

Prototype Design and Research Collection

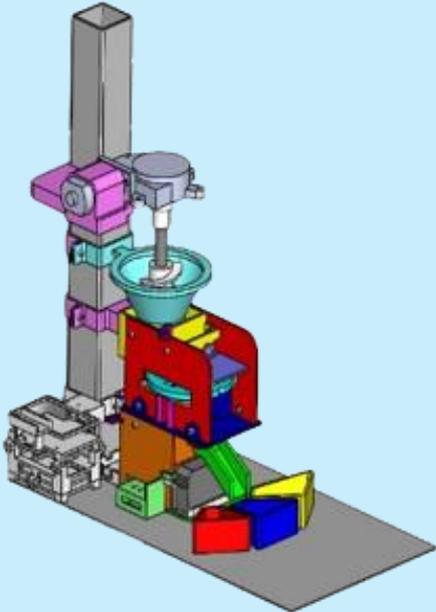
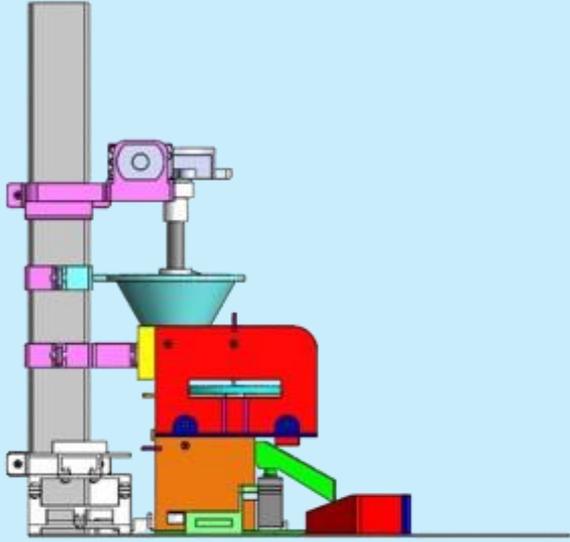
Series 1



Universiti Teknologi MARA
Pasar Gudang Campus

Prototype Design and Research Collection

Series 1



AHMAD NAJMIE RUSLI

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CHIEF EDITOR:

Ahmad Najmie Rusli

EDITOR:

Nurul Nadiyah Rasdi

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FOREWORD

This digital book on Prototype Design and Research Collection Series 1 (PDRC Series 1), is designed as a comprehensive reference for mechanical engineering students. The designs featured in this collection undergo an extensive analysis process, incorporating both prototype development and research to ensure a thorough understanding of design principles. Each project is carefully analysed before the prototype fabrication with detailed summaries of the project description and design parameters. The design and research products presented in this series cover a wide range of tools and equipment for various applications including household, workshop and entrepreneurial purposes.

This collection aims to foster innovation by offering students valuable insights into both the technical and research aspects of product design. It is hoped that this book will inspire future engineers and designers to approach product development with a deeper understanding of the design and research processes.

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CHAPTER 7

Stress Analysis of Mini Compact Manually Operated Crane Design

Nurrul Amilin Zainal Abidin ¹, Muhammad Irsyad bin Fauzi ² and Norjasween Abdul Malik ^{3*}
^{1,2,3}*Faculty of Mechanical Engineering, Universiti Teknologi MARA Johor Branch, Pasir Gudang
Campus, Bandar Seri Alam, 81750 Masai, Johor Darul Ta'zim.*
**Corresponding author (e-mail): norjasween@uitm.edu.my*

ABSTRACT

This project aims on designing a mini compact manually operated crane. This crane is designed to be easily maneuverable and can fit into tight spaces, making it ideal for tasks such as lifting tools, materials, or equipment in confined work areas. The design of mini compact crane is incorporating with features such as articulating arms and lever-operated model. A stress analysis is performed on the articulating arm to ensure that this manually operated crane can withstand the expected loads and forces it will experience during its extended use.

Keywords: Mini crane

1 INTRODUCTION

Cranes are lifting tools found in various industries and applications, including construction, shipping, logistics and manufacturing [1]. They often come in different types and sizes to accommodate different needs, ranging from small-scale operations to large construction projects. Mini compact designs of cranes are particularly useful in situations where space is limited or where smaller loads need to be lifted. The mini compact cranes are particularly designed to be easily maneuvered, fit into confined spaces but able for general tasks such as lifting tools, materials or equipment in confined work areas. Manually operated cranes, such as hand-cranked or lever operated models, can be suitable for lighter loads or situations where power sources are limited or unavailable. They are typically more affordable and easier to maintain than powered cranes [2]. This project aims to design a mini compact, manually operated crane ideal for such purposes. A stress analysis is performed on the articulating arm to optimize the design, improve its long-term performance, and reduce the risk of failure or mechanical problems in real-world applications.

2 LITERATURE REVIEW

A patent of mini crane has been reported, capable of moving a weight in the up and down direction or right and left directions after being fixed on the inner wall of a building. The load of the weight is supported using a jack [3]. This project adopts the working concept of the arm pulley in [3], while transmuting the jack with solid base. The Mini Compact Manually Operated Crane is a versatile and efficient lifting device designed for use in small-scale industrial and construction applications. Its compact size allows it to be used in areas with space constraints while still providing reliable lifting capabilities. The manually operated mechanism ensures ease of use without relying on electricity or fuel, making it both cost-effective and environmentally friendly. This crane is ideal for transporting light to medium

loads across short distances. By integrating a user-friendly design with durability, the Mini Compact Crane serves as an indispensable tool for workshops, warehouses, and small construction projects.

3 METHODOLOGY

The mini compact design of the manually operated crane is design using SolidWorks 2020 as shown in Fig. 1. The engineering calculation for buckling was performed on the hollow bar pole of the crane as to ensure it will not be buckling as it performs. Most of the body frame is made from mild steel due to its strength and durability. Stress analysis is then performed using SolidWorks to simulate and visualize how a part or assembly behaves under different types of mechanical stresses, such as tension, compression, shear, and bending (Fig. 2). [4].



Fig. 1: Isometric view of manually operated mini crane design using SolidWorks 2020

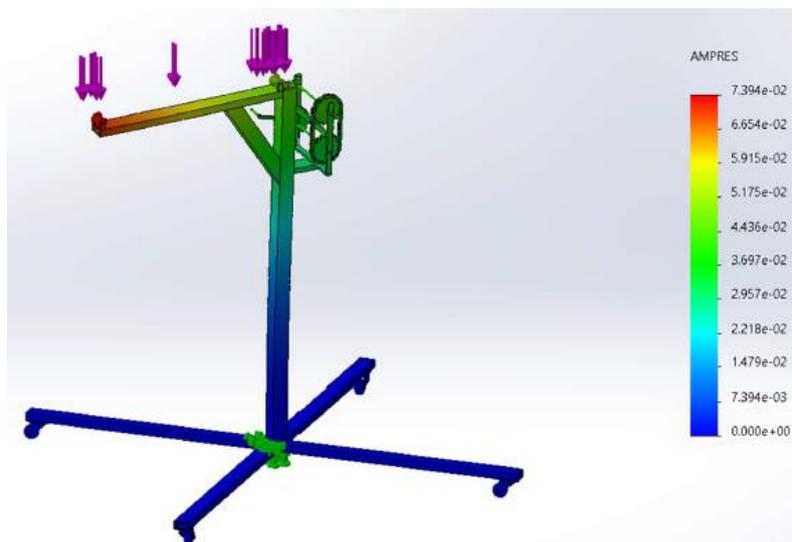


Fig. 2: Stress analysis performed on the design of manually operated mini crane

4 RESULTS AND DISCUSSION

Fig. 1 shows the stress analysis performed using SolidWorks on the mini crane. The edge of the arm displays a region of high stress concentration where failure is more likely to occur. This area may require design modifications or additional reinforcement to improve the structural integrity of the component. By analysing the stress distribution at this area and making design modifications, this can iteratively optimize the design to reduce stress concentrations, improve structural performance, and enhance product reliability.

5 CONCLUSIONS

The project has been successfully designed and analysed. The manually operated crane can carry around 20kg, with mini compacted design that can easily manoeuvred, and should have no problem delivering its general tasks.

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