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Decolonizing Tacit Knowledge of The Bugis Traditional House through Ethnomathematics

Yusfan Adeputera Yusran[1*], Sri Utami[1], Siti Mar'atul Fadhilah[1], Mohammad Mochsen Sir[2], Josef Prijotomo[3]
1 Department of Architecture, Universitas Brawijaya, Indonesia
2 Department of Architecture, Universitas Hasanuddin, Indonesia
3 Department of Architecture, Universitas Katolik Parahyangan, Indonesia
Corresponding Author: yusfan@ub.ac.id

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Abstract

This study aims to reveal the logical factors behind the cultural values of traditional house. Through an ethnomathematical study approach, this study reconstructs various patterns of Bugis house forms using photo documentation belonging to the KITLV institution published around 1880-1953. The Bugis vernacular house forms is often described as the embodiment of the basic knowledge of non-physical (intangible) in the form of culture, belief, and the principles of community life. However, when viewed from the building process, rules, and sizes, to the development of its form and typology, a Bugis house cannot be seen as a mere embodiment of the cosmological concept, but also an embodiment of form that implements scientific knowledge. This is indicated by the various patterns of Bugis' traditional houses formed from an ethnomodelling point of view as a result of humans knowledge to the context and the environment in which they inhabit.

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1. Introduction

In a certain indigenous group, the notion of house can also be interpreted as a form of cultural identity so that the form between each house and another has a function, spatial pattern, variety of ornaments, and different characteristics according to local culture. Due to the close relationship with the environment and natural resources, local (or traditional, or indigenous) people, through "trials" have developed an understanding of the ecological system in which they live and adapt while maintaining their natural resources (Mitchell in Rosyadi, 2015).

However, the discussion about traditional houses is never separated from cultural viewpoint. As a result, the traditional houses and how to build them is confined by tacit intangible knowledge which is always merely explained at the philosophical and cosmological ways (Pangarsa, 2006; Naing, 2021). Needs an effort to decolonize this knowledge so that this cultural wisdom can be explained explicitly. Decolonization can be

interpreted as a liberation effort which in a cultural context is aimed at liberating ways of thinking by involving assessment and revitalization of knowledge in order to get rid of biases or assumptions that have influenced the existence of indigenous peoples (Alfred and Corntassel, 2005).

Based on previous research, the shape of the Bugis traditional house is often described as the embodiment of the basic knowledge of non-physical (intangible) such as culture, beliefs, and principles of the Bugis people (Ismail, 2012; Hartawan, *et al*., 2015a-b, Abidah, 2021). Beddu (2010) said that the shape of the Bugis traditional house is an implementation of the community's way of life. It also represents the concept of macrocosm and microcosm space (Abidah, 2010; Musdaria, 2018; Wardiman, 2020; Naing, 2021). When these two concepts are related and influence each other, it is believed that they will create harmony and balance, both in terms of functional, proportional, aesthetic, and structural.

However, as seen from the building process, rules, and sizes, to the development of its form and typology, Bugis traditional houses cannot be seen as merely an embodiment of the cosmological concept but also a form that implements scientific knowledge. Therefore, through ethnomathematical reconstruction (D'Ambrosio, 2006; Barta and Shockey, 2006; Rosa and Orey, 2015; 2018; Orey and Rosa, 2021), this research aims to find the explicit knowledge beyond the formation of various patterns of Bugis traditional houses from an ethnomathematical point of view and make it conceivable to measure and interpret them in different contexts through mathematical principles. Through this approach, it is hoped that several factors that affect the shape can be seen, such as climate, geography, natural environment, material requirements, costs, and others.

Based on this hypothesis, this study reconstructs various patterns of Bugis traditional houses using photograph documentation belonging to the Koninklijk Instituut voor Taal, Land-en Volkenkunde (KITLV) through ethnomathematical study approach, in order to understand the relationship between mathematical models and cultural anthropology of Bugis traditional houses critically through history, point of view, and patterns of thought of the people themselves. This study focuses on the pattern of the facades of the Bugis traditional house since the data displayed by the KITLV photo documentation in the period around 1880 - 1953 as the research sample only shows the front part of the Bugis house. The use of documentation during this period was based on the consideration that the shape of the house at that time was still strongly influenced by aspects of culture, beliefs, principles of life, social strata, still used materials from the local natural environment, and had not undergone significant changes.

2. Method

This research generally uses a qualitative evaluative approach by trying to understand the various forms of Bugis traditional houses using mathematical principles and then describing their relationship with aspects of local wisdom through ethnomathematical studies. First, data collection was carried out using a purposive sampling technique from the documentation of Bugis houses on the KITLV website at *digitalcollections.universiteitleiden.nl*.

Based on predetermined criteria, such as the clarity of the picture of the house and its location in Celebes (the name of Sulawesi in the colonial era), at the data collection stage, this research obtained five images of Bugis traditional houses published around 1880-1953 as samples (see Table 1). The data is then presented by giving the alphabetical

code "D" which stands for "Documentation" and numbering according to the order of publication year in each object of study.

Table 1. List of images of Bugis traditional house objects

Code	Object Documentation	Source	Title	Author	Doc. Number	Year	Doc. topic	Location
D1		hdl.handle.net/1887.1/item:790914	*Woning van de sultan van Goa, I-Koemala, ook Abdoelkadir Moehammad Aidid genaamd, die regeerde van 1844 tot 1893, ten zuiden van Makassar*	Wood-bury & Page (Batavia)	KITLV 3376	Setelah 1880	Houses Sultanates	Gowa, Sulawesi Selatan
D2		hdl.handle.net/1887.1/item:852982	*"37. Passantenhuis (Roema Sobat) te Makassar.", Pasanggrahan te Makassar*	Stoomdrukkerij Celebes (Makassar)	KITLV 1403252	Sekitar 1910	Pasanggrahan	Makassar, Sulawesi Selatan
D3		hdl.handle.net/1887.1/item:765732	*Voormalige woning van de radja van Boni te Makassar*	-	KITLV 34227	Sekitar 1915	Houses Sultanates	Makassar, Sulawesi Selatan
D4		hdl.handle.net/1887.1/item:781936	*Inheemse woning te Makassar*	-	KITLV 5945	Sekitar 1920	Houses	Makassar, Sulawesi Selatan
D5		hdl.handle.net/1887.1/item:830856	*Terrein van de sultan van Goa, ten zuiden van Makassar*	-	KITLV 163420	Sekitar 1941 — 1953	Sultanates	Gowa, Sulawesi Selatan

The process of identifying and analyzing research data begins with 2D tracing the facades of each image of the object. In the next stage, the tracing image is then identified and analyzed for the pattern-forming elements of the facades through a theoretical review of previous studies, especially a review of the Bugis house size determination in Shima

(2006) and Sani, et al. (2015), as well as anthropometric data from the Bugis on the *antropometriindonesia.org* site. After the size and detail of the elements that make up the pattern of the Bugis traditional house are determined, then finally the tracing results from the façade of each house are reconstructed into a two-dimensional modeling image to be compared with each other and linked to the Bugis cultural context.

3. Results and Discussion

The Bugis traditional house contained in the KITLV archive is a residential building for the Bugis community which was documented around 1880 – 1953, so the shape of the house is still strongly influenced by culture, belief, life principles, social strata, and uses materials from the local natural environment which are then symbolized in a unique and distinctive rectangular house pattern. The shape of the rectangular pattern is a consequence of the different sizes used in the width and length of the house, which is based on the size of the couples (husband and wife) that inhabit the house.

According to Shima (2006:40), the shape of the house is a representation of the cosmos (the upper world-*Boting langi*; the middle world-*Ale Kawa*; the underworld-*Buri Liung*) and also the human body consisting of the head, body and legs (figure 1). Therefore, this representation is also related to the size of the human body (occupants) on the size of the house. The measurement system commonly used is *Reppa* or *Depa* (measurement along the length of both hands from the tip of the middle finger of the left hand to the right hand) (figure 2). For the length of the house, the husband's *depa* is used, while the width is the wife's *depa*.

For the size of the *awa bola* and *alle bola* sections of a Bugis house, the height between the ground and the floor of the house is 1½ times the husband's height and the height between the floor of the house to the rakkeang plinth is 1½ times the wife's height (Shima, 2006:41), or for *saoraja/bola soba*, the height of *awa bola* is 1,4 times the husband's height and the height of the *alle bola* is 3 times the wife's height (Sani et al, 2015). Meanwhile, based on anthropometric data on the antropometriindonesia.org site (in centimeters), the average *depa* size of Bugis women is 162.5 cm, the average height of Bugis men is 165 cm, and the average height of Bugis women is 153 cm.

Figure 1. Cosmological representation and humans in the Bugis house

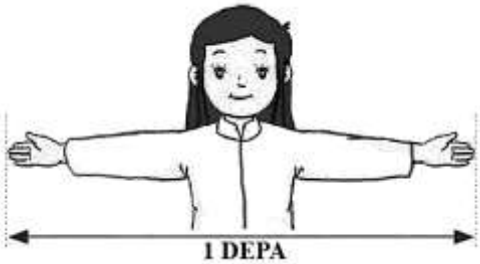

Figure 2. Measuring 1 *depa* (*reppa*)

Table 2. Bugis house measure

House's parts	The size of the house is associated with the size of the husband/wife (Shima, 2006:41-65)	Associated with the size in *antropometriindonesia.org*
		Depa Bugis female = 1,625 m Average Bugis male height = 1,65 m Average Bugis female height = 1,53 m
House's length (side part of the house)	Odd multiples of the husband's *depa* size	Usually 9 x husband's *depa*
House's width (house façade)	Odd multiples of the wife's *depa* size	Usually 7 x wife's *depa* = 11,375 m
Height under the house (*Awa-Bola*)	1½ x husband's height	1,5 x 1,65 m = 2,475 m
The height of the walls (*Ale-bola*)	1½ x wife's height	1,5 x 1,53 m = 2,295 m

(Source: Shima, 2006 and assumptions of *antropometriindonesia.org*)

Based on the measurements above, the analysis of the five samples of Bugis houses is carried out as follows.

Ethnomathematical study of Bugis House D1

House D1 is a photographic documentation of a Bugis traditional house located in Gowa, South Sulawesi, and published around 1880. In the façade, the elements forming the front view of the D1 house consist of a gable shape characteristic of a five level *timpak laja* on the *rakkeang*. It has seven support poles at the awa bola, five windows, a door, and an additional space called *lego-lego* and *sapana* that is used as an intermediary room before the entrance to the *alle bola* section (Figure 3).

Figure 3. D1 image and tracing
(Source: hdl.handle.net/1887.1/item:830856)

Based on the analysis, it is known that the width of the *alle bola* house D1 is 6 times 1,625 m or about 9,75 m, the height of the *awa bola* is 2,3 meters, the height of the *alle bola* is 4,6 m, and the width of the *lego-lego* and *sapana* is 162,5 cm or equivalent to the width of one wife's *depa*. Meanwhile, the width of the *rakkeang* base is 4 wife's depa or about 6,5 meters, the height of the *rakkeang* is ½ times the width of the *rakkeang* base which is around 3,25 m, and the area of the *rakkeang* is 10,56 m^2.

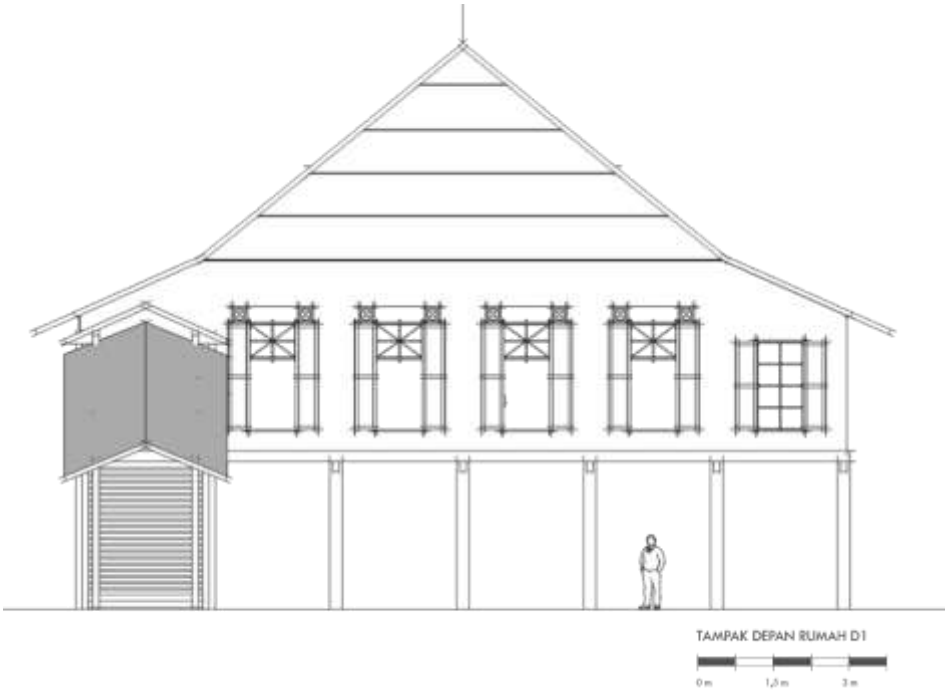

Figure 4. 2D façade model of D1 image

Ethnomathematical study of Bugis House D2

House D2 is a photographic documentation of a Bugis traditional house located in Makassar, South Sulawesi and published around 1910. In the façade, the elements that make up the D2 house consist of a saddle roof with three-level *timpak laja* on the *rakkeang* section, has five support poles at the *awa bola*, three windows, a door, and an additional space called *sapana* before the entrance to the *alle bola* section (Figure 5).

Based on the analysis, it is known that the width of the *alle bola* house D2 is 4 times 1,625 m or about 6,5 m, the height of the *awa bola* is 2,5 m, the height of the *alle bola* is 2,3 m. Meanwhile, the width of the *rakkeang* base is same to the width of the *alle bola* or about 6,5 m, the height of the *rakkeang* is ½ times the width of the *rakkeang* base which is around 3,25 m, and the area of the *rakkeang* is 10,56 m^2.

Figure 5. D2 image and tracing
(Source: hdl.handle.net/1887.1/item:830856)

Figure 6. 2D façade model of D2 image

Ethnomathematical study of Bugis House D3

House D3 is a photographic documentation of a Bugis traditional house located in Makassar, South Sulawesi and published around 1915. In the façade, the elements that make up the D3 house consist of a saddle roof with five-level *timpak laja* on the *rakkeang* section, has five support poles at the *awa bola*, four windows, a door, and an additional space called *sapana* before the entrance to the *alle bola* section which is located separately from the main house (Figure 7).

Based on the analysis, it is known that the width of the *alle bola* house D3 is 4 times 1,625 m or about 6,5 m, the height of the *awa bola* is 2,3 m, the height of the *alle bola* is 4,6 m, and the width of the lego-lego and sapana is 1,625 m or equivalent to the width of one wife's *depa*. Meanwhile, the width of the *rakkeang* base is same to the width of the *alle bola* or about 6,5 m, the height of the *rakkeang* is ½ times the width of the *rakkeang* base which is around 3,25 m, and the area of the *rakkeang* is 10,56 m^2.

Figure 7. D3 image and tracing
(Source: hdl.handle.net/1887.1/item:830856)

Figure 8. 2D façade model of D3 image

Ethnomathematical study of Bugis House D4

Figure 9. D4 image and tracing
(Source: hdl.handle.net/1887.1/item:830856)

House D4 is a photographic documentation of a Bugis traditional house located in Makassar, South Sulawesi and published around 1920. In the façade, the elements that make up the D4 house consist of a saddle roof with two-level *timpak laja* on the *rakkeang* section, has five support poles at the *awa bola*, three windows, an additional space called *tamping,* a door at the *alle bola* section (Figure 9).

Based on the analysis, it is known that the width of the *alle bola* house D4 is 4 times 1,625 m or about 6,5 m, the height of the *awa bola* is 2,5 m, the height of the *alle bola* is 2,3 m. Meanwhile, the width of the *rakkeang* base is 3 times of wife's depa or about 4,9 m, the height of the *rakkeang* is ½ times the width of the *rakkeang* base which is around 2,44 m, and the area of the *rakkeang* is 5,98 m^2.

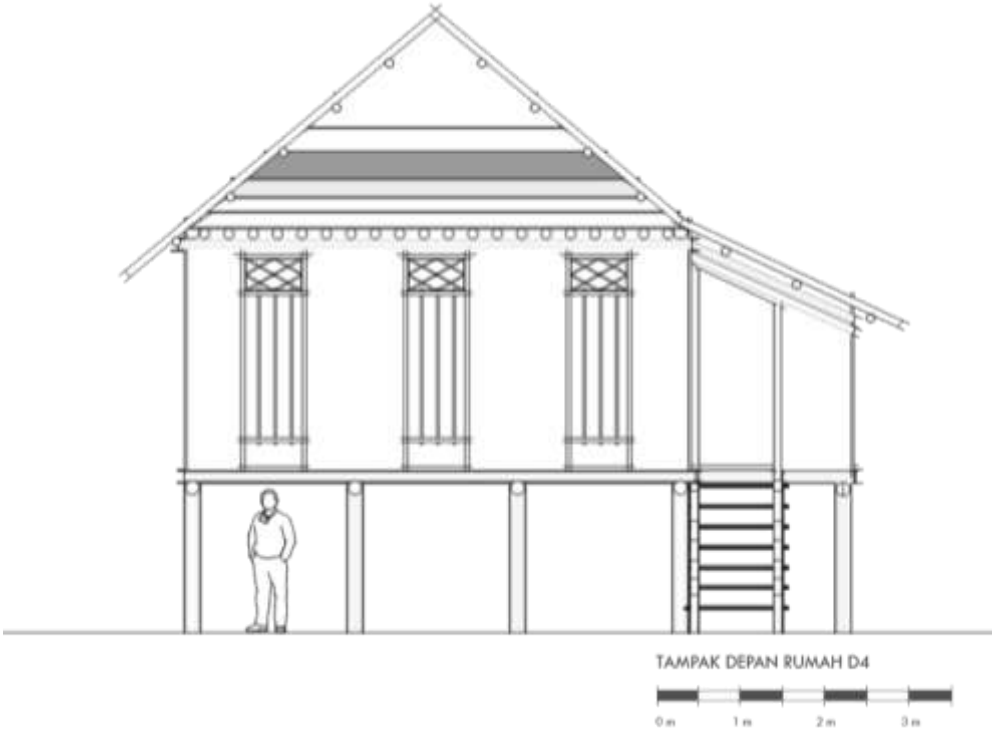

Figure 10. 2D façade model of D4 image

Ethnomathematical study of Bugis House D5

Figure 11. D5 image and tracing
(Source: hdl.handle.net/1887.1/item:830856)

House D5 is a photographic documentation of a Bugis traditional house located in Gowa, South Sulawesi and published around 1941 – 1953. In the façade, the elements that make up the D5 house consist of a saddle roof with three-level *timpak laja* on the *rakkeang* section, has five support poles at the *awa bola*, three windows, a door, and an additional space called *sapana* that is used as an intermediary room before the entrance to the *alle bola* section (Figure 11).

Based on the analysis, it is known that the width of the *alle bola* house D4 is 4 times 1,625 m or about 6,5 m, the height of the *awa bola* is 2,5 m, the height of the *alle bola* is 2,3 m. Meanwhile, the width of the *rakkeang* base is 3 times of wife's depa or about 4,9 m, the height of the *rakkeang* is ½ times the width of the *rakkeang* base which is around 2,44 m, and the area of the *rakkeang* is 5,98 m^2.

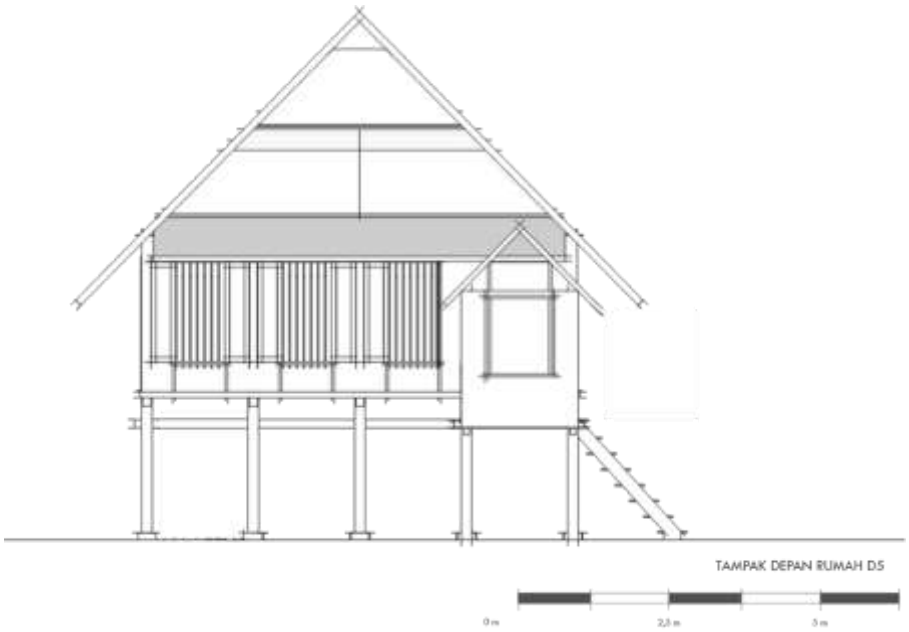

Figure 12. 2D façade model of D5 image

Based on the results of the analysis of the five objects, the synthesis of the differences in the façade between one Bugis house and another based on the characteristics of the *timpak laja* level as follows (Table 3).

Table 3. The difference in the shape pattern of the façade of the Bugis house related to the number of *timpak laja*

Aspects	***Amount of Timpak Laja***		
	2 Level	**3 Level**	**5 Level**
Number of poles (*Alliri*)	5 poles	5 poles	6 or 7 poles
Number of openings (windows + doors)	3 windows and 1 entrance door	3 windows and 1 entrance door	4 windows or 5 openings and 1 entrance door
House's width	4 x *depa's* wife	4 x *depa's* wife	4 or 6 x *depa's* wife
Total area of *Rakkeang*	5,98 m^2	10,56 m^2	10,56 m^2
Additional space/chamber	No additional space	At least it consists of *lego-lego* or *sapana*	Consists of *lego-lego* and *sapana*

From the size comparison between houses D1 to D5, it can be concluded that house D1 is the largest and D5 is the smallest house (D1 > D3 > D2 > D4 > D5). This is based on the width which refers to the standard *depa* size of Bugis woman (wife). In ancient times, before the introduction of metric measures, the *depa* size was a standard measure used in

determining distance because it was related to determining the proportions and ergonomics of occupants.

To get a proportional house shape, the width of the house also determines the height of the house. As seen in houses D1 and D3, to balance the width of the *alle bola* (house body) be proportional, it takes a towering top (*rakkeang*). With the larger opening of the front *rakkeang*, a structure that can bind/resist the slope of the roof is also needed. This part of the retaining structure which is then called *timpak laja* is what according to Bugis culture represents the social strata of its inhabitants. From the results of the analysis, it can be said that houses D1 and D3 are houses with residents from among the nobility, while the houses D2, D4, and D5 are homes of residents from among the common people.

Large houses usually function to accommodate the needs and the number of occupants in them. The bigger the house, the more the material is needed. Bugis houses made of wood, of course, must also optimize wood processing techniques. The bigger the house, it also has consequences on the selection, processing, and woodworking processes that must be good too. In addition, the bigger the house, the more wood material of good quality is needed. Thus, the manufacturing process requires substantial funding. Not to mention the enhancing decoration in the house which of course requires the ability of a qualified craftsman. It is not surprising that houses owned by nobles (especially kings) have very beautiful and attractive decorative elements. Very different from the houses owned by ordinary people which are very simple and do not even have decorations or ornaments. For the Bugis, ornaments and home decorations are an inseparable part of the actualization of the status of the occupants as well as a form of effort to harmonize oneself with the universe. From the view of the study object's house, it can be seen that the visualization of houses D1 and D3 requires ornamentation on the facade.

From the previous explanation, the dimensions of the house are closely related to the resources involved in the construction process. The wood material used in the homes of nobles and kings certainly uses the best materials such as first-class wood. The location and availability of this material are of course very remote and limited, so it takes a lot of human labor to process and move this wood. It can be seen that the price to be paid by the owner will be higher. In contrast to houses owned by ordinary people who only rely on ordinary wood materials with small dimensions because they only support the dimensions of a small and simple house.

Formally most of the Bugis people embrace Islam, but in daily practice, there are many elements of tradition that still color their lives. Every traditional house establishment always tries to harmonize with the surrounding nature, according to the manners of placing oneself, based on the religious practices or the axis of the earth (axis Mundi). It is not surprising that from earlier until after a Bugis house was built, a series of traditional ceremonies were carried out to celebrate the process and at the same time avoid misfortune. All of these things are in the framework of a goal that refers to cosmic harmony towards situations and conditions that are completely reassuring, prosperous, and happy for the inhabitants. The embodiment of this concept appears in the form of uniqueness in every Nusantara's house (Cecep in Rosyadi, 2015).

Figure 13. Explicit analysis of Bugis houses based on ethnomathematical descriptions of local tacit knowledge

4. Conclusions

Differences in shape, dimensions, number of poles, or many openings of the five objects studied are known to occur due to physical factors, such as the need to accommodate the occupants of the house which encourages residents to add space for additional activity functions. The consequences of these needs encourage the occupants of the house to adjust the shape of the house. Based on the results of the analysis, it can be concluded that houses D1 and D3 are noble houses (or kings) while houses D2, D4, and D5 can be alleged to be homes for ordinary people. For ordinary people, a simple house with small dimensions is certainly enough. Things are different for residents from the nobility, or even kings, who need a large house to accommodate their activities and the number of their relatives.

A big house, of course, requires a lot of materials as well. To compensate for the dimensions of the wide body of the house, it takes the form of a roof and legs that are both proportional and strong. At the foot or pole of the stage, it takes a lot of strong wood material. Likewise, on the roof, strong wooden material is also needed that can withstand the gable plane. It is not surprising that in the gable opening of the Bugis house a lattice is found which is commonly referred to as *timpak laja*. For Bugis people, the *timpak laja* is often associated as a symbol of the house owner's status, with the more *timpak laja* the house is, the higher the status of the owner. However, when viewed from the side of explicit knowledge by examining the size of the house and the needs of its owner, it can be concluded that the symbolization of the status of the house's occupants with the number of *timpak laja* is part of the intelligence of the occupants in utilizing the potential of the surrounding environment.

The wood material used by the larger house must of course be stronger and generally this type of material is taken from remote and distant places inside the forests. Because of the large costs incurred to meet these needs, houses with the characteristic shape of five *timpak laja* (or more) are often referred to as houses of the nobility. Meanwhile, a Bugis house with the characteristics of a two-level timpak laja with a smaller building width dimension and a simple shape is said to be an ordinary people's house. The condition of the natural environment and historical and spiritual experiences have provided lessons for the Bugis people to use and utilize the various potentials of the

natural environment around them for the benefit of building their settlements. This knowledge is passed down from one generation to the next and then develops into a tradition.

This is the importance of efforts to decolonize tacit knowledge which still clings to traditional architectural knowledge. This is an attempt to straighten out our frame of reference to local wisdom as well as to consider what we need to do to change misunderstandings, prejudices, and assumptions about the products of indigenous peoples that actually have the opportunity to be transformed into contemporary forms.

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