

# Redesign of Goods Transportation Tools Through Stairs in Multilevel Buildings Based on a System Perspective (Case Studies at Telkom University Dormitory)

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## ABSTRACT

Telkom University is one of the private universities that has a dormitory program for students as a residential facility in Bandung. The large number of students coming from outside Bandung makes a dormitory program on the campus area of Telkom University as the appropriate residential solution for non-indigeneous students. The dormitory is in the form of a 4-storey building that can be reached using stairs. However, there was actually found another problem that the residents of dormitory who lived in the third and fourth floors found the difficulty when transporting goods that were quite heavy and large in term of going up and down using stairs. In a previous study with the title "The Design of goods-transporting tools through stairs in multi-storey buildings based on system perspective", it was still found a lack in the part of the system where the chain wheels have not been able to run well yet and also inavailability of the safety system for goods which prevents items from falling off the conveyance. Therefore, it is necessary to redesign the goods transport equipment through stairs by focusing on developing wheel system and also goods safety system. The method used in this redesign is the qualitative method by observing Telkom University dormitories and conducting interviews with a number of dormitory residents. In addition, an analysis of the design of wheel system and safety of the previous conveyance of goods is carried out. The result of this analysis produce, products transporting goods that can be used through stairs so as to reduce the risk of accidents when transporting goods in multi-storey dormitories.

**Keywords :** Goods Transport Equipment, Stairs, Rubbertrack wheel System.

## 1. Introduction

Telkom University Student Dormitory was inaugurated in 2012 which now consists of 10 male dormitory buildings and 8 female dormitory buildings. This dormitory consists of 4 floors which are only facilitated. The stairs are the main road to take each floor without an elevator, this is because the floors in a multi-storey building are less than 5 floors which can still be reached by stairs. One of the problems experienced by the student dormitories especially for students who bertinggal on floors 3 & 4, namely when residents perform activities of transporting goods from the ground floor through the stairs.

The absence of transportation equipment that can be used to transport goods through stairs so that transporting goods through stairs is very

difficult. Seeing these problems, researchers see opportunities to find an appropriate solution, which is to facilitate boarders to transport goods, especially between the floor.

In a previous study entitled "Designing Goods Transport Through Stairs in Multilevel Buildings Based on System Perspectives" the author has designed a conveyance that can be used through a ladder that comes from an existing conveyance, the Trolley. The trolley was developed on a wheel system, skeletal system, system handle. But there are still shortcomings in the placement of the wheel position which turns out to be less suitable with the frame body to make the wheel's pedestal in the frame unbalanced and become bent, it is necessary to readjust the good position of the wheel In addition, the locking system is not yet available so that items are still at risk of falling when

climbing or descending stairs. Therefore, further research is needed on the conveyance through this ladder so that the product can be used optimally.

## 2. Research Method

The type of research method used in this study is Qualitative Research. Qualitative / naturalistic research is research carried out on the condition of natural objects, researchers as key instruments, data collection techniques carried out in combination, the resulting data are descriptive and data analysis is done inductively and this research emphasizes more meaning than generalization (Sedarmayanti and Hidayat, 2011: 33). But qualitative research is not enough to attempt to describe a data, but the description is the result of collecting data obtained through in-depth interviews, observations, or documentation.

### 2.1 Observation

In order to obtain accurate data, direct data collection is by observing or jumping directly to the place where the problem lies, namely the Telkom University dormitory. From these observations obtained from the data in the form of accessibility facilities, namely the stairs inside and emergency roads that are outside the dormitory. But emergency doors are very rarely opened and traversed so they are not used. In addition, stair dimensions are measured as a reference and consideration in the process of designing this product. The dimensions of the boarding stairs are as follows:

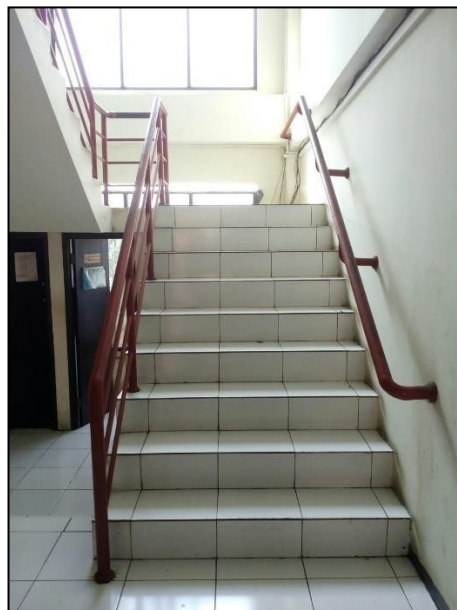


Figure 1. Main Stairway of Telkom University Male Dormitory

(Source: Author documentation)

- **Stair Dimensions**

- Number of steps 9 pieces
- The width of the stairs is 150 cm
- Height of stairs 19.5 cm
- The step width of the stairs is 30 cm
- The total length of the stairs is 320.5 cm
- Stopan width is 123 cm
- Stopan length 340.5 cm

### 2.2 Interview

In order to know the freight activities carried out in a dormitory environment, interviews were conducted directly with a number of students from male and female dormitories and boarders of Telkom University dormitories. The freight activities carried out are as follows:

Table 1 Activities for transporting boarders based on the period

Goods Transport Period	Goods Transport Activities
Annual / Monthly	If you enter and exit the hostel

Weekly / Daily	Each day, always there are students who buy a gallon of drinking water
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(Source: Author Processed Data)

### 2.3 Literature Review

Literature studies are carried out to explore further information about theories that support the design of various trusted and accurate data sources in both print and digital media.

## 3. Discussion

### 3.1 Design Aspect

The design aspect is a certain factor or element which is a material consideration that becomes a reference, limitation, or guideline in the product design process. In this design, the design aspects discussed are aspects of the system. According to Bram Palgunadi (2008: 409), System Aspects are divided into 3 levels based on the level of priority / importance, namely:

1. Primary System Aspects
2. Secondary System Aspects
3. Tertiary System Aspects

To determine the priority scale aspects of the system, a problem analysis is needed based on the product description and background. This analysis will then produce dominant aspects. the weighting results can be used as design priority considerations. The results of the analysis are carried out as follows:

**Table 2** System Aspect Priority Analysis

No.	Problems from background	Problems from previous transportation equipment
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1	- Goods transport activities carried out by students at certain periods at Telkom University Dormitory	- Pre-loaded goods transport can not be used optimally because of the use of a wheel system that is not right.
2.	- Unavailability of goods for transportation through stairs in the dormitory.	- The use of frame material that is too light so it is less sturdy. - Product safety system that is not yet available.

(Source: Author Processed Data)

Based on the above problems, the most dominant problems found related to other aspects contained in goods transport through the previous ladder, namely wheel, frame, material and security aspects. From this, the percentage of the dominant aspects found in the conveyance of goods through the ladder is as follows:

**Table 3** System Aspect Weighting Results

System Aspects		
Primary Aspects	Secondary Aspects	Tertiary Aspect
Wheel System (30%)	Frame System (25%) Handle System (25%)	Security System (20%)

(Source: Author Processed Data)

### Term Of Reference (TOR)

- Design Consideration

The idea of system design considers the convenience of use and security of goods which has an impact on the effectiveness of freight transport activities.

- Design Limits (*Design Constraints*)

The design of the conveyance system is designed to be limited to the wheel system and the development of

goods security systems is a major problem without changing the frame system and grip system.

- Product *Descriptions*

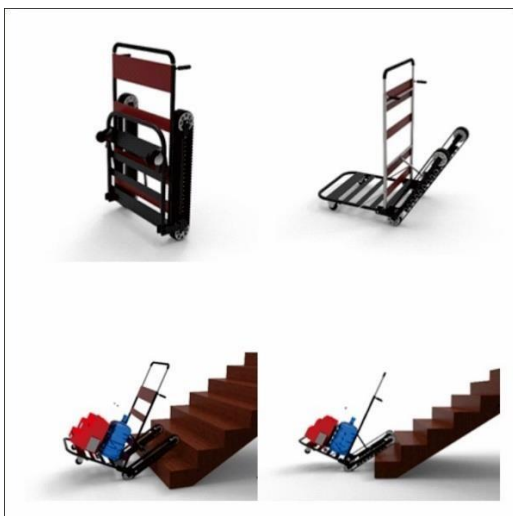
The product that is redesigned is a freight vehicle through a ladder that is developed in the aspect of a chain system that is adapted from the shape of a wheel tank and an appropriate security system such as a strap strap.

- Product Output (*Design Outcome*)

Products that are designed can facilitate the transport of goods when they have to climb or descend stairs in Telkom University dormitories so that they can prevent the risk of accidents while carrying goods.

### 3.2 Design Concept

Products designed will be goods transport that will make it easier for users when transporting goods up or down stairs so as to reduce the risk of bodily injury when transporting goods independently. Descriptive, these products develop a chain wheel system that allows the main wheel goods transportation equipment walk through the stairs without a hitch. In addition to maintaining the security of goods, this product is equipped with a security system in the form of a strap that can tie luggage so that it reduces the risk of items damaged due to falling when transported.



**Figure 2** Blocking Design of Goods Transport Equipment

(Source: Author Processed Data)

- Main Products

Product transportation of goods with the basic form of hand trolley which is named "Upstairs" which is equipped with:

- Dual Handle system
- Folding Frame System
- Chain Wheel System and Nylon Wheel
- Strap Strap Safety System

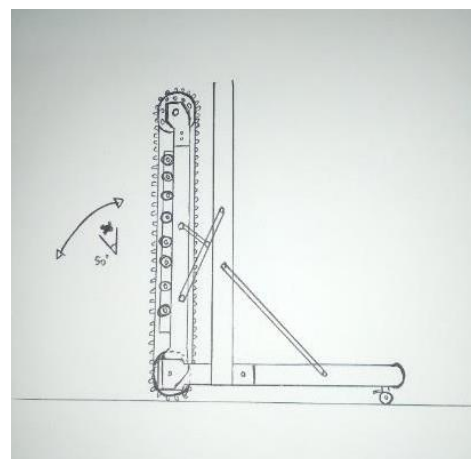
- Design Focus

In this report, the design carried out is the design of the Wheel System and the Security System. The design is done in the lower and rear wheel area. As well as a separate security system.



**Figure 3** Areas of Wheel System Design and Goods Safety

(Source : Author Processed Data)



**Figure 4** Wheel System Design Sketches

(Source: Author Processed Data)

### Descriptive Design

○ Product name:

The product is a conveyance of goods that can pass stairs using the chain wheel system under the name *UPSTAIRS*, an acronym for the word *Up* which means to ride and *Stairs* which means stairs.

○ Product Function:

Helping boarders when transporting items that are difficult to do through stairs.

○ Product Purpose:

Facilitate the transport of goods when you have to go through stairs and reduce the risk of bodily injury if done manually without tools.

○ Product Goals:

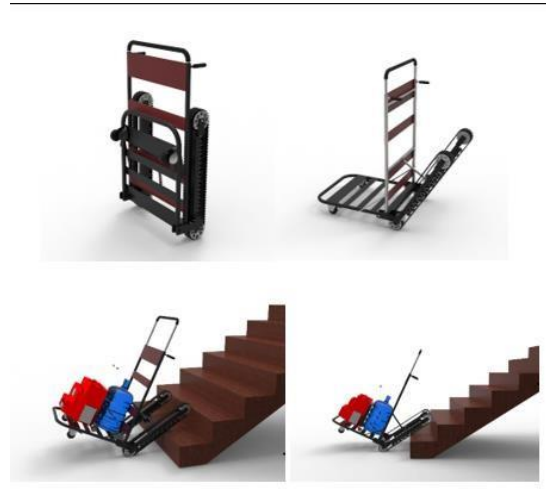
Goods transport via stairs using the chain wheel system and the security of the "UPSTAIRS" strap strap.

○ Product User

This product is used for residents of Telkom University student dormitories or occupants of multi-storey buildings that do not have *elevator* facilities .

### 3.3 Design Visualization

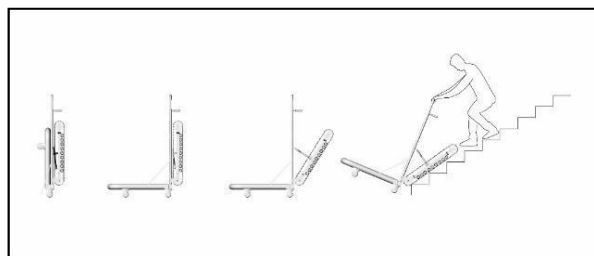
The design layout is arranged in product blocking to find out the design needed according to needs. After that the design is visualized in the form of sketches and models.



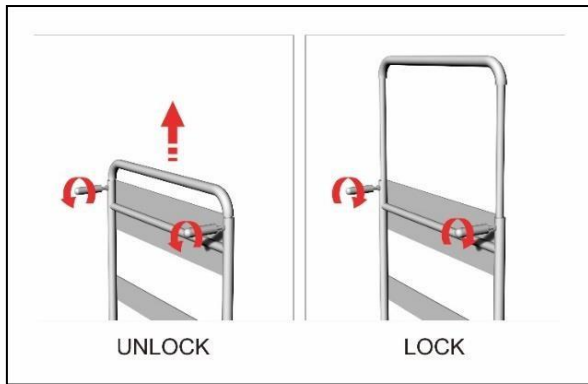
**Figure 5** Rendering of the Wheel System of Goods Carrying Equipment Through Stairs (**Source:** Author Processed Data)



**Figure 6** Rendering of the Security System of Goods Transport Equipment Through Stairs (**Source:** Author Processed Data)

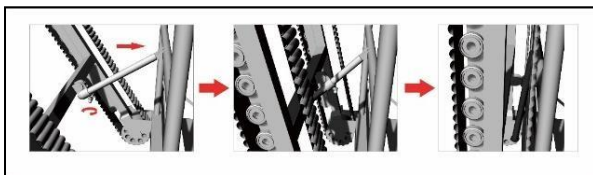


**Figure 7** Illustration of Operational System  
(**Source:** Author Processed Data)

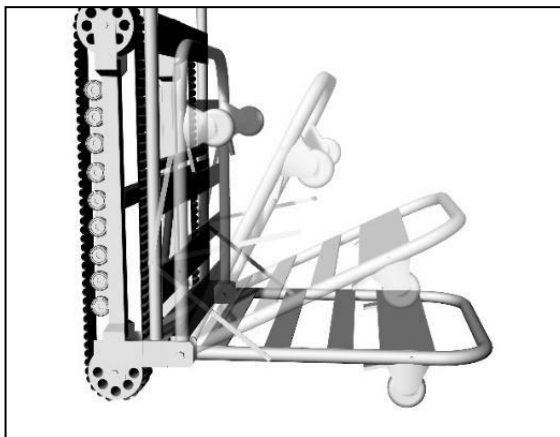


**Figure 8** Illustration of Handle System Usage

(Source : Author Processed Data)



**Figure 9** Operational Illustration Open the Rubber Wheel Cap (Source : Author Processed Data)



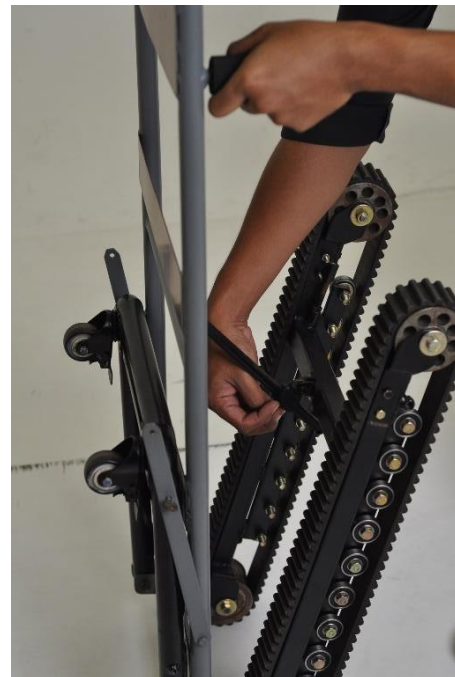
**Figure 10** Illustration of Base Frame Fold System

(Source: Author Processed Data)



**Figure 11** Product Prototype

(Source: Author documentation)



**Figure 12** Chain Link System Usage

(Source: Author documentation)



Figure 13 Folding Storage System

(Source: Author documentation)

## 4. CONCLUSION

Based on the redesign and testing of the system that has been done by the author, there are several things that can be concluded to answer the identification of problems including:

- 1) Goods transport through stairs is very helpful for the process of transporting goods for residents of the hostel which is more than 2 stories high.
- 2) Goods transport through stairs can minimize the risk of injury compared to when transporting goods manually.
- 3) The rubbertrack wheel system is very suitable for use on goods transport through stairs without any obstacles.
- 4) The stem strap strap is very suitable to be applied to keep the goods from shifting or falling when transported using goods transport through stairs.

However, this research still lacks aspects of the lock handle system and the braking aspect of the wheel. Therefore more research is needed and

collaboration with other related scientific fields can produce products that are ready for use in the community.

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