National University of Science and Technology

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FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

FINAL YEAR PROJECT

Design of a Rock Breaking Machine

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ABSTRACT

The project involves the design of a rock/metal breaking machine that will be used particularly at Zimasco Kwekwe in the downsizing of oversized rocks to a size less than -100mm at a minimum hammering strike rate of 100 blows per minute. A value of -100mm means that the fragmented rock should fit through a 100mm diameter ring regardless of its orientation. Chapter one highlights the aim, objective and the scope of the project. Details of the theories and mathematical equations used in designing the rock breaking machine are indicated in chapter two. Issues such as concept generation and selection, mechanical component design, robotics and hydraulics are all covered in considerable detail in chapter two. The theories in use for both fatigue and static loading conditions will form their basis on the maximum shear and the distortion energy (von-mises) theories. Specifications of the material to be handled are found in chapter three together with the company audit exhibiting the position in the production line where the rock breaker will make a contribution. The actual design and calculation of the machine parts, motions and hydraulic circuits is done in chapter four. Fatigue loading theories such as the Gerber theory and the ASME theory come into play in the design of the rock breaker's components experiencing fatigue loading. Because the rock breaker will take the form of a robot with four degrees of freedom then it is vital to develop the specific forward kinematic equations and the Jacobian matrix for the machine, details of these calculations and deductions are in chapter four of the project. Chapter five contains the simulation results of the proposed hydraulic circuit that was designed based on the calculations obtained in chapter four courtesy of a design simulation package called simulation x 3.2 version. The sixth chapter contains the actual cost of the machine components and the recommendations that are necessary in the smooth operation of the machine within the Zimasco production line. The cost benefit analysis of the project was based on two accounting theories and these are the payback theory and the return on investment concept.