

# A Study of Swing Jaw Plates for Size Reduction Machine

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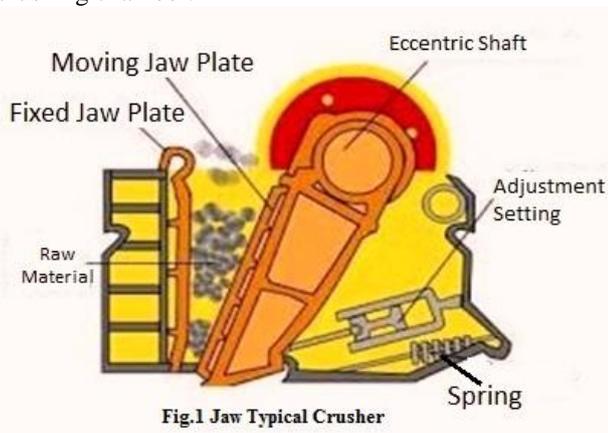
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**Abstract :-** Crushers are machinery that uses a metal surface to break or suppress mining operations using crushers, which are usually classified at which they separate the first material into lower and secondary coarse crushers and high-quality and quaternary crushers reducing particles. ore to be well made. This paper focuses on a review of the work done by researchers in the analysis of a flexible jaw plate i.e. a powerful and dynamic analysis of the jaw plate design due to the quality of jaw machine design has improved, although there were many researcher work done in the analysis, yet there is still room for improvement.

**Keywords:-** Crusher, Swing Jaw Plate, Kinematic, dynamic analysis, machines

## 1. INTRODUCTION

Jaw crushers generally of heavy duty steel box, fitted with fix vertical crushing “jaw” at one end and a moving “jaw” opposing it, with a method of transferring motion to the moving jaw. The moving jaw swing towards and away from the fixed jaw creating a compression action on the rock. The opening between the fixed and moving jaw tapers vertically from wide at the narrow at the bottom, thus gradually reducing the size of the rock as it move down through the crushing chamber.



### 1.1 JAW CRUSHER LINER PLATE DESIGN & PROFILE SHAPES

**Straight Jaw Plates:** A shows a figure 2 of a standard type of Blake crusher with regular or straight jaw plates. This type of plate has been the standard from the time of its inception, emulating, in this respect, the straight concaves in the gyratory machine. And it will be noted that the theoretical action in this straight-plate jaw chamber follows quite closely the pattern of the action in the straight-concave gyratory chamber.

**Non-Choking Jaw Plates:** When the non-choking concave demonstrated its capabilities in the gyratory crusher, it was only natural that the principle should be applied to the jaw crusher. But, inasmuch as the Blake-type jaw is used very largely for primary breaking, where maximum receiving

opening is, more often than not, a controlling factor, the application of non-choking plates to standard machines of this type has one unfavorable aspect, as will be evident from an examination of B “Standard Blake jaw crusher non-choking swing jaw plate.” This diagram shows the same machine as the last one considered, except that the swing jaw is fitted with a curved jaw plate.

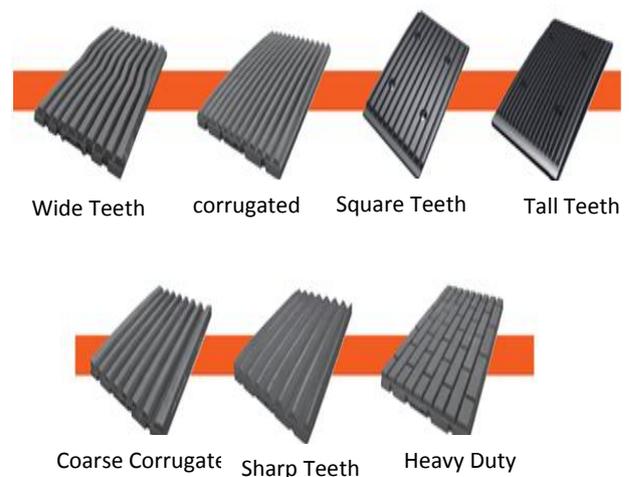


Fig.2: Types of Swing Jaw Plates

## 2. LITERATURE REVIEW

**Martin (1982) [1]** featured the double toggle jaw crusher mechanism as an example of a machine that uses the toggle effect to obtain a large output force that acts through a short distance, but he did not perform a static force analysis of the mechanism.

**Erdman and Sandor (1991) [2]** presented the determination of the mechanical advantage of a double toggle jaw crusher mechanism, as an exercise problem to be solved by (1) the method of instant centres, which is essentially a graphical method, analytical method that utilized complex number representation of vectors.

**Norton (1992) [3]** also discussed the mechanical advantage of linkage mechanisms and explained the toggle effect by the use of a jaw crusher mechanism of the Dodge type.

**Lin and Change (2003) [4]** addressed the issue of force transmissivity in planar linkage mechanisms. They derived and proposed a force transmissivity index (FTI) that considered the power flow path from the input linkage to the output linkage. They calculated the effective force ratio (EFR) as the ratio of the sum of actual power transmitted at each of the linkage joints in the power flow path to the sum of the maximum possible power that could be transmitted

along the same power flow path. They then obtained the FTI as the product of the EFR and the mechanical advantage of the mechanism, thus taking into account the effect of the external load acting on the mechanism.

**Chang et al. (2002) [5]** extended and applied this method to parallel manipulators, defined and proposed a mean force transmission index (MFTI). The presentation here will perform a static force analysis and obtain the mechanical advantage of the single toggle jaw crusher mechanism, from first principles.

**Ashish Kumar Shrivastava, Avadesh K. Sharma (2012) [6]** had represented parametric feature-based design of 3D software and capable to solve the motion dynamics of the motion, and the reactions at the constraints of the mechanisms can be used as the inputs for any Finite element program to understand the behavior of stresses and deformations of the individual component of the machine to estimate the working life of the machine elements designed for the application. Parametric modeling functions. To reduce the development cycle and improve the design quality of jaw crusher, this paper takes full advantage of the Function module of the Pro/Engineer platform to make model simulation and dynamic analysis on the actual jaw crusher mechanism, and provided the updated path for the design and manufacture of Jaw Crusher.

**Shivam Choudaha, Sunil Kumar Tiwari, Sarang Pande (2012) [7]** had represented machines used to break or compress using the metallic plates during mining of materials. The chronic problem of High Maintenance cost and extensive downtime in Jaw crusher. In this paper this problem is solved by implementing various techniques like process mapping, why analysis, Brain storming and appropriate use of plan-do-check-act (PDCA) cycle. The developments achieved by these techniques led to increase in customer satisfaction and productivity enhancement. The Customer requirement of Crushed Bath has been fulfilled by increasing the availability by 17%, Eliminating Breakdown, Reducing the MTTR by 89% and Maintenance Cost by 86% of Jaw Crusher. The study is helpful for gaining improvement in similar field as well as also in others.

**A. Refahi, J. Aghazadeh Mohandesi, and B. Rezai (2009) [8]** had represents Predicting the energy consumption during the size-reduction process; the Bond approach is often used. The PFC3D discrete element method (DEM) software was employed to model the crushing behavior of some rocks with different mechanical properties in a laboratory jaw crusher. FLAC3D software was adopted to analyze the stress distribution in the rocks. The rocks studied were modeled as granular assemblies in the shape of a sphere and/or a cube located between two jaws and the work done by the jaws in the crusher was determined. Nine different types of rocks were studied and the energies consumed by the crusher were compared to those of the Bond combination energy estimated from the Bond index. There is considerable difference between Bond crushing energy and work done by the jaw crusher for rocks. It appears that the Bond approach is not a suitable method for predicting single particle fracture energy done by the crusher. To verify the results obtained from DEM models, the fracture behavior of the crushed rocks was examined and was compared to the PFC3D results. The tensile mode of fracturing is favorably modeled by the PFC3D software while the delaminating mode cannot be well modeled by PFC3D software.

**Vishal N. Kshirsagar, Dr. S.K Choudhary, Prof. A.P Ninawe (2014) [9]** had represented about the design of various components of can or plastic bottle crusher machine. This machine is widely used in beverage industries or in scrap dealers shop to reduce the volume of the cans/bottles. Hence in this design of various parts are necessary, and design of various parts due to which the design quality of those parts will be improved. There are so many researchers who have done work on design and analysis also, but still there are so many areas of scope regarding this design. Overall, this project involves processes like design, fabrication and assembling of different components etc. After all process has been done, this crusher may help us to understand the fabrication and designing that involved in this project.

**Eugeniusz Rusiński, Przemysław Moczko, Damian Pietrusiak, Grzegorz Przybyłek (2013) [10]** investigates into the causes of fatigue cracks of a jaw crusher supporting structure are presented. The problems appeared after short time of operation at a new crushing facility. A large number of fatigue cracks with a high growth rate and bolt failures were observed in the crusher supporting structure. Considering the high dynamic forces that occur during the operation of such equipment, an investigation into the problem was undertaken in order to prevent catastrophic failure of the crushing station. A specially developed, combined numerical and experimental method was used to determine the reasons for the problems and to solve them.

**Bharule Ajay Suresh in 2009[11]** Department of Mechanical Engineering National Institute of works on the swing jaw plate for Design of lighter weight jaw plate by using and varying no of stiffeners for different thickness. as the energy required for the crushing the material decrease due to which the weight of swing jaw plate is decrease. This paper use point-load deformation failure (PDF) relationships along with interactive failure of rock particles as a model for such a weight reduction for the design and analysis of the swing plate.

**Marit FladvadTero et al 2020 [12]** A parameter study using a jaw crusher is designed to investigate the influence of feed gradation, feed rate, crusher setting and crusher speed on the crusher operation and the quality of the produced aggregates. The study is focused on the production of all-in large-size (top size  $\geq 90$  mm) aggregates, suitable for use in subbase and frost protection layers in a pavement structure. Aggregate quality is measured in terms of product gradation, particle shape and mechanical properties. Feed gradation, crusher setting and crusher speed affects the specific energy consumption during crushing. Particle shape is affected by all parameters; feed gradation, feed rate, crusher setting and crusher speed. Mechanical properties are least affected by the jaw crusher parameters, but sample preparation using laboratory crushing clearly affect mechanical properties. The results from this study provide valuable knowledge for the optimisation of single-stage crushing re-garding crusher operation and aggregate quality. By adapting the crushing process to the available feed material and desired product, the quality of the crushed product can be optimised along with the crusher operation



**Fig.3: Jaw plate with stiffeners**

The present jaw plate models accurately predict the various stresses for plates. As the as the number of stiffener increases the strength/weight ratio of the jaw plate increases making it stronger than that of without stiffener. And hence the stiffened plate models which leads to 25% saving in energy, of course this 25% is an estimate.

**M. Johansson et al 2017 [13]** In this study, an analytical perspective is used to develop a fundamental model of a jaw crusher. Previously, jaw crushers were modelled in regard to certain aspects, for example, energy consumption (Legendre and Zevenhoven, 2014) or kinematics (Oduori et al., 2015). Approaches to date have been mainly property specific. In this work a physical modelling approach has been used to derive the modules, which are based on established facts of comminution machines, from the literature. A modelling methodology mainly inspired by Evertsson has been applied (Evertsson, 2000). The modules are divided into kinematics, flow, breakage, capacity, pressure and power. Each module has been derived and tested decoupled from the other modules to provide increased transparency of the module and its behaviour. The results of the modelling are presented for a baseline case of one industrial-scale jaw crusher and compared to manufacturer data. Future work will include validation and DEM simulations.

### 3. CONCLUSION

Static analysis is helpful for understanding and improving the operating performance of the swing jaw plates. Static and dynamic analysis have very important significance for the life of the specific parts. Specific process will be no longer introduced. This concept of statics is followed by number of researches for their application. This review provides the background of jaw crusher kinematics to carried out further research work in same era.

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