DESIGN AND MODIFICATION OF THREE SHAFT THRESHING MACHINE IN AGRICULTURE TECHNOLOGY

PROJECT MEMBERS:

1. Krupal Patel — Roll No.:D12me27 — Enroll No.:120783119010
2. Jitendra Patel — Roll No.:D12me22 — Enroll No.:120783119013
3. Dainik Patel — Roll No.:10me55 — Enroll No.:100780119058
4. Sanjay Rajput — Roll No.:D12me33 — Enroll No.:120783119031

GROUP NO.:- 30 **GROUP ID.:- 9917**

Under Guidance of : Prof. N.N.CHAUDHARY

Department of Mechanical engineering,
Smt. S. R. Patel Engineering College,
Dabhi,Unjha-384170

CONTENTS

INTRODUCTION

- In past of 20th century conventional system of threshing was used for threshing the crop like manual system, pedal thresher and then implementation of simple axial thresher was done. Threshers are used in agriculture for threshing the crops like wheat, rice, corn, millet, castor etc.Just now day's threshers are used in single or double shafts.

SINGLE SHAFT THRESHING MACHINE

In the single shafting thresher machine rotor and blowers are mounted on same shafts. Required Input RPM to the threshing shaft is given by belt and pulley drive from the input power unit eg. Tractor engine. There are two blowers mounted one is for suction and throwing chopped waste and second is for fine cleaning of the output grain. Body of very heavy gauge welded steel plates with the following features.

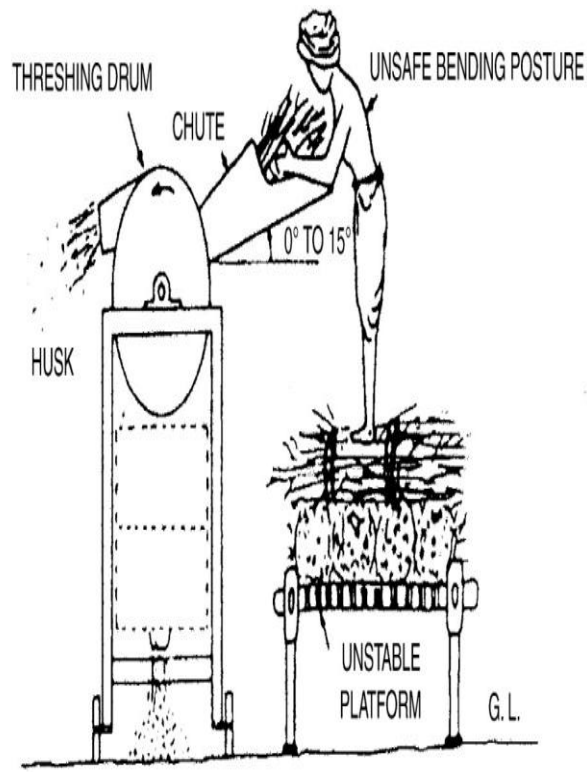
DOUBLE SHAFT THRESHING MACHINE

- In the double shafting thresher machine rotor and blowers are mounted on different shafts. Required Input RPM to the threshing shaft is given by belt and pulley drive from the input power unit e.g. Tractor/motor or engine. There are two blowers mounted one is for suction and throwing chopped waste and second is for fine cleaning of the output grain. Body of very heavy gauge welded steel plates are used in threshers.

INDUSTRY DEFINED PROBLEM

Ergonometric problems

- Arm injury during feed the crops in bucket.
- Uncomfortable design of feeding hoper.
- Separation of grain during feeding the crop.
- More time requirement during threshing the crop because of more time to feed the crops.
- Fly straw particles may drop in farmer's eye from the rotor drum and having eye injury.



THRESHER EFFICIENCY PROBLEM

- There are many problems of efficiency leads to bad output products.
- Bending of shafts due to its more length.
- Detuning of rotor and blower speed.
- With changing of crops pulleys have to been change.
- V-belt changing operation with changing of pulleys is very difficult.

METHODOLOGY

Study about thresher mechanism

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Searching the research paper

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Study the research paper and other introductory topics

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Study and analysis of single shaft thresher machine

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Study and analysis of double shaft thresher machine

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Design of three shaft thresher machine

↓

Modified auto feeder to reduce the ergonomics problem

↓

Design of elevating system

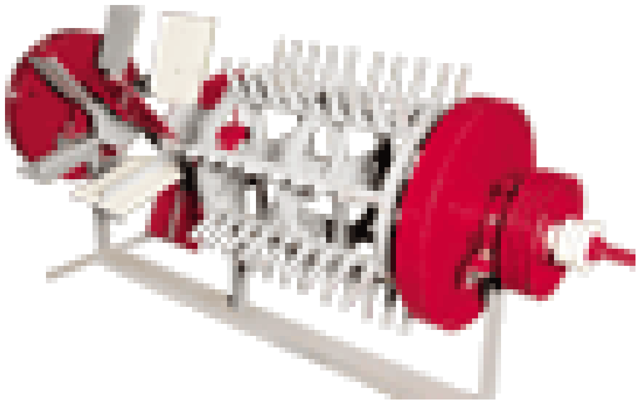
↓

conclusion

VARIOUS PARTS OF THRSHER

- **Thresher Rotor**

It is available in two types. This rotor rotates on two shaft and due to that the speed of the rotor and fan is proportionally same.

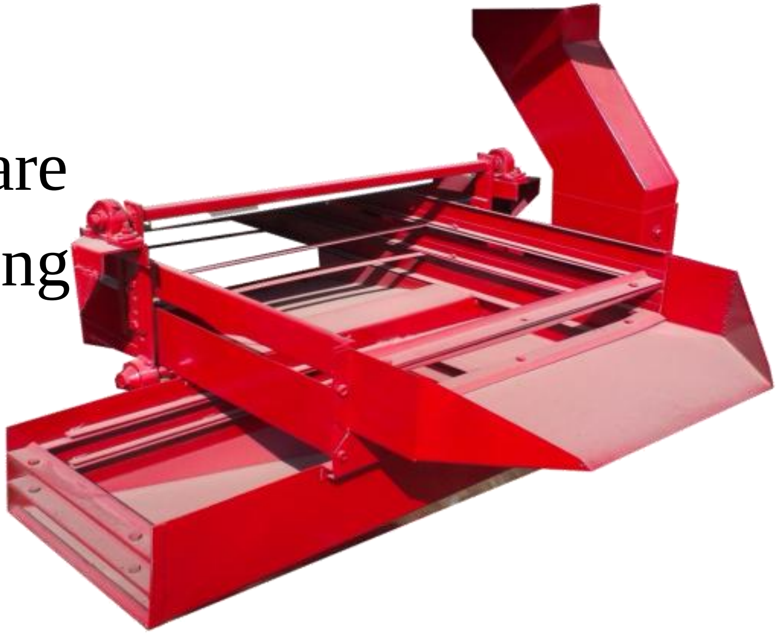


- **Chaffer**

It is very useful for refined chaffing of grains.

- **Big Size Sieve**

The new model is 30" wide. So there are no chances of clogging and the cleaning Is done speedily.

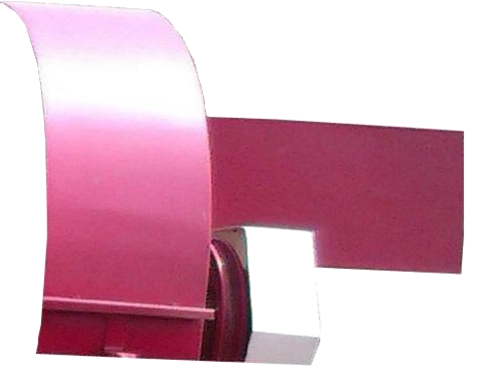


- **Table**

  Due to its special design it can be moved to and fro and up and down even though it is attached to Thresher.

- **Rear- Side Blower**

  This facility helps to throw away residue and to avoid spoiling tractor's radiator in case of change in the direction of wind.

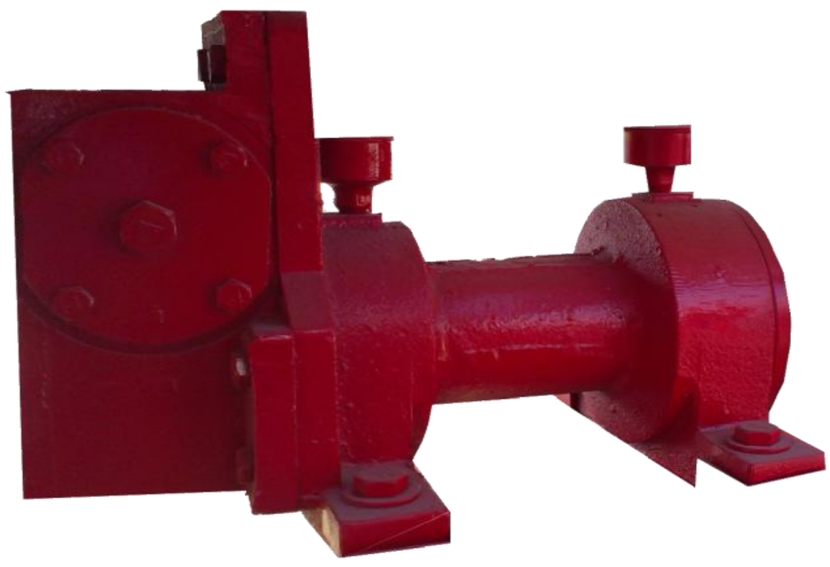


- **Traction Joint Hook**

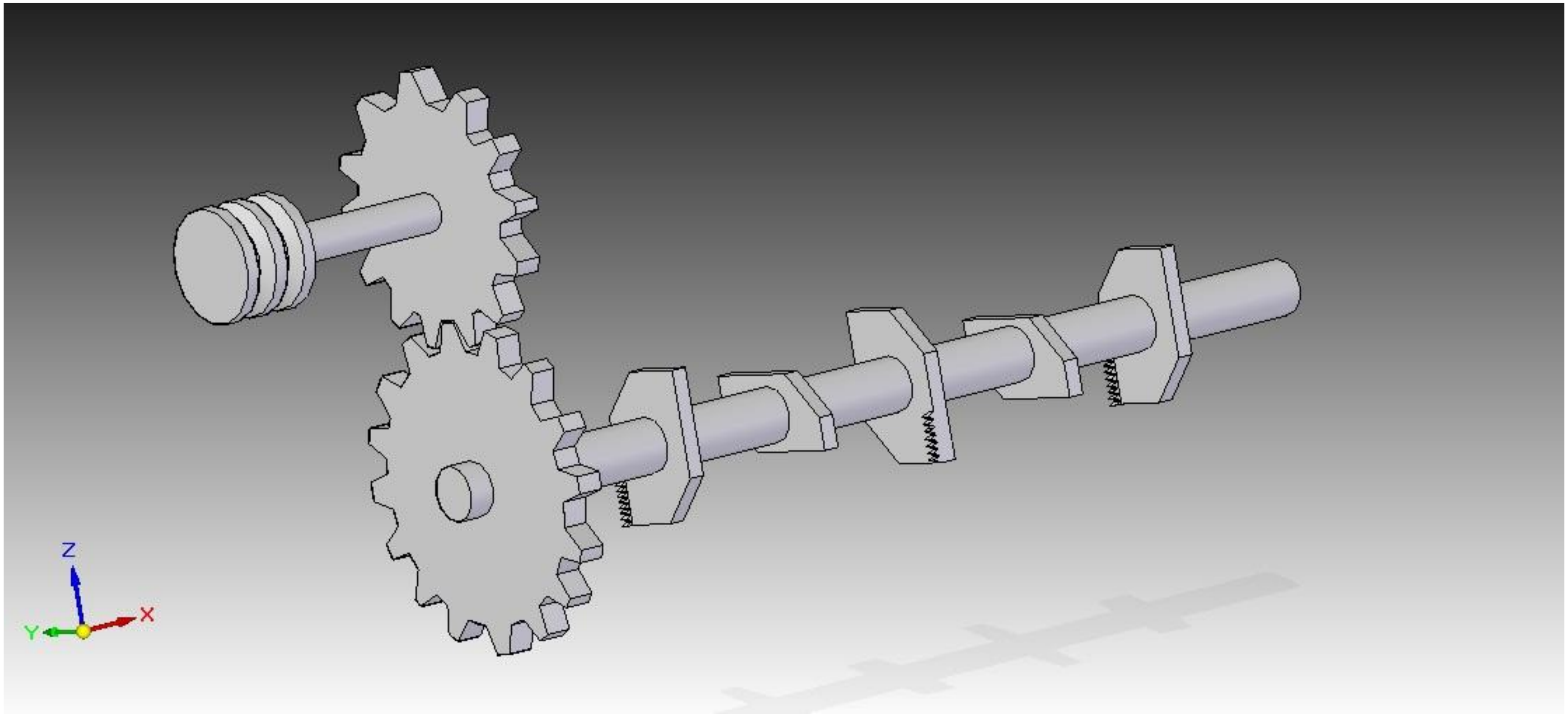
  It is specially designed to adjust it up or down as per requirement.

- **Gearbox**

  It is designed in accordance with R.P.M of tractor. So the speed of the sieve can be adjusted according to the crop.



Implementation of Auto feeder Mechanism in Thresher



Calculative Measurements of Auto feeder Mechanism

- N1=SPEED OF DRIVING SHAFT, (rpm)
- N2=SPEED OF DRIVEN SHAFT, (rpm)
- T1=NO. OF TOOTH ON DRIVING GEAR
- T2= NO. OF TOOTH ON DRIVEN GEAR
-
- P1=INPUT SHAFT POWER,(kw)
- P2=OUTPUT AUTOFEEDER SHAFT POWER,(kw)
- T=TORQUE TRANSMITTED,(n.m)

- NOW, INPUT POWER OF THRESHER FROM TRECTOR

  $P1 = 25$ HP $=18.65$ KW

  COMMONLY SPEED OF INPUT SHAFT TO THRESHER

  $N1=650$ RPM

  $T1=18$

  $T2=26$

- USING FORMULA OF GEARS, $N2/N1 = T1/T2$

  $N2/650 = 18/26$

  $N2 = 450$ RPM

- NOW,USING FORMULA OF POWER TRANSMISSION,

INPUT POWER $P1 = 2\pi NT/60$

$18.65 = 2*650*T/60$

$T = 274.1$ N.M

- NOW, OUTPUT POWER AT AUTOFEEDER SHAFT

$$P2 = 2\pi NT / 60$$

$$P2 = *450*340.5/60$$

P2 = 16.05 KW

- EFFICIENCY:

$$\eta = \text{OUTPUT POWER/INPUT POWER}$$

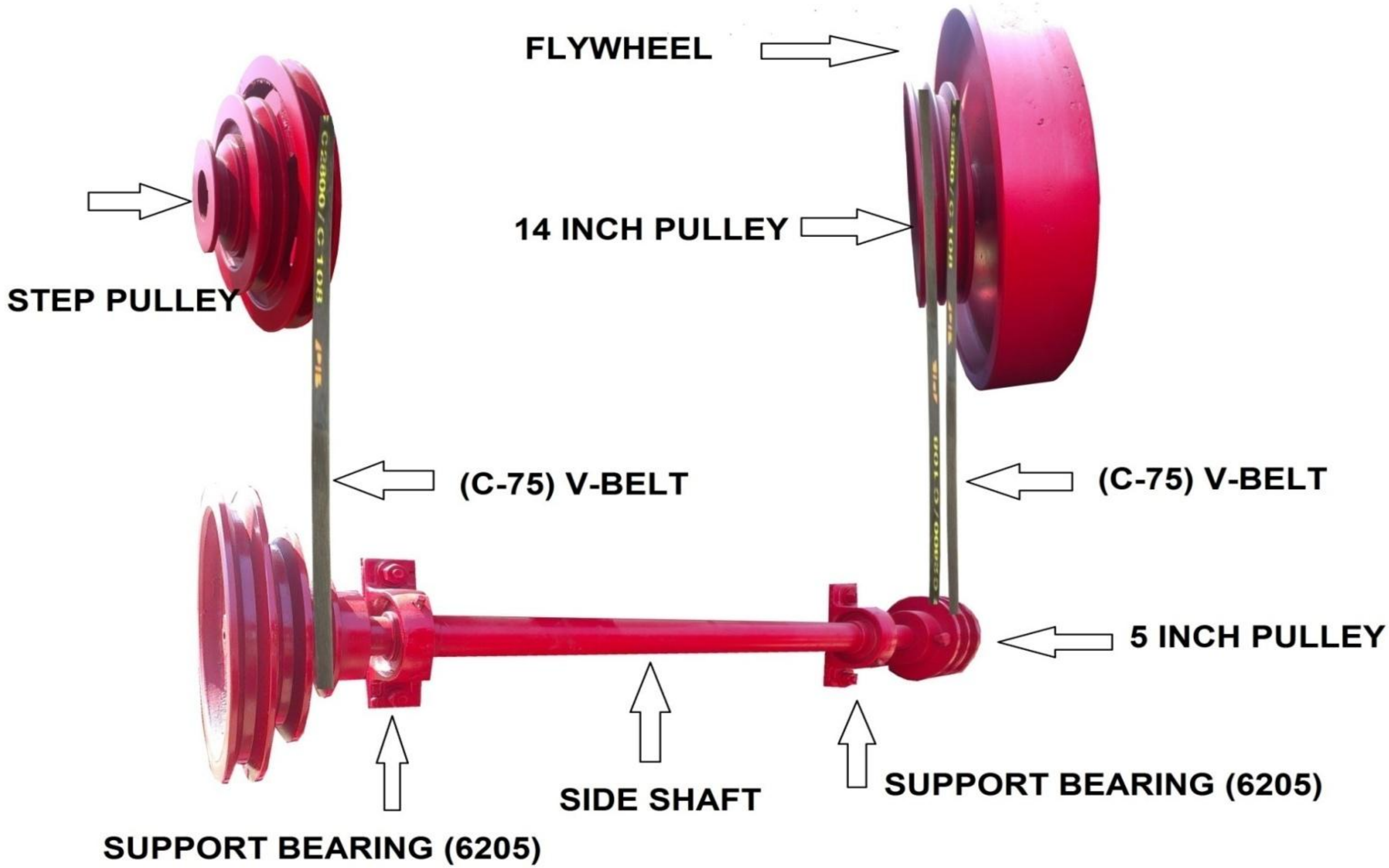
$$\eta = P2/P1$$

$$\eta = 16.05/18.65$$

η = 86.05 %

SO, **EFFICIENCY OF AUTOFEEDER = 86.05 %**

Assembly of side shaft thresher



calculations

- N1=SPEED OF DRIVING SHAFT, (rpm)
- N2=SPEED OF ROTOR SHAFT, (rpm)
- N3=SPEED OF SIDESHAFT, (rpm)
- N4=SPEED OF FANSHAFT, (rpm)
- P1=INPUT SHAFT POWER,(kw)
- P2=OUTPUT ROTORSHAFT POWER,(kw)
- T=TORQUE TRANSMITTED,(n.m)
- (10 INCH PULLEY DIAMETER) D1= 254 mm
- (14 INCH PULLEY DIAMETER) D2= 355 mm
- (5 INCH PULLEY DIAMETER) = 127 mm
- (11 INCH PULLEY DIAMETER) = 279 mm

- <u>Speed of rotor shaft(N2)</u>

$$N2/N1 = D1/d2$$

$$N2 = (N1*D1)/D2$$

$$N2 =(254*540)/355.6$$

$$N2 = 385.71 \text{ rpm}$$

- <u>Speed of side shaft(N3)</u>

$$N3/N2 = D2/d3$$

$$N3 = (N2*D2)/D3$$

$$N3 =(385.71*355.6)/127$$

$$N3 = 1079.988 \text{ rpm}$$

- <u>Speed of fan shaft (N4)</u>

Fan shaft is connected to side shaft with fabric belt by step pulley of (5-8-11)inch diameter so speed of fan shaft is dependent on which step belt is mounted.

- <u>N4 when 5inch-11 inch step is connected with belt</u>

$N4/N3 = D3/D4$

$N4 = (N3*D3)/D4$

$N4 = (1079.988*127)/279.4$

N4 = 490 rpm

- <u>N4 when 8inch-8inch step is connected with belt</u>

here D3= D4

so, N3=N4

now, here N3= 1079.988 rpm

so, N4= 1079.988 rpm

- <u>N4 when 11inch-5inch step is connected with belt</u>

$N4/N3 = D3/D4$

$N4 = (N3*D3)/D4$

$N4 = (1079.988*279.4)/127$

N4 = 2375.97 rpm

- <u>Efficiency of side shaft thresher</u>

Generally tractor output is taken 35 hp power and 540 rpm of shaft. so we take P1= 35 hp and N1= 540 rpm.

now, 1 hp = 746 watt

so, 35 hp = 26110 watt

Input power, P1 = 2ΠN1T/ 60

26110 = (2Π*540*T)/60

T = 26110* 60/(2Π*540)

Torque, T = 461.96 N.m

<u>Output power at rotor shaft</u>

P2 = 2ΠN2T/ 60

= (2Π*385.71*461.96)/60

P2 =18649.77 watt

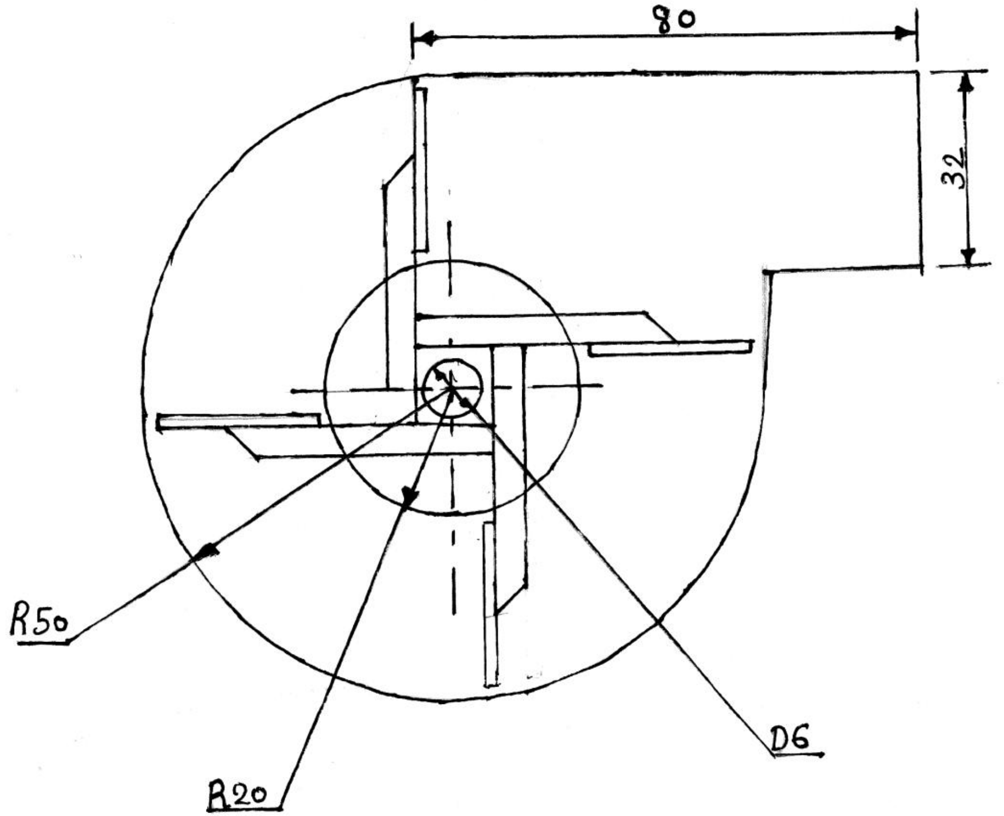
- Efficiency, $\eta = P2/P1$

  $\eta = (18649.77)/(26110)$

  $\eta = 71.42\ \%$

- Single shaft thresher has 58 % efficiency which can improved to 71.42 % with sideshaft thresher.

Calculation of Implementation Blower



- **The linear velocity of blower as well as wheat straw chaff.**

$V_{\text{(at inlet with eye)}} = r\,\omega$

$= 20\text{x } 73.303$

$= 1466.07$ cm/sec

$V_{\text{(at blade tip)}} = r\,\omega$

$= 50 \text{ x } 73.303$

$= 3665.19$ cm/sec

- **Area of blower at the inlet for air and wheat straw chaff .**

Area at the eye of redeveloped blower,

$A_{\text{(inlet)}} = 2 \text{ x } \pi \text{ x } r \text{ x } L$

$= 2\text{x}3.14\text{x}20\text{cm x}10\text{cm}$

$A_{\text{(inlet)}} = 1256.63\text{cm}^2$

- **Area at the exit for air and wheat straw chaff**

Area at the exit end of redeveloped blower,

$A\ out = 32\ cm \times 32\ cm$

$= 1024\ cm^2$

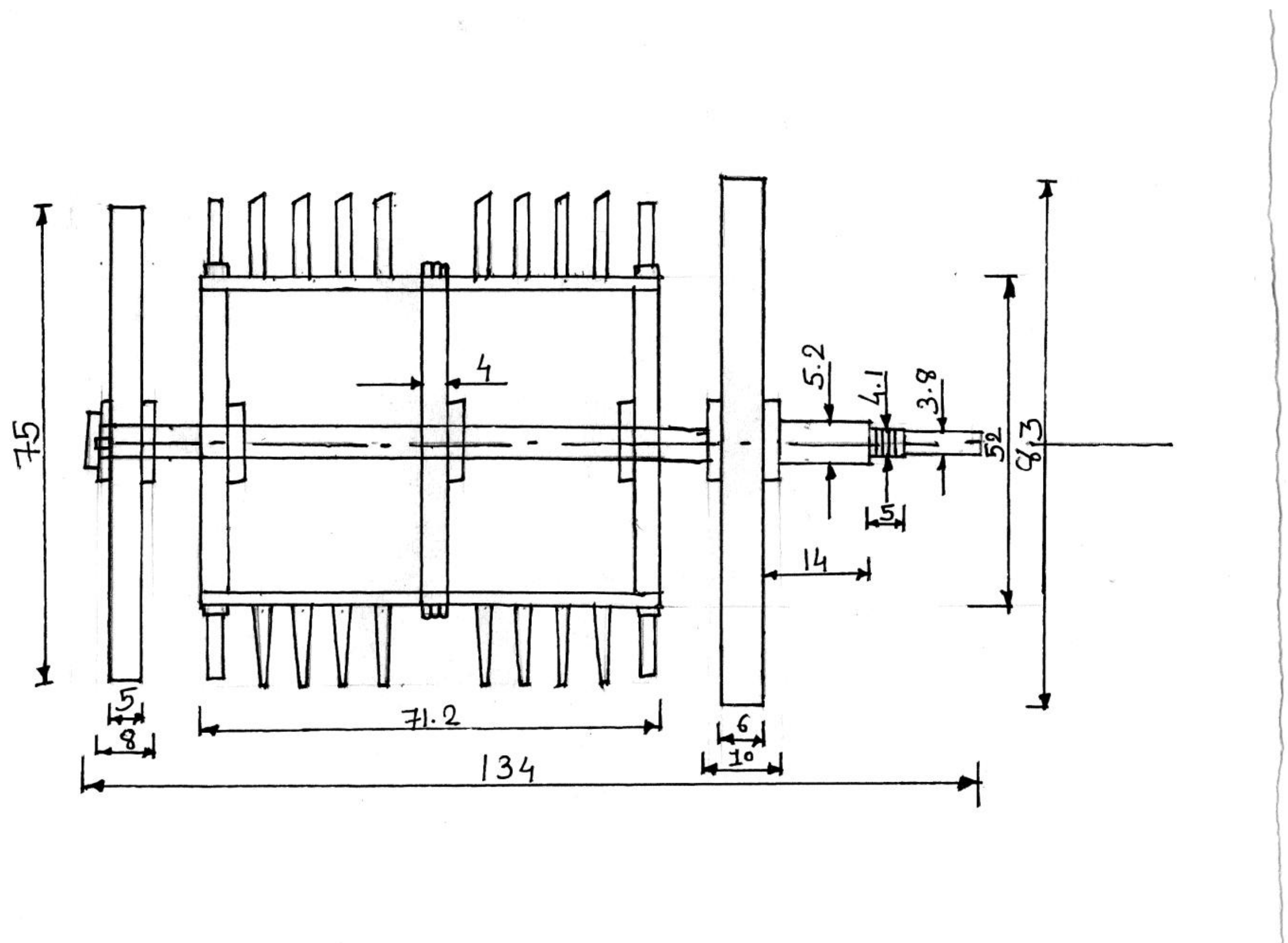
- **The centrifugal force of fan blower paddle to throw the chaff**

$Fc = m\ r\ \omega^2$

$= 0.38 kg/sec\ x\ 0.50\ m\ x\ (73.303 red/sec)^2$

$= 1392.77\ N$

Calculation of Implementation Rotor



F= Centrifugal Force

e= Specific Unbalance

$M_{(m\ r)}$= Maximum Residual Mass

SU= Specific Unbalance Required

M_r= Rotor Mass

R_c= Radius of Rotor

- **Centrifugal Force**

$$Fc = m\ r\ \omega^2$$

$$= 1*52*3317.28 \quad \text{where… (N=550)}$$

= 172.49 kN

- **Unbalance**

$$U = m\ r$$

$$= 1*52$$

$$\underline{\mathbf{= 52\ gmm}}$$

- **Specific Unbalance**

$$e = m\ r / M \qquad \text{where..(M= rotor mass)}$$

$$= 1*52/ 200$$

$$\underline{\mathbf{= 0.26\ gcm/ kg}}$$

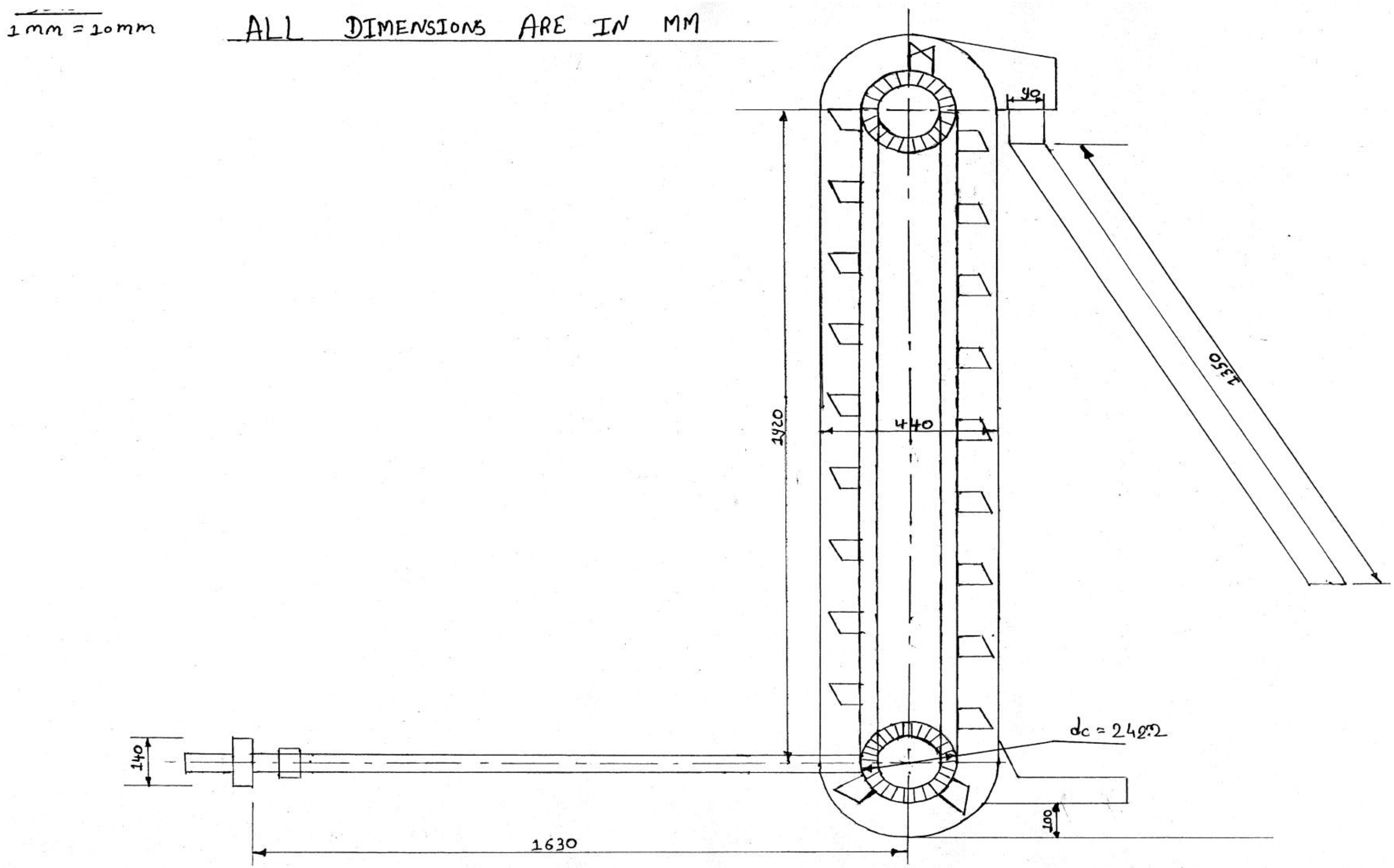
- **Maximum Residual Mass**

$$M_{(m\ r)} = SU*M_r / R_c$$

$$= 0.26*200/ 52$$

$$\underline{= \mathbf{1\ kg}}$$

Design of Elevating System



N1= Input rpm= 560

N2= Output rpm= ?

T1= Input gear teeth= 20

T2= Output gear teeth= 40

D1= Diameter of input pulley= 127 mm

D2= Diameter of output pulley= 127 mm

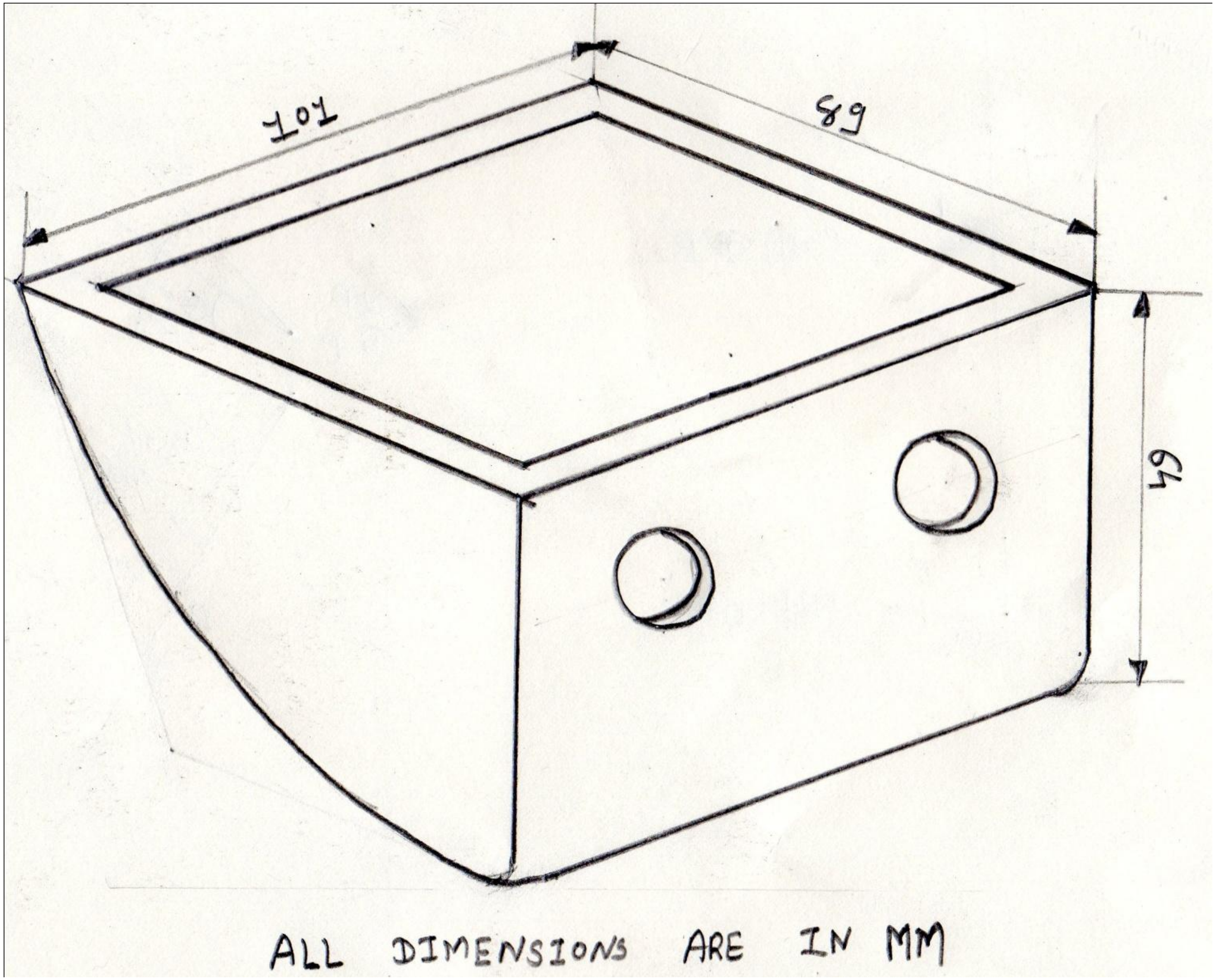
- Solving by gear ratio equation;

N2/N1=T1/T2

N2/560=20/40

N2=280 rpm

Bucket



➢ Bucket Calculation

- The handling capacity of a bucket elevator . Q tones/hours

$$Q = 3.6*v*\Psi*\gamma(io/a)$$

$$=3.6*0.5*0.85*1.5(0.3/0.15)$$

= 4.59 tones/hours

Where, io= capacity of the bucket

a = bucket spacing in meter

v = chain speed meter/second

γ = bulk weight of load tones/meter3

Ψ = bucket loading efficiency

- The maximum static tension of the driving member S_{max} is

S_{max} = 1.15*3H (q+k1 q0)

= 1.15*3*1 (10.19+1.5*25.50)

= 168 kg

Where, H = height of which the load is elevated in meter

q = weight of the load per meter of elevator length

q0= weight per meter of chain with bucket

k1,k2,k3= factor allowing for the resistance to motion and bending of the driving member and the buckets

- Required motor(tractor) power on the drive shaft

  N0 = (Qh/367)*(1.15*k2*k3*v)

  = (21.29/367)*(1.15*2.1*2.5*0.5)

  = 175.12 watt

- Chakkar diameter (dc)

  dc = Ws – { lb+l}*2

  = 440 – {88.9+10}*2

  = 242.2 mm

Where, lb= Length of bucket

Ws= Width of system

l= Distance b/t bucket & system body

- Center length of the chakkar (l_c)

  l_c = (2360-220*2)

  = **1920 mm**

- Total chain length

  = l_c*2+2πr

  = 1920*2+(2π *121)

  = 1920*2+(6.28*121)

  = 3840+760.26

  = **4600.26 mm**

ADVANTAGES

- This machine is use to make threshing process easy.
- Less human effort use for operating threshing machine.
- Clean seed are achieved by use of threshing machine.
- Less time required for threshing operation.
- Less human worker use in threshing process by use of threshing machine.

CONCLUSION

- In this project we are using three shaft thresher machines it can improve the efficiency of the overall machine and reduce the shaft bending problem and improve the quality of the crops.
- Also using the elevating system in the thresher machine it can reduce the man power and crops are direct feed to the trolley and other transportation vehicles.
- Auto feeder mechanism can help to farmers for feeding the crop easily so some arm injury during feeding the crop can be reduced and auto feeder power requirement and friction loses is also very small so it is a very important improvement in multi crop thresher history. Auto feeder mechanism also helps to reduce working thresher time.

LETERATURE REVIEW

1. **“Development of grain threshers based on ergonomic design criteria”**

Objective: Reduce the ergonomics Problem

Design criteria: Chute

Main topics observed: In thresher machine proper length and height of chute should be selected so reduce the human injuries problem

Conclusion: change chute height, length and chute angle etc.

2. “The Design and Construction of Maize Threshing Machine “

Objective : The machine is simple, less bulky and effective with its self-cleaning ability.

Design criteria : design of all thresher parts.

Main topics observed : design and calculation of thresher parts like shaft, pulley, drum, hopper, chute, bearing and any other parts are design discuss in detail and improve the efficiency.

Conclusion : Grains loss and mechanical visible damage have been very minimal. Performance test has revealed that the efficiency of the machine is 99.2%.

3. “ REDESIGNING AND DEVELOPMENT OF INDIGENOUS BEATER WHEAT THRESHER “

Objective: the major problems on conventional threshers have been identified as bulky weight, poor machine performance, human accidents and a high fuel consumption rate

Design criteria: Modified designs and fabrication drawings of various components of thresher machine.

Main topics observed: Total weight of redesigned wheat thresher was reduced from 1600 kg to 1300 kg by improving beaters in thresher drum and the grain damage in redesigned thresher reduced four times. The mean threshing efficiency is increased from 98% to 99% and redesigning and redeveloping the direction of fan blower exhaust, the mean grain cleaning efficiency improved from 97.44 to 98.18%

Conclusion: redesign the various parts of thresher machine like as flywheel, beater drum, feeding conveyer, direction of fan blower exhaust.

4. “Design, fabrication and testing of a millet thresher “

Objective : the major problem of this machine is the poor machining performance and moisture contain affected the thresher speed.

Design criteria : redesign the all parts of thresher machine.

Main topics observed : change the design of thresher parts like hopper, threshing chamber, cleaning chamber, separating chamber, blower housing, threshring drum and screen.

Conclusion : The machine was designed to be powered by a 5 hp electric motor and improve the highest threshing and cleaning efficiencies of 63.2 and 62.7% and the successful development of this machine is expected to reduce drudgery associated with the traditional method of threshing millet and therefore increase productivity of farmers.

5. “ Occupational Health Hazards & Efficacy of Protective Masks in Threshing Operation “

Objective : reduce the human health problem.

Main topic observed: Four different protective masks were given and tested on various Parameters.

Conclusion : These masks were used to protect the inhalation of organic dust as well as exposure of various body parts i.e. head, face, ears and neck.

6. “Designing and Testing of a Threshing Cone “

Objective : reduce the cone problem.

Design criteria : design of threshing cone.

Main topics observed : change the cone angel, cone length etc. and suitable cone material are selected so efficiency of threshing machine are more.

Conclusion : change the cone angle, cone length and cone material.

7. “Effect of type of drum , drum speed and feed rate on sunflower threshing “

Objective : the major problem of thresher machine are the output capacity,threshering efficiency, grain damage, reduce the grain losses, power requirement and specific energy consumption against the drum type and drum speed.

Design criteria : change the power output.

Main topics observed : change power requirement and specific energy consumption against different drum types, drum speeds and feed rates and improve the efficiency.

Conclusion : The threshing efficiency was found to be in the range of 99.77–100% when the threshing material change like drums, drum speeds and feed rates.

8. “Performance evaluation of four wheel tractor driven high capacity combined paddy thresher “

Objective : this thresher machine is produce the high moisture in environment and straw caused to higher percentage of damaged grain losses and lower output capacity.

Design criteria : design the chute by the paddle fan

Main topics observed : The four wheel tractor driven high capacity combined paddy thresher worked satisfactorily with higher moisture content of crop and showed relatively higher average performances without vibration, clogging or any other deficiencies.

Conclusion : this thresher worked satisfactorily with higher moisture content of crop and higher average performance and without vibration.

9. “Design of throw-in type rice thresher for small scale farmers “

Objective : reduce the low quality of paddy rice and grain loss.

Design criteria : change the thresher mechanism.

Conclusion : the speed and the feeding speed increase than improve the drudgery and threshing challenges with small scale farmers.

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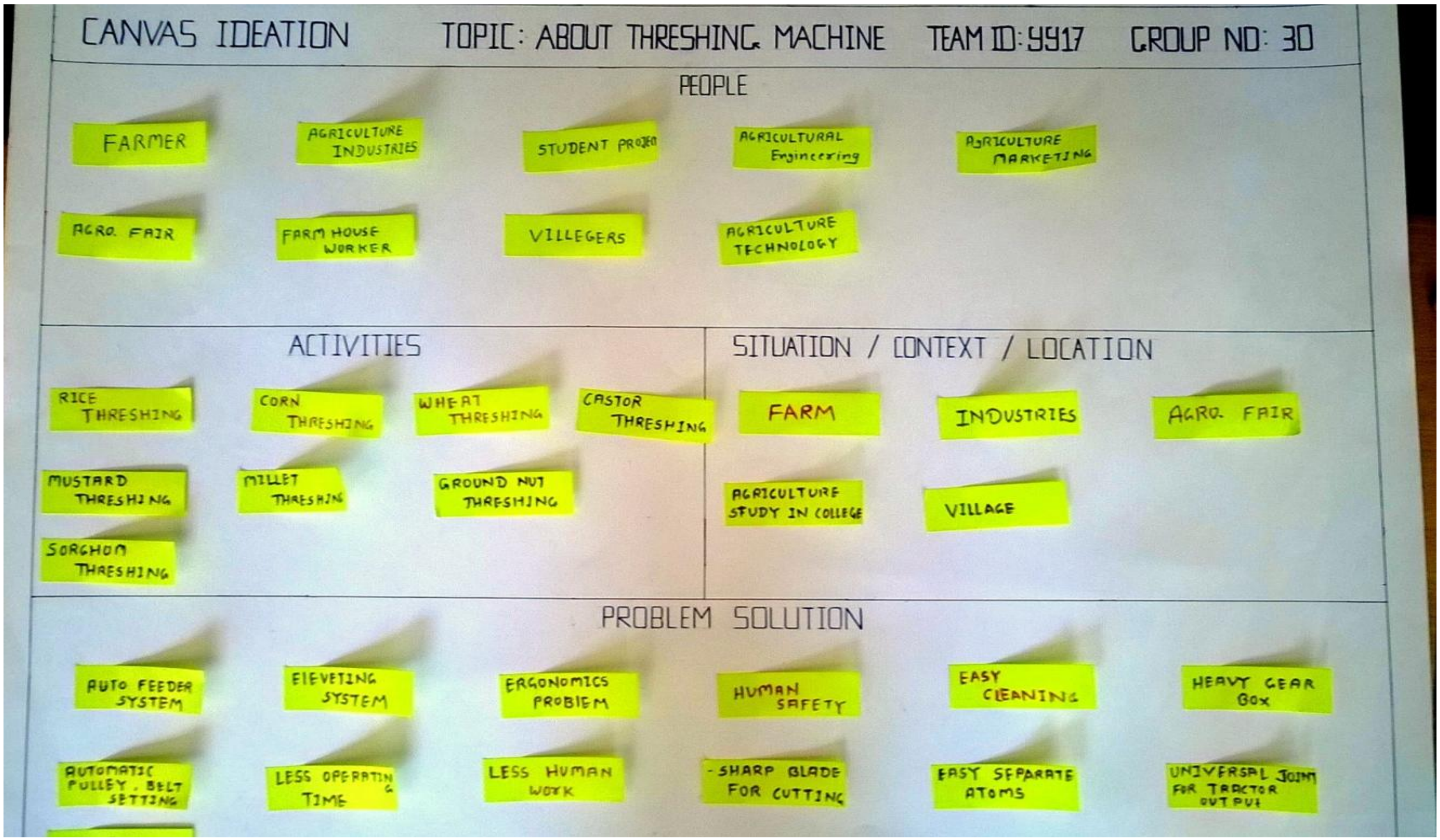
Model Preparation

APPENDIX


CANVAS IDEATION
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GROUP NO: 30
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FARMER
AGRICULTURE INDUSTRIES
STUDENT PROJECT
AGRICULTURAL Engineering
AGRICULTURE MARKETING
AGRO. FAIR
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AGRICULTURE TECHNOLOGY
ACTIVITIES
RICE THRESHING
CORN THRESHING
WHEAT THRESHING
CASTOR THRESHING
MUSTARD THRESHING
MILLET THRESHING
GROUND NUT THRESHING
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SITUATION / CONTEXT / LOCATION
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INDUSTRIES
AGRO. FAIR
AGRICULTURE STUDY IN COLLEGE
VILLAGE
PROBLEM SOLUTION
AUTO FEEDER SYSTEM
ELEVETING SYSTEM
ERGONOMICS PROBLEM
HUMAN SAFETY
EASY CLEANING
HEAVY GEAR BOX
AUTOMATIC PULLEY, BELT SETTING
LESS OPERATING TIME
LESS HUMAN WORK
- SHARP BLADE FOR CUTTING
EASY SEPARATE ATOMS
UNIVERSAL JOINT FOR TRACTOR OUTPUT

THANK YOU...