CHAPTER III

BASIC PROPERTIES OF WOOD

Tests were conducted to determine the basic properties of Dang (Xylia Kerrii), Teng (Shorea Obtusa) and Kiem (Cotylelobium Lanceolatum). The specimens were prepared from the same piece as that used in fabricating the six main beams DA, DB, TA, TB, KA,and KB.

The small specimens "DA1", "DA2" and "DA3" were the sample of Dang wood cut from the same piece as the timber used in fabricating main beam DA. The first letter "D", "T" and "K" define the specy of wood such as Dang, Teng and Kiem respectively. The second letter "A" and "B" state that it was cut from the same piece of beam "A" and beam "B" of Dang, Teng or Kiem wood which defined by the first letter. The suffix number "1", "2" and "3" state that it was cut from the same piece of wood of upper, middle and lower position respectively of the laminated main beam.

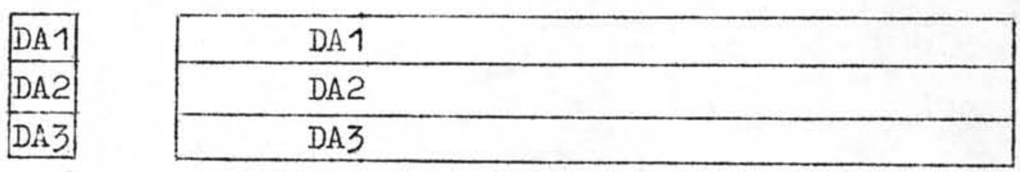


Fig. 3.1 Position of laminated main beam.

Tests consisted of static bending, compression parallel to grain, tension parallel to grain and shear parallel to grain. Methods of test were based on ASTM STANDARD D 143-52 (1964). The test results are presented in table (3.1), (3.2) and (3.3).

3.1 Static Bending Tests

The static bending tests were made on 5 by 5 and 76 cm. long (2 by 2 and 30 in. long). Actual sectional dimensions were measured at the beam center. Center loading with a span length of 70 cm. (28 in.) was used. The load was applied continuously throughout the test at a rate of motion of the movable crosshead of 2.5 mm. (0.01 in.) per minute. The deflections at midspan were recorded at each load increment of 250 kilogram. The ultimate load and type of failure were also recorded.

Typical load-deflection curve of Dang, Kiem and Teng are shown in Appendix A. All of the beam failures were in splintering tension and compression.

3.2 Compression Parallel to Grain Tests

The compression parallel to grain tests were made on 5 by 5 and 20 cm. long (2 by 2 and 8 in. long) specimens which were taken from the unfractured parts of static bending specimens. The end surfaces of the specimens were cut parallel to each other and at right angles to the longitudinal axis. The load was applied continuously at a rate of motion of the movable cross-head of 0.003 cm. per cm. of specimen length per minute. The deformation was measured at load increment of 1,000 kilogram. The ultimate load and type of failure were also recorded.

Typical stress strain curves of compression parallel to grain of Dang, Kiem and Teng are shown in Appendix C. Most failures of the specimens were due to wedge-splitting and crushing.

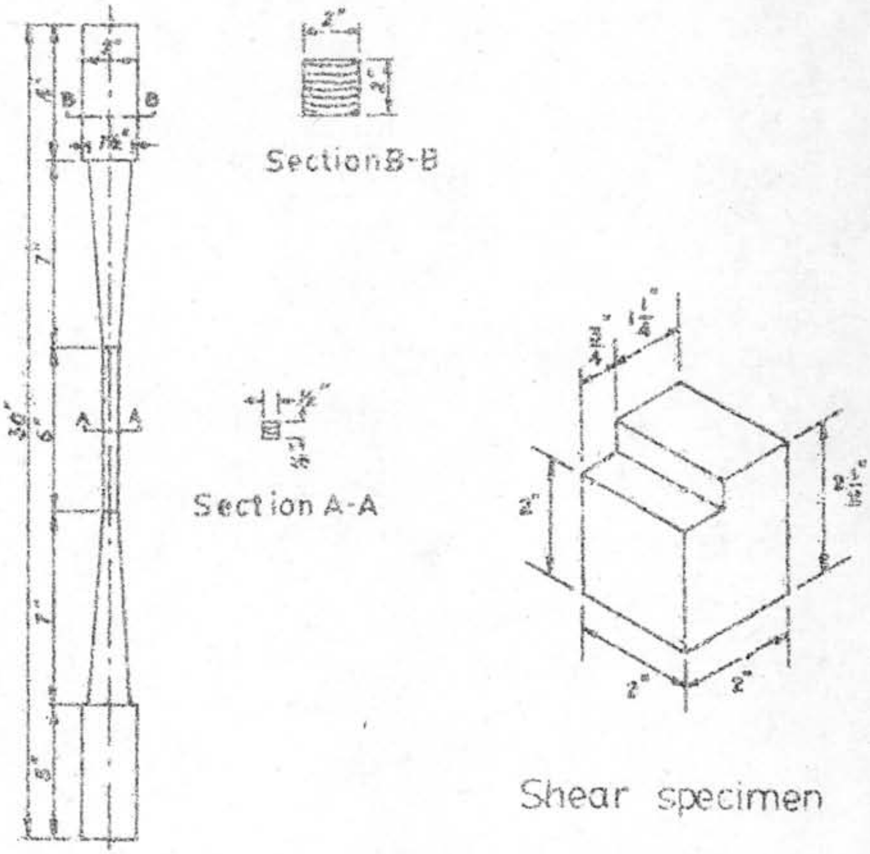
3.3 Tension Parallel to Grain Tests

The tension parallel to grain tests were made on the specimen of the size and shape as shown in figure (3.2). The actual cross-sectional dimensions at minimum section were measured. The specimen was held in special grips. Load extension curves were taken for a 15 cm. central gage length on all specimens. Load was applied continuously through out the test at a rate of motion of the movable crosshead of 1 mm. per minute. Extensions were recorded at each load increment of 250 kg. and continued until the proportional limit was passed.

Typical stress strain curves of tension parallel to grain of Dang, Kiem and Teng are shown in Appendix B. All specimen were sudden failure. Most failures occured inside the gage length except the sample TA3 of Teng wood which occured outside the gage length.

3.4 Shear Parallel to Grain Tests

The shear parallel to grain specimens were $2 \times 2 \times 2\frac{1}{2}$ in blocks which were cut from unfractured parts of the minor bending specimens. The specimens were notched as shown in figure (3.2) to produce failure on a 2 x 2 in. surface.



Tension specimen

FIG. 3.2 DETAILS OF TENSION PARALLEL TO GRAIN AND SHEAR TEST SPECIMEN.

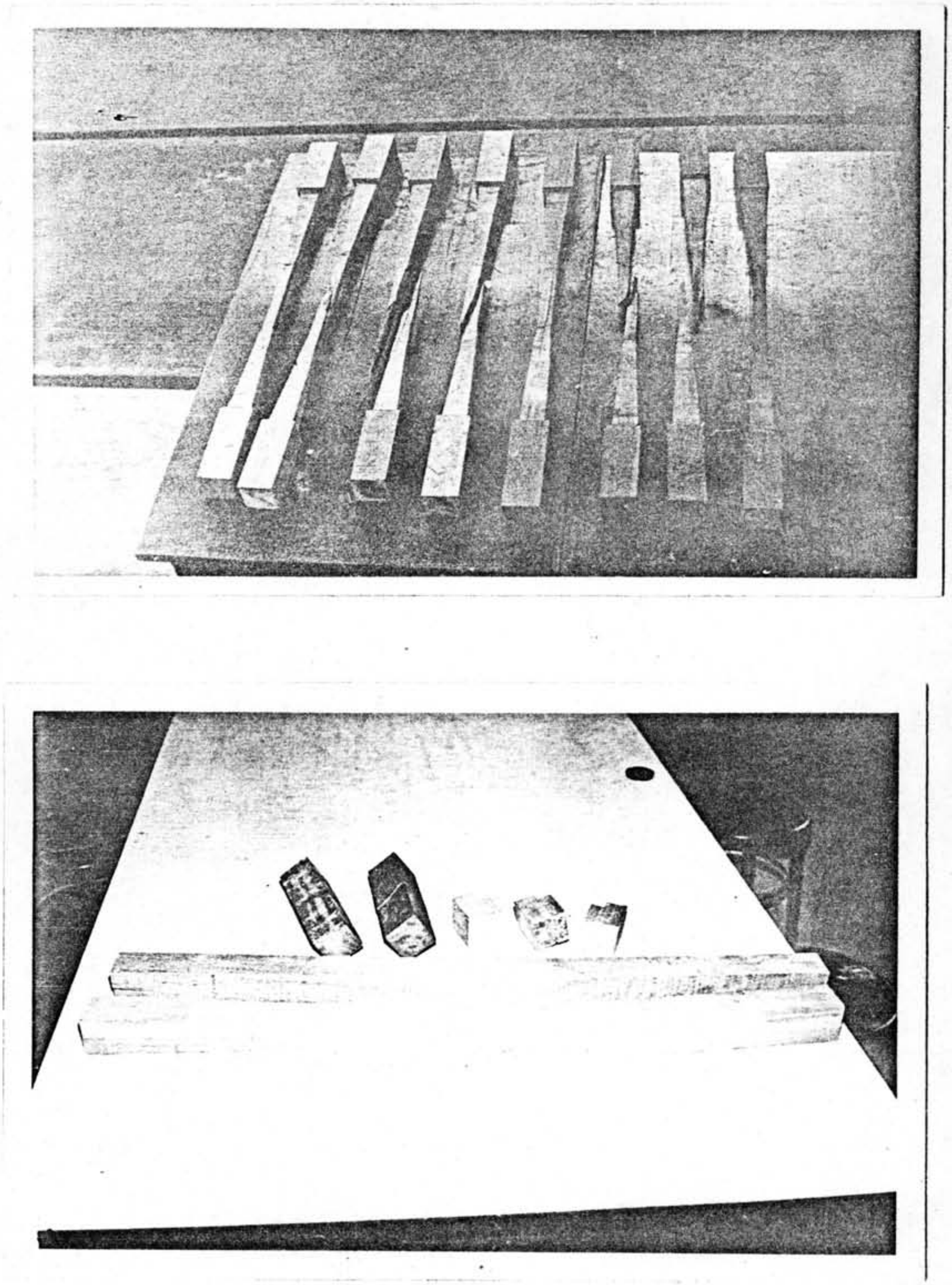


FIG. 3.3 TYPICAL FAILURE OF SMALL SPECIMEN

TABLE 3.1 MECHANICAL PROPERTIES OF DANG WOOD

Properties			Clear Specimens						Average
			DA1	DA2	DA3	DB1	DB2	BB3	
Moisture Content		%	11.8	12.0	12.4	12.8	11.6	11.8	
Tension Stress Parallel to Grain	σ_t	ksc.	1,479	1,470	1,488	1,374	1,468	1,340	1,436
	E_T	ksc.	277,000	260,000	270,000	210,000	245,000	220,000	247,000
Compression Stress Parallel to Grain	σ_c	ksc.	704	720	703	599	724	679	688
	E_C	ksc.	200,000	170,000	150,000	180,000	187,000	175,000	177,000
Modulus of Rupture		ksc.	1,438	1,366	1,382	1,400	1,142	1,367	1,349
Shear Parallel to Grain		ksc.	181	202	187	175	190	178	185

TABLE 3.2 MECHANICAL PROPERTIES OF KIEM WOOD

Properties			Clear Specimens						Average
			KA1	KA2	KA3	KB1	KB2	KB3	
Moisture Content		%	12.0	12.3	12.0	12.6	11.7	12.5	
Tension Stress Parallel to Grain	σ_t	KSC	1,278	1,175	1,161	1,215	1,165	1,318	1,219
	E_T	KSC	210,000	240,000	190,000	187,000	200,000	184,000	201,800
Compression Stress Parallel to Grain	σ_c	KSC	690	705	680	612	666	678	679
	E_C	KSC	198,000	260,000	193,000	197,000	241,000	225,000	219,000
Modulus of Rupture		KSC	1,180	1,172	1,182	1,230	1,164	1,211	1,190
Shear Parallel to Grain		KSC	170	162	157	165	170	155	163

TABLE 3.3 MECHANICAL PROPERTIES OF TENG WOOD

Properties			Clear Specimens						Average
			TA1	TA2	TA3	TB1	TB2	TB3	
Moisture Content		%	12.1	11.7	13.2	12.4	11.5	11.2	
Tension Stress Parallel to Grain	σ_t	KSC	1,388	1,352	813	1,380	1,404	1,419	1,293
	E_T	KSC	190,000	200,000	192,000	191,000	215,000	212,000	200,000
Compression Stress Parallel to Grain	σ_c	KSC	620	675	654	651	692	682	662
	E_C	KSC	180,000	190,000	210,000	192,000	188,000	198,000	193,000
Modulus of Rupture		KSC	1,284	1,386	1,302	1,302	1,281	1,297	1,308
Shear Parallel to Grain		KSC	150	148	141	152	158	166	152.5

TABLE 3.4 COEFFICIENT OF BENDING MOMENT OF DANG WOOD BY THE PRINCIPLE OF SECOND DEGREE PARABOLA APPROXIMATION.

Properties		Clear Specimens						Mean
		DA1	DA2	DA3	DB1	DB2	DB3	
Tensile Strength σ_t	, KSC	1,479	1,470	1,488	1,374	1,468	1,340	1,436
Compressive Strength σ_c	KSC	704	720	703	599	724	679	688
$n = \frac{\sigma_t}{\sigma_c}$		2.101	2.041	2.116	2.294	2.027	1.973	
$\xi = \frac{3n}{3n+4}$		0.612	0.605	0.613	0.632	0.603	0.597	
$\frac{5}{12}\xi^2$		0.156	0.152	0.156	0.166	0.151	0.149	
$\frac{1}{3}n(1-\xi)^2$		0.105	0.106	o.106	0.104	0.106	0.107	
$\left[\frac{5}{12}\xi^2 + \frac{1}{3}n(1-\xi)^2\right]$		0.261	0.258	0.262	0.270	0.257	0.256	
$R = \left[\frac{5}{12}\xi^2 + \frac{1}{3}n(1-\xi)^2\right]\sigma_c$	KSC	184	186	184	161	186	174	179
Modulus of Rupture	KSC	1,104	1,116	1,104	966	1,116	1,044	

TABLE 3.5 COEFFICIENT OF BENDING MOMENT OF KIEM WOOD BY THE PRINCIPLE OF SECOND DEGREE PARABOLA APPROXIMATION.

Properties	Clear Specimens						Mean
	KA1	KA2	KA3	KB1	KB2	KB3	
Tensile Strength σ_t , KSC	1,278	1,175	1,161	1,215	1,165	1,318	1,219
Compressive Strength σ_c , KSC	690	705	680	612	666	678	671
$n = \frac{\sigma_t}{\sigma_c}$	1.852	1.667	1.707	1.985	1.749	1.944	
$\xi = \frac{3n}{3n + 4}$	0.581	0.556	0.561	0.598	0.567	0.593	
$\frac{5}{12}\xi^2$	0.141	0.129	0.131	0.149	0.134	0.146	
$\frac{1}{3}n(1-\xi)^2$	0.108	0.109	0.110	0.107	0.109	0.107	
$\left[\frac{5}{12}\xi^2+\frac{1}{3}n(1-\xi)^2\right]$	0.249	0.238	0.241	0.256	0.243	0.253	
$R = \left[\frac{5}{12}\xi^2+\frac{1}{3}n(1-\xi)^2\right]\sigma_c$ KSC	172	168	164	157	162	171	166
Modulus of Rupture KSC	1,032	1,008	984	942	972	1,026	

TABLE 3.6 COEFFICIENT OF BENDING MOMENT OF TENG WOOD BY THE PRINCIPLE OF SECOND DEGREE PARABOLA APPROXIMATION.

Properties	Clear Specimens						Mean
	TA1	TA2	TA3	TB1	TB2	TB3	
Tensile Strength σ_t, KSC	1,338	1,352	813	1,380	1,404	1,419	1,293
Compressive Strength σ_c, KSC	620	675	654	651	692	682	662
$n = \frac{\sigma_t}{\sigma_c}$	2.158	2.003	1.243	2.120	2.029	2.080	
$\xi = \frac{3n}{3n+4}$	0.618	0.600	0.482	0.614	0.603	0.609	
$\frac{5}{12}\xi^2$	0.159	0.150	0.097	0.157	0.151	0.155	
$\frac{1}{3}n(1-\xi)^2$	0.105	0.107	0.111	0.105	0.107	0.106	
$\left(\frac{5}{12}\xi^2 + \frac{1}{3}n(1-\xi)^2\right)$	0.264	0.257	0.208	0.262	0.258	0.261	
$R = \left[\frac{5}{12}\xi^2 + \frac{1}{3}n(1-\xi)^2\right]\sigma_c$ KSC	164	173	136	171	178	178	167
Modulus of Rupture KSC	984	1,038	816	1,026	1,068	1,068	