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DESIGN AND ANALYSIS OF RADIAL ARM USED IN DRILLING MACHINE

[1]GEDALA JAYASREE [2]RAYAPATI SEEMONU

[1]Department of mechanical engineering, M-Tech student (CAD/CAM), AVANTHI 'S RESEARCH AND TECHNOLOGICAL ACADEMY (Approved by AICTE, Recognized by the Govt of A P; Affiliated by JNTU Kakinada) Basavapalem(V), Bhogapuram(M) - 531162, Andhra Pradesh, India.

[2]Department of mechanical engineering, assistant professor (M.E manufacturing) AVANTHI 'S RESEARCH AND TECHNOLOGICAL ACADEMY (Approved by AICTE, Recognized by the Govt of A P; Affiliated by JNTU Kakinada) Basavapalem(V), Bhogapuram(M) - 531162, Andhra Pradesh, India.

ABSTRACT: A computational capability is evolved for the gold standard design of radial drilling gadget shape to satisfy static stress and natural frequency necessities the use of finite element idealization. The radial drilling device structure is idealized with body elements and is analyzed by way of the usage of specific combos of move sectional shapes for the radial arm and the column. From the consequences acquired, the best mixture of cross sectional shapes is recommended for the structure.

With this mixture of cross sectional shapes, mathematical programming strategies are used to find the minimal weight design of the radial drilling device shape. A sensitivity analysis is carried out about the most excellent factor to locate the consequences of adjustments in layout variables on the structural weight and the reaction quantities.

3D Modeling in CREO parametric software program and evaluation in ANSYS software.

INTRODUCTION TO DRILLING

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills. In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible.

PROCESS

Drilled holes are characterized through their sharp area on the entrance aspect and the presence of burrs at the exit facet (except they were removed). Also, the internal of the hollow typically has helical feed marks.

Drilling in metal

High velocity metallic twist bit drilling into aluminum with methylated spirits lubricant Under normal usage, swarf is carried up and faraway from the top of the drill bit by using the fluting of the drill bit. The slicing edges produce extra chips which maintain the movement of the chips outwards from the hole. This is successful till the chips % too tightly, both because of deeper than everyday holes

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or insufficient backing off (getting rid of the drill slightly or totally from the hollow while drilling). Cutting fluid is from time to time used to ease this hassle and to prolong the device's life by way of cooling and lubricating the tip and chip waft. Coolant can be added thru holes via the drill shank, that is not unusual whilst using a gun drill. When slicing aluminum in particular, cutting fluid enables ensure a clean and correct hole even as stopping the metal from grabbing the drill bit within the method of drilling the hollow.

DRILLING MACHINE

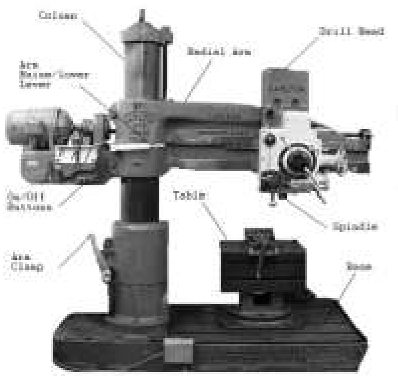

FIG.1.2 DRILLING MACHINE

A drilling system includes a horizontal table, a vertical column, a head helping the motor and riding mechanism, and a vertical spindle. The upright drilling machine is larger and heavier than a sensitive drilling machine

A radial arm press is a geared drill head that is set up on an arm meeting that may be moved round to the volume of its arm attain. The maximum crucial components are the arm, column, and the drill head. The drill head of the radial drilling machine can be moved, adjusted in top, and circled. Aside from its compact layout, the radial drill press is capable of positioning its drill head to the paintings piece through this radial arm mechanism.

This is probably one of the reasons why extra machinists opt for the usage of this kind of drilling system. In fact, the radial drilling device is taken into consideration the most flexible type of drill press. The tasks that a radial drilling machine can do encompass boring holes, countersinking, and grinding off small debris in masonry works.

DESIGN AND ANALYSIS SOFTWARES

INTRODUCTION TO CAD

Computer-aided design (CAD) is the use of laptop systems (or workstations) to resource within the advent, modification, evaluation, or optimization of a layout. CAD software software is used to growth the productivity of the fashion designer, enhance the exceptional of layout, enhance communications thru documentation, and to create a database for manufacturing. CAD output is frequently within the form of digital documents for print, machining, or exceptional manufacturing operations.

2 INTRODUCTION TO CREO

PTC CREO, formerly referred to as Pro/ENGINEER, is three-D modeling software software carried out in mechanical engineering, design, manufacturing, and in CAD drafting issuer companies. It became one of the first three-d CAD modeling applications that used a rule-based parametric device. Using parameters, dimensions and abilities to seize the behavior of the product, it is able to optimize the improvement product in addition to the layout itself.The name changed into modified in 2010 from Pro/ENGINEER Wildfire to CREO.

3-D MODEL OF DRILLING MACHINE

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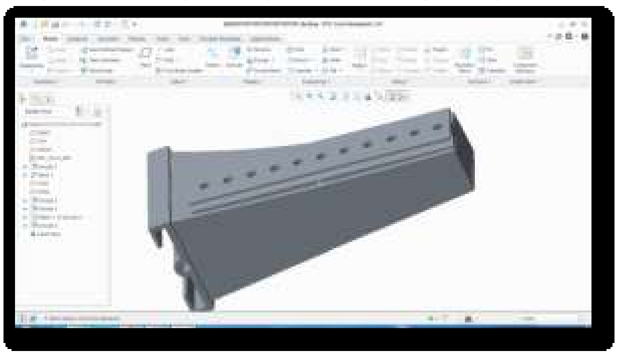
FIG.2.1 3-D MODEL OF DRILLING MACHINE



2D MODEL OF RADIAL ARM

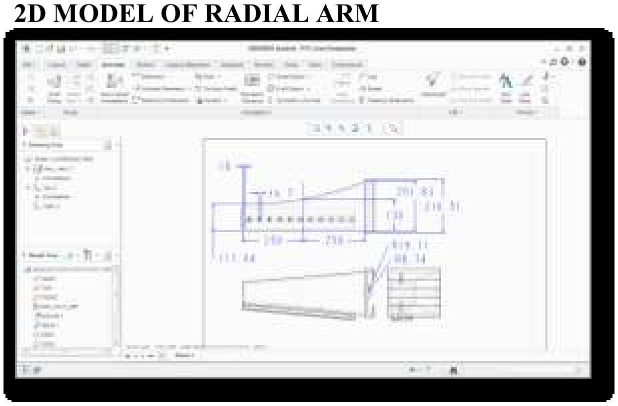


FIG 2.2 2D MODEL OF RADIAL ARM

INTRODUCTION TO FEA

Finite element evaluation is a manner of fixing, typically about, exceptional troubles in engineering and era. It is used mainly for problems for which no actual answer, expressible in some mathematical form, is available. As such, it is a numerical instead of an analytical approach. Methods of this kind are wanted because of the truth analytical techniques can not cope with the real, complicated problems which might be met with in engineering.

INTRODUCTION TO ANSYS

Structural Analysis

ANSYS Autodyne is pc simulation device for simulating the reaction of materials to quick period immoderate loadings from impact, excessive stress or explosions. ANSYS Mechanical ANSYS Mechanical is a finite detail evaluation tool for structural assessment, together with linear, nonlinear and dynamic studies. This laptop simulation product offers finite factors to version behavior, and allows fabric fashions and equation solvers for a big style of mechanical design problems.

LITERATURE REVIEW

Optimum Design of Radial Drilling Machine Structure to Satisfy Static Rigidity and Natural Frequency Requirements

A computational capability is developed for the most fulfilling layout of radial drilling gadget structure to fulfill static stress and herbal frequency requirements using finite detail idealization. The radial drilling gadget shape is idealized with body elements and is analyzed by way of the usage of unique combinations of pass sectional shapes for the radial arm and the column. From the outcomes acquired, the high-quality mixture of go sectional shapes is recommended for the shape. With this aggregate of move sectional shapes, mathematical programming techniques are used to discover the minimum weight layout of the radial drilling gadget structure. A sensitivity analysis is performed about the most efficient factor to discover the effects of modifications in design variables on the structural weight and the reaction quantities.

STRUCTURAL ANALYSIS OF RADIAL ARM

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4.1 STATIC ANALYSIS

- **Materials –mild steel**

Physical Properties	Metric	English
Density	7.87 g/cc	0.284 lb/in³

Mechanical Properties	Metric	English
Tensile Strength, Ultimate	<= 380 MPa	<= 55100 psi
Tensile Strength, Yield	<= 260 MPa @Strain 0.200 %	<= 37700 psi @Strain 0.200 %
Elongation at Break	>= 30 %	>= 30 %
Bend Radius, Minimum	>= 0.50 t	>= 0.50 t

Component Elements Properties	Metric	English
Iron, Fe	98 %	98 %

- **Materials –EN 31 steel**

Component Elements Properties	Metric	English
Carbon, C	0.0500 - 1.29 %	0.0500 - 1.29 %
Chromium, Cr	0.300 - 3.30 %	0.300 - 3.30 %
Iron, Fe	91.9 - 98.9 %	91.9 - 98.9 %
Manganese, Mn	0.300 - 3.00 %	0.300 - 3.00 %
Molybdenum, Mo	0.0800 - 0.750 %	0.0800 - 0.750 %
Nickel, Ni	0.650 - 3.80 %	0.650 - 3.80 %
Phosphorous, P	0.0200 - 0.0400 %	0.0200 - 0.0400 %
Silicon, Si	0.150 - 1.05 %	0.150 - 1.05 %
Sulfur, S	0.0200 - 0.400 %	0.0200 - 0.400 %

Physical Properties	Metric	English
Density	7.75 - 7.88 g/cc	0.280 - 0.284 lb/in³
Particle Size	6.70 - 12.0 µm	6.70 - 12.0 µm

Mechanical Properties	Metric	English
Hardness, Brinell	121 - 578	121 - 578
Hardness, Knoop	140 - 616	140 - 616
Hardness, Rockwell B	68.8 - 112	68.8 - 112
Hardness, Rockwell C	10.0 - 62.6	10.0 - 62.6
Hardness, Vickers	38.0 - 1140	38.0 - 1140
Tensile Strength, Ultimate	450 - 1970 MPa	65300 - 286000 psi
Tensile Strength, Yield	275 - 1860 MPa	39900 - 270000 psi
Elongation at Break	8.00 - 34.0 %	8.00 - 34.0 %
Reduction of Area	16.0 - 74.4 %	16.0 - 74.4 %
Modulus of Elasticity	192 - 213 GPa	27800 - 30900 ksi
Compressive Yield Strength	1650 - 1800 MPa	239000 - 260000 psi
Bulk Modulus	152 - 170 GPa	22000 - 24700 ksi
Poissons Ratio	0.270 - 0.300	0.270 - 0.300
Fatigue Strength	138 - 772 MPa	20000 - 112000 psi
Fracture Toughness	33.0 - 115 MPa-m½	30.0 - 105 ksi-in½
Machinability	50.0 - 75.0 %	50.0 - 75.0 %
Shear Modulus	74.0 - 82.0 GPa	10700 - 11900 ksi

Materials –EN8 steel

Physical Properties	Metric	English
Density	7.87 g/cc	0.284 lb/in³

Mechanical Properties	Metric	English
Hardness, Brinell	101	101
Hardness, Knoop	119	119
Hardness, Rockwell B	58	58
Hardness, Vickers	104	104
Tensile Strength, Ultimate	345 MPa	50000 psi
Tensile Strength, Yield	190 MPa	27600 psi
Elongation at Break	28 %	28 %
Reduction of Area	50 %	50 %
Modulus of Elasticity	200 GPa	29000 ksi
Bulk Modulus	160 GPa	23200 ksi
Poissons Ratio	0.29	0.29
Machinability	60 %	60 %
Shear Modulus	80.0 GPa	11600 ksi

Component Elements Properties	Metric	English
Carbon, C	0.13 - 0.18 %	0.13 - 0.18 %
Iron, Fe	99.13 - 99.57 %	99.13 - 99.57 %
Manganese, Mn	0.30 - 0.60 %	0.30 - 0.60 %
Phosphorous, P	<= 0.040 %	<= 0.040 %
Sulfur, S	<= 0.050 %	<= 0.050 %

- **Materials –Carbon steel**

Physical Properties	Metric	English
Density	0.451 - 8.26 g/cc	0.0163 - 0.298 lb/in³
Particle Size	6.70 - 12.0 µm	6.70 - 12.0 µm

Mechanical Properties	Metric	English
Hardness, Brinell	163 - 600	163 - 600
Hardness, Knoop	195 - 769	195 - 769
Hardness, Rockwell B	43.0 - 100	43.0 - 100
Hardness, Rockwell C	10.0 - 70.0	10.0 - 70.0
Hardness, Vickers	182 - 746	182 - 746
Tensile Strength, Ultimate	161 - 3200 MPa	23300 - 464000 psi
Tensile Strength, Yield	275 - 3340 MPa	39900 - 484000 psi
Elongation at Break	0.600 - 30.0 %	0.600 - 30.0 %
Reduction of Area	13.4 - 73.0 %	13.4 - 73.0 %
Modulus of Elasticity	13.8 - 235 GPa	2000 - 34100 ksi
Flexural Yield Strength	159 - 5130 MPa	23000 - 744000 psi
Compressive Yield Strength	1320 - 3100 MPa	191000 - 450000 psi
Bulk Modulus	160 GPa	23200 ksi
Poissons Ratio	0.268 - 0.313	0.268 - 0.313
Fracture Toughness	13.2 - 165 MPa-m½	12.0 - 150 ksi-in½
Machinability	10.0 - 125 %	10.0 - 125 %
Shear Modulus	78.0 - 82.7 GPa	11300 - 12000 ksi

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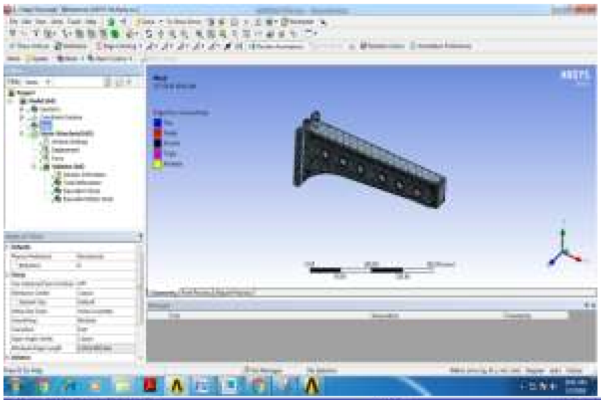

Component Elements Properties	Metric	English
Aluminum, Al	0.0600 - 1.25 %	0.0600 - 1.25 %
Boron, B	0.000500 - 0.00300 %	0.000500 - 0.00300 %
Carbon, C	0.100 - 3.40 %	0.100 - 3.40 %
Chromium, Cr	0.150 - 14.0 %	0.150 - 14.0 %
Cobalt, Co	0.250 - 14.0 %	0.250 - 14.0 %
Copper, Cu	0.100 - 0.350 %	0.100 - 0.350 %
Iron, Fe	66.5 - 99.1 %	66.5 - 99.1 %
Manganese, Mn	0.100 - 13.0 %	0.100 - 13.0 %
Molybdenum, Mo	0.0800 - 10.5 %	0.0800 - 10.5 %
Nickel, Ni	0.150 - 10.0 %	0.150 - 10.0 %
Phosphorous, P	0.0120 - 0.0800 %	0.0120 - 0.0800 %
Silicon, Si	0.100 - 2.20 %	0.100 - 2.20 %
Sulfur, S	0.00200 - 0.220 %	0.00200 - 0.220 %
Tungsten, W	0.250 - 13.0 %	0.250 - 13.0 %
Vanadium, V	0.0700 - 14.5 %	0.0700 - 14.5 %

FIG 4.2 MESHED MODEL

Select static structural right click on → insert → pick rotational velocity and stuck assist → Select displacement → select required area → click on practice → positioned X,Y,Z factor 0 →

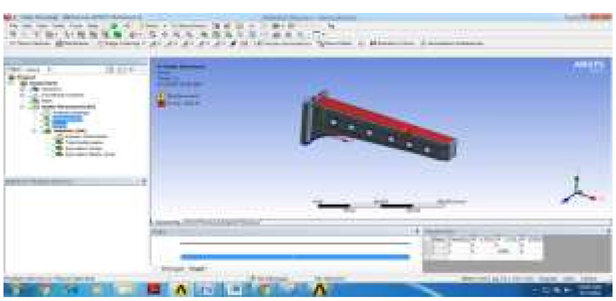

FIG 4.3 BOUNDARY CONDITIONS

Select force → pick required place → click on follow → enter rotational speed

Select solution proper click on → remedy →

Solution right click on → insert → deformation → general → Solution proper click on → insert → strain → equivalent (von-mises) →

Solution proper click → insert → stress → equivalent (von-mises) →

Right click on on deformation → examine all result

4.1.1 MATERIAL-MILD STEEL

- **TOTAL DEFORMATION**

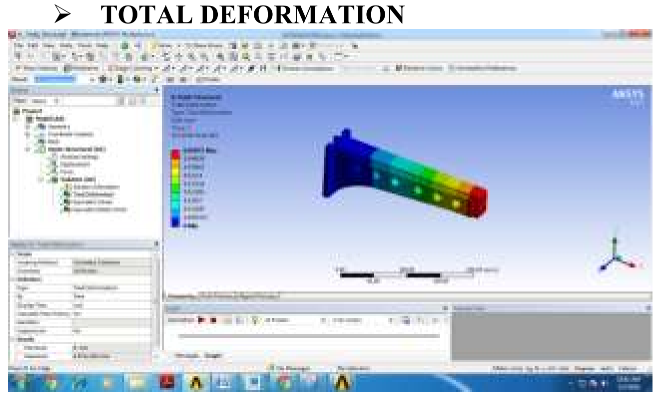

FIG 4.4 TOTAL DEFORMATION OF MILD STEEL

- **VON-MISES STRESS**

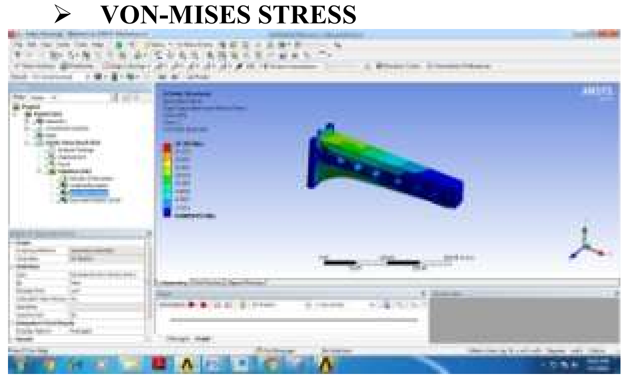

FIG 4.5 VON-MISES STRESS OF MILD STEEL

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- **VON-MISES STRAIN**

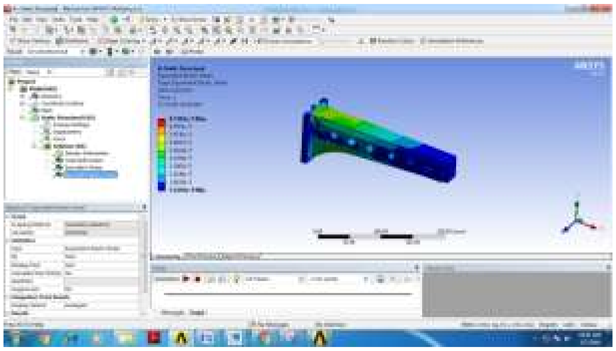

FIG 4.6 VON-MISES STRAIN OF MILD STEEL

FATIUGE ANALYSIS OF RADIAL ARM

- **SAFTEY FACTOR**

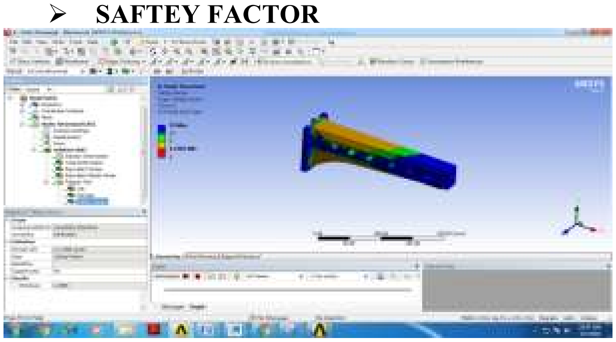

FIG 4.14 SAFETY FACTOR OF EN 8 STEEL

4.2 MODAL ANALYSIS OF RADIAL ARM

4.2.1 MATERIAL-MILD STEEL

- **TOTAL DEFORMATION 1**

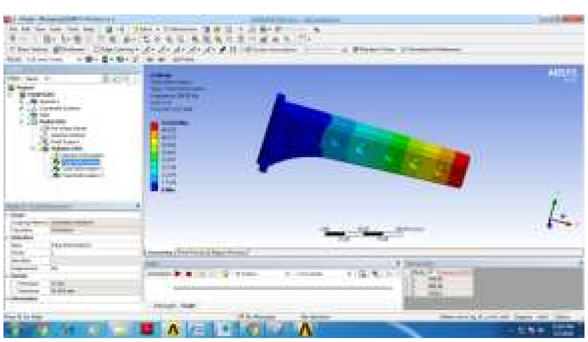

FIG 4.19 TOTAL DEFORMATION 1 OF MILD STEEL

- **TOTAL DEFORMATION 2**

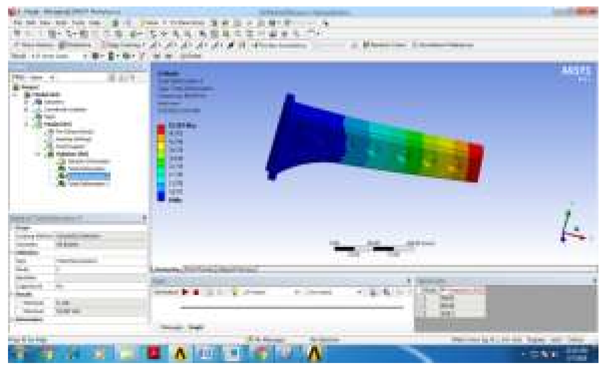

FIG 4.20 TOTAL DEFORMATION 2 OF MILD STEEL

- **TOTAL DEFORMATION 3**

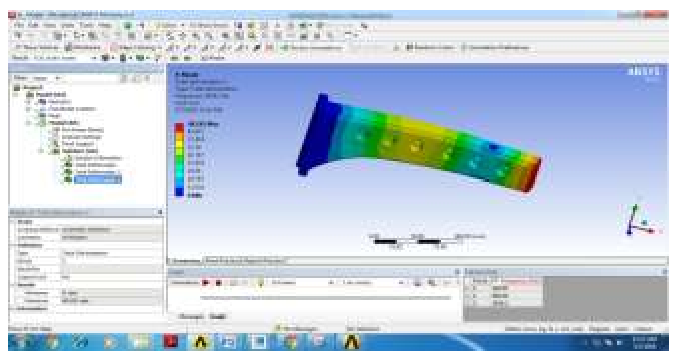

FIG4.21 TOTAL DEFORMATION 3 OF MILD STEEL

MATERIAL –EN 8 STEEL

AT TIME -10 SEC

- **DEFORMATION**

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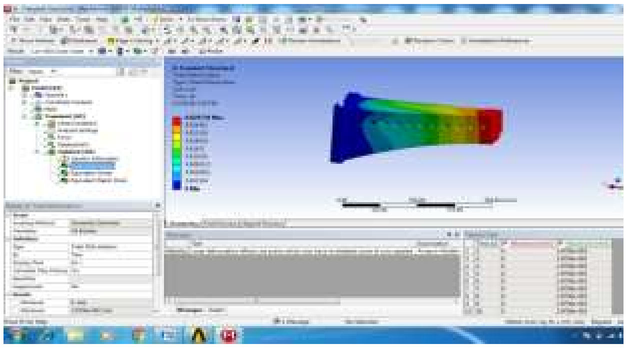

FIG 4.49 TRANSIENT ANALYSIS DEFORMATION EN 8 STEEL AT 10SEC

- **STRESS**

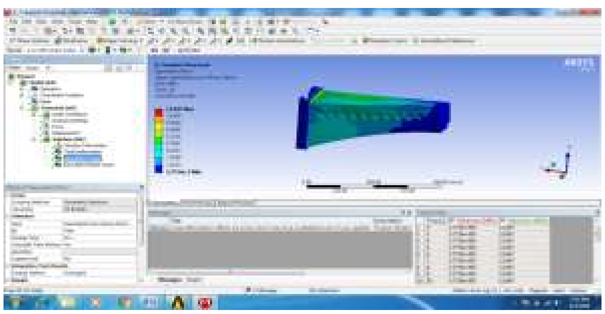

FIG 4.50 TRANSIENT ANALYSIS STRESS EN 8 STEEL AT 10SEC

- **STRAIN**

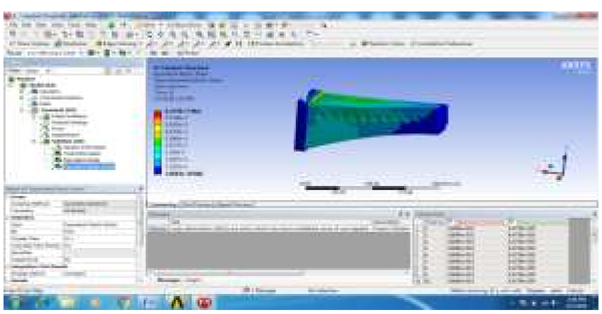

FIG 4.51 TRANSIENT ANALYSIS STRAIN EN 8 STEEL AT 10SEC

AT TIME -20 SEC

- **DEFORMATION**

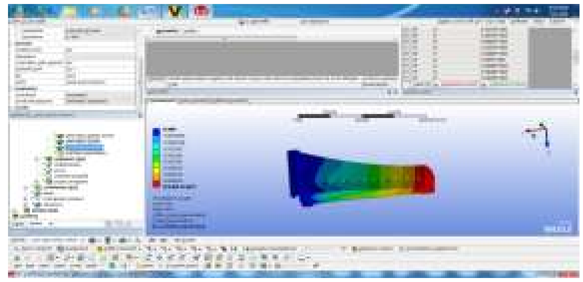

FIG 4.52 TRANSIENT ANALYSIS DEFORMATION EN 8 STEEL AT 20SEC

STRESS

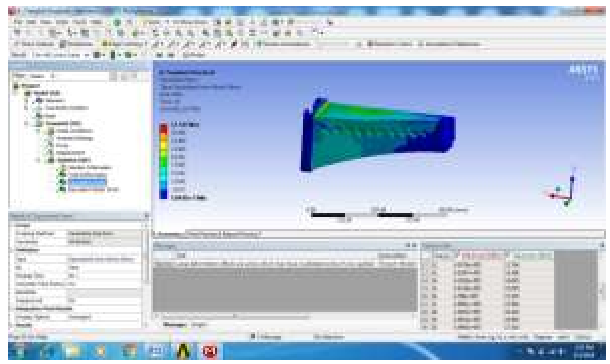

FIG 4.53 TRANSIENT ANALYSIS STRESS EN 8 STEEL AT 20SEC

- **STRAIN**

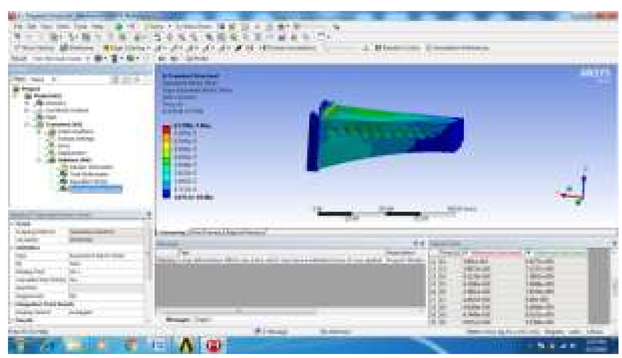

FIG 4.54 TRANSIENT ANALYSIS STRAIN EN 8 STEEL AT 20SEC

AT TIME -30 SEC

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➢ **DEFORMATION**

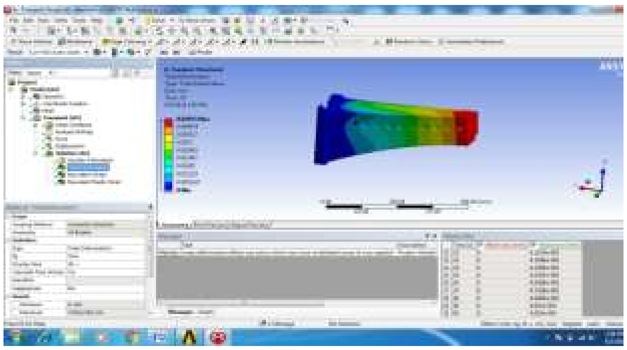

FIG 4.55 TRANSIENT ANALYSIS DEFORMATION EN 8 STEEL AT 30SEC

➢ **STRESS**

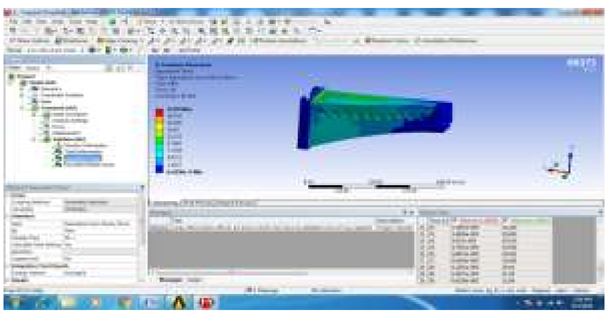

FIG 4.56 TRANSIENT ANALYSIS STRESS EN 8 STEEL AT 30SEC

➢ **STRAIN**

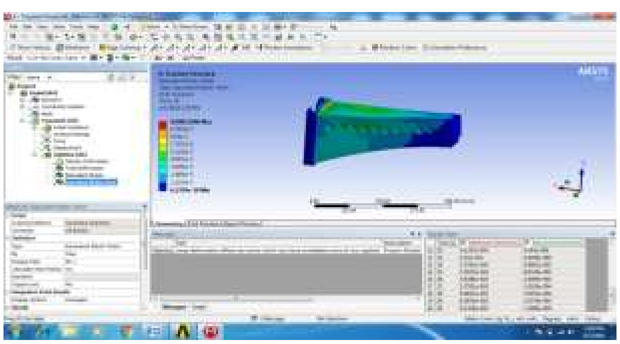

FIG 4.57 TRANSIENT ANALYSIS STRAIN EN 8 STEEL AT 30SEC

STATIC RESULTS

Material	Deformation (mm)	Stress (N/mm^2)	Strain	Safety factor	
				Min	Max
Mild steel	0.04971	19.392	9.7138e-5	1.1113	15
EN 31 steel	0.046204	18.025	9.0514e-5	1.1956	15
EN 8 steel	0.044611	17.403	8.7393e-5	1.2383	15
Carbon steel	0.043815	17.092	8.532e-5	1.2608	15

MODAL ANALYSIS RSULTS

Material	Deformation 1 (mm)	Frequency (Hz)	Deformation 2 (mm)	Frequency (Hz)	Deformation 3(mm)	Frequency (Hz)
Mild steel	51.654	589.85	53.367	868.667	48.181	2636.2
EN 31 steel	49.64	566.85	51.286	827.1	46.382	2533.6
EN 8 steel	48.241	550.88	49.841	803.78	44.997	2462.0
Carbon steel	46.955	536.18	48.512	782.36	43.797	2396.3

TRANSIENT ANALYSIS RESULTS

MATERIAL	TIME (SEC)	DEFORMATION(mm)	STRESS(N/mm^2)	STRAIN
MILD STEEL	10	0.0037172	16.058	8.0922e-66
	20	0.0047538	20.554	1.0358e-5
	30	0.0057989	25.051	1.2624e-5
EN 31 STEEL	10	0.0033453	14.453	7.832e-5
	20	0.043856	18.949	9.5491e-5
	30	0.054267	23.446	0.00011815
EN 8 STEEL	10	0.0029736	12.847	6.4739e-5
	20	0.040143	17.343	8.7398e-5
	30	0.05055	21.84	0.0011006
CARBON STEEL	10	0.026019	11.241	5.6647e-5
	20	0.036427	15.737	7.9306e-5
	30	0.046834	20.234	0.00010196

CONCLUSION

3D modeling in CREO parametric software program and evaluation in ANSYS software program. In this thesis, static, fatigue and modal evaluation finished with extraordinary substances including moderate metal, EN 31 metal, EN eight metallic and carbon metal.

- Static evaluation is to determine strain, deformation and pressure.
- Modal analysis is to decide the deformation mode shapes with appreciate to frequencies.
- Fatigue evaluation is to decide the lifestyles of the component.
- By looking on the static evaluation the strain values are a lot much less for carbon metal examine with different substances

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- By looking at the modal evaluation the deformation values are plenty less for carbon steel examine with other materials

- So it may be finish the carbon metal is higher material for radial arm.

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[1] GEDALA JAYASREE

[1]Department of mechanical engineering, M-Tech student (CAD/CAM), AVANTHI 'S RESEARCH AND TECHNOLOGICAL ACADEMY (Approved by AICTE & Affiliated by JNTU Kakinada) Basavapalem(V), Bhogapuram(M) - 531162, Andhra Pradesh, India.

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