A REVIEW ON ANALYSIS AND STRUCTURAL OPTIMIZATION OF UPPER BEAM OF PRESS BRAKE MACHINE

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ABSTRACT

This paper presents the literature survey for different analysis and structural optimization techniques of hydraulic press brake. Press frame play the key role in the process of sheet metal bending. Analysis and optimization of structural components is needed to increase performance of the machine as well as to reduce the cost of it. Deformation of the machine structural component highly influences the work piece bending accuracy. Minor penetration error of punch is resulting in significant bending error of work piece .Minimize the bending error is necessary to reduce the use of deflection compensating devices that some manufactures have been offering. In this case, it is essential to development of new solutions by analysis of current press Brake design and optimization of their performance. Such review will help in selection of proper method of structural optimization for research work in the similar direction. Overview of different analysis and optimization methods to design desired tool has been reported in this study. The study of various researchers' works indicates that to increase accuracy of hydraulic presses with different methods. There is scope to change the geometry of upper beam to increase its stiffness to get permissible deflection.

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Keyword: *-Hydraulic press, Structural optimization, structure Analysis, GA*

1. INTRODUCTION

The press brake machine is used to bend sheet metal. The sheet metal located between the two tools stationary lower die and the upper punch assembled to movable the upper beam (ram). The sheet metal is placed between the two tools and pair of hydraulic actuators pushing punch in to the die by which work piece bend formulated along a straight stroke to the desired angle. The depth of the punch penetration determines the bending angle. The press brake is controlled by two synchronized hydraulic actuators on the C-shaped frame to move the ram. The die is attached to the bed and takes all the load during operation [1]. Stresses in upper beam are varying due to properties and thickness of work piece.

The angular accuracy of the sheet metal rest on the consistency of the bending angle end to end the whole length. Constant punch penetration is required to obtain uniform bending angle though out the length which is achieved by similar deflections upper beam and bed. Bending load increases with the decrease of bending length due to high load concentration at middle of upper beam. Therefore, the deformation of the ram becomes larger, causing greater difficulties in ensuring accuracy for large span machines. Deformation and stress in upper beam is increase due to bending of short length Sheet in larger span machine.

2. LITRATURE REVIEW

There are various factors affecting deflection in beam like the material of sheet, thickness and length of sheet. Based on this we have to design appropriate upper beam to satisfy the accuracy requirement.

Pedro G. Coelho et al.[1] had proposed different solution for press brake to minimize the deflection parallelism errors. Expressions for error derived by considering dimensions and Shape for machine structural components. Sandwich type lower beam is proposed as design solution for desire accuracy. Optimized initial deflection had introduced for all bending length and capacity value where the upper beam and ram supports are positioned in the machine columns. Timoshenko theory of beams used for derives expression for parallelism between the deflected beams.

Shihao Liu et al.[2] had suggested multi-objective optimization of stiffener plates of structural. Geometric dimensions like length, width, height and thickness are selected as design variable. Second-order response surface method is used to build the optimization model from data of orthogonal experimental design. Based on the computer-aided engineering analysis, optimization model is recognized. Particle swarm optimization algorithm is used after validating the precision of response surface optimization model.

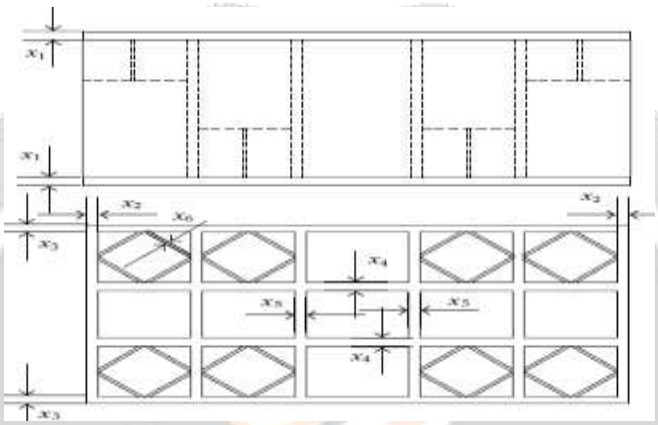

Fig-1: Design parameters of upper beam of press [2]

Peihao Zhu, et al. [3] had study on rib box of machine tool for dynamic characteristics. Sensitivity ranking by regression analysis shows the impact order of various rib box constraints on the rib box characteristic. Span of rib box ends, thickness of rib walls and the hole dimensions are taken as design parameters. Orthogonal design is used for the analysis of higher sensitivity factors affecting the strength and toughness through the allocation of natural frequencies. In accordance with the table of orthogonal design, modal analysis is carried out and extracted the natural frequency.

Xinhao Zhao et al. [4] had investigated Blanking press frame for high structural stiffness by two stage optimization. Non manufacturable result obtain from topology optimization is converted in to plate structure. Topology optimization outcome is manually understood plate by plate for additional FEA and optimization. To cope with these exposed issues and obtain the result from manufacturing constraints play an important role.

Wei Wei et al.[5] had proposed structural optimization for upper beam of hydraulic press. Upper beam is consisted of normal steel plates connected by welding. For structural optimization thickness of all sidewise plates and lengthwise plate are used as design variables. Experiment design method is proposed for obtain connection between stiffness, mass and design variables. Second order stepwise regression model is used for establish Mathematical model for structural optimization. Key factors influencing stiffness and mass are extracted and analysis results are obtained by experiment design. In structural optimization weight is set as the limit during increase the rigidity of the upper beam.

Wujiao Xu et al. [6] had conducted study on three beams of hydraulic press for light weight optimization. Thickness of different plates in beam taken as deign parameter for optimization to reduce the mass by considering two working conditions , the center and the eccentric loading situation. To solve global strength of structure and the localized stress concentration the mathematical programming algorithm and the FEM are used to reshape the hydraulic press. Sensitivities of all thickness of plates is calculated to obtain the optimal design.

Weiwei Zhang et al. [7] had proposed dimension optimization of cylinder-crown integrated structure of hydraulic press. In which variables are divided into two categories, global shape parameters and local size parameters. Objective selected for adaptive macro genetic algorithms (Amga) is weight reduction, as well as to reduce the peak load. Analysis of the sensitivity of the variables can be achieved by planning experiments from method of Latin Hypercube design. Projected variables are analyzed by establishing a multivariate quadratic regression model. Optimization of Multi-Purpose Design (MAO) based on adaptive genetic algorithms macro (AMGA) is focused on.

Li Yancong et al. [8] had proposed optimal design of 10MN hydraulic press beam, ram and column for reduce forming error. Structure configuration of the upper and lower beam of the press is box-type with inner ribs. For that nine key structure parameters are selected from upper and lower beam as design variable. Selection of key structure parameters by sensitivity analysis of the prototype design

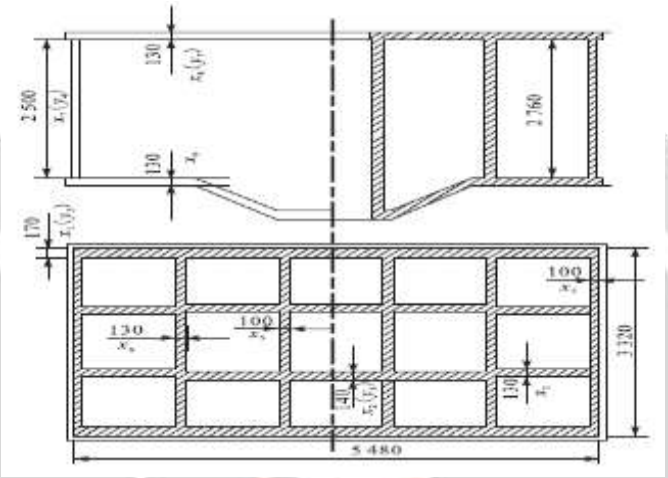

Fig-2: Design parameters of upper beam of press [8]

Optimization of press structures Carried out by DOE and RSM with the stiffness as constraint and lightweight as objective. Response surface model for FUB and FLB had obtained by regression.

Zhu PeiHao et al. [9] had proposed method for effective selection of the key dimension parameters for the optimization which remarkably impact on the structural performance of hydraulic press. In that condition Model analysis which gives the natural frequency is takes less computation than finite element analysis for strength and stiffness. Mathematical models of the natural frequency and mass of upper lower beam and column was proposed using an orthogonal design and Regression model. Design simulation training center, or the point for fitting quadratic response surface models are selected in accordance with an orthogonal design.

Romeo Cioara et al. [10] had concerning with rigidity increment of C-frames Keeping constant frame thickness. they had been established models with different ribs orientation intermediate in between at 50, 75 and 100 mm's which concerning the stiffness increase of casted C-frame. They come with conclusion that vertical ribs are obviously more to those with horizontal ones, in terms of stiffness. Instead of, it seems clear that, ribs arrangement at an angle of 10º gives optimum results for frames.

Songmei Yuan et al.[11] had proposed optimization of size and location of ligament and the wall thickness of machine tool bed these parameters are selected as design parameters due high impact on stress and natural frequency according to finite element analysis, Based on the analysis result, BP - NN algorithm is used to achieve global relationship between the design parameters and weight and the natural frequency .GA is recommended for optimization to improve performance and light weight structure.. Proposed method requires less time than the FEA and gives good optimal solution.

3. CONCLUSIONS

The accuracy of bend angle is most important criteria in design of press brake structure. Which is highly depended on stiffness of ram and bed of press brake Previous investigations on the analysis of various frame structures of

press and hydraulic press machine are shown in this paper various techniques of analysis and optimization through the various methods lie FEA, GA ANN can be used for derive desire accuracy. Shape optimization which allows analysis of the existing press design to give new solutions which optimize their productivity. Mathematical model for design parameter can be prepared by use of DOE and RSM. Therefore, there is possibility of applying Optimization technique to decrease the deflection in press brake to improve its performance. Dimensional optimization can be done for current design for accuracy of bending angle. Due to requirement of light weight design with high performance ribbed structure is very effective for reduce parallelism error.

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