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Conformity of Vertical Public Housing's Performance With Resilience Agenda in Bandung Metropolitan Area

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ABSTRACT

The ideas of resilient housing have been rapidly developed for better future quality improvement. On the other side, resilience is a critical framework, which is not only for housing in the future but also for those that have been built and already inhabited. Therefore, it is necessary to conduct a study that can identify the compatibility of existing housing performance with the framework of resilience. Five vertical housing in Bandung were selected as case studies. These five housing are vertical public-housing prototype from national government that have been used in many cities for low income people. Post occupancy evaluation was used to assess the performance. Benchmarking and occupant survey instruments were combined in this study. The performance measurement results were then compared with critical resilient framework for housing to support community livelihood, reduce the vulnerability of resident to environmental risk and stresses, enhance personal security, and empower communities. It is concluded that the resilience of existing vertical public housing is differentiated according to the corridor design type and the occupant behavior to adapt the design. These two factors are closely linked to the achievement of resilient housing framework and are key inputs for short-term improvements in the vertical public housing that have been built.

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1. INTRODUCTION

Resilience has become one of the major issues in housing design and development, including for vertical housing in Indonesia. Resilience is the ability of a social or ecological system to respond a problem while maintaining the basic structure and ability to adapt the distractions and changes. The main ideas emphasized in the resilient principle is the need of urban or settlement systems, especially for low-income people who are

often exposed to natural disasters, to increase their capacity to deal with the impact of the disaster (Arup, 2013; Folke, 2006; Moench and Tyler 2012)

In urban context, resilience means the housing settlements that have the capacity to maintain their basic functions and structures so that communities who live and work in site, in particular low-income communities affected by disasters, can survive and adapt in the situation of distractions and changes, including climate change. From the resilience agenda, the low income people as major user of public housing would be the important actor (Paramita *et al.*, 2016).

The plan and design concept of resilient settlement has grown widely today. Resilience is critical framework not only for housing in the future but also for housing that have been built and already inhabited by the low income people. According to data from the Ministry of Public Works and Housing in 2016 showed that 39 of the 250 twin blocks or 15.6% of the vertical public housing with rental scheme (called as rumah susun sewa/rusunawa or walk-up housing type) built in Indonesia are in West Java, where 24 of 39 twin blocks or 61.5% was built in West Java located in Bandung Metropolitan Area. These statistics show that Bandung Metropolitan Area is one of the highest vertical public housing supply areas due to the increasing population growth (Firman, 1998).

The vertical public housing in this area needs to be assessed, including its quality through certain evaluation techniques to find out the production quality that have been built by the government and to meet with the needs of its inhabitants that majority is the low income people. In term of resilience agenda, the identified quality would be useful for operational and maintenance strategy of the building manager and the inhabitant's who live in the existing vertical public housing, as well as the input for future planning. The assessment also would be usefull for valuation/certification of vertical housing performance that is mandated on the Law of Indonesia Vertical Housing No. 20/2011.

2. RESILIENCE AGENDA AND THE EXISTING VERTICAL PUBLIC HOUSING

2.1. Resilience Agenda.

Urban Climate Resilience is divided into three parts: urban systems, social agents, and institutions. Urban system include built environment (building and infrastructure) and natural environment. The housing inhabitants become the main social agent among other actors. The formal and informal rules, regulation, and agency taking part to enhace urban resiliency (Alberti, Marzluff *et al.*, 2004; Andersson, 2006; Berkes, 2007; Ernstson *et al*. 2010; Folke 2006; Leichenko 2011; Liu *et al*. 2007). Detailed information can be seen in http://www.kantei.go.jp/foreign/kan/topics/201106/20110601iaea_tyousa_e.pdf.

In building and ecology system, housing should have some characteristics to achieve resilience, including: (a) Flexibility and diversity; (b) Redundancy and modularity; and (c) Safe failure. Flexibility and diversity refers to the ability to perform fundamental tasks under the broadest possible conditions, and to convert assets or modify structures to introduce new ways to achieve basic goals. An elastic system has key assets and functions distributed functionally so that each function and asset are not affected by spatial diversity and have various ways to meet the needs (functional diversity).

Redundancy and modularity is system that has a reserve capacity for various possible situations as a way of accommodating extreme and volatile pressure or demand. The last character is safe failure that is the ability to absorb sudden shocks (including surprises that exceed design thresholds) or

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the cumulative impact in a way that avoids major disasters.

Those three characteristics is very related to the building or housing performance especially for safety factor. Based on that, the main issue in resiliency is to connect the fabricant system with the inhabitants or the residents itself. The resident as well as the building manager should have the ability to operate and maintain their building performance. As the American Institute of Architects (AIA, 2016) pointed out: "A resilient building in a non-resilient community is not resilient."

The building performance should be seen in resilient framework that is critical on housing to support community livelihood, reduce the vulnerability of resident to environmental risk and stresses, enhance personal security, and empower communities. This agenda is not only for better future design but also becomes the most important point in how to be implemented in existing housing context, especially in vertical housing.

2.2. The Existing Vertical Public Housing Condition

The vertical public housing become an alternative dwelling related to the high increase population and the lack of land in urban areas, including in Bandung Metropolitan Area. From the previous research results about vertical public housing in several cities in Indonesia, it is identified various problems. For example problem associated with less accommodated needs of residents, such as physical degradation of the buildings due to lack of maximum capacity management in Pekunden and Bandarharjo, Semarang (Hendaryono 2010), changes in occupancy in Cokrodirjan, Yogyakarta (Pamungkas, 2010), changes in the use of spatial function, changes in the nature of the space, and changes in the facade of Kutobedah, Malang (Kristina, 2009), physical and functional changes of space in Penjaringan, Jakarta (Luthfiah, 2010), and changes in function and physical appearance of unit in Sombo, Surabaya (Puspitasari, 2011) Some of these problems potentially occur in Cingised, Cigugur, Cibeureum, Kodam III, and Sadang Serang, which are five vertical public housing or called as rusunawa in Bandung Metropolitan Area, that has experienced more than two years of occupancy. Alleged problems about the fulfillment of the needs is related to building performance, such as technical performance, functional performance, and behavioral performance. On the other hand, there are still obstacles about the assessment of buildings in Indonesia. These constraints related to the absence of standards that can be used as a benchmark of assessment, including for vertical housing.

2.3. The Vertical Housing and Performance Valuation

Building performance is one aspect contained in the building system as a whole factor. The building system is structured in order for the buildings to operate as planned (Lutzkendorf & Speer, 2005). Preiser and Nasar (2008) include aspects of behavior as one aspect of building performance in addition to technical and functional aspects. The user needs in the building associated with the performance of buildings. Ideally, if the performance of the building goes well, the needs of residents will be accommodated well and vice versa. There are three aspects that must be considered in the fulfillment of the residents need for housing: the physic, social, and economic aspects. Especially for low-income groups, the main level of needs to be achieved is still at the level of physiological and safety / security needs (see **Table 1**), as the most basic needs level (Haris & Young, 1983).

The measurements of building performance can be categorized in two points of views: from the expert's point of view and the user's point of view. Performance measurements based on experts such as architects and other building experts can be used

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especially in pre-occupancy cycle, such as planning and building construction periods.

On the other side, user based-performance measurements are important in the occupancy cycle of the building (Preiser and Nasar, 2008). The occupancy period is the longest cycle in the overall building performance cycle (Zimmerman & Martin, 2001). Therefore, residents' responses can be a lesson learned as a foundation for feedback on existing building performance to be improved or upgraded, and also can become important information for upcoming planning and designing the typical buildings. In this study, the results of the performance appraisal of the public vertical housing can be used to see the level of need fulfillment from occupant's points of view. Furthermore, the results can indicate the compatibility of the existing building with resilience agenda which its inhabitants become the important actors.

3. METHODOLOGY

3.1. Research Boundary

The discussion in this research is limited to performance measurement of vertical public housing's attributes on social/behavioral aspect. This aspect is important to support the existence of building performance in the occupancy period.

In this research, Cingised, Cigugur, Cibeureum, Kodam III, and Sadang Serang housing are selected as research cases, since they are prototype flats that built by government and have been occupied for more than two (2) years with rental scheme. The Cingised, Cibeureum, Cigugur, and Sadang Serang housing have similarity in designs with single loaded corridor types that are joined in twinblock or in the form of tower (especially Cigugur). On the other side, the Kodam III housing has different design as double loaded corridor type. These objects were selected as representation of housing that supplied by government to meet with the basic housing needs, especially for low-income people.

The sample for this research was one of the residential blocks in each housing site. The main consideration in the selection is the full occupancy of the building, since the behavior/social aspect is user-based.

3.2. Research Variables and Analysis Phase

The variables in this study are related to the important architectural components associated to physiological and safety aspect. The variables used in this study can be seen in Table 2.

To collect the data, direct observation to the sites and survey to respondents was conducted. The type of sampling in this study is categorized as purposive sampling. This type of sampling is useful when the researcher will describe reality and phenomenon and develop it. As a sample of respondents, there are 96 residents from Cingised housing, 48 residents from Cigugur housing, 96 residents from Cibeureum housing, 75 residents from Kodam III housing and 72 residents from Sadang Serang housing.

Tabel 1. The level of housing need and characteristics

Level of Needs	Housing characteristics dimension		
	Physic	Social	Economy
Physiological	Healthy building with basic facilities	Accessible location to go to workplace with public transport facilities	Lowest cost
Safety / Security	Privacy fulfillment for family unit	Free from environment hazard and market uncertainty	

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Tabel 2. Selected housing attributes for performance valuation

Variables	Area	
	Private property	Public property
The height size of corridor handrail		√
The distance size of baluster's corridor handrail		√
The height size of stairs handrail		√
The distance size of baluster's stair handrail		√
Prohibition to use housing units as business activities	√	
Prohibition to use common facilities as private/business activities		√
Availability of social facilities		√
Free from physical/criminal disturbance	√	
Free from visual disturbance	√	
Free from audial disturbance	√	
Free from olfactory disturbance	√	

In this evaluation, the benchmark-based measurement and occupant-based survey questions were separated analysis, since they have different characteristics. For benchmark-based questions, there were only 2 (two) mark options: "benchmark qualified" (100%) and "un-qualified", while for occupant-based questions would have 4 (four) degree of qualification (very good, good, fair, poor/bad). The benchmarking was gained from national and international standard for safety factor. The phase of data analysis to measure the performance value of the building is as follows.

(1) At the first phase, the performance value of each sub-aspect of performance on the benchmark assessment is identified;

(2) If the scores on the benchmark appraisal evaluation tool do not meet the specified threshold (100%), then the assessment of related aspects is not continued on the assessment of the occupant survey, it will be marked as the lowest grade;

(3) If the value in the benchmark assessment tool meets the specified threshold (100%), then the assessment is continued on the assessment of the occupant survey;

(4) The occupant survey assessment will show problem of housing attributes in occupancy period and also reflect the level of awareness from the occupant themselves.

(5) Correlational analysis of occupant's character and perception of housing performance was done to gain understanding about the occupancy problem.

(6) At the last phase, the qualitative valuation of public housing related to resilience framework was conducted. The result will determine the intervention to be proposed.

4. RESULTS AND DISCUSSION

From survey process, it can be identified problem of public housing in the occupancy period. The problem is associated with the design that can affect the behavior of residents, especially those who live as family and have children.

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The most un-qualified aspects related to safety factor are the distance between ballustrade stair railing and the height of the staircase, especially in Cingised housing (Figure 1). These lacks of quality aspect at single loaded corridor housing type may endanger the building user, especially the children.

Figure 1. The un-qualified condition for

The next problem included in the behavioral/social aspect is the lack of social facilities, visual comfort, audial comfort, and olfactory comfort. There are many occupants who use circulation corridor/common corridor for their private activities. For example, they place additional benches in the corridor around their dwelling units (Figure 2). This habbit can disturb the evacuation circulation of building users itself in hazard/emergency situation. In addition, the existence of these benches can be potentially dangerous when it is used by the children who play close to the handrail corridor.

Furthermore, the common corridor occupied by private activities would generate disturbance of other aspects such as visual, audial, and olfactory aspects, for family daily life. The residents also make some additional material like paper coverage on their windows to avoid visual disturbance (Figure 2).

It is identified based on benchmarking assessment and occupant-based survey assessments, several performance problem of public housing that confirmed to the result of the survey process. All of public housing in this study has lack of height size of stair handrail (compare to global safety standard).

In other side, there are several gap value of housing performance between benchmarking assessment and occupant survey assessment. Almost all of studied attributes pass the standard (except the height of the stair handrail), but perceive by the resident still have lack of performance to fullfil their individual need. The gap is mostly occurred in Sadang Serang, Cibeureum, Cingised (single loaded corridor type), followed by Cigugur (tower type), while the lowest gap value is in Housing of Kodam III (double-loaded corridor type). It can be identified that the public housing with single loaded corridor model tends to be adjusted or self modified by the occupants for the fulfillment of various family activities (See Figure 3).

(a) (b)

Figure 2. The resident's habits that generate disturbance and safety problem (a) Private activities on common circulation, (b) Material addition on unit opening to avoid disturbance

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Based on correlation analysis between occupant characteristics and perceptions of housing performance, it can be identified the most respondable or noticed performances. This respons which indicate problems according to the occupants, includes the availability of social facilities, visual disturbance, audial disturbance and olfactory disturbance for all public housing typology. Meanwhile, the problem of trading activity in the unit and in the shared area as well as the freedom from physical disturbance is more responded by the occupants in the double loaded corridor than the residents in the single loaded corridor around void towers. This confirms the survey results, that residents (who are mostly family occupant) in double loaded corridors are more sensitive to problems in their shared corridor or public areas rather than the resident in single loaded corridor (See Table 3). This sensitivity tend to protect shared circulation from private adjustment or private interest.

After each case study was analyzed their performance according to specific attributes, it could be qualitatively assessed by the resilience framework (Table 4). It is identified that the public housing with single loaded corridor around void type tend to have lower performance than other type to support community livelihood, reduce the vulnerability of resident to environmental risk and stresses, personal security, and empower community. Since major occupant in those public housing is family type, then the double loaded corridor could be more appropriate for livelihood and more enhance community sensitivity.

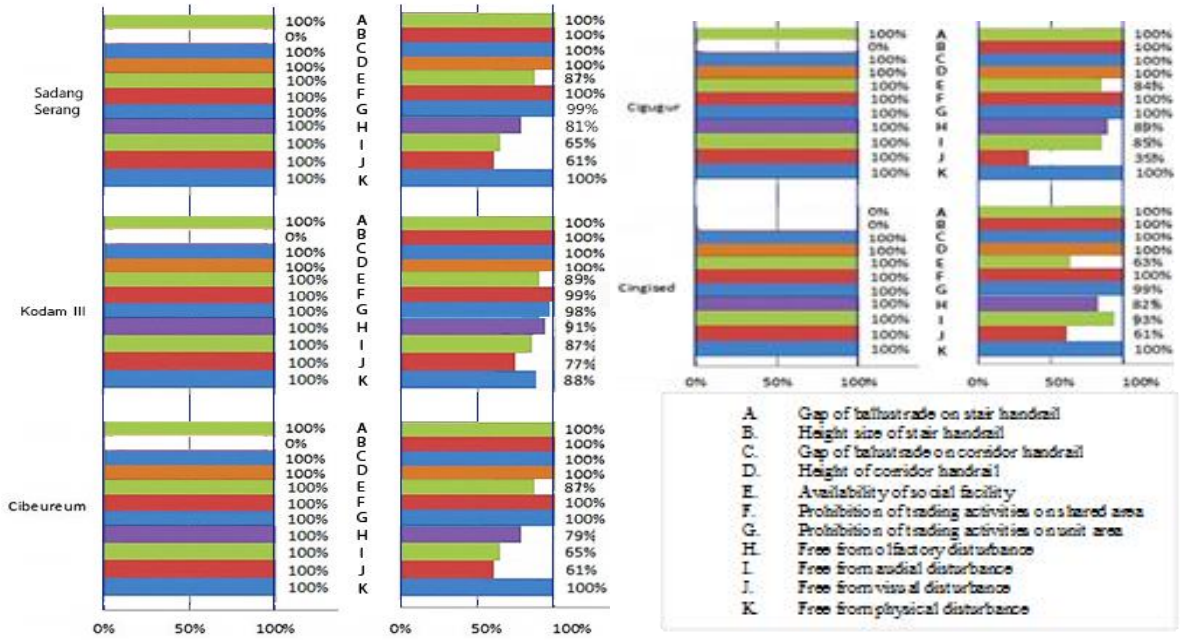

Figure 3. Analysis of benchmarking assessment and occupant survey assessment

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Table 3. Correlation between resident character and perception of performance problem

Type of Public Housing	*Location*		Height of corridor handrail	Gap of balustrade on corridor handrail	Height of staircase	Gap of balustrade on staircase	Prohibition for store/trading activities in dwelling unit	Prohibition for store/trading activities in shared area	Availability of social facilities	Free from physical disturbance	Free from visual disturbance	Free from audial disturbance	Free from olfactory disturbance
Tower	Cigugur	Age	0.00	0.00	0.00	0.00	0.00	0.00	0.05*	0.00	0.25**	-0.10**	0.11**
		Income	0.00	0.00	0.00	0.00	0.00	0.00	0.29**	0.00	-0.36**	0.05*	0.11**
		Number of family members	0.00	0.00	0.00	0.00	0.00	0.00	-0.59**	0.00	0.10**	0.13**	0.11**
		Number of children	0.00	0.00	0.00	0.00	0.00	0.00	-0.59**	0.00	0.10**	0.13**	0.09*
		Degree/level of education	0.00	0.00	0.00	0.00	0.00	0.00	-0.14**	0.00	-0.32**	0.16**	-0.39**
Double Loaded Corridor	Kodam III	Age	0.00	0.00	0.00	0.00	-0.05*	0.14**	0.01*	0.06*	0.21**	0.25**	0.01*
		Income	0.00	0.00	0.00	0.00	0.09*	0.25**	-0.12**	0.05*	0.26**	0.21**	0.22**
		Number of family members	0.00	0.00	0.00	0.00	-0.16**	0.03*	0.01*	-0.04*	0.05*	-0.05*	-0.16**
		Number of children	0.00	0.00	0.00	0.00	-0.16**	0.03*	0.01*	-0.04*	0.05*	-0.05*	-0.16**
		Degree/level of education	0.00	0.00	0.00	0.00	0.19**	-0.19**	-0.06*	-0.15**	0.13**	0.14**	0.12**
Single Loaded Corridor around Void	Cingised, Cibeureum, Sadang Serang	Age	0.00	0.00	0.00	0.00	0.01*	0.00	0.08*	0.00	0.10**	-0.02*	0.04*
		Income	0.00	0.00	0.00	0.00	-0.11**	0.00	0.02*	0.00	0.00	0.12**	0.02*
		Number of family members	0.00	0.00	0.00	0.00	-0.04*	0.00	-0.35**	0.00	-0.07*	0.17**	-0.05*
		Number of children	0.00	0.00	0.00	0.00	-0.04*	0.00	-0.36**	0.00	-0.06*	0.18**	-0.04*
		Degree/level of education	0.00	0.00	0.00	0.00	0.11**	0.00	0.16**	0.00	-0.06*	-0.05*	-0.02*

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Table 4. The valuation of resilience framework problem

Public Housing Typology	Support community livelihood	Reduce the vulnerability of resident to environmental risk and stresses	Enhance personal security	Empower communities
Tower : Cigugur	Moderate	Moderate	Moderate	Moderate
Double loaded corridor : Kodam III	High	High	High	High
Single loaded corridor around void : Cingised, Cibeureum, Sadang Serang	Low	Low	Low	Low

5. CONCLUSIONS

It is concluded from this study that the resilience of existing vertical public housing in Bandung Metropolitan Area is differentiated according to the building/corridor design type and the occupant behavior to adapt the design. These two factors are closely linked to the achievement of resilient housing framework and are key inputs for short-term improvements in the vertical public housing that have been built. Major public housing's resident is family occupant, and their specific need have significant influence to the functioning of some housing attribute, and at the end it will correlate to overall quality performance of the public housing. According to the building/corridor type of public housing, the single loaded corridor around void type should be prioritized for improvement, both physical intervention and occupant empowerment to achieve resilience agenda. It should be followed by the other types. Prior physical improvement includes renovation of handrail in corridor and stairs to be safer for family activities with children. The next one is additional room for family or social activities at every floor and at ground-floor. In other side, the occupant should more refrain themselves to put private furniture/object or to occupy public corridor for their private interest.

Resiliency of existing public housing have to be achieved not only by physical intervention (like modification of existing housing attributes: renovation, re-layout or re-function), but also by the enhancement of resident or community awareness as the main actor. The public housing community need collective knowledge about safety living as their pre-requisite entering the vertical public housing.

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The author(s) declare(s) that there is no conflict of interest regarding the publication of this article. Authors confirmed that the data and the paper are free of plagiarism.

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