International Journal of Advanced Technology in Engineering and Science
Vol. No.3, Special Issue No. 01, November 2015
www.ijates.com
ijates
ISSN 2348 - 7550

NUMERICAL ANALYSIS OF WOOD LATHE

Poonam Diwan[1], Amrita Singh[2]

[1,2]*Department of Mechanical Engineering, Sarguja University (India)*

ABSTRACT

To achieve the aim of production a functional and efficient wood lathe machine, we analyses and as well synthesized the different possible design solutions and concepts. We carried out the machine to determine their suitable dimensions based on loading and stresses due to them. We used available local material and tool from a private workshop. We also made use of some machine tools in the college workshop.

This objective of this thesis work is to analyze drilling operation and the taper turning in the turning operation. A number of tests are performed with different cutting speed and feed rates.

The experiments are carried out and the results are plotted in the form of graphs. These graphs show the variation of cutting forces and cutting speed .UsingScatterwhich helped to find out torque and thrust force graphs with different control factors like feed, speed etc. the piezoelectric dynamometer has been used for measuring thrust forces and torque on varying the feed rate, speed, and drill diameters.

Keywords*: *Drilling Lathe, Machine, Materia, Tools, Turning Lathe

I. INTRODUCTION

1.1 Introduction of Wood lathe

Lathe machine is a basic machine when compared to other machine. It considered to be an important tool. The lathe machine is manufactured by using all the fundamental machine elements. A Lathe is probably the oldest machine tool, stemming from the early tree lathe, which was turned by a rope passed around the work a few times and attached to a sparingly branch overhead. The work was supported by two dowels struck in adjacent trees. The operator's foot supplied the motion, which was intermittent and fluctuating. The tool was held in the operator's hand. Lathe a strip of wood called a "lathe" was used to support the rope and hence named as lathe.

A Lathe is a machine that spins a block in order to perform a certain manipulation to it such as cutting and sanding with the help of tools to form of symmetry based on its axis of rotation. The end goal is to smooth and shapetheblock into a new form. Keep in mind that lathe is not just for wood, there are also metal lathes and even glass lathes. Since, we're all about here; we'll just go over the wood lathe and wood turning. It seems that wood turning is making a bit of resurgence and is gaining in popularity in woodworker's shops. Although gaining in popularity, this is form of wood working is nothing new. The first wood lathe was patented by Thomas Blanchard way back in 1820. The first version of the lathe was very different than what we see today. They were manually operated and the rotation of the spindle was very slow. By the mid-1900s there were introductions of wood lathes that represent more closely to what we know and love today.

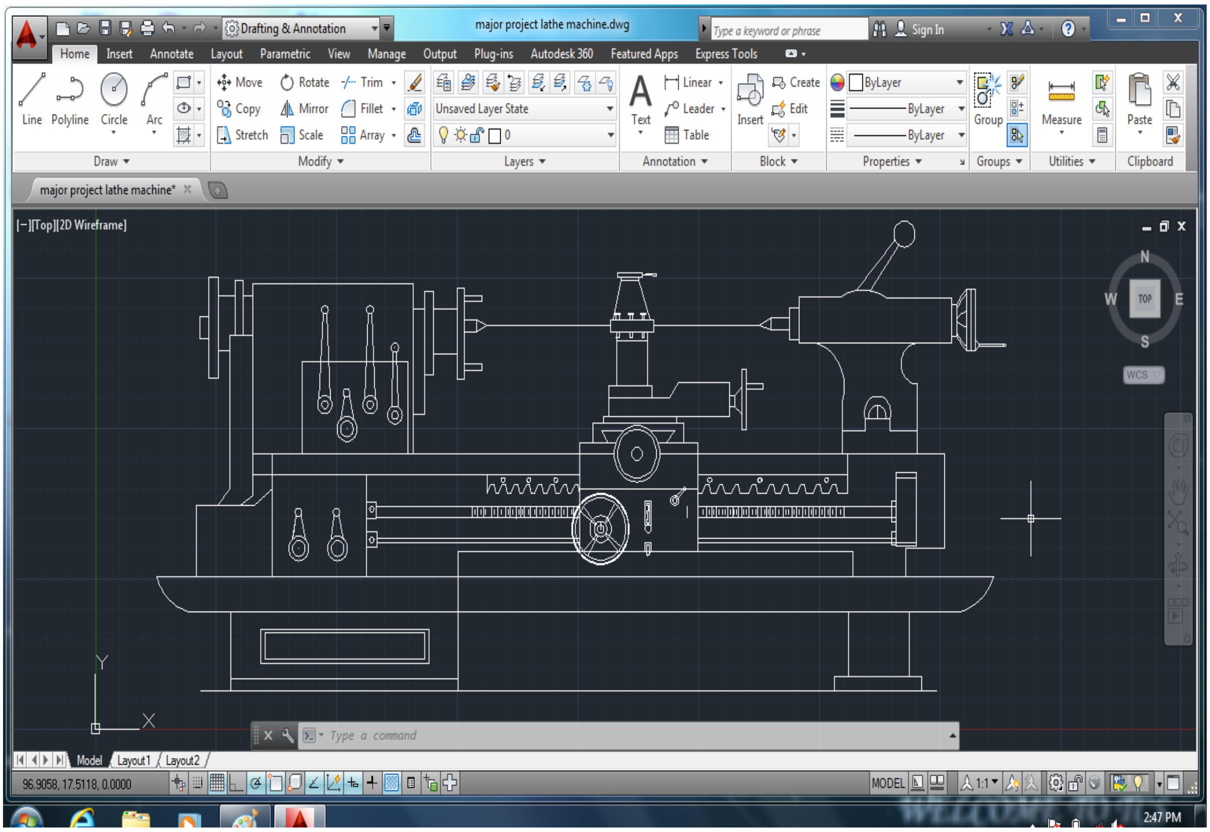

Figure 1.1 – Wood Lathe Diagram in Auto CAD 2014

1.1.1Function of the Wood Lathe

Lathe removes undesired material from a rotating work piece in the form of chips with the help of a tool which is traversed across the work and can be fed deep in work. The tool material should be harder than the work piece and the latter held securely and rigidly on the machine. The tool may be given linear motion in any direction. A lathe is used principally to produce cylindrical surfaces and plane surface, at right angles to the axis of the rotation. It can also produce tapers and bellows etc. Operation of turning is done on parts as small as those used by watches tough parts weighing several tons. Wood lathes are used in design and technology to shape round parts either by turning between centers or faceplate turning.

1.1.2 Wood Lathe Parts

To describe the pieces of the wood lathe let's start at one end and work our way over. The machine will start more or less with the left side and work our way over then down:

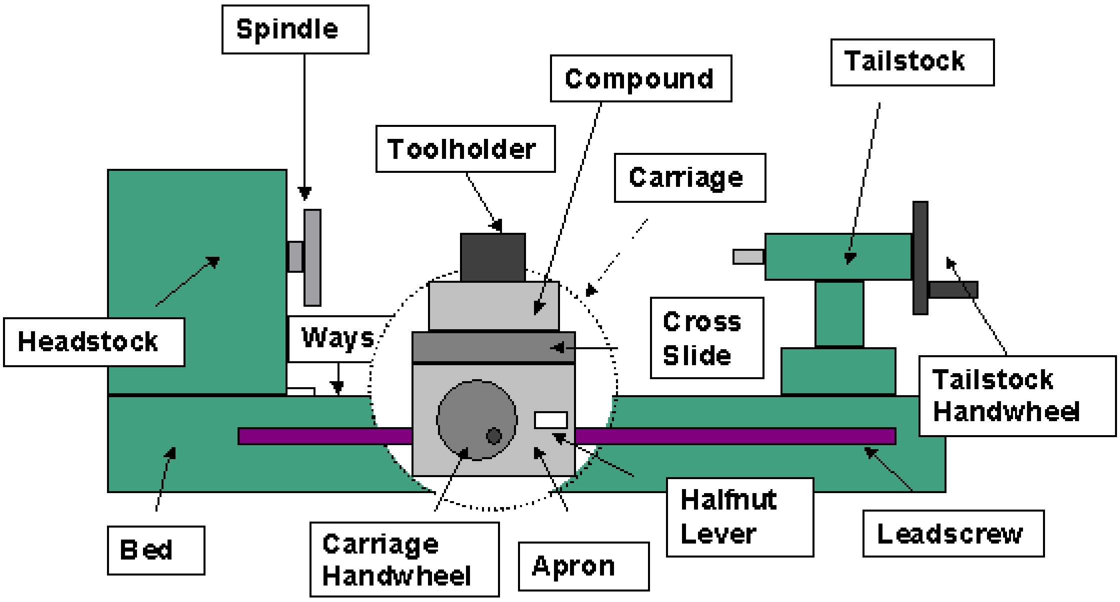

Figure 1.2 - Simple Diagram of a Wood Lathe and its Part

1. **Head Stock:** The whole side of the machine that has the drive motor or the "live" end of the lathe. It supports the main spindle in the bearings and aligns it properly.
2. **Spindle & Thread for Face Plate:** The actual spinning part is called the spindle, on the spindle is machined threading to attach the face plate. This is also one of the areas where the wood lathe chuck is mounted. It is a hollow cylindrical shaft and long slender jobs can pass through it.
3. **Live Center:** The exact center of your turning work, more how to find the center of your piece later on.
4. **Tool Rest:** This is the portion of the machine where you guide your tools to manipulate the wood.
5. **T Rest Adjustment:** This adjusts the height of the tool rest to accommodate both the size of the piece as well as the size of the individual making it.
6. **Dead Center:** It's a wood lathe term. This is the exact center of your piece on the tail stock, the side without the motor drive.
7. **Tail Stock:** As stated above, this is the end of the lathe that does not drive the spinning action, it simply supports the other end of the block.
8. **Tail Stock Hand Wheel:** When this hand wheel is rotated, it mounts tail stock to the wood block via the wood lathe chuck.
9. **Bed:** This is the length of the wood lathe connecting the head and tail stocks. Lathes will come in a variety of bed lengths to work on different scales of projects.
10. **Leg:** Duh, yes we all know what a leg is. Although, keep in mind that not all lathes come with legs, many common lathes are designed to sit on your work bench, not as standalone tools. It is supported on broad box-section columns.

1.1.3 Wood Lathe Operations

Table 1.1: Relative Motion of Various Cutting Operations

Operation	Motion of Cutting Tool	Motion of work piece
Turning	Translation	Rotation
Shaping	Translation	Intermittent Translation
Planing	Intermittent Translation	Translation
Milling	Rotation	Translation
Drilling	Rotation and translation	Fixed
Boring	Rotation	Forward Translation
Hobbing	Rotation and Translation	Rotation
Surface Grinding	Rotation	Translation

1.1.4 Types of Wood Lathe

Wood Lathes of various designs and constructions have been developed to suit the various conditions of metal machining. But all of them employ the same fundamental principle of operation and perform the same function. The types generally used are:

Speed Lathe, engine lathe,bench lathe,Tool room Lathe,Capstan and Turret Lathe, Special purpose.

1.2 Problem Statement

Then, there comes the need for urgent attention to a better locally made wood lathe machine. Wood lathe machine is making noise, generating vibration,splintering problem, weight is very high,transportation problem and very costly.

II. ANALYSIS OF TURNING AND DRILLING WOOD LATHE

2.1 Introduction of wood turning lathe

Wood turning is a form of wood working that is used to create wooden objects on a lathe. Wood turning differs from most other forms of wood working in that the wood is moving while a stationary tool is used to cut and shape it. Many intricate shapes and designs can be made by turning wood.

2.1.1 Tools used in wood turning lathe

Turning tools are generally made from three different types of steel; carbon steel, high speed steel (HSS), and more recently powdered metal. Comparing the three types, high speed steel tools maintain their edge longer, requiring less frequent sharpening than carbon steel, but not as long as powdered metal tools. The harder the type of high speed steel used, the longer the edge will maintain sharpness. Powdered steel is even harder than HSS, but takes more effort to obtain an edge as sharp as HSS, just as HSS is harder to get as sharp as Carbon Steel.

2.1.2 Type of wood turning lathe

1. Eccentric turning
2. Oval or elliptical turning
3. Therming
4. Segmented turning

5. Green or wet turning
6. Natural edge work
7. Ornamental turning
8. Plywood

2.1.3 Safety of wood turning

Woodturning, it is important to wear certain personal protective equipment (PPE). Loose clothing should not be worn, all jewellery should be removed, and long hair should be tied back. Wood shavings generated during turning will also need to be periodically removed. Like Eye protection, Hand/skin protection, Hand/skin protection

2.2 Introduction of Wood Drilling Lathe

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross- section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the workpiece, cutting off chips from the hole as it is drilled.

Exceptionally, specially- shaped bits can cut holes of non- circular cross-section; a square cross- section is possible.

2.2.1 Process of Wood Drilling Lathe

Drilling holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.Drilling may affect the mechanical properties of the workpiece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on newly formed surface. This causes the workpiece to become more susceptible to corrosion and crack propagation at the stressed surface. A finish operation may be done to avoid these detrimental conditions.

III.METHODOLOGY

3.1Turning Wood Lathe

This Operation is one of the most basic machining processes. That is, the part is rotated while a single point cutting tool is moved parallel to the axis of rotation. Turning can be done on the external surface of the part as well as internally. The starting material is generally a workpiece generating by other processes such as casting, forging, extrusion, or drawing.

3.1.1Taper Turning

A large variety of component used in engineering practice is found to have conical shapes or, if flat, having a gradual reduction in its width or thickness along their length. Such components are known as tapered. For conical pieces, the difference between the diameters of their ends is known as taper and for flat pieces the difference between the widths or thicknesses of their ends is known as taper.

1. **Taper per foot,** the difference in inches of end diameters per foot length of the job.
2. **Taper per inch,** the difference in inches of end diameters per inch length of the job.
3. **Taper** 1 in $\varkappa$; for this, the units should be uniform, such as a taper 1 in 20 means either a taper of 1 inch on 20 inches length or a taper of 1 foot over 20 feet length of the job.

Refer to Fig. 4.1.3. Here, D is the diameter of the large end and *d* of the small end. *L* represents the total length of the tapered piece. As per the definition given above, the total taper on the job is given by:

Total taper = D - d

It is usually expressed, as stated above, as taper per unit length of the job.

Taper = $\frac{D-d}{L}$

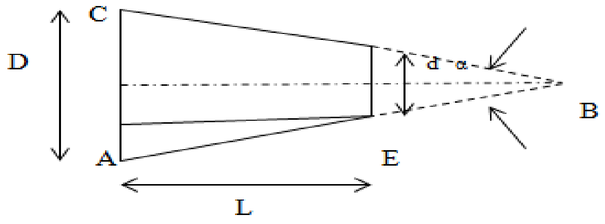

Fig.3.1 Element of Taper

Units of this expression will depend upon the units of D, *d* and *L*. If all are taken in inches, then:

Taper = $\frac{D-d}{L}$ in. per inch length.

If we assume that the difference between D and *d* is equal to 1 mm where the tapered length =100 mm, then:

Taper = $\frac{D-d}{L} = \frac{1}{100}$

This is the form which we usually express as **1 in. ϰ.** Here ϰ = 100. So the obtained result will be expressed thus:

Taper = 1 in. 100.

Further, it will be observed that the tapered component is a frustum of the right circular cone *ABC*, in which *L* represents the altitude of the frustum. Angle ABC, format at the apex of the cone is known as total included angle of taper or simply taper angle. Consider similar triangles *ABP* and *AEF*.In these triangles.

ABC = *AEF* = α (say)

= $\frac{1}{2}$ of the taper angle.

In right – angled triangle *AEF*,

tanα = $\frac{AF}{EF}$

But *AF*= $\frac{1}{2}$ of total taper, and *EF* = *L*

tanα = $\frac{D-d}{2}$. / *L*

= $\frac{D-d}{2L}$

Units of this expression will depend upon the units of D, *d* and *L*. If all are taken in inches, then:

Taper = $\frac{D-d}{L}$ in. per inch length.

If we assume that the difference between D and *d* is equal to 1 mm where the tapered length =100 mm, then:

Taper = $\frac{D-d}{L} = \frac{1}{100}$

This is the form which we usually express as **1 in. ϰ.** Here ϰ = 100. So the obtained result will be expressed thus:

Taper = 1 in. 100.

Similarly in F.P.S. system if D – *d* = 1 inch and *L* =100 inches, the same relationship will be obtained, that is:

Taper = $\frac{D-d}{L}$ = $\frac{1}{100}$; expressed as 1 in 100.

Further, it will be observed that the tapered component is a frustum of the right circular cone *ABC,* in which *L* represents the altitude of the frustum. Angle ABC, format at the apex of the cone is known as total included angle of taper or simply taper angle. Consider similar triangles *ABP* and *AEF.*In these triangles.

ABC = *AEF* = α (say)

= $\frac{1}{2}$ of the taper angle.

In right – angled triangle *AEF*,

$\tan\alpha = \frac{AF}{EF}$

But *AF*= $\frac{1}{2}$ of total taper, and *EF* = *L*

$\tan\alpha = \frac{D-d}{2}$. / *L*

$= \frac{D-d}{2L}$

By applying the above result it is quite easy to find out the taper angle. For example: if D = 40 mm, *d*=35 mm, and *L*= 50 mm, we have:

$\tan\alpha = \frac{40-35}{2\times 50} = \frac{5}{100}$ = 0.05

$\alpha = \tan^{-1} 0.05$

From trigonometric function it can be readily obtained that α will be equal to 2° 50’. So the total included angle will be = 5° 40’.

The term tanα is known as taper gradient. Also, the ratio $\frac{D-d}{L}$ is as conicity. If this be represented by the letter K (say), such that K= $\frac{D-d}{L}$ it can easily be shown that K will also be = 2.tan α. The Table 4.2 gives a summary of formulae for finding out the different taper elements.

Table 3.2 Useful Formulae for Taper Elements

To calculate	Use Formulae
Half taper angle (α)	Tanα =$\frac{D-d}{2L}$
Small diameter (*d*)	*d* = D -2*L* tanα = D – *KL*
Large diameter (D)	D = *d* + 2*L* tanα = *d* + *KL*
Conicity (K)	K =2 tanα = $\frac{D-d}{L}$
Taper gradient	Gradient = tanα $\frac{D-d}{2L}$
Length of taper (L)	*L* = $\frac{D-d}{2\tan\alpha}$

Similarly, in F.P.S system Table 4.3 will help in finding out the different taper elements.

Table 3.3 Useful formulae

Given	To find	Use formula
D, *d* and *L* in inches	Taper per inch	Taper = $\frac{D-d}{L}$
L and *d* in inches and taper per foot(*TPF*)	D in inches	D = $d + \frac{L \times TPF}{12}$
L and *D* in inches and taper per foot (*TPF*)	*D* in inches	d = D- $\frac{L \times TPF}{12}$
TPF and a certain length of taper (*l*) in inches	Amount of total taper over the length *l*	Taper = $\frac{TPF}{12} \times l$

3.2 Drilling Wood Lathe

Cutting Speed

The cutting speed in a drilling operation refers to the peripheral speed of a point on the surface of the drill in contact with the work. It is usually expressed in metres per minute. The cutting speed (v) may be calculated as:

$$V = \frac{\pi d n}{1{,}000} = \text{m per min.}$$

Where, *d* is the diameter of the drill in mm and n is the r.p.m. of the drill spindle.

3.2.1 Machining Time in Drilling

Machining time in drilling is determined by the formula:

$$L = \frac{L}{n \times Sr} \text{ min.}$$

Where, n = r.p.m. of the drill

Sr = Feed per revolution of the drill in mm.

L = Length of travel of the drill in mm.

T = Machining time in mm.

Analysis the drilling lathe machine and calculate the diameter of drilling 0.2 mm to 100 mm and find the value of Speed in R.P.M. then plot the graph.0.2 mm is smallest diameter in drilling.

Table 3.4 Machining Parameters Used for Experimentation

Diameter in mm	Speed in R.P.M.
0.2	39788.73
3.52	2260.723
6.84	1163.413
10.16	783.242
13.48	590.337
16.8	473.675
20.12	395.514
23.44	339.494
26.76	297.374

30.08	264.552
33.4	238.255
36.72	216.714
40.04	198.744
43.36	183.527
46.68	170.474
50.00	159.154
53.32	149.245
56.64	140.49
59.96	130.717
63.28	125.75
66.6	119.485
69.92	113.812
73.24	108.653
76.56	103.941
79.88	99.621
83.2	95.645
86.52	91.975
89.84	88.576
93.16	85.420
96.48	82.480
99.8	79.736
100	79.57

A **Scatter plot** or **Scattergraph** is a type of mathematical diagram using Cartesian coordinates to display values for two variables for a set of data. The data is displayed as a collection of points, each having the value of one variable determining the position on the horizontal axis and the other variable determining the position on the vertical axis. This kind of plot is also called a scatter chart, scattergram, scatter diagram or scatter graph. A scatter plot is used when a variable exists that is under the control of the experimenter. If a parameter exists that is systematically increments and decremented by the other, it is called the control parameter or independent variable and is customarity plotted along the horizontal axis. The measured or dependent variable is customarily plotted along the vertical axis.

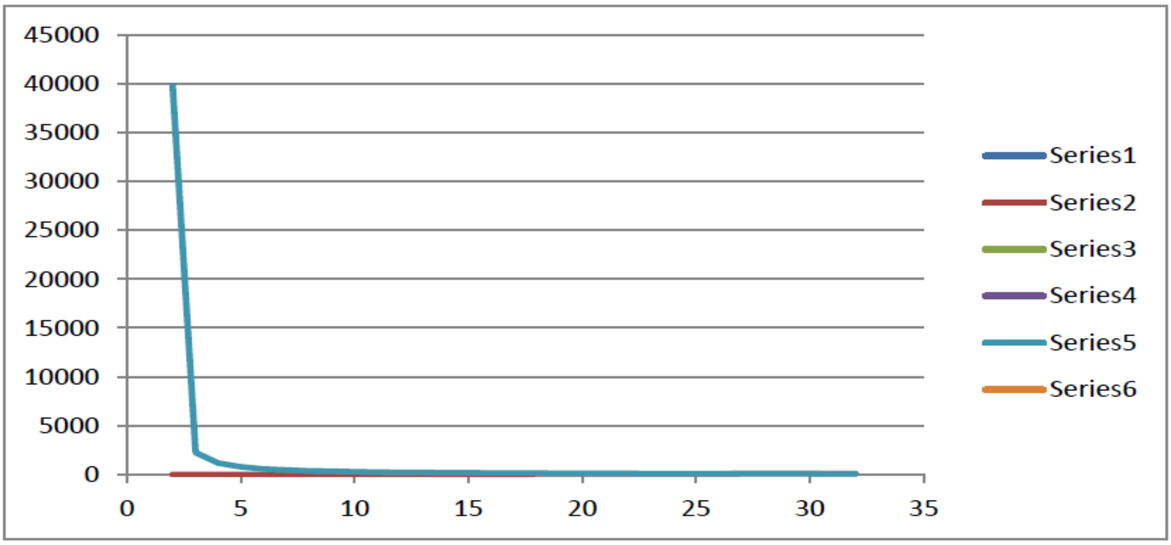

Fig.3.2 Scatter Plot Graph

IV. RESULT AND CONCLUSIONS

4.1 Result and Conclusions

In drilling- induced delamination, the selection of proper tool geometry and operating conditions are important. Twist drill has been found more advantageous than the Core drill. An experimental approach to the evaluation of thurst force in drilling composite laminate by twist drill using taguchi method was presented in this study. The experimental results show that the speed and feed rate are the main parameters among the four control factors (diameter, depth of cut, feed rate and spindle speed) that influence the thrust force. Large grit size produces low thrust force in drilling parameters was obtained by multi- variable linear regression and compared experimental results.

4.2 Hole Quality & Performance

In the drilling the quality of the cut surface is strongly dependent on the appropriate choice of drilling parameters. The aim of this work is to clarify the interaction mechanisms between the drilling tool and material. Drilling tests were carried out using standard HSS tools.

V. FUTURE SCOPE OF THE WORK

The following recommendations are made for future work:

1. Development of similar models for different tool geometries and comparing them to the existing one.
2. Force appears to provide a reasonable metric to rate drill performance. In future work a mechanistic model of drilling force based on the geometry which quantifies the effect of changes in drill geometry on force should be developed. Given that temperature is also a critical issue in drilling success, the mechanistic drilling model colud be augmented to perform heat transfer calculations and estimate drilling temperature.
3. It is worthwhile to apply the supervisory control approach to drilling of circuit boards, laminated metals, aramid and glass laminates. However, if the thickness of the specimen is smaller than the point length of the drill, a new dynamic model and new delamination model must be developed.

4. For the successful carrying out of adrilling operation, the optimal speed of feed, speed must be maintained to avoid increase in thrust force, torque & tool wear.
5. The feed rate and drill diameter are seen to make the largest contribution to the overall performance.
6. The HSS drill bit causes a large delamination compared to other drill bits.

REFERENCES

[1] Danai, K and Ulsoy, A.G. 1988, "Dynamic Modeling of cutting Forces in turning, Milling, and Drilling, from Experimental data" in control Methods for Manufacturing Processes, ed. by D.E. Hardt.

[2] F. Veniali, A.D. Llio, V. Tagliaferri, An experimental study of the drilling of aramid composities, ASME J. Energ. Res. Technol. (1995)

[3] J. Mathew, N. Ramakrishnan, N. K. Naik, Investigations into the effect of geometry of a trepanning tool on thrust and torque during drilling of GFRP composities, J. Mater. Process. Technol. (1999)

[4] S. Thamizhmanii, S. Hasan, "Analyses of roughness, forces and wear in turning gray cast iron", Journal of Achievements in Material and Manufacturing Engineering, vol.(2006)

[5] Work Shop book by R.K. Jain

[6] Work shop technology book by HajraChoudhry

[7] Advance in manufacturing technology C. J. Thomas

[8] www. wikipedia.org

[9] www. Springerlink.com

[10] www. Howstuffwork.com