International Journal of Research
eISSN: 2348-6848 & pISSN: 2348-795X Vol-5 Special Issue-13
International Conference on Innovation and Research in Engineering, Science & Technology
Held on 23rd & 24th February 2018, Organized by Tulsiramji Gaikwad Patil College of Engineering & Technology, Nagpur, 441108, Maharastra, India.

"Design and Analysis of Swing Jaw Plates of Jaw Crusher Machine - A Review"

Ms. Pooja Khanorkar[1], Mr.Ritesh Banpurkar[2], Mr.Dilip Borkar[3]

[1]*PG Student of Mechanical Engineering Department,* [1]*Professor of Mechanical Engineering Department,* [1,2]*Abha Gaikwad-Patil College of Engineering,* [1,2]*Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur.*[3]*MIET College of Engineering Bhandara, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur*

.

Abstract:

The machines which are use to break or compress materials mining operations purpose is a crushers, crushers are commonly classified with the help of the degree to which they fragment the starting material with primary and secondary crushers handling oars materials and tertiary and quaternary crushers reducing ore particles to finer gradations. This paper writes on review of a work carried out by researchers in the field of kinematic & dynamic analysis of the jaw crusher attachment. Kinematic & Dynamic analysis is helpful for understanding and improving the design quality of jaw crusher. There are many researcher work done by researcher in the same field but still there is a scope to develop design & dynamic analysis to jaw crusher attachment.

Generally, stiffness of swing plates has not been varied with changes in rock strength. Rock strength has only been study because of the need to know the maximum force exerted by the toggle for energy considerations.
Force to decrease energy consumed in crushing have lead to consideration of decreasing the weight of the swing plate of jaw crushers for easily crushed material. In this research paper, we study the design of the swing jaw plate using The design of the swing jaw plate is carried out with the help of using CAD. And theoretical design calculations of jaw plates of the jaw crusher have been carried out by software.

. .

Keywords
Jaw Crusher, Computer Aided Design (CAD), Finite Element Analysis,

I. Introduction

Jaw crusher is one of the important types of primary crushers in a mining or ore processing plant. The size of a jaw crusher is designated with the rectangular or square opening at the top of the jaws. There are two types crusher Primary jaw crushers and secondary jaw crusher , primary jaw crusher are typically of the square opening design, and secondary jaw crushers are of the rectangular opening design. However, there are many exceptions to this general rule. In Jaw crusher which has two jaws, out of these one is stationary jaw (fix) with the crusher frame and the other moves in between a small throw forward and return back gradually to crush the ore or rock. Boulders Jaw crushers are typically used as primary crushers, or the first step in the process of reducing rock. They typically crush using compression. The rock is feed in between two rigid plates of metal, one of which then move inwards towards the rock, and the rock is crushed, due to it has a lower breaking point than the opposite metal plates. The first stage of size reduction of hard and big size of stone of mine ore is to crush and reduce their size. Soft ores, like tin, gold, mineral sands etc not require such treatment. In the Large scale crushing operations are mainly performed by mechanically operated equipment like jaw crushers, gyratory crusher and roll crushers. Mechanically driven crushers are used for very large size ore pieces or similar tools are used to break them down to size. The mechanism of crushing machine is either by applying impact force, pressure or a combination of both. The jaw crusher is generally a compression crusher while the others are to operate by the application of impact of the force.

Figure 1.Typical Jaw Crusher

The working principal of Jaw Crusher is based on modern design. The crushing machine are consists of two Jaws, one jaw fixed and the other moving. The openings between the jaws are smaller at the bottom side and the wider at the top side. The pitman moving on an eccentric shaft on bearing, Moving Jaw swings on center pin. The stone feed in between two Jaws and crushed by mechanical pressure.

The AC motor drives the belt pulley and the belt pulley drives the eccentric shaft to rotate, and make the moving jaw approach and leave the fixed jaw periodically shaft rotation, to crush, rub and grind the material sand slower and gradually fall down and finally discharge from the discharge opening desired dimension of the crushed product stationary breaking surface with stationary plate. The ore or rock is fed to the crusher where the jaws are further apart, i.e. at the maximum opening or gape. When the jaws come IN contact the ore is crushed and slip down in the crushing chamber. The process is repeated till particles having size less than the bottom opening passage. The reparative action of the jaw from its furthest end of travel is by springs for small crushers or by a pitman for larger crushers. Heavy flywheels are used in both types of crushers & the eccentric shaft. For a smooth reciprocating action of the moving jaws,

The characteristics of crusher are as following.

1. Larger, rough, as well as sticky rock or ore stone can be crushed.
2. Reinforcement of the crusher is possible with the help of high strength crusher frame to crush very hard rock or ore lumps.
3. It is very simple to adjust to prevent much of wear and also very easy to repair.
4. Maintenance of the crusher is very easy.

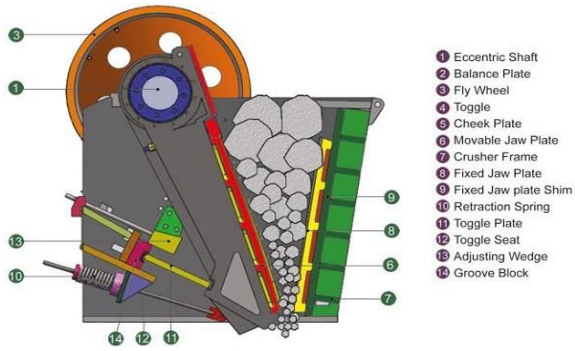


Figure. 2.Elevation View of Jaw Crusher

II. Literature review

In this work others compared the stress and natural frequency for different material (MARTENSTIC steel and EN31 steel) having Swing Jaw Plates. The swing jaw plates material martensitic steel but here we replace and compare the EN31 steel. The EN 31 steel material has more strength. The Swing Jaw Plates is designed IN PRO-ENGINEER and analyzed in ANSYS. The swing jaw plates have no stiffeners, but in this project they are adding the stiffeners of the swing jaw plates. The Swing Jaw Plates which is fixed at BOTTOM SURFACE OF THE Swing Jaw Plate is vibrated to obtain the natural frequency, mode shapes and deflection with different geometries and materials. [1].

In this paper work the authors are study to reduce weight of swing jaw plate assembly by using different composite material and compare with previous material and choose best suitable composite material for jaw plate holder. For this CAD modelling of jaw plate assembly is done in CREO and structural analysis in ANSYS for using different composite material. Static analysis result shows composite material more safe than martensite steel. Equivalent stress and total deformation of fibber reinforced aluminium less than the martensite steel. Hence for swing plate holder fibber reinforced aluminum is replace the martensite steel as a material and light weighted also because density of fibber reinforced aluminum is less than martensite steel. [2]

In this paper the author studied design of the swing jaw plate using point-load deformation failure (PDF) relationships along with interactive failure of rock particles as a model for such a weight reduction. Jaw Crusher machine breaks minerals, high strength stones and lumps. The stiffness of swing jaw plate and the strength of the rock are not depending to each other because stiffness has not been varied with changes in rock strength. Thus stiffness of swing plate is enough to crush stone with an Unconfined compressive strength (QU) of up to 308 MPa, may be over signed for softer fragmental. Hence the weight of the swing plate is necessary to reduced. [3]

In this paper the author studied the design of the corrugated swing jaw plate is carried out by using cad software i.e. jaw crusher plate has been solid modelled by using Catia. The calculated dimensions are validated with the drawing of reputed manufacturers. Finite Element Analysis of jaw plates are carried out by Computerization of the theoretical design calculations of jaw plates of the jaw crusher. The computerized program facilitates for quick design of the plates of the jaw crusher. The different comparisons of corrugated swing jaw plates behavior, calculated with the traditional and the new FEA failure models with stiffeners, shows that some 10-25% savings in plate weight may be possible. [4]

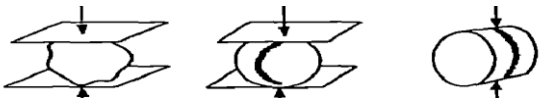
III. Problem Description

The objective of the present work is to study for a design and analysis of commercially available swing jaw plates that is 0.9 m (36 in.) wide with 304 mm and 51 mm top and bottom openings of jaw crusher. The finite element method is applied to the analysis of the swing jaw plate. Also we study of swing jaw plate with stiffness is done using finite element analysis; theoretical design calculations of jaw plates have been computerized. The design and modelling jaw plates of crusher is accomplished by using CAD i.e. parametric design package (CATIA).

By using this package three dimensional model of jaw crusher has been developed. Finite Element Analysis of jaw plates are carried and this work is extended to improve the strength/weight ratio of swing jaw plate by adding different number of stiffness elements on the jaw plates.

IV. The methodology

Create a 3D model of the swing jaw plates of jaw crusher assembly using parametric software pro-engineer. Convert the surface model into Para solid file and import the model into ANSYS to do analysis and perform static analysis on the swing jaw plates of jaw crusher assembly for static loads. In this study point-loading of cylinders (or discs) are undertaken to model behaviour of irregular rock particles. Thus, the plate idealization may be replaced by the point load shown in fig.



Irregular Particle Sphere Particle Cylinder Partic

Figure.3.Comparison of plate and point-loaded particles.

V.Results and Discussions

The swing jaw plates of jaw crushers modelled using the given specifications and design formula from data book. The isometric view of swing jaw plates shown in below figure. The swing jaw plates of jaw crusher outer casing body profile is sketched in sketcher and then it is sweep option and tubes are designed and assemble to in swing jaw plates of jaw crusher using extrude option. In Ansys.The swing jaw plate which is fixed at bottom surface of the swing jaw plate is vibrated to obtain the natural frequency, mode shapes and deflection with different geometries and materials.

By observing the static analysis, the stress values are more for martensitic steel than en 31 steel. When we compare the models of swing jaw plates jaw crusher, the stress values are less for swing jaw plates of jaw crushes at plate thickness 160mm. By observing the fatigue analysis, the life, damage and ssafety factor values are better for en 31 steel. By observing the modal analysis, the deformation more for en31 steel. So it can be concluded the en 31 steel is better for swing jaw plates of jaw crushes at plate thickness 160mm.

VI.References

[1]. Mr. Reddy Abhishek et al. "Design and Analysis of Swing Jaw Plates of Jaw Crusher", *(IJITR) International Journal of Innovative Technology And Research Volume no.5, issue no.4, June – July 2017, 6919-6923.*

[2]. Neeraj Pateriya."Computer aided design and analysis of swing jaw plate using composite material. ", *International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, Issue 7, July 2016.*

[3].M.AvulaiahT.Seshaiah "Computer Aided Design and Analysis of Swing Jaw Plate of Jaw Crusher", International Journal of Scientific Engineering and Technology Research Volume.04, IssueNo.09, April-2015, Pages: 1611-1616.

[4].Ramkrushna S. More. "A Design & Analysis of Swing Jaw Plates of Jaw Crusher", International Journal of Enhanced Research in Science Technology & Engineering, Vol. 3 Issue 4, April-2014, pp: (400-408

[5]..Russell A.R., Wood D. M. "Point load tests and strength measurements for brittle Spheres", *International Journal of Rock Mechanics and Mining Sciences, Volume 46, Issue 2, February 2009, Pages 272-280.*

[6]. Gabor M. Voros "Finite element analysis of stiffened plates" *Mechanical Engineering Volume51Issue2, 2007, Pages 105-112*

7. Mukhopdhyay M, Sheikh A. B, "Matrix and Finite Element Analyses of Structures" *Ane Books, New Delhi, 2004, Pages 408-413.*