

BAB VI

KESIMPULAN DAN SARAN

6.1 Kesimpulan

Berdasarkan hasil penelitian yang telah dilakukan, maka dapat ditarik kesimpulan sebagai berikut :

1. Perbandingan rasio aktivator ($\text{Na}_2\text{SiO}_3/\text{NaOH}$) juga sangat berpengaruh pada kuat mekanik beton geopolimer. Semakin tinggi perbandingan rasio ($\text{Na}_2\text{SiO}_3/\text{NaOH}$) tidak selalu menghasilkan kuat tekan yang tinggi. Pernyataan tersebut dibuktikan dari hasil penelitian pada molaritas larutan NaOH 8M, 10M, dan 12M dengan rasio aktivator 4 : 2 berturut-turut mempunyai kuat tekan sebesar 37,92 MPa, 32,38 MPa, dan 28,76 MPa dan modulus elastisitas berturut-turut sebesar 28238.38 MPa, 25673.49 MPa, dan 24556.03 MPa yang cukup tinggi dibandingkan rasio aktivator 5 : 2 berturut-turut sebesar 31.13 MPa, 32.89 MPa, dan 30.41 MPa untuk kuat tekannya dan 25312.34 MPa, 26111.80 MPa, dan 25145.51 MPa untuk modulus elastisitasnya. Untuk kuat tarik belah pada molaritas larutan NaOH 8M, 10M, dan 12M dengan rasio aktivator 4 : 2 berturut-turut sebesar 4.11 MPa, 4.41 MPa, dan 4.55 MPa dan untuk molaritas larutan NaOH 8M, 10M, dan 12M dengan rasio aktivator 5 : 2 berturut-turut sebesar 4.05 MPa, 4.95 MPa, dan 4.56 MPa.
2. Pengaruh molaritas aktivator alkali menunjukkan bahwa pada perbandingan rasio aktivator 5 : 2 diperoleh hasil tertinggi kuat tekan dan modulus elastisitas

yang menggunakan molaritas larutan NaOH 10M yaitu sebesar 32.89 MPa dan 26111.80 MPa kemudian pada perbandingan rasio aktivator 4 : 2 diperoleh hasil tertinggi kuat tekan dan modulus elastisitas yang menggunakan molaritas larutan NaOH 8M yaitu sebesar 37,92 MPa dan 28238.38 MPa. Dari kedua hasil tertinggi tersebut diperoleh hasil paling tinggi diperoleh pada molaritas larutan NaOH 8M dengan rasio aktivator 4 : 2 dan dapat direkomendasikan untuk beton struktural.

3. Perbandingan pengaruh penggunaan limbah terak baja (*Steel Slag*) dengan penelitian Risdanareni dkk (2014) menunjukkan bahwa beton geopolimer dengan terak baja (*Steel Slag*) menghasilkan kuat mekanik lebih besar maksimal 28%.

6.2 Saran

Saran yang dapat penulis berikan setelah melakukan penelitian ini adalah sebagai berikut :

1. Direkomendasikan untuk melakukan penelitian dengan molaritas lebih dari 12M untuk mengetahui hasil selanjutnya.
2. Pembuatan beton geopolimer harus lebih memperhatikan proses pengadukan dan pemadatan supaya adukan lebih merata dan beton yang dimasukkan ke silinder lebih padat dan pampat lagi.

3. Walaupun kuat tekan beton sudah lumayan baik tetapi *workability*-nya kurang baik. Maka pada penelitian selanjutnya disarankan untuk menambahkan bahan yang bisa memperbaiki *workability*-nya.



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PENGUJIAN BERAT JENIS *FLY ASH*

- I. Waktu Pemeriksaan : 17 Mei 2019
- II. Bahan
- a. Fly Ash type F : PLTU Tanjung Jati B Jepara

| Pemeriksaan | Berat (gram) |
|---|--------------|
| Berat <i>fly ash</i> (W_1) | 5,178 |
| Berat fly ash + minyak tanah + labu takar (W_2) | 74,423 |
| Berat labu takar + minyak tanah (W_3) | 71,047 |

Maka berat jenis *fly ash* dapat dihitung dengan rumus :

$$\begin{aligned}
 \text{Berat jenis } fly \text{ ash} &= \frac{0,8 \times W_1}{W_1 + W_3 - W_2} \\
 &= \frac{0,8 \times 5,178}{5,178 + 71,047 - 74,423} \\
 &= 2,298 \text{ gram/cc}
 \end{aligned}$$

Kesimpulan :

- Berat jenis fly ash yang didapat dalam pengujian ini adalah 2,298 gram/cc.



UNIVERSITAS ATMA JAYA YOGYAKARTA

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PENGUJIAN KANDUNGAN KIMIA FLY ASH



LEMBAGA ILMU PENGETAHUAN INDONESIA
BALAI PENELITIAN TEKNOLOGI BAHAN ALAM
LABORATORIUM PENGUJIAN

Jln. Jogja-Wonosari Km 31.5, Gading, Playen, Gunungkidul, Yogyakarta
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Laporan Hasil Uji

Laporan No. : 70/LHU/BPTBA/IV/2019

Data Pelanggan

Nama : Trevi Arga

Institusi : Universitas Atmajaya Yogyakarta

Alamat : Jl. Jangkarbumi Blok F Puluhdadi Rt/Rw 005/002 Caturtunggal Depok

Jumlah Sampel Uji : 1 (satu)

Nama Sampel Uji : Abu Flyas

Tanggal Penerimaan : 30 April 2019

Tanggal Pengujian : 30 April 2019

Parameter Uji : SEM - EDX
: *Instruction Manual for Model SU3500 Scanning Electron Microscope*

Acuan Standar

Hasil Pengujian : Hasil pengujian tersimpan dalam CD dengan nomor "70/LHU/BPTBA/IV/2019".

Gunungkidul, 30 April 2019

Manajer Teknik
Laboratorium Pengujian
BPTBA LIPI



"Laporan hasil uji merupakan hasil pengukuran, analisa dari sampel yang hanya disebutkan dalam dokumen ini serta tidak diperbolehkan mengubah, menggandakan atau mendistribusikan sebagian atau keseluruhan dari laporan hasil uji ini dalam segala bentuk untuk kepentingan apapun juga tanpa persetujuan tertulis dari Manajer Mutu Laboratorium Pengujian BPTBA LIPI"



PENGUJIAN KANDUNGAN LUMPUR AGREGAT HALUS

- I. Waktu Pemeriksaan : 11 April 2019
- II. Bahan
- b. Pasir Kering Tungku, asal: Kali Progo, berat : 100,00 gram
- c. Air Jernih, asal : LSBB Prodi TS FT - UAJY
- III. Alat
- a. Gelas Ukur, ukuran : 250 cc
- b. Timbangan
- c. Tungku (oven), suhu antara 105 – 110⁰C
- IV. Pasir + Piring Masuk Tungku
- V. Hasil
- Pasir + Piring Keluar Tungku
- a. Berat Pasir : 93,48 gram
- Kandungan Lumpur : $\frac{100,00 - 93,48}{100,00} \times 100\%$
- : 6,52%

Kesimpulan : Kandungan lumpur 6,52% > 5%, maka syarat tidak terpenuhi. Pasir harus dicuci terlebih dahulu.



PENGUJIAN KANDUNGAN ZAT ORGANIK AGREGAT HALUS

I. Waktu Pemeriksaan : 11 April 2019

II. Bahan

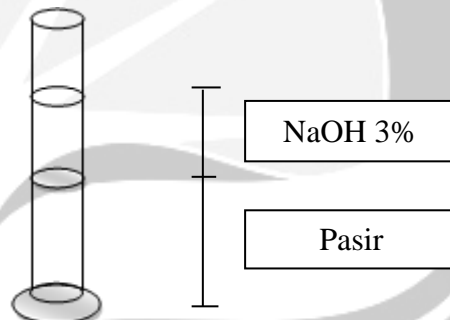
d. Pasir Kering Tungku, asal : Kali Progo

e. Larutan NaOH 3%

III. Alat

d. Gelas Ukur, ukuran : 250 cc

IV. Sketsa



V. Hasil

Setelah didiamkan selama 24 jam, warna larutan di atas pasir sesuai dengan *Gardner Standart Colour*.

Kesimpulan : Warna *Gardner Standart Colour* No. 5, maka dapat disimpulkan pasir tersebut baik digunakan.



PENGUJIAN BERAT JENIS DAN PENYERAPAN AGREGAT HALUS

- I. Waktu Pemeriksaan : 11 April 2019
- II. Bahan : Pasir
- III. Asal : Kali Progo
- IV. Lokasi Pengujian : Laboratorium Struktur dan Bahan Bangunan (LSBB), Jurusan Teknik Sipil, Universitas Atma Jaya, Yogyakarta

| Pengujian Berat Jenis & Penyerapan Agregat Halus | | |
|---|---------|--------------------|
| Berat Kering Pasir Dalam Oven (A) | 489,97 | gr |
| Berat Labu Ukur + Air | 706,2 | gr |
| Berat Labu Ukur + Air + Pasir | 1012,01 | gr |
| Berat Pasir | 500 | gr |
| ↓ | | |
| Berat Jenis Bulk | 2,523 | gr/cm ³ |
| Berat Jenis SSD | 2,575 | gr/cm ³ |
| Berat Jenis Semu (<i>Apparent</i>) | 2,661 | gr/cm ³ |
| Penyerapan (<i>Absorption</i>) | 2,047 | % |

Kesimpulan : Berat jenis agregat halus (Pasir) 2,592 gram/cm³ dan penyerapan agregat halus (Pasir) 2,047%. Maka berat jenis dan penyerapan agregat halus memenuhi syarat.



PENGUJIAN ANALISIS SARINGAN AGREGAT HALUS

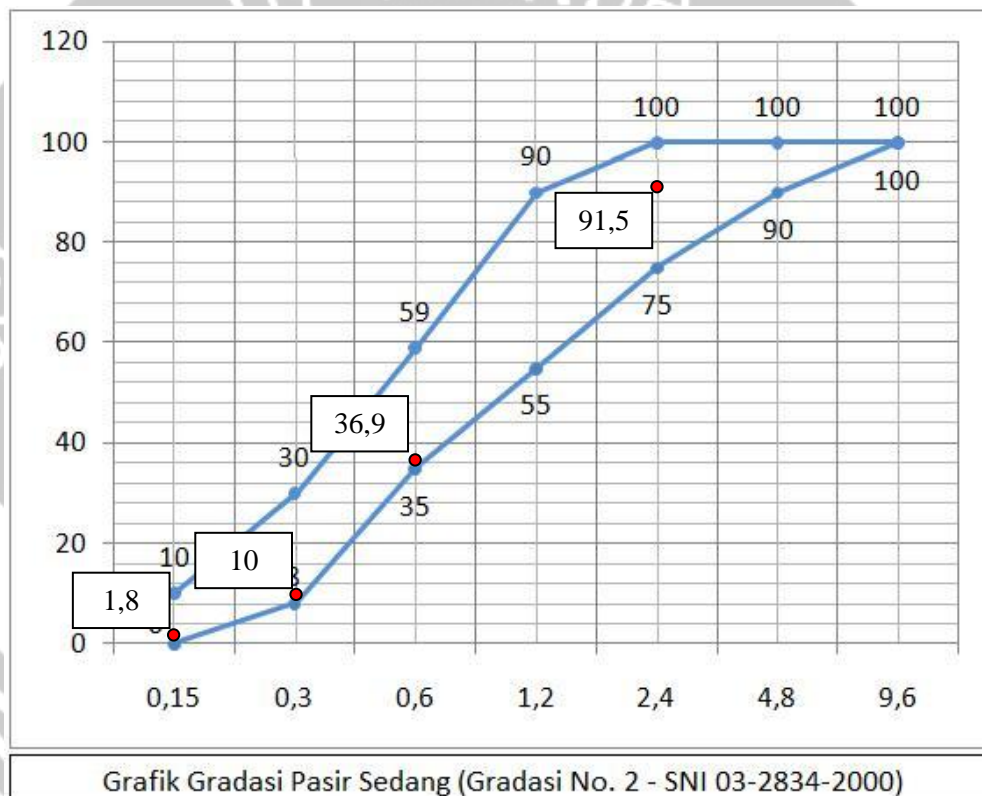
- I. Waktu Pemeriksaan : 11 April 2019
- II. Bahan : Pasir
- III. Asal : Kali Progo
- IV. Lokasi Pengujian : Laboratorium Struktur dan Bahan Bangunan (LSBB), Jurusan Teknik Sipil, Universitas Atma Jaya, Yogyakarta.

| Ayakan | Berat Saringan | Berat Saringan + Pasir | Berat Pasir | Kumulatif | % Tertahan | % Lolos |
|----------------|----------------|------------------------|-------------|-----------|------------|---------|
| 3/8" (9,52mm) | 543 | 543 | 0 | 0 | 0 | 100 |
| No.4(4,75 mm) | 507 | 507 | 0 | 0 | 0 | 100 |
| No.8(2,36 mm) | 329 | 414 | 85 | 85 | 8,5 | 91,5 |
| No.30(0,60mm) | 402 | 948 | 546 | 631 | 63,1 | 36,9 |
| No.50(0,30mm) | 373 | 642 | 269 | 900 | 90 | 10 |
| No.100(0,15mm) | 289 | 371 | 82 | 982 | 98,2 | 1,8 |
| Pan | 369 | 387 | 18 | 1000 | 100 | 0 |

Kesimpulan : Dari data diatas maka didapat nilai MHB (Modulus Halus Butir) sebesar 3,598. Berdasarkan SK SNI S-04-1989-F (Spesifikasi Bahan Bangunan Bagian A), maka nilai MHB agregat halus tersebut memenuhi syarat karena berada pada kisaran 1,50 – 3,80 (OK).



Berdasarkan data analisis saringan tersebut, maka dapat ditentukan untuk daerah golongan pasirnya. Untuk menentukan pasir tersebut termasuk di golongan pasir berapa, dapat dilihat pada grafik di bawah ini.



Setelah angka %lolos saringan dimasukkan ke dalam grafik di atas, maka dapat disimpulkan bahwa agregat halus tersebut termasuk ke dalam pasir golongan 2.



PENGUJIAN BERAT JENIS DAN PENYERAPAN AGREGAT HALUS (*STEEL SLAG*)

- I. Waktu Pemeriksaan : 11 April 2019
- II. Bahan : Terak Baja (*Steel Slag*)
- III. Asal : Batur Ceper, Klaten
- IV. Lokasi Pengujian : Laboratorium Struktur dan Bahan Bangunan (LSBB), Jurusan Teknik Sipil, Universitas Atma Jaya, Yogyakarta

| Pengujian Berat Jenis & Penyerapan Agregat Halus | | |
|---|------|----|
| Berat Kering Pasir Dalam Oven (A) | 487 | gr |
| Berat Labu Ukur + Air | 702 | gr |
| Berat Labu Ukur + Air + Terak Baja | 1052 | gr |
| Berat Terak Baja | 500 | gr |



| | | |
|--|--------|--------------------|
| Berat Jenis Bulk | 3,082 | gr/cm ³ |
| Berat Jenis SSD | 3,215 | gr/cm ³ |
| Berat Jenis Semu (<i>Apparent</i>) | 3,555 | gr/cm ³ |
| Penyerapan (<i>Absorption</i>) | 2,669 | % |
| Berat Jenis Agregat Halus (Terak Baja) | 3,3185 | gr/cm ³ |

Kesimpulan : Berat jenis agregat halus (Terak Baja) 3,3185 gram/cm³ dan penyerapan agregat halus (Terak Baja) 2,669%. Maka berat jenis dan penyerapan agregat halus memenuhi syarat.



PENGUJIAN BERAT JENIS DAN PENYERAPAN AGREGAT KASAR (*STEEL SLAG*)

- I. Waktu Pemeriksaan : 12 April 2019
- II. Bahan : Terak Baja (*Steel Slag*)
- III. Asal : Batur Ceper, Klaten
- IV. Lokasi Pengujian : Laboratorium Struktur dan Bahan
Bangunan (LSBB), Jurusan Teknik Sipil,
Universitas Atma Jaya, Yogyakarta

| | NOMOR PEMERIKSAAN | I |
|---|---|--------|
| A | Berat Contoh Kering | 995 |
| B | Berat Contoh Jenuh Kering Permukaan (SSD) | 1007 |
| C | Berat Contoh Dalam Air | 738 |
| D | Berat Jenis Bulk $= \frac{(A)}{(B) - (C)}$ | 3,699 |
| E | BJ.Jenuh Kering Permukaan (SSD) $= \frac{(B)}{(B) - (C)}$ | 3,743 |
| F | Berat Jenis Semu (Apparent) $= \frac{(A)}{(A) - (C)}$ | 3,872 |
| G | Penyerapan (Absorption) $= \frac{(B) - (A)}{(A)} \times 100 \%$ | 1,206% |
| H | Berat Jenis Terak Baja (<i>Steel Slag</i>) | 3,7855 |

PERSYARATAN MENURUT SNI 1969-2008 :

- Absorption : 3%
- Berat Jenis : > 2,8



**PENGUJIAN KEAUSAN AGREGAT KASAR DENGAN MESIN LOS
ANGELES ABRATION**

- I. Waktu Pemeriksaan : 12 April 2019
- II. Bahan : Terak Baja (*Steel Slag*)
- III. Asal : Batur Ceper, Klaten
- IV. Lokasi Pengujian : Laboratorium Transportasi, Jurusan Teknik Sipil, Fakultas Teknik, Universitas Atma Jaya Yogyakarta.

| Gradasi Saringan | | Nomor Contoh | |
|------------------|----------|----------------------|----------------------|
| | | I | II |
| Lolos | Tertahan | Berat Setiap Agregat | Berat Setiap Agregat |
| 3/4" | 1/2" | 2500 | - |
| 1/2" | 3/8" | 2500 | - |

| Nomor Contoh | | I |
|--------------------------------------|-------------------------|-----------|
| Berat Sebelumnya | (A) | 5000 gram |
| Berat Sesudah Diayak Saringan No. 12 | (B) | 4105 gram |
| Berat Sesudah | (A) - (B) | 895 gram |
| Keausan | $\frac{(A) - (B)}{(A)}$ | 17,9 % |

Kesimpulan : Keausan Agregat didapat sebesar $17,9\% \leq 40\%$, memenuhi syarat
(OK).

| UKURAN SARINGAN | | BERAT AGREGAT | | | |
|------------------|----------|---------------|------|------|------|
| LOLOS | TERTAHAN | A | B | C | D |
| 1 1/2" | 1" | 1250 | - | - | - |
| 1" | 3/4" | 1250 | - | - | - |
| 3/4" | 1/2" | 1250 | 2500 | - | - |
| 1/2" | 3/8" | 1250 | 2500 | - | - |
| 3/8" | 1/4" | - | - | 2500 | - |
| 1/4" | No. 4 | - | - | 2500 | - |
| No. 4 | No. 8 | - | - | - | 5000 |
| TOTAL | | 5000 | 5000 | 5000 | 5000 |
| JUMLAH BOLA BAJA | | 12 | 11 | 8 | 6 |



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PENGUJIAN KANDUNGAN KIMIA STEEL SLAG



UPT LABORATORIUM

HASIL ANALISIS

NOMOR KODE LAB : LS.24.05.19/351
NAMA PEMOHON : Mustika Adi Sukma
JENIS ANALISIS : Kadar Lengan, Al₂O₃, MgO, SO₃, K₂O, Na₂O, LOI
 SiO₂ dan CaO
JUMLAH SAMPEL : 3
TANGGAL MASUK : 24 Mei 2019
TANGGAL PENGUJIAN : 12 Juni -1 Juli 2019

| NO | Kode Sampel | Kadar Lengan | LOI | Al ₂ O ₃ | MgO | SO ₃ |
|----|-------------|--------------|------|---|-------|-----------------|
| | | | | Ekstrak HNO ₃ +HClO ₄ | | |
| 1 | Semen | 0,510 | 0,78 | 11,43 | 1,44 | 0,43 |
| 2 | sleet slag | 0,260 | 0,91 | 10,90 | 1,25 | 0,33 |
| 3 | GGBFS | 8,770 | 0,88 | 15,38 | 12,36 | 0,41 |

| NO | Kode Sampel | K ₂ O | Na ₂ O | SiO ₃ | CaO |
|----|-------------|------------------|-------------------|---|------|
| | | | | Ekstrak HNO ₃ +HClO ₄ | |
| 1 | Semen | 0,62 | 1,01 | 31,08 | 0,81 |
| 2 | sleet slag | 0,51 | 0,09 | 34,21 | 1,36 |
| 3 | GGBFS | 0,46 | 1,21 | 25,8 | 0,52 |

Ka.UPT.Laboratorium&Perpustakaan

Dr.Ir. Candra Ginting, MP.

Yogyakarta, 4 Juli 2019

Ka Bag UPT Lab

Roostriyanti



PENGUJIAN BERAT JENIS DAN PENYERAPAN AGREGAT KASAR

- I. Waktu Pemeriksaan : 12 April 2019
- II. Bahan : Kerikil / *Split* (Ukuran 10 mm)
- III. Asal : Clereng
- IV. Lokasi Pengujian : Laboratorium Struktur dan Bahan
Bangunan (LSBB), Jurusan Teknik Sipil,
Universitas Atma Jaya, Yogyakarta

| NOMOR PEMERIKSAAN | | I |
|-------------------|---|---------|
| A | Berat Contoh Kering | 988 |
| B | Berat Contoh Jenuh Kering Permukaan (SSD) | 1012 |
| C | Berat Contoh Dalam Air | 625 |
| D | Berat Jenis Bulk $= \frac{(A)}{(B) - (C)}$ | 2,5529 |
| E | BJ.Jenuh Kering Permukaan (SSD) $= \frac{(B)}{(B) - (C)}$ | 2,6149 |
| F | Berat Jenis Semu (Apparent) $= \frac{(A)}{(A) - (C)}$ | 2,7217 |
| G | Penyerapan (Absorption) $= \frac{(B) - (A)}{(A)} \times 100 \%$ | 2,4291% |
| H | Berat Jenis Kerikil (Ukuran 10 mm) | 2,6373% |

PERSYARATAN MENURUT SNI 1969-2008 :

- Absorption : 3%
- Berat Jenis : 2,5 – 2,7



PENGUJIAN ANALISIS SARINGAN AGREGAT KASAR

- I. Waktu Pemeriksaan : 12 April 2019
- II. Bahan : Kerikil/*Split* (Ukuran 10 mm)
- III. Asal : Clereng
- IV. Lokasi Pengujian : Laboratorium Transportasi , Jurusan
Teknik Sipil, Universitas Atma Jaya,
Yogyakarta

| Ayakan | Berat Saringan | Berat Saringan + Kerikil | Berat Kerikil | Kumulatif | % Tertahan | % Lolos |
|--------|----------------|--------------------------|---------------|-----------|------------|---------|
| 3/4" | 570 | 644 | 74 | 74 | 7,4 | 92,6 |
| 1/2" | 448 | 1225 | 777 | 851 | 85,1 | 14,9 |
| 3/8" | 543 | 690 | 147 | 998 | 99,8 | 0,2 |
| No.4 | 508 | 510 | 2 | 1000 | 100 | 0 |
| No.8 | 329 | 0 | 0 | 1000 | 100 | 0 |
| No.30 | 402 | 0 | 0 | 1000 | 100 | 0 |
| No.50 | 373 | 0 | 0 | 1000 | 100 | 0 |
| No.100 | 284 | 0 | 0 | 1000 | 100 | 0 |
| PAN | 369 | 0 | 0 | 1000 | 100 | 0 |

Kesimpulan : Dari data diatas maka didapat nilai MHB (Modulus Halus Butir) sebesar 7,923. Berdasarkan SK SNI S-04-1989-F (Spesifikasi Bahan Bangunan Bagian A), maka nilai MHB agregat kasar tersebut memenuhi syarat karena berada pada kisaran 6,00 – 8,00 (OK).



**PENGUJIAN KEAUSAN AGREGAT KASAR DENGAN MESIN LOS
ANGELES ABRATION**

- I. Waktu Pemeriksaan : 12 April 2019
- II. Bahan : Kerikil/*Split* (Ukuran 10 mm)
- III. Asal : Clereng
- IV. Lokasi Pengujian : Laboratorium Transportasi, Jurusan Teknik Sipil, Fakultas Teknik, Universitas Atma Jaya Yogyakarta.

| Gradasi Saringan | | Nomor Contoh | |
|------------------|----------|----------------------|----------------------|
| | | I | II |
| Lolos | Tertahan | Berat Setiap Agregat | Berat Setiap Agregat |
| 3/4" | 1/2" | 2500 | - |
| 1/2" | 3/8" | 2500 | - |

| Nomor Contoh | | I |
|--------------------------------------|-------------------------|-----------|
| Berat Sebelumnya | (A) | 5000 gram |
| Berat Sesudah Diayak Saringan No. 12 | (B) | 3836 gram |
| Berat Sesudah | (A) - (B) | 1164 gram |
| Keausan | $\frac{(A) - (B)}{(A)}$ | 23,28 % |

Kesimpulan : Keausan Agregat didapat sebesar $23,28\% \leq 40\%$, memenuhi syarat
(OK).

| UKURAN SARINGAN | | BERAT AGREGAT | | | |
|------------------|----------|---------------|------|------|------|
| LOLOS | TERTAHAN | A | B | C | D |
| 1 1/2" | 1" | 1250 | - | - | - |
| 1" | 3/4" | 1250 | - | - | - |
| 3/4" | 1/2" | 1250 | 2500 | - | - |
| 1/2" | 3/8" | 1250 | 2500 | - | - |
| 3/8" | 1/4" | - | - | 2500 | - |
| 1/4" | No. 4 | - | - | 2500 | - |
| No. 4 | No. 8 | - | - | - | 5000 |
| TOTAL | | 5000 | 5000 | 5000 | 5000 |
| JUMLAH BOLA BAJA | | 12 | 11 | 8 | 6 |



PENGUJIAN BERAT JENIS BETON GEOPOLIMER 28 HARI

| Kode | Berat Beton (kg) | Diameter (cm) | Tinggi (cm) | Luas Permukaan (cm ²) | BJ (kg/m ³) |
|----------------------|------------------|---------------|-------------|-----------------------------------|-------------------------|
| 8M 5 : 2 | 4.92 | 10.17 | 20.56 | 81.29 | 2943.92 |
| | 4.76 | 10.14 | 20.49 | 80.73 | 2877.44 |
| | 4.88 | 10.21 | 20.62 | 81.87 | 2891.08 |
| | 4.78 | 10.17 | 20.45 | 81.29 | 2876.00 |
| | 4.70 | 10.18 | 20.47 | 81.45 | 2819.56 |
| | 4.88 | 10.16 | 20.45 | 81.07 | 2943.40 |
| 8M 4 : 2 | 4.94 | 10.19 | 20.50 | 81.55 | 2954.37 |
| | 4.82 | 10.20 | 20.59 | 81.71 | 2864.84 |
| | 4.86 | 10.28 | 20.45 | 83.05 | 2861.44 |
| | 4.90 | 10.12 | 20.55 | 80.38 | 2965.85 |
| | 4.80 | 10.10 | 20.59 | 80.12 | 2909.26 |
| | 4.80 | 10.17 | 20.55 | 81.18 | 2876.81 |
| 10M 5 : 2 | 4.88 | 10.03 | 20.54 | 79.01 | 3007.45 |
| | 4.88 | 10.11 | 20.57 | 80.22 | 2957.19 |
| | 4.88 | 10.06 | 20.56 | 79.54 | 2984.65 |
| | 4.88 | 10.04 | 20.59 | 79.17 | 2994.17 |
| | 4.72 | 10.12 | 20.67 | 80.44 | 2839.36 |
| | 4.84 | 10.02 | 20.17 | 78.85 | 3043.09 |
| 10M 4 : 2 | 4.92 | 10.17 | 20.91 | 81.29 | 2894.18 |
| | 4.84 | 10.06 | 20.40 | 79.43 | 2987.36 |
| | 4.80 | 10.18 | 20.81 | 81.34 | 2836.21 |
| | 4.84 | 10.16 | 20.45 | 81.02 | 2920.71 |
| | 4.66 | 10.03 | 20.36 | 79.06 | 2894.39 |
| | 4.82 | 10.08 | 20.55 | 79.85 | 2937.22 |
| 12M 5 : 2 | 4.92 | 10.11 | 20.61 | 80.22 | 2976.13 |
| | 4.90 | 10.15 | 20.70 | 80.97 | 2924.07 |
| | 4.92 | 10.01 | 20.69 | 78.64 | 3023.68 |



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| | | | | | |
|----------------------|------|-------|-------|-------|---------|
| 12M 5 : 2 | 5.02 | 10.14 | 20.88 | 80.75 | 2977.67 |
| | 4.82 | 10.16 | 20.58 | 81.02 | 2891.21 |
| | 4.90 | 10.12 | 20.69 | 80.49 | 2942.38 |
| 12M 4 : 2 | 4.90 | 10.23 | 20.72 | 82.25 | 2874.83 |
| | 4.86 | 10.23 | 20.81 | 82.14 | 2842.74 |
| | 4.86 | 10.14 | 20.61 | 80.70 | 2921.99 |
| | 4.86 | 10.16 | 20.71 | 81.13 | 2892.17 |
| | 4.82 | 10.04 | 20.67 | 79.12 | 2947.39 |
| | 4.84 | 10.01 | 20.51 | 78.75 | 2996.63 |



PENGUJIAN KUAT TEKAN BETON GEOPOLIMER

Contoh Perhitungan

NM 2B – 28 Hari

$$P = 360 \text{ KN}$$

$$\text{Luas (A)} = \frac{1}{4} \pi d^2 = \frac{1}{4} \pi 105,7401 = 8305,35 \text{ mm}^2$$

$$f'c = \frac{P}{A} = \frac{360}{8305,35} \times 1000 = 43,35 \text{ MPa}$$

$$f'c = 43,35 \times 1,04 = 45,08 \text{ MPa}$$

**TABEL HASIL PERHITUNGAN KUAT TEKAN BETON GEOPOLIMER
28 HARI**

| Kode | | Luas (A) (mm ²) | Beban (KN) | Kuat Tekan f'c (Mpa) | Kuat Tekan f'c (Mpa) x 1,04 | Kuat Tekan Rerata |
|-----------|-------|-----------------------------|------------|----------------------|-----------------------------|-------------------|
| 8M (1) | 5 : 2 | 8128.61 | 215 | 26.45 | 27.51 | 31.13 |
| 8M (2) | | 8072.78 | 265 | 32.83 | 34.14 | |
| 8M (3) | | 8187.31 | 250 | 30.54 | 31.76 | |
| 8M (4) | | 8128.61 | 205 | 25.22* | 26.23* | |
| 10M (1) | 5 : 2 | 7901.18 | 295 | 37.34 | 38.83 | 32.89 |
| 10M (2) | | 8022.43 | 280 | 34.90 | 36.30 | |
| 10M (3) | | 7953.78 | 180 | 22.63 | 23.54 | |
| 10M (4) | | 7916.94 | 165 | 20.84* | 21.68* | |
| 12M (1) | 5 : 2 | 8022.43 | 185 | 23.06 | 23.98 | 30.41 |
| 12M (2) | | 8096.68 | 155 | 19.14* | 19.91* | |
| 12M (3) | | 7864.46 | 265 | 33.70 | 35.04 | |
| 12M (4) | | 8075.43 | 250 | 30.96 | 32.20 | |
| 8M (1) | 4 : 2 | 8155.27 | 285 | 34.95 | 36.34 | 37.92 |
| 8M (2) | | 8171.28 | 220 | 26.92* | 28.00* | |
| 8M (3) | | 8305.35 | 360 | 43.35 | 45.08 | |



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| | | | | | | |
|-----------|-------|---------|-----|--------|--------|-------|
| 8M (4) | 4 : 2 | 8038.31 | 250 | 31.10 | 32.35 | 32.38 |
| 10M (1) | | 8128.61 | 260 | 31.99 | 33.27 | |
| 10M (2) | | 7943.25 | 190 | 23.92 | 24.88 | |
| 10M (3) | | 8133.94 | 305 | 37.50 | 39.00 | |
| 10M (4) | | 8102.00 | 170 | 20.98* | 21.82* | 28.76 |
| 12M (1) | | 8224.78 | 100 | 12.16* | 12.64* | |
| 12M (2) | | 8214.06 | 250 | 30.44 | 31.65 | |
| 12M (3) | | 8070.12 | 220 | 27.26 | 28.35 | |
| 12M (4) | | 8112.64 | 205 | 25.27 | 26.28 | |

*Tidak diperhitungkan



PENGUJIAN MODULUS ELASTISITAS BETON GEOPOLIMER

PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER 8M (5 : 2) (2) – 28 HARI

| | |
|---------------------|---------------------------|
| Po | = 149,5 mm |
| Ao | = 8072,78 mm ² |
| Kuat tekan | = 32,83 MPa |
| 0,5 Beban minimum | = 0,5 x 265 = 132,5 KN |
| Modulus elastisitas | = 24163,709 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.6032 | 1.6722 | 1.5047 |
| 1000 | 9806.7 | 12.50 | 6.25 | 1.2064 | 4.1806 | 4.0130 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.8097 | 6.6890 | 6.5214 |
| 2000 | 19613.4 | 27.50 | 13.75 | 2.4129 | 9.1973 | 9.0298 |
| 2500 | 24516.75 | 37.50 | 18.75 | 3.0161 | 12.5418 | 12.3742 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.6193 | 15.0502 | 14.8826 |
| 3500 | 34323.45 | 52.50 | 26.25 | 4.2225 | 17.5585 | 17.3910 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.8258 | 20.0669 | 19.8993 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.4290 | 21.7391 | 21.5716 |
| 5000 | 49033.5 | 72.50 | 36.25 | 6.0322 | 24.2475 | 24.0799 |
| 5500 | 53936.85 | 82.50 | 41.25 | 6.6354 | 27.5920 | 27.4244 |
| 6000 | 58840.2 | 90.00 | 45.00 | 7.2387 | 30.1003 | 29.9328 |
| 6500 | 63743.55 | 95.00 | 47.50 | 7.8419 | 31.7726 | 31.6050 |
| 7000 | 68646.9 | 105.00 | 52.50 | 8.4451 | 35.1171 | 34.9495 |



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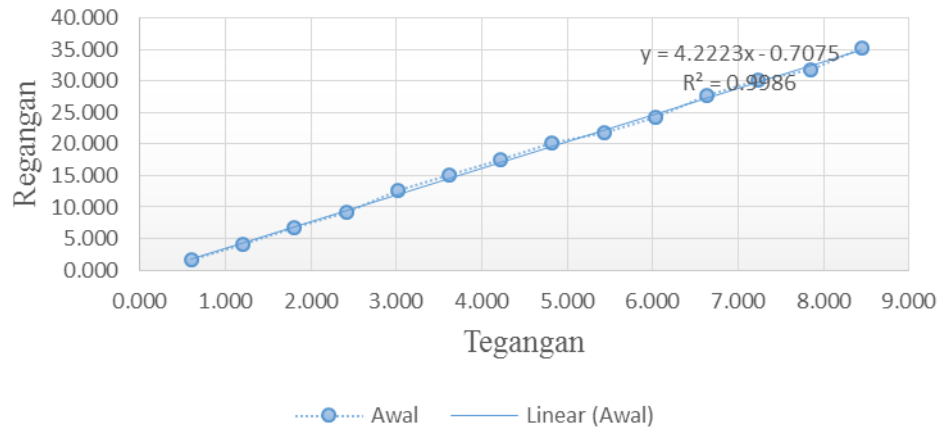
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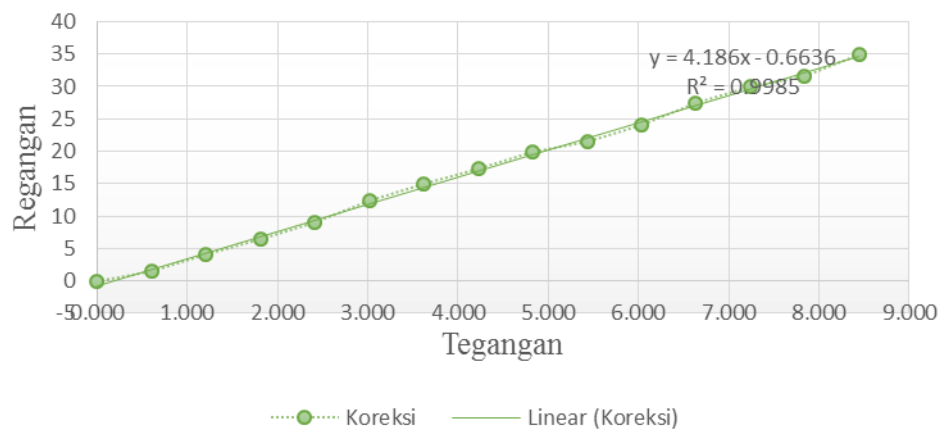
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Grafik Awal Modulus Elastisitas 8M (5 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 8M (5 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
8M (5 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 149,9 mm |
| Ao | = 8187,31 mm ² |
| Kuat tekan | = 30,54 MPa |
| 0,5 Beban minimum | = 0,5 x 250 = 125 KN |
| Modulus elastisitas | = 26719,821 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.6074 | 1.6678 | 1.8047 |
| 1000 | 9806.7 | 15.00 | 7.50 | 1.2148 | 5.0033 | 5.1402 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.8222 | 6.6711 | 6.8080 |
| 2000 | 19613.4 | 27.50 | 13.75 | 2.4296 | 9.1728 | 9.3097 |
| 2500 | 24516.75 | 37.50 | 18.75 | 3.0370 | 12.5083 | 12.6453 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.6444 | 15.0100 | 15.1469 |
| 3500 | 34323.45 | 50.00 | 25.00 | 4.2518 | 16.6778 | 16.8147 |
| 4000 | 39226.8 | 57.50 | 28.75 | 4.8591 | 19.1795 | 19.3164 |
| 4500 | 44130.15 | 62.50 | 31.25 | 5.4665 | 20.8472 | 20.9841 |
| 5000 | 49033.5 | 67.50 | 33.75 | 6.0739 | 22.5150 | 22.6519 |
| 5500 | 53936.85 | 75.00 | 37.50 | 6.6813 | 25.0167 | 25.1536 |
| 6000 | 58840.2 | 80.00 | 40.00 | 7.2887 | 26.6845 | 26.8214 |
| 6500 | 63743.55 | 87.50 | 43.75 | 7.8961 | 29.1861 | 29.3230 |
| 7000 | 68646.9 | 95.00 | 47.50 | 8.5035 | 31.6878 | 31.8247 |



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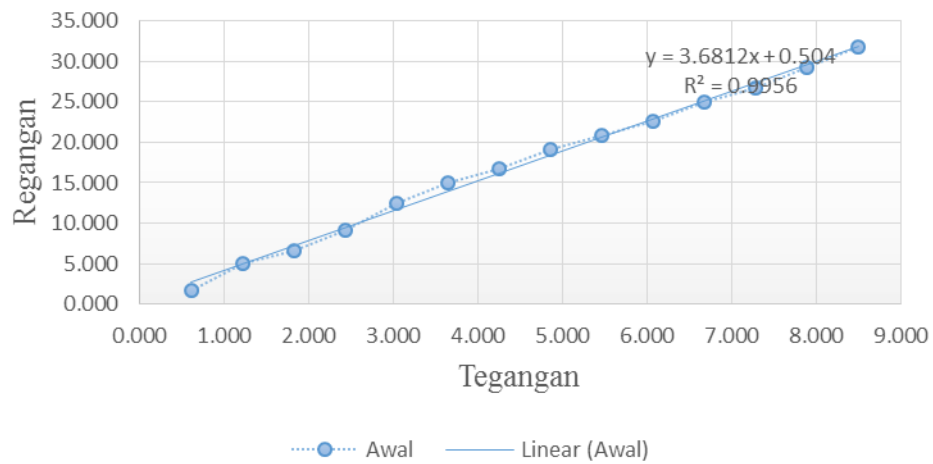
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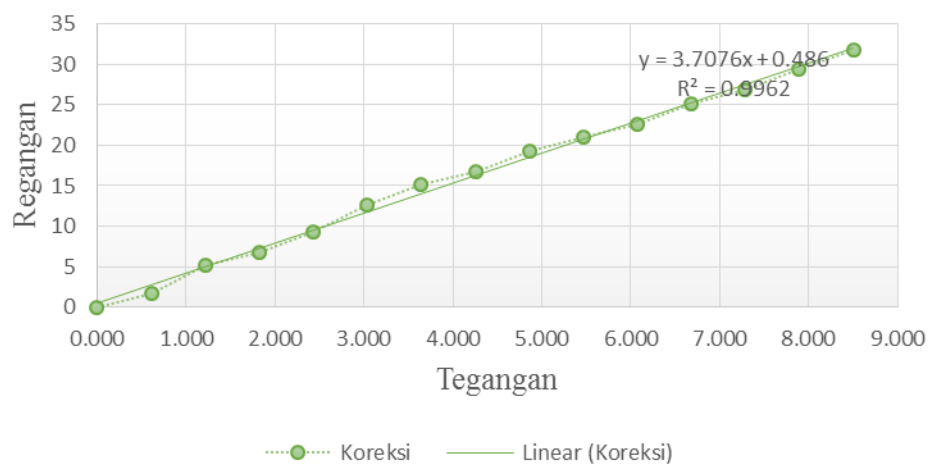
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Grafik Awal Modulus Elastisitas 8M (5 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 8M (5 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
8M (5 : 2) (4) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,2 mm |
| Ao | = 8128,61 mm ² |
| Kuat tekan | = 25,22 MPa |
| 0,5 Beban minimum | = 0,5 x 205 = 102,5 KN |
| Modulus elastisitas | = 25053,478 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 7.50 | 3.75 | 0.5989 | 2.4802 | 2.8780 |
| 1000 | 9806.7 | 17.50 | 8.75 | 1.1978 | 5.7870 | 6.1849 |
| 1500 | 14710.05 | 25.00 | 12.50 | 1.7967 | 8.2672 | 8.6650 |
| 2000 | 19613.4 | 35.00 | 17.50 | 2.3956 | 11.5741 | 11.9719 |
| 2500 | 24516.75 | 40.00 | 20.00 | 2.9945 | 13.2275 | 13.6253 |
| 3000 | 29420.1 | 47.50 | 23.75 | 3.5934 | 15.7077 | 16.1055 |
| 3500 | 34323.45 | 52.50 | 26.25 | 4.1923 | 17.3611 | 17.7589 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.7912 | 19.8413 | 20.2391 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.3901 | 21.4947 | 21.8925 |
| 5000 | 49033.5 | 72.50 | 36.25 | 5.9890 | 23.9749 | 24.3727 |
| 5500 | 53936.85 | 80.00 | 40.00 | 6.5879 | 26.4550 | 26.8528 |
| 6000 | 58840.2 | 85.00 | 42.50 | 7.1868 | 28.1085 | 28.5063 |
| 6500 | 63743.55 | 92.50 | 46.25 | 7.7857 | 30.5886 | 30.9864 |
| 7000 | 68646.9 | 100.00 | 50.00 | 8.3845 | 33.0688 | 33.4666 |



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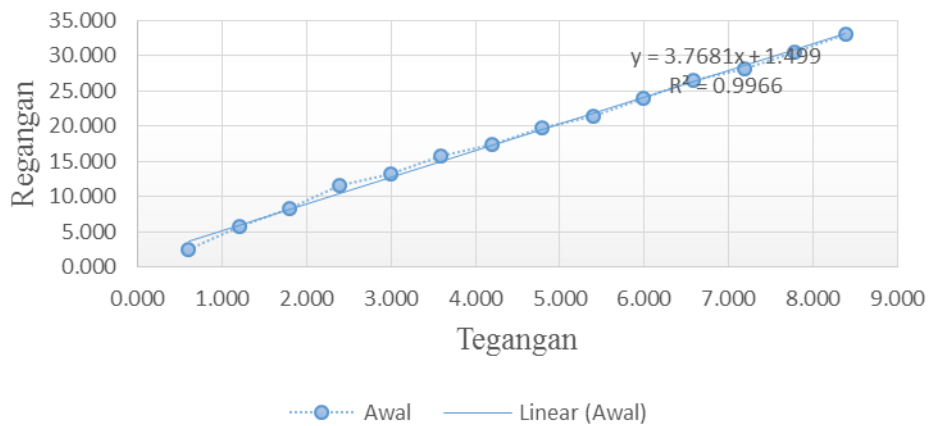
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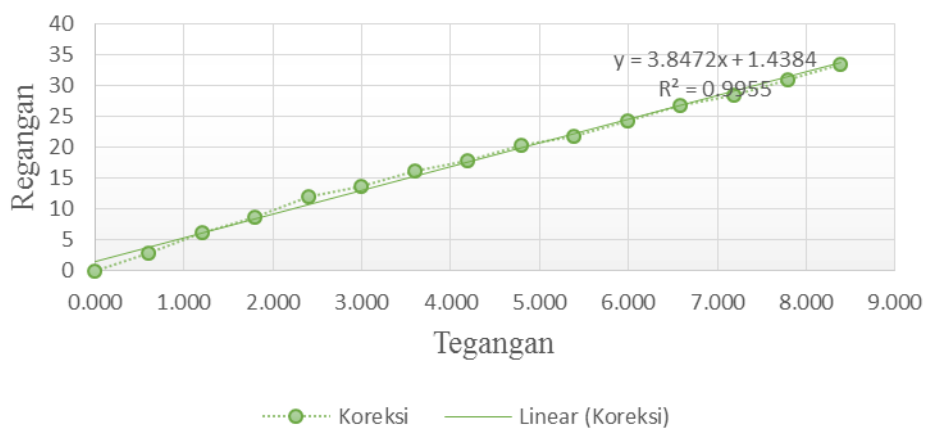
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Grafik Awal Modulus Elastisitas 8M (5 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 8M (5 : 2) No. 4





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
10M (5 : 2) (2) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,9 mm |
| Ao | = 8022,43 mm ² |
| Kuat tekan | = 34,9 MPa |
| 0,5 Beban minimum | = 0,5 x 280 = 140 KN |
| Modulus elastisitas | = 29217,308 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 2.50 | 1.25 | 0.6206 | 0.8229 | 0.2452 |
| 1000 | 9806.7 | 10.00 | 5.00 | 1.2412 | 3.2916 | 2.7139 |
| 1500 | 14710.05 | 15.00 | 7.50 | 1.8618 | 4.9375 | 4.3598 |
| 2000 | 19613.4 | 20.00 | 10.00 | 2.4823 | 6.5833 | 6.0056 |
| 2500 | 24516.75 | 27.50 | 13.75 | 3.1029 | 9.0520 | 8.4743 |
| 3000 | 29420.1 | 32.50 | 16.25 | 3.7235 | 10.6978 | 10.1201 |
| 3500 | 34323.45 | 45.00 | 22.50 | 4.3441 | 14.8124 | 14.2347 |
| 4000 | 39226.8 | 50.00 | 25.00 | 4.9647 | 16.4582 | 15.8805 |
| 4500 | 44130.15 | 57.50 | 28.75 | 5.5853 | 18.9269 | 18.3492 |
| 5000 | 49033.5 | 65.00 | 32.50 | 6.2058 | 21.3957 | 20.8179 |
| 5500 | 53936.85 | 70.00 | 35.00 | 6.8264 | 23.0415 | 22.4638 |
| 6000 | 58840.2 | 82.50 | 41.25 | 7.4470 | 27.1560 | 26.5783 |
| 6500 | 63743.55 | 90.00 | 45.00 | 8.0676 | 29.6248 | 29.0470 |
| 7000 | 68646.9 | 97.50 | 48.75 | 8.6882 | 32.0935 | 31.5158 |
| 7500 | 73550.25 | 100.00 | 50.00 | 9.3088 | 32.9164 | 32.3387 |
| 8000 | 78453.6 | 105.00 | 52.50 | 9.9294 | 34.5622 | 33.9845 |



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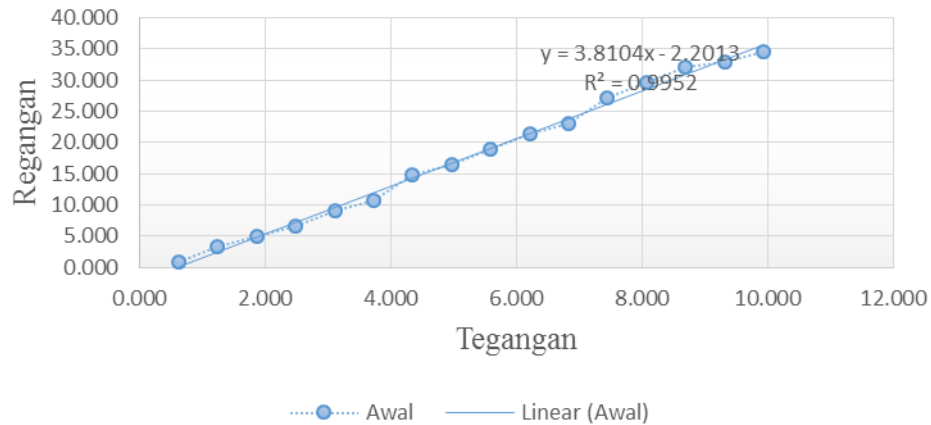
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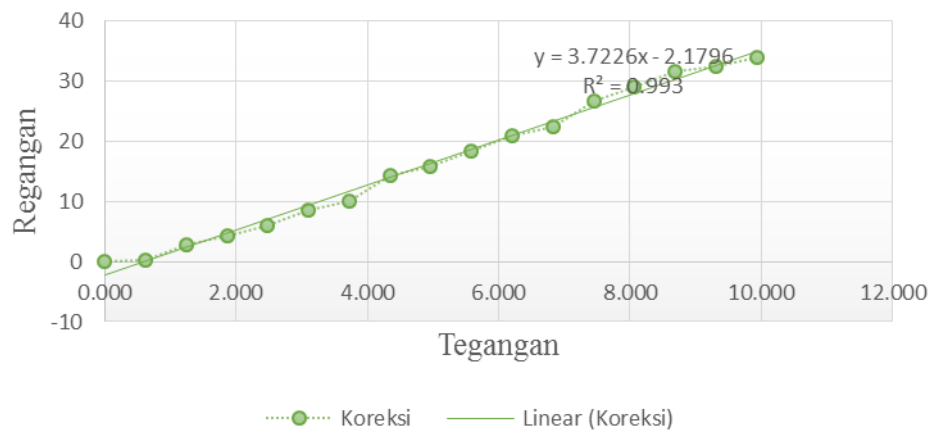
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Grafik Awal Modulus Elastisitas 10M (5 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 10M (5 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
10M (5 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,4 mm |
| Ao | = 7953,78 mm ² |
| Kuat tekan | = 22,63 MPa |
| 0,5 Beban minimum | = 0,5 x 180 = 90 KN |
| Modulus elastisitas | = 27089,350 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 7.50 | 3.75 | 0.6112 | 2.4606 | 2.4715 |
| 1000 | 9806.7 | 15.00 | 7.50 | 1.2224 | 4.9213 | 4.9321 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.8336 | 6.5617 | 6.5726 |
| 2000 | 19613.4 | 27.50 | 13.75 | 2.4448 | 9.0223 | 9.0332 |
| 2500 | 24516.75 | 35.00 | 17.50 | 3.0560 | 11.4829 | 11.4938 |
| 3000 | 29420.1 | 40.00 | 20.00 | 3.6672 | 13.1234 | 13.1342 |
| 3500 | 34323.45 | 50.00 | 25.00 | 4.2784 | 16.4042 | 16.4151 |
| 4000 | 39226.8 | 57.50 | 28.75 | 4.8896 | 18.8648 | 18.8757 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.5008 | 21.3255 | 21.3363 |
| 5000 | 49033.5 | 70.00 | 35.00 | 6.1121 | 22.9659 | 22.9768 |
| 5500 | 53936.85 | 77.50 | 38.75 | 6.7233 | 25.4265 | 25.4374 |
| 6000 | 58840.2 | 85.00 | 42.50 | 7.3345 | 27.8871 | 27.8980 |
| 6500 | 63743.55 | 92.50 | 46.25 | 7.9457 | 30.3478 | 30.3586 |
| 7000 | 68646.9 | 100.00 | 50.00 | 8.5569 | 32.8084 | 32.8193 |
| 7500 | 73550.25 | 105.00 | 52.50 | 9.1681 | 34.4488 | 34.4597 |
| 8000 | 78453.6 | 110.00 | 55.00 | 9.7793 | 36.0892 | 36.1001 |



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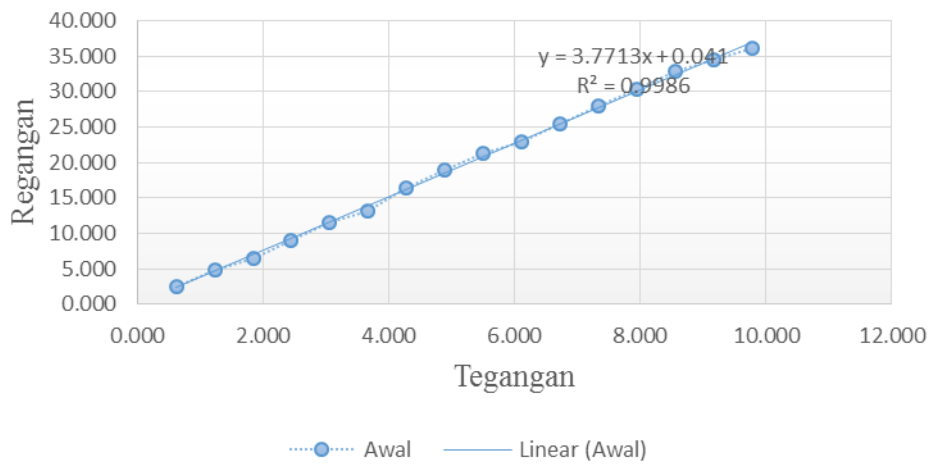
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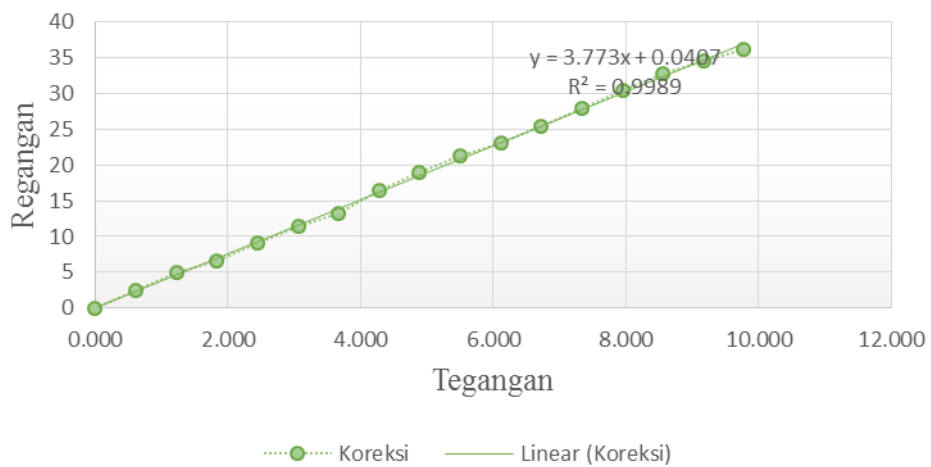
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Grafik Awal Modulus Elastisitas 10M (5 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 10M (5 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
10M (5 : 2) (4) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,7 mm |
| Ao | = 7916,94 mm ² |
| Kuat tekan | = 20,84 MPa |
| 0,5 Beban minimum | = 0,5 x 165 = 82,5 KN |
| Modulus elastisitas | = 22028,747 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 10.00 | 5.00 | 0.6165 | 3.2960 | 3.5767 |
| 1000 | 9806.7 | 20.00 | 10.00 | 1.2330 | 6.5920 | 6.8727 |
| 1500 | 14710.05 | 30.00 | 15.00 | 1.8494 | 9.8879 | 10.1687 |
| 2000 | 19613.4 | 37.50 | 18.75 | 2.4659 | 12.3599 | 12.6406 |
| 2500 | 24516.75 | 45.00 | 22.50 | 3.0824 | 14.8319 | 15.1126 |
| 3000 | 29420.1 | 55.00 | 27.50 | 3.6989 | 18.1279 | 18.4086 |
| 3500 | 34323.45 | 60.00 | 30.00 | 4.3154 | 19.7759 | 20.0566 |
| 4000 | 39226.8 | 70.00 | 35.00 | 4.9318 | 23.0719 | 23.3526 |
| 4500 | 44130.15 | 77.50 | 38.75 | 5.5483 | 25.5438 | 25.8246 |
| 5000 | 49033.5 | 85.00 | 42.50 | 6.1648 | 28.0158 | 28.2965 |
| 5500 | 53936.85 | 95.00 | 47.50 | 6.7813 | 31.3118 | 31.5925 |
| 6000 | 58840.2 | 102.50 | 51.25 | 7.3978 | 33.7838 | 34.0645 |
| 6500 | 63743.55 | 110.00 | 55.00 | 8.0142 | 36.2558 | 36.5365 |
| 7000 | 68646.9 | 120.00 | 60.00 | 8.6307 | 39.5517 | 39.8325 |
| 7500 | 73550.25 | 127.50 | 63.75 | 9.2472 | 42.0237 | 42.3044 |
| 8000 | 78453.6 | 135.00 | 67.50 | 9.8637 | 44.4957 | 44.7764 |



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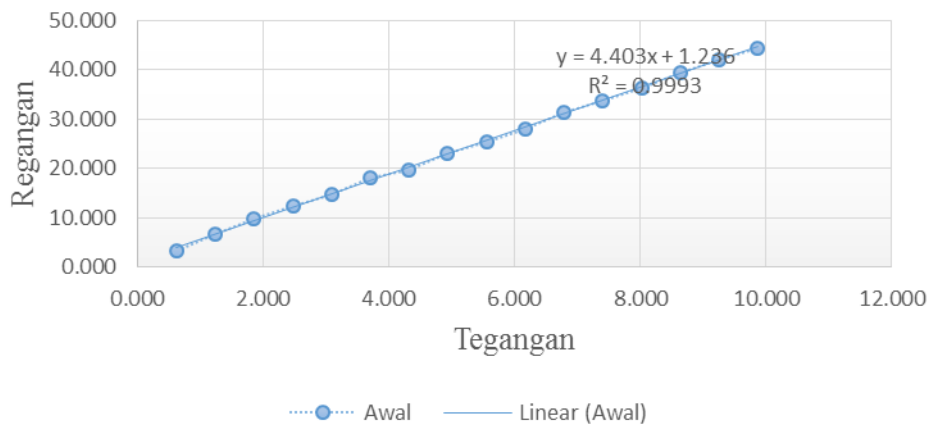
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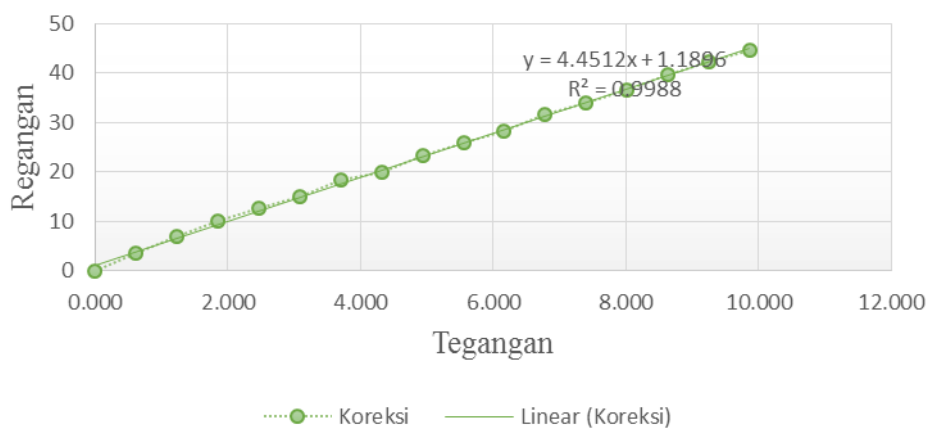
Jl. Babarsari No.44 Yogyakarta 55281 Indonesia Kotas Pos 1086

Fax. +62-274-487748

Grafik Awal Modulus Elastisitas 10M (5 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 10M (5 : 2) No. 4





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (5 : 2) (2) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,5 mm |
| Ao | = 8096,68 mm ² |
| Kuat tekan | = 19,14 MPa |
| 0,5 Beban minimum | = 0,5 x 155 = 77,5 KN |
| Modulus elastisitas | = 22299,604 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 12.50 | 6.25 | 0.6112 | 4.0984 | 4.7658 |
| 1000 | 9806.7 | 22.50 | 11.25 | 1.2224 | 7.3770 | 8.0444 |
| 1500 | 14710.05 | 30.00 | 15.00 | 1.8336 | 9.8361 | 10.5035 |
| 2000 | 19613.4 | 37.50 | 18.75 | 2.4448 | 12.2951 | 12.9625 |
| 2500 | 24516.75 | 47.50 | 23.75 | 3.0560 | 15.5738 | 16.2412 |
| 3000 | 29420.1 | 57.50 | 28.75 | 3.6672 | 18.8525 | 19.5199 |
| 3500 | 34323.45 | 65.00 | 32.50 | 4.2784 | 21.3115 | 21.9789 |
| 4000 | 39226.8 | 75.00 | 37.50 | 4.8896 | 24.5902 | 25.2576 |
| 4500 | 44130.15 | 80.00 | 40.00 | 5.5008 | 26.2295 | 26.8969 |
| 5000 | 49033.5 | 85.00 | 42.50 | 6.1121 | 27.8689 | 28.5363 |
| 5500 | 53936.85 | 90.00 | 45.00 | 6.7233 | 29.5082 | 30.1756 |
| 6000 | 58840.2 | 97.50 | 48.75 | 7.3345 | 31.9672 | 32.6346 |
| 6500 | 63743.55 | 105.00 | 52.50 | 7.9457 | 34.4262 | 35.0936 |
| 7000 | 68646.9 | 115.00 | 57.50 | 8.5569 | 37.7049 | 38.3723 |



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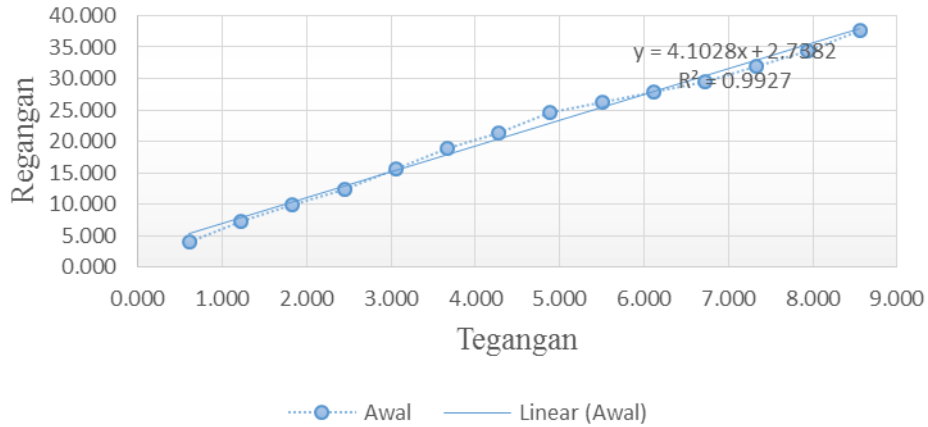
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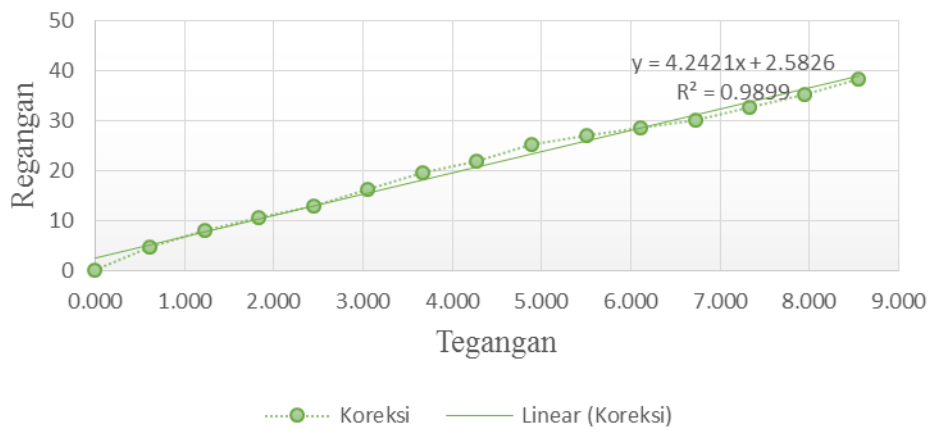
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Grafik Awal Modulus Elastisitas 12M (5 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 12M (5 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (5 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,8 mm |
| Ao | = 7864,46 mm ² |
| Kuat tekan | = 33,7 MPa |
| 0,5 Beban minimum | = 0,5 x 265 = 132,5 KN |
| Modulus elastisitas | = 27185,944 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.6235 | 1.6469 | 1.6399 |
| 1000 | 9806.7 | 17.50 | 8.75 | 1.2470 | 5.7642 | 5.7571 |
| 1500 | 14710.05 | 22.50 | 11.25 | 1.8704 | 7.4111 | 7.4040 |
| 2000 | 19613.4 | 30.00 | 15.00 | 2.4939 | 9.8814 | 9.8744 |
| 2500 | 24516.75 | 35.00 | 17.50 | 3.1174 | 11.5283 | 11.5213 |
| 3000 | 29420.1 | 40.00 | 20.00 | 3.7409 | 13.1752 | 13.1682 |
| 3500 | 34323.45 | 50.00 | 25.00 | 4.3644 | 16.4690 | 16.4620 |
| 4000 | 39226.8 | 57.50 | 28.75 | 4.9879 | 18.9394 | 18.9324 |
| 4500 | 44130.15 | 67.50 | 33.75 | 5.6113 | 22.2332 | 22.2262 |
| 5000 | 49033.5 | 75.00 | 37.50 | 6.2348 | 24.7036 | 24.6965 |
| 5500 | 53936.85 | 82.50 | 41.25 | 6.8583 | 27.1739 | 27.1669 |
| 6000 | 58840.2 | 90.00 | 45.00 | 7.4818 | 29.6443 | 29.6372 |
| 6500 | 63743.55 | 95.00 | 47.50 | 8.1053 | 31.2912 | 31.2841 |
| 7000 | 68646.9 | 97.50 | 48.75 | 8.7288 | 32.1146 | 32.1076 |



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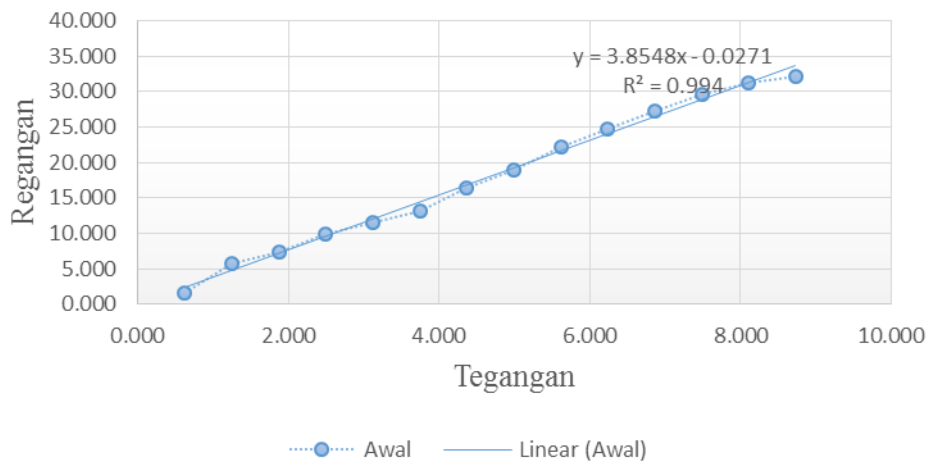
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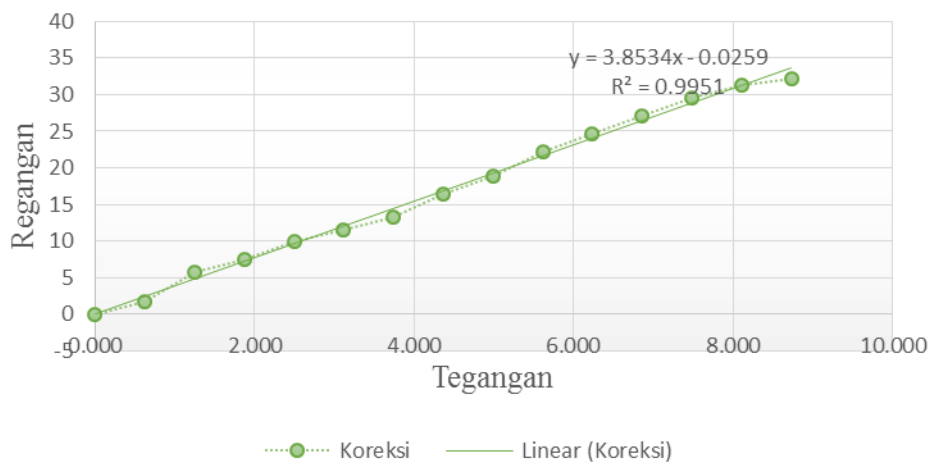
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Fax. +62-274-487748

Grafik Awal Modulus Elastisitas 12M (5 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 12M (5 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (5 : 2) (4) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,1 mm |
| Ao | = 8075,43 mm ² |
| Kuat tekan | = 30,96 MPa |
| 0,5 Beban minimum | = 0,5 x 250 = 125 KN |
| Modulus elastisitas | = 25950,994 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.6072 | 1.6437 | 1.5273 |
| 1000 | 9806.7 | 12.50 | 6.25 | 1.2144 | 4.1091 | 3.9928 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.8216 | 6.5746 | 6.4583 |
| 2000 | 19613.4 | 27.50 | 13.75 | 2.4288 | 9.0401 | 8.9238 |
| 2500 | 24516.75 | 37.50 | 18.75 | 3.0360 | 12.3274 | 12.2111 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.6432 | 14.7929 | 14.6766 |
| 3500 | 34323.45 | 52.50 | 26.25 | 4.2504 | 17.2584 | 17.1420 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.8575 | 19.7239 | 19.6075 |
| 4500 | 44130.15 | 70.00 | 35.00 | 5.4647 | 23.0112 | 22.8948 |
| 5000 | 49033.5 | 77.50 | 38.75 | 6.0719 | 25.4767 | 25.3603 |
| 5500 | 53936.85 | 85.00 | 42.50 | 6.6791 | 27.9421 | 27.8258 |
| 6000 | 58840.2 | 90.00 | 45.00 | 7.2863 | 29.5858 | 29.4695 |
| 6500 | 63743.55 | 95.00 | 47.50 | 7.8935 | 31.2295 | 31.1131 |
| 7000 | 68646.9 | 100.00 | 50.00 | 8.5007 | 32.8731 | 32.7568 |



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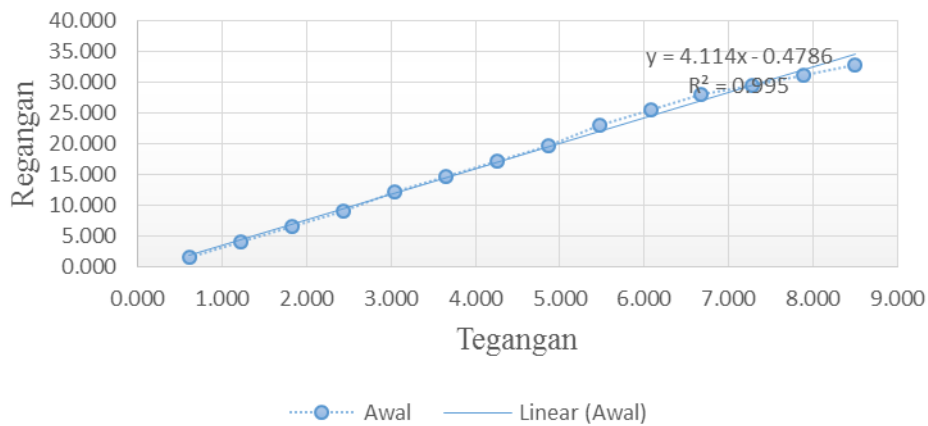
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Laboratorium Struktur dan Bahan Bangunan

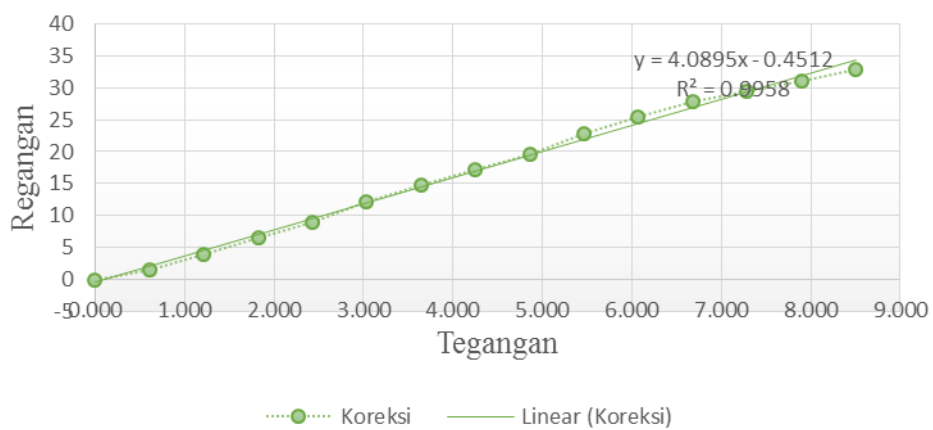
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Fax. +62-274-487748

Grafik Awal Modulus Elastisitas 12M (5 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 12M (5 : 2) No. 4





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
8M (4 : 2) (2) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,3 mm |
| Ao | = 8171,28 mm ² |
| Kuat tekan | = 26,92 MPa |
| 0,5 Beban minimum | = 0,5 x 220 = 110 KN |
| Modulus elastisitas | = 27424,449 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 7.50 | 3.75 | 0.6012 | 2.4785 | 2.8252 |
| 1000 | 9806.7 | 12.50 | 6.25 | 1.2025 | 4.1309 | 4.4775 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.8037 | 6.6094 | 6.9560 |
| 2000 | 19613.4 | 30.00 | 15.00 | 2.4050 | 9.9141 | 10.2607 |
| 2500 | 24516.75 | 37.50 | 18.75 | 3.0062 | 12.3926 | 12.7392 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.6075 | 14.8711 | 15.2178 |
| 3500 | 34323.45 | 55.00 | 27.50 | 4.2087 | 18.1758 | 18.5225 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.8100 | 19.8282 | 20.1748 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.4112 | 21.4805 | 21.8271 |
| 5000 | 49033.5 | 72.50 | 36.25 | 6.0125 | 23.9590 | 24.3057 |
| 5500 | 53936.85 | 77.50 | 38.75 | 6.6137 | 25.6114 | 25.9580 |
| 6000 | 58840.2 | 85.00 | 42.50 | 7.2150 | 28.0899 | 28.4365 |
| 6500 | 63743.55 | 92.50 | 46.25 | 7.8162 | 30.5684 | 30.9151 |
| 7000 | 68646.9 | 97.50 | 48.75 | 8.4175 | 32.2208 | 32.5674 |
| 7500 | 73550.25 | 102.50 | 51.25 | 9.0187 | 33.8731 | 34.2197 |
| 8000 | 78453.6 | 110.00 | 55.00 | 9.6200 | 36.3516 | 36.6983 |
| 8500 | 83356.95 | 115.00 | 57.50 | 10.2212 | 38.0040 | 38.3506 |
| 9000 | 88260.3 | 120.00 | 60.00 | 10.8225 | 39.6563 | 40.0030 |
| 9500 | 93163.65 | 125.00 | 62.50 | 11.4237 | 41.3087 | 41.6553 |



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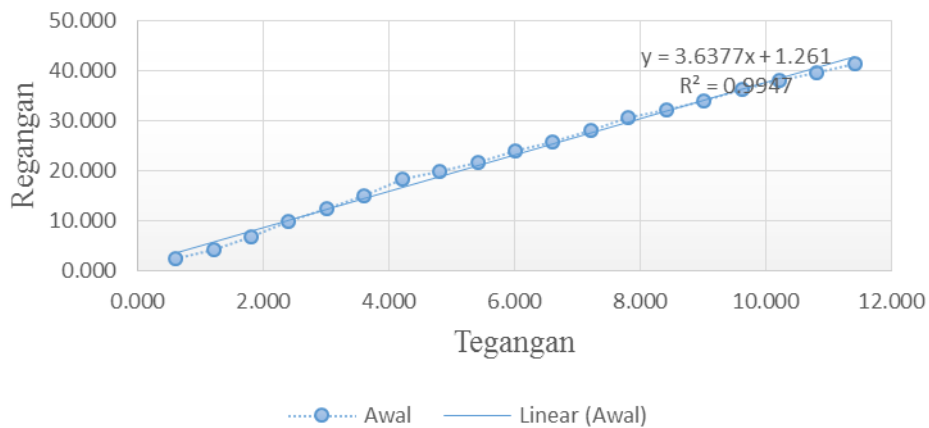
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Laboratorium Struktur dan Bahan Bangunan

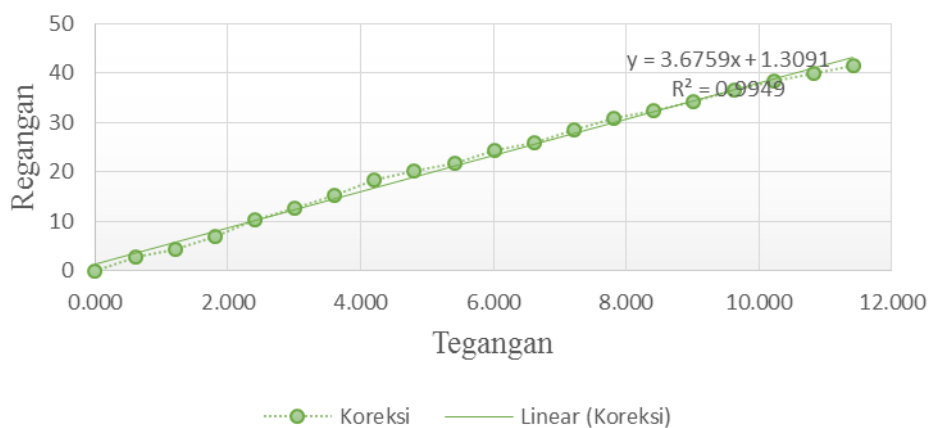
Jl. Babarsari No.44 Yogyakarta 55281 Indonesia Kotas Pos 1086

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Grafik Awal Modulus Elastisitas 8M (4 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 8M (4 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
8M (4 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,6 mm |
| Ao | = 8305,35 mm ² |
| Kuat tekan | = 43,35 MPa |
| 0,5 Beban minimum | = 0,5 x 360 = 180 KN |
| Modulus elastisitas | = 31586,766 Mpa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.5904 | 1.6491 | 0.8821 |
| 1000 | 9806.7 | 7.50 | 3.75 | 1.1808 | 2.4736 | 1.7066 |
| 1500 | 14710.05 | 10.00 | 5.00 | 1.7712 | 3.2982 | 2.5312 |
| 2000 | 19613.4 | 15.00 | 7.50 | 2.3615 | 4.9472 | 4.1802 |
| 2500 | 24516.75 | 22.50 | 11.25 | 2.9519 | 7.4208 | 6.6539 |
| 3000 | 29420.1 | 27.50 | 13.75 | 3.5423 | 9.0699 | 8.3029 |
| 3500 | 34323.45 | 32.50 | 16.25 | 4.1327 | 10.7190 | 9.9520 |
| 4000 | 39226.8 | 40.00 | 20.00 | 4.7231 | 13.1926 | 12.4256 |
| 4500 | 44130.15 | 45.00 | 22.50 | 5.3135 | 14.8417 | 14.0747 |
| 5000 | 49033.5 | 52.50 | 26.25 | 5.9038 | 17.3153 | 16.5483 |
| 5500 | 53936.85 | 57.50 | 28.75 | 6.4942 | 18.9644 | 18.1974 |
| 6000 | 58840.2 | 65.00 | 32.50 | 7.0846 | 21.4380 | 20.6710 |
| 6500 | 63743.55 | 75.00 | 37.50 | 7.6750 | 24.7361 | 23.9692 |
| 7000 | 68646.9 | 80.00 | 40.00 | 8.2654 | 26.3852 | 25.6182 |
| 7500 | 73550.25 | 87.50 | 43.75 | 8.8558 | 28.8588 | 28.0919 |
| 8000 | 78453.6 | 95.00 | 47.50 | 9.4462 | 31.3325 | 30.5655 |
| 8500 | 83356.95 | 100.00 | 50.00 | 10.0365 | 32.9815 | 32.2145 |
| 9000 | 88260.3 | 105.00 | 52.50 | 10.6269 | 34.6306 | 33.8636 |
| 9500 | 93163.65 | 110.00 | 55.00 | 11.2173 | 36.2797 | 35.5127 |



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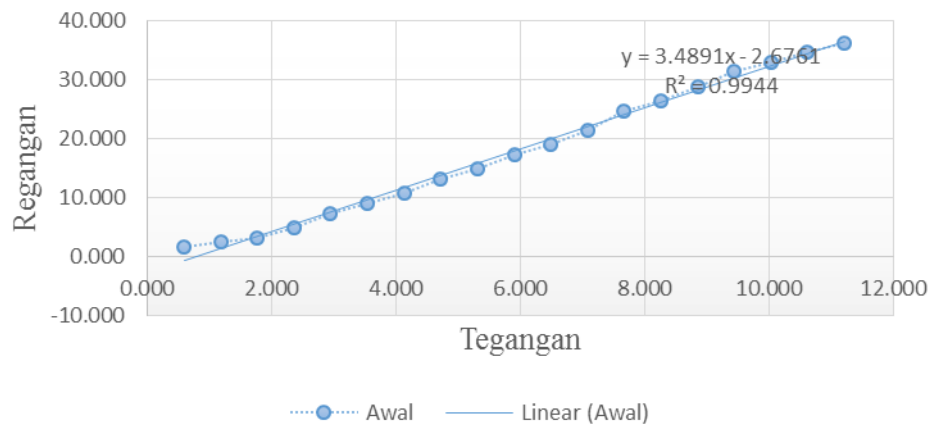
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Laboratorium Struktur dan Bahan Bangunan

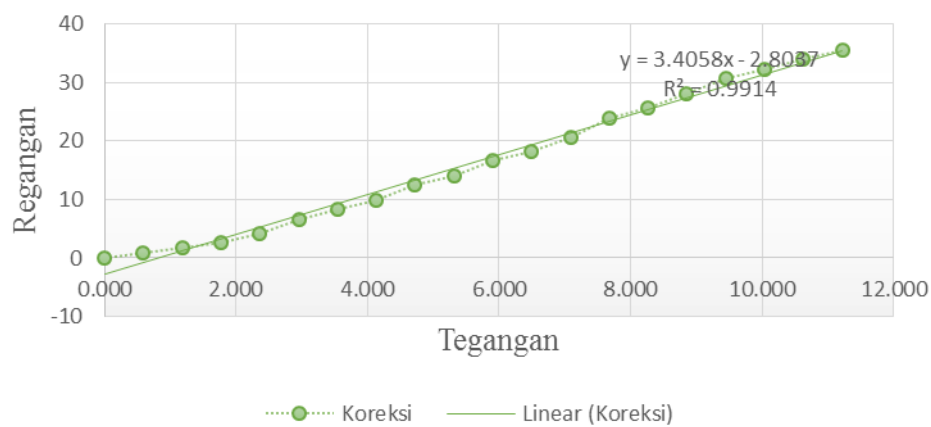
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Grafik Awal Modulus Elastisitas 8M (4 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 8M (4 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
 8M (4 : 2) (4) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,8 mm |
| Ao | = 8038,31 mm ² |
| Kuat tekan | = 31,1 MPa |
| 0,5 Beban minimum | = 0,5 x 250 = 125 KN |
| Modulus elastisitas | = 25703,94 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 10.00 | 5.00 | 0.6100 | 3.2723 | 4.1870 |
| 1000 | 9806.7 | 22.50 | 11.25 | 1.2200 | 7.3626 | 8.2774 |
| 1500 | 14710.05 | 32.50 | 16.25 | 1.8300 | 10.6348 | 11.5496 |
| 2000 | 19613.4 | 37.50 | 18.75 | 2.4400 | 12.2709 | 13.1857 |
| 2500 | 24516.75 | 45.00 | 22.50 | 3.0500 | 14.7251 | 15.6399 |
| 3000 | 29420.1 | 50.00 | 25.00 | 3.6600 | 16.3613 | 17.2761 |
| 3500 | 34323.45 | 55.00 | 27.50 | 4.2700 | 17.9974 | 18.9122 |
| 4000 | 39226.8 | 62.50 | 31.25 | 4.8800 | 20.4516 | 21.3664 |
| 4500 | 44130.15 | 67.50 | 33.75 | 5.4900 | 22.0877 | 23.0025 |
| 5000 | 49033.5 | 75.00 | 37.50 | 6.1000 | 24.5419 | 25.4567 |
| 5500 | 53936.85 | 82.50 | 41.25 | 6.7100 | 26.9961 | 27.9109 |
| 6000 | 58840.2 | 90.00 | 45.00 | 7.3200 | 29.4503 | 30.3651 |
| 6500 | 63743.55 | 95.00 | 47.50 | 7.9300 | 31.0864 | 32.0012 |
| 7000 | 68646.9 | 100.00 | 50.00 | 8.5400 | 32.7225 | 33.6373 |
| 7500 | 73550.25 | 105.00 | 52.50 | 9.1500 | 34.3586 | 35.2734 |
| 8000 | 78453.6 | 112.50 | 56.25 | 9.7600 | 36.8128 | 37.7276 |
| 8500 | 83356.95 | 120.00 | 60.00 | 10.3700 | 39.2670 | 40.1818 |
| 9000 | 88260.3 | 127.50 | 63.75 | 10.9800 | 41.7212 | 42.6360 |
| 9500 | 93163.65 | 135.00 | 67.50 | 11.5900 | 44.1754 | 45.0902 |



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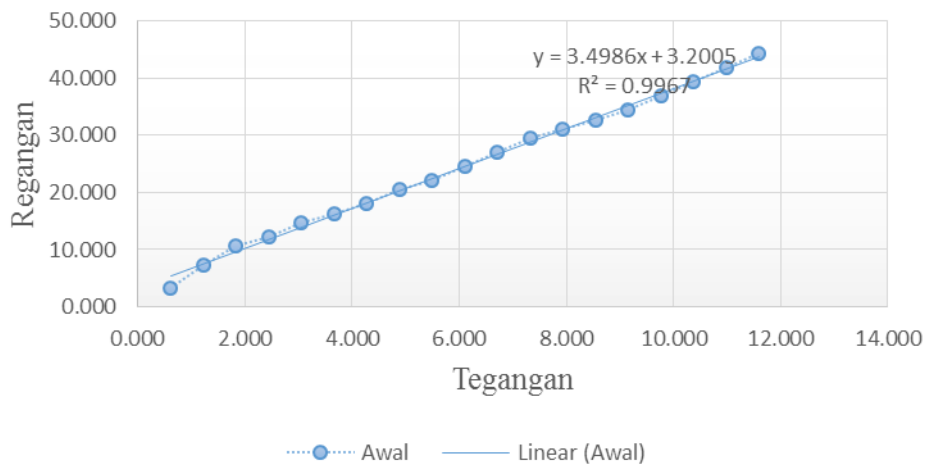
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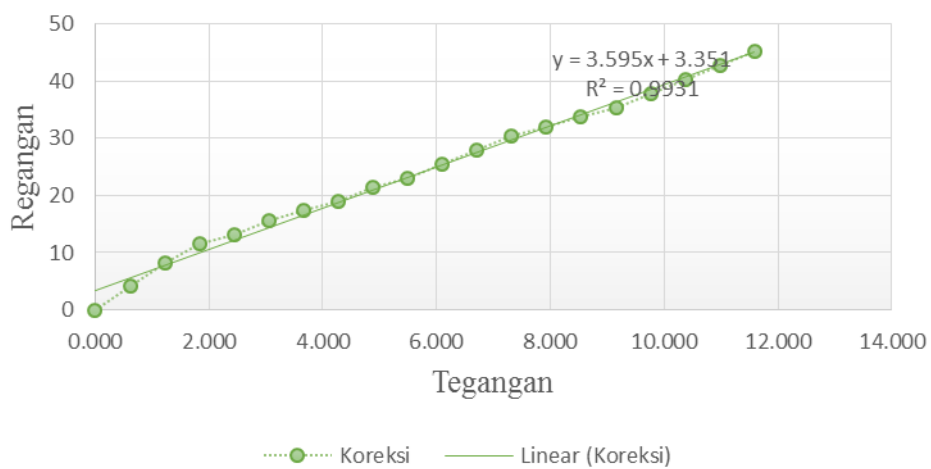
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Grafik Awal Modulus Elastisitas 8M (4 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 8M (4 : 2) No. 4





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
10M (4 : 2) (2) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,9 mm |
| Ao | = 7943,25 mm ² |
| Kuat tekan | = 23,92 MPa |
| 0,5 Beban minimum | = 0,5 x 190 = 95 KN |
| Modulus elastisitas | = 26072,007 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 2.50 | 1.25 | 0.6032 | 0.8175 | 0.2300 |
| 1000 | 9806.7 | 5.00 | 2.50 | 1.2064 | 1.6351 | 1.0475 |
| 1500 | 14710.05 | 12.50 | 6.25 | 1.8097 | 4.0876 | 3.5001 |
| 2000 | 19613.4 | 22.50 | 11.25 | 2.4129 | 7.3578 | 6.7702 |
| 2500 | 24516.75 | 35.00 | 17.50 | 3.0161 | 11.4454 | 10.8579 |
| 3000 | 29420.1 | 37.50 | 18.75 | 3.6193 | 12.2629 | 11.6754 |
| 3500 | 34323.45 | 45.00 | 22.50 | 4.2225 | 14.7155 | 14.1280 |
| 4000 | 39226.8 | 55.00 | 27.50 | 4.8258 | 17.9856 | 17.3981 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.4290 | 21.2557 | 20.6682 |
| 5000 | 49033.5 | 72.50 | 36.25 | 6.0322 | 23.7083 | 23.1208 |
| 5500 | 53936.85 | 80.00 | 40.00 | 6.6354 | 26.1609 | 25.5734 |
| 6000 | 58840.2 | 85.00 | 42.50 | 7.2387 | 27.7959 | 27.2084 |
| 6500 | 63743.55 | 97.50 | 48.75 | 7.8419 | 31.8836 | 31.2961 |
| 7000 | 68646.9 | 100.00 | 50.00 | 8.4451 | 32.7011 | 32.1136 |
| 7500 | 73550.25 | 105.00 | 52.50 | 9.0483 | 34.3362 | 33.7487 |
| 8000 | 78453.6 | 115.00 | 57.50 | 9.6515 | 37.6063 | 37.0188 |



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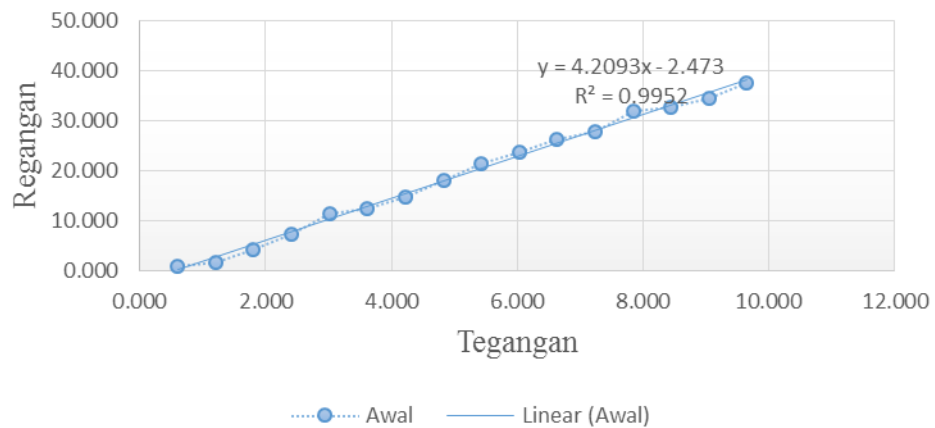
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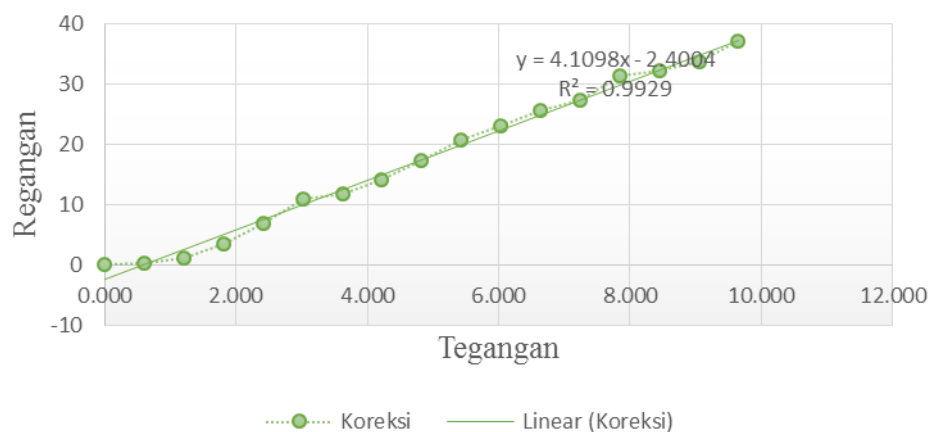
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Grafik Awal Modulus Elastisitas 10M (4 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 10M (4 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
 10M (4 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,4 mm |
| Ao | = 8133,94 mm ² |
| Kuat tekan | = 37,5 MPa |
| 0,5 Beban minimum | = 0,5 x 305 = 152,5 KN |
| Modulus elastisitas | = 23110,531 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 5.00 | 2.50 | 0.6173 | 1.6513 | 1.4557 |
| 1000 | 9806.7 | 12.50 | 6.25 | 1.2346 | 4.1281 | 3.9326 |
| 1500 | 14710.05 | 22.50 | 11.25 | 1.8519 | 7.4306 | 7.2351 |
| 2000 | 19613.4 | 35.00 | 17.50 | 2.4692 | 11.5588 | 11.3632 |
| 2500 | 24516.75 | 37.50 | 18.75 | 3.0865 | 12.3844 | 12.1889 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.7038 | 14.8613 | 14.6658 |
| 3500 | 34323.45 | 55.00 | 27.50 | 4.3211 | 18.1638 | 17.9683 |
| 4000 | 39226.8 | 65.00 | 32.50 | 4.9384 | 21.4663 | 21.2708 |
| 4500 | 44130.15 | 72.50 | 36.25 | 5.5557 | 23.9432 | 23.7477 |
| 5000 | 49033.5 | 80.00 | 40.00 | 6.1730 | 26.4201 | 26.2245 |
| 5500 | 53936.85 | 87.50 | 43.75 | 6.7903 | 28.8970 | 28.7014 |
| 6000 | 58840.2 | 97.50 | 48.75 | 7.4076 | 32.1995 | 32.0039 |
| 6500 | 63743.55 | 105.00 | 52.50 | 8.0249 | 34.6764 | 34.4808 |
| 7000 | 68646.9 | 115.00 | 57.50 | 8.6422 | 37.9789 | 37.7833 |
| 7500 | 73550.25 | 120.00 | 60.00 | 9.2595 | 39.6301 | 39.4346 |
| 8000 | 78453.6 | 130.00 | 65.00 | 9.8768 | 42.9326 | 42.7371 |



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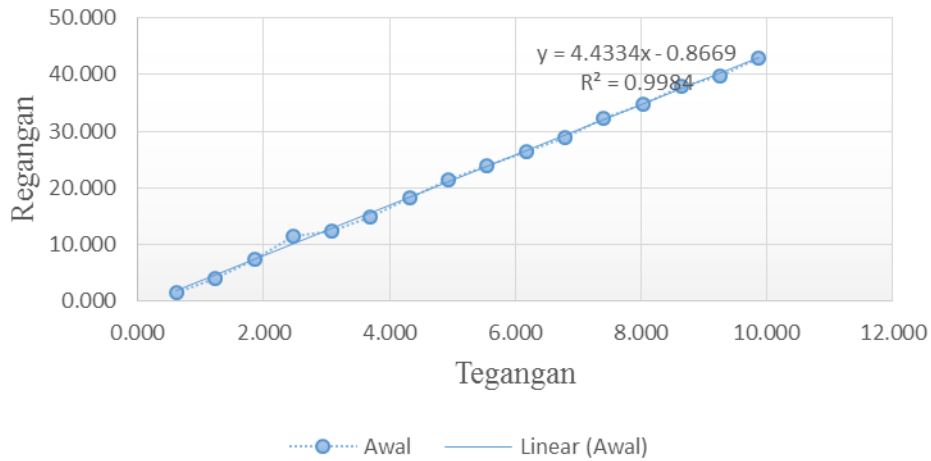
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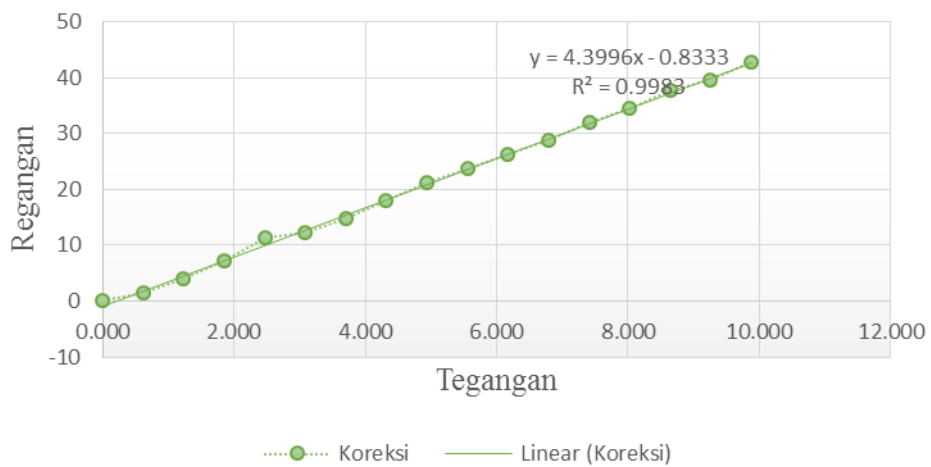
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Grafik Awal Modulus Elastisitas 10M (4 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 10M (4 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
10M (4 : 2) (4) – 28 HARI**

| | |
|---------------------|------------------------|
| Po | = 151,6 mm |
| Ao | = 8102 mm ² |
| Kuat tekan | = 20,98 MPa |
| 0,5 Beban minimum | = 0,5 x 170 = 85 KN |
| Modulus elastisitas | = 27837,939 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 7.50 | 3.75 | 0.6028 | 2.4736 | 2.4907 |
| 1000 | 9806.7 | 15.00 | 7.50 | 1.2057 | 4.9472 | 4.9644 |
| 1500 | 14710.05 | 22.50 | 11.25 | 1.8085 | 7.4208 | 7.4380 |
| 2000 | 19613.4 | 27.50 | 13.75 | 2.4113 | 9.0699 | 9.0870 |
| 2500 | 24516.75 | 32.50 | 16.25 | 3.0141 | 10.7190 | 10.7361 |
| 3000 | 29420.1 | 35.00 | 17.50 | 3.6170 | 11.5435 | 11.5607 |
| 3500 | 34323.45 | 45.00 | 22.50 | 4.2198 | 14.8417 | 14.8588 |
| 4000 | 39226.8 | 52.50 | 26.25 | 4.8226 | 17.3153 | 17.3324 |
| 4500 | 44130.15 | 60.00 | 30.00 | 5.4254 | 19.7889 | 19.8060 |
| 5000 | 49033.5 | 65.00 | 32.50 | 6.0283 | 21.4380 | 21.4551 |
| 5500 | 53936.85 | 70.00 | 35.00 | 6.6311 | 23.0871 | 23.1042 |
| 6000 | 58840.2 | 80.00 | 40.00 | 7.2339 | 26.3852 | 26.4024 |
| 6500 | 63743.55 | 85.00 | 42.50 | 7.8367 | 28.0343 | 28.0514 |
| 7000 | 68646.9 | 97.50 | 48.75 | 8.4396 | 32.1570 | 32.1741 |
| 7500 | 73550.25 | 100.00 | 50.00 | 9.0424 | 32.9815 | 32.9987 |
| 8000 | 78453.6 | 105.00 | 52.50 | 9.6452 | 34.6306 | 34.6477 |



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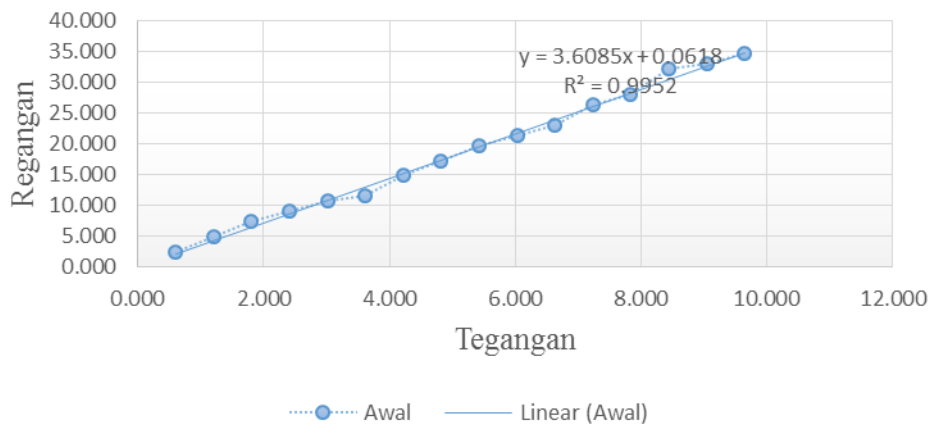
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Laboratorium Struktur dan Bahan Bangunan

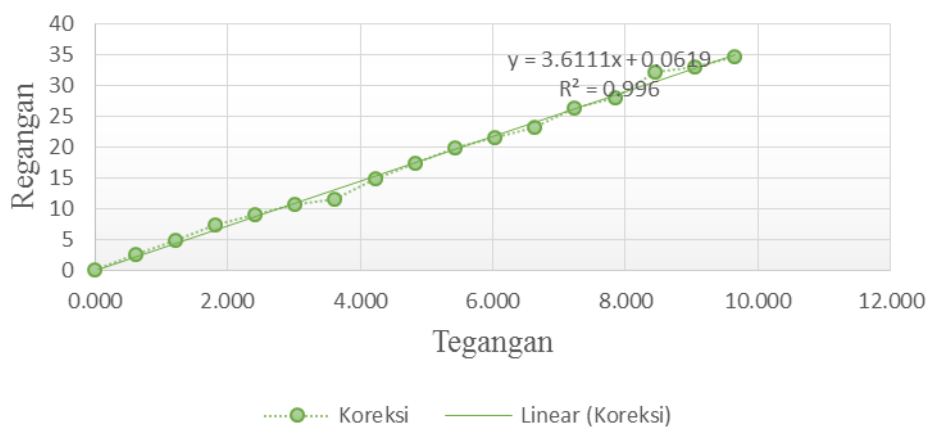
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Grafik Awal Modulus Elastisitas 10M (4 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 10M (4 : 2) No. 4





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (4 : 2) (2) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,1 mm |
| Ao | = 8214,06 mm ² |
| Kuat tekan | = 30,44 MPa |
| 0,5 Beban minimum | = 0,5 x 250 = 125 KN |
| Modulus elastisitas | = 26201,003 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 7.50 | 3.75 | 0.60 | 2.47 | 2.50 |
| 1000 | 9806.7 | 15.00 | 7.50 | 1.19 | 4.93 | 4.96 |
| 1500 | 14710.05 | 20.00 | 10.00 | 1.79 | 6.57 | 6.61 |
| 2000 | 19613.4 | 25.00 | 12.50 | 2.39 | 8.22 | 8.25 |
| 2500 | 24516.75 | 35.00 | 17.50 | 2.98 | 11.51 | 11.54 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.58 | 14.79 | 14.83 |
| 3500 | 34323.45 | 52.50 | 26.25 | 4.18 | 17.26 | 17.29 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.78 | 19.72 | 19.76 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.37 | 21.37 | 21.40 |
| 5000 | 49033.5 | 70.00 | 35.00 | 5.97 | 23.01 | 23.04 |
| 5500 | 53936.85 | 77.50 | 38.75 | 6.57 | 25.48 | 25.51 |
| 6000 | 58840.2 | 85.00 | 42.50 | 7.16 | 27.94 | 27.97 |
| 6500 | 63743.55 | 90.00 | 45.00 | 7.76 | 29.59 | 29.62 |



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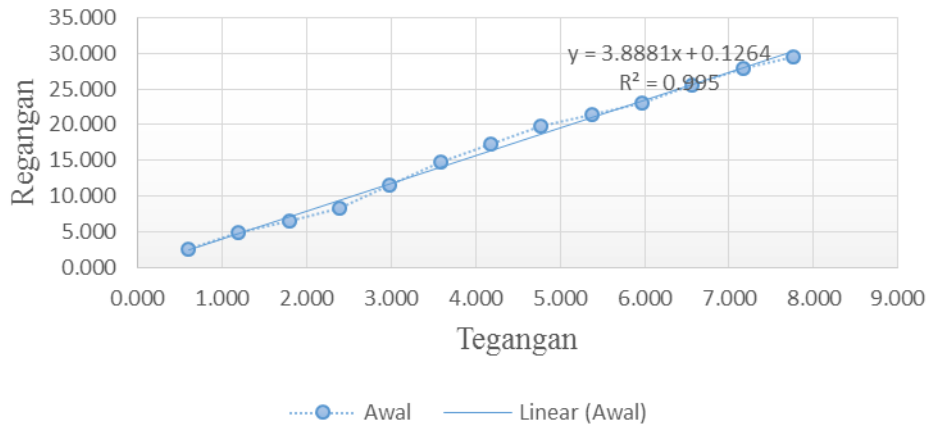
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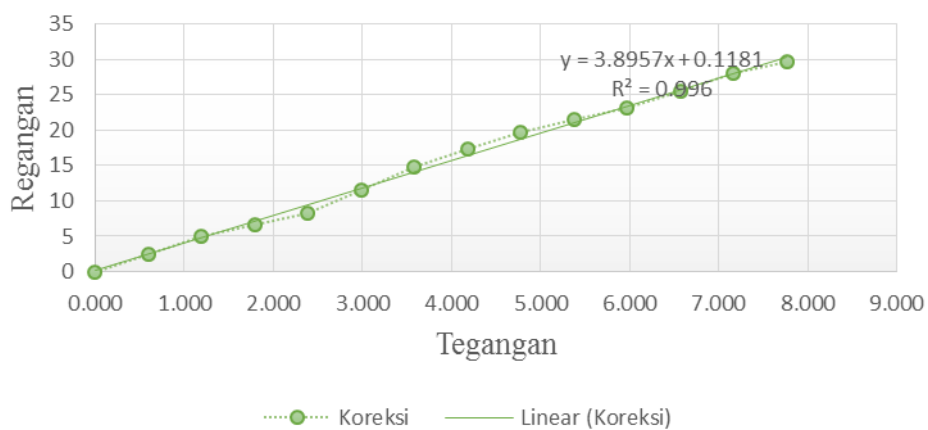
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Grafik Awal Modulus Elastisitas 12M (4 : 2) No. 2



Grafik Koreksi Modulus Elastisitas 12M (4 : 2) No. 2





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (4 : 2) (3) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 151,9 mm |
| Ao | = 8070,12 mm ² |
| Kuat tekan | = 27,26 MPa |
| 0,5 Beban minimum | = 0,5 x 220 = 27,26 KN |
| Modulus elastisitas | = 23635,568 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-------------------------------|-----------------------------------|----------|-------------------------|-------------------------|
| (kgf) | N | ΔP x 10 ⁻² (mm) | 0,5 ΔP x 10 ⁻² (mm) | (Mpa) | (ε) (10 ⁻⁵) | (ε) (10 ⁻⁵) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 10.00 | 5.00 | 0.61 | 3.29 | 3.79 |
| 1000 | 9806.7 | 20.00 | 10.00 | 1.22 | 6.58 | 7.09 |
| 1500 | 14710.05 | 30.00 | 15.00 | 1.82 | 9.87 | 10.38 |
| 2000 | 19613.4 | 35.00 | 17.50 | 2.43 | 11.52 | 12.02 |
| 2500 | 24516.75 | 40.00 | 20.00 | 3.04 | 13.17 | 13.67 |
| 3000 | 29420.1 | 50.00 | 25.00 | 3.65 | 16.46 | 16.96 |
| 3500 | 34323.45 | 55.00 | 27.50 | 4.25 | 18.10 | 18.61 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.86 | 19.75 | 20.25 |
| 4500 | 44130.15 | 65.00 | 32.50 | 5.47 | 21.40 | 21.90 |
| 5000 | 49033.5 | 75.00 | 37.50 | 6.08 | 24.69 | 25.19 |
| 5500 | 53936.85 | 80.00 | 40.00 | 6.68 | 26.33 | 26.84 |
| 6000 | 58840.2 | 90.00 | 45.00 | 7.29 | 29.62 | 30.13 |
| 6500 | 63743.55 | 100.00 | 50.00 | 7.90 | 32.92 | 33.42 |



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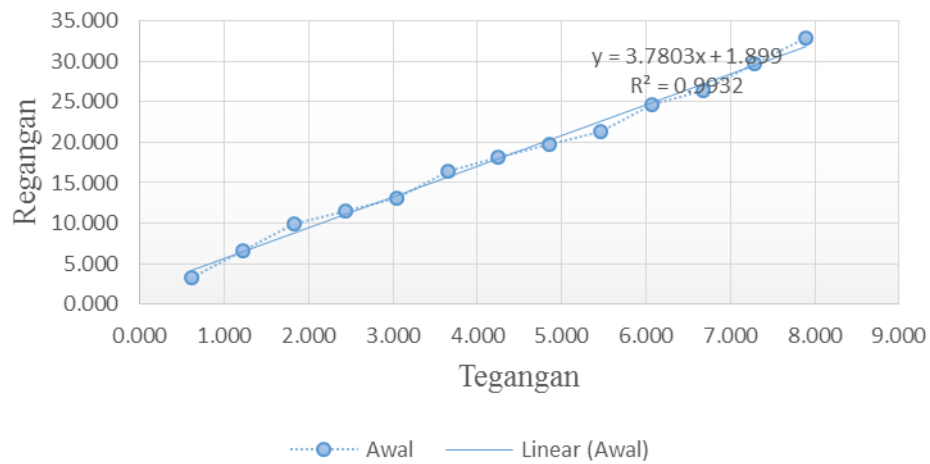
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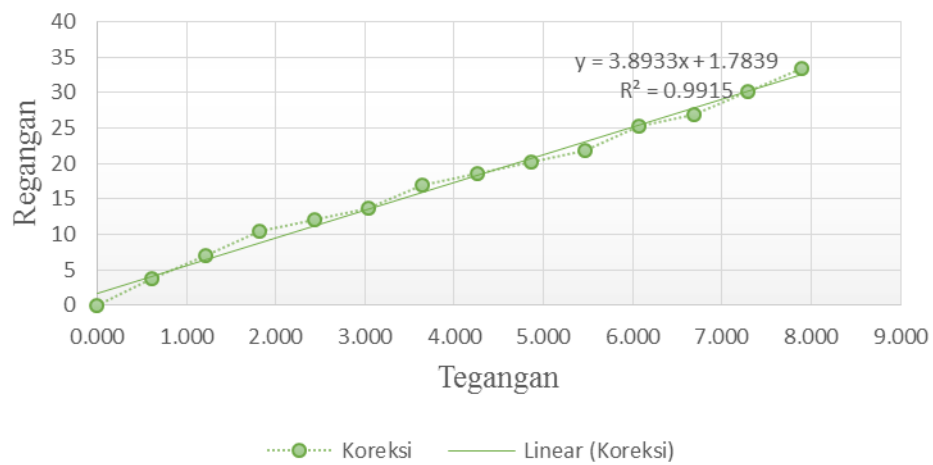
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Grafik Awal Modulus Elastisitas 12M (4 : 2) No. 3



Grafik Koreksi Modulus Elastisitas 12M (4 : 2) No. 3





**PEMERIKSAAN MODULUS ELASTISITAS BETON GEOPOLIMER
12M (4 : 2) (4) – 28 HARI**

| | |
|---------------------|---------------------------|
| Po | = 152,4 mm |
| Ao | = 8112,64 mm ² |
| Kuat tekan | = 25,27 MPa |
| 0,5 Beban minimum | = 0,5 x 205 = 102,5 KN |
| Modulus elastisitas | = 23831,529 MPa |

| P | | Compressometer ΔP | | Tegangan | Regangan | Regangan koreksi |
|-------|----------|-----------------------------------|---------------------------------------|----------|------------------------------|------------------------------|
| (kgf) | N | $\Delta P \times 10^{-2}$ (mm) | $0,5 \Delta P \times 10^{-2}$ (mm) | (Mpa) | (ϵ) (10^{-5}) | (ϵ) (10^{-5}) |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 4903.35 | 10.00 | 5.00 | 0.60 | 3.28 | 3.44 |
| 1000 | 9806.7 | 20.00 | 10.00 | 1.21 | 6.56 | 6.72 |
| 1500 | 14710.05 | 25.00 | 12.50 | 1.81 | 8.20 | 8.36 |
| 2000 | 19613.4 | 30.00 | 15.00 | 2.42 | 9.84 | 10.00 |
| 2500 | 24516.75 | 40.00 | 20.00 | 3.02 | 13.12 | 13.29 |
| 3000 | 29420.1 | 45.00 | 22.50 | 3.63 | 14.76 | 14.93 |
| 3500 | 34323.45 | 55.00 | 27.50 | 4.23 | 18.04 | 18.21 |
| 4000 | 39226.8 | 60.00 | 30.00 | 4.84 | 19.69 | 19.85 |
| 4500 | 44130.15 | 70.00 | 35.00 | 5.44 | 22.97 | 23.13 |
| 5000 | 49033.5 | 77.50 | 38.75 | 6.04 | 25.43 | 25.59 |
| 5500 | 53936.85 | 85.00 | 42.50 | 6.65 | 27.89 | 28.05 |
| 6000 | 58840.2 | 95.00 | 47.50 | 7.25 | 31.17 | 31.33 |
| 6500 | 63743.55 | 100.00 | 50.00 | 7.86 | 32.81 | 32.97 |



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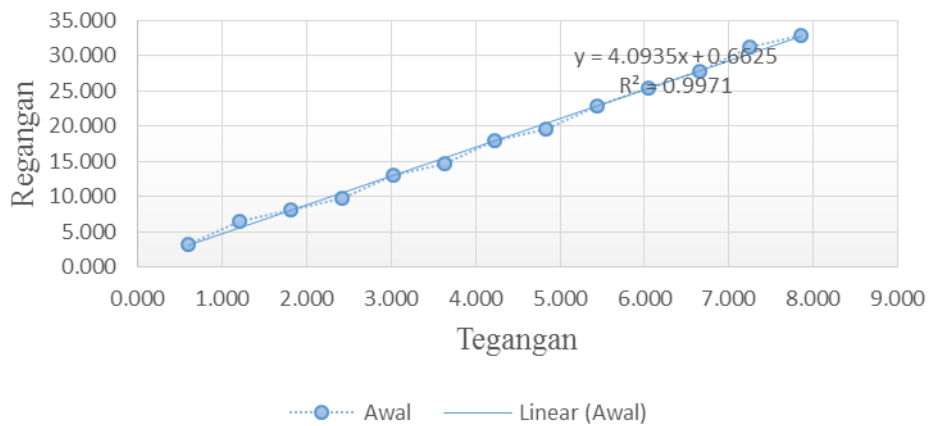
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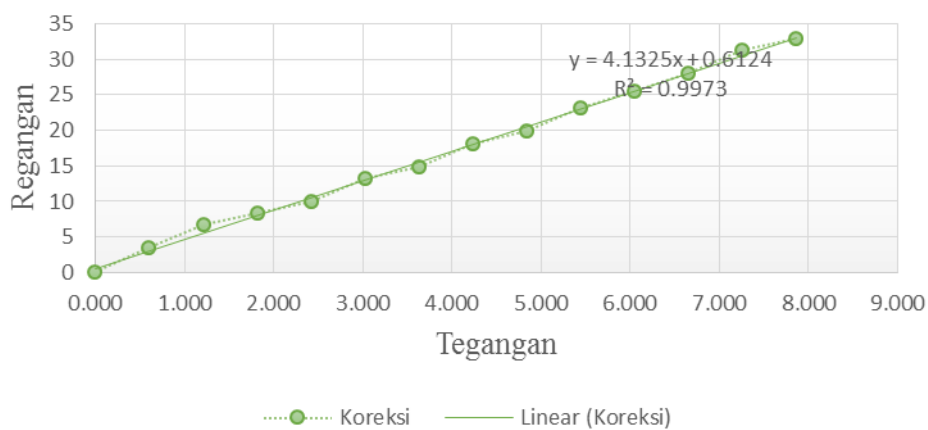
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Grafik Awal Modulus Elastisitas 12M (4 : 2) No. 4



Grafik Koreksi Modulus Elastisitas 12M (4 : 2) No. 4





MIX DESIGN

KEPERLUAN AGREGAT KASAR (KERIKIL)

| | | |
|---------------------|---------|-------------------|
| Berat Jenis : | 2637 | kg/m ³ |
| Jml Agregat : | 0.0011 | m ³ |
| Jml Agregat kasar : | 0.0003 | m ³ |
| Jml Agregat kasar : | 0.7539 | kg |
| Jml tot silinder : | 27.1396 | kg |
| Total : | 27.1396 | kg |
| SF 30% | 8.1419 | kg |
| Total : | 35.2815 | kg |

KEPERLUAN AGREGAT HALUS (PASIR)

| | | |
|---------------------|---------|-------------------|
| Berat Jenis : | 2592 | kg/m ³ |
| Jml Agregat : | 0.0011 | m ³ |
| Jml Agregat halus : | 0.0002 | m ³ |
| Jml Agregat halus : | 0.3990 | kg |
| Jml tot silinder : | 14.3643 | kg |
| Total : | 14.3643 | kg |
| SF 30% | 4.3093 | kg |
| Total : | 18.6735 | kg |

KEPERLUAN FLY ASH

| | | |
|--------------------|---------|-------------------|
| Berat Jenis : | 2298 | kg/m ³ |
| jml binder : | 0.0005 | m ³ |
| jml fly ash : | 0.0003 | m ³ |
| jml fly ash : | 0.8014 | kg |
| Jml tot silinder : | 28.8486 | kg |
| Total : | 28.8486 | kg |
| SF 30% | 8.6546 | kg |
| Total : | 37.5032 | kg |

**KEPERLUAN AGREGAT KASAR TERAK BAJA (STEEL SLAG)**

| | | |
|---------------------|---------|-------------------|
| Berat Jenis : | 3786 | kg/m ³ |
| Jml Agregat : | 0.0011 | m ³ |
| Jml Agregat Kasar : | 0.0004 | m ³ |
| Jml Agregat Kasar : | 1.6235 | kg |
| Jml tot silinder : | 58.4475 | kg |
| Total : | 58.4475 | kg |
| SF 30% | 17.5342 | kg |
| Total : | 75.9817 | kg |

KEPERLUAN AGREGAT HALUS TERAK BAJA (STEEL SLAG)

| | | |
|------------------------|---------|-------------------|
| Berat Jenis : | 3319 | kg/m ³ |
| Jml Agregat : | 0.0011 | m ³ |
| Jml Agregat Halus : | 0.0002 | m ³ |
| Jml Agregat Halus : | 0.7664 | kg |
| Jml tot silinder : | 27.5897 | kg |
| Total : | 27.5897 | kg |
| SF 30% | 8.2769 | kg |
| Total : | 35.8666 | kg |

KEPERLUAN AKTIVATOR Na_2SiO_3 & NaOH

| | | |
|---------------------------------------|-------------|----|
| jml binder : | 0.000471 | m3 |
| jml Aktivator : | 0.00012252 | m3 |
| jml Na_2SiO_3 : | 8.75158E-05 | |
| jml NaOH : | 0.00003501 | |
| Perbandingan : | 2.5 | |
| Na_2SiO_3 (2x campur) | 175.0315907 | ml |
| jml tot silinder | 3150.568633 | ml |
| NaOH (2x campur) | 70.01263628 | |
| jml tot silinder | 1260.227453 | ml |
| Perbandingan : | 2.5 | |
| JML Na_2SiO_3 | 6091.099356 | ml |
| SF 30% | 1218.219871 | ml |
| TOT | 7309.319228 | ml |

| | | |
|---------------------------------------|-------------|----|
| jml binder : | 0.000471239 | m3 |
| jml fly Aktivator : | 0.000122522 | m3 |
| jml Na_2SiO_3 : | 8.16814E-05 | |
| jml NaOH : | 4.08407E-05 | |
| Perbandingan : | 2 | |
| Na_2SiO_3 (2x campur) | 163.362818 | ml |
| jml tot silinder | 2940.530724 | ml |
| NaOH (2x campur) | 81.68140899 | |
| jml tot silinder | 1470.265362 | ml |
| Perbandingan : | 2 | |
| JML NaOH | 2730.492815 | ml |
| SF 30% | 546.098563 | ml |
| TOT | 3276.591378 | ml |



FOTO – FOTO DOKUMENTASI PENELITIAN



Pengujian berat jenis agregat kasar terak baja



Pengujian berat jenis agregat halus terak baja



Pengujian *slump*



Pengujian kuat tekan beton geopolimer



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Pengujian kuat tarik belah



Pengujian modulus elastisitas



Ambient curing



Dry curing

Pengujian modulus elastisitas



Setting Time Fly Ash