

## ***ABSTRACT***

*The use of heavy equipment in various industrial sectors continues to increase along with technological developments. Company X, which operates in the heavy equipment sector, focuses on the sale of heavy equipment units and component maintenance services, including hydraulic cylinder components. In the hydraulic cylinder maintenance process, the company faces obstacles in removing the lock nut on the cylinder rod due to variations in lock nut sizes and limited wrenches that impact the maintenance duration. If the wrench size is not available, the entire hydraulic cylinder maintenance process requires 6 days because it must involve an external party. However, if the company has the appropriate wrench size, the hydraulic cylinder maintenance duration can be completed in 3 days. This study aims to design an adjustable wrench with a range of 52 mm to 152 mm that can withstand a torque load of 2,200 foot-pounds by utilizing scrap materials, analyzing its structural strength, and evaluating its effect on maintenance time efficiency. The design process was carried out using Computer Aided Design (CAD) and structural strength analysis was carried out using Finite Element Analysis (FEA). The results of the analysis using the FEA method show that the adjustable wrench structure at positions 52 mm, 102 mm, and 152 mm has a maximum Von-mises stress value of 195.1 MPa, 230.6 MPa, and 188.5 MPa, respectively. The resulting displacement values at these three positions are 3,348 mm, 3,542 mm, and 3,235 mm. In addition, the safety factor values are 3.79, 3.2, and 3.9, respectively. These values indicate that the adjustable wrench using scrap material is capable of performing a torque of 2,200 foot-pounds. In addition, the use of an adjustable wrench increases the efficiency of the hydraulic cylinder maintenance process at Company X, so that the entire maintenance duration can be completed within 3 days without involving external parties.*

*Keywords: Design, CAD, Finite Element Analysis*

## INTISARI

Penggunaan alat berat di berbagai sektor industri terus meningkat seiring perkembangan teknologi. Perusahaan X yang bergerak di bidang alat berat, berfokus pada penjualan unit alat berat serta layanan perawatan dan pemeliharaan komponen, termasuk komponen *hydraulic cylinder*. Dalam proses perawatan *hydraulic cylinder*, perusahaan menghadapi kendala pada pelepasan *lock nut* pada batang silinder akibat variasi ukuran *lock nut* dan keterbatasan *wrench* yang berdampak pada durasi perawatan. Apabila ukuran *wrench* tidak tersedia, proses perawatan *hydraulic cylinder* secara keseluruhan memerlukan waktu 6 hari karena harus melibatkan pihak eksternal. Namun, apabila perusahaan memiliki ukuran *wrench* yang sesuai durasi perawatan *hydraulic cylinder* dapat diselesaikan dalam waktu 3 hari. Penelitian ini bertujuan untuk merancang *adjustable wrench* 52 mm hingga 152 mm yang mampu menahan beban torsi sebesar 2.200 *foot-pounds* dengan memanfaatkan material *scrap*, menganalisis kekuatan strukturnya, serta mengevaluasi pengaruhnya terhadap efisiensi waktu perawatan. Proses perancangan dilakukan menggunakan *Computer Aided Design (CAD)* dan dilakukan analisis kekuatan struktur dengan *Finite Element Analysis (FEA)*. Hasil analisis menggunakan metode *FEA* menunjukkan bahwa struktur *adjustable wrench* pada posisi 52 mm, 102 mm, dan 152 mm memiliki nilai tegangan *Von-mises maximum* masing-masing sebesar 195,1 MPa, 230,6 MPa, dan 188,5 MPa. Nilai *displacement* yang dihasilkan pada ketiga posisi tersebut adalah 3,348 mm, 3,542 mm, dan 3,235 mm. Selain itu, nilai faktor keamanan berturut-turut sebesar 3,79, 3,2, dan 3,9. Nilai-nilai tersebut menunjukkan bahwa *adjustable wrench* dengan menggunakan material *scrap* mampu dalam melakukan torsi 2.200 *foot-pounds*. Selain itu, penggunaan *adjustable wrench* meningkatkan efisiensi proses perawatan *hydraulic cylinder* di Perusahaan X, sehingga seluruh durasi perawatan dapat diselesaikan dalam waktu 3 hari tanpa melibatkan pihak eksternal.

Kata kunci: *CAD*, *Finite Element Analysis*, Perancangan