Modelling and Simulation of Radial Drilling Machine and Analysis of Drill Bit

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Abstract – In this paper, firstly we have used CATIA V5 R20 software to design parts and developed the model of Radial Drilling Machine and assembled it. Then we did simulation of the model to check the functions of various parts. Later, we have designed the drill bit in CATIA and did analysis of drill bit in ANSYS. In present analysis we have taken three different rake and relief angles to find out the variation in values of total deformation and equivalent stresses for the applied moment. We have done meshing and give boundary conditions for proper result. The purpose of our project is to design such a drill bit which can withstand for long time and give high accurate result and increases productivity.

Keywords– Radial Drilling, CATIA V5 R20, Modeling, Simulation, Drill Bit, Ansys 2014

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I. INTRODUCTION

Drilling machine is one of the most important machine tools in a workshop. It was designed to produce a cylindrical hole of required diameter and depth on metal work-pieces. Though hole can be made by different machine tools in a shop, drilling machine is designed specifically to perform the operation of drilling and similar operations. There are various types of drilling machines:-

(a) Portable drilling machine

(b) Sensitive drilling machine

(c) Radial drilling machine

(d) Gang drilling machine

(e) Multiple drilling machine

(f) Multiple spindle drilling machine

(g) Deep hole drilling machine

II. REDIAL DRILLING MECHINE

(a) Features of Radial Drilling Machine:-

(i) It has largest and most versatile used for drilling medium to large and heavy work-piece.

(ii) Radial drilling machine belong to power feed type.

(iii) The column and radial drilling machine supports the radial arm, drill head and motor.

(iv) The radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor.

(v) The drill head is mounted on the radial arm and moves on the guide ways provided radial arm can also be swiveled around the column.

(b) Main components of Redial Drilling Machine:-

(i) Base

(ii) Radial arm

(iii) Colum

(iv) Working Table

(v) Motor

(vi) Spindle

(vii) Tool Holder

(viii) Base Holder

(ix) Tool Bit

(x) Handle

(xi) Sleeve

(xii) Rotor

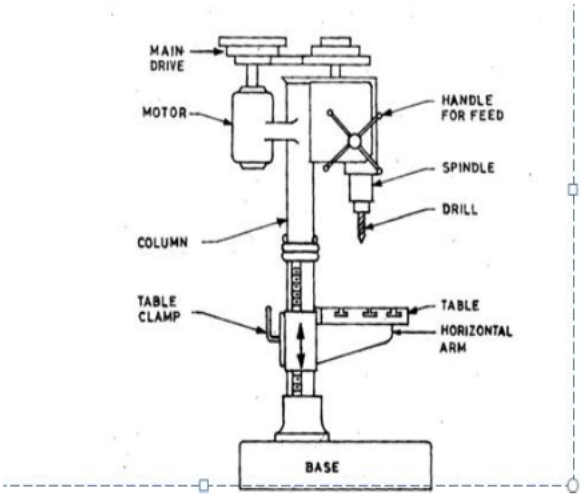


Fig. 1

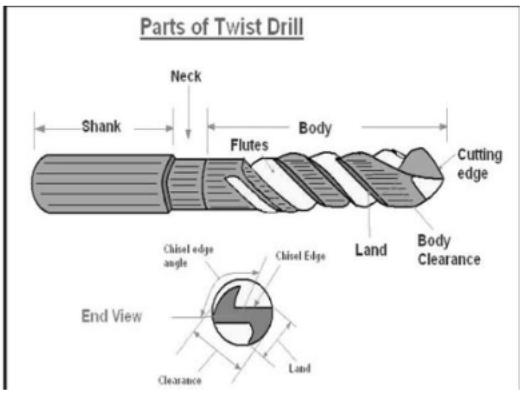


Fig. 2

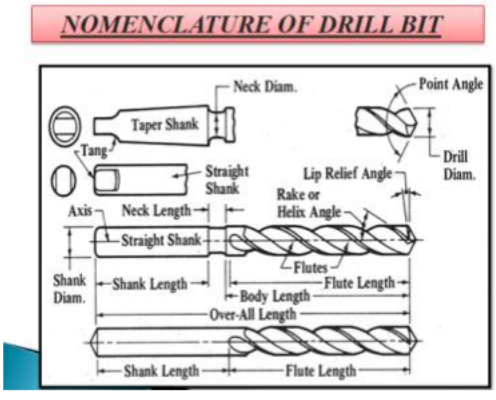


Fig. 3

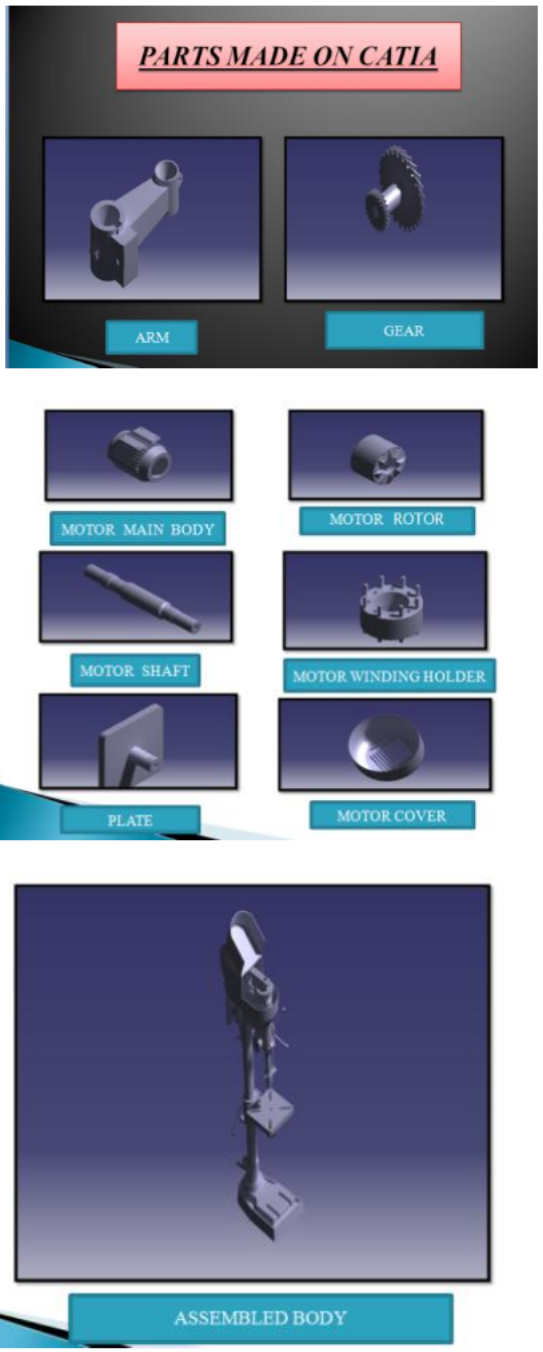


Fig. 4

III. SIMULATION

The act of simulating something first requires that a model be developed then this model represents the key characteristics, behaviors or function s of the selected physical or abstract system or process.

In simulation we have to do fix some parts using fixed joints likes foundations, base etc. And we have to apply different joints in different parts according to degree of freedom of that parts which have relative motion to each other.

IV. JOINTS USED DURING SIMULATION

(a) **Revolute joint** (pin joint or hinge joint) is a one-degree-of-freedom kinematic pair used in mechanisms. Revolute joints provide rotation function used in many places such as door hinges.

(b) **Prismatic joint** provides a linear sliding movement between two bodies, and is often called a slider, as in the slider-crank linkage.

(c) **Rack and pinion** that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion thereby translating the rotational motion of the pinion into linear motion.

(d) **Cylindrical joint** is a two-degrees-of-freedom kinematic pair used in mechanisms. Cylindrical joints provide sliding function as well as rotation, providing a way for two rigid bodies to translate and rotate freely.

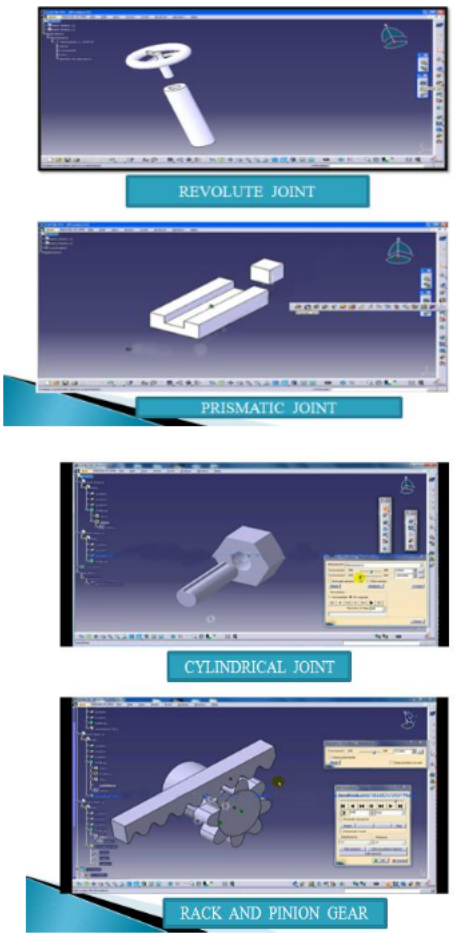


Fig. 5

V. ANALYSIS OF DRILL BIT

The analysis of drill bit has been done in various processes. In analysis, firstly we have to save the CAD file into .step or .its format. Import the geometry in static structural module of Ansys workbench.

After that we add material like high speed steel (HSS) and aluminum alloy from engineering data sources. Now, going to the model & apply different boundary conditions.

Following are the steps of analysis of drill bit are as follows:-

➢Apply the material high speed steel for drill bit and alluminium alloy for work-piece in model .

➢After that give the contact between drill bit and work-piece as frictionless.

➢Now we have done meshing the drill bit and work-piece as shown in fig(a).

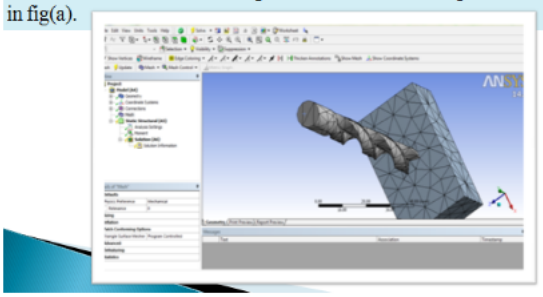
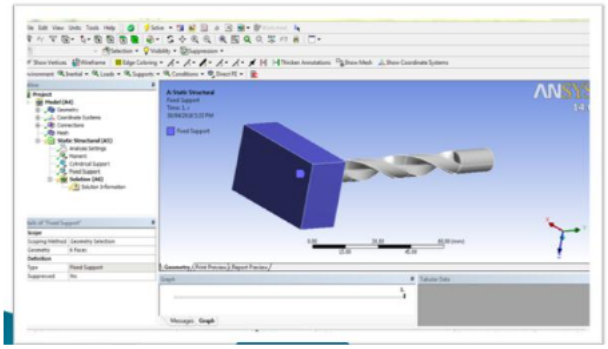
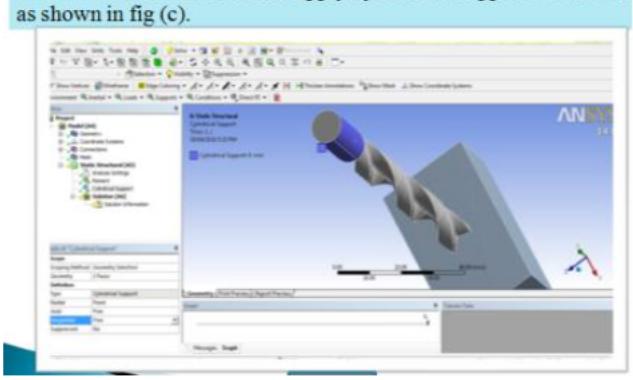


Fig (a)

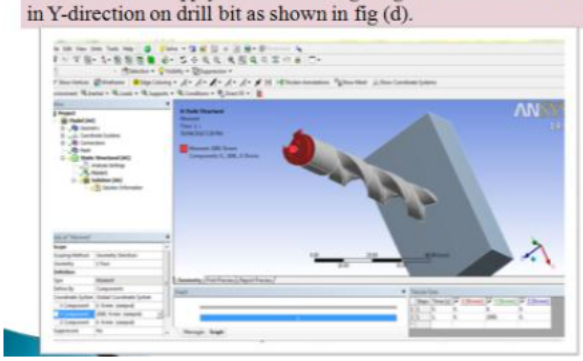
➢ In static structural we have to apply fixed support for work-piece as shown in fig (b).



➢ Now from static structural apply cylindrical support in drill bit as shown in fig (c).



➢ After that we apply moment having magnitude of 1000 N/mm, in Y-direction on drill bit as shown in fig (d).



➢ Lastly, solve the whole process so that we get the total deformation and equivalent stress as shown in fig (e).

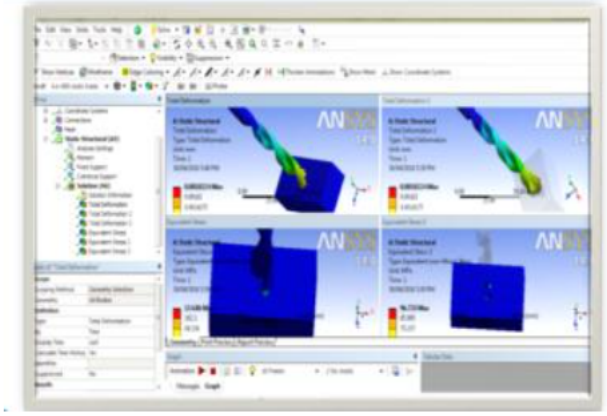


Fig. 6

IV. RESULT

As drill bit have been analyzed under various rack & relief angle and the best result is generated from that we have done the fine meshing of drill bit for proper results. As we have shown the stress and deformation generated at each drill bit with different geometries condition. In the best result i.e. at rack angle 4` and relief angle 10`. In this the colour of the analysis bit shows that the stress & deformation is more in the point angle of the drill bit where it is in contact with the work piece. The moment of 1000N had been given on the drill bit. And the result has been taken out after that.

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