

Research Article

Design and Fabrication of 3 in 1 Foldable Hand Trolley

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Abstract: The project "Design and fabrication of 3 in 1 foldable trolley" that has been proposed is from facing difficulties when trying to move a lot of heavy items while using a regular trolley. Older people who use a regular trolley to move heavy items can experience backache. This 3 in 1 foldable trolley project's target is to facilitate and save energy for users. This project intends to design and fabricate a 3 in 1 foldable hand trolley to consume less energy, especially for workers or people who need to lift a lot of heavy items daily and have 3 styles to lift items. To make this project, the most suitable and affordable material is by using steel as the main material. Other than that, such as rubber tires and non-slip fabric for the handle. There is also an idea about putting a pedometer to record the distance when using the trolley, and even how much our calories burned. The objectives of this project are to upgrade a regular trolley to a trolley that can make lifting heavy items easier and more comfortable.

Keywords: Trolley; SolidWorks; Design



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1. INTRODUCTION

Nowadays, having a healthy body is important for everybody. According to the National Medical Care Statistics (NMCS), approximately 12% of the Malaysian population is facing the issue of back pain (Sivasampu S. et al. 2014). Transporting moving large and heavy object have been a problem, especially for warehouse workers who need to transport heavy items from point A to point B. The force required to push or pull materials may overload the musculoskeletal system and could injure various body parts. The neck (Cervical spine), shoulders, elbows, hands, low back (Lumbar spine), knees, and feet are the most injured body parts. Nobody in this world would want an injured body part. Trolleys are an incredibly practical material-handling solution for transporting both light and heavy items. They increase warehouse efficiency by allowing employees to load, transport, and locate items quickly and efficiently. This in turn reduces the operational costs of the warehouse and contributes towards worker safety. There are various types of trolleys, all made for carrying out specific tasks. Some of the most popular types include the platform trolley, cage trolley, tool trolley, and shelf trolley.

2. METHOD & MATERIAL

A brief brainstorming with the supervisor was conducted to find out the problems they have to develop this Foldable Hand Trolley. The main advantages of this prototype are easy to transform into 3 types of trolleys, is easy to handle, and ability to lift large items. There are five phases involved, namely information and idea gathering, literature review analysis, design, development, and testing. There is no task overlap between the phases, and each step must be completed before moving on to the next.

- a) Phase 1 (Information and Idea Gathering) – This phase is focused on the application's requirements. Detail of the problem statements and limitations was gathered.
- b) Phase 2 (Literature Review Analysis) – The literature review was analyzed and documented. Every past project related to this prototype was considered.
- c) Phase 3 (Design) – Design is one of the critical phases. Developed using SolidWorks software to design the prototype based on hand sketching.
- d) Phase 4 (Development) – There are several steps of the fabrication process namely, material selection, measuring, cutting mild steel according to their respective dimensions, drilling, welding using SMAW, polishing, and grinding and spraying the prototype.
- e) Phase 5 (Testing) – Testing is critical to ensure the prototype will function as intended to the requirements. Testing was carried out by providing test inputs, simulation testing, and confirming that the result fulfilled all the objectives.

3. FINDINGS

There are several findings from this prototype.

1) Engineering analysis

The product's durability is assessed using computer-aided engineering (CAE). The nose plate, body frame, and frame support have been selected as the project's most crucial components since they can handle the largest loads when compared to other components. 1000N of the load is applied during the simulation. The examination of the nose plate in Figure 1 shows that the minimum Von Mises Stress is $1.634 \times 10^4 \text{ Nm}^2$, and the maximum stress is $4.093 \times 10^6 \text{ Nm}^2$. The minimum Von Mises Stress for the body frame in Figure 2 is $0.000 \times 10^0 \text{ Nm}^2$, whereas the maximum value is $1.338 \times 10^9 \text{ Nm}^2$. The minimum Von Mises Stress for the frame support in Figure 3 is $7.982 \times 10^{-2} \text{ Nm}^2$, while the maximum value is $1.628 \times 10^3 \text{ Nm}^2$. The value used to assess the material's yield or fracture is called the von Mises stress.

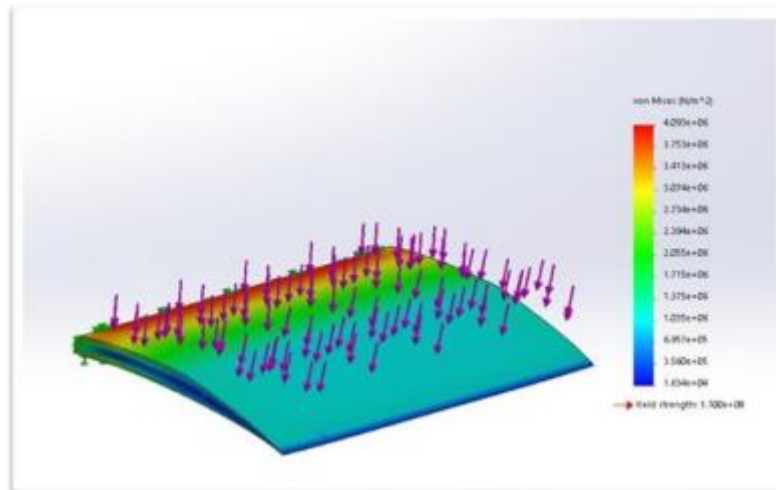


Figure 1. Nose plate analysis

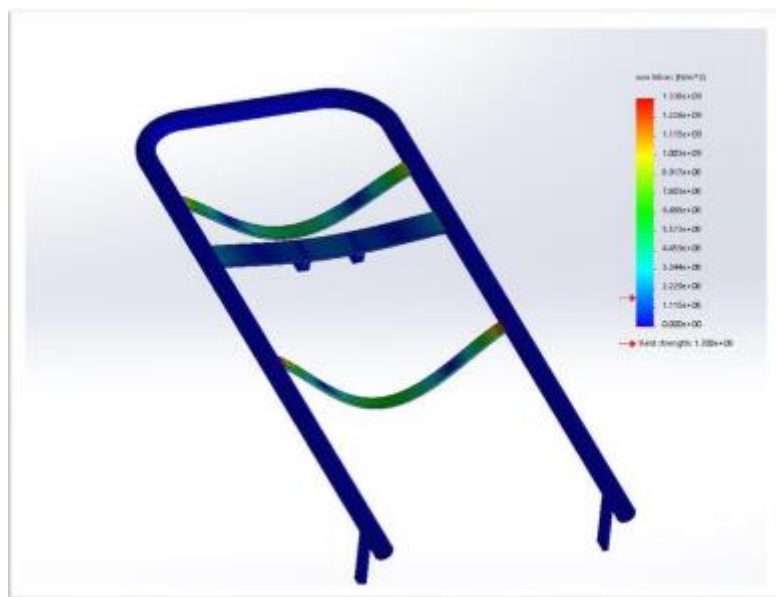


Figure 2. Body frame

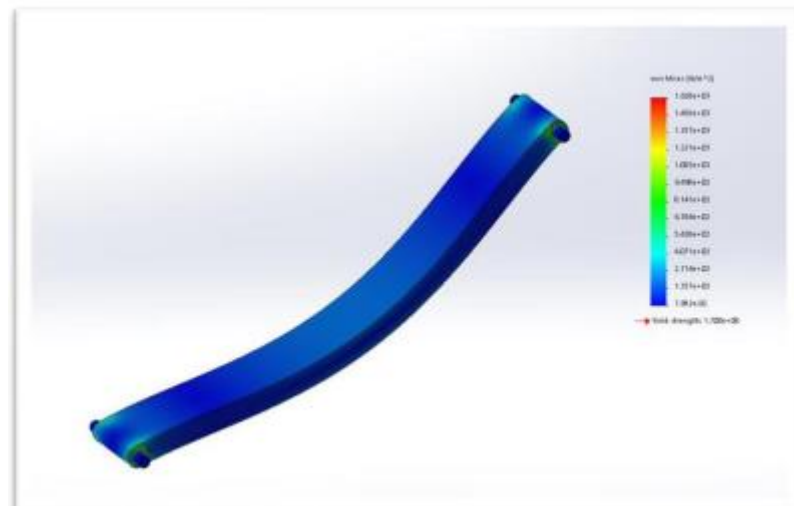


Figure 3. Frame support

2) Complete Prototype

Figure 4 shows the complete design for this prototype. Table 1 shows the prototype's final specification.



Figure 4. Complete Prototype

Table 1. Prototype final specification

Types	Specifications
Frame	Square hollow steel
Product weight	40Kg

Material	Mild steel
Maximum load	150Kg
Market price	RM450.00
Basic function	Carry item/load
Dimension	1450mm x 475mm
Hollow steel round bar	D25mm, 500mm x 1mm

4. DISCUSSION

This prototype will rebound to the society as trolley plays an important role for workers or someone that need to lift heavy loads often. While lifting big objects, this three-in-one hand trolley project can reduce the user's risks of experiencing back, knee, and hand pain. It can also assist users in reducing the amount of effort required to carry big items, allowing them to transfer heavier loads more efficiently. This project is especially effective in a warehouse where massive, heavy objects are stored. Because this trolley can be used as a hand trolley, platform trolley, and ground support hand trolley, this project can save time while changing trolley types. Changing the trolley types requires only a little folding

To keep our product or machine in its best condition, it must be maintained at least every day, week, and year. Here are some maintenances for the prototype that can be done to maintain its condition.

1) Daily

After using the trolley, clean the trolley using a wet cleaning cloth to keep the trolley clean from dirt.

2) Monthly

Spray lubricant at the bearing holding the connector to make sure the bearing can be used smoothly and to prevent the bearing from rust.

3) Annually

Check if there is any rust on the trolley and the bearing. If the frame was rusty, Coat deeply rusted metal areas with a special primer that can chemically convert rust to a paintable surface. Then, you can paint over the rust. Do the same thing for the bearing

5. CONCLUSION

The main reason for making this product is to ease the burden of people that need to carry heavy loads often such as warehouse workers, grocery stores, and even households. Other than that, people need to buy different types of trolleys if they need to. With this product, you can get 3 types of trolleys which are normal, 45-degree angle trolleys, and even platform trolleys. The main objective for this project which is to design and fabricate a 3-in-1 hand trolley that can transform into 3 types of trolleys hand trolley, 45degree trolley, and platform trolley is achieved because this project can

successfully be transformed into 3 different types of trolley. The second objective has also been achieved which is to produce a trolley that can turn into 3 types of trolley so that users can easily switch to another type of trolley that they wanted. This product can save money because users don't need to buy different types of trolleys anymore.

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References

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