0.5 for the convenience in comparison of event data. The relationship between t_{op} and N_s obtained by fitting the mean values of events is defined as the most likely operation pattern from field database and expressed by N_s as the function of t_{op} as follows.

$$N_s = At_{op}^b \tag{4}$$

Substituting Eq.(4) into Eq.(2), we obtain Q expression by t_{op} as follows.

$$Q(t_{op}) = \frac{1}{1-\rho^2}\left\{\frac{(\ln t_{op} - \mu_{Let})^2}{\sigma_{Let}^2} - 2\rho\frac{(\ln t_{op} - \mu_{Let})(\ln A + b\ln t_{op} - \mu_{LeN})}{\sigma_{Let}\sigma_{LeN}} + \frac{(\ln A + b\ln t_{op} - \mu_{Let})^2}{\sigma_{LeN}^2}\right\} \tag{5}$$

For evaluating risks, we must define the values of consequence, but here we put them as unity for the simplicity of data manipulation and then we can sum up the probabilities as the measure of risk value. The resultant risk function r (t_{op}) is expressed by the function of t_{op} as follows

$$r(t_{op}) = \sum_{i=1}^{m} C_i F_i(t_{op}) = \sum_{i=1}^{m} F_i(t_{op}) \qquad (6)$$

Where, C_i: consequence of failure of event i(assumed=1), m: total number of subject events, $F_i(t_{op})$: probability of failure of event i obtained by Eq.(1).

IV. Marginal Distribution

As the first step, the marginal distribution are obtained against operation tome t_{op} and number of starts N_s as shown in Fig. 2 for high pressure inner casing cracking events. Log-normal type distribution are obtained for most of the event data like this case. The unreliability function of log-normal type is written as follows[2].The variable Y can be put as time of operation t_{op} or number of starts N_s.

$$F(Y) = \Phi\left(\frac{\ln Y - \mu_{Le}}{\sigma_{Le}}\right) = \int_{-\infty}^{Y} \frac{1}{\sigma_{Le}\sqrt{2\pi}} e^{\frac{(\ln x - \mu_{Le})^2}{2\sigma_{Le}^2}} dx \qquad (7)$$

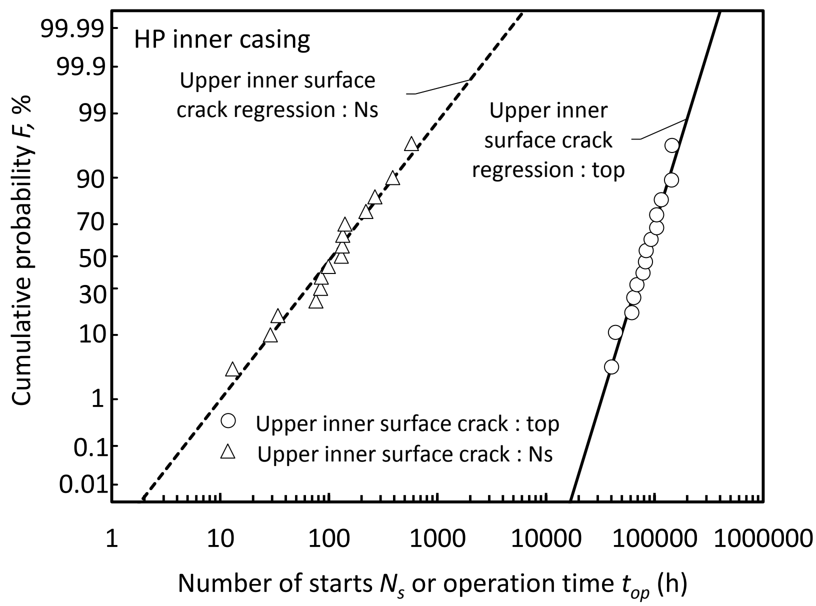

Fig. 2 : Examples of marginal distributions for HP (High Pressure) inner casing cracking event

V. Two-Dimensional Log-Normal Distribution Analysis for Various Events and Casualty Assessment

Based on Eqs.(5) and the marginal distributions obtained in section4, two dimensional log-normal distribution are obtained and then causality assessment can be conducted by using the risk functions of Eq.(6). Individual analytical results for HP (High Pressure) and LP(Low Pressure) turbine sections are described as follows. IP(Intermediate Pressure) turbine section showed almost similar trend with HP turbine section, therefore the IP turbine section was omitted here due to the lack of space.

a) HP (High Pressure) Turbine

Figure 3 shows N_s-t_{op} mean point damage mapping for HP blades and nozzles with 50% unreliability contour. The mean trend is obtained from the regression of mean event data by Eq.(4) excluding HP-2 nozzle erosion which shows irregular plot from the majority trend. This is caused by the data mismatch due to the small number of events (here, only 2 events available but the sets of N_s and t_{op} showed contrary combinations). The orientation of major axis on the N_s-t_{op} plot may represent the tendency for cycle dependence or time dependence. Rather stronger cycle dependences are observed for HP-2 nozzle fouling, HP-2 nozzle deformation, HP-2 nozzle wear, HP-2 blade lifting and HP-2 blade erosion but each does not show the trend clearly enough due to small number of obtained data. On the other hand, HP-1 blade lifting shows more apparent tendency of time dependence compared with other events and it has more data numbers. More detailed event scenario is shown as the flow chart form in Fig.4 referring Fig.3. Resultant risk curve shown in Fig.5 indicates an apparent peak, so the t_{op} value at the peak of risk function can be adopted as the recommendation of inspection timing.

Figure 6 shows N_s-t_{op} mean point damage mapping for HP inner casing plots and almost all data are categorized as the thermo-mechanical fatigue cracking located in the narrow sets of t_{op} and N_s, so there is no motivation to draw mean trend by regression of the data. The shapes of 50% contours show more horizontal orientation which suggests the stronger dependency on number of starts than operation time.

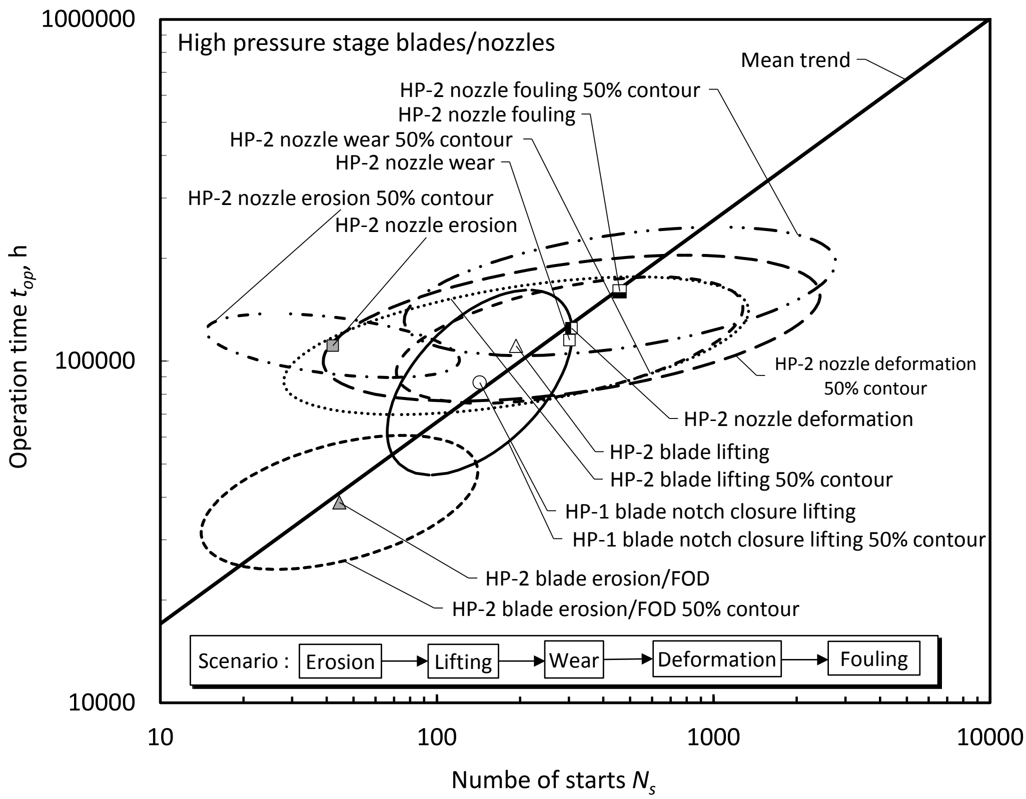

Fig. 3 : Time-cycle damage map for HP blades and nozzles.(HP-1,2:High Pressure Stage 1, 2)

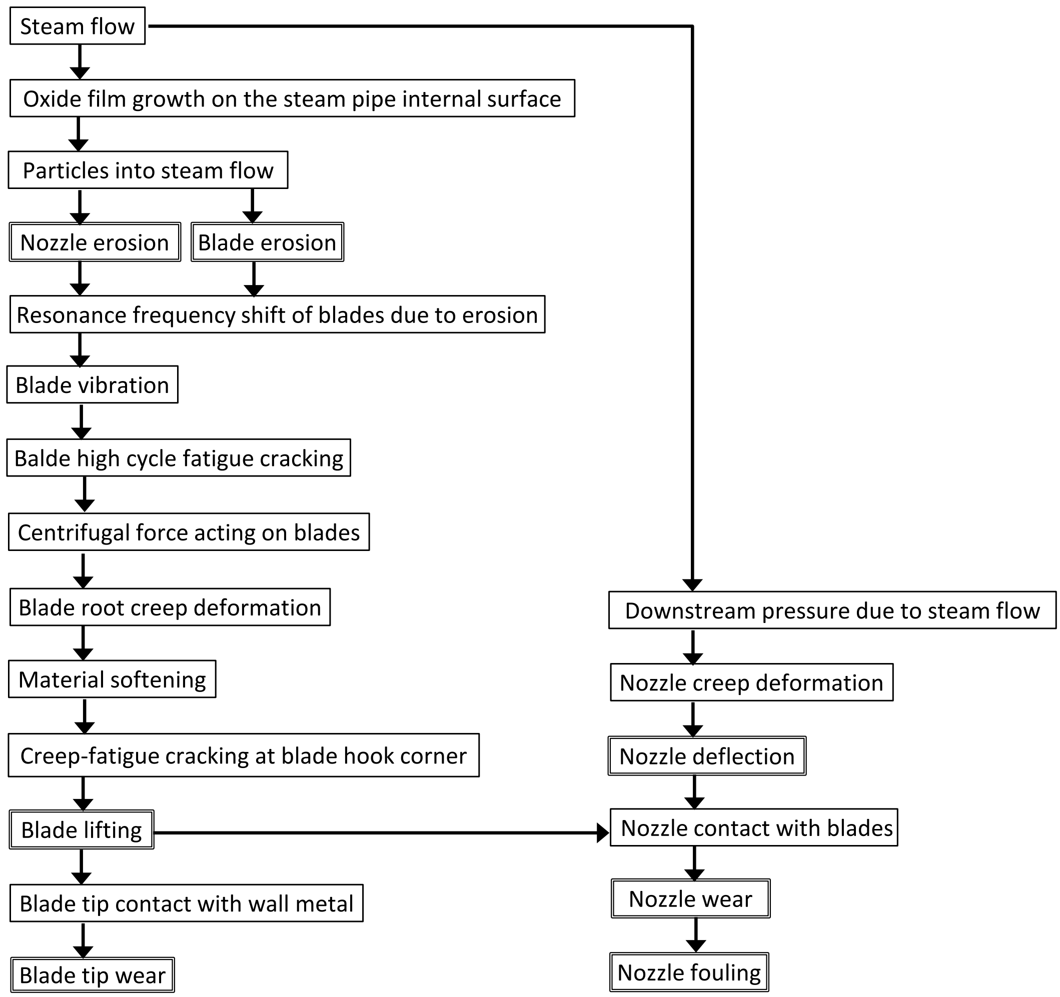

Fig. 4 : Detailed damage flow for HP blades and nozzles (doublets indicate the subtracted events from Fig.3)

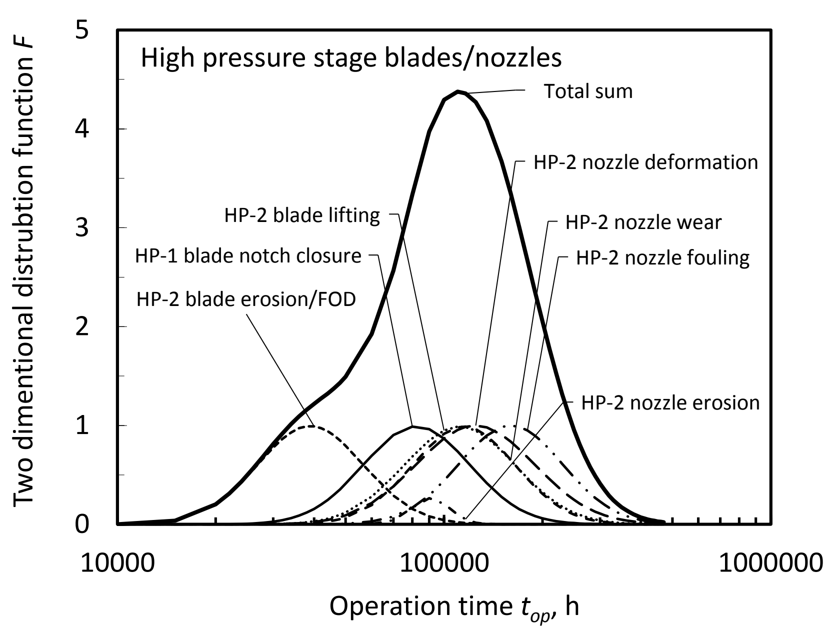

Fig. 5 : Resultant risk curve for HP blades and nozzles

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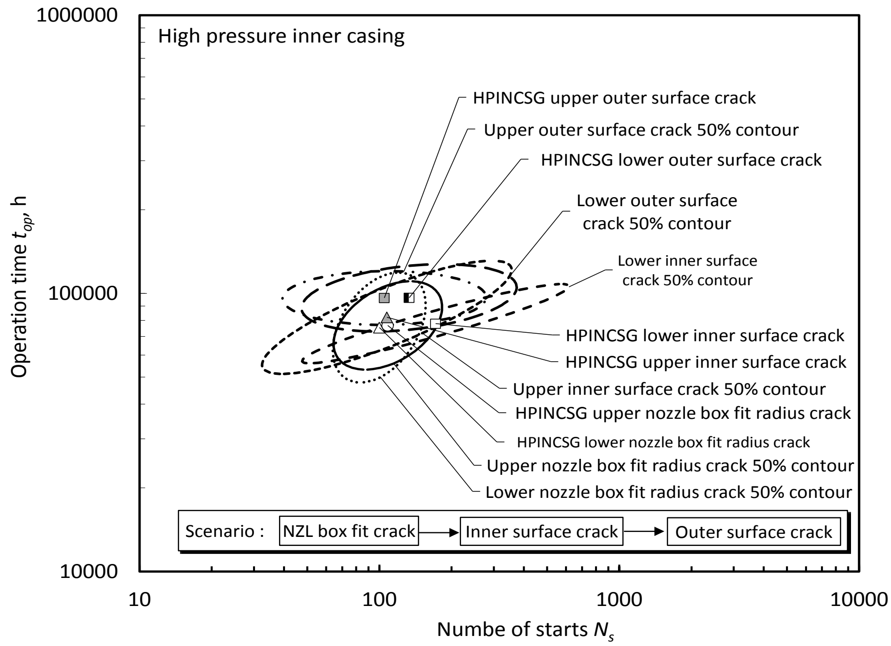

Fig. 6 : Time-cycle damage map for HP inner casings(HPINCSG)

b) LP(Low Pressure) Turbine

Figure7 shows the N_s-t_{op} mean point damage mapping for LP turbine rotor and blades. The majority of events may occur along the mean trend line, and then the sequence can be expressed as early blade damage of erosion/lifting/crack and as the subsequent crack/scoring/erosion damage in rotors. By judging from the 50% failure loci, L-0 blade crack, L-0 erosion shield crack, L-0 lacing wire crack, L-1 lacing wire crack and L-1 shroud crack, show rather cycle dependent than time dependent tendency, but on the other hand, LP rotor journal scoring and L-0 erosion shield erosion show rather time dependent tendency but not so clear. More detailed event scenario is shown as the flow chart form in Fig.8 referring Fig.7. Resultant risk curve shown in Fig.9 indicates an apparent peak, so the t_{op} value at the peak of risk function can be adopted as the recommendation of inspection timing. The optimum timing shows almost similar top value to Fig.5 around over 100,000hours t_{op} which has been recognized widely as the onset of full inspection application.

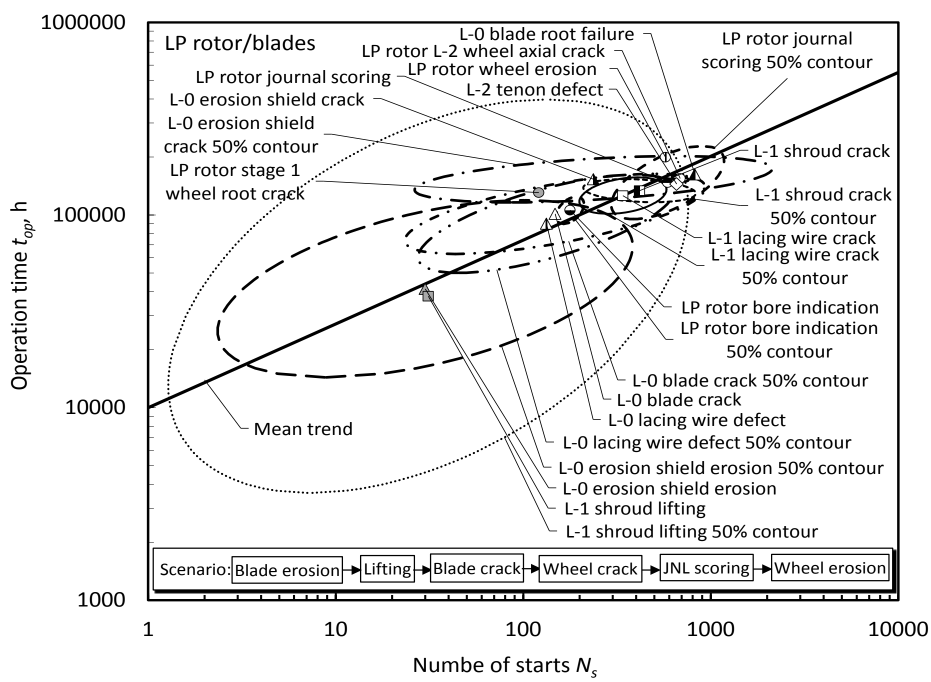

Fig. 7 : Time-cycle damage map for LP rotors and blades (L-0 means the last stage of Low Pressure turbine, L-1 means one stage ahead of L-0 and L-2 means two stages ahead of L-0)

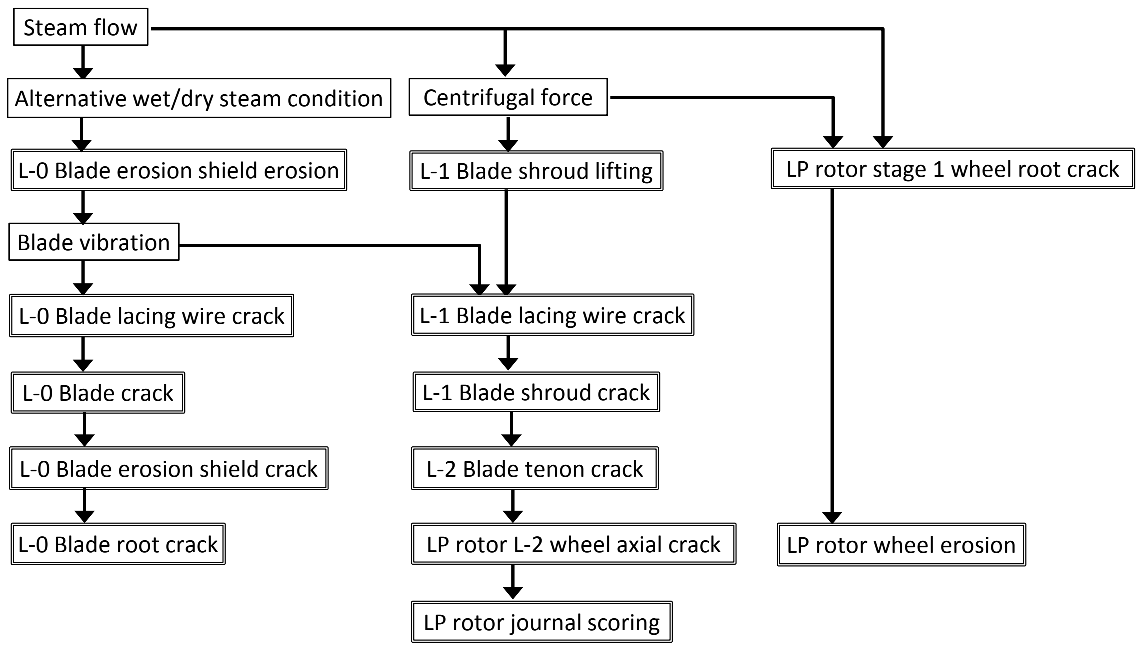

Fig. 8 : Detailed damage flow for LP rotors and blades (doublets indicate the subtracted events from Fig.7)

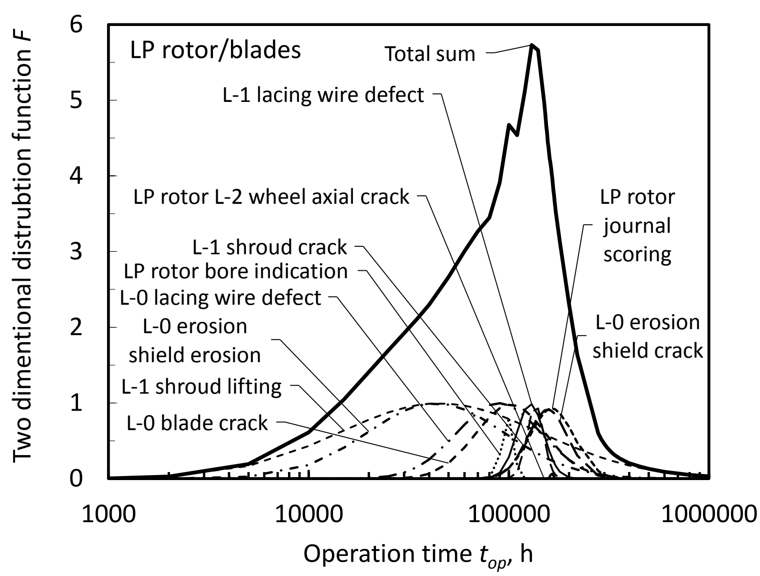

Fig. 9 : Resultant risk curve for LP rotors and nozzles

c) Risk-cost measures for optimum maintenance planning[8]

The risk function $r(t_{op})$ in Eq.(6) represents the possible cost for unfavorable damage occurrence and the monotonically increasing function of top. On the other hand, the cost for applying preventive maintenance action is inversely proportional to maintenance intervals. By plotting the risk function and the preventive cost function as shown in Fig.10, we can get resultant cost curves against operation time t_{op}. The resultant curves have minimum points as the recommendation for total predicted cost minimum condition. The timing of these preventive maintenance application is somewhat earlier than the time to peak risk cost which suggests the earlier maintenance can contribute total cost savings.

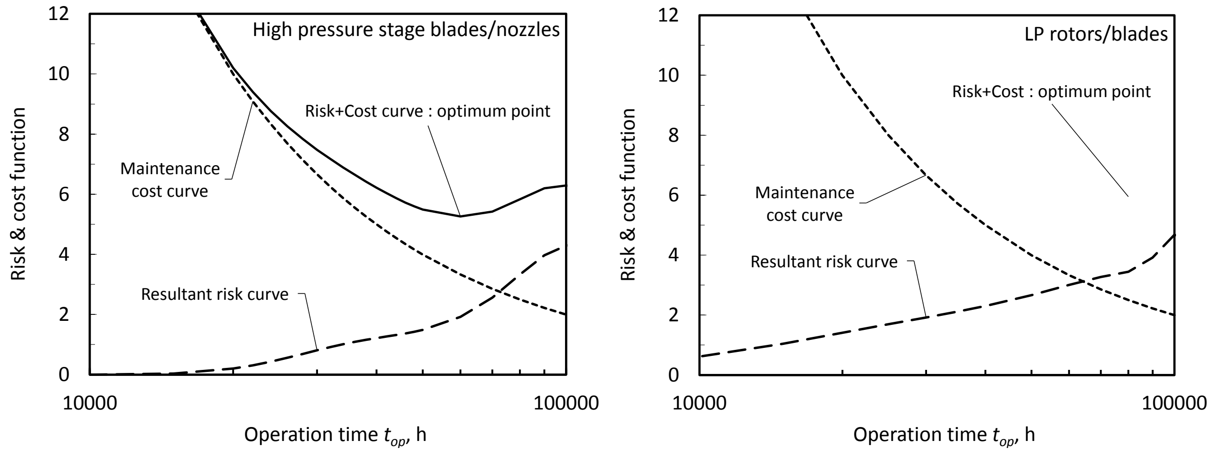

Fig.10 : Schematic risk-cost analysis examples for HP blades/nozzles and LP rotors/blades

VI. Conclusions

Field inspection database can be fully utilized to constitute damage scenario and to make up maintenance decision making for steam turbine major compound sections. Statistical analyses are utilized to quantify the event occurrence timing and the order with the scatter band of each event data. The accumulation of field data is quite important and scenario inference should be performed by combining the data analyses and the knowledge of experts in the form of damage sequence flow chart. The "Informatics" for plant damage may contribute to make more improvement in the accuracy for predicting the life of components and to identify the casualty of the events.

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Constant Pitch Propeller Design for Low Subsonic Airplane

By Arif Ahmed Sohel, Md. Abdus Shamir Talukder & Dr. Mohammad Arif Hasan Mamun
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Abstract- Constant pitch propeller whose blade angle is fixed with respect to hub is suitable for low speed airplane. The objectives of this thesis are to determine thrust, torque and the performance of the low subsonic airplane propeller. The thesis has been carried out by the two different approaches- Analytical and Computational Fluid Dynamic (CFD) simulation. The Analytical Method using "Propeller Blade Element Theory" is one of the most effective methodologies available for determining the thrust and torque produced by the propeller. On the other hand, the Computational Fluid Dynamic simulation has been used to simulate and capture the performance of the propeller. Through both methodologies, the propeller performance was analyzed and compared. The results obtained were tabulated and the corresponding graphs were plotted. Both methods suggest that the thrust and torque change with the change in relative velocity. Besides, there are several factors that contribute to the variations in results of the Analytical method and CFD Simulation.

Keywords: CFD, constant pitch, blade element theory, advance ratio, airfoil, coefficients of thrust, torque, power, etc.

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I. Introduction

An aircraft propeller is one of the most common important parts in the aircraft. It is an airfoil section designed to generate the aerodynamic forces. The propeller provides the necessary force i.e. thrust to push the aircraft through the air. Thrust is the component of the aerodynamic force that is parallel to the axis of rotation of the propeller. A propeller achieves a specified level of thrust by giving a relatively small acceleration to a relatively large mass of air. Maximizing thrust while minimizing the torque necessary to turn a propeller has becomes one of the most important aspects of good propeller design. The power that must be supplied by the engine is the multiplication of the torque required to turn the propeller and the angular velocity. The thrust developed by the propeller multiplied by the airspeed of the aircraft is called the propulsive power. The aircraft is propelled forward against the airframe drag by this power. The ratio of the propulsive power to the brake power for a propeller gives the propulsive efficiency which is one of the important measures of propeller performance. The thrust developed by the propeller when the aircraft is stationery is called the static thrust. This thrust is important for a propeller to produces high static thrust in order to accelerate the aircraft during takeoff.

In order to design an aircraft propeller, Computational Fluid Dynamic (CFD) analysis has been done to simulate the fluid flow over a body to solve and analyze the aerodynamic properties of a body. Moreover, analytical approach has been used to compare the result gathered from the CFD simulation.

In the time of rapid industrial development along with the current competition in the market has required companies to improve products and create more innovation compared to other products. Aviation industry is also on that trend, and the propeller performance plays an important role. A good propeller should meet the requirements of the flight and push the aircraft with high performance on the aerodynamic characteristics.

For studying these characteristics of the propeller, the numerical study seems to be the best way to accomplish that goal. In particular, the application of CFD simulation software to calculate the propeller aerodynamics is not so new study now and it has become popular methods. Today it becomes most powerful compared to other methods as well as experience or the other traditional methods. The present works focus on numerical simulation of the propeller at different rotating speed. Specific studies were conducted with the flight speed change, a fixed number J from 0 to 1. From these results such as pressure field, we can evaluate the performance of the propeller in the range of the flight velocity.

By using the mathematical models with considered assumptions, simulation results allow the predictions on propeller performance. The simulation has helped save time, effort and cost a lot for the design and manufacture of propellers.

II. Physical Model

Propeller blade has different airfoil shape; the shape varies quite a lot from root to tip. In practice a large number of different airfoils are used to make up one propeller blade but we designed our propeller simply taking only one airfoil along the blades. There are hundreds of airfoils suitable for this application but we think it is better to make a choice of an airfoil containing flat bottom surface. We are going to select NACA 4412 (Fig. 1) flat bottom airfoil used in a lot of propeller

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designs in the past, and is also used today for simple designs.

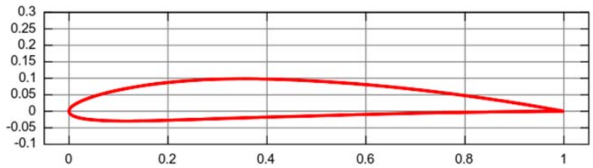

Figure 1 : NACA4412 airfoil [14]

In this design one blade has been considered which consists of 10 sections each having different airfoil shape, and representing different chord length & thickness.

The front plane has been taken as the reference plane in the Solid works part file and 10 more planes were created which are equally spaced. Plane 1 was at 2.4 inch far from reference plane and other 9 more planes were placed successively maintaining 2.4 inch distance between two consecutive planes up to 24 inch. The 2.4 inch difference between reference and 1st plane was kept for propeller hub. Airfoil data points from text file are imported to draw profile curves on each of the 10 planes by "curve through XYZ points" commands. These curves are converted into sketches for every slice of the blade sections. Fig. 2 represents a sample array of slices inserted into a Solid Works part file.

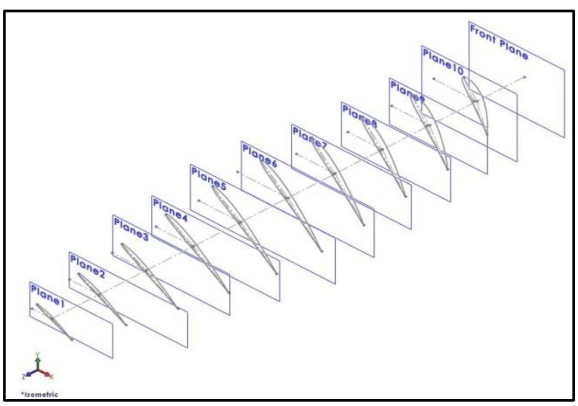

Figure 2 : array of propeller cross sections

The airfoil sections are placed on a line such a way that the line goes through the center of gravity of each section. Because, unbalanced exists when the center of mass does not coincide with the center of rotation, when the mass center axis is different to its running center axis. The centrifugal force due to the unbalance causes the device to vibrate. This vibration causes wear to the bearings, creates unnecessary noise, and can result in complete failure. "Mass properties" command of the "Evaluate" tab was used to determine these gravity centers of the sections. This will keep the propeller vibration free during rotation due to the balanced blade mass distribution.

Then the section profiles are rotated in the design geometric angles of the respective sections that will ensure the design pitch for the rotating propeller. "Loft" feature was used to create a solid body by lofting from root to tip of the section's profile sketches. Automatic linear twist distribution is generated in the blade according to the geometric angles given in the profiles. Tip of the blade is rounded by using dome features.

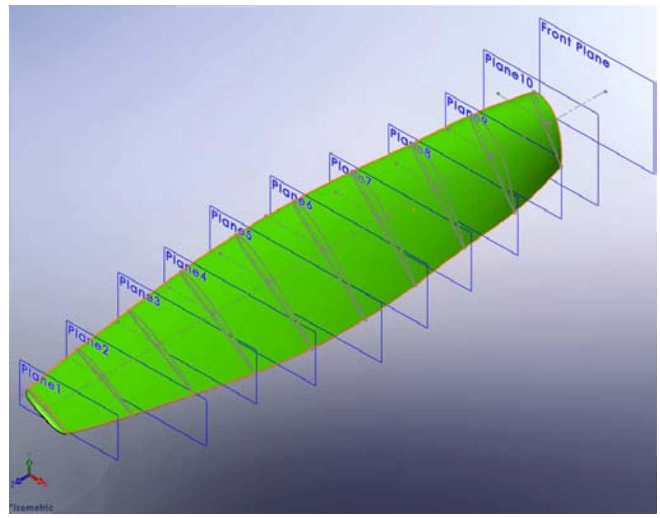

Figure 3 : propeller blade with sliced sections

Propeller hub is inserted in the origin of the part drawing which looks like a cylinder, and this is done by using the "boss extrude" command on a circular profile of 5.1inch diameter. After an array operation of the blade about the origin, blades are added with the hub. "Fillet" feature is used in the joints between the hub and blades. A pointy dome is created on the hub to reduce the drag.

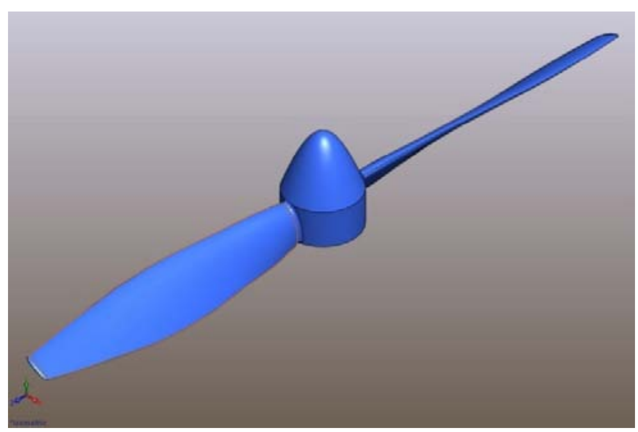

Figure 4 : Final propeller design

III. Mathematical Model

Development of a rational propeller theory begins with the work of Rankine and Froude with their interest in moving propulsion, but the fundamental principle is the same for water and air. They developed the fundamental momentum relation governing a propulsive device in fluid medium.

Stefan Drzewiecki however, was the first to rigorously examine and apply Blade Element Theory (BET). He performed his work between 1892 and 1920. BET is very similar to the Strip Theory for fixed wing aerodynamics. The blade is assumed to be composed of numerous, miniscule strips that are connected from tip to tip. The lift and drag are estimated at the strip using the 2-D airfoil characteristics of the section.

Also, the local flow characteristics are accounted for in terms of climb speed, inflow velocity, and angular velocity. The section lift and drag may be calculated and integrated over the blade span. BET is a very useful tool for the engineer. He or she may perform a fairly detailed local analysis of the rotor in a short amount of time.

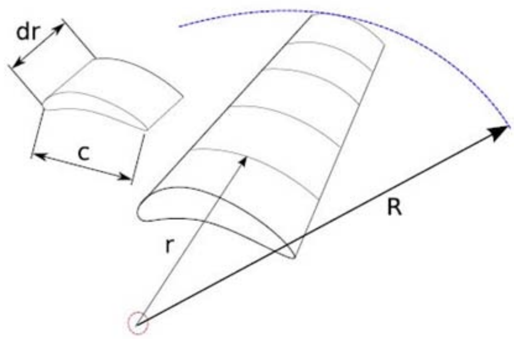

Figure 5 : Schematic of propeller blade

A propeller blade is simply a twisting wing (Fig. 5) which produces lift and drag. The two most important performance parameters for the design and analysis of a propeller are the thrust and torque.

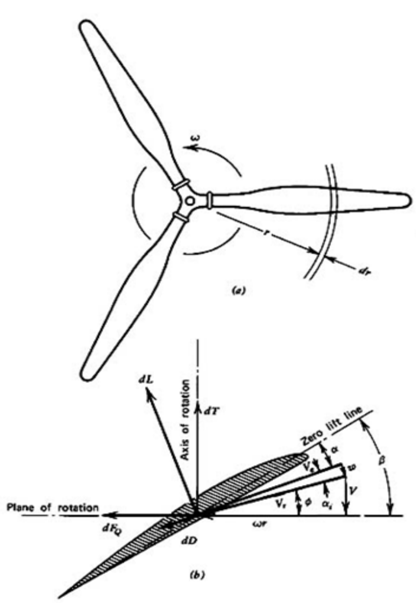

Figure 6 : Schematic of propeller cross-section

Fig. 6 shows a cross section of the blade. The force exerted on the span wise extension of the blade element is the resultant of two components i.e. lift and drag.

Where,

v=Incoming air velocity

ωr =tangential velocity of the rotating propeller

We can write the expressions of the elemental thrust and torque for the radial element (dr) on one of the blades:

$$dT = dL \cos\varphi - dD \sin\varphi$$
$$= \tfrac{1}{2}\rho V R^2 c\, dr\, (C_l \cos\varphi - C_d \sin\varphi)$$
$$dQ = (dL \sin\varphi + dD \cos\varphi) r$$
$$= \tfrac{1}{2}\rho V R^2 c\, dr\, (C_l \sin\varphi + C_d \cos\varphi)\, r$$

If

Resultant velocity, $V_R = V_\infty / \sin\varphi$

& Dynamic pressure, $q = \tfrac{1}{2}\rho {V_\infty}^2$,

Then the elemental thrust,

$$dT = q\, c\, dr\, (C_l \cos\varphi - C_d \sin\varphi)/ \sin^2\varphi$$

The elemental torque,

$$dQ = q\, c\, r\, dr\, (C_l \sin\varphi + C_d \cos\varphi)/ \sin^2\varphi$$

Where,

dL= elemental lift

dD= elemental drag

Cl = coefficient of lift

Cd= coefficient of drag

ρ = density of air

C = chord length

Φ= angle subtended by relative velocity

V_∞=incoming air velocity

Propeller thrust and torque are computed by integrating the equations of the elemental thrust and torque from root to tip of the blade. For number of blades B,

The total thrust,

$$T = qB\int_0^R c\, dr\, (C_l \cos\varphi - C_d \sin\varphi)/ \sin^2\varphi$$

Simplified

$$T = q\, B\, R \int_0^1 c\, dr\, (C_l \cos\varphi - C_d \sin\varphi)/ \sin^2\varphi; \qquad (1)$$

Where x=r/R

The total torque

$$Q = q\, B \int c\, r\, dr\, (C_l \sin\varphi + C_d \cos\varphi)/ \sin^2\varphi$$

Simplified

$$Q = q\,B\,R^2 \int_0^1 c(r/R)dr\,(C_l \mathrm{Sin}\,\varphi + C_d \mathrm{Cos}\,\varphi)\,\mathrm{Sin}^2\,\varphi$$;(2)where x=r/R)

Elemental blade efficiency, [1] [2] [3]

$$\eta = \frac{C_l \mathrm{Cos}\,\varphi - C_d \mathrm{Sin}\,\varphi}{C_l \mathrm{Sin}\,\varphi + C_d \mathrm{Cos}\,\varphi}\tan\varphi$$

The first important task is the selection of an airfoil to design a propeller. The selected airfoil must maintain the aerodynamic characteristics that will provide lift and drag required for the thrust (propulsive force for airplane) and torque (available torque from engine shaft to rotate propeller).

As the maximum operating altitude ranges up to 25,000 feet and for smaller aircraft with propellers and normally aspirated engines, the service ceiling (maximum altitude where 100 feet per minute climb can be maintained) ranges 12,000-14,000 feet, we choose 10,000 feet as the design altitude for the airplane that can be propelled by our propeller.

Followings are the design characteristics:

Altitude- 10,000 feet (3048 m)

Airplane speed- 50ms-1

Airfoil- NACA 4412

Diameter- 48 inch (1.22 m)

Pitch- 75 inch (1.905 m)

Operating pressure [5],

P= 101325 e^ (-[(M×g×h) ÷(R×T)])

Air density, ρ=P/RT=0.854 kgm-3 where T=288 k

Sound velocity, C= (KRT)-1/2=340ms-1 where k=1.4

IV. Numerical Procedure

a) Computational Design

The computational design is comprised of a frame of 2.5m×9.5m×2.5m. Now the boundary conditions are assigned as; 'Surface A' is the 'Velocity Inlet' of 50m/s uniform velocity, 'Surface B' is the 'Pressure Opening' of 70600pa'Surface C, D, E&F' are considered as the 'Ideal Wall'

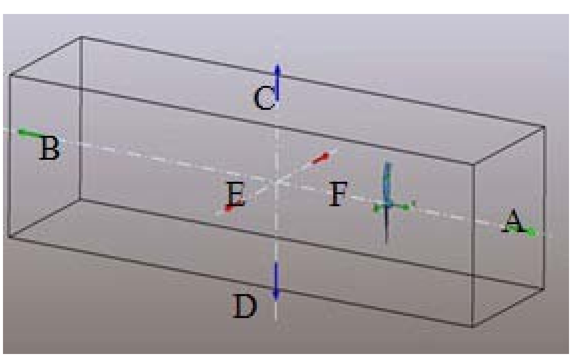

Figure 7 : Computational domain

An enclosed volume is considered as rotating region of the propeller. Here propeller is kept constant and rotating frame indicating the rotating region rotates about the propeller axis at same RPM of the propeller but opposite in direction.

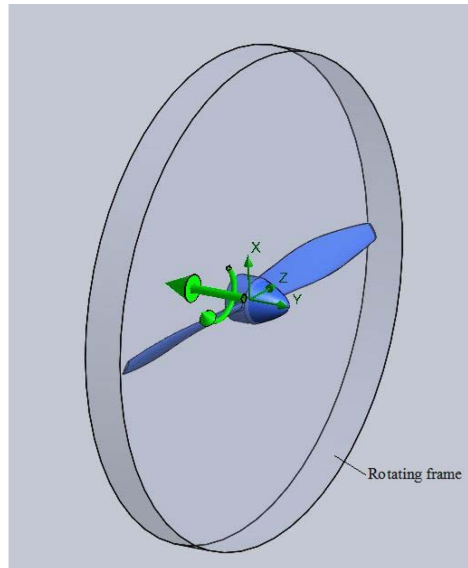

Figure 8 : Computational domain with rotating frame

b) Computational Meshing

In computational domain of flow simulation computational mesh is rectangular everywhere, so the mesh cells' sides are orthogonal to the specified axes of the Cartesian coordinate system and are not fitted to the solid/fluid interface. As a result, the near-walls of mesh cell are cut by the solid/fluid interface. Nevertheless, due to special measures, the mass is treated properly in these cells named partial.

At first a basic mesh is constructed. For that, the computational domain is divided into slices by the basic mesh planes, which are evidently orthogonal to the axes of the Cartesian coordinate system. The basic mesh is determined only by the computational domain and does not depend on the solid/fluid interfaces.

Then, the basic mesh cells intersecting with the solid/fluid interface are split uniformly into smaller cells in order to capture the solid/fluid interface with mesh cells of the specified size (with respect to the basic mesh cells). The following procedure is employed each of the basic mesh cells intersecting with the solid/fluid interface is split uniformly into 8 child cells; each of the child cells intersecting with the interface is in turn split into 8cells of next level, and so on, until the specified cell size is attained.

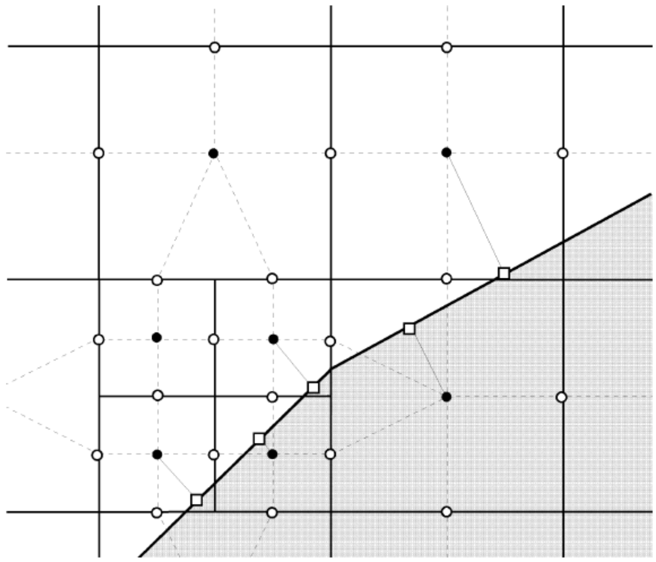

Figure 9 : Computational mesh cells at the solid/fluid interface

At the next stage of meshing, the mesh obtained at the solid/fluid interface with the previous procedure is refined in accordance with the solid/fluid interface curvature.

Finally, the mesh obtained with these procedures is refined in the computational domain to satisfy the so-called narrow channel criterion: for each cell lying at the solid/fluid interface, the number of the mesh cells (including the partial cells) lying in the fluid region along the line normal to the solid/fluid interface and starting from the center of this cell must not be less than the criterion value. Otherwise each of the mesh cells on this line is split into 8 child cells. As a result of all these meshing procedures, a locally refined rectangular computational mesh is obtained and used then for solving the governing equations on it.

After completion of mesh generation, flow Simulation solves the Navier-Stokes equations (formulations of mass, momentum and energy conservation laws for fluid flows) with the finite volume (FV) method on a spatially rectangular computational mesh designed in the Cartesian coordinate system.

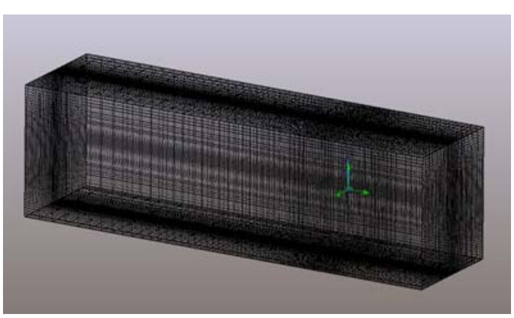

Figure 10 : Basic mesh

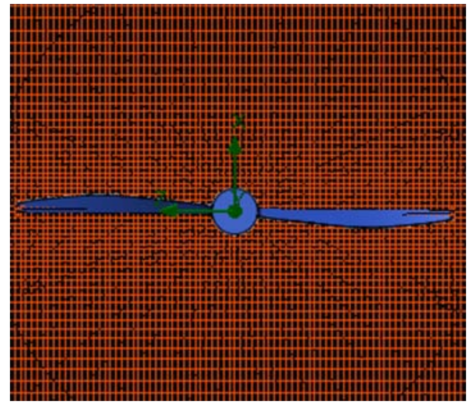

Figure 11 : Basic mesh (Top view)

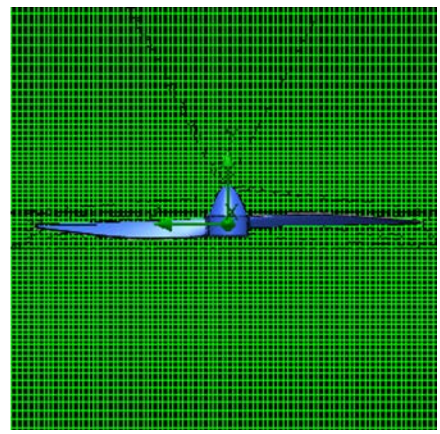

Figure 12 : Basic mesh (Right side View)

V. Results and Discussion

a) Analytical Result

To calculate elemental thrust and torque from eqn. (1) & (2) we have calculated φ, C_l, C_d & Chord length which varies with respect to the radial distance from the propeller center for 10 sliced sections. The tangential velocity changes with distance from the root to tip that contribute in the change of the relative velocity while the incoming air velocity remains fixed. This variation in the relative velocity changes the angle of attack in order to keep the pitch of the propeller fixed. We have calculated Cl and Cd for different angle of attack by using the Characteristics of NACA 4412 chart shown in the Fig. 13.

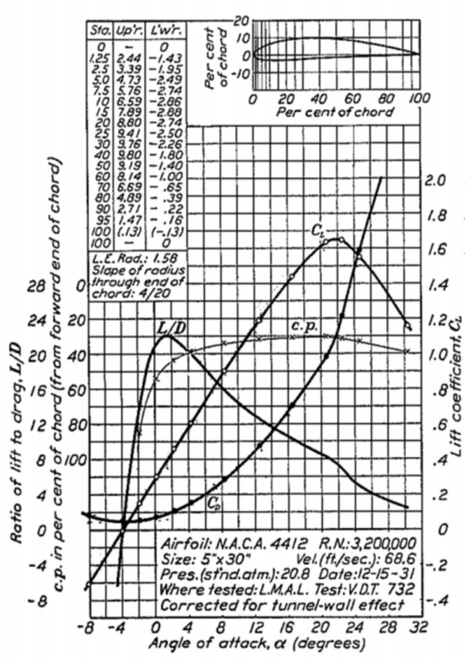

Figure 13 : Characteristics of NACA 4412

Dynamic pressure q∞ = ½ ρ V∞2 =1067.68 Pa

The angle subtended by relative velocity VR [7], φ=β (blade pitch angle)-α (Angle of attack)

We have plotted dCT/dx vs X &dCQ/dx vs X in the Fig. 14 to get the equations for dT/dx and dQ/dx. Therefore,

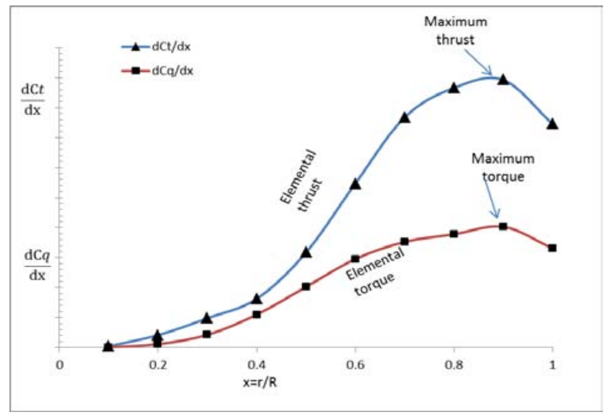

Figure 14 : Elemental coefficients gradient vs radial distance from root of the propeller

Here,

Total thrust, T= ∫ (dT/dx) dx

$$= \int_{0.1}^{1} (39748x^6 - 96725x^5 + 58676x^4 + 11010x^3 - 15011x^2 + 4063.1x - 266.78)dx = 817.24\ N$$

Total torque, Q= ∫ (dQ/dx) dx

$$= \int_{0.1}^{1} (-78162x^6 + 259394x^5 - 334610x^4 + 206529x^3 - 60258x^2 + 8159.6x\ 388.43)dx = 395.54\ Nm$$

By analyzing the curve of the gradient of the elemental thrust and torque coefficient plotted against span wise direction of a blade (root to tip distance), it is observed that maximum thrust and maximum torque cannot be obtained for the same element. For the maximum thrust, the torque obtained is somewhat less than the maximum torque and the thrust obtained is less than its maximum value when the torque is maximum. The maximum thrust and the maximum torque typically occur at the outer half of the propeller blade and the lower half contributes little to the thrust and torque. So, one need to be much careful while designing the propeller that the thrust needs to be distributed in a manner so that together the blended propeller would give the necessary thrust which is required for flying the aircraft.

b) CFD Result

Flow simulation of CFD software provides total thrust and torque 1007 N and 311.19 Nm respectively.

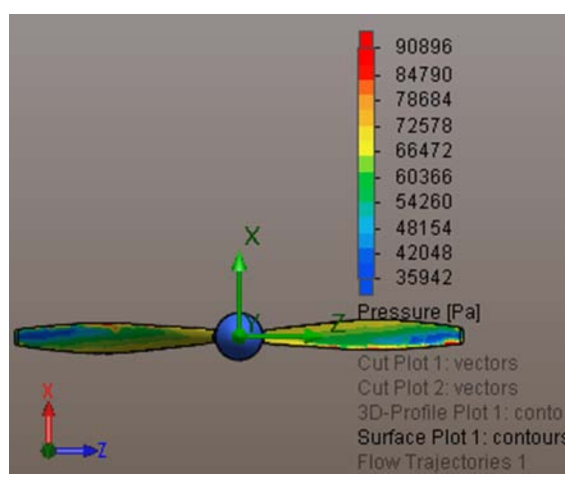

Figure 15 : Suction side pressure distribution (Upstream)

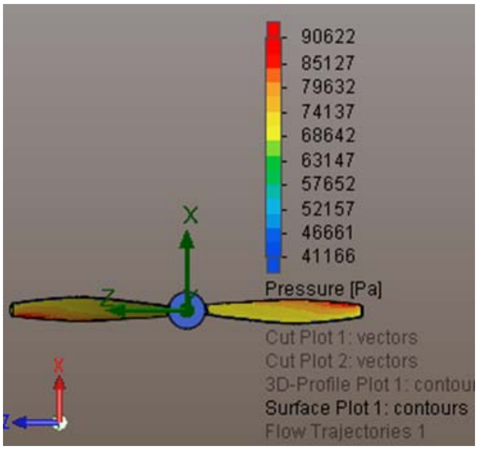

Figure 16 : Pressure side pressure distribution (Downstream)

Pressure distributions on the blade surface are plotted in Fig. 15 for suction side and Fig. 16 for pressure side. As seen, the pressure distributions show a typical pattern that a very high pressure gradient occurs at the leading and trialing edges.

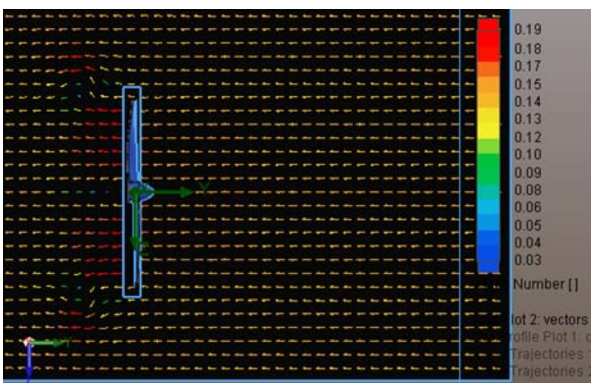

Figure 17 : Velocity vector plot

Velocity vector plot in longitudinal plane is drawn in Fig. 17. As shown, due to the action of propeller, fluid is sucked to the propeller disk and starts to accelerate in front of the propeller toward downstream direction and there is swirling motion due to centrifugal action of the flow in the downstream.

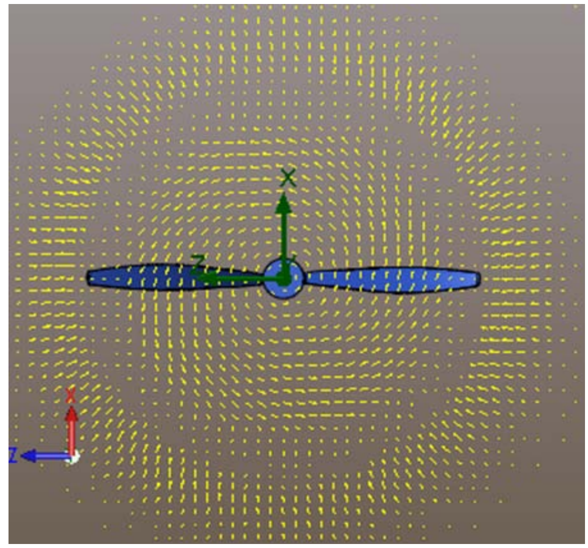

Figure 18: Cross flow vector behind propeller

Cross flows at propeller downstream are given in Fig. 15; a strong swirling flow can be seen. Finally, Fig. 19 shows velocity vector of the propeller blade on the top plane. It is seen that Mach no. is highest on the leading edge of the blade due to suction action of the propeller.

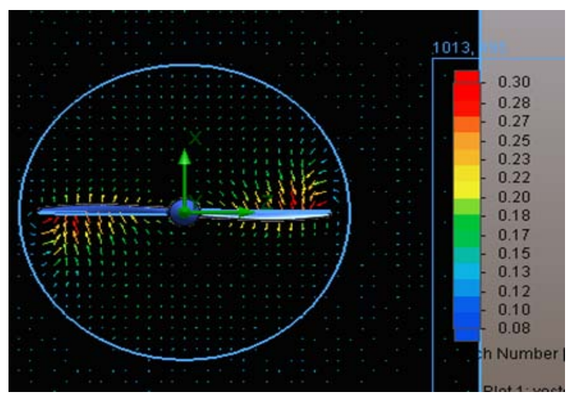

Figure 19 : Velocity vector presenting Mach no

To have a general view of the flow pattern, the velocity vector plots are given in Fig. 20, 21, 22 for various distances from the root.

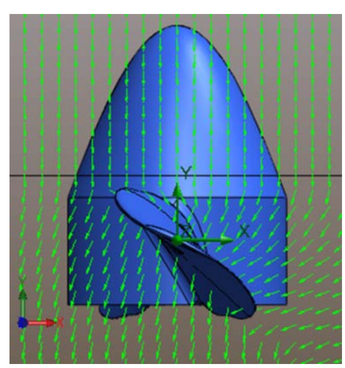

Figure 20 : Velocity vector at .5R section

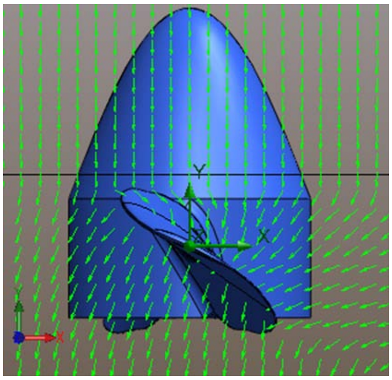

Figure 21 : Velocity vector at .7R section

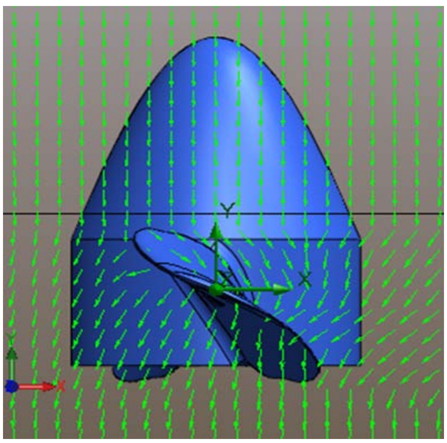

Figure 22 : Velocity vector at .9R section

The propeller sucks the flow in the opposite direction of the free stream flow and the free stream flow becomes slow down in front of the propeller. However, as seen in Figures.

Highest design RPM for our propeller is 4525 which limits Mach number to .85 at the tip of our propeller. So, it is in the transonic range 0.8-1.2, but it is desirable to drop the Mach no. to subsonic range when RPM decrease because of inconsistency of the supplied power to the propeller. In propeller design prospect, Mach no is tried to keep below .85 to avoid the shockwave due to the sonic flow around the propeller.

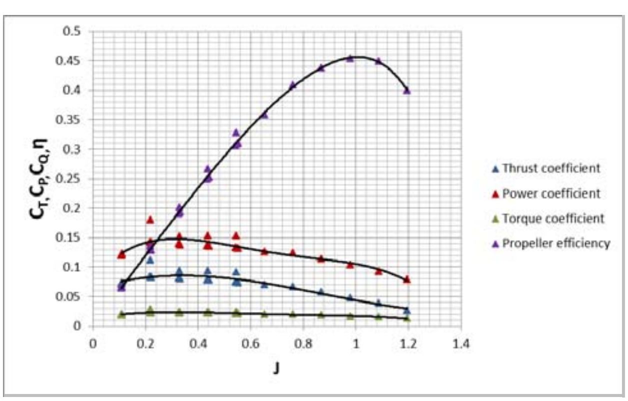

Figure 23 : Propeller coefficients vs advance ratio

From graph it is evident that highest thrust and power coefficient occur at lower advance ratio and efficiency is highest at higher advance ratio. For fixed blade propeller the pitch is fixed, angle of attack will decrease as the forward velocity of aircraft increases. Although this will result in an efficiency increase initially, further increasing the velocity will make the angle of attack zero and the Propeller will not be able to generate thrust which is avoidable by using variable pitch propeller. In the figure cruise point will be somewhere nears the point of highest efficiency, for which we will lose some thrust and power, but there still enough thrust and torque to propel the aircraft.

The performance graph of our propeller that we have obtained is similar to the characteristics graph of the propeller which is represented in Fig. 24.

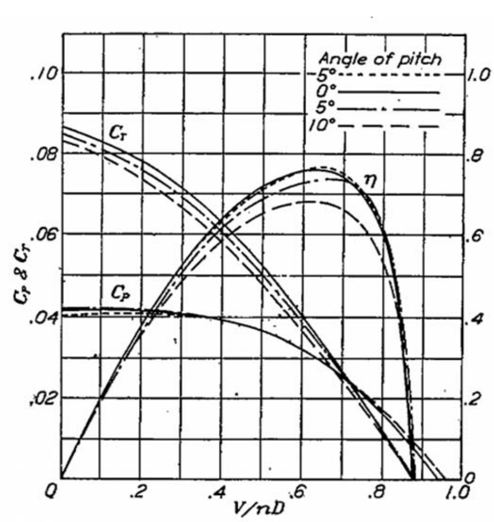

Figure 24 : Characteristics graph of propeller no. 4412

VI. Conclusion

From CFD analysis the thrust and torque for our propeller are 1007N and 311.19Nm which are 22.3% and 21.3% less than the theoretical calculated values. At 4525 RPM the propeller will provide maximum efficiency if the aircraft speed is 92ms-1 and there are 47% and 33.33% reduction in thrust and torque respectively than the maximum value that can be obtained by this propeller.

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A Thermal Modeling to Predict and Control the Cutting Temperature. The Simulation of Face-Milling Process

By Farida Benabid, Hocine Benmoussa & Mohamed Arrouf
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Abstract- This paper presents a new procedure to evaluate the cutting temperature milling. In HSM. The study of the thermal behavior is important because the life expectancy of a cutting tool is limited by its temperature: the higher the temperature, the shorter its life. Tests made on many uncoated tools at stand still, after milling, have shown that there is an important drop for the temperature measured values. This is due to the ventilation phenomenon which was created by the rotation of the mill, which, in turn, requires the knowledge of the global overall coefficient of heat transfer at the tool interface as a function of the cutting conditions in order to predict the cutting temperature. The performance of the model is compared to the analytically and numerically (FEM) determined performance of a cutting tool with boundary conditions or to the experimentally determined performance and the results obtained are in good agreement [12].

Keywords: milling; nonlinear equivalent resistance; cutting temperature; finite difference method; modified lamped capacitance method.

GJRE-A Classification : FOR Code: 290501

ATHERMALMODELINGTOPREDICTANDCONTROLTHECUTTINGTEMPERATURETHESIMULATIONOFFACEMILLINGPROCESS

Strictly as per the compliance and regulations of:

A Thermal Modeling to Predict and Control the Cutting Temperature. The Simulation of Face-Milling Process

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Abstract- This paper presents a new procedure to evaluate the cutting temperature milling. In HSM. The study of the thermal behavior is important because the life expectancy of a cutting tool is limited by its temperature: the higher the temperature, the shorter its life. Tests made on many uncoated tools at stand still, after milling, have shown that there is an important drop for the temperature measured values. This is due to the ventilation phenomenon which was created by the rotation of the mill, which, in turn, requires the knowledge of the global overall coefficient of heat transfer at the tool interface as a function of the cutting conditions in order to predict the cutting temperature. The performance of the model is compared to the analytically and numerically (FEM) determined performance of a cutting tool with boundary conditions or to the experimentally determined performance and the results obtained are in good agreement [12].

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I. Introduction

During machining, heat is generated at the cutting point from three sources. Those sources cause the developments of cutting temperature:

- Primary shear zone where the major part of energy is converted into heat.
- Secondary deformation zone at the chip–tool interface where further heat is generated due to rubbing and/or shear. At the worn out flanks due to rubbing between the tool and the finished surfaces. LOWEN and SHAW [1] have shown that the heat generated is shared by the chip, cutting tool and the workpiece.

The apportionment of sharing that heat depends upon the configuration, size and thermal conductivity of the tool-work material and the cutting condition. The maximum amount of heat is carried away by the flowing chip. From 10 to 20% of the total heat goes into the tool and some heat is absorbed in the workpiece [1]. With the increase in cutting velocity, the chip shares heat increasingly. The effect of the cutting temperature, particularly when it is high, is mostly detrimental to both the tool and the workpiece [2]. The major portion of the heat is taken away by the chips. So attempts should be made such that the chip takes away more and more amount of heat leaving small amount of heat to harm the tool and the work. The possible detrimental effects of the high cutting temperature on cutting tool edge are:

- Rapid tool wear, which reduces tool life, Plastic deformation of the cutting edges of the tool material is not enough hot-hard and hot strong.
- Thermal flaking and fracturing of the cutting edges due to thermal shocks.
- And the possible detrimental effects of cutting temperature on the workpiece are:
- Dimensional inaccuracy of the workpiece due to thermal distortion and expansion-contraction during and after machining.
- Surface damage by oxidation, rapid corrosion, burning etc.
- Cutting temperature can be determined by three ways:
- Analytically using mathematical models for thermal field which can be developed. This method is simple, quick, inexpensive but less accurate.
- Experimentally, this method is always used because it is more accurate, precise and reliable.
- Numerically, this technique is widely used tools for thermal machining simulation and benefits the reduction of the cost and increase technical performance. Many researchers have developed models and studied, mainly experimentally, on the effects of the various parameters on cutting temperature like: work material, process parameters, cutting tool material, tool geometry and cutting fluid. A well established overall empirical equation is:

$$T = \frac{0.4U}{\rho C}\left(\frac{vt_o}{K}\right)^{0.333} \quad (1)$$

Where T = temperature-rise at tool-chip interface; U = specific energy; v = cutting speed; t_o = chip thickness before cut; ρc = volumetric specific heat of work material; K = thermal conductivity of the work material.

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Recently, Lazohlu and Altintas4 [3] have applied the FDM, finite difference method, for the first time for the prediction of steady-state tool and chip temperature fields in continuous machining and transient temperature variation in interrupted cutting (milling) of different materials such as steels and aluminum alloys. A combination of grids in Cartesian coordinates for the chip and in cylindrical polar coordinates for the tool like in Refs5.[4]. The analytical approach to temperature modeling is difficult to apply to milling due to the intermittent cutting process and the varied thickness. Jaeger and Carslaw and Jaeger [5] introduced the heat source method for solving a variety of heat transfer problems for orthogonal cutting. The Jaeger moving heat source model has been modified and developed to represent the physical characteristics of peripheral milling, and has described how it can be applied in an industrial context to model workpiece temperatures due to peripheral milling. This intermittent heat is represented as a band of heat because the teeth move rapidly through the material and the time between cutting teeth is constant [6]. This model should be applicable to the milling of other materials such as titanium and carbon composites. The thermal impact to the cutting tool during heating is larger in down milling than in up milling [7].

Versions of a system equivalent circuit are commonly used in the manufacturing industry, due to its simplicity and its ability to provide reliable results,. This paper describes how it can be applied to model a tool when milling. The tool thermal model is based on the equivalent circuit. A simple RC circuit is employed to predict the cutting temperature. In the thermal model, all heat losses tool are represented by a current source injecting heat into the system. The capacitances are combined as one lumped capacitance. The thermal resistance is represented by a nonlinear term and the temperatures are represented as thermal potentials.

II. Cutting Temperature Control

Apart from photo cell technique and infrared photographic technique, cutting temperature can be controlled and reduced as far as possible, in varying extent, by the well following general methods:

Tool work thermocouple technique, moving thermocouple technique which cannot be applicable in operations like milling, grinding etc., embedded thermocouple can serve the purpose. However, the standard thermocouple monitors the cutting temperature at a certain depth d from the cutting zone so the T(d) curve has to be extrapolated up to d=0 to get the actual milling zone temperature.

III. Experimental Set-up

we purpose a new method to predict the cutting temperature by taking measurements of tool edge when the tool leave the work piece, at shutdown, almost 12s, the values Ti has to be very low, which is not possible, so the curve T (t) has to be extrapolated to correct the temperature drop during cooling, and would not be linear due to the rotating tool, which is not the same problem in turning. The problem of extrapolation is related to the adequate tool cooling. This in turn, requires the knowledge of the mechanism by which heat is transferred from tool edge to the surroundings [8], we also include some simple but useful equations of the lamped capacitance under thermal analogy, enabling us to determine with reasonable accuracy, the heat loss, temperature rise, equivalent resistance, etc., of tool cutting.

The thermal conductivity as function of temperature is taken into account as shown in fig.1.b.

A series of experiments were carried on mild steel specimens to measure tool temperature under different tools materials. The cutting tools were uncoated carbides; all operations were executed in dry conditions. The tests were executed at a cutting speed Vc ranging from 100 to 1000 m/min, and a feed rate ranging from 1 to 5 (mm/min). An infrared radiation pyrometer was placed at a distance lm from the rake face, we report some of the experimental results, concerning temperatures measurements of cooling mill as a function of short period of time where the cutting speed was decreasing, see fig.5.b.

Table 1 : Cutting conditions

Vc(m/min)	ae(mm)	ap(mm)	f(rd/s)	U(W/m^3.s)
400	1	5	2547/60	4.5

Table 2 : Tungsten carbide thermal properties

Conductivity (W/mK)	Specific heat (J/kg.K)	Density (kg/m^3)	Heat_Transfert coef (W/m^{2}K)	Emissivity
174	130	19300	$h = 7 + \sqrt{\frac{Vc}{60}}$ [5]	0.3

IV. Mill Thermal Model based on Equivalent Circuit

Due to its simplicity and ability to provide reliable results, we use an equivalent circuit.

In electricity and according to Ohm's law current which flow through it; in thermal, we broaden the meaning to describe the thermal behavior of a system or device when cooling or heating with its surroundings.

$$T = R_{th} q^n \tag{2}$$

T: thermal potential (°C), R_{th}: non linear thermal resistance (m^{2}°C/ W), q: thermal flux (W), n: indice

In contrast to an analytical solution, which allows for temperature determination at any point in the medium, a numerical solution enables determination temperature at only discrete points. The first step in any numerical analysis is to subdivide the mill (semi-infinite cylindrical form), 10 mm diameter, and 65mm length, into a number of small discs assigning to each a reference and involves 2 resistances by convection and conduction respectively, for one dimensional system, may take the form shown by the figure 1. The main is to calculate the equivalent resistance of single pin fin of rectangular profile.

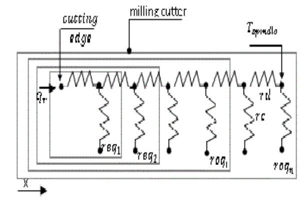


Fig. 1 : The equivalent resistance model

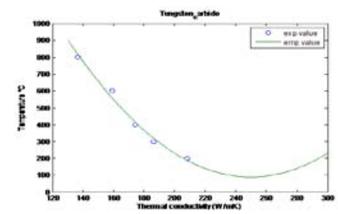


Fig. 2 : The temperature dependence of the thermal conductivity of tungsten carbide [5]

Recalling the definition of the conductive and convective resistance, that is:

$$rd = \frac{ep}{k.sf} \quad \text{and} \quad rc = \frac{1}{h.sl} \tag{3}$$

ep: disc thickness, sf and sl: frontal and lateral surfaces of the disc, respectively.

We can write the first equivalent resistance:

$$req_1 = \frac{rd.rc}{rd+rc} \quad \text{and} \quad req_i = rd + \frac{req_{i-1}.rc}{req_{i-1}+rc} \quad \text{Finally:} \quad req_n = rd + \frac{req_{n-1}.rc}{req_{n-1}+rc} \tag{4}$$

a) *Rate of Convergence Analysis*

As shown in the figure 3.a, the equivalent resistance model chosen converges for all cooling time, and the convergences values increase from the beginning to the end of cooling [1s,12s]. Consequently, we can write the following expression:

$$req_n = req_{n-1} \text{ then } req_n = rd + \frac{req_n.rc}{req_n+rc} \tag{5}$$

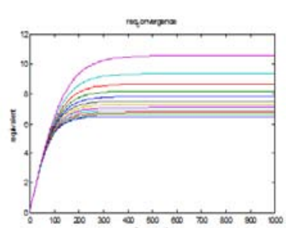
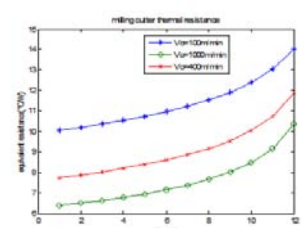


Fig. 3 : *(a)* Convergence of the equivalent resistance different times;



(b) Equivalent resistance of milling cutter values for during cooling

b) *Modified lumped thermal capacitance method*

Our objective is to develop procedures for determining the time dependence of the temperature distribution within the mill during transient process as well as for determining heat transfer between the mill and its surroundings. The nature of the procedure depends on assumptions that may be made for the process. The essence of the modified lumped capacitance method is the assumption that the temperature of the mill is not uniform at any instant during the transient process. This assumption implies that temperature gradient within Intel the first disc is negligible. This behavior is analogous to the voltage decay that occurs when a capacitor (first disc) is discharging through a nonlinear resistor (other discs) per conduction, convection and less degree per radiation. Fig.4.

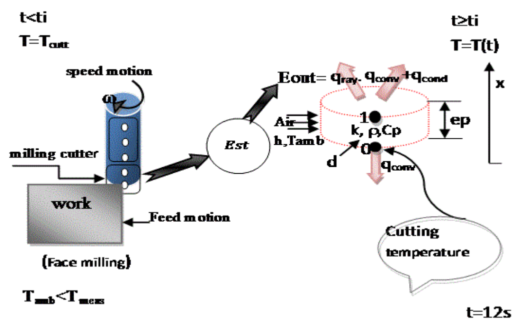


Fig. 4 : Disc node at one dimensional transient conduction with convection and radiation

$$\rho V c\frac{dT}{dt} = \left[\frac{1}{req(t)} + \frac{1}{r(t)} + \frac{1}{r'c(t)}\right][T - T_{amb}] \;\; and \; T_{final} = T_{measured}$$

$$\frac{\Delta T}{\Delta t} = \frac{1}{\tau(t)}[T - T_{amb}] \;\; \text{and } T_i = T_{i-1} + \frac{T_{i-1} - T_{amb}}{\tau(t)} \tag{7}$$

$$\text{With: } \frac{1}{\tau(t)} = \left[\frac{1}{req\,(t)} + \frac{1}{r\,(t)} + \frac{1}{r'c\,(t)}\right] . \left[\frac{1}{\rho V C}\right] \tag{8}$$

Where $\tau(t)$ may be interpreted as the *modified thermal constant time* and $\tau(t) = R(t)_t . C_t$ (9)

$$R(t) = req(t)//r(t)//r'c(t) \tag{10}$$

$$C = \rho V c \;\; \text{and} \;\;\; h_r(t) = \varepsilon\sigma s_l(T + T_{sur})(T^2 + T^2{}_{sur})$$

Where $h_r(t)$ is the heat transfer coefficient per radiation, ε is the emissivity of the uncoated carbide $\sigma = 5.67 * 10^{-8} W/m^2K^4$: Stefan Boltzmann constant and $r'c = \frac{1}{h'sf}$ is a linear convective resistance.

Any increase in R(t) or in C will cause the mill to respond more slowly to changes in its thermal environment[10]. The non linear resistance is due to the turbulence produced by the revolving mill, thus any increase in cutting speed will cause the reduction in temperature rise($T_l - T_{i-1}$). The cutting temperature is calculated by inverse method as seen in the fig.5, $T_1 = 789\,℃$ for tungsten carbide.

The temperature of the spindle edge may also be measured by a thermometer.

The temperature of the cooling agent: air may be measured at a distance of 1m from the tool cutting.

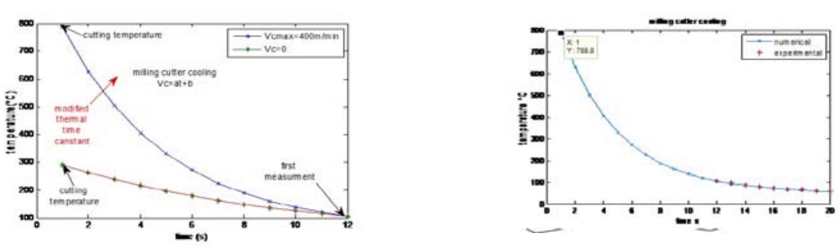


Fig. 5 : Results of cutting temperature calculation using inverse method a) taking into account rotating speed b) temperature comparaison between experimental and calculated values

c) Validity of the purposed thermal model

The study of the cutting power is important because it gives us a clue how it may be reduced.

It is created by machine which may be evaluated by the product of the torque developed by the spindle times its rotational speed, this power is required to cut metal, and 98% was transformed into heat causing the cutting temperature to rise.

The cutting power is given by: $P_{cutt} = U.MRR$ (11)

MMR is the material removal rate. $MRR = ae.ap.f$ (12)

If we suppose that the portion of cutting power go to the tool, we have: $P_{mill} = 10\%\, P_{cutt}$ (13)

To estimate the cutting temperature, we have: $T_{cutt} = U_{tot} P_{mill} + T_{amb}$ (14)

Where: $U_{tot} = \frac{1}{req}$, the overall heat transfer coefficient $U_{tot} < h$ [10], We find: $T_{cutt} = 799\,℃$

V. Conclusion

In this paper, a simple and quick method is performed in order to calculate and control the cutting temperature in operation like milling:

The warmest up part in the milling cutter is the rake face. The hot spot temperature is rather difficult to measure because it has to be taken when the tool rotate and at a depth from the rake face where start the crater due to the higher temperatures, is in contact with the moving chip. Hence, the measurements were taken when the tool leave the work piece after 12s, at standstill, however, a large drop in temperature is found, which is corrected by the study of heat transfer in transient state, which, in turn, seems require the knowledge of the nonlinear equivalent resistance due to the turbulence created by the rotating mill. The equivalent resistance for a semi infinite cylinder as a function of time, is plotted with accuracy and it increase with the decreasing cutting speed, this because milling cutter blows air over to the surrounding [11]. The cooling curve is also plotted by inverse method both for two cases: when the mill rotates and if it does not and the cutting temperature is illustrated in fig.5.a and is in good agreement with equation 14. We can broaden the meaning of the equivalent resistance concept to predict the temperature for several cutting speeds provide that temperature at standstill must be taken. The precision of the thermal models depends on the exactitude of the parameters: thermal properties, cutting conditions: work and cutting material.

This brings us to very important conclusions: this method may succefully also be applied in drilling operation where radiation exchange cannot be neglected in this case. The performance of this model will reduce the need for expensive experimental measurements.

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Importance of Lathe Machine in Engineering Field and its usage

By Jahnavi Madireddy
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Introduction- The lathe, probably one of the earliest machine tools, is one of the most versatile and widely used machine tool, so also known as mother machine tool.

An engine lathe is the most basic and simplest form of the lathe. It is called so because in early lathes, power was obtained from engines.

The job to be machined is held and rotated in a lathe chuck; a cutting tool is advanced which is stationary against the rotating job. Since the cutting tool material is harder than the work piece, so metal is easily removed from the job.

Some of the common operations performed on a lathe are facing, turning, drilling, threading, knurling, and boring etc.

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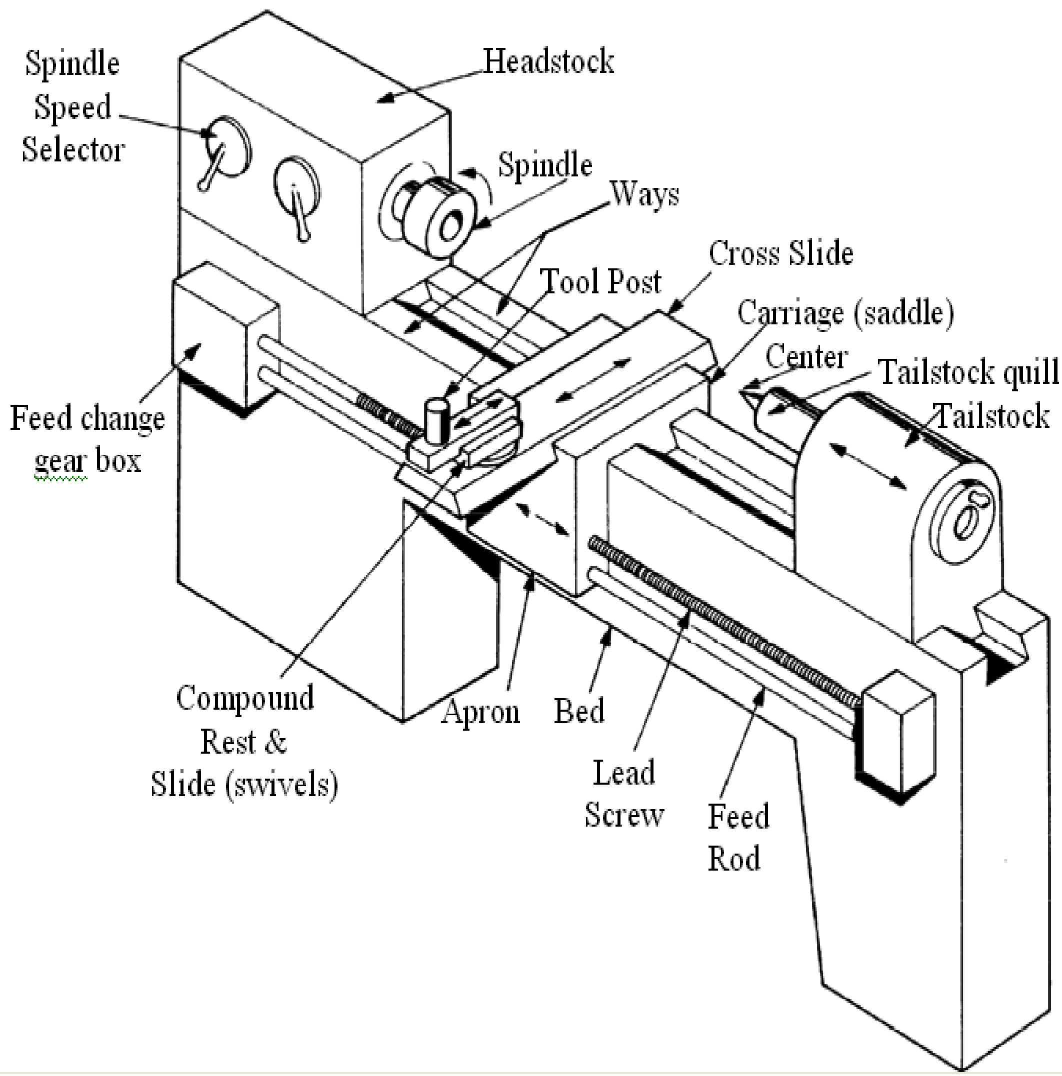
IMPORTANCEOFLATHEMACHINEINENGINEERINGFIELDANDITSUSAGE

Strictly as per the compliance and regulations of:

Importance of Lathe Machine in Engineering Field and its usage

Jahnavi Madireddy

Parts of Lathe Machine



I. Introduction

The lathe, probably one of the earliest machine tools, is one of the most versatile and widely used machine tool, so also known as mother machine tool.

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Some of the common operations performed on a lathe are facing, turning, drilling, threading, knurling, and boring etc.

II. Lathe Machine Parts

Bed: Supports all other machine parts.

Carriage: Slides along the machine ways.

Head stock: Power train of system (spindle included).

Tail Stock: Fixes piece at end opposite to the head stock.

Swing: Maximum diameter of the machinable piece.

Lead screw: Controls the feed per revolution with a great deal of precision.

Lathe Tools: Left handed, Right handed, Threading, Boring, Groove, Parting (Cut-Off)

a) Cutting Speeds

Typical Lathe Cutting Speeds:

Nominal cuts

-30 - 800 ft./min.

Roughing cuts

- Depth of cut greater then .02 in
- Feed speed of .008 - .08 in/rev.

Finishing Cuts

- Lower than roughing cuts

b) Turning Operations

Turning (Performed on lathe)

– Part is moving and tool is stationary.

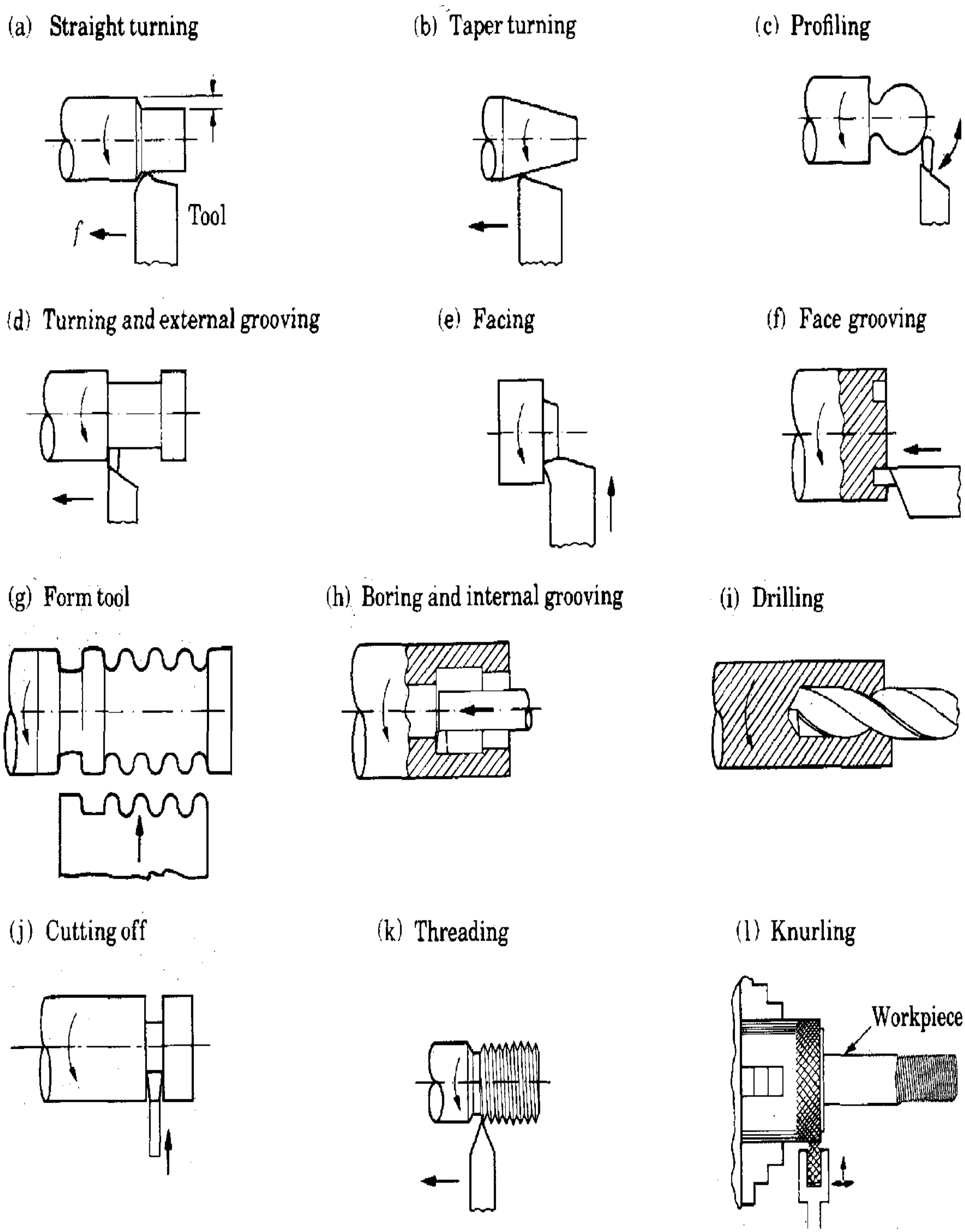
Used to make parts of round cross section

– Screws, shafts, pistons

Number of various lathe operations

– Turning, facing, boring, drilling, parting, threading

III. Lathe Operations



IV. Lathe -Plain Turing, Step Turning, Taper Turning, Knurling and Chamfering

In order perform various lathe operations such as plain turning, step turning, taper turning knurling and chamfering on a given material made of Mild steel.

We need mild steel bar of 22 mm diameter and 95 mm length.

a) Tools and Equipment used

H.S.S. single point cutting tool,

Parting tool,

Knurling tool,

Chuckey,
Tool post key,
Outside caliper,
Steel rule.

b) Operation Chart

S No.	Sequence of Operations	Cutting Tool Used
1.	Facing	H.S.S Single Point tool
2.	Rough turning	H.S.S Single Point tool
3	Finish turning	H.S.S Single Point tool
4	Step turning	Parting tool
5	Taper turning	H.S.S Single Point tool
6	Knurling	Knurling tool
7	Chamfering	H.S.S Single Point tool
7	Drilling	H.S.S Drill bit

V. Types of Operation

a) Facing Operation

Facing is the operation of machining the ends of a piece of work to produce a flat surface square with the axis. The operation involves feeding the tool perpendicular to the axis of rotation of the work piece.

A regular turning tool may be used for facing a large work piece. The cutting edge should be set at the same height as the center of the work piece. The tool is brought into work piece from around the center for the desired depth of cut and then is fed outward, generally by hand perpendicular to the axis of rotation of the work piece.

b) Rough Turning Operation

Rough turning is the operation of removal of excess material from the work piece in a minimum time by applying high rate of feed and heavy depth of cut. The depth of cut for roughing operations in machining the work ranges from 2 to 5 mm and the rate of feed is from 0.3 to 1.5 mm per revolution of the work.

c) Finish Turning Operation

It requires high cutting speed, small feed, and a very small depth of cut to generate a smooth surface. The depth of cut ranges from 0.5 to 1 mm and feed from 0.1 to 0.3 mm per revolution of the work piece.

d) Step Turning

Is the operation of making different diameters of desired length. The diameters and lengths are measured by means of outside caliper and steel rule respectively.

e) Taper Turning

A taper may be defined as a uniform increase or decrease in diameter of a piece of work measured along its length. In a lathe, taper turning means to produce a conical surface by gradual reduction in diameter from a cylindrical work piece.

A taper may be turned by any one of the following methods:

i. Form tool method
ii. Tail stock set over method
iii. Swiveling the compound rest and
iv. Taper turning attachment

Taper turning by swiveling the compound rest:

This method employs the principle of turning taper by rotating the work piece on the lathe axis and feeding the tool at an angle to the axis of rotation of the work piece. The tool mounted on the compound rest is attached to a circular base, graduated in degrees, which may be swiveled and clamped at any desired angle. Once the compound rest is set at the desired half taper angle, rotation of the compound slide screw will cause the tool to be fed at that angle and generate a corresponding taper.

The setting of the compound rest is done by swiveling the rest at the half taper angle. This is calculated by the equation.

$$\tan \alpha = (D-d) / 2L$$

Where α = Half taper angle

f) Knurling

Knurling is the process of embossing a diamond shaped pattern of the surface of a work piece. The purpose of knurling is to provide an effective gripping surface on a work piece to proven it from slipping when operated by hand. Knurling is performed by a special knurling tool which consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers are pressed against the revolving surface of work piece to squeeze the metal against the multiple cutting edges, producing depressions in a regular pattern on the surface of the work piece.

Knurling is done at the slowest speed and oil is flowed on the tool and work piece. Knurling is done at the slowest speed and oil is flowed on the tool and work piece to dissipate heat generated during knurling. The feed varies from 1 to 2 mm per revolution.

g) Chamfering

Chamfering is the operation of beveling the extreme end of a work piece. This is done to remove the burrs, to protect the end of the work piece from being damaged and to have a better look. The operation may be performed after the completion of all operations. It is an essential operation after thread cutting so that the nut may pass freely on the threaded work piece.

VI. Metal Cutting Parameters

The cutting speed of a tool is the speed at which the metal is removed by the tool from the work piece. In a lathe, it is the peripheral speed of the work past the cutting tool expressed in meters/minute *a) Cutting speed (V) = π DN/1000, m/min*

Where, D = Diameter of the work in min

N = RPM of the work

b) Feed

The feed of a cutting tool in a Lathe work is the distance the tool advances for each revolution of the work. Feed is expressed in mm/rev.

c) Depth of cut

The depth is the perpendicular distance measured from the machined surface to the uncut surface of the work piece.

Depth of cut = (d1-d2) / 2

Where, d1= Diameter of the work surface before machining

d2= Diameter of the work surface after machining

While using HSS tool for turning mild steel work piece. The following parameters are to be chosen.

d) Rough Turning Operation

Cutting speed (V) = 25m/min,

feed(f) = 0.2 mm/rev,

Depth of cut(t) = 1 mm

e) Finish turning operation

Cutting speed (V) = 40m/min,

feed(f) = 0.1 mm/rev,

Depth of cut(t) = 0.2 mm

f) Tool geometry

Back rake angle = 7^0,

End relief angle = 6^0

Side relief angle = 6^0,

End cutting edge angle = 15^0

Side cutting edge angle = 15^0,

Nose radius = 2 mm

VII. Procedure

a) The work piece and HSS single point cutting tool are securely held in the chuck and tool post respectively.
b) Operations such as facing, rough turning and finish turning are performed on a given mild steel bar one after the other in sequence up to the dimensions shown. Then the step turning is performed using parting tool.
c) Then the compound rest is swiveled by calculated half taper angle and taper is generated on the work piece. Rotation of the compound slide screw will cause the tool to be fed at the half-taper angle.
d) HSS single point cutting tool is replaced by the knurling tool and knurling operation is performed at the slowest speed of the spindle.
e) The knurling tool is replaced by the HSS single point tool again; the work piece is removed from the chuck and refixed with the unfinished part outside the chuck. This part is also rough turned, finish turned and facing is done for correct length.
f) Finally, the chamfering is done at the end of the work piece.

VIII. Precautions

a) Operate the machine at optimal speeds
b) Do not take depth of cut more than 2 mm.
c) Knurling should be done at slow speeds and apply lubricating oil while knurling
d) Care should be taken to obtain the required accuracy.

IX. Lathe -Thread Cutting

In order to V-thread cutting on a lathe forming right hand and left hand metric threads as shown in fig.

We require Mild steel bar of 24 mm diameter and 100 mm length.

a) Tools and Equipment

H.S.S. single point cutting tool,

Grooving tool,

Threading tool thread gauge,

Outside caliper,

Chuck key,

Tool post key,

Steel rule.

X. Operation Chart

S no.	Sequence of Operations	Cutting tool used
1.	Facing	H.S.S Single Point cutting tool
2.	Rough turning	H.S.S Single Point cutting tool
3	Finish turning	H.S.S Single Point cutting tool
4	Step turning	H.S.S Single Point cutting tool
5	Grooving	Grooving tool
6	Thread cutting	Threading tool
7	Chamfering	H.S.S Single Point cutting tool

XI. Principle of Thread Cutting

The principle of thread cutting is to produce a helical groove on a cylindrical or conical surface by feeding the tool longitudinally when the job is revolved between centers or by a chuck. The longitudinal feed should be equal to the pitch of the thread to be cut per revolution of the work piece. The lead screw of the lathe, through which the saddle receives its traversing motion, has a definite pitch. A definite ratio between the longitudinal feed and rotation of the head stock spindle should therefore be found out so that the relative speeds of rotation of the work and the lead screw will result in the cutting of a screw of the desired pitch.

This is affected by change gears arranged between the spindle and the lead screw or by the change gear mechanism or feed box used in a modern lathe.

a) Calculation of change-wheels, metric thread on English lead screw

To calculate the wheels required for cutting a screw of certain pitch, it is necessary to know how the ratio is obtained and exactly where the driving and driven wheels are to be placed. Suppose the pitch of a lead screw is 12 mm and it is required to cut a screw of 3 mm pitch, then the lathe spindle must rotate 4 times the speed of the lead screw that is

$$\frac{\text{Spindle turn}}{\text{Lead screw turn}} = \frac{\text{Driven teeth}}{\text{Driver teeth}}$$

Hence we may say,

$$\frac{\text{Driven teeth}}{\text{Driver teeth}} = \frac{\text{Lead screw turn pitch of the screw to be cut}}{\text{spindle turn pitch of the lead screw}}$$

In British System

$$\frac{\text{Driven teeth}}{\text{Driver teeth}} = \frac{\text{Threads per inch on lead screw}}{\text{Threads per inch on work}}$$

Often engine lathes are equipped with a set of gears ranging from 20 to 120 teeth in steps of 5 teeth and one translating gear of 127 teeth. The cutting of metric threads on a lathe with an English pitch lead screw may be carried out by a translating gear of 127 teeth.

$$\frac{\text{Driven teeth}}{\text{Driver teeth}} = \frac{5\,p\,n}{127}$$

Where,

p = pitch of the thread to be cut and

N= threads per inch on lead screw

This is derived as follows:

$$\frac{\text{Driven teeth}}{\text{Driver teeth}} = \frac{\text{pitch of the work}}{\text{pitch of the lead screw}} = \frac{p}{(1/n) \times (127/5)} = \frac{5\,pn}{127}$$

$$\text{Since, pitch} = \frac{1}{\text{No. of threads per inch}}$$

XII. Thread Cutting Operation

In a thread cutting operation, the first step is to remove the excess material from the work piece to make its diameter equal to the major diameter of the screw thread. Change gears of correct size are then fitted to the end of the bed between the spindle and the lead screw.

The shape or form of the thread depends on the shape of the cutting tool to be used. In a metric thread, the included angle of the cutting edge should be ground exactly 60^0. The top of the tool nose should be set at the same height as the center of the work piece. A thread tool gauge is usually used against the turned surface to check the cutting tool, so that each face of the tool may be equally inclined to the center line of the work piece as shown.

The speed of the spindle is reduced by one half to one – fourth of the speed require for turning according to the type of the material being machined and the half – nut is then engaged. The depth of cut usually varies from 0.05 to 0.2 mm is given by advancing the tool perpendicular to the axis of the work.

After the tool has produced a helical groove up to the desired length of the work, the tool is quickly withdrawn by the use of the cross slide, the half-nut disengaged and the tool is brought back to the starting position to give a fresh cut. Before re-engaging the half-nut it is necessary to ensure that the tool will follow the same path it has traversed in the previous cut, otherwise the job will be spoiled. Several cuts are necessary before the full depth of thread is reached arising from this comes the necessity to “pick-up” the thread which is accomplished by using a chasing dial or thread indicator.

a) Chasing dial or thread indicator

The chasing dial is a special attachment used in modern lathes for accurate “picking up” of the thread. This dial indicates when to close the split of half nuts. This is mounted on the right end of the apron. It consists of a vertical shaft with a worm gear engaged with the lead screw. The top of the spindle has a revolving dial marked with lines and numbers. The dial turns with the lead screw so long the half nut is not engaged.

If the half-nut is closed and the carriage moves along the dial stands still. As the dial turns, the graduations pass a fixed reference line. The half-nut is closed for all even threads when any line on the dial coincides with the reference line. For all odd threads, the half-nut is closed at any numbered line on the dial determined from the charts. If the pitch of the thread to be cut is an exact multiple of the pitch of the lead screw, the thread is called even thread, if otherwise the thread is odd thread.

In a chasing dial, the rule for determining the dial division is: In case of metric threads, the product of the pitch of lead screw and the no. of teeth on the worm wheel must be an exact multiple of the pitch of the threads to be cut. In case of English threads, the product of the threads per inch to be cut and the number of teeth on the worm wheel must be an exact multiple of the number of threads per inch of the lead screw. For example, if the pitch of the lead screw is 6 mm and the worm wheel has 15 teeth.

The product will be 90. so any pitch which is exactly divisible by 90, such as 1, 1.25, 2.25,3,3.75,4.5,5,6,7.5,9,10,15,30,45,90 may be picked up when any line of the dial coincides with the reference line.

b) Right hand and left-hand thread

If the bolt advances into the nut when rotated in clockwise direction, the thread is called right-hand thread. When cutting a right-hand thread the carriage must move towards the head stock.

If the bolt advances into the nut when rotated in counter-clockwise direction, the thread is called left-hand, for a left hand thread the carriage moves away from the head stock and towards the tail stock. The job moves as always in the anti-clock wise direction when viewed from the tail stock end. The direction at which the carriage moves in relation to lathe head stock is controlled by means of the tumbler gears or bevel gear feed reversing mechanism.

XIII. Procedure

a) The work piece and HSS single point cutting tool are fixed in chuck and tool post respectively.
b) Operations such as facing, rough turning finish turning and step turning are performed on the given mild steel bar one after the other in sequence up to the dimensions shown.
c) Single point cutting tool is replaced by a grooving tool and grooving operation is performed at half of the normal spindle speed.
d) The grooving tool is replaced by a threading tool. Right hand and left hand metric threads are cut on the work piece up to the required length at $1/4^{th}$ of the normal speed of the spindle.
e) Threading tool replaced by a single point cutting tool again and finally chamfering is done at right end of the work piece at normal spindle speed.

XIV. Precautions

a) Low spindle speeds should be used for accurate threads in thread cutting operation.
b) Ensure correct engage and dis-engage of half-nut.
c) Plenty of oil should be flowed on the work and tool during thread cutting.

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Fellows

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (FARSE)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards “FARSE ” title to individuals. The 'FARSE' title is accorded to a selected professional after the approval of the Editor-in-Chief /Editorial Board Members/Dean.

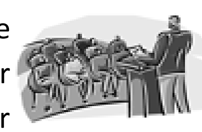
- The “FARSE” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSE or William Walldroff, M.S., FARSE.

FARSE accrediting is an honor. It authenticates your research activities. After recognition as FARSE, you can add 'FARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSE designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSE title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA).The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

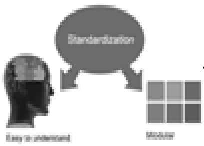


You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSE can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSE, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.



The FARSE will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSE member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

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The FARSE is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSE can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSE member can decide its price and we can help in making the right decision.

The FARSE member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

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The ' MARSE ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSE” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSE or William Walldroff, M.S., MARSE.

MARSE accrediting is an honor. It authenticates your research activities. After becoming MARSE, you can add 'MARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSE designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSE, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSE member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

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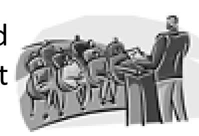
The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA)
The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.
The author fees of such paper may be waived off up to 40%.



The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

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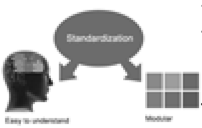
We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

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We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

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- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone. "

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The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not conveninet , and then email the paper directly to dean@globaljournals.org.

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- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, “Abstract” word in Italic Bold.
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You can use your own standard format also.
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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

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Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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Abstract, used in Original Papers and Reviews:

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Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

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Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

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Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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