Tema A1a.Diseño mecánico: *Análisis de mecanismos*

"Comparative Mechanical Analysis of 1 DoF Mechanisms for Reinforced Concrete Jaw Crusher Application"

Cos Díaz, J.J.[a], Yañez-Valdez, R.[a], Hernández Padilla, F.[a], Espinosa Bautista, A.[a],

[a]División de Ingeniería Mecánica e Industrial, Conjunto sur de la Facultad de Ingeniería UNAM, Circuito exterior, Ciudad Universitaria, C.P.04510, Ciudad de México, México.

R E S U M E N

Este trabajo desarrolla el análisis y la evaluación de diferentes mecanismos mediante tres índices de desempeño: ventaja mecánica, rigidez y capacidad de manipulación, con el fin de discriminar estas configuraciones y seleccionar aquella que proporcione el movimiento y la fuerza óptimos para el funcionamiento de una máquina trituradora de hormigón armado. Las configuraciones iniciales se seleccionaron en función de dos características comunes: a) todos son mecanismos con un grado de libertad (GDL=1), y b) su eslabón de entrada representa el movimiento de una manivela. Del análisis se concluye que, el mecanismo de seis barras en el cual el eslabón de salida funciona como un oscilador, presenta las mejores características para la implementación deseada; con la longitud de cada eslabón y la posición del suelo establecida, se determinó el comportamiento del par de entrada necesario para mantener la fuerza de salida deseada a lo largo del movimiento de compresión.

Palabras Clave: Concreto, Trituradora, Máquina, Mecanismos, Índice de desempeño..

A B S T R A C T

This work develops the analysis and evaluation of different mechanisms by means of three performance indices: mechanical advantage, stiffness and manipulability, with the purpose of discriminating these configurations and select the one that provides the optimal movement and force values for the operation of a reinforced concrete crusher machine. The initial configurations where selected based on common characteristics: they all are one degree of freedom mechanisms (DoF=1), and their input link represents the movement of a crank. From the analysis, it is concluded that the six-bar mechanism in which the output link performs as an oscillator presents the best characteristics for the desired implementation; with the length of each link and the position of the ground established, the required behavior of the input torque to maintain the desired output force throughout the compression movement range was determined.

Keywords: Concrete, Crusher, Machine, Mechanisms, Performance index.

1. Introduction

Reinforced concrete is a composite which is obtained by adding corrugated steel bars to the concrete (a mixture of gravel or crushed rocks, sand, water and cement), giving, as a result a material with better mechanical properties when compared to both concrete and steel separately [1]. Fresh concrete is poured upon a previously armed steel structure. As the concrete hardens and due to the corrugated surface of the steel, a high mechanical resistance is obtained and thus, the adherence between concrete and steel is almost absolute [2].

1.1. Mechanical behavior of concrete under compression forces

Both cement and the aggregates which integrate the concrete show brittle behavior and linear stress-strain relation under compression forces [3].

Brittle materials such as ceramics tend to develop orthogonal fractures to the axis of maximum deformation, thus, when concrete is under a compression load, cracks spread parallel to the applied force. Under a cyclic compression load, the concrete fatigue strength is considerably lower than its static strength. If a cyclic compression load which oscillates between zero and the concrete rupture stress is introduced, the material will present a fatigue limit around 50-60 % its static compression limit. If the concrete has a steel reinforcement, its fatigue limit is around 50% the static compression limit [2]. Hence, steel bars presence has little to none impact in the fatigue