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Experimental Results of Machining EN8 steel using VMC Machine

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***Abstract*-- Steel is an alloy of iron and other elements. Its primary element is carbon. It has high tensile strength and low cost. So it is major component in automobiles, ships, buildings, tools, infrastructure, buildings weapons and different appliances. Iron is the base metal of steel due to which steel is able to take two crystalline forms : BCC and FCC depending upon its temperature. In typical steel alloys carbon may contribute upto 2.1% of its weight.**

The machine parameters used in milling operation are concerned with manufacturing environment. Here in this research we have undergone experimental record of the machine performance using various depth of cut cutting speed and feed using face milling cutter. Taguchi design of experiments and analysis of variance (ANOVA) were used for surface roughness. (S/N) signal to noise ratio was used to identify the machine parameters. Experimental results show that the cutting speed plays a dominating role in surface roughness in milling parameters.

***Keywords*— EN8 Steel, Feed, Depth of cut ,Taguchi Methodology, SN Ratio, ANOVA**

I. INTRODUCTION

EN8 steel is a very popular grade of medium carbon steel. It is machinable in any condition i.e suitable for high tensile strength and wear resistant components. It contains good homogenous metallurgical structure and very good machine and mechanical properties. Very few researches have been done using side and face milling cutter in hardened steel.

II. EXPERIMENTAL DETAILS

The tests were conducted on VMC having maximum speed 1450rpm and 25kw drive motor. No cutting fluid was used.

*Milling Cutter***:** A tool holder with 125 mm side and face milling cutter was used in this experiment.

Cutting rake angle 10º , axial angle 20º radial rake angle 5º.

Table 1
Specification Of VMC

Diameter of milling arbour	25.5 mm
Working surface	1372× 305 mm
No. of longitudinal feeds	3(18.51) P/M
Spindle Motor	3 H.P/1440 RPM
Feed Motor	3 H.P/960 RPM
Coolant Motor	1/10 H.P

A flat plate of EN8 steel having 55mm × 12 mm thickness is taken. Its Hardness is 255 Brinell.

Surface Roughness Tester: MITUTOYO SURFACE TESTER SI 201P having cut of length 0.25-25mm with diamond stylus is used for the measurement of the surface roughness values.

Table 2
Mechanical Properties Of EN8 Steel

Max Stress	Proof Stress	Yield Stress	Elongation	Impact strength
850N/mm^2	450 N/mm^2	465N/mm^2	16%	28j

Figure 1 : Surface Roughness Tester

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Table 3
Chemical Composition Of EN8 Steel

C	Mn	P	S	Si
0.44	1.0	0.5	0.05	0.40

Methodology:

1. Give the Problem Statement
2. State the objective of the experiment
3. State the quality characteristics of measurement system
4. State the factors that influence the selected quality characteristics.
5. Find the quality and noise factors.
6. Choose proper orthogonal Arrays and locate interactions.
7. Conduct the test described in trials of orthogonal arrays and locate interactions.
8. Analyze and interpret the result of experimental trials.
9. Conduct the experiment.

III. Design Of Experiment

There are three level which are specified for each factor which are indicated in table.

The first column shows cutting speed (Vc). The second column specifies feed rate (f) and third column shows depth of cut (d). A test for each combination was performed resulting in 9 experiments,which allows the analysis of variance in result.

Table 4.
L9 Orthogonal Array

Test No	Cutting Speed (Vc)	Feed Rate (f)	Depth Of Cut (d)
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

IV. Taguchi Method

Taguchi process is a very powerful tool in the optimization of quality.

I makes use of design of orthogonal array (OA) to examine the number of experiments used to design the orthogonal array for the three parameters i.e Cutting Speed, feed rate, and depth of cut for each parameters at three different levels.

The parametric optimization, no of experiments to be conducted was calculated as:-

Minimum Experiments= [(L-1)× P]+ 1
= [(3-1)×3]+1=7≈ L9

The S/N Ratio of the smaller the better can be expressed as:

S/N =-10 log1/j×Y×i∧2

Where, j is number of repetition of experiments
Yi is the average measured rate of experimental data.

V. Results And Discussion

It can be concluded that the spindle speed is a very significant factor and contributes more on the surface roughness of EN8 Steel plates. It was predicted that the bigger difference in S/N ratio shows more effect on surface roughness.

S/N ratio result values of mlling parameters were analysed by variance method which consists of (DOF)degree of freedom, (S)sum of square, (V) variance, (F) variance ratio and P (significant Factor). Most significant values were selected by 5% (. = 0.05) from this main effect interaction when we plot values of milling parameters show that the low plot values of milling parameters predict the low value of surface roughness as indicate at spindle speed of 290m/min, depth of cut 0.4mm and 0.27/mm/rev were the best combination.

Table 5
Surface Roughness Values For EN8

Test No.	Cutting Speed(Vc) m/min	Feed Rate(F) mm/Rev	Depth of Cut (d) mm	Surface Roughness(Rd) µm
1	180	0.125	0.4	0.780
2	180	0.170	0.8	0.751
3	180	0.275	1.2	0.791
4	280	0.125	0.8	0.733
5	280	0.170	1.2	0.745
6	280	0.275	0.4	0.691
7	400	0.125	1.2	0.727
8	400	0.170	0.4	0.694
9	400	0.275	0.8	0.698

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Table 6
S/N Ratio(Smaller The Better)

Level	Cutting Speed	Feed	Depth of Cut
1	2.272	2.579	2.893
2	2.818	2.743	2.769
3	0.030	2.798	2.458
Delta	0.758	0.219	0.435
Rank	1	3	2

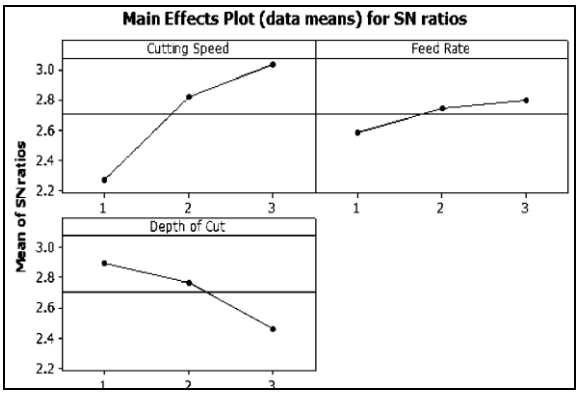

Figure 2 : S/N Ratio for Milling Parameters, Signal to noise: smaller is better

Table 7
Analysis Of Variance For Surface Roughness Of EN8

Sources	DF	Seq SS	Adj SS	Adj Ms	F	P
Cutting Speed	2	0.0066297	0.0066286	0.00331422	12,13	0.075
Feed Rate	2	0.005006	0.0005006	0.0002502	0.91	0.522
Depth Of cut	2	0.002124.5	0.0021246	0.0010622	3.88	0.204
Error	2	0.0005461	0.0005461	0.0002731		
Total	8	0.0098000				

VI. CONCLUSION

1. At 285m/min cutting speed, 0.27mm/rev feed and depth of cut 0.4mm low surface roughness is obtained.
2. The significant factor that influences the surface roughness in milling is cutting speed.
3. Side and face milling cutter is suitable for EN8 steel which produces good surface finish with required accuracy.
4. As compared to the conventional machining processes like shaping, turning the milling process is better for machining EN8 Steel.

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