

ASCEND: Prototype of a Mobile-Adjustable Ladder for Home Use

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Abstract: ASCEND is a prototype of a mobile-adjustable ladder designed as a means of reaching high places at home such as attics, ceiling fans, and elevated shelves. Existing ladders on the market are either mobile or adjustable, therefore ASCEND consist of the best of both worlds. ASCEND includes a mechanism which allows the operator to move the ladder without having to climb down. The height of ASCEND can be adjusted by two steps allowing the user to access high reach places. Additionally, ASCEND features sturdy, non-slip rungs and a durable metal frame, ensuring user safety and longevity of the ladder. ASCEND's durable construction makes it a reliable and safe choice for both personal and professional use. The project utilized computer-aided design software, Solidworks to develop and refine the ladder's specifications, which was then followed by the fabrication process using cutting, milling, and welding. Product testing was conducted to ensure its functionality, safety, and ease of use. ASCEND has significant potential for use not only in homes, but also in a variety of industries, such as construction, manufacturing, and maintenance. The successful creation of ASCEND represents a promising step towards the commercialization of this innovative ladder design, with the potential to fill a gap in the market for a high-quality mobile-adjustable ladder.

Keywords: Ladder; Mobile; Adjustable.



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1. INTRODUCTION

A ladder is a crucial piece of equipment for homeowners to have at home to assist when doing chores. Home chores such as cleaning the ceiling or ceiling fan, changing the light bulb, painting and outdoor repairs requires the use of a ladder to successfully complete the chore (Raval. C,2022). Not having a suitable ladder at home can lead to accidents and injuries (Tan. A,2016; Bernama ,2023), making it important to choose a ladder that is both sturdy and reliable. to reach high areas for tasks such as cleaning, storage, painting, maintenance, and outdoor repairs. Existing ladders on the market may not always meet the specific needs of homeowners. For instance, some may not be adjustable enough to reach high places, while others may not be easily mobile, making it difficult to move them around the home. This is where the ASCEND prototype comes in. Designed as a mobile-adjustable ladder, ASCEND offers the best of both worlds, enabling users to easily move the ladder without having to climb down, and adjust its height by two steps to reach high areas with ease.

2. METHOD & MATERIAL

Figure 1 shows the process flow chart for the completion of ASCEND. The duration for the project was four months.

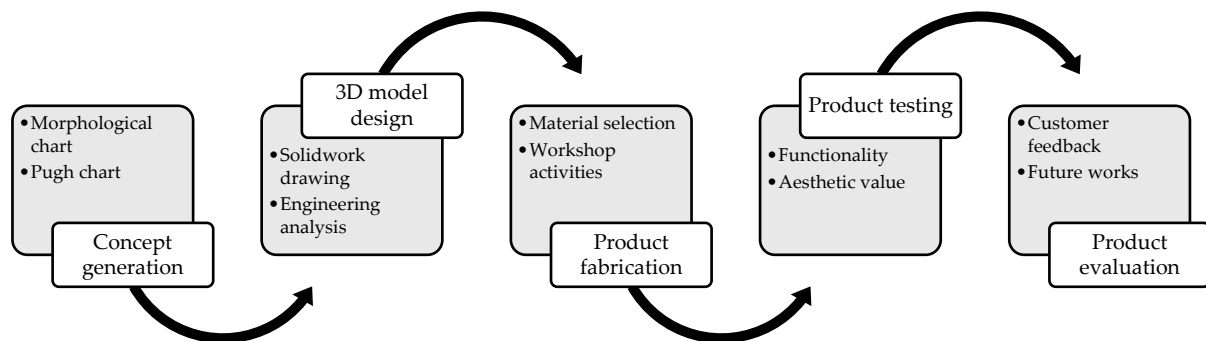


Figure 1. Process flow chart

Concept generation for ASCEND involved using a morphological chart to organize different characteristics and features which might be included. Features such as ladder's length, material, rung size and spacing, mechanism for adjustment and mobility were considered. Combining different options for each feature allowed the creation of potential ladder designs for ASCEND. The concept designs generated were then evaluated using the Pugh chart. Each design concepts were evaluated based on criteria's such as functionality, ease of use and cost. This ultimately led to the selection of the final design for ASCEND.

The 3D model design for ASCEND was created using the Solidworks software. Also conducted was the engineering analysis for the critical parts of the product. Based on the analysis, the 3D model design was reviewed and refined until it accurately represents the desired design. Material selection prior to the fabrication process was conducted to ensure that the most suitable materials were used and its cost relatively low. The fabrication process includes cutting, milling, and welding, where the metal frame and rungs are cut to the appropriate size and shape, and then welded together to form the ladder's structure. The process requires precision and attention to detail to ensure that the ladder is of high quality and meets the design specifications. Rigorous testing is also conducted to ensure that the ladder is functional, safe, and easy to use.

Finally, product evaluation was conducted from potential customers and end-users regarding the ASCEND prototype. Feedback from potential customers were collected to identify areas for improvement or modifications that can be made to the design. Additionally, the evaluation process provides valuable information on the product's commercial viability and potential market demand. By taking customer feedback into consideration, further iterations of ASCEND can be developed to better meet the needs of the target audience and increase its potential for success in the marketplace.

3. FINDINGS

The use of Solidworks software in the design process for ASCEND proved to be a valuable tool. The software allowed for the creation of a 3D model of the ladder, which aided in visualizing the design and identifying any potential issues before fabrication. The software also allowed for easy modification of the design, which resulted in a more efficient design process. Figure 2 shows the 3D model for ASCEND using Solidworks.

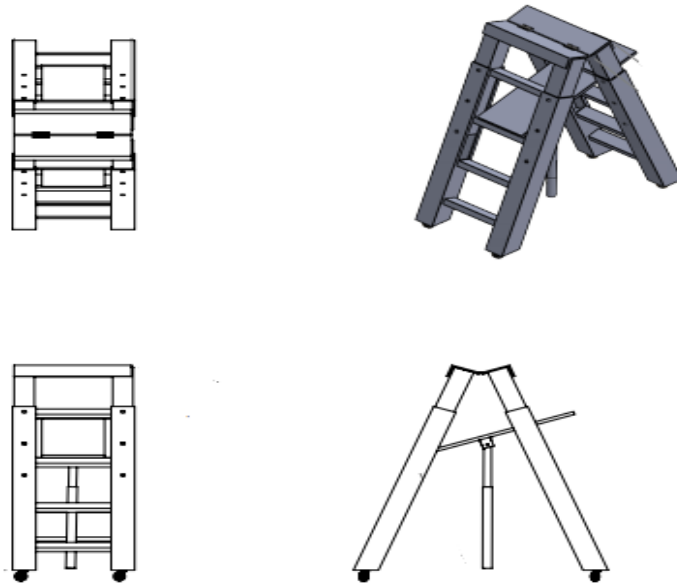


Figure 2. ASCEND 3D design model

The fabrication process involved selecting appropriate materials and using various manufacturing processes such as grinding, welding, and machining to create the ASCEND ladder. The material selection process involved choosing materials that were durable and could withstand the weight and pressure of the ladder. Different manufacturing processes were used to shape and join these materials together to create the final product. This process required careful attention to detail and skilful use of specialized tools and equipment. Figure 3 shows example for fabrication process for creating ASCEND.

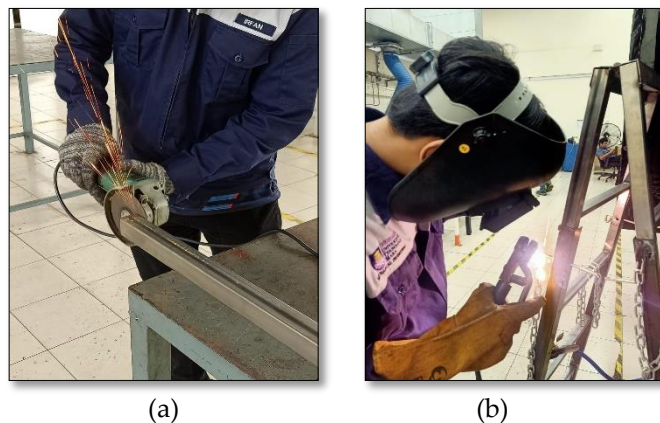


Figure 3. Example for fabrication process a) grinding b) welding

During the assembly and finishing process, the fabricated parts were put together to create the final product, ASCEND. This process involved joining the metal frame components with the non-slip rungs to ensure stability and safety. The finishing process included painting the ladder for aesthetics and added protection against corrosion. After the assembly and finishing process was completed, rigorous testing was conducted to ensure the ladder's functionality, safety, and ease of use. Figure 4 shows the assembly process and final product.

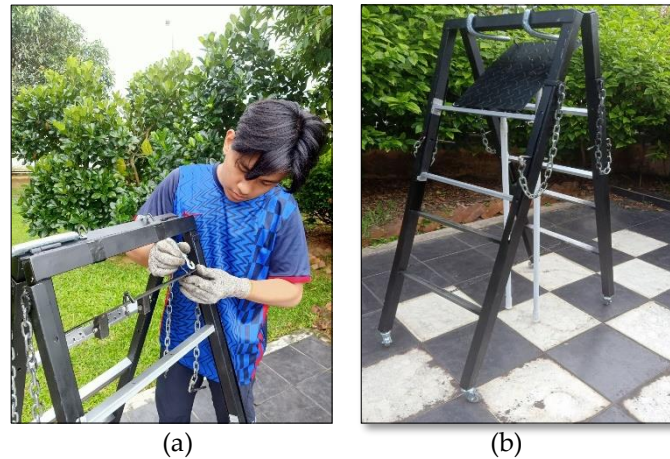


Figure 4. a) Assembly process b) Final product design

4. DISCUSSION

The mobility testing was conducted to evaluate the ease of moving the ASCEND ladder from one place to another. The results of the testing showed that the ladder was relatively easy to move around, with the wheels and lightweight design making it simple to manoeuvre. However, it was noted that the ladder's adjustable nature made it slightly more difficult to move, as the different components required some adjustment to be made before it could be safely moved. Overall, the mobility testing showed that the ASCEND ladder was a convenient and functional piece of equipment for homeowners to have in their homes. Figure 5 shows the mobility testing process.

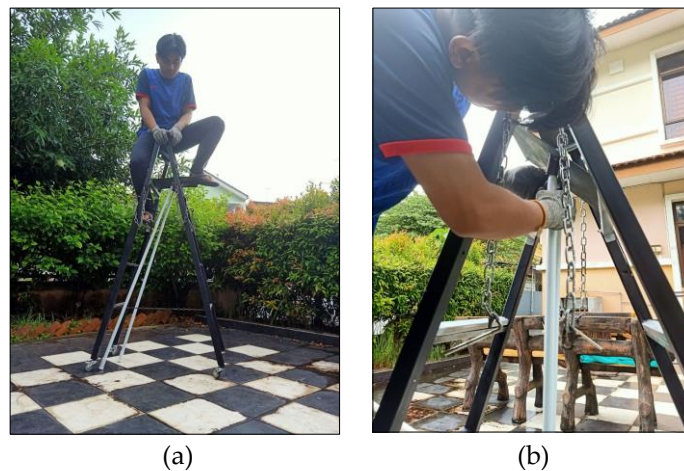


Figure 5. a) Mobility testing b) ASCEND adjustment

The height adjustability testing of ASCEND ladder showed that the product's design successfully addressed the needs of users in terms of adjustability. The ladder was able to reach a maximum height of 1.65m from 1.3m. The height adjustment mechanism was also found to be easy to use and reliable. However, there were some minor issues identified during testing, such as the need for improved grip on the adjustment mechanism and the need for additional safety features to prevent accidents when adjusting the height. Overall, the height adjustability testing showed that the ASCEND ladder is a promising product that meets the needs of users in terms of height adjustability, with some room for further improvement. Figure 6 shows the height comparison for ASCEND before and after adjustment.

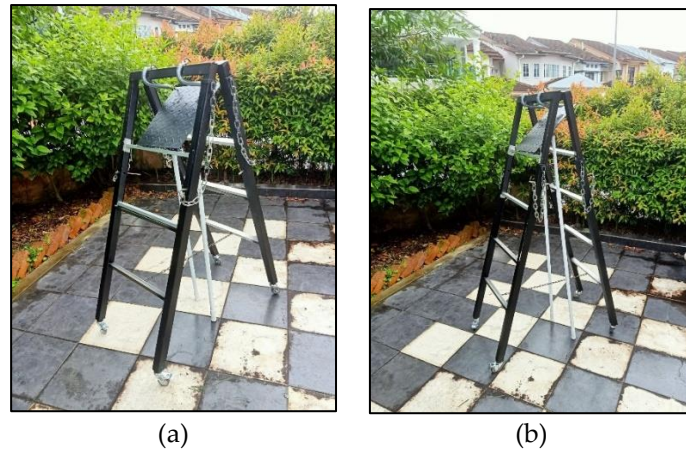


Figure 6. ASCEND height adjustment a) before, 1.3m b) after, 1.65m

5. CONCLUSION

ASCEND: Prototype of a Mobile-Adjustable Ladder for Home Use is a project that aimed to address the need for a ladder which is both mobile and adjustable. Initially targeted to help homeowners to complete their household chores and maintenance task safely and efficiently, ASCEND has the potential to be used in other places, such as warehouses and supermarkets. Feedback from potential customers will help identify areas for future improvements. Future recommendations include further product testing to ensure its compliance with industry standards and the integration of innovative technologies to enhance its usability. In conclusion, the successful creation of ASCEND is a promising step towards the commercialization of this innovative ladder design, with the potential to make household tasks safer and easier for homeowners, while also meeting the needs of various industries.

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