

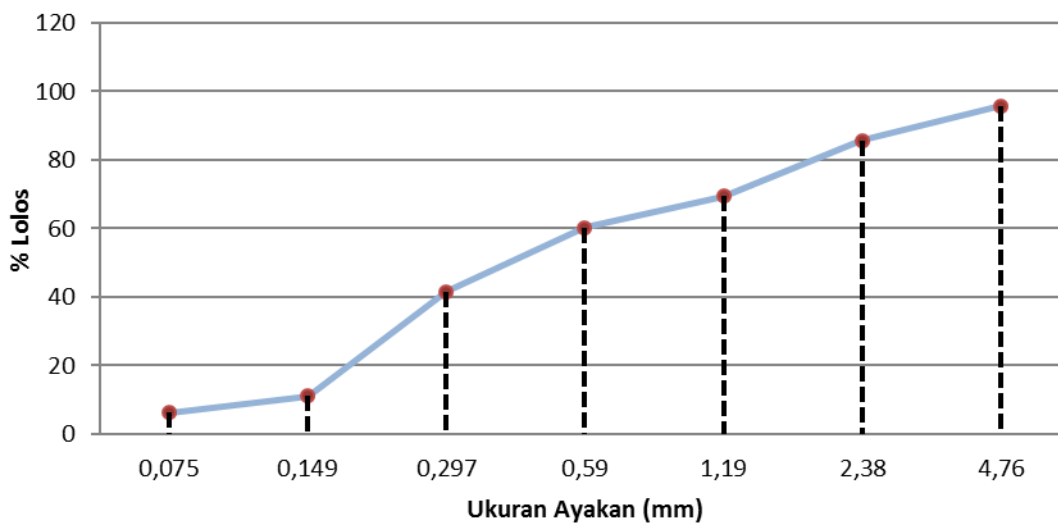


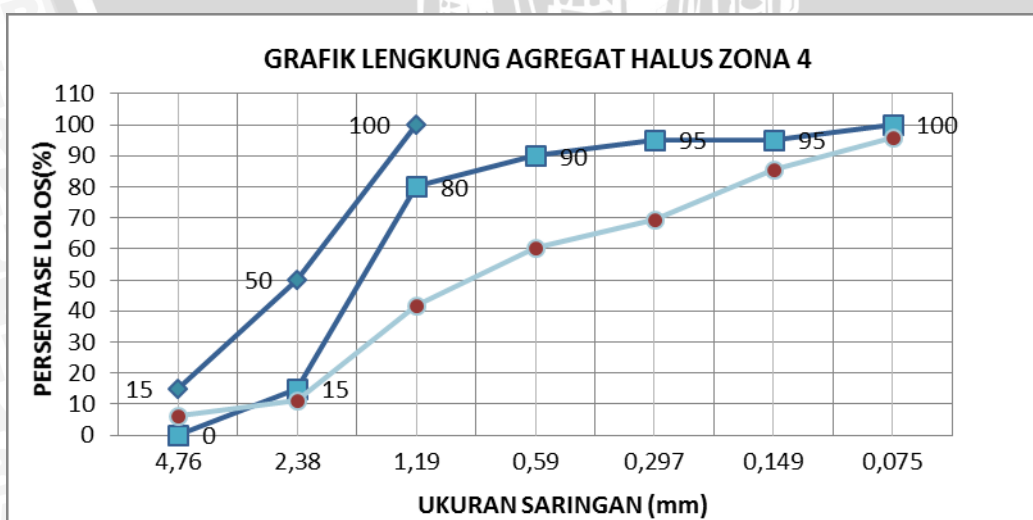
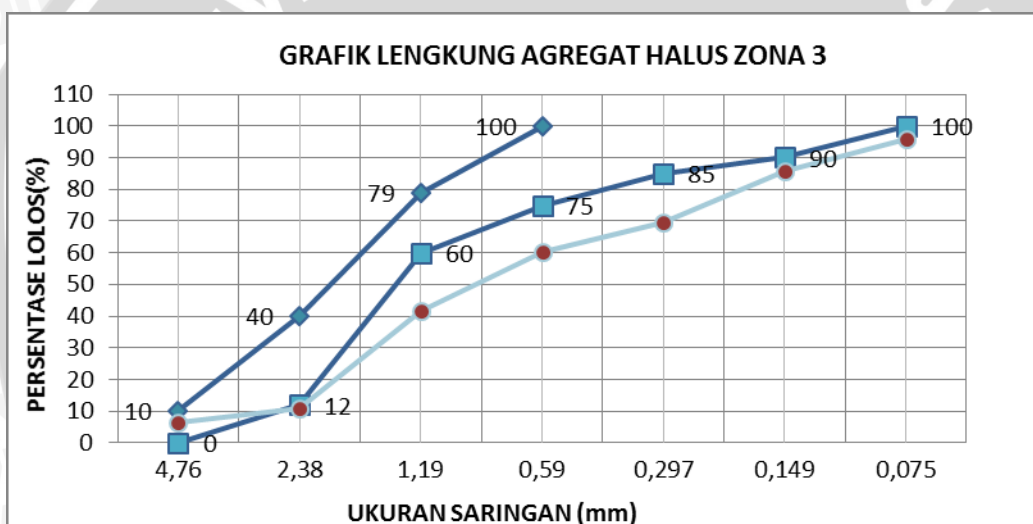
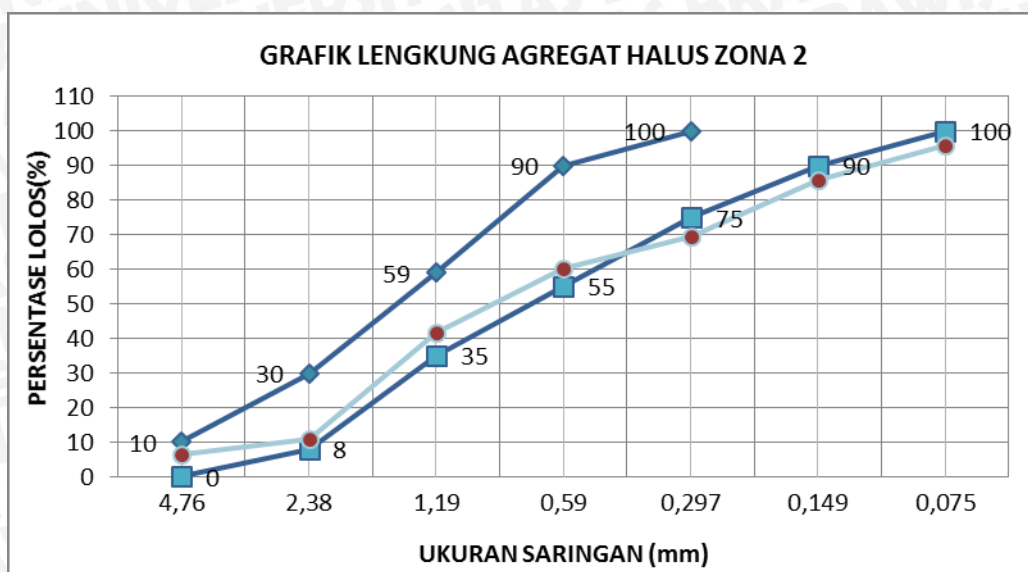
## LAMPIRAN

### Lampiran 1. Hasil Analisa Gradasi Agregat Halus

| Lubang Saringan |       | Pasir      |        | %Kumulatif |        |
|-----------------|-------|------------|--------|------------|--------|
| no              | Mm    | Tertinggal | %      | Tertinggal | Lolos  |
| 3"              | 76,2  | -          | -      | -          | -      |
| 2.5"            | 63,5  | -          | -      | -          | -      |
| 2"              | 50,8  | -          | -      | -          | -      |
| 1.5"            | 38,1  | -          | -      | -          | -      |
| 1"              | 25,4  | -          | -      | -          | -      |
| 3/4"            | 19,1  | -          | -      | -          | -      |
| 1/2"            | 12,7  | -          | -      | -          | -      |
| 3/8"            | 9,5   | -          | -      | -          | 100    |
| 4               | 4,76  | 37,8       | 3,848  | 3,848      | 96,152 |
| 8               | 2,38  | 63,20      | 6,433  | 10,281     | 89,719 |
| 16              | 1,19  | 105,3      | 10,719 | 21,000     | 79,000 |
| 30              | 0,59  | 192,9      | 19,636 | 40,635     | 59,365 |
| 50              | 0,297 | 200,6      | 20,419 | 61,055     | 38,945 |
| 100             | 0,149 | 230,6      | 23,473 | 84,528     | 15,472 |
| 200             | 0,075 | 99,9       | 10,169 | 94,697     | 5,303  |
| Pan             |       | 52,1       | 5,303  | -          | -      |
| $\Sigma =$      |       | 982,4      | 100    | 316,042    |        |

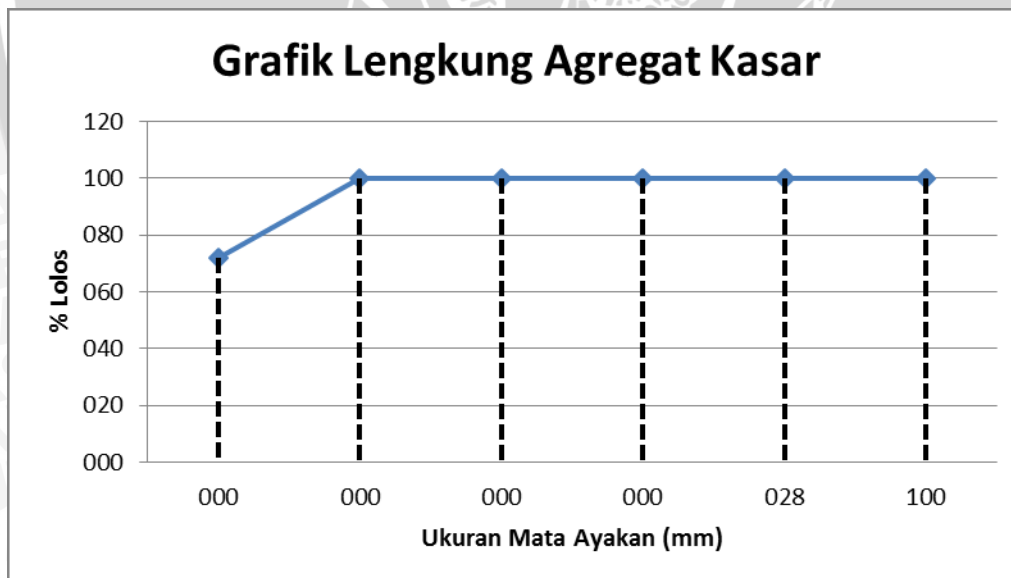
### Grafik Lengkung Agregat Halus

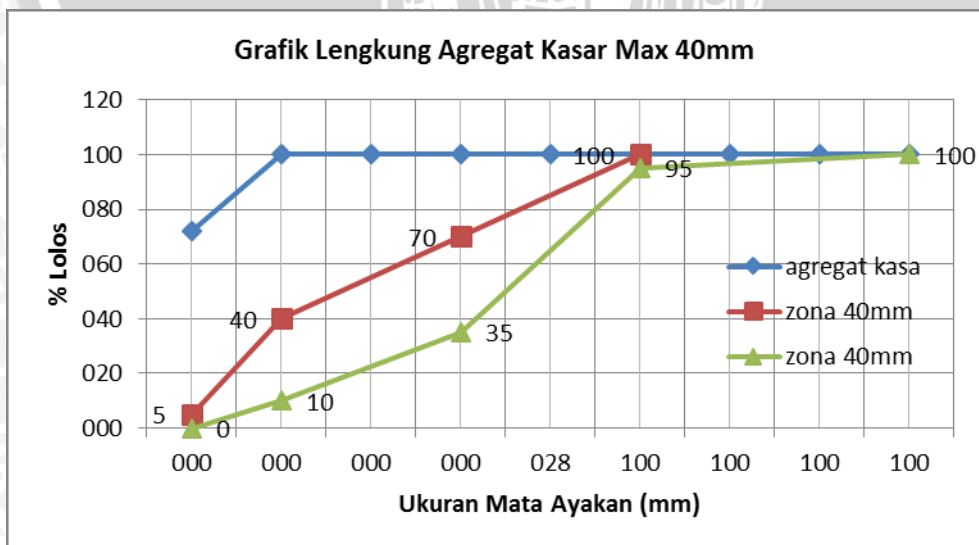
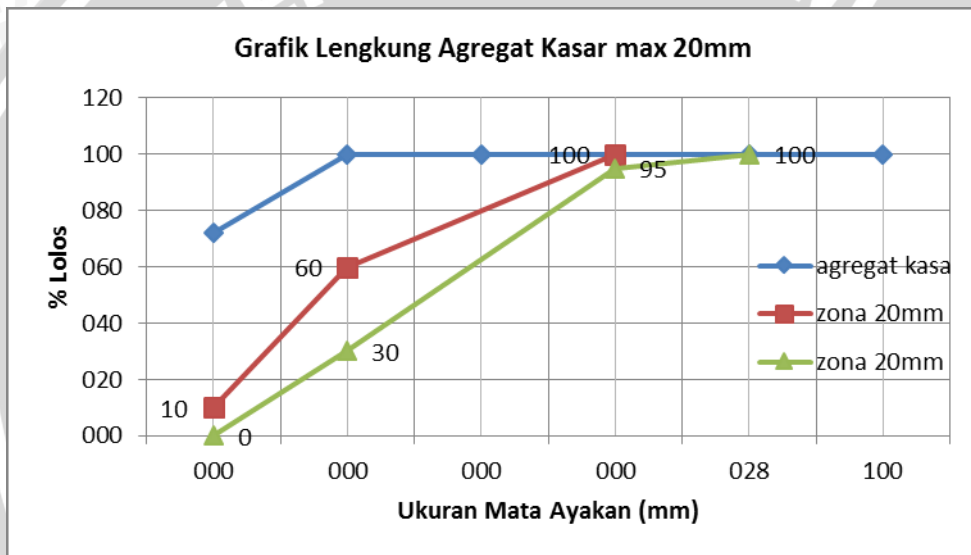
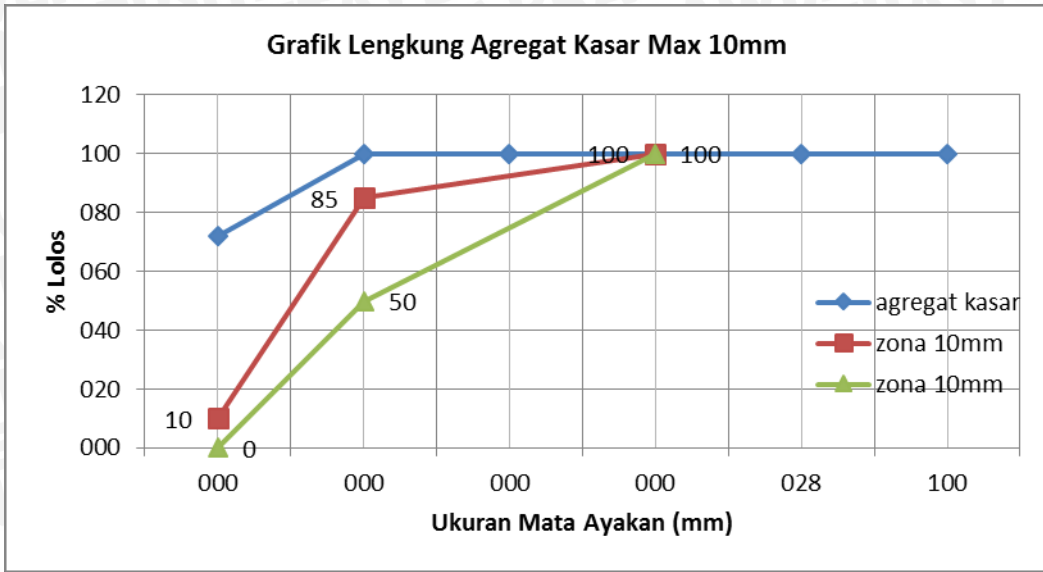




## Lampiran 2. Hasil Analisa Gradasi Agregat Kasar

| Lubang Saringan |       | Pasir      |       |            |        |
|-----------------|-------|------------|-------|------------|--------|
|                 |       | Tertinggal |       | %Kumulatif |        |
| no              | Mm    | Gram       | %     | Tertinggal | Lolos  |
| 3"              | 76,2  | -          | -     | -          | 100    |
| 2.5"            | 63,5  | -          | -     | -          | 100    |
| 2"              | 50,8  | -          | -     | -          | 100    |
| 1.5"            | 38,1  | -          | -     | -          | 100    |
| 1"              | 25,4  | 0          | 0,00  | 0,00       | 100,00 |
| 0.75"           | 19,1  | 0          | 0,00  | 0,00       | 100,00 |
| 0.5"            | 12,7  | 0          | 0,00  | 0,00       | 100,00 |
| 0.375"          | 9,5   | 0          | 0,00  | 0,00       | 100,00 |
| 4               | 4,76  | 2800       | 28,00 | 28,00      | 72,00  |
| 8               | 2,38  | 7200       | 72,00 | 100,00     | -      |
| 16              | 1,19  | -          | -     | 100,00     | -      |
| 20              | 0,85  | -          | -     | 100,00     | -      |
| 50              | 0,297 | -          | -     | 100,00     | -      |
| 100             | 0,149 | -          | -     | 100,00     | -      |
| 200             | 0,075 | -          | -     | 100,00     | -      |
| Pan             |       | -          | -     | 100,00     | -      |
| $\Sigma =$      |       | 10000      | 100,0 | 728,00     |        |





### Lampiran 3 Kadar Air agregat Halus dan Kasar

#### KADAR AIR AGREGAT HALUS

| Nomor Contoh |                               |      | 1    |      |
|--------------|-------------------------------|------|------|------|
| Nomor Talam  |                               |      | A    | B    |
| 1            | Berat Talam + Contoh basah    | (gr) | 103  | 103  |
| 2            | Berat Talam + Contoh kering   | (gr) | 99,6 | 99,5 |
| 3            | Berat Air = (1)-(2)           | (gr) | 3,4  | 3,5  |
| 4            | Berat Talam                   | (gr) | 25,1 | 24,9 |
| 5            | Berat Contoh Kering = (2)-(4) | (gr) | 74,5 | 74,6 |
| 6            | Kadar Air = (3)/(5)           | (%)  | 4,56 | 4,69 |
| 7            | Kadar Air rata-rata           | (%)  | 4,63 |      |

#### KADAR AIR AGREGAT KASAR

| Nomor Contoh |                               |      | 1    |      |
|--------------|-------------------------------|------|------|------|
| Nomor Talam  |                               |      | A    | B    |
| 1            | Berat Talam + Contoh basah    | (gr) | 103  | 103  |
| 2            | Berat Talam + Contoh kering   | (gr) | 99,6 | 99,5 |
| 3            | Berat Air = (1)-(2)           | (gr) | 3,4  | 3,5  |
| 4            | Berat Talam                   | (gr) | 25,1 | 24,9 |
| 5            | Berat Contoh Kering = (2)-(4) | (gr) | 74,5 | 74,6 |
| 6            | Kadar Air = (3)/(5)           | (%)  | 4,56 | 4,7  |
| 7            | Kadar Air rata-rata           | (%)  | 4,63 |      |



### Lampiran 4. Pemeriksaan Berat Isi Agregat Halus dan Kasar

#### PEMERIKSAAN BERAT ISI AGREGAT HALUS

|   |                                   |         |               |                 |
|---|-----------------------------------|---------|---------------|-----------------|
| 1 | Berat takaran                     | (gr)    | 1650          | 1650            |
| 2 | Berat takaran + air               | (gr)    | 4700          | 4700            |
| 3 | Berat air = (2)-(1)               | (gr)    | 3050          | 3050            |
| 4 | Volume air = (3)/(1)              | (cc)    | 3050,0        | 3050            |
|   | <b>CARA</b>                       |         | <b>RODDED</b> | <b>SHOVELED</b> |
| 5 | Berat Takaran                     | (gr)    | 1650          | 1650            |
| 6 | Berat takaran + benda uji         | (gr)    | 6650          | 6000            |
| 7 | Berat benda uji = (6)-(5)         | (gr)    | 5000          | 4350            |
| 8 | Berat isi agregat halus = (7)/(4) | (gr/cc) | 1,6393        | 1,4262          |
| 9 | Berat isi agregat halus rata-rata | (gr/cc) |               | 1,533           |

#### PEMERIKSAAN BERAT ISI AGREGAT KASAR

|   |                                   |         |               |                 |
|---|-----------------------------------|---------|---------------|-----------------|
| 1 | Berat takaran                     | (gr)    | 1640          | 1640            |
| 2 | Berat takaran + air               | (gr)    | 4780          | 4780            |
| 3 | Berat air = (2)-(1)               | (gr)    | 3140          | 3140            |
| 4 | Volume air = (3)/(1)              | (cc)    | 3140          | 3140            |
|   | <b>CARA</b>                       |         | <b>RODDED</b> | <b>SHOVELED</b> |
| 5 | Berat Takaran                     | (gr)    | 1640          | 1640            |
| 6 | Berat takaran + benda uji         | (gr)    | 5800          | 5400            |
| 7 | Berat benda uji = (6)-(5)         | (gr)    | 4160          | 3760            |
| 8 | Berat isi agregat halus = (7)/(4) | (gr/cc) | 1,3248        | 1,1975          |
| 9 | Berat isi agregat kasar rata-rata | (gr/cc) |               | 1,26            |

## Lampiran 5. Berat Jenis dan Penyerapan Agregat Halus dan Kasar

### BERAT JENIS DAN PENYERAPAN AGREGAT HALUS

| NOMOR CONTOH   |     |      | A      |
|--|-----|------|--------|
| Berat benda uji kering permukaan jenuh                   | 500 | (gr) | 500    |
| Berat benda uji kering oven                              | Bk  | (gr) | 496,1  |
| Berat benda uji dalam air                                | B   | (gr) | 657,1  |
| Berat piknometer + benda uji (ssd) + air (pd suhu kamar) | Bt  | (gr) | 1002,1 |

| NOMOR CONTOH  |                            | B            |
|---|----------------------------|--------------|
| Berat Jenis Curah<br>(Bulk Specific Grafity)  | $Bk/(B+500-Bt)$            | 3,201        |
| Berat Jenis Kering Permukaan Jenuh<br>(Bulk Specific Grafity Saturated Surface Dry) | $500/(B+500-Bt)$           | <b>3,226</b> |
| Berat Jenis Semu<br>Apparent Specific Gravity)                                      | $Bk/(B+Bk-Bt)$             | 3,283        |
| Penyerapan (%)<br>(Absorption)  | $(500-Bk)/Bk \times 100\%$ | 0,786        |

### BERAT JENIS DAN PENYERAPAN AGREGAT KASAR

| Nomor Contoh                           |    |      | A     |
|--|----|------|-------|
| Berat benda uji kering permukaan jenuh | Bj | (gr) | 980   |
| Berat benda uji kering oven            | Bk | (gr) | 960   |
| Berat benda uji dalam air              | Ba | (gr) | 537,1 |

| Nomor Contoh  |                           | B     |
|---|---------------------------|-------|
| Berat Jenis Curah<br>(Bulk Specific Grafity)  | $Bk/(Bj-Ba)$              | 2,168 |
| Berat Jenis Kering Permukaan Jenuh<br>(Bulk Specific Grafity Saturated Surface Dry) | $Bj/(Bj-Ba)$              | 2,213 |
| Berat Jenis Semu<br>Apparent Specific Gravity)                                      | $Bk/(Bk-Ba)$              | 2,270 |
| Penyerapan (%)<br>(Absorption)  | $(Bj-Bk)/Bk \times 100\%$ | 2,083 |



### Lampiran 6. Data Perancangan Beton Normal

| NO   | URAIAN                                 | TABEL / GRAFIK      | NILAI                     |                        |                        |
|--|--|---------------------|---------------------------|------------------------|------------------------|
| 1  | Kuat tekan yang disyaratkan (2 HR, 5%) | Ditetapkan          | 22.5 Mpa                  |                        |                        |
| 2  | Deviasi standar                        | Diketahui           | -                         |                        |                        |
| 3  | Nilai Tambah (Margin)                  | (K=1,64) 1,64*(2)   | 12 Mpa                    |                        |                        |
| 4  | Kuat tekan rata2 yg ditargetkan        | (1) + (3)           | 34.5 Mpa                  |                        |                        |
| 5  | Jenis Semen                            | Ditetapkan          | Normal (Tipe I)           |                        |                        |
| 6  | Jenis Agregat Kasar                    | Ditetapkan          | Batu pecah                |                        |                        |
|  | Jenis Agregat Halus                    | Ditetapkan          | Pasir                     |                        |                        |
| 7  | Faktor Air semen Bebas                 | Tabel 2, Grafik 1/2 | 0,52                      |                        |                        |
| 8  | Faktor air semen Maksimum              | Ditetapkan          | 0,6                       |                        |                        |
| 9  | Slump                                  | Ditetapkan          | 60 - 180 mm               |                        |                        |
| 10   | Ukuran Agregat Maksimum                | Ditetapkan          | 5 mm                      |                        |                        |
| 11   | Kadar Air Bebas                        | TABEL 6             | 205 kg/m <sup>3</sup>     |                        |                        |
| 12   | Jumlah semen                           | (11) : (8)          | 394,231                   |                        |                        |
| 13   | Jumlah Semen Maksimum                  | Ditetapkan          | -                         |                        |                        |
| 14   | Jumlah Semen Minimum                   | Ditetapkan          | 275 kg/m <sup>3</sup>     |                        |                        |
| 15   | FAS yg disesuaikan                     | -                   | -                         |                        |                        |
| 16   | Susunan besar butir agregat halus      | Grafik 3 - 6        | Zona 2                    |                        |                        |
| 17   | Persen agregat halus                   | Grafik 13 - 15      | 40%                       |                        |                        |
| 18   | Berat isi relatif agregat (SSD)        | Diketahui           | 2.875 kg/m <sup>3</sup>   |                        |                        |
| 19   | Berat isi beton                        | Grafik 16           | 2520 kg/m <sup>3</sup>    |                        |                        |
| 20   | Kadar agregat gabungan                 | (19) - (11) - (12)  | 1973.33 kg/m <sup>3</sup> |                        |                        |
| 21   | Kadar agregat halus                    | (17) * (20)         | 986.665 kg/m <sup>3</sup> |                        |                        |
| 22   | Kadar agregat kasar                    | (20) - (21)         | 986.665 kg/m <sup>3</sup> |                        |                        |
| Banyaknya Bahan<br>(Teoritis)                    |  | Semen<br>( kg )     | Air<br>( kg/lt )          | Ag.<br>Halus<br>( kg ) | Ag.<br>Kasar<br>( kg ) |
| Tiap m <sup>3</sup> dg ketelitian 5kg (Teoritis) |  | 394,23              | 205                       | 768,308                | 1152,462               |
| Tiap campuran uji 0,034 m <sup>3</sup>           |  | 13,31               | 6,92                      | 25,93                  | 38,90                  |
| Tiap m <sup>3</sup> dg ketelitian 5kg (Aktual)   |  | 394,23              | 146,16                    | 797,823                | 1181,785               |
| Tiap campuran uji 0,034 m <sup>3</sup>           |  | 13,31               | 4,93                      | 26,93                  | 39,89                  |
| Proporsi (Teoritis) (1/3)                        |  | 1                   | 0,5                       | 1,9                    | 2,9                    |
| Proporsi (Aktual)                                |  | 1                   | 0,4                       | 2,02                   | 3,00                   |

### Lampiran 7. Hasil Pengujian Kuat Tekan Beton

| BEN<br>DA<br>UJI | BERA<br>T | LUAS<br>PENAMP<br>ANG | VOLU<br>ME      | BERAT<br>ISI       | UM<br>UR | BEBAN<br>MAKSI<br>MUM | KUAT<br>TEKAN<br>7hari (fci) | KUAT<br>TEKAN<br>28 hari<br>(fci) | fcm                    | (fci-<br>fcm)2     | S                      | f'c                    | syarat 1 :               | syarat 2 :                     |
|------------------|-----------|-----------------------|-----------------|--------------------|----------|-----------------------|------------------------------|-----------------------------------|------------------------|--------------------|------------------------|------------------------|--------------------------|--------------------------------|
|                  |           |                       |                 |                    |          |                       |                              |                                   |                        |                    |                        |                        | 0,85 x<br>f <sub>c</sub> | f <sub>c</sub> ' + 0.82 x<br>s |
| No               | kg        | cm <sup>2</sup>       | cm <sup>3</sup> | kg/cm <sup>3</sup> | hari     | kg                    | kg/cm <sup>2</sup>           | kg/cm <sup>2</sup>                | kg/c<br>m <sup>2</sup> | kg/cm <sup>2</sup> | kg/c<br>m <sup>2</sup> | kg/c<br>m <sup>2</sup> | 108,282<br>0614          | 141,918                        |
| 1                | 8,1       | 225                   | 3375            | 0,00240<br>0       | 7        | 19100                 | 84,889                       | 130,598                           | 156,4<br>44            | 668,02<br>4        | 17,7<br>16             | 127,3<br>91            | memenu<br>hi             | tidak<br>memenuhi              |
| 2                | 7,7       | 225                   | 3375            | 0,00228<br>1       | 7        | 24000                 | 106,667                      | 164,103                           |                        | 58,647             |                        |                        | memenu<br>hi             | Memenuhi                       |
| 3                | 7,62      | 225                   | 3375            | 0,00225<br>8       | 7        | 21100                 | 93,778                       | 144,274                           |                        | 148,13<br>2        |                        |                        | memenu<br>hi             | Memenuhi                       |
| 4                | 7,84      | 225                   | 3375            | 0,00232<br>3       | 7        | 19600                 | 87,111                       | 134,017                           |                        | 502,98<br>6        |                        |                        | memenu<br>hi             | tidak<br>memenuhi              |
| 5                | 7,96      | 225                   | 3375            | 0,00235<br>9       | 7        | 21800                 | 96,889                       | 149,060                           |                        | 54,533             |                        |                        | memenu<br>hi             | Memenuhi                       |
| 6                | 7,82      | 225                   | 3375            | 0,00231<br>7       | 7        | 22900                 | 101,778                      | 156,581                           |                        | 0,019              |                        |                        | memenu<br>hi             | Memenuhi                       |
| 7                | 7,66      | 225                   | 3375            | 0,00227<br>0       | 7        | 24600                 | 109,333                      | 168,205                           |                        | 138,31<br>4        |                        |                        | memenu<br>hi             | Memenuhi                       |
| 8                | 8         | 225                   | 3375            | 0,00237<br>0       | 7        | 23100                 | 102,667                      | 157,949                           |                        | 2,263              |                        |                        | memenu<br>hi             | Memenuhi                       |
| 9                | 7,74      | 225                   | 3375            | 0,00229<br>3       | 7        | 25000                 | 111,111                      | 170,940                           |                        | 210,12<br>6        |                        |                        | memenu<br>hi             | Memenuhi                       |
| 10               | 7,58      | 225                   | 3375            | 0,00224<br>6       | 7        | 27600                 | 122,667                      | 188,718                           |                        | 1041,5<br>79       |                        |                        | memenu<br>hi             | Memenuhi                       |
|                  |           |                       |                 | 0,02311<br>7       |          |                       |                              | 1564,444                          |                        | 2824,6<br>21       |                        |                        |                          |                                |



### Lampiran 8. Hasil Uji Tarik Tulangan

Uji Tarik Tulangan Tarik  $\phi 12$

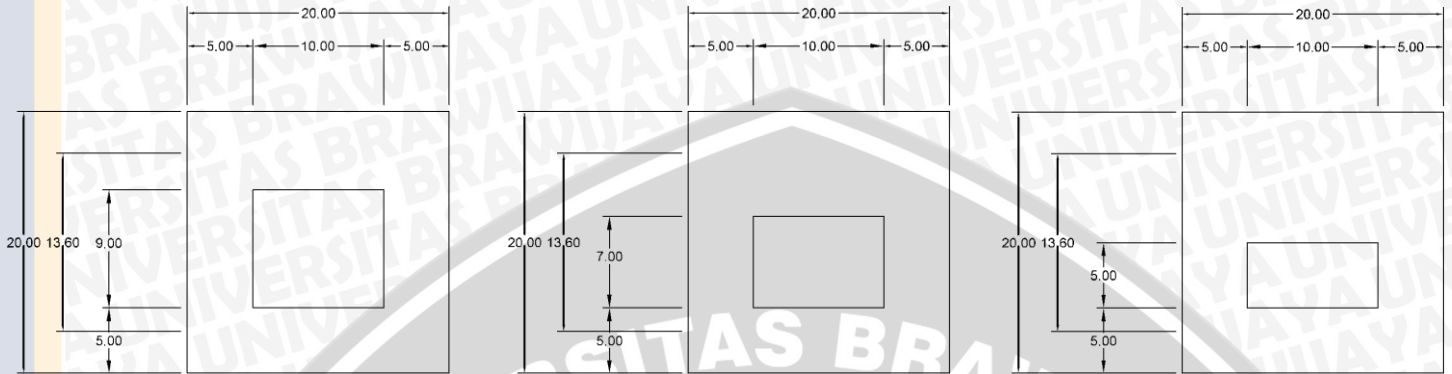
| No        | N/mm  | mm <sup>2</sup> | Mpa    |
|-----------|-------|-----------------|--------|
| 1         | 37000 | 113,04          | 327,32 |
| 2         | 34000 | 113,04          | 300,78 |
| 3         | 34500 | 113,04          | 305,20 |
| Rata-Rata |       |                 | 311,1  |

Uji Tarik Tulangan Geser  $\phi 6$

| No        | N/mm | mm <sup>2</sup> | Mpa    |
|-----------|------|-----------------|--------|
| 1         | 1600 | 28,26           | 56,62  |
| 2         | 4000 | 28,26           | 141,54 |
| 3         | 2800 | 28,26           | 99,08  |
| Rata-Rata |      |                 | 99,08  |



### Lampiran 9 Perhitungan Momen Inersia Penampang Balok



### Penentuan titik berat penampang

| Keterangan        | Luas (A)<br>(cm <sup>2</sup> ) | Jarak titik berat terhadap garis bawah y (cm) | A x y (cm <sup>3</sup> ) | Jarak titik berat terhadap garis bawah x (cm) | A x x (cm <sup>3</sup> ) |
|-------------------|--------------------------------|---|--------------------------|---|--------------------------|
| Luas total        | 20 x 20 = 400                  | 10  | 400 x 10 = 4000          | 10  | 400 x 10 = 4000          |
| Luas Rongga Dalam | 10 x 5 = 50                    | 7,5   | 50 x 7,5 = 375           | 10  | 50 x 10 = 500            |
|                   | 10 x 7 = 70                    | 8,5   | 70 x 8,5 = 595           | 10  | 70 x 10 = 700            |
|                   | 10 x 9 = 90                    | 9,5   | 90 x 9,5 = 855           | 10  | 90 x 10 = 900            |
| ΣA                | 400 - 50 = 350                 | ΣA.y  | 4000 - 375 = 3625        | ΣA.x  | 4000 - 500 = 3500        |
|                   | 400 - 70 = 330                 |   | 4000 - 595 = 3405        |   | 4000 - 700 = 3300        |
|                   | 400 - 90 = 310                 |   | 4000 - 855 = 3115        |   | 4000 - 900 = 3100        |

$$\bar{y} = \frac{\sum Ay}{\sum A}$$

$$\bar{y}_1 = \frac{\sum A_1 y_1}{\sum A} = \frac{3625}{350} = 10,357 \text{ cm dari dasar}$$

$$\bar{y}_2 = \frac{\sum A_2 y_2}{\sum A} = \frac{3405}{330} = 10,318 \text{ cm dari dasar}$$

$$\bar{y}_3 = \frac{\sum A_3 y_3}{\sum A} = \frac{3115}{310} = 10,048 \text{ cm dari dasar}$$

$$\bar{x} = \frac{\sum Ax}{\sum A} = 10 \text{ cm dari ujung kiri}$$

### Momen inersia terhadap sumbu X

| Keterangan           | Luas (A)<br>(cm <sup>2</sup> ) | y<br>(cm) | A.y <sup>2</sup> | I <sub>x0</sub>                                | I <sub>x</sub> = I <sub>x0</sub> + A.y <sup>2</sup> |
|----------------------|--------------------------------|-----------|------------------|--|---|
| Luas total           | 20 x 20 = 400                  | 10        | 40000            | $\frac{1}{12} \cdot 20 \cdot 20^3 = 13333,333$ | 13333,333 + 40000 =<br>53333,333                    |
| Luas Rongga<br>Dalam | 10 x 5 = 50                    | 7,5       | 2812,5           | $\frac{1}{12} \cdot 10 \cdot 5^3 = 104,167$    | 2812,5 + 104,167 =<br>2916,667                      |
|                      | 10 x 7 = 70                    | 8,5       | 5057,5           | $\frac{1}{12} \cdot 10 \cdot 7^3 = 285,833$    | 285,833 + 5057,5 =<br>5343,333                      |
|                      | 10 x 9 = 90                    | 9,5       | 8122,5           | $\frac{1}{12} \cdot 10 \cdot 9^3 = 607,5$      | 607,5 + 8122,5 = 8730                               |

$$I_{x_{total}} = 53333,333 \text{ cm}^4$$

$$I_{x_1} = 53333,333 - 2916,667 = 50416,666 \text{ cm}^4$$

$$I_{x_2} = 53333,333 - 5343,333 = 47990 \text{ cm}^4$$

$$I_{x_3} = 53333,333 - 8730 = 44603,333 \text{ cm}^4$$

### Momen inersia terhadap sumbu Y

| Keterangan           | Luas (A)<br>(cm <sup>2</sup> ) | x<br>(cm) | A.x <sup>2</sup> | I <sub>y0</sub>                                | I <sub>y</sub> = I <sub>y0</sub> + A.x <sup>2</sup> |
|----------------------|--------------------------------|-----------|------------------|--|---|
| Luas total           | 20 x 20 = 400                  | 10        | 40000            | $\frac{1}{12} \cdot 20 \cdot 20^3 = 13333,333$ | 13333,333 + 40000 =<br>53333,333                    |
| Luas Rongga<br>Dalam | 10 x 5 = 50                    | 10        | 5000             | $\frac{1}{12} \cdot 5 \cdot 10^3 = 416,667$    | 416,667 + 5000 =<br>5416,667                        |
|                      | 10 x 7 = 70                    | 10        | 7000             | $\frac{1}{12} \cdot 7 \cdot 10^3 = 583,333$    | 583,333 + 7000 =<br>7583,333                        |
|                      | 10 x 9 = 90                    | 10        | 9000             | $\frac{1}{12} \cdot 9 \cdot 10^3 = 750$        | 750 + 9000 = 9750                                   |

$$I_{y_{total}} = 53333,333 \text{ cm}^4$$

$$I_{y_1} = 53333,333 - 5416,667 = 47916,666 \text{ cm}^4$$

$$I_{y_2} = 53333,333 - 7583,333 = 45748 \text{ cm}^4$$

$$I_{y_3} = 53333,333 - 9750 = 43584,333 \text{ cm}^4$$

| Keterangan        | Dimensi (cm) | Ix (cm <sup>4</sup> ) | Iy (cm <sup>4</sup> ) |
|-------------------|--------------|-----------------------|-----------------------|
| Luas total        | 20 x 20      | 53333,333             | 53333,333             |
| Luas Rongga Dalam | 10 x 5       | 50416,667             | 47916,666             |
|                   | 10 x 7       | 47990                 | 45748                 |
|                   | 10 x 9       | 44603,333             | 43584,333             |



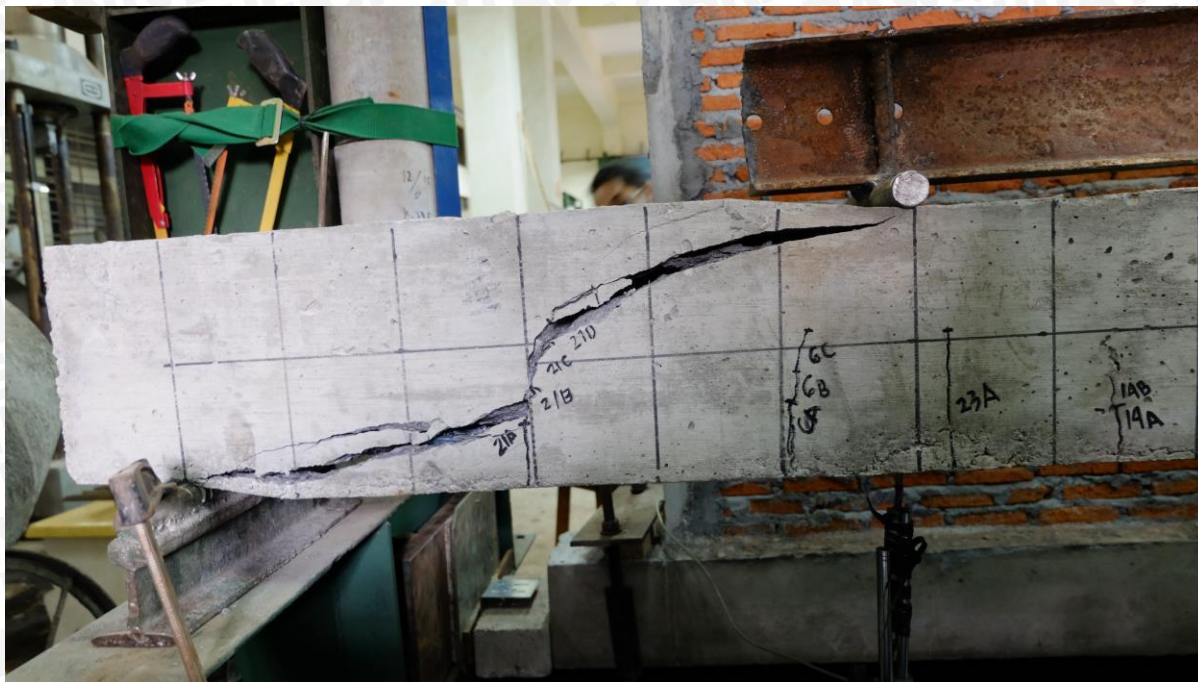
**Lampiran 10. Dokumentasi Hasil Uji Balok**



Keterangan : Runtuh geser pada balok Normal



Keterangan : Runtuh geser pada balok Hollow Core ukuran 5 cm



Keterangan : Runtuh geser pada balok Hollow Core ukuran 7 cm



Keterangan : Runtuh geser pada balok Hollow core 9 cm