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Evaluation of Strength of Steel for Government Project

Trupti U. Patil1, Pankaj P.Bhangale2
Department Of Civil Engineering, Shri Sant Gadge Baba College Of Engineering And Technology, Bhusawal, Maharashtra, India.

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ABSTRCT: Universal testing machine is use for the testing of steel. The Test Based on Steel are also conducted for Government Projects. As per IS 1608:Part 1: 2008 & IS 1786:2008. We can calculate the various test such as ultimate tensile strength, Yield strength, Elongation and weight per meter etc. the result is conducted by graphically method and the graphically, the graph is already prepared by UTM Machine. Ultimate tensile strength tells us the value that is necessary for complete failure and breaking. also the 8 to 32 mm diameter steel bar are checked with the help of UTM machine. As the machine is modular, the parts can be swapped with better components that fits the requirement, leaving the possibility for many upgrades in the future.

I. INTRODUCTION

Steel structure is the main structure form used for buildings and bridges at present because of its good anti-seismic property, environmental protection, quick construction, and high utility rate of space, novel images and many other advantages. In the Wenchuan earthquake, the fact steel-structure buildings suffered relatively slighter damages and provided a safe and efficient solution for poster-disaster temporary housing and reconstruction, has clearly demonstrated the outstanding anti-seismic ability of steel structures. After years of study, particularly on the Northbridge earthquake and Kobe earthquake respectively taken place in the U.S.A, 1994 and in Japan,1995, researchers have found that the properties of steel utilized for buildings are major elements influencing the safety of steel structures under earthquake. Controlling the range of yield strength, with ensuring lower yield ratio, higher tenacity and good welding property plays decisive roles in guaranteeing the ductility and avoiding brittle failure under earthquakes. Therefore, scholars come up with a thought of improving structures' anti-seismic performance by perfecting the properties of steel and a conception of developing high performance steel for constructions.

II. MATERIAL PROPERTIED REQUIRED FOR DESIGN

Fatigue strength is the highest stress that a material can withstand for a given number of cycles without breaking. Fatigue strength is affected by environmental factors, such as corrosion. The maximum stress that can be applied for a certain number of cycles without fracture is the fatigue strength.

Steel corrosion involves an electrolysis in which the metallic surface releases electrons into an electrolyte, such as a layer of moisture in the presence of oxygen. This electrochemical reaction occurs due to the tendency for metals to return to their natural state.

Hardness is the material's ability to withstand friction and abrasion. It is worth noting that, while it may mean the same as strength and toughness in colloquial language, this is very different from strength and toughness in the context of metal properties. A material's ability to withstand friction, essentially abrasion resistance, is known as hardness. Diamonds are among the hardest substances known to man, it is incredibly difficult to scratch a diamond. However, while a diamond is hard it is not tough. If you took a hammer to a diamond it would shatter, which demonstrates that not all materials that are hard are also tough. In the world of metal tools, drill bits and grinding discs must be extremely hard to be able to handle high amounts of friction.

Toughness is difficult to define but generally is the ability to absorb energy without fracturing or rupturing. It is also defined as a material's resistance to fracture when stressed. It is usually measured in foot lbs. per sq. in or Joules per sq. centimeter. It is important to distinguish this from hardness as a material that severely deforms

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without breaking, could be considered extremely tough, but not hard. How well the material can resist fracturing when force is applied. Toughness requires strength as well as ductility, which allows a material to deform before fracturing. Do you consider silly putty to be tough stuff? Under these terms, believe it or not, it actually is relatively tough, as it can stretch and deform rather than break.

It is very common that a single material will have more than one of these properties. These three categories do overlap. Drill bits, which are hard, must also be strong and tough so that they can perform as needed. Anvils are very tough and strong, they have to be with all the abuse that they take, but they are not necessarily hard. Bulletproof glass, on the other hand, is hard and tough but not incredibly strong.

There are also ways to enhance these properties. Metals coated with a ceramic finish can lend hardness to a metal that is already strong and tough. Alternately, carbon infused steel can maintain steel's properties in the core but take on some of carbon's properties at the edges. So the next time you hear someone describe a material as being strong, hard or tough, consider whether or not those are the correct terms. In other words, think like a materials scientist.

Yield strength is a measurement of the force required to start the deformation of the material (i.e. bending or warping). The Upper Yield Strength represents the point at which a sudden leveling, or drop in stress or load occurs as a material transitions from elastic to plastic deformation. It also marks the beginning of yield point elongation (YPE).YEILD strength is a measurement of the force required to start the deformation of the material (i.e. bending or warping).

Tensile strength is a measurement of the force required to break the material. Ultimate Tensile Strength (Uts), often shortened to tensile strength (TS), is the maximum stress that a material can withstand while being stretched or pulled before breaking. TENSILE strength is a measurement of the force required to break the material .In brittle materials, the material breaks soon after the yield point have been reached.

Elongation (or Ductility) is the "Degree" to which the material can be stretched or compressed before it breaks. It is expressed as a percent of the length being tested and is between the tensile strength and yield strength (i.e. what percent does the material bend before breaking). Elongation At Break, also known as fracture strain, is the ratio between changed length and initial length after breakage of the test specimen. It expresses the capability of natural plant fiber to resist changes of shape without crack formation. The elongation at break can be determined by tensile testing in accordance with EN ISO 527. It is expressed as a percent of the length being tested and is between the tensile strength and yield strength (i.e. what percent does the material bend before breaking).

III. METHODOLOGY

1.UTM comprises two main units, one is the loading unit and other is the control panel.

Fig.1.Universal Testing Machine (UTM)

2.Loading unit: The loading of the specimen is conducted in the loading unit. In the figure above, the equipment in the left is called as the loading unit. The loading unit consists of three crossheads, they are the upper head, middle head, and lower head. These crossheads are used depending on the type of load(tensile, compressive or shear) applied on the specimen. When undergoing the tensile test, the upper and lower crossheads are used.

Control Panel: This unit facilitates the load application on the specimen. The load application is performed by the action of hydraulic pressure. A pendulum dynamometer is fitted to measure and indicate the force coming on the specimen. A big size load indicating dial fitted with a glass cover is mounted at the side of the control panel. The range indicating dial is to be adjusted for the particular range selected.

Theory

The specimen is subjected to constant tension load and the extension caused in the steel rod is noted against the load within the elastic limit. The load values at yield point, breaking point, and ultimate point are carefully noted. With the obtained values, the stress and strain are calculated and plotted in a graph. From the data, we get:

Modulus of Elasticity, E = Stress/Strain[This is calculated within the elastic limit. The slope of the stress-strain curve provides the modulus of elasticity]

Yield Stress = Load at yield Point/Original C/s Area

Ultimate Stress = Ultimate Load/Original C/s Area

Nominal Breaking Stress = Breaking Load/Nominal Breaking Stress

Actual Breaking Stress = Breaking load/Neck Area

Percentage elongation = (Change in length/Original Length)/100

Percentage reduction in the area = (Change in length/Original Area)/100

Procedure for Tension Test on Steel Rod

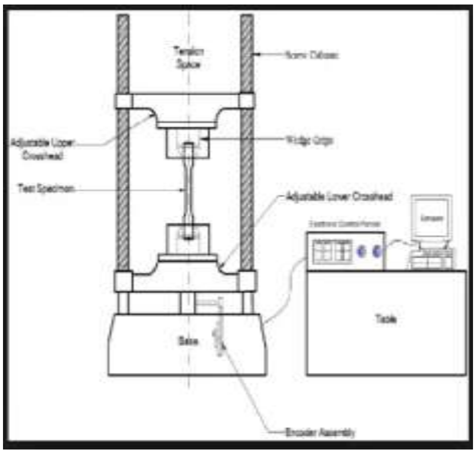

Fig.2. Tension Test on Steel Rod Arrangement on UTM

Preparation of Specimen: Initially, the steel rod specimen is cleaned and gauge length is marked on it. The gauge length is calculated by the formula image . The gauge length can be marked on the specimen by punching tool.

Range Calculation: A tensile stress value is assumed for which the maximum expected load capacity of the rod is calculated. From this, the range is calculated and this range is set in the UTM. Assuming working stress = 140N/mm² Factor of safety = 3.i.e Ultimate stress = 140x3 = 420N/mm². Ultimate load = 420 x area of c\s. From the ultimate load, range to be used can be fixed.

Placing the Specimen: The handle is operated such that the specimen firmly fits to the top base. The left valve is kept in a fully closed position and the right valve in a normal open position. Open the right valve and close it after the lower table is slightly lifted. Adjust the load pointer to zero with the zero adjusting knobs. By operating the handle, lift the lower crosshead chuck up and grip firmly the lower part of the specimen. Once the specimen is placed, the jaws are locked.

Placing Extensometer: Fix the extensometer on the specimen and set the reading to zero.

Load Application: Turn the right control valve slowly to open position to get the desired loading rate. When the specimen is under load, slowly unclamp the locking handle. Note the extension at a convenient load increment. Extensometer must be removed before reaching the yield point. The right valve is used to apply the load and the left valve is used to release the load on the specimen.

Important Load Points: With the increase in load at some point, the load pointer remains stationary. Load corresponding to this indicates the yield point. With further increase in load, the pointer goes backward and specimen breaks. The load before this breaking is the ultimate load. The load at the breaking of the specimen is called as the breaking load.

As shown in figure below, once the load crosses the ultimate stress (ultimate load) necking starts to form in the steel rod. Necking is a large reduction caused in the cross-sectional area of the steel rod.

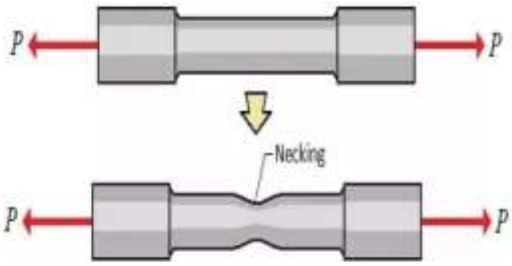

Fig.3.Necking of Steel Rod Under Tension Load

Close the right control valve and take out the broken piece. Open the left control valve to pump the oil back. Maximum capacity of the specimen can be seen against the red pointer. Measure the diameter of the specimen at the neck. Change in length is obtained from reading recorded from extensometer. Therefore, Strain = Change in length/Original Length Stress at different values of strains is also determined as, Stress = Load /Area; With different values of stress and corresponding strains, the stress-strain graph is plotted.

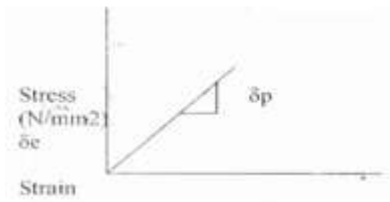

Fig.4.Stress-Strain Graph for Tension Test on Steel Rod

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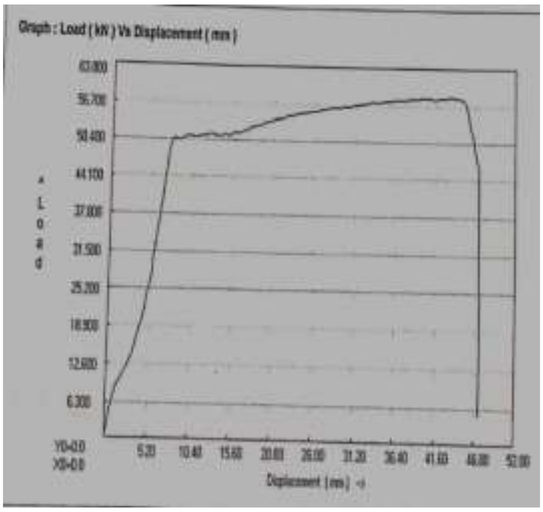
IV. RESULT AND DISSCUSSION

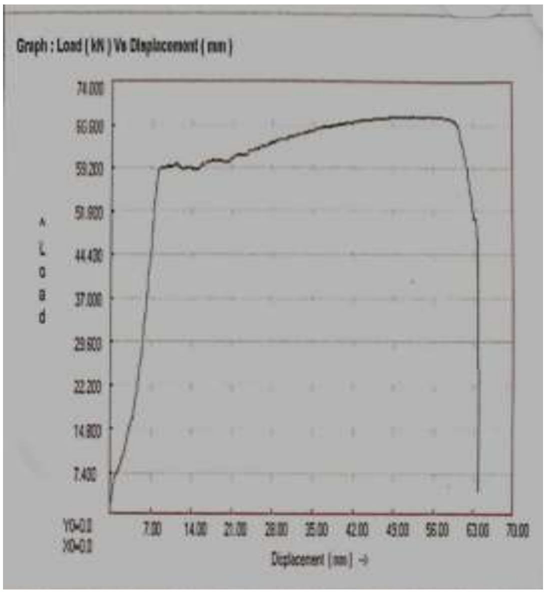
Sample Description: GOEL TMT 500D

Nominal Diameter of bar in (mm)	**C/S Area (mm^2)**	**Weight (Kg/m)**	**Yield stress (Mpa)**	**Tensile Strength (Mpa)**	**Acceptable Limit**
10 mm	77.70	0.61	652.45	748.32	Yeild Stress=min500Mpa Tensile
12mm	113.37	0.89	525.68	600.21	
16mm	202.54	1.59	519.63	609.23	

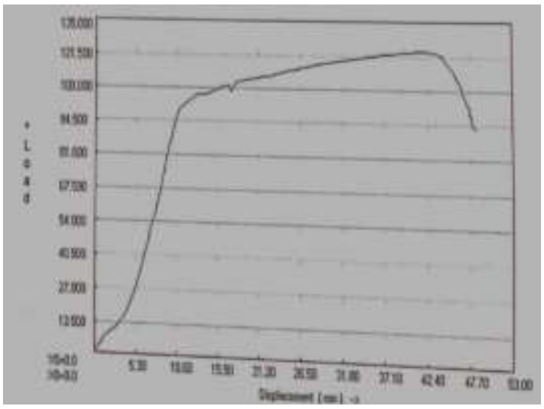
Test Result For:-10 mm bar-



Test Result For:-12 mm bar-



Test Result For:-16 mm bar-



V. CONCLUSION

We were able to successfully tensile test steel using the universal testing machine, from the data obtained we were able to successfully obtain the young's modulus, ultimate tensile strength and yield stress values of the two metals. By comparing the values of the two metals we can see that mild steel has higher values in all of the three properties which means it is stronger and more ductile than aluminum. This project gives the results of mechanical properties of high strength deformed steel bar. The parameter determined in this project are Ultimate Tensile Strength, Upper Yield Strength, Elongation at Break & Mass per Meter Run. The Results are ok as per IS 1608:Part 1: 2008 & IS 1786:2008.

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