Design And Analysis Of Spur Gear Cuttting Attachment For Lathe Machine

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Abstract: *Lathe machines play a pivotal role in various manufacturing sectors due to their versatility in performing numerous operations such as turning, drilling, and threading. However, they have inherent limitations when it comes to complex operations like spline and gear cutting. Traditionally, milling machines are used for gear and spline production, but their use adds significant operational costs, and their capabilities are often underutilized in smaller manufacturing units. CNC machines, while more efficient and capable of automating these processes, come with high initial costs and additional indirect costs, which makes them unsuitable for some smaller or mid-sized manufacturers.*

This project seeks to overcome these challenges by designing and developing an attachment for a general-purpose lathe machine that can perform gear cutting operations, specifically spur gears. By introducing such an attachment, it is anticipated that the production cost could be significantly reduced while maintaining or even improving the quality of the produced gears compared to conventional milling operations. The attachment is designed to increase the versatility of a lathe, allowing it to perform complex tasks without the need for expensive CNC machines.

Keywords: Spline gear cutting, Special purpose motor, Tool post, Head stock, Solid works.

I. INTRODUCTION

Job shops and small-scale industries often face financial constraints that limit their ability to invest in specialized machinery. As a result, they heavily rely on general-purpose machines, such as lathes and milling machines, which are versatile, cost-effective, and easy to maintain. Researchers continually strive to assist these industries by developing innovative methods to expand their production capabilities using these general-purpose machines. Various attachments are already in use to enhance the functionality of these machines.

Although attachments like keyway cutters, slotting tools, internal keyway tools, grinding wheels, and eccentric turning tools for lathe machines are commonly available, challenges persist. For instance, machining gears and splines on shafts remains difficult. To address this issue, it is essential to design a flexible and efficient attachment for lathes that can overcome these limitations while being compatible with standard machines.

1.1 MACHINING

Machining encompasses a wide range of processes that transform raw materials into finished products. It is defined as a controlled method of shaping materials to achieve the desired form and size, which may involve material removal (e.g., cutting, drilling, boring) or material addition. While machining is most commonly associated with metalworking, it is also applicable to materials such as wood, ceramics, plastics, and composites.

Today, machining primarily consists of three principal processes: turning, drilling, and milling. These processes, along with others like shaping, boring, broaching, and sawing, are integral to modern machining due to their reliance on advanced machine tools.

1.2 TURNING OPERATIONS

Turning is a machining process used to remove excess material from a work piece by rotating it between the headstock and tailstock of a lathe machine. It is one of the fundamental operations performed on lathes. In turning, the work piece rotates while a cutting tool removes unwanted material to achieve the desired shape and size, as illustrated in Figure 1

Lathe machines can perform a variety of operations, all based on the same principle: the rotation of the work piece between the headstock and tailstock, with the cutting tool removing material from the work piece.

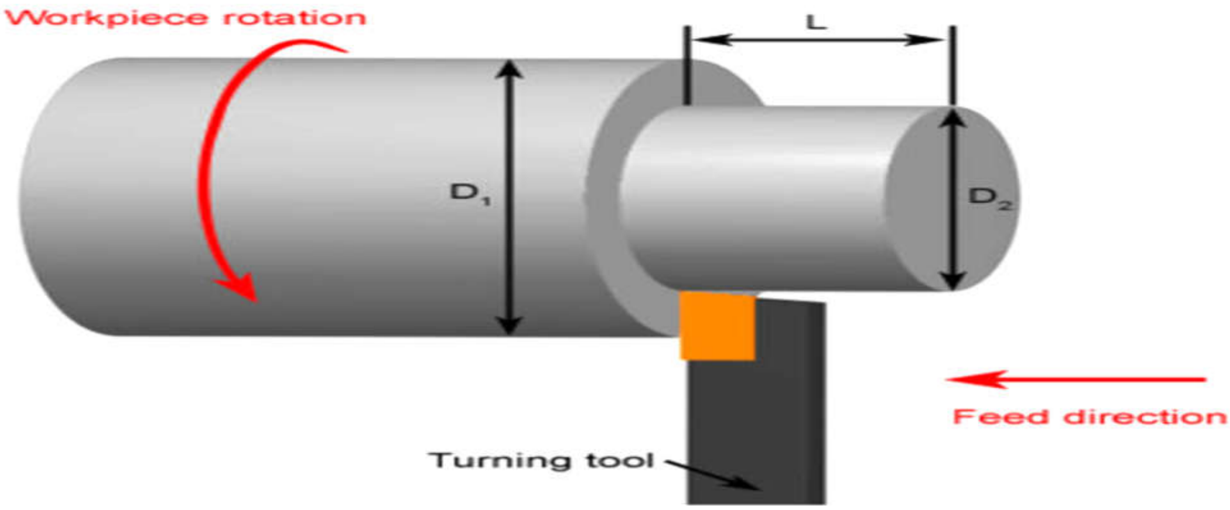

Fig No1: Turing operation

1.3 MILLING OPERATIONS

Milling is a machining operation that will do machining by fixing workpiece at acertain position and then doing operation by guiding cutting tool towards the workpiece as shown in Fig (2). That is a vertical milling operation there are different milling operation is available in now a days and most of them are operated by CNC machines to get much precision and reduce time in production.

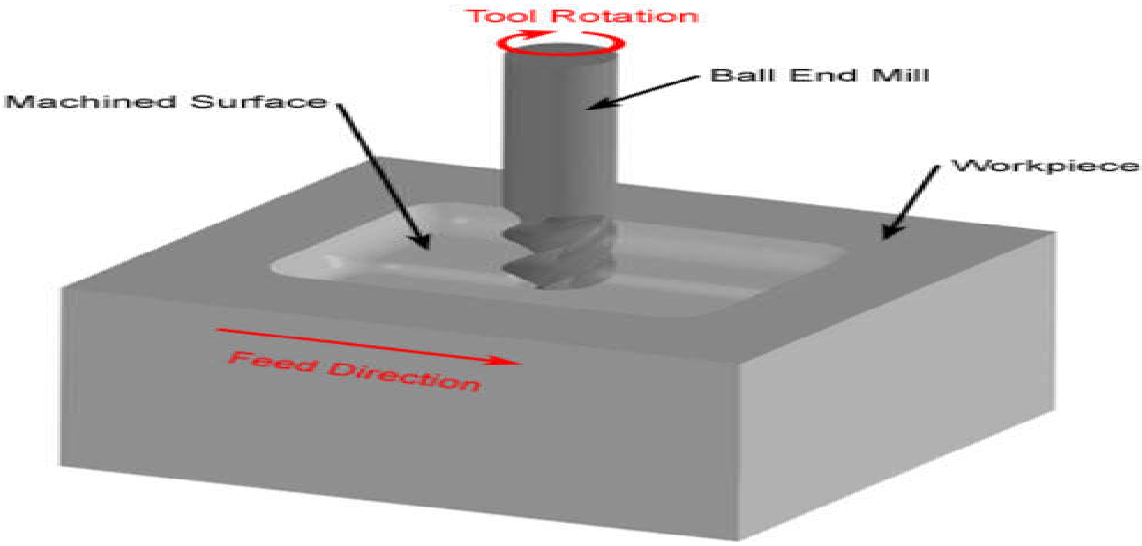

Fig No 2: Milling operation

1.4 DRILLING OPERATIONS

Drilling also a machining operation that will remove material by generating holes on the work piece. the workpiece is fixed on the table by jaw or clamp devices and drill bit i.e., the cutting tool is guided towards work piece in rotational condition and material will be removed as shown in Fig (3) to produce holes on the work piece. To do this operation drilling machine is created and this machine is not only for drilling operation also it is used for tapping, reaming and boring etc. operations can be performed.

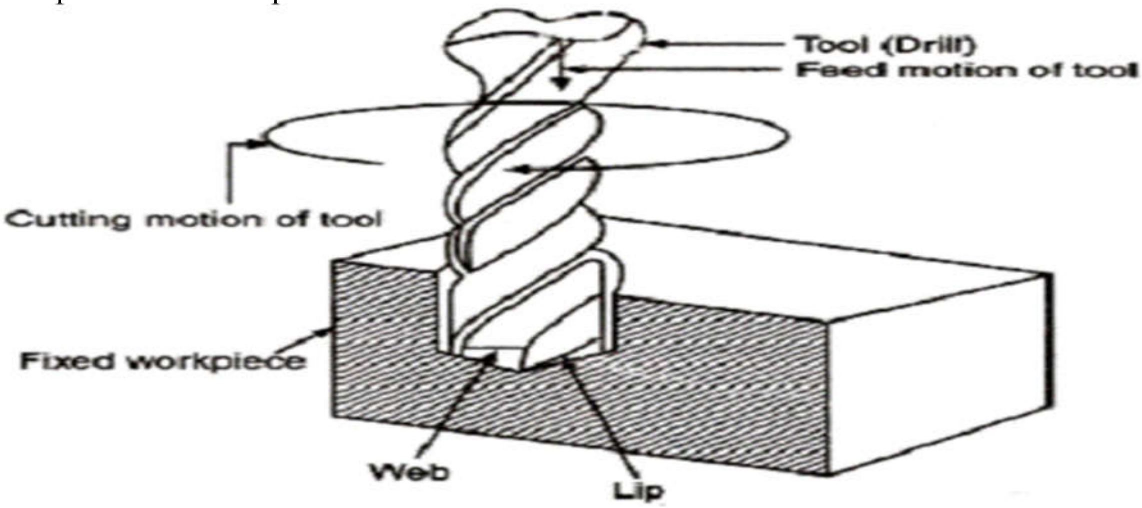

Fig No 3: Drilling operation

2. BASIC PRINCIPLES

2.1 GEARS: Assume that two plain wheels mounted bolt to two parallel shafts and pressed tightly connected with one another. If one wheel is rotated regarding its axis, the opposite wheel conjointly can rotate due to the friction between them as shown in Fig (4) The rotation is thus transferred from one shaft to another. Without slip, two wheels maintain constant speed at surfaces. In the same way, the load will transfer between shafts, due to this there is a tendency to occur slipping. To reduce slipping these slots i.e., teeth are implemented on the outer surface of the wheels

2.2 SPUR GEAR: Spur gears consist of parallel teeth to the axis and are utilized for transferring power between two parallel shafts. they're simple in construction as shown in Fig (5), simple to manufacture and low cost. They need the most effective potency and smart accuracy rating. they are used in high speed and high load application altogether varieties of trains and an honest sort of velocity ratios. Hence, they perceive wide applications right from clocks, organization gadgets,motorcycles,vehicles.

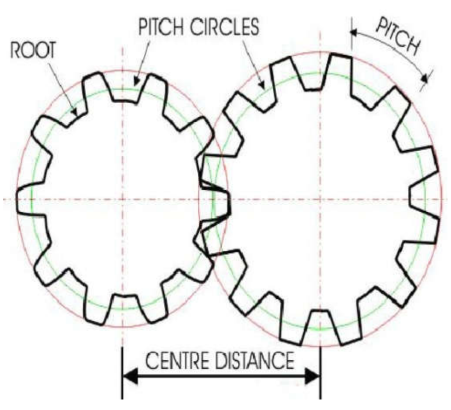

Fig No 4: Mating Gears

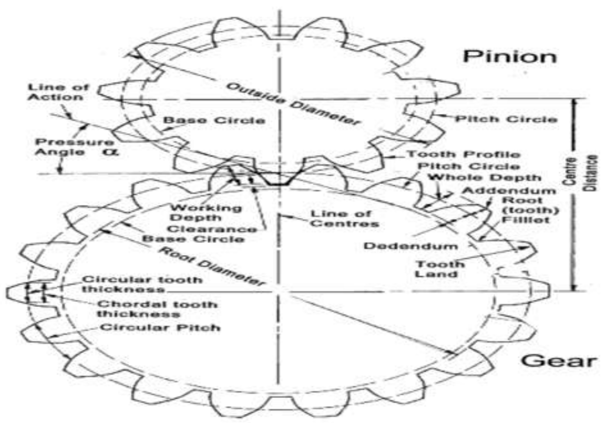

Fig No 5: Mating Spur Gear

2.3 GEAR MANUFACTURING PROCESS

Gear producing is classified into two classes particularly forming and machining. Forming refers direct casting, molding, drawing, or extrusion of tooth forms in liquid, powdered, or heat softened materials and machining consist of roughing and finishing operations as shown in Fig (6).

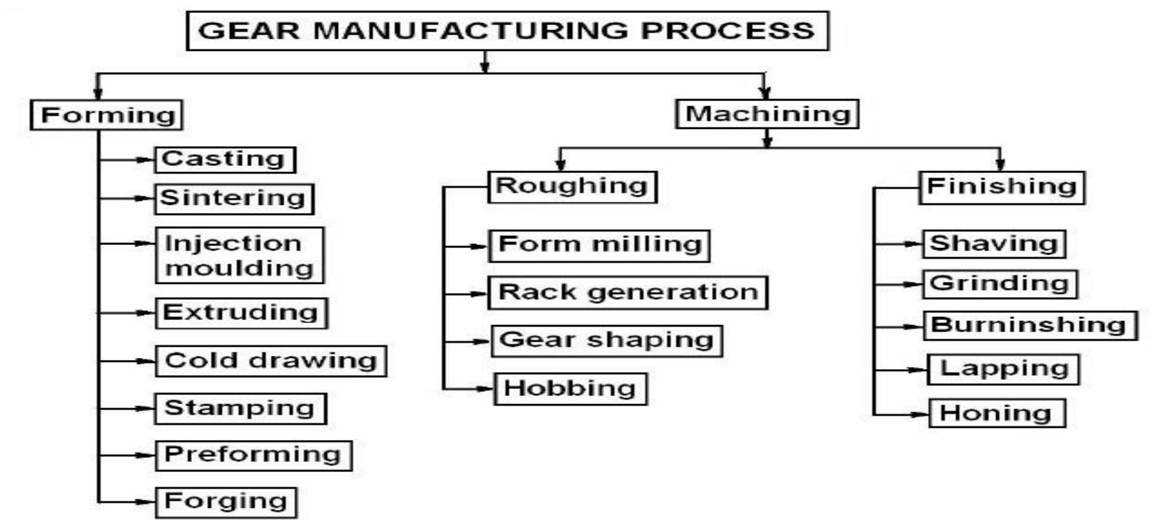

Fig No 6: Gear manufacturing processes

2.4 INDEXING: Indexing is an operation of dividing the outer boundary of a piece of work into any number of equal elements, for e.g. this operation may be adopted for manufacturing hexagonal and square-headed bolts, cutting grooves on shafts, fluting drills and in gear cutting. all these works need a holding device which can allow the rotation of the work concerning the axis so outer boundary of the piece of work will be divided equally and accurately. Such a work holding devices are called Dividing head or indexing head.

2.5 METHODS OF INDEXING: Direct Indexing ,Simple Indexing, Compound Indexing ,Differential Indexing

2.6 DIRECT INDEXING: It is additionally known as rapid indexing. this is often used when a large variety of identical items are indexed by the very small number of divisions as shown in Fig (7). The rapid plate is mostly fitted to the front end of the spindle nose. The plate has twenty-four numbers of equally spaced holes. Into anyone of which a spring loaded pin is pushed to lock the spindle with the frame whereas indexing, the pin is taken out and therefore the spindle is revolved by hand. after the specified position is reached, it's once more locked by the pin. now the dividing head spindle and work also are turned through a similar part of the revolution. With this kind of indexing with a plate of twenty-four holes, the outer boundary will be divided into2,3,4,6,8,12 or 24 parts which are all factors of 24.

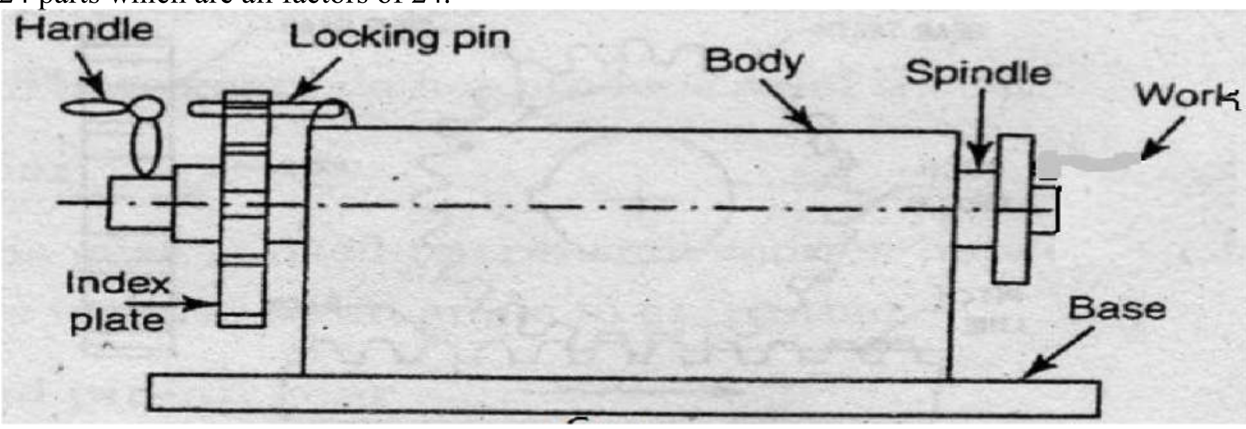

Fig No 7: Directing indexing

2 LITERATURE REVIEW

Literature review is divided into 3 parts

Lathe machine related, Milling machine related, Gear cutting attachment related.

I. 2.1 LATHE MACHINE RELATED

Amar S. Bhandare, (2017), [1] reviewed on Keyway Milling Attachment for Lathe Machine, in this paper discussed the milling attachment for lathe machine through this might eliminated price of machining keyways. The machine operates through lathe machine.

The attachment is a good tool for contemporary industrialization which is able to undoubtedly facilitate to enhance the productivity and can facilitate the industries to enhance the standard of keyway operation. The compact style of attachment can facilitate simple operation of thekeyway.

Rana Mihir et al., (2017), [2] reviewed on slotting attachment for lathe machine.By this attachment, ability to create a slot on a shaft in the lathe machine. which might save Investment of little businessman by avoiding the subcontracting of works which need special machines. This paper aims to assist the small scale production floors where a lathe machine exists. this project slots may be cut on work items employing a lathe machine. This is a trial to style associate in fabricates of an attachment for lathe machine which might produce slot is much easier than the presently accessible ways.

This attachment provides an honest answer to the small scale industries that can't afford a separate slotting or milling machine, and have in possession a lathe machine, and should need doing bound slotting operations. This eliminates the presence of slotting machine in the workshop. The variation of the speed of the slotting tool makes this product a possible one for completing machining operations on materials that need utmost care whereas fabricating.

Shakeel A Sherkar et al.,(2017), [3] reviewed on key way attachment for lathe the special attachment for lathe machine to machining of the internal slot. In this paper discussed the internal key means attachment for lathe machine through which we eliminated price of broaching or edge. The machine operates through lathe machine. It consists of lathe machine, a cam follower attachment, power chuck, cutting implement etc. He developed a compact moveable mechanism for changing the movement of the shaping machine spindle into reciprocal motion of the cutting implement from the results obtained from the operational testing of project model, we tend to over that the project model satisfies the operating sensible conditions. In this project, they got succeeded with designed & developed the interior keyway attachment for the lathe machine.

Darshan Attardeet al., (2016), [4]reviewedongrinding wheel attachment on alathe machine.This work describes a trial to decrease the time in loading and unloading of work with the desired surface end. This report describes the choice of the wheel for grinding. It additionally considers the rigidity of style, damping and vibration owing to motor speed and stress analysis of essential a part, that is analyzed on INVENTOR software and compared with theoretical calculations. It additionally lists the assorted operations performed to fabricate the attachment. the grinding wheel Attachment on a lathe this method has straightforward setup on lathe machine

Abhishek M et al., (2016), [5] reviewed on grinding attachment on a center lathe machine.the target of this project was to model and manufacture a compact, sturdy and economic grinding attachment for a middle lathe machine that provides a surface end of grade N5. All elements were styled as per the settled methodology of design. when the planning procedure was completed, thefinite part analysis was performed on the element that old worst loading conditions i.e. the shaft. Then a number of the elements were factory-made and a few were chosen from manufacturers' catalog and at last all elements were assembled. Then the attachment was tested on a lathe machine and also the achieved surface end worth was measured. Then they tend to test our attachment on a lathe and measured the surface roughness. The surface roughness was found to be 0.63 microns i.e. N5 grade surface end.

II. 2.2 MILLING MACHINE RELATED

Vandana N.Mahajanet al., (2017), [9] reviewed on optimization techniques of various machining parameters of the milling machine. This involved in optimization of cutting speed depth of cut vibration material and material sizes. In this paper mainly concentrated on minimum surface roughness minimum time and minimum cutting force Required to perform Operation of materials like En8 steels. This paper concentrated on industrial parameters to optimize milling operations.

Sagar, MR et al., (2016), [10] reviewed on spur gear cutting using milling machine Initially parameters like gear terminology speed feed depth of cut etc. are calculated and examine in several test condition and also this project involved in calculation of the alignment of mandrel and alignment of teeth in general spur gears in the end this paper exploded all calculations and parameters suitable for cutting spur gear in general horizontal milling machine.

ShadabAnwar et al., (2016), [11] reviewed onoptimization of end milling parameters for improving surface roughnessto get better accuracy and surface finish by implementing Taguchi method. Implemented Taguchi method successfully and compared on obtained results by conducting various experiments based on the method followed. At the end of this paper, they mentioned value that satisfies the condition of end mill parameters while surface roughness taking into consideration.

Prof. R. L. Patel et al., (2015), [12] reviewed on static and dynamic analysis of base of thevertical machining center. In general, a vertical spindle milling machine contains several loads while performing milling operation so this project involved to find out the static and dynamic loads which are generally developed in a vertical milling machine by using fea software in this analysis stays mainly concentrated on general Lords and natural frequencies and corresponding mode shapes which will turn preventing castor pic St Joseph the machine tool

YaswanthKumaret al., (2013), [13] reviewed on CNC machine cutting parameters optimization in milling. It is cutting speed feed rate and depth of cut radial forces etc. are examined and analyzed by performing different sets of spindle speed and different cutting depth feed rate in a CNC machine. In the end, we have compared all results and gave a final optimized parameter to get the good accuracy and surface finish of a particular material the main aim of this paper is to prove there will be different cutting parameters for each material.

Amir Mahyar Khorasaniet al., (2012), [14] reviewed on tool life prediction in face milling machining. This paper involved in the analysis of milling tool while machining a part. By taking main three parameters it is cutting speed feed rate and depth of cut, by using Taguchi method. In this project, two types of results were compared that is predicted and test results. At the end of this project, the results they have obtained was near to equal.

M. Narasimha1 et al., (2013), [15]reviewed on adjustable multi-spindle attachment. The main motto of this project is machining 3 t-slots at a time, which is in the range of 40 mm to 320 mm. In initial stage this attachment was designed in CAD model letter this attachment was fabricated based on the requirement to accomplish. In the end, accomplished the requirements in the range of 40 mm to 160 mm in a single pass to cut T-slots by implementing three different cutters on an arbor in a milling machine Tool

III. 2.3 GEAR CUTTING ATTACHMENT IN LATHE
IV.

Dr. Ramachandra c g et al., (2017), [17]reviewed on gear cutting attachment for the lathe. it's designed to be mounted to the side of the gear cutting machine and to be used without troubling a setup in the associated holding device. The attachment is additionally designed to be mounted to the front of a gear cutting machine and permits the programming of the very point of single point tool contact therefore on following no matter contour or steps are desired. Gears are successfully made from this attachment. surface finish is achieved.

GadakhRameshs et al., (2016), [18]reviewed conventional lathe gear production. This attachment which makes gear when it inatalled on the cross slide. This one is a reasonable device, therefore, avoids dependency on an expensive milling machine for job production. By using this attachment manufacture spur, helical likewise as bevel gear can manufacture. This machine having benefits like easy assembly, simple installation on lathe machine

J.C.Harbison(1994), [19] presented a milling attachment for lathes. He modified the attachment that cutting tool fitted to the arbor and that is supported by chuck and tailstock. He modified direct indexing to compound indexing.

J.W.Bracus (1942), [20] presented a gear cutting attachment. He was studied and modified smith's attachment and he tried to initiated indexing in the attachment.

T.E.Smith(1940), [21] presented a keyway and gear cutting attachment for lathes. He is the initiator for this concept he builds a gear and keyway cutting attachment for lathe by adding another motor to the cutting tools and chuck modified as holding and indexing device but this attachment is heavy and complex.

2.4 SOFTWARE USED:

CATIA v5:

CATIA (computer-aided three-dimensional interactive application) is a strong application that allows us to make a fashionable and complicated design. it's a feature-based, parametric solid modeling design tool that may enhance us easy to making models and assemblies. Modeling and assembly of this project are done by exploitation this software.

SOLIDWORKS:

SOLIDWORKS uses a 3D design approach. As we design a component, from the initial sketch to the final models, by using this kind of design software we can convert 3D models or assemblies in to 2D drawings by using simple tools. This is not limited to this software, by using this we can do 3D assembly by giving relative joints between modeled components and also we can simulate them Motion simulation for synthesis and analysis of the mechanism Suppose an engineer is planning an elliptic trammel meant for tracing different ellipses. when he has outlined mates within the CAD assembly, he will animate the model to review however the parts of the mechanism move. though assembly animation will show the relative motion of assembly parts, the speed of motion is inapplicable and timing is unfair. to search out velocities, accelerations, joint reactions, power needs, etc., the designer desires a a lot of powerful tools Motion simulation provides complete, quantitative data concerning the kinematics—involved position, velocity, and acceleration, and therefore the dynamics—involving joint reactions, mechanical phenomenon forces, and power necessities, of all the parts of a moving mechanism. usually of nice extra importance, the results of motion simulation will be obtained virtually at no overtime expense, as a result of everything required to perform motion simulation has been outlined within the CAD assembly model already and just needs to be transferred to the motion simulation program.

All CAD parts and assemblies converted from .cat part and .cat product into.igs file format then these files are dragged to Solid works software to do motion simulation.

ANSYS:

ANSYS Mechanical is associate FEA software for the study of deferent aspects like structural analysis, as well as linear, nonlinear and dynamic. This analysis product provides finite components to model behavior and supports material models and equation solvers for a large range of mechanical design issues. ANSYS Mechanical conjointly includes thermal analysis and paired physics capabilities involving acoustics, piezoelectric, thermal structural and thermos electrical analysis. Static structural analysis of this project is completed by using this software

3. METHODOLOGY

In this chapter the methodology is covered to create spur gear cutting attachment for alathe machione. The methodology should be easy to implement and able to correct if any modifications are made in the middle of the process.

3.1 FLOW CHART

Initially, a flowchart was designed as shown in Fig 9. It refers methods of making gear cutting attachment, Selection of a method, Basic drawings, designing and modifications, Design and analysis, material selection as per requirement, Fabrication, Assembly and Testing.

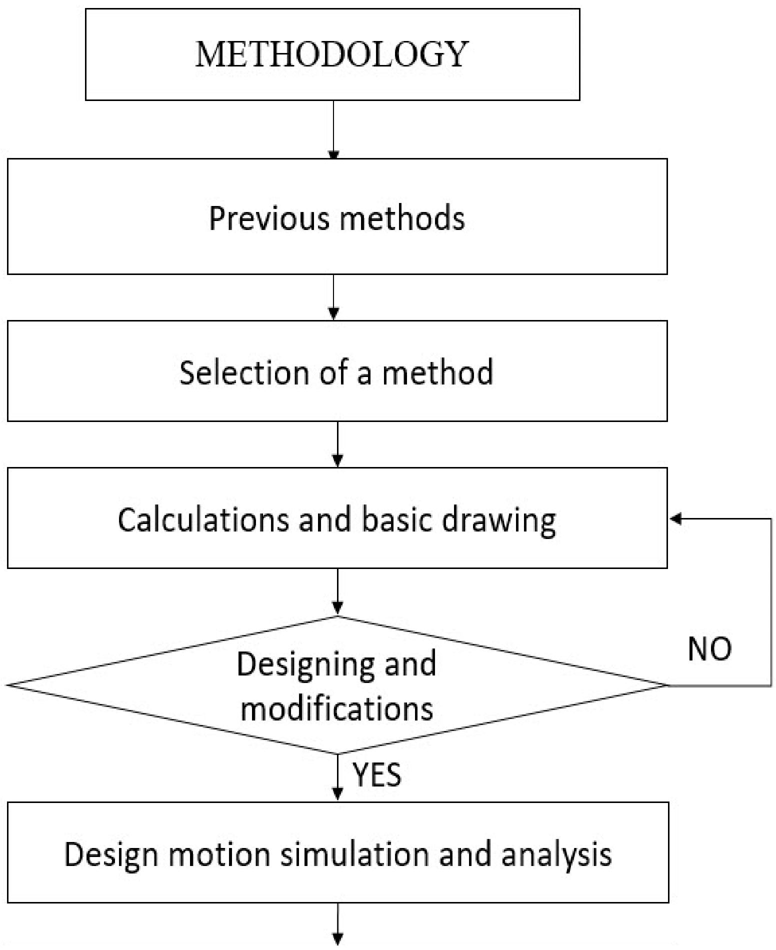

Fig No 8: Methodology flow chart

3.2 PREVIOUS METHODS:

Two concepts are being attempted in the design and development of the attachment. One is to provision the headstock with the workpiece while tool post is loaded with a tool and is guided by a special purpose motor. The second method is that the headstock containing the tool is going to rotate at various speeds while the tool post or tailstock contains workpiece for holding, cutting angle and changing direction to perform gearing and slotting operations.

3.3 SELECTION OF A METHOD

This project, therefore, aims at the design and development of an attachment that can help lathe operations to produce splines and gears of a product effectively and also realize cost reduction. It is essential that the product quality should be made comparable with that of milling operation or even better. Ways and means will be found to incorporate features both at design stage and production stage to achieve this goal. Such an attachment will increase the flexibility of the lathe.

After analyzing the methods, In the end, choosen the method based on some consideration like work piece holding tendency external bodies to be attached in lathe machine regarding complete setup it should be strong, safety, flexible, low cost and also it should be easy to attach and remove. By considering all these things the first method was chosen.

3.4 CALCULATIONS

INDEXING

In general, direct indexing plate has 24 holes in a circle.

The workpiece is divided by using the formula.

Holes by which pin is to be moved = 24/n

n = no divisions in work piece.

by this direct indexing plate these many slots can be cut.

2 divisions in work piece = 24/2 = 12 holes, 3 divisions in work piece = 24/3 = 8 holes.

4 divisions in work piece = 24/4 = 6 holes,6 divisions in work piece = 24/6 = 4 holes.

8 divisions in work piece = 24/8 = 3 holes,12 divisions in work piece = 24/12 = 2 holes.

24 divisions in work piece = 24/24 = 1holes,2, 3, 4, 6, 8, 12, 24.

To get other divisions we have taken 18 holes in the same plate.

2 divisions in work piece = 18/2 = 9 holes,3 divisions in work piece = 18/3 = 6 holes.

6 divisions in work piece = 18/6 = 3 holes, 9 divisions in work piece = 18/9 = 2 holes.

18 divisions in work piece = 18/18 = 1 holes,2, 3, 6, 9, 18

SPUR GEAR CREATION

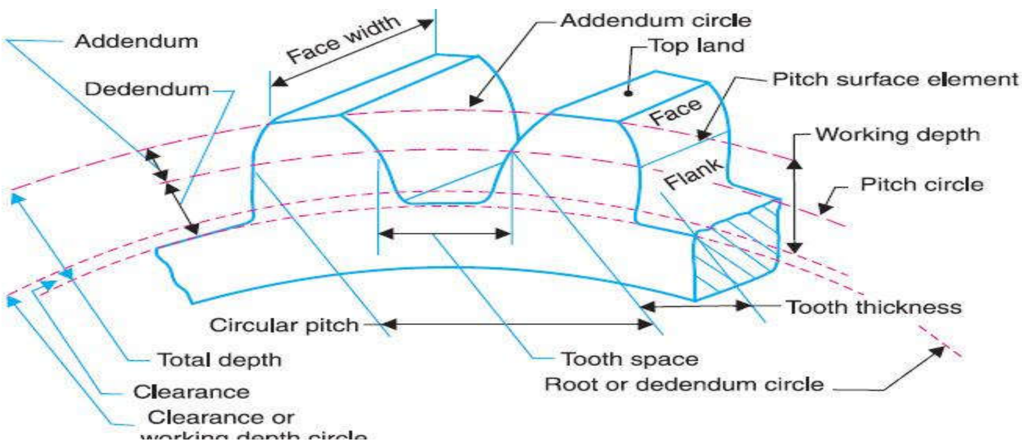

Fig No 9: Spur gear nomenclature

Whole Depth (W) = 2.157/P
Addendum (a) = 1/P
Tooth Radius (R) = ¾(CP)
Pitch Diameter (D1) = N/P
Circular Pitch (CP) = 3.1416/P
Diametral Pitch (P) = N/D1
Teeth number (N) = D1xD
Dedendum (d) = W-a
Outside Diameter (D) = (N+2)/P
Cordial Thickness (T) = D1sin(90/N)
Workpiece diameter 50 mm
For this workpiece if number of teeth 18 then the gear parameters will be
Outside Diameter D = (N+2)/P
Outside Diameter = 50 mm
Teeth number = 18
50 = (18+2)/P
P = 20/50
= 0.4 mm
Pitch Diameter D1 = N/P
P = 0.4
D1 = 18/0.4
= 45 mm
Addendum a = 1/P
= 1/0.4
= 2.5 mm
Dedendum d = w-A

Whole Depth W = 2.157/P
= 2.157/0.4
= 5.3925
D = 5.3925 – 2.5
= 2.8925 mm
Circular Pitch CP = 3.1416/P
= 3.1416/0.4
= 7.854 mm
Tooth Radius R = ¾(CP)
= ¾ (7.854)
= 2.94 mm
Module m = D1/N
= 45/18
= 2.5
Chordal thickness T = D1 sin(90/N)
= 45 sin (90/18)

= 3.922 mm

Workpiece diameter 50 mm

For this workpiece if number of teeth 24 then the gear parameters will be

Outside Diameter OD = (N+2)/P

Outside Diameter = 50 mm

Teeth number = 24

50 = (24+2)/P

P = 26/50

= 0.52 mm

Pitch Diameter D1 = N/DP

P = 0.52

D1 = 24/0.52

= 46.15 mm

Addendum a = 1/DP

= 1/0.52

= 1.92 mm

Dedendum d = w-A

Whole Depth W = 2.157/P

= 2.157/0.52

= 4.15 mm

d = 4.15 – 1.92

= 2.23 mm

Circular Pitch CP = 3.1416/P

= 3.1416/0.52

= 6.04 mm

Tooth Radius R = ¾(CP)

= ¾ (6.04)

= 4.53 mm

Module m = D1/N

= 46.15/24

= 1.922

Chordal thickness T = D1 sin(90/N)

= 46.15 sin (90/24)

= 26.38 mm

Outside diameter (OD):

Diameter of workpiece.

Pitch diameter (D1):

It is the diameter of the pitch circle. The size of the gear is usually specified by the pitch circle diameter. It is also known as pitch circle diameter

Addendum (a):It is the radial distance of a tooth from the pitch circle to the top of the tooth.

Dedendum (d): It is the radial distance of a tooth from the pitch circle to the bottom of the tooth.

Whole Depth (W): It is the radial distance between the addendum and the dedendum circles of a gear. It is equal to the sum of the addendum and dedendum.

Circular Pitch (CP): It is an imaginary circle which by pure rolling action, would give the same motion as the actual gear.

Module (m): It is the ratio of the pitch circle diameter in millimeters to the number of teeth.It is usually denoted by m. Chordal thickness (T): The length of an arc, which is difficult to measure directly

4. DESIGNING AND MODIFICATIONS

4.1 MODELLING

Modellingof parts is divided into 5 steps
Basic lathe.
Attachment design.
Work holding design.
Tool holding design.
Assembly.
All CAD models are modeled by using CATIA V5 tool. Each stage explained in detail below

4.2 Basic lathe:

Modelling basic lathe is nothing but headstock, tailstock, lathe base, guideways,andcross slide etc.,These parts specifications are taken from general purpose standard lathe and few are assumed measurements. Headstock with bed and guide ways Headstock with bed and guide ways specifications like the distance between chuck and bed, bed length and width, and guides etc., are considered are shown in Fig 10

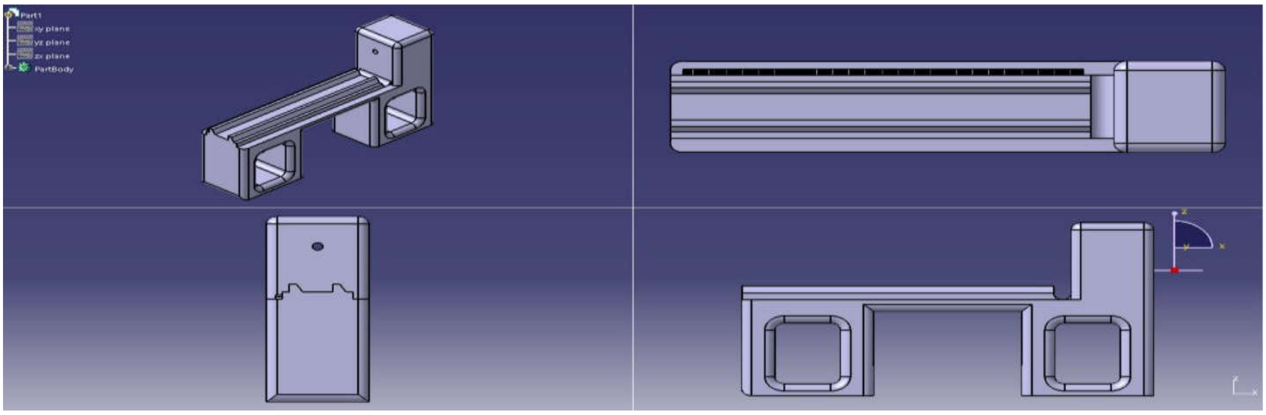

Fig No 10: Headstock with bed and guide ways

4.3 Tailstock:

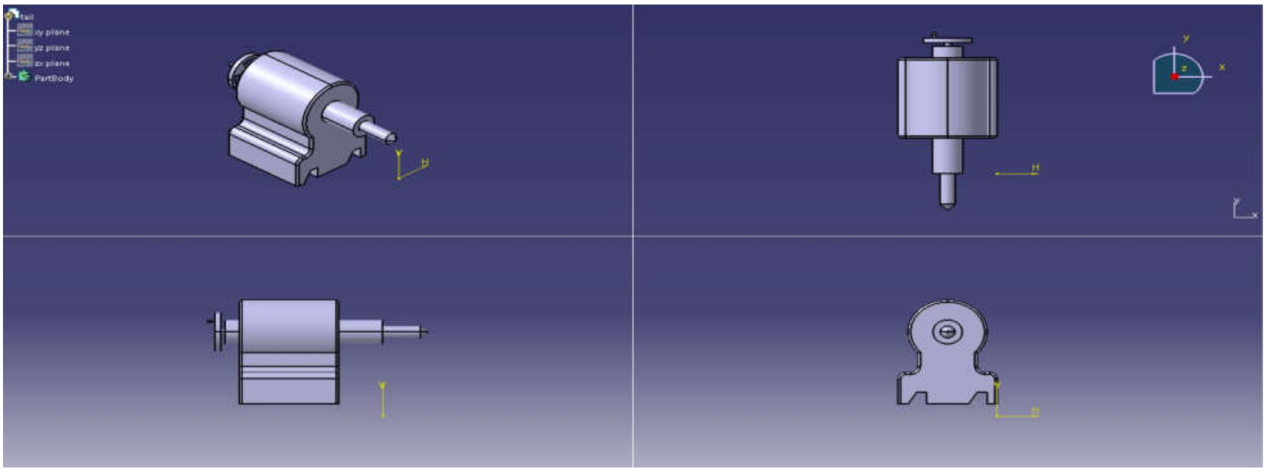

Fig No 11: Tailstock

Carriage
Chuck
Cross slide
Carriage wheel

4.4 Final modified assembly

Final assembly is made after doing some modification in the alignment of attachment. The designed final modified assembly is shown in Fig 12

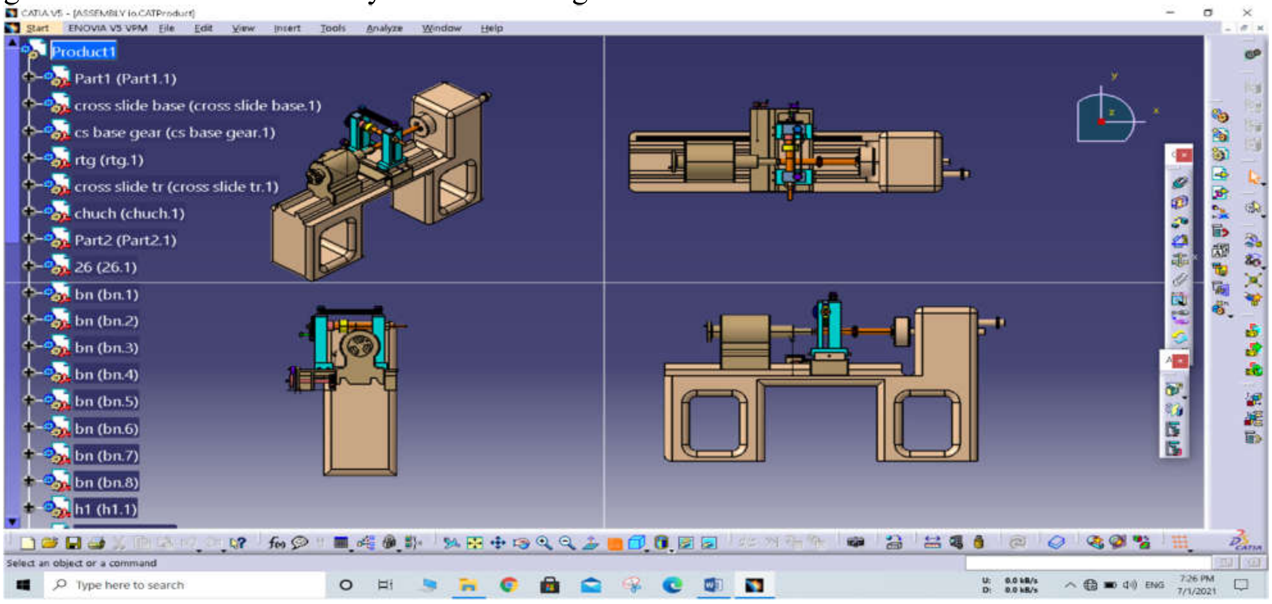

Fig No 12: Final modified assembly

4.5 Rendered image

Rendering is nothing but converting 2D or 3D models in to realistic images. Rendered image of lathe machine with attachment is shown in Fig 13

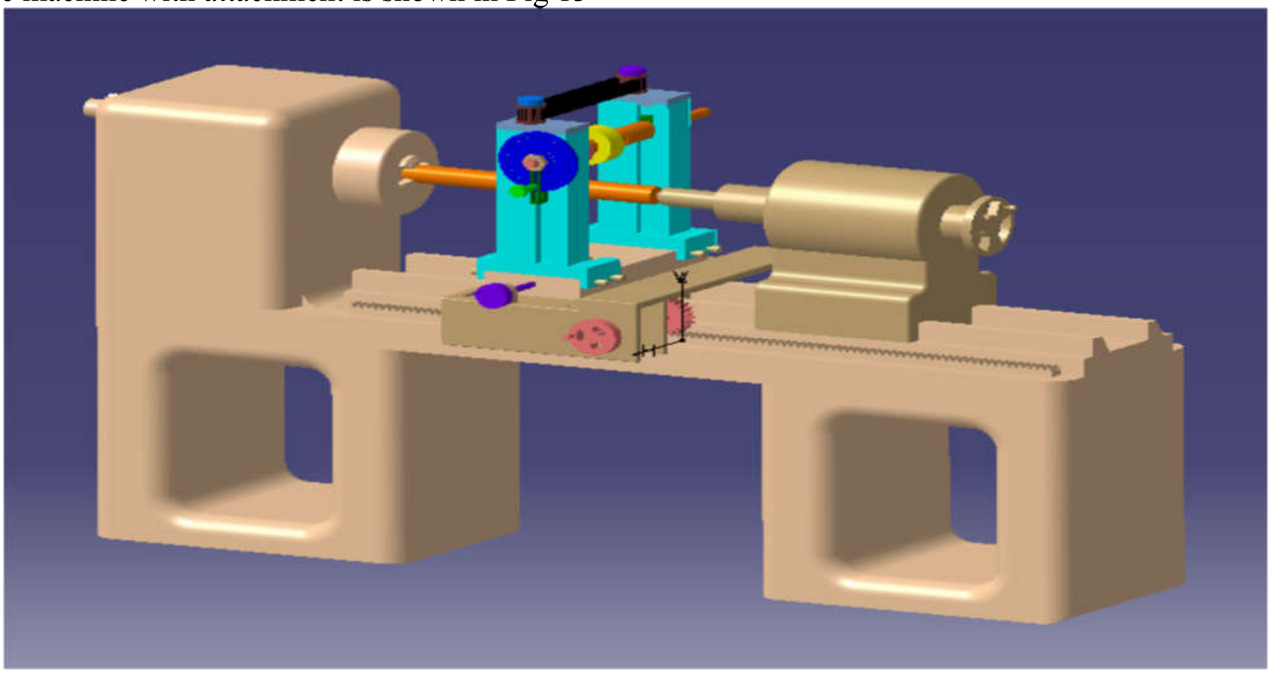

Fig No 13: Rendered image

5. MOTION SIMULATION AND ANALYSIS

In this stage, all parts are converted from '.cat part and .cat product' in to '.igs' format to do motion simulation in SolidWorks software.

All motions are applied to the assembly parts and the final animated video was saved.

Motions applied to the assembly parts are illustrated in Table 1

S.NO	PARTS	X linear (mm)	X rotation (RPM)	Y linear (mm)	Y rotation (RPM)	Z linear (mm)	Z rotation (RPM)
1	Cross slide	-200	0	0	0	0	0
2	Centers	0	0	0	0	-100	0
3	Cross slide	0	0	150	0	0	0
4	chuck	0	600	0	0	0	0
5	other	0	0	0	0	0	0

Table No 1 : Motion simulation details

Initially, motion allotted to the cross slide to position the work with respect to cutting toolas cross slide -200 mm linear motion in x-direction after moving the cross slide in x negative direction check weather tool and work are properly arranged or not if it is arranged then give linear motion to the shaft by applying screw joint in between center and shaft. Center linear motion in z negative direction i.e., -100 mm by this motion depth of cut applied.

6. ANALYSIS

In analysis stage, we have considered two forces which exist in milling machine operation

Cutting force

Thrust force

Cutting force

Power (P) = 1 kw

Cutter diameter (D) = 45 mm

Speed of chuck (N) = 600 rpm

Velocity (V) = πDN / 60

= (π*0.045*600)/60

V = 1.88 m/s

Power (P) = F. V

Cutting force (F) = P / V

= 1000/1.88

F1 =796 N

F2 = 7960 N Taken for test attachment strength.

Thrust force

Cutter diameter (D) = 45 mm

Speed of chuck (N) = 600 rpm

thrust force constant(K) = 42.35

Feed rate (f) = 1.5 mm/min

Thrust force (th) = K*N*D*f^0.7

= 42.35*600*0.045*1.5^0.7

= 1200 N

All parameters are taken from general purpose lathe and milling machine Now these values will be applying on the modeled assembly structure and analyzed by using ansys software 'static structural analysis'

Terms are going to find with this analysis:

Equivalent elastic stress (von- mises)

Equivalent stress (von- mises)
Max shear stress
Maximum principal elastic strain
Units:
Units considered while doing analysis stage are shown in Table 2

Unit system	Metric (mm, kg, mv) Degree red/s
Angle	Degree
Rotational velocity	red/s

Table No 2: Units

6.1 Meshing:

Meshing details are given in Table 3

Object Name	Mesh
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	0
Element Order	Program Controlled
Sizing	
Size Function	Adaptive
Relevance Center	Fine
Element Size	5.0 mm
Initial Size Seed	Assembly
Transition	Fast
Span Angle Center	Coarse
Automatic Mesh Based Defeaturing	On
Defeature Size	Default
Minimum Edge Length	2.50 mm

Table No 3: Meshing

6.2 Equivalent elastic stress (von- mises):

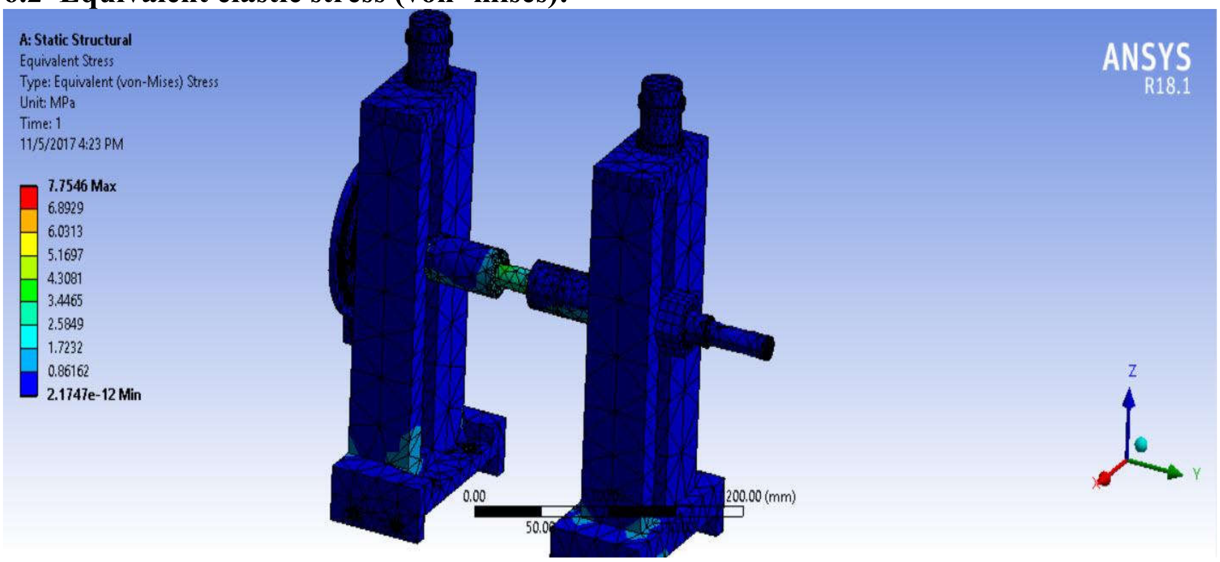

Fig No 14: Equivalent elastic stress in MPa

6.3 Equivalent stress (von- mises)

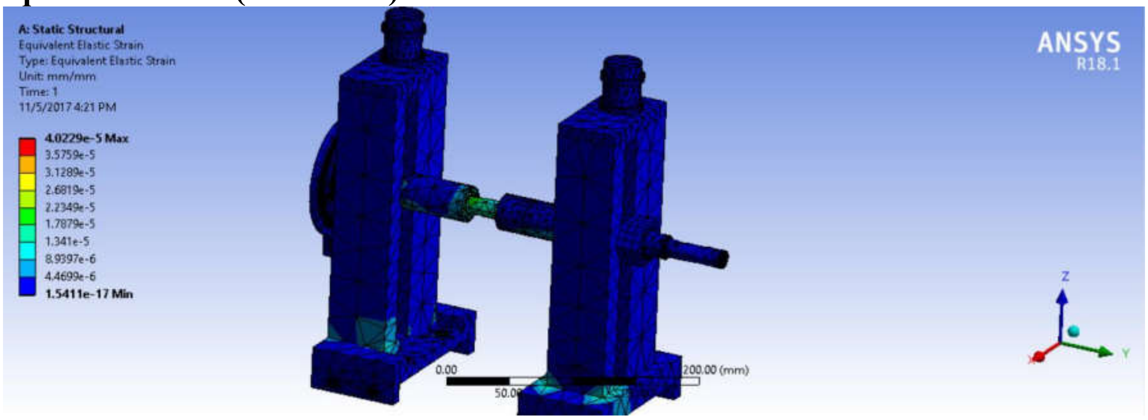

Fig No 15: Equivalent stress

6.4 Maximum principal elastic strain

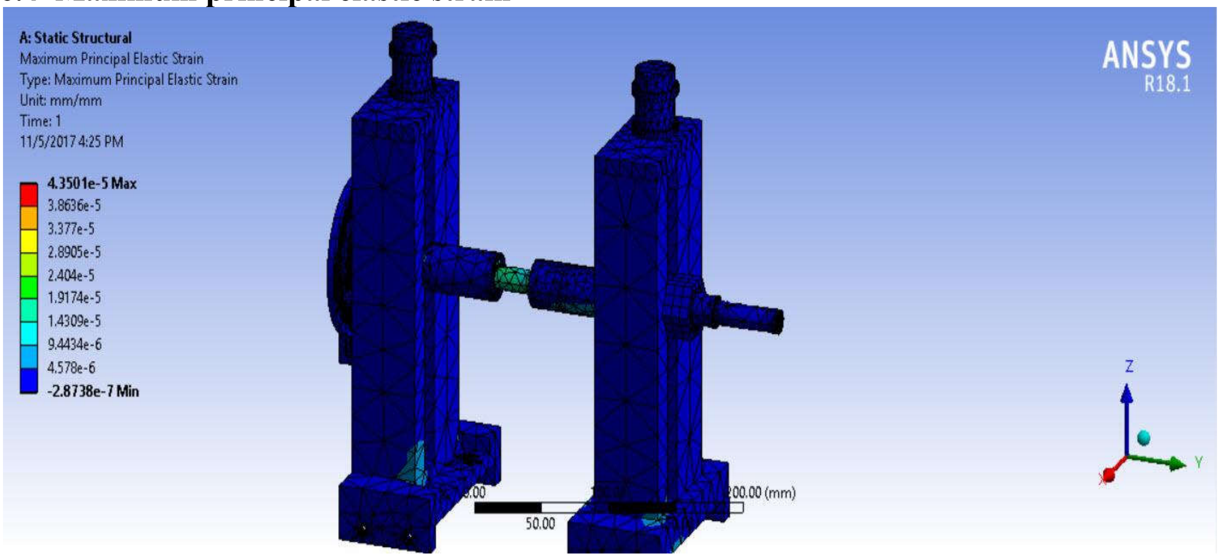

Fig No 16: Maximum principal elastic strain

6.5 Simulation calculations:

Hence stress concentration factor F1 ($\alpha_{\circ}$) = $\frac{\sigma_{max}}{\sigma}$

$$= \frac{247}{7.76} = 31.8$$

Hence stress concentration factor F2 ($\alpha_{\circ}$) = $\frac{\sigma_{max}}{\sigma}$

$$= \frac{247}{77.87} = 3.17$$

Hence stress concentration factor for F1 and F2 are in save zone. The maximum load can apply on the attachment is 7960 N and the load which we have collected from the milling machine is 796 N stress concentration factor is far most saver side so that we can consider the attachment can accept the load while machining.

Analysis stage successfully completed all results are verified and the modeled assembly design is in safe condition now moving into next step i.e., material selection and fabrication.

7. RESULTS AND CONCLUSION

Modelling and assembly of CAD parts are accomplished by CATIA V5 software.

Motion simulation was done by SolidWorks motion simulator software and the video was recorded.

The static structural analysis was done by ANSYS software and results are examined.

A lot of investment is saved instead of buying a milling machine.

Also by using this attachment production cost of making gear also reduced.

8. FUTURE WORK

In this attachment direct indexing chosen as dividing head. This has particular limitation it is only afew no of divisions can make by using this attachment. This limitation can overcome by using compound indexing.If the centeris combined with bushes, then the shaft wear and tear will be reduced.Material like cast iron and stainless steel willimprove the strength of the attachment and that will help us to perform almost all horizontal milling operations.This attachment is made for spur gear cutting only. It is possible to machine spine shaft also.

9. REFERENCES

1. Amar S. Bhandare, “Design and Development of Keyway Milling Attachmentfor Lathe Machine”, International Journal of Advance Research in Engineering, Science & Technology,Volume 4, Issue 3, March 2017,ISSN 0974-3154.
2. Rana Mihir, Rohit Hardik, Patel Abhishek, Raj Dhavalsinh, Mistry Arpit and Maitreya Pandya, “Designing and Fabrication of Slotting Attachment for Lathe”,International Journal of Advance Research in Engineering, Science & Technology, Volume 4, Issue 3, March 2017,e-ISSN: 2393-9877, p-ISSN: 2394-2444
3. Shakeel A Sherkar, Atul A. Yamagar,and Amar S Bhandare,“Development of Internal Keyway Attachment for Lathe Machine”, International Journal of Engineering Research and Technology,Volume 10, Number 1 2017, ISSN 0974-3154.
4. Darshan Attarde, Anand Chavda, SwanandBorkar and Rohan Deogharkar,“Design and Fabrication of Grinding Wheel Attachment On Lathe Machine”, International Journal of Mechanical Engineering and Technology,Volume 7, Issue 4, July–Aug 2016, pp.281–288
5. Abhishek M. Kawade, Shreyansh S. Chougule, Shantanu R. Shinde, and Pratik P. Kharmale,“Design, Analysis, And Manufacturing of a Grinding Attachment On a Center Lathe Machine”, International Research Journal of Engineering and Technology, Volume3, Issue 9, Sep 2016,e-ISSN: 2395 -0056, p-ISSN: 2395-0072.
6. Akash Tiwari, Niral Panchal, Parth Solanki, Lalit Parmar and DipteshPatel,“Designing and Fabrication of Multipurpose Tool Post for Lathe Machine”,International Journal for Scientific Research & Development, Vol 2, Issue 03, 2014 ISSN: 2321-0613.
7. JahnaviMadireddy,“Importance of Lathe Machine in Engineering Field and Its Usage”, Global Journal of Researches in Engineering: AMechanical and Mechanics Engineering, Volume 14, Issue 6, Version 1.0, 2014,ISSN: 2249-4596.
8. Dr. G. Naga Malleshwar Rao, Dr.S.L.V.Prasad,and P. Sreenivasulu,“Design And Fabrication Of Eccentric Turning Attachment”, International Journal of Application or Innovation in Engineering & Management,Volume 2, Issue 8, August 2013,ISSN 2319 – 4847.
9. VandanaN.Mahajan, PunamPatil,andParagYadav,“A Review on Optimization Techniques of Various Machining Parameters Of Milling Machine”, International Journal Of Engineering Sciences & ResearchTechnology, may, 2017, issn2277-9655.
10. Sagar, Mr. Neeraj Kumar,andMr. JagbirSharma,“Analysis of Spur Gear Cutting Using Milling Machine”, International Journal for Technological Research in Engineering, Volume 3, Issue 6, February 2016, ISSN 2347 –4718.
11. ShadabAnwa AndSaleemUzZaman Khan, “Optimization of End Milling Parameters for Improving Surface Roughness Using Taguchi Method”, International Journal of Mechanical and Production Engineering, Volume 4, Issue8, Aug2016, ISSN 2320-2092.

12. Prof. R. L. Patel and nikunjaadeshra,“Static and Dynamic Analysis of Base of Vertical

Machining Center", International Journal of Engineering Trends and Technology, Volume 21, March 2015,issn: 2231-5381.

13. Yaswanthkumar and dr. G. Shankaraiah,"Cutting Parameters Optimization in Milling of P – 20 Tool Steel and En31b M", IOSR Journal of Mechanical and Civil Engineering, Volume 8, Issue 5, Sep. - Oct. 2013, e-ISSN: 2278-1684,
14. Amir MahyarKhorasani, MohammadRezaSoleymaniYazdi and Mir SaeedSafizadeh,"Tool Life Prediction in Face Milling Machining of 7075 Al by Using Artificial Neural Networks (Ann) And Taguchi Design of Experiment (Doe)", International Journal of Engineering and Technology, Vol 3, No 1, February 2011, ISSN: 1793-8236.
15. M. Narasimha, R. RejiKumar,and R. Srinivasa Moorthy,"Design of Adjustable Multi-Spindle Attachment",International journal of industrial engineering research and development,Volume 4, Issue 2, August 2013, ISSN 0976 – 6979.
16. Onkar Dhepe, Shrikant Girme, andSuneetaPhadkule Design, "Development and Manufacturing of an Attachment Unit for Horizontal Boring and Milling Machine", International Engineering Research Journal, Special Issue 2, Page 2832-2834, 2015, ISSN 2395-1621,ISSN 2395-1621.
17. Dr. Ramachandra C G, Shashank S, Raghavendra M J and Kaushikranganath T,"Design and Fabrication of Gear Cutting Attachment for Lathe", International Journal of Engineering Research And Advanced Technology, Vol.3 10, Oct 2017, E-ISSN: 2454-6135 DOI: http://dx.doi.org/10.7324/IJERAT.2017.3136
18. GadakhRamesh S, Londhepradip G, Shaikh Bilal A and Shaikhfiroj S,"Gear Manufacturing by Using Conventional Lathe Machine", International Journal of Research in Engineering and Technology,eISSN: 2319-1163, pISSN: 2321-7308.
19. J.C.Harbison,"Milling Attachment For Lathes",No: 2453315., Nov. 9, 1948.
20. J.W.Bracus,"Gear Cutting Attachment", No:2286709, June 16, 1942.
21. T.E.Smith,"Keyway and Gear Cutting Attachment for Lathes", US; No: 2188447, Jan30, 1940.