DAFTAR PUSTAKA

Aizi, M. I., Sehono, & F. S. (2022). Pengaruh Penggunaan Serat Daun Nanas Dalam Pembuatan Komposit Menggunakan Metode Vacum Bagging Terhadap Kekuatan Tarik Dan Bending. *Engine Vol. 8, No. 2 2022*, 267 - 273.

Bhayangkara, R. P. (2023). *Analisis Pengaruh Fraksi Volume Serat Daun Nanas Bermatriks Unsaturated Polymer Resin (UPR) Terhadap Sifat Mekanik Material Pada Aplikasi Helm.* Bekasi: Universitas Islam "45" Bekasi.

Buntaram, M. (2019). *Analisis Karakteristik Komposit Serat Daun Nanas (Ananas Comosus) Dengan Matrik Epoksi Dan Polipropilena Pada Fraksi Volume 40%, 50% Dan 60%.* Surakarta: Universitas Muhammadiyah Surakarta.

Erlansyah, A. D. (2022). *Rekayasa Material Komposit Sebagai Bahan Dasar Alternatif Pembuatan Helm Sni.* Magelang: Universitas Tidar.

Fadilah, R., & G. W. (2020). Analisis Kekuatan Tarik Dan Struktur Mikro Material Komposit Pada Body Mobil Listrik Prosoe KMHE 2019. *Jurnal Teknik Mesin, Vol. 09, No. 2 2020*, 124 - 136.

Gibson, R. (1994). *Principles of Composite Material Mechanics.* New York: Mc Graw Hill.

Hambali, M. I. (2021). *Studi Kekuatan Adhesi Serat Daun Nanas Terhadap Matrik Polyester Dengan Pengujian Debonding.* Bandar Lampung: Universitas Lampung.

Millati, R., & A. E. (2018). Pengembangan Material Komposit Serat Daun Nanas Untuk Desain Produk Furnitur. *Jurnal Sains Dan Seni ITS Vol. 7, No. 2 2018*, 1 - 5.

Ningrum, L. Y. (2017). *Potensi Serat Daun Nanas Sebagai Alternatif Bahan Komposit Pengganti Fiberglass Pada Pembuatan Lambung Kapal.* Surabaya: Institut Teknologi Sepuluh Nopember Surabaya.

Rifa'i. (2020). *Pengaruh Variasi Fraksi Volume Serat Daun Nanas Sebagai Penguat Komposit Terhadap Ketangguhan Impak Dan Kekuatan Bending.* Magelang: Universitas Tidar.

Subadra dkk. (2018). Analisis Kekuatan Impact Komposit Matrix Polyester Berpenguat Serat Rami Dengan Perlakuan Alkali 0%, 5%, 10% dan 15% NaOH Untuk Bodi Kendaraan. *Jurnal Universitas Pendidikan Ganesha* , 1 - 38.

Supriyanto, & Jimin. (2021). Karakteristik Kekuatan Komposit Serat Daun Nanas Dengan Variasi Panjang Serat. *Jurnal Mesin Nusantara Vol. 4, No. 1 2021*, 30 - 39.

Susanti, D. N. (2018). *Pengaruh Variasi Panjang Serat Nanas Terhadap Kekuatan Tarik Dan Impact Komposit Polyester - Serat Nanas.* Semarang: Universitas Muhammadiyah Semarang.

LAMPIRAN

1.1 Perhitungan Komposisi

Perhitungan komposisi dilakukan berdasarkan volume total cetakan yang digunakan, yaitu 20 x 20 x 0,5 cm dengan variasi fraksi volume 15% serat dan 85% matriks. Selanjutnya untuk menghitung komposisi antara serat dan matriks dilakukan dengan perhitungan sebagai berikut.

Massa jenis serat nanas (ρ) = 0,985 g/cm³

Volume Cetakan (V_{cet}) = Volume Komposit (V_{komp})

Sehingga, V_{komp} = 20 x 20 x 0,5 cm

= 200 cm³

a. Menghitung volume serat Volume serat (V_s) = 15% x V_{komp}

$$= \frac{15}{100} \text{ x } 200 \text{ cm}^3$$

$$= 30 \text{ cm}^3$$

Massa serat dapat dihitung menggunakan perhitungan volune serat dengan persamaan $\rho = m/v$, sehingga massa serat (m_s)

Massa serat (m_s) = ρ x V_{serat}

= 0,985 g/cm³ x 30 cm³

= 29,55 g

b. Menghitung volume matriks Volume matriks (V_m) = 85% x V_{komp}

$$= \frac{85}{100} \text{ x } 200 \text{ cm}^3$$

$= 170\ cm^3 = 170\ ml$

c. Menghitung volume katalis

Volume katalis ($V_{katalis}$) = 1% x Volume matriks (V_m)

$= \frac{1}{100}$ x $170\ cm^3$

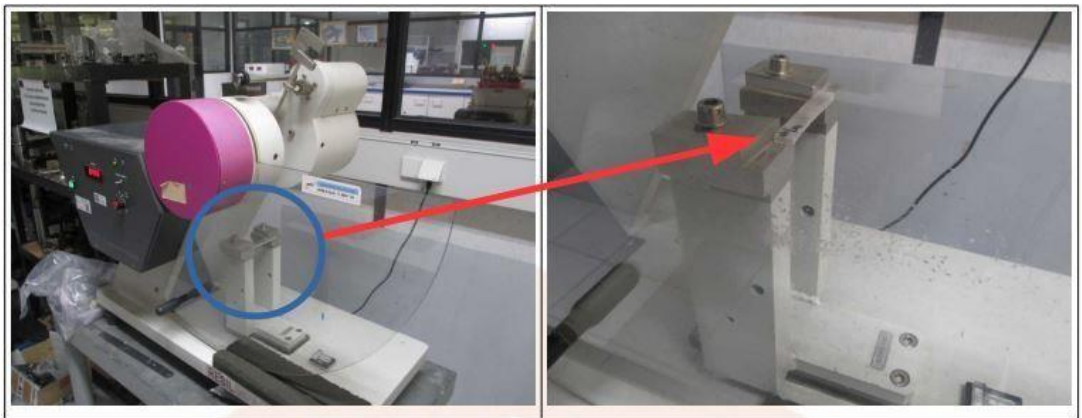
$= 1{,}70\ cm^3 = 1{,}70\ ml$

1.2 Lampiran Pembuatan Spesimen

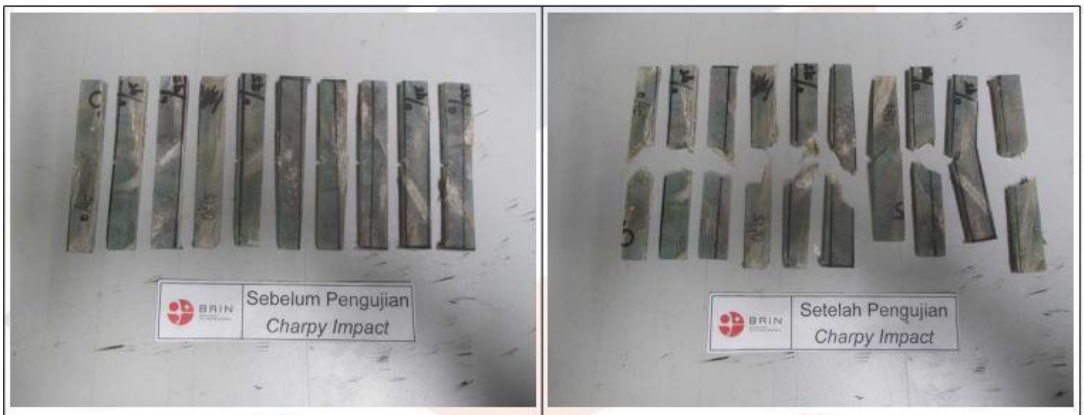
		
Perlakuan Alkali	Pembilasan	Pengeringan Serat
		
Penimbangan Serat 15%	Penimbangan resin (85%)	Pengukuran Katalis 1%

		
Woven Fibre 0°/90°	Woven Fibre 0°/45°	Woven Fibre 45°/90°

Lampiran 2.1 Dokumentasi Pengujian Impak

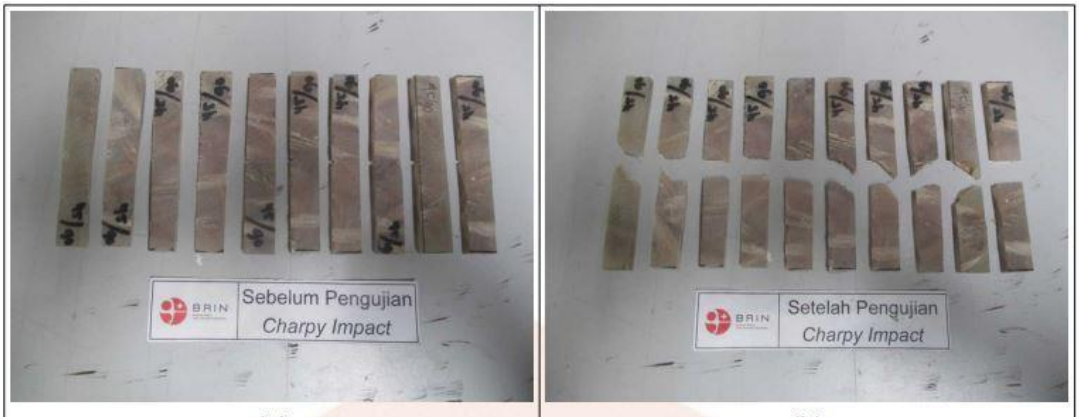


Gambar 1. Kondisi pengujian *Charpy Impact*.



(a) (b)

Gambar 2. Sampel 0/45, (a) Sebelum dan (b) Setelah Pengujian *Charpy Impact*.



(a) (b)

Gambar 3. Sampel 45/90, (a) Sebelum dan (b) Setelah Pengujian *Charpy Impact*.

(a)

(b)

Gambar 4. Sampel 0/90, (a) Sebelum dan (b) Setelah Pengujian *Charpy Impact*.

Lampiran 2.2 Data Pengujian Impak 0°/45°

BRIN

CHARPY IMPACT NOTCHED TEST

Date of testing	:	10-Jun-24	
ELSA ID	:	160798	
Order from	:	HKM	
Material Tested	:	0/45	
Humidity	:	54.2	%
Temp.	:	23.6	°C
Methode	:	ISO 179	Determination of Charpy impact properties
Methode of tested	:	Notched / Un-notched Edgewise	
Velocity of Impact	:	2.9	m/sec
Pendulum Energy	:	1	J
Correction Energy	:	0.011	J
Equipment	:	Impact tool :	Resil Impactor CEAST
		Micrometer :	Preisser Digi-Met ID-NR 150994129
		Thermohygrograph :	-

No.	Width	Thickness	Impact Energy	Corrected Energy	Charpy Impact Strength	Type of failure
	(mm)	(mm)	(Joule)	(Joule)	(kJ/m²)	
1	10.59	5.73	0.410	0.399	6.575	C
2	10.38	5.67	0.144	0.133	2.260	C
3	10.17	5.82	0.361	0.350	5.913	C
4	11.16	5.36	0.274	0.263	4.397	C
5	10.47	5.83	0.326	0.315	5.161	C
6	10.58	5.76	0.452	0.441	7.237	C
7	10.67	5.81	0.532	0.521	8.404	H
8	10.42	5.73	0.183	0.172	2.881	C
9	10.19	5.04	0.274	0.263	5.121	H
10	9.21	5.25	0.408	0.397	8.211	C
Mean					5.616	
Standard Deviation					2.077	
Standard Deviation (%)					37%	

*) C = Complete break, H = Hinge break

Lampiran 2.3 Data Pengujian Impak 45°/90°

BRIN

CHARPY IMPACT NOTCHED TEST

Date of testing	:	10-Jun-24	
Order Number	:	160798	
Order from	:	HKM	
Material Tested	:	45/90	
Humidity	:	54.2	%
Temp.	:	23.6	°C
Methode	:	ISO 179	Determination of Charpy impact properties
Methode of tested	:	Notched / ~~Un-notched~~ Edgewise	
Velocity of Impact	:	2.9	m/sec
Pendulum Energy	:	1	J
Correction Energy	:	0.011	J
Equipment	:	Impact tool :	Resil Impactor CEAST
		Micrometer :	Preisser Digi-Met ID-NR 150994129
		Thermohygrograph :	-

No.	Width	Thickness	Impact Energy	Corrected Energy	Charpy Impact Strength	Type of failure
	(mm)	(mm)	(Joule)	(Joule)	(kJ/m²)	
1	10.72	5.18	0.166	0.155	2.791	C
2	11.69	5.23	0.089	0.078	1.276	C
3	10.95	5.28	0.045	0.034	0.588	C
4	10.67	5.48	0.050	0.039	0.667	C
5	10.18	5.36	0.056	0.045	0.825	C
6	11.25	5.07	0.106	0.095	1.666	C
7	10.75	4.76	0.175	0.164	3.205	C
8	10.91	4.82	0.206	0.195	3.708	C
9	10.23	5.29	0.110	0.099	1.829	C
10	10.35	5.26	0.057	0.046	0.845	C
Mean					1.740	
Standard Deviation					1.129	
Standard Deviation (%)					65%	

*) C = Complete break

Lampiran 2.4 Data Pengujian Impak 0°/90°

BRIN

CHARPY IMPACT NOTCHED TEST

Date of testing	:	10-Jun-24	
Order Number	:	160798	
Order from	:	HKM	
Material Tested	:	0/90	
Humidity	:	54.2	%
Temp.	:	23.6	°C
Methode	:	ISO 179	Determination of Charpy impact properties
Methode of tested	:	Notched / ~~Un-notched~~ Edgewise	
Velocity of Impact	:	2.9	m/sec
Pendulum Energy	:	1	J
Correction Energy	:	0.011	J
Equipment	:	Impact tool :	Resil Impactor CEAST
		Micrometer :	Preisser Digi-Met ID-NR 150994129
		Thermohygrograph :	-

No.	Width	Thickness	Impact Energy	Corrected Energy	Charpy Impact Strength	Type of failure
	(mm)	(mm)	(Joule)	(Joule)	(kJ/m^2)	
1	12.79	4.64	0.565	0.554	9.335	C
2	10.54	4.32	0.317	0.306	6.720	C
3	11.82	4.45	0.233	0.222	4.221	C
4	12.47	4.29	0.156	0.145	2.710	C
5	10.95	4.38	0.147	0.136	2.836	C
6	12.38	4.52	0.069	0.058	1.036	C
7	11.82	4.26	0.823	0.812	16.126	C
8	10.86	4.32	0.379	0.368	7.844	C
9	11.79	4.68	0.379	0.368	6.669	H
10	10.76	4.24	0.078	0.067	1.469	C
Mean					5.897	
Standard Deviation					4.559	
Standard Deviation (%)					77%	

*) C = Complete break

Lampiran 2.5 Perhitungan Uji Impak

Variasi Serat (°)	Lebar (mm)	Tebal (mm)	Luas Penampang (mm^2)	Energi Serap (Joule)	Kekuatan Impak (Kj/m^2)
45°/90°	10,74	5,17	55,2558	0,0950	1,740
0°/45°	10,38	5,6	58,128	0,3254	5,616
0°/90°	11,68	4,41	51,5088	0,3036	5,897

1) Perhitungan Variasi ASN_1

Diketahui :

m = 0,514 Kg E_{serap} =

Cos α = 150° E_{serap} =

g = 9,81 m/s^2 A_0 = 55,2558

$A_0 = 55,2558 \times 10^{-6} = 0,0000552558\ m^2$

a) Menghitung Nilai Cos β

E = m.g.R (Cos β - Cos α)

0,0950 Kgm^2/s^2 = 0,514 kg . 9,81 m/s^2 . 0,23 m (Cos β – (-0,866))

0,0950 Kgm^2/s^2 = 1,160 kgm^2/s^2 (Cos β – (-0,866))

0,0950 Kgm^2/s^2 = 1,160 kgm^2/s^2 . (Cos β + 1,00456 kgm^2/s^2

1,160 kgm^2/s^2 . Cos β + 1,00456 kgm^2/s^2 = 0,0950 Kgm^2/s^2

1,160 kgm^2/s^2 . Cos β = 0,0950 Kgm^2/s^2 - 1,00456 kgm^2/s^2

1,160 kgm^2/s^2 . Cos β = -0,90956

$$\text{Cos } \beta = \frac{-0{,}90956\ \text{kgm}^2/\text{s}^2}{1{,}160\ \text{kgm}^2/\text{s}^2}$$

Cos β = -0,7841

Cos β = 142°

b) Menghitung Nilai Eserap

E = m.g.R (Cos β – Cos α)

E = 0,514 Kg . 9,81 m/s² . 0,23 m ((-0,7841) - (-0,866))

E = 1,160 Kgm²/s² (0,0819)

E = 0,0950 Kgm²/s² = 0,0950 Joule

c) Menghitung Nilai Harga Impak (HI)

HI = $\frac{E}{A_0}$

HI = $\frac{0{,}0950 \text{ Joule}}{55{,}2558\ mm^2}$

HI = $\frac{950\ x\ 10^{-6}\ Kj}{552558\ x\ 10^{-6}\ m^2}$

HI = 1,719 $\frac{Kj}{m^2}$

2) Pehitungan Variasi ASN_2

Diketahui :

m = 0,514 Kg E_{serap} =

Cos α = 150° E_{serap} =

g = 9,81 m/s² A_0 = 58,128

A_0 = 58,128 x 10^{-6} = 0,000058128 m²

a) Menghitung Nilai Cos β

E = m.g.R (Cos β - Cos α)

0,3254 Kgm²/s² = 0,514 kg . 9,81 m/s² . 0,23 m (Cos β – (-0,866))

0,3254 Kgm²/s² = 1,160 kgm²/s² (Cos β – (-0,866))

0,3254 Kgm^2/s^2 = 1,160 kgm^2/s^2 . (Cos β + 1,00456 kgm^2/s^2

1,160 kgm^2/s^2 . Cos β + 1,00456 kgm^2/s^2 = 0,3254 Kgm^2/s^2

1,160 kgm^2/s^2 . Cos β = 0,3254 Kgm^2/s^2 - 1,00456 kgm^2/s^2

1,160 kgm^2/s^2 . Cos β = -0,6791

$$\text{Cos } \beta = \frac{-0{,}6791 \text{ kgm}^2/\text{s}^2}{1{,}160 \text{ kgm}^2/\text{s}^2}$$

Cos β = -0,5854

Cos β = 126°

b) Menghitung Nilai Eserap

E = m.g.R (Cos β – Cos α)

E = 0,514 Kg . 9,81 m/s^2 . 0,23 m ((-0,6791) - (-0,866))

E = 1,160 Kgm^2/s^2 (0,1869)

E = 0,2168 Kgm^2/s^2 = 0,2168 Joule

c) Menghitung Nilai Harga Impak (HI)

$$HI = \frac{E}{A0}$$

$$HI = \frac{0{,}2168 \text{ Joule}}{58{,}128\ mm^2}$$

$$HI = \frac{2168\ x\ 10^{-6} Kj}{58128\ x\ 10^{-6}\ m^2}$$

$$HI = 3{,}7\ \frac{Kj}{m^2}$$

3) Perhitungan Variasi ASN_3

Diketahui :

m = 0,514 Kg E_{serap} =

Cos α = 150° E_{serap} =

g = 9,81 m/s² A_o = 51,5088

A_o = 51,5088 x 10^{-6} = 0,0000515088 m²

a) Menghitung Nilai Cos β

E = m.g.R (Cos β - Cos α)

0,3036 Kgm²/s² = 0,514 kg . 9,81 m/s² . 0,23 m (Cos β – (-0,866))

0,3036 Kgm²/s² = 1,160 kgm²/s² (Cos β – (-0,866))

0,3036 Kgm²/s² = 1,160 kgm²/s² . (Cos β + 1,00456 kgm²/s²

1,160 kgm²/s² . Cos β + 1,00456 kgm²/s² = 0,3036 Kgm²/s²

1,160 kgm²/s² . Cos β = 0,3036 Kgm²/s² - 1,00456 kgm²/s²

1,160 kgm²/s² . Cos β = -0,7009

$$\text{Cos } \beta = \frac{-0{,}7009 \text{ kgm}^2/\text{s}^2}{1{,}160 \text{ kgm}^2/\text{s}^2}$$

Cos β = -0,6042

Cos β = 127°

b) Menghitung Nilai Eserap

E = m.g.R (Cos β – Cos α)

E = 0,514 Kg . 9,81 m/s² . 0,23 m ((-0,6042) - (-0,866))

E = 1,160 Kgm²/s² (0,2618)

E = 0,3036 Kgm²/s² = 0,3036 Joule

c) Menghitung Nilai Harga Impak (HI)

$$HI = \frac{E}{A_0}$$

$$HI = \frac{0{,}3036\ Joule}{51{,}5088\ mm^2}$$

$$HI = \frac{3036\ x\ 10^{-6}\ Kj}{515088\ x\ 10^{-6}\ m^2}$$

$$HI = 5{,}8\ \frac{Kj}{m^2}$$

3.1 Lampiran Lampiran Data Pengujian Struktur Mikro

LABORATORIUM MATERIAL TEKNIK MESIN
WORKSHOP FAKULTAS TEKNIK
UNIVERSITAS ISLAM "45" BEKASI
Jl. Cut Meutia No. 83 Bekasi 17113 Telp. (021)8802015, 8801027 Ged. Workshop

LAPORAN PENGUJIAN

Tanggal : Bekasi, 26 Juni 2024

Nama Pelanggan	: **ABU BAKAR FATTAH**
Asal Institusi	: Mahasiswa Teknik Mesin Srata1 UNISMA Bekasi.
NPM	: 411870012000036.
Kontak Person	: Akhmad Hanif H., A.Md. (0812-2708-3714).
Nama Sampel	: Komposit serat nanas *woven fibre*.
Penerimaan Sampel	: 26 Juni 2024.
Tanggal Pengujian	: 26 Juni 2024.
Jenis Pengujian	: Metalografi

LABORATORIUM MATERIAL TEKNIK MESIN
WORKSHOP FAKULTAS TEKNIK
UNIVERSITAS ISLAM "45" BEKASI
Jl. Cut Meutia No. 83 Bekasi 17113 Telp. (021)8802015, 8801027 Ged. Workshop

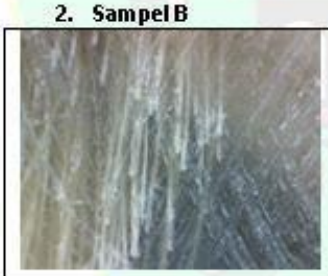
HASIL PENGUJIAN

Pengambilan Gambar Citra Mikroskop Pembesaran 300x

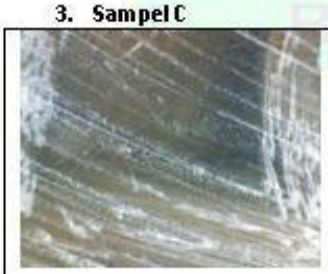
1. **Sampel A**

	
Pic 1. 0-45	Pic2. potongan

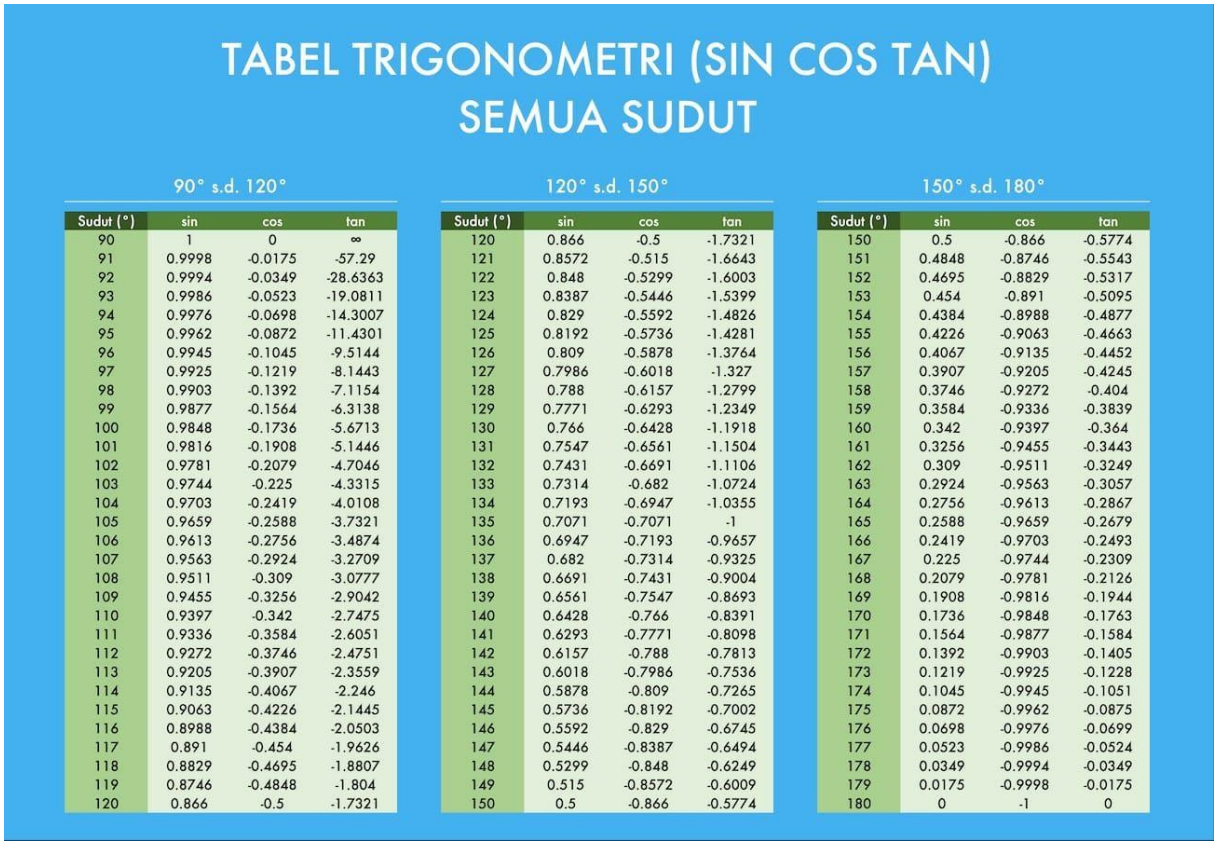
2. **Sampel B**

	
Pic 1. 45-90	Pic2. potongan

3. **Sampel C**

	
Pic 1. 0-90	Pic2. potongan

3.2 Lampiran Tabel Trigonometri



TABEL TRIGONOMETRI (SIN COS TAN)
SEMUA SUDUT

90° s.d. 120°

Sudut (°)	sin	cos	tan
90	1	0	∞
91	0.9998	-0.0175	-57.29
92	0.9994	-0.0349	-28.6363
93	0.9986	-0.0523	-19.0811
94	0.9976	-0.0698	-14.3007
95	0.9962	-0.0872	-11.4301
96	0.9945	-0.1045	-9.5144
97	0.9925	-0.1219	-8.1443
98	0.9903	-0.1392	-7.1154
99	0.9877	-0.1564	-6.3138
100	0.9848	-0.1736	-5.6713
101	0.9816	-0.1908	-5.1446
102	0.9781	-0.2079	-4.7046
103	0.9744	-0.225	-4.3315
104	0.9703	-0.2419	-4.0108
105	0.9659	-0.2588	-3.7321
106	0.9613	-0.2756	-3.4874
107	0.9563	-0.2924	-3.2709
108	0.9511	-0.309	-3.0777
109	0.9455	-0.3256	-2.9042
110	0.9397	-0.342	-2.7475
111	0.9336	-0.3584	-2.6051
112	0.9272	-0.3746	-2.4751
113	0.9205	-0.3907	-2.3559
114	0.9135	-0.4067	-2.246
115	0.9063	-0.4226	-2.1445
116	0.8988	-0.4384	-2.0503
117	0.891	-0.454	-1.9626
118	0.8829	-0.4695	-1.8807
119	0.8746	-0.4848	-1.804
120	0.866	-0.5	-1.7321

120° s.d. 150°

Sudut (°)	sin	cos	tan
120	0.866	-0.5	-1.7321
121	0.8572	-0.515	-1.6643
122	0.848	-0.5299	-1.6003
123	0.8387	-0.5446	-1.5399
124	0.829	-0.5592	-1.4826
125	0.8192	-0.5736	-1.4281
126	0.809	-0.5878	-1.3764
127	0.7986	-0.6018	-1.327
128	0.788	-0.6157	-1.2799
129	0.7771	-0.6293	-1.2349
130	0.766	-0.6428	-1.1918
131	0.7547	-0.6561	-1.1504
132	0.7431	-0.6691	-1.1106
133	0.7314	-0.682	-1.0724
134	0.7193	-0.6947	-1.0355
135	0.7071	-0.7071	-1
136	0.6947	-0.7193	-0.9657
137	0.682	-0.7314	-0.9325
138	0.6691	-0.7431	-0.9004
139	0.6561	-0.7547	-0.8693
140	0.6428	-0.766	-0.8391
141	0.6293	-0.7771	-0.8098
142	0.6157	-0.788	-0.7813
143	0.6018	-0.7986	-0.7536
144	0.5878	-0.809	-0.7265
145	0.5736	-0.8192	-0.7002
146	0.5592	-0.829	-0.6745
147	0.5446	-0.8387	-0.6494
148	0.5299	-0.848	-0.6249
149	0.515	-0.8572	-0.6009
150	0.5	-0.866	-0.5774

150° s.d. 180°

Sudut (°)	sin	cos	tan
150	0.5	-0.866	-0.5774
151	0.4848	-0.8746	-0.5543
152	0.4695	-0.8829	-0.5317
153	0.454	-0.891	-0.5095
154	0.4384	-0.8988	-0.4877
155	0.4226	-0.9063	-0.4663
156	0.4067	-0.9135	-0.4452
157	0.3907	-0.9205	-0.4245
158	0.3746	-0.9272	-0.404
159	0.3584	-0.9336	-0.3839
160	0.342	-0.9397	-0.364
161	0.3256	-0.9455	-0.3443
162	0.309	-0.9511	-0.3249
163	0.2924	-0.9563	-0.3057
164	0.2756	-0.9613	-0.2867
165	0.2588	-0.9659	-0.2679
166	0.2419	-0.9703	-0.2493
167	0.225	-0.9744	-0.2309
168	0.2079	-0.9781	-0.2126
169	0.1908	-0.9816	-0.1944
170	0.1736	-0.9848	-0.1763
171	0.1564	-0.9877	-0.1584
172	0.1392	-0.9903	-0.1405
173	0.1219	-0.9925	-0.1228
174	0.1045	-0.9945	-0.1051
175	0.0872	-0.9962	-0.0875
176	0.0698	-0.9976	-0.0699
177	0.0523	-0.9986	-0.0524
178	0.0349	-0.9994	-0.0349
179	0.0175	-0.9998	-0.0175
180	0	-1	0