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**PROFESSORIAL  
LECTURE *UiTM***

**SPEAKER**

**PROF. DR. ZAKIAH AHMAD**

**Renaissance In Tropical Hardwood Timber  
Construction**

Date : **24 September 2020 (Thursday)**  
Time : **9.00 a.m.**  
Venue : **Dewan Seri Impian, Hotel UiTM,  
Shah Alam**  
fb live link : **[www.facebook.com/zakiah](https://www.facebook.com/zakiah)**

## **Professorial Lecture UiTM | Prof. Dr. Zakiah Ahmad**

### **Renaissance In Tropical Hardwood Timber Construction**



Program

## Professorial Lecture UiTM

Dewan Seri Impian, Hotel UiTM Shah Alam

24 September 2020 (Rabu), Jam 9.00 pagi

**Nama** : Prof. Dr. Zakiah Ahmad  
**Tajuk** : Renaissance In Tropical Hardwood Timber Construction  
**Jangka masa** : 1 jam 11 minit

Transkrip:

- 0:02 : Bismillahirrahmanirrahim. Assalamualaikum warahmatullahi wabarakatuh. Yang berbahagia, Professor Ts. Dr. Haji Mohd Kamal Haji Arun, Deputy Vice-Chancellor, Academy and International, UiTM, which I consider him my mentor.
- 0:22 : Yang berbahagia, Professor Dr. Mohd Nazim Suratman, Deputy Vice-Chancellor, Research and Innovation, UiTM, Yang berbahagia Professor Ts. Dr. Mohd Fauzi Ali, Deputy Vice-Chancellor, Development, UiTM, Yang berbahagia Professor Dato' Dr. Mizan Hitam, Assistant Vice-Chancellor, Institute of Leadership and Development (ILD), Yang berbahagia, respective Rectors and Deputy Deans, distinguished guests, ladies and gentlemen. Terlebih dahulu, saya ingin mengucapkan rasa syukur kepada Allah SWT kerana dengan limpah kurniaNya, dapatlah kita bersama pada hari ini, walaupun saya agak nervous. Okay, thank you all for accepting our invitation to be at this gracious occasion of Professorial Lecture today with me.
- 1:19 : Thank you all the TNCs for making time here, my colleagues at FKA and UiTM in general, all the Deans and Rectors, my lovely family members, my friends and everyone wherever you are, whether you are in UiTM or outside. We have friends from other countries and industries as well actually following this event. I really appreciate for all the support and this has given me the strength to be here today.
- 1:52 : Thank you for the generous introduction by Professor Dr Hamida, the Deputy Dean, Research, Innovation and Alumni on my humble bio. I also would like to take this opportunity to extend my appreciation to the top management of UiTM over the years since the beginning of my service 33 years ago until now for giving me the opportunity to impart my knowledge to UiTM students. UiTM community, industries as well as the whole community.
- 2:27 : Okay, now let's start my purpose here. I will talk a little bit about my research history, which also has already been elaborated just now. I started in 1999, it's quite late actually, even though I started working in UiTM in 1986, but it's at the PPP UiTM, so it's not a research centre.



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- 2:56 : So in 1999, I first embarked into oil pump reinforced concrete studies. Then in 2001, I started working on timber per se, even though oil pump is also part of the Lelorosik material, considered as plant and also can be used for reinforced concrete. Between that time also, I worked on solid timber, structure-sized timber, more for permissible stress design requirement.
- 3:28 : And then 2004, where I started my PhD, I worked on bonded in timber connection with nanopolymer adhesive. This is the place where I start working with polymer, where initially I have zero knowledge on that. It's quite a struggle, but alhamdulillah, with the assistance from my supervisor and my colleague in University of Bath, now I can be considered a nano-expert.
- 3:59 : So there are many outcomes from that project, but I'm not going to explain that in here. In 2008, I started working on glue laminated timber, and then continue with other engineered timber products, including CLT in 2016 until today, plus other composite material along the way. So besides that, working on timber, I also work on wood-wool cement board, which is also incorporating timber strand in the cement board.
- 4:37 : And then working on KNAF water rating system to get good fibers, long fibers, that incorporate it into concrete. And then I also work on Lego-like building block cement-based bricks, which has been commercialized. And then wood-wool, essentially we have prototype in Puncak Alam, and then there's a company working on that one.
- 5:04 : So there are many. But today, for this purpose, I only concentrate on timber. There are many types of timber products that I have worked on, but I only can dwell on four types of timber products for the purpose of this lecture, which has greatest impact to Malaysia in general.



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- 5:29 : Before that, I would like also to express my dedication to the timber research partner from UPM, and then from Japan, Dr. Noh Shariza here, and from University of Bath, from Korea, from UK, and from Germany. So they have contributed a lot in my career and also in my research. At the same time, I already expand my expertise to these mentees from different universities, whether it is private university or government university, to expand the knowledge on timber so that we can express the development of timber industry in Malaysia.
- 6:17 : So in fact, they are my students. Now they are working at this prospective university, so I urge them to continue working on timber and expand the timber industry. I also would like to express my appreciation to my main collaborators.
- 4:37 : And then working on KNAF water rating system to get good fibers, long fibers, that incorporate it into concrete. And then I also work on Lego-like building block cement-based bricks, which has been commercialized. And then wood-wool, essentially we have prototype in Puncak Alam, and then there's a company working on that one.
- 5:04 : So there are many. But today, for this purpose, I only concentrate on timber. There are many types of timber products that I have worked on, but I only can dwell on four types of timber products for the purpose of this lecture, which has greatest impact to Malaysia in general.
- 6:37 : The first one is Malaysian Timber Industry Board, and I have a representative from Malaysian Timber Industry Board, which is Puan Masuri, who has helped me a lot in also promoting the use of timber in construction. And besides that, I'm working closely with JKR, and then Woodsfield, Malaysian Timber Council, Kilang Papa Muhammad Yusof, Sampulot. This is only for timber, but for other types of research, I have other types of collaboration.



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- 7:09 : And for international collaborators, I have Eugen Decker, Rubner, Rotafix, to name a few. The recent one is the Besbahe, but it's more for bamboo. That will be another branch of research in the future.
- 7:22 : With my research team later. Now, at the same time, along the way, my research career, we have received more than 2 million equipment that's stationed in Fakulti Kejuruteraan Awam, and this has made our lab suitable for industry application, to generate income for the industry. And as mentioned before, this is some of my achievements.
- 4:37 : And then working on KNAF water rating system to get good fibers, long fibers, that incorporate it into concrete. And then I also work on Lego-like building block cement-based bricks, which has been commercialized. And then wood-wool, essentially we have prototype in Puncak Alam, and then there's a company working on that one.
- 7:51 : I will not have to elaborate anymore. But I have 11 copyrights and waiting for a patent, too. So hopefully we'll get it soon.
- 8:02 : Then we are actually working with industries to commercialize some of the products. Alright, now, for global visibility and branding, I have been invited as keynote and guest lecturer in international conference or forum, about 13 events from 6 countries, and then keynote lectures at national conference and forum 40 times, and then invited trainer at lab and workshop at 15. Before that, I didn't realize these were my numbers.
- 8:31 : Now, because I want to prepare this, I start counting, then I realize I have been talking a lot. So these are my topics for my lecture. I will touch on sustainability and wooden structures, Renaissance in timber construction, modern wood building system, and then focus on Malaysia and timber, where I will show some of my work, how to put our timber into international market, and also be used by the engineers in Malaysia.



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- 9:06 : And then some advancement in tropical engineered wood product for the construction. Alright, when we talk about timber, people always relate that we jeopardize our forest. We cut forest, then comes environmental problem, landslide, flooding, and so on.
- 9:27 : But that is the other perspective from the one who doesn't understand, actually, on how we can put timber in the positive side. Now, the impact on the sustainability of the world environment is on the population growth and also urbanization that will cause the global warming from the material that we use for construction. There are many other factors, but I just want to talk about timber.
- 9:58 : What impact of timber into the environment? In order to overcome the global warming, we have to look at the sustainable material for construction. We only talk about the material for construction industry. The impact of construction to the environment is that, in terms of energy, the construction industry represents 35 to 40 percent of the national energy consumption in order to produce the construction material.
- 10:27 : And once we build the construction, it will produce solid waste and represent 25 percent. And at the same time, it will take up 50 percent of our primary resources to do the construction. Mainly we use sand, we use aggregates, and we use steel, and they are non-renewable construction material.
- 10:50 : But people don't relate that for the global warming. People hardly relate that on the impact on the environment. When it comes to cutting the trees, where's the... Okay, when it comes to cutting the trees, then people make so much noise about that.
- 11:13 : So due to this, we have to look at the long life of building products affects our sustainability. Now, why we have to build using timber? There are many facts that I can elaborate, but I only mention the most important one. Timber uses very low energy to produce.



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- 11:35 : For one kilogram of material, timber uses the least energy compared to other construction material. In terms of carbon absorption, timber is the only material that absorbs carbon outside, but the rest emits carbon outside. And also, in terms of construction, timber has better strength-to-weight ratio.
- 12:00 : To put this in perspective, this bridge, Felisa Bridge in Norway, was built in 2003. We span 70.5 meters, and it's only one carriageway. But due to the expansion of the traffic, they have to widen the bridge, but they want to increase costs, because if they have to demolish everything, it will cost a lot.
- 12:23 : So they want to increase the price of the construction. So the only material that can be used to construct this bridge is by using timber. I'm the engineer who inspects, is it? No.
- 12:39 : I just went there to visit. Now, in terms of the sustainability effect of timber, we know that timber is a renewable resource. In terms of construction, because it's a very clean material, speed construction can be done, and it has very less pollutants and also biodegradable residues.
- 13:03 : But in terms of abundant resources, that is a question mark in Malaysia right now. And we can see from the export of timber products, the logs have decreased from year to year. So it shows that we have very limited sources of timber.
- 13:19 : So that will come to sustainability. If we want to have a sustainable building system, we also need to have a sustainable material supply. For timber also, we need to have sustainable forests.
- 13:33 : So how to get this sustainable construction material from timber, how to sustain that, that means the government has to put the policy, the political, people have to appreciate our timber, and we have to do selective management. This is the one that's actually being promoted, but somewhere along the way, it's not really being practiced. And then we have to start looking at plantation timber, which we can harvest in 15 years, not waiting for 60 years, 70 years, or 100 years to get that timber.



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- 14:08 : And we have to start looking on the engineered timber product. Instead of using large logs, we can use small logs, but we have to have the same performance of the solid timber. Now, in terms of revolution of timber industry, construction industry, let's look at some of the historical multi-story timber structures in other world.
- 14:31 : Actually, I have a lot of slides to show, but I reduce it to accommodate our time. This is Yingxian Pagoda in China, built in 1056, height 67 meters. At that time, they already got the technology to build multi-story building, and it's still standing until today.
- 15:12 : And then Pagoda Nara was built in 7th century, at 32.5 meter height, and considered as the oldest timber building, and still standing until today. Even this Todaiji Temple in Nara, built in 1709, but you can see that why they can still standing and still strong, because they use the whole log, the whole pole. So that will become problem now.
- 15:45 : Same thing as hanger in California, 52 meter high, but when we put to the perspective, that Todaiji Temple can fit inside this hanger, to show that how big is this hanger. And it's still standing until today. Similarly, if you go to Japan, Osaka, definitely you will visit this castle.
- 16:11 : It's also built in 1609, 7 stories, and still standing until today. And you can see that the column here is made from the whole log. It's a pole.
- 16:23 : Similarly to Istana Sri Menanti, I have the opportunity to work together with the team to do the repair of this Istana. And you can see that this tower is built from four columns of straight pole. So huge.
- 16:45 : And it is 50 feet high. So consider as whole tree to be used to construct this column. And then because of the nature of the pole, it cannot have the same cross-section from bottom to top.



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- 17:02 : So bottom cross-section is 13.5, and the top is only 10. And anyway, the weight at the top is less compared to the bottom, so bottom will carry the higher load. So we know that the natural resources of timber is not the same previously and now.
- 17:20 : Previously, one lorry can fit only one log, but now one lorry can fit many, many logs. So you can see that the strength reduces so much from that to that. And at the same time, so this was before, people are very small, and this is the large one.
- 17:38 : But now, I'm taller than the logs. And also, if we have some, but very rare and very limited, and become very, very expensive. This project, we want to find cengal to replace the column for the Istana Sri Menanti because the Sultan wants original cengal and one piece, but it's very difficult to get.
- 18:05 : And then it will dry very slow. So at the end of the day, we also cut. But the history, we have to explain why we cannot do that.
- 18:14 : And also, at the same time, the timber have defect in the middle, so you cannot cut full beam, full column from one log because there are defects in the middle. So therefore, it's not the same as the way we were. So therefore, we need to look at other form of material and also construction technique.
- 18:40 : So therefore, there are many engineered timber product has been established overseas like glue laminated timber, structural wood product, laminated vinyl lumber, para-strand lumber, laminated strand lumber, so many types, oriental strand board. And then we have cross-laminated timber, doorway laminated timber, nail laminated timber. These are to name some of the engineered timber product whereby we can use smaller cross-section, glue them together and have cross-section that we want for the construction, for the structural element.



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- 19:09 : So Europe standard has already come up with the product standard to produce solid timber. In order to get longer length, you have to do finger jointed and using glue. And then the section may be not enough to support load.
- 19:23 : You can combine two together. They'll become glue product. But if you arrange it differently and then it becomes glue laminated timber and then you want to make a panel, a board to force-slab, then we can arrange it differently like this so we can have bigger section instead of taller section.
- 19:44 : And then there are also, because of the machine, it's not enough to accommodate 10 by 10 or 20 by 20 or 20 by 30 panels. So they can combine the two panels together by using finger jointed machine. Alright? So it can go on and go on.
- 20:02 : Even this one, one piece here is glue laminated, but the cross-section may not be enough to support the load. We can glue together a series of glue laminated, become block glue laminated, and then this will become suitable for certain load to apply. Alright? So now we have started talking about constructing timber structures from low rise to high, high rise.
- 20:30 : Alright? By using light structure previously, we're only using sawn timber, but then we clad it with laminated product like plywood, OSB to make the panel, or we can use glue lam for posts and beams, and then we can use CLT plate as a load bearing, no need column and beam anymore to construct the structures, but also we can become hybrid, combine it with different timber materials, steel, glass, and concrete. Alright? So that the stability of tall building is there. Alright? Now, so these are some of example, how beautiful of this product being used for structure.
- 21:15 : Alright? Before this solid timber, you cannot curve it nicely. Alright? And this one also, many, and this one also because of the technology of gluing, you can curve it at certain degrees without breaking. Okay? And also, how beautiful is this building? We have timber structure clad with glasses.



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- 21:39 : Alright? So this one is actually available overseas. If you Google, you have many, many types of timber building all over the world. Now, they have, the timber structures have moved from three stories up to 30 stories in Canada, and in 2035, they will be 34 stories in Stockholm.
- 22:03 : Alright? So from normal housing timber into gigantic building structures. Now, let's talk about Malaysia and timber construction. Before I go into my actual lecture, I have to explain a little bit.
- 22:16 : Alright? Now, National Timber Industry Policy has been developed by NTIB Timber Industries to come up with a roadmap for the timber industry in Malaysia. They have National Furniture Design Roadmap 2070-2035. This UiTM faculty should have this, so that when we develop our syllabus, we know what is going on in the planning of the government on the timber perspective.
- 22:52 : Alright? And also roadmap for furniture industry. FSG can take up on that one. And then roadmap on IBS technology, IBS promotion, IBS training and technical support.
- 23:02 : And they have seven trusts related to timber industry. Okay? And also, they try to promote the use of IBS for timber. Alright? These are some of the timber, the amount that they export for the timber product.
- 23:18 : Alright? But somehow rather, even though they have IBS timber product, they have timber and timber product like sawn timber, plywood, door frame. Alright? And then some using for column and beams, very limited. But for construction, it's only 10%.
- 23:34 : Alright? So that's why my research is actually to promote the use of timber in construction. Alright? So we know already these are the products available overseas. Whether we can adopt the same product in Malaysia or not, whether the industry will take up this one or not, then we have to think about that.



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- 23:56 : Alright? So in order to build timber, structural using timber, because it's more sustainable material to be used, we need to have sustainable timber supply. We need standard development. We need to do promotion, education and training.
- 24:13 : We have to develop or we have to create talents, civil engineering talents, in order for them to be able to design timber structures. We need architects to be able to appreciate timber in their design. Alright? And also we need to have specific policy on the use of IBS timber for construction.
- 24:31 : Because right now, 70% of the construction must use IBS. Alright? But mainly for concrete and steel. So we want to say that at least 10% of 70% must be timber.
- 24:45 : Because right now, mostly are being used as decorative. Alright? In the construction, but not mainly for columns, for beams, to support the structure. Okay.
- 24:55 : So in order for us to have modern timber construction, what do we need? We need structural timber design. We need a standard to manufacture all the products, so that when the industry produces, we can inspect, we can audit whether that can be. Because we are talking about structural applications, so it has to be strictly followed.
- 25:19 : Then, when they design, they have to follow Uniform Building By-law. And also JKR standard specifications, CIDB building specification. At the same time, when building using timber, we have to get approval from fire department because timber is considered as combustible material.
- 25:39 : Alright? So people are worried whether it will burn under fire. The safety must come first. So how to overcome all this? So we have committee for timber structures, and I'm the chairman of the timber structures.



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- 25:57 : So we strategically plan for the revision of the current standard, proposed new standard, promote standard, and also we conduct training. So MS444 Part 5, because in order for us to construct the structures, we need connection, bolts and nuts. So we have to develop standards for jointing.
- 26:18 : And then MS444 Part 1 to Part 3 is already published in 2009 revision. It's for the solid timber. And then we need to produce glue laminated timber in Malaysia, so the industry has to follow certain standards.
- 26:30 : So we have manufacturing standard for MS758. And then we also have, recently we are working on developing the protocol for manufacturing of CLT, which we plan to complete in 2022 so that the industry can follow. And then, again, to overcome the fire department requirement, we have to have a design on fire performance.
- 26:55 : So MS444 Part 9, so we hope we can complete it in 2023. And then MS444 Part 12 on laminated vineyard lumber. But these are based on permissible stress design.
- 27:06 : Now the design method has changed, has moved from permissible to limit state design, which I will not be able to explain the difference in here at this moment. But at least everybody will know that there are two methods of design. One is permissible, another one for limit state.
- 27:22 : So if you want to move along with the rest of the world in terms of design, for more safe and economical, we have to design it based on limit state design. Therefore, we need to prepare standards relevant to that for each type of material. So that's opened a lot of research.
- 27:45 : So that's why my research embarked towards that, related to a standard the industry can use, the product can be produced by the industry. It's not just basic sciences. Start with sciences, grow until it can be commercialized.
- 28:04 : But not only commercialized, it can be used by engineers, by architects, and by contractors. So that's the journey that I want to bring all of you today. Okay, so these are the design codes in Malaysia, but these are based on permissible stress design.



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- 28:21 : These are all design standards for different types of material, solid timber, glue lamps, such as plywood, cement bonded particle board. And then we need to join, so we have joint standards. We have overcome fire resistance, so we need to know how to design in terms of fire requirement.
- 28:40 : And then preservative, and then laminated vinyl lumber for structural application. Besides that, we also look at the manufacturing standards for roof truss and also for the glue laminated timber, because at that time we have only for glue laminated timber. Now, again, in terms of design standard, there are measures standard right now still use permissible stress design.
- 29:05 : It's very conservative. We are using data from small-scale specimen. The actual one, long section, definitely there are defects.
- 29:12 : So when we use small-scale specimen data, we have to input a lot of safety factors. So instead of small cross-sectional beam, now become larger cross-sectional beam, so it's not economical. So that's why European also started with permissible stress design, and they have already changed to limit state.
- 29:28 : Design is based on large-size specimen. It's more economical, and they have already designed data for glue lamp and CLT, which we don't have. So therefore, we need to develop standards for this product.
- 29:46 : So we need to do some testing to gather the data so that we can develop the standard. Can we adopt European standard? We cannot adopt it directly because there are temperate hardwood and softwood timber, ours is tropical hardwood. So they have different characteristics.
- 30:04 : So it's not like steel and concrete, grade 40 concrete. In UK, it's a similar grade 40 concrete in Malaysia because it's designed, it's man-made. But timber is a natural product.



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- 30:17 : They are not the same. So therefore, my work, related research work, for me, in developing a development of manufacturing and design standard, I work on manufacturing standard of LVL, glue lamp, and also cross-laminated timber, the recent one. I also do the design standard for solid timber, design standard for glue laminated timber, design standard for laminated vineyard lumber, design standard for connection, design standard for fire resistant, design standard for limit state.
- 30:50 : This is the one that we're going to embark on now, and limit state for fire requirement and also for engineered timber product. So the first product that I want to mention is on laminated vineyard lumber, which is one of the products that we can use for joists, can use for beams, can use for columns. The production is we have to peel the log, so there also must be investigation.
- 31:13 : Not all timber can be peeled. So then we do clipping, we have to dry, so we need also to know what is the drying temperature suitable for different types of species. So that also research coming in.
- 31:28 : And then, because of not long enough, so they will have to do scuff joint, and then because when we peel, there are holes along the way, so we have to do patching, gluing, laminating, and then we do cold press and that. At the end of the day, we have that laminated vineyard lumber. This one, we received around \$225,000 in conjunction with UPM at that time.
- 31:52 : This was my first project on timber per se, directly. So based on this project, after doing all the testing, we produced data for design. And this data has been incorporated in MS544 Part 12.
- 32:07 : And we produced books on manufacturing, on the properties, and also we improvised the manufacturing standard for laminated vineyard lumber, production of laminated vineyard lumber. So from sciences, we carry up until it can be used by the engineers, by the industry. Now, as I mentioned before, our design method is based on permissible stress design, based on data gathered from small, clear specimens.



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- 32:41 : Therefore, we need to change our design method into a limited design, so the data has to be tested again by using structural size specimen. Structural size specimen can be 100 by 120 by 6 meters, 7 meters. It's not by 50 by 90 by 1.8 meters only, previously.
- 33:03 : Now it's by 7 meters, by 12 meters length. It's huge. This is to develop Eurocode 5 Malaysian version design standard based on permissible stress design and the limited design.
- 33:16 : At the same time, we need to come up with the strength classes for Malaysian timber. So previously in MS544 Part 2, the design data here is based on small, clear specimen. In MS544 Part 3, which we used to design glue laminated timber based on solid timber, but the data is by conversion from small, clear specimen to large size specimen.
- 33:39 : We adopt from British standard 5268. We then do the testing. We adopt from there, and we found that it is not totally correct because the data comes from Southeast Asia.
- 33:52 : So it's not necessarily timber comes from Malaysia. It's from Southeast Asia. So we have to put higher safety factor.
- 34:00 : Again, our dimension or cross-section of the structural element will become huge and will cost a lot. So inside European British standard comes BSEN. They adopt kapur, balau, kempas, merbau, and keruing.
- 34:16 : So Southeast Asian countries, this is a lot. These are all producers of hardwood timber, so we don't know from which country the UK took it last time. Okay, so therefore we need to do something.
- 34:31 : Our present standard MS544 Part 3 adopted BS5268 in 1998. These are the classes, but they have evolved. The standards have evolved from small, clear specimen to large size specimen.
- 34:43 : You can see that balau previously D70 now goes to D50, so reduced a lot from 70 megapascal to 50 megapascal. So in terms of exporting, the price is lower now. Do we agree with that? When they manipulate the data and change the standard from 70 to 50, we don't want that because we lose our export value.



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- 35:13 : So therefore, they explain why they change, how they change, but we need to investigate because they manipulate on the current data. They are not testing new sets of timber. So they convert from small, clear to large size by using this modification factor.
- 35:33 : So in order to overcome that, we have to do some testing. Now in Eurocode, to design based on the state, they have to come up with new strength classes in EN388 for hardwood timber. Start with D, mean hardwood.
- 35:46 : There's another table, C means softwood. But these hardwoods are from temperate, from Europe. So can we adopt European standard directly? We have to investigate.
- 35:59 : So these are for softwood. Start with C. Again, they only did bending test, and the rest to get design value for compression, tension, and so on, they use formula. They develop formula to get that.
- 36:17 : Then at the same time, they also develop tensile classes for designing glulam. That will be later. So in order for us to embark on the project to develop our own strength classes for tropical timber in large size and be accepted in European community, I have to study correct and the right way.
- 36:45 : I cannot just simply do the test, get the bending, and then declare it, no. Because at the end of the day, I want our data to be accepted and incorporated in European standard. So therefore, in order to do that, I'm glad that I am able to collaborate with these well-known people in the European Standards Committee, Dr. Simon Eicher, Dr. Jural in the Eurocode, and also Stefan.
- 37:13 : He's the chairman of the European Timber Structures Committee. So we need to work with them. So in order to run the test, because of large size, we need equipment.



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- 37:24 : So MTIB has sponsored us 2.3 million torsion machine, the only one in Malaysia right now. So any university can use it, but they have to pay. Even my students from other universities, they have to pay for it.
- 37:37 : But to complement that, I can also provide us with tensile machine 2.5 million, because the sample is so large, our current machine will not be able to accommodate that. So in order to be relevant, the data, we have to take the sample from all over Malaysia, because timber in Sarawak is not the same in Terengganu, in Johor, in Pahang. So there has to be representative of all that.
- 38:01 : So then timber must, in order to be accepted and published in ISO standard, and also in European standard, we must prove that the timber comes from sustainable forest. We go to that extent. Not just buy from the sawmill anywhere and do the timber.
- 38:22 : Do the test. Then the sample, almost 20,000 number. These are my students who completed that.
- 38:29 : Other students do five samples enough, 20 samples enough, they do thousands of samples. So these are some tests. So they also came to inspect whether the methodology that we do is correct or not.
- 38:46 : Correct, comply with the standard. We found that their testing standard does not really comply to our timber. The rate that they put, let's say 10 millimetres per second, is for their saw food.
- 39:01 : Our timber is so hard. So we have to change. So there are modifications in terms of the standard, the testing standard that they provide, actually.
- 39:10 : All right? So that's one that we're going to do. So based on that, we come up with our new strength class. Then this one, now in the process of getting approval from European Technical Committee, and once it is approved, this one will appear in our new standard design, and also we will push it into ISO standard, and hopefully Dr. Simon can help to put it into European code.



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- 39:39 : Then when they buy our timber for design, they don't use their standards whereby they can save material for design. Then along the way, we also modify some of the formulas, some of the modifications that are available in the European standard to accommodate our timber. So we also develop new formulas.
- 40:08 : We develop new things. So this one will be incorporated into our standard later on. So the outcome of that, we use it for our code, because UiTM is the only faculty that offers masters on timber design.
- 40:27 : And we still maintain in undergraduate. Some of the universities do not cover that. So we become center for timber design.
- 40:35 : That's the one that we want. So later on, these are the new standards that we create. Then we also want it to be in the ISO standard. I am also the committee member for all these standard ISO. We have been rotating from country to country, so I meet a lot of traveling, meet a lot of friends. That's where you go for internationalization.
- 41:01 : The next one, I want to talk about glue laminated timber. You have to be patient with me today. It's my special day, so you have to wait. All right? Okay, so the next product that I want to talk about is the glue laminated timber. From logs, we sawn it into sawn timber. And then, if not long enough, we finger jointed them, and then put glue in between, and then press it.
- 41:27 : It becomes glue laminated timber. It's not as simple as that, because a lot of study, a lot of parameters need to be considered. All right? All right.
- 41:38 : So, again, previously, we have a design for glue laminated timber based on permissible stress design. So we want to move to limit state design. And in the European Code, it mentioned that here, if you are able to see that, for glue laminated sawed wood timber only.



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- 41:58 : So we cannot adopt 100% the Euro Code 5, because some of the data there specifically mention on sawed wood timber. So we need to get what is the new modification factor that relevant to our timber. So if engineer wants to design glue laminated structures, based on this, they have to put a lot of safety factor on that.
- 42:21 : So then it will cost more, okay? Because the section from small become large. All right? So, again, we need to have the T-classes, the tensile test of the finger-jointed lamella, the tensile test of the lamella alone, because these are required in terms of design of glue laminated timber. So, so far in the Euro Code EN14080, so they have glue lam of strength 20 megapascal up to 32 megapascal.
- 42:51 : And then this one equivalent to T-classes, 10 megapascal, tensile test, 10 megapascal. And then the bending strength of the finger joint is 25. So when we did our test, we did locally, and also we send some to German to validate the test method that we do, because we cannot send all, because it's very expensive.
- 43:12 : So we send it to University of Stuttgart. We collaborate with University of Stuttgart. So these are the number of sample that we send to them for them to do the test. All right? We send only Kruwing and Light Red Meranti. They do a series of tests. And then these are the bending strength for malangganggai.
- 43:31 : We found it in GL40. In European Code just now, the highest grade is GL32. Our malangganggai is SG3.
- 43:40 : And the class is GL4, 40. And then, so these are the design table for glue laminated timber in European Code. All right? So we set up to 32 only, from 20 megapascal up to 32 megapascal.
- 43:57 : So when we did our timber, we have Kruwing of GL44, Light Meranti, because it's lower density, GL22. So that means our Kruwing is strength class 5, all right? SG5. So still much higher than their highest timber.



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- 44:19 : All right? So if we don't have this data, and you can see that the tensile strength is 50, 19, 50. Here it's only 26. All right? And the bending strength, ours is 80. And the highest is only 41. So if we want to use their standards, their data to design for beam of 24-meter span with same applied load for GL28, the size is 80 by 228. But if you are using GL44, it's 80 by 144.
- 44:51 : So this is only for one beam. So we are using many, many beams. So it will save us a lot. All right? So how important is that? Then we also decouple Mapau and so on and so on. This one is kind of unique. So with this collaboration, now our data has been published in European Technical Committee.
- 45:12 : European Technical Committee has been approved. So now we need to have industry to export the product. In order for Malaysian industry to export the product overseas, their timber product must be certified by European Committee.
- 45:28 : All right? So we go to that length so that our industry can sell the product not only locally but also in Europe. All right? So to do that, we have come up with route to CE marking. We teach them how to get their product, get the CE mark, and then get to be exported overseas.
- 45:57 : We lose this project. We bid for the Cebu airport, Philippine. They like to use our timber because they know that our data that we produce and all that, they know that they can save a lot, but then our product is not yet CE mark.
- 46:15 : So the committee and MTIB, we try to help the industry to get the CE mark because that's the only way that this product can be exported overseas, even in Singapore. Even in Singapore. If you go to Singapore, there are a few buildings that are already built using glulam and CLT but imported from Finland.



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- 46:35 : We are very near, but they cannot buy because we don't have the CE mark to guarantee that the production control is good. All right? Because this is for structural application. Okay. So now, with this project, the outcome is we will have new version of MSEN 338. We will have ISO 1222-3. We also have MSEN 14080.
- 47:05 : In the process, I will show you the gun chart where we want it to be published. All right? And for this, we also prepared books, hopefully will publish soon, on the manufacturing of glulam timber and some properties of the glulam timber. And because of that project, we have a few companies emerge.
- 47:27 : From this study, we have Woodsfield Glulam Manufacturing in Johor Bahru, and then we have PEKA. All right? So we have them. In fact, they got the machinery from MTAB, but to get the contractors, the builders, to believe in this product.
- 47:45 : So a lot of promotion needs to be done. All right? So based on this product, we have built, I will show you some of the buildings in Malaysia has already been built using glulam timber because we are not export, so we don't have to have the sea marking, but we check their product production. So this one is the glulam gallery in Johor Bahru.
- 48:09 : And then the timber also being used for MITI Exhibition Pavilion in Milan. All right? And then TLDM Blue Moat, because it's very near to the sea. It was designed based on steel.
- 48:21 : So it will have problems in corrosion. So replace it with timber. We still maintain the same cost, and yet we make profit out of it.
- 48:32 : So people say that timber expensive, steel, but this project shows that we can replace it using timber without additional cost. And yet the company make profit. And then we have the CFR, Cross for Future Research Crops in Seminyak.



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- 48:50 : And then Ruffas Hospital Steel, it was collapsed because of the so many services hanging. It was not designed for. So in order to speed construction and then to be able to have a wider area, so we use glulam.
- 49:09 : All right? Without have to remove all the patient, all the machinery, and all that. So we managed to do it by using glulam. And then to showcase that timber also friendly to weather.
- 49:21 : People were afraid that it's not good in terms of durability. We have some example in Taman Negara Kukuk, mangrove area. And it's also emitted the shell, all that. So it's there. You can go. And then Ritz Carlton Hotel Langkawi again.
- 49:39 : This bubu at first was built using steel. It start to corrode. Then we change to glulam. And then also built for the warehouse. Now restaurant use it. Sugar bun and then pizza restaurant in Johor Bahru also using it.
- 49:54 : And the latest one is also on the restaurant. Okay. So now last one is on the CLT, which is my current project, still active. Okay, almost finished. So still using long sawn timber, but now we cross each other. All right.
- 50:16 : So that we can have bigger panel. All right. So these are some of the methods. So these are the products. Some cross this way. Another one cross that way. Because we can make it into big panel. So save a lot of time. Then we can just do opening window, the door.
- 50:35 : And then connect that together like Lego. So you can have the building. That's it. Very, very fast. All right. So this is market story in this one is somewhere in Germany. All right. Okay. So you can see that they don't need beam and column.
- 50:54 : The whole panel is load bearing wall. Just cut opening for the window. And just connect each other with proper design of connection. All right. So you can do that. And then you can build this very fast. Okay. I'll show you at the end the video on the construction of the building. So in order to do that, Malaysia wants to have this product available.



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- 51:17 : And for design purposes, we need to have manufacturing standard. All right. So, again, right now ISO standard on CLT is still under draft.
- 51:27 : So if we have our data, we can incorporate in that ISO standard some of the pertinent to tropical hardwood. So in order to do that, we cannot start from scratch because we don't want to make so many trial and error and take longer time. We want to do it very fast.
- 51:44 : And the product can easily accepted by the industry locally and internationally. And the standard, we can change it very fast rather than have to wait five or six years. So we conducted our production of CLT at Germany.
- 52:01 : And also in Italy. But it's not easy to convince them to incorporate with us in the manufacturing of this. Not many people can bring your product into their factory and look at their technology. All right. So, alhamdulillah, I have good connection. And also with support from MTRB, we managed to do it. Alhamdulillah. All right. Okay.
- 52:30 : So there are two methods. One is by hydraulic press. Another one is by vacuum press. Why? Because the cost to produce by using this method is only \$600,000. But the machinery for this can go to \$10 million. So as a start, we want to give the industry opportunity. All right. Start small. And then after that, grow bigger.
- 52:56 : So we have both methods of production of CLT. All right. So we are not only thinking of producing one panel, but we also have to think whether there is industry also not to take up this project. If it is the capital is too much and there's no guarantee there will be public to use it, then so goes. The product will not be used in Malaysia. So we have to think along that way. All right. So these are the production of CLT in the factory. Okay.
- 53:28 : So can we start the video? Just small, just short video on the product. Another cross section, the one that cross, put on top and another one, another one. So we have to create three layers, five layers, seven layers, in the odd numbers.



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- 54:07 : All right. There's a reason for that possibility. And they did, because they are machines, they are glue. So this specifies for certain pressure, but also for the application of the glue. On the glue, suitable or not for our use. If not suitable, the bonding is not good. Once completed, one can bring to the industry, and the industry will change that for you. All right. So this is the first CLT.
- 55:49 : We did crewing and light rep mounting. The first production of CLT from Malaysia tropical hardwood in Europe. Now they have experience producing CLT from us. Hopefully they will buy timber from us. If they are finding that it is good, then we show that the strength is much higher. So the smaller section, they can combine.
- 56:07 : Actually, a lot of study can be done. The middle section can be European timber, top and bottom, because we need the compression and tension for design purposes, so we can use our timber. So there's opportunity for us to export more.
- 56:22 : All right. Okay. So the outcome, we come up with a technical guide for protocol of how to manufacture cross-laminated timber from Malaysian timber. We're going to do MSISO 16692, and then we have one factory that's producing CLT now. All right. See how it goes from research into industry.
- 56:45 : All right. Another issue, fire. We also have to tackle. If not, the fire department will not approve our timber structures, especially when it goes more than three stories, more than six stories. All right. Okay.
- 57:04 : Because we always say that timber is combustible. Now, if a bomber does not approve, you can never get insurance covered. All right. And then if they want to cover, you put 30% higher. That will put off the contractors, the developer. All right.
- 57:22 : And also, the UBBL uniform building bylaw, we need to look at the law, and then we have to change the law, because inside that law, it says that the beam, the column, the compartment floor must be built or must be constructed using non-combustible material, timber gone. All right. Timber is considered combustible, but we have to make it such a way that it is considered as non-combustible.



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- 57:51 : All right. So I'm heading the committee, looking at the revision of the UBBL, together with the fire department, MTIB, and industry, and so on. Alhamdulillah, we have made some progress on that one, now waiting for the parliament to approve the law. But at the same time, we have to educate bomber. Things change. It's not like before.
- 58:16 : When I say that, they are very sensitive. Now it's live. But then we have got very good cooperation with them. They are very supportive. Even now, we're going to construct one building using CLT in Sabah, and the fire department is very supportive. We agree with that after we show some proof to that.
- 58:37 : So in order to prove that, there are two ways. One is by full-scale testing. Another one is by design method. So I'm going for design method, because full-scale testing, it will cost a lot, because we have to construct large-sized building, and then put fire, burn it. All right. So that's very expensive.
- 58:58 : So we have to do by calculation. So there are two parts. When it starts to ignite, then after the fire builds up, then slowly the structure loses its integrity. So there are two parts that we need to take care of, the fire resistance and also reaction to fire, how it contributes for the fire development. All right. So the reaction classification for timber, European standard wood, is at D class.
- 59:25 : All right. So we did a reaction test in University of Stuttgart, because we don't have the equipment for this. Even in Malaysia, we don't have that for the large size.
- 59:34 : So we did a test in Europe, and we found that for glulam crewing, instead of class D, we push to class C. So our timber is actually not easily catch fire, but engineered timber product, when you design it, not just simply normal wood stick for fire. That one is burn easily. All right.
- 59:59 : That have to have design. And fire department worried about the toxic smoke. So we did also test on that.



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- 1:00:08 : We have class 1, very little smoke. We have to go to that extent. Now, to design fire resistant, European code in EN1 and EN5-1-2, all right, specify on how to design timber structures using to overcome fire, whichever mentioned in UVBL, two hours or three hours or half an hour.
- 1:00:32 : All right. In order to do that, when we put the section into fire, there will be reduction of cross-section and also consideration of heated. All right. So we have to look at how much the timber is being charred. All right. So we can design it by using notional charred rate.
- 1:00:50 : These are the current in MS54.9, based on strength grouping. For BS5268, it's based on density. And then now, recent one, Eurocode 5, also based on density.
- 1:01:02 : They have for softwood, they have softwood glulam, but they don't have hardwood glulam, and also for the LVL. So, therefore, we have to change our charring rate instead of using strength grouping because the charring rate depends on the density, not based on strength. So we have to change that.
- 1:01:25 : So we did some study. We did a fire test at Trada, and also in Sweden. And latest, we did it in FRIM. So that we learn from here, we learn from there, and then we did in FRIM. All right. So in Eurocode, there are two formula to use, two parameters to use, beta 1 and beta 2, which is for the floor like this, fire is only one-sided.
- 1:01:53 : For column, it can be three, three-sided. So we design column different than we design for floor slab. All right. So we need to have these two data. So these are the test conducted in Trada. And then we get the charring rate is 0.44. In MS449, it's 0.7, but we have 0.44. It's much lower.
- 1:02:17 : All right. And then for one-sided test, we test in Sweden. We have also 0.69. This one is for one-sided test. All right. And then we did in FRIM for two-dimensional, and also for three-dimensional, for different species. All right.
- 1:02:34 : And then also for solid timber, for glue lamp, and also for LVL. And we measure. This is the original piece.



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- 1:02:41 : After half an hour, okay, we have to calculate what are the charring rate available. There are so many formulas. So we have to come up with our own justification. And then we have our – these are the value that we recommend for time being. We need to do more just to validate. We use very small numbers.
- 1:03:06 : All right. Now, overseas, we are looking for tall stories, 80-story clock tower in London, and then 120-story in China. All right. Malaysia, two stories at most. All right. So we have to push, all right, because of sustainability of the material.
- 1:03:28 : And then there's also mention that they believe ingenial wood will become the cheapest way to construct tall buildings in the future. All right. So before that, let's look at video. Video. Very short time. They built in six weeks.
- 1:04:08 : Very, very short time. Because it's IBS. It's already done in the factory. Bring to the site. It's very safe construction, very clean construction, and it's very fast. You will be very fast.
- 1:04:23 : You don't have to wait for one year. Sometimes you do renovation. It takes you one year. All right. It's okay. It's just to tell you that the construction is... It's very, very fast.
- 1:04:43 : (Unclear audio)
- 1:06:10 : So I would like to say thank you to all of you, especially my children, my family, FKA staff, my beloved FKA staff and Isom also. I was the pengarah at that time, and friends, students, and collaborators, as well to UiTM. With that, wa'alaikumussalam wa'alaikum warahmatullahi wabarakatuh.
- 1:06:36 : Any questions? What is this? The spotlight is hot. Yeah, I already asked, is there any question to... One question about the... If based on the current scenario, present scenario, if the demand, let's say from overseas, from the EU countries, is it sufficient enough for the availability of our timber or log in our forest to supply the high demand from the EU countries? And if yes, how long can sustain with that demand? That's a very difficult question to answer. Alright, I think we at MITB take it rather not so abruptly.



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- 1:07:45 : We realise that first thing, the promotion must be good to buy in. Let's say, everything is already in place, but along the way, we have policy on replanting. And now we are working with OM in Kelantan.
- 1:08:05 : They have already rented quite a large number of land from the government, they rent the land to plant the plantation timber, laran and batai. So we cannot rely on our reserve forest, because for forest management, a small number can only be logged. We need a mass number, so the best way is to buy plantation timber.
- 1:08:33 : That day also, I worked with a company in Sabah. They are also looking at renting land from the government, or trying to get some more land from the government for the plantation. In fact, laran and batai is already part of the policy, native policy.
- 1:08:52 : So we focus more on laran and batai because we can see the potential. Right now, in the lab, and this one is actually sponsored by the industry, to show that it is from CLT, made from laran. So we have already some samples in our lab, Dr Noshariza will do the testing, to see the performance of laran and batai CLT performance.
- 1:09:18 : If it is good in terms of glueability, strength-wise, and then later on, maybe FSG can help me on the treatment, how to treat. Prof Nasir can look at that one also, on the treatment, how it affects on the bondability and so on. So the planning is there.
- 1:09:48 : Thank you, Prof Zakia, for enlightening us on the usefulness of hardwood timbers. And I fully agree with the suggestion for us to focus on the forest plantations as the future resources, to lessen the pressure on the natural forest. But then, things like to make sure that when we are opening up the forest plantation, we should avoid opening the natural forest for that.
- 1:10:22 : What we might want to do is to find the degraded land. For example, in Sabah-Sarawak, there has been an unsustainable practice of farming, that they do the cliff heading and shifting cultivation. That would be some of the potential for us to grow the plantations.



Program

## **Professorial Lecture UiTM**

Dewan Seri Impian, Hotel UiTM Shah Alam

24 September 2020 (Rabu), Jam 9.00 pagi

**Nama** Prof. Dr. Zakiah Ahmad  
**Tajuk** Renaissance In Tropical Hardwood Timber Construction  
**Jangka masa** : 1 jam 11 minit

Transkrip:

1:10:46 : Because as we talk about the degraded forests, actually we can treat them. Because you showed to us this SMS, the selective management system, after logging, we can replant to enrich the area. So rather than clearing the remaining of the timber, we treat them. But when you want to do the fast-growing forest plantations, let's focus on the land that's available, the idle land and the degraded area. Thank you. That's what the OM is doing.

1:11:37 : You can ask me further during lunch. Thank you very, very much for coming, for listening. I hope it does benefit some of you, all of you.