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DYNAMIC SIMULATION ON TOOL IN TURNING PROCESS USING DEPTH OF CUT VARIANCE USING ANSYS

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ABSTRACT

High Speed Steel (HSS) is one of the most used material for making lathe tool, because of its ability to work under high rotation and friction condition without losing its mechanical properties significantly. On turning process, careful decision of machining parameters that matched its tool material ability for turning. In Simulation process, machining parameters which will be used in it had been researched by Pramod, Kumar, et al., (2014) with adjustments. Machining parameters are feed rate at 0.24 mm/rev, spindle rotation at 1500 rpm, and main cutting angle are orthogonal cutting angle at (90). In this simulation, the writer using depth of cut variance of 1 mm, 1.5 mm, and 2 mm. purposes of using these varies cuts are to find frequency and amplitude had occurred on lathe tool with different depth of cut.

Keywords: Harmonic Response, Simulation, HSS, ANSYS

1. INTRODUCTION

Machining process technologies developing within time. Because of that, increasing efficiency of production process must be done. Lathe Machine is one of tool the manufacturers used in machining process and have purposes to making a product. For better result in product, it need some special skills and economic aspects for achieving maximum results and cut production cost. If any of its requirements above is not meet, products will get less demand, and it get unsatisfactory result when it still selling in market, because the product did not achieve the standard.

Near perfect-cylindric part is one of the well-machining result characteristics, and planning machining process step is must be done. For that, we must know cutting parameters like feed rate and spindle rotation speed for turning a material, because with higher feed rate and spindle rotation speed, we will get better result and near-perfect cylindric part.

Tool's material failure because vibration when starting the lathe machine. Vibration is happen when frequency value and deflection on tool exceed its maximum value, making it will break. Accurate prediction in tool's failure is the most thing to be considered in turning process. Because of that, calculations and researches must be done in order to know tool's deflection happen when it vibrates.

Research about critical depth of cut and critical feed rate selection on Al 6061 orthognal turning process, Alfian (2013) said that good chip geometry on turning process is a discontinous chip, when continous chip will resultingdid not meet the standard. selecting cutting parameters like depth of cut and feed rate is one of the things to be considered to produce discontinous chip. Depth of cut is most important thing in machining process, especially on tool, Because it will affects deflection itself. On this research, we must select frequency value used in AISI 1045 medium carbon steel as workpiece and HSS used as tool.

Taufiq Rohim (1993) said that on machining process are consisted by systemically other processes for making product, started by material that has been prepared, and then produces functional components. Engine component must have ideal geometrical characteristics for each uses on engine, and also must have exact dimension, perfect form, and smooth surfaces.

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Lathe Machine is a production tool which is used for cutting cylindric part. On this process, workpiece is attached on chuck, where it placed at spindle. Workpiece cutting process on Lathe Machine had done by rotating the workpiece and attached cutting tool are moved to touched the rotating workpiece with axes of each other are parallel, are called Relative Cutting Movement (Rochim, 2007).

On turning process, there are some parameter which are be considered, such as:

1. Cutting Speed
2. Feed Rate
3. Depth of Cut
4. Cutting Time
5. Chip Producing Speed

Lathe tool material must have higher toughness than workpiece toughness, so cutting side of tool have resistance to cutting the workpiece, and it must be ductile in order to keeping cutting side can not easily break and resisting to heat. Some of most used tool material are non-ferro alloyed steel, alloyed high carbon steel like HSS, carbides, diamond, and ceramic. (Dieter, 1988)

Model consisted by informations about anything that related to actual system. Model can be a replicate of actual thing, system, or event which are consisted by useful informations only.

Model that had made are purposed to:

1. Help on thinking, because model are systematic descriptions that can be easy to learn about that system.
2. Make easy-to-describe system when described it to people.
3. Tool for sharpen skill.
4. Prediction tool from influences that is want to know if there is a system changing in the future.
5. Help on experiments.

Simulation is a designing a model from actual system process, where it will used for experiments and then evaluating the results. Below of these are advanteges of using simulation:

1. Describes system behaviours
2. Replicates the system process using a digital model.
3. Solves mathematical problems with numerical analysis.
4. Gives system behaviours description within time.
5. Builds theory or hypotheses which is responsible by system behaviours.
6. Predicts system behaviours which will be coming that influencing the results given or operation changes.

Dynamic behaviors from a learned system with researching any variances from any system conditions as a function. Afterwards, we collect and analyze statistic system. Event that occurs and changes system condition and shortcut within represented time as internal clock which is built in simulator. (Silberschatz, & Peterson, 1988)

2. METHODOLOGY/ EXPERIMENTAL

On this research, we must make a research methodology that using ANSYS 15.0 in order to know harmonic response on AISI 1045 workpiece turning process. Strarted by making the model until making the result report from this research, where this flowchart is showing on figure 1:

Model that used on this simulation are lathe tool. For making this model, we used Autodesk Inventor 2016 for convinient use. Making model process has done by in several steps from sketching the model for used on simulation, then selecting geometry selection. Model geometries are showing on table 1:

Table 1. Tool Geometries

Tool Height	13 mm
Tool Length	101,6 mm
Tool Thickness	13 mm
Rake angle	5^o
Clearance angle	10^o

On this simulation process, where the machining parameters used on this simulation is based on earlier researches that has been done by Pramod Kumar, et al., (2014) with some customization. Machining parameters are showing on table 2:

Table 2. Machining Parameters (Soe, et al., 2012)

Feed rate	0.24 mm/rev
Depth of cut	1 mm, 1,5mm, 2mm
Spindle Speed	1500 rpm
Main Cutting Angle	90^0 (orthogonal)

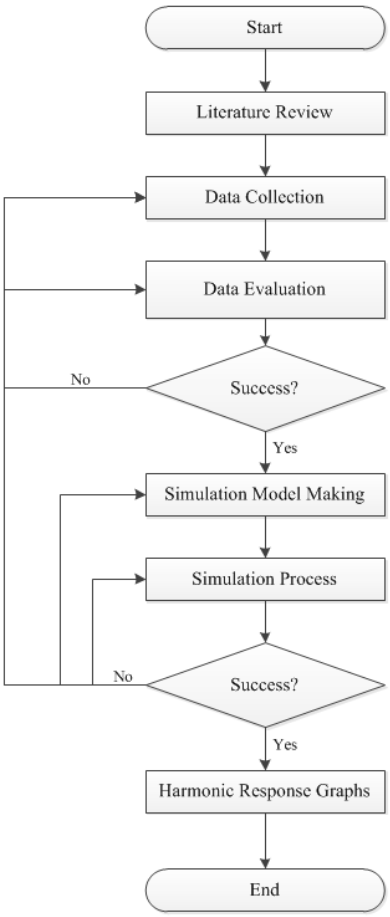

Figure 1. Research Flowchart

3. RESULTS AND DISCUSSION

Simulating turning process is had be done with three different depth of cut, which is 1 mm, 1,5 mm dan 2 mm. Simulation is done to know the impact that occuring on tool, where this simulation had done by different depth of cut. These results are showing on figures and graphs below:

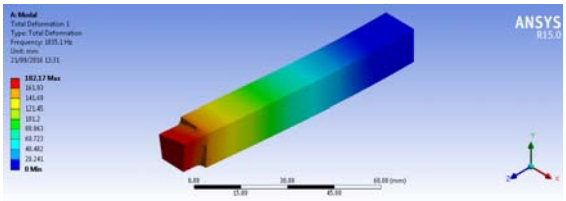

Figure 2. Total Deformation 1

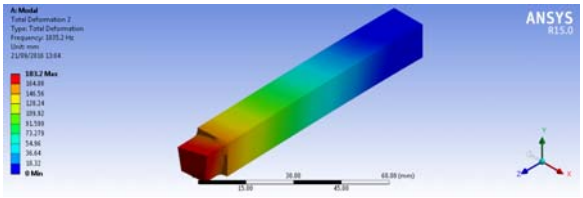

Figure 3. Total Deformation 2

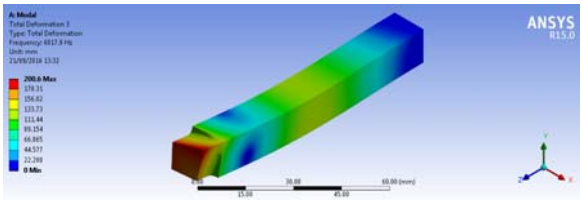

Figure 4. Total Deformation 3

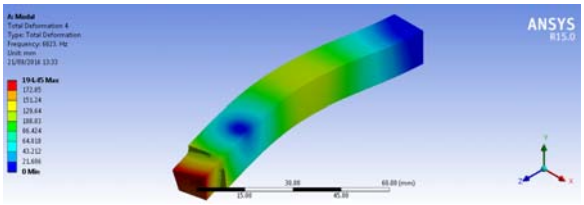

Figure 5. Total Deformation 4

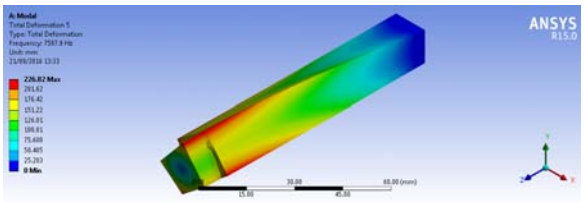

Figure 6. Total Deformation 5

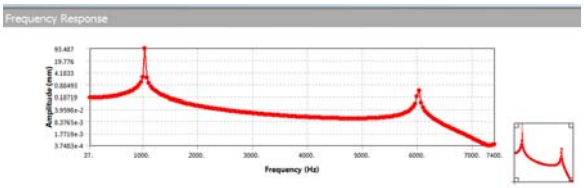

Figure 7. Graph of 1 mm Depth of Cut

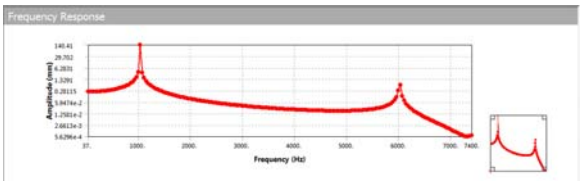

Figure 8. Graph of 1,5 mm Depth of Cut

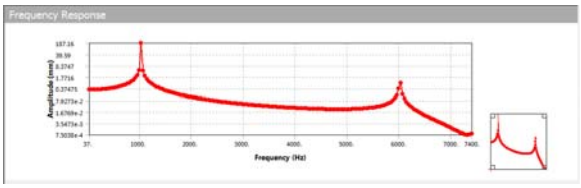

Figure 9. Graph of 2 mm Depth of Cut

These graphs representing frequency value in simulation have same values, but with different value of amplitude, where A_1 is 93 mm, A_2 is 140 mm and A_3 is 187 mm, where are showing on Table 3:

Table 3. Simulation Result of Harmonic Response

NO	Deep of Cut (mm)	Frequency (Hz)	Amplitude (mm)
1	1 (Fc = 518,92 N)	1036	93
2	1,5 (Fc = 778,38 N)		140
3	2 (Fc = 1037,85 N)		187

4. CONCLUSION

By the results of simulation, we can conclude that:

1 Cutting force on 1 mm depth of cut is 518,92 N. Cutting force on 1,5 mm depth of cut is 778,38 N. Cutting force on 2 mm depth of cut is 1037,85 N.

2 On this turning process simulation, we get result, where in every depth of cut that has been used in simulation have same frequency value, but with different value of amplitude for each depth of cut. Value of amplitude on 1 mm depth of cut is 93 mm. Value of amplitude on 1,5 mm depth of cut is 140 mm. Value of amplitude on 2 mm depth of cut is 187 mm.

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