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Design and Analysis of Shot Blasting Machine Hanger

Prof. Shital Bhosale[1], Akshay Shelke[2], Ayaj Shaikh[3], Rohit Chavan[4], Kishor Savant[5]
(Assistant Professor Mechanical Engineering Department, J.S.P.M. (NTC) SPPU, Pune) [1],
(Mechanical Engineering, J.S.P.M. (NTC) SPPU, Pune) [2,3,4,5]
Email:sbhosale17@gmail.com[1],akshayshelke13@gmail.com[2],ayajshaikh44@gmail.com[3], rchavan1997@gmail.com[4],kishorshavant730@gmail.com[5]

Abstract-In Shot Blasting machine various hangers are used during shot blasting processes as per component size & Types, in this work we worked out to increase production rate in current industry. For this it is required to increase hanger capacity for the various castings produced in the current industry. The shot blasting machine in foundry is 300 kg. The current hanger capacity of shot blasting machine is 16 castings. Thus to increase hanger capacity of castings its required to modify the hanger such a way that its capacity is maximum up to 300Kg of short blasting machine. With the study of shot blasting machine and its hanger we should have to design new hanger as per capacity of machine. This work contains modification of current hanger, design of modified hanger, stress analysis by analytically and by using Ansys Software. Also in this work efficient and reliable design of hanger is find out.

Keywords - Shot blasting machine, hanger, casting (ape brake drum), and abrasive particles.

1. INTRODUCTION

Shot blasting is a surface finishing technique that involves rapidly impacting the surface of an object with a controlled stream of abrasive shot material. It is faster and more effective than filing for removing flash that may remain on a part after a casting or stamping process. It is also used for removing burrs, scale and rust that may interfere with the parts integrity, appearance or definition. Shot Blasting can also prepare a surface of a part for coating by removing surface contaminants and provide a surface profile for increase coating adhesion**.** Shot Blasting is different than shot peening which is used to induce compressive stresses on a parts surface for increased fatigue life, increase the part strength or preventing fretting. It uses different hangers to mount the various castings that requires to goes to process. The castings are mounted manually or by using automation for heavy castings purpose on the hanger. The different abrasives are used as per the requirements of different size and shape of abrasives.

Fig.1. Existing Hanger with casting

1.1. *Existing Hanger Dimension*

Total Height	:-700 mm
Rod Diameter	:-18 mm
Hanger Hook Outer Día	:-122 mm
Total Horizontal length	:-600 mm
Middle Distance between two horizontal rod	:- 345mm

2 DESIGN OF NEW HANGER HEADINGS

2.1. *Material of New hanger.*

New hanger made of mild steel having following properties,

New hanger material	:-	Steel (Fe500)
Ultimate tensile strength	:-	500 N/mm^2
Yield Strength	:-	290 N/mm^2

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2.2. *Calculation for Diameter of steel rod.*

Weight of Casting	: - 4.5 Kg.
Casting on Hanger	: - 48 nos
Number of branches of hanger	: - 48 nos
Number of casting per branch	: - 01 no

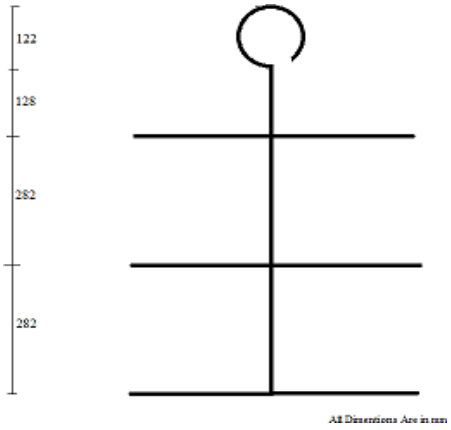

Fig. 2. Dimensions of new Hanger

2.3. ***Load of castings acting per branch***

Load of single Casting = 4.5 * 9.81 = 44.145 N
Considering 45 N for Calculation

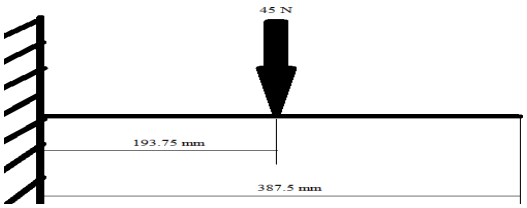

Fig. 3. Hanger branch as a cantilever beam

Bending Moment:-
M_b = (45*193.75)
M_b = 8718.75 N-mm
FOS: - 1.5
S_{yt} :- 290 N/mm^2

Working Stress = Syt / FOS
= 290 / 1.5 = 193.33 N/mm2

Bending Stress (σb)
σb = 32 Mb / π d3
193.33 = (32 * 8718.75) / π d3
d = 7.71 mm d = 12 mm

In Shot blasting machine, shots of abrasives hitting on the casting as well as hanger also due to this hanger wears, therefore Additional increased diameter is use because of this increase life of hanger.

Actual Bending Stress on hanger
σb = 32 Mb / π d3
= (32*8718.75)/123
σb = 161.458 N/mm2
Working stress > Actual working stress
193.33 N/mm2 > 161.458 N/mm2
Hence design is safe

2.4. ***Calculation of Middle Rod Diameter***

Ultimate tensile strength = 500 N/mm^2
Factor of Safety = 1.5
Working Stress = S_{ut} / FOS
500 / 1.5 = 333.33 N/mm2
Stresses acting on middle Rod
i.e. Direct Stress and Bending Stress.

Load on Single Casting = 45 N

Total load of Casting on Hanger = 45* 48 = 2160 N
Direct Stress (σd)=F/A= (2160*4)/π d2 = 2750.19/d2
Bending Moment on Single Branch = 8718.75 N-mm
Total Bending Moment=8718.7*48= 418500 N-mm
Bending Stress (σb) = (32 * Mb) / π d3
= (32 * 418500)/ π d3 = 4262805.996 / d3

Working Stress = σd + σb
333.33 = (2750.19 / d2) + (4262805.996 / d3)
d3 = (2750.19 * d) / 333.33 + (4262805.996 / 333.33)
d3 = 8.25 d + 12788.54
d3 – 8.25 d – 12788.54 = 0
d = 23.50 mm d = 40 mm

In Shot blasting machine, shots of abrasives hitting on the casting as well as hanger also due to this hanger wears, therefore Additional increased diameter is use because of this increase life of hanger.

Direct Stress (σd) =F/A=(2160*4)/π402=1.71 N/mm2
Bending Stress (σb) = (32 * Mb) / π d3
= (32 * 418500)/ π 403
= 66.60 N/mm2

Working Stress = σd + σb
= 1.71 + 66.60
= 68.31 N/mm2

Working stress > Actual working stress
333.33 N/mm2 > 68.31 N/mm2
Hence design is safe

2.5. ***Weight of Existing Hanger***

Weight of single branch
W = Volume * Density
Where,
Density = 7850 Kg / m3
Radius (r) = 6 mm = 0.006 m
Length (l) = 387.5 mm = 0.3875 m
W = π r2 l * 7850 = π * 0.0062 * 0.3875 *7850
= 0.3440 Kg

Total Weight of Branches = 48 * 0.3440= 16.51 Kg

Weight of Vertical Bar Radius (r) =20 m = 0.020 m
Length (l) = 692 mm = 0.692 m

Length of Hook = π * d = 3.14 * 0.122 = 0.3832m
Total Length of Hanger = 0.692 + 0.3832 = 1.075 m
W = Volume * Density
W = π r2 l * 7850
Weight (W) =3.14* 0.0202 *1.075*7850 =10.60 Kg

2.6. *Weight of circular ring*

Length of circular ring = π * d = 3.14 * 0.800
= 2.51m
W = Volume * Density
$W = \pi r^2 l * 7850$

Weight (W) = $3.14 * 0.006^2 * 2.51 * 7850 = 2.22$Kg
Total weight of circular ring = 2.22*3 = 6.66 kg Total Weight of Hanger = 16.51 + 10.60 + 6.66 =33.77 Kg

Thus weight carrying capacity of shot blasting machine i.e. 300 kg therefore total weight with 48 no. of castings and hanger is 250 kg. Hence modification of new hanger is done with greater productivity.

New hanger design

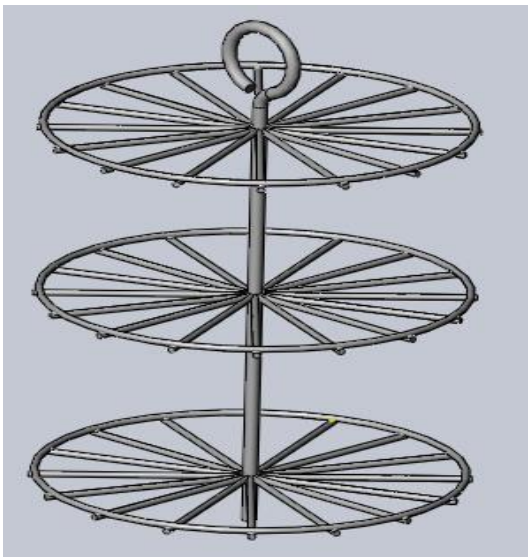

Fig.4. Proposed model of hanger

3. ANALYSIS OF HANGER

Table 1. Properties of Structural steel

Properties	**Values**
Density	7850 Kg/m^3
Young's Modulus	$2*10^5$Mpa
Poisson's ratio	0.3
Bulk Modulus	$1.6667*10^5$Mpa
Shear Modulus	$7.6923*10^4$Mpa
Tensile yield strength	$2.5*10^2$Mpa
Tensile ultimate strength	$4.6*10^2$Mpa

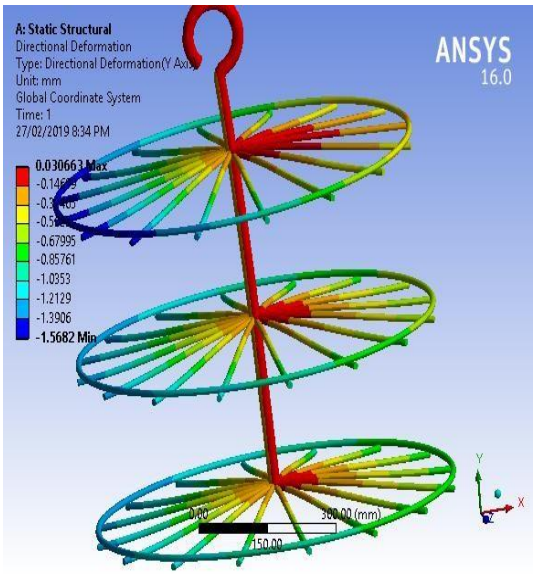

Fig.5. Equivalent stress: 87.64 N/mm (Max.)

3.1. *Ansys Result*

By observing generated equivalent stress value which is less than yield stress of structural steel, hence **Design is safe** as a principle of Theories of failure.

Deformation due to load is negligible.

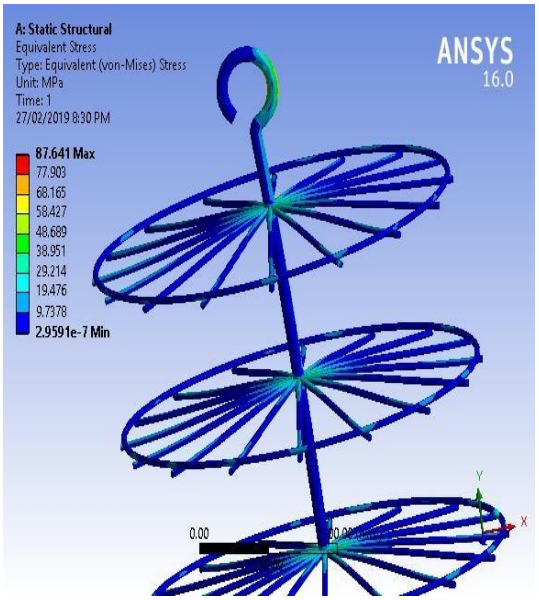

Fig.6. Deformation: 0.03 (Max.)

4. EXPERIMENTAL TESTING

Fig.7. Hanger with Casting before Shot Blasting

Fig.8.Hangers with Casting after Shot Blasting

5. CONCLUSION

In this project work, castings carrying capacity of hanger is increase hence production rate of brake drum increases by using newly design hanger as compare to existing hanger using in shot blasting machine. Following table represent the work conclusion.
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Table 2. Comparison of existing and new hanger

Parameters	Existing Hanger	New Hanger
Number of Casting produce	16	48
No of Cycle	2	1
Total Cycle time	41 min	93 min
Time required for producing 1 casting.	2.56 min	1.94 min

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