# "Productivity Improvement For Machining Process By Using Time & Motion Study"

[1]Ketan K. Tonpe [2]Ram R. Wayzode, [3]Mahesh Makode, [4]Saurabh Patte, [5]Suraj Deshmukh,

[1] Assistant Professor, [2] Assistant Professor, [3] UG Student, [4] UG Student, [5] UG Student,
Department of Mechanical Engineering,
Suryodaya College of Engineering and Technology, Nagpur, India

***Abstract :*** The Purpose of productivity improvement on Material handling, as various operations are performed on Radial Drilling machine. Most of the time, machine is in idle condition due to worker's fatigue, during scrap handling, product management and breakdown. So production out from machine is decreases. The paper presents the review of productivity improvement methods using motion study & time study. Using motion study ineffective motion of worker is eliminating and replace it with effective motions. Time study helps to analyze time require completing each operation and finding out bottleneck operation. After analyzing bottleneck operation, time required for that operation is minimizes by using another alternate working method.

***IndexTerms* - Radial Drilling machine, productivity improvement, idle time, time study, motion study, bottleneck operation.**

## I. INTRODUCTION

This project is being performed in the **" J.M.D. PRECISION PVT. LTD.( DISHA ENGINEERING ) "** This industry is inaugurated in year 1994. This industry is located at Plot No S 23, M I D C, Hingna Road, M I D C, Nagpur, Maharashtra 440016. This industry started with a simple job of fetting and finishing of rough foundry casting. J.M.D. Industries is professionally managed organization engaged in manufacturing and supplying a range of spares to Mahindra and Mahindra Ltd. This industry makes product such as Clutch Housing and Vertical Transmission Unit for Tractors . In J.M.D.Precision 300MT capacity Radial Drilling Machine is allowed for the productivity improvement.

This paper all about productivity improvement of Radial Drilling machine of Drilling capacity 60mm & Overall Power capacity 9 kw, to improve productivity in the Radial Drilling machine follows various methods and improve the quality of product produced and also the worker performance. Productivity is the quantitative relation between what we produce and what we use as resources to produce them i.e., an arithmetic ratio between the amount produced (output) and the amount of resources used in course of production (input). The productivity is mainly coming from the following parameter, viz.

- Technology Based
- Employee Based
- Material Based
- Process Based
- Product Based
- Task Based

Among this parameter the technology based includes the computer aided design (CAD), computer aided manufacturing (CAM), which is very much useful to design and control the manufacturing. It helps to achieve the effectiveness in production system by line balancing. Material based includes the Material planning and control, Purchasing, logistics, Material storage and retrieval, source selection and procurement of quality material, Waste elimination. And Processes based is the Methods engineering and work simplification, Job design evaluation, job safety, Human factors engineering and Product Based is value analysis and value engineering Product diversification, Standardization and simplification, Reliability engineering, Product and promotion and task Based includes Management Communication in the organization, Work culture, Motivation, Promotion group activity.

For improving the productivity, the parameter machine and man is fixed and we have to improve the productivity of industry for that we study about Radial Drilling machine, this is the metalworking machines used primarily to cut, drill, boring, reaming, counter boring or form metal using tooling attached to the slide (ram) and bed. The main components for power transmission on a machine are the clutch, flywheel, and crankshaft.

This power press has a capacity of 300MT. different press cutting operations are as follows,

**1. Drilling :**Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials

**2. Boring:**In machining, boring is the process of enlarging a hole that has already been drilled .

**3. Reaming:**Reaming has been defined as a machining process that uses a multi-edged fluted cutting tool to smooth, enlarge or accurately size an existing hole.

.**4. Counter Boring:**A counter bore is a cylindrical flat-bottomed hole that enlarges another coaxial hole, or the tool used to create that feature.

To improve the productivity of industry we use to prefer the work study method. Work-study forms the basis for work system design. The purpose of work design is to identify the most effective means of achieving necessary functions. This work-study aims at improving the existing and proposed ways of doing work and establishing standard times for work performance. Work-study is encompassed by two techniques, i.e., method study and work measurement. "Method study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs." Work study includes the time study and the motion study. Time study is the A work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analyzing the data so as to determine the time necessary for carrying out the job at the defined level of performance. In other words, measuring the time through stop watch is called time study.

Fig 1.1 Radial Drilling Machine

## II.OBJECTIVE

When we visit the industry in a given interval we observed that the radial drilling and horizontal milling machine performing drilling, boring, reaming and counter boring operations to the casting. There is only one product is produced from the radial drilling machine, for products we used to take readings of operations by the time study. We find out the problem area and process type that they follow for production. According that our main objectives behind the productivity improvement in industry is to improve the overall productivity of the press machine by the means of time and motion study for achieving this we have some objectives that are,

- **To minimize the time required for ineffective motions:** - This refers to the extra time which required to the employee apart from the production of product. This ineffective motion made much more impact in the productivity because it consumes more time for production.
- **To minimize the idle time of machine:** - The idle time is the time in which the machinery (i.e. power press) is ON but there is no production done. If this time is much more than the idle time then it consumes the more electricity and ultimately affect the economy, if we able to reduce that much of time it will defiantly make good impact.
- **To reduce the time required for product and scrap handling: -** when we make visit to the industry we observed that the product and scarp handling take much more time hence, this is a one of the objectives of our project.
- **To create better working environment for reducing the fatigue of employees: -** This refers to the surrounding space where the employee is working, this means the aesthetics of the working area which directly or indirectly the reaso0ns for fatigue of employee. If we improve it will improve the performance of employee.

## III.METHODOLOGY

To start of this project, To we arrange meeting with plant head in the first week is discus to manage the schedule of weekly meetings and the schedule of weekly visits to the industry. In that meetings we decided to divide our team into two groups and visit the industry alternately for more precious data collection. During this meetings plant head told us industry working on the lean manufacturing approach. The purpose is to inform the plant head on the progress of the project and guided by the plant head to solve difficulty. Briefing based on the introduction and next task of the project is given by supervisor. Make research of literature review with the means of the internet, books, available published articles and materials that is related to the title. For achieving the productivity improvement, we concern with them and start the detail observation of the operation study on the basis of that we decided to follow the work study method which includes the time study and motion study. After that we made the therblings for the time study approach to solve the problems and improvement in productivity. In that we visited the industry more than fifteen days and the methodology that we were going to follow as,

1) Collecting data from machine.
2) Analyzing the data.
3) Organizing the solutions.

According to the methodology the working starts as our first method is to collected data from radial drilling machine, in that on the first day we used to understand what actually employs performing the tasks and from next visits we collect data in the form of time. For the data collection we follow the therblings they are select, grasp, hold, inspect, release load, avoidable delay unavoidable delay, rest for overcoming fatigue, product handling, product settlement, break down time, other work, idle time, total time required for the production made from single casting. During this visits we were got the chance to see the gear changing of machine. We also made the readings for that in that we observe that much of the time is required for the tool changing operation. This may be a bottle neck operation which is given from the literature survey. During data collection it is seen that every day there is different operator operates the radial drilling machine therefore data is collected for all the product produced. .

. After the completion of the first stage of our methodologies we proceed towards the next step that is Analyzing the data in this step we are going to analyzing the data that we are already taken by means of different approaches like analyzing data by use of software like Microsoft office Excel by plotting the different charts and graphs among the different therblings and we try other approach like TAGUCHI METHOD. And we are also going to use the Time Vs Strip Curve. After this step our next methodology is Predicting the failures which includes the identification of the causes that affects the productivity of that industry in that stage the analyzed data helps us for predicting the failures and the failures that occurring during operation were noted by our team segregation of this failures are also done in this step. After that our last methodology is to organize the solutions in the steps we are going to provide the solutions on the problem which are identified some solution are in the form of additions attachments to the roller conveys, in the form of CAD MOUDLING and working prototype of the solution.
Among our methodology first one collection of data form machine, here is one sample of this step when we visited industry.

*A.* Product name: Clutch Housing

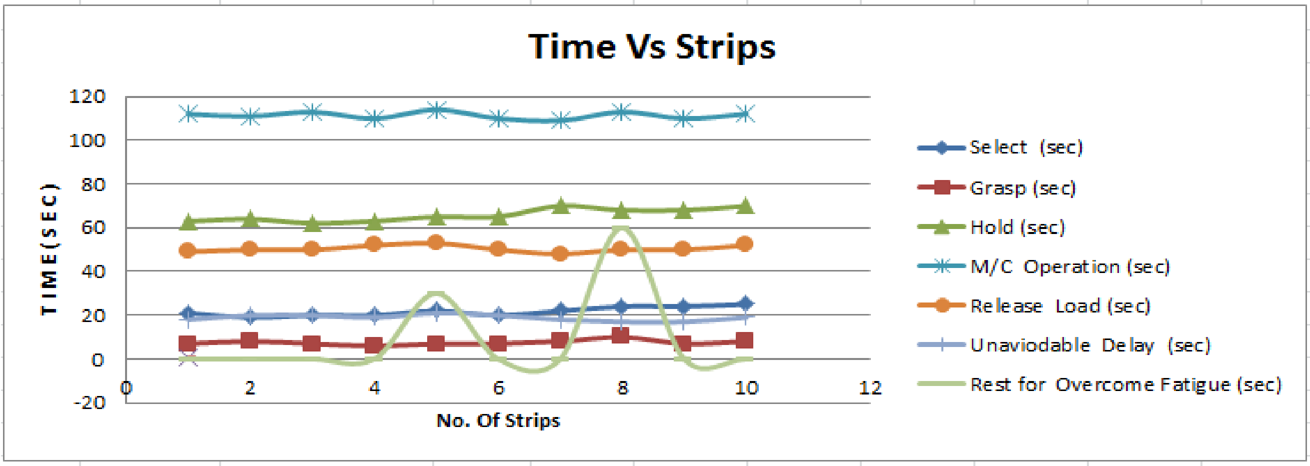
*B.* Dimension of raw strip: - Length=82 mm
Width=457.2 mm

*C.* Number of product: - 10 per strip

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1–3 | No. of Strips | Select (sec) | Grasp (sec) | Hold (sec) | **M/C Operation (sec)** | Release Load (sec) | Unaviodable Delay (sec) | Rest for Overcome Fatigue (sec) | Total Time (sec) | **Average Time (sec)** |
| 4 | Strip 1 | 21 | 7 | 63 | **112** | 49 | 18 | 0 | 270 | |
| 5 | Strip 2 | 19 | 8 | 64 | **111** | 50 | 20 | 0 | 272 | |
| 6 | strip 3 | 20 | 7 | 62 | **113** | 50 | 20 | 0 | 272 | |
| 7 | Strip 4 | 20 | 6 | 63 | **110** | 52 | 19 | 0 | 270 | |
| 8 | Strip 5 | 22 | 7 | 65 | **114** | 53 | 21 | 30 | 312 | **284.7** |
| 9 | Strip 6 | 20 | 7 | 65 | **110** | 50 | 20 | 0 | 272 | **(sec)** |
| 10 | Strip 7 | 22 | 8 | 70 | **109** | 48 | 18 | 0 | 275 | |
| 11 | Strip 8 | 24 | 10 | 68 | **113** | 50 | 17 | 60 | 342 | |
| 12 | Strip 9 | 24 | 7 | 68 | **110** | 50 | 17 | 0 | 276 | |
| 13 | Strip 10 | 25 | 8 | 70 | **112** | 52 | 19 | 0 | 286 | |
| 14 | | | | | | | | **TOTAL TIME** | **2847** | |

Table 1.1. Radial Drilling Machine

- **GRAPH: -**




Graph 1.1. Radial Drilling Machine

- **SIMO Chart for Radial Drilling Machine: -**

In this SIMO chart the operation performed by the left and right hand of the worker are maintain on the table according the sequence of performance. This SIMO chart is for the Radial Drilling Machine, the time required for the process is also shown and the processes which are performed by the both hand of the worker is also present on this SIMO chart.

After plotting this SIMO chart we have observed that the product management i.e. product handling takes more time and become a bottleneck workstation. Rather the inspection of machine is the temporary bottleneck, it is done whenever it needed.

| Sr. No. | Left Hand Operations | Therblings | Time (Sec.) | Therblings | Right Hand Operations |
|---|---|---|---|---|---|
| 1. | Select & Grasp | SL & GR | 29.2 | SL & GR | Select & Grasp |
| 2. | | | 08 | Mrk | Marking On Casting |
| 3. | Hold | H | 65.8 | H | Hold |
| 4. | Machining Operations | MC/O | 111.4 | MC/O | Machining Operations |
| 5. | Release Load | RL | 50.4 | RL | Release Load |
| 6. | Casting Pull Out For Next M/C | CH | 12 | CH | Casting Pull Out For Next M/C |

Table 1.2 SIMO chart of Radial Drilling Machine

## IV.PROBLEM IDENTIFIED

When we visit the industry for data collection purpose, while this observation we observed some difficulties which employ faces during production cycle of this Radial Drilling Machine also the difficulty in material handling and other problems which directly or indirectly affect the productivity and performance of worker. Some of these problems are listed below,

a) More time consumes during product handling process.
b) Buffer storage of casting is more when reference point has to be done.
c) Factor of safety for the worker is less.

Above problems plays an important role in productivity of industry, as we consider the first problem that is more time consumption during the product handling process, here is observed that the product settlement is full manual and there is no any mechanism or extra arrangement is provided for handling mainly the product Clutch housing because of its dimension the handling of this product is difficult in nature and requires more time we are trying to reduce the handling time of the product. Next problem found is that the buffer storage of casting is more after creating the reference point. Because radial drilling machine having two jigs and fixtures to create reference points on the casting therefore before milling machine there are more buffer storage created.

Our further observation identifies that after some period buffer storage created on the other machine after radial drilling machine. This problem occurs only in horizontal milling machine because there are two fixtures in the radial drilling machine. Next problems which comes during the tapping operation the zminor tapping on the product. The Operator have visual problems doing same operations then after extra time needed to the operator.

## V. SOLUTION PROPOSED

After performing methodology, the solutions are provided on the basis of the parameter which takes more time to perform the operation. The handling operation is the bottleneck operation found while study for resolving this bottleneck operation solution are as follows,

**4.1 Roller conveyor: -**

This inclined roller is attached at the bottom side of the Radial Drilling Machine where the products are to be kept by the operator. This roller is assembled with the ball rollers which can be other end of roller. This roller made path for the product from buffer storage to the radial drilling machine.

This system efficiently reduces the working time required for the process as there is no need to collect the product form the base of the machine and it also reduces the fatigue and mental stress acting upon worker while production.

**Fig. 1.2** Roller conveyor

- ## Drafting of roller conveyor: -

Drafting means the technical drawing, drafting or drawing, is the act and discipline of composing drawings that visually communicate how something functions or is constructed.

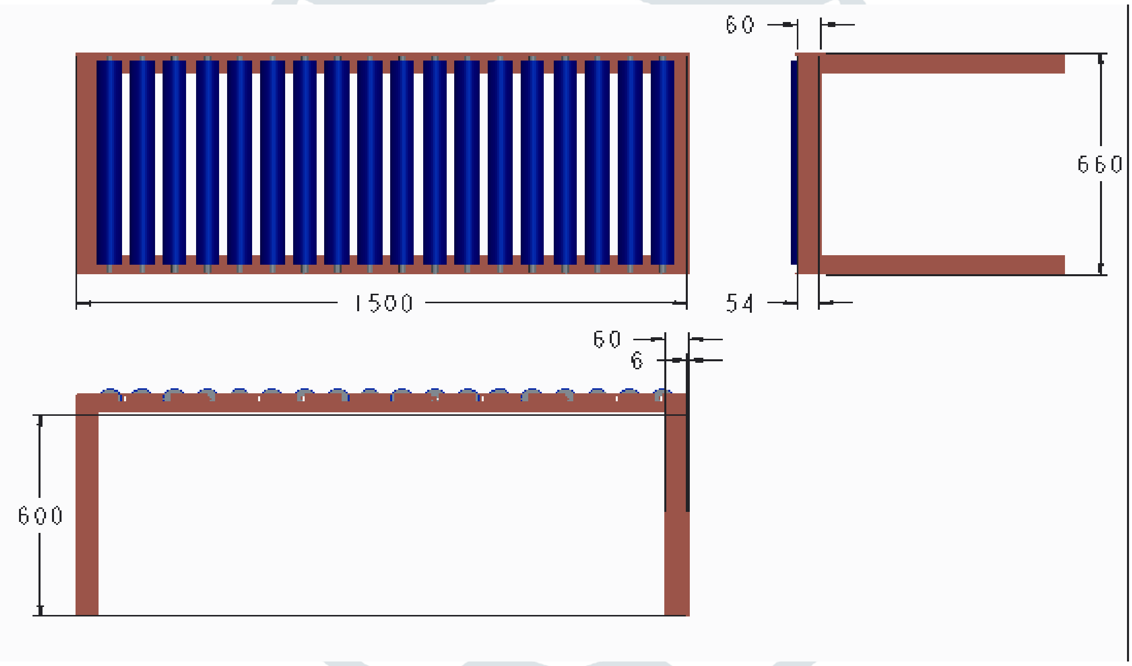



**Fig. 1.3** Drafting of roller conveyor

- ## 4.2 Gravity Roller conveyor system: -

Gravity conveyor is an unpowered conveyor such as a gravity chute or a roller conveyor that uses the force of gravity to move materials over a downward path.A *conveyor system* is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the [material handling] and [packaging] industries.

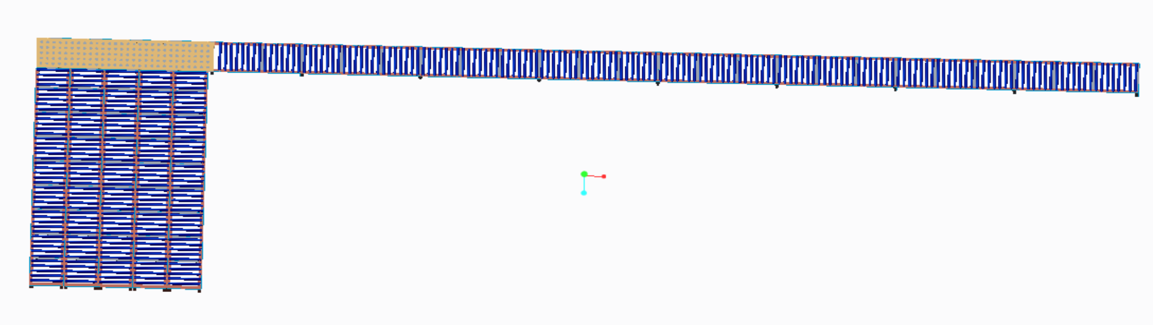


**Fig. 1.4** Roller conveyor system

- **Drafting of Roller Conveyor system: -**

Drafting means the technical drawing, drafting or drawing, is the act and discipline of composing drawings that visually communicate how something functions or is constructed. At the design stage, both freehand and mechanical drawings serve the functions of inspiring and guiding the designer and of communicating among the designer, collaborators, production department, and marketing or management personnel.

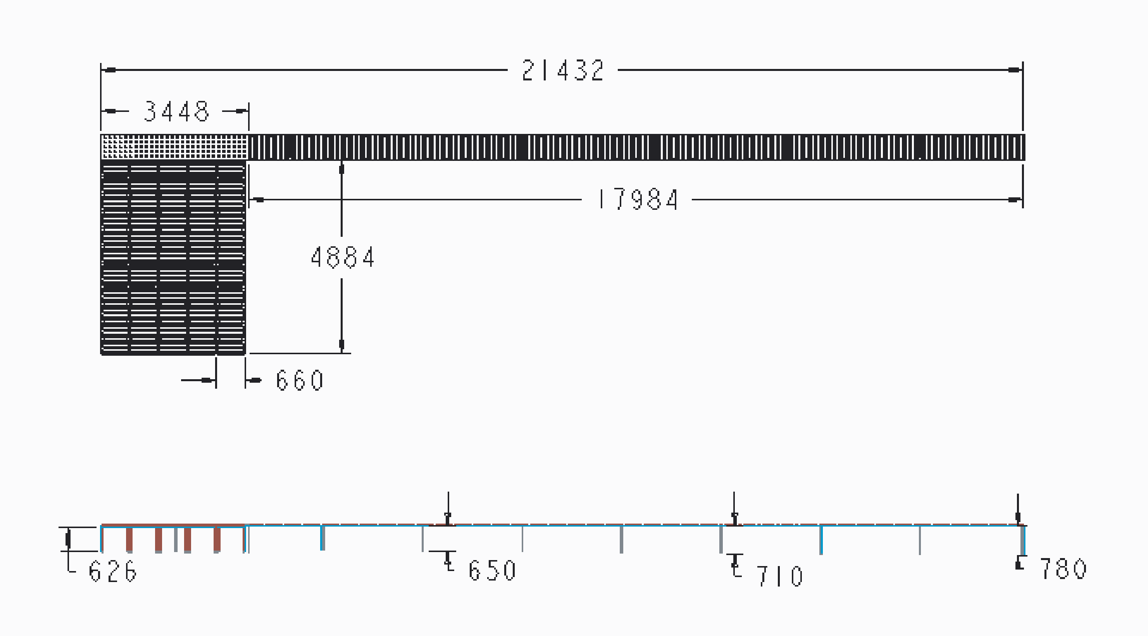



**Fig. 1.5** Drafting of roller conveyor system

## VI. DESIGN CALCULATION

The part of the axle which is between the two bearings on either sided will be given a rough surface finish and can have a diameter of more than 30mm. This will reduce machining costs. The part of the axle in contact with the bearing will be given a good surface finish and will have an exact diameter as the bore of the bearing. There will be an interference fit between the inner race of the bearing and the axle. The part of the axle outside the bearing will have a smaller diameter than 30mm. This will ensure that when the bearing is fitted there is no rubbing between the axle and the bearing.

Some Sample Calculation of Conveyer Design:-

The minimum inclination angle ‘β’ of the gravity conveyor:

Pitch = 100mm

Total length of the conveyor =22 meters = 21458mm

Number of rollers necessary =21458/100 = 214

Volume of the 73OD pipes $= \pi/4 \times h \times (D1^2 - D2^2)$

$= \pi/4 \times 450 \times (60^2 - 54^2)$

$= 244715.55 mm^3$

$=2417.65547\ cm^3$

Weight of the rotating part of the roller = density of C.I × Volume

= 7.874 × 2417.4557

= 19035.044g =19.035kg

- **Angle of conveyor**

$$\tan \beta = (2k/D) + [\{1+ (wn'/G)\} \times (\mu d/D)] + \{q \times (Z0nwv2/gLG)\}$$

k = rolling friction factor (C.I) = 0.00051m = 0.51mm

D = roller diameter =60mm

w = weight of the rotating part the roller = 19.03kg

n′= No. of roller supporting total load = 5

G = total load = 84kg

μ = coefficient of friction at journal=0.5

d = journal diameter = 30mm

q = factor of value between 0.8 to 0.9, because not all the mass of the roller moving parts is on the periphery, and thereby not moving with velocity

v = 1 (assumed)

Z0 = numbers of loads moving simultaneously on the conveyor = 1(assumed)

n = number of rollers= 20

v = linear velocity of the load = 0.2 m/s (assumed)

g = acceleration due to gravity = 9.81m/s2
L = total length = 21.458m = 21458mm

tanβ=(2k/D)+[{1+(wn′/G)}×(μd/D)]+{q×(Z0nwv2/gLG)}
=(2×0.51/60)+[{1+(19.035×5/84)}×(0.5×30/60)]+{0.85(1×214×19.035)/(9.81×21458×84)}
tanβ= 0.55
β = 28.8 ° ≈ **29** °

- **SFD AND BMD CALCULATION**

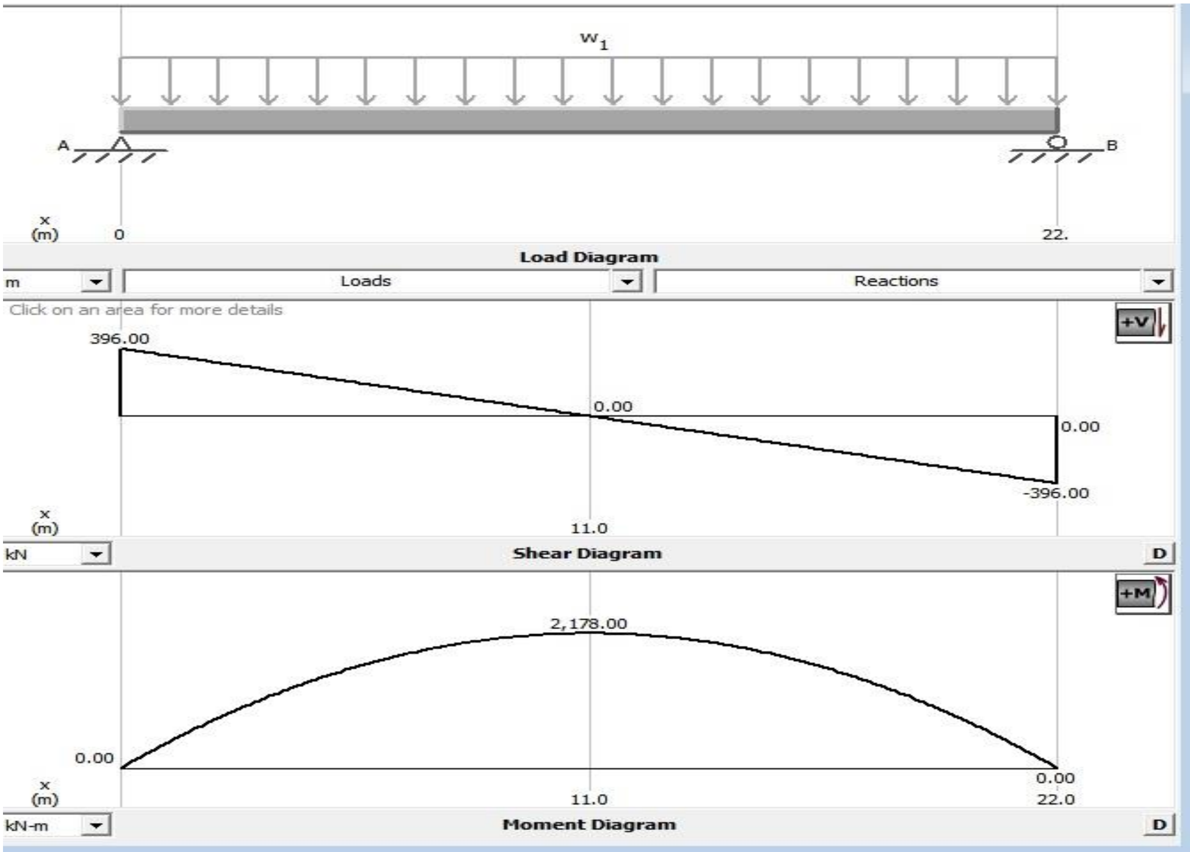



**Fig.1.5** Horizontal & Vertical Force Moment & Bending Moment Diagram

$R_A$+$R_B$= 792 KN
Taking moment about A
$R_B$ x 22 =792 x 11
$R_A$ = 396 KN and $R_B$ =396 KN

- **Design of Bearing: -**

$F_R$=Radial force

For Bearing A,$F_R$ = $\sqrt{(R_A)^2 + (R_B)^2} = \sqrt{(396\,)^2 + (396\,)^2} = 560.028KN = 560028$N

for bearing (A)

$F_R$ = 560028N, $F_a$ = 0 (Axial force],N = 25 rpm

For Machines for continuous duties.

Design step (1): -

Fe (X $F_R$ + Y$F_a$] $K_s$ $K_0$ $K_p$ $K_r$ [T – XIII – 13]

$F_a$/ $F_R$ =0/560028= 0

e = 0 for deep groove ball bearing [T – XIII – 14]

Since, $F_a$/ $F_r$< e

X = constant =1 Y = constant = 0 [T – XII – 14]

$K_s$ = Service factor = 1.7 for moderate shock & ball bearing [T – XIII – 15]

$K_0$ = Oscillation factor = 1 for constant rotational speed [T–XIII – 15]

$K_p$ = Preloading factor = 1.125 for non-preloading bearing

$K_r$ = Rotational factor = 1 for outer race fixed & winner race rotating

[T– XIII –15]

$F_e$ = (1 x 560028 + 0] 1.7 x 1 x1.125x1

$F_e$ = 1071038.25 N

Average life: -

For Machines for continuous duties

Desirable life in hours is 30000

$$V = \frac{\Pi Dn}{60}$$

$$0.2 = \frac{\Pi x 0.15 x n}{60}$$

N= 25rpm

L= (Desirable life in hours' x Min. in one-hour x rpm)

L = 30000 x 60 x 25 =45 x $10^6$ rev.

L= 45 million rev.

$$L = \left(\frac{C}{Fe}\right)^n K_{rel}$$

Where, L = 45 million rev., C = Dynamic load capacity N

n = 3.33 for roller bearing, $K_{rel}$ = 5 for 50 % reliability

[T – XII -15]

Average life = $L_{10}$ x $K_{rel}$

$L_{10}$ = Average life / $K_{rel}$ = 45/5 = 9 N

C = $(L10)^{1/3}$ $F_e$

C= $(9)^{1/3}$ x 1071038

C = 2227880

**VII. CAD AND ANALYSIS**

Computer-aided design software or CAD software refers to a type of software program used by designers and engineers to create two-dimensional and three-dimensional models of physical components. CAD software has all but replaced the T-squares and protractors used by the designers of yesterday in a process known as manual drafting, the traditional 'pencil on paper' approach to engineering and design.

**Analysis of ROLLER : -**

- **Stress Analysis: -**

The stress analysis gives us the stresses induced in the working model while in operation. This is very important for the successful operation of the model. After this analysis we can calculate the required desired dimension for the model. Under working conditions may residual stresses are induced in the components, so for keeping the stresses in the allowable limit the structural stress analysis is performed. It is used to find out the stress developed in the body.

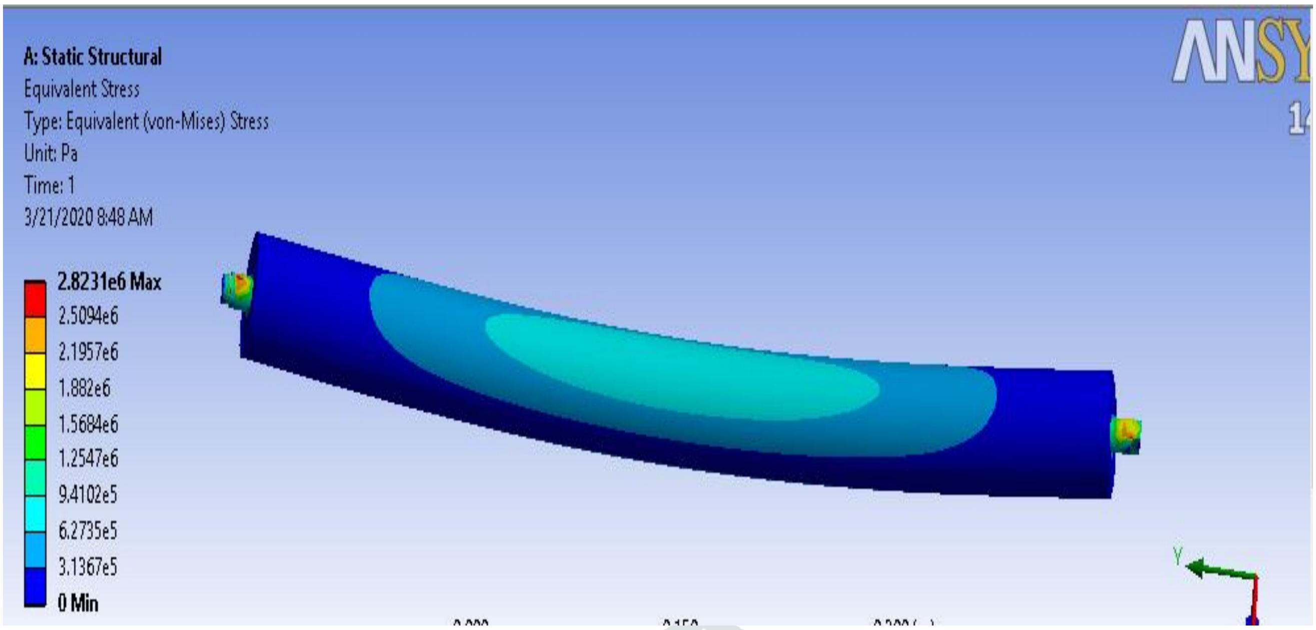
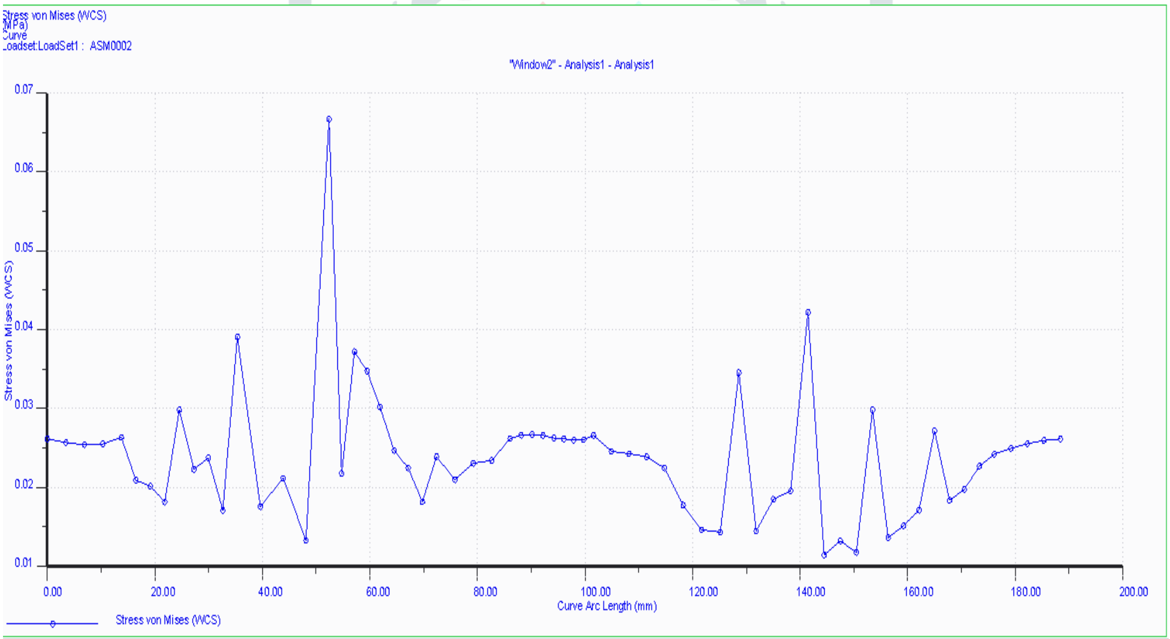



**Fig.1.6** Stress analysis

- **Stress analysis graph: -**

The stress analysis graph is the graph plot between the stress induced and the respective length. Here it is found that the maximum stress developed at the joint of the assembly and which is in the allowable limit, so for this graph it is cleared that the design of the inclined plate is safe.




**Graph:1.2** Stress Analysis Graph

- **Displacement analysis: -**

Deformation in continuum mechanics is the transformation of a body from a reference configuration to a current configuration. A configuration is a set containing the positions of all particles of the body. A deformation may be caused by external loads, body forces (such as gravity or electromagnetic forces), or changes in temperature, moisture content, or chemical reactions, etc.

This analysis gives the idea about what degree of deformation occurs during the working condition of the component. which is very important as the safety purpose, if the material deforms more than that of yield value there may be the change of the failure this failure my cause failure of hole assembly.From the displacement analysis it is observed that the maximum displacement or deformation is occurs at the middle of the plate. This value is 0.00233 mm and which is very negligible, hence we can conclude that our design is safe.

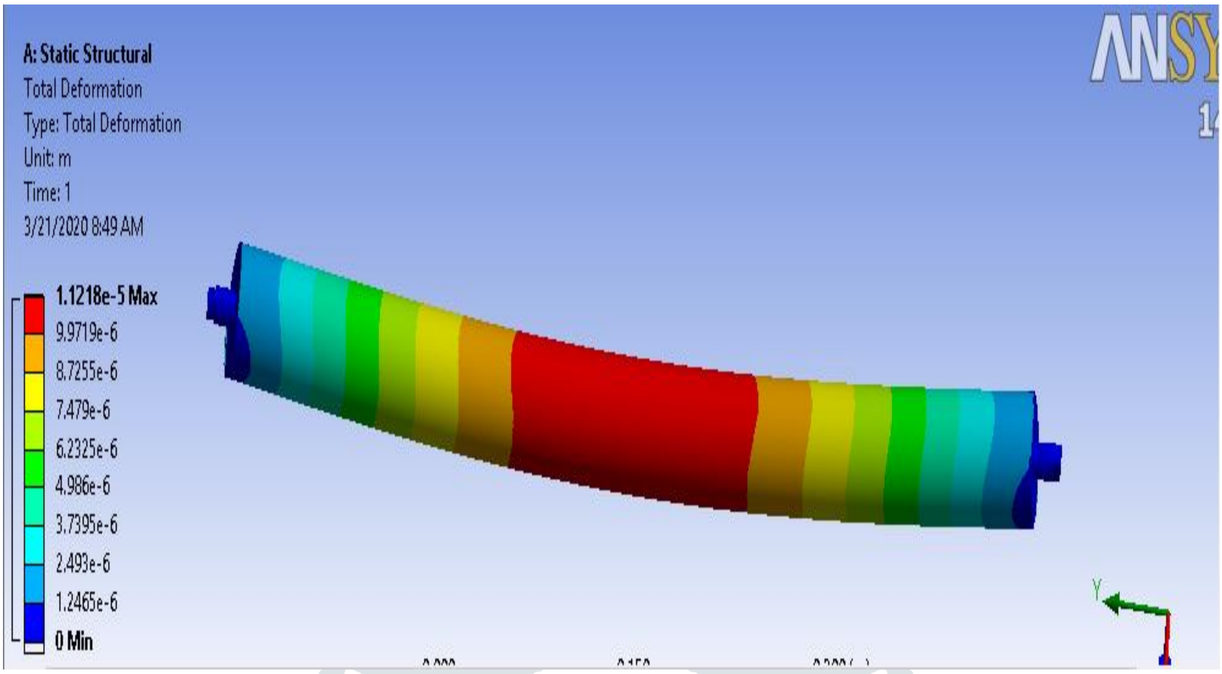
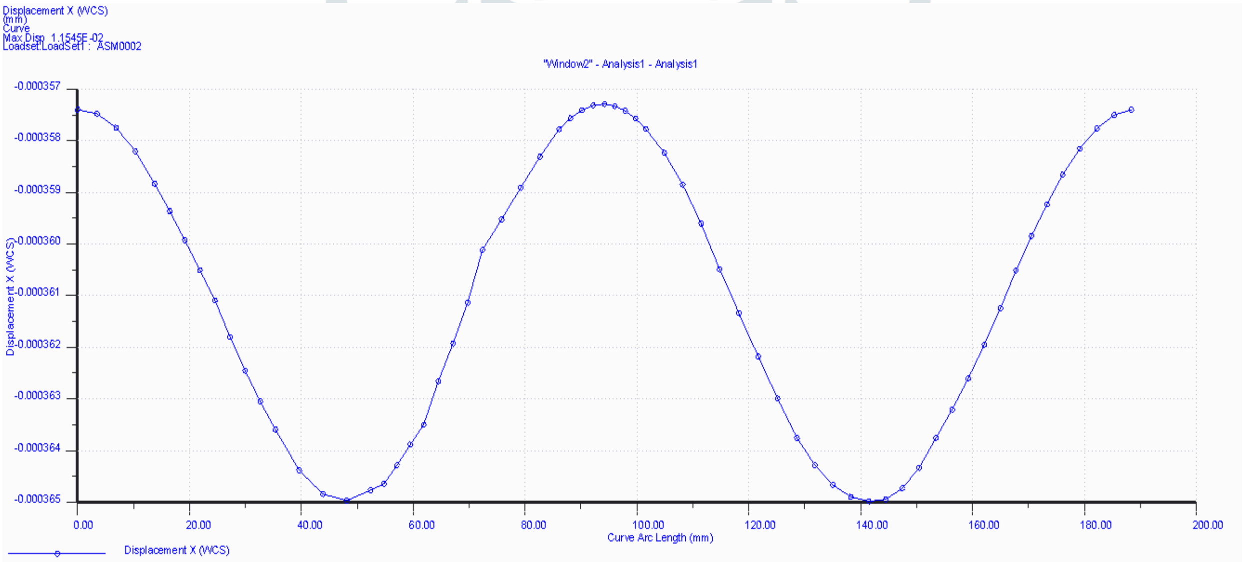



**Fig.1.2** Displacement analysis

- **Displacement analysis graph: -**

This graph is shows that displacements in the respective distance of the plate. This graph is plotted based on the results obtained by the displacements analysis. According to the results of this graphs it is clear that the maximum deformation occurs in the middle of the plate which is very negligible in nature and hence our design is safe.




**Graph.1.3** Displacement Analysis Graph

## VII. RESULT AND DISCUSSION

This section consists of the results obtained by the analytical calculation. It shows that the increase in the productivity of the machine by reducing the time in the product handling process. In this section we have some input parameter got from the machine and current working method of the industry. Such as the product weight of the product produced, front end shaft diameter, capacity of machine, production shift timing etc. and the output parameter which are found they are bearing dimension of the Roller conveyor system, shaft diameter and its length, and length of gravity roller conveyor etc. This analytical results are for the gravity conveyor roller system and the inclined plate. We can attach to the roller this become an accessory for the productivity improvement of industry.

- **Analytical Results: -**

| S.R. No. | Input parameters | Values |
|---|---|---|
| 1. | Weight of products | 84 Kg |
| 2. | Total length of Roller Conveyor | 21.45 m |
| 3. | Centre to center distance between two Rollers | 100 mm |
| 4. | Coefficient of friction between Journal | 0.5 |
| 5. | Speed of Roller | 25 RPM |
| 6. | Outer side diameter of Roller | 60 mm |
| 7. | Inner side diameter | 54 mm |
| 8. | Material of shaft | SAE 1030 |
| 9. | Constants of shaft while suddenly applied load(minor shock) $K_t$&$K_b$ | 1.0 & 1.5 |
| 10. | Desirable life of Bearing | 30000 hrs |
| 11. | Material of shaft | SAE 1030 |
| 12. | Constants of shaft while suddenly applied load(minor shock) $K_t$&$K_b$ | 1.0 & 1.5 |
| 13. | Desirable life of Bearing | 30000 hrs |

**By performing analytical method**

| SR. No. | Output parameters | Values |
|---|---|---|
| 1. | Angle of friction ($\vartheta$) | $17.74^0$ |
| 2. | Inclination angle from dimension | $29^0$ |
| 3. | Diameter of shaft | 30 mm |
| 4. | The series of the bearing | 3080 |
| 5. | Outer side diameter of bearing (D) | 57 mm |
| 6. | inner side diameter of bearing (D) | 30 mm |
| 7. | Width of bearing (B) | 13 mm |
| 8. | Weight of Bearing | 19.95 Kg |
| 9. | Weight Of Shaft | 43.73 Kg |
| 10. | Weight of Roller | 103.53 Kg |
| 11. | No. of Rollers | 214 |
| 12. | Maximum Deflection | 1.17 mm |
| 13. | Weight of Frame | 34.16 Kg |

**Table :1.2** Analytical Method

- **Virtual method/ CAE method Result: -**

| S.R. No. | Type of analysis | Extension of file | Result | |
|---|---|---|---|---|
| | | | Deformation (mm) | Stress (MPa) |
| 1. | Structural analysis of frame | FINAL_ASM.ASM | $2.333 \text{ x } 10^{-3}$ | $1.822 \text{ x } 10^{-01}$ |
| 2. | Structural analysis of Roller conveyor system | CONVEYOR_ROLLER_ASM.ASM | 1.1218 | 2.823 |

**Table 1.3** Virtual method/ CAE method Results

This results are obtained by the analysis of the both the solution proposed for the productivity improvement. This results consist of the deformation (mm) occurs during the operation of the both inclined plate and the automated conveyor belt system and the stresses induced (MPa) in the both inclined plate and the conveyor belt system. This results indicated that the durability of both the inclined plate and the conveyor belt system. This results are obtained in the CAE software.

- **Experimental Setup / Reliability Testing Results: -**

| S.R. No. | Actual readings taken from machine. | Before modification (time) | After modification (time) (Approx.) |
|---|---|---|---|
| 1. | In terms of time | 720 min. | 680 min. |
| 2. | In terms of Product | 90 Product | 110 Product |
| 3. | In terms of Percentage | 13 % Increased | |

**Table 1.4** Experimental Setup / Reliability Testing

This results are obtained by actual readings from the machine. This is a comparison between the readings taken from machine before modification and after modification. This provides actual increase in the productivity after the modification of the machine. This increase in productivity is measured in terms of the time consumed, product produce in given time and the actual increase in the productivity. It is found that 13% increase in overall productivity after modification in industrial layout.

## V. CONCLUSION

After completing all design calculations, analysis and reliability testing we got a result which is mentioned in above chapters. In analytical calculations, we considered some input parameters such as weight of product, total length of shaft, center to center distance between shaft, coefficient of friction between Roller & Casting, speed of roller, etc. and output parameters which we got after calculations, it includes angle of friction, diameter of shaft, inclination angle from the dimensions, the series of bearing, no. of rollers, length of gravity roller conveyor system, deflection of roller, weight of roller, weight of frame etc. From this data we finalized the dimension of proposed system so that the productivity will improve parallel these results are checked by using virtual software i.e. Cero-simulate and Ansys. In this we applying actual boundary condition and loading we got results in terms of deformation and stresses. The stress which we get will then compared with the yield strength of material as per the theory of material. It observed that stress values are within yield strength so design is safe. After conducting comparison between before modification and after modification, we got improved result i.e. we save approximately 40 minutes so we concluded that productivity improved.

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