Sustainable Campus Architecture and Society 5.0

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Abstract. Campus, merely known as the studying space for students, hoped to be agents of change in many fields, not only becomes a space but also a place. Place for the agents for growing up, facing many real experiences in life. It was not newly known the sustainable approach in physical aspects, specially architecture, hold an important role in terms of building place for students. The environmental issue holds a highlight in many decades. It was concerned in many levels of life and changed the way people think, act and do. Back to sustainable aspects in campus, is it only physical aspect that counts to support grow-up phases for students? What other aspects can help to overcome the whole process of student’s development? Not to mention about society 5.0 that blends technology in many ways of life, to keep balance between technology and integrated solution to bring easiness to solve problems in economy, social, education, health and many more. Mitchell Thomashow, former college president, describes nine elements of sustainable campus agenda, those are energy, food, materials, governance investment, wellness, curriculum, interpretation and aesthetics (aspects of learning). With the human-centred approach of Society 5.0, can those elements of sustainable campus agenda also bring back student’s basic nature as humans, to live happily and productively to achieve the best version of themselves? With the qualitative method approach, this paper finds the aspects in sustainable architecture and other related field in terms of reaching the goals through putting those elements into practice in building the comprehensive sustainable campus for happy and productive students.

Keywords: sustainable campus, sustainable architecture, society 5.0, students.

1. Introduction

We often hear and read about sustainable architecture. Sustainable architecture, based on the definition from Wikipedia is architecture that intended to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space and the ecosystem at big portion. Sustainable architecture developes some conscious approach to energy and ecological conservation of the built environment designed. The idea of sustainability, or ecological design, is to ensure that our use of present resources does not end up having harm and give bad effects to our collective well-being or making it less possible to obtain resources for further use in the long run. Aspects of sustainable architecture can end up in many ways of solution, starting from sustainable energy use, sustainable building materials, waste management, building
placement, sustainable building consulting, changing pedagogues, sustainable urbanism and architecture and the use of building information modelling (BIM).

1.1. Background

Sustainable architecture holds and important yet still hard to reach globally, it depends on the awareness and the implication of willingness to make it real not only in plans and theories but also practicing in everyday way of life and life style. Talking about sustainable campus, it means a “university that contributes to building of a sustainable society through education, research, collaborating with the society and campus development.” Sustainable Campus is not something that merely means a “campus with low environmental impact.” It aims to practically and multilaterally support the well-being of a society by “expanding education and research that are rooted in social challenges as policies of the entire university” and “implementing campus development that harmonizes with surrounding areas”. In terms of building sustainable society, it is logically accepted that the education must be comprehensively embedded in multi verse of studies in several terms The activities can be vary from working to reduce our ecological footprint, raise awareness about environmental problems or research sustainable solutions, educational institutions that are working to transform themselves as agents of change are living and provide learning institutions for sustainability. The concept of sustainable campus is an aspiration, a vision that blended in our daily activities and nourishes the practical things. Each educational institution with the particularly unique in its history and culture, can create its own path of sustainability acts, within the regulation or the practical activities.

1.2. Goals

This research will study not only about the role of sustainable campus in architecture but in other field to propose the whole approach to embrace the culture of sustainability that fulfill the basic need of human in Society 5.0. in terms of life of students in campus, hopefully the sustainable approach can help them to gain happiness and productivity to solve the problems in social, economy, environmental, physically and mentally.

1.3. Scope

The scope of this research will study in elements of sustainable architecture of campus and any other related fields that connect to physical and mental support to gain happiness and productivity for students of a campus in terms to reach Society 5.0.

1.4. Methods

The method used in this research is literature study and qualitative approach to compare the aspects of sustainable architecture in campus and other related field in terms of reaching the goals through putting those elements into practice in building the comprehensive sustainable campus for happy and productive students and gaining Society 5.0
2 History, Definition and Theories of Sustainable Architecture and Sustainable Campus

2.1 History of Sustainable Architecture and Sustainable Campus

History of Sustainable Campus started since 2008, adopted at G8 University Summit at “Sapporo Sustainability Declaration,” at Sapporo Japan to widely declare the concept of Sustainable Campus as a major university strategy. Preceding this, initiatives to take in the principles of “sustainable development” into university administration have started from 1990s, mainly in Northern American universities. These were mainly results of higher education institutions being influenced by policies of nations and various declarations being adopted internationally.

Today, Sustainable Campus initiatives have taken root as a natural responsibility in various higher education institutions across Europe, the United States and Canada. Hokkaido University has established its Office for a Sustainable Campus in 2010 and has been pulling the Sustainable Campus initiatives among Japanese higher education institutions to this day. From April 1, 2018, it became a new structure and was reorganized into “Sustainable Campus Management Office”. “World Commission on Environment and Development” of the United Nations proposed a concept called Sustainable Development in 1987. Today, the word “sustainability” is being used even more widely. From 1990s to 2000s, numerous declarations promoting sustainability were adopted one after another at educational institutions as well; initiatives to include sustainable development into university administrations had accelerated, especially in Europe and America.

2.2 Definition and theories of Sustainable Architecture

Sustainability has become an integral aspect of contemporary architectural design. As climate change becomes an increasingly pressing concern, so too does the need to create sustainable buildings that offer minimal environmental impact and maximum human comfort. Sustainable considerations such as energy efficiency and water management are now regulated under national and state building codes, allowing today’s architects to conserve resources and materials and construct buildings that work with their natural surroundings rather than against them. Three pillars of sustainability are environmental, social and economic, those pillars would have implication on these elements:

1. Environmentally sustainable building: energy, water, material, landscape and site impact.
2. Socially sustainable building: health and comfort, safety and security.
3. Economically sustainable building: construction costs, running costs.

Energy efficiency over the entire life cycle of a building is the most important aspect that should be highlighted as a goal of sustainable architecture. Many different passive and active techniques to reduce the energy needs of buildings are developed by engineers and architects to increase building ability to capture or generate their own energy and more less capturing from outer source in their surroundings. Many technologies and system are founded and brought in the house system, such as heating, ventilation and cooling system efficiency; renewable energy generation from active solar panels, wind turbines, solar water heating and heat pumps. Not to mention there are many newly invented sustainable building’s materials such as recycled materials, lower volatile organic compounds and standards in sustainable
materials used in the building. Other inventions are founded in waste management system, building codes, and last but not least are building information modelling (BIM). BIM is used to help enable sustainable design by allowing architects and engineers to integrate and analyze building performance in every design elements of the building. BIM services, including conceptual and topographic modelling, offer a new channel to green building with successive and immediate availability of internally coherent and accurate project information. BIM enables designers to quantify the environmental impacts of systems and materials to support the decisions needed to design sustainable buildings.

Despite all the approaches in physical aspects above, there are more strategies to achieve the successful of sustainable architecture in publicbuilding. While cost is always a top consideration for civic building planners, spending more up-front on sustainable strategies can not only provide large savings over time, but also positively impact air quality, well-being, and lead to a regenerative future. Sustainable architecture is the use of design strategies that reduce the negative environmental impact from a built environment. Architects take the site landscape, energy management, and stormwater management into consideration when planning, and then use environmentally friendly systems and building materials during construction. Engineers and architect sometimes use the strategies in terms of gaining the optimal effort of sustainable approach. The strategies are:

1. **Passive Sustainable Design.** Passive strategies, such as considering sun orientation and climate when siting and being thoughtful about window placement and operation, are used to best manage daylighting and natural ventilation and go a long way in reducing energy requirements for the building. In certain climates, thermal mass techniques can be used to harness solar energy.

2. **Active Sustainable Design.** Architects consult with mechanical and electrical engineers to implement high-efficiency electrical, plumbing, HVAC, and other systems, which are designed to have small environmental footprints.

3. **Renewable Energy Systems.** Renewable energy systems, including those that harness solar and wind energy, are also great options for some buildings. These systems are often used in conjunction with passive design strategies.

4. **Green Building Materials and Finishes.** By making it a priority to purchase steel, lumber, concrete, and finishing materials, such as carpet and furnishings, from companies that use environmentally responsible manufacturing techniques or recycled materials, architects up the ante on sustainability.

5. **Native Landscaping.** Landscaping choices can make a big impact in civic building water consumption. By using trees, plants, and grasses that are native to the area, architects can greatly reduce irrigation needs. Landscaping can also be used as part of a passive energy strategy. By planting trees that shade the roof and windows during the hottest time of the day, solar heat gain inside the building can be reduced.

6. **Stormwater Management.** The water runs off these surfaces and into storm drains. By implementing stormwater management strategies, such as pervious pavement that helps to reduce runoff and retention ponds that capture runoff and slowly release water back into the ground, the negative environmental impact of buildings can be reduced.

### 2.3 Definition and theories of Sustainable Campus

Definition of sustainable campus of some experts described as follow:
• “A sustainable campus is one that has achieved a reduction of its ecological footprint well beyond standards and has done so with an institutional ethos that advocates for justice, peace, respect and action to protect the integrity of natural systems and demonstrates an open willingness to share this information beyond its own walls, wherever it’s needed” (Adam, Chris- Coordinator of Sustainable Dawson).
• “A sustainable campus is a space in which the community can learn and gradually develop a culture of sustainability and stewardship of natural resources” (Luisa Montes, Sustainability Coordinator at Benito Juárez Teachers’ College).

As one of the Sustainable Development Goals, sustainability in education holds a very important aspects of all people in the world. It said that ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. College or University, placing in a building named campus, is one of the important and highest level of education people can get, either it is bachelor, master or doctoral or phd stages. Campus holds a very important phase of somone life where they spent 3-7 years of study and living the campus’s life dynamically. At the stage a person is already considered as adult that starting to overcome problem and be responsible for anything that happened in their lives.

Campus, not only a space – to study, to socialize, to learn, to play- but already becomes a place. Place has meaning and values, not just boundaries and more than just a space to do all the activities. Place can bring meaning through the senses and mind, therefore sense of place can shape through the elements of architecture, interior, urban context. Despite all of the meaning that a place can bring, campus as a place that students spent years of living and doing all the grown-up stuff in terms of facing the real problems, hopefully can shape the best version of themselves through all of its elements. Here, we are going to give specific scope of sustainable campus in terms of connecting the society 5.0 that we face in this time. What are the elements of sustainable campus?

Mitchell Thomashow, thought about teaching sustainability as a way of life in his book “Nine Elements of Sustainable Campus”. Sustainability as a way of life has a long tradition in U.S. higher education, is crucial to understand that sustainability is a response to a planetary emergency. We are in the early stages of the sixth mega-extinction (a catastrophic loss of species), plunging declines in biodiversity, and a rapidly destabilizing climatic-oceanic circulation, and how we choose to respond poses an immediate challenge for all educators. How do we teach sustainability as a way of life? This is the single biggest challenge for higher education. The goal should be nothing less than to train a new generation of sustainability leaders, graduates who understand the intricate connections between economics and ecology, place and planet, between how we live and the consequences of our actions.

As a means for meeting this challenge, he proposes nine elements of a sustainable campus, designed to evoke a 21st century catalog of transformational sustainable practices. They entail three broad categories—infrastructure (energy, materials, and food), community (governance, investment, and wellness), and learning (curriculum, interpretation, and aesthetics). Imagine these categories as dynamic, emergent, and intrinsically interconnected. Any sustainable endeavor may involve multiple categories. Ideally, campus becomes an exemplary learning and living laboratory for a sustainable culture. From that people who visit sustainable campus—students, parents, community members, or donors—will get dozens of ideas that
will in turn inspire their own practices. These nine elements are energy, materials, food, governance, investments, wellness, curriculum, interpretation and aesthetic.

2.4 Association for the Advancement of Sustainability in Higher Education

Association for the Advancement of Sustainable in Higher Education (AASHE) holds an key function as inisitator of Sustainable Campus Index (SCI), recognizes top performing colleges and universities overall by institution type and in 17 sustainability impact areas, as measured by the Sustainability Tracking, Assessment and Rating System (STARS), a voluntary framework used by hundreds of colleges and universities to measure, report and strengthen their contribution to global sustainability. The field of SCI are about 1) Air and climate; 2) Buildings; 3) Campus engagement; 4) Coordination and planning ; 5) Curriculum ; 6) Diversity and affordability; 7) Energy; 8) Food and dining; 9) Ground; 10) Investments and finance; 11) Public engagement; 12) Purchasing; 13) Research; 14) Transportation; 15) Waste; 16) Water; and 17) Wellbeing and work.

Sustainable architecture campus in enhancing the happiness and productivity of students. In enhancing the happiness and productivity of students in terms of gaining the society 5.0, is there any connection between them? Are sustainable campus elements really holding the key to achieve human-centered approaches that really emphasize and bring benefit to the students as the main user of the campus?

2.5 Achieving sustainable campus

The nine elements of sustainable campus:
1. **Energy.** Energy refers to the ability to do work, involving the transformation of matter to produce heat and electricity. The highlight of sustainable energy uses is to maximize the efficiency the processes and to minimize unwanted and unused effect from products. For colleges and universities, a important challenge is the way to approach zero-carbon energy use. This goal can be accomplished through a combination of ingenious technical innovations, renewable energy sources, and rigorous conservation and reinforcement. Examples for energy sources are windmills, solar panels, and geothermal installations all require interpretive displays that help campus users better understand the complexity of energy choices, while allowing our students to develop new habits of thinking about their energy use.

2. **Materials.** Sustainable materials practice emphasizes minimizing the energy use and by-products involved in the manufacture of these goods, valuing resilience, durability, and recyclability. The choices that can be done are to use recycled materials in campus building construction process, or initiate paperless notes reports and minutes of meetings, minimum use of materials is intrinsic to countless procurement and financial actions and decisions.

3. **Food.** Rooftop gardens can be goodsources to give meal supply for high-rise dormitories. Administration and offices buildings could have small greenhouses attached to their entrances. Cafeterias should not only serve more local and organic food, but they have interesting show off plates that illustrate farm-to-garden food pathaysor calculate the
energy costs of different methods of food production. Campus can initiate effort to self-supply need of the supporting function in serving some of the meal need to be sustain.

4. **Governance.** On a college campus there must be alignment between internal vision and mission, governance regulation, and curriculum arrangement. If the motivation is entirely generated from the grass roots, it will always be a struggle to influence senior leadership and the campus institution or foundation board. If leadership for sustainability comes mainly from the administration, the people may not necessarily follow. This is why sustainable practices must be built and embedded into the vision and mission, master plan, and strategic plan and actions for a campus, conceived as crucial value to its philosophy in education.

5. **Investment.** Every campus has a significant economic (beside social and environmental) impact on the surrounding community. Colleges, communities, and businesses can work together to transform their regions into thriving sustainable economies. Colleges serve as dynamic economic multipliers. The campus becomes an incubator to bear innovative entrepreneurial approaches to empower their partner communities. Faculty and business leaders work together to educate the technical skills, life experience attributes, and knowledge foundation that will best equip the new sustainability professions.

6. **Wellness.** The ultimate point of a sustainable campus is to provide a nourishing and supporting learning environment that promotes personal, community, and planetary well-being. Placed in an ecological context, it’s important to take note to biodiversity, atmospheric and oceanic circulations, and ecosystem services in relationship to the human community. The value of human health is linked to ecosystem health in greater context.

7. **Curriculum.** The best way in sustainability curriculum is to that provides the hands-on experience of living, implementing, and designing a sustainable campus, tangibly linked to the more formal curricular expectations of programs and majors. Every major should have sustainability-related courses that provide a foundation for the relevant discipline and career. These sustainable ideas and initiatives have to connect to the tangible application in the campus community. Colleges and universities have an impressive breadth of educational outreach which hopefully every visitor, participant, and community member learn something from the campus environment. The sustainability curricular agenda must be taken as comprehensive, direct, and intrinsic to the educational vision and mission of a campus.

8. **Interpretation.** To share and introduce awareness to campus visitor, can very the activities, including tours, exhibits, recommended buildings to visit, and other features of the sustainable landscape. Campus signage and wayfinding system would emphasize these initiatives. Are there organic gardens on campus? Show them on a map and explain why they are there. Is there a geothermal installation? Develop a kiosk at the site that diagrams how it works. Make these sustainable stories obvious through board signage, embedded curriculum, website exhibitions and all campus publications through online and offline medias.

9. **Aesthetic.** Aesthetic and visual products such as murals on the sides of buildings, recycled-materials art sculptures, soundscape designs, native-plants sculptures, an arrow of time to represent geological events, and landscape artwork that captures the movement of water, grass, and pollen can be constructed at minimal expense, while providing local and regional artists with a venue to display their work. They also
represent terrific opportunities to get students, staff, and faculty engaged in taking great pride in the campus, as well as making the landscape much more interesting. Art projects catalyze some of the emotional responses surrounding these issues. Ultimately, this kind of collaborative art allows the campus to experience reciprocity between the built environment and the natural world.

Sustainability, despite the awareness and education, should also embrace aesthetics aspects in every step along the way. All the subjects connected to campus as a place, should be given opportunity to make their placemaking effort, through the way they desire and capable of. This has the great chance of making a campus a more vital, vibrant, lively and dynamic place to work, learn and play. If the effort shown by the work of art in campus, hopefully every art project contributes to the sense that the campus is a place in real space and time, a living and working environment that creates an aesthetic impression in the surrounding environment.

2.6 Improvements to achieve through sustainable campus

There are highlighted differences between the elements in AASHE and what Thomashow researched about sustainable campus. And the different points make a significant improve that show, it is NOT only physical aspects that hold important roles in shaping the sustainability compromises in campus life. They are:

- Campus engagement
- Coordination and planning
- Diversity and affordability
- Public engagement
- Research
- Waste
- Water

Those aspects mostly are not about physical but merely wider and more socialy and humanize based. The successful of sustainable campus not only the ability to use less energy but also empowering the human inside it, make them more human and more powerful in basic nature as persons to reach the optimum ability and overcome the best version of them.

Sustainable Campus and Society 5.0

What is Society 5.0? (Serpa, 2018) presents a number of definitions he found relating to the formation of society 5.0 in his country, Portugal. He quoted a lot of the origin of the concept of Society 5.0, Japan, including the definition (Harayama, 2017) "Society 5.0 is an information society built on Society 4.0, which aims to create a prosperous society that is centered on humans" (p.10). (Serpa, 2018) said that Society 5.0 proposes to "advance the potential of individual relationships with technology in encouraging improvement in the quality of life of all people through super smart societies" (Serpa & Ferreira, 2018, paragraph 1) and what appears, in part, as a consequence of the application of the Industry 4.0 concept and its effects (Shamim, 2017 et al). (Serpa, 2018) mentions that innovation is another key concept in Industry 4.0 (Di Fabio, 2018, et al.) In order for permanent innovation to occur, individual socio-emotional learning mechanisms and organizational flexibility are essential, for change, because technological learning alone is not enough (Abreu, 2018 et al). This context, which is
presented directly, is one of the fundamental economic and social foundations of the emergence of Society 5.0.

The concept of Society 5.0 emerged in 2015 in Japan (Abreu, 2018), in a strategic national political initiative (Harayama, 2017). Society 5.0 follows, to some extent, Industry 4.0, and, while Industry 4.0 focuses on production, Society 5.0 seeks to place people at the center of innovation. It also utilizes the technological impact and results of Industry 4.0, by deepening the integration of technology in improving the quality of life, social responsibility and sustainability (Serpanos, 2018).

2.7 What elements of sustainable campus that relates to Society 5.0

Sustainability in campus aspects define the needs of sustainability for the wider elements, these are:

- Sustainability at the human, social economy and environmental, in local acts and global impacts.
- Sustainability issues are beyond urgent political concerns, it is about humanity needs.
- All universities have an important role in problem-solving to give legacy a sustainable world to future generations. Through universities’ research, they expected to provide solutions to sustainable problems and to closely collaborate with policy-makers and community and society
- Sustainability is a broad area that embraces a complex diversity of interrelated factors ranging from the natural environment to socioeconomic systems. That is why it is needed to restructure scientific and knowledge about sustainable in education.
- The need for networks and utilizing the technology as tools of reaching the goals.
- Achieving sustainability requires social change, in terms for changing public awareness. Universities and their researchers have a responsibility to propagate and spread new sustainability-related scientific knowledge and information to community and society at large scale. It is needed to socialize about continuous knowledge innovation.
- Campuses have a critical role to play in educating about sustainability for future generations, the agent of changes with visionary approaches, distribute and spread information about sustainability, and particularly giving training to leaders with the skills to solve problems from a global and interdisciplinary perspective.
- Campuses function and equipped with living laboratory for experimental models to explore. Another potential role for universities in the effort to achieve sustainability is using their campus facility as models for a sustainable society, based on interactions with various stakeholders in community and society through the academic research and education processes.

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