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1st Tarumanagara International Conference on the Applications of Technology and Engineering 2018

Preface

On behalf of the organising committee of 1st Tarumanagara International Conference on the Applications of Technology and Engineering (TICATE) 2018, I would like to welcome all delegates to the Campus of Universitas Tarumanagara (UNTAR) in Jakarta, Indonesia with great pleasure. Being held from November 22 to 23, 2018 the international conference is organized by UNTAR and technically sponsored by IOP Conference Series: Materials Science and Engineering (MSE).

Universities play an important role in facing the rapid development of technology and engineering in recent digital era. The rapid developments of technology and engineering impact various aspects of people's life in welcoming the era of Industry 4.0. The biggest challenge faced by universities due to these rapid developments is how the results of research and technological innovation can contribute to the people's prosperity. As a form of contribution from universities in responding this challenge, Universitas Tarumanagara hold the 1st TICATE 2018 with the theme of: "The Implementation of Research Results and Innovation for People's Prosperity".

This international conference activity is expected to be a forum of discussion, networking and exchanging ideas among researchers, academicians, and practitioners to work together to pursue research and technological innovation that can be used to contribute to people's prosperity.

Over 160 papers have been submitted to 1st TICATE 2018 from 6 different countries, those are Germany, France, Australia, Taiwan, Malaysia, and Indonesia. We categorized the papers under seven groups, namely Mechanical Engineering and Technology; Electrical Engineering; Industrial Engineering; Civil and Environmental Engineering; Food and Agriculture Technology; Informatic Engineering & Technologies; and Medical & Health Technology. All papers, regardless of their standing or initial classification, were available for general discussion at the committee's meeting.

Our special thank goes to our Rector, Prof. Dr. Agustinus Purna Irawan, who has initiated this conference, Dr. Svann Langguth as Head of Science and Technology Division from the Embassy of the Federal Republic of Germany in Jakarta, Prof. Dr. Mohd. Zulkifly bin Abdullah as Professor from Universiti Sains Malaysia, and Dr. Ir. Yono Reksoprodjo, DIC as Vice President Corporate Affairs of Sintesa Group, as our pleanary speakers and Bank DKI, Bank Mandiri, Tarzan Photo, Hyperzone Computer, as our patrons. I would like to give special thanks to all of you for the interesting keynote speech at this international conference.

We also thank all individuals and organisations such as the members of international editorial board, the conference organisers, the reviewers, and the authors, for their contribution in making TICATE 2018 as a successful international conference and a memorable gathering event. I am also grateful for the support of publication service of IOP Conference Series: Materials Science and Engineering (MSE).

We hope that the conference could present you wonderful memories to bring home in addition to new insights and friendship congregated during the event. We truly value your participation and support for the conference. We hope that you will enjoy TICATE 2018 and Betawi culture and tradition in Jakarta.

Dr. Hugeng, S.T., M.T. (SMIEEE)

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Changing the face of modern architecture: bamboo as a construction material. case study: Green school, Bali – Indonesia

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Changing the face of modern architecture: bamboo as a construction material. case study: Green school, Bali – Indonesia.

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Abstract. Traditionally, bamboo has been used extensively as a building material in tropical and subtropical regions. Bamboo has risen in contemporary issues recently, elevating local wisdom and genius loci, while its preservation method and processing technology have been improved significantly. Bamboo reference and observation are used to highlight its structural and non-structural analysis. As one of the most suitable building materials for tropical climate, bamboo has been constructed for beam, column, roof, laminated boards, and interior finishes throughout Indonesia. Although, bamboo has been reproduced in a more advanced manner, the indigenous idea has been a source of great inspiration: *Tongkonan* house from Toraja has proved its resistance to earthquake, because it has a pliability and wide span construction; On the other hand, The Sundanese house, *Imah*, offers a great ambience and faithful adherence to the harmony with nature and environment for architectural inspiration. Nowadays, bamboo material has been one of the most talked-able building materials. It is developed to offer a new architectural look, applied to elevate natural touch in a modern architectural style, whether it is used as a fence, construction, sun screen, doubled skinned facade. Bamboo potentially presents the new face of modern architecture.

1. Introduction

Bamboo is one of the most rapid growing plants in the world, reaching its maximum height in just 3 - 4 months. It is faster in comparison with other types of timber produced by commercial trees which need to be grown within 3 - 7 years [1]; This is why the timber becomes more expensive and difficult to obtain. With a short growth cycle and its omnipresent, bamboo is a great alternative for construction material, though its durability has been questioned through the ages. Easily found in most of Indonesian region, bamboo is a familiar local material that is commonly used for house, craft, and other daily products. It plants are considered as a member of the grass sub family, with around 1250 - 1500 bamboo species has been found in the world, Indonesia has its share of 154 species to the world's bamboo collection [2], [3].

Bamboo characteristic is flexible yet sturdy as a building material [4], and potentially developed as a more advanced material to replace timber in the near future, as it is promoted on the launch of the International Festival of Bamboo Architecture. The durability of bamboo, which undergoes a process of soaking, can be durable up to 100 years. Its flexibility may adapt to the movement of the earth, and

facilitate tensile strength and "bending". Toraja house is a perfect example, this house may last ten to hundreds of years with a capacity that can accommodate several families [5].

Undeniable, timber is the most preferable material for Indonesian construction right now, but logging and deforestation should be urgently included in the consideration for saving timber. Timber's popularity, commercial value, and high demand have caused deforestation throughout Indonesia. In order to save the environment, bamboo is offered as an alternative material for the builders [6].

Extensively utilized as a building material in tropical and subtropical regions, bamboo fiber is also a raw material for industrial purposes: paper, plywood, craft, art, and grocery. Although bamboo has been disregarded as a lower class material and has been encountering various obstacles; it is undeniably has many advantages. For instance, bamboo is believed as environmentally friendly and sustainable material, despite the fact that its population in Indonesia has not been successfully projected in both specifically and comprehensively, making even more difficult to predict and calculate its potential both economically and functionally [5].

Respecting context and local wisdom, bamboo may be used to question globalization, which is filled with the credo of "uniformity". The creativity in constructing an architecture should promote local material as our identity while reflecting a global trend. As an architect, it is our responsibility for creating a better, more sustainable world by improving economic, social, as well as our community. Bamboo in this sense should be promoted as a material that represents our cultural identity, engaging local material and creativity.

By studying the advantages of bamboo [7], an alternative can be offered for presenting a new face of modern architecture. A different feel and atmosphere can be proposed by utilizing bamboo in order to add context and promoting local tectonic through building facade, not only in Indonesia but also in Asia as the dominant producer of bamboo.

2. Material and Method

Reference and observation taken from several bamboo buildings are investigated to analyze bamboo durability in facing climate and earthquake conditions in Indonesia. Moreover, bamboo as a finishing material is scrutinized to offer a new possibility for presenting the face of modern architecture.

3. Results and Discussion

It is necessary to study bamboo for its simplicity, wider span capability, resistance to tropical climate, and adaptability to the earthquake. Its capability is presented by demonstrating a few tectonic samples in Green School in Sibang Kaja, Bali in order to highlight advanced construction and finishing.

3.1. Bamboo for Construction Materials.

There are still many traditional houses in Java that use bamboo as building materials, such as: roof and wall. High quality bamboo is strong like a steel [8], [9], it can be used for a simple construction to wide span. In addition, bamboo facilitates most temporary traditional Steiger in Indonesian as it is easily obtained, cheaper, longer, capacity of supporting a range of loads. In Addition, bamboo is also often utilized to construct an emergency bridge, a traditional infrastructure in Indonesian villages (Figure 1).

Figure 1. Construction of Bamboo Fences, Walls, Column and Roof Truss.
Source: https://id.images.search.yahoo.com/images?, retrieved on October 06, 2014

Bamboo processing technology elaborates the traditional method and improving preservation method to add bamboo value. Bamboo's strength can be increased to its maximum capacity in order to be readily utilized for beam, column and roof truss. With a modified method, a high quality laminated board, panel board or even bamboo roof can be produced for higher durability. Bamboo now presents a stronger material that can be last for a longer period of time, and for that reason preservation done in advance may guarantee a longer support and higher quality of finishes.

As the structural element of architecture, bamboo faces more challenges. Especially when implementing grafting techniques, natural bamboo requires more care. As consisting of structure, filled with cavity, various rods and segment distance, it is easily getten broken. In addition, it is considered difficult to take bamboo as a modular material: the trunk has various widths, discrepancy in module, and not perfectly round in shape. Presenting an organic character, bamboo should not be compared to other fabricated and industrialized materials. Embracing a lesson taken from a range of traditional buildings might be more effective in order to investigate bamboo as a construction material. Bamboo construction has been used for generations in Indonesia, *Tongkonan* houses (Figure 2) for instant, using bamboo as a roof cover. It functions as a buffer which is effective in presenting a very good for air circulation while presenting a natural facade possessing a high architectural profile and traditional values [10].

Figure 2. *Tongkonan* Houses, Toraja, Indonesia
Source: https://id.images.search.yahoo.com/images?, retrieved on October 06, 2014

From various studies, bamboo offers many positive characteristics. Pliant yet elastic are considered excellent criteria for a weight-bearing material (both compressive load/tensile, shear, and bending). Faculty of Forestry, ITB (Institut Teknologi Bandung) reveals that the compressive strength of a good quality bamboo is equivalent to timber; its tensile strength is even better in term of performance. In fact, with such capability, certain types of bamboo may replace steel as a concrete reinforcement [11].

The lightweight characteristic of bamboo suggests a better foundation/pedestal without sloof (Figure 3). To avoid decay, the bottom structure and bamboo flooring should avoid direct contact with the ground by elevating at least 40-50 cm from the ground surface. Concrete in this sense is commonly combined as an effective material to construct a pedestal or plinth, and often used at a construction stage.

Figure 3. Gazebo from Bamboo Materials to the Construction Stage
Source: https://id.images.search.yahoo.com/images?, retrieved on October 06, 2014

3.2. Bamboo and Earthquake.

Prone to earthquakes, Indonesia has been several times hit by earthquakes, such as Aceh in 2004 and Yogyakarta in 2006. The earthquakes in Indonesia can be destructive and immediately destroyed buildings in the affected areas. Major earthquakes have resulted building loss, homelessness, and injured victims due to construction's falls and building's rubbles.

However, building made of bamboo construction may offer a better resistance to earthquake. Bamboo's strength and flexibility can be obtained by designing movable stake, lock system, and suitable bonding materials such as rope fibers. Movable means a capability of a building to adjust the quake secured by connecting joints. Even though these principles have been applied in most Indonesian traditional buildings, recent development has disregarded the tradition by not profoundly implementing these local principles.

Evidence that bamboo is resistible to earthquake is demonstrated by "Kampung Adat Naga" in Neglasari, Salawu, Tasikmalaya - Indonesia. Although the 7.3-magnitude earthquake hit the area in September 2009, none of the traditional house made of bamboo was damaged by the earthquake [12].

3.3. Case study: Green School, Bali – Indonesia.

Environmentalists and designers, John and Cynthia Hardy motivate people to live healthier by establishing the Green School in order to promote eco-living and green peace. The school is designed by using bamboo as a natural material. With its affiliate, Foundation Meranggi, they initiate bamboo plantation in collaboration with local farmers. It's a construction company promotes bamboo as the primary building material in order to reduce the use of timber, as well as avoiding the depletion of sustainable forest [13].

Green School is an educational institution, located at The Ayung River in Sibang Kaja, Bali – Indonesia. Situated in the midst of a forest, it contains native plants, trees and an organic garden. Green school is constructed from bamboo, both construction and finishing materials. It also uses alternative energy sources, such as: bamboo dust for a cooking appliance, while its building's energy is powered Hydro vortex generators, bio-gas from animal waste and solar panels.

Local bamboo is taken from a plantation around the site, promoting replanting through sustainable planning. The school provides an understanding and insight to the students by accommodating a lot of outdoor activities and open classrooms, so that they can respect nature. In addition, the building does not need to use the air conditioner as it is supported by natural light (Figure 4a, 4b). The walls are opened to embrace surrounding environment, while generating natural ventilation. The design facilitates the future generation to be freed from the dangers of the greenhouse effects, promoting sustainable living through green architecture.

Bamboo in this sense is embraced as a natural material. It is composed as a construction material in order to construct the overall building shape and structure. Various tectonics are used to present more connection with local craftsmanship (Figure 4c, 4d, 4e, 4f). While wider extension is built to produce spacious room and free columned space (Figure 4a, 4f).

Figure 4. Green School Used Bamboo Material for Construction and Finishing
Source: http://addyarchy07.blogspot.com/2012/01/desain-bangunan-sekolah-dari-bambu.html, retrieved on October 06, 2014

3.4. Bamboo and Modern Architecture.

Bamboo can be designed for a wide span, so that a spacious room or a free columned room can be presented. Various shapes may be planned for resembling a modern structure. Bamboo is curved to demonstrate the strength that capable to bear more burden while producing larger space (Figure 5a, 5b, 5c). For instant, Vo Throng Nghia, a Vietnamese architect designs a curved bamboo construction for the Wind and Water Bar, a cafe and meeting rooms whose structure exhibit a form that resembles a dome shape (Figure 5d) to prove that bamboo can be a replacement for steel in the 21st century [14].

Figure 5. Bamboo Material for Wide Span Building Construction
Source: https://id.images.search.yahoo.com/search/images?, retrieved on October 06, 2014

While modern architecture is dominantly designed by using reinforced concrete and steel, a twist may be needed to give a more natural touch and organic look in order to reduce cold and hard characteristic, commonly possessed by major industrialized materials. Bamboo in this sense, potentially modified to present a dramatic makeover to contrast monotonous industrialized materials. Bamboo is easily assembled for constructing whether parts or a whole building; it is often used as fences, doors, partitions (Figure 6a, 6b) and roof construction. Nowadays, sun screen made of bamboo is one of the most trendiest architectural fins. It is effective as a buffer for windows, reducing solar heat excess, so that electricity for air conditioner can be reduced (Figure 6c). Others, double skinned facade is also considered preferable. It facilitates natural impression and a totally different atmosphere both in the external and internal area of a building (Figure 6d).

A house (Figure 6e) is wrapped in bamboo cladding materials, implemented as a doubled skinned facade. Architects Atelier Sacha Cotture designs their house with reinforced concrete, while bamboo and glass are composed as the skin for the sake of productivity and effectivity. Bamboo in this case is composed as building fins, a sunscreen that designed to protect the internal area and its courtyard. Despite its economical aspect, bamboo texture is also believed possesing Asian characteristics as easily founded around Asia while exhibiting the usefullness from the roots to the leaves [14].

Figure 6. A Blend of Bamboo Materials in a Modern Style Building
Source: https://id.images.search.yahoo.com/search/images?, retrieved on October 06, 2014

In a combination with modern materials such as concrete, steel, masonry and glass, the appearance of bamboo material may give not only familiar ambiance, but also natural texture and colour that potentially presenting a new face of modern architecture; whether in Indonesia, Asia and beyond.

4. Conclusion

Bamboo as a construction material can replace timber. It has a good strength, resistant to earthquake, and presenting a high architectural value. Moreover, bamboo is effectively used to construct wide span building, resembling a modern organic shaped building that previously can only be constructed by using steel. Bamboo preservation is required in advance in order to ensure bamboo's durability and endurance.

Last but not least, Bamboo can be modified for constructing modern building envelope, sun screen, doubled skinned facade in order to present a completely different ambiance of a natural look, while giving an alternative for presenting a new face of modern architecture.

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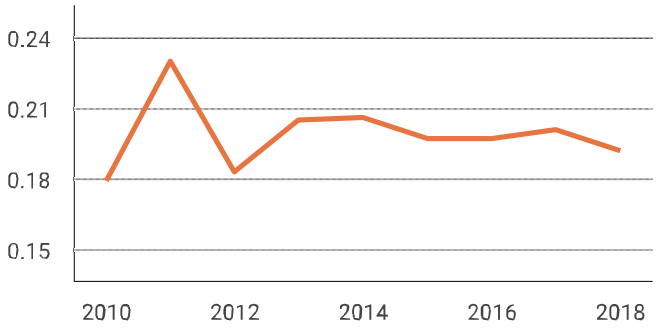

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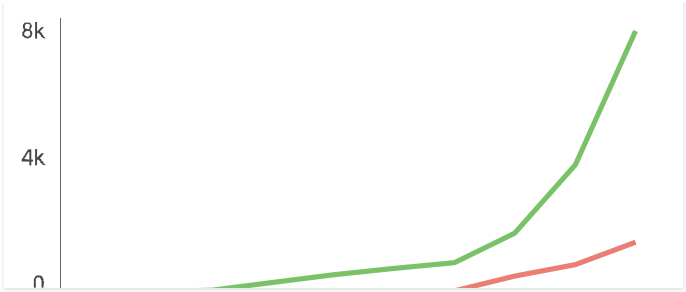

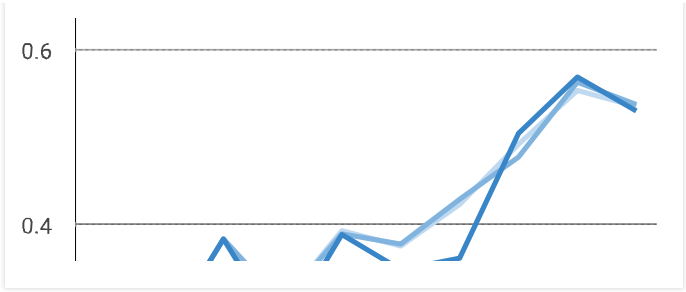

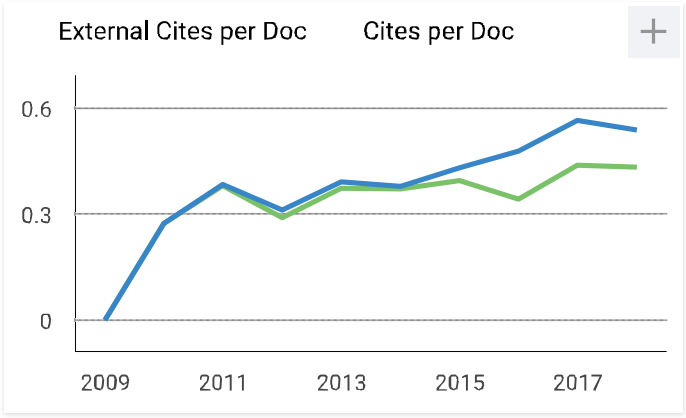

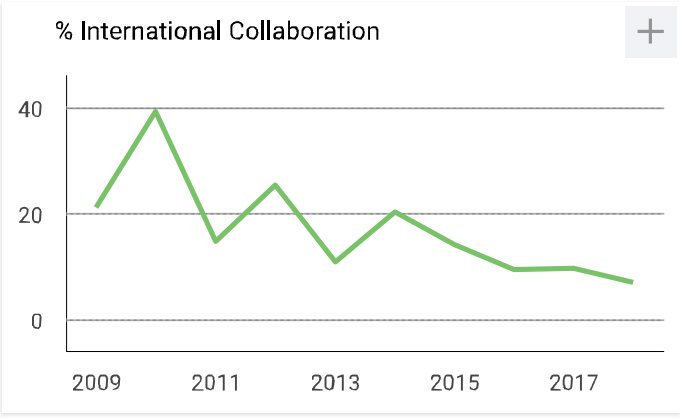

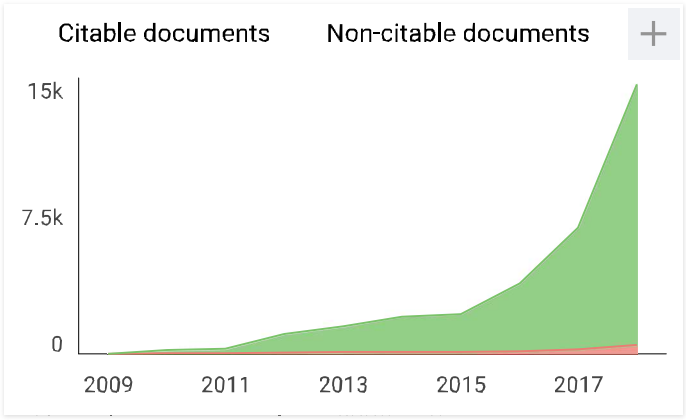

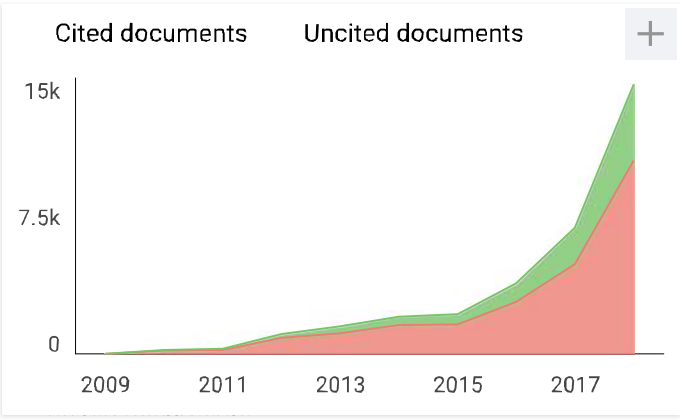

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