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Application of Universal Design Principles Study for the Circulation of Elderly, Disabled People, and Goods in *Rusunawa* Pesakih, Jakarta

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Abstract. Rental Low-Cost Apartment (*Rusunawa*) is a vertical residential building inhabited by many people from various backgrounds. There are elderly and people with disabilities who use wheelchairs. Then such residents would have difficulty circulating in the building, especially vertical circulation. The vertical circulation of heavy goods is also a problem if the building has many floors and no vertical transportation facilities. The methodology used in this paper is a descriptive analysis method with Universal Design Principles as a parameter. From the analysis of the application of Universal Design Principles, a solution would be produced without changing the building on a large scale. The solution is to provide a foldable stairlift platform for the elderly and people with disabilities who use a wheelchair and add a mini freight elevator to the building.

INTRODUCTION

Rental Low-Cost Apartment (*Rusunawa*) is a vertical residential building inhabited by many people from various backgrounds. Among the residents of the *Rusunawa*, it is possible that there are elderly and people with disabilities who use wheelchairs. Then such residents would have difficulty circulating in the building, especially vertical circulation. In the *Rusunawa* Pesakih building, which does not have an elevator, it is necessary to find a solution. The solution so that they can circulate vertically, safely and comfortably. Another problem at building with multiple levels is the vertical circulation of heavy and oversized goods. Not everyone can carry heavy items from the ground floor to the upper floor. As quoted from Antaranews.com, carrying gallons of water requires a lot of effort and money in this *Rusunawa*. The higher the residential floor, the more expensive the transportation service fee. So, the tools for transporting goods are needed in these buildings with no elevator service.

The benefits of this study are; 1) Identifying the application of Universal Design Principles to the *Rusunawa* Pesakih building, especially in the circulation of the elderly, persons with disabilities and goods; 2) Finding solutions to problems with the circulation of the elderly, disabled and goods in *Rusunawa* Pesakih.

MATERIAL AND METHOD

Theoretical Review

Apartment or *Rusun,* according to *Undang-Undang Nomor 20 Tahun 2011*, are multi-storey buildings, each part of which can be owned and used separately, especially for residential areas [1]. This type of housing is built to facilitate residents who do not have a house or live in an inappropriate environment [2]. *Rusun* is a solution for settlements in urban areas because it can increase the efficiency and effectiveness of space utilization [3]. This vertical building also helps save the land from green open spaces or public spaces [3].

Buildings with Universal Design concepts must occupy all the needs of their users of various ages, abilities, and statuses. Buildings can be accessed easily without obstacles (barrier-free design) by everyone [4]. Including the elderly and people with disabilities who use wheelchairs, they need guarantees for independence in their lives [5]. Persons with disabilities have physical, cognitive, mental, and emotional limitations [6]. In the application of the Universal Design Principles, there are seven principles: 1) Equitable Use; 2) Flexibility in Use; 3) Simple and Intuitive Use; 4) Perceptible Information; 5) Tolerance for Errors; 6) Low Physical Effort; 7) Size and Space for Approach and Use [7]. Not all rooms in a building must be accessible, but only the essential parts [8].

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In this paper, we will focus on studies based on the principles of Equitable Use, Low Physical Effort, and Size and Space for Approach and Use [7]. These three principles are related to human circulation in buildings. The elderly and people with disabilities need special attention because of their limited mobility. The circulation of goods would be studied using the principle of Low Physical Effort. The principle of Equitable use emphasizes that a design must be helpful and can be used by all people with various abilities. Buildings used by the public are universally accessible [7].

A design that applies the principle of Low Physical Effort can be used comfortably efficiently and does not cause severe fatigue. This principle is needed because the elderly are getting older, which decreases physical abilities, and moving heavy objects from the first floor to the top floor requires much energy. The principle of size and space for approach and use emphasizes that the size of the designed space is appropriate to be reached and used by various postures, body sizes, and mobility abilities [7]. The dimensions of the tools are considered in determining the size of the room [9].

Elderly as they get older experience several challenges, such as stress, physical and emotional. This makes them unable to move freely and carry out daily activities [7]. The building is designed with the flexibility to accommodate various user needs and preferences [10]. Buildings that apply this principle can be used for a long time because of the users' demographic (age) housing [7]. The Universal Design Principles of Building aim to remove barriers and ensure the accessibility of all individuals, including people with disability or the elderly [11]. Accessibility is essential in design aimed at humans in the built environment [12].

Research Methodology

The method used in this paper is the descriptive analysis method. The descriptive analysis method describes the research object through its data [13]. The descriptive analysis in this paper would use the Universal Design Principles [7] as a parameter. The discussion in this paper should be divided into two sections; 1) Vertical circulation of the elderly and persons with disabilities; 2) Vertical circulation of goods. The first discussion in Universal Design Principles would use the principles of Equitable Use, Low Physical Effort, and Size and Space for Approach and Use. The second discussion would use size and space for approach and use.

Prior Research

Prior research on circulation and existing evacuation routes is as follows (Table 1).

TABLE I. Prior Research

No	Title	Description	Source
1	Penerapan Aspek Efisiensi Terhadap Sirkulasi Rumah Susun Pasar Rumput	Analysis of apartment corridors from corridors to residential units.	Seminar Nasional Cendekiawan ke 4, Tahun 2018, Buku 1 [14]
2	Evaluasi Persepsi Penghuni Terhadap Kondisi Fisik Jalur Evakuasi di Bangunan Rusun Pesakih	Perception analysis of emergency evacuation routes in *Rusunawa* Pesakih.	Vitruvian Jurnal Arsitektur, Bangunan & Lingkungan, Vol. 9, No. 3, 2020 [15]
3	Live-Work Housing Concept for Rusunawa in Indonesia: Is it Possible?	Analysis of users and economic activities in Rusunawa Pesakih	Journal of Regional and City Planning, Vol. 31, No. 2 [16]

Based on the previous research above, this paper focuses on describing the facilities of the *Rusunawa* Pesakih building for the vertical circulation of residents of various ages, especially for the elderly, people with disabilities (disabled people), and goods.

Case Study

Rusunawa Pesakih is located on Daan Mogot Street, Duri Kosambi, Cengkareng, West Jakarta, DKI Jakarta (Figure 1).

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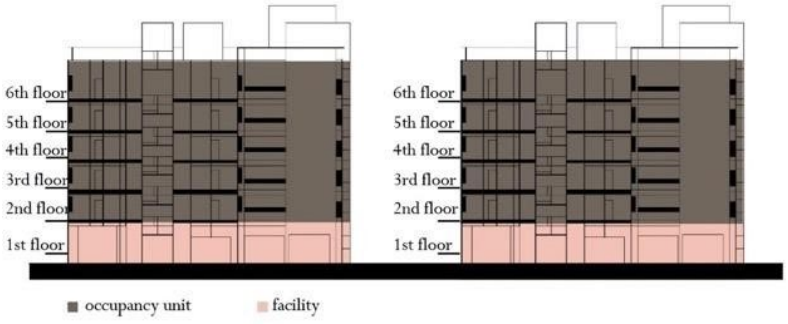
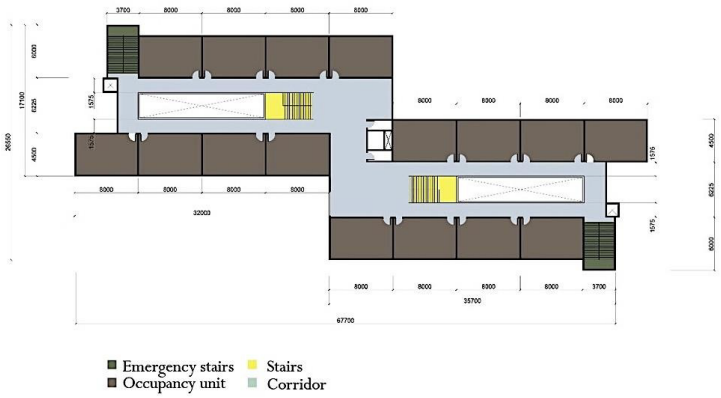
FIGURE 1. *Rusunawa* Pesakih Location.
Source: Google Earth, accessed on: 20-11-2021

The *Rusunawa* Pesakih complex has 8 low-rise building towers, with 80 residential units in each block. The *Rusunawa* Pesakih building has 6 floors (Figure 2a). The 1st floor is used as the public area floor in parking, commercial, and building facilities. The floors of the residential units are on floors 2nd – 6th, with a total of 16 residential units per floor (Figure 2b). In this paper, we should focus on block F of *Rusunawa* Pesakih.



(a)



(b)

FIGURE 2. (a) *Rusunawa* pesakih building section; (b) Residential floor *Rusunawa* Pesakih plan.
Source: Live-work housing concept for *Rusunawa* in Indonesia: Is it possible? [16]

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RESULT AND DISCUSSION

Vertical Circulation for The Elderly and Disabled People (Using a Wheelchairs)

The Pesakih *Rusunawa* building is not accessible to disabled persons who use wheelchairs [15]. So, this paper should discuss the issue of accessibility for persons with disabilities and the elderly (Figure 3a and 3b) and the accessibility of residents in moving goods vertically (Figure 3c) using Universal Design Principles.

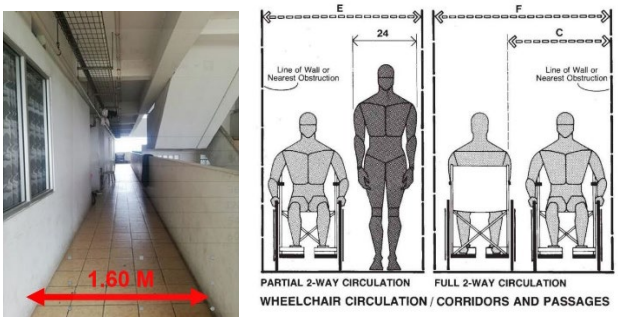
(a) (b) (c)

FIGURE 3. (a) Illustration of elderly having difficulty climbing stairs; (b) People with disabilities cannot climb stairs; (c) People climbing stairs carrying things.
Source: (a) https://www.dreamstime.com/photos-images/elderly-walker-stairs.html, accessed on: 21-11-2021; (b) https://www.merdeka.com/peristiwa/masjid-baiturrahman-banda-aceh-dinilai-tak-ramah-untuk-disabilitas.html, accessed on: 21-11-2021; (c) https://repository.uin-suska.ac.id/3550/2/BAB%20I.pdf, accessed on: 21-11-2021

The equitable use principle in the Universal Design Principles leads to the fair *in* use. This means that the *Rusunawa* Pesakih building must be accessible to everyone with various physical abilities, including the elderly and people with disabilities. Accessible roads should not have height differences, stairs, or escalators [12].

There is a discrepancy with applying the principle of Equitable use in residential areas on floors 2-6. The discrepancy is found in the access to vertical circulation in this building. *Rusunawa* Pesakih building does not have an elevator for vertical transportation. The *Rusunawa* building only has four stairs in each block (Figure 2b) as the only access for vertical circulation. For people with disabilities who need a wheelchair, stairs are like a barrier. The elderly who can still walk can still circulate vertically. But people with disabilities who use wheelchairs cannot go up through stairs (Figure 3b). The principle of Equitable use in the circulation of the elderly and people with disabilities is not achieved in the *Rusunawa* Pesakih building.

The principle of size and space for approach and use can be achieved if the building can be accessed by individuals with various sizes, body postures, and standards of space required for each human being. Individuals with mobility aids require more space than ordinary people. The residential units in this building have direct access with a single-loaded corridor 160 cm wide (Figure 4a) [15]. By the way, the standard corridor size for a two-way wheelchair is 152.4 cm (Figure 4b); So, the size of the corridor allows wheelchair users to circulate. The *Rusunawa* Pesakih building has complied with the principles of size and space for approach and use in the Universal Design Principles.



in	cm
30	76.2
24	61.0
36	91.4
120	304.8
54	137.2
60	152.4

(a) (b)

FIGURE 4. (a) Second-floor corridor width; (b) Corridor size standard for wheelchairs
Source: (a) Evaluation of occupants' perceptions of the physical condition of the evacuation route in the *Rusunawa* Pesakih [15]; (b) Human dimension & interior space [17]

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The Low Physical Effort principle's application emphasizes practical buildings and does not cause severe fatigue for the users. In the case of *Rusunawa* Pesakih, which has 6 floors, there are only stairs as the only access for vertical circulation of the building. All residential units are located on the second floor to the sixth floor, so vertical access is essential. For ordinary people, circulating by stairs does not cause severe fatigue. But for the elderly, it would cause severe fatigue because of the decrease in physical ability with age (Figure 3a). People with disabilities with mobility aids (wheelchairs) would also have difficulty.

To solve the problem of accessibility of the elderly and persons with disabilities from the ground floor to the upper floor (residential unit), the author proposes the construction of a foldable staircase platform (Figures 5d). The Stairlift foldable platform is used by the elderly and people with disabilities who have difficulty climbing stairs as vertical transportation facilities. This solution was chosen because the installation in the building does not make significant changes to the building in line with universal design principles. This platform is mounted on a stair in the middle of this building (Figure 5a). This aims to make the service radius area evenly distributed so that the distance to reach each residential unit is not too far (application of the Low Physical Effort principle). The placement decision was because the ground floor was closest to the lobby (main entrance of the building) and the parking area. The choice of the Stairlift foldable platform is because it can be folded when it doesn't in used (Figures 6a, 6b, and 6c).

The Foldable Stairlift Platform dimension is 750 x 700 mm (figure 5b). So it can fit with these *rusunawa* buildings. This stair has met the standard Stairlift installation size because it has a stair width of 120 cm and a turning radius of 57 cm for the stairlift rail. The minimum requirements for this stairlift type must have a minimum stair width of 97.5 cm and a 100 cm turning radius [18]. The rail of the stairlift platform will install at stair bricks wall railing with a wall fastening system (figure 5d).

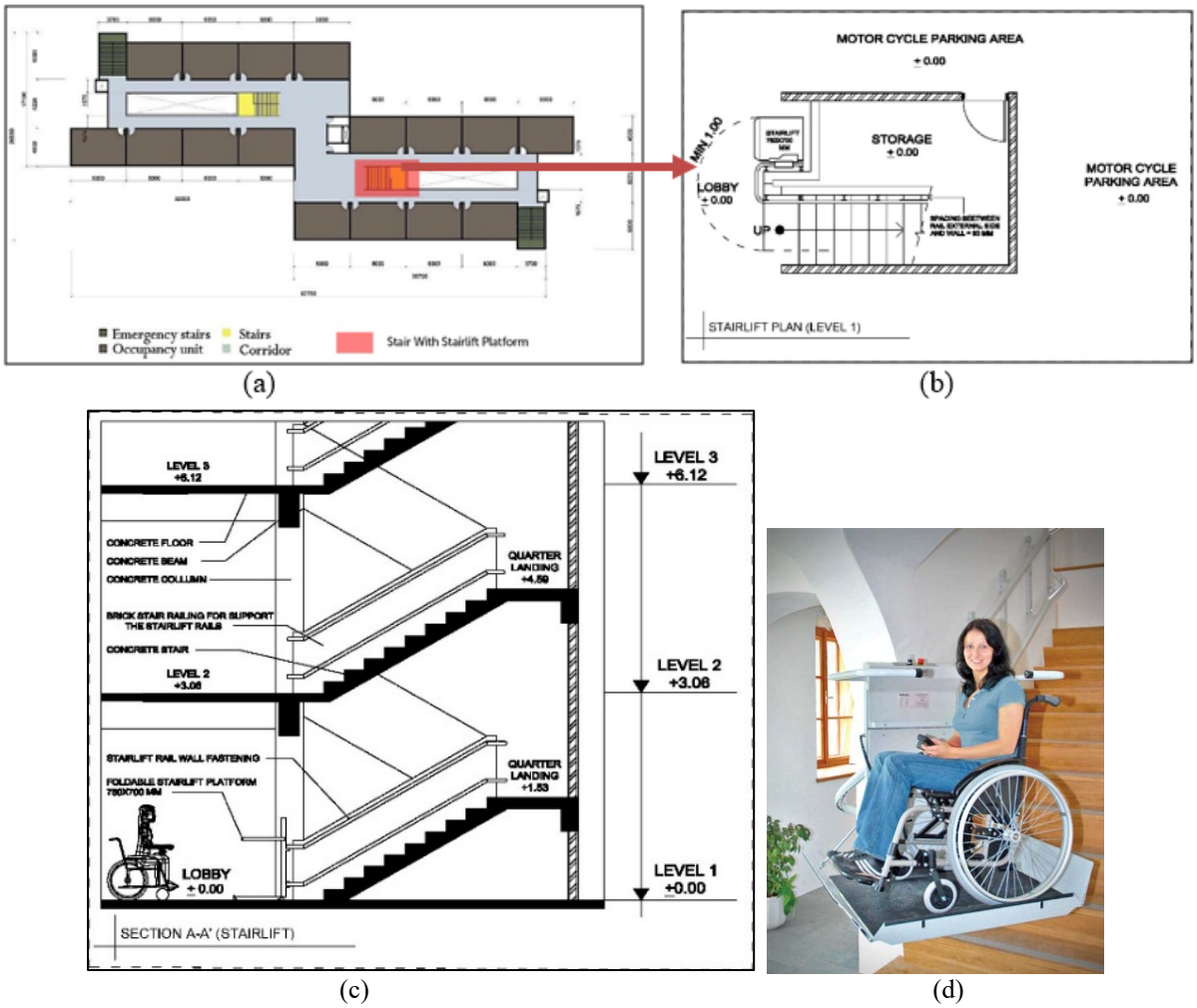

FIGURE 5. (a) Stairlift foldable platform plan, (b) Ground floor stairlift plan (c) Section of stairlift plan (A-A') Source: (a) Live-work housing concept for *Rusunawa* in Indonesia: Is it possible? [16], (b&c) Author, 2021, (d) https://vlt-eng.com/stairlift-platform-lift/, accessed on: 16-03-2022

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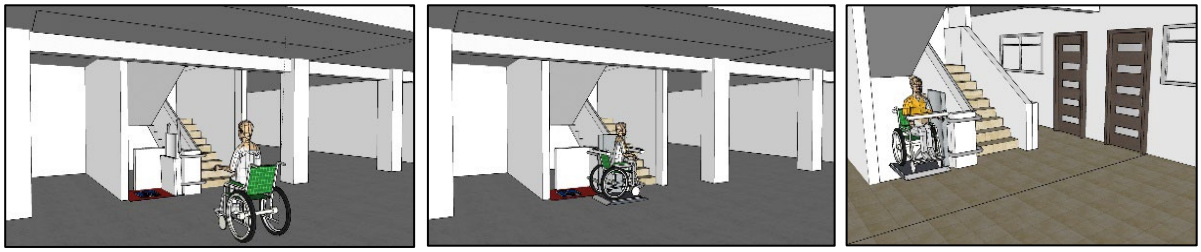


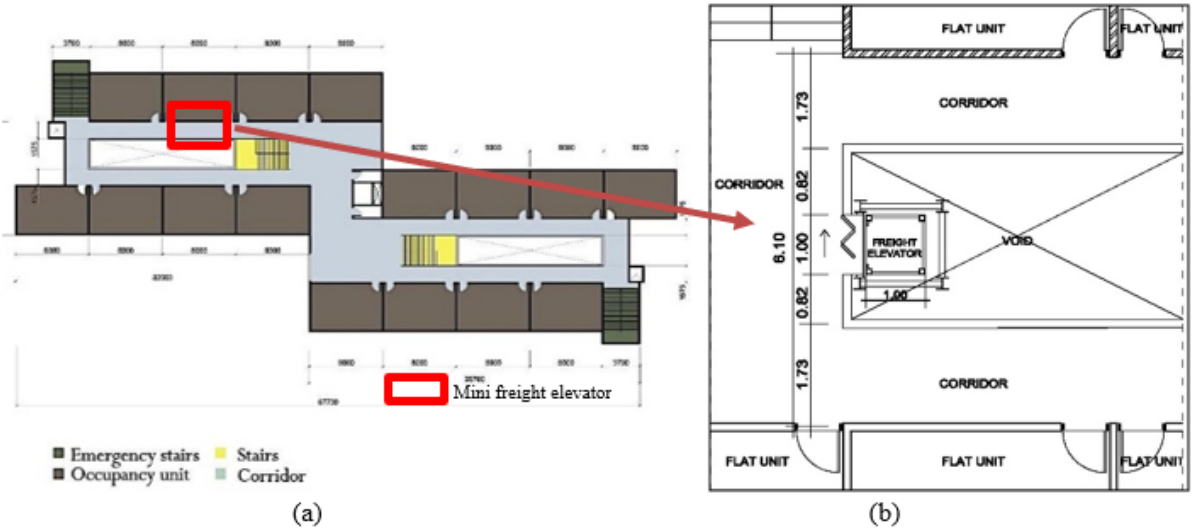
(a) (b) (c)

FIGURE 6. (a) Stairlift foldable platform be parked at ground floor; (b) Wheelchair user is using the stairlift; (c) Wheelchair go to the second floor
Source: Author, 2021

Vertical Circulation for Goods

Carrying goods from the ground floor to the residential floor above requires a significant effort. Not everyone can carry heavy goods while climbing stairs. An example of a case quoted from the Antaranews.com website is that the occupants have difficulty carrying drinking water gallons from the ground floor to the residential floor above, requiring a large amount of effort and cost [19]. The higher the floor, the higher the delivery cost. So, according to the universal design principle, this is not appropriate because it bothers the residents' activities. So that the absence of vertical transportation is not a solution to save costs, but it can add unexpected costs. In the application of this principle, must pay attention to the long term into the future. Residents who used to be young would get older and healthy people can get sick. Buildings that comply with the universal design principle can anticipate this. So, it is necessary to add a tool for vertical circulation for goods in the *Rusunawa* Pesakih building.

The problem of transporting goods from the ground floor to the residential floor can use the mini freight elevator (figure 7d). The elevator car dimension is 100 x 100 x 170 cm and is proposed to have a capacity of 250 kg. It's big enough to carry up to 10 gallons of drinking water or large enough to bring a two-door refrigerator. A freight elevator that is separated from the main structure of the building to easy assembly process (Figures 7b and 7c) [20]. The freight elevator will use WF and hollow steel for the structure. Elevator placed in the void (atrium) of the building (figure 7a). Using an elevator would save the cost of delivering heavy goods from the ground floor. But this elevator is only for goods, considering the safety factor. Place mini freight elevators on the first floor closest to the commercial area in the building area. The close placement would make the circulation of goods more energy efficient (Figure 7c).



(a) (b)

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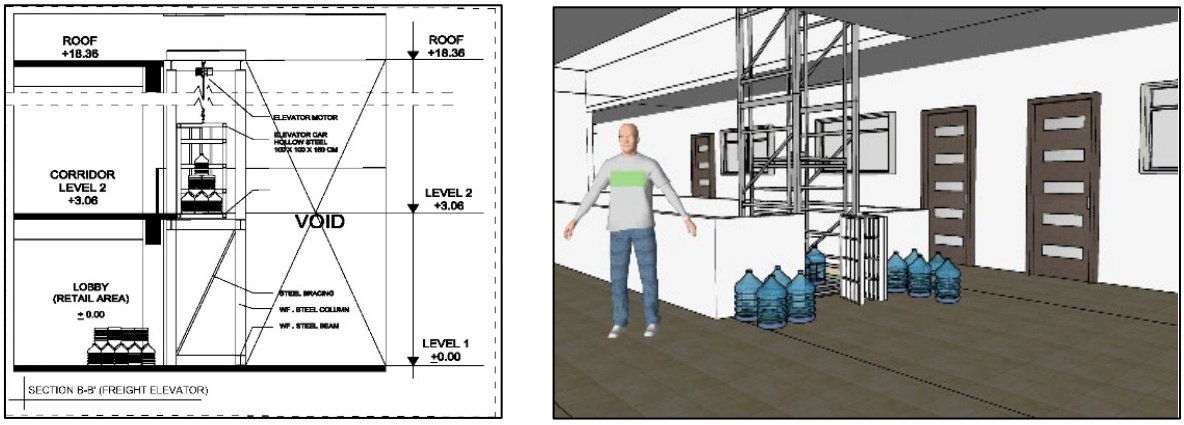

(c) (d)

FIGURE 7. (a) Mini freight elevator key plan; (b) Mini freight elevator on second floor plan; (c) Mini freight elevator section; (d) Mini freight elevator interior perspective
Source: (a) Live-work housing concept for *Rusunawa* in Indonesia: Is it possible? [16];
(b, c, and d) Author, 2021

CONCLUSION

The *Rusunawa* Pesakih building has not applied the Universal Design Principles. The Vertical circulation of the elderly and people with disabilities have not been according to Equitable Use and Low Physical Effort principles. Only the principle of size and space for approach and use has been fulfilled. So, a solution is to install a foldable stairlift platform on the building stairs as vertical transportation for the elderly and people with disabilities who use wheelchairs. The circulation of goods in the *Rusunawa* Pesakih building has not been according to Low Physical Effort principles. Then a specific vertical transportation tool is needed for goods. The solution is given a mini goods lift in the void area of the building.

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