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Design And Analysis For A New Design Of Bending Arm On Bending Machine

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Abstract: This study presents the design produced for the bending arm component of the bending machine. This study was conducted for improvements so that the component is more durable and able withstand heavier loads. In the precast industry, bending machines are very important to form the material produced for development, which is the building's bones. Bending arm on this bending machine is an important component to shape the final product. Therefore, this bending arm needs to be improved. With this improvement, the maintenance of the bending arm is less and thus can save costs for the precast industry. This study was carried out with new designs for the bending arm and then select the most suitable its material. This study was conducted using the Solidworks software. Data collection is done by comparing the maximum value for each material with the yield strength value. This data can be collected by placing a certain load value for each material. Based on this research, the tool steel match with the suitability to be used on the bending arm, this is because the maximum value of von mises for each load applied to the bending arm is less than the yield strength of the tool steel.

Keywords: Bending Machine, Bending Arm, Solidwork Software

1. Introduction

A bending machine is a machine to bend the product like a mesh product by using hydraulic pressure. Products are put into alignments on the machine to be bent. There are a lot of bending machine's component, but the most important part is bending arm. This component is the most focused for improvement. The position of the bending machine is used as a pivot for the bending former.

Bending arm that attach to the bending former is easy to erode due to friction when bending mesh products. Figure 1 below shows an example of a broken bending arm that occurs which makes it unusable and needs to be improved. This project is to improve the bending arm to be more durable. With these improvements, the cost to maintain will also be less. Nowadays the world is focusing into automation. Every work of human is reduced by a machine, but few areas like construction the usage of machines for bending a mesh.

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A bending machine is used for the last process of making the mesh product. Mesh products as shown in Figure 2, undergo a few processes such as straightening process, welding process and then bending process. This study focuses on designing and performing analysis on the new shape of bending arms.

Figure 1: Broken bending arm

Figure 2: Mesh products

2. Materials and Methods

There are 3 designs proposed and the best design selected using the matrix score method. Analysis study is using Solidwork software, the component is subjected to a range of load condition. Analysis results based on Von mises criterion trend using a colour-coded tension intensity map [1].

2.1 Materials

There are 3 materials used, namely carbon steel, tool steel and stainless steel in the analysis. The yield strength for carbon steel, tool steel and stainless steel are 250 MPa, 1400 MPa and 170 MPa respectively. The load is carried out on the bending arm with different materials.

2.2 Matrix score method

Table 1 shows the proposed designs for the bending arm. The final design is selected using the matrix score method as shown in Table 2 [2]. The weight for the factors is measure of their importance, ranging from 0.25 (low importance) to 1.0 (high importance) [2]. For the score is from 1 to 4 which is from weak to good. The final step is to calculate the weighted score by multiplying the weight and the score. Once this has been done for all, add each design's score for the total score [4]. From the matrix score, design 2 is the highest weighted score and selected as the best design for bending arm.

Table 1: Proposed design

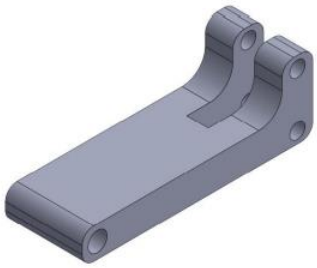
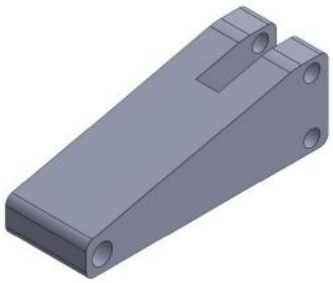
Design	Type of Design
Design 1	 Mass :10.5 kg
Design 2	 Mass :12.7 kg
Design 3	 Mass :15.8 kg

Table 2: Matrix score

Factors	**Weight**	**Design 1**		**Design 2**		**Design 3**	
		Score	**Weighted Score**	**Score**	**Weighted Score**	**Score**	**Weighted Score**
Innovation	0.25	3	0.75	4	1.00	4	1.00
Weight	0.20	2	0.40	4	0.80	3	0.60
Product quality	0.15	3	0.45	3	0.45	3	0.45
Life-span	0.20	2	0.40	3	0.60	3	0.60
Maintenance	0.20	2	0.40	3	0.60	2	0.40
Total	**1.00**		**2.40**		**3.45**		**3.05**

3. Results and Discussion

The data from the analysis conducted on 3 different materials which is carbon steel, tool steel and stainless steel using 5 different loads starting from 500 N, 1000 N, 1500 N, 2000 N and 2500 N. The Von Mises stress data analysed as Figure 3.

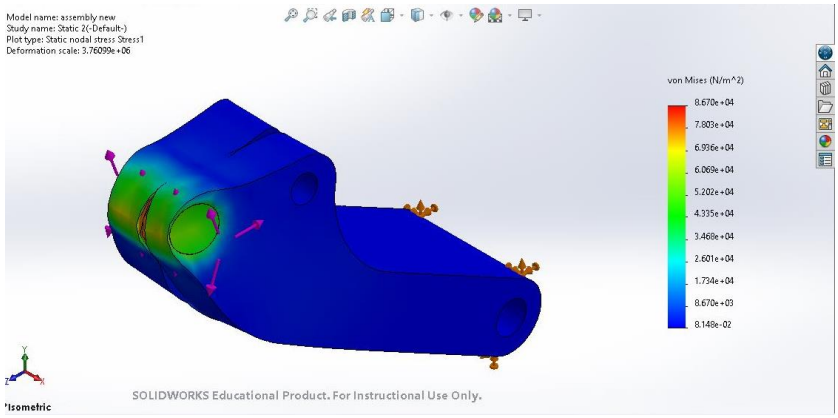
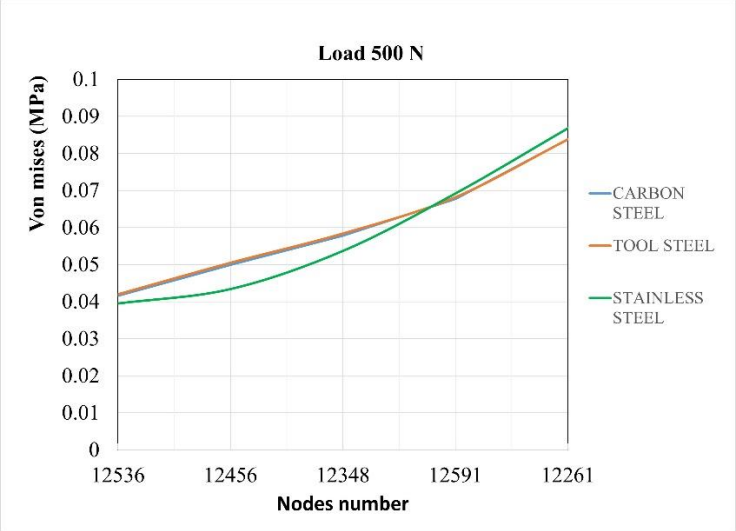


Figure 3: Result analysis

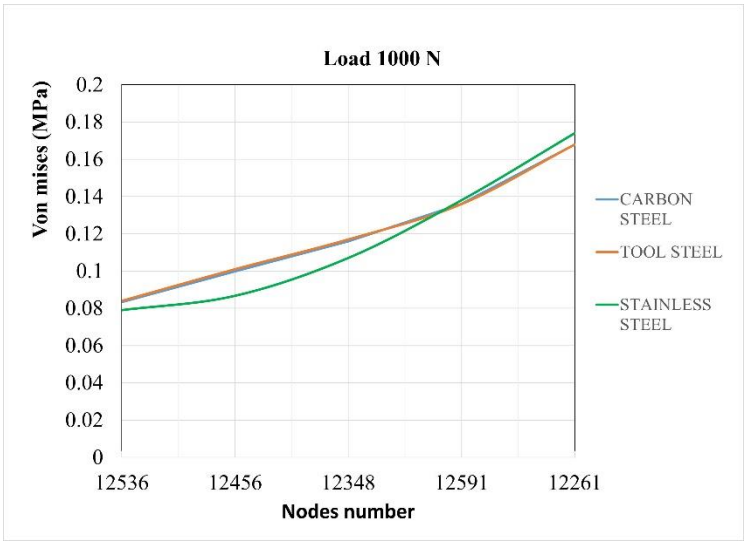
3.1 Von mises stress versus nodes

Results for graph Von mises stress at different load are shown in Figure 4(a), 4(b), 4(c), 4(d), and 4(e) for load 500 N, 1000 N, 1500 N, 2000 N and 2500 N respectively.

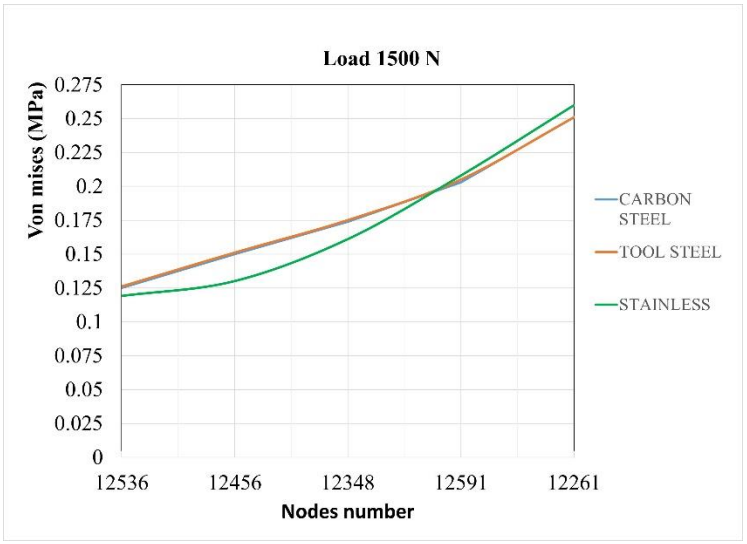
Based on the graph in Figure 4, increasing the load from 500 N to 1000 N results in an increase of 100% of the Von mises stress. This pattern cannot be seen for other loads. From 1000 N to 1500 N, it rises about 50% and less than 50% for 1500 N to 2000 N and 2000 N to 2500 N.



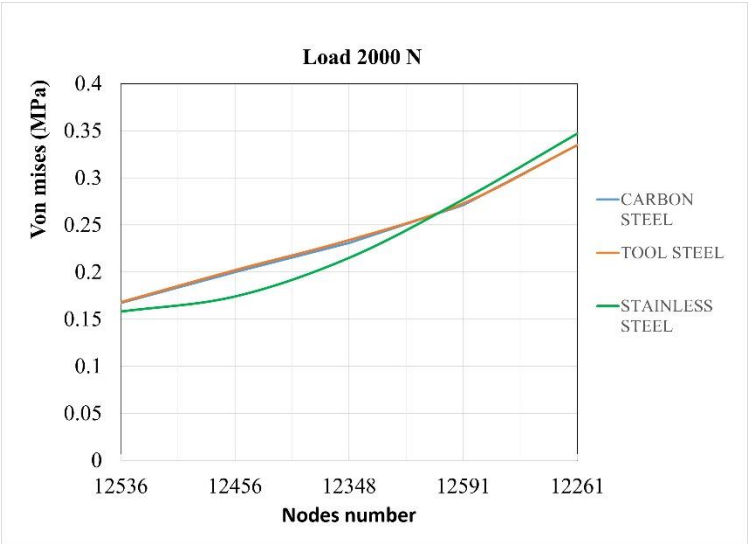
(a)


Load 1000 N
Von mises (MPa)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
12536
12456
12348
12591
12261
Nodes number
CARBON STEEL
TOOL STEEL
STAINLESS STEEL

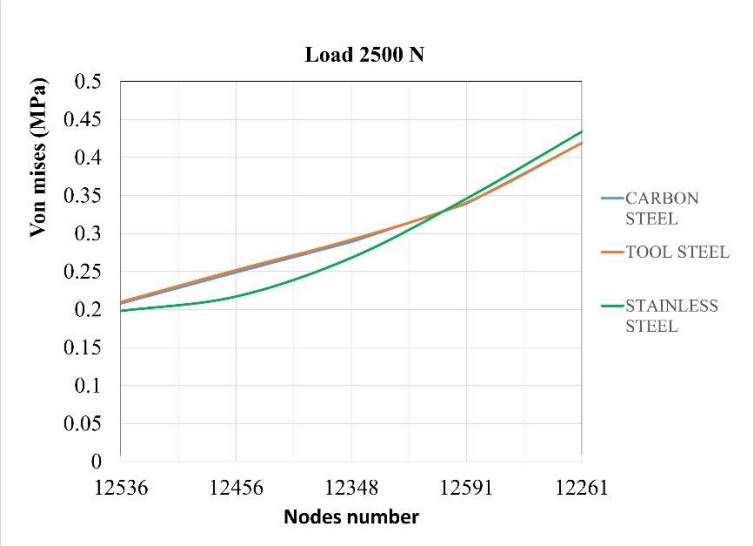
(b)


Load 1500 N
Von mises (MPa)
0.275
0.25
0.225
0.2
0.175
0.15
0.125
0.1
0.075
0.05
0.025
0
12536
12456
12348
12591
12261
Nodes number
CARBON STEEL
TOOL STEEL
STAINLESS

(c)


Load 2000 N
Von mises (MPa)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
12536
12456
12348
12591
12261
Nodes number
CARBON STEEL
TOOL STEEL
STAINLESS STEEL

(d)



(e)

Figure 4: Graph Von mises stress versus nodes number for load (a) 500 N, (b) 1000 N, (c) 1500 N, (d) 2000 N, and (e) 2500 N respectively.

4. Conclusion

Tool steel has been chosen for its good material compared to stainless steel and carbon steel. Tool steel has a higher yield strength value and is based on the simulation results. The value for von mises stress to reach the maximum level with a certain load is also not high. This means, a high load value and many products can be applied to fabricate bending arm with tool steel material. The life span for the compartment bending arm is longer. Therefore, there is no need to do frequent maintenance on this compartment and can save costs.

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