

# The Role of Building Adaptation on Sustainability in Indonesia: A Literature Review

Jarwa Prasetya Sih Handoko

Department of Architecture, Faculty of Civil Engineering and Planning, University Islam Indonesia, Yogyakarta, Indonesia

**Email address:**

jarwa.prasetya@uii.ac.id

**To cite this article:**

Jarwa Prasetya Sih Handoko. (2024). The Role of Building Adaptation on Sustainability in Indonesia: A Literature Review. *International Journal of Architecture, Arts, and Applications*, 10(1), 1-8. <https://doi.org/10.11648/j.ijaaa.20241001.11>

**Received:** December 17, 2023; **Accepted:** January 2, 2024; **Published:** January 18, 2024

---

**Abstract:** This paper presents the role of building adaptation on sustainability in Indonesia. This paper was encouraged by the population growth in the community that pressures the availability of new building stocks to meet community needs. One of the steps to fulfill these needs can be adapting the existing building into a function following today's needs. Many building owners select building adaptation to provide new facilities as it has numerous advantages over new buildings. One of which is calculated as a step that fulfills the sustainability aspect. In addition to the problem of the rising population in urban areas today, there is also a phenomenon of high vacancy rates or buildings that are not employed due to several causes. Such as low building comfort and the incompatibility of building functions with community needs, encouraging the growing number of building owners to adapt their buildings so they can operate again. Thus, it is essential to investigate the extent of adapting existing buildings to contribute to a more sustainable built environment. Furthermore, it is expected that after a study has been conducted on the role of adapting and realizing sustainability. This study examines the role of building adaptation in obtaining sustainability in our built environment, especially in Indonesia as a developing country. Besides that, it looks at how to adapt buildings to overcome housing procurement problems related to sustainable development in Indonesia. The expected findings from this study define building adaptation's role in realizing the concept of sustainability in the built environment, especially in housing procurement in Indonesia as a developing country. This study uses a literature review approach with a content comparison analysis as an empirical method. This study examines secondary data obtained from several references, scientific journals, and books that discuss the relationship between building adaptation and the concept of sustainability, in addition to reviewing papers related to housing problems in developing countries, including Indonesia, as material for discussion. Thus, understanding the role of building adaptation in providing new facilities in realizing sustainability in developing countries, including Indonesia, is essential. From this research, it can be concluded that Building Adaptation in Sustainability is associated with building adaptation to realize three aspects or dimensions of sustainability: environmental, economic, and social. Adaptation of buildings can be a solution to problems in housing procurement in Indonesia, considering economic, social, and environmental conditions around the dwelling.

**Keywords:** The Role, Building Adaptation, Sustainability, Indonesia

---

## 1. Introduction

Population growth in the community puts pressure on the availability of new building stocks to fulfill the community's needs. The need can be obtained by constructing new buildings, dismantling existing buildings, or adapting existing ones to suit current needs. In addition to the problem of the rising population in urban areas today, there is also a phenomenon of high vacancy rates or buildings that are not utilized due to several causes.

This is especially the case in urban areas in developing

countries, including Indonesia, where there are several problems related to the background of the condition of the people and related to the housing problems that have been built. There are the limited economic conditions of the community in general in the procurement of self-help housing, little land owned by the community, and the high population density in an urban area. This condition makes it difficult to meet the need for sustainable housing by building new housing, which costs more. Therefore, it is this reason that makes an exciting building adaptation to be realized. In addition to the increasing community population, the rising

construction cost for procuring new buildings motivates the adaptation of existing buildings to meet buildings with new functions according to current needs. The age of the existing building and the quality of the available building stock in an area can affect the number and scope of the building adaptation measures implemented. Hence, their buildings can operate again. Moreover, vacant buildings are more susceptible to vandalism, the encroachment of which raises maintenance costs. In the long term, the impact of the vacuum may cause social ills and economic decline for the people in the region.

In established cities, especially in developing countries, the average building age is still higher; a small percentage of new buildings are completed to the existing building stock each year. Adaptation mostly dominates the facilities to use existing buildings [31]. It further broadens the scope of the need to adapt the existing stock to fulfill the needs of current and future investors and building users, thereby generating further opportunities to adapt buildings. There are three adaptation strategies encompassing adaptation by reaction, adaptation by adjustment, and adaptation by withdrawal [4]. The community that responds by adapting the building is an adaptation-by-reaction effort. The response by changing the building's capacity to accommodate the evolving demands of the context can effectively maximize the value through life [26]. It can be in the form of changes in function, capacity, or building performance [31].

Adapting existing buildings can help contribute to a more sustainable built environment. Thus, it is necessary to examine the role of adapting and acquiring sustainability in our built environment. This study investigated secondary data from several references and scientific journals, discussing the relationship between building adaptation and sustainability. Therefore, an understanding is acquired regarding the role of building adaptation in providing new facilities and realizing sustainability, especially in Indonesia as a developing country. Besides that, it examines how to adapt buildings to overcome housing procurement problems related to sustainable development in Indonesia.

The expected findings from this study define building adaptation's role in realizing the concept of sustainability in the built environment, especially in housing procurement in Indonesia as a developing country. As a housing procurement solution that applies the concept of sustainability. Furthermore, it is expected that after a study on the role of building adaptation in realizing sustainability was compiled, we were able to overcome various environmental, economic, and social sustainability challenges, which are by optimizing the adaptation of buildings in providing new facilities in a built environment, without having to create a new building from scratch.

## 2. Method

The objective of this research is to construct the role of building adaptation in the sustainability concept and how building adaptation possesses a role in realizing the sustainability concept in the built environment, particularly in

making the building provision for current new activities. This study implemented a literature review on the role of building adaptation in sustainability. The sustainability concept encompasses environmental, economic, and socio-cultural aspects and is identified as Elkington's Triple Bottom Line (TBL) theory [13]. This research employed various published sources such as journal articles, proceedings papers, and other related materials. The study administered qualitative comparison-content analysis techniques by using secondary data. Content analysis is research that provides an in-depth discussion of the contents of the written or printed information by implementing secondary data.

## 3. Literature Review

### 3.1. Building Adaptability and Adaptability

Adaptability is the capacity to adopt and adapt to changes by conducting various uses, enabling different spatial configurations, being coherent with socio-cultural trends and environmental changes, and updating technology without significant disruption [22]. In the context of the building, adaptation is a term that has been extensively interpreted and defined by many researchers [12, 6]. Adaptation of buildings comes from the Latin 'ad' (to) and 'capture' (fit), which is obtained to incorporate any work on the maintenance of a building to change its capacity, function, or performance. In other words, any intervention to adapt, reuse, or enhance a building to suit the new conditions and requirements [12]. Generally, the definition refers to 'change of use, maximum 'retention' of the original building structure, and extending the useful life of the property [6]. Building adaptation occurs 'within use' and 'across the use,' meaning, for instance, that an office can adapt and still be employed as an office (adaptation in use), or it can change the use into housing (adaptation between uses) [30].

### 3.2. Triple Bottom Line (TBL) Theory of Sustainability

Triple bottom line (TBL) accounting expands the traditional reporting framework, considering social and environmental performance and financial performance. The Triple Bottom Line comprises social equity and economic and environmental factors. The phrase "people, planet, and profit" to demonstrate the triple bottom line and the goal of sustainability was invented by John Elkington in 1994 while at Sustainability [13].

## 4. Results and Discussion

### 4.1. The Role of Building Adaptation on Sustainability

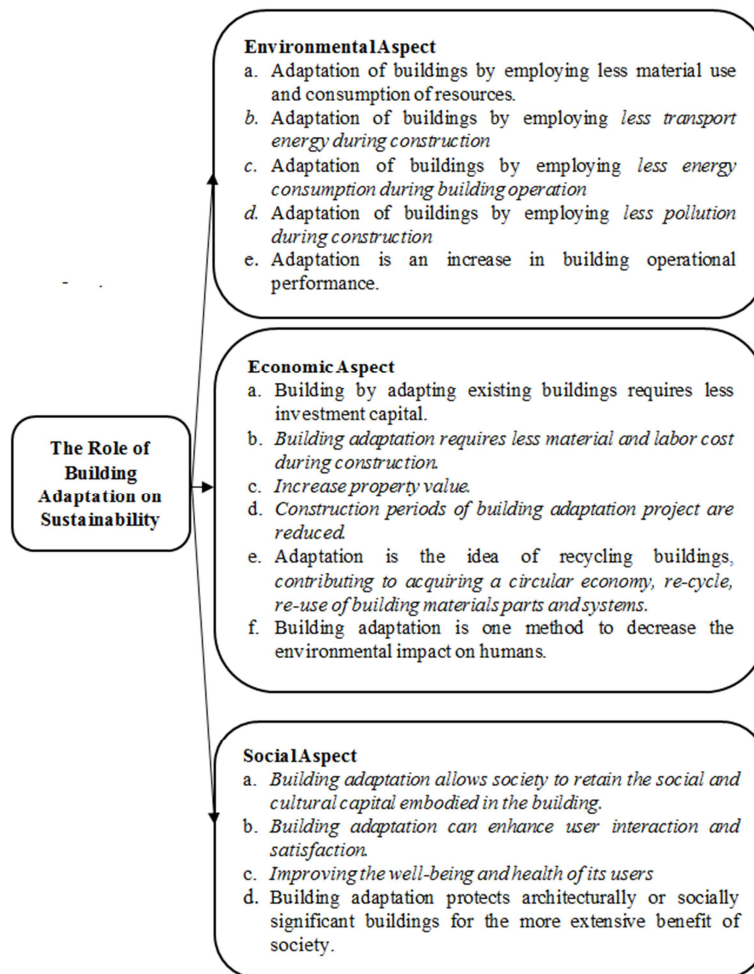
The role of building adaptation is divided into three aspects of sustainability, namely the environmental aspect, economic aspect, and social aspect. The three sustainability aspects refer to the triple bottom line concept from John Elkington [13] and the sustainability concept based on the Brundtland Report document. The reference material on the

role of building adaptation in sustainability, which consists of these three aspects, is mentioned in Table 1.

**Table 1.** The Role of Building Adaptation on Sustainability.

No.	Sustainability Aspect	The Role of Building Adaptation Associated with Sustainability	Reference
1.	Environmental Aspect	a. Adaptation of buildings by employing less material use and consumption of resources	[19, 6, 12]
		b. Adaptation of buildings by employing less transport energy during construction	[19, 6, 31]
		c. Adaptation of buildings by employing less energy consumption during building operation	[19, 6, 11]
		d. Adaptation of buildings by employing less pollution during construction	[19, 6, 23]
		e. Adaptation is an increase in building operational performance.	[25]
2.	Economical Aspect	a. Building by adapting existing buildings requires less investment capital.	[17, 12, 3]
		b. Building adaptation requires less material and labor costs during construction.	[17, 12, 18]
		c. Increasing property value	[17, 9, 35, 34, 8, 3, 28, 20, 21]
		d. Construction periods of building adaptation projects are decreased	[17]
		e. Adaptation is the idea of recycling buildings. Contributing to acquiring a circular economy, recycling, and reusing building materials, parts, and systems.	[2, 3, 10, 21, 27]
3.	Social Aspect	f. Building adaptation is one method to decrease the environmental impact on humans.	[31, 6, 3]
		g. Adaptation extends the life of the whole building.	[25, 15]
		a. Building adaptation allows society to retain the social and cultural capital embodied in the building.	[5, 6, 31]
		b. Building adaptation can enhance user interaction and satisfaction (reinforcing working or living conditions)	[3, 31, 12, 14]
		c. Improving the well-being and health of its users.	[31, 6, 24]
		d. Building adaptation protects architecturally or socially significant buildings for the more extensive benefit of society.	[3, 7]

The explanation for each role of building adaptation, which consists of three aspects of sustainability, is explained in the figure and description below:



**Figure 1.** The Role of Building Adaptation on Sustainability.

### 1) Environmental Aspect

- a. Adaptation of buildings by employing less material use and consumption of resources.

Adaptation is inherently sustainable as it requires less material use, less transport energy, less energy consumption, and less pollution during construction [19, 6]. Adaptation in older industrial areas and working-class sub-urbs is a trend that limits urban sprawl, stabilizes the requirement for using concrete and other materials, and reduces material flows associated with building construction [12].

- b. *Adaptation of buildings by employing less transport energy during construction*

The benefits for owners or tenants are lower energy costs, reduced impact of future emission trading schemes, reduced emissions, reduced obsolescence, sound risk management strategy, more competitive buildings, enhanced capital value, and high rental growth [31]. Adaptation is inherently sustainable as it incorporates less material use, less transport energy, less energy consumption, and less pollution during construction [19, 6].

- c. *Adaptation of buildings by employing less energy consumption during building operation*

Adaptation is inherently sustainable, requiring less transport energy and energy consumption [19, 6]. The most significant environmental impact of buildings is the greenhouse gas emissions associated with energy use [12].

- d. Adaptation of buildings by employing less pollution during construction

Adaptation is inherently sustainable, requiring less construction pollution [19, 6].

- e. Adaptation is an increase in building operational performance.

Building stock is a crucial resource that needs to be appropriately managed to be sustainable - as all urban areas experience problems associated with poor use of buildings and high flows of energy and materials [25].

### 2) Economic Aspect

Elkington's third component of sustainability is economic sustainability [13].

- a. Building by adapting existing buildings requires less investment capital.

Building adaptations are more economical than demolishing and making new ones [17, 12]. A Study in Stoke-on-Trent in the UK concluded that adaptation was the cheapest option [3].

- b. Building adaptation requires less material and labor costs during construction.

Maintenance and cost of adapting existing building conditions compared to cost savings [18]. Cost is a robust driver for adaptation. A 2250 UK Projects 2005 study revealed that adaptation costs were around 66% of new buildings [12].

- c. Increase property value.

Properties with high plot ratios work favorably with reuse as higher profits are delivered because higher development densities are performed [17]. Adaptation can increase property value and is a robust driver [9, 35, 34]. Owners adapt to

elevate rental returns [8]. Adapted buildings possess lower vacancy rates in adapted buildings compared to non-adapted stock [3].

- d. Construction periods of building adaptation projects are reduced.

Construction periods of building adaptation projects are decreased because less or no demolition is conducted, reducing the financing cost [17].

- e. Adaptation is the idea of recycling buildings, contributing to acquiring a circular economy, recycling, and re-using building materials, parts, and systems.

Adapting existing buildings and recycling buildings are the most critical aspects in enhancing the sustainability of the built environment [2, 3, 10]. Advancing the performance of the existing buildings through adaptation may be the most crucial aspect of expanding the sustainability of the built environment. Adaptability can be perceived to decrease the amount of new construction (reduce), reactivate the stock of buildings that are less utilized or empty (reuse), and increase the dismantling/de-construction of components (reuse, recycle) [21, 27].

- a. Building adaptation is one method to decrease the environmental impact on humans.

Adaptation of buildings utilizes, conserves, and enhances community resources. Adaptation is an opportunity to decrease water consumption by adopting measures that reduce consumption at the point of use, recycling, harvesting rainwater, reusing water, and increasing sustainability [31]. Acid rain pollution causing erosion of stone is a crucial aspect of the environment associated with sustainability [6]. Acid rain pollution is affected by prevailing wind patterns and affects some countries, whereby deposits are performed across national borders and deposited onto building facades during rainfall [31]. Furthermore, adverse environmental impacts during construction include excessive noise, dust, and dirt [3].

- b. Adaptation extends the life of the whole building.

More efficient uses of space-adapted buildings tend to employ the same amount of space and materials more efficiently, on average, over their lifetime. A sustainable building does not have to last forever but can quickly adapt to change. Thus, creating a more sustainable environment can be coupled with adaptable design strategies that result in flexibility in the building and allow various changes to accommodate [25, 15].

### 3) Social Aspect

Social aspect or social sustainability is a paramount component of Elkington's Triple Bottom Line (TBL) Theory [13].

- a. Building adaptation allows society to retain the social and cultural capital embodied in the building.

Adaptation allows society to retain the social and cultural capital embodied in the building. Adaptation can be part of urban regeneration with aspirations that future generations obtain from the protection of structures [5, 6]. Adaptation is perceived as a pivotal part of sustainable development, which

lends identity to city districts by accessing local history [31].

- b. Building adaptation can enhance user interaction and satisfaction.

Adaptation of buildings within urban regeneration projects delivers social goals such as social housing or employment opportunities in areas of high unemployment [3]. The adaptability of a building universally refers to the capacity of a building to accommodate changing needs in the future. Most buildings are rebuilt during their life cycle to fulfill legal and technical requirements, fulfilling the changing societal needs [14].

- c. Improving the well-being and health of its users

A social argument against adaptation is the standards required by contemporary buildings. Users cannot adapt to the existing stock; in some cases, indoor air quality and thermal and acoustic performance requirements cannot be fulfilled [6]. User expectations of building quality, particularly initial environment quality, accelerate over time [24]. Compliance with performance standards varies depending on the physical form of the building adapted and the required end use [6].

- d. Building adaptation protects architecturally or socially significant buildings for the more extensive benefit of society.

Historic listing protects architecturally or socially significant buildings for the more comprehensive benefit of society [3] and as an element of social sustainability. Each project involved building adaptation as a component of immense regeneration of areas suffering social and economic blight if these high-profile projects' social goals promise significant positive social impact [5].

The word "sustainability" and the phrase "Sustainable Architecture" are more prevalent than in 1987 after the first consensus was obtained between countries on sustainable development under the auspices of the World Commission on Environment and Development (WCED), acknowledged as the Brundtland Report [33]. Sustainable development fulfills the needs of the present without compromising the ability of future generations to meet their own needs [33].

Sustainable architecture is designed to decrease this material and energy consumption. Building construction consumes a lot of energy and materials. If a building not only serves the purpose of the present but can also fulfill the needs of the future to some extent, a lot of energy and materials can be saved. Therefore, the biggest challenges in architecture are rapidly changing requirements and changes. Buildings require flexible structures and flexible spatial configurations to fulfill rapidly evolving demands. Sustainable buildings do not last forever but adapt to different conditions [15]. Sustainability is an illusion if a building does not support changes and reuse [11].

#### **4.2. Housing Procurement Problems in Indonesia**

The studies conducted with case studies of urban housing procurement in Indonesia found several housing procurement problems that were also found in other developing countries. Several housing procurement problems, namely [29]:

Problems of occupant comfort and safety are often found in urban housing. In the orderly development of the city, there

are problems related to the comfort and safety of housing in housing procurement.

The road pattern does not always support the existing road system; the unavailability of adequate public infrastructure and the safety and comfort of the occupants are neglected factors.

Urban regeneration is one of the foremost contemporary challenges facing human and territorial development, especially in developing countries [1]. Urban regeneration includes providing drinking water to ensure a dignified life for its inhabitants. The problem of providing clean water is related to the health level of community housing found in housing procurement in developing countries. Issues related to energy consumption in buildings, Susanti et al. [30] found that the problem of uncontrolled consumption of natural resources often occurs in housing procurement in developing countries. The growth in the use of intelligent technology is one of the efforts to control the consumption of natural resources. In addition, sporadic housing growth is also a housing problem.

The studies on housing procurement in developing countries and Indonesia studied housing procurement problems. Namely, the high level of energy consumption in residential buildings, the non-fulfillment of building comfort standards, various healthy building levels, and safety levels have not become a significant consideration in efforts to procure urban housing, Degrading Human Dignity [16].

#### **4.3. The Role of Building Adaptation on Adaptability in Indonesia**

The procurement of housing in developing countries, including Indonesia, has several problems related to the background, the condition of the people, and the housing problems that have been built. The issues described in the previous section are related to housing conditions constructed in the community. In addition to the topics mentioned above, problems or the background of community conditions become challenges in providing sustainable housing. Namely related to the limited economic conditions of the community in general in the procurement of self-help housing, little land owned by the community, especially in urban settlements, and the high population density in an area. It is a problem and challenges to procure housing in developing countries, including Indonesia. From the background conditions of urban communities in developing countries mentioned above, it becomes difficult to build new buildings to create sustainable residential buildings, so adapting old buildings to better functions and performance is a solution to the problem of housing procurement in urban developing countries.

Building adaptation calculates new economic life for the existing buildings, which are no longer under the times regarding fulfilling the need for further activity spaces with lower construction costs compared to building new ones by dismantling old buildings. Furthermore, it can also revive existing buildings with good structural conditions to optimize their life cycle. The adaptation of buildings created by the community causes them to enhance the suitability of building functions required today in the rapid development of their

environment. The existing developments do not erode them but can adapt and survive economically and socially.

The problems found in several studies carried out in Indonesia, especially research related to the provision of self-help public housing, require solutions to the background of the condition of the community. Building adaptation actions can be taken to improve the performance of existing residential buildings without having to build new housing from scratch. Building adaptation requires a lower cost than creating a new one so that with the limited economic conditions of the occupants, repairs and improvements to the

quality of housing can be realized. Below is a table showing the housing conditions in urban settlements in developing countries, including Indonesia. The suitability between the role of building adaptation characteristics and the problem of sustainable housing procurement in Indonesia illustrates the role of adapting and realizing sustainable housing development in Indonesia, especially in the housing provision for urban communities.

The role of building adaptation on sustainability in Indonesia is shown in the table below:

**Table 2.** *The Role of Building Adaptation on Sustainability in Indonesia.*

<b>Role of Building Adaptation on Sustainability</b>	<b>Housing conditions in urban settlements in developing countries, including Indonesia.</b>
Environmental Aspects	
Adaptation of buildings by employing less material use and consumption of resources	Occupancy in urban settlements in developing countries is dominated by housing with limited economic capacity, so the concept of building adaptation fits the background conditions of urban communities in developing countries.
Adaptation of buildings by employing less transport energy during construction	The high energy consumption of residential buildings is one of the problems faced by housing in Indonesia and other developing countries. Building adaptation can be a solution to overcome this building's energy consumption problem.
Adaptation of buildings by employing less energy consumption during building operation	-
Adaptation of buildings by employing less pollution during construction	-
Adaptation is an increase in building operational performance.	Building comfort, safety, and health are still problems in housing procurement in developing countries, including Indonesia. Adapting the building can overcome these problems by requiring lower costs than building a new dwelling. Building adaptation follows the limited economic conditions of most urban communities in developing countries, including Indonesia.
Economic Aspects	
Building by adapting existing buildings requires less investment capital.	The adaptation role of existing buildings requires lower costs in its implementation following the limited economic conditions of urban communities.
Building adaptation requires less material and labor costs during construction.	-
Increase property value.	Building adaptation measures adapt to the demands of the latest needs and improve the performance of the building so that the building adaptation of the building increases in quality.
Construction periods of building adaptation projects are reduced.	Building adaptation requires a faster development time than creating a new dwelling, thus saving the necessary budget.
Adaptation is the idea of recycling buildings, contributing to acquiring a circular economy, recycling, and re-using building materials, parts, and systems.	Building adaptation allows residents to use reused or recycled materials in adapted buildings. It also extends the life of building materials, protecting the environment from excessive piles of garbage.
Building adaptation is one method to decrease the environmental impact on humans.	-
Adaptation extends the life of the whole building.	
Social Aspects	
Building adaptation allows society to retain the social and cultural capital embodied in the building.	People in developing countries have very close daily lives with local cultures or customs, both individual and communal. Adapting the building allows the adjustment of residential conditions while maintaining the previous habits.
Building adaptation can enhance user interaction and satisfaction.	With building adaptation, the community can survive and follow the development of the progress of their residential area without moving from place to place so that the level of occupancy satisfaction also increases.
Improving the well-being and health of its users.	With the adaptations, the community can improve designs that are less healthy and insufficient for daily needs.
Building adaptation protects architecturally or socially significant buildings for the more extensive benefit of society.	Adaptation of buildings can increase the benefits of buildings and collections of residential buildings in a residential area. Limited residential land and dense housing in urban settlements in developing countries can be maintained for their existence and comfort with the concept of building adaptation.

Source: Author Analysis, 2023.

## 5. Conclusions

From the analysis, findings, and theoretical discussion, conclusions can be identified regarding the role of building

adaptation on sustainability as follows:

- 1) Environmental Aspects
  - a. Adaptation of buildings by employing less material use and consumption of resources.
  - b. Adaptation of buildings by employing less transport

energy during construction

- c. Adaptation of buildings by employing less energy consumption during building operation
- d. Adaptation of buildings by employing less pollution during construction
- e. Adaptation is an increase in building operational performance.

## 2) Economic Aspects

- a. Building by adapting existing buildings requires less investment capital.
- b. Building adaptation requires less material and labor costs during construction.
- c. Increase property value.
- d. Construction periods of building adaptation projects are reduced.
- e. Adaptation is the idea of recycling buildings, contributing to acquiring a circular economy, recycling, and re-using building materials, parts, and systems.
- f. Building adaptation is one method to decrease the environmental impact on humans.
- g. Adaptation extends the life of the whole building.

## 3) Social Aspects

- a. Building adaptation allows society to retain the social and cultural capital embodied in the building.
- b. Building adaptation can enhance user interaction and satisfaction.
- c. Improving the well-being and health of its users.
- d. Building adaptation protects architecturally or socially significant buildings for the more extensive benefit of society.

- 4) Building adaptation is significant in realizing sustainable residential development in Indonesia and developing countries. This is considering that the background conditions of urban communities in Indonesia are limited in terms of their economic conditions. Building adaptation measures improve residential conditions by the limited financial capacity of the community, limited residential land, and dense population, especially in urban areas.

## ORCID

0000-0002-4076-4844

## Conflicts of Interest

The author declares no conflicts of interest.

## References

- [1] Amado M. Wall Up: Method for the Regeneration of Settlements and Housing in The Developing World, *Sustainable Cities and Society*. 2018, 41: 22-34.
- [2] Arge, K. Adaptable Office Buildings: Theory and Practice, *Facilities*. 2005, 23(3-4), 119-127.
- [3] Ball, R. M. Re use potential and vacant industrial premises; revisiting the regeneration issue in Stoke on Trent, *Journal of Property Research*. 2002, 19, 93-110.
- [4] Berry, John, W. Cultural Ecology, and Individual Behaviour. Dalam Altman, Irvin, Wohwill, Joachim, Rapoport (Eds.), *Human Environmental and Behaviour Advances in Theory and research Volume 4*. Pergamon Press, New York. 1980.
- [5] Bromley, R. D. F., Tallon, A. R. and Thomas, C. J. City center regeneration through residential development: contributing to sustainability, *Urban Studies*. 2005, 42(13), 2407-2429.
- [6] Bullen, P. A. Adaptive reuse and sustainability of commercial buildings, *Facilities*. 2007, 25(1-2), 20-31.
- [7] Burby, R. J., Salvase, D. A. and Creed, M. Encouraging residential rehabilitation with building codes: New Jersey's Experience, *Journal of the American Planning Association*. 2006, 72(2), 183-196.
- [8] Chandler, I. *Repair and Refurbishment of modern Buildings*, London: B. T. Batsford Ltd. 1991.
- [9] Chau, K. W., Leung, A. Y. T., Yui, C. Y. and Wong, S. K. Estimating the value enhancement effects of refurbishment, *Facilities*. 2003, 21(1), 13-19.
- [10] Cooper, I. Post Occupancy Evaluation: Where are you? *Building Research Information*. 2001, 29(2), 158-163.
- [11] Croxton, W. *Disassembly and Deconstruction*, Architectural Record. 2003, p. 147.
- [12] Douglas, J. *Building Adaptation* (2<sup>nd</sup> edition), London: Elsevier. 2006.
- [13] Elkington, J. Cannibals with forks: The Triple bottom line of 21<sup>st</sup> century business, Oxford: Capstone Publishing. 1999.
- [14] Ferenias, O., Geromel, F. Adaptable Housing? A Quantitative study of contemporary apartment layouts that have been rearranged by end-users, *Journal of Housing and Built Environment*, <https://doi.org/10.1007/s10901-019-09693-9>
- [15] Graham, P. *Design for Adaptability- An Introduction to the Principles and Basic Strategies*, The Royal Australian Institute of Architects, Australia. 2005, p. 7.
- [16] Handoko, Jarwa. P. S. *Permasalahan Perumahan Mewujudkan Pembangunan Berkelanjutan (Housing Problem Realizing Sustainable Development in Indonesia)*, Arsitektura: Jurnal Ilmu Arsitektur dan Lingkungan Binaan, Vol. 20(2) October 2022.
- [17] Highfield, D. *Refurbishment and Upgrading of Buildings*, London: E&FN Spon. 2000.
- [18] Holyoake, K. and Watt, D. The Sustainable reuse of historic urban industrial buildings: interim result and discussion, in *Proceedings of COBRA*, Nottingham Trent University, UK, September 5-6. 2002.
- [19] Johnstone, I. M. An actuarial model of rehabilitation versus new housing construction, *Journal of Property Finance*. 1995, 6(3), 7-26.
- [20] Kersting, J. M. Integrating past and present: the story of a building through adaptive reuse, Master's Thesis, University of Cincinnati, OH. 2006.

- [21] Kincaid, D. (2002). *Adapting Building For Changing Uses: Guidelines For Change Of Use Refurbishment*, London: Spon Press. 2002.
- [22] Kronenburg, D. *Flexible: Architecture that Responds to Change*, Laurence King Publishers. 2007.
- [23] Langston, C. Green adaptive reuse: issues and strategies for the built environment (keynote paper), in proceedings of first International Conference on Sustainable Construction and Risk Management, Chongqing, China, June 12-13. 2010, pp. 1165-1173.
- [24] Pinder, J., Price, I., Wilkinson, S. and Demack, S. A Method for Evaluating Workplace Utility, *Property Management*. 2003, 21(4), 218-229.
- [25] Russell, P., Moffatt, S., (2001), Assessing the Adaptability of Buildings, in Annex 31, Energy-Related Environmental Impact of Buildings. 2001, IEA Annex.
- [26] Schmidt III, Robert., Austin, S., Brown, D., Designing Adaptable Buildings, Harnessing the Power of Information, Oct. 12-13. 2010.
- [27] Schmidt, R. Designing for Adaptability in Architecture. Doctoral Thesis. Loughborough University. United Kingdom. 2014.
- [28] Snyder, G. H. Sustainability Through Adaptive Reuse: The Conversion of Industrial Buildings, Master's thesis, University of Cincinnati, OH. 2005.
- [29] Soemarno I., Sudarma E. *The Implication of Small Scale Land Division for Formal Housing toward Sustainable Living and Environment*. Procedia-Social and Behavioural Sciences. 2015, 179: 230-236.
- [30] Susanti R., Soetomo S., Buchori I., Brotosunaryo P. M. *Smart Growth, Smart City and Density: in Search of The Appropriate indikator for residential Density in Indonesia*, Procedia \_Social and Behavioural Sciences. 2016, 227: 194-201.
- [31] Wilkinson, S. J. Thermal Improvements in commercial refurbishment: an International Comparison, in Proceedings of RICS COBRA, University of Portsmouth, UK, September 1997.
- [32] Wilkinson, S. J. Sustainable Building Adaptation: Innovations in Decision-Making, First Edition, John Wiley & Sons, Ltd. Published 2014 by John Wiley and Son, 2014.
- [33] World Commission on Environment and Development. Report of the World Commission on Environment and Development: Our Common Future (Brundtland Report), United Nations General Assembly. Oxford University Press. 1987, p. 43.
- [34] Yau, Y., Chau, K. W., Ho, D. C. W. and Wong, S. K. An Empirical Study on the positive externality of Building Refurbishment, *International Journal of Housing Market and Analysis*. 2008, 1(1), 19-32.
- [35] Yui, C. Y. and Leung, A. Y. T. A cost-and-benefevaluation of housing rehabilitation, *Structural Survey*. 2005, 23(2), 138-151.