Technical talk on Development & Fabrication of Low to High Strength and Antiballistic of M'sian Bamboo Laminated Composites by Prof. Dr. Aidy Ali

by Ir. Dr Huzein Fahmi bin Hawari

Ir. Dr Huzein Fahmi bin Hawari is currently the Honorary Secretary cum Treasurer in Electronic Engineering Technical Division (eETD).

On 10th August 2020, Electronic Engineering Technical Division (eETD) conducted an online evening talk on development & fabrication of low to high strength and antiballistic of Malaysian bamboo laminated composites presented by Prof. Dr. Aidy Ali from Universiti Pertahanan Nasional Malaysia (UPNM). The event well was attended by 27 participants. The session started at 6.00pm with short introduction of bamboo as natural fibre with different varieties available and geometries of bamboo specimens. For the project, buluh semantan was selected due to its availability and suitable geometries. Before it can be used as an anti-ballistic composite, the buluh semantan must be cut to a specific dimension and then moulded as laminated strip.

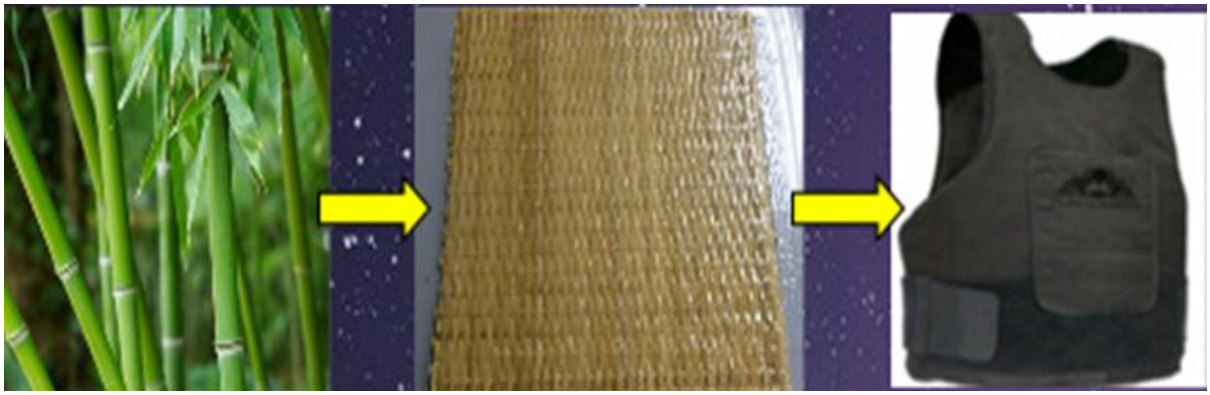


Figure 1: ***The transformation of bamboo for antiballistic material***

Next, the bamboo is then woven with a thickness range of 0.4mm to 0.6mm before being laminated with e-glass composite. Several layers of the fabricated composites were prepared and sent for a mechanical test to measure its fatigue and fracture toughness. From the testing, the fatigue strength of the composite at 30 MPa registered the highest with 1 x 10^6 cycles. The 3-mm thickness were also observed to provide the best fatigue resistance.

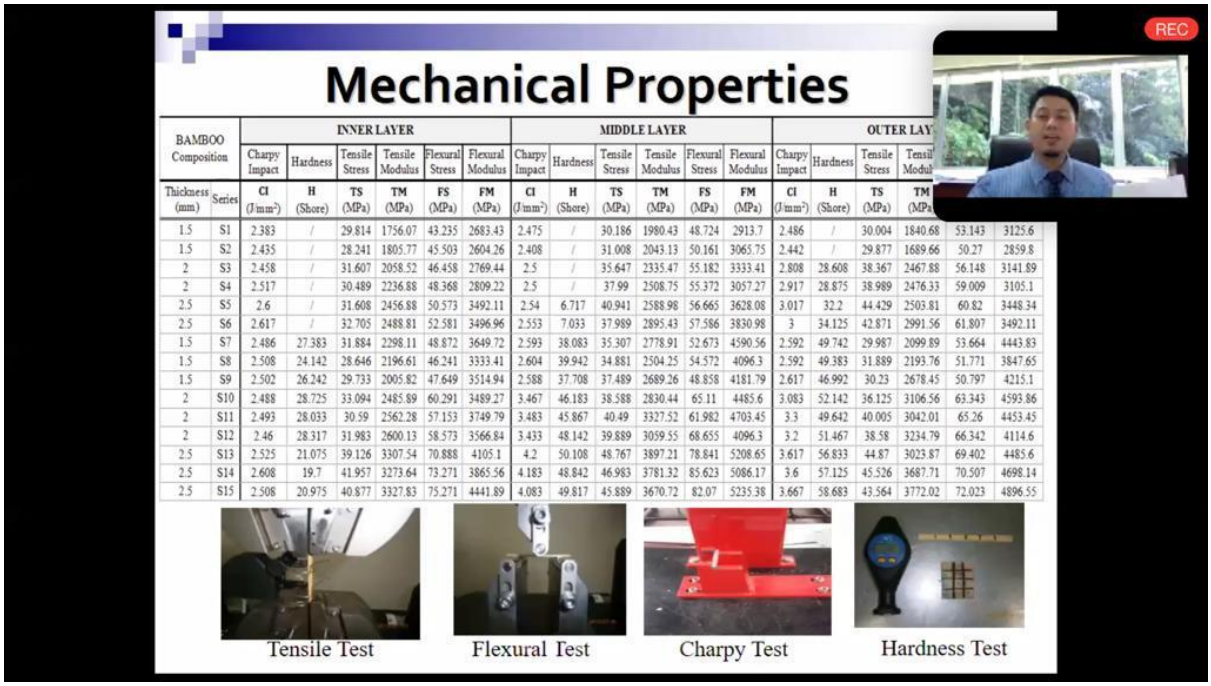
The next part of the technical talk was about the ballistic limit testing (v50) conducted on the composite. The test was conducted using a test gun machine per the NIJ Standard. During this test, several test bullets such as 22 Caliber LR, 9 mm, 357 Magnum and etc were used. Prior to each test, several information for example, the bullet weight and reference velocity were first recorded.

Figure 2: Field testing conducted

Shooting tests were successfully performed in order to determine the ballistic limit (V50) following the military standard of ML-STD-6682, it was discovered that 4:18 WB: WEG was able to withstand the bullet up to 482 m/s, which is more than the minimum speed to qualify for Level of National Institute of Justice (NIJ) IIIA standards. In the case of,9:4:9 WEG: WB:WEG laminated arrangement, the materials only reached level II of the NIJ standards at 414 m/s.

Figure 3: The bullet did not penetrate the laminated woven bamboo/woven E-glass

Finally, Prof Aidi also shared some of the awards and publication pertaining to the hybrid bamboo composites. The Q&A session went well as participants were interested to understand more on next strategy for the hybrid bamboo composites. The talk was completed about 7.30pm. Overall, it was a good learning experience for the IEM members who took part in the talk.



BAMBOO Composition		INNER LAYER						MIDDLE LAYER						OUTER LAY			
		Charpy Impact	Hardness	Tensile Stress	Tensile Modulus	Flexural Stress	Flexural Modulus	Charpy Impact	Hardness	Tensile Stress	Tensile Modulus	Flexural Stress	Flexural Modulus	Charpy Impact	Hardness	Tensile Stress	Tensil Modul
Thickness (mm)	Series	CI (J/mm²)	H (Shore)	TS (MPa)	TM (MPa)	FS (MPa)	FM (MPa)	CI (J/mm²)	H (Shore)	TS (MPa)	TM (MPa)	FS (MPa)	FM (MPa)	CI (J/mm²)	H (Shore)	TS (MPa)	TM (MPa
1.5	S1	2.383	/	29.814	1756.07	43.235	2683.43	2.475	/	30.186	1980.43	48.724	2913.7	2.486	/	30.004	1840.68
1.5	S2	2.435	/	28.241	1805.77	45.503	2604.26	2.408	/	31.008	2043.13	50.161	3065.75	2.442	/	29.877	1689.66
2	S3	2.458	/	31.607	2058.52	46.458	2769.44	2.5	/	35.647	2335.47	55.182	3333.41	2.808	28.608	38.367	2467.88
2	S4	2.517	/	30.489	2236.88	48.368	2809.22	2.5	/	37.99	2508.75	55.372	3057.27	2.917	28.875	38.989	2476.33
2.5	S5	2.6	/	31.608	2456.88	50.573	3492.11	2.54	6.717	40.941	2588.98	56.665	3628.08	3.017	32.2	44.429	2503.81
2.5	S6	2.617	/	32.705	2488.81	52.581	3496.96	2.553	7.033	37.989	2895.43	57.586	3830.98	3	34.125	42.871	2991.56
1.5	S7	2.486	27.383	31.884	2298.11	48.872	3649.72	2.593	38.083	35.307	2778.91	52.673	4590.56	2.592	49.742	29.987	2099.89
1.5	S8	2.508	24.142	28.646	2196.61	46.241	3333.41	2.604	39.942	34.881	2504.25	54.572	4096.3	2.592	49.383	31.889	2193.76
1.5	S9	2.502	26.242	29.733	2005.82	47.649	3514.94	2.588	37.708	37.489	2689.26	48.858	4181.79	2.617	46.992	30.23	2678.45
2	S10	2.488	28.725	33.094	2485.89	60.291	3489.27	3.467	46.183	38.588	2830.44	65.11	4485.6	3.083	52.142	36.125	3106.56
2	S11	2.493	28.033	30.59	2562.28	57.153	3749.79	3.483	45.867	40.49	3327.52	61.982	4703.45	3.3	49.642	40.005	3042.01
2	S12	2.46	28.317	31.983	2600.13	58.573	3566.84	3.433	48.142	39.889	3059.55	68.655	4096.3	3.2	51.467	38.58	3234.79
2.5	S13	2.525	21.075	39.126	3307.54	70.888	4105.1	4.2	50.108	48.767	3897.21	78.841	5208.65	3.617	56.833	44.87	3023.87
2.5	S14	2.608	19.7	41.957	3273.64	73.271	3865.56	4.183	48.842	46.983	3781.32	85.623	5086.17	3.6	57.125	45.526	3687.71
2.5	S15	2.508	20.975	40.877	3327.83	75.271	4441.89	4.083	49.817	45.889	3670.72	82.07	5235.38	3.667	58.683	43.564	3772.02

Figure 4 Prof Aidi elaborating mechanical properties of bamboo composites