MATERIALS TESTING LABORATORY

FACULTY OF ENGINEERING

CHULALONGKORN UNIVERSITY

Party No. ..... Date of tested .....

Name ..... Graded by .....

TEST No. T1

FLEXURE TEST OF WOOD

PURPOSE

To determine the mechanical properties of wood subjected to bending.

To observe the behavior of the material under load and study its failure.

The specific properties to be determined are

1. The stress at the outer fiber at Proportional Limit
2. The modulus of rupture
3. The modulus of elasticity
4. The modulus of resilience
5. The maximum shearing stress
6. The approximate total work to ultimate load
7. Type of failure

REFERENCE

ASTM D143

JIS

SPECIMEN

Clear wood specimen size 5 x 5 x 75 cm

APPARATUS

Amsler universal testing machine and deflectometer or dial gage

Revised by PPS @May 1998

PROCEDURE

1. Measure and weigh each specimen. Make a sketch of each specimen in perspective showing any defects and direction of rings on the end sections.

2. Set the beam supports for a 70 cm span. Place the specimen in position so that the tangential surface nearest to the pitch will face up when using a machine with downward load or face down when the beam is pulled upward with a loading shackle.

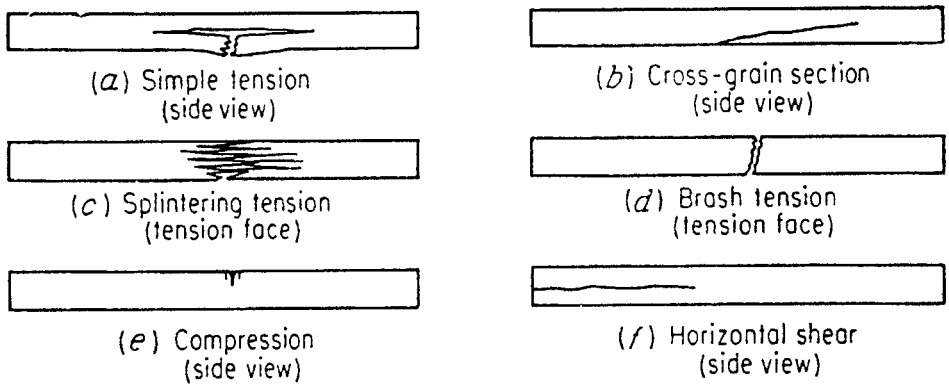
3. Adjust the deflectometer and the testing machine to read zero.

4. Apply the load continuously at a slow speed of 2.5 mm per minute. Take simultaneous load and deflectometer readings for increments of load that will give at least 20 readings below the ultimate. Secure reading at the ultimate load if possible.

5. Sketch the appearance of the failure.

6. Plot a curve showing the relation between the applied loads as the ordinates and the center deflections as the abscissas.

7. Calculate all values as required. Summarize results in tabular form.



Various modes of failure of wood beam

DATA

	Specimen No. 1	Specimen No. 2
Width and depth of specimen, b x d (cm x cm)	....	....
Span length of specimen, L (cm)	....	....
Weight of specimen (gm)	....	....

Load (kg)	dial gage reading (division)	Deflection Specimen No. 1 (mm)	dial gage reading (division)	Deflection Specimen No. 2 (mm)
P_{max} (kg)				

Sketch type of failure

SAMPLE OF CALCULATION

Specimen No. .....

Flexural stress at outer fiber at PL, f_{PL} = $3 P_{PL} L / (2 b d^2)$

= ..... = ... ksc

Modulus of rupture = $3 P_{max.} L / (2 b d^2)$

= ..... = ... ksc

Modulus of elasticity, E = $P L^3 / (48 I \Delta)$ (use P and Δ at PL)

= ..... = ... ksc

Modulus of resilience = $f_{PL}^2 / (18 E)$

= ..... = ... kg-cm/cc

Maximum shearing stress = $3 P_{max.} / (4 b d)$

= ..... = ... ksc

Approximate total work to ultimate load = $(P_{max} \times \Delta_{max.})/2$

= ..... = ... kg-cm

SUMMARY OF RESULTS

	Specimen No. 1	Specimen No. 2
Flexural stress at outer fiber at PL, f_{PL} (ksc)	.....	.....
Modulus of Rupture (ksc)	.....	.....
Modulus of elasticity (ksc)	.....	.....
Modulus of resilience (kg-cm/cc)	.....	.....
Maximum shearing stress (ksc)	.....	.....
Approximate total work to ultimate load (kg-cm)	.....	.....

DISCUSSION AND CONCLUSIONS

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TEST No. T2

COMPRESSION TEST OF WOOD PARALLELLED TO GRAIN

PURPOSE To study the behavior of wood under compression parallel to grain and to determine the following mechanical properties.

1. Elastic compressive stress at Proportional Limit
2. Yield compressive stress at an offset of 0.05% strain
3. Ultimate compressive stress
4. The modulus of elasticity
5. The modulus of resilience

REFERENCE ASTM D143

JIS

SPECIMEN Clear wood 5 x 5 x 20 cm specimen

APPARATUS Compressometer of 15 cm gage length

Revised by PPS @May 1998

PROCEDURE

1. The specimen shall be prepared with special care to ensure that the end grain surfaces will be parallel to each other and at right angles to the longitudinal axis. If deemed necessary, at least one plate of the testing machine shall be equipped with a spherical bearing to obtain uniform distribution of load over the ends of the specimen.

2. Measure the actual cross sectional dimensions to the nearest 0.2 mm and length of specimen to the nearest 0.5 mm and weigh to the nearest 0.1 gram.

3. Record the gage length and the multiplication ratio of the compressometer. Deformation shall be read to 0.002 mm.

4. Attach the compressometer to the specimen and center the specimen on the testing machine. Adjust the compressometer dials and load to read zero.

5. Apply load continuously throughout the test at a speed of 0.06 cm per minute.

6. Record load - deformation readings with load increment of 500 kg until the proportional limit is well passed. Remove the compressometer and load the specimen up to failure record the ultimate load.

7. Record type of failure for each specimen. Compression failures shall be classified according to the appearance of the fractured specimen. In case of two or more kinds of failures develop, all shall be described in the order of their occurrences, e.g. shearing followed by splitting. The failure shall also be sketched in its proper position on the data sheet.

8. Plot load - deformation curve and also mark proportional limit and yield strength on the curve. If the curve does not pass through the origin, correct the curve.

TYPES OF FAILURE IN COMPRESSION

CRUSHING This term shall the used when the plane of rupture is approximately horizontal.(Fig. a)

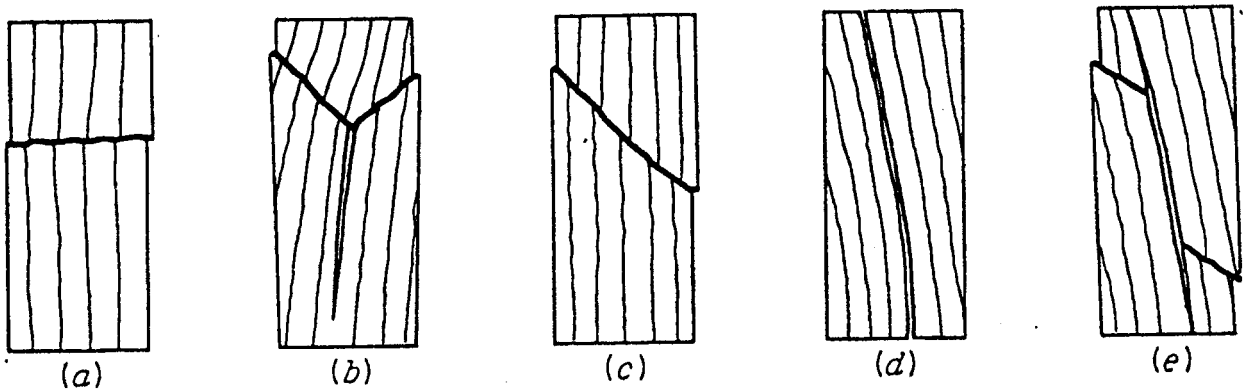
WEDGE SPLIT The direction of split, that is whether radial or tangential ,shall be noted. (Fig. b)

SHEARING This term shall be used when the plane of rupture makes an angle of more than 45 degrees with the top of the specimen. (Fig. c)

SPLITTING This type of failure usually occurs in specimen having internal defects prior to test and shall be the basis for culling the specimen. (Fig. d)

COMPRESSION AND SHEARING PARALLEL TO THE GRAIN This failure usually occurs in cross-grained plane and shall be the basis for culling the specimen. (Fig. e)

BROOMING OR ROLLING This type of failure is usually associated with either an excess moisture contents at the ends of the specimen or improper cutting of the specimen, or both. This is not an acceptable type of failure and usually is associated with a reduced load. Consideration should be given to remedial conditions where this type or failure is observed.



(a) Crushing (plane of rupture approximately horizontal).
(b) Wedge split (note direction of split: radial or tangential).
(c) Shearing (plane of rupture at acute angle with horizontal).
(d) Splitting.
(e) Shearing and splitting parallel to grain. (Usually occurs in cross-grained pieces).

Typical failures in compression

DATA

	Specimen No. 1	Specimen No. 2
Cross section of specimen, b x d (cm x cm)	....	....
Length of specimen, L (cm)	....	....
Gauge length (cm)	....	....
Weight of specimen (gm)	....	....

Load (kg)	dial gage reading (division)	Deflection Specimen No. 1 (mm)	dial gage reading (division)	Deflection Specimen No. 2 (mm)
Pmax. (kg)				

Sketch and type of Failure

SAMPLE OF CALCULATION

Specimen No. .....

Compressive stress at PL, f_{PL} = Load at PL / Cross sectional area

= ..... = ... ksc

Yield compressive stress at 0.05% offset = Load at 0.05% offset / Cross sectional area

= ..... = ... ksc

Ultimate compressive stress = Ultimate load / Cross sectional area

= ..... = ... ksc

Modulus of elasticity, E = Stress / Strain (at any point within PL)

= ..... = ... ksc

Modulus of resilience = $0.5\ f_{PL}^{\ 2} / E$

= ..... = ... kg-cm/cc

SUMMARY OF RESULTS

	Specimen No. 1	Specimen No. 2
Compressive stress at PL, f_{PL} (ksc)	.....	.....
Yield compressive stress at 0.05% offset (ksc)	.....	.....
Ultimate compressive stress (ksc)	.....	.....
Modulus of elasticity (ksc)	.....	.....
Modulus of resilience (kg-cm/cc)	.....	.....

DISCUSSION AND CONCLUSIONS

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TEST No. T3

COMPRESSION TEST OF WOOD PERPENDICULAR TO GRAIN

PURPOSE To study the behavior of wood under compressive loading perpendicular to its grain and to determine the following mechanical properties

1. The compressive stress at Proportional Limit
2. Yield stress at 0.05 % strain offset
3. The modulus of elasticity

REFERENCE ASTM

SPECIMEN Clear wood 5 x 5 x 15 cm in size

APPARATUS Dial micrometer with bearing block

Revised by PPS @ May 1998

PROCEDURE

1. Measure the dimensions of the specimen to the nearest 0.02 cm and weight to the nearest gram. Note any defects in the specimen.

2. Place the specimen on the bearing block with the grain horizontal and with a radial surface uppermost. Note the width of this surface. Place a 5-cm wide loading plate across the middle third of the specimen, with the long axis of the plate normal to the long axis of the specimen. Place a spherical bearing block on the top of the loading plate.

3. Adjust the height of the dial micrometer so that the feeler point is a few millimeters above the top surface of the specimen.

4. Apply an initial load of 100 kg and adjust the dial pointer to zero by turning the dial face.

5. Apply the load continuously at a speed of about 0.05 cm per minute. Observe dial readings at load increments of 100 kg. Take readings up to two complete revolutions of the dial pointer (2 mm) or when the pointer begins to move rapidly without stopping.

6. Plot a graph with stresses on the loaded area as ordinates and strains as abscissas, mark the proportional limit and the yielding strength on the curve.

7. Discuss the significance of the compressive stress of wood perpendicular to the grain and why the ultimate compressive stress perpendicular to the grain is never determined. Also compare your test result with the result obtained from the compressive test of wood paralleled to grain.

DATA

Specimen No.	Weight (gm)	Dimension (cm x cm x cm)	Defect of Specimen

DATA (continued)

Specimen No.				Specimen No.			
Load (kg)	Deformation (mm)	Stress (ksc)	Strain	Load (kg)	Deformation (mm)	Stress (ksc)	Strain

DATA (continued)

Specimen No.				Specimen No.			
Load (kg)	Deformation (mm)	Stress (ksc)	Strain	Load (kg)	Deformation (mm)	Stress (ksc)	Strain

SAMPLE OF CALCULATION

Specimen No. .....

Compressive stress at PL (from graph) = ... ksc

Yield stress at 0.05% strain offset (from graph) = ... ksc

Modulus of elasticity, E = Stress / Strain (at PL or within PL)

= .....

= ..... ksc

SUMMARY OF RESULTS

	Specimen No. 1	Specimen No. 2	Specimen No. 3	Specimen No. 4
Compressive stress at PL (ksc)	.....	.....	.....	.....
Yield stress at 0.05% strain offset (ksc)	.....	.....	.....	.....
Modulus of elasticity, E (ksc)	.....	.....	.....	.....

DISCUSSION AND CONCLUSIONS