

# **LAMPIRAN 1**

## PERHITUNGAN FRAKSI VOLUME SERAT SISAL DAN MatriK PMMA

Sebelum melangkah pada proses fabrikasi spesimen komposit sisal bermatrik PMMA, maka perlu dilakukan perhitungan massa serat dan matrik. Perbandingan fraksi volume serat dan matrik menggunakan perbandingan 80:20 (%berat)

Berikut ini merupakan perhitungan yang digunakan untuk menentukan volume dan massa komposit:

$$\begin{aligned} \text{Volume cetakan, } V_c &= p \times l \times t \\ &= 19 \text{ cm} \times 9 \text{ cm} \times 0,4 \text{ cm} \\ &= 68,4 \text{ cm}^3 \\ \text{Volume matriks, } V_m &= \frac{80 \%}{100 \%} \times 68,4 \text{ cm}^3 \\ &= 54,72 \text{ cm}^3 \\ \text{Volume serat, } V_f &= \frac{20 \%}{100 \%} \times 68,4 \text{ cm}^3 \\ &= 13,68 \text{ cm}^3 \\ \text{Massa matriks, } m_m &= V_m \times \rho_m \\ &= 54,72 \text{ cm}^3 \times 1,19 \text{ gr/cm}^3 \\ &= 65,1168 \text{ gr} \\ \text{Massa serat sisal, } m_{\text{sisal}} &= V_{\text{sisal}} \times \rho_{\text{sisal}} \\ &= 13,68 \text{ cm}^3 \times 1,45 \text{ gr/cm}^3 \\ &= 19,836 \text{ gr} \end{aligned}$$

# **LAMPIRAN 2**

# GRAFIK PENGUJIAN TARIK SERAT TUNGGAL SISAL

2096/IX/17

13.09.2017

## KUAT TARIK SERAT TUNGGAL

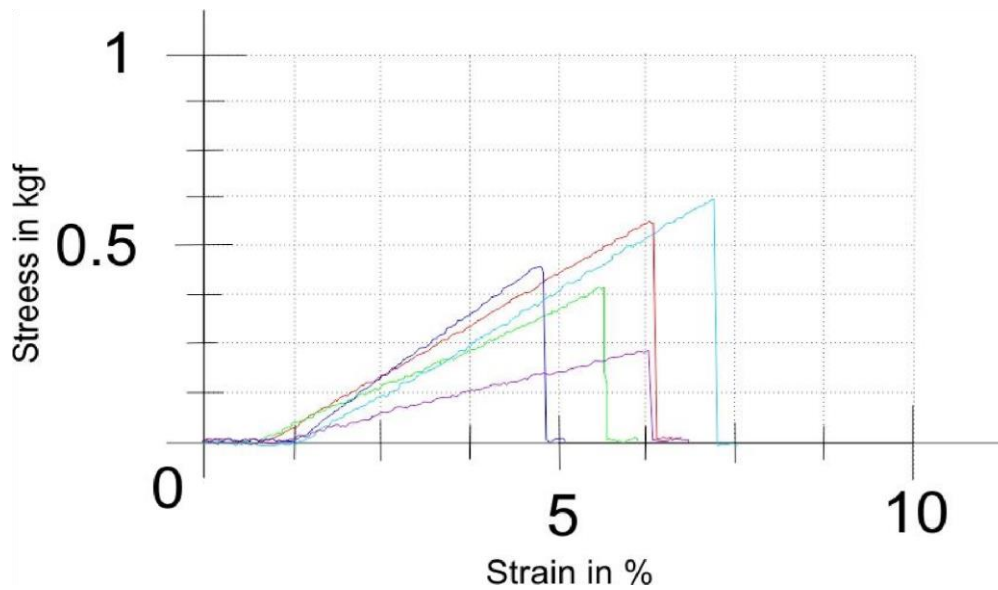
### Parameter table:

|                              |                            |                 |                        |
|------------------------------|----------------------------|-----------------|------------------------|
| Headline                     | : KUAT TARIK SERAT TUNGGAL | Pre-treatment   | : Kecepatan 5 mm/menit |
| Company name                 | : 2096/IX/17               | Testing machine | : ASTM D 3799-75       |
| Tester                       | : APRIAL                   | Extensometer    | :                      |
| Material                     | : Serat Sisal (I)          |                 |                        |
| Test speed                   | : 5 mm/min                 |                 |                        |
| Standard travel gauge length | : 20 mm                    |                 |                        |

### Results:

| Nr | $\sigma_{Fmax}$<br>kgf |
|----|------------------------|
| 1  | 0,703                  |
| †2 | 0,652                  |
| †3 | 0,220                  |
| †4 | 0,338                  |
| †5 | 1,076                  |

### Series graph:



# **LAMPIRAN 3**



**TABEL HASIL PERHITUNGAN PENGUJIAN BENDING KOMPOSIT SISAL DENGAN Matrik POLYMETHYL METAKRILAT (PMMA)**

| Waktu perendaman serat sisal | Spesimen | Panjang (L) | Lebar b(mm) | Tebal d(mm) | Defleksi (mm) | Beban (N) | m(N/mm) | Teg bending (MPa) | Regangan bending (%) | Modulus elastisitas (MPa) |
|------------------------------|----------|-------------|-------------|-------------|---------------|-----------|---------|-------------------|----------------------|---------------------------|
| 4 jam                        | 1        | 62          | 13,2        | 4,2         | 5,90          | 340,21    | 80,76   | 135,881           | 0,039                | 4,920                     |
|                              | 2        | 62          | 13,1        | 4,3         | 4,90          | 317,81    | 95,71   | 122,023           | 0,033                | 5,475                     |
|                              | 3        | 62          | 13,3        | 4,1         | 5,26          | 352,29    | 96,15   | 146,543           | 0,032                | 6,250                     |
|                              | 4        | 62          | 13,2        | 4,2         | 4,90          | 381,44    | 91,83   | 152,348           | 0,032                | 5,595                     |
|                              | 5        | 62          | 13,1        | 4,1         | 4,80          | 301,46    | 71,15   | 127,313           | 0,031                | 4,695                     |
| Rata-rata                    |          |             |             |             |               |           |         | 136,822           | 0,034                | 5,387                     |
| Standar deviasi              |          |             |             |             |               |           |         | 12,707            | 0,003                | 0,611                     |
| Max                          |          |             |             |             |               |           |         | 152,348           | 0,039                | 6,250                     |
| Min                          |          |             |             |             |               |           |         | 122,023           | 0,031                | 4,695                     |

| Waktu perendaman serat sisal | Spesimen | Panjang (L) | Lebar (mm) | Tebal (mm) | Defleksi (mm) | Beban (N) | m(N/mm) | Teg bending (MPa) | Regangan bending (%) | Modulus elastisitas (MPa) |
|------------------------------|----------|-------------|------------|------------|---------------|-----------|---------|-------------------|----------------------|---------------------------|
| 24 jam                       | 1        | 62          | 13,3       | 4,1        | 5,53          | 310,35    | 74      | 129,097           | 0,035                | 4,810                     |
|                              | 2        | 62          | 13,2       | 4,3        | 5,80          | 348,38    | 88,23   | 132,747           | 0,039                | 5,009                     |
|                              | 3        | 62          | 13,1       | 4,2        | 5,68          | 346,61    | 89,06   | 139,494           | 0,037                | 5,467                     |
|                              | 4        | 62          | 13,1       | 4,3        | 5,40          | 311,77    | 80,76   | 119,704           | 0,036                | 4,620                     |
|                              | 5        | 62          | 13,2       | 4,0        | 5,60          | 345,54    | 81,81   | 152,155           | 0,035                | 5,770                     |
| Rata-rata                    |          |             |            |            |               |           |         | 134,639           | 0,037                | 5,135                     |
| Standar deviasi              |          |             |            |            |               |           |         | 12,122            | 0,022                | 0,474                     |
| Max                          |          |             |            |            |               |           |         | 152,155           | 0,039                | 5,770                     |
| Min                          |          |             |            |            |               |           |         | 119,704           | 0,035                | 4,620                     |



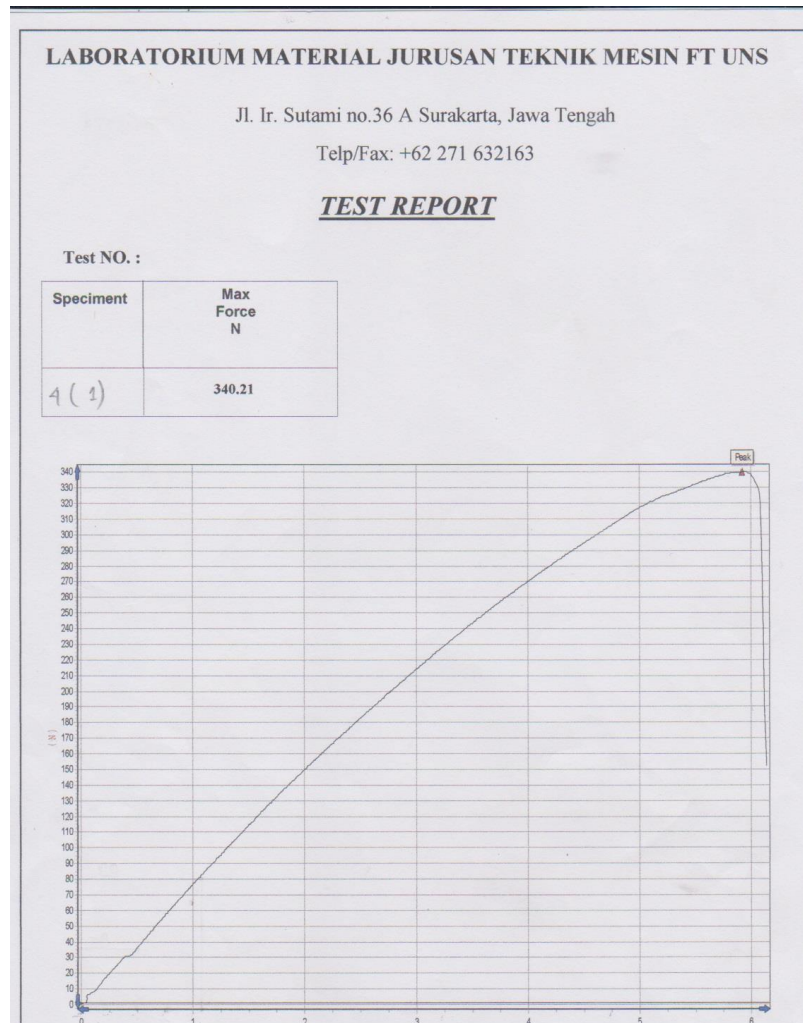
| Waktu perendaman serat sisal | Spesimen | Panjang (L) | Lebar b(mm) | Tebal d(mm) | Defleksi (mm) | Beban (N) | m(N/mm) | Teg bending (MPa) | Regangan bending (%) | Modulus elastisitas (MPa) |
|------------------------------|----------|-------------|-------------|-------------|---------------|-----------|---------|-------------------|----------------------|---------------------------|
| 40 jam                       | 1        | 62          | 13,2        | 4,1         | 5,29          | 271,95    | 53,06   | 113,980           | 0,034                | 3,475                     |
|                              | 2        | 62          | 13,3        | 4,2         | 5,90          | 328,48    | 60,83   | 130,209           | 0,039                | 3,678                     |
|                              | 3        | 62          | 13,2        | 4,3         | 4,80          | 289,37    | 71,87   | 110,262           | 0,032                | 4,080                     |
|                              | 4        | 62          | 13,3        | 4,2         | 6,15          | 273,73    | 60,36   | 108,506           | 0,040                | 3,650                     |
|                              | 5        | 62          | 13,2        | 4,1         | 5,80          | 297,19    | 53,06   | 124,559           | 0,037                | 4,006                     |
| Rata-rata                    |          |             |             |             |               |           |         | 117,503           | 0,036                | 3,778                     |
| Standar deviasi              |          |             |             |             |               |           |         | 9,447             | 0,003                | 0,256                     |
| Max                          |          |             |             |             |               |           |         | 130,209           | 0,040                | 4,080                     |
| Min                          |          |             |             |             |               |           |         | 108,506           | 0,032                | 3,475                     |

# **LAMPIRAN 4**

## GRAFIK PENGUJIAN KEKUATAN BENDING KOMPOSIT

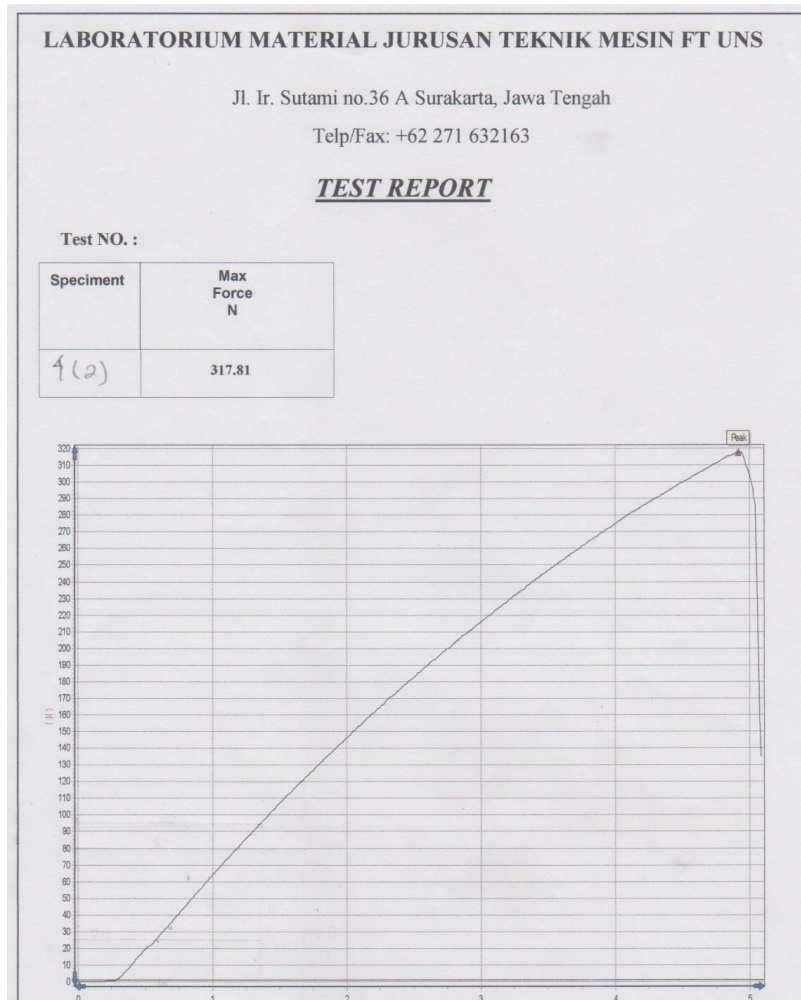
### 1. KOMPOSIT DENGAN WAKTU ALKALISASI 4 JAM

#### a. Spesimen 1



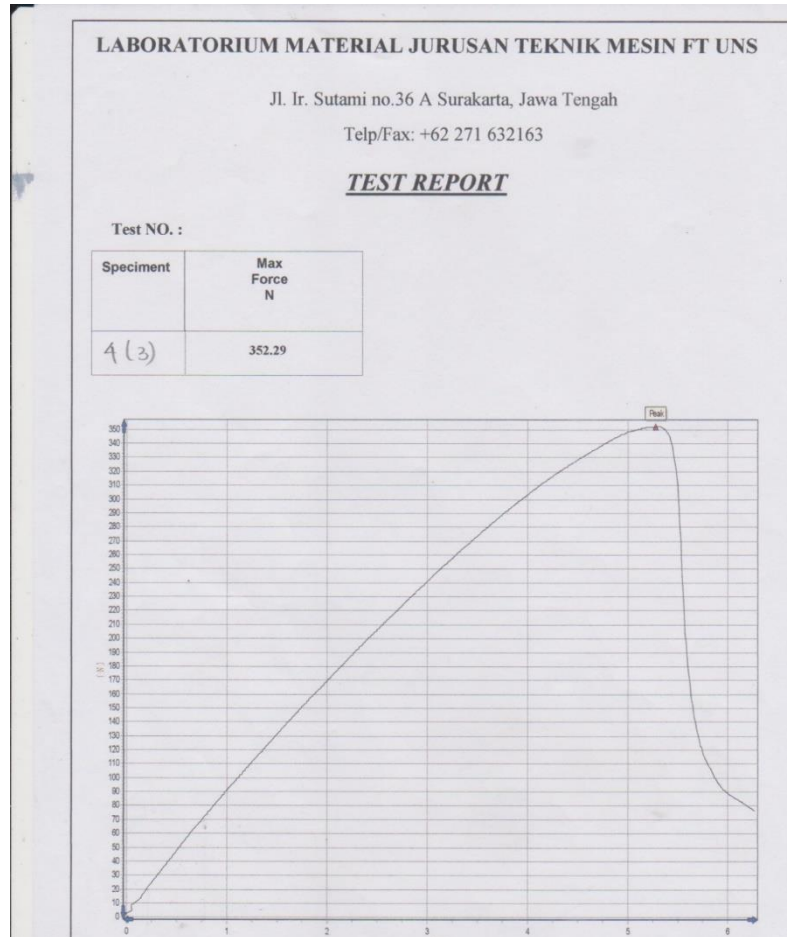
| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 1  | 62      | 13,2          | 4,2           | 5,90             | 340,21       | 80,76   | 135,881                 | 0,039                      | 4,920                           |

b. Spesimen 2



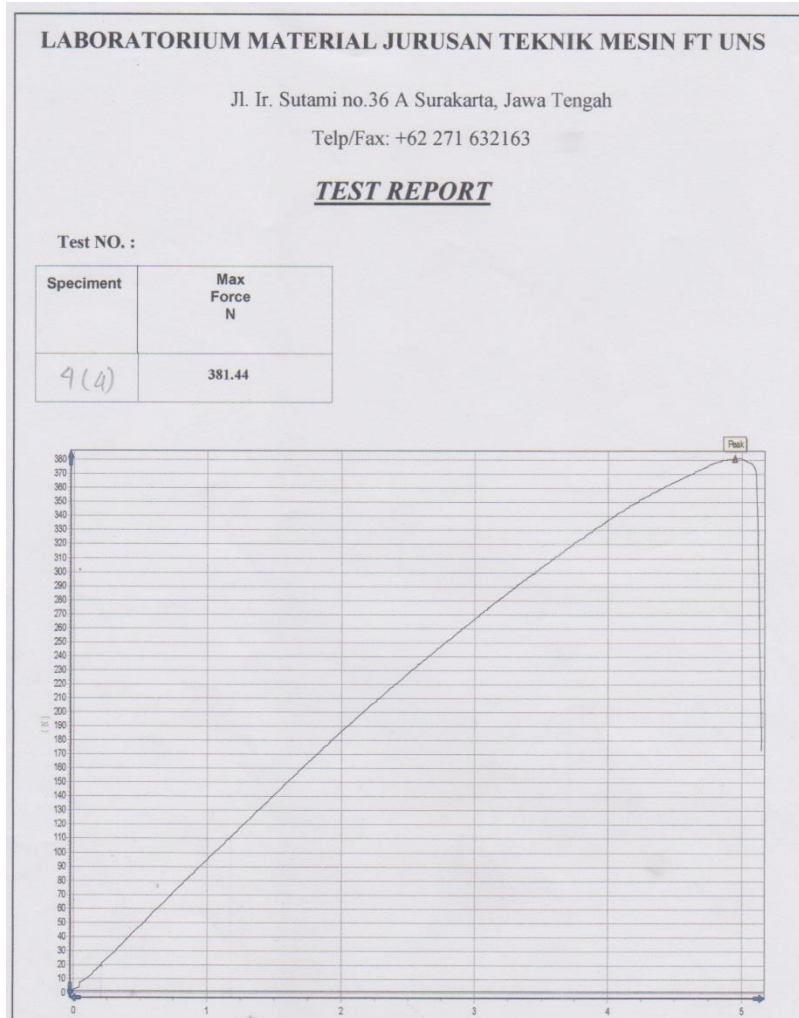
| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 2  | 62      | 13,1          | 4,3           | 4,90             | 317,81       | 95,71   | 122,023                 | 0,033                      | 5,475                           |

c. Spesimen 3



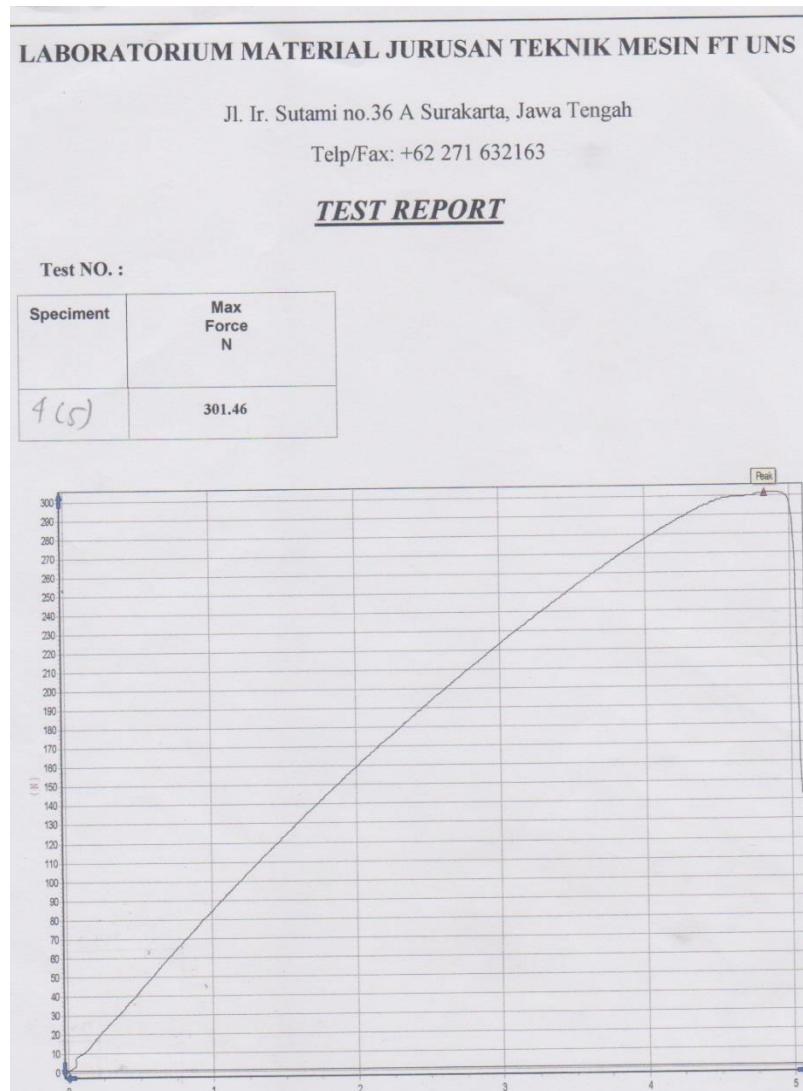
| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 3  | 62      | 13,3          | 4,1           | 5,26             | 352,29       | 96,15   | 146,543                 | 0,032                      | 6,250                           |

d. Spesimen 4



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 4  | 62      | 13,2          | 4,2           | 4,90             | 381,44       | 91,83   | 152,348                 | 0,032                      | 5,595                           |

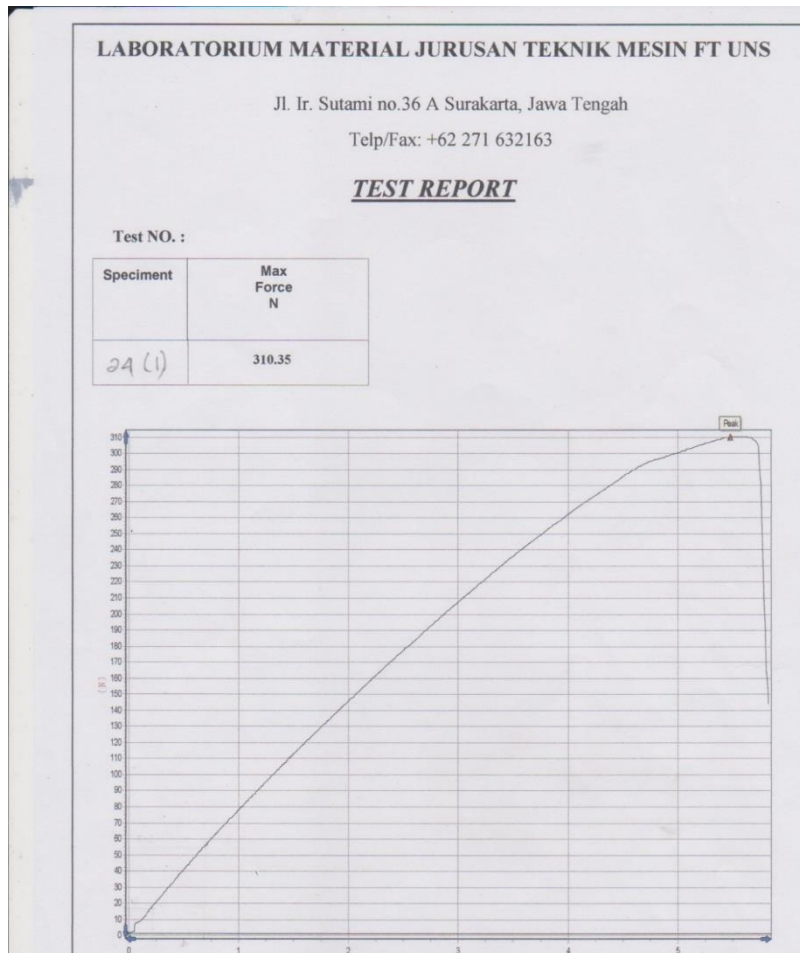
e. Spesimen 5



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 5  | 62      | 13,1          | 4,1           | 4,80             | 301,46       | 71,15   | 127,313                 | 0,031                      | 4,695                           |

## 2. KOMPOSIT DENGAN WAKTU ALKALISASI 24 JAM

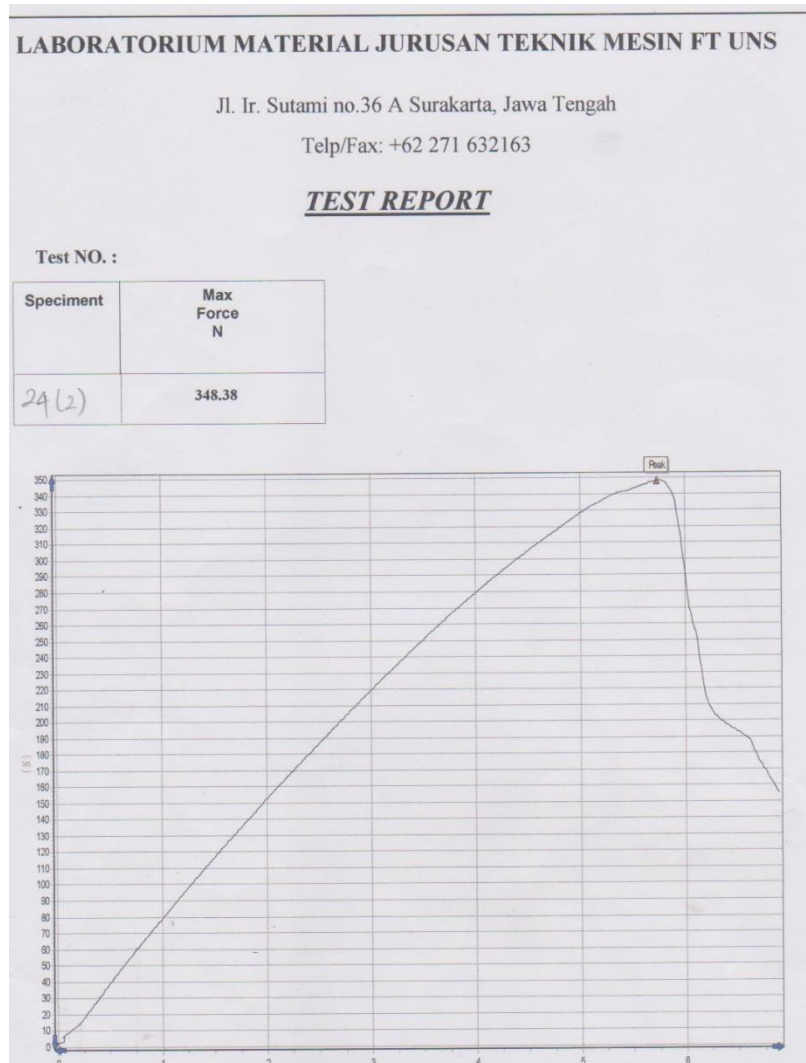
### a. Spesimen 1



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 1  | 62      | 13,3          | 4,1           | 5,53             | 310,35       | 74      | 129,097                 | 0,035                      | 4,810                           |

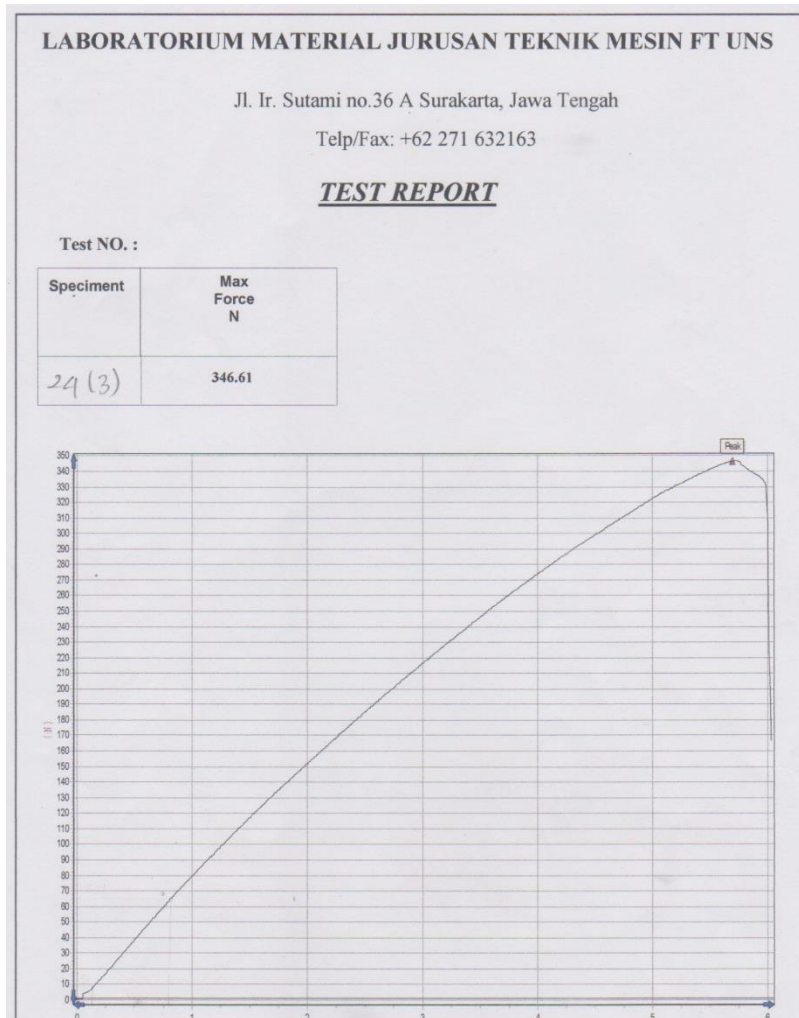


b. Spesimen 2



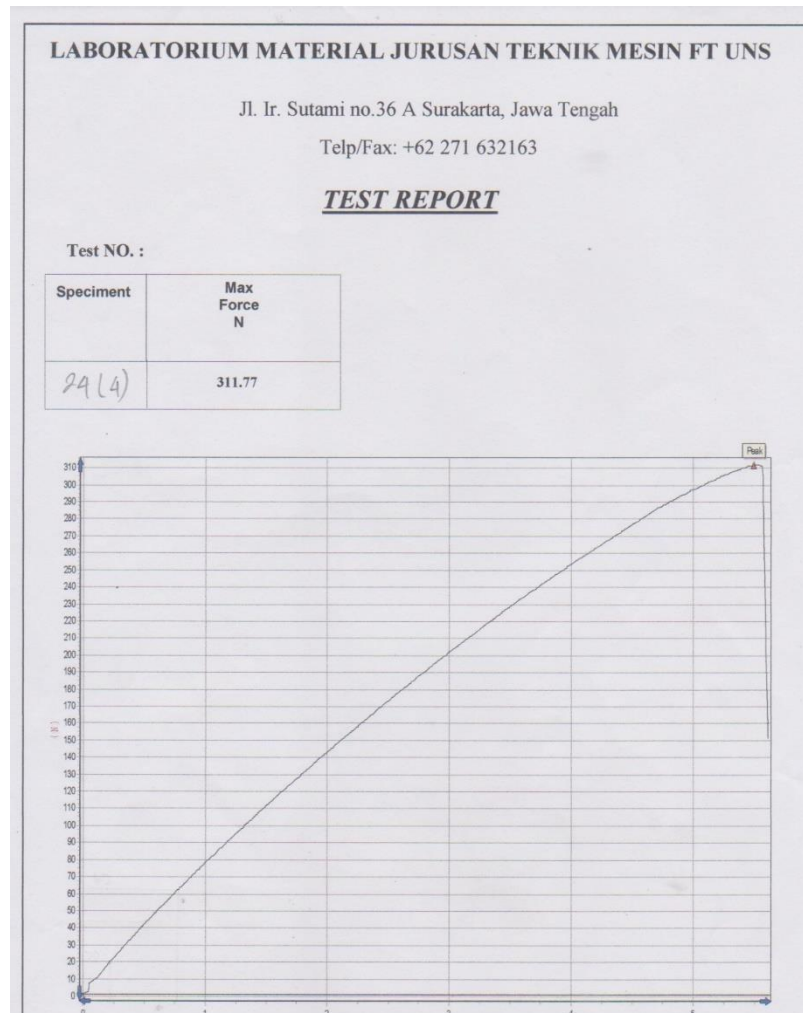
| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 2  | 62      | 13,2          | 4,3           | 5,80             | 348,38       | 88,23   | 132,747                 | 0,039                      | 5,009                           |

c. Spesimen 3



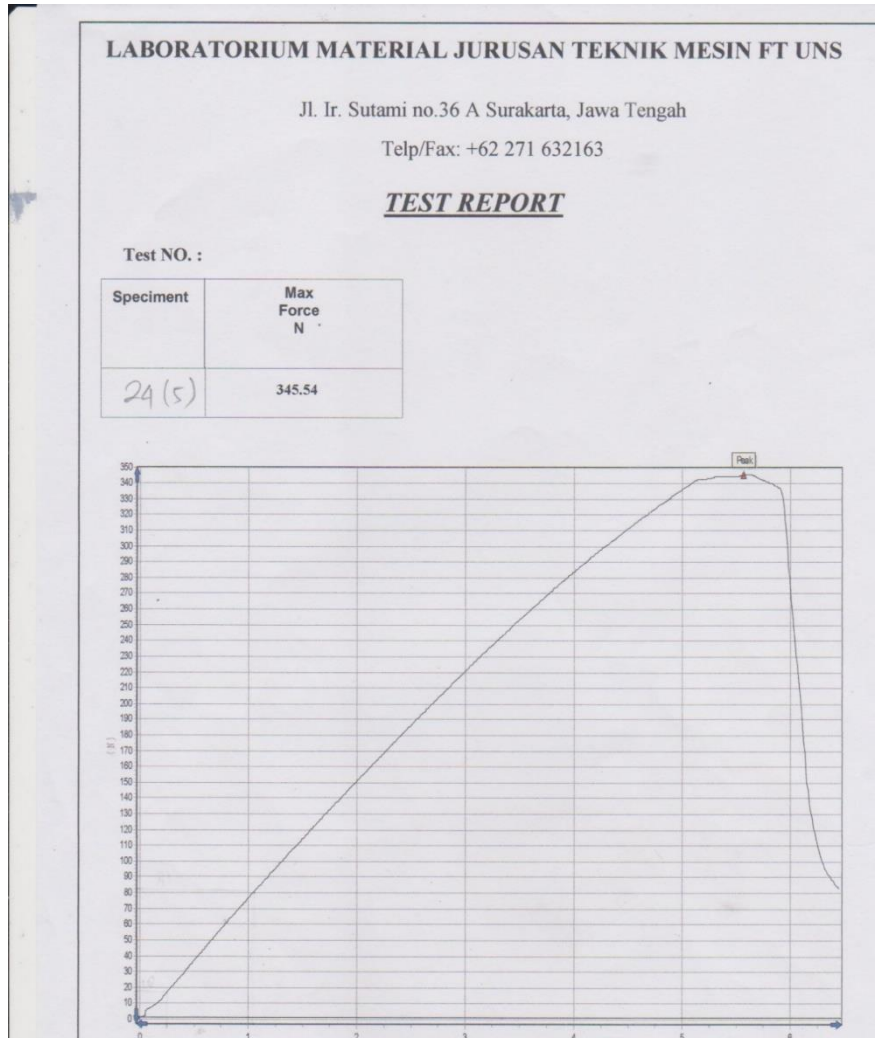
| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 3  | 62      | 13,1          | 4,2           | 5,68             | 346,61       | 89,06   | 139,494                 | 0,037                      | 5,467                           |

d. Spesimen 4



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 4  | 62      | 13,1          | 4,3           | 5,40             | 311,77       | 80,76   | 119,704                 | 0,036                      | 4,620                           |

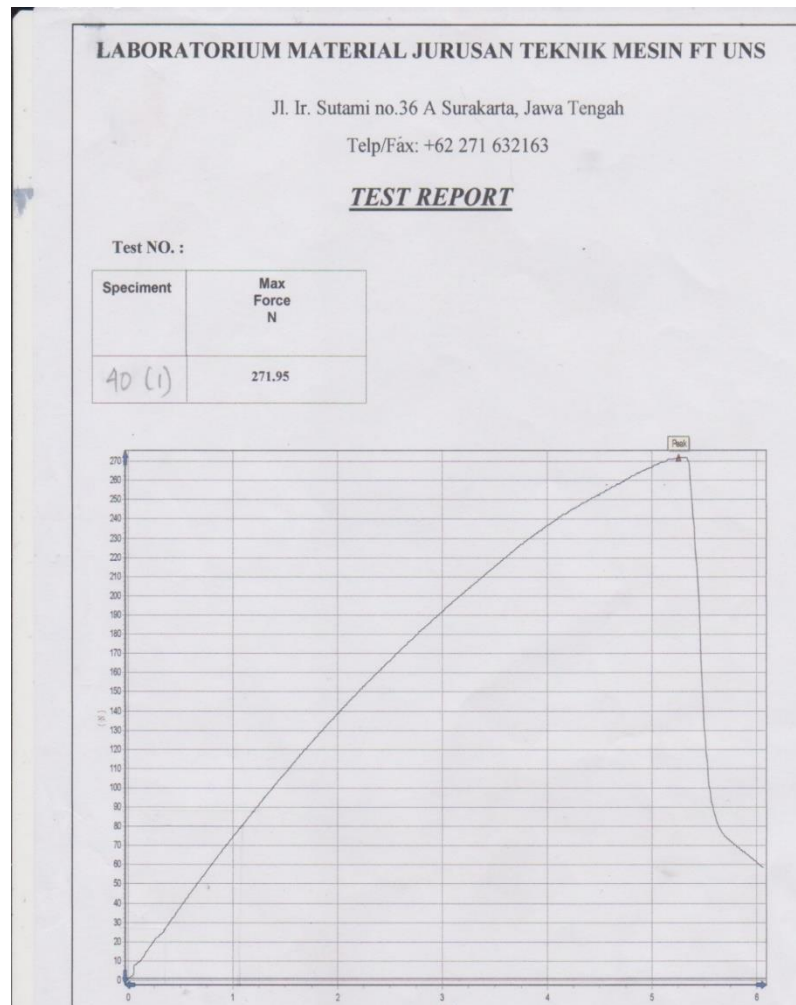
e. Spesimen 5



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 5  | 62      | 13,2          | 4,0           | 5,60             | 345,54       | 81,81   | 152,155                 | 0,035                      | 5,770                           |

### 3. KOMPOSIT DENGAN WAKTU ALKALISASI 40 JAM

#### a. Spesimen 1



| No | Panjang | Lebar (mm) | Tebal (mm) | Defleksi (mm) | Beban (N) | m(N/mm) | Teg bending (MPa) | Regangan bending (%) | Modulus elastisitas (MPa) |
|----|---------|------------|------------|---------------|-----------|---------|-------------------|----------------------|---------------------------|
| 1  | 62      | 13,2       | 4,1        | 5,29          | 271,95    | 53,06   | 113,980           | 0,034                | 3,475                     |

#### b. Spesimen 2

LABORATORIUM MATERIAL JURUSAN TEKNIK MESIN FT UNS

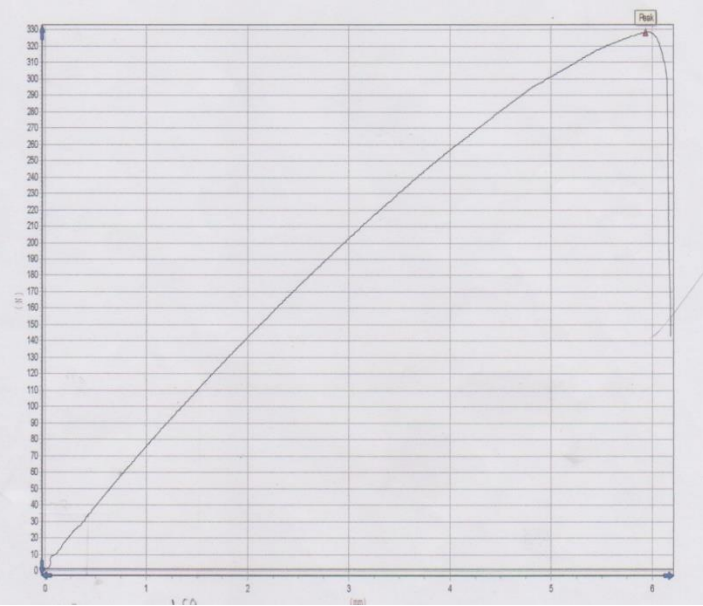
Jl. Ir. Sutami no.36 A Surakarta, Jawa Tengah

Telp/Fax: +62 271 632163

**TEST REPORT**

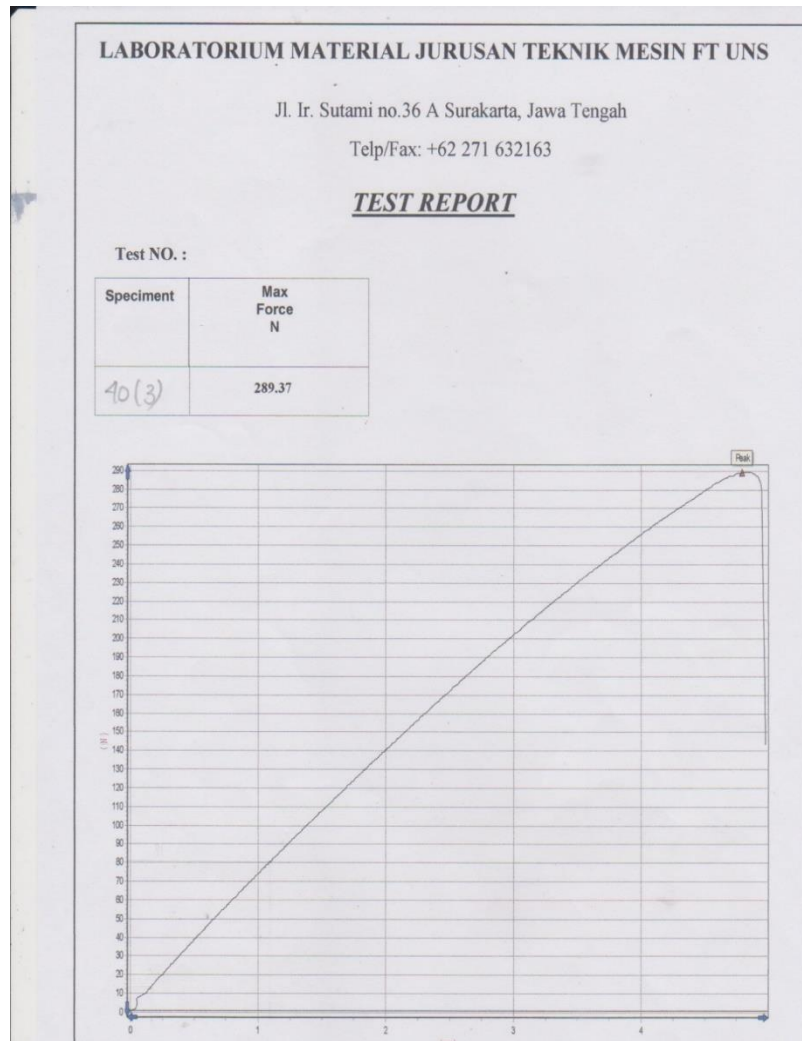
Test NO. :

| Speciment | Max Force N |
|-----------|-------------|
| 40(2)     | 328.48      |



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 2  | 62      | 13,3          | 4,2           | 5,90             | 328,48       | 60,83   | 130,209                 | 0,039                      | 3,678                           |

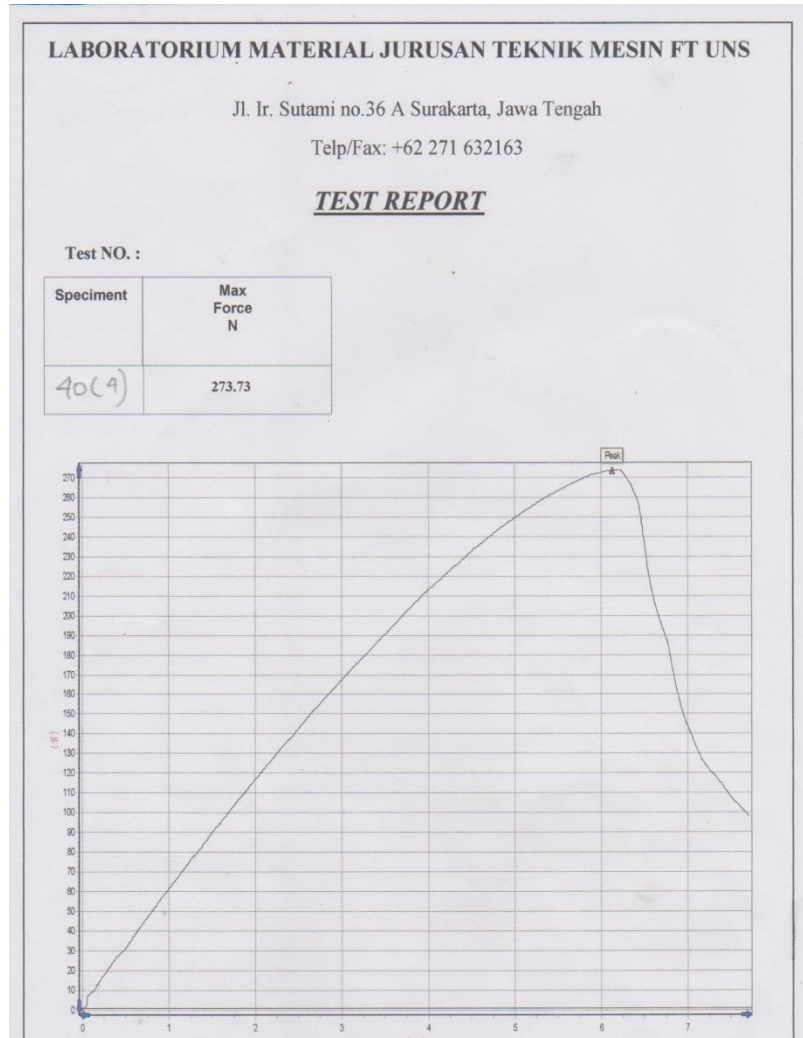
c. Spesimen 3



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 3  | 62      | 13,2          | 4,3           | 4,80             | 289,37       | 71,87   | 110,262                 | 0,032                      | 4,080                           |



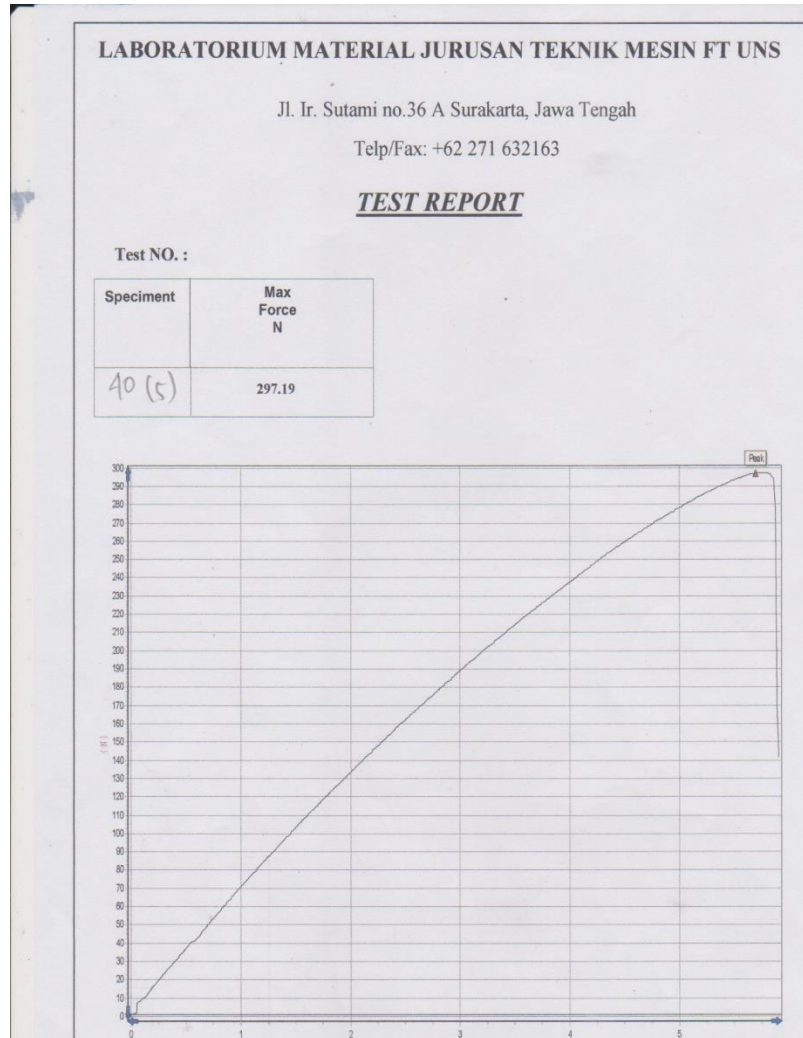
d. Spesimen 4



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 4  | 62      | 13,3          | 4,2           | 6,15             | 273,73       | 60,36   | 108,506                 | 0,040                      | 3,650                           |



e. Spesimen 5



| No | Panjang | Lebar<br>(mm) | Tebal<br>(mm) | Defleksi<br>(mm) | Beban<br>(N) | m(N/mm) | Teg<br>bending<br>(MPa) | Regangan<br>bending<br>(%) | Modulus<br>elastisitas<br>(MPa) |
|----|---------|---------------|---------------|------------------|--------------|---------|-------------------------|----------------------------|---------------------------------|
| 5  | 62      | 13,2          | 4,1           | 5,80             | 297,19       | 53,06   | 124,559                 | 0,037                      | 4,006                           |