REVIEW PAPER ON DESIGN OPTIMIZATION OF WORK ROLL CHOCK AND BACKUP ROLL CHOCK IN COLD ROLLING MILL

Tukesh Sahu[1], Prof. G.R. Kesheorey[2]

[1]*M.Tech Scholar,Mechanical Engineering Department, VITS Indore, M.P (India)*

[2]*Assistant professor Mechanical Engineering Department, VITS Indore, M.P (India)*

ABSTRACT

A rolling process is as a process in which metal is formed through a pair of revolving rolls with plain or grooved Barrels.The metal changes its shape i.e. reduction in thickness during the period in which it is in contact with the two rolls. The major use of rolling process is in mechanical working processes. A Rolling mill is a complex machine for distorting metal in rotary rolls and execution various operations such as transference of stock to rolls, disposal after rolling, cutting, cooling, melting. The problem of failure of Rolling mill chock was there in industry, which can be efficiently resolved by incorporating the designs with computers. The present work involves the design optimization of working roll chock and backup Roll chock in cold rolling mill, to control the failure of chock in the cold rolling mill to minimize the material cost and longer life of the roll chock. The roll chock stress distribution had been analyzed by software ANSYS from which maximum static stress at critical areas have been calculated. To forecast structural behavior of Roll chock under the given boundary conditions and loading using an analytical model are very difficult. Therefore solid model was chosen in order to predict the stress and strain response details by using ANSYS 14.5

Keywords: Central Burst, Cold Rolling, Design Methodologies, Housing, Plastic Deformation, Rolls, Split End,

I. INTRODUCTION

Rolling is defined as a process in which metal is formed through a pair of revolving rolls with plain or grooved barrels. The metal changes its shape gradually during the period in which it is in contact with the two rolls. Rolling is a major and a most widely used mechanical working technique. A Rolling mill is a complex machine for deforming metal in rotary rolls and performing auxiliary operations such as transportation of stock to rolls, disposal after rolling, cutting, cooling and melting.

Chocks are the highest stressed component in a manufactured item, and so are most susceptible to invariable the financial losses incurred as a result of chock failure will be far greater than the actual value of the chock instantiated delivery of chocks because of manufacturing presetting failure could stop a production failure at the assembly stage is almost certain to halt production if only one or two chocks out of a large batch tailback no manufacturer would willingly assemble goods that are suspecting failure in serviceable the most catastrophic consequences example failure of cold rolling mill chock is very likely to result in the complete

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destruction of the cold rolling mill. Failure of chocks in a cold rolling mill is basically because of higher stressed generated during start up and shut down condition of rolling mill so for a design of chocks for a cold rolling mill it is essential to know the maximum load acting on a chock to prevent it from a fatigue failure because of cyclic loading, is also a criteria of chock design. Second most important function of to work as an isolator, so design of chock also have a required stiffness to transmit a vibration from a source to receiver.

So while designing a chock for cold rolling mill two factors are very important i.e. strength of chock to sustain a maximum load and deflection of the chock should be minimum.

II. LITERATURE SURVEY

During the literature survey it is found that many researchers had worked on the rolling mill and its components. Many authors have worked on rolling mill housings, designing of housing, Manufacturing of rolling mill frames, rolling rolls. Many components are optimized for their functioning. Optimizations are also done for the heat distribution in rolling rolls, deformation preventions and strengthening for the work rolls. Some author has worked on the vibration in rolling mill and the rolling rolls and stress on rolling mill housing. For the controlling of rolling speed many models have developed, but it is found that the component like Chock of rolling mill is still not considered for research work so it is decide to work on the rolling chock for the structural analysis.

Remn-Min Guo et.al [1] proposed the hydraulic system for the entry edge guide control system was investigated using a mathematical model and measured input sidewall data. The components of the system were designed to Optimize usage of the existing mechanical equipment. The target control level was ±1.59 mm. As observed from the coil sidewall data, most of control change rates are within ±12.7 mm/sec using a maximum operating strip speed. The control system model shows that the average predicted standard error is entirely acceptable. The majority of the coilsare expected to have tracking errors less than the required accuracy.

Yanping Sun et.al [2] proposed the horizontal vibration problem in strip rolling was studied; dynamic model was established; the mechanism of self-excited vibration was analyzed. The mechanism of the level of vibration was analyzed to study vibration pattern of the steel surface .The vibration model was built and the vibration quantitatively was analyzed. The horizontal vibration displacement was obtained by the real product. The level of vibration mill is self-excited vibration which leading to tension fluctuations and affecting the rolling force change. Self-excited vibration levels changed to vertical vibration excitation, resulting in self-excited vibration of the vertical mill which influences surface quality of steel. Vibration of the rolling mill is analyzed by FEM.

Péricles Guedes Alves et.al [3] proposed the model deduced here is tailored for control, useful for studies and researches on new control strategies applied to tandem mill. The obtained results are coherent and robust to design parameters. The variations due to the input disturbances have small amplitude and the linearized model seemed adequate. The method obtain a modeling procedure for tandem cold metal rolling, including the linearization step and system identification for control. The tandem cold rolling process is described by a mathematical model based on algebraic equations developed for control purposes and empirical relations. A state-space model is derived and detailed analyses in open loop are presented, concerning the sensitivity with regard to the variations in process parameters and results for the application of a new subspace identification method are compared with classical methodologies.

E.K. Antonson et.al [4] proposed the method of imprecision (MOI),a formal method based on the mathematics of fuzzy set, for representing and manipulating imprecision in engineering design.The result of a design cost estimation example, utilizing a new informal cost specification, is presented.

K. Devarajan et.al [5] proposed the a two-dimensional Elastic-plastic finite element model to simulate the cold rolling of thick strip with different roll angular velocity and roll diameter models is described. The angular velocity of the rigid rolls ranged from 30 to 480 revolutions per minute (r.p.m.) and the rigid roll diameter ranged from 100 to 300 mm The method obtain speed of the rolls and the diameter of the rolls have any influence on the contact pressure and the residual stress in cold rolling process. The roll speed is an easily controlled operational parameter which may be used to enhance the process and the quality of the final products by changing the roller diameter and see the effect of stress and contact pressure on the thick plates strip is new one.

IMRE KISS et.al [6] proposed the durability in exploitation is extremely current, both for immediate practice, and for the scientific research attributed to the cast-iron. Also, the realization of optimum chemical compositions of the cast-iron can constitute a technical efficient way to assure the exploitation properties, the material from which the rolling mills rolls.

SUN Jianliang et.al [7] proposed the Coupled Dynamic Modeling of Rolls Model and Metal Model for Four High Mill Based on Strip Crown Control. In this, the simulation program can calculate the dynamic changes of the following parameters in the rolling process dynamic transverse changes of work roll and backup roll along the roll length direction Variation of transverse distribution of roll gap with time that is the dynamic changes of strip crown Variation of distributed rolling force with time.

Baoyu Xu1 et.al [8] proposed the stochastic excitation model obtained has significance for analyzing and researching stochastic dynamics characteristics to the system, and also generalized energy H in the range of 0.02 to 0.4, the system's response has the minimum transition probability density, and the system state is not easy to change,therefore the system generalized energy H should be to limit in this range In the design and operation of the rolling mill.

Tanehiro Kikkawa et.al [9] proposed the a new rolling method and facility (Zoom-Mill TM) that allows a leader strip and a product coil are connected using a spot welding machine and are finished through even-numbered passes in a reversing cold rolling mill. It is expected to reduce unrolled portions (improvement of yield) as well as improvement of productivity.

U.S.Dixit et.al [10] proposed the a systematic design procedure for a rolling mill. The fuzzy set-based methodology could easily consider many attributes concurrently, while deciding the specifications of the rolling mill. An optimum roll radiu was arrived at by considering two conflicting objectives. The methodology can be easily extended to a situation involving diverse conflicting objectives. The priority decision table provided an objective and crisp method to choose among three possible designs, whereas the conventional design methodology would have chosen any one of the minanintuitive and subjective manner. The motor power was decided considering the uncertain ties and imprecision present in the process parameters.

J.H. Rong et.al [11] proposed the method for maximising the critical buckling load of a structure of constant weight. based on the formulations of derivatives for eigen values, the sensitivity numbers of the first eigen value

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or the first multiple eigen values (for closely spaced and repeated eigen values) are derived by performing a variation operation. The method Obtained better optimum design for structures against buckling than the mean method. It can be readily implementedin any of the existing finite-element codes.

III. HISTORY OF ROLLING MILLS

The earliest rolling mills were slitting mills which were introduced from what is now Belgium to England in 1590. These passed flat bars between rolls to form a plate of iron, which was then passed between grooved rolls (Slitters) to produce rods of iron. The first experiments at rolling iron for tinplate took place about 1670. These were followed by the erection by 1697 by Major John Han bury of a mill at Pont pool to roll 'Pont pool plates' - back plate. Later this began to be reenrolled and tinned to make tinplate. The earlier production of plate iron in Europe had been in forges, not rolling mills. The slitting mill was adapted to producing hoops (for barrels) and iron with a half-round or other sections by means that were the subjects of two patents of c. 1679.Some of the earliest literature on rolling mills can be traced back to Christopher Polhem in 1761 in Patriotism Testament,where he mentions rolling mills for both plate and bar iron. He also explains how rolling mills can save on time and labor because a rolling mill can produce 10 to 20 and still more bars at the same time which is wanted to tilt only one bar with a hammer. A patent was granted to Thomas Block leys of England in 1759 for the polishing and rolling of metals. Another patent was granted in 1766 to Richard Ford of England for the first Tandem Mill.A tandem mill is where the metal is rolled in successive stands; Ford’s tandem mill was for hot rolling of wire rods. Rolling mills for lead seem to have exited by the late 17th century. Copper and brass were also rolled by the late 18th century.

IV. TYPES OF ROLL CHOCKS

Roll Chocks are used in different applications and depending upon the nature of the application, the roll chocks are broadly categorized into 4 types. These types of roll chocks are:

Work Roll Chocks
Back-up Roll Chocks
Upper Roll Chocks
Bottom Roll Chocks

V. FIELD OF THE PROJECT

This study relates to rolling mill bearing chock supports and more particularly to an improved wear plate structure providing increased support and alignment stability for the work roll bearing chocks in a rolling mill.The project may readily be adapted for use in various rolling mill configurations, but is particularly well-suited for application to a four high strip mill and will be described in conjunction with such a mill. Mills of this type employ upper and lower work rolls which cooperate to define a pass line at their nip for the strip to be rolled there between, with the ends of the rolls being supported in bearing chocks which, in turn, are mounted in the windows of mill housings disposed one on each side of the pass line, with the chocks and the work rolls supported therein being removable as a unit from the operator side of the mill. Upper and lower backup rolls

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also have their ends supported in chocks mounted in the mill housings, with power-driven screw downs forcing the backup rolls into rolling engagement with the work rolls during operation of the mill.

The axes of the upper and lower work rolls and the large upper and lower backup rolls are contained in a common vertical plane so that the extremely heavy workloads exerted by the power-driven screw downs, through the backup roll chocks and rolls, to the work rolls should theoretically produce only a vertical load on the work bearing chocks in the static load condition. However, minor misalignments inherent in such equipment as a result of manufacturing tolerances, wear, strain, and the like, and as a result of loads produced by the roll drive and by the work piece moving through the mill stand, produce very heavy loads on the work roll chocks Tending to upset the coplanar relation of the roll axes and, as a result, the mill stand housings must place heavy restraining loads on the work roll chocks. These heavy loads have, in the past, caused wear on the bearing surfaces of both work roll chocks and the mill housing. To minimize this wear, and to facilitate maintenance of the roll stands, it has been conventional practice to provide wear plates, or liners, in the form of high-strength hardened steel plates on the face of the mill housing and on the adjacent face of the roll chocks. While these liner plates have generally been effective in reducing wear and keeping the chocks centered in the mill housing, there have been instances where the chocks have been permitted to move sufficiently to produce a hammering effect causing excessive wear on the liner plates and in extreme cases to cause wear or damage to the face of the mill housing beneath the liner. This has been particularly true in the case of the lower work roll chock which generally has been provided with substantially smaller liner plate area than the top work roll chock. Examples of known rolling mills wherein liner plate for the bottom work roll chock is substantially smaller than that of the top work roll chock can be found in the above-mentioned U.S. Pat.No. 3,733,875 and U.S Pat.No. 3,864,954. Other known rolling mill configurations similarly employ liner plates of unequal area on the lower and upper work roll bearing chocks.

It is a primary object of the present invention to provide an improved chock structure for the work rolls of a rolling mill. Another object of the invention is to provide a lower work roll bearing chock having an increased liner support surface. Another object of the invention is to provide a rolling mill including upper and lower work roll bearing chocks having liner plates rigidly mounted thereon and including means for providing an increased vertical dimension for the lower work roll bearing chock liner plate to thereby provide greater strength and dimensional stability for the lower work roll bearing chock. Another object is to provide a rolling mill in which the upper and lower work roll chocks have substantially equal bearing face areas in contact with the supporting mill housing. Configurations, the 4-high variety are the most widely used – both in single-stand and multi-stand tandem mills. The 2-high mill, which consists of two working rolls only and no other supporting rolls are mainly used for “skin-pass” or temper rolling, the purpose of which is mainly to impart the desired mechanical properties rather than to cause significant reductions in thickness.

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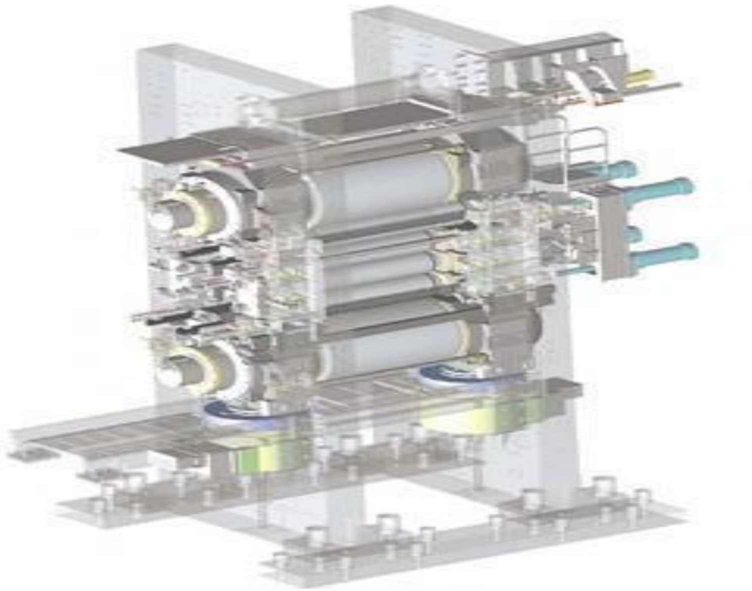

Fig.1 Mill showing the load transferred from the rolls to the housing

VI. CONCLUSION

This paper studies the earlier literature in the rolling mill, which gives statistics about rolling mill chock material and its operating conditions. The studied literature only gives the idea about operating areas where the stresses are generated in the rolling mill operational area during the working conditions. From this literature we study that by using computation integrated engineering and design for reduction of the weight of chock without affecting the worming conditions of the rolling mill housing. The rolling chock can be modified by applying Computer Aided Engineering method for rolling housing mill and pressure generated on the surface of chock. The main study of this paper is weight reduction of critical components of cold rolling mill such as bearing housing, chock.

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[12] Guide and Principal, Mechanical Department, VITS Indore, M.P India)