

## Design Rule and Social Dimensions of the *Bengkilas* of Vernacular Limas Houses in South Sumatra

Ibnu Aziz<sup>a,\*</sup>, Ari Siswanto<sup>b</sup>, Ngakan Putu Sueca<sup>c</sup>, Dadang Hikmah Purnama<sup>d</sup>

<sup>a</sup>Department of Architecture Engineering, Tridianti University Palembang, Kapten Marzuki Street No. 2446, Palembang, 30129, Indonesia

<sup>b</sup>Department of Architecture Engineering, Sriwijaya University, Raya Palembang Street Km. 32, Indralaya, 30662, Indonesia

<sup>c</sup>Department of Architecture Engineering, Udayana University, P.B. Sudirman Street Km. 32, Denpasar, 80234, Indonesia

<sup>d</sup>Department of Sociology, Sriwijaya University, Raya Palembang Street Km. 32, Indralaya, 30662, Indonesia

Corresponding author: \*ibnuaziz0307@gmail.com

**Abstract**— This article explores the guidelines used to theoretically and empirically determine the *bengkilas*' measurement of Limas house to understand how the social dimension is integrated into the vernacular housing design process. This goal was achieved by conducting a multi-case study, mixed methods, interviews with four interviewees chosen purposively because of their limas house ownership and recognition of expertise in its architecture, and measurements on 30 *limas* houses in Palembang, South Sumatra, Indonesia. The data was collected quantitatively through measurements of the dimensions of the house and qualitatively through interviews with community leaders. Previous research literature was also used to cross-examine various interviewees' statements. This literature was likely to be local studies that cannot be avoided due to the lack of international publications related to the limas house. The guideline used in determining the size of *bengkilas* is the *dulang* module system and the step count system. The social dimension can be seen from the priority of space to share food in the house based on the dish module. Based on the study results, a theory was developed which explained that the origins of *bengkilas* were semi-public space instead of social stratification. Governments trying to revitalize vernacular housing for reasons of tourism, culture, or preservation, can build on the findings of this study to build sustainable housing design. This article contributes to the understanding of vernacular design that exists today.

**Keywords**— Vernacular housing; *bengkilas*; dish module; revitalize; *limas* house.

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### I. INTRODUCTION

Increased awareness of the importance of vernacular architecture concerning sustainable development has triggered various studies on vernacular houses in various countries [1]. These studies seek to study the superior aspects of vernacular shelter and find out various aspects related to the purpose of preservation and adaptation to modern housing models. Multi-terrace houses are models of houses that are classified as rare in vernacular architecture. The existence of buildings with many terraces is often associated with land topology problems [2]. Therefore, it is possible that such houses are only found in mountainous areas. Even so, in Indonesia, three types of multi-terrace houses can be found: the *limas* house, Bubungan Tinggi house, and Tongkonan. The last house is the home of the people who live in the highlands in the southern peninsula of Sulawesi and can therefore be interpreted as adaptations to sloping topography.

However, the first two houses are houses of coastal communities, Palembang and Banjar, both of which are part of the Malay family.

Terrace houses are a common feature of Malay houses [3], but multi-terrace houses can only be found in Palembang and Banjar. The existence of this multi-terrace is considered more due to social factors than topography by referring to social stratification in societies that are familiar with complex government and political systems. However, social stratification theory has weaknesses because Malay society is a collective society. In a collective society, group norms and social harmony are highly prioritized, in contrast to individual societies that prioritize personal interests and justice [4]. When viewed from the perspective of social stratification, the existence of a multi-terrace house will cause problems because it will create an individualistic impression where the owner shows off his wealth to the surrounding society. Therefore, it is possible that social stratification is not the main goal of the existence of terraces in multi-terrace houses

in collective societies. It can also be seen from Malay [13], Minangkabau [14], and Toraja houses [15]. We suspect that *limas* house can also be related to the anthropometry of the house's occupants. According to anthropometric theory, houses tend to be made based on the measurements of the human body [16]. This explains why many vernacular housings in Southeast Asia are elbow-shaped rather than curvilinear. Curvilinear form (curved, rounded) has no anthropometric relations with the human body [17].

Palembang City in South Sumatra is a city where *limas* houses are still commonly found. We focus on *limas* house because, based on the observations from Taal [5], there has been no construction of a new *limas* house since 1950 [5], [6]. Moreover, *limas* expert builders are increasingly disappearing, either because of old age and no heir or disappearing and possibly changing jobs. Taal [6] notes that in the early 1970s, there was only one sculpture expert left in Palembang. In the situation of *limas* houses that are no longer undergoing new construction while old buildings continue to diminish, it becomes important to carry out conservation efforts, including examining the principles that make up the proportions in *limas* buildings and the sociological content behind them. These proportions can also be identified by looking at the house's horizontal, sagittal, and vertical plane [7]. Symmetry is also related to the aesthetic principle of proportion [8], which can be applied to palaces in the Malay area [9] and some of the *limas* houses. The proportion size of a room can also effect the ventilation system. For cross ventilation in *limas house* to be effective, the room's depth must be at most five times the height of the room [10].

The previous research has identified simple ratios that apply to *limas* [11] based on the theory of proportions [12]. The results of this study found that *limas* architects use the ratio of 1:1 intensively together with other simple ratios, specifically 2:3. For *bengkilas*, it was found that 24.4% of level 1 *bengkilas* area was built at 2:3 ratio, 17.7% of level 2 *bengkilas* at 1:4 and another 17.7% at 2:3, and 22.2% of level 3 *bengkilas* at 1:4. Furthermore, it was found that the most dominant simple ratio is in the floor and roof area, which reflects the function of the *limas* house as a private housing that allows residents to enjoy more in the house. In the end, it is not yet known on what basis the dimensions of this building are formed, especially one-dimensional parameters such as the room's length.

This paper aims to determine the meaning of the existence of terraces in multi-terrace houses in Indonesia by taking the case of Palembang *Limas* House. To achieve this goal, this study collects measurement data that is juxtaposed with expert information so that it is able to obtain an overview of the system used to determine the size of each terrace. Furthermore, the measurement results are interpreted from the socio-cultural perspective of the society. Specifically, this study focused on *limas* houses with three *bengkilas* construction (Fig. 1). A house with a three *bengkilas* construction was chosen because it is the most common type of *limas* found in South Sumatra. From the initial survey of researchers, obtained 50 *limas* houses at least 100 years old in the area of Seberang Ulu, Palembang City, the capital of South Sumatra province. Of these 50 *limas* houses, 30 (60%) of them are three *bengkilas limas*.

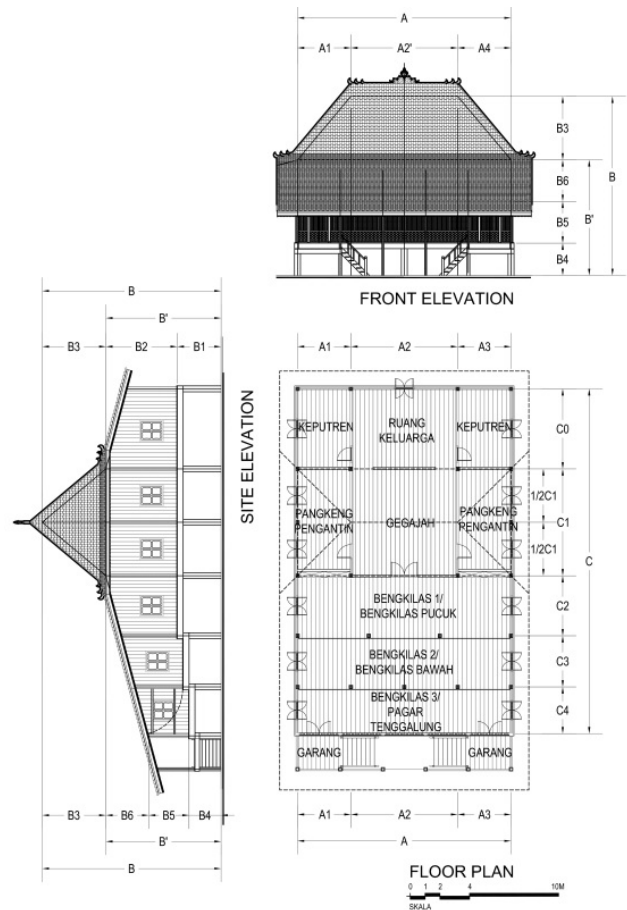


Fig. 1 Three *bengkilas* *Limas* House plan and instructions for measurement

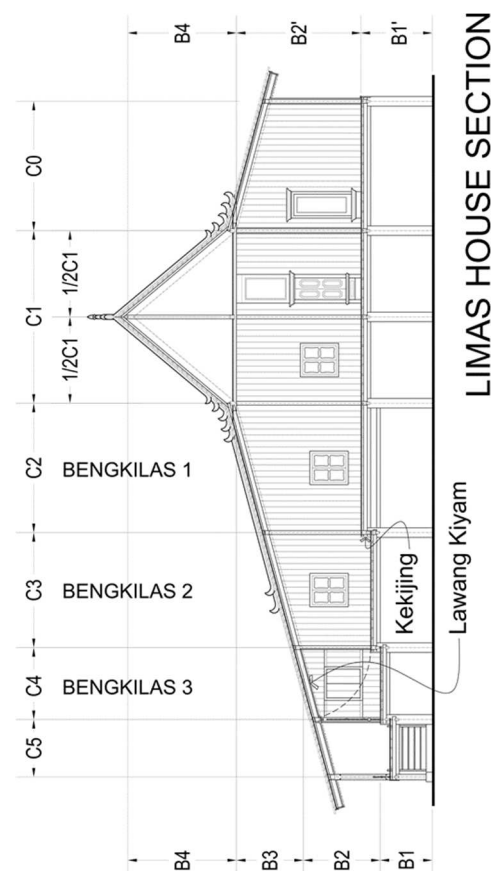


Fig. 2 *Limas* House Section

## II. MATERIALS AND METHOD

This research is a mixed-method multi-case study with four cultural experts in Palembang that was chosen purposively because of their ownership of the *limas* house and recognition of their expertise in the architecture of *limas* house. The number of interviewees is low because it is, as implied by Taal [5], *limas* knowledge is very rare. Moreover, our interviewees have high authoritative knowledge, so that they have high compatibility with the research topic.

As part of the mixed method, quantitative measurements on the dimensions of *bengkilas* and *gegajah* from eight types of existing *limas* houses with three *bengkilas* in Palembang City (covering a total of 30 houses), were also carried out.

Furthermore, we also use previous research literature to cross-examine a variety of interviewee statements. Previous literature used is likely to be local studies which cannot be avoided due to the lack of international publications related to the *limas* house.

The research location is Palembang City, the capital of South Sumatra Province. The city has a fairly large concentration of *limas*. The survey result of Aziz *et al.* [11] found 50 *limas* houses with a minimum age of 100 years. Some of these *limas* face the Musi River, the river that divides Palembang City and is also the widest river in Indonesia.

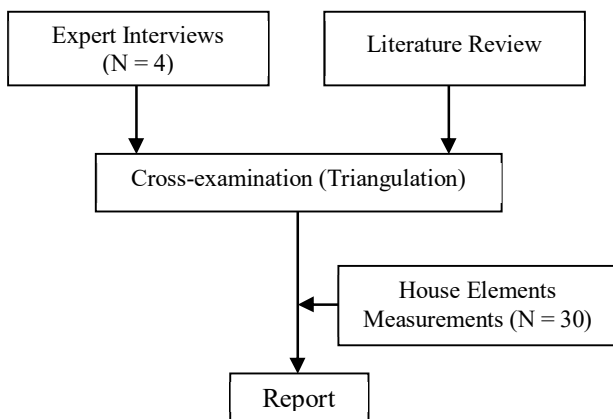


Fig. 3 Research Method Flow Chart

Data analysis in this research is qualitative and quantitative analysis. Simply put, we compare the interviewees' claims with quantitative data and interpret the results according to the comparison results. The interview itself is carried out in-depth. Four guiding questions are used: (1) what are the spatial components of the *limas* house? (2) what is the current condition of the *limas* house in Palembang? (3) On what basis did the *bengkilas*' measurement of *limas* house be determined? And (4) what is the social meaning contained in the *limas* house?. For the purpose of the present study, only the answers to questions (3) and (4) are analyzed, while questions (1) and (2) are for introductory questions.

## III. RESULTS AND DISCUSSION

The main basis of determining the size of a *limas* is the dish row. One *bengkilas* has the size of one row, where one row consists of six dishes. One dish serves eight people who are sitting cross-legged around the dish. As a result, each dish can be a unit of measurement (module) to determine the size of a

*bengkilas* floor area.

One dish module forms a box with concentric circles inside it. This concentric circle consists of one *dulang* in the middle, then a plate for side dishes, a plate for rice, and finally human. The following figure shows the size of one dish module. It can be said that one dish module has a diameter of 260 cm. In line with this, an ideal *bengkilas* has a length of  $6 \times 260 = 15.6$  m.

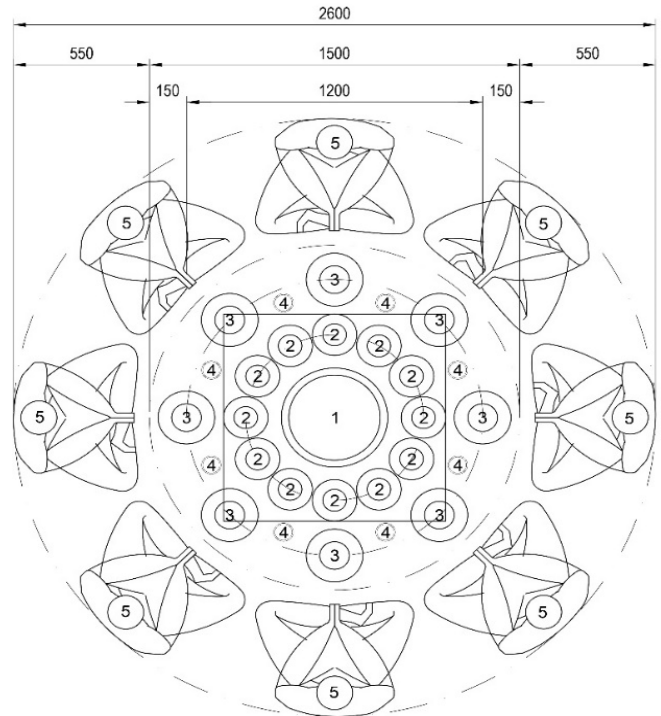


Fig. 4 Measurement of One Dish Module

Note: 1 = *dulang* for rice  $d = 43$  cm, 2 = plates for side dishes, vegetables, and fruits  $d = 18$  cm, 3 = plates for eating  $d = 23$  cm, 4 = glasses of drinking water, 5 = people sitting cross-legged. All measurements are in mm,  $d$  = diameter

However, the data from Table 1 shows that this rule was not fulfilled in the three *bengkilas limas* houses. None of the three *bengkilas limas* houses adhere to a ratio of 1: 6. The highest ratio is 1: 4, which can only be found in *bengkilas* III. This means that, on average, there are only four dishes in a row in *bengkilas* III. The ratio at *bengkilas* II is lower at 1: 3 while at *bengkilas* I is only 1: 1.

TABLE I  
CALCULATION OF *BENKILAS* DIMENSION

Item	Length (cm)	Width (cm)	Dish Module (/260cm)		Ratio (DM L/W)
			Length	Width	
<b><i>Bengkilas</i> I</b>					
Type I	960	840	3.69	3.23	1.14
Type II	960	680	3.69	2.62	1.41
Type III	1080	720	4.15	2.77	1.50
Type IV	1050	690	4.04	2.65	1.52
Type V	1050	700	4.04	2.69	1.50
Type VI	960	670	3.69	2.58	1.43
Type VII	840	740	3.23	2.85	1.14
Type VIII	900	700	3.46	2.69	1.29
<b>Average</b>	<b>975.00</b>	<b>717.50</b>	<b>3.75</b>	<b>2.76</b>	<b>1.37</b>

<b>Bengkilas II</b>					
Type I	960	360	3.69	1.38	2.67
Type II	960	260	3.69	1.00	3.69
Type III	1080	280	4.15	1.08	3.86
Type IV	1050	280	4.04	1.08	3.75
Type V	1050	320	4.04	1.23	3.28
Type VI	960	300	3.69	1.15	3.20
Type VII	840	300	3.23	1.15	2.80
Type VIII	900	260	3.46	1.00	3.46
<b>Average</b>	<b>975.00</b>	<b>295.00</b>	<b>3.75</b>	<b>1.13</b>	<b>3.34</b>
<b>Bengkilas III</b>					
Type I	960	240	3.69	0.92	4.00
Type II	960	220	3.69	0.85	4.36
Type III	1080	240	4.15	0.92	4.50
Type IV	1050	220	4.04	0.85	4.77
Type V	1050	240	4.04	0.92	4.38
Type VI	960	210	3.69	0.81	4.57
Type VII	840	220	3.23	0.85	3.82
Type VIII	900	240	3.46	0.92	3.75
<b>Average</b>	<b>975.00</b>	<b>228.75</b>	<b>3.75</b>	<b>0.88</b>	<b>4.27</b>

More than that, if seen from the width of the *bengkilas*, then one *bengkilas* can accommodate 2-3 rows, each 3-4 dishes in *bengkilas* I. On average, in *bengkilas* II and III, it can accommodate only 1 row with 3-4 dishes per row. It should be noted that *bengkilas* I in three *bengkilas limas* house is actually *bengkilas* I and II in four *bengkilas limas* house. That is, if applied to a house with four *bengkilas*, the capability of *bengkilas* I to accommodate a row of dishes can decrease from 2-3 to only 1 row of dishes. In this case, the three *bengkilas limas* house has the advantage of being able to accommodate more dishes than the four *bengkilas limas* house. Overall, this also means that the rules of one row per *bengkilas* are fulfilled; it is just that the number of dishes for one row is not met.

Even so, Table 2 shows that these two-row rules are not fulfilled. *Gegajah* in the *limas* house with three *bengkilas* takes the shape of a square with a ratio of 1:1. If you follow the rules twice, then the ratio of *gegajah* should be 2:6 = 1:3. Moreover, the length of the *gegajah* cannot accommodate two rows of dish. *Gegajah* dimension can only accommodate one row with one dish.

The small size of *gegajah* at three *bengkilas limas* house can be interpreted because of the changing role of space. Residents no longer use *gegajah* room as the main room but instead chose *bengkilas* I. *Gegajah* switches function as a space between two rooms. This is different from the situation in the past where the *gegajah* room became the main room, so that it was larger than *bengkilas*.

TABLE II  
CALCULATION OF GEGAJAH DIMENSION

Item	Length (cm)	Width (cm)	Dish Module (/260cm)		Ratio (DM L/W)
			Length	Width	
<b>Gegajah</b>					
Type I	320	280	1.23	1.08	1.14
Type II	320	360	1.23	1.38	0.89
Type III	360	360	1.38	1.38	1.00
Type IV	350	390	1.35	1.50	0.90
Type V	350	380	1.35	1.46	0.92
Type VI	320	320	1.23	1.23	1.00

Type VII	280	300	1.08	1.15	0.93
Type VIII	300	400	1.15	1.54	0.75
<b>Average</b>	<b>325.00</b>	<b>348.75</b>	<b>1.25</b>	<b>1.34</b>	<b>0.94</b>

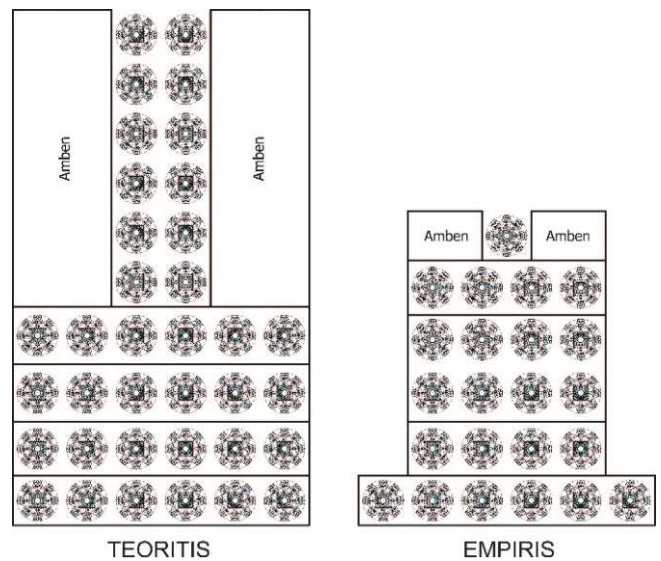


Fig. 5 Theoretical and empirical *dulang* layout, the total of dishes for eight people in *Limas* Three *Bengkilas*

The interviewee also stated that one *limas* house should ideally be able to accommodate 30 dishes. Since each dish can accommodate eight people, in total *limas* house can accommodate 240 people sitting around the dish. This value is obtained from three *bengkilas* and one *gegajah* so that five rows can be obtained with each of six dishes.

TABLE III  
CALCULATION OF TOTAL DISH COUNTS

<i>Limas</i>	<i>Bengkilas</i> I	<i>Bengkilas</i> II	<i>Bengkilas</i> III	<i>Gegajah</i>	Total	People
Type I	11.93	5.11	3.41	1.33	21.78	174.20
Type II	9.66	3.69	3.12	1.70	18.18	145.42
Type III	11.50	4.47	3.83	1.92	21.73	173.82
Type IV	10.72	4.35	3.42	2.02	20.50	164.02
Type V	10.87	4.97	3.73	1.97	21.54	172.31
Type VI	9.51	4.26	2.98	1.51	18.27	146.18
Type VII	9.20	3.73	2.73	1.24	16.90	135.20
Type VIII	9.32	3.46	3.20	1.78	17.75	142.01
<b>Average</b>	<b>10.34</b>	<b>4.26</b>	<b>3.30</b>	<b>1.68</b>	<b>19.58</b>	<b>156.64</b>

Table 3 shows that the existing three *bengkilas limas* cannot achieve this amount. The average house is only able to provide 20 dishes with an average of 157 people. Type I and III houses have a relatively large capacity because of the large *bengkilas* I. Even so, this capacity is still 172-174 people, far below 240 people who could ideally be accommodated in a *limas* house.

The use of the dish module in the *limas* house aims to ensure that there is sufficient space for community dining activities. This joint dining (alms) activity takes place when the house is finished built, circumcision of the resident's child, wedding of the resident, praying for the deceased, or other events organized by the residents, inviting the wider community. The existence of a limit of 240 people can indicate the size of the existing community. In the past, this 240 people could cover a wider area than now and could be

interpreted as a village size.

When compared to the four *bengkilas limas* house, as long as the total size is the same, the three *bengkilas limas* house can accommodate more people. This is because the *bengkilas* I and II in the four *bengkilas limas* house combined to become *bengkilas* I at three *bengkilas limas* house. The loss of barriers leaves extra room for food rows.

The existence of fusion of *bengkilas* in three *bengkilas limas* house, in turn, defies caste theory. According to caste theory, the five *bengkilas* in *limas* represent Palembang's Malay social stratification. The five classes in this social stratification are the sultan, prince, raden, kemas, and kiagus [18]. At the level of social status, it is clear that the number of social status holders will increase in line as the status lowers. There was only one sultan, but there were several princes, followed by more radens, and so on. On the other hand, in the three *bengkilas*, the highest *bengkilas* (*bengkilas* I) becomes the largest *bengkilas* to accommodate more people. This clearly contradicts the social stratification system in caste theory. Furthermore, the use of a dish module consisting of eight people also opposes caste theory because it does not distinguish between modules. There are no special modules for sultans, princes, radens, and so on. There is only one module that applies to all *bengkilas*.

If so, then what is the function of *bengkilas* if not for social stratification? In our opinion, *bengkilas* acts more as a system of transition between private and public space. Rather than as social stratification, the highest *bengkilas* becomes a semi-private domain where only families of residents can eat in this area. Other communities can be in the lower *bengkilas*. However, this can be situational, where if the upper part is not full, the community can fill in the upper part. In the context of the nobility, this cannot be distinguished from caste theory because of the farther a person's kinship with the king, the lower the social status. However, the explanation of the transitional theory is more universal because it can also apply to *limas* houses in the community and in accordance with the dish module, which is the basis of anthropometry in building *limas* houses. This theory also explains why people are not too concerned about the number of *bengkilas* in social norms, so there are houses with two *bengkilas*, three *bengkilas*, up to five *bengkilas*. Because of the amount of *bengkilas* is linear with costs [5], this is more about economic problems than social problems. Of course, rich people can choose to build a house with five *bengkilas*, but this has nothing to do with the nobility/social status that exists in the community around the house. In other words, the reason for the existence of *bengkilas* is more an individual reason than a social one.

The application dish module is not unique to *limas* house. In the Malay community in general, the dish module is the basis for building a house. In Malaysia, one dish module consists of only four people with a diameter of about 2 meters and is used to determine the terrace area [13].

The importance of giving food to many people in the community in the design of *bengkilas* reflects the strong social aspects in influencing architecture. In a study of the Tigray community, Ethiopia, Lyons [19] found that the wide serving of food in the community had an important role in maintaining social status and membership in the community of mutual cooperation. The same thing can also be true of why giving food to many people is the basis for the design of

*bengkilas*. In this case, the homeowner makes every effort to ensure that all people involved in mutual cooperation of building the house can be accommodated in the house that has been built with the activity of eating together as a form of gratitude. For the next time after the house is built, *bengkilas* can be a means of entertaining the community for various activities. This method allows homeowners to remain accepted by the community and maintain their social status.

Although both of them use the dish module, the eight-person dish module in *limas* is different from the Malay, which uses the four-person dish module for Malaysia's Malay society [13]. Four-person dish modules are also commonly used in pesantren communities. On the other hand, the eight-person dish module at the *limas* house has similarities to the dish module in the Megibung tradition in the Bali community [20]. It also might be because of the Buddhist influence where the pagoda has an octagonal-shaped roof which can be interpreted as the eight paths of kindness [21].

The reason for choosing eight people, rather than four, seems to indicate a high degree of collectivism. Eight people is the maximum amount that can be accommodated by a *dulang* that one person can carry. Palembang people seem to be trying to maximize the togetherness within the anthropometric boundaries in *bengkilas* design. Of course, the amount can be even more with a row system based on the tradition of the *ngeliwet* in Sundanese society. This is less collective because only two people face each other, and there is an extreme point that creates a degree difference. In the circular shape, everyone faces, and there is no end in this circle, indicating equality. Again, this cannot be explained through caste theory.

Two facts support the theory of collectivity as an explanation for the choice of eight people. First, the teachings of Islam, which is the religion of the absolute majority of *limas* residents, teach eating in the congregation. Two main hadiths discuss the number of people to eat together [22]. Hadith by Bukhari No. 5392 states that "food for two people is enough for three people, and food for three people is enough for four people," while Hadith by Muslim No. 2059 states, "food for one people is enough for two people, food for two people is enough for four people, food for four people is enough for eight people". Malay society seems to adopt Bukhari's perspective while Palembang people take Muslim's perspective.

The second fact is the occurrence of cultural transformation in the Balinese and Sasak people. Kasih *et al.* [20] state that the Megibung dish module was eight people in the past, but in the present time, there are only four people. This can be interpreted as the fading of togetherness in a society where fewer people want to eat together. That is, eight people contain more togetherness than four people.

This explanation can then be harmonized with the motto "Batanghari Sembilan" which is the motto of the Palembang people, describing the existence of eight rivers that are branches of the Musi river. This motto is a modern attachment to the principle of togetherness based on eight people in Palembang's collectivist system.

In conclusion, the sociological dimension related to anthropometric characteristics of *bengkilas* is a strong sense of togetherness. This strong togetherness is realized in the maximized dish module design. This togetherness is

strengthened by expanding the upper *bengkilas* to be wider in the three *bengkilas limas* house. This is against the caste theory, which states that the function of *bengkilas* is for social stratification. Even so, the size of *bengkilas* in the three-*bengkilas limas* house has been reduced from the ideal size to accommodate fewer people than it should be, which are 240 people to only 156 people.

#### IV. CONCLUSION

This research focuses on the relation between the guidelines for building *limas* house and the social dimension of the vernacular architecture of three-*bengkilas limas* house in Palembang, South Sumatra. It was found that there are some rules in determining the dimensions of *bengkilas*, private spaces (*gegajah*), roof truss, and stairs' step. The rules in determining the dimensions of *bengkilas* and *gegajah* are not strictly adhered to by the 30 *limas* examined in this study. Nevertheless, the basic rules are still adhered to with food module as a basis for determining the size of *bengkilas* and *gegajah*. Sociologically, this reflects the meaning of high collectivity in Palembang community. The sense of togetherness is reflected in the maximum use of space in the circular area of *dulang* to create optimal group cohesion by utilizing the crops that are to be shared. Further interviews about the sociological or philosophical aspects can be conducted on homeowners with basic knowledge obtained from the few interviewees in this study, such as how the community interacts in celebration activities between *bengkilas*.

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