APPENDIX G

Wear Resistance Test Results
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**Types Of Testing**: Vickers Hardness Test

**Types of Indenter**

**Load**: 30 kg

**Load Time**: 10 sec

**Loading speed**: 55.1 um/sec

MAMKAT SAINS BAHAN
Jabatan Kejuruteraan Bahan Dan Rekabentuk
Fakulti Kejuruteraan Mekanikal & Pembuatan
Kolej Universiti Teknologi Tun Hussein Onn
APPENDIX I
Density Test Results
Density Test

**Equipment:** Ultrapylnometer 1000

**Cell:** Medium

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<td>9.5129</td>
<td>2.7176</td>
<td>0.008</td>
<td>25.852</td>
</tr>
<tr>
<td></td>
<td>30.9</td>
<td>9.5096</td>
<td>2.7199</td>
<td>9.5129</td>
<td>2.7176</td>
<td>0.008</td>
<td>25.852</td>
</tr>
<tr>
<td></td>
<td>31.0</td>
<td>9.2351</td>
<td>2.7098</td>
<td>9.241</td>
<td>2.70</td>
<td>0.045</td>
<td>24.951</td>
</tr>
<tr>
<td></td>
<td>31.0</td>
<td>9.2351</td>
<td>2.7098</td>
<td>9.241</td>
<td>2.70</td>
<td>0.045</td>
<td>24.951</td>
</tr>
<tr>
<td></td>
<td>31.0</td>
<td>9.2351</td>
<td>2.7098</td>
<td>9.241</td>
<td>2.70</td>
<td>0.045</td>
<td>24.951</td>
</tr>
<tr>
<td></td>
<td>31.0</td>
<td>9.2351</td>
<td>2.7098</td>
<td>9.241</td>
<td>2.70</td>
<td>0.045</td>
<td>24.951</td>
</tr>
</tbody>
</table>
APPENDIX J

Compression Test Results
<table>
<thead>
<tr>
<th>Project Name: Al+Cu</th>
<th>Max. load: 85.24kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area: 314.16mm²</td>
<td>Elongation at break: 13.99mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength: 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break: 23.31%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus: 1915.29MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point: 0.14kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2%: 0.20kN/mm²</td>
</tr>
</tbody>
</table>

Graph showing load (kN) vs displacement (mm) with a linear trend indicating the load-bearing capacity of Al+Cu material.
# Compression Test Report

<table>
<thead>
<tr>
<th>Project Name : Al(LM6)</th>
<th>Max. load : 85.58kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 4.10mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 6.83%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 7876.90MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.00kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

![Graph](image-url)
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name : Al(LM6)B</th>
<th>Max. load : 85.37kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 4.33mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 7.21%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 6824.27MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.00kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

---

![Graph](image-url)
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC1A</td>
<td>85.53kN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Elongation at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>314.16mm²</td>
<td>4.28mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ultimate tensile strength</th>
<th>0.27kN/mm²</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Strain at break</th>
<th>7.13%</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Young's Modulus</th>
<th>8712.03MPa</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Yield Point</th>
<th>0.21kN/mm²</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Yield strength @0.2%</th>
<th>0.21kN/mm²</th>
</tr>
</thead>
</table>

![Graph Showing Compression Load vs. Deformation](image-url)
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name : Al-MMC1B</th>
<th>Max. load : 85.58kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 5.65mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 9.42%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 4161.86MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.22kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

---

**Graph**

The graph shows the relationship between load (kN) and deformation (mm) for the compression test. The data points are plotted on a grid with axes labeled as follows:

- **X-axis (mm)**: 0.00 to 6.00
- **Y-axis (kN)**: 0.00 to 90.00

The graph includes a line of best fit indicating the trend of the data points.
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name : Al-MMC2B</th>
<th>Max. load : 85.38kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 8.91mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 14.85%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 5862.93MPa</td>
</tr>
<tr>
<td>Yield Point : 0.19kN/mm²</td>
<td></td>
</tr>
<tr>
<td>Yield strength @0.2% : 0.20kN/mm²</td>
<td></td>
</tr>
</tbody>
</table>

![Graph](image-url)
### Compression Test Report

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
<th>Area</th>
<th>Elongation at break</th>
<th>Ultimate tensile strength</th>
<th>Strain at break</th>
<th>Young's Modulus</th>
<th>Yield Point</th>
<th>Yield strength @0.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC2A</td>
<td>85.32kN</td>
<td>314.16mm²</td>
<td>7.65mm</td>
<td>0.27kN/mm²</td>
<td>12.75%</td>
<td>6134.20MPa</td>
<td>0.18kN/mm²</td>
<td>0.20kN/mm²</td>
</tr>
</tbody>
</table>

![Graph](image-url)
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name : Al-MMC3B</th>
<th>Max. load : 85.52kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 3.84mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 6.40%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 5777.51MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.20kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

---

**Graph**

- x-axis: mm
- y-axis: kN
- Grid lines for visual representation
### Compression Test Report

<table>
<thead>
<tr>
<th>Project Name : Al-MMC3A</th>
<th>Max. load : 86.19kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 3.28mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 5.46%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 10695.37MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.23kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.22kN/mm²</td>
</tr>
</tbody>
</table>

![Graph](image)
### Compression Test Report

<table>
<thead>
<tr>
<th>Project Name: Al-MMC4A</th>
<th>Max. load: 85.39kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area: 314.16mm²</td>
<td>Elongation at break: 5.55mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength: 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break: 9.25%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus: 6768.55MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point: 0.19kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2%: 0.20kN/mm²</td>
</tr>
</tbody>
</table>

![Graph showing load versus deflection relationship]
<table>
<thead>
<tr>
<th>Project Name : Al-MMC4B</th>
<th>Max. load : 85.37kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 6.75mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 11.25%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 6746.33MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.20kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.20kN/mm²</td>
</tr>
</tbody>
</table>

![Graph](image-url)
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name : AI-MMC5A</th>
<th>Max. load : 85.35kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 3.90mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 6.50%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 8608.06MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.23kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

---

**Graph**

![Graph](image)
Compression Test Report

<table>
<thead>
<tr>
<th>Project Name : Al-MMC6A</th>
<th>Max. load : 85.38kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 2.70mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 4.50%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 9410.06MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.00kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.22kN/mm²</td>
</tr>
</tbody>
</table>

![Graph](image)
**Kolej Universiti Teknologi Tun Hussein Onn**  
**Makmal Mekanik Pepejal**  
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC7A</td>
<td>85.32kN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Elongation at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>314.16mm²</td>
<td>5.21mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ultimate tensile strength</th>
<th>Strain at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.27kN/mm²</td>
<td>8.69%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Young's Modulus</th>
<th>Yield Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>6156.43MPa</td>
<td>0.19kN/mm²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yield strength @0.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20kN/mm²</td>
</tr>
</tbody>
</table>

---

**Graph**

- The graph shows the relationship between applied load (kN) and displacement (mm).
- The data points are plotted along the curve, indicating a linear relationship between the variables.
- The graph is used to determine the load-displacement behavior of the material being tested.
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC7B</td>
<td>85.36kN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Elongation at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>314.16mm²</td>
<td>4.31mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ultimate tensile strength</th>
<th>Strain at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.27kN/mm²</td>
<td>7.19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Young's Modulus</th>
<th>Yield Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>7431.14MPa</td>
<td>0.19kN/mm²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yield strength @0.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.21kN/mm²</td>
</tr>
</tbody>
</table>

**Graph**

![Graph showing test data](image_url)
### Compression Test Report

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC8A</td>
<td>85.35kN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Elongation at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>314.16mm²</td>
<td>4.76mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ultimate tensile strength</th>
<th>Strain at break</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.27kN/mm²</td>
<td>7.94%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Young's Modulus</th>
<th>Yield Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>6863.60MPa</td>
<td>0.19kN/mm²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yield strength @0.2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.21kN/mm²</td>
</tr>
</tbody>
</table>

---

**Graph:**

- **X-axis:** mm
- **Y-axis:** KN
- **Scale:**
  - X-axis: 0.00 to 5.00 mm
  - Y-axis: 0.00 to 90.00 kN
- **Graph line:**
  - Line 1
  - Line 2
## Compression Test Report

<table>
<thead>
<tr>
<th>Project Name : Al-MMC8B</th>
<th>Max. load : 85.27kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area : 314.16mm²</td>
<td>Elongation at break : 4.79mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength : 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break : 7.98%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus : 6948.66MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point : 0.18kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2% : 0.21kN/mm²</td>
</tr>
</tbody>
</table>

![Graph showing load vs. deformation]
**Compression Test Report**

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Max. load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-MMC9A</td>
<td>85.33 kN</td>
</tr>
</tbody>
</table>

| Area            | 314.16 mm²  |

<table>
<thead>
<tr>
<th>Elongation at break</th>
<th>4.29 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate tensile strength</td>
<td>0.27 kN/mm²</td>
</tr>
<tr>
<td>Strain at break</td>
<td>7.15%</td>
</tr>
<tr>
<td>Young's Modulus</td>
<td>4228.53 MPa</td>
</tr>
<tr>
<td>Yield Point</td>
<td>0.16 kN/mm²</td>
</tr>
<tr>
<td>Yield strength @0.2%</td>
<td>0.24 kN/mm²</td>
</tr>
</tbody>
</table>

![Graph showing load vs. strain]
### Compression Test Report

<table>
<thead>
<tr>
<th>Project Name: Al-MMC9B</th>
<th>Max. load: 85.44kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area: 314.16mm²</td>
<td>Elongation at break: 1.93mm</td>
</tr>
<tr>
<td></td>
<td>Ultimate tensile strength: 0.27kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Strain at break: 3.21%</td>
</tr>
<tr>
<td></td>
<td>Young's Modulus: 28073.09MPa</td>
</tr>
<tr>
<td></td>
<td>Yield Point: 0.00kN/mm²</td>
</tr>
<tr>
<td></td>
<td>Yield strength @0.2%: 0.22kN/mm²</td>
</tr>
</tbody>
</table>

**Graph**

![Graph showing compression load vs. deformation]