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Student Boarding House Quality in term of Health Design
(Case study: Boarding House near University of Bengkulu)

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Abstract. Health is an important requirement in designing a residential building. One of them is a boarding house. Most of the nomad students who came from another city spend their time mostly in their room of boarding house (id: kost). It makes the health quality of boarding house needs to be considered. This study will examine the conditions of boarding houses around the University of Bengkulu in terms of health aspects from the building design. The health quality of a building will be assessed from the location and environment of a boarding house, as well as the design of lighting and ventilation. This study uses a mixed method of quantitative and qualitative. The primary data collection was carried out by online questionnaire survey to UNIB students who live by renting boarding rooms around the campus. The result is boarding houses around the University of Bengkulu are in good condition. But some problems of natural light are found in the glare, and in some cases, rooms do not get natural lighting. Ventilation is the biggest problem for students’ showed by the opening position that only on one side, no opening in the bathroom, which does not meet the rules. The environment students’ boarding houses around the University of Bengkulu, indicated by clean environmental conditions, good water quality, and not noisy. But, some boarding houses are still lacking in greeneries. Results of this study are expected to contribute to improving the environmental health quality around the University of Bengkulu by the buildings and other built environment design.

Keywords: Boarding house, healthy building design, environment.

1. Introduction
Residential is a small built environment that is very close to everyday human life, so it can affect the building users’ quality of life. One of the residential quality parameters is the building health [1], which includes building materials, components and spatial planning, lighting, air quality, ventilation, animal disease, water, food storage facilities, waste and density of bedroom. These parameters are the requirement to improve the health quality of Indonesian people [2]. The emergence of Coronavirus Disease 2019 (Covid-19) issue in 2020, makes the environmental health of the living space with building design efforts needs special attention, because the contagious and development of Covid-19 virus can be delayed by increasing the body’s immune system, which is obtained by maintaining the health of the residential environment.

One type of residential housing is a boarding house, a type of rental residence. There are many boarding houses for students around the campus, including the University of Bengkulu. Since most of the student comes from outside Bengkulu City, they need to rent a place as their living space As a residence that is usually inhabited by immigrants, boarding houses usually have high population
density which decreased in the settlement quality in terms of health that makes it vulnerable to proliferation several types of diseases caused by bacteria (parasites) and viruses [3]. So, it is necessary to guarantee the health of boarding houses, so thus students’ health, segments market of a boarding house, can be preserved from various diseases for increasing students’ productivity. The final purpose of this study in the future is to improve the whole environment quality near the University of Bengkulu as well as Bengkulu city in general.

2. Literature Review
Residential health can be seen from the realization of cleanliness, health, and providing comfort for occupants in the building and in the surrounding environment. Boarding house is a temporary residence type chosen by migrants with a certain amount of rent payment. Usually, the units are in small size, so thus the rented prices is more affordable for urban millennial generation such as students who prefer to live in boarding houses [4]. Moreover, boarding house location which is 1-5km away from campus [5], can make student mobility become easy. Comfort, complete facilities, calmness can also be a consideration in choosing a boarding house [6]. Student boarding house usually consists of one room filled with one bed, one desk, and one wardrobe. Usually, boarding houses use shared bathroom and kitchen. But now the facilities provided are also developed in exclusive way, such as the provision of air conditioning, private bathrooms, living rooms, and others [7].

The quality of boarding houses has a bad tendency, such as a small yard, and poor accessibility conditions, negatively affecting and disrupting student academic activities. Meanwhile, a good boarding house is one that has good air circulation and lighting, provides a comfortable and calming atmosphere for its residents and has supporting facilities such as a common room, a large motorbike parking area, a terrace and a front garden [8]. Medwin [6] describes the basic principles of a healthy boarding house, including the condition of the bedroom according to the standard of comfort, getting air circulation and good lighting, a hallway with a minimum width of 1.2 meters for the circulation area as well as space between rooms, communal space, service area, bathroom, yard, and orientation for the view. A comfortable bedroom according to Medwin [6] has a minimum room size of 2.5 m x 3 m with the assumption that the furniture used is 1 single bed, wardrobe and study table. Therefore, the number of rooms must be adjusted to the available land area so that the minimum space requirements for occupancy are met.

Several government regulations regarding building health are contained in Law of the Republic of Indonesia number 28 of 2002 concerning Buildings [9], Government Regulation of the Republic of Indonesia Number 36 of 2005 [1], and Regulation of the Minister of Public Works number 29 of 2006 which include ventilation systems, natural lighting, and sanitation systems [10]. The Minister of Health of the Republic of Indonesia also issued Decree number 829 / MENKES / SK / VII / 1999 [2] regarding Housing Health Requirements, covering building materials, components and spatial planning, lighting, air quality ventilation, disease-infected animals, water, food, waste, and occupancy density.

According to Seftyarizki [11], things that need to be considered in providing the wind inside the building are by provision of several openings on the building sides which are located according to the direction of wind direction to lengthen the air movement inside the room. Designing a too deep room plan needs to be avoided so that wind speed inside the building can be maintained. Utilization of vegetation can create a microclimate by reducing solar radiation through shading, and allowing cool dry winds from hills to enter the building. And the height of the opening, position and orientation of the openings, barrier elements in the space, other design elements around the inlet, window type, and room layout are affect the airflow pattern in the room.

According to Febrina [12], air is flowing when there are two holes or openings perpendicular with each other, or facing each other. Openings should be located on both sides of the building or room, but will not give much effect if the opening is only on one side of the building, because outside air will not be able to enter the space if there is no other opening for outlet air.

Utilization of natural lighting in space can be obtained from sky light, reflections of surrounding objects, and reflections of inner space. According to SNI 03-2396-2001 Design Procedures for Natural Lighting Systems in Buildings, opening size, position, and orientation, shading elements dimensions,
glazing type, walls thickness, and the presence of plants and other buildings in front of openings also affect the amount of natural light that entered the room [13]. Opening shape also has an influence on the distribution of light. Meanwhile, the orientation of the residence should be placed in the north-south direction of the sun's path and perpendicular to prevailing wind direction. Distribution of the natural light should be spread evenly throughout the sun hours, which is between 8:00 until 16:00. For the bathroom placement area [14], the Ministry recommends on the side of the building that gets sunlight to overcome humidity, and requires openings or exhaust fan face directly to the outside space so that hot air and bad smells can be flushed out immediately.

Adequate lighting from the sun, especially in the morning, and prevent glare during the day, are need to be considered. Direct sunlight that enters the room for at least one hour through an opening, with one tenth of the floor area sizes, without being obstructed by room furniture, can kill germs and deliver warm, healthy air [15] [16] and [17].

Some things that need to be considered for a healthy environment according to Wibisono [18] are collecting residential garbage in a landfill location (which is far from the neighborhood where you live), or by making a garbage hole for compost. A puddle or water should not be stagnant for more than a week, because it can be a pleasure place for a lot of mosquitoes. Providing small canal or gutter can be the solution of this problem. Sewage place construction should meet requirements. A place of sewage and septic tanks need to be noted when making wells for clean water sources, with 7 meters as the minimum distance to avoiding bad contaminated. Lush plants and trees around the house can forbid morning sun and make dark and humid environment.

3. Method
This study uses a mixed method of quantitative and qualitative. Identifying UNIB student boarding houses condition around the campus is conducted by assessing the quality of the building use health aspect concept. Then, some variables including: (1) location and environmental comfort; (2) room design. Variables; are used to determine the quality scale of boarding houses as well as to confirm and compare the conditions of boarding house. Some indicators from both of this variable are then will be used as questionnaire instruments to collect primary data.

![Figure 1. Concept-Variable-Indicator Research](image)

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The primary data collection was carried out by online questionnaire survey that distributed using the snowball-non-random sampling method to UNIB students who live by renting boarding rooms around the campus without restrictions on students’ major and length of study. A total of 61 respondents, who lived by renting in boarding house scattered around the campus were obtained. There are three types of questions, close-end questions to determine the exact conditions of boarding house, questions with semantic-differential answers that will be assessed in percent, and open-end questions to identify other factors that affect the health of students while living in the boarding house. All obtained data will then be analyzed with a quantitative approach. Distribution analysis is used to determine the characteristics of boarding house environment. For open-ended questions, interpreted and categorized will be to find student preferences for the boarding house. Each data obtained will then be correlated to find relationships and causal factors related to the health quality of boarding houses.

4. Findings and Discussion
The boarding rooms around UNIB have various room areas. From 61 respondents, half of them are in 10 - 15 m², then 15% is in 10 - 20 m², 13.3% is in 20-30 m², 6.7% is more than 30m², and the rest are less than 9 m². This shows that most boarding house around the UNIB campus has a comfortable area to live in. With an adequate area, residents can rest comfortably and have sufficient space to move.

4.1 Wall Opening
Wall openings are important to be presence in a room as natural lighting and natural ventilation. Openings can be a doors, windows and ventilation. The position of the openings for sunlight and air circulation in boarding houses are mostly in adjacent sides (47.5%), 41% is on one side only, and 11.5% of the openings are facing each other. It showed that rented room condition in boarding house based on wall opening position are still lack. The position of the openings that facing each other which enable cross ventilation where air circulation can flow and provide natural ventilation is one of the concepts of health design.

Building orientation is also the factors that influence natural lighting and natural ventilation. However, boarding houses around UNIB do not have a special concept regarding this matter. It can be seen from the respondents' data where boarding houses orientation are vary from all directions.

Ventilation for occurs air changes in Bathroom / toilet is a must. However, only 26.2% of 61 respondents have bathroom opening, while 73.8% stated that they did not have an opening in their bathroom. It can be concluded that boarding houses around UNIB condition due to the absence of bathroom / toilet opening, can affecting the temperature, humidity of the bathroom / toilet which can invite viruses or bacteria to grow and develop.
4.2 Lighting
Natural lighting is important in a room. Good natural lighting can support all indoor activities during the day. If the room has bad natural lighting, the room will have a humid temperature which is not good for the health of the occupants. From the data obtained, most of the boarding houses around the campus have good natural lighting which indicates by 34.4% answer strongly agree and 32.8% agree to the good natural lighting and bright room conditions. 18% said it was neutral or maybe getting natural lighting, 3.3% strongly disagreed, and 11.5% disagreed with having good natural lighting or in other words bad natural lighting.

This can also be seen from the use of artificial lights during the day. A total of 27.9% strongly disagreed and 27.9% disagreed, indicating that residents do not use artificial lights during the day. As many as 24.6% stated that they are neutral or may not use artificial lights during the day, and 4.9% and 14.8% stated that they use artificial lights during the day. It showed that there are still many boarding houses around campus that have not been able to maximize natural lighting in the room. From the data obtained, 5 respondents stated that they turned on the artificial lights for almost 24 hours and 5 respondents stated that they turned on the artificial lights before noon until late afternoon. This happens because the orientation of the boarding house does not meet the rules in natural lighting. The orientation of boarding houses around the UNIB campus varies and there is no special pattern, such as in other villages in other areas due to adjusting existing road infrastructure.

Most of the boarding houses receive natural light that enters through openings, so they can carry out activities in the room without turning on artificial lighting during the day. Based on respondents' data, 65.6% stated that sunlight enters the room was too bright / causing glare and 34.4% stated that sunlight entering through openings was not too bright. A room that is too bright due to the strong reflection of sunlight according to Yunwono [19]feels uncomfortable and pleasant because of the orientation of the openings both doors, windows and vents facing directly to the West and East which is the orientation of the rising and setting sun. The orientation of the room opening can affect the amount of lighting received.
Table 1. Lighting

| Natural Lighting | Do not use lights during the day | Opening wall orientation |
|------------------|----------------------------------|--------------------------|
| 34.4%            | Strongly agree 27.9%             | 65.6%                    |
| 32.8%            | agree 27.9%                      | sunlight enters the room was too bright / causing glare |
| 18%              | neutral 24.6%                     | West: 31.4%              |
| 11.5%            | disagree 4.9%                     | East: 16.4%              |
| 3.3%             | Strongly disagree 14.8%           | sunlight entering through openings was not too bright / glare |
|                  |                                   | North: 31.1%             |
|                  |                                   | South: 21.3%             |

Reference: author, 2020

From the figure above, it can be seen that the number of boarding houses around UNIB with bad natural lighting is directly proportional to the frequency of lamp use during the day and vice versa. The number of respondents who stated that the incoming light is too bright / glare is also directly proportional to natural lighting and the minimal use of lights during the day. Meanwhile, the orientation of boarding houses around UNIB varies, West: 31.4%, East: 16.4%, North: 31.1%, and South: 21.3%.

4.3 Ventilation

Natural ventilation is the process of exchanging or circulating air which is needed to provide a sense of comfort in carrying out activities in space. If the room does not get natural ventilation, the room will feel humid. From 61 respondents, 14.8% and 16.4% are strongly disagreeing and disagree if the room is stuffy. 41% stated neutral, 13.1% agreed and 14.8% strongly agreed that rooms feel stuffy. It is showed that almost 28% of boarding house around the UNIB campus is stuffy. A stuffy room can be caused by the position of ventilation are not placed perpendicular with each other, though perpendicular opening is good to consider cross ventilation for circulating the air.

Figure 5. Instrument Ventilation

For room walls condition, 19.7% stated that the room walls felt very hot during the day to evening and 16.4% stated that the room walls felt hotter from day to evening. The hotter wall feeling in the room is directly proportional to the data which states that sunlight entering through the openings is too
bright / glares. The glare / bright sunlight conditions received by the boarding house can also increase the temperature of the room, and makes natural convective cooling are hampered. So that the occupants of boarding houses are 24.6% very often and 21.3% often use fans to help air circulation and 34.4% stated neutral. Only a few stated that they use fans very rarely (8.2%) and not often (11.5%). Because if the mechanical fixture not in active mode, the room will feels very hot and stuffy, especially when the window / door is closed. The reasons given by respondents who use mechanical fixture such as fans are showed in Table 1. Hot and stuffy air is the most reason by the participant. This explains that the air circulation in the boarding house around UNIB is not optimal.

**Table 2. Reason of using mechanical tools (fans)**

| The reason for using mechanical tools (fans)          | Number of Respondents |
|-----------------------------------------------------|-----------------------|
| Hot                                                 | 26                    |
| Hot and stuffy                                       | 6                     |
| Don’t have                                           | 6                     |
| Need to do job/task                                  | 4                     |
| stuffy                                               | 2                     |
| Depending on the weather                             | 1                     |
| More Flexible                                        | 1                     |
| Because of the Coastal Areas                         | 1                     |
| Air circulation                                      | 1                     |
| Mosquitoes                                           | 1                     |
| No Answer                                            | 12                    |
| **Total Respondents**                               | **61**                |

**Reference:** author, 2020

From the Figure below, it can be seen that there is a relation between bad natural ventilation with the use of mechanical fixture such as electrical fans in the room. This can be caused by the orientation of the openings are not in accordance with the wind path direction, and the position of the openings are not facing each other so that optimum air flow cannot be obtained. Meanwhile, only 11.5% of boarding houses around UNIB had openings facing each other in. As many as 47.5% had adjacent openings and 41% had one side only openings.

**Table 3. Ventilation**

| Room does not get natural ventilation (stuff) | Using mechanical tools (fans) | Wall opening position |
|----------------------------------------------|-------------------------------|-----------------------|
| 14,8%                                        | Strongly agree                | 24,6%                 |
|                                              | 41% Wall opening on one side only |
| 13, 1%                                       | agree                         | 21,3%                 |
|                                              | 47,5% Adjacent wall opening   |
| 41%                                          | neutral                       | 34,4%                 |
| 16,4%                                        | disagree                      | 8,2%                  |
|                                              | 11,5% Wall opening facing each other |
| 14,8%                                        | Strongly disagree             | 11,5%                 |

**Reference:** author, 2020

4.4 Environment
Boarding house environment also needs to be considered for residents. Boarding houses environment around UNIB is still in good condition, because 31.1% respondent answer very clean, 31.1% clean, and 34.4% neutral. Only 3.3% stated that their environment was not clean. This indicates that almost all of respondents keep their environment clean.

Boarding houses' clean water quality around the UNIB, from well / pdam are mostly in good condition. Among all respondent, 39.31% strongly agree, 29.5% agree that clean water condition are generally clear, clean, colorless, and odorless. While 19.7% respondents are in neutral. 11.5% of boarding houses around UNIB have bad clean water conditions, with 8.2% disagree and 3.3% strongly disagree if the condition of the well water is clear, colorless, clean, and odorless. This could be because the campus of the University of Bengkulu is ± 600 m from the shoreline, so that brackish water can occur and smell.

Environment noise level around the boarding house also needs attention, because it can affect the comfort in doing activities in the room. In the boarding house around the UNIB as much as 29.5% has very low noise, 26.2% low noise. 26.2% are neutral, 13.1% have high noise and 4.9% have very high noise. It can be conclude that boarding houses around the UNIB have quite low noise level, because the location of boarding houses around the UNIB are many in alley villages rather than on the main road.

Greeneries or vegetation in residential area can affect lighting and ventilation in the environment. Greening can provide a sense of coolness and comfort for residents. Utilization of tall lush vegetation is carried out to reduce direct sunlight through shading, and allow wind to enter the building. 19.7% of respondents stated that there were a lot of greeneries / vegetation in the boarding house, 49.2% had some vegetation, 21.3% said it was little, and 9.8% had no vegetation at all.

Among 61 respondents who live in boarding houses around UNIB, 88.5% said they felt comfort with their living space, 11.5% said they were not satisfied enough. From the table above it can be seen that the health factor of the building design from openings, natural ventilation, natural lighting, and the surrounding environment can affect the residential user’s satisfaction. 88.5% of boarding house
residents due to the availability of clean water, low noise level, and had the adequate room size. In addition, there are other factors that affect students’ satisfaction about their boarding houses, such as presence of close friends, complete facility, safety and security, and close distance to campus. Meanwhile, 11.5% of boarding house occupants stated that they were felt not comfortable at their place because of the high air temperature, unpleasant water conditions sometimes, the stuffy, cramped, and dirty room, and lacked lighting and bad air circulation in the bathroom. Other factors that affect students’ satisfaction about their boarding house are limited interaction with other residents, strict rules, uncomfortable environments, bad mobile networks, parking space too small, and unsafely.

| Comfort                  | Not Satisfied Enough                              |
|--------------------------|---------------------------------------------------|
| Comfortable              | Hot                                               |
| Clean and smooth water   | Sometimes jammed and dirty water                  |
| Many friends             | Lack of interaction                               |
| Not noisy                | Can’t back home late                              |
| Large                    | Bad environment                                   |
| Complete facilities      | Stuffey                                           |
| Secure                   | Bad connection                                    |
| Close to campus          | Lacks ligting and pores circulation in bathroom   |
|                          | Not safe                                           |
|                          | Dirty                                              |
|                          | Narrow parking                                     |

Table 4. Response to their boarding house

Reference: author, 2020

5. Conclusion
Based on the above discussion, it can be concluded that boarding houses around the University of Bengkulu is in good condition. It is also showed by high percentage of students’ satisfaction about their rented living place. Health factor of the building design takes a place for students comfort. Most of students’ boarding houses have a good natural light, so thus artificial lighting during the day is not necessary. Some problem of natural light found is the glare, and in some case, rooms do not get natural lighting. Ventilation is the biggest problem for students’ boarding houses around the University of Bengkulu. It is showed by opening position that only in one side, no opening in bathroom, which does not meet the rules. Even though most of the student does not find their room not comfortable in term of ventilation, but most habit such as frequent use of mechanical ventilation because hot feeling reason, is mostly found. The environment also another good aspect for students’ boarding houses around the University of Bengkulu, indicated by clean environmental conditions, good water quality, and not noisy. But, some of boarding houses are still lacking in greeneries.

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