International Journal of Architecture and Urbanism Vol. 04, No. 03, 2020 | 311 – 322

Medan Nature School with the Application of Energy Saving Ecological Architecture

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Abstract. Schools in Indonesia are conventional schools where students and teachers do activities which are commonly referred to as teaching and learning activities even though the school is not a place to lure students with stacks of information but also to train in terms of maturity of thinking and maturity of attitude. Now has developed a nature school that uses nature as a learning space, media, and teaching materials and learning objects that can take advantage of nature and can preserve nature for the next life. However, Medan only has a few nature schools. This nature school design uses the problem-solving methodology approach to solve existing problems, starting from the formulation stage, data collection, analysis to synthesis using survey techniques, interviews, literature studies, and comparative studies. So, through the design of Medan Nature School is expected to be able to educate students who emphasize education, character, and skills with the Ecological Architecture design approach where school buildings can maintain the environment to be sustainable, related to the plantation system, animal husbandry system, utility system, circulation systems, building design, and layout.

Keyword: ecological architecture, nature school, school

Received date month year. | Revised 3 October 2020 | Accepted 17 November 2020

1 Introduction

School is a determining factor for the developing personalities in how they think, behave, and behave in a better direction. The schools that we often encounter in Indonesia are conventional schools where students and teachers carry out activities, commonly called teaching and learning activities, with teachers providing and explaining lessons. Students only get knowledge through books and teachers in the classroom for about six hours without directly practice in the field. Most of the schools in Indonesia apply conventional learning models, and this causes the atmosphere in the classroom tends to be teacher-centered so that students become very passive because they only look and listen. Students do not get a learning model that can help them understand the subject matter, learn about various materials, think creatively, and motivate

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ISSN: 2622-0008 e-ISSN: 2622-1640 | DOI: 10.32734/ijau.v4i3.5043
Journal Homepage: https://talenta.usu.ac.id/ijau

them. The school is not a place to spill students with a pile of information but also train in terms of maturity of thinking and maturity to behave [1]. That is what is not paid attention to by schools in Indonesia in general. Now has developed a natural school that uses nature as a learning space, media, and teaching materials and learning objects.

The role of natural schools in Indonesia is fun for students in fun learning without being burdened and can be a second home for students. Natural schools can also function as alternative education for parents who want their children to develop not only in terms of theory but also soft skills. The natural school also has a goal to be able to discuss how to use nature and preserve nature for the next life, given how we deal with quite severe problems such as environmental problems, global warming, and other damage to nature. Hence the school needs to teach students about some life skills to respect and respect nature in which we ordinary life. All of the roles mentioned earlier can be said to be natural schools as a place of education that is fun, environmentally friendly, and appropriate life skills compared to conventional schools in Indonesia, especially in Medan.

Instilling environmental awareness education and life skills is very important to do early and provide benefits in the future through this natural school. However, the fact is that there are still very few natural schools in Medan, namely four natural schools, namely Alam Semangat Bangsa School (Johor), Medan Nature School (Padang Bulan), Medan Raya Nature School (Pancur Batu), and Bukit Hijau Nature School (Tuntung).

The existence of natural school design in the city of Medan aims to educate students by emphasizing character education and skills with an Ecological Architecture design approach where school buildings can preserve the environment.

2 Literature Review

Natural school education adopts the Montessori education method and student-centered learning. This method emphasizes schools to try to create a pleasant atmosphere of teaching and learning so that the learning atmosphere is not tense, communication between teachers and students is also warm and also concerned with active learning, i.e., students do not focus on textbooks but experience firsthand what they learn, can pass experiments, observations and so on [2].

Whereas the student-centered learning method is a student-centered learning method. This method emphasizes the activeness of children in the learning process so that the teaching process here is no longer one-way only. However, it can also be two-way or more, depending on the learning needs at the time. There are times when the teacher explains; there are times when discussion takes place, and there are times when experiments or practical processes occur. Discussion can also divide students into small groups and large groups [3].

School of nature is one form of education that uses nature as the primary medium for student learning with active learning methods. The natural school education method emphasizes the desire of children as students to gain freedom of learning and satisfy their curiosity without being hindered by classrooms, clothing, school rules that "turn off" creativity, or teachers who are too regulating. Learning methods that exist in natural schools aim to not only students to pursue values but to be able to utilize and apply the knowledge they can in their daily lives. Learning without the threat of learning in the open will instinctively create a pleasant atmosphere without pressure and away from boredom so that the school becomes synonymous with excitement. The essence of learning can be well absorbed, learning at the initiative of students. So, students learn not only during school hours but also can learn from anything. At any time (active and independent learning); therefore, children are expected to be able to adapt to the ever-dynamic environment [4].

Meanwhile, the curriculum system implemented in natural schools is the morals curriculum that using the method of modeling, that is, the teacher exemplifies real character to students, the cognitive curriculum that using the spider web method, namely through the method of active learning, discussion and making nature a laboratory for students to learn directly from nature, the leadership curriculum that using the out-bound method as a learning medium, is the teacher doing practical out-bound activities with students and entrepreneurship curriculum that using market day or internship methods, so that students can interact with units, business people and the business environment, and can start a business early.

Besides, the curriculum system in natural schools uses the 2013 SD / MI curriculum system, which is almost the same as the learning methods in natural schools, namely the integrative thematic system. "Integrative thematic" curriculum is a learning process based on themes and then combined with existing subjects [5]. Thus, the use of materials in natural schools must be careful in their selection [6]. The material used must be environmentally friendly and not dangerous, especially for the health and safety of children. As well as the potential to be a source of learning for children. Along with the many negative impacts caused by development, then the right solution is needed to reduce the negative impacts on the environment caused by development. One of them is the application of ecological architecture. Ecological architecture is an environmentally sound development that has a role in maintaining the surrounding environmental ecosystem. The principles of ecological architecture in this design are responsive to the local climate, so the building must adapt to the influence of the climate at the location of the building. Buildings must be able to survive in any weather conditions, to support the activities that take place in it, as well as provide protection and comfort for its users. This adaptation is made through the use of plants and water as a climate regulator.

Every building needs the energy to support the activities that occur in it, so we need a substitution of renewable energy sources. There are two types of energy, namely renewable

energy and non-renewable energy. Buildings with the principles of Ecological Architecture must be able to minimize energy use, especially non-renewable or limited types of energy. One way to apply ecological architecture to buildings is to utilize more renewable energy effectively and efficiently and assist in the process of renewing that energy.

Then the use of materials that get manage. In the selection of building materials that will be used by buildings must pay attention to things like building materials must come from the local area, production must use as little energy as possible, as much as possible to renew natural resources used for building materials, and in the production, the process must not pollute the environment. The building must provide a source of energy and water to sustain the activities of users in it. Also, the building must provide a place for disposal of building materials and the resulting waste. It is necessary always to remember not to pollute the Surrounding Environment. The design must consider the supply of energy such as air, disposal of building materials, and waste disposal.

Moreover, the last one is the use of appropriate humane technology. In the process of making up to the building, maintenance must use appropriate technology. Appropriate technology includes three things, including environmentally friendly, economical, and social aspects. Environmentally friendly means that it does not require excessive and wasteful energy does not pollute the environment and does not damage the ecological cycle. The economic aspect means that the costs used are not too expensive. In social terms, appropriate technology must be humane and absorb labor [7].

Data and references obtained relating to the conceptualization of the School of Nature building in Medan, which includes data on natural schools that already exist, the condition of education in Indonesia, educational theory in natural schools, psychological theories of child education, psychological theories of children, data on how to create low-cost schools, learning strategies & methods, site selection strategies, space management, use of local materials, and recycling, data on kindergarten and elementary school level education facilities, data on local materials in Medan and cost-effective materials and recycled materials [8].

3 Methodology

The design carried out in the design of natural schools uses a problem-solving methodology approach aimed at solving existing problems, starting from the formulation stage, data collection, analysis to synthesis using survey techniques, interviews, literature studies, and comparative studies. The design phase consists of two phases. In the first phase, which is the data collection phase, to produce hypotheses. After that continued on the second phase, namely, the design phase, in this phase, produced a design to get the planning and design that best suits the concept [9]. Field Survey, they are namely conducting field studies conducted on selected

sites with observations and understanding of the character of the site regarding boundaries, problems, and existing potential. Make direct observations on buildings that have the same function or have similarities to the project to be designed and conduct question and answer with the manager of the natural school and other parties concerned with the project [10]. Thus, this method aims to be an effective way to get more subjective data to support project planning and design. The interview technique used is to compile a list of questions in advance. Direct observation through a visit to the Alam Semangat Bangsa School, Johor, Medan. In this school, students can learn and play from morning to evening (Figure 1). There are two types of classes, namely indoor and outdoor classrooms (Figure 2). There is other facilities like a library in Saung for students to learn and also a play area for students to do outdoor activities during breaks and after school (Figure 3).

Figure 1 School Activity

Figure 2 Kindergarten Classroom & Saung Classroom

Figure 3 Library and Out-bound Area

4 Result and Discussion

Programming

The need for space and supporting facilities activities at Medan Nature School requires a variety of indoor and outdoor spaces so that there are main buildings and supporting buildings. The primary function of the school is teaching, and learning activities carried out inside the building, namely the classroom and outside, namely the saung classes. Other supporting functions include school hall, canteen, animal husbandry area, plantation area, school field, and out-bound area. The school has a mini design with the aim of having a freer and more open impression by presenting lots of open spaces and outdoor classrooms to create a pleasant learning space that does not appear rigid.

Location Choosing

Schools must have natural environmental conditions that can support the Natural School learning methods. School location needs to consider several supporting aspects that are of particular concern and primary consideration in the Natural School program such as environment, close to river flow and easy to get water supply, having agricultural areas such as rice fields, fields, and aquaculture ponds, the land has lush trees. It is a green area, contoured land conditions with low slope, the air condition at the site is still clean. The area is still beautiful and clean, and adequate infrastructure makes it easy to reach the site. The location of the School of Nature is close to the planning of residential areas and academic environment [11].

Medan city is the location of design because there are still a few natural schools in Medan while the number of interesting ones is increasing every year. The design land is at a suburb of Tuntung Regency with a land area of 2 Ha with a distance of +/- 13 km from the center of Medan (Figure 4), measured using Google Earth located on the edge of the city. Belawan River with land in the form of vacant land (Figure 5) and bordering residential areas.

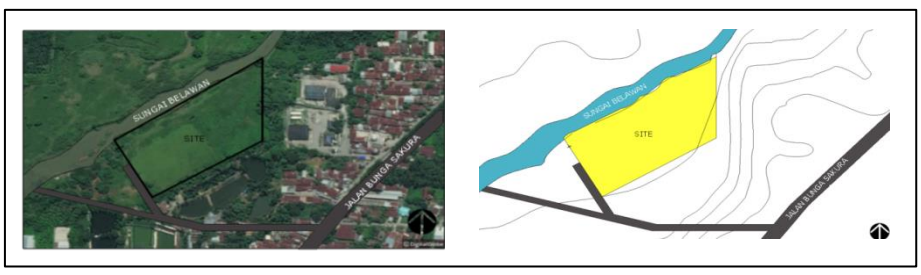

Figure 4 Site Location

Figure 5 Location Existing

Zoning

There are four areas in the natural school area, namely public, semi-public, private, and out-bound areas. Public areas function as parking lots to meet the parking needs of staff and employees who work and the parking needs of school visitors (Figure 6). The semi-public area is a school hall that can be used as a multipurpose room to hold various events. The private area is a school building for teaching and learning activities and other supporting facilities such as saung class, canteen, plantation area, livestock area, and out-bound area.

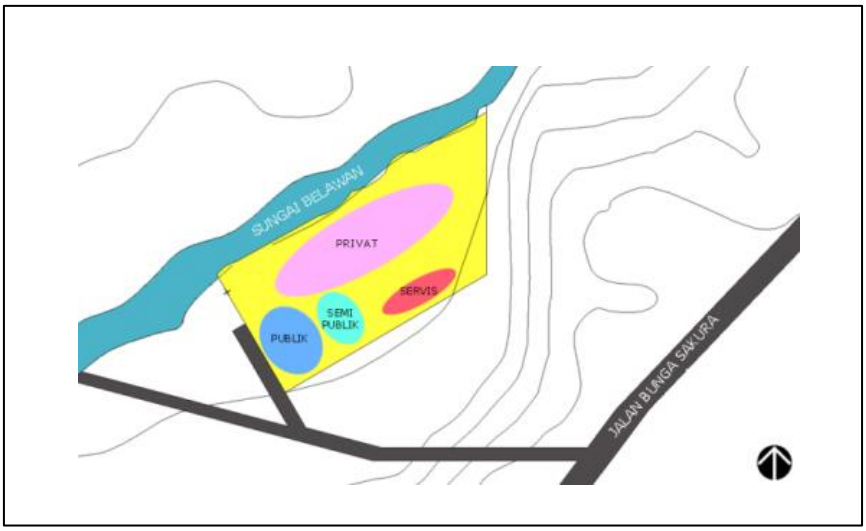

Figure 6 Site Zoning

Circulation and Organization of Vertical and Horizontal Spaces

The design site is on flat land that borders directly with the river. Outer space in this design is significant because the natural school learning system is 70%: 30% comparison of outdoor and indoor activities. So that connectivity must be created between the outside space and functional inner space. A path inside the school area connects buildings and outside space in the school area. Connectivity between buildings in the school area is reached on foot in the form of footpaths with natural stone materials, paving blocks, and grass blocks well connected from the farm area, plantation area, classrooms, school buildings, school hall buildings, school grounds, canteens, and out-bound area (Figure 7). The school building and school hall with a height of three floors and two floors. To reach each floor, users can use the available stair. The existing

condition of the site is of concern because, in ecological architecture, there are principles in the form of preserving natural resources and design sites.

Figure 7 Building Mass and Facade Concept

Multi Mass and Facade

The amount of space needed in meeting the administration of activity facilities, learning activities, and support for nature schools form a multi-mass concept. Indoor activities can be done in school buildings, halls, libraries. While the student can do outdoor activities in outdoor classes and outside the school building.

The number of space requirements in fulfilling facilities for administrative activities, learning activities, and supporting natural schools will form a multi-mass concept (Figure 8). There are several single buildings scattered on the design site and connected by footpaths with radial circulation. Students can do indoor activities in school buildings, halls, and libraries. While outdoor activities can be done in the gazebo and outside the schoolroom. The zoning concept related to River Borderline, which is 15 m, massive building masses away from the river banks.Based on the analysis related to the intensity of buildings in the design site area [12], the height of buildings permitted in this area is a maximum of 51 meters. However, in this design, it should be sought to make buildings that are not too high; for example, 2-3 floors (Figure 9). The aim is that the visual toward the river is not obstructed by the building making the building more integrated with the surrounding buildings, so it does not appear too gigantic.

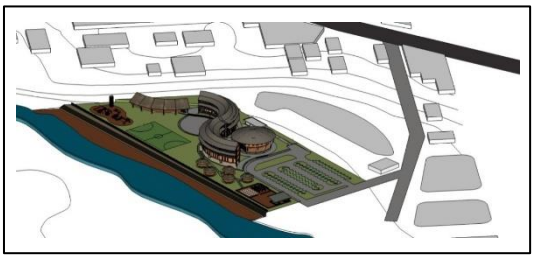

Figure 8 Axonometric Site Project

Figure 9 Building Exterior

Responsive Building

According to interviews with residents obtained, Belawan River can overflow and cause flooding in the riverbank area in certain months. Therefore, to anticipate this, the main building is not placed right on the edge of the river, and the entire building uses the staging system (Figure 10).

The river boundary area is dredged 10m in anticipation of overflowing river water if it floods to collect water before it overflows into the school area (Figure 11). The design of the school building has a different height from the road and fields, and it aims to make the building have a private impression and stand out. High-level motorized parking area with the high street.

Figure 10 Building Exterior View

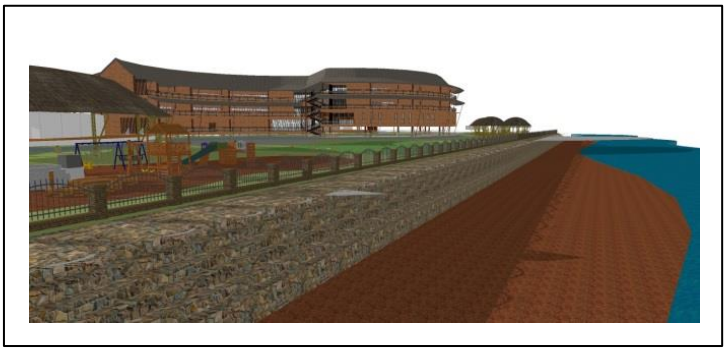

Figure 11 River Border Area

Structural Concept

The foundation is the lowest component or structure of a building that functions to support the entire weight of the building and forward it to the ground [13]. There are three types of foundations used in the design of natural schools, which are pile foundation with pedestals that used in the main building, which is the school building, and the hall building. The pedestal is made of reinforced concrete and is given the impression of a stone base with natural stone, then drilled as a steel entry point into the ground. The second one is a base foundation used in simple buildings that use lightweight wooden or bamboo walls. This foundation is used in buildings that use wooden and bamboo floor structures to not touch the ground directly. For the wooden beams to be durable, the foundation base has a height of 0.65 meters and 1.95 meters above the ground. The class building uses a foundation with a height of 0.65 meters, while the canteen uses a foundation with a height of 1.95 meters.

Moreover, the last one is a continuous foundation used in wooden buildings that are column-free in the center of the building. Buildings that use the foundation base will continue to use the foundation continuously on wet parts, namely the kitchen and bathroom (Figure 12). The continuous foundation material used is stone.

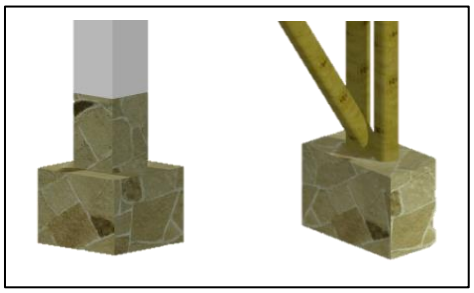

Figure 12 Building Foundation

In the middle structure of the primary school building body using 30x30 composite columns and d30 steel columns in the school hall building. Whereas in saung and canteen use bamboo columns d10 and d16. Besides being a simple building, bamboo material accents also add aesthetic value to the building itself. The structure of the school floor and the hall uses steel floor beams and reinforced concrete floor plates with a thickness of 15cm (Figure 13).

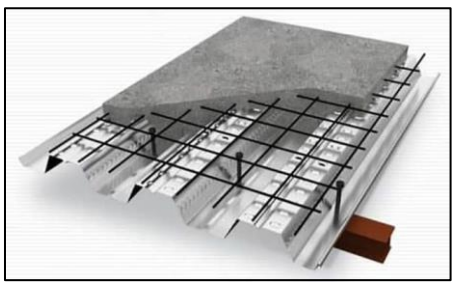

Figure 13 Building Floor Structure

5 Graphic Content

School of nature is one form of education that uses nature as the medium for student learning with active learning methods. The natural school has an intention to be able to utilize nature and be able to preserve nature for the next life [14]. The planning and design concept of Medan's Natural School uses a conceptual approach with the theme of Ecological Architecture, which has an intention to teach students how to be friendly with the environment and nature.

The application of ecological architecture principles is an appropriate way to solve problems in designing the Medan Nature School to optimize the application of ecological architectural principles to buildings. Further research on ecological architecture can support activities at natural schools. Also, the influence of the surrounding environment can affect the application of the principles of ecological architecture. Therefore, further analysis necessary for all elements related to ecological architecture and building functions that constitute educational buildings. Thus, harmony can occur between the principles of ecological architecture and the function of natural school buildings.

Acknowledgment

This article is a research to be taken into consideration for the North Sumatra provincial government in the procurement of natural schools in North Sumatra, especially the city of Medan, so students get the right learning methods and can utilize the knowledge they can in their daily lives, and advance human resources in the future.

REFERENCES

[1] Trianto, Mendesain Model Pembelajaran Inovatif Progresif: Konsep, Landasan dan Implementasinya pada Kurikulum Tingkat Satuan Pendidikan (KTSP), Jakarta: Kencana Prenada Media Group, 2009.

[2] M. Montessori, Metode Motessori Panduan Wajib untuk Guru dan Orang Tua DIdik PAUD (Pendidikan Anak Usia Dini), Yogyakarta: Purtaka Pelajar, 2013.

[3] *Peraturan Menter Pendidikan dan Kebudayaan Nomor 70,* 2013.

[4] S. A. Ayu, "Penerapan Teori Belajar pada Pendidikan Sekolah Alam," 2008.

[5] L. Novo, "Kurikulum Sekolah Alam," 2009. [Online]. Available: www.sekolahalamindonesia.org/konsep-pendidikan/kurikulum/. [Diakses 6 August 2019].

[6] A. Santoso, "Studi Deskriptif Effect Size Penelitian-penelitian di Fakultas Psikologi Universitas Sanata Dharma," *Jurnal Penelitian,* vol. 14, 2010.

[7] Frick, Heinz dan B. Sukiyatno, Dasar-dasar Arsitektur Ekologis, Semaring: Kansius, 2007.

[8] N. S. Sukmadinata, Metode Penelitain Pendidkan, Bandung: PT. Remaja Rosdakarya,

2005.

[9] S. Yulani, Metode Perancangan Arsitektur Ekologis, Surakarta: UNS Press, 2014.

[10] Sukardi, Metode Penelitian Pendidikan (Kompetensi dan Praktiknya), Jakarta: Bumi Aksara, 2003.

[11] L. B. &. W. D. C. Perkins, Schools, New York: Reinhold Publishing, 1949.

[12] *Lampiran X Peraturan Daerah Kota Medan Nomor 2 Tentang Rencana Detail Tata Ruang dan Peraturan Zonasi Tata Ruang dan Peraturan Zonasi Kota Medan Tahun 2015-2035, Intensitas Pemanfaatan Ruang Sarana Pelayanan Umum*, 2015.

[13] L. B. S. S. a. A. S. Ambarwati, "Perencanaan Sekolah Alam Dengan Material Alami di Kota Batu," *Jurnal Mahasiswa Jurusan Arsitektur 2*, no. 2, 2014.

[14] M. a. S. Suhendi, Belajar Bersama Alam, Bogor: SoU Publisher, 2011.