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Research Article

Design & Analysis of Stress on Drill Bit

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Abstract: The manufacturing sector of India mainly depends on its productivity and quality. In many manufacturing activities, drilling is an ordinary operation that forms the main machining cost. This paper reviews development in drill bit with available geometric properties, materials for a drill bit, and coatings. For the lowest machining cost and highest profit rate, it's a difficult task to select the best tool with its cutting parameters.

With a slight improvement in drill bit geometric properties, we can minimize stress and improve the tool's quality and life. This paper will compare the stress generated over drills by making certain changes in drill geometric properties such as point angle. Drill with lower stress shows longer tool life. Micro drill with point angle 1160 shows less stress distribution. Micro drills with lower stress will have longer tool life. Two different materials as Alpha titanium alloy and Beta titanium alloy used for analysis. We got the different results with parameters, from that the beta titanium alloy is best, which comes in the nearby comparison with HSS. Comparison between alpha and beta titanium alloy is done with HSS based on their equivalent stress, strain, and deformation.

Keywords: Drill Bit, Analysis, Stress

1. Introduction

A drill is made with a cutting tool connection for the element with riding force bit used for producing holes or openings in different materials or affixing substances together by using clasp. The connection is held utilizing the use of a toss in the route of one facet of the drill and pivoted while squeezed in the direction of the objective fabric. The tip and time edges of the reducing device take the critical step of reducing the goal material. This could possibly reduce off thin shavings (wood screw bits or bend drills), granulating off little particles, pounding and evacuating bits of the workpiece, counterboring, countersinking, or specific sports. Drills are mostly used in carpentry, metalworking. Extraordinarily planned drills are likewise applied in remedy, area missions, and unique packages. Drills are available with a massive assortment of execution characteristics, for instance, electricity and limit.

Drilling is the most common material removal process. It is a standard process for producing holes in the workpieces. The drilling tool is called a drill bit which is rotated by the spindle of the machine. Drilling is an essential operation in manufacturing industries. The drill bit is used to produce round holes in solid, hard materials and used for enlarging existing holes provided on the workpiece. It is a type of multipoint cutting tool which has multiple cutting edges. For producing holes on workpieces, either drill is used to rotate, and the workpiece kept fixed, or in some other cases, the drill remains stationary, and the workpiece is used to rotate.

2. Academic Review

"Machining parameters and material of workpiece is mainly responsible for improvement in drill bit used in an industry. Different materials and coating materials are used for improvement in drill bit. Machining of workpiece can be done by using different geometries of drill bit. A proper drill bit selection can be done by using different types of flute style, tip style and shank style for machining of different materials and applications." [1].

"The prevailing FEA investigation the penetrating apparatus essentially with assist of Finite thing examination. Right off the bat the boring apparatus is tested in CATIA and the equivalent is added into the ANSYS for modular and simple examination of current Tungsten carbide tool and D2 metallic fabric tool. The end result from the investigation it's miles seen that with express condition the D2 steel cloth is taken into consideration instead cloth for making drill it. The D2 metallic drill modular investigation the recurrence created is sort of relatively near that of tungsten carbide correspondingly inside the fundamental exam because the similar strain, whole disfigurement and shear stress are likewise visible to be competitive"[2].

"Drill with lower stress shows longer tool life. Micro drill with point angle 1160 shows less stress distribution. Micro drills with lower stress will have longer tool life. When micro drill with point angle 116^0 is compared with

micro drill with point angle 114^0 through analysis ,it is found that micro drill with point angle 116^0 shows longer tool life. Micro drill with point angle 116^0 will be best geometry of micro drill."[3].

"3D model was developed to calculate cutting forces occurred in drilling process. Simulation is performed to obtain different stress plots. Residual stresses generated during machining processes and other parameters are also studied. Temperature generated during cutting process can be obtained by modeling of a coupled thermos model. By making slight alteration in analysis set up and material modeling , a model can be prepared to study cutting process in composite material."[4].

3. Analysis

A General Procedure For Finite Element Analysis •

Preprocessing

– Characterize the geometric location of the issue.

– Define the aspect type(s) to be applied.

– Define the cloth properties of the additives.

–Define the geometric houses of the components (duration, territory, and such).

– Define the element networks (paintings the model).

– Define the physical imperatives (restrict conditions). Characterize the loadings.

• Solution

– figures the difficult to understand estimations of the important area variable(s)

– figured features are then used by back substitution to technique more, decided elements, as an example, response powers, factor stresses, and warmth move.

• Post processing

– Postprocessor programming consists of superior schedules applied for arranging, printing, and plotting selected consequences from a restrained issue arrangement. The fabric and their homes that are used in this examination are seemed.

4. Tool Geometry

The winding (or rate of flip) within the dull device controls the fee of chip evacuation. A short winding (high curve charge or "smaller woodwind") boring apparatus is applied in high feed charge programs underneath low shaft speeds, where evacuation of an enormous volume of swarf is needed. Low winding (low bend rate or "lengthened woodwind") bores are applied in reducing packages wherein high cutting costs are generally utilized. The material tends to bother on the bit or typically impede the distance, for instance, Al or copper. The factor side, or the brink framed on the bit's tip, is dictated via the fabric the bit will work in. Hard substances require a more significant factor facet, and milder substances require a greater honed aspect. The good point plot for the hardness of the material controls meandering, jabber, opening form, put-on price, and exclusive characteristics. The lip area comes to a decision the measure of assist gave to the front line. An extra prominent lip side will make the bit cut all the greater forcefully below a comparable measure of factor weight as a bit with a little lip facet.

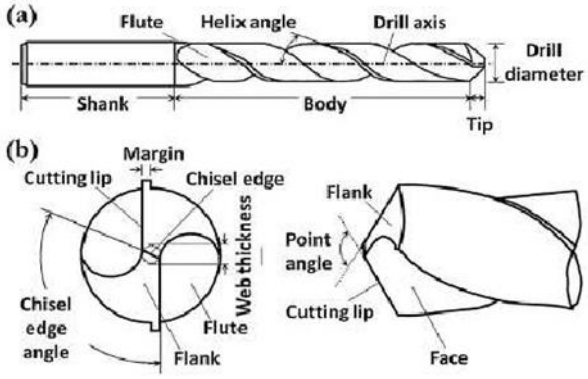
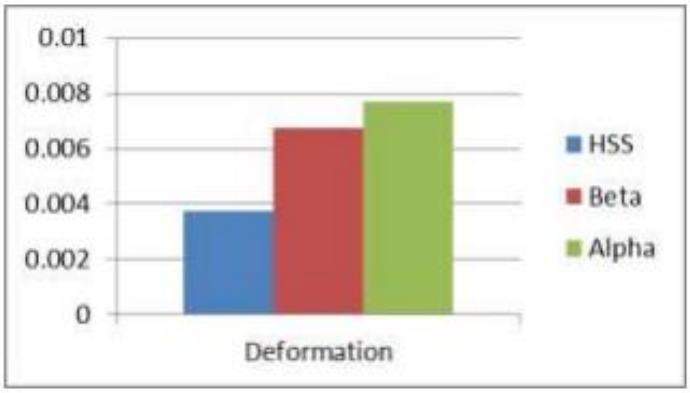


Figure 1:- Geaometry of Drill Bit

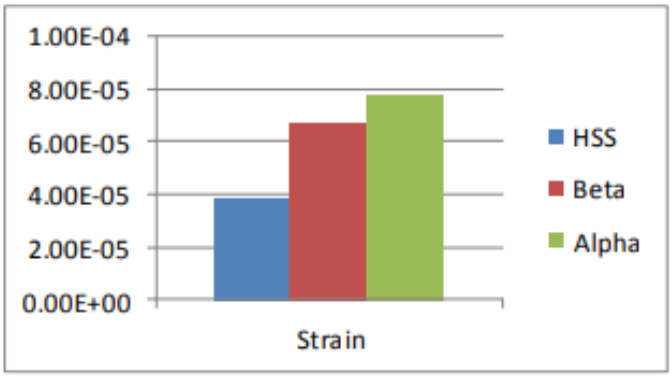
The conditions can reason authoritative, wear, and inevitable disastrous sadness of the instrument. The point area controls the exceptional possible measure of lip freedom. An excessive point area has more internet floor territory exhibited to work at any particular time, requiring a forceful lip area. A level piece is tremendously delicate to little lip facet adjustments because of the small surface sector assisting the bleeding edges. The length of a chunk decides to what extent a gap may be bored and decides on the solidness of the bit and exactness of the resulting hole. Contort boring gear are available in overall lengths, alluded to as Stub length or Screw-Machine-length (short), the amazingly primary Jobber-period (medium), and Taper-length or Long-Series (lengthy).

5. Analysis of Stress And Strain

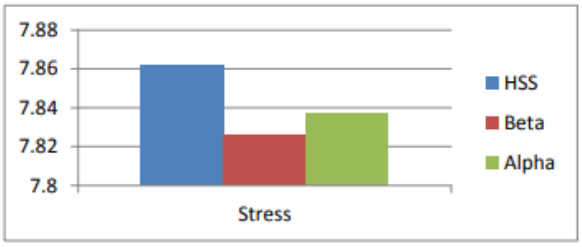
In the analysis, we can see two materials **(Alpha titanium alloy and Beta titanium alloy)** used for analysis. We got the different results with parameters, from that the beta titanium alloy is best, which comes in the nearby comparison with HSS. Usually, drill bits are made from HSS and Cobalt by forging, but we mostly use HSS as a material for drill bit making. To check the von misses stress and total deformation under the same condition of momentum with fix support, We have used different materials for the overall drill bit design.



Graph 1 :-Comparison between alpha and beta titanium alloys with HSS on the basis of their deformation.



Graph – 2 Comparison between alpha and beta titanium alloys with HSS on the basis of their equivalent strain.



Graph – 3 Comparison between alpha and beta titanium alloys with HSS on the basis of their equivalent stress.

The life of drill bit changes accordingly different types of work piece and different types of drill bit.

Material	Drill Bit Type	Capacity

Wood	Auger	7/8 in (22mm)
	Paddle	1 ¼ in (32mm)
	Twist	½ in (13mm)
	Self-Feed	1 3/8 in (35mm)
	Hole Saw	2 in (51mm)
Metal	Twist	½ in (13mm)
	Hole Saw	1 3/8 in (35mm)

Table 1 :- Capacity of Drill Bit

6. Capacity of Drill Bit

In this paper it shows the property of various drill bit and its conclude that every metal work piece must have the different types of drill bit. Like metal and wood.

Fig:- 2 Different Types of Drill Bit

Tool Geometry			
Workpiece Material	Point Angle	Helix Angle	Lip Relief Angle
Aluminium	90 to 135	32 to 48	12 to 26
Brass	90 to 118	0 to 20	12 to 26
Cast Iron	90 to 118	24 to 32	7 to 20
Mild Steel	118 to 135	24 to 32	7 to 24
Stainless Steel	118 to 135	24 to 32	7 to 24
Plastics	60 to 90	0 to 20	12 to 16

Table 2:- Different Angles for Different Materials

Micro drills have Geometric features like Flute length, Helix Angle, diameter, Web thickness, Point Angle, Chisel Edge Angle, etc. The Geometric features of micro drills are as below.

Geometric Feature	**Drill 1**	**Drill 2**
Diameter	0.1mm	0.1mm
Flute Length	1mm	1mm
Body Length	1mm	1mm
Helix Angle	30^0	30^0
Web Thickness	0.03mm	0.03mm
Point Angle	114^0	116^0
Chisel Edge Angle	62.5^0	62.5^0
Web Taper	1.7^0	1.7^0

Table 3:- First drill with point angle 114^0

Second drill with point angle 116^0

In CATIA, revolve option is used for creating the solid cylindrical model. A curve is made along the drill axis to obtain a helix angle using the curve option. To get the curve, the following equations are made.

D = 0.05 M = -1

N = 1 X = d × cos (n×t×360)

Y = d × sin (n×t×360) Z = m × t

The helical cut is prepared on the cylindrical part of the drill for a given dimension using the cut and swept blend option. Chisel edge angle for 62.50^0 is generated by using the pattern plane option. Point angle is obtained by cut option. Tilt the lip to the required dimension using the tweak and draft option. Thus for the given dimension, a 3D Model of the micro drill

7. Analysis of the Model

Analysis of 3D Micro Drill with Point Angle 114^0

Drill material:

Tungsten Carbide

Tungsten Carbide – 93.5 – 94.5%

Cobalt - 5.5 – 6.5%

Physical Properties:

Specific Gravity is 15.00

Nominal Density (Approx) is 0.54 lbs/in3

Mechanical Properties:

Ultimate Tensile strength is 1516.84 Mpa Ultimate Compression strength is 5171.06– 5446.8 Mpa

Transverse Rupture strength is 2206.3– 2516.5 Mpa

Hardness Rockwell is A89 – 92

Modulus of Elasticity is 634317.83– 641212.5 Mpa Poisons Ratio is 0.26

Maximum Useful temperature is 800 F

Magnetic Property is Slightly Magnetic

Target Material –

Copper: Type – C110

Ultimate tensile strength is 331 Mpa

Yield Strength is 310 Mpa

Shear Modulus is 44.7 e3 Mpa

Young's Modulus is 108e3 Mpa

Density is 8885 kg/m3

Hardness (Vickers) is 92

The comparison of drill bits with two helix angles (114^0, 116^0) are geared up by comparing their von mises stresses, shear stress and deflection.

Micro Drills	**Drill 1 (114^0)**	**Drill 2 (116^0)**
Vonmises Stress N/mm^2	305.987	346.88
Deflection (mm)	0.409E-04	0.366E-04
Shear Stress in XY Plane	97.126	40.222
Shear Stress in YZ Plane	66.684	70.751

Shear Stress in XZ Plane	37.708	116.446

Table 4 :-Result of two different angles

8. Conclusion:

After studying various research papers, it is concluded that there are still some sector need some improvement and can minimize stress and improved quality and life of the tool. This is an aim for utilization of full strength of tool with minimum damage. It also needs to improve the geometry of the tool as well.

We have compared the stresses generated over the drills by making certain changes in drill geometric properties such as point angle. Drill with lower stress shows longer tool life. Micro drill with point angle 1160 shows less stress distribution. Micro drills with lower stress will have longer tool life. Two different materials as Alpha titanium alloy and Beta titanium alloy used for analysis. We got the different results with parameters, from that the beta titanium alloy is best, which comes in the nearby comparison with HSS. We are trying to reduce the stress on the drill bit and increase the life of it. It is still under study to find the best way to complete our objective with the help of various formulas and basic parameters of the material.

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