Stripped Bamboo
Mechanical Characteristics Measurement

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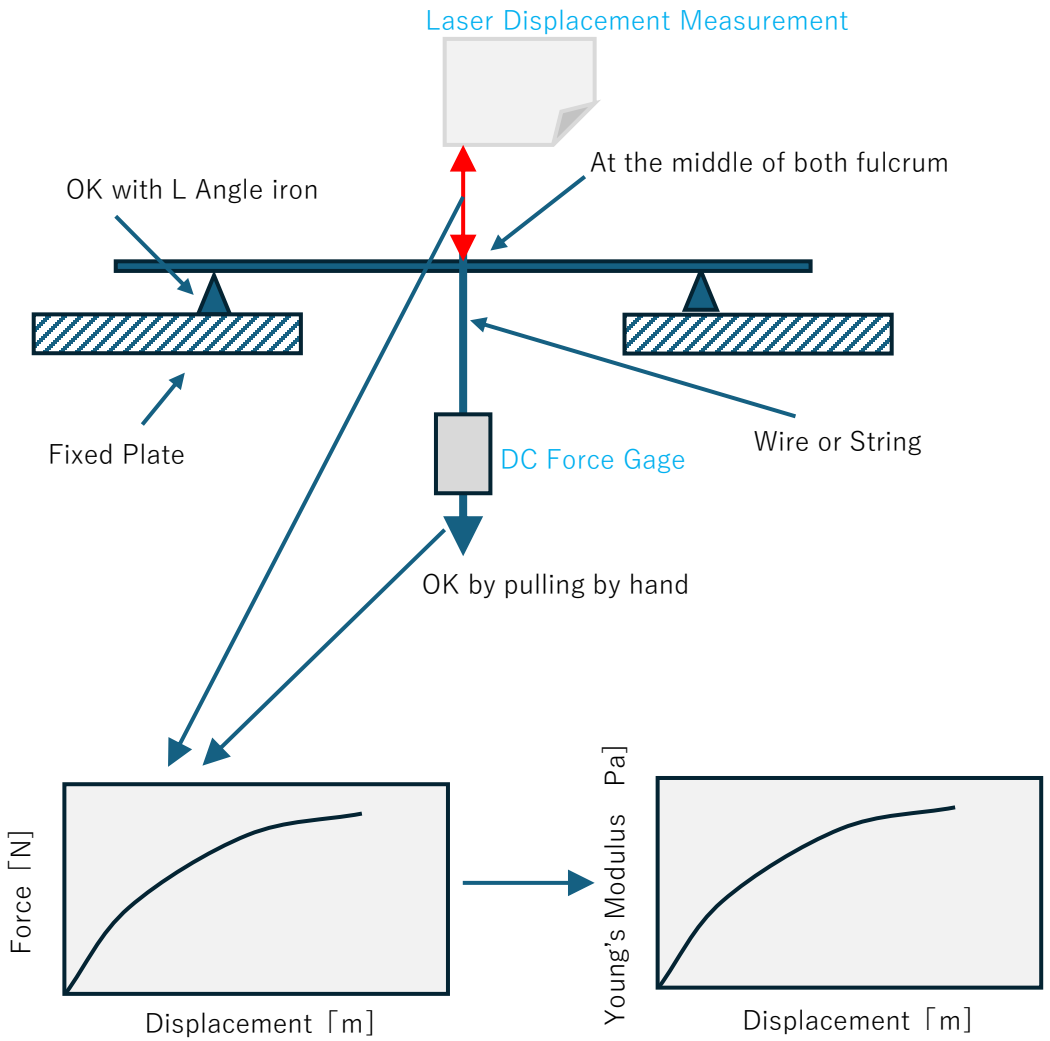
Young's Modulus Measurement

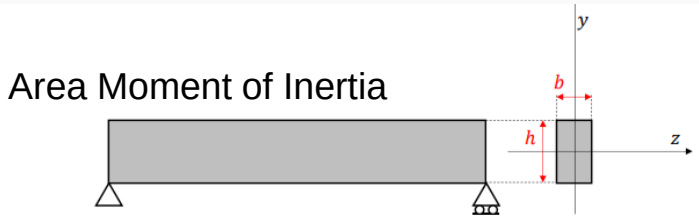


Copilot

How to Calculate Young's Modulus (Elastic Modulus) from a Bending Test (Three-Point Bending Method)

1. Test Preparation

- **Specimen**: A rectangular cross-section beam (according to JIS or similar standards).
- **Support span (L)**: The distance between the supports in the test.
- **Load (P)**: The force applied at the center of the beam.
- **Deflection (δ)**: The displacement at the center of the beam.
- **Second moment of area (I)**: Depends on the cross-sectional shape.
  For a rectangular section:
  $I = \frac{bh^3}{12}$
  where b = width, h = height.



Area Moment of Inertia

$$I = \int_S y^2\,dA = \int_{-\frac{h}{2}}^{\frac{h}{2}}\int_{-\frac{b}{2}}^{\frac{b}{2}} y^2\,dz\,dy = \int_{-\frac{h}{2}}^{\frac{h}{2}} [y^2 z]_{-\frac{b}{2}}^{\frac{b}{2}}\,dy = \int_{-\frac{h}{2}}^{\frac{h}{2}} y^2 b\,dy = b \times \left[\frac{y^3}{3}\right]_{-\frac{h}{2}}^{\frac{h}{2}}$$

$$= b \times \left(\frac{h^3}{24} - \left(-\frac{h^3}{24}\right)\right) = \frac{bh^3}{12}$$

2. Deflection Formula (Three-Point Bending)

When a load is applied at the center, the deflection at the midpoint is given by:

$$\delta = \frac{PL^3}{48EI}$$

Where:

- δ = central deflection
- P = applied load
- L = span length
- E = Young's modulus (the value to be determined)
- I = second moment of area

3. Formula for Young's Modulus

Rearranging the above equation to solve for Young's modulus:

$$E = \frac{PL^3}{48\delta I}$$

This method is commonly used in material mechanics, especially for evaluating metals and plastics.

Tools:

Stripped Bamboo sizes

1: Madake

2: B. Vulgais

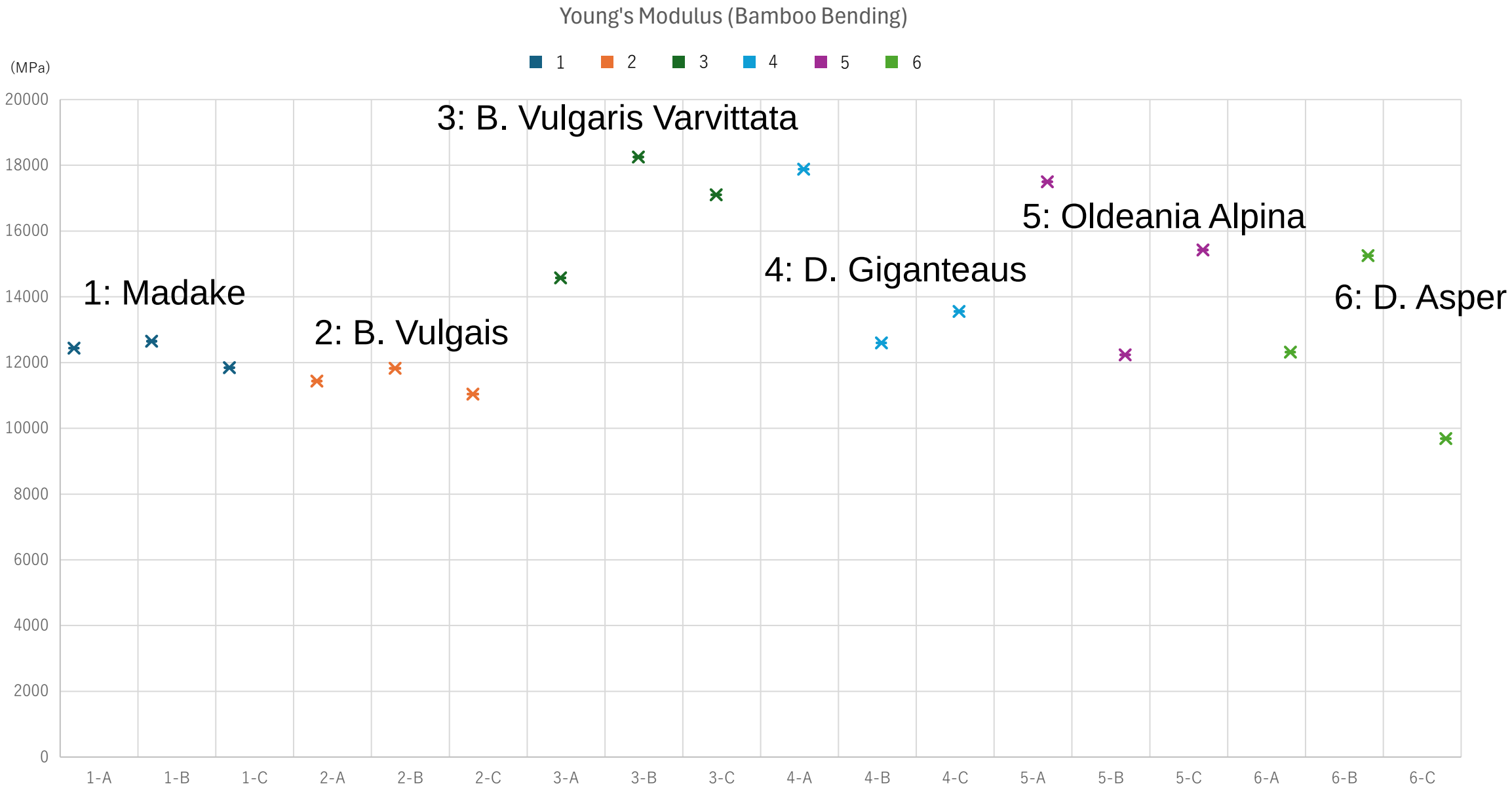
3: B. Vulgaris Varvittata

4: D. Giganteaus

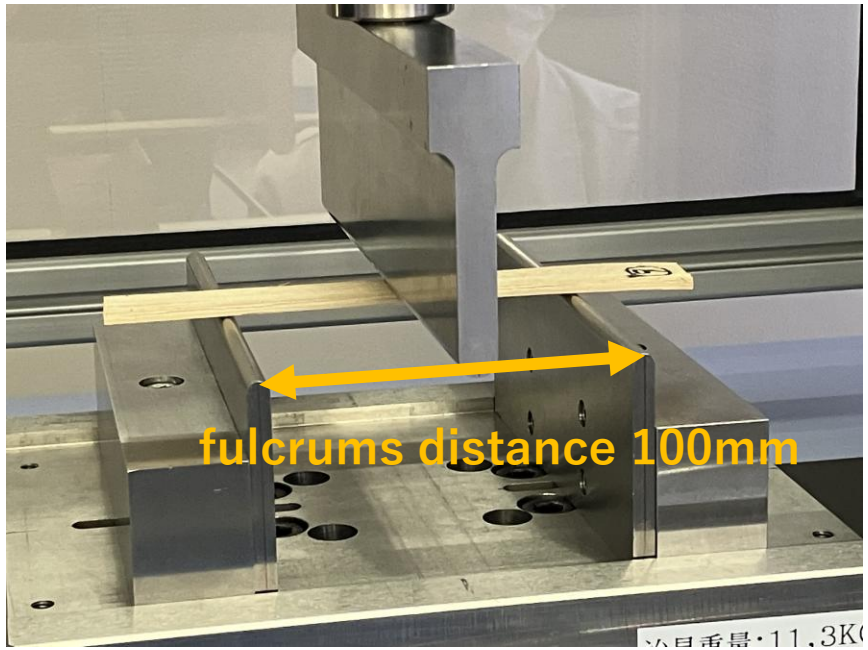
5: Oldeania Alpina

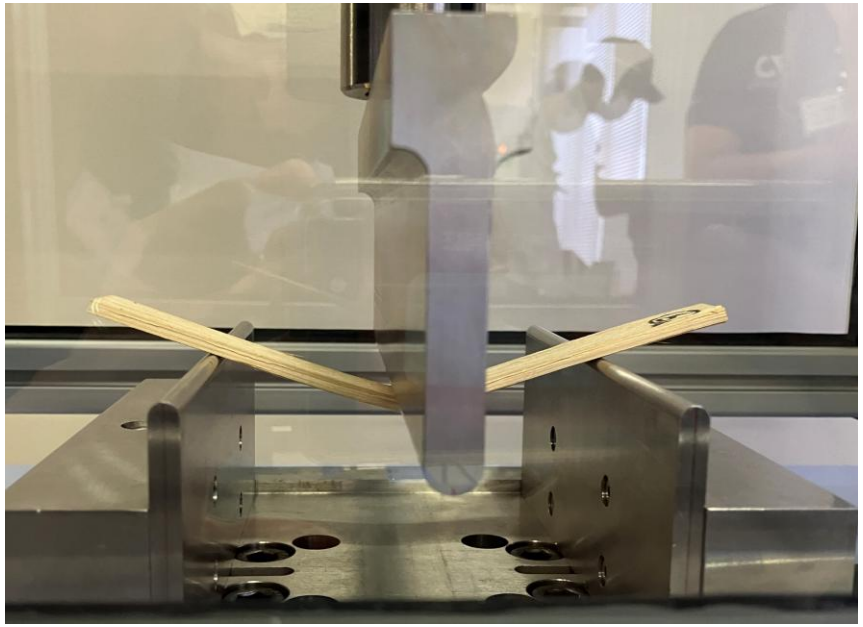
6: D. Asper

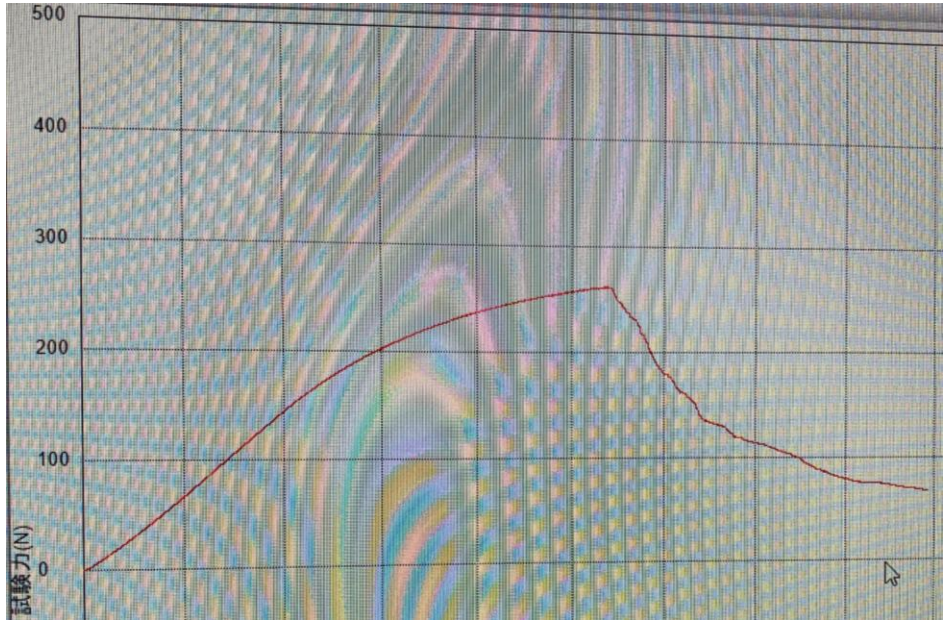
	Width (mm)	Thickness (mm)	Weight (g)
1-A	16.48	3.54	8.22
1-B	17.55	4.11	9.19
1-C	16.7	3.74	7.92
2-A	18.04	2.65	5.63
2-B	17.84	3.12	6.17
2-C	18.31	3.03	6.18
3-A	17.24	3.38	8.96
3-B	16.55	3.19	8.55
3-C	18.23	3.47	9.9
4-A	18.31	3.38	10.99
4-B	16.91	4.08	10.98
4-C	17.2	4.04	10.94
5-A	17.64	3.74	11.13
5-B	18.81	4.05	11.16
5-C	18.85	3.68	11.63
6-A	20.52	3.85	9.13
6-B	19.05	4.13	8.43
6-C	19.23	4.11	7.44


Young's Modulus (Bamboo Bending)
1
2
3
4
5
6
(MPa)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1-A
1-B
1-C
2-A
2-B
2-C
3-A
3-B
3-C
4-A
4-B
4-C
5-A
5-B
5-C
6-A
6-B
6-C
1: Madake
2: B. Vulgais
3: B. Vulgaris Varvittata
4: D. Giganteaus
5: Oldeania Alpina
6: D. Asper

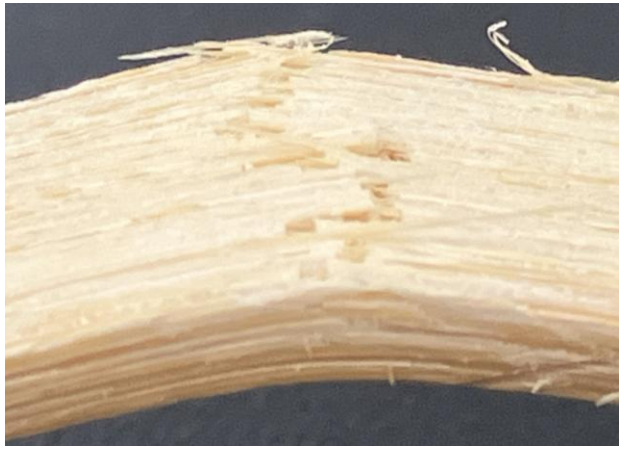
Test Rig:

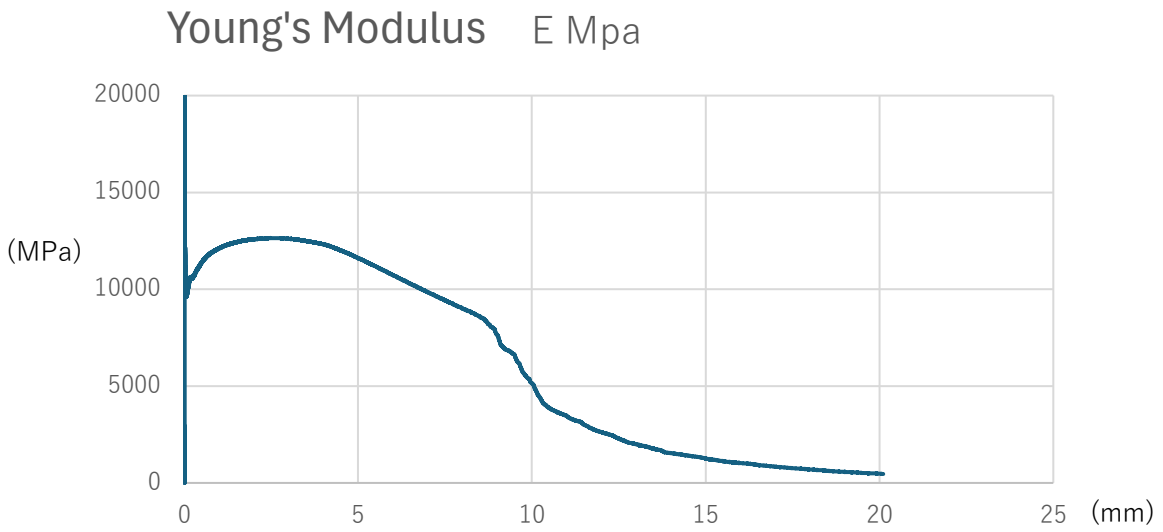


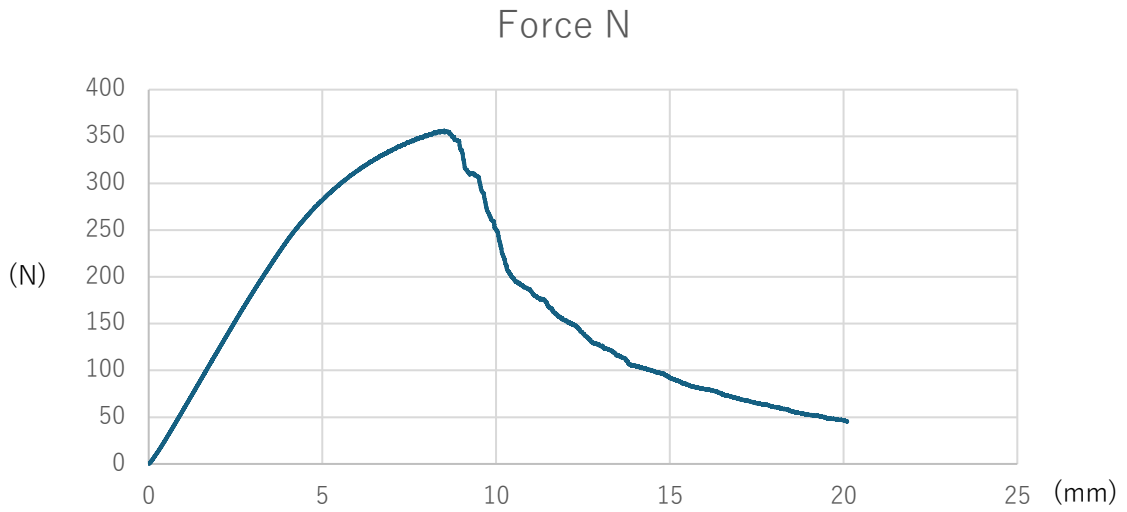




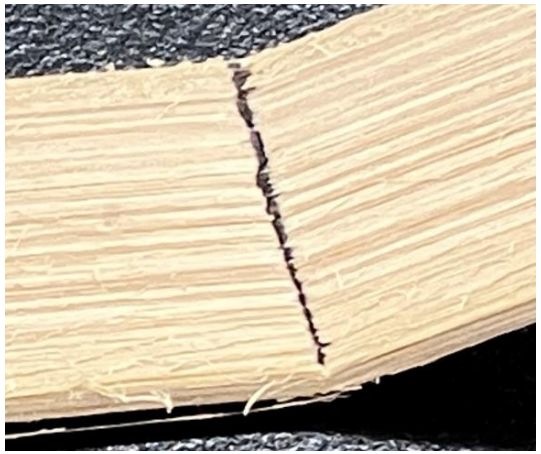
1: Madake

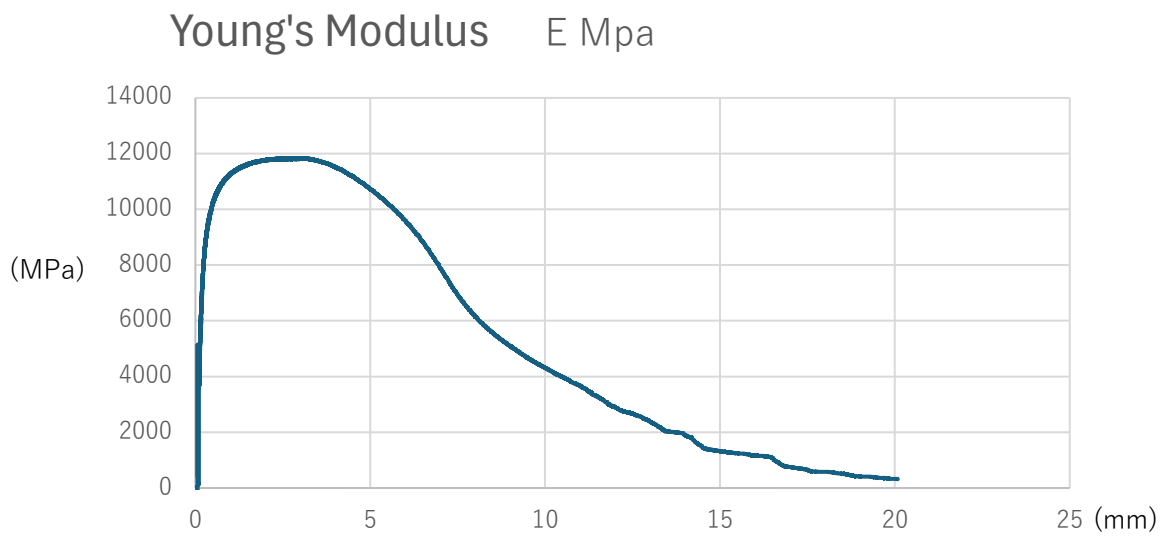


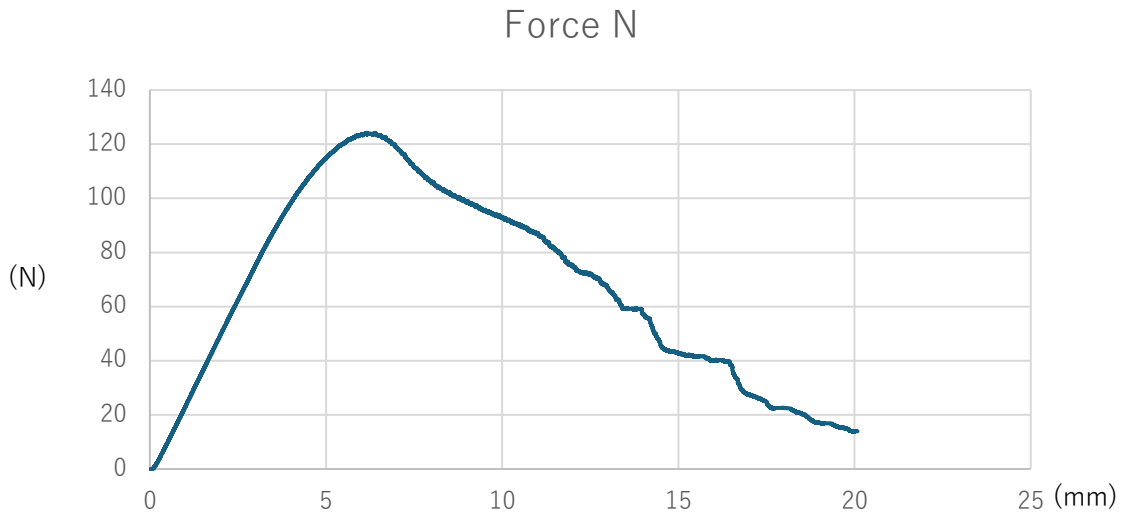

Young's Modulus E Mpa
20000
15000
10000
5000
0
(MPa)
0
5
10
15
20
25
(mm)


Force N
400
350
300
250
200
150
100
50
0
(N)
0
5
10
15
20
25
(mm)

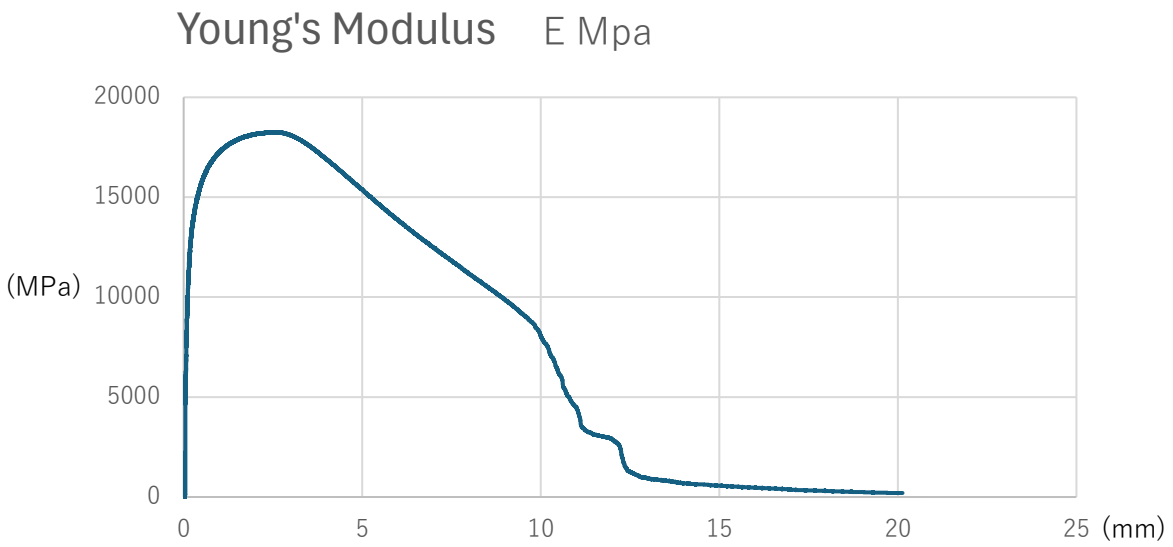
2: B. Vulgais

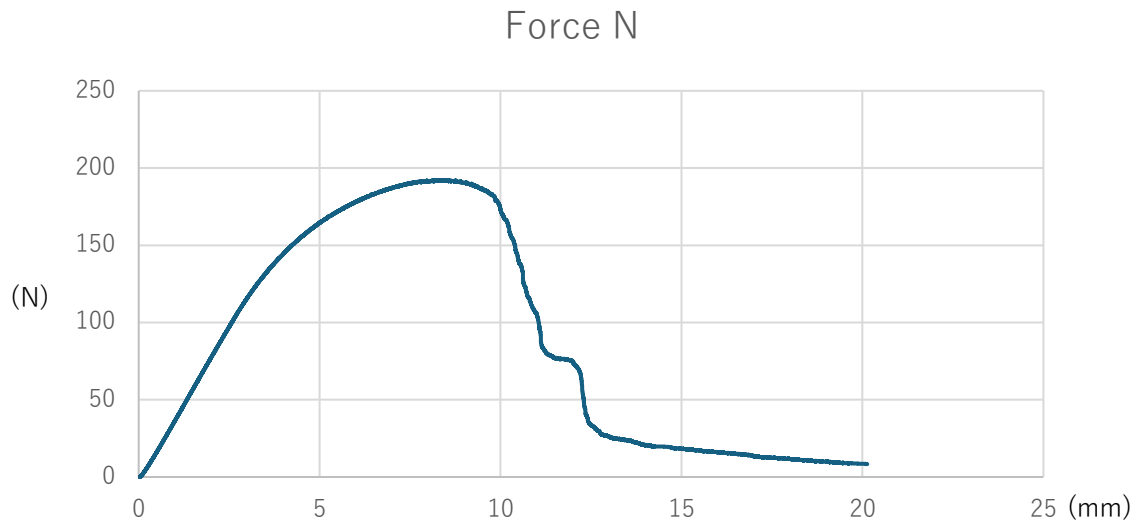



Young's Modulus E Mpa
(MPa)
14000
12000
10000
8000
6000
4000
2000
0
0
5
10
15
20
25
(mm)

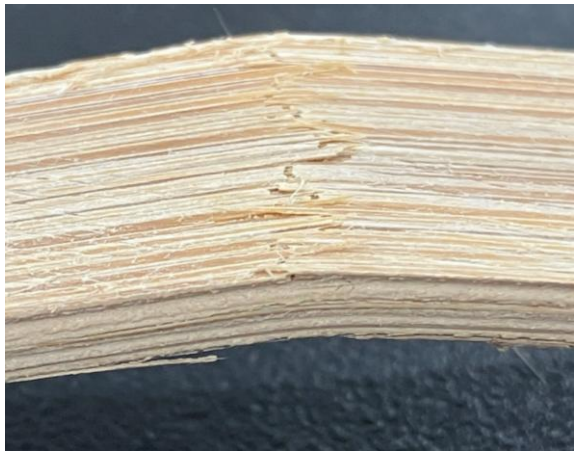

Force N
(N)
140
120
100
80
60
40
20
0
0
5
10
15
20
25
(mm)

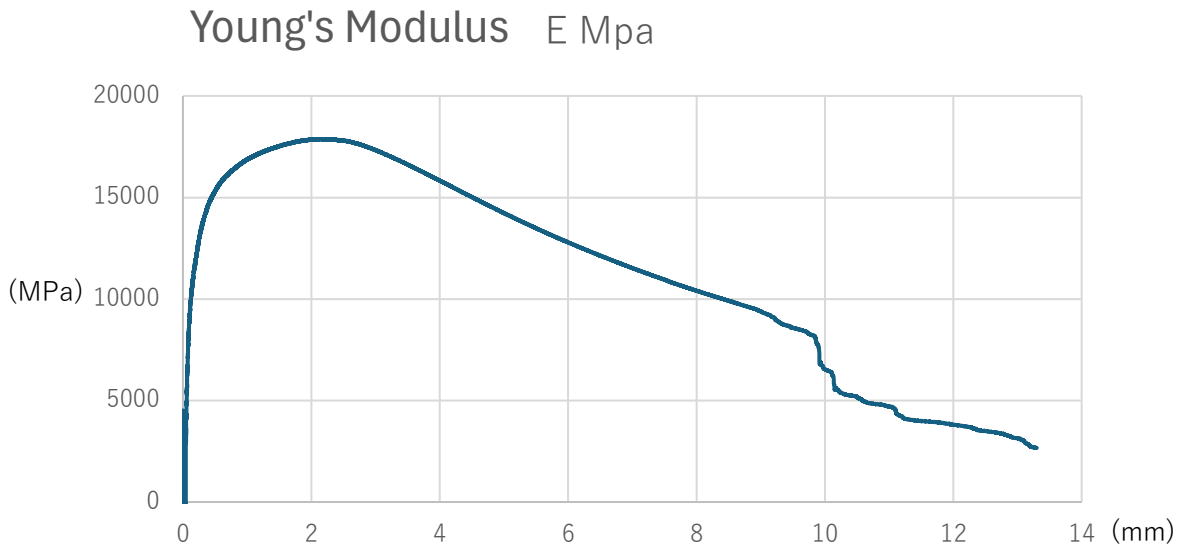
3: B. Vulgaris Varvittata

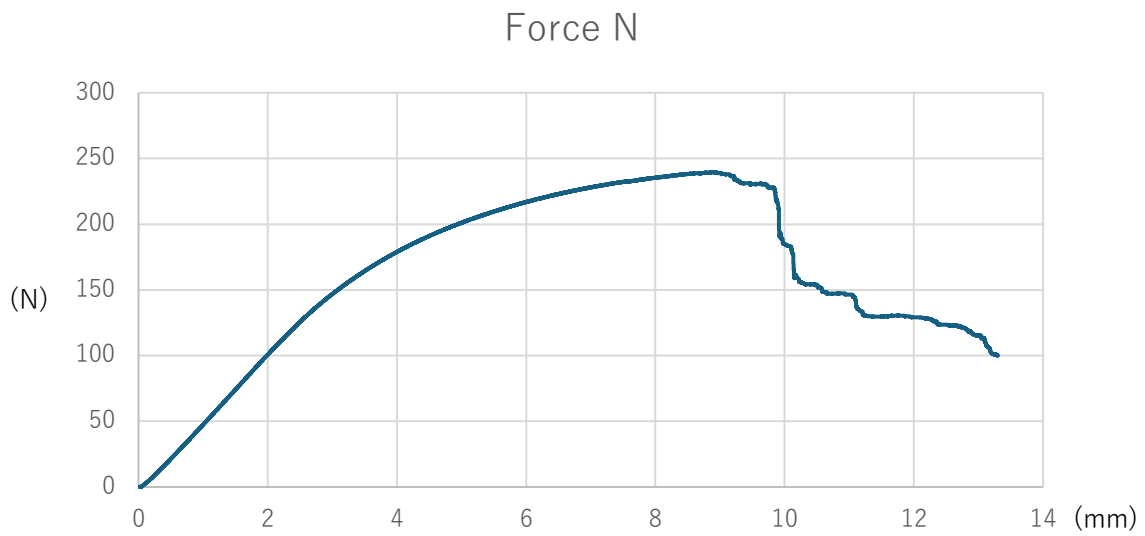




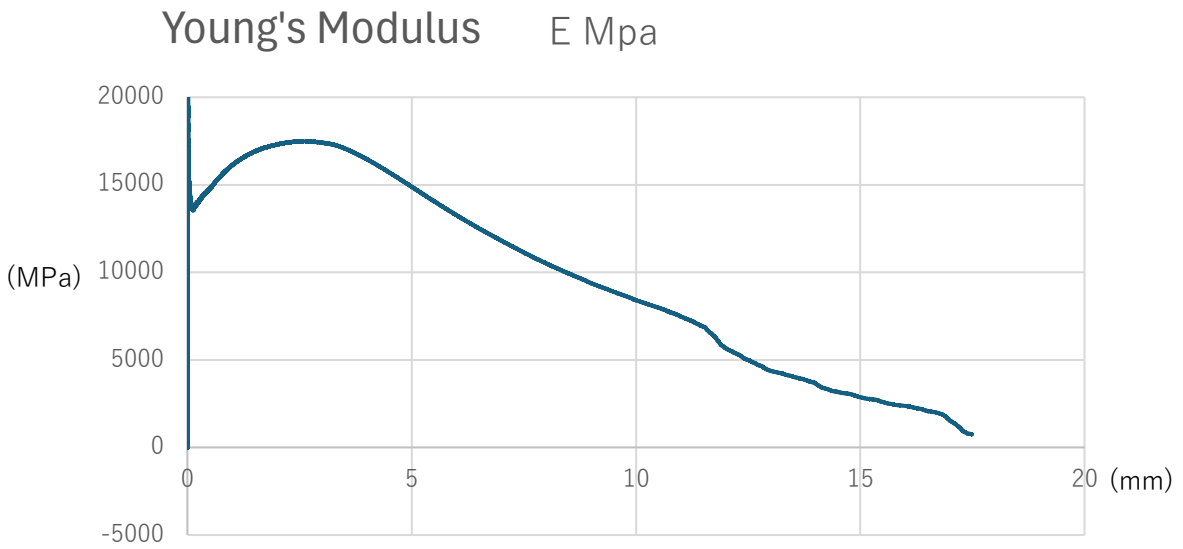
4: D. Giganteaus

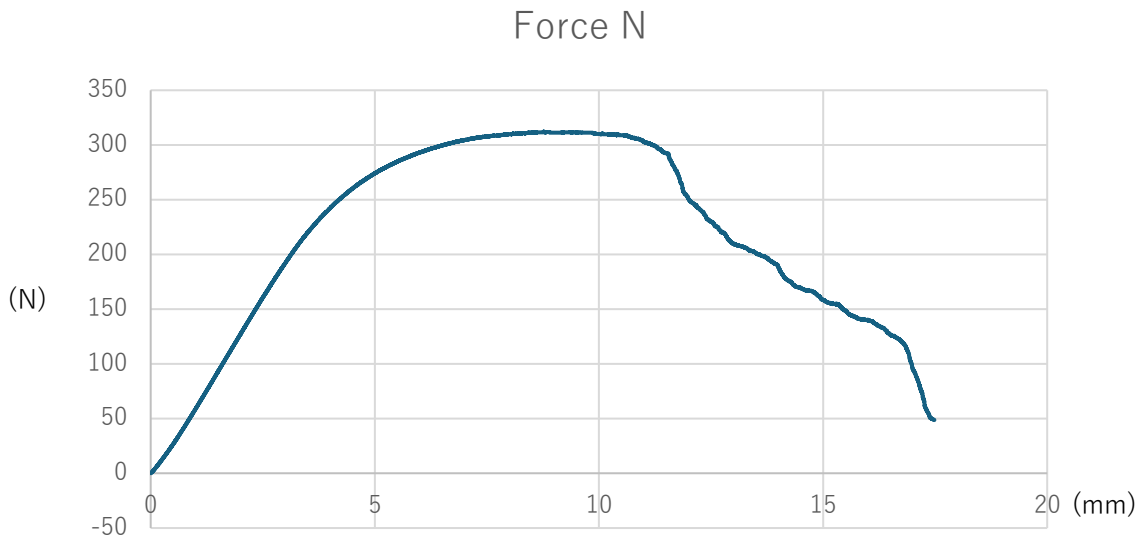




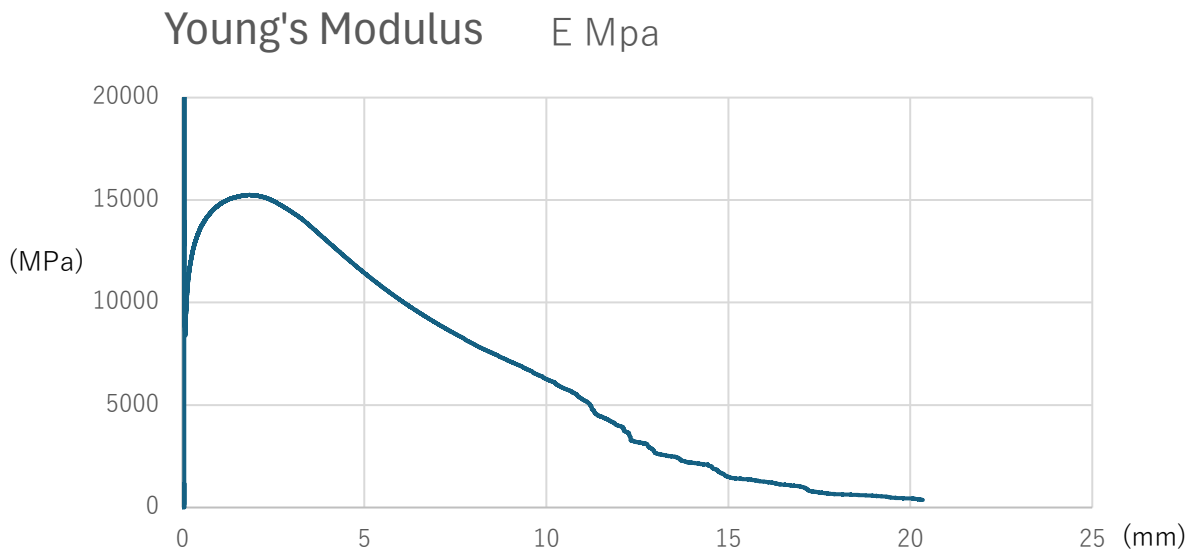


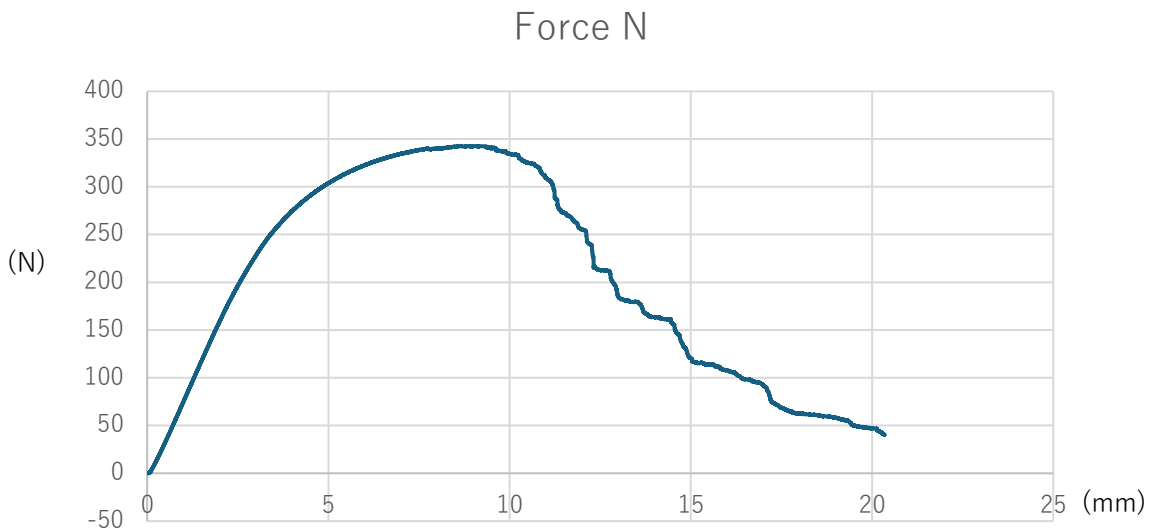
5: Oldeania Alpina





6: D. Asper


Young's Modulus
E Mpa
(MPa)
20000
15000
10000
5000
0
0
5
10
15
20
25
(mm)


Force N
(N)
400
350
300
250
200
150
100
50
0
-50
0
5
10
15
20
25
(mm)