# LAMPIRAN

**Lampiran 1. Tabel Hasil Uji Laboratorium**

Tabel 1. Lokasi pengambilan material

| Material | Lokasi Pengambilan |
|---|---|
| Agregat Halus | Merapi |
| Agregat Kasar | Merapi |

## Pengujian Modulus Halus Butir (MHB) / Analisis Agregat Halus

| Lubang Ayakan (mm) | Berat Tertinggal (gram) | Berat Tertinggal (%) | Berat Tertinggal Kumulatif (%) | Persen Lolos Kumulatif (%) |
|---|---|---|---|---|
| 40.00 | 0 | 0 | 0 | 100 |
| 20.00 | 0 | 0 | 0 | 100 |
| 10.00 | 0 | 0 | 0 | 100 |
| 4.80 | 55 | 2.756 | 2.756 | 97.244 |
| 2.80 | 99 | 4.960 | 7.715 | 92.285 |
| 1.20 | 222 | 11.122 | 18.838 | 81.162 |
| 0.60 | 747 | 37.425 | 56.263 | 43.737 |
| 0.30 | 655 | 32.816 | 89.078 | 10.922 |
| 0.15 | 174 | 8.717 | 97.796 | 2.204 |
| Sisa | 44 | 2.204 | 100.000 | 0.000 |
| Jumlah | 1996 | 100 | - | - |

## Gradasi Pasir

| Lubang Ayakan (mm) | Persen Butir Agregat Yang Lolos Ayakan | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daerah I | | Daerah II | | Daerah III | | Daerah IV | |
| 10.00 | 100 | | 100 | | 100 | | 100 | |
| 4.80 | 90 | 100 | 90 | 100 | 90 | 100 | 95 | 100 |
| 2.80 | 60 | 95 | 75 | 100 | 85 | 100 | 95 | 100 |
| 1.20 | 30 | 70 | 55 | 90 | 75 | 100 | 90 | 100 |
| 0.60 | 15 | 34 | 35 | 59 | 60 | 79 | 80 | 100 |
| 0.30 | 5 | 20 | 8 | 30 | 12 | 40 | 15 | 50 |
| 0.15 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 15 |

Keterangan:

Daerah I : Pasir Kasar

Daerah II : Pasir Agak Kasar

Daerah III : Pasir Agak Halus

Daerah IV : Pasir Halus

## Pengujian Modulus Halus Butir (MHB) / Analisis Agregat Kasar

| Lubang Ayakan (mm) | Berat Tertinggal (gram) | Berat Tertinggal (%) | Berat Tertinggal Kumulatif (%) | Persen Lolos Kumulatif (%) |
|---|---|---|---|---|
| 40.00 | 0 | 0 | 0 | 100 |
| 20.00 | 1856 | 37.202 | 37.202 | 62.798 |
| 10.00 | 2216 | 44.418 | 81.620 | 18.380 |
| 4.80 | 389 | 7.797 | 89.417 | 10.583 |
| 2.80 | 113 | 2.265 | 91.682 | 8.318 |
| 1.20 | 197 | 3.949 | 95.630 | 4.370 |
| 0.60 | 0 | 0.000 | 95.630 | 4.370 |
| 0.30 | 0 | 0.000 | 95.630 | 4.370 |
| 0.15 | 0 | 0.000 | 95.630 | 4.370 |
| Sisa | 218 | 4.370 | 100.000 | 0.000 |
| Jumlah | 4989 | | | |

## Gradasi Kerikil

| Lubang Ayakan (mm) | Persen Butir Agregat yang Lolos Ayakan / Besar Butiran Maksimum | |
|---|---|---|
| | **40 mm** | **20 mm** |
| **40.00** | 95 - 100 | 100 |
| **20.00** | 30 - 70 | 95 – 100 |
| **10.00** | 10 - 35 | 25 – 55 |
| **4.80** | 0 - 5 | 0 – 10 |

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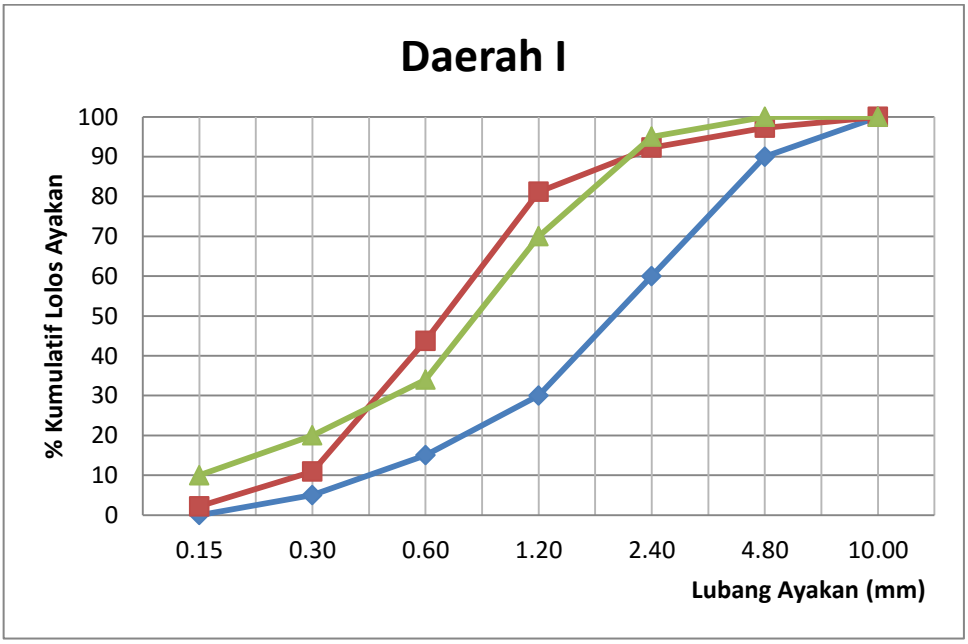
## Pemeriksaan Berat Jenis Dan Penyerapan Air Agregat Halus

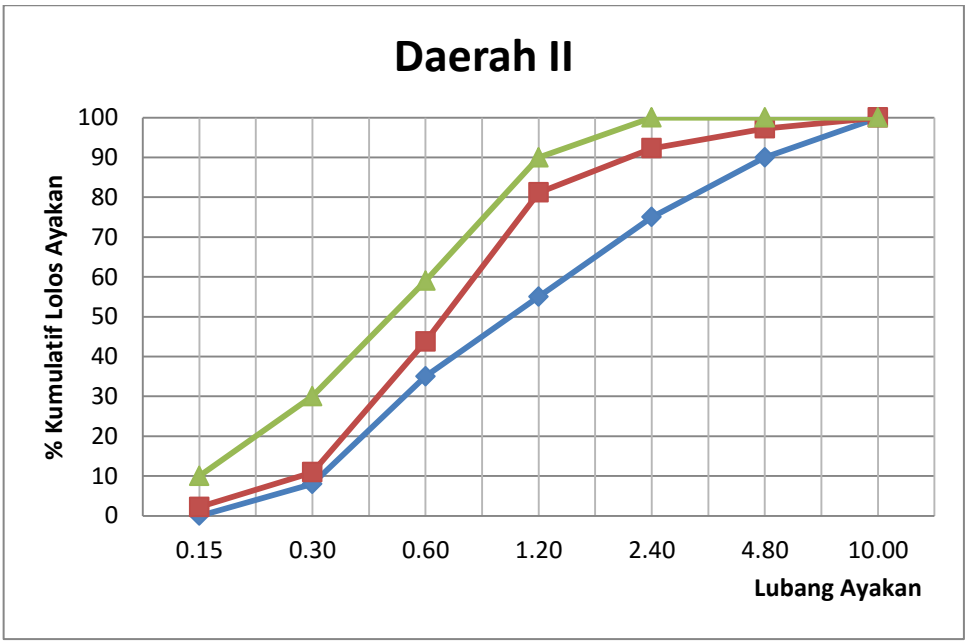
| Uraian | Jumlah | Satuan |
|---|---|---|
| Berat pasir kering mutlak (Bk) | 490.85 | gram |
| Berat pasir kondisi jenuh kering muka (SSD) | 500 | gram |
| Berat piknometer berisi pasir dan air (Bt) | 1005 | gram |
| Berat piknometer berisi air (B) | 679.5 | gram |
| Berat Jenis Curah<br>Bk/(B+500-Bt)<br>.....(1) | 2.813 | - |
| Berat Jenis henuh kering muka<br>500/(B+500-Bt)<br>.....(2) | 2.865 | - |
| Berat Jenis semu<br>Bk/(B+Bk-Bt)<br>.....(3) | 2.968 | - |
| Penyerapan Air<br>(500-Bk)/Bk x 100%<br>.....(4) | 1.864 | - |

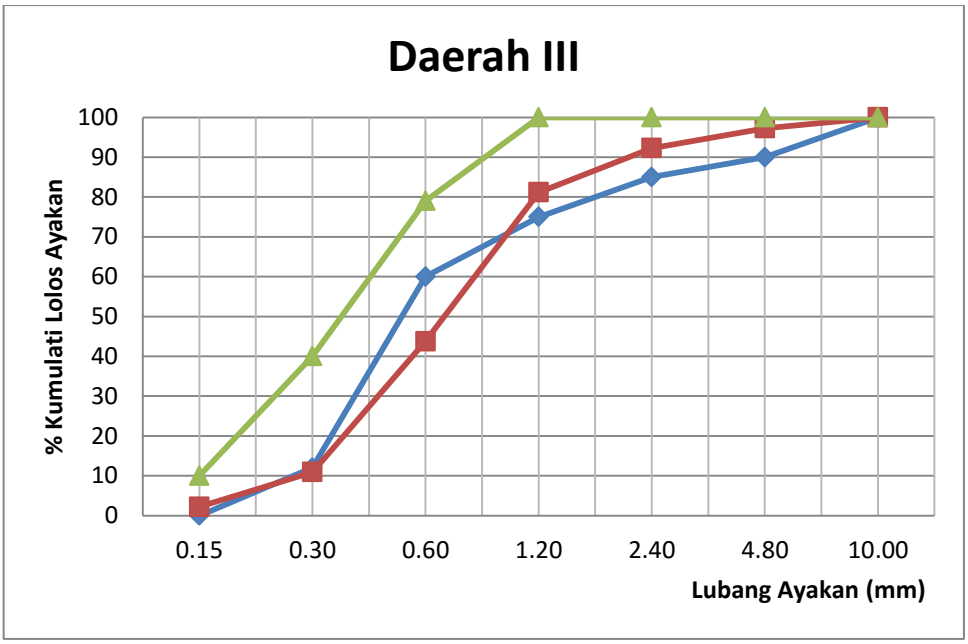
## Pemeriksaan Berat Jenis Dan Penyerapan Air Agregat Kasar

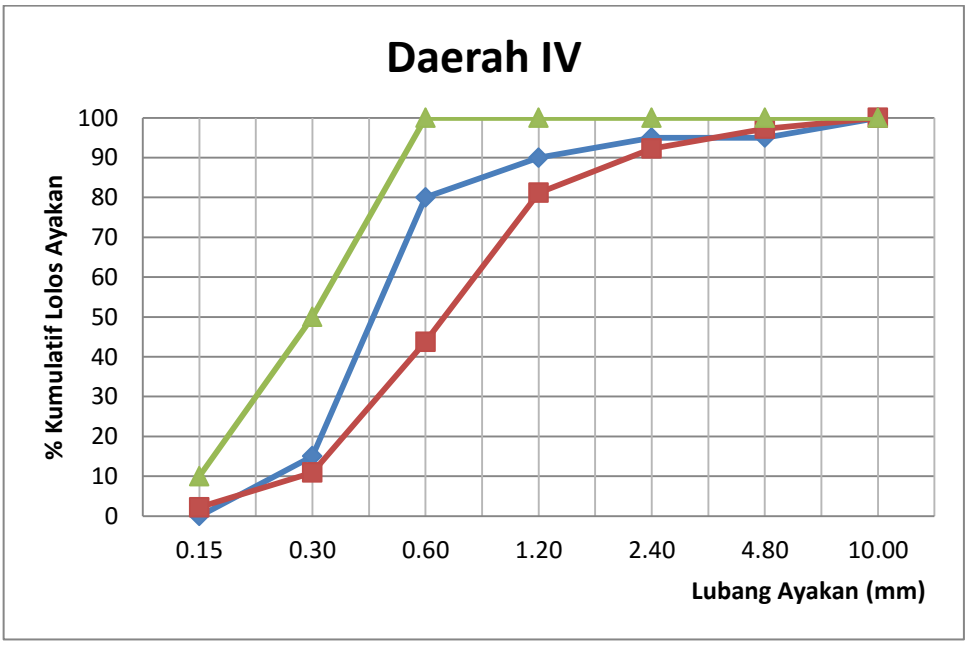
| Uraian | Jumlah | Satuan |
|---|---|---|
| Berat pasir kering mutlak (Bk) | 4920 | gram |
| Berat pasir kondisi jenuh kering muka (SSD) | 5000 | gram |
| Berat piknometer berisi air (Ba) | 3270 | gram |
| Berat Jenis Curah<br>Bk/(B+500-Bt)<br>.....(1) | 2.843 | - |
| Berat Jenis henuh kering muka<br>500/(B+500-Bt)<br>.....(2) | 2.890 | - |
| Berat Jenis semu<br>Bk/(B+Bk-Bt)<br>.....(3) | 2.981 | - |
| Penyerapan Air<br>(500-Bk)/Bk x 100%<br>.....(4) | 1.626 | - |

# Grafik Grading Pengujian Agregat Halus



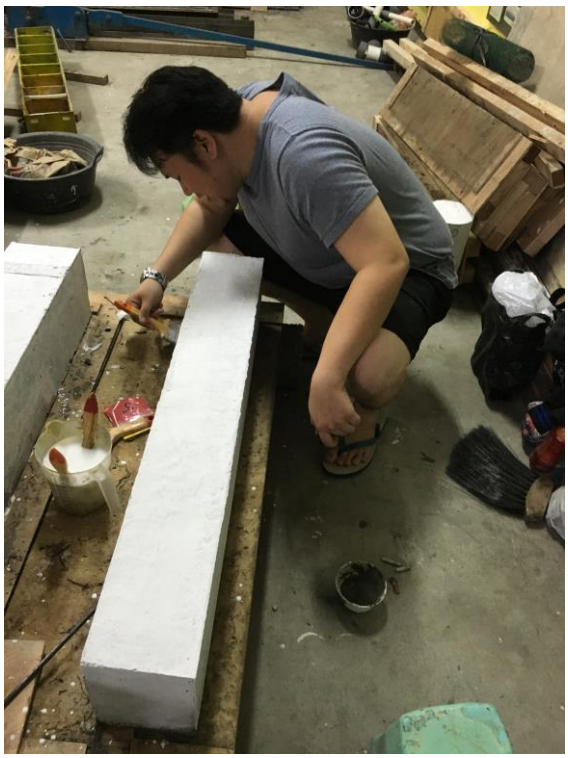

Daerah III
% Kumulati Lolos Ayakan
100
90
80
70
60
50
40
30
20
10
0
0.15
0.30
0.60
1.20
2.40
4.80
10.00
Lubang Ayakan (mm)


Daerah IV
% Kumulatif Lolos Ayakan
100
90
80
70
60
50
40
30
20
10
0
0.15
0.30
0.60
1.20
2.40
4.80
10.00
Lubang Ayakan (mm)

| MIX DESIGN SNI 03-2834-2000 | | | |
|---|---|---|---|
| Jenis semen | = | Type 1 | |
| Jenis pasir | = | Alami | |
| Jenis kerikil | = | Batu Pecah | |
| Berat jenis pasir | = | 2.866 | |
| Berat jenis kerikil | = | 2.982 | |
| Ukuran agregat maks | = | 40 | mm |
| Gradasi pasir | = | Daerah 2 | |
| F'c | = | 20 | Mpa |
| Deviasi standar | = | 7 | Mpa |
| M | = | 11,48 | Mpa |
| M (dibulatkan) | = | 12 | Mpa |
| F'cr | = | 32 | Mpa |
| **Nilai fas** | | | |
| Fas (tabel 2) | = | 0,6 | |
| Fas (grafik 1) | = | 0,541 | |
| Fas pakai | = | 0,6 | |
| Slump rencana | = | 60-180 | Mm |
| Kadar air bebas | | 185 | kg/m³ |
| Kadar semen | = | 341.9593 | kg/m³ |
| Kadar semen maks | = | 341.9593 | kg/m³ |
| Kadar semen min | = | 275 | kg/m³ |
| Kadar semen pakai | | 342 | kg/m³ |
| % Agregat halus | = | 37,5 | % |
| Berat jenis gabungan | = | 2.938 | Kg |
| Berat isi beton (grafik) | = | 2310 | Kg |
| Kadar agregat gabungan | = | 1783 | Kg |
| Kadar agregat halus | = | 668,625 | Kg |
| Kadar agregat kasar | = | 1114 | kg |

| Kebutuhan setiap m3 | | | |
|---|---|---|---|
| Air | = | 185 | kg |
| Semen | = | 342 | kg |
| Pasir | = | 668,6 | kg |
| Kerikil | = | 1114 | kg |
| **Benda uji** | | | |
| 5 Balok | = | 5*(0,1*0,2*1) | m3 |
| | = | 0,100 | m3 |
| Penyusutan | = | 115% | |
| Vol penyusutan | = | 0,1242 | |
| Setiap campuran benda uji | | | |
| Air | = | 19 | kg |
| Semen | = | 45,6 | kg |
| Pasir | = | 95,3 | kg |
| Kerikil | = | 148,1 | kg |

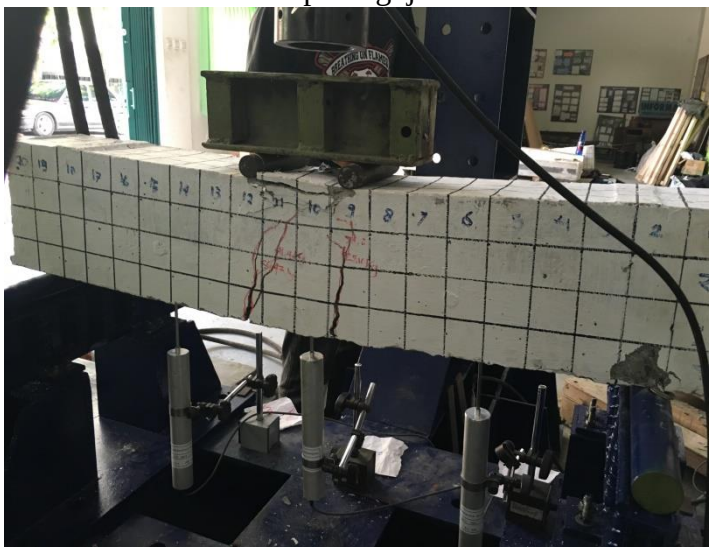
## Lampiran 2. Dokumentasi



1.Perawatan Balok

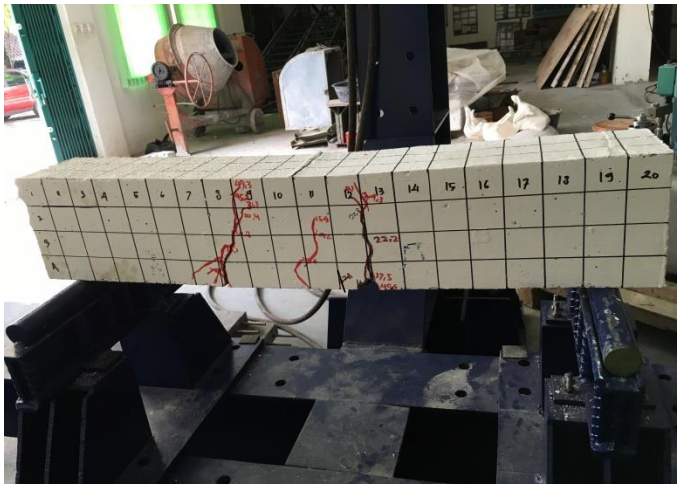
2.Pemasangan Perkuatan

3.Set Up Pengujian Balok



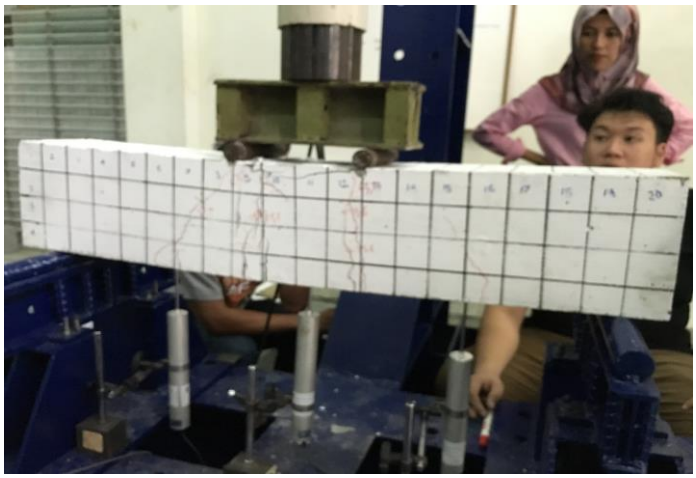
4.Pola Keretakan BK-1 (A)

5.Pola Keretakan BK-1 (B)

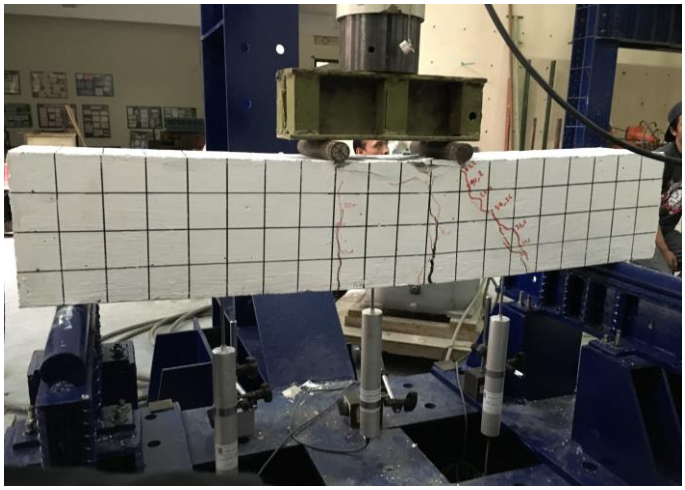


6.Pola Keretakan BP-1 Tanpa Perkuatan (A)

7.Pola Keretakan BP-1 Tanpa Perkuatan  (B)

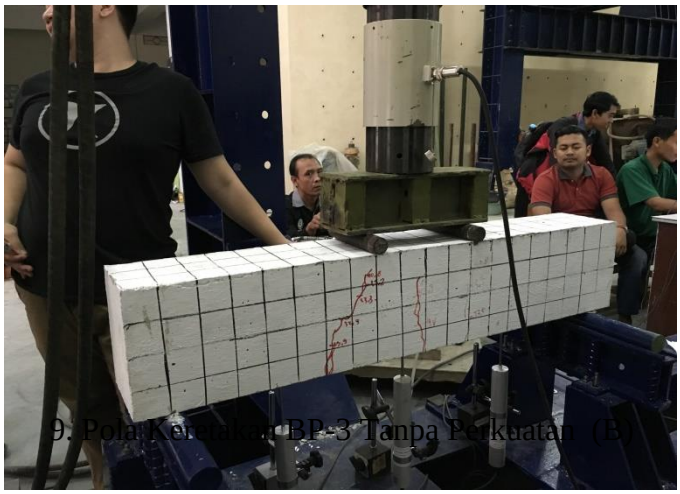


8.Pola Keretakan BP-2 Tanpa Perkuatan  (A)



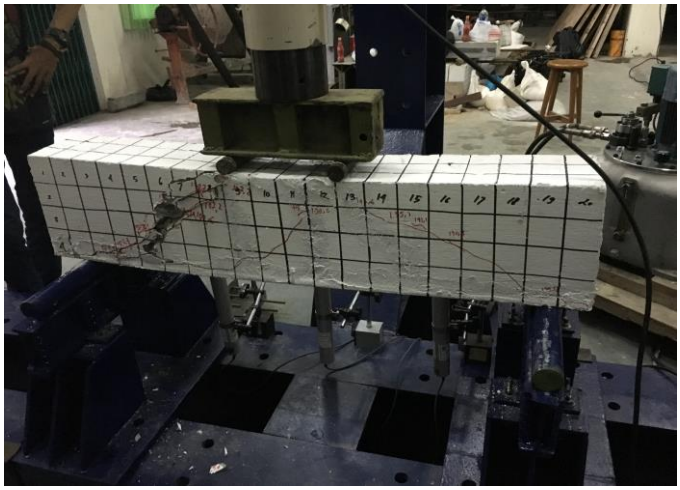
10.Pola Keretakan BP-3 Tanpa Perkuatan (A)


10.Pola Keretakan BP-3 Tanpa Perkuatan (A)

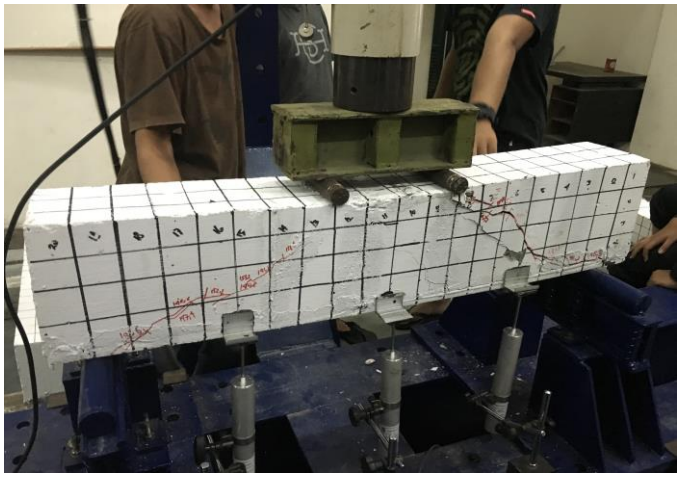


9. Pola Keretakan BP-3 Tanpa Perkuatan (B)

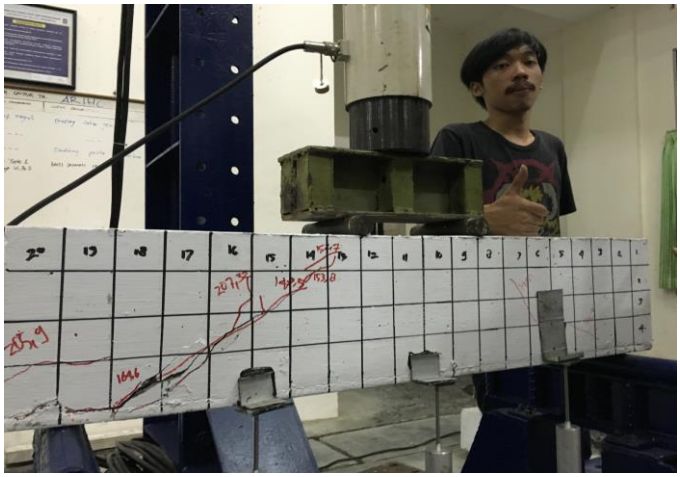
11. Pola Keretakan BP-3 Tanpa Perkuatan (A)



12. Pola Keretakan BP-1 Dengan Perkuatan (A)

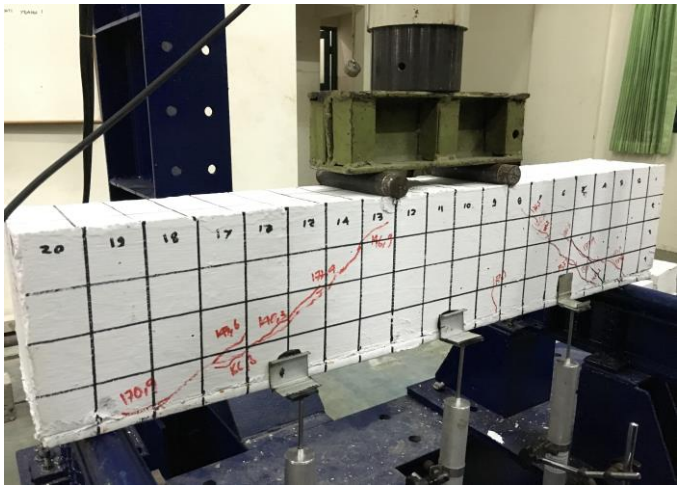


13. Pola Keretakan BP-1 Dengan Perkuatan (B)

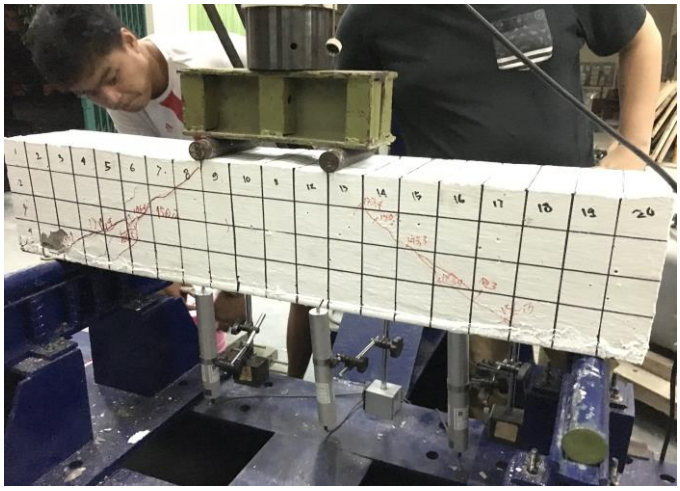


14. Pola Keretakan BP-2 Dengan Perkuatan (A)

15. Pola Keretakan BP-2 Dengan Perkuatan (B)



16. Pola Keretakan BP-3 Dengan Perkuatan (A)



17. Pola Keretakan BP-3 Dengan Perkuatan (B)

Construction

# Sikadur®-31 CF Normal

## 2-part thixotropic epoxy adhesive

### Product Description

Sikadur®-31 CF Normal is a moisture tolerant, thixotropic, structural two part adhesive and repair mortar, based on a combination of epoxy resins and special fillers, designed for use at temperatures between +10°C and +30°C.

### Uses

As a structural adhesive and mortar for:

- Concrete elements
- Hard natural stone
- Ceramics, fiber cement
- Mortar, Bricks, Masonry
- Steel, Iron, Aluminium
- Wood
- Polyester, Epoxy
- Glass

As a repair mortar and adhesive:

- Corners and edges
- Holes and void filling
- Vertical and overhead use

Joint filling and crack sealing:

- Joint and crack arris / edge repair

### Characteristics / Advantages

Sikadur®-31 CF Normal has the following advantages:

- Easy to mix and apply
- Very good adhesion to most construction materials
- High strength adhesive
- Thixotropic: non-sag in vertical and overhead applications
- Hardens without shrinkage
- Different coloured components (for mixing control)
- No primer needed
- High initial and ultimate mechanical strength
- Good abrasion resistance
- Impermeable to liquids and water vapour
- Good chemical resistance

### Tests

| | |
|---|---|
| **Approval / Standards** | Testing according to EN 1504-4. |

## Product Data

### Form

| | |
|---|---|
| **Colours** | Part A: white<br>Part B: dark grey<br>Parts A+B mixed: concrete grey |
| **Packaging** | 6 kg (A+B) Pre-batched unit, pallets of 480 kg (80 x 6 kg).<br>1.2 kg (A+B) Pre-batched unit, box of 6 x 1.2 kg. |

### Storage

| | |
|---|---|
| **Storage Conditions / Shelf Life** | 24 months from date of production if stored properly in original unopened, sealed and undamaged packaging, in dry conditions at temperatures between +5°C and +30°C. Protect from direct sunshine. |

### Technical Data

| | |
|---|---|
| **Chemical Base** | Epoxy resin. |
| **Density** | 1.90 $\pm$ 0.1 kg/l (part A+B mixed) (at +23°C) (evacuated) |
| **Sag Flow** | On vertical surfaces it is non-sag up to 15 mm thickness. (According to EN 1799) |
| **Layer Thickness** | 30 mm max.<br>When using multiple units, one after the other. Do not mix the following unit until the previous one has been used in order to avoid a reduction in handling time. |
| **Change of Volume** | Shrinkage:<br>Hardens without shrinkage. |
| **Thermal Expansion Coefficient** | Coefficient W:<br>$5.9 \times 10^{-5}$ per °C (Temp. range +23°C - +60°C) (According EN 1770) |
| **Thermal Stability** | Heat Deflection Temperature (HDT):<br>HDT = +49°C (7 days / +23°C) (According to ISO 75) (thickness 10 mm) |

## Mechanical / Physical Properties

### Compressive Strength

(According to DIN EN 196)

| | Curing temperature | | |
|---|---|---|---|
| Curing time | +10°C | +23°C | +30°C |
| 1 day | 25 - 35 N/mm$^2$ | 45 -55 N/mm$^2$ | 50 - 60 N/mm$^2$ |
| 3 days | 40 - 50 N/mm$^2$ | 55 -65 N/mm$^2$ | 60 - 70 N/mm$^2$ |
| 7 days | 50 - 60 N/mm$^2$ | 60 -70 N/mm$^2$ | 60 - 70 N/mm$^2$ |

### Flexural Strength

(According to DIN EN 196)

| | Curing temperature | | |
|---|---|---|---|
| Curing time | +10°C | +23°C | +30°C |
| 1 day | 11 - 17 N/mm$^2$ | 20 - 30 N/mm$^2$ | 20 - 30 N/mm$^2$ |
| 3 days | 20 - 30 N/mm$^2$ | 25 - 35 N/mm$^2$ | 25 - 35 N/mm$^2$ |
| 7 days | 25 - 35 N/mm$^2$ | 30 - 40 N/mm$^2$ | 30 - 40 N/mm$^2$ |

### Tensile Strength

(According to ISO 527)

| | Curing temperature | | |
|---|---|---|---|
| Curing time | +10°C | +23°C | +30°C |
| 1 day | 2 - 6 N/mm$^2$ | 6 - 10 N/mm$^2$ | 9 - 15 N/mm$^2$ |
| 3 days | 9 - 15 N/mm$^2$ | 17 - 23 N/mm$^2$ | 17 - 23 N/mm$^2$ |
| 7 days | 14 - 20 N/mm$^2$ | 18 - 24 N/mm$^2$ | 19 - 25 N/mm$^2$ |

### Bond Strength

(According to EN ISO 4624, EN 1542 and EN 12188)

| Time | Temperature | Substrate | Bond strength |
|---|---|---|---|
| 1 day | +10°C | Concrete dry | > 4 N/mm$^2$ * |
| 1 day | +10°C | Concrete moist | > 4 N/mm$^2$ * |
| 1 day | +10°C | Steel | 6 - 10 N/mm$^2$ |
| 3 days | +10°C | Steel | 10 - 14 N/mm$^2$ |
| 3 days | +23°C | Steel | 11 - 15 N/mm$^2$ |
| 3 days | +30°C | Steel | 13 - 17 N/mm$^2$ |

*100% concrete failure.

### E-Modulus

Tensile:
~ 5'000 N/mm$^2$ (14 days at +23°C) (According to ISO 527)

Compressive:
~ 4'600 N/mm$^2$ (14 days at +23°C) (According to ASTM D695)

### Elongation at Break

0.4 $\pm$ 0.1% (7days at +23°C) (According to ISO 527)

## System Information

### Application Details

| | |
|---|---|
| **Consumption / Dosage** | The consumption of Sikadur®-31 CF Normal is ~ 1.9 kg/m$^2$ per mm of thickness. |
| **Substrate Quality** | Mortar and concrete must be older than 28 days (depends on minimal requirement of strengths).<br>Verify the substrate strength (concrete, masonry, natural stone).<br>The substrate surface (all types) must be clean, dry or mat damp (no standing water) and free from contaminants such as dirt, oil, grease, existing surface treatments and coatings etc..<br>Steel substrates must be de-rusted similar to Sa 2.5.<br>The substrate must be sound and all loose particles must be removed. |
| **Substrate Preparation** | Concrete, mortar, stone, bricks:<br>Substrates must be sound, dry or mat damp (no standing water), clean and free from laitance, ice, standing water, grease, oils, old surface treatments or coatings and all loose or friable particles must be removed to achieve a laitance and contaminant free, open textured surface.<br>Steel:<br>Must be cleaned and prepared thoroughly to an acceptable quality i.e. by blastcleaning and vacuum. Avoid dew point conditions. |

### Application Conditions / Limitations

| | |
|---|---|
| **Substrate Temperature** | +10°C min. / +30°C max. |
| **Ambient Temperature** | +10°C min. / +30°C max. |
| **Material Temperature** | Sikadur®-31 CF Normal must be applied at temperatures between +10°C and +30°C |
| **Substrate Moisture Content** | Substrate must be dry or mat damp (no standing water)<br>Brush the adhesive well into the substrate |
| **Dew Point** | Beware of condensation!<br>Substrate temperature during application must be at least 3°C above dew point. |

### Application Instructions

| | |
|---|---|
| **Mixing** | Part A : part B = 2 : 1 by weight or volume |
| **Mixing Time** |  <br>Pre-batched units:<br>Mix parts A+B together for at least 3 minutes with a mixing spindle attached to a slow speed electric drill (max. 300 rpm) until the material becomes smooth in consistency and a uniform grey colour. Avoid aeration while mixing. Then, pour the whole mix into a clean container and stir again for approx. 1 more minute at low speed to keep air entrapment at a minimum. Mix only that quantity which can be used within its potlife. |
| **Application Method / Tools** | When using a thin layer adhesive, apply the mixed adhesive to the prepared surface with a spatula, trowel, notched trowel, (or with hands protected by gloves).<br>When applying as a repair mortar use some formwork.<br>When using for bonding metal profiles onto vertical surfaces ,support and press uniformly using props for at least 12 hours, depending on the thickness applied (not more than 5 mm) and the room temperature.<br>Once hardened check the adhesion by tapping with a hammer. |

Construction

**Cleaning of Tools**

Clean all tools and application equipment with Sika® Thinner C immediately after use. Hardened / cured material can only be mechanically removed.

**Potlife**

Potlife (200 g) (According to EN ISO 9514)

| +10°C | +23°C | +30°C |
|---|---|---|
| ~ 145 minutes | ~ 55 minutes | ~ 35 minutes |

The potlife begins when the resin and hardener are mixed. It is shorter at high temperatures and longer at low temperatures. The greater the quantity mixed, the shorter the potlife. To obtain longer workability at high temperatures, the mixed adhesive may be divided into portions. Another method is to chill parts A+B before mixing them (not below +5°C).

**Notes on Application / Limitations**

Sikadur® resins are formulated to have low creep under permanent loading. However due to the creep behaviour of all polymer materials under load, the long term structural design load must account for creep. Generally the long term structural design load must be lower than 20-25% of the failure load. Please consult a structural engineer for load calculations for your specific application.

## Value Base

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

## Local Restrictions

Please note that as a result of specific local regulations the performance of this product may vary from country to country. Please consult the local Product Data Sheet for the exact description of the application fields.

## Health and Safety Information

For information and advice on the safe handling, storage and disposal of chemical products, users shall refer to the most recent Material Safety Data Sheet containing physical, ecological, toxicological and other safety-related data.

## Legal Notes

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika's recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the product's suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

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