DESIGN AND ANALYSIS OF ARM OF REAPER AND BINDER MACHINE

Tejaskumar Patel[#1], Prof. Chetan Vora[*2], Prof. Vipulkumar Rokad[$3]

[#]PG student Mechanical Department, Kalol Institute of Technology and Research Centre
[*]Asso. Professor Mechanical Department, KITRC, Kalol, Gujarat, India
[$]Assist.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.

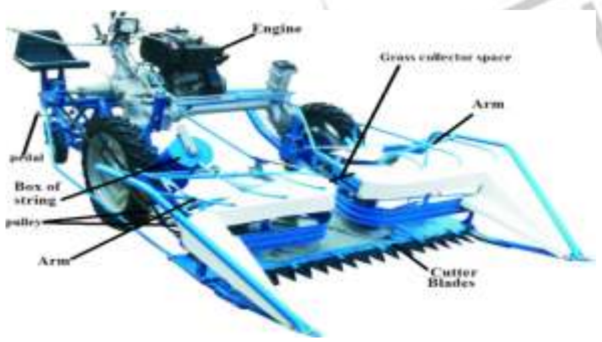

Figure 1 Reaper and Binder machine

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

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

3. DESIGN CALCULATIONS

Load on the arm = 600 N

Material = Aluminum Aloy

Young's Modulus, E = 71 GPa

Moment of Inertia is calculated as under,

$$I = \frac{1}{12} wh^3$$

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

$$\therefore I = 32.55 \times 10^3 mm^4$$

Deflection of arm under loading condition is calculated by,

$$\delta = \frac{PL^3}{3IE}$$

$$= \frac{600 \times 444.91^3}{3 \times 32.55 \times 10^3 \times 71 \times 10^3}$$

$$= 7.82\ mm$$

Modified Material

Load on the arm = 600 N

Material = MS

Young's Modulus, E = 210 GPa

Moment of Inertia is calculated as under,

$$I = \frac{1}{12} wh^3$$

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

$$\therefore I = 32.55 \times 10^3 mm^4$$

Deflection of arm under loading condition is calculated by,

$$\delta = \frac{PL^3}{3IE}$$

$$= \frac{600 \times 444.91^3}{3 \times 32.55 \times 10^3 \times 210 \times 10^3}$$

$$= 2.58\ mm$$

4. FEA BASE MODAL ANALYSIS FOR REAPER AND BINDER MACHINE

Basic Steps of FEA Analysis for Aluminum Aloy

(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, axsymmetric, 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.

Mode1

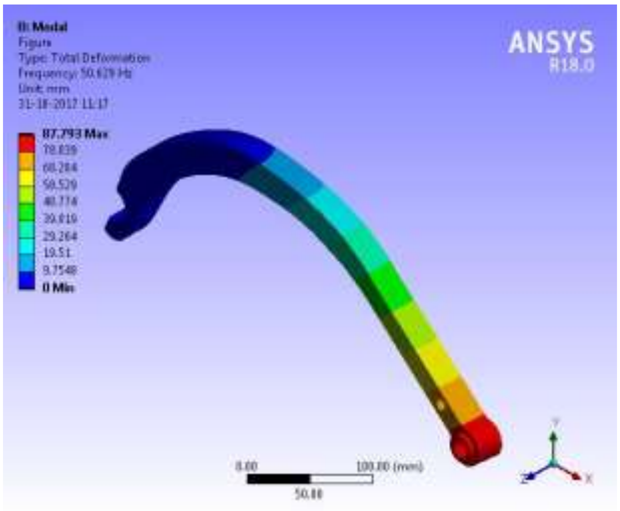

Figure 2 Total deformation of mode 1

Mode-2

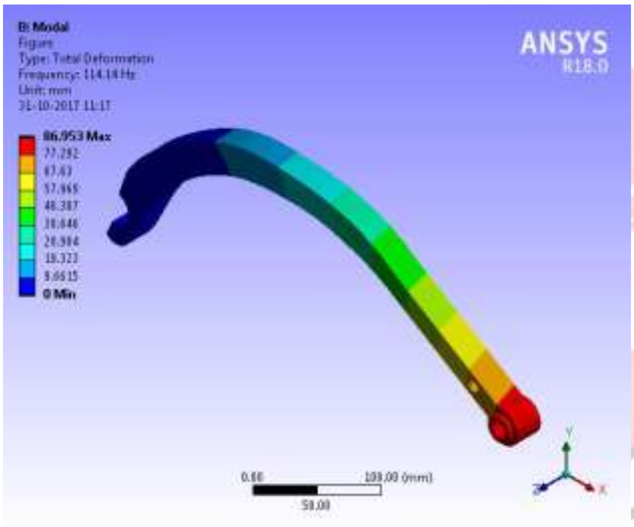

Figure 3 Total deformation of mode 2

Mode3

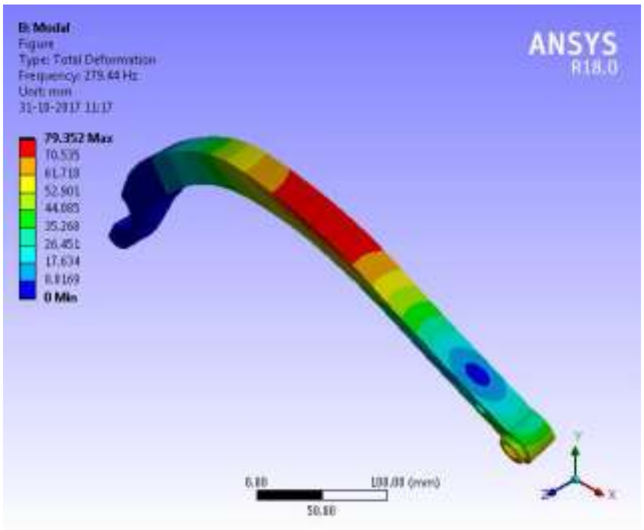

Figure 4 Total deformation of mode 3

Mode-4

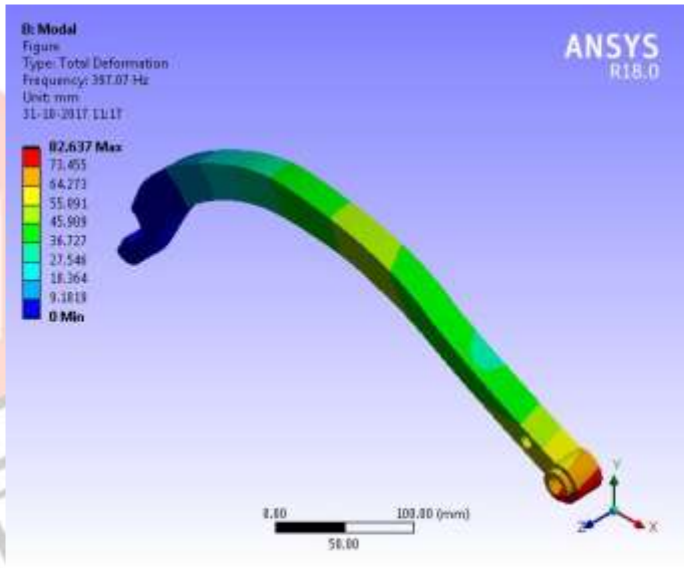

Figure 5 Total deformation of mode 4

Mode5

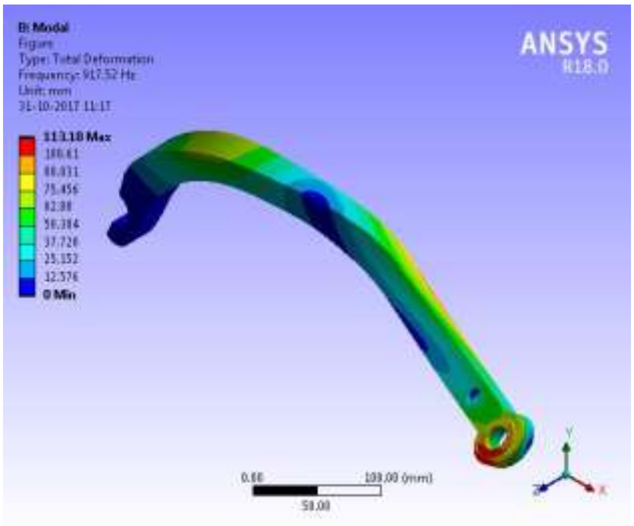

Figure 6 Total deformation of mode 5

Mode-6

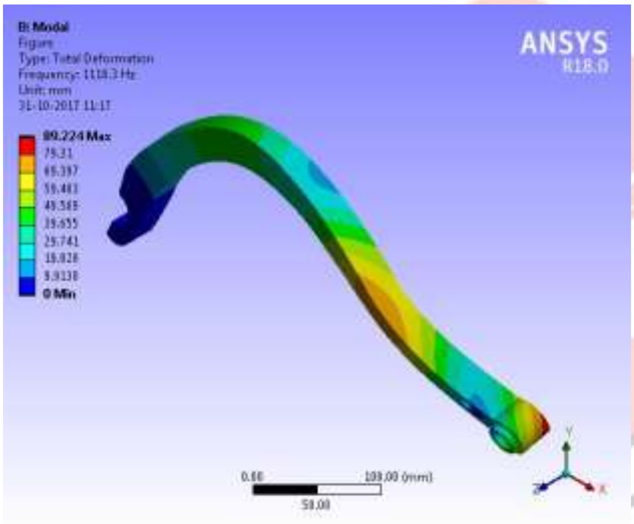

Figure 7 Total deformation of mode 5

5. MODIFIED DESIGN

Mode1

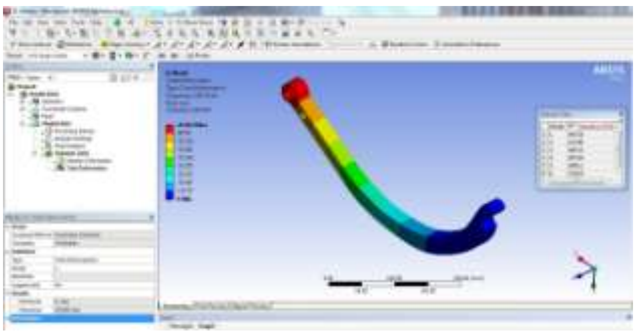

Figure 8 Total deformation of mode 1

Mode-2

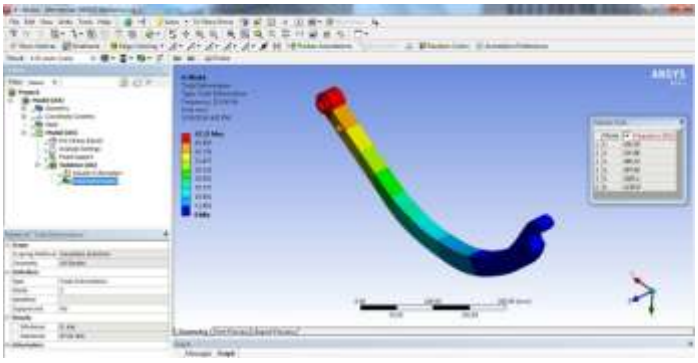

Figure 9 Total deformation of mode 2

Mode-3

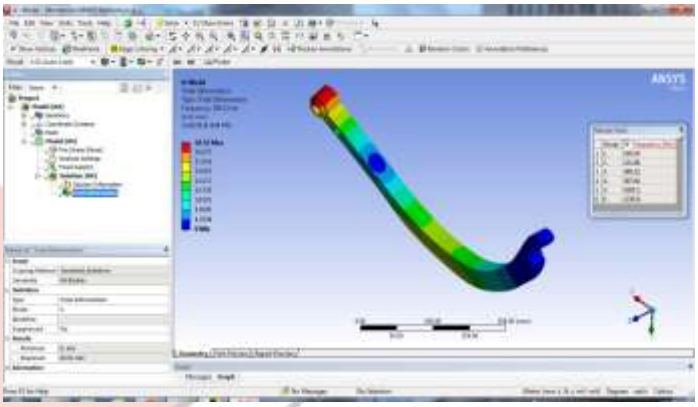

Figure 10 Total deformation of mode 3

Mode-4

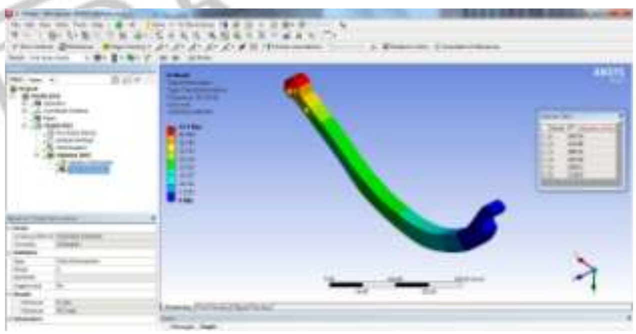

Figure 11 Total deformation of mode 4

Mode-5

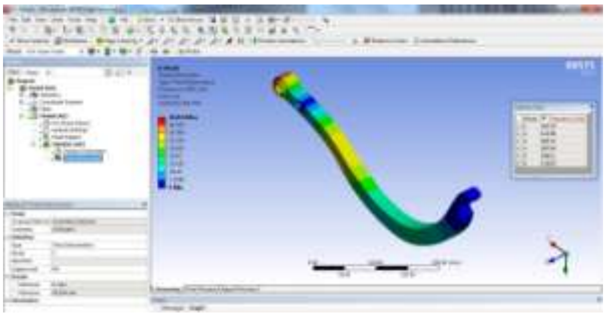

Figure 12 Total deformation of mode 5

Mode-6

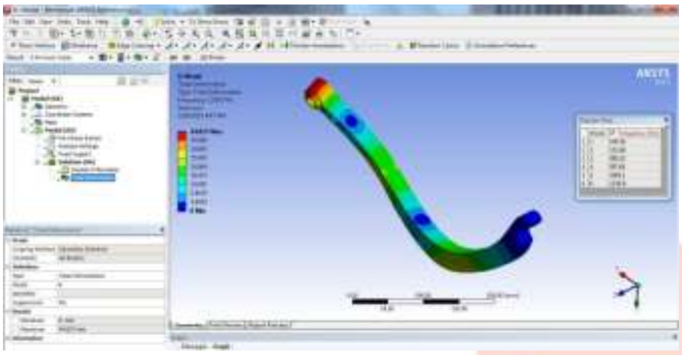

Figure 13 Total deformation of mode 6

6. Experimental setup

7. Comparison of deformation

Total Deformation of Arm of Reaper and Binder Machine		
Mode	**Maximum deformation Al-Alloy (mm)**	**Maximum deformation MS (mm)**
1	87.79	45.663
2	86.95	47.21
3	79.35	43.51
4	82.63	47.3
5	113.18	46.844
6	89.22	44.827

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

[1] Mahbubul Alam Zami1, Md. Altaf Hossain, M. A. Sayed, B. K. Biswas1 and M. A. Hossain "Performance Evaluation of the BRRI Reaper and Chinese Reaper Compared to Manual Harvesting of Rice"

[2] Prof. P.B.Chavan1, Prof. D .K. Patil and Prof. D .S. Dhondge "Design and Development of manually Operated Reaper"

[3] Laukik P. Raut1 Vishal Dhandare, Pratik Jain, Vinit Ghike, Vineet Mishra "Design, Development and Fabrication of a Compact Harveste

[4] Sharmin Alam Brishti, guided by Dr. Md. Ashik-E-Rabbani,thesis, (2014), "IDENTIFICATION OF THE FUNCTIONAL PROBLEMS OF REAPER AVAILABLE IN BANGLADESH"

[5] Nesar Mohammadi BANEH Hosein NAVID, Mohammad Reza ALIZADEH, and Hamid Reza GHASEM ZADEH (2012) "Design and Development of a Cutting Head for Portable Reaper Used in Rice Harvesting Operations"

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

[7] S. Jarolmasjed , SH. Abdollahpour ,T. Mesri Gundoshmian, M. A. Ghazvini,(2013)," Mathematical Modeling of Combine Harvester Header Loss using Dimensional Analysis"