DESIGN AND DEVELOPEMENT OF PALLET USED ON PLANOMILLER MACHINE

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Abstract: Planomillar machine is use for the face milling operation. In planomillar machine the face milling process is done by using the rotary cutters. Planner milling machine is mostly used for the facing operation in mass production in industry. Using the pallet loading the loading and the unloading time is reduce. While using Pallet the required man power is less and the productivity of the machine is increase. Pallet loading is very easy to loading and unloading from the planomillar machine bed. In this process the pallet design is a very important part for holding a component and also the cycle time is reduce. This paper is related to the design of pallet loading which is efficient and more effective.

Keywords- Stresses in pallets, productivity, and Equivalent deformation, CATIA, ANSYS

1. INTRODUCTION

This project is related to the pallet loading which use for the face is milling operation are done on the Planomiller machine. The planomillar machine is use for the milling operating on the various jobs. The company is placed in at M.I.D.C., Ahmednagar and company name is superb engineers, during the visit to superb engineer productivity the problem was discussed has been assigned the project of designing and manufacturing pallet. The previous design is less efficient. In previous manufacturing process no pallet are used for processing hence the time of placing job on machine bed is more. The cycle time for production is more and floor to floor time taking is more. During this project, various causes was identified and solution by using collected data from the industry. The pallet loading are used for holding the job and reduce the floor to floor time. In this project we are using two pallet one is use for the internal setup and another is use for the external setup. The setup mounted on machine bed is internal setup and the setup which can be done while the machine is still running is external setup.

2. LITERATURE SURVEY

Ana Sofia Alevs (2009) [1] has studied, single minute exchange of die (SMED) is important tools to decrease waste and improve flexibility in manufacturing processes. SMED decreases the non-productive time by standardizing the operations for trade apparatuses, utilizing straightforward strategies and simple applications. It is easily changeable the job on machine bed. Also reduces the investment of the company. The methodology of SMED is very important in application as well as adapt them to the reality in the companies to be successful implementation.

Khushee Ram et al (2015) [2] has studied that, the improvement in the setup handle of a mechanical machines in the company. It reduces the setup time. The concept of SMED improves mechanical and product efficiency because of less setup time. The SMED concept is focuses on Flexibility and responsiveness. This paper shows the internal as well as external setup. The setup mounted on machine bed is internal setup and that part of the setup which can be done while the machine is still running is external setup.

O. Karacal et al (2013) [3] has studied, the behavior of pallet system under loading was determined according to material behavior and strain-stress distribution. The results of this paper are helpful for pallet design, material selection and material handling. After the calculation we are selecting the mild steel for the pallet.

A Bajwoluk et al (2015) [4] has studied, the effect of pallet component geometry due to temp gradient. The gradient is very important factor for the determination of the thermal stresses in the pallet. It means that by shaping the geometry of pallet components, we can up to some extent, influence the generation of thermal stresses during the palette operation cycle.

Abdullah Waseem et al [5] has studied, the Analysis of different Materials for Pallet in ansys, the Pallets are used mostly in lifting the heavy and large jobs in industries. In this paper the selection of material for the pallet. The material for the making pallet are strong and ductility hence the mild steel use for the manufacturing the pallet. Analysis is done by considering uniformly distributed load on pallet**.**

Lucian Mihaila et al (2013) [6] has studied the automatic pallet changer mechanism, which is hydraulically driven, it also comes with its guiding and transmission systems. The most important advantage is less consumption of time. In this mechanism material

handling is easy, which reduces in man power. The main purpose of this paper changing of pallet by using machine centring. The automatic pallet changer mechanism presented in this paper can be attached to any ordinary machine tool along its travel axis.

Javad Mokhlesi et al (2009) [7] says that pallets play important role in whole distribution systems by the supply chain. It denotes use of pallets in today's fast growing indurstry. Pallet utilization was studied from this topic. [7]

3. DESIGN AND CALCULATION

1. FBD for both plate and table

Weight of job = 500

=500×9.81

=4905N

Weight of pallet $= \frac{Density \times volume}{10^6} \frac{N}{m^2}$

$= \frac{7.85 \times 1700 \times 900 \times 25}{10^6}$

$= 2945.575 \ {}^{N}/_{m^2}$

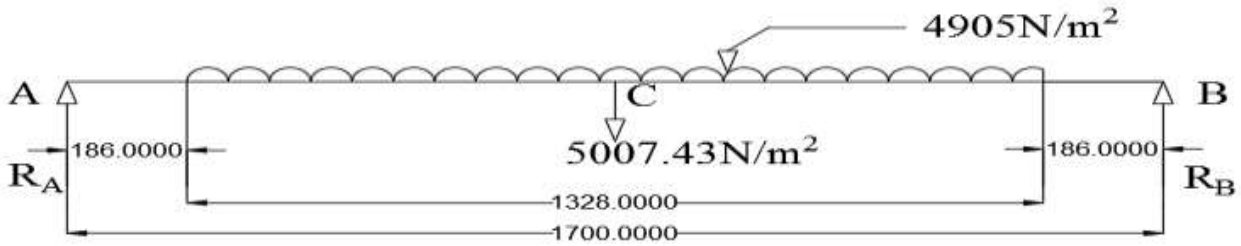


Fig 2. Loading diagram

Find R_A and R_B

$R_A+R_B=0.530\times (4905\times1.328) + (2945.575\times1.7\times0.9)$

$R_A+R_B=7959.02N$

Find moment at point A

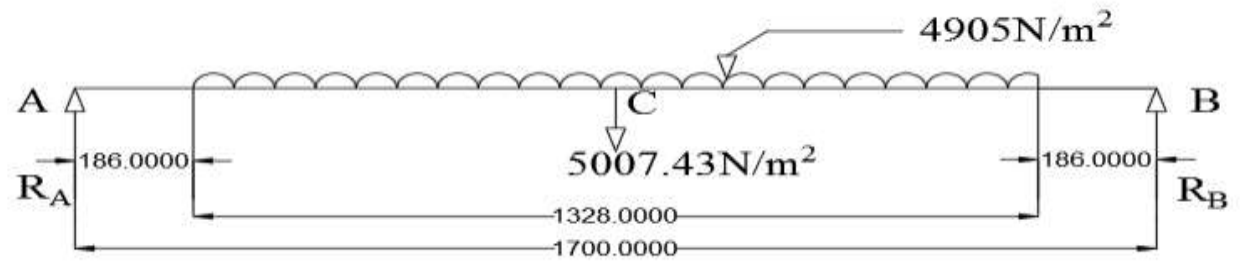
$M_A= (4905\times1.328\times0.53\times (1.7/2)) + (2945.57\times1.7\times0.9\times0.85) - R_A\times1.7$

$R_B\times1.7=6765.198$

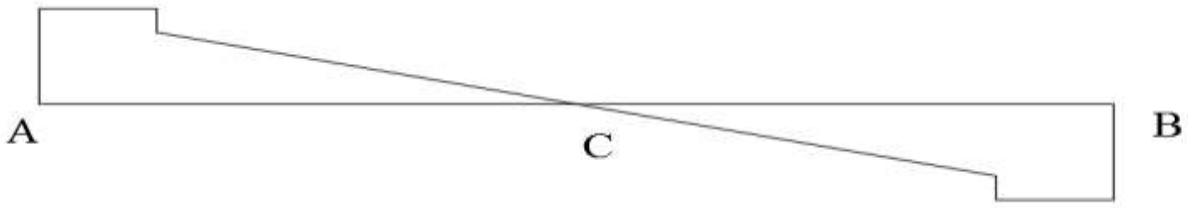
$R_B=3979.2$ N

$R_A=3979.2$ N

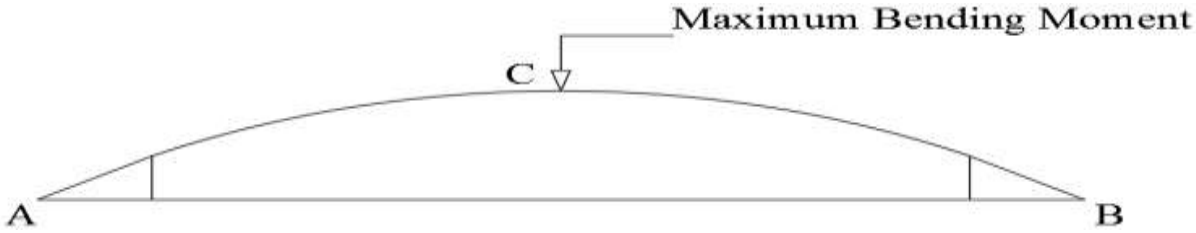
Find SFD and BMD



Load Diagram



Shear Force Diagram(SFD)



Bending Moment Diagram (BMD)

Shear Force

$(SF)_{AL}=0$

$(SF)_{AR}=3979.52$ N

$(SF)_{CL}=3979.52$ N

$(SF)_{CR}=3979.52-(2945.57\times0.186\times0.9)$

$=3486.43$ N

$(SF)_{DL}=3486.43$ N

$(SF)_{DR}=3486.43-(2945.57\times1.514\times0.91)-(4905\times1.328\times0.53)$

$=-3979.53$ N

$(SF)_{BL}=-3979.53$ N

$(SF)_{BR}=0$

Bending Moment:

$M_A=0$

$M_D=(3949.53\times0.186)\times0.9$

$=666.171$ N.m

$M_E=(3979.52\times0.85)-(4905\times\frac{1.328}{2}\times0.53\times0.332)$

$=2809.50$ N.m

The maximum Bending Moment At point E=2809.50 N.m

$$\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$$

σ For Mild Steel (M.S) = 155 – 165 MPa

$$\frac{M}{I}=\frac{\sigma}{y}$$

$2y = t$

$Y = \sigma \times \frac{I}{M}$

$I = \frac{BD^3}{12}$

$I = 0.1032\ m^4$

$y = 165 \times \frac{0.1032}{2809.5}$

$y = 6.0608 \times 10^{-3}$

$2y = t$

$= 2 \times 6.0608 \times 10^{-3}$

$t = 12.1mm$

Assume Standard size

$t = 13mm$

We take factor of safety 2

Thickness will be doubled

FOS = 2

Thickness of pallet will be

t= 26mm

We can tack standard size of pallet is

t=25mm

Deflection Formula

$$\partial = \frac{0.142\ Pa^4}{E\ t^3[2.21(\frac{a}{b})3+1]} \ldots\ldots\ldots\ldots (1)$$

Where,
a = width of pallet=0.9m
b= length of pallet=1.7m
E = Modulus of Elasticity for Mild Steel
E = $2*10^{11}$ N/m^2
P= Load on the Pallet due to weight of Job (EJ-60)
W= 530 Kg.
P = W×g = 530×9.81= 5199.3N

The deflection of pallet should be 0.2 mm

We have to find corresponding thickness of pallet.
Put all value in equation (1)

$$0.2 \times 10^{-3} = \frac{0.142 * 5199.3 * 0.9^4}{2 \times 10^{11} \times t^3[2.21 + (\frac{0.9}{1.7})^3 + 1]}$$

$$0.2 \times 10^{-3} = \frac{484.399}{2.6558 * 10^{11}}$$

$t^3 = 9.1194 * 10^{-6}$

t=0.02089 m

t=20.89 mm

Weight of job W=464 Kg
Load of Job on pallet due to job 5G7=P=W*g

P=464×9.81

P=4551.84 N

$$0.2\times10^{-3} = \frac{0.142*4551.84*0.9^4}{2\times10^{11}\times t^3[2.21+\left(\frac{0.9}{1.7}\right)^3+1]}$$

$$0.2\times10^{-3} = \frac{424.0776}{2.6558*10^{11}}$$

$t^3=7.98*10^{-6}$

t=19.98~20 mm

Deflection of plate

Formula for rectangular plate deflection (∂)

$$\partial = \frac{0.142\ Pa^4}{E\ t^3[2.21\left(\frac{a}{b}\right)3+1]}$$

E=Modulus of elasticity for mild steel =$2*10^{11}$ N/m^2

a = width of pallet=0.9m

b= length of pallet=1.7m

t= Thickness of plate=25 mm=0.025 m

P= Load on the Pallet =500*9.81

=4905 N

$$\partial = \frac{0.142 * 4905 * 0.9^4}{2\times10^{11}\times\ 0.025^3[2.21+\left(\frac{0.9}{1.7}\right)^3+1]}$$

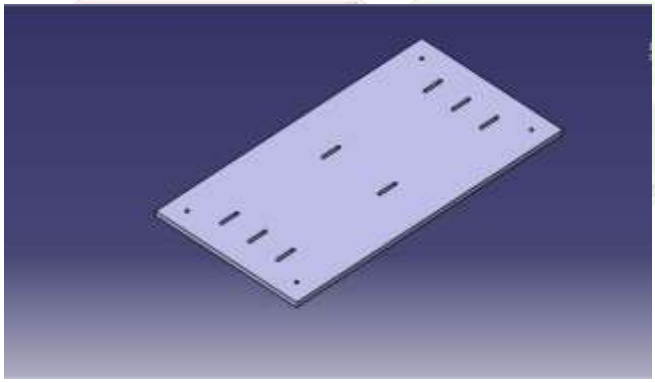
$=\frac{456.9802}{4149762.11}$

$=1.10^{-4}$ m

∂=0.11mm

Hence this is proved that corresponding thickness (t=25mm) will be deflect the plate by 0.11mm, which is less than 0.2 hence design is safe.

4. DESIGN



Model in CATIA

Actual model

5. RESULTS AND DISCUSSION

ANALYSIS OF PALLET

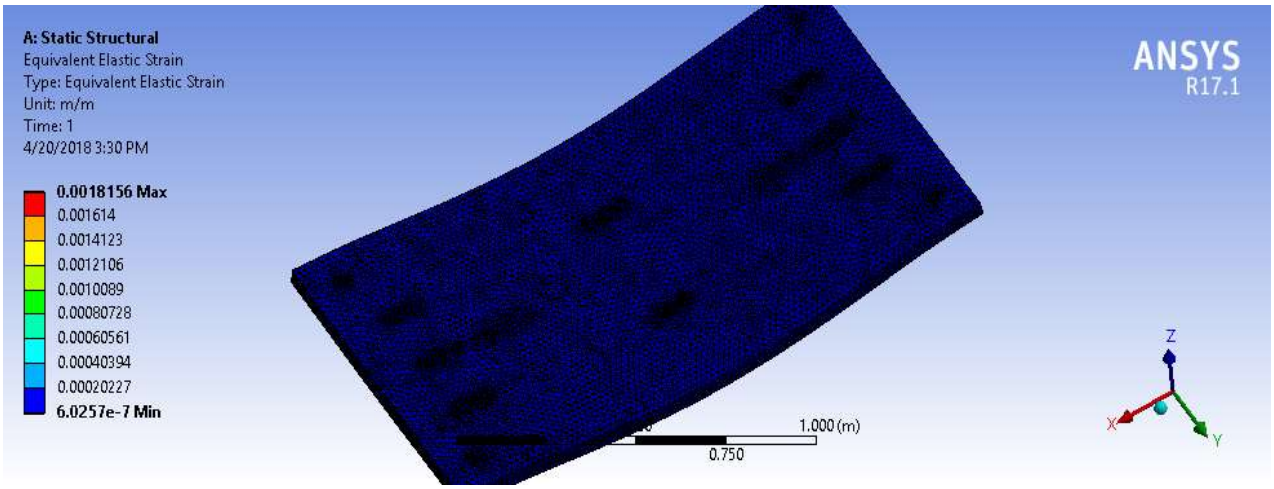


Fig. Strain

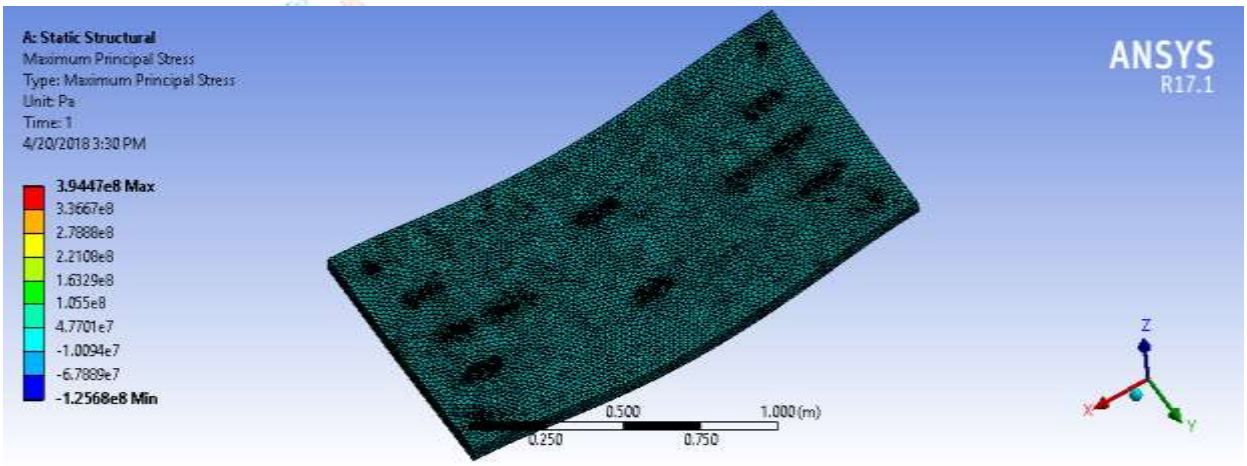


Fig. Stress

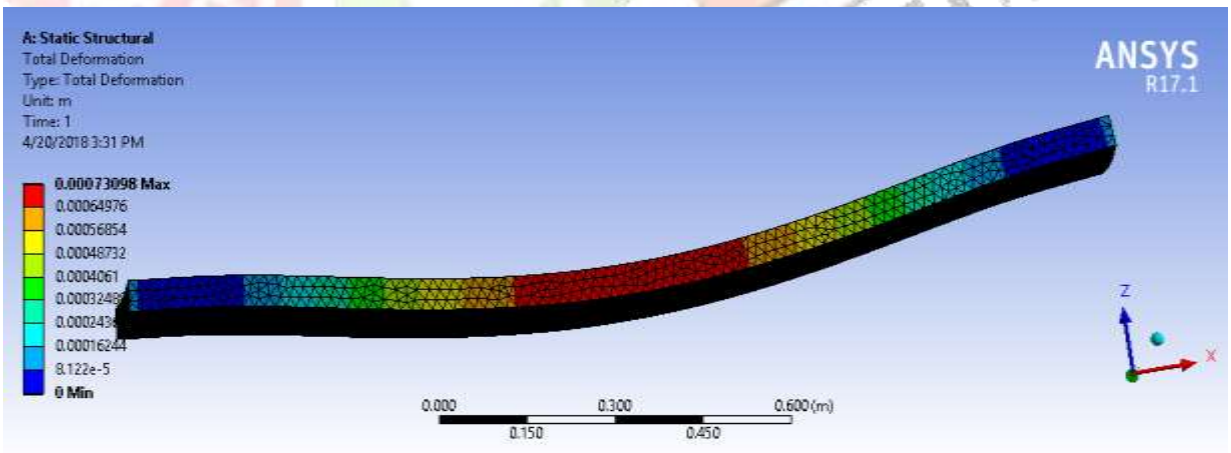


Fig. Total deformation

CONCLUSION

1. To reduce the cycle time of production.

2. Manufacturing and use of pallets on machine bed of planomillar machine for increasing the productivity of man, machine by introducing concept SMED (single minute exchange of Die).
3. To reduce floor to floor time.
4. By using common pallet which will be universal for various type of jobs on planomillar machine.

References

1. Ana Sofia Alves "Improving SMED in the Automotive Industry" POMS 20th Annual conference Orlando, Florida U.S.A, May 1 to May 4, 2009.
2. Khushee Ram, Sanjeev Kumar and D. P. Singh "Industrial benefits from a SMED Methodology on high speed press in a punching machine" Advances in Applied Science Research, 2015, 6(9):38-41.
3. Ö. Karaçal and A. Taner Ulguel "Finite Element Analysis of Pallet Nail Materials Used in Pallet Joint Design for Material Handling Works" Proceedings of the 3rd International Congress APMAS2013, April 24_28, 2013, Antalya, Turkey
4. A. Bajwoluk, P. Gutowski "The Effect of Pallet Component Geometry on Temperature Gradient during Cooling" ISSN (2299-2944) Volume 15 Issue 1/2015
5. Abdullah Waseem, Ahmad Nawaz, Nauman Munir, Bilal Islam, Sahar Noor "Comparative Analysis of different Materials for Pallet Design using ANSYS" IJMME-IJENS Vol:13 No:02
6. Lucian Mihaila, Gheorghe Stan, Marian Funaru, Claudiu Obreja, Dragos Andrioaia "Automatic Pallet Changer Mechanism Used Onmachining Centres" Journal Of Engineering Studies And Research – Volume 19 (2013) No. 1
7. Javad Mokhlesi, Saman Lohrasebi "The Current State and Future Trends in the Use of Pallets in Distribution Systems" October 2009.