FABRICATION OF EN 9 ROUND BAR USING CENTER LATHE MACHINE AND CALCULATING ITS TENSILE STRENGTH UNDER UNIVERSAL TESTING MACHINE

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Abstract: Fabrication of raw material of EN 9 round bar into the test specimen which to be tested under universal testing machine for tensile loading is presented in this paper. EN 9 round bar in the form of raw material is selected and is fabricated with the help of the gear head center lathe machine having 3HP. The raw workpiece is then passes through number of various center lathe operations like center drilling, facing, turning etc, to get the desired furnished specimen which is to be tested for the tensile loading under the universal testing machine. Tensile loading is done on the specimen to get the various desired output results. Various points like elastic point, plastic point, yield point and breaking point have been discussed in the load-displacement and stress- strain graphs. The maximum load under which the EN 9 specimen fails during tensile testing varies from 63 KN to 66 KN, while 0.560 KN/mm^2 is the maximum stress under which the specimen tends to break or fail during tensile testing.

Keywords: Stress, load, EN 9, center drilling, breaking point, tensile testing

1. INTRODUCTION

DeoreDhiraj et al. (2014) have stated the elaboration and evaluation of cutting forces in turning operation of specimen. In this elaboration analysis of variance is done to find which specifications have significant effect. It is found out that feed is the most significant factor followed by speeds which drag that the silage force. Tangential force Depth of cut result in feed is the significant factor. **Sharma et al. (2013)** Machining is a general principle manufacturing procedure for the manufacture of machine components, target evaluation of metal turning by machine tools is often based on their efficiency in machining work piece to specified details. The ISO standards had described the arithmetical methods of controlling the machining process of sample work piece on machine tools. Process capability is the long-term doing level of a process brought under arithmetical control. Arithmetical operation control is an excellent quality insurance tool to improve the quality of manufacture and ultimately scores on end-customer satisfaction **Rajshekhar Lalbondre et al. (2013)** stated the factors such as: machining process, steady or intermittent; cutting tool geometry; cutting fluid type and application; machining parameters like speed feed and depth of cut; rigidity of holder and machine tool. This intricate combination makes machinability of steels an intrinsic technological property which is complex to understand and difficult to determine. Then the assessment of the machinability of steel becomes a matter of prime activity to make proper decision and improve productivity. Approximately 75% of the manufacturing activities in the industrialized countries deal with production of a small batch size with a large variety of products which are diverse in nature. **Rajvanchi et al. (2012)** study that capability of indices is wicked tools for the unfaltering improvement of quality, potency and managerial decisions. **Shinde et al.(2012)** the surface roughness of a machined piece lead to decrease with increasing cutting speed in the mean while turning operation up to a specified limit while the roughness decreases with decreasing feed rate of the machine tool. Turning tests the performed on material to show that the cutting speed during turning of the material had valid mark on the surface roughness and chip formation **Shreehah T.A.A (2010)** the ratio forms for complementary system of measurement of process enforcement. The turning operation process capability clue could be evaluated towards measuring the performance of the process. **Karin et al. (2008)** verified similar situation is hardening steel, Mild Steel round bar was selected for investigations. With suitable corrected heat treatment four collections of microstructures of the clone steel were obtained. The UTM test forms it possible to noxious material by tool depreciation with relatively small pattern and low material volumes. The authors stated that almost 410 mm length of bar and 20 mm in diameter is needed for testing a material and the other traditional test with respect to tool wear are more costly to perform, both in time and material utilization. **Venkatrao R. (2006)** presented a logical procedure to evaluate the machinability of the work material for a given machining operation and also proposed globally machinability index to evaluate and rank the work materials. So far no report on the application and implementation of the global machinability index is found. **Salak et al. (2006)** have evaluated the cylindrical turning method for assessing machinability of five different types of powder metallurgy steels. Flank wear, (width of flank wear) Vb of 0.3mm was taken as tool life criterion. **Hiroshi Yaguchi (2005)** reports and relates the available engineering raw materials and semi-finished products to specify machinability ratings. It is advantageous for the industries to know in advance the behaviour of wear and life of tool with respect to specific steel grades which needs to be processed since the chemical composition and mechanical data is not enough to cover the machining characteristics of the material. There are six reported types of tests to determine machinability of steels performed at specialized laboratories with complex set-ups, which are long term in nature. The main drawback in long term test is that the tools require a fairly long time before reaching the stipulated wear limit. Moreover the long term test is possible only in the industries with research and development centres. **Trent E.M and Wright (2000)** involves very careful measurement of the very small amounts of wear and the use of a microscope being essential. Adequate industrial experience and judgment is required for the investigator on what is significant and what can safely be ignored. Such tests are beyond the reach of small and medium scale industries who are working with four to five grades or large variety of commercially available steels. Thus the efforts to minimize consumption of the material and to save time on the long tests have led to the development of short time tests. **Trent and Wright (2000)** experimented the tests which were all borne out by centre lathe machine; turning of very large steel chunks adopting single point tool. Such elaborate tests have been too expensive in time and manpower to repeat frequently, and it has become customary to use standardized conditions, with cutting speed and feed as the only variables. The results are presented using what is called simplest form V Tn = C. where V = cutting speed, T = cutting time to produce a standard amount of flank wear, C and n are empirical constants for the material or conditions used. For decades together, practising engineers and researchers are looking for some methodology to have a common base for the machinability evaluation as the manufacturers are in ambiguity over the selection of appropriate material for their product since numerous new engineering materials enter the market every year. It is usual practice of the researchers to characterise the machinability studies by way of experimentation.

2. EXPERIMENTATION

2.1 Material Selection

Mild Steel is use in present experimental work due to its durability, light weight, economical properties. The work pieces cut for the experiment were of similar dimensions and cut from 20 mm diameter rod. High speed steel used as tool material due to easy detection of cutting force with changes in parameters and high hardness, abrasion resistance properties. Mechanical properties of work piece and tool material given below:

Table 1 Mechanical properties of work piece and tool material.

S. NO.	Object	Material	Density	Elasticity	Measurement
1.	Work piece	Mild steel	7861.093	210,000	20×410mm
2.	Tool	High speed steel	7900	207,000	

2.2 Experimental Setup

The measurement of fabricating forces is done by the simple lathe machine as shown in **Fig.1** and measured by Lathe Tool Dynamometer by changing the fabricating parameters as rake position angle and spindle speed.

Fig 1. Line diagram of simple lathe machine

2.3. Machine and accessories required

1. Lathe machine
2. 3-jaw Chuck
3. Facing Tool
4. Turning Tool
5. Chamfering Tool
6. Marking and Measuring Tool.

2.4. Experimental Procedure

Fig Specimen line diagram

Fig2. Mild Steel Round Bar (ϕ 20×410) mm

A mild steel round bar of diameter 20 mm is taken and is cut into length of 410 mm as given in fig 2. Then perform number of operations to be done on lathe machine to get a required specimen

Fig 3. Centre drilling of M.S Round Bar

Firstly the centre drilling operation is done on the lathe followed by the facing operation as shown in fig 3. In facing operation we remove some part which gives a smooth surface to our work piece, and after that the step turning operation is done in which the workpiece is given a conical down with the help of the tool assembled in lathe machine as shown in fig 4.

Fig 4. Step turning of M.S Round Bar

This method is applied on both sides of the work piece. After the step turning method, with the help of the file chamfering is done to make the surface smooth the surface from both side end as shown in fig 5. The test piece is ready for the tensile testing under UTM.

Fig 5. Various operations done under U.T.M

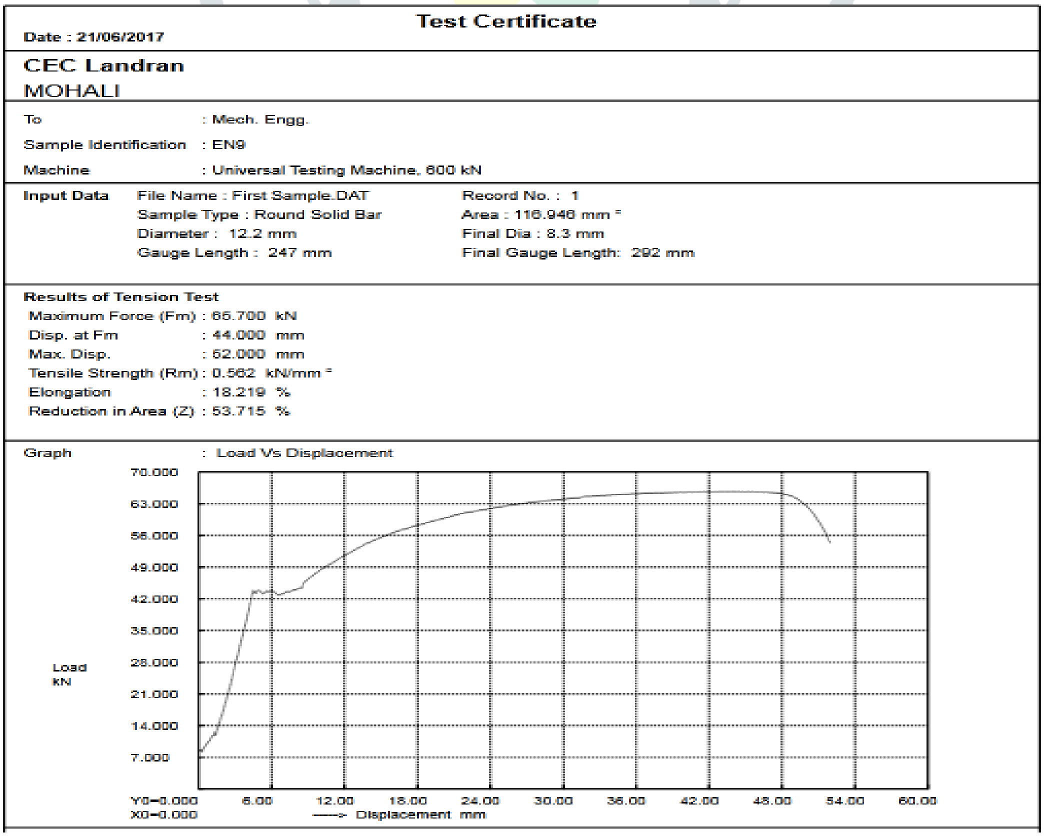
Fig 6. Specimen to test under U.T.M

Fig 7 & 8. Specimen holded in U.T.M

Fig 9. Specimen Breakage under tensile loading

3. Results And Discussions

3.1 Load Vs Displacement Graph



Test Certificate

Date : 21/06/2017

CEC Landran
MOHALI

To : Mech. Engg.
Sample Identification : EN9
Machine : Universal Testing Machine, 600 kN

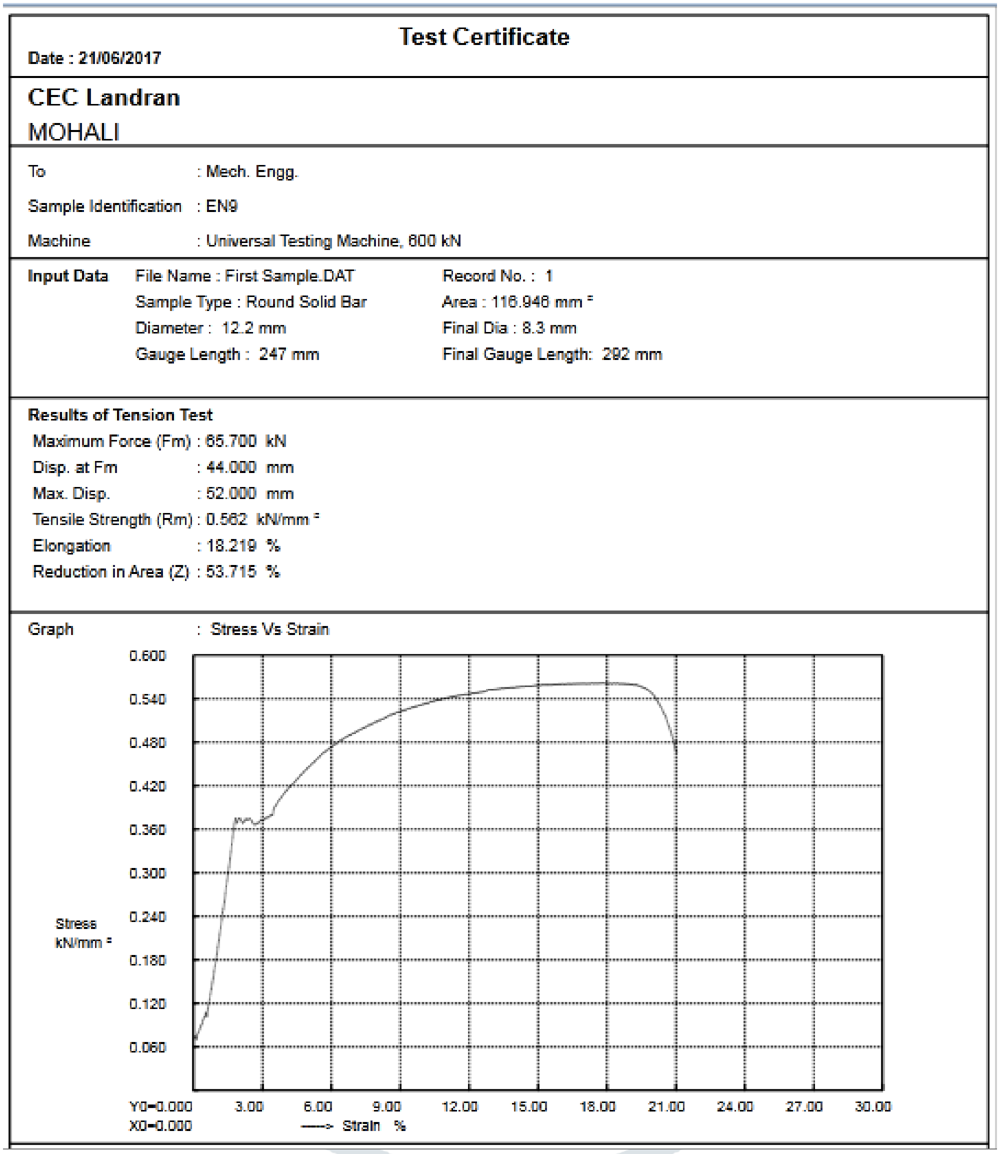
Input Data
File Name : First Sample.DAT
Sample Type : Round Solid Bar
Diameter : 12.2 mm
Gauge Length : 247 mm
Record No. : 1
Area : 116.946 mm ^{2}
Final Dia : 8.3 mm
Final Gauge Length: 292 mm

Results of Tension Test
Maximum Force (Fm) : 65.700 kN
Disp. at Fm : 44.000 mm
Max. Disp. : 52.000 mm
Tensile Strength (Rm) : 0.562 kN/mm ^{2}
Elongation : 18.219 %
Reduction in Area (Z) : 53.715 %

Graph : Load Vs Displacement

Fig 10. Load Vs Displacement Graph

The test specimen was tested using the 600 KN UTM, experimental results shows that as the load started increasing the displacement also increased at a rapid pace almost upto 44 KN which is known as limit of proportionality line as shown in figure 9. After this the line is shown to be no longer linear but elastic in nature which means if the load is removed the shape is retained. After this the yield strength formation is shown above 44 KN to 49 KN. Plastic region starts to occur above 49 KN in which the specimen is permanently deformed and no retention in the shape is possible. The plastic region lies between the range from 49 KN to 65 KN. There is a sudden dip in the graph above 65 KN as the breaking point or fracture point has occurred which means the specimen is failed under the tensile loading.



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Maximum Force (Fm) : 65.700 kN

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Max. Disp. : 52.000 mm

Tensile Strength (Rm) : 0.562 kN/mm^2

Elongation : 18.219 %

Reduction in Area (Z) : 53.715 %

Graph : Stress Vs Strain

Fig 11. Stress Vs Strain Graph

3.2 Stress Vs Strain Graph

The test specimen was tested using the 600 KN UTM, experimental results shows that as the stress started increasing the strain also increased at a rapid speed almost upto 0.368 KN/mm^2 which is known as limit of proportionality line as shown in figure 10. After this the line is shown to be no longer linear but elastic in nature which means if the stress is removed the shape is retained. After this the yield strength formation is shown above 0.368 KN/mm^2 to 0.420 KN/mm^2. Plastic region starts to occur above 0.420 KN/mm^2 in which the specimen is permanently deformed and no retention in the shape is possible. The plastic region lies between the range from 0.420 KN/mm^2 to 0.546 KN/mm^2. There is a sudden dip in the graph above 0.560 KN/mm^2 and between 18 to 21 % strain which shows the breaking point or fracture point, therefore the specimen is failed under the tensile loading.

4. CONCLUSIONS

Load versus displacement and stress versus strain graphs have been studied in this paper. Various points like elastic point, yield point and breaking point have been discussed in both the graphs. In the load-displacement graph 65 KN is the breaking point or fracture point beyond which the specimen breaks, similarly in the stress-strain graph 0.560 KN/mm^2 is the breaking limit beyond which the specimen will fail under tensile loading.

5. REFERENCES

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