

# Eco-tech Design Application on Campus Development (A Case Study of Stain Majene, Indonesia)

1<sup>st</sup> Wasilah<sup>1</sup>  
{wasilah@uin-alauddin.ac.id }

Islamic State Alauddin University, Science and Technology Faculty, Makassar, Indonesia<sup>1</sup>

**Abstract.** The development of STAIN Majene campus with an Eco-tech approach aims to provide functional and visual comfort. The design of campus buildings with the application of the eco-tech concept is expected to be a supporting element of the STAIN Majene Campus towards world class university. The concept of Eco-tech is carried out with a problem approach from a holistic point of view and is realized using environmentally friendly technology that is efficient and accordance with local conditions. By using exploratory research methods to review the shape, orientation, structure and building materials that can strengthen the application of eco-tech in the STAIN Majene campus design. The design results are realized by expressing the structure and construction that is integrated with the environment, the use of building materials in accordance with the demands of the times, having continuity with the surrounding environment, not having a negative impact, as well as the long life of durable materials, a cooling system that uses natural ventilation by utilizing building design and outside air processing to be used as artificial insulation in buildings, as well as lighting systems by utilizing natural lighting as much as possible as lighting in buildings. The specialty of campus design lies in the transformation of forms that apply the element of calligraphy as a form of implementation of the STAIN Majene's vision and mission as the center of Islamic civilization in West Sulawesi.

**Keywords:** campus design; eco-tech; sustainable; calligraphy; environment.

## 1 Introduction

The presence of the campus in middle of the society is a enlighten source for social activity in the context of nation and state. Consequently, campus is a gathering place for scientists and certainly become a positive inspiration source for the nation to manage all aspect of human life. Campus is a center of education and learning in the development of science, technology, and socio-culture. Campus expected as a innovation references that would create a nation becoming a dignified and competitive nation when the science and technology has rapid development. Campus is also become a competitiveness resource as the attribute of the actual civilization value.

Campus should produce the intellectual policy maker with nationalist insight who adhere to ethic and culture to create national civilization and nationality that submit with the value of Unity in Diversity (Bhinneka Tunggal Ika) to strengthen the Unitary State of the Republic of Indonesia. This condition will always threat by a lost of nationality civilization by ignoring the Pancasila philosophy values as Indonesian state principle.

Campus is a wide dimension entity in its development process and completely support on the preservation of people civilization prestige. This condition is a reality of life and become the challenge of campus principals to return campus civilization values as a fountain of life. The value should contain a life values and harmony [1][2][3]. Presently, the actual condition of campus is not only a source of inspiration but a source of struggling power for a great civilization. Consequently, building a conducive academic environment in every campus become preferred options and one of them is from building architectural aspect.

STAIN Majene or Majene State Islamic Institute is one of Islamic higher education in West Sulawesi province. The campus has development potency, because the Tanah Mandar or West Sulawesi land area has an intellectual history. Tanah Mandar has a long historical relationship with educational history development, either in general or specific history. Kalumpang Site in Mamuju believed as the oldest site with comprehensive artefact in the Indonesian Archipelago, even in South-East Asia. STAIN Majene commitment is to integrate the secular and religious science in unitary of comprehensiveness.

The vision and mission statement of STAIN Majene is creating an intelligent, excellent, glorious values (*mala'bi*), and socially student based on religious value [4][5][6] by implementation of religious and social values, providing a student place to develop student individual potency, and creating a center of learning and research in the society to create a collective change with the STAIN Majene student. The vision and mission is not apart from the relationship of an appropriate facility and campus infrastructure. Therefore, STAIN Majene campus should developed a stepping-stone to create student and its graduates with competent and creative characteristic. The case aforementioned is related to the experience in campus environment that support creative idea from architecture art presence in the STAIN Majene campus design.

Aim of this project is to present a comfortable, one of them is revitalization of the old building into a new and better building. The building should become a new icon of STAIN Majene Campus with the application of eco-tech concept. The eco-tech concept approaches from the holistic point of view and realized by an efficiency in sustainable development and adapted the local environment.

According to the theory of architecture, eco-tech is an architecture with environment-oriented technology. Currently, a development of eco-tech principles is the combination between two principles in design the architectural plan, sustainable and high technology [7][8][9]. Catherine Slessor argue an Eco-tech as: Sustainable architecture and high technology, a building with eco-tech concept characteristics are:

1. Expressing the structure and construction with environment integration.
2. An application of building material based on the requirements of the time, natural sustainability connection, does not has negative impact, and application on long-lasting material.
3. The ventilation system developed with a natural ventilation through the building design advantage and exterior air management as an artificial ventilation for building interior.
4. The lighting system take advantage of natural illumination as much as possible for interior illuminance.

Therefore, the development on the campus design with eco-tech approach must practices the eco-tech characteristics above. Furthermore, a development of STAIN Majene Campus should comply with security standard for all occupant. Zoning management and building mass positioning are consider with the potency and obstacle of the local environment, related on the relationship of public, private, and also the function of the building.

## **2 Methods**

The research practice qualitative method. Qualitative method is the research that refers to the post-positivism philosophy to observe the object in natural condition. The researcher is the key instrument in the sampling of data source purposively. The method in design approach are consist of data collection, data analysis, and design method.

### **2.1 Data Collection Method**

A data collections method consists of observation, interview, and literature study. Observation activity is observing the condition of existing location by identifying the potency and site problem. Interview activity will collect a related information to the existing problem by asking the related party. The literature study is a investigation activity or collecting the data and basic thing of the design through the references, either in book, journal, or printing media or electronic media.

### **2.2 Data Analysis Method**

The normative analysis method applied in this research, adapting the theory of eco-tech building characteristic as the basic in design strategy. The analysis data processes are:

1. Object typology approach

Typology approach design has two activity processes, identifying the type of typology and processing the type.

2. Site plan and environment study approach

Analysis of site plan location performed in this approach and analyzing the selected site location and its environment.

3. Thematic approach (Eco-Tech Architecture)

The theme presentation required more knowledge to create a dialog between space dimensional connection with psychology relationship and emotional of architectural space.

### **2.3 The Design Method**

The design method guideline in theme application design is Islamic civilization campus that express calligraphy symbol in the building form of STAIN Majene campus. From the data collecting result, the steps of design are:

1. Structural Expression

Most of eco-tech building design prioritizes a high technology structural building and implements a natural integration.

2. Sculpting with Light

The eco-tech building focus on the lighting system, a building will become impressive and take advantage of natural lighting for interior building illumination.

3. Energy Matters

The eco-tech building focus on the energy efficiency practice for the building application with existing technology.

4. Urban Responses

The study of eco-tech building concern on the urban environment context or based on the urban response.

5. Making Connections

The focus of eco-tech building study is making a connection between the environment design or form analogy or the building function.

6. Civic Symbolism

The design representing the building role as a public symbol with different design to find a new value.

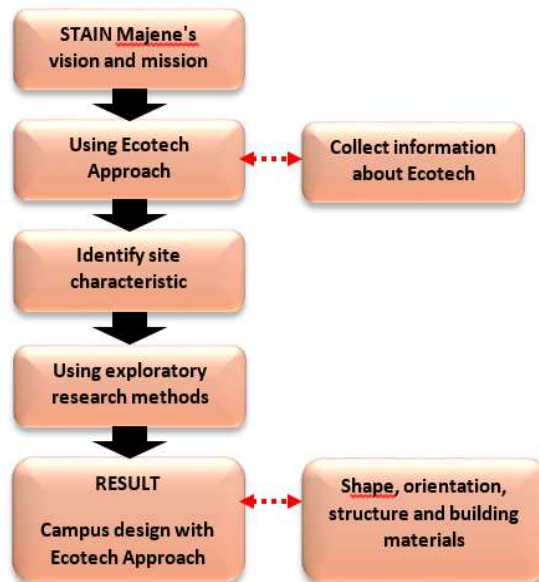
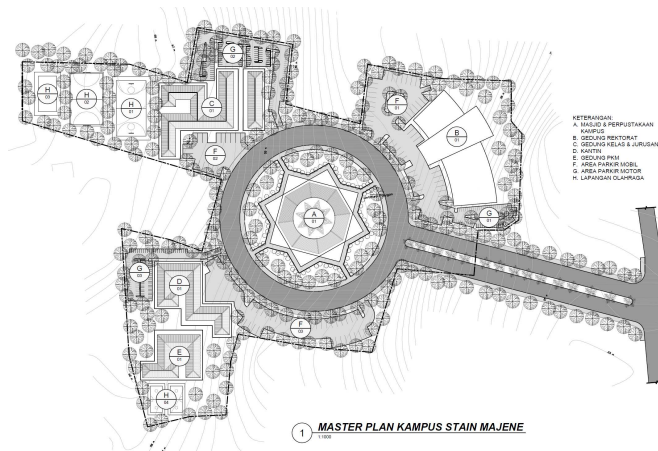


Figure 1. Stages of research and design

### 3 Result and Discussions

#### 3.1 Site design approach

The STAIN Majene campus master plan consist of some building functions to support the basic function [10][11][12] of the campus. STAIN Majene campus presents the mosque and library as the center of the area, surrounded by campus facility such as study room, presidency or rectorate building, canteen, parking area, and sport center.

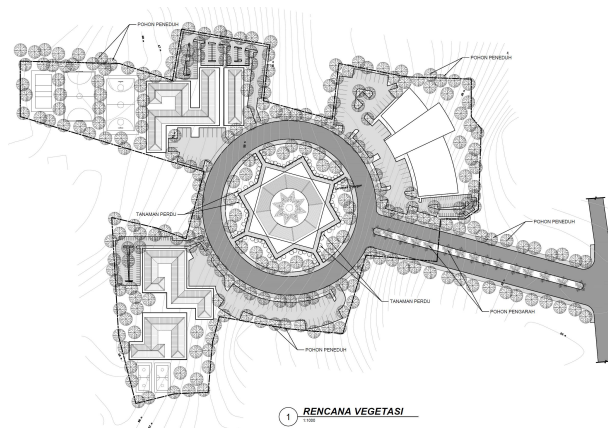


**Figure 2.** Master plan of STAIN Majene Campus



**Figure 3.** The Building Function in STAIN Majene Campus

In order to create friendly environment condition, STAIN Majene campus design practices a vegetation area development as a shading or a park. Concerning the existing land condition before development is leafy vegetation, then the design of campus area preserve as much as possible the existing vegetation. Vegetation plan in area of STAIN Majene campus are below.

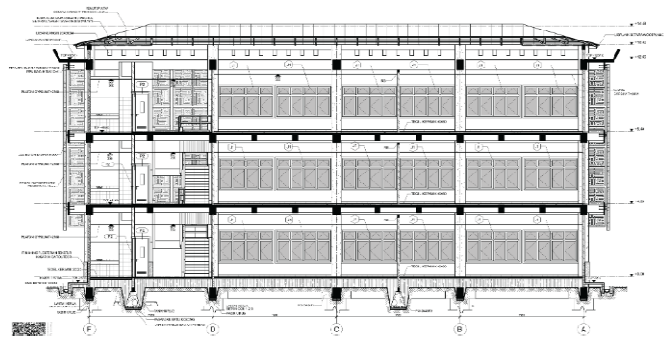


**Figure 4.** STAIN Majene Campus Vegetation Planning

### 3.2 Thematic Approach (eco-tech)

#### Structural Expression

The structural systems implement the concentrate structural system. There is a column element (pile) and beam as the pile connection horizontally and supporting the floor. The concentrate brick wall covers the non-structural characteristic. The building concentrate structural systems has 30 cm x 60 cm column and the gap is 7 m. The concrete class for the column and beam structure is K-300. The reinforcing bar concrete is solid structure to improve the structure strengthen.



**Figure 5.** Section of STAIN Majene Study Building

The roof frame construction is light steel truss to support the roof load, including steel load and creates a form of the roof. The type of the truss is light weight steel C profile and the plafond material is gypsum and wood (lammersering). Moreover, the floor material is ceramic tiles, because its high flexibility application and applicable on all part of the building. In addition, the ceramic floor material does not require a polish process and easy maintenance. The ceramic material could provide a warm impression.

### **Sculpting with Light**

The campus building uses a secondary skin as a building secondary skin. The element is not only for aesthetic element but also intentionally creates a natural shading art pattern that follows the sun path orientation and reducing the heat and block the flash. The sun exposure will not directly hit the building because of the secondary skin but blocks by the skin. The secondary skin reduces an excessive sun exposure to the building facade and has important role for the aesthetic of building 'surface'.



**Figure 6.** Room ambiance with the natural lighting advantage from the building facade.

### **Energy Matters**

The building designed with passive cooling concept to reduce energy consumption. The concept applied in the design of the building that track the sun path and maximize the natural air circulation. The building design provide sufficient opening to maximize the illuminance and natural ventilation. The design become one of the efforts to reduce excessive electrical consumption. The application of secondary skin, providing a window in every building room with cross ventilation system, light color applications are the effort to maximize the lighting distribution in all building area. Moreover, artificial energy applied as a supporting energy resource with eco-friendly and energy saving characteristics.

### **Urban Responses**

In accordance with the development instruction from South Sulawesi government, the green building development should practice built-up and green open space area is 60:40 and become the basic consideration in determining the mass layout of STAIN Majene campus building. The application and preservation on green open space area has a function as water infiltration of campus communal area, reduction of noise and solar radiation, and a guides of circulation lane.

### **Making Connections**

The design of STAIN Majene campus is the example of calligraphy art development in architecture [13][14][15]. Calligraphy is not only as something that only read and write but the society may enter and feels the calligraphy in form of the space. As a result, a beauty of calligraphy is not only as building ornament but calligraphy could impress physically and spiritually. The function of the building is the place of study, strengthen the meaning of Alif Lām Mīm as a medium to approach to Allah as a God and motivates the user to study the religion continuously.



**Figure 7.** The study building adapted Alif Lām Mīm calligraphy form and applied secondary skin with Asmā'ul-Husnā pattern.

The building expression is similar with Alif Lām Mīm as a reflection of Islamic campus. This visualization should improve student understanding where calligraphy is not only as a two-dimensions art but also applicable into the building form as Quran that contain a beautiful verses reflection but presenting a benefit to all aspect of life [16][17][18]. In addition, the land percentage is equal between the building and green open space as a realization of harmony between human needs and other living things with mutualism relationship.

### **Civic Symbolism**

Calligraphy element applied in the form transformation to the building facade to emphasize the Islamic campus theme. The element highlights STAIN Majene as one of Islamic collage in Majene Regency, West Sulawesi. The building design adapts calligraphy that generates pleasant and peaceful atmosphere. This impression produces from space chronological as calligraphy essence achievement through sign reading (semiotic) [19] [20] meaning of the calligraphy symbol.



**Figure 8.** Application of calligraphy element

### **Discussion**

Eco-tech concept express in structure and construction with environment integration, application of building material in accordance with prefabrication material availability but consistently sustainable with the nature, does not has negative impact, and calculating the



long-lasting material usage according to natural condition in STAIN Majene campus. Additionally, the ventilation system maximizes the natural ventilation by the advantage of building design and exterior air management as an artificial ventilation for the building interior through cross ventilation. The lighting system utilizes the natural illumination as much as possible as interior building with optimizing the opening function, window and secondary skin pattern.

## 4 Conclusion

The eco-tech concept approach is one of the harmonization forms in development and natural sustainability and balance but consistently keep abreast of the time. The STAIN Majene campus design is not only fulfill the space needs for society of academicians and the student but it also an effort to protect and preserve green open space. As a result, the percentage on built-up land application proportion and public space are equal. The application of technology transformation includes building design transformation and building facade, adapted the calligraphy form as a reflection of Islamic campus. The advantage of eco-tech design is the capability in utilizing the natural potency to support architectural element, such as lighting, ventilation, and acoustic (noise). The trees around the building will reduce the solar radiation level, controlling the air quality, and reducing the vehicle noise. However, maintenance management in high technology application become the problem in some design area.

**Acknowledgements.** The author would like to thank the Architecture team from UIN Alauddin Makassar with generous support and invaluable contribution. The author would also gratitude on supporting facility usage and the instrument of architecture of UIN Alauddin Makassar Laboratory to support accomplishment of this design. This paper in conjunction with the 9th International Conference on Green Technology, Malang, East Java.

## References

- [1] Antoniadis, Anthony C. 1992. *Poetics of Architecture: Theory of Design*. New York: Van Nostrand Reinhold
- [2] Tomiyama, T. "Function Allocation Theory for Creative Design" *Procedia CIRP.*, vol 50, pp.210-215, 2016
- [3] Erk, G.K. "Design and Practice in Architectural Theory Education", *The International Journal of Arts Education*. Vol. 7 issue 3, pp. 17-44, 2013
- [4] Al Faruqi, Ismail Raji. 1999. *Seni Tauhid Esensi dan Ekspresi Estetika Islam [Art of Tawhid Essence and Islamic Aesthetic Expression]*. Yogyakarta: Yayasan Bentang Budaya.
- [5] Ahmad, AS., "The Spiritual Search of Art Over Islamic Architecture With Non-Figurative Representations", *Journal of Islamic Architecture*, vol 3 no 1, pp. 1-13, 2014
- [6] Pramono, A. "Pola Geometri Pada Seni Dan Arsitektur Islam Di Andalusia", *Journal of Islamic Architecture*, vol.1 issue 3, pp.133-136, June 2011
- [7] Daniel Claus, 2011, "Eco-Tech", *Eco-tech Building in Architecture*, <http://www.finddocs.com>
- [8] Lányi, E. "The basic principles of sustainable architecture", *Periodica Polytechnica Architecture*, vol 38 no 2, pp. 79-81, 2007
- [9] Samadzadehyazdi, S., Khalili, M.J., Mahdavejad, M.J., "Windphil Poetic in Architecture: Energy Efficient Strategies in Modern Buildings of Iran", *International Journal of Architectural, Civil and Construction Sciences: 11.0.*, vol 6., 2018

- [10] Ching, DK. 2000. *Arsitektur: Bentuk, Ruang, dan Tatanan* [Architecture: Form, Space, and Layout]. Jakarta: Erlangga.
- [11] Shaari, S. J., Mohd Ali, N.A. and Abu Bakar, S., "Environmental design criteria to stimulate creative thinking a case study of polytechnic campus in Merlimau Melaka". *ALAM CIPTA, International Journal on Sustainable Tropical Design Research & Practice*, vol.10 (2), pp. 33-39, 2017
- [12] Markkanen, P., "Knowledge Work in Campus Environment - Opportunities of New Technologies in Working and Learning Spaces". *Proceedings of the Annual Architectural Research Symposium in Finland*, pp. 255-267, 2014, Retrieved from <https://journal.fi/atut/article/view/45383>
- [13] Hattstein, M and Delius, P. 2000. *Islam Art and Architecture*. Konemann: Cologne
- [14] Fikriarini, A. "ARSITEKTUR ISLAM: Seni Ruang dalam Peradaban Islam". *El-Harakah Jurnal Budaya Islam*, vol.12 no.3, 2010
- [15] Rabbat, N., "What is Islamic architecture anyway?", *Journal of Art Historiography*, Vol 6, Pp 6-NR/1, 2012
- [16] Barliana, S. M. 2008. *Perkembangan Arsitektur Masjid: Suatu Transformasi Bentuk dan Ruang, Jurusan Pendidikan Teknik Arsitektur Universitas Pendidikan Indonesia* [Development of Mosque Architecture: A Transformation Form and Space, Education of Architecture Engineering Department, Indonesia University of Education]. Bandung.
- [17] Khan, H., "Contemporary Mosque Architecture", *ISIM Review*, vol.21 issue 1, pp. 52-53, 2008
- [18] Kahera, A.I. "A Mosque Between Significance and Style", *ISIM Review*, vol. 16 issue 1, pp. 56-57, 2005
- [19] Hershberger, Robert G. 2008. *Memprediksi Makna dalam Arsitektur* [Predicting the Meaning in Architecture]. Arizona State University.
- [20] Dimković, D.M., "Memorial Architecture as the Symbol of Remembrance and Memories", *South East European Journal of Architecture and Design*; Vol 2016, p. 1-6, 2016.