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DESIGN AND ANALYSIS OF SPINDLE IN MILLING MACHINE

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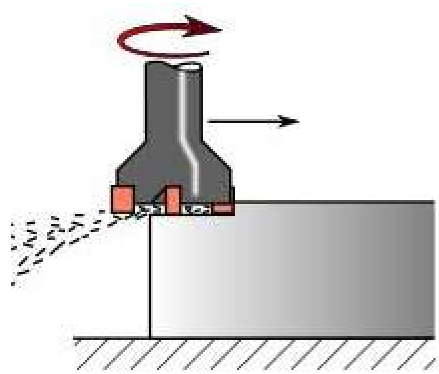
Abstract

In this paper we are generating electrical power as non-conventional method by simply running on the chain drive in the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step needs no fuel input power to generate the output of the electrical power. It is all about generating electricity when people walk on the Floor. Think about the forces you exert which is wasted when a person walks. The idea is to convert the weight energy to electrical energy. The Power generating floor intends to translate the kinetic energy to the electrical power. Energy Crisis is the main issue of world these days. The motto of this research work is to face this crisis somehow. Though it won't meet the requirement of electricity but as a matter of fact if we are able to design a power generating floor that can produce 100W on just 12 steps, then for 120 steps we can produce 1000 Watt and if we install such type of 100 floors with this system then it can produce 1MegaWatt. Which itself is an achievement to make it significant.

In this project we are using simple chain drive mechanism such as rack and pinion assembles and chain drive mechanism. The conversion of the force energy into electrical energy is done. The Control mechanism carries the rack & pinion, D.C generator, battery and inverter control. We have discussed the various applications and further extension also. So this project is implemented to all footsteps, the power generation is very high. The initial cost of this arrangement is high.

INTRODUCTION TO MILLING

Milling is the machining technique of the usage of rotary cutters to remove material from a workpiece advancing (or feeding) in a path at an perspective with the axis of the tool. It covers a big range of various operations and machines, on scales from small character additives to large, heavy-responsibility gang milling operations. It is one of the most normally used approaches in enterprise and machine shops today for machining factors to particular sizes and shapes.



Face milling process

INTRODUCTION TO SPINDLE

In device equipment, a spindle is a rotating axis of the tool, which often has a shaft at its coronary heart. The shaft itself is referred to as a

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spindle, however additionally, in keep-floor exercise, the word often is used metonymically to seek advice from the entire rotary unit, along with now not only the shaft itself, but its bearings and something connected to it (chuck, and so forth.).

A machine device may also additionally have numerous spindles, along side the headstock and tailstock spindles on a bench lathe. The main spindle is normally the biggest one. References to "the spindle" without similarly qualification advocate the primary spindle. Some machine gear specializing in immoderate-extent mass production have a hard and fast of 4, 6, or maybe more most important spindles. These are known as multispindle machines. For example, gang drills and masses of screw machines are multispindle machines. Although a bench lathe has more than one spindle (counting the tailstock), it isn't always called a multispindle machine; it has one critical spindle.

HIGH SPEED SPINDLES

A high speed spindle for you to be applied in a steel cutting system tool want to be designed to provide the desired overall performance capabilities. The foremost common overall performance capabilities encompass:

- Desired Spindle Power, Peak and Continuous
- Maximum Spindle Load, Axial and Radial
- Maximum Spindle
- Speed Allowed
- Tooling Style, Size and Capacity for ATC
- Belt Driven or Integral Motor-Spindle Design

HIGH SEED SPINDLE DESIGN: MAJOR COMPONENT LIST

The number one additives required for a excessive tempo milling spindle layout embody:

- Spindle Style; Belt Driven or Integral Motor-Spindle
- Spindle Bearings; Type, Quantity, Mounting, and Lubrication Method
- Spindle Motor, Belt-Type, Motor-Spindle, Capacity, Size
- Spindle Shaft; Including Tool Retention Drawbar and Tooling System Used
- Spindle Housing; Size, Mounting Style, Capacity

LITERATURE SURVEY

In this paper through Deping Liu, Hang Zhang, Zheng Tao and Yufeng Su[1], gives a technique to investigate the characteristics of a excessive-pace motorized spindle system. This paper taking the high-speed milling motorized spindle of CX8075 produced via Anyang Xinsheng Machine Tool Co. Ltd. For instance, a finite detail model of the excessive-velocity motorized spindle is derived and offered. The outcomes display that the most rotating velocity of the motorized spindle is some distance smaller than the herbal resonance location pace, and the static stiffness of the spindle can meet the necessities of design. The static and dynamic traits of the motorized spindle accord with the requirements of high-pace machining. The thermal deformation of spindle is 6.56μm, it's miles too small to affect the precision of the spindle. The outcomes illustrate the rationality of the spindle structural layout. In the paper through Lan Jin, Zhaoyang Yan, Liming Xie, Weidong Gou, Linhu Tang[2], a method is described on this paper for measuring t he spindle rotation mistakes and a technique for separating the eccentric errors as a result of setup errors of the grasp cylinder. The machine consists of non-contact capacitance sensors used to measure the radial displacement of the rotating grasp cylinder and an LMS Test.Lab used to collect the measurement records. LMS Test.Lab gives a entire engineering answer for rotating equipment. Based on our experimental research, it indicates that this gadget can be used to measuring the spindle rotary errors at extraordinary speeds. It is likewise established the feasibility of the error separation methods

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developed on this paper. In the paper by R. Radulescu, S. G. Kapoor and R. E. DeVor[3], a mechanistic dynamic model is used to simulate a face milling technique at some point of consistent and variable speed machining. The version can be used to expect the premier speed trajectory which could offer a low stage of vibration and consequently a big productiveness charge and a small floor blunders.

INTRODUCTION TO CAD

3.1 Computer-aided layout

CAD Additionally known as laptop-aided layout and drafting (CADD), is using laptop technology for the technique of design and design-documentation. Computer Aided Drafting describes the system of drafting with a computer. CADD software, or environments, offer the user with input-gear for the cause of streamlining layout tactics; drafting, documentation, and manufacturing approaches. CADD output is frequently within the shape of digital files for print or machining operations. The improvement of CADD-based software is in direct correlation with the techniques it seeks to save money; enterprise-based totally software (production, manufacturing, and so on.) generally uses vector-based totally (linear) environments while photograph-primarily based software program utilizes raster-primarily based (pixelated) environments.

Pro/ENGINEER

Wildfire is the standard in 3D product layout, providing enterprise-main productiveness tools that sell great practices in design while ensuring compliance along with your industry and company requirements. Integrated Pro/ENGINEER CAD/CAM/CAE solutions allow you to layout quicker than ever, even as maximizing innovation and high-quality to in the long run create extremely good merchandise.

Fig 4.1 spindle

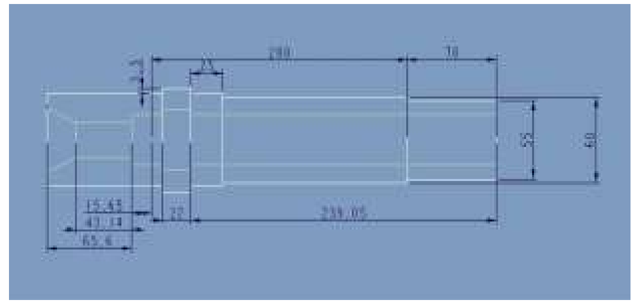
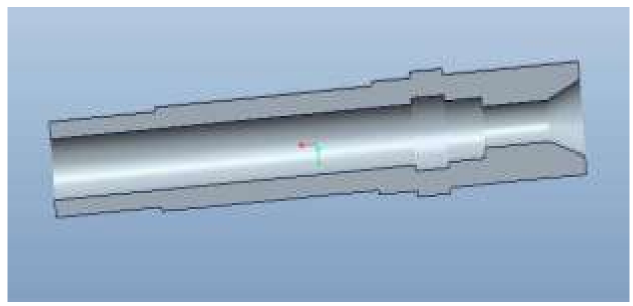


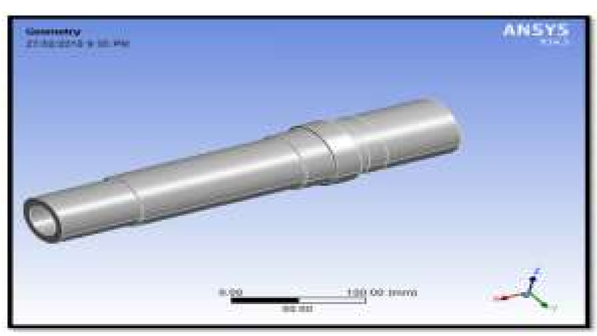
Fig 4.2 Cut section



STATIC ANALYSIS OF HIGH SPEED MOTORIZED SPINDLE

Material properties

Material	Density (kg/mm3)	Young's modulus (MPa)	Poisson's ratio
Aluminum alloy 6061	0.0000027	68900	0.33
Aluminum 7075	0.0000028	71700	0.33
steel	0.00000785	205000	0.3
Carbon fiber	0.00000160	70000	0.3



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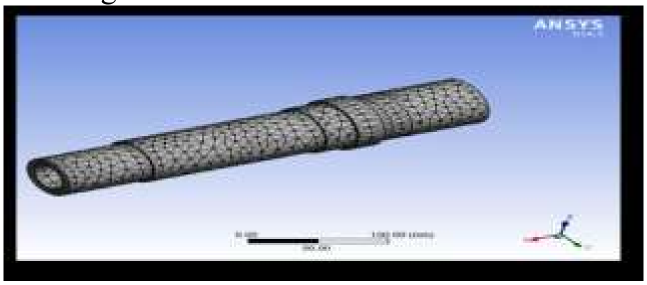
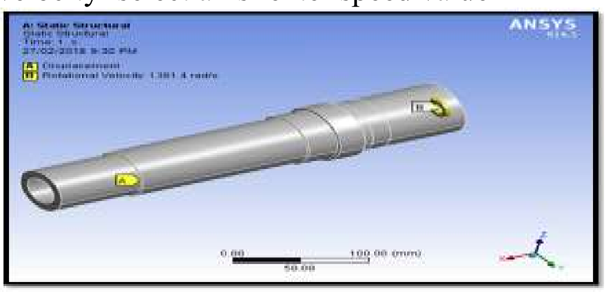
Click on model>select EDIT
Select model >apply materials to all the objects (different materials also)
Mesh> generate mesh>ok



Static structural A5>insert>select .displacement>select fixed areas>ok

>Select pressure>select pressure areas> enter pressure value

>Select rotational velocity>select axis>enter speed value



Solution A6>insert>total deformation>right click on total deformation>select evaluate all results

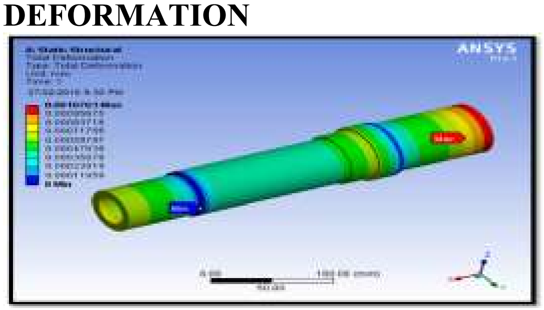
Insert>stress>equivalent (von misses)>right click on equivalent >select evaluate all results

Insert>strain>equivalent (von misses)>right click on equivalent >select evaluate all results

CASE: 1 SPINDLE SPEED 10000rpm

MATERIAL- ALUMINUM ALLOY 7075

DEFORMATION



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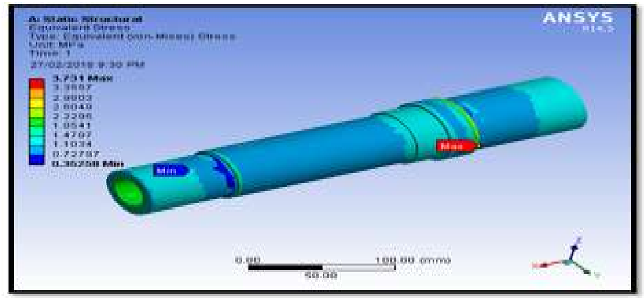

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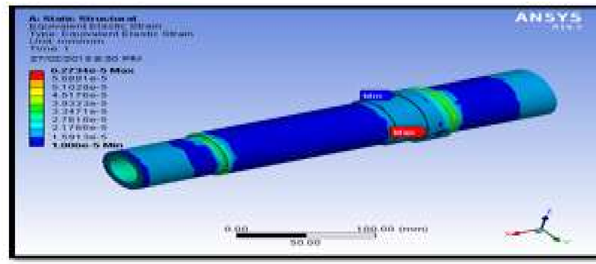
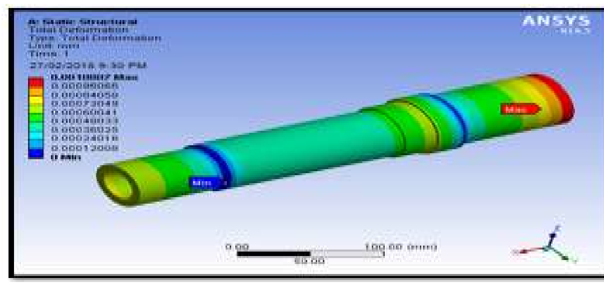


MATERIAL- ALUMINUM ALLOY 6061

DEFORMATION



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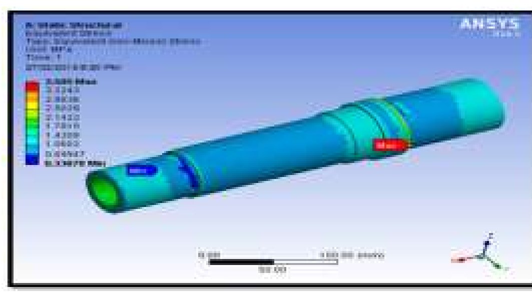

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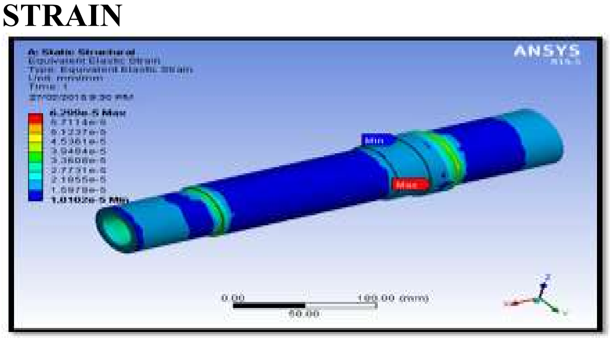

MATERIAL- STEEL

DEFORMATION

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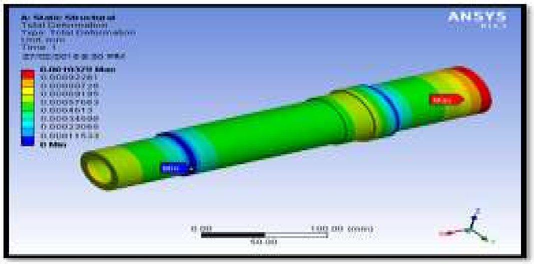

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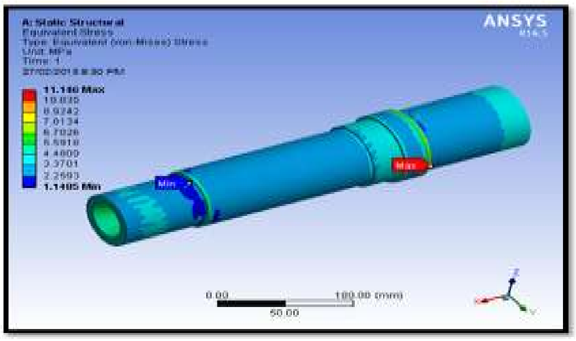

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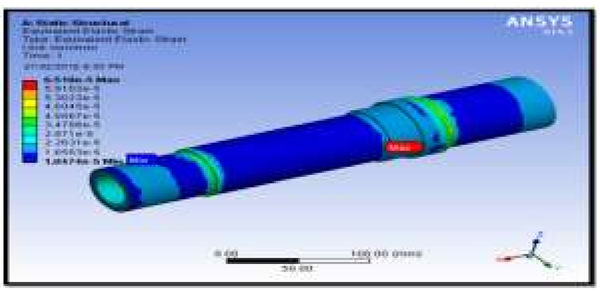
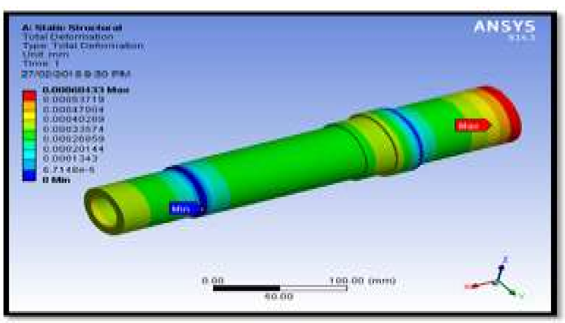


MATERIAL- COMPOSITE FIBER
DEFORMATION



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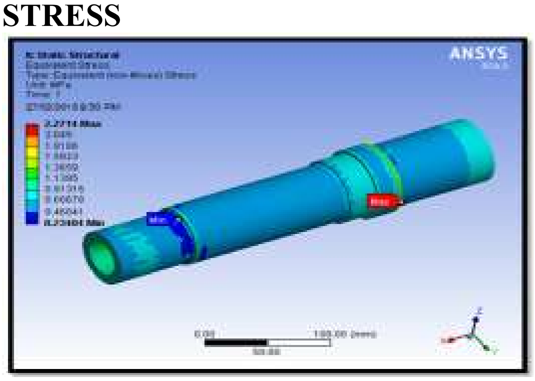
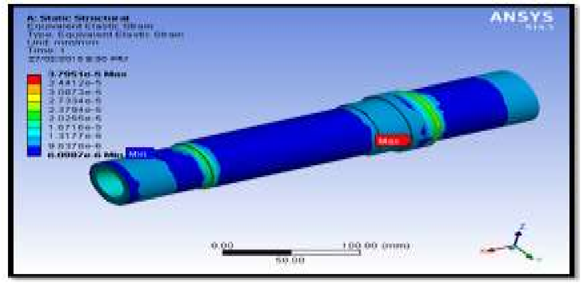


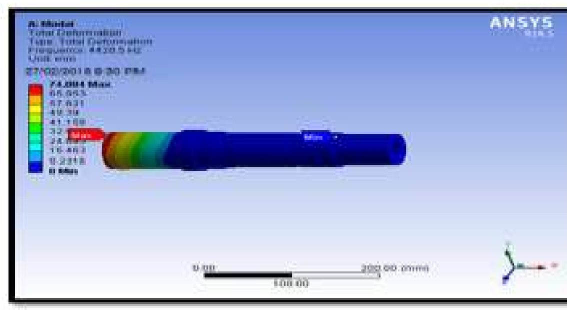
STRAIN



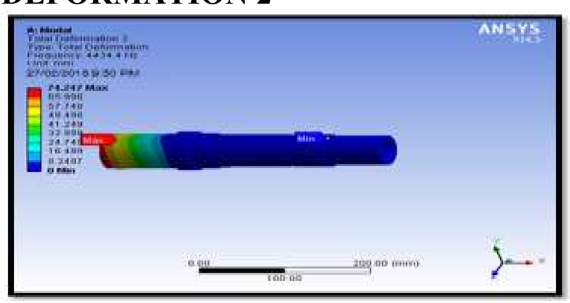
MODAL ANALYSIS OF HIGH SPEED MOTORIZED SPINDLE

MATERIAL- ALUMINUM ALLOY 6061

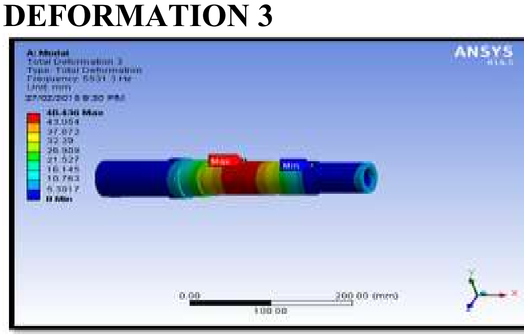
DEFORMATION 1



DEFORMATION 2



DEFORMATION 3



MATERIAL- ALUMINUM ALLOY 7075
DEFORMATION 1

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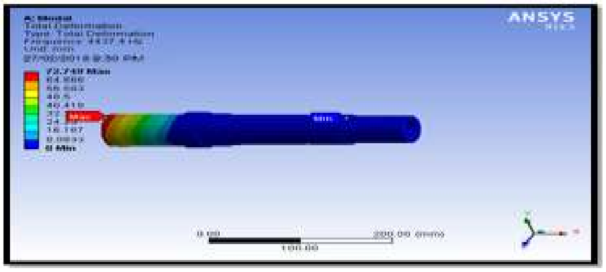

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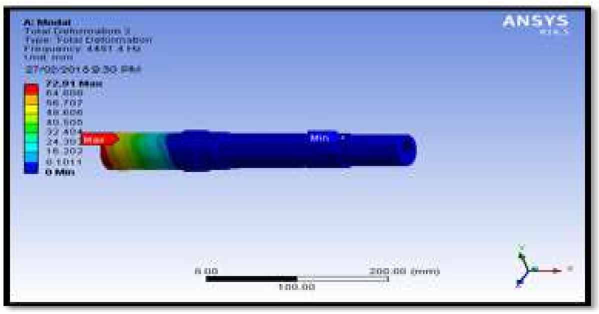

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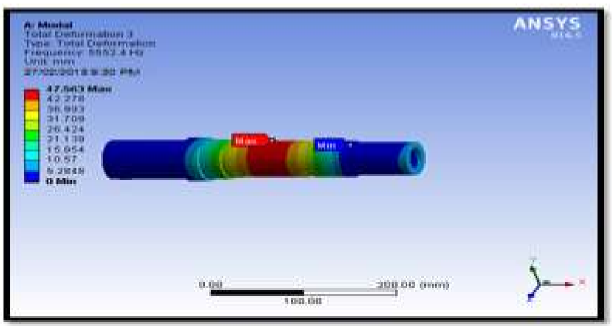
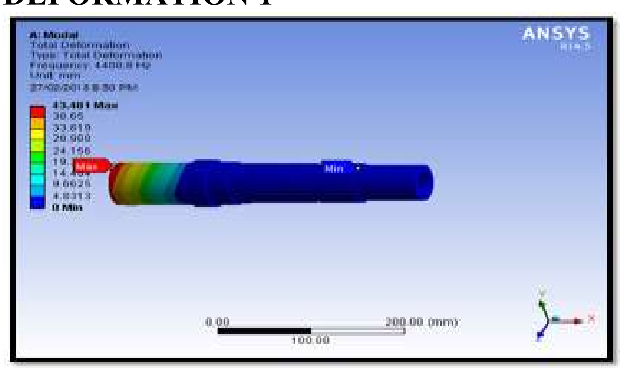


MATERIAL- STEEL
DEFORMATION 1



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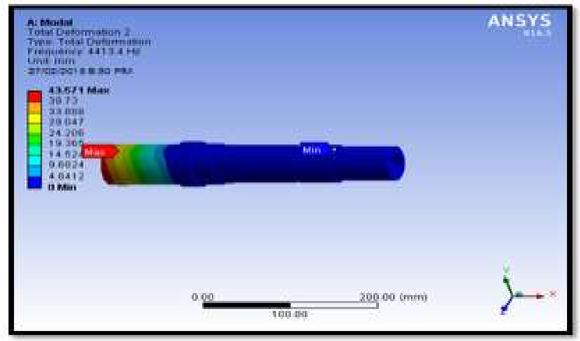
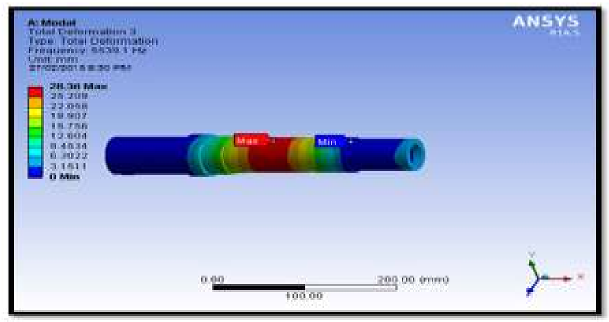
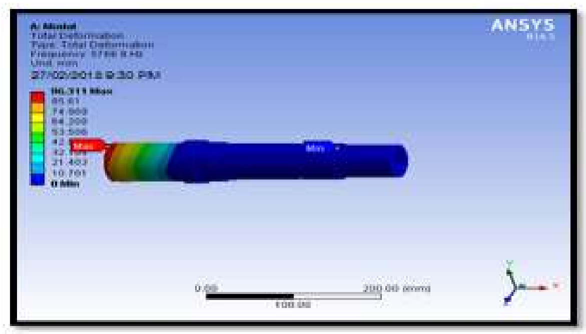


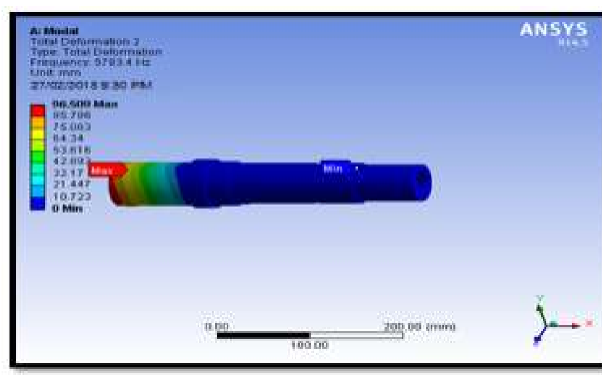
DEFORMATION 3



MATERIAL- CARBON FIBER
DEFORMATION1



DEFORMATION2



DEFORMATION3

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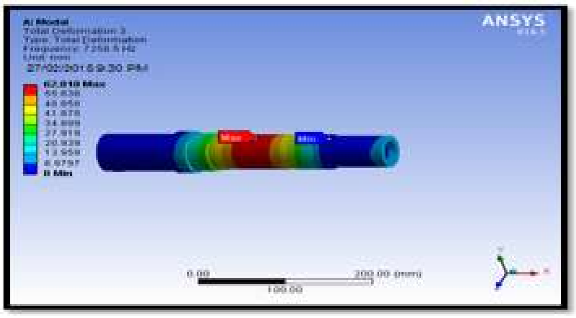


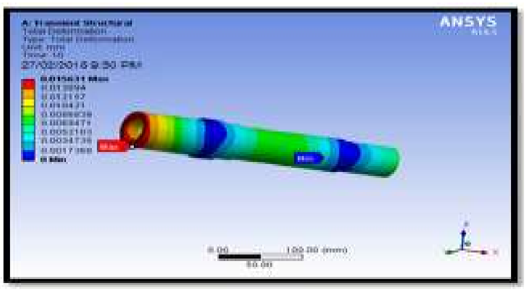
TRANSIENT ANALYSIS OF HIGH SPEED MOTORIZED SPINDLE

CASE: 1 SPEED – 10000 RPM

MATERIAL- ALUMINUM ALLOY 7075

AT 10 SEC

DEFORMATION



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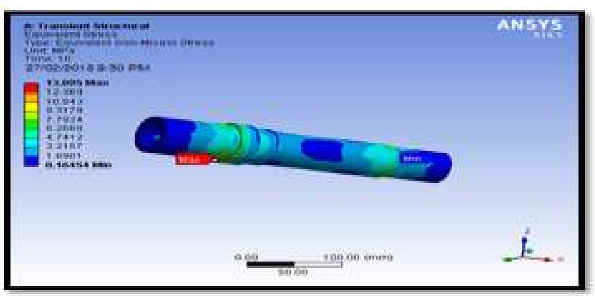

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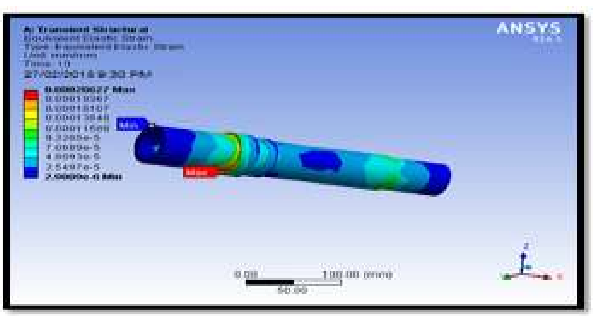
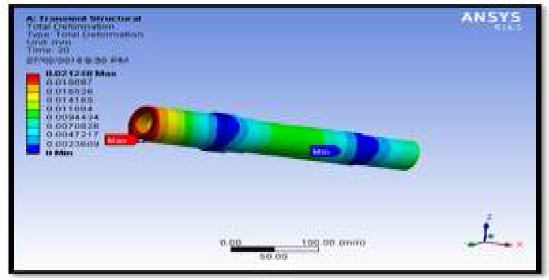


AT 20 SEC

DEFORMATION



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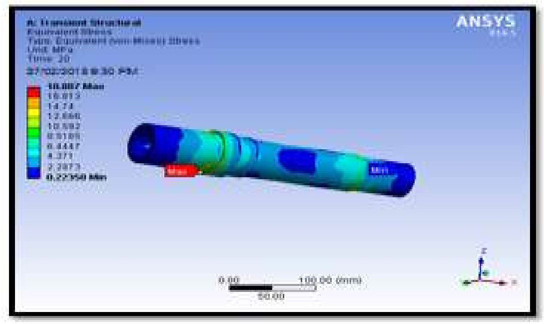
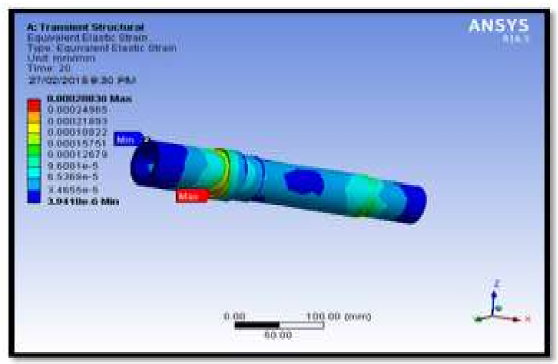
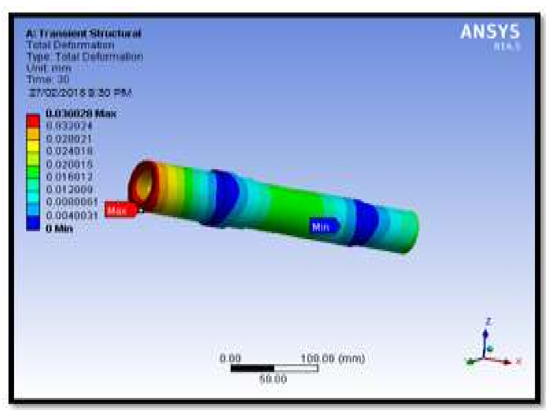


STRAIN



AT 30 SEC

DEFORMATION



STRESS

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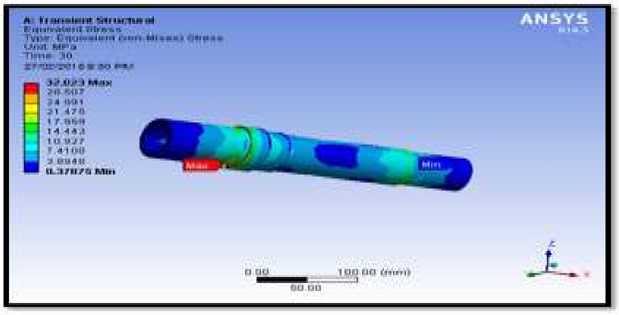

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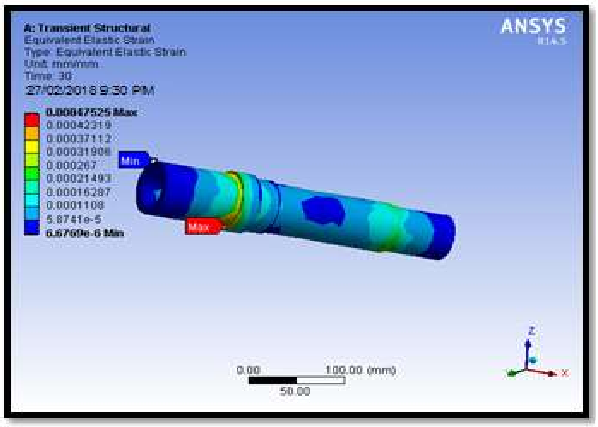

Static analysis resuts

Speed (rpm)	material	Deformation(mm)	Stress(MPa)	strain
10000	Aluminum alloy7075	0.0010763	3.731	6.2734e-5
	Aluminum alloy 6061	0.0010807	3.585	6.299e-5
	steel	0.0010379	11.146	6.518e-5
	Carbon fiber	0.00060433	2.2714	3.7951e-5
13000	Aluminum alloy 7075	0.001819	6.3056	0.00010602
	Aluminum alloy6061	0.0018265	6.0587	0.00010645
	steel	0.0017541	18.837	0.00011016
	Carbon fiber	0.0010215	3.8393	6.4149e-5
16000	Aluminum alloy 7075	0.002755	9.5516	0.0001606
	Aluminum alloy 6061	0.0027667	9.1776	0.00016126
	steel	0.0026571	28.534	0.00016686
	Carbon fiber	0.001547	5.8158	9.712e-5

Modal analysis results

Material	Modes	Deformation (mm)	Frequency (Hz)
Aluminum 7075	1	72.749	4437.4
	2	72.91	4451.4
	3	47.563	5552.4
Aluminum 6061	1	74.084	4420.5
	2	74.247	4434.4
	3	48.436	5531.3
Steel	1	43.481	4400.8
	2	43.571	4413.4
	3	28.36	5539
Carbon fiber	1	96.31	5766.9
	2	96.509	5783.4
	3	62.818	7258.8

Transient analysis results

Speed 10000rpm

Material	Time (sec)	Deformation (mm)	Stress (MPa)	Strain
Aluminum 7075	10	0.015631	13.895	0.00020627
	20	0.021248	18.887	0.00028036
	30	0.036028	32.0.23	0.00047525
Aluminum 6061	10	0.15695	13.351	0.0002071
	20	0.021335	18.148	0.0002815
	30	0.036175	30.769	0.0004772
steel	10	0.015844	38.034	0.0002168
	20	0.021538	51.699	0.0002946
	30	0.036519	87.656	0.0004995
Carbon fiber	10	0.0092248	7.7506	0.0001264
	20	0.012539	10.535	0.00017159
	30	0.021256	17.858	0.00029084

Speed 1300rpm

Material	Time (sec)	Deformation (mm)	Stress (MPa)	Strain
Aluminum 7075	10	0.021016	18.681	0.0002773
	20	0.039758	35.338	0.00052443
	30	0.060937	54.159	0.00080351
Aluminum 6061	10	0.02402	17.95	0.00027843
	20	0.0399	33.955	0.00052657
	30	0.061187	52.039	0.00080679
steel	10	0.021303	51.135	0.00029148
	20	0.04301	96.731	0.00055126
	30	0.06177	148.25	0.00084464
Carbon fiber	10	0.012402	10.42	0.0001697
	20	0.023456	19.706	0.0003209
	30	0.035941	30.194	0.00049165

Speed at16000rpm

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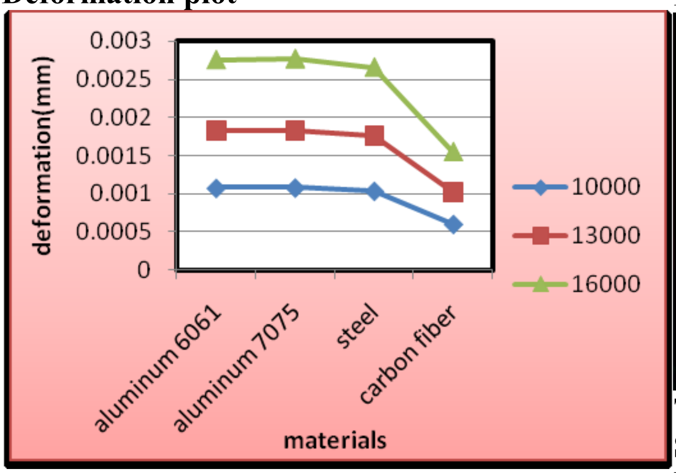
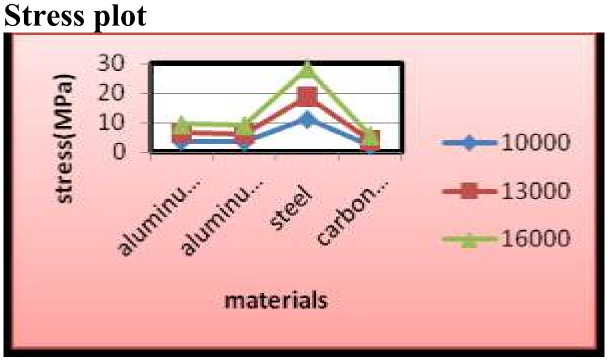
Material	Time (sec)	Deformation (mm)	Stress (MPa)	Strain
Aluminum 7075	10	0.026618	23.66	0.00035118
	20	0.022894	38.125	0.0005657
	30	0.092406	82.116	0.0012178
Aluminum 6061	10	0.026727	22.734	0.00035262
	20	0.043069	36.633	0.0005680
	30	0.092784	78.902	0.0012228
steel	10	0.026981	64.765	0.0003691
	20	0.04348	104.36	0.0005947
	30	0.093669	224.78	0.0012802
Carbon fiber	10	0.015706	13.196	0.0002149
	20	0.025305	21.259	0.00034622
	30	0.054477	45.762	0.000745

Static analysis graphs

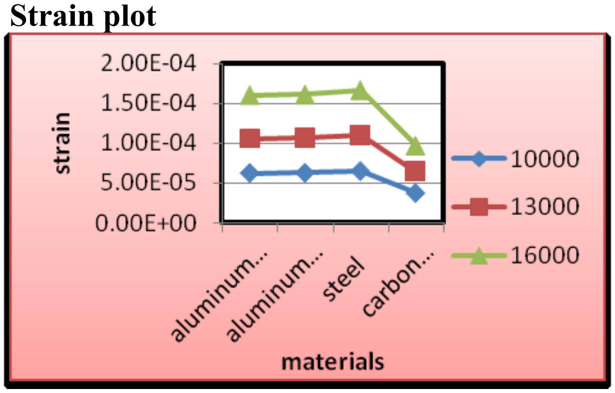
Deformation plot



Stress plot

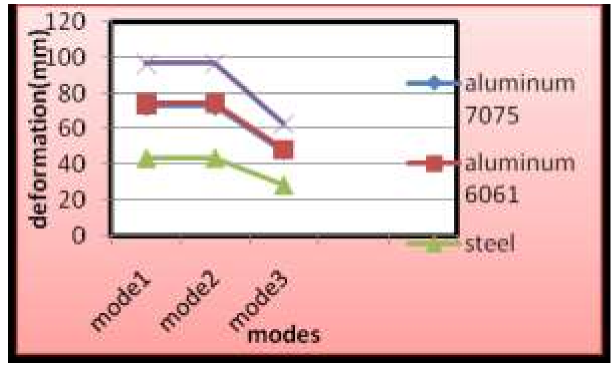


Strain plot

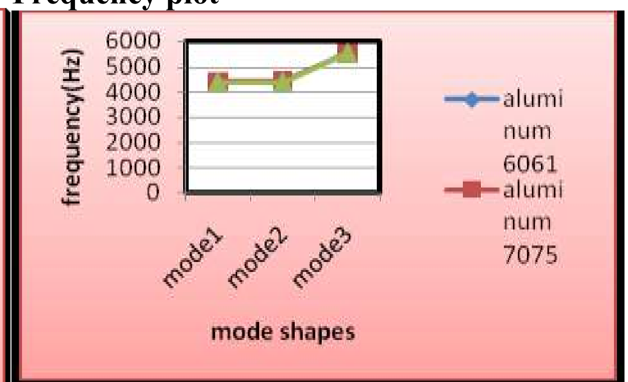


Modal analysis graphs

Deformation plot



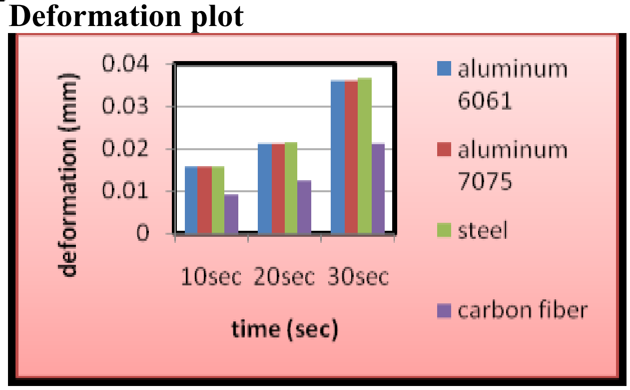
Frequency plot



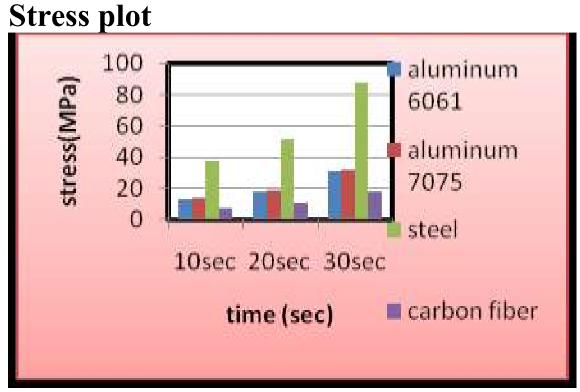
Transient analysis graphs

Speed at 10000 rpm

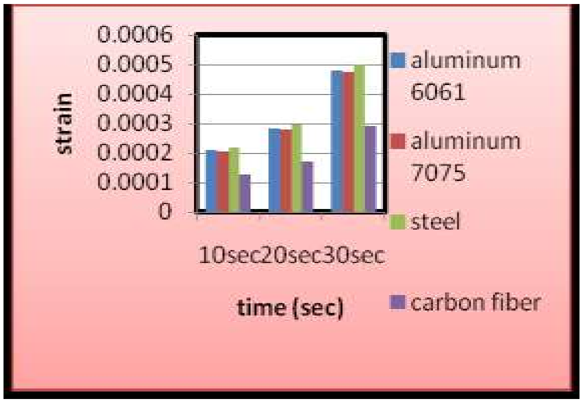
Deformation plot



Stress plot

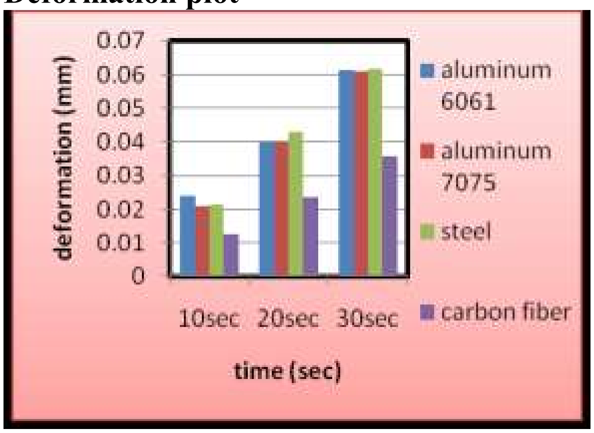


Strain plot

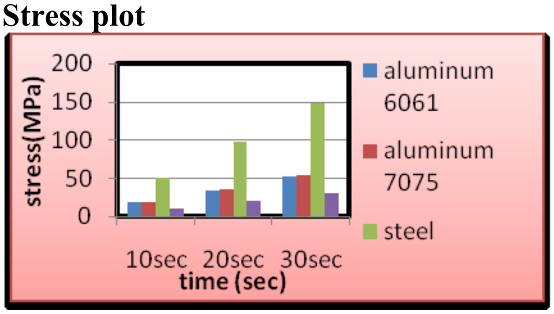


Speed at 13000 rpm

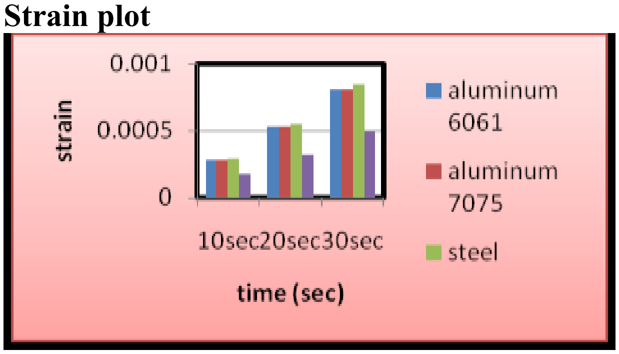
Deformation plot



Stress plot



Strain plot



ONCLUSION

The geometric satisfactory of excessive-precision components is rather depending on the dynamic overall performance of the entire machining gadget, which is determined through the interrelated dynamics of device tool mechanical shape and reducing process. This performance is of outstanding significance in advanced, high-precision manufacturing strategies. The today's in device device predominant spindle devices is awareness on motorized spindle units for excessive-speed and excessive performance slicing.

In this thesis, exclusive substances are analyzed for spindle. Aluminum alloy 6061 and 7075 are replaced with metal. By changing the metal with aluminum alloys, the weight of the spindle decreases. Structural and Dynamic analyses is performed the use of Ansys software program. Modal analysis is also performed to determine the frequencies.

By gazing the static and dynamic evaluation, the pressure boom by way of growing spindle velocity and stresses reducing for carbon fiber than aluminum 7075, aluminum 6061 and metallic.

By gazing the modal evaluation, the pressure growth by means of growing spindle velocity and stresses lowering for aluminum 7075 then aluminum 6061 and steel.

By gazing the modal evaluation, the deformation increases and frequency increasing for carbon fiber than aluminum 7075, aluminum 6061 and metallic.

So we finish the proper fabric for high speed motorized spindle is carbon fiber.

REFERENCES

[1]Ramireddy Manasa

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[2]Department of mechanical engineering Associate professor AVANTHI'S RESEARCH AND TECHNOLOGICAL ACADEMY

1. Design and analysis of high velocity motorized spindle. Syath Abuthakeer.S 1 , Mohanram P.V 1 , Mohan Kumar G 3 1- Department of Mechanical Engineering, PSG College of Technology, Coimbatore 3- Park college of Engineering and Technology, Coimbatore

2. Finite Element Analysis of High-Speed Motorized Spindle Based on ANSYS
Deping Liu* Hang Zhang, Zheng Tao and Yufeng Su

3. Dynamic and thermal analysis of high pace motorized spindle.

4. Dynamic traits analysis of high Speed motorized spindle
1,2. Department of mechanical engineering, psg college of technology, coimbatore – 641 004, india three park university of engineering and technology, coimbatore, india