DESIGN AND ANALYSIS OF ARM OF REAPER AND BINDER MACHINE

Tejaskumar Patel¹, Prof. Chetan Vora², Prof. Vipulkumar Rokad³

¹PG student Mechanical Department, Kalol Institute of Technology and Research Centre
²Asso. Professor Mechanical Department, KITRC, Kalol, Gujarat, India
³Assist. Professor, KITRC, Kalol, Gujarat, India

Abstract- Our research paper is based on reaper and binder machine. It performs cutting and binding simultaneously. During operation in the field we face the problem of arm for binder which transmits the motion from the base mechanism to the fingers which collects the grass. We will carried out analysis for failure of arm by ANSYS and modify the design.

Keywords- Reaper and binder machine, arm of binder part etc.

1. INTRODUCTION

Harvesting is an operation carried out after the maturity of crop. It includes the cutting of crops and binding the straws. There are four types of technologies available for cereal crops in India. Traditional using hand tools like sickle, Using manual reaper, Self-propelled reaper and binder machine, Modern technology using combine harvester.

Reaper and binder machine is manufactured by BCS Company. The physical construction is divided into three parts: steering mechanism, Engine mounting and cutting and binder mechanism.

Steering mechanism: In this machine, steering or direction controlling of machine is done by foot, so its foot propelled machine. Paddle is provided to control direction.

Engine mounting: Chassis is provided to mount the engine of machine that engine is of 10 hp and 1440 rpm.

Header: Blades are mounted on the base and binder mechanism is provided to bind the cut straws by means of sting.

2. MACHINE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>10 HIP or 7.5 KW</td>
</tr>
<tr>
<td>Type of fuel</td>
<td>Diesel</td>
</tr>
<tr>
<td>Width of cutter</td>
<td>4 feet</td>
</tr>
<tr>
<td>Gear</td>
<td>4 Forward and 1 reverse gear</td>
</tr>
<tr>
<td>Weight of machine</td>
<td>400 kg.</td>
</tr>
<tr>
<td>Dimensions (l * w)</td>
<td>360 cm * 150 cm</td>
</tr>
<tr>
<td>Type of clutch</td>
<td>Dry clutch</td>
</tr>
<tr>
<td>Binding height</td>
<td>28 cm</td>
</tr>
</tbody>
</table>

Figure 1 Reaper and Binder machine
3. DESIGN CALCULATIONS

Load on the arm = 600 N

Material = Aluminum Alloy

Young’s Modulus, E = 71 GPa

Moment of Inertia is calculated as under,

\[ I = \frac{1}{12} \times w \times h^3 \]

\[ \therefore I = \frac{1}{12} \times 25 \times 25^3 \]

\[ \therefore I = 32.55 \times 10^3 \text{mm}^4 \]

Deflection of arm under loading condition is calculated by,

\[ \delta = \frac{P \times L^3}{3EI} \]

\[ = \frac{600 \times 444.91^3}{3 \times 32.55 \times 10^3 \times 71 \times 10^2} \]

\[ = 2.58 \text{mm} \]

Modified Material

Load on the arm = 600 N

Material = MS

Young’s Modulus, E = 210 GPa

Moment of Inertia is calculated as under,

\[ I = \frac{1}{12} \times w \times h^3 \]

\[ \therefore I = \frac{1}{12} \times 25 \times 25^3 \]

\[ \therefore I = 32.55 \times 10^3 \text{mm}^4 \]

4. FEA BASE MODAL ANALYSIS FOR REAPER AND BINDER MACHINE

Basic Steps of FEA Analysis for Aluminum Alloy

(1) Preprocessing: defining the problem

The major steps in preprocessing are define key points/lines/areas/volumes,

(i) define element type and material/geometric properties,

(ii) Mesh lines/areas/volumes as required. The amount of detail required will depend on the dimensionality of the analysis, i.e., 1D, 2D, ax symmetric, and 3D.

(2) Solution: assigning loads, constraints, and solving

Here, it is necessary to specify the loads (point or pressure), constraints (translational and rotational), and finally solve the resulting set of equations.

(3) Post processing: further processing and viewing of the results

In this stage one may wish to see lists of nodal displacements,

(i) element forces and moments,

(ii) deflection plots, and

(iii) Stress contour diagrams or temperature maps.
Mode 1

Figure 2 Total deformation of mode 1

Mode 2

Figure 3 Total deformation of mode 2

Mode 3

Figure 4 Total deformation of mode 3

Mode 4

Figure 5 Total deformation of mode 4
5. MODIFIED DESIGN

Mode 1

Figure 8 Total deformation of mode 1

Mode 2

Figure 9 Total deformation of mode 2

Mode 3

Figure 10 Total deformation of mode 3

Mode 4

Figure 11 Total deformation of mode 4
6. Experimental setup

7. Comparison of deformation

<table>
<thead>
<tr>
<th>Mode</th>
<th>Maximum deformation Al-Alloy (mm)</th>
<th>Maximum deformation MS (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>87.79</td>
<td>45.663</td>
</tr>
<tr>
<td>2</td>
<td>86.95</td>
<td>47.21</td>
</tr>
<tr>
<td>3</td>
<td>79.35</td>
<td>43.51</td>
</tr>
<tr>
<td>4</td>
<td>82.63</td>
<td>47.3</td>
</tr>
<tr>
<td>5</td>
<td>113.18</td>
<td>46.844</td>
</tr>
<tr>
<td>6</td>
<td>89.22</td>
<td>44.827</td>
</tr>
</tbody>
</table>

8. CONCLUSION

We have compared the deformations of the existing material Aluminum alloy and Mild steel. As the comparison indicates that the maximum deformation is reduced from 113.18 mm to 47.21 mm. The reduced deformation reduces the loses of cut stroes which are collected.

REFERENCES


[6] Ephrem Zeleke Kassa, Dr. Ing Zewdu Abdi 2014 ,” Design and Modification of Appropriate Reel Mechanism to Harvest Tef Crop”