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DESIGN AND ANALYSIS OF SINGLE POINT CUTTING TOOL

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ABSTRACT

The standard feature method is used to study the effect of different angles on the force applied to the instrument in between to cut. Researchers use this method to better understand the mechanisms of chip formation, heat generation in cutting areas, as well as the features of the tool-chip surface collision in mechanized areas. The value of Vonmisses stress decreases as the rake angle increases. In the present study, mesh was created in the ANSYS once boundary conditions are applied and analysis is performed due to the constraints used. Results are calculated in the software and can be verified.

Keywords: Analysis, Design, Research, Software, Stress.

I. INTRODUCTION

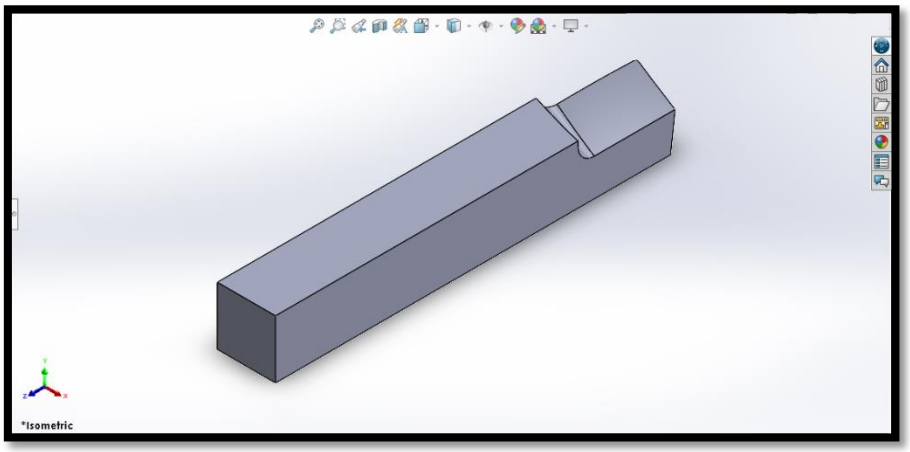
Machining is the process in which a material is cut to a desired final shape and size by a controllable material-removal process. It is the most widespread process for the shaping of metal, it has become a very significant aspect of modern society and industry. Machining is a common fabrication technique in which metal is removed from a part using a tool with a small, hard tip.Over the history of machining, guidelines and conventions have arisen based on empirical information of trade-offs between cutting speed and tool replacement time. Machining is a term covering a large collection of manufacturing processes designed to remove material from a work piece. The purpose of this paper is to provide a review of efforts related to single-point cutting tool and finite element analysis. The review is done to offer insight to how the cutting tool behaves when it is acted upon by various loads.

The use of the software , **ANSYS** has been very helpful for determining the deformation of the cutting tool under the influence of maximum loads.

INTRODUCTION OF SINGLE POINT CUTTING TOOL

The single point cutting tool is used for turning, boring, shaping and planning operations, that is,tool used on Lathes, boring machines, shaper, planer etc. are single point cutting tool.

GEOMETERY (SINGLE POINT CUTTING TOOL)



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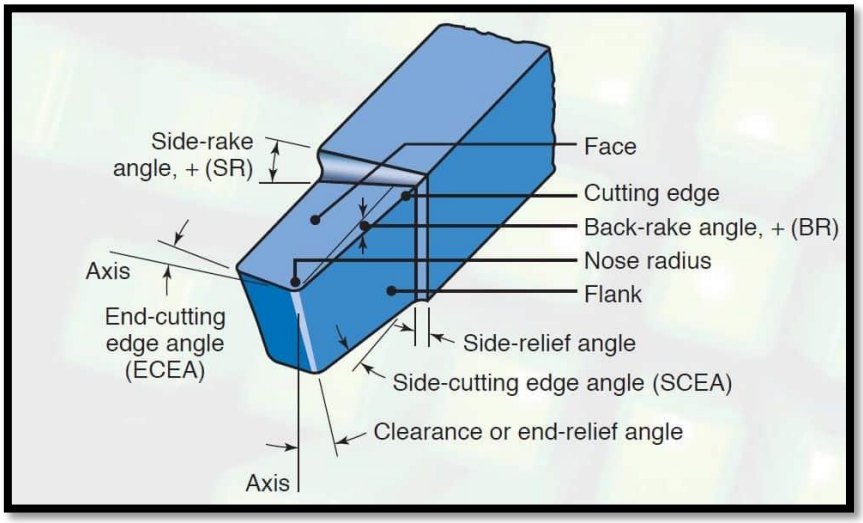

1. Side cutting edge angle:

This angle also is known as the lead angle. This is the angle between the side cutting edge and side of the tool shank.

2. End cutting edge angle:

This is the angle between the end cutting edge and a line normal to the tool shank.

3. Side relief angle:

It is the angle between the portion of the side flank immediately below the side cutting edge and a line perpendicular to the base of the tool and measured at the right angle to the end flank.

4. End relief angle:

It is the angle between the portion of the end flank immediately below the end cutting edge and a line perpendicular to the base of the tool and measured at the right angle to the end flank.

5. Back rack angle :

It is the angle between the tool face and a line parallel to the base of the tool and measured in a plane perpendicular through the side cutting edge.

The back rack angle is positive if the side cutting edge slopes downwards from the point towards the shank and The back rack angle is negative if the slope is side cutting edge is reversed.

6. Side rack angle:

It is the angle between the tool face and a line parallel to the base of the tool and measured in a plane perpendicular to the base and the side cutting edge.This angle gives the slope of the face of the tool from the cutting edge.

II. LITERATURE REVIEW

A review of previous research efforts related to single-point cutting tools and limited feature analysis is presented in it this chapter. There are also reviews of other relevant research studies. Rogério Fernandes Brito, Solidônio Rodrigues de Carvalho, Sandro MetrevelleMarcondes de Lima e Silva, JoãoRoberto Ferreira [1] investigates the effects of heat on cutting tools considering the thickness of the coating and the temperature fluctuations.Diamond tools, K10 substrates, and TiN and Al2O3 coatings were used. Numerical methods are applied usingANSYS CFX software. Numerical analysis involves solid objects with known and consistent boundary conditionsthermophysical properties. The test is used to confirm the proposed operation.

L.B.Abhang and M. Hameedullah [2] analyzed the experimental data to improve the first and second systemmathematical models depending on the parameters of the application using the response area function. Using the appthermocouple technique, EN-31 steel alloy with tungsten carbide inserts was modified. Results analysis is availabledone mathematically and graphically. Metal cutters, speed, feed values, cutting depth, and toolbar radius areproper.

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Maheshwari N Patil, ShreepadSarange [3] explained how tools and temperatures can be calculated for usenumerical model of metal cutting processes. In the test, it is clear that with increasing depthof cut, temperature at tool tip also increased. Moreover, as the power of the tools increases with the depth of cutting, they also increasedepth of cut. Tool failure is mainly due to this problem. Additionally, we see that the tool vibratesabout 2.5 mm in cut depth. Heat is emitted too much in this case, leading to faint tools. The setting is designed to measure power during dynamometer cutting and tool response analysis.

According to Sambhav et al. [4], the standard definition of piercing used in the grinding parameters was straightforwardCAD must be used as opposed to NURBS. However, a mathematical model that includes standard SPCTto facilitate digestion needs to be improved, as described in this paper.

III. MATERIAL AND METHODOLOGY

HIGH SPEED STEELS

High speed tool includes a set of steel alloys called for their cutting capacity faster than traditional high carbon steel tools previously used for cutting tools. This is due to the unusual strength, resistance to scratches and resistance to softness at high temperatures, due to the composite materials and heat treatment used. We follow the American Society for Testing and Materials in describing high-speed steel as given in Specification A600-79 — high carbon steel containing tungsten and / or molybdenum, as well as chromium, vanadium and sometimes cobalt. High-speed instruments (HSS) are likely to continue to be used in the foreseeable future in many applications such as drilling, reshaping, pressing and dying, forming, brushing and grinding due to their comfort which can be molded with both soft materials. and the situation is difficult.

STEEL 4340

AISI 4340 steel (UNS G43400) is a very strong medium carbon low alloy steel, which combines deep durability, high ductility, durability and strength, and has high wear resistance and crawling resistance. It is particularly susceptible to irritation and embrittlement, and shows good energy retention at high temperatures and softens easily. In small parts, the metal is hardened in the air. By doing so, the oil is often extinguished.

IV. MODELLING AND ANALYSIS

Computer-aid design (CAD) uses pc structures (or workstations) for use during arrival, conversion,testing, or format development. CAD software enhances fashion designer product, improves format,helps to communicate and create production details. CAD output remains in state of electronic documents for printing, manufacturing, or various production activities. CADD time (soComputer Aid Design and Drafting) is also used. Its use in designing visual systems is called digital designautomation, or EDA. Mechanical format automation (MDA) or computer-aid drafting (CAD), i.e.the process of creating technical drawings with the help of computer programs, is what we call a machinedesign. The CAD software design system uses both vector-primarily based entirely on shortcutsshow custom draft gadgets, or they can also produce beautiful images that reflect the normal look of gadgets designed.

4.1. INTRODUCTION TO SOFTWARES USED

INTRODUCTION TO SOLIDWORKS

Solidworks, is a three-dimensional modeling software.engineering, design, production, and editing of CAD. CAD programs that use devices based on parameter law tocapture product behavior. These systems use limits, size and power.. Solidworks says it may provide a more efficient building feeling thandifferent modeling software due to its unique capabilities that integrate parameter integration as welldirect modeling in one place. A complete set of applications includes product development,to provide designers with alternatives for all stages of the process. The software system is also greatan excellent customer interface that gives maximum pleasure to designers. In addition it has interpersonal skillsthat makes it easier to share designs and make changes. There are countless benefits of using Solidwporks. We will test them in this feature series.First, the most important advantage is the extended production due to its green design and flexibility.It is finally designed to be easy to use and has the ability to allow formatting methods to move the briefer, creatingan increase in the degree of production of a fashion designer.Another feature is that the software system is available in 10 languages. PTC knows it has someonepeople from all over the world use their software, to provide it in a few languages as well

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INTRODUCTION TO ANSYS

Structural Analysis :-

ANSYS Autodyne is a pc simulation tool for simulating the response of building materials in a nutshell.period of unbalanced loading from impact, high difficulty or explosion. ANSYS Mechanical ANSYS Mechanical is aan analytical device for the limited aspect of structural assessment, as well as direct, indirect and dynamic research. Thispc simulation product provides limited features in version behavior, and assists fabric models and mathematical modelsa wide variety of machine design issues. ANSYS Mechanical also contains hot tests as wellsimilar physics skills in acoustics, piezoelectric, thermal-structural and thermo-electric tests.

Fluid Dynamics:-

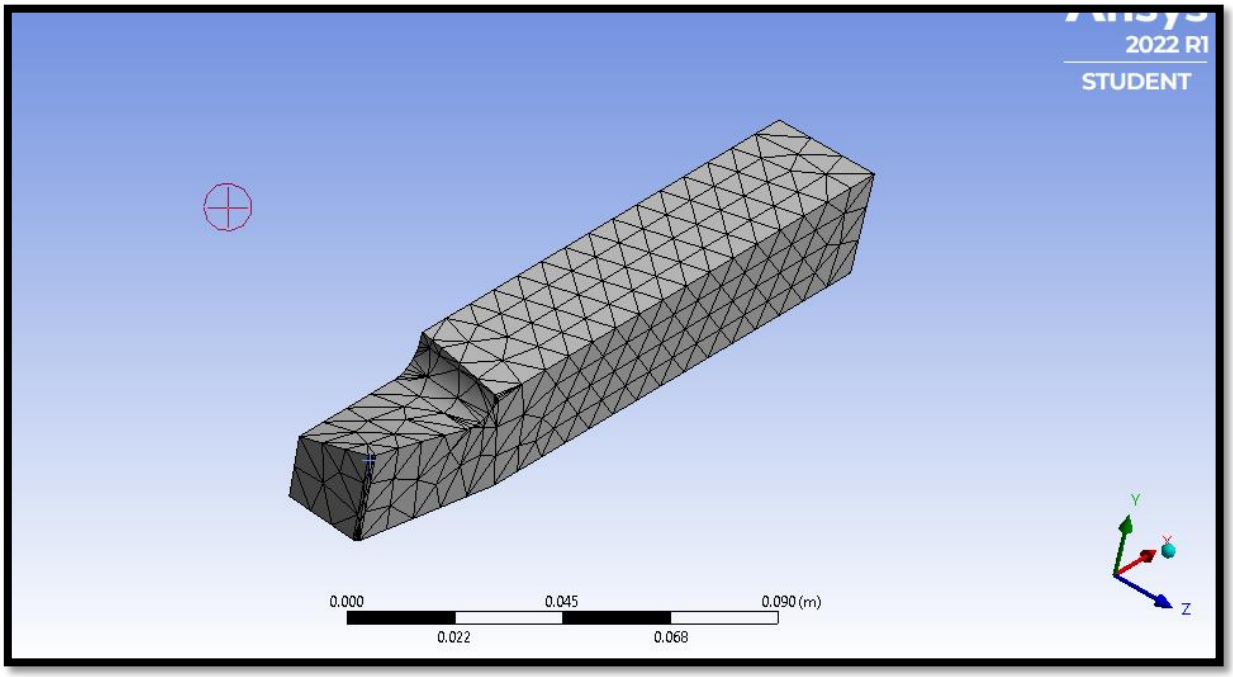
ANSYS Fluent, CFD, CFX, FENSAP-ICE and related software programComputational Fluid Dynamics program material used by engineers for planning and testing. Thisequipment can mimic the flow of fluid in a digital environment - for example, the energy of a liquid in a ship;gas turbine engines (including compressors, fire chamber, mills and afterburners); flightaerodynamics; pumps, lovers, HVAC buildings, mixed vessels, hydro cyclones, vacuum cleaners, and more forward.

Explicit Dynamics :-

Time management method used in the Explicit Dynamics analysis system. It is so named because the way it calculates the answer in the present tense uses clear information Once the body is properly placed, the next step is to define the initial conditions or boundary conditions. At least one first condition is required to complete the setup.After defining the initial conditions (initial velocity, Angular velocity), the analysis setting should be maintained according to the need for the problem. In the case of analysis, time measures should be clearly defined. The timing of the solution depends on the steps of time.

MESHED MODEL

Meshing is one of the most important aspects of getting accurate results from FEA/FEM and CFD simulations.



4.2. DETAILS OF MESH

Element size = 0.01

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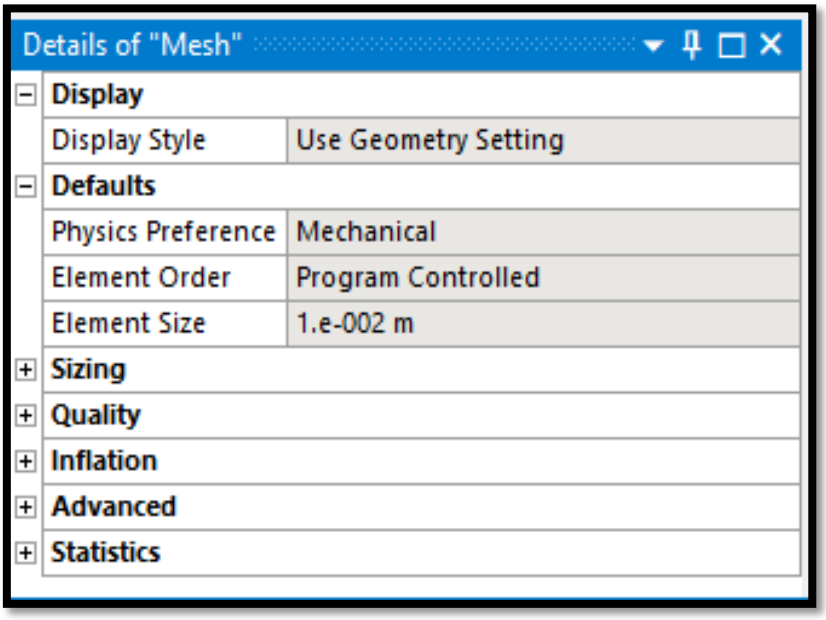
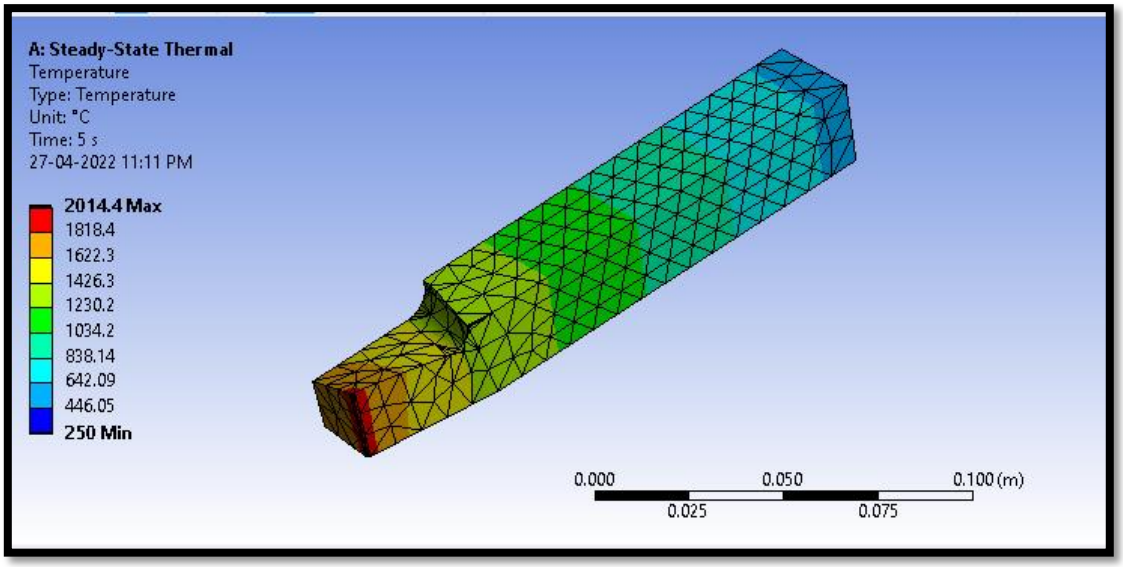


STEADY STATE THERMAL

Solid temperature analysis checks the temperature balance of the system where the temperature remains unchanged over time. In other words, the analysis of the robustness of solidity involves assessing the equilibrium of the system under constant temperature loads and environmental conditions. An easy way to analyze the solid state is to analyze the line position in which input parameters, such as material structures, are determined by independent variables.



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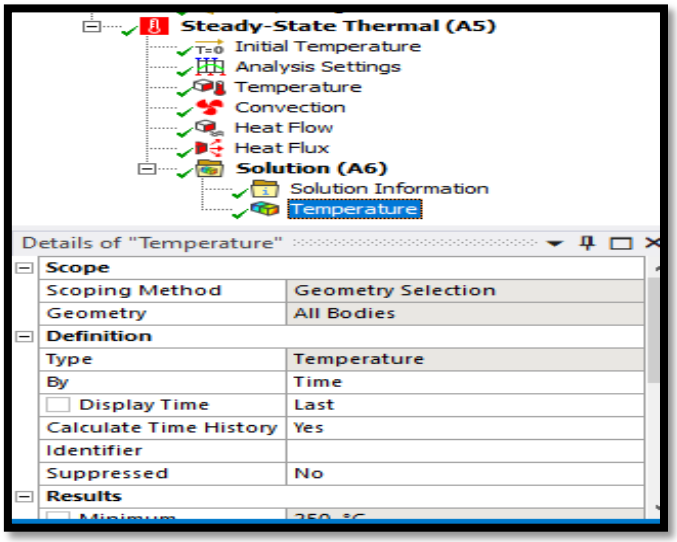
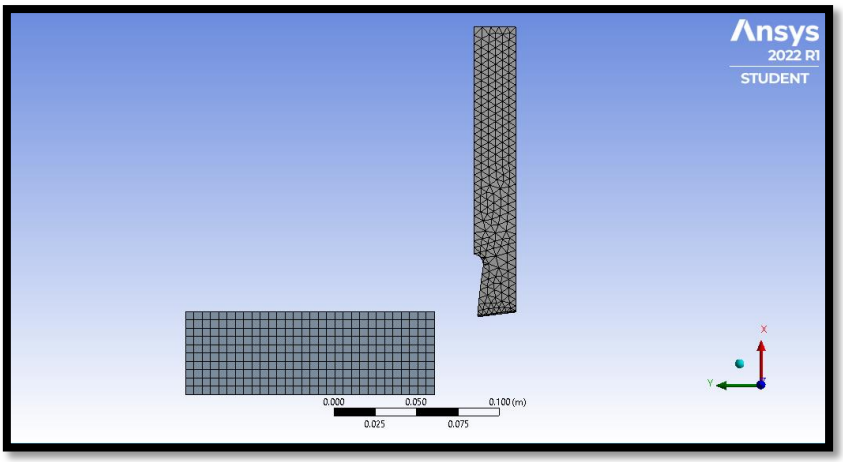


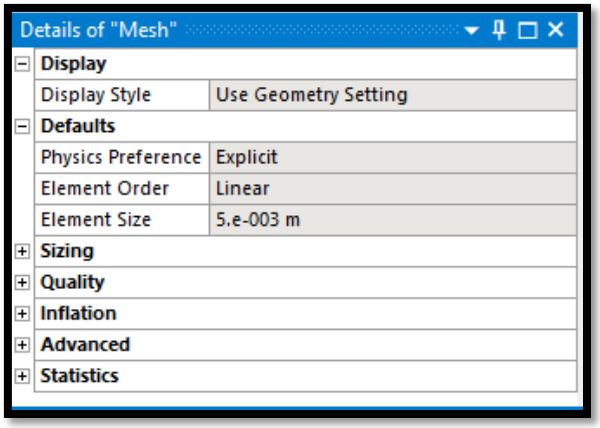
CUTTING OPERATION

Cutting is manufacturing by removal of material. Material particles, chips, are mechanically extracted from raw material or unfinished part by cutting the edges of the tool. The tool has one or more cutting edges, which can be geometrically defined by number, shape, and shape (cutting with cut-out-cut geometric edges), and in the process of damaging chips separation occurs with multiple cutting edges that have to be mathematically defined. and which are distributed randomly within the tool (cutting with geometric cutting edges). Figure shows the cutting processes.



Material of single point cutting tool -> HIGH SPEED STEEL

Material of workpiece -> STEEL 4340



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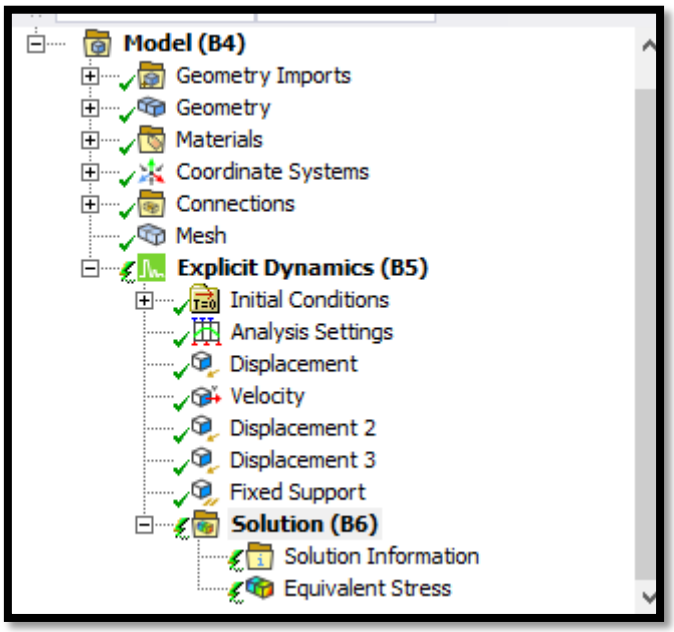
OUTLINE TREE

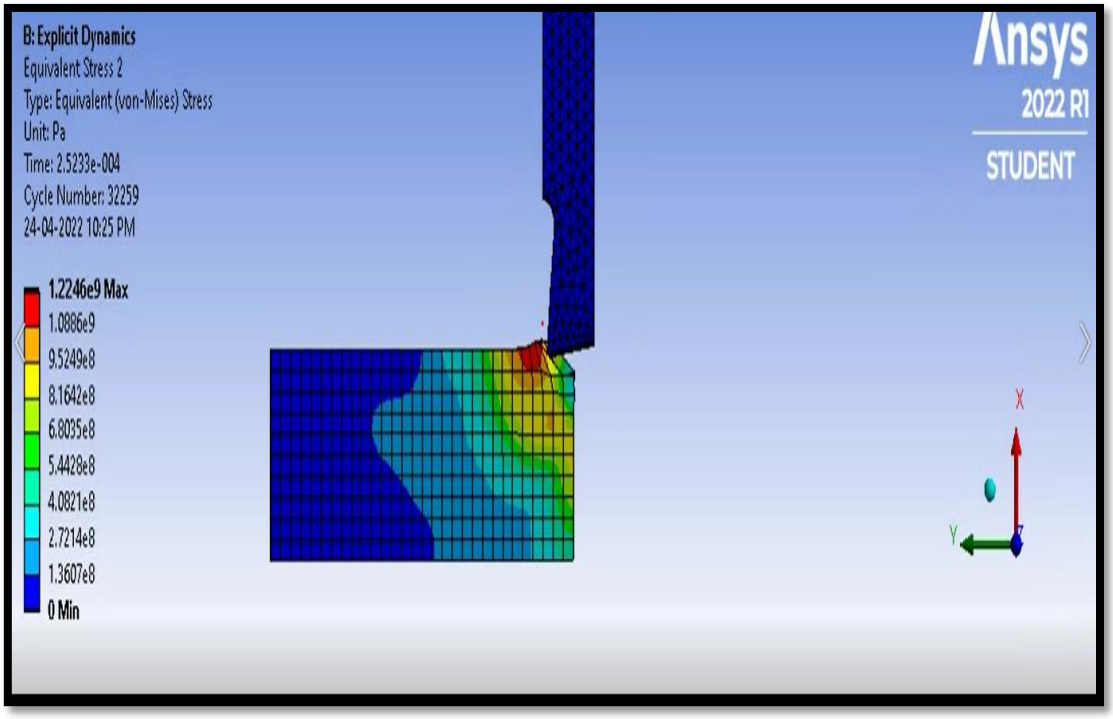


EQUIVALENT STRESS

Equal pressure is actually the result of a shear strain power output per unit measured at different points in the emphasis and helps determine the probability of the failure of the said objects in terms of Von Mises failure. It is often used for ductile substances.

$$\sigma_v = \sqrt{\frac{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2)}{2}}$$

STRESS



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V. CONCLUSION

In our study the design, optimization and analysis of single point cutting tool was carried out with consideration of parameters like stress, equivalent stress, steady state thermal using various softwares like solidworks and ansys. The analysis part contains various operations and analysis like cutting operation depicted clearly and the thermal analysis part whose animations are given. We get to know how single point cutting tool is made, what are materials and procedures in single point cutting tool and how it works.

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