The concept of equilibrium of tough objects in saoraja lapinceng traditional house in barru regency.

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Abstract. The Saoraja Lapinceng traditional house in Barru Regency has social, cultural and religious values. In addition, this traditional house has a physical value, namely the concept of rigid body equilibrium. The research objective is to analyze the concept of rigid body equilibrium at the Saoraja Lapinceng traditional house. The research method used is the traditional review. Data obtained from journals, books, and websites that are relevant to this research, which are then reduced, presented, verified, and conclusions drawn. Based on the results of the research, it is obtained: (1) The support poles (Aliri) in the main building are rectangular in shape following the Bugis Sulapa Appa philosophy and an odd number with the total force and torque acting on the poles equal to zero, the support poles cause the main building to not move (balance). (2) The foundation of the umpak (Pallangga) is rectangular and has an odd number of values of life and death for the Buginese community where Pallangga functions to make Aliri immobile (balance). (3) Attic support (Pattolo) following the width of the house gives Aliri and Arateng a style which is the same as the force received by Pallangga, thereby helping Aliri to balance the main building. (4) Floor support (Arateng) functions to connect Aliri with other Aliri in the long direction of the house so that the force and torque to the main building body are equal to zero (balance). (5) The stairs (Addengeng) are made with a slope of 30° to 45° from Aliri, so that the vertical force from the floor and the horizontal force from the wall, balances the ladder when given Addengeng’s load.

1. Introduction

The traditional house of Saoraja Lapinceng is the royal palace of Balusu established by balusu king Andi Muhammad Saleh Daeng Parani Arung Balusu in 1879 [1], [2]. This house has social, cultural and religious values such as vertical spatial arrangement based on the social status of the community and gender of the residents (Wasilah and Hildayanti, 2016), the arrangement of this house is also kai with the concept of Islam namely Habluminallah, Habluminannas, Habluminal'alam [3].

In addition to the above values, saoraja lapinceng traditional house also has physics values that can be used as an approach to learning. The learning process is expected to shape the character of the nation according to identity based on national culture, increase learning motivation, and facilitate students in receiving physics materials [4],[5]. One of the physics values contained in Saoraja Lapinceng is the equilibrium of tough objects. The equilibrium of a strong object can be interpreted as equal or balanced in strength. Mathematically the condition of the object is said to be balanced i.e. the net force is equal to zero and all torque that works together with zero [6] can be said to be not moving or moving constantly.

Saoraja Lapinceng traditional house has been established since 141 years and did not move or collapse until now, meaning intentionally or not the traditional house of Saoraja Lapinceng was designed with the concept of equilibrium of good objects. From the description, it is necessary to analyze the concept of equilibrium of tough objects in the traditional house of Saoraja Lapinceng. The writing method used is traditional review: Data is...
obtained from journals, books, and websites relevant to this study, which are then reduced, presented, verified, and drawn conclusions. The results of the analysis of the concept of equilibrium of objects is expected to be used as a learning approach and introduce saoraja lapinceng traditional house in Barru Regency to the community.

2. The Concept Of Equilibrium

Any object that cannot change the shape and location of the particles that make up it is called a tough object \[7\]. Tough objects can transact and or rotate when given force or torque against a shaft \[8\]. The shaft of objects in moving rotation can be a heavy point \[9\]. The weight point of an object is narrowed to its center of mass if the object is in a homogeneous gravitational field.

Equilibrium comes from the latin *equilibrum* which means equal or balanced strength. The equilibrium of a tough object according to \[6\] has two conditions, namely, for a solid object to be balanced each component of the net style equal to zero. In addition to its zero net style, the amount of all torque that works on all objects calculated against any bu sum, should be zero.

The inner objects in parts of the building have various shapes, so that in equilibrium according to \[10\] is codified in three categories namely stable equilibrium if the torque or force that arises due to the small displacement of the object forces the object back towards the equilibrium position equilibrium (when forces or torque arises arise due to a small displacement of an object forcing an object away from its equilibrium position), and neutral equilibrium (if the force imposed on an object does not change the center of gravity of the object).

3. Components Of Saoraja Lapinceng

Saoraja Lapinceng traditional house as one of bugis traditional houses designed and managed by a Panrita Bola \[11\], Panrita Bola from this traditional house is from Wajo \[3\]. Panrita bola as an architect without going through formal architecture education is able to play a role in the construction of traditional houses and rely more on intangible knowledge \[12\]. Saoraja Lapinceng traditional house has components such as support pole (Aliri), foundation umpak (Pallangga), attic buffer (Pattolo'), floorsupport (Arateng), and stairs (Addengeng).

![Figure 1. Support Pole (Aliri)](source: [3])

According to \[12\], [3] who examined the "buffer pole (Aliri)" stated that the wood to make Aliri was chosen from the type of bitti wood and formed a square following the philosophy of Bugis *Sulapa Appa* which means the balance of life. The number of poles in the traditional house of Saoraja Lapinceng is 9 Aliri in the front building, 35 on the main building, 22 on the back building, and including 1 posi' ball (central pole) which is considered the center of everything. This is our basis in determining the concept of physics related to the object of study. The height of the house, the distance between kolong, and the center of the house according to *Panrita ball is determined* based on a special ritual. However, there can be an in-depth study of the concept of physics about force (F) and heavy force on the concept of equilibrium of a hard object (Figure 6). When the building does not collapse or is silent, then the structure of each element of the building provides a reactive style that creates the equilibrium of the building \[13\],[14].
Figure 2. Foundation of Umpak (Pallangga)
Source: [3]

For the next component, Pallangga according to [15], [3] stated that Pallangga was placed on the ground in the form of a rectangular stone. This foundation is usually reserved for nobles only. Based on the results of our review, Pallangga deals with the concept of torque and total working force (Figure 7). Torque in buildings is defined as the load that causes buildings to rotate, and the force in the building is defined as the load that causes it to move straight [16], [17].

Figure 3. Pattolo' Attic Stand
Source: [3]

According to [18] which examines Pattolo' connecting between Aliri on the width of the house should have an odd amount of death and life value for the bugis community. Based on our study, the concept of torque and associated force in this component (Figure 8).

Figure 4. Stairs (Addengeng)
Source: [3]

The next component is the stairs (Addengeng). According to [15], [18], [3] stated that the stairs are made with a slope of 30 to 45 from Aliri, the number of stairs selected is always odd, the stairs are tightly arranged and wide. According to the results of our review analysis, the odd amount relates to the center of mass on the concept of equilibrium of a tough object (Figure 10).

Figure 5. Floor Support (Arateng)
Source: [3]

According to [18], [3] Arateng were installed following the long direction of the house to connect Aliri and other Aliri, the distance between the upper and lower peg holes in the selected column is always odd. Based on the results of the research review analysis that the distance of the central hole can be reviewed with the concept of torque and total force working on arateng (Figure 9).

4. The Concept Of Equilibrium Of Tough Objects In The Traditional House Of Saoraja Lapinceng

Based on the analysis of the concept of equilibrium of hard objects on the components of saoraja lapinceng traditional house in Barru Regency, it was obtained that:

1. Support pole (Aliri)
Aliri gives style to the body of the house has the same value as the style that Aliri received from the body of the house and the central pole or *posi ball propping up* the center of the mass of the house.

2. **Foundation of umpak (Pallangga)**

![Foundation Diagram (Pallangga)](image)

Pallangga styled the pole with the same value as the style received by Pallangga and Pallangga styled the land of the same value as the style received by the foundation from the ground.

3. **Pattolo’**

![Attic Buffer Diagram (Pattolo’)](image)

Pattolo’ style on the pole is the same as *pattolo’s from* the pole and Pattolo’ style to Arateng which is equal in value to the style received by Pattolo’ from Arateng.

4. **Arateng**
5. Stairs (Addengeng)

Addengeng accepts the style of the floor as well as the style of Pattolo', the vertical style of the floor against the stairs is balanced by the heavy force of the stairs, while the horizontal style of the wall against the stairs is balanced by the force of the swipe of the stairs against the floor.

References
[1] E. Hariansah, ‘Rumah Adat Bugis Di Berbagai Daerah (Sejarah, Keunikan, dan Gambar)’, NEHANESIA, Jul. 17, 2018. https://nehanesia.com/rumah-adat-bugis/ (accessed Aug. 25, 2020).
[2] Wasilah and A. Hildayanti, ‘Filosofi Penataan Ruang Spasial Vertikal Pada Rumah Tradisional Saoraja Lapinceng Kabupaten Barru’, Rev. Urban. Archit. Stud., vol. 14, no. 2, pp. 70–79, Dec. 2016, doi: 10.21776/ub.ruas.2016.014.02.7.
[3] Zulkarnain and A. Hildayanti, ‘INTEGRASI KONSEP ARSITEKTUR ISLAM PADA RUMAH ADAT SAORAJA LAPINCENG KABUPATEN BARRU’, Nat. Natl. Acad. J. Archit., vol. 5, no. 1, pp. 1–12, Jun. 2018, doi: 10.24252/nature.v5i1a1.
[4] M. Randy and A. E. Fananta, Materi Pendukung Literasi Sains. Jakarta: Kementerian Pendidikan dan Kebudayaan, 2017.
[5] H. A. R. Tilaar and Mukhlis, Pendidikan, kebudayaan, dan masyarakat madani Indonesia. Remaja Rosdakarya, 1999.

[6] D. C. Giancoli, ‘Fisika: Prinsip dan Aplikasi Edisi ke 7Jilid 1’, Jkt. Erlangga, 2014.

[7] R. A. Serway, J. W. Jewett, and W. John, ‘Fisika untuk Sains dan Teknik Buku 2’, Salemba Tek., 2010.

[8] D. Halliday, R. Resnick, and K. S. Krane, Fundamentals of physics, extended edition, Vol. 2. Wiley, 1992.

[9] M. Abdullah, ‘Fisika Dasar I’, Bdg. Inst. Teknol. Bdg., 2016.

[10] E. Trisnowati, R. Niza, and F. Ismiyatun, ‘ANALISIS KESETIMBANGAN BENDA DENGAN HUKUM I NEWTON’, SPEKTRA J. Kaji. Pendidik. Sains, vol. 3, no. 2, pp. 122–129, 2017.

[11] N. Nawawi, ‘TEKNOLOGI MEMBANGUN RUMAH BUGIS MENURUT PANRITA BOLA UGI’, TEKNOSAINS MEDIA Inf. SAINS DAN Teknol., vol. 14, no. 1, Mar. 2020, doi: 10.24252/teknosains.v14i1.12943.

[12] S. Beddu and Muh. T. Ishak, ‘Arsitek Arsitektur Tradisional Bugis’, Laporan Penelitian, 2009.

[13] V. Kapila and S.-H. Lee, ‘Science and mechatronics-aided research for teachers’, IEEE Control Syst. Mag., vol. 24, no. 5, pp. 24–30, 2004.

[14] E. J. Hearn, Mechanics of Materials 2: The mechanics of elastic and plastic deformation of solids and structural materials. Elsevier, 1997.

[15] S. Rosyidah, ‘TRADITIONAL ARCTECTURE CONCEPT OF HOUSE BUGIS OF WITH THE ACCOMPLISHMENT OF DWELLER REQUIREMENT’, Universitas Hasanuddin, Laporan Penelitian, 2009.

[16] W. J. Spencer, Fundamental structural analysis. Macmillan International Higher Education, 1988.

[17] R. Serway and J. Jewett, Physics for Scientists and Engineers, Volume 2, Chapters 23-46. Nelson Education, 2010.

[18] Hartawan, B. Suhendra, E. Pradipto, and A. Kusumawanto, ‘Perubahan Sistem Struktur Bangunan Rumah Bugis Sulawesi Selatan’, Forum Tek., vol. 36, no. 1, p. 12, 2015.