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Finite Element Analysis of Deep Drawing Press.

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Abstract:- Many Deep drawing press are designed more than the required stability. This leads to an increase in manufacturing cost as well as material cost. Considerable transportation cost is also increased. Thus we concentrate on reducing the various costs and reducing weight of the press as well. This will be done by designing and redesigning press to required stability. In other words FOS shall be reduced to a level that satisfies the design to a sufficient level. Various software's are used for the same.

***Keywords**:- FOS.*

I. INTRODUCTION

Fluid system is device in which power is transmitted with the help of a fluid which may be liquid or a gas under pressure. Most of these devices are based on the principles of fluid statics and fluid kinematics. The hydraulic operated press is a machine used for moving heavy weights by the application of a much less force.

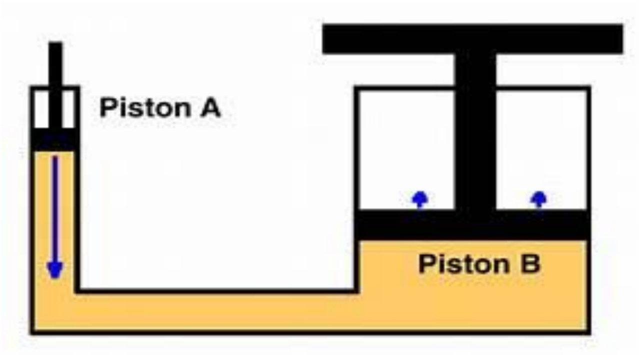

Fig 1:- Hydraulic Press

The hydraulic press consists of two different diameters of cylinders. One is of large diameter other cylinder is of smaller diameter and contains a plunger as shown in Fig. 1.1 The cylinders and pipe contain a liquid through which pressure is transmitted pipe contain a liquid which connects two cylinders. As shown in Fig.1.1. The heavier weight placed on the ram is then lifted up. When small force is put on plunger the pressure is transmitted in all directions. Same principle is used in earth moving equipments.

II. DESIGN OF COMPONENT

A. Design of 80t Double Acting Hydraulic Actuator.

Material used – Mild Steel
F= Required Force is = 80×1000×9.81=784800 N
Working Pressure = Pr = 10N/ mm^2
ID = 325mm = Inside diameter
OD=400mm = Outside diameter
T = Thickness= (OD-ID)/2= (400-325)/2 = 37.5 mm
Hoop Stress = (Pr ×ID)/2T = Stress
= (10×325)/(2×37.5) = 3250/75 = 43.33 N/m^2
Yield Stress = 250 N/m^2
Factor of Safety = (Yield Stress)/(Working stress)
= 250/43.33= 5.7

As Factor of Safety is too high, optimization is required for double acting hydraulic actuator. By considering, Outside diameter = OD=400
Thickness of Cylinder =T= (OD-ID)/2 =(400-360)/2
T= 20mm
Working Pressure = Pr = 10 N/mm^2
Hoop Stress = T = PrID/2T = (10×360)/(2×20) = 3600/4
= 90 N/mm^2
Factor of Safety = 250/90 =2.7.

B. Design of Tension Bar.

D= Diameter of Rod =70mm
D= Core Diameter =64mm
Force Acting of Each Rod =80T/4 =20T
= 20×1000×9.81 =196200 N
No of Tie Rod = 4
A= Area of Tie Rod = $\pi/4\ (d)^2 = \pi/4\ (64)m^2$
=3215.36 mm^2
Stress in Tie Rod = Force/Area
= 196200/3215.36 =61.0 N/ m^2
Yield Stress = 250 N/ m^2 [1]
FOS = Factor of Safety = 250/61.0 = 4

C. Design of Fixed Frame.

We have M/I= σb/y =E/R
M= Bending Moment in N–mm
I= Moment of Inertia in m m^4
Y= Axis = h/2 = 700/2 = 350mm
Maximum Bending Moment M = P×L/4
M= 784800×900/4 =176580000 N
I= (b×h3)/12= (25×(700)3)/12= 714583333.33mm4

Z =l/(y) =Shear modules
Z= 714583333.33/350= 2041666.66 mm3
Bending Stress= Stress= SI = M/z
= 176580000/2041666.66
=86.48 /m m^2
Bending Stress in Ribs
M= 784800×900/(4)= 17658000 N
I = 100(275)3/12 =173307291.666 m m^4
Z = 173307291.66/137.5= 1260416.66 mm^3

Bending Stress= S2= M/Z
=176580000/1260416.66 =140.0 N/mm^2
Stress in the Top Cylinder Plate =
= Stress S2 – Stress S1
= 140.0 - 86.48
= 53.61 N/ mm^2 [2]

D. Design of Optimized Fixed Frame.

We have M/I = σb/y =E/R
M= Bending Moment in N-mm
I= Moment of Inertia in m m^4
Y=Axis = h/2 =700/2 =350mm
Maximum Bending Moment M=P×L/4
M= 784800×900/4 =176580000 N
I = (b×h3)/(12)= (25×(700)3)/12= 714583333.33 mm^4
Z= I/y= Shear modules
Z=714583333.33/350= 2041666.66 mm^3
Bending Stress = Stress = S1 = M/Z
=176580000/2041666.66
= 86.48 N/mm^2
Bending Stress in Ribs
We have M/I= σb/y =E/R
M= Bending Moment in N- mm^3
I= Moment of Inertia in mm^4
Y=Axis =h/2 =100/2=50 mm
Maximum Bending Moment M =P×L/4
M= 784800×900/4 =176580000 N
I = (b×h3)/12 = (100×(175)3)/12 = 44661458.33 mm^4
Z= I/y =Shear modules
Z= 44661458.33/50= 893229.166mm^3
Bending Stress = Stress S2 = M/Z
=176580000/893229.16
=197.6 N/mm^2
Stress in the Top Cylinder Plate= Stress S2 – Stress S1
= 197.6 – 86.48
= 111.12 N/mm^2.

III. DEVELOPMENT OF COMPONENTS

The developments of all components are made by designing and development on software. A view of the press along with its software view is show below.

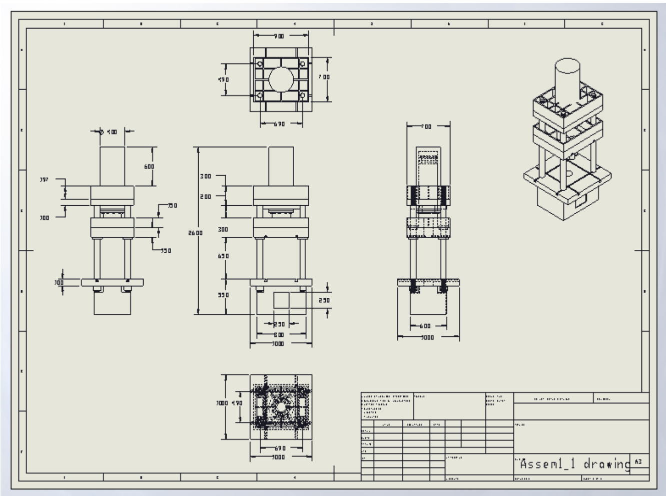

Fig 2:- 2D Assembly view of DD press.

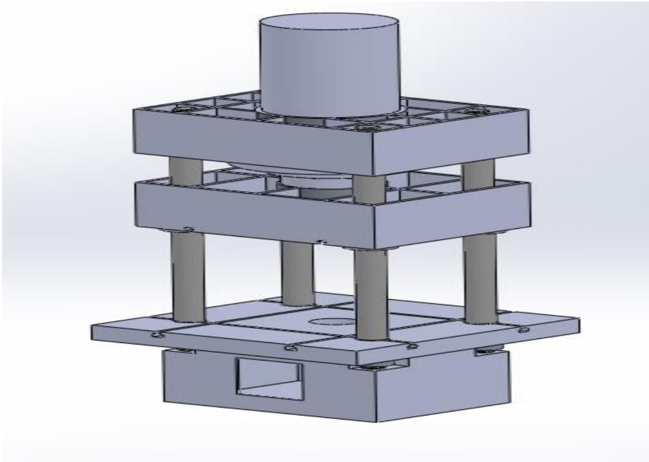

Fig 3:- 3D Assembly view of DD press

IV. RESULTS AND DISCUSSION

Optimization of all the components was carried out. It was found that optimization was required for only two parts. The re-optimization was carried out for the required parts.

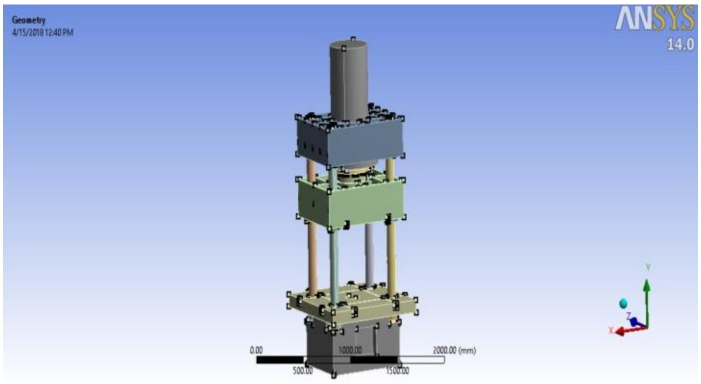

Fig 4:- Messed view of the press.

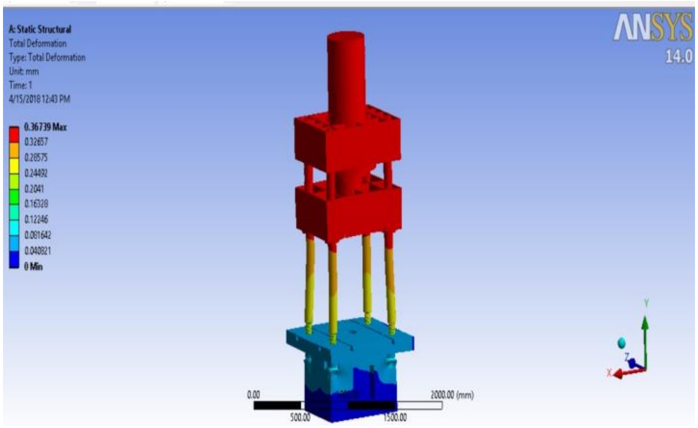

Fig 5:- Deformation induced in press.

Thus from the above findings it is clear that Double acting hydraulic actuator and fixed frame have to be further optimized. After Optimization of the same, FOS is reduced to 4.2 and 3.11 respectively.

Sl No	Description	Stress in N/mm2	Deformation In MM.	FOS
1	80 T double acting hydraulic Actuator.	41.83	0.075	5.9
2	Tension Bar	54.40	0.31	4.5
3	Fixed frame	38.99	0.028	6.4
4	Moving frame	70.73	0.13	3.5
5	Optimized 80 T double acting hydraulic actuator.	58.45	0.14	4.2
6	Optimized fixed frame.	80.29	0.10	3.11

Table 2: Result Table

Thus respective weight savings was found.

Sl No	Description	Weight in Kg.
1	80 T double acting hydraulic Actuator.	522.25
2	Fixed frame	618.29
3	Optimized 80 T double acting hydraulic actuator.	302.24
4	Optimized fixed frame.	501.30

Table 3: Weight savings.

As per Design requirement we have maintained FOS between 3 to 4.5. Cylinder and top cylinder plate ware optimized as initial FOS found higher.

V. CONCLUSION

This dissertation resulted in designing of 80T Deep Drawing (DD) press using Solid works software and ANSYS. Press is also successfully redesigned to meet the standard requirements. The following were achieved

- Reduction in thickness is without any deformation.
- Cost of production is reduced by implementing optimized design of cylinder and fixed frame.
- Raw material saved in cylinder is 220 Kg. (Initial weight was 522.25 kg whereas after optimization the weight of cylinder is 302.24 kg). 40% of saving is found.
- Raw material saved in fixed frame is 116.99 Kg. (Initial weight was 618.29 kg whereas after optimization weight of the fixed frame is 501.30 kg).

VI. ACKNOWLEDGMENT

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