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Reconditioning Load Cell Tensile Testing Machine Capacity 2 Ton

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Abstract
Test equipment is an educational laboratory facility that is very important in supporting and supporting the teaching and learning process in the laboratory. , load cell is an electronic device that is used as an additional device in a tensile testing machine. The tensile test results will be better or more accurate if the tensile test equipment is equipped with a load cell using a data device system.
Obtained from this test, namely the stress value that occurs in the load cell, the stress on the ST37 steel specimen is 48.56 kg/mm², the maximum stress is 952.99 kg/mm². While the stress on the 6061 aluminum specimen is 15.6 kg/mm², and the maximum stress is 306.15 kg/mm². In addition to the workpiece that breaks due to
tension, a tensile test curve is also generated. This curve is a description of the workpiece loading process from the beginning of the withdrawal to the end of the workpiece
.
Keywords: *Tensile Test, Load cell, Aluminum 6061, stress, strain.*

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Introduction

Test equipment is an educational laboratory facility that is very important in supporting and supporting the teaching and learning process in the laboratory. Currently, technological developments are more focused on the development of materials that are lighter, with high strength and have good performance. So that in the development of these materials, test equipment is needed that is in accordance with the properties of the material being tested.

Load cell is a force transducer that measures the force by measuring the deflection caused by the force. According to Engkos Koswara, a load cell is an electronic device that is used as an additional device in a tensile testing machine. The tensile test results will be better or more accurate if the tensile test equipment is equipped with a load cell using a data device system. From this test, apart from the workpiece breaking due to tension, a tensile test curve is also obtained. This curve is a description of the workpiece loading process from the beginning of the withdrawal to the end of the workpiece.

Research Method

Most of the research methods are to use flow charts that are aimed at the basis for acting and simplifying the implementation of the research process.

Identification of problems

Identification is the problem raised in the research background of this final project, the identification of the problem in this final project is as follows: How to redesign the load cell of the tensile testing machine in order to get more accurate data? How is the aluminum material testing process?

Study of literature

Literature study is a search for journals or materials related to the discussion of this final project.

Data collection

Collecting the data needed to find the data needed.

a. The old loadcell has a capacity of 1 ton, while the new loadcell has a capacity of 2 tons.

b. Aluminum 6061 . Specifications

Material Selection

The material to be used for testing is aluminum 6061. Following are the specifications of aluminum 6061:

Design Process

This design process contains the redesign of the tensile testing machine. Which includes the redesign of a 2 ton capacity load cell.

Testing Process

After the design process is complete, the next step is the aluminum material testing process.

Results and Discussion

Test Specimen

The specimen that will be used in this test uses 6061 aluminum material. Here are the dimensions of the specimen.

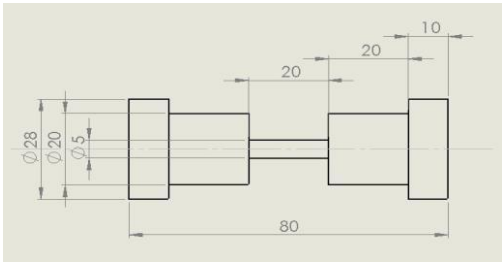

Figure 1 Specimen Dimension

Testing Steps

The steps for tensile testing are as follows :

1. Check the tensile test machine.
2. Make the settings on the indicator.
3. Calibrate the loadcell measuring instrument against the indicator.
4. Setting indicators, such as units, baud rate and others.
5. Prepare measuring tools such as caliper or micrometer.
6. Prepare the tensile test specimen.
7. Measure the dimensions of the specimen.
8. Attach the specimen to the tensile testing machine, attach both ends correctly and perpendicularly.
9. Perform tensile load on the specimen.
10. Giving the load starts from zero (0) with the addition of the load evenly.
11. During the test, there will be an increase in length and a reduction in the cross section until fracture occurs.
12. Count the number of turns until the specimen breaks.

13. Record the test results data.
14. After the specimen is broken, measure the dimensions again.
15. Process the data so that it becomes a tensile test curve.

Tensile Test Results Data

From the tensile test results, the mechanical properties of ST37 steel and aluminum 6061 that have been tested will be obtained.

1. ST37 . steel test results

a. The ST37 steel specimen test data is shown in Table 1.

Table 4.1 ST37 Steel Test Result Data

Putaran	Beban (kg)
1	3
2	7
3	9
4	20
5	31
6	32
7	33
8	36
9	72
10	154
11	264
12	393
13	589
14	690
15	839
16	998
17	oL
18	oL
19	oL
20	oL
21	983

b. Stress

Dik : F = 953

A = ... mm²

Dit : σ = ...

Jawab :

$$A = \frac{\pi.d^2}{4} = \frac{3{,}14.5^2}{4} = 19{,}625\ mm^2$$

$$\sigma = \frac{F}{A} = \frac{953\ kg}{19{,}625\ mm^2} = 48{,}56\ kg/mm^2$$

c. Modulus Elasticity

Dik :

l_0 = 2 cm = 20 mm

l = 100 mm

$Dit : \varepsilon = ...$

$$Jawab : \varepsilon = \frac{l\ -l_0}{l_0} \times 100\% = \frac{100-80}{80} \times 0{,}01 = 0{,}0025$$

d. Maximum Stress

$$F_{maks} = \sigma \times A = 48{,}56 \times 19{,}625 = 952{,}99\ kg/mm^2$$

e. Stress – Strain Curve

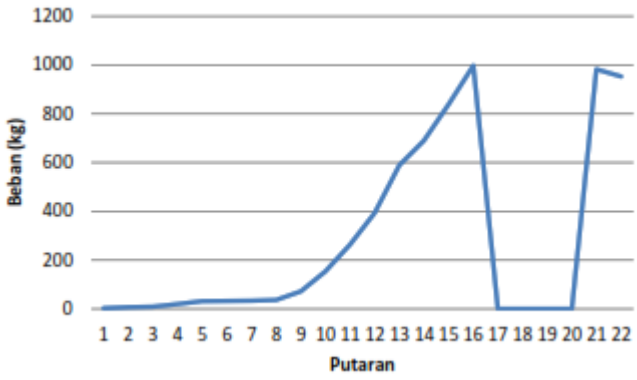

Figure 2 ST37 Steel Test Result Curve

From Figure 5 shows the change in elastic deformation to plastic deformation at a value of 483 kg. It can be seen that the value at that point indicates yield strength. While the value of tensile strength (Tensile Strength) is the end point of the tensile test which is marked by a fracture at a value of 953 kg.

Designing Load Cells

The load cell is designed with a strain of ± 2000 at a load of 2000 kgf. The calculation of the load cell cross section for a design load of 100 kN, with the expected strain (ε) = 0.1%, is carried out by entering the values of F, and E in the equation $=F\varepsilon xE$ and obtained :

$$A = \frac{2000kgf}{1000 \times 10^{-6} \times 21000kgf/mm^2} = 95{,}4mm^2$$

By entering the values of A and dd (inner diameter), then the value of dl (outer diameter) can be determined as follows:

$$dl = \sqrt{\frac{4.A}{\pi} + dd^2} = \sqrt{\frac{4.95{,}23}{3{,}14} + 16^2} = 20mm$$

From the results of these calculations, both ends of the load cell are drilled with an inner diameter of 16 mm and an outer diameter of 20 mm. The eye bolt used is the M-279 type with the size M20.

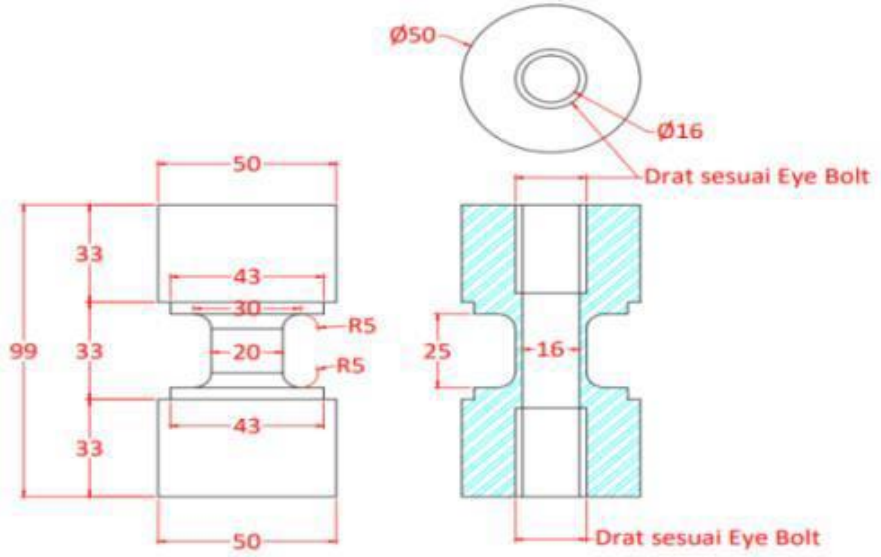

Figure 3 Dimensions of the load cell after adjusting to the eye bolt table.
(Sri Wahyuni Sitorus, et al. : 2018)

For stress and strain can be calculated by the following equation:

$$\sigma = \frac{F}{\pi/4(dl^2 - dd^2)}$$

$$\sigma = \frac{2000}{3{,}14/4(20^2 - 16^2)} = 17{,}69\,\frac{kg}{mm^2} = 173{,}54\,MPa$$

$$\varepsilon = \frac{\sigma}{E}$$

$$\varepsilon = \frac{17{,}69kg/mm^2}{21.000kg/mm^2} = 8{,}42\,x10^{-4} = \mu\varepsilon$$

With the dimensions of the designed load cell, it is expected that if the load cell is given a maximum load of 20 kN (2000 kgf), the strain that occurs is still in the linear region. The attachment of the strain gauge must be carried out properly and correctly at the location that has the highest and most homogeneous stress concentration. Therefore, a simulation is carried out to determine the stress distribution on the load cell rods whose dimensions have been determined.

Conclusion

Based on the results of the final project entitled Reconditioning the load cell tensile testing machine with a capacity of 2 tons, the following conclusions can be drawn:

a. Redesigning the load cell of the tensile testing machine, the inside diameter = 16 mm and the outside diameter = 20 mm. With the dimensions of the designed load cell, it is expected that if the load cell is given a maximum load of 20 kN (2000 kgf), the strain that occurs is still in the linear region.
b. ST37 Steel Testing obtained = 48.56 kg/mm², = 0.0025, and maximum stress = 952.99 kg/mm². While aluminum 6061 obtained data = 15.6 kg/mm², = 0.002, and maximum stress = 306.15 kg/mm². This shows that the 1 ton load cell is not strong enough to withstand the load, so it must use a load cell with a capacity of more than 1 ton.

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