



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.

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



FIG.1.2-D MODEL OF DRILLING MACHINE



2D MODEL OF RADIAL ARM

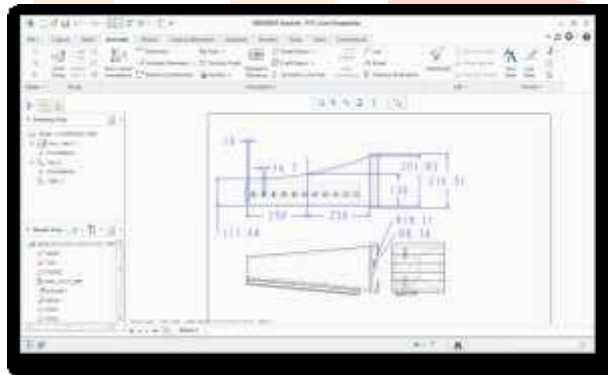


FIG 2.2 2D MODEL OF RADIAL ARM

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.

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/cc	0.284 lbf/in ³
Mechanical Properties	Metric	English
Tensile Strength, Ultimate	<= 380 MPa	<= 55 000 psi
Tensile Strength, Yield	<= 260 MPa	<= 37 700 psi
Elongation at Break	>= 30 %	>= 30 %
Bend Radius, Minimum	>= 0.50 t	>= 0.50 t
Component Elements Properties	Metric	English
Iron, Fe	98 %	98 %

Fig2.1Materials –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	0.0000 - 0.750 %	0.0000 - 0.750 %
Nickel, Ni	0.650 - 3.90 %	0.650 - 3.90 %
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 %	0.0200 - 0.400 %

Materials –EN8 steel

Physical Properties	Metric	English
Density	7.75 - 7.85 g/cc	0.280 - 0.284 lb/in ³
Particle Size	6.70 - 12.0 µm	6.70 - 12.0 µm
Mechanical Properties	Metric	English
Hardness, Brinell	121 - 670	121 - 670
Hardness, Knoop	143 - 616	143 - 616
Hardness, Rockwell B	88.9 - 112	88.9 - 112
Hardness, Rockwell C	18.0 - 62.6	18.0 - 62.6
Hardness, Vickers	38.0 - 1140	38.0 - 1140
Tensile Strength, Ultimate	450 - 1500 MPa	65000 - 205000 psi
Tensile Strength, Yield	275 - 1000 MPa	39000 - 140000 psi
Elongation at Break	8.00 - 34.0 %	8.00 - 34.0 %
Reduction of Area	16.0 - 76.4 %	16.0 - 76.4 %
Modulus of Elasticity	192 - 211 GPa	27800 - 30200 ksi
Compressive Yield Strength	1650 - 1800 MPa	238000 - 260000 psi
Bulk Modulus	152 - 176 GPa	22000 - 24700 ksi
Poissons Ratio	0.290 - 0.300	0.290 - 0.300
Fatigue Strength	135 - 772 MPa	20000 - 112000 psi
Fracture Toughness	33.0 - 115 MPa√m	30.0 - 105 ksi√in
Machinability	60.0 - 70.0 %	60.0 - 70.0 %
Shear Modulus	74.0 - 82.6 GPa	10700 - 11900 ksi

Physical Properties	Metric	English
Density	7.87 g/cc	0.284 lb/in ³

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	180 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 %
Phosphorus, P	<= 0.040 %	<= 0.040 %
Sulfur, S	<= 0.050 %	<= 0.050 %

Physical Properties	Metric	English
Density	7.85 - 8.25 g/cc	0.283 - 0.292 lb/in ³
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 - 760	195 - 760
Hardness, Rockwell B	43.0 - 180	43.0 - 180
Hardness, Rockwell C	10.0 - 70.0	10.0 - 70.0
Hardness, Vickers	182 - 740	182 - 740
Tensile Strength, Ultimate	61 - 3200 MPa	23000 - 460000 psi
Tensile Strength, Yield	275 - 3240 MPa	39000 - 460000 psi
Elongation at Break	9.00 - 30.0 %	9.00 - 30.0 %
Reduction of Area	15.4 - 73.0 %	15.4 - 73.0 %
Modulus of Elasticity	13.8 - 235 GPa	2000 - 34100 ksi
Flexural Yield Strength	169 - 500 MPa	33000 - 74000 psi
Compressive Yield Strength	1020 - 3100 MPa	147000 - 450000 psi
Bulk Modulus	156 GPa	22000 ksi
Poissons Ratio	0.268 - 0.311	0.268 - 0.311
Fracture Toughness	13.2 - 165 MPa√m	12.2 - 190 ksi√in
Machinability	70.0 - 125 %	70.0 - 125 %
Shear Modulus	76.0 - 80.7 GPa	11000 - 13000 ksi

Materials –Carbon steel

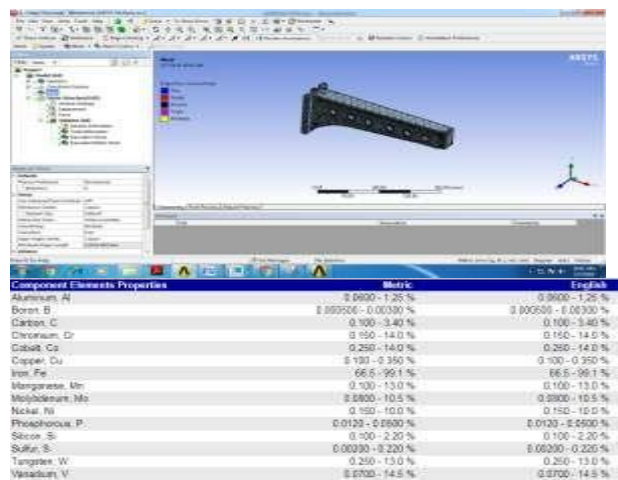


FIG 4.2 MESHEd MODEL

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 →

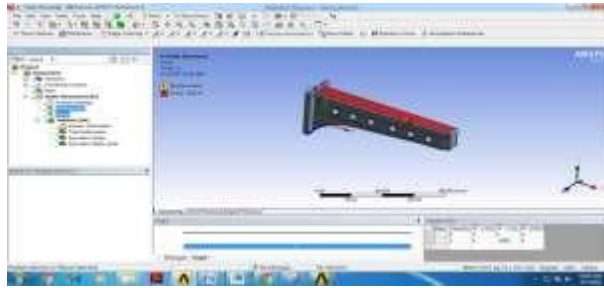


FIG 4.3 BOUNDARY CONDITIONS

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

MATERIAL-MILD STEEL

TOTAL DEFORMATION

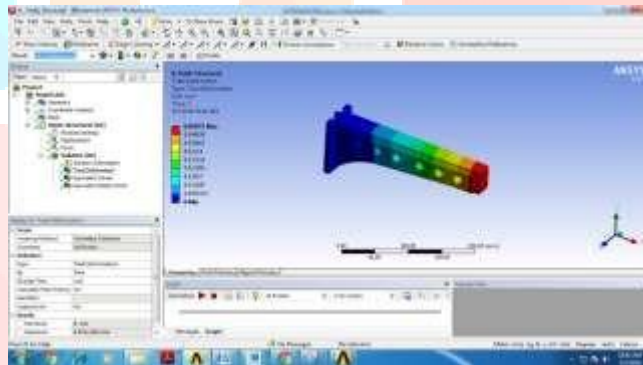


FIG 4.4 TOTAL DEFORMATION OF MILD STEEL

VON-MISES STRESS

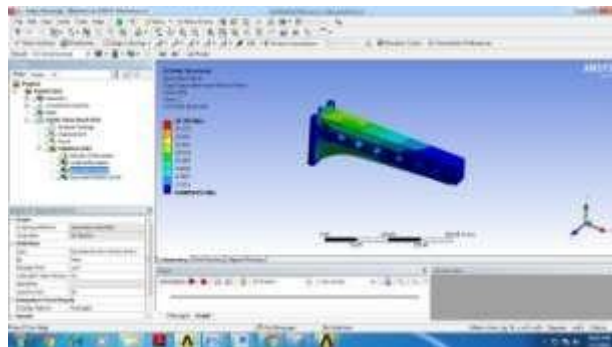


FIG 4.5 VON-MISES STRESS OF MILD STEEL

VON-MISES STRAIN

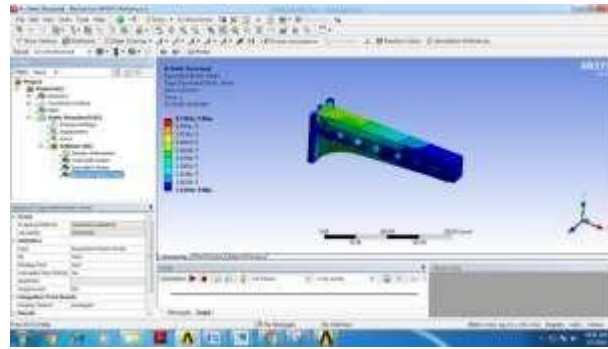


FIG4.6 VON-MISES STRAIN OF MILD STEEL

5.RESULT

STATIC RESULTS

Material	Deformation (mm)	Stress (N/mm 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 RESULTS

Material	Deformation 1 (mm)	Frequency (Hz)	Deformation 2 (mm)	Frequency (Hz)	Deformation 3(mm)	Frequency (Hz)
Mild steel	51.654	589.85	53.367	886.607	43.181	2636.3
EN 31 steel	49.64	586.85	51.286	827.1	43.382	2533.8
EN 8 steel	48.241	559.58	49.841	803.78	44.897	2462.0
Carbon steel	46.955	559.18	48.512	782.36	43.787	2386.3

TRANSIENT ANALYSIS RESULTS

MATERIAL	TIME (SEC)	DEFORMATION(mm)	STRESS(N/mm ²)	STRAIN
MILD STEEL	10	0.0637172	16.058	8.0922e-66
	20	0.0647558	20.554	1.0358e-5
	30	0.0657989	25.051	1.2624e-5
EN 31 STEEL	10	0.0633453	14.453	7.832e-5
	20	0.043856	18.949	9.5491e-5
	30	0.024267	23.446	0.00011815
EN 8 STEEL	10	0.0629758	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	7.9366e-5
	30	0.046834	20.234	0.0010186

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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