



## Design And Analysis Of Radial Arm Used In Drilling Machine

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### 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.

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

### 1.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.



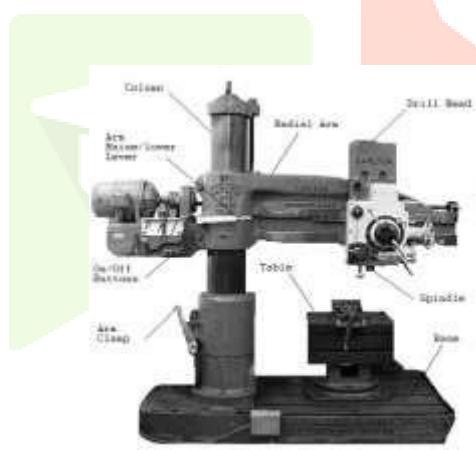
## PROCESS

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 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.1.1 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.

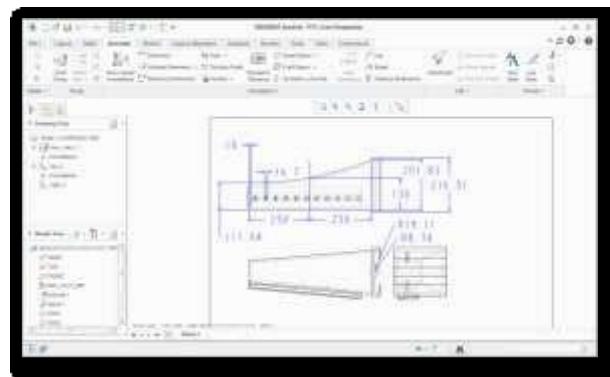
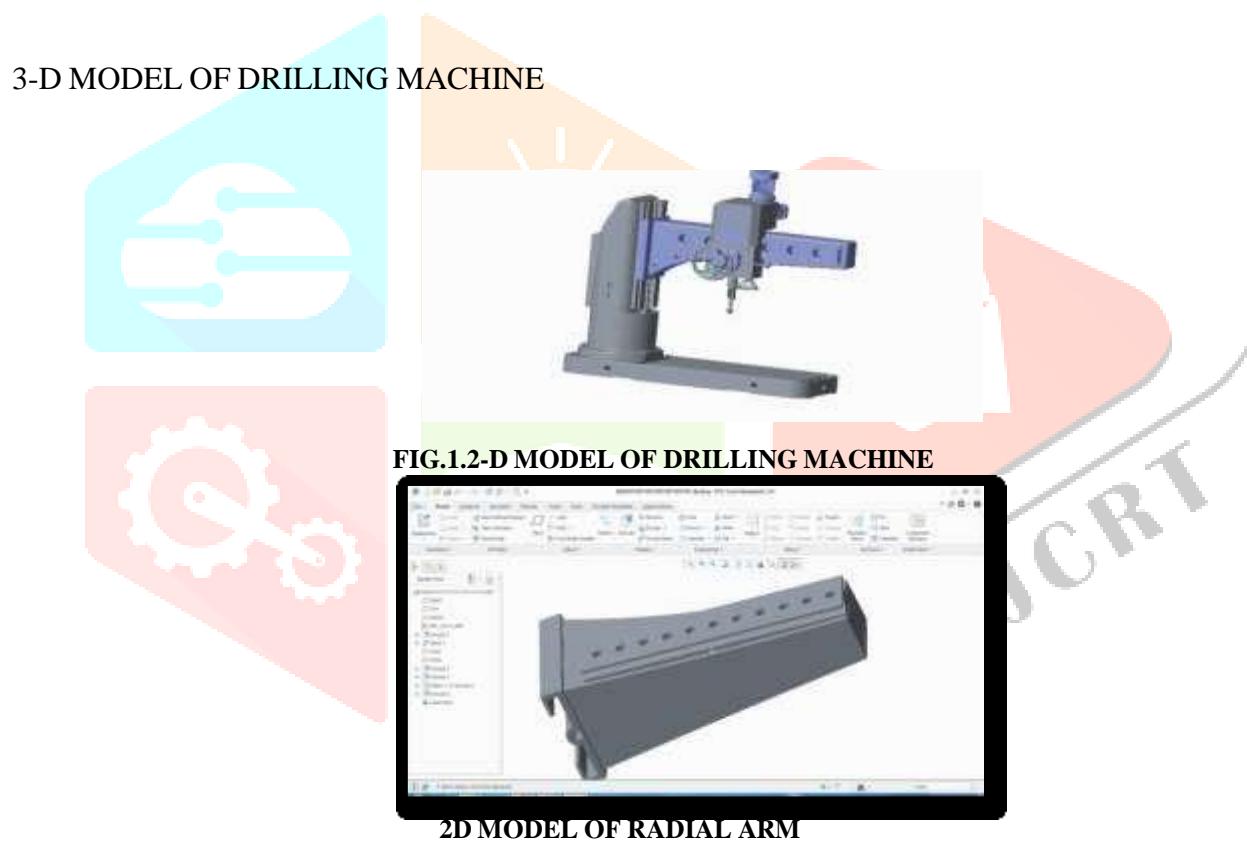
DESIGN AND ANALYSIS SOFTWARES INTRODUCTION TO CAD

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 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 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



## 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.

## 2.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

### STATIC ANALYSIS

Materials –mild steel

Physical Properties	Metric	English
Density	7.87 g/cm <sup>3</sup>	0.294 lb/in <sup>3</sup>
Mechanical Properties	Metric	English
Tensile Strength, Ultimate	≥ 350 MPa	≥ 51.00 psi
Tensile Strength, Yield	≥ 250 MPa	≥ 37.00 psi
	≥ 200 MPa	≥ 29.10 psi
Elongation at Break	≥ 30 %	≥ 30 %
Bend Radius, Minimum	≥ 0.50 t	≥ 1.50 t
Component Elements Properties	Metric	English
Iron, Fe	98 %	98 %

Fig2.1Materials –EN 31 steel

Component Elements Properties	Metric	English
Carbon, C	0.0800-1.25 %	0.0500-1.25 %
Chromium, Cr	0.100-1.30 %	0.100-3.50 %
Iron, Fe	91.9-98.9 %	91.9-98.9 %
Manganese, Mn	0.300-1.00 %	0.300-3.00 %
Molybdenum, Mo	0.0800-0.750 %	0.0000-0.750 %
Nickel, Ni	0.650-1.80 %	0.650-3.00 %
Phosphorus, 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 %	0.0000-0.400 %

## Materials –EN8 steel

Physical Properties	Metric	English
Density	7.75 - 7.85 g/cm <sup>3</sup>	0.280 - 0.284 lb/in <sup>3</sup>
Particle Size	6.70 - 12.0 $\mu$ m	6.70 - 12.0 $\mu$ m

Mechanical Properties	Metric	English
Hardness, Brinell	121 - 170	121 - 170
Hardness, Knoop	140 - 216	140 - 216
Hardness, Rockwell B	68.3 - 112	68.3 - 112
Hardness, Rockwell C	10.0 - 62.0	10.0 - 62.0
Hardness, Vickers	38.0 - 110.0	38.0 - 110.0
Tensile Strength, Ultimate	450 - 1070 MPa	65300 - 250000 psi
Tensile Strength, Yield	275 - 1060 MPa	39900 - 270000 psi
Elongation at Break	0.00 - 34.0 %	0.00 - 34.0 %
Reduction of Area	16.0 - 74.4 %	16.0 - 74.4 %
Modulus of Elasticity	192 - 213 GPa	27833 - 30960 GPa
Compressive Yield Strength	1650 - 1880 MPa	236900 - 260000 psi
Bulk Modulus	157 - 176 GPa	22500 - 24700 GPa
Poisson's Ratio	0.270 - 0.300	0.270 - 0.300
Fatigue Strength	138 - 772 MPa	20000 - 112000 psi
Fracture Toughness	35.0 - 115 MPa $\sqrt{\text{m}}$	50.0 - 168 kpsi $\sqrt{\text{in}}$
Machinability	60.0 - 70.0 %	60.0 - 70.0 %
Shear Modulus	74.3 - 82.6 GPa	10700 - 11900 GPa

Physical Properties	Metric	English
Density	7.07 g/cm <sup>3</sup>	0.254 lb/in <sup>3</sup>

Mechanical Properties	Metric	English
Hardness, Brinell	101	101
Hardness, Knoop	119	119
Hardness, Rockwell B	58	58
Hardness, Vickers	134	134
Tensile Strength, Ultimate	345 MPa	5000 psi
Tensile Strength, Yield	180 MPa	2700 psi
Elongation at Break	28 %	28 %
Reduction of Area	50 %	50 %
Modulus of Elasticity	200 GPa	2900 GPa
Bulk Modulus	160 GPa	2300 GPa
Poisson's Ratio	0.29	0.29
Machinability	60 %	60 %
Shear Modulus	80.0 GPa	11500 GPa

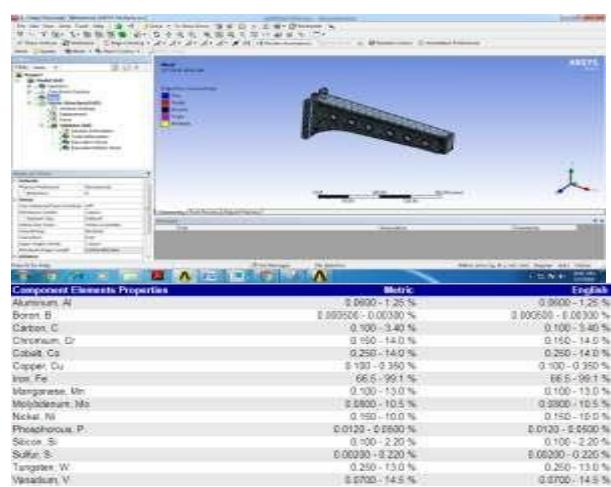
Component Elements Properties	Metric	English
Carbon, C	0.13 - 0.18 %	0.13 - 0.18 %
Iron, Fe	99.13 - 99.57 %	99.13 - 99.57 %
Manganese, Mn	0.30 - 0.60 %	0.30 - 0.60 %
Phosphorus, P	≤ 0.040 %	≤ 0.040 %
Sulfur, S	≤ 0.030 %	≤ 0.030 %

Physical Properties	Metric	English
Density	8.405 - 8.50 g/cm <sup>3</sup>	0.2953 - 0.2965 lb/in <sup>3</sup>
Particle Size	6.70 - 12.0 $\mu$ m	6.70 - 12.0 $\mu$ m

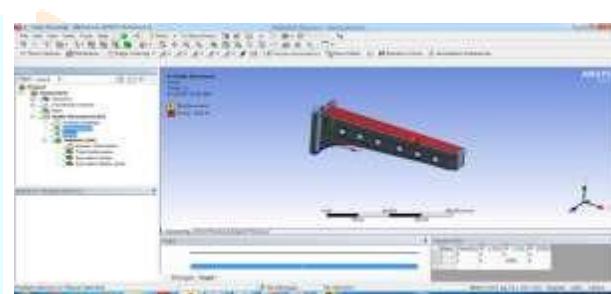
  

Mechanical Properties	Metric	English
Hardness, Brinell	163 - 800	163 - 800
Hardness, Knoop	165 - 769	165 - 769
Hardness, Rockwell B	43.9 - 180	43.9 - 180
Hardness, Rockwell C	10.0 - 72.0	10.0 - 72.0
Hardness, Vickers	168 - 748	168 - 748
Tensile Strength, Ultimate	161 - 3200 MPa	23300 - 464000 psi
Tensile Strength, Yield	275 - 2942 MPa	39900 - 464000 psi
Elongation at Break	1.5 - 30.0 %	1.5 - 30.0 %
Reduction of Area	≤ 50.0 %	≤ 50.0 %
Modulus of Elasticity	13.8 - 23.0 GPa	20000 - 33000 GPa
Fatigue Strength	180 - 9130 MPa	26000 - 134000 psi
Compressive Yield Strength	1320 - 3100 MPa	181000 - 400000 psi
Bulk Modulus	566 - 959 GPa	82000 - 120000 GPa
Poisson's Ratio	0.269 - 0.313	0.269 - 0.313
Fracture Toughness	13.2 - 163 MPa $\sqrt{\text{m}}$	12.8 - 193 ksi $\sqrt{\text{in}}$
Machinability	70.0 - 125.0 %	70.0 - 125.0 %
Bilinear Modulus	78.8 - 107.1 GPa	102000 - 120000 GPa

## Materials –Carbon steel

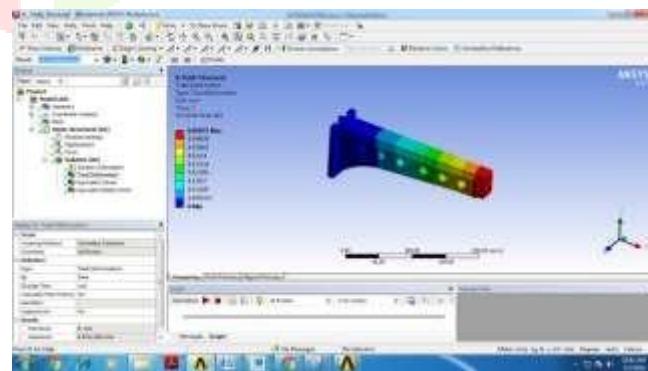
**FIG 4.2 MESHED MODEL**

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 → stra → equivalent (von-mises) → Solution proper click → insert → stress → equivalent (von-mises) → Right click on on deformation → examine all result

MATERIAL-MILD STEEL  
TOTAL DEFORMATION

**FIG 4.4 TOTAL DEFORMATION OF MILD STEEL**

## VON-MISES STRESS

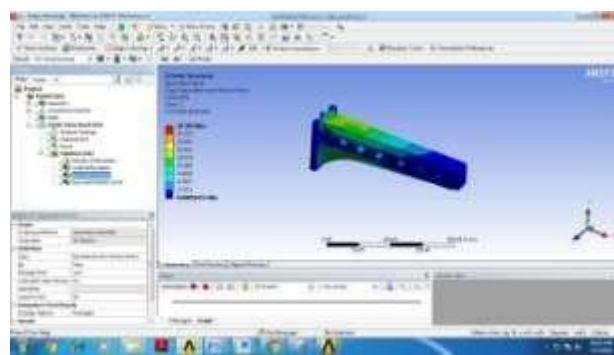


FIG 4.5 VON-MISES STRESS OF MILD STEEL

## VON-MISES STRAIN

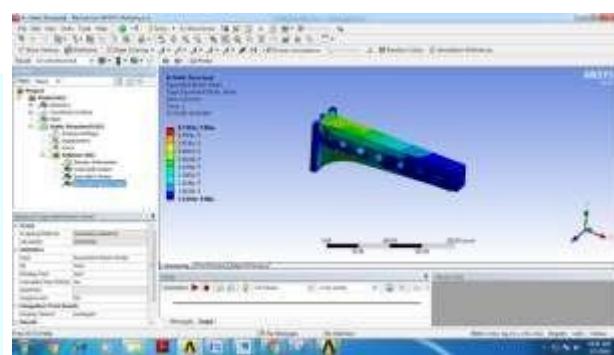


FIG4.6 VON-MISES STRAIN OF MILD STEEL

## 5.RESULT

## STATIC RESULTS

Material	Deformation (mm)	Stress (N/mm <sup>2</sup> )	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 RESULTS

Material	Deformation 1 (mm)	Frequency (Hz)	Deformation 2 (mm)	Frequency (Hz)	Deformation 3 (mm)	Frequency (Hz)
	1 (mm)	Frequency (Hz)	2 (mm)	Frequency (Hz)	3 (mm)	Frequency (Hz)
Mild steel	51.654	589.85	53.367	868.667	43.181	1636.3
EN 31 steel	48.64	586.85	51.296	827.1	43.282	1533.4
EN 8 steel	48.241	559.58	48.941	833.78	44.987	1462.0
Carbon steel	48.859	536.18	48.512	782.36	43.783	1398.3

## TRANSIENT ANALYSIS RESULTS

MATERIAL	TIME (SEC)	DEFORMATION(mm)	STRESS(N/mm <sup>2</sup> )	STRAIN
MILD STEEL	10	0.0037172	16.058	8.0922e-6
	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	0.0043856	18.948	9.5491e-5
	30	0.0054261	23.446	0.00011815
EN 8 STEEL	10	0.0029736	12.847	6.4739e-5
	20	0.0040143	17.343	8.7398e-5
	30	0.0050555	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

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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