Maximum Pull Load Test on Anchor Bolt

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Abstract- This research aims to determine the provisions of standardization and implementing rules governing the feasibility test of the anchor bolt test object. The Anchor Bolt is the iron bar with the screw at the end. Anchor Bolt is used for binding between foundation/concrete with different parts of construction materials such as steel pole or machine construction. The tensile test is a mechanical test that provides a drag load on the test material with a static loading speed. A pull test is one of destructive testing. The pull test is widely used in the industry because of the information it gives about the mechanical properties of the material is quite numerous and easy to be processed. In addition, this test can also be used for almost all material types, starting from metals, ceramics, and polymers. The information obtained from the regular tensile test is used as the basis for material selection, alloy development, quality control, and design process under various conditions. At first, many industries require raw materials to make a product. To ensure the quality of raw materials needed and to ensure whether the raw material is suitable or not, take a pull test.

Keywords – Pull, Load Test, Anchor Bolt, Standard

I. INTRODUCTION

The development of building structures in the era of globalization and modernization can be felt now with the rapid development of developments such as buildings, towers, bridges, offices, hotels, and other buildings. Construction is generally made from a mixture of steel and concrete materials. The function of the steel material is strong to hold the tensile force and press while the concrete material is strong to hold the force press. The method of construction is a series of construction activities that follow the work plan and technical requirements that have been designed with the knowledge and standards that have been tested.

Steel structures that have high strength and construction of steel profiles are easy on the unloading pairs. Composite concrete structures are formed by combining the components between sand, cement, gravel, and water forming a single unit.

Problems will arise if the load cannot be clearly defined. To overcome these problems, measurement data in a research or testing is necessary to know until the success of such research or testing. In addition, understanding the measurement techniques is very necessary for the data to be produced, the truth can be accounted for.

II. MATERIALS AND METHODS

2.1 Linear Variable Differential Transformer

Linear Variable Differential Transformer (LVDT) [1-3] is an example of a position sensor that works based on the presence of magnetic field. LVDT is one example of a position sensor, which works based on the presence of magnetic field. At present LVDT sensors have been widely used. In the application LVDT can be used as proximity sensors, angular sensors, and other mechanical sensors. For this time the sensor is applied as a distance sensor. An LVDT essentially consists of a primary coil, two secondary coils and the nucleus of the ferromagnetic material. The coils are wrapped in a sleeve, while the iron core is placed inside the sleeve cavity. The sleeve is made of non-magnetic materials. The primary coils are wrapped in the inner sleeve while both secondary coils are wrapped on each side of the primary coil. Both of these secondary coils are connected the series in contrast to the same number of coil.

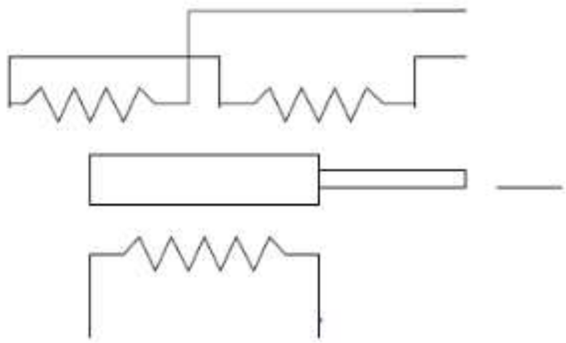

Figure 1. Schematic of LVDT

At the ends of the primary coil are given an excitation voltage that is alternating voltage (AC). The output of this sensor is taken from the ends of the secondary coil. The large output voltage of LVDT depends on the core position. At the time of the iron core position in the center, the electric Motion force induced by the secondary coil 1 and 2 is equally large. But since both secondary coils are linked series opposite then the output voltage will be equal to zero. If our iron core is sliding towards the left then the secondary coil 1 gets a higher flux density compared to the secondary coil 2. As a result, the electric motion induction force on the secondary coil 1 would be larger than the secondary coil 2. The resulting output voltage is the second voltage difference of the secondary coil.

The relationship between the output and the LVDT nuclei are linear at a certain distance interval. The connection between the output voltage U and the linear position of the iron is in the center of the sleeve, and not linear when the nucleus is at the edges of the sleeve. LVDT can be used to measure distance changes. For this purpose, we connect the LVDT core handle to the part that will be measured by movement.

2.2 Measurement System

Measuring is comparing parameters to an object measured against a standardized magnitude, while measurement is an attempt to obtain quantitative descriptive information from the physical and chemical variables of a measured substance. Generally, the measuring system can be divided into three stages.

1. Stage Detector-transducer/sensor
   Transducer [4, 5] is a tool that can transform a physics effect into another useful physics effect and is largely transformed into an electrical signal because in this form the signal is easy to be processed. The main function of this phase is to detect or feel any physical magnitude changes to the object measured. This stage should be immune to other undesirable influences, e.g. style sensors should not be affected by acceleration or linear acceleration sensors, should not be altered by angular acceleration changes. But it's never been found to be ideal, a small change by that other variable is still acceptable as long as it's still within the allowable limitation. Examples: temperature sensors, force sensors, and pressure sensors.
2. Intermediate Stage/Signal Conditioning
   The treatment done at this stage is usually filtration, reinforcement and transformation of the signal [6, 7]. The common function of this stage is to increase the signal ability to a level that activates the last stage. Equipment at this stage should be designed in such a way as to match the conditions between the first stage and the last stage. Examples: power supply, Wheatstone Bridge, operational amplifier, A/D and D/A converter.
3. Reading Stage (Data Acquisition)
   This stage is a stage containing information in a level that can be censored by humans and/or control devices [8-10]. For example, data logger and oscilloscope. If the output is expected to be read by humans.
   - Relative movements, e.g. scale indicator needles or wave movements on the oscilloscope.
   - Digital, this form represents figures, such as Digital thermometer.

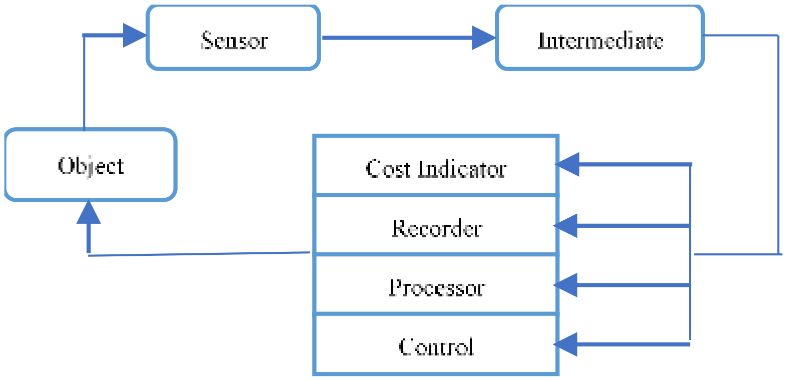

Figure 2. Block Diagram of the Measurement System

2.3 Measurement Error

In reality, there are no measurements that produce perfect accuracy because each measurement process is not detached from the error. This can be seen from the difference between the value of measured result and calculation. However, to produce a measurement value close to the value is actually worth noting the factors that can cause irregularities or errors in the measurement so that the measurement results do not deviate far from the actual value (still within the permissible tolerance limit). The type in error measurement can be divided into three.

1. Gross error

   This type of error is very fatal so the consequences of measurements must be repeated. An example of this error is the contamination of the reagent used, the equipment that is completely damaged, the samples are wasted, and others. The indications of this error are quite obvious from the very distorted image of the data, the data can not provide a clear pattern, and a very low level of remanufacturibility.

2. Random error

   This type of error is a form of error that causes the outcome of a loop to be relatively different from each other where the individual results are around the average price. This error gives effect to the level of accuracy and ability to be repeated (reproducible). This error is inevitable can only be reduced with caution and concentration in work.

3. Systematic error

   A systematic error is a type of error that causes all data results to be incorrect with a resemblance. This can be solved by:

   - Standardization procedures
   - Material standardization

III. Results and Discusssion

3.1 Measurement on anchor bolt

The initial stage is to test the anchor bolt [11-13] by measuring the length of the outer diameter and inner diameter/screw on the anchor bolt using the digital wheeling term.

Figure 3. Outer diameter measurement on anchor bolt

Figure 4. Inner diameter/threaded measurements of anchor bolt

3.2 Application of LVDT

In the maximum load measurement on anchor bolt performed LVDT forging [14] at the point where an actuator works to pull a load of anchor bolt to know how big the engine steps. These results can be seen in the image below.

Figure 5. Position of LVDT placement on RH-Z machine

Figure 6. Position of (1) LVDT (2) anchor bolt

Figure 7. Anchor Bolt Test Objects

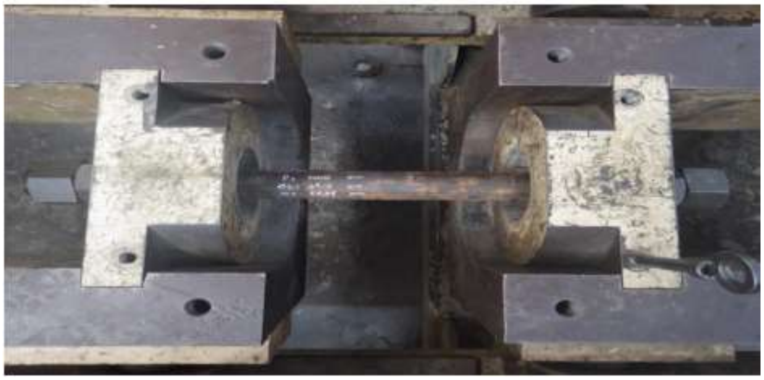

Figure 8. Position of Anchor Bolt Placement on RH-Z Machine of Top View

Figure 9. X-Y Recorder and KWS 3073 Amplifier

3.3 Maximum Load Testing on Anchor Bolt

The test bolt is done in a stasics, with the assay being placed on the test machine with the position as in the test set-up in Figure 8. Then the style is gradually generated from 0 kN until it reaches its maximum pull load. During the loading, the magnitude and steps of the machine are recorded using the X-Y Recorder [15]. The style of the tensile load (kN) and the engine step (mm) are indicated on the test curve or chart.

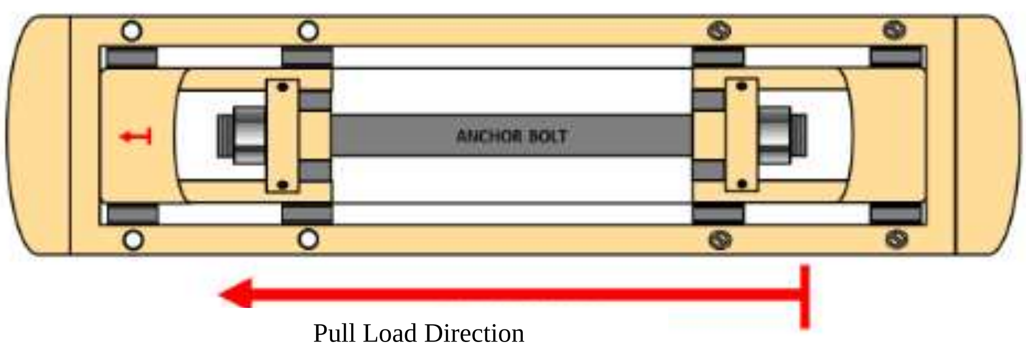

Figure 10. A Static Pull Testing Scheme of Anchor Bolt in RHZ Test Machines

3.4 Maximum Load Measurement on Anchor Bolt

The purpose of this test is to know the magnitude of the melting voltage and strong tensile steel, and to find out the mechanical strength of the anchor bolt and the screw forces when receiving the maximum static pull load. One unit of Anchor Bolt with dimension length 1000 mm with rod diameter 65.18 mm and screw diameter in 59.75 mm. The maximum load measurement on Anchor Bolt is shown in the graphs and table below.

Table -1 Measurement Result in Area A

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Pull Load in Area A (kN)	**Machine Step (mm)**	**Remarks**
0	0	Test objects still elastic
132.32	10.4	
644.53	12.49	
1523.44	15.31	
1661.62	16.0	
1890	17.10	

Table -2. Measurement Result in Area B

Pull Load in Area B (kN)	Machine Step (mm)	Remarks
1891.85	17.94	Test objects start yield
2030.27	19.67	
2031.25	19.81	
2030.27	19.81	
2031.25	20.00	
2032.23	20.07	

Table -3. Measurement Result in Area C

Pull Load in Area C (kN)	Machine Step (mm)	Remarks
2063.48	23.95	Test objects broken on screw parts (Figure 12)

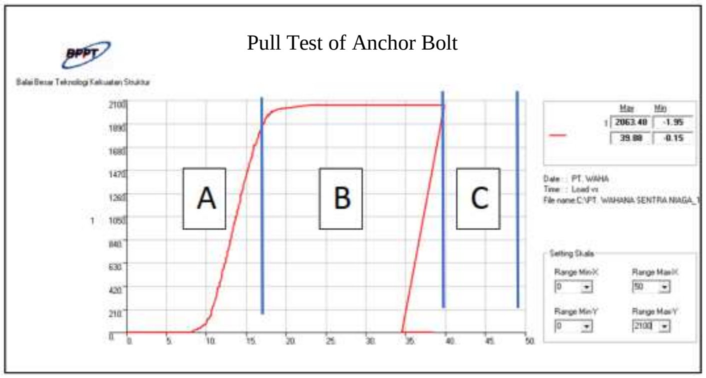

Figure 11. Testing Result in Area A, B and C

Figure 12. Test Result of Anchor Bolt

From the measurement results, Area A is an elastic area characterized by a linear straight line, on this area the material is still elastic. Area B, in this area the material has undergone permanent deformation, and the C area of the test object has suffered damage to the connection screw. In general, the maximum voltage that can be used is 75% from maximum voltage. In this case the maximum voltage in question is the initial voltage of the test object suffered damage that is in the tensile force 2063.48 kN with the engine step 23.95 mm. The maximum permit voltage in use is on the tensile strength 75% of 2063.48kN as 1547.61 kN. Here it appears that the voltage on the tensile strength is still in the elastic area.

IV.CONCLUSION

From the results of the above tests could be taken several conclusions as follows.

1. The Anchor Bolt test object reaches a maximum point of 2063.48 kN.
2. At the time of testing in area A there is fluctuations when the load 1477.54 kN.
3. By using LVDT sensor, we can only know the step of the machine.
4. Every test is required personnel who actually understand the object tested and mastered the measuring equipment used, so that the error can be minimized and the result can be accounted for.

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