OPTIMISATION AND ANALYSIS OF ALLUMINIUM ALLOY USING END MILLING.

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ABSTRACT

In this study the end milling is used to optimize and analyse the aluminium materials using different parameters, like speed, feed, depth. This influence is usually reflected in other variables and parameters (output), such as, among others, forces, temperature, tool life and tool wear. Cutting force is one of the most relevant output variables since the information that can provide for the machining process evaluation. So the material is analyzed and optimized using the analysis software and optimization software, and to obtain the result according to the inputs of speed, feed, depth given

Keyword:-*End milling, Aluminium material, analysis, optimization*

1. INTRODUCTION

The end milling input parameters play a very significant role in determining the quality of machining. Generally all end milling processes are used with the aim of obtaining a product with the desired machining quality, minimum surface roughness, cutting force, vibration amplitude, temperature and tool wear. The literature survey also gives collective information about various methodologies employed for conducting experiments, application of artificial neural networks for developing predictive models and optimization of process parameters using nontraditional optimization techniques with respect to various machining processes. The dynamometers are mounted between the tool or workpiece and non rotating part of the machine tool structure. A coordinate system can be used to resolve the cutting forces into directional components. In the milling process, force components are related to the axes of motion of the machine tool.

One method presented in this article is an experimental design process called the Taguchi method. Similar to DOE , the Taguchi method is a technique for optimizing a process or design using multiple parameters. A researcher should always fully understand the various experimental methods in order to properly apply them to individual studies to maximize both the efficiency and the result of a study. The complete Taguchi methods are actually comprised of three main phases , which are all intended to be conducted offline . These three phases include system design , parameter design, and tolerance design. The Taguchi parameter design stage , which is the phase used in study, is commonly referred to here. This phase requires that the factors are known ant that production should be in progress. The major goal of this phase is to increase the performance of the production process by adjusting the controlled factors.

2.OBJECTIVE

The main objective of the proect work are:

- To perform End milling on Aluminium plate
- To analyse the aluminium plate using the parameters

- To optimize the aluminium material obtain the optimization result using optimization software

3. EXPERIMENTAL WORK

3.1. END MILLING

The end milling process is similar enough to conventional milling that the introduction of this process into the normal factory environment can happen with relativley small operational changes when the proper elements have been addressed. End milling is best accomplished with cutting inserts made from carbide inserts. Since end milling is single point cutting, a significant benefit of this process is the capability to produce contours and to generate complex forms with inherent motion capability of modern machine tools.

High quality end milling applications do require a properly configured machine tool and the appropriate tooling. For many applications, Carbide tooling will be the most dominant choice. However, ceramic also have roles in this process. The range of applications for end milling varies widely, where in some cases end milling serves as a grinding replacement process and can also be quite effective for pre-grinned preparation processes. The attractiveness of the process lies in the performance numbers.

3.2. ANALYZATION AND OPTIMIZATION

3.2.1. PRO\ENGINEERING

Pro/ENGINEER is a computer graphics system for modelling various mechanical designs and for performing related design and manufacturing operations. The system uses a 3D solid modelling system as the core, and applies the feature-based, parametric modelling method. In short, Pro/ENGINEER is a feature-based, parametric solid and surface modelling system with many extended design and manufacturing applications. Pro/ENGINEER is the first commercial CAD system entirely based upon the feature-based design and parametric modelling philosophy.

3.2.2. ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. The software implements equations that govern the behaviour of these elements and solves them all, creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated, or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex to analyse by hand. Systems that may fit into this category are too complex due to their geometry, scale or governing equations.

ANSYS is the standard FEA teaching tool within the Mechanical Engineering Department at many colleges. ANSYS is also used in Civil and Electrical Engineering, as well as the Physics and Chemistry departments.

ANSYS provides a cost-effective way to explore the performance of products or processes in a virtual environment. This type of product development is termed virtual prototyping.

3.2.3. TAGUCHI TECHNIQUE

One method presented in this article is an experimental design process called the Taguchi method. Similar to DOE , the Taguchi method is a technique for optimizing a process or design using multiple parameters. A researcher should always fully understand the various experimental methods in order to properly apply them to individual studies to maximize both the efficiency and the result of a study. The complete Taguchi methods are actually comprised of three main phases , which are all intended to be conducted offline . These three phases include system design , parameter design, and tolerance design. The Taguchi parameter design stage , which is the phase used in study, is commonly referred to here. This phase requires that the factors are known ant that production should be in progress. The major goal of this phase is to increase the performance of the production process by adjusting the controlled factors.

4. ANALYZATION

The second phase of design of experiments is conducting phase. In conducting phase experiment are conducted for the selected process parameter combinations at a random order. The conducting phase involves the following tasks.

1. Preparation of work piece
2. Procurement of tool
3. Conducting experiments
4. Measuring speed, feed, depth of cut

Different sets of machining conditions experiments are conducted in order to obtain the cutting forces and temperatures. For measuring cutting forces nine set of experiments were conducted as per DOE (Design of Experiments). The work material is fixed to the chuck and the job is centered. The insert is clamped to the tool holder and the necessary settings are made.

The work material is AISI 52100 Alloy Steel (En31).

Dimension of Aluminium Plate: 150*50*4 (mm)

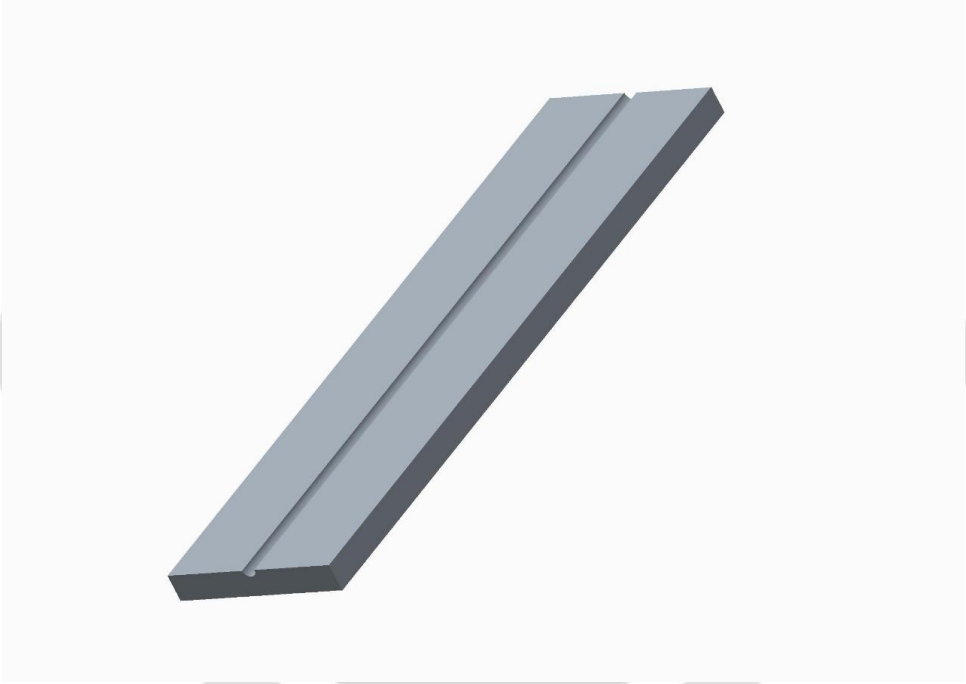


Chart-1. Design of aluminium plate in PRO\ENGINEERING

The multifaceted nature of ANSYS also provides a means to ensure that users are able to see the effect of a design on the whole behaviour of the product, be it electromagnetic, thermal, mechanical etc.

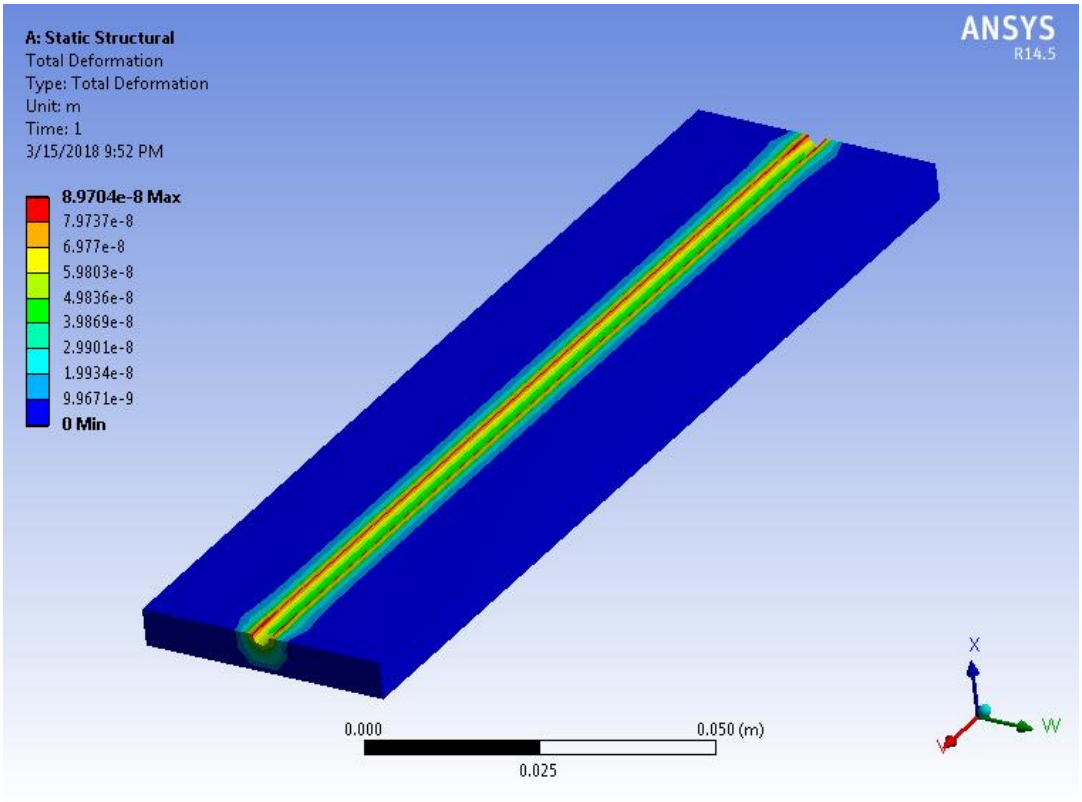


Chart-2. Analysis on ANSYS (STRUCTURAL)

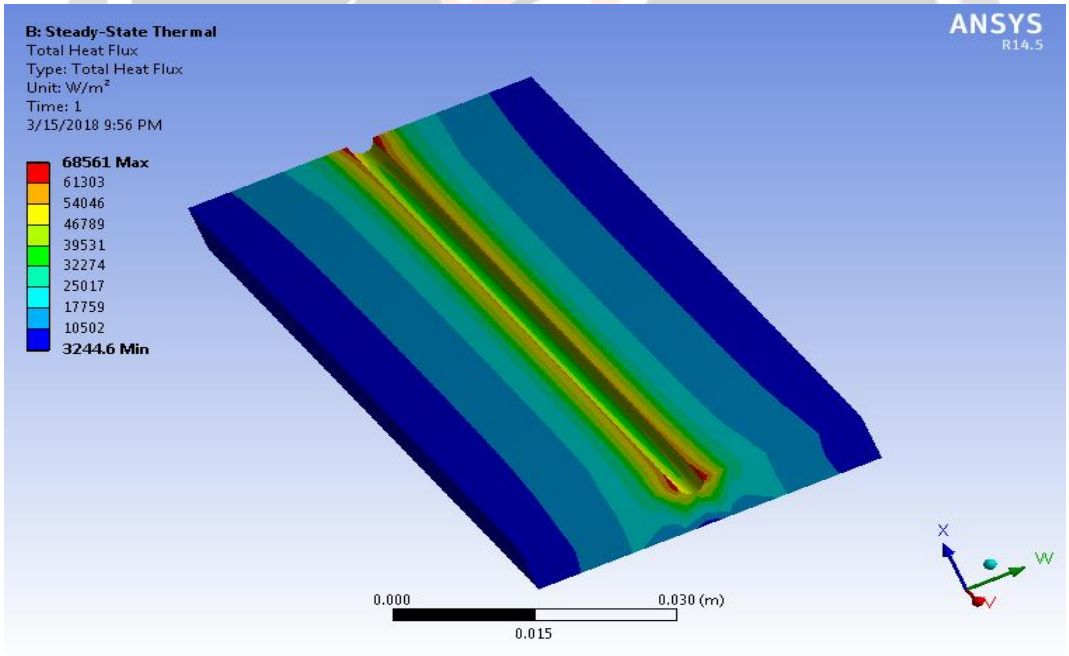


Chart-3. Analysis on ANSYS (THERMAL)

4. RESULT

4.1 VALIDATION OF CUTTING FORCES

1. From the Post-Processor values, cutting forces are calculated for the simulations involving following machining parameters.

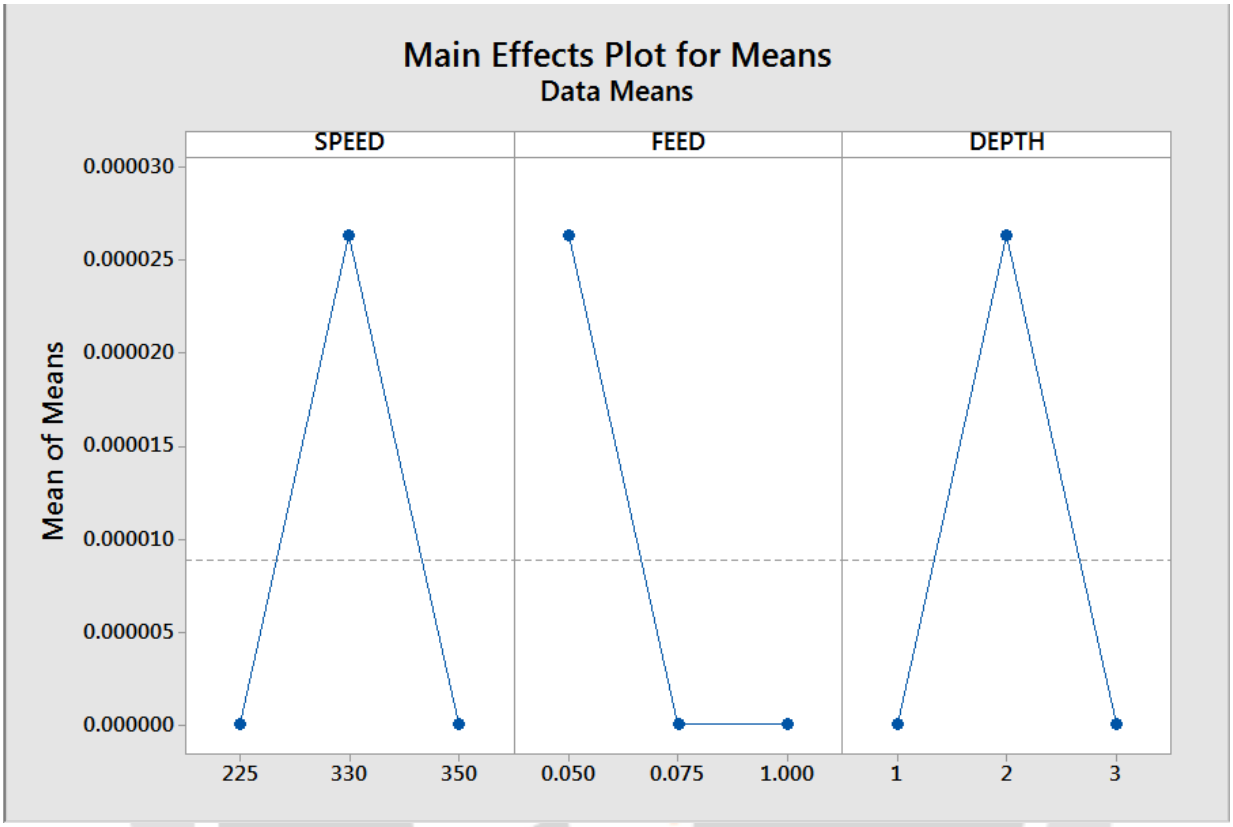
Table 4.1 Cutting conditions and simulated forces

S.NO	SPEED	FEED	DEPTH	LOAD	DEFORMATION	EQUIVQLENT STRESS
1	225	0.05	1	20.53	8.97E-08	3.92E+06
2	225	0.075	2	29.67	8.52E-08	3.72E+06
3	225	1	3	37.34	1.01E-07	4.40E+06
4	330	0.05	2	25.67	7.89E-05	3.45E+06
5	330	0.075	3	32.56	1.10E-07	4.82E+06
6	330	1	1	41.33	1.03E-07	4.50E+06
7	350	0.05	3	29.68	1.10E-07	4.42E+06
8	350	0.075	1	37.12	7.40E-08	3.23E+06
9	350	1	2	45.89	1.15E-07	5.01E+06

THERMAL RESULT

S.NO	SPEED	FEED	DEPTH	THERMOCOUPLE READING	TOTAL HEAT FLEX	TEMPERATURE
1	225	0.05	1	358	6.86E+04	3.53E+02
2	225	0.075	2	430	6.30E+04	3.26E+02
3	225	1	3	509	5.53E+04	3.26E+02
4	330	0.05	2	396	6.71E+04	3.46E+02
5	330	0.075	3	371	7.55E+04	3.86E+02
6	330	1	1	534	5.42E+04	3.08E+02
7	350	0.05	3	445	7.10E+04	3.65E+02
8	350	0.075	1	513	6.77E+04	3.49E+02
9	350	1	2	554	7.39E+04	3.79E+02

TEMPERATURE



CONCLUSION

In this study the aluminium plate has been used for analysis and optimization by using end milling has been made and the result about the experiment can be determined by the parameter and different inputs of speed, feed, depth of cut of the aluminium plate.

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