CHAPTER VI

CONCLUSION AND SUGGESTION

6.1 Conclusion

Based on the results of research and discussion that has been described previously then obtained some conclusions as follows:

1. Based on research that has been done, the compressive strength average value of concrete for red tile waste proportion 0%, 10%, 20%, 30%, 40% and 50% at the age 7 days in a row are 36.13 MPa, 41.20 MPa, 48.39 MPa, 54.28 MPa, 62.94 MPa and 64.74 MPa. For concrete at the age 14 days obtained the compressive strength average value for red tile waste proportion 0%, 10%, 20%, 30%, 40% and 50% in a row are 39.41 MPa, 44.14 MPa, 52.15 MPa, 59.18 MPa, 65.5635 MPa and 68.83 MPa. While, for concrete at the age 28 days obtained the compressive strength average value for red tile waste proportion 0%, 10%, 20%, 30%, 40% and 50% in a row are 42.51 MPa, 46.27 MPa, 55.09 MPa, 63.92 MPa, 69.81 MPa and 71.94 MPa.
2. The maximum compressive strength value at the age 7, 14 and 28 days obtained on concrete with 50% red tile waste proportion, that are 64.74 MPa, 68.83 MPa and 71.94 MPa.
3. The average modulus of elasticity value of red tile waste with proportion 0%, 10%, 20%, 30%, 40% and 50% when the concrete at the age 28 days

in a row are 13365.40 MPa, 16888.35 MPa, 19419.16 MPa, 21488.33MPa, 24716.74 MPa and 25863.19 MPa.

4. The maximum modulus elasticity value when the concrete at the age 28 days obtained on concrete with red tile waste proportion of 50% by 25863.19 MPa.
5. The average modulus of rupture value of red tile waste with proportion 0%, 10%, 20%, 30%, 40% and 50% when the concrete at the age 28 days in a row are 3.61 MPa, 4.38 MPa, 4.71 MPa, 5.61 MPa, 6.03 MPa and 7.07 MPa.
6. The maximum modulus of rupture value when the concrete at the age 28 days obtained on concrete with red tile waste proportion of 50% by 7.07 MPa.

6.2 Suggestion

From the research that has been done, the suggestions are expected to be useful for the readers and author who undertake further research related this study, are as follows:

1. The need to understand the characteristics of each material tested to be added as a mixture of concrete.
2. At the same variation, it better to do the mixing in one times and do not rush in the process so that the mixture completely homogeneous.
3. The used of red tile proportion in this research only 10%, 20%, 30%, 40% and 50%, so still need to do further research that use more than 50% red tile waste proportion.

4. The tests that has been done in this research were compressive strength, modulus of elasticity and modulus of rupture only, so still need to do further research such as splitting tensile strength, durability, water content, etc.
5. Using red tile waste as substitute of fine aggregate, it is better to prepare the red tile waste under saturated surface dry (SCC) condition.
6. The making of red tile waste become fine aggregate it is better using stone crusher to obtain the desired grain fraction and it can produce the good grain gradation.
7. Red tile waste is material that have physical properties more fragile than normal aggregate so the selection of function and the location of using concrete must be consider. Concrete with red tile waste should not use in building with high moisture and high abrasion as well as extreme weather changes.

REFERENCES

Agil, L., 2013, Pengaruh Penambahan Serat Baja Lokal (Kawat Bendrat) pada Beton Memadat Mandiri (Self Compacting Concrete), *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Antono, A, 1995, *Bahan Konstruksi Teknik Sipil*, Penerbit Universitas Atma Jaya Yogakarta, Yogyakarta.

ASTM, C 33., *Standar Spesifikasi Agregat Untuk Beton*

As'ad, Sholihin and Selvia Agustina, 2012, *Beton Agregat Pecahan Genteng. Harian JOGLOSEMAR*, accessed on December 12, 2016, http://sipil.ft.uns.ac.id/index.php?option=com_content&task=view&id=199&Itemid=8.

Bernadus, C.W., 2016, Pengaruh Penambahan Foaming Agent ADT terhadap Beton dengan Limbah Genteng Merah Sebagai Agregat Halus, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Dehn, F., Holschemacher, K. dan Weiβe, D., 2000, *Self-Compacting Concrete (SCC) Time Development of the Material Properties and the Bond Behaviour, LACER No.5., Leipzig.*

Dipohusodo, I., 1996, Struktur Beton Bertulang, Gramedia Pustaka Utama, Jakarta.

EFNARC, 2002, *Specification and Guidelines for Self-Compacting Concrete.*

EFNARC, BIBM, CEMBUREAU, EFCA, ERMCO, 2005, *The European Guidelines for Self-Compacting Concrete.*

Ginting, Arusmalem, et al., 2011, Pengaruh Kadar Air Agregat Terhadap Kuat Tekan Beton, *Jurusan Teknik Sipil Fakultas Teknik Universitas Janabadra*, Yogyakarta.

Herbudiman, B. and Dewi., 2012, Beton Ringan Self-Compacting dengan Agregat dan Powder Limbah Pecahan Genteng Merah, *Department of Civil Engineering, Faculty of Engineering Institut Teknologi Nasional (Itenas)*, Bandung.

Hubertova, M. and Hela, R., 2007, Development and Experimental Study on the Properties of Light-weight Self Compacting Concrete, *5th RILEM Symposium on Self Compacting Concrete*, Ghent, Belgium, 2007.

Krisnarosa, V., 2015, Pengaruh Penggunaan Serat Kawat Galvanis pada Sifat Mekanik Beton Memadat Mandiri (Self Compacting Concrete/SCC) dan Beton Non-SCC, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Leonardo., 2014, Studi Pengaruh Penambahan Fiber Lokal terhadap Kuat Geser Balok Beton Memadat Mandiri, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Lisantono, A, Henanussa Gladies, P., 2009, *Pengaruh Penggunaan Plastizicer Pada Self Compacting Geopolymer Concrete Dengan Atau Tanpa Penambahan Kapur Padam*, Media Teknik Sipil, Vol. IX, No.2.

Mahot, F., 2016, Pengaruh Penggunaan kalsium Karbonat Sebagai Substitusi Semen pada Beton dengan Pecahan Genteng, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Miranty, R., 2014, Pengaruh Penggunaan Silica Fume, Fly Ash, Dan Superplasticizer Pada Beton Mutu Tinggi Memadat Mandiri, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Mulyono, T., 2004, *Teknologi Beton*, Penerbit Andi, Yogyakarta.

Murdock, L. J., Brook, K. M., dan Hindarko, S., 1986, *Bahan dan Praktek Beton Edisi Keempat*, Penerbit Erlangga , Jakarta.

Neville, A. M., 2003, *Properties of Concret 4th Edition*, Pearson Education, Delhi.

Neville, A.M., Brooks, J.J., 1891, *Concrete Technology*, Longman Group Ltd, London.

Poerwadi, M.R., 2014, Pengaruh Penggunaan Mineral Lokal Zeolit Alam Terhadap Karakteristik Self-Compacting Concrete (SCC), *Department of Civil Engineering, Faculty of Engineering Universitas Brawijaya*, Malang.

PT. Sika Indonesia., 2007, *Sika Viscocrete-10 High Performance Superplasticiser*.

Riono., 2012, Pengaruh Penambahan Filler Zeolit pada Kuat Lentur Balok Beton Memadat Mandiri (Self Compacting Concrete) dengan Viscocrete-10, *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

Skarendahl, A., 2000, *State of the Art report of RILEM technical Committee 174-SCC*, RILEM Publication, France.

SNI 03-2834-2000, 2000, *Tata Cara Pembuatan Rencana Campuran Beton Normal*, Badan Standardisasi Nasional BSN. Indonesia.

SNI 03-2847-2002, 2002, *Tata Cara Perhitungan Struktur Beton Untuk Bangunan Gedung*, Badan Standardisasi Nasional BSN. Indonesia.

SNI 03-4431, 2011, *Cara Uji Kuat Lentur Beton Normal dengan Dua Titik Pembebanan*, Badan Standardisasi Nasional BSN. Indonesia.

SNI 03-6821-2002, 2002, *Spesifikasi Agregat Ringan untuk Batu Cetak Beton Pasangan Dinding*, Badan Standardisasi Nasional BSN. Indonesia.

SNI 15-2049-2004, 2004, *Semen Portland*, Badan Standardisasi Nasional BSN. Indonesia.

SK SNI M-02-1990-F, 1990, *Metode pengujian Keausan Agregat dengan Mesin Abrasi Los Angeles*, Badan Standardisasi Nasional BSN. Indonesia.

SK SNI T-15-1990-03, 1990, *Tata Cara Pembuatan Rencana Campuran Beton Normal*, Badan Standardisasi Nasional BSN. Indonesia.

Tjokrodimuljo, K., and Sumartono,A., 1993, *Makalah Seminar Nasional Hasil Penelitian Bahan*, Ilmu Teknik Universitas Atma Jaya, Yogyakarta.

Tjokrodimuljo, K., 1996, *Teknologi Beton*, Nafiri, Yogyakarta.

Tjokrodimuljo, K., 2007, *Teknologi Beton*, Biro Penerbit Teknik Sipil Universitas Gadjah Mada, Yogyakarta.

Tjokrodimuljo, K., 2009, *Teknologi Beton*, Biro Penerbit Teknik Sipil Universitas Gadjah Mada, Yogyakarta.

Wang C. K., Salmon, C. G., and Binsar, H., 1986, *Disain Beton Bertulang, Edisi Keempat*, Penerbit Erlangga, Jakarta.

Yudha, P., 2016, Pengaruh Variasi Kadar Silica Fume terhadap Sifat Mekanik Self-Compacting Fiber Reinforced Concrete (SCFRT), *Department of Civil Engineering, Faculty of Engineering Universitas Atma Jaya Yogyakarta*, Yogyakarta.

APPENDICES

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A. MATERIAL TEST

A.1. LOS ANGELES ABRATION TEST

Material : Gravel (split)

From : Clereng

Check : November 23rd 2016

Sieve Gradation		**Number of Sample**
		I
Pass	**Retrain**	**Weight of Aggregate**
¾”	½”	2500 gram
½”	3/8”	2500 gram

Sample Number		I
Previous weight	(A)	5000 gram
Weight after sifted with sieve no. 12	(B)	3266 gram
Weight after = (A) – (B)		1734 gram
Wear = $\frac{(A)-(B)}{(A)}\ x\ 100\%$		34.72 %
Average wear		34.72 %

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A.2. SOUNDNESS TEST SPLIT

Material : Gravel (split)

From : Clereng

Check : November 23rd 2016

A	Weight before test	100	gram
B	Weight after test	100	gram
C	% Loss = $\frac{A-B}{A} x\ 100\%$	0	%
P	% Retrained	100	%
W	% Weight loss $\frac{C\ x\ P}{A}$	0	%

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A.3 FINE AGGREGATE GRADATION TEST

Material : Sand

From : Progo

Check : November 23rd 2016

SIEVE LIST

Sieve number	Weight of sieve (gram)	Weight of sieve + retrained (gram)	Weight of retrained (gram)	Σ weight of retrained (gram)	Percentage weight of retrained (%)	Percentage of pass (%)
¾"	572	572	0	0	0	100
½"	452	452	0	0	0	100
3/8"	458	459	1	1	0.1	99.9
4	530	536	6	7	0.7	99.3
8	326	346	20	27	2.7	97.3
30	292	690	398	425	42.5	57.5
50	375	648	273	698	69.8	30.2
100	351	542	191	889	88.9	11.1
200	269	358	89	978	97.8	2.2
Pan	307	329	22	1000	100	0
Total			1000		302.5	

Fine grain modulus = $\frac{total\ prcentage\ weight\ of\ retrained}{100} = \frac{302.5}{100} = 3.025$

Conclusion if fine grain modulus 1.5 ≤ fine grain modulus ≤ 3.8 then OK

1.5 ≤ 3.025 ≤ 3.8 → OK

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A.4 COARSE AGGEGATE GRADATION TEST

Material : Gravel (split)

From : Clereng

Check : November 23rd 2016

SIEVE LIST

Sieve number	Weight of sieve (gram)	Weight of sieve + retrained (gram)	Weight of retrained (gram)	Σ weight of retrained (gram)	Percentage weight of retrained (%)	Percentage of pass (%)
¾"	452.95	777.23	324.28	324.28	32.4621	67.5379
½"	558.39	1015.68	457.29	781.57	78.2392	21.7608
3/8"	554.72	736.21	181.49	963.06	96.4072	3.5928
4	508.99	529.87	20.88	983.94	98.4974	1.5026
8	477.27	477.62	0.35	984.29	98.5325	1.4675
30	407.25	410.6	3.35	987.64	98.8678	1.1322
50	293.37	294.35	0.98	988.62	98.9659	1.0341
100	289.73	292.07	2.34	990.96	99.2002	0.7998
200	241	242.72	1.72	992.68	99.3723	0.6277
Pan	138.91	145.18	6.27	998.95	100	0
Total			998.95		700.5456	

Fine grain modulus = $\frac{total\ prcentage\ weight\ of\ retrained}{100} = \frac{700.5456}{100} = 7.005$

Conclusion if fine grain modulus 6 ≤ fine grain modulus ≤ 7.1 then OK

6 ≤ 7.005 ≤ 7.1 → OK

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A.5 DENSITY AND ABSORPTION OF FINE AGGREGATE

Material : Sand

From : Progo

Check : November 24th 2016

A	Weight of SSD sample	500 gram
B	Dry weight sample	499 gram
C	Weight of Erlenmeyer + water	717 gram
D	Weight of Erlenmeyer + water + SSD	1054 gram
E	Bulk specific gravity = $\frac{A}{C+500-D}$	3.0675 gr/cm^3
F	Bulk specific gravity SSD = $\frac{B}{C+500-D}$	3.0613 gr/cm^3
G	Apparent specific gravity = $\frac{B}{C+B-D}$	3.0802 gr/cm^3
H	Absorption = $\frac{500-B}{B}$ x 100%	0.2 %

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A.6 DENSITY AND ABSORPTION OF COARSES AGGREGATE

Material : Gravel (split)

From : Clereng

Check : November 24th 2016

Weight of dry sample (A)	954 gram
Weight in SSD condition (B)	993 gram
Weight under water (C)	601.5 gram
Bulk specific gravity = $\frac{A}{B-C}$	2.4386 gr/cm^3
Bulk specific gravity SSD = $\frac{B}{B-C}$	2.5364 gr/cm^3
Apparent specific gravity = $\frac{A}{A-C}$	2.7063 gr/cm^3
Absoroption = $\frac{B-A}{A}$	4.0881 %

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A.7 WATER CONTENT OF FINE AGGREGATE TEST

Material : Sand

From : Progo

Check : November 24th 2016

Weight of plate	10.405 gram
Weight of plate + wet fine aggregate (A)	60.118 gram
Weight of plate + dry fine aggregate (B)	59.997 gram
Weight of water (C) = (A) – (B)	0.121 gram
Weight of dry sample (D) = (B) – weight plate	49.592 gram
Water content (W) = $\frac{(C)}{(D)} x100\%$	0.244 %

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A.8 WATER CONTENT OF COARSE AGGREGATE TEST

Material : Gravel (split)

From : Clereng

Check : November 24th 2016

Weight of plate	58.33 gram
Weight of plate + wet coarse aggregate (A)	158.33 gram
Weight of plate + dry coarse aggregate (B)	157.3 gram
Weight of water (C) = (A) – (B)	1.03 gram
Weight of dry sample (D) = (B) – weight plate	98.97 gram
Water content (W) = $\frac{(C)}{(D)} x100\%$	1.0407 %

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A.9 CONTENT OF MUD IN THE FINE AGGREGATE TEST

1. Date of test: November 25th 2016
2. Material
   a. Sand from Progo, weight: 100 gram
   b. Water from Laboratory of Structural and Building Materials and transportation laboratory, Faculty of Engineering, Department of Civil Engineering, University of Atma Jaya Yogyakarta
3. Equipment
   a. Beaker glass 250 cc
   b. Scales
   c. Pan
   d. Oven, with temperature 105-110^{o}C
   e. Fine aggregate + pan, put in the oven on November 24th 2016, at 11.00 WIB
4. Result

   Fine aggregate + pan, out from the oven on November 25th 2016, at 11.00 WIB

   a. Weight of pan + fine aggregate = 218.4 gram
   b. Weight of empty pan = 120.2 gram
   c. Weight of fine aggregate = 98.2 gram

   Mud contain = $\frac{100-weight\ of\ fine\ aggregate}{100} x100\%$

   $= \frac{100-98.2}{100} x100\% = 1.8\%$

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A.10 CONTENT OF MUD IN THE COARSE AGGREGATE TEST

1. Date of test: November 25th 2016
2. Material
   a. Dry split, from: Clereng, weight: 500 gram
   b. Water from Laboratory of Structural and Building Materials and transportation laboratory, Faculty of Engineering, Department of Civil Engineering, University of Atma Jaya Yogyakarta
3. Equipment
   a. Pan
   b. Scales
   c. Oven, with temperature 105-110^{o}C
   d. Coarse aggregate (split) + plate, put in the oven on November 22nd 2016, at 11.00 WIB
4. Result

   Coarse aggregate (split) + plate, out from the oven on November 23rd 2016, at 11.00 WIB

   a. Weight of pan + split = 541.93 gram
   b. Weight of empty pan = 64 gram
   c. Weight of split = 477.93 gram

   Mud contain = $\frac{500-weight\ of\ split}{100} x100\%$

   $= \frac{500-477.93}{100} x100\% = 2.207\%$

   Conclusion: if the mud contain ≤ 1% then safe, but the result show that the mud level is 2.207% so the coarse aggregate must wash before use it to make the concrete.

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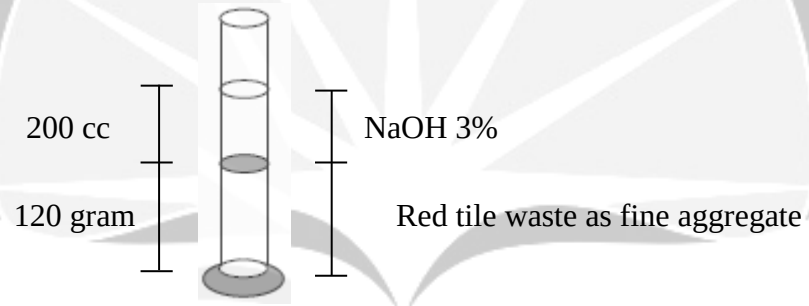
A.11 FINE AGGREGATE ORGANIC SUBSTANCE TEST

1. Date of test: November 25th 2016
2. Material
   a. Dry sand, from: Progo, weight: 120 gram
   b. NaOH 3% solution
3. Equipment

   Measured glass 250 cc
4. Sketch



5. Result

   Let it for 24 hours, the color of solution above the red tile waste is same with Gardner Standard Color no. 8

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B. MIX DESIGN

A. Materials data

1. Portland cement, brand : Holcim type I
2. Fine aggregate : Sand from Progo
3. Coarse aggregate : Gravel from Kali Clereng, Kulon Progo
4. Water : From Laboratory of Structural and Building Materials and Transportation Laboratory, Faculty of Engineering, Department of Civil Engineering, University of Atma Jaya Yogyakarta

B. Specific Gravity Data

1. Specific gravity of fine aggregate : 3.0613 gr/cm^3
2. Specific gravity of coarse aggregate : 2.5364 gr/cm^3

C. Calculation

1. Concrete stress (f'c) after 28 days. f'c = 25 MPa
2. Determine the standard deviation based on the quality of the mixing concrete
3. Margin value had been determine 12 MPa

Tabel 1
Faktor pengali untuk deviasi standar bila data hasil uji yang tersedia kurang dari 30

Jumlah Pengujian	Faktor Pengali Deviasi Standar
Kurang dari 15	Lihat butir 4.2.3.1 1) (5)
15	1,16
20	1,08
25	1,03
30 atau lebih	1,00

(5) bila data uji lapangan untuk menghitung deviasi standar yang memenuhi persyaratan butir 4.2.3.1 1) di atas tidak tersedia, maka kuat tekan rata-rata yang ditargetkan f'_{cr} harus diambil tidak kurang dari (f'_c+12 MPa);

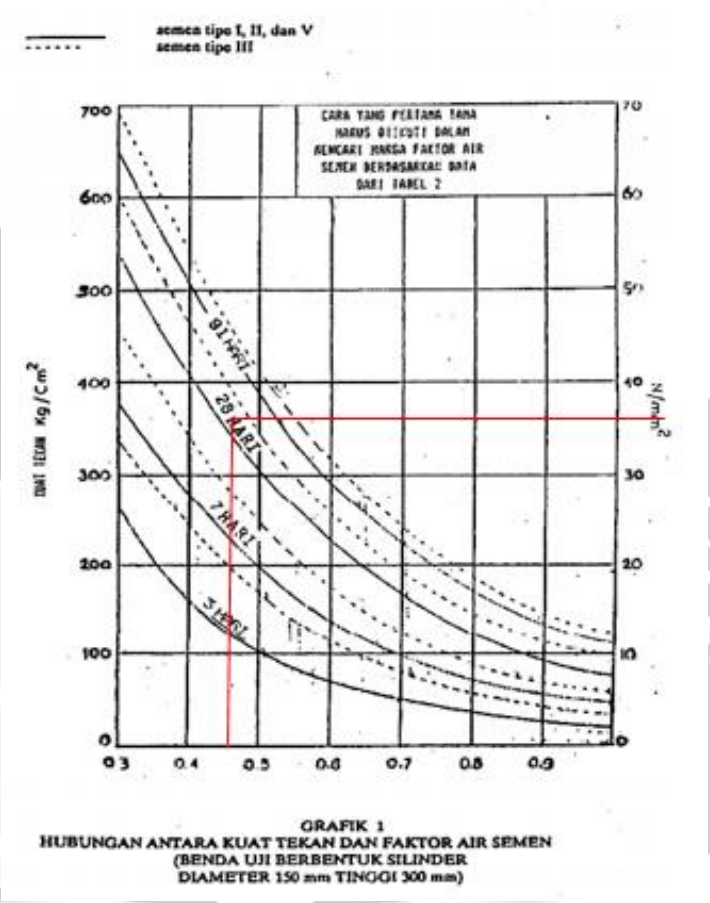
4. Determine the average concrete stress planning

   f'cr = f'c + m

   f'cr = 25 + 12

   f'cr = 37 MPa

5. Type of cement is class I with brand Gersik
6. Type of aggregate:
   - Fine aggregate : sand
   - Coarse aggregate : split stone
7. Determine the water cement ratio (wcr), based on type of cement that used, and average stresses concrete cylinder planned in a specific age. From the graph of SK SNI T-15-1990-03 page 7, the wcr = 0.45



GRAFIK 1
HUBUNGAN ANTARA KUAT TEKAN DAN FAKTOR AIR SEMEN
(BENDA UJI BERBENTUK SILINDER
DIAMETER 150 mm TINGGI 300 mm)

8. Determine the maximum water cement ratio. From the table 4 SNI 03-2834-2000, for concrete inside the building and non-corrosive, concrete outside the building and protected from rain and direct sunlight, the maximum wcr = 0.6

Tabel 4
Persyaratan jumlah semen minimum dan factor air semen maksimum untuk berbagi Macam pembetonan dalam lingkungan khusus

Lokasi	Jumlah Semen minimum Per m^3 beton (kg)	Nilai Faktor Air-Semen Maksimum
Beton di dalam ruang bangunan:		
a. keadaan keliling non-korosif	275	0,60
b. keadaan keliling korosif disebabkan oleh kondensasi atau uap korosif	325	0,52
Beton di luar ruangan bangunan:		
a. tidak terlindung dari hujan dan terik matahari langsung	325	0,60
b. terlindung dari hujan dan terik matahari langsung	275	0,60
Beton masuk ke dalam tanah:		
a. mengalami keadaan basah dan kering berganti-ganti	325	0,55
b. mendapat pengaruh sulfat dan alkali dari tanah		Lihat Tabel 5
Beton yang kontinu berhubungan:		
a. air tawar		
b. air laut		Lihat Tabel 6

Compare with number 7, use the smallest. So, use wcr = 0.45

9. Determine the slump value. Use slump value 60-180 mm
10. Determine the maximum aggregate is 10 mm
11. Determine the water used each m^3 concrete

- Maximum aggregate 10 mm
- Slump value 60-180 mm
- Ah = amount of water needed by fine aggregate = 225
- Ak = amount of water needed by coarse aggregate =250

  A = (0.67 x Ah) + (0.33 x Ak)

  A = (0.67 x 225) + (0.33 x 250)

  A = 233.25 liter/m^3

Tabel 3
Perkiraan kadar air bebas (Kg/m^3) yang dibutuhkan untuk beberapa tingkat kemudahan pengerjaan adukan beton

Slump (mm)		0-10	10-30	30-60	60-180
Ukuran besar butir agregat maksimum	Jenis agregat	---	---	---	---
10	Batu tak dipecahkan	150	180	205	225
	Batu pecah	180	205	230	250
20	Batu tak dipecahkan	135	160	180	195
	Batu pecah	170	190	210	225
40	Batu tak dipecahkan	115	140	160	175
	Batu pecah	155	175	190	205

Catatan : Koreksi suhu udara :
Untuk suhu di atas 25 °C, setiap kenaikan 5 °C harus ditambah air 5 liter per m^2 adukan beton.

12. Calculate the cement weight that needed

    Per m^3 concrete = (A/wcr) = 233.25 / 0.45 = 518.333 kg

13. Minimum cement requirement

    Based on table of water cement ratio requirement and minimum cement (kg/m^3) for various of concrete and special environment (SNI 03-2834-2000)

14. The total cement that used is 518.333 kg

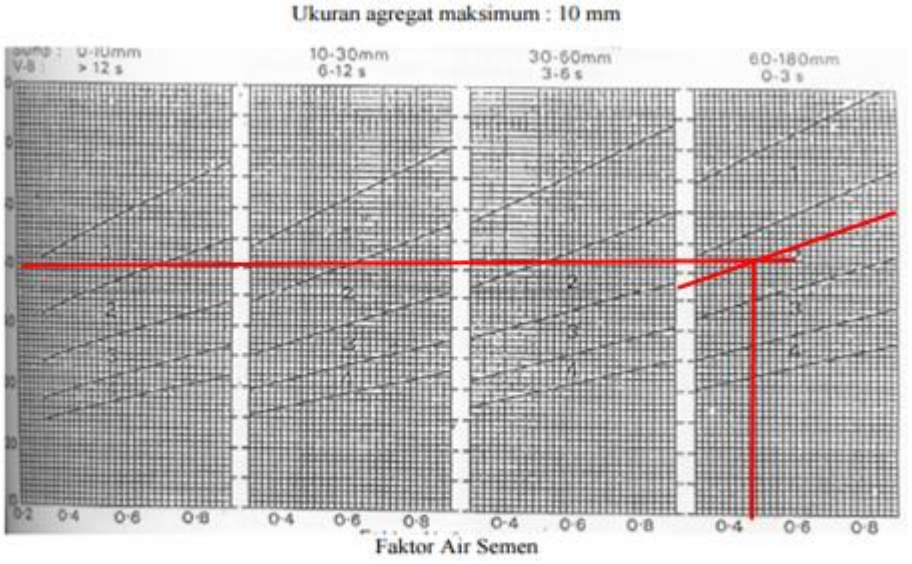
15. The adaptation of water cement ratio is 0.45

16. Determine the fine aggregate gradation area (SNI 03-2834-2000), the result shown in gradation area no. 2

17. The comparison of coarse aggregate and fine aggregate (graph 13 – 15 SNI 03-2834-2000)

    - The maximum size 10 mm
    - Slump value 60-180 mm
    - Water cement ratio 0.45
    - The type of gradation no.2

So the proportion of sand is 52% and proportion of split is 48%



Grafik 13
Persen pasir terhadap kadar toal agregat yang dianjurkan
Untuk ukuran butir maksimum 10 mm

18. Density of mix aggregate

    = (P/100) x fine aggregate density + (K/100) x density of coarse aggregate

    = ((52/100) x 3.0613) + ((48/100) x 2.5364)

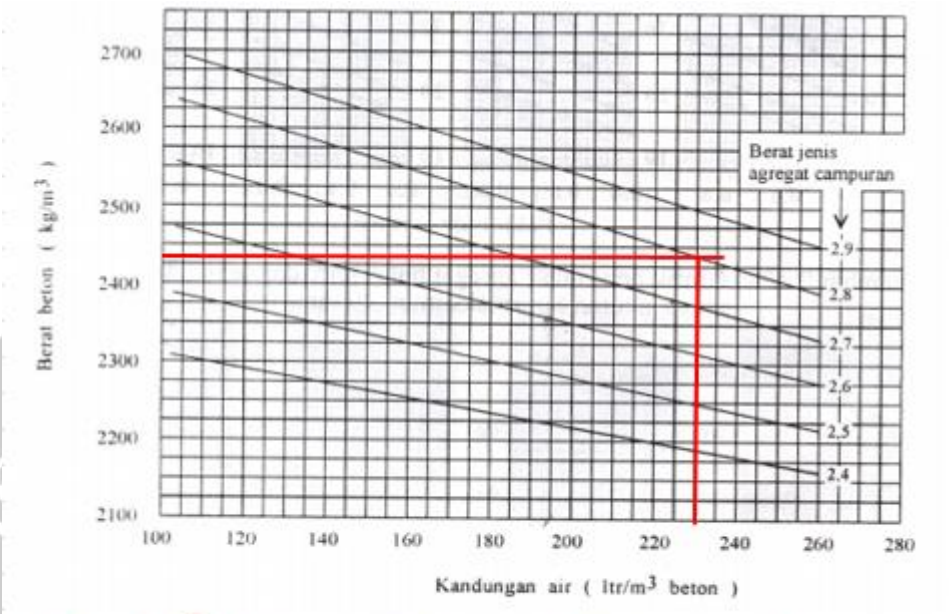
    = 2.80935 kg/m^3

    P: percentage of fine aggregate toward mix aggregate

    K: percentage of coarse aggregate toward mix aggregate

19. Density of concrete

    = 2430 kg/m^3



Gambar 5. Grafik Hubungan Kandungan Air, Berat Jenis Campuran dan Berat Beton

20. Mixed aggregate requirement

    = weight of concrete each m^3 – water and cement requirement

    = 2430 – (233.25 + 518.333)

    = 1678.42 kg/m^3

21. Calculate the weight of fine aggregate

    = (% of fine aggregate) x (weight of mix aggregate)

    = (52% x 1678.42 kg/m^3)

    = 872.7767 kg/m^3

22. Calculate the weight of coarse aggregate

    = (result number 20 – result number 21)

    = (1678.42 kg/m^3 – 872.7767 kg/m^3)

    = 805.64 kg/m^3

23. The requirement for 1 m^3 normal concrete with water cement ratio 0.45

Water = 233.23 liter

Cement = 518.333 kg

Sand = 872.7767 kg

Gravel = 805.64 kg

Say that safety factor (fs) = 1.1 so

Water = 256.575 liter

Cement = 570.1667 kg

Sand = 960.0543 kg

Gravel = 886.204 kg

Red tile waste as fine aggregate substitution, using 1.25% viscocrete-10 of weight of cement.

Mix design SCC for 1 m^3

material	red tile waste substitution					
	0%	10%	20%	30%	40%	50%
cement (kg/m^3)	570.1667	570.1667	570.1667	570.1667	570.1667	570.1667
sand (kg/m^3)	960.0543	864.0489	768.0435	672.0380	576.0326	480.0272
red tile (kg/m^3)	0	96.0054	192.0109	288.0163	384.0217	480.0272
gravel (kg/m^3)	886.2040	886.2040	886.2040	886.2040	886.2040	886.2040
water ($liter/m^3$)	256.5750	256.5750	256.5750	256.5750	256.5750	256.5750
viscocrete (kg/m^3)	7.1271	7.1271	7.1271	7.1271	7.1271	7.1271

Volume concrete mixer = 0.04 m^3

Mix design SCC for 1 times mixing

material	red tile waste substitution					
	0%	10%	20%	30%	40%	50%
cement (kg/m^3)	22.8067	22.8067	22.8067	22.8067	22.8067	22.8067
sand (kg/m^3)	38.4022	34.5620	30.7217	26.8815	23.0413	19.2011
red tile (kg/m^3)	0.0000	3.8402	7.6804	11.5207	15.3609	19.2011
gravel (kg/m^3)	35.4482	35.4482	35.4482	35.4482	35.4482	35.4482
water ($liter/m^3$)	10.2630	10.2630	10.2630	10.2630	10.2630	10.2630
viscocrete (kg/m^3)	0.2851	0.2851	0.2851	0.2851	0.2851	0.2851

Actual data of water that used for 1 times mixing

Red tile waste proportion	The actual needs of water
0%	10 liter
10%	4 liter
20%	5 liter
30%	6 liter
40%	7 liter
50%	8 liter

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C. COMPRESSIVE STRENGTH DATA

7 Days

Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
0%	1	14.88	14.96	29.94	29.95	12.52	2378.7635	345	33.8445	36.1335
		15.04		29.95						
		14.96		29.97						
	2	14.95	14.91	30.04	30.01	12.42	2370.3388	345	33.8445	
		14.88		29.98						
		14.90		30.01						
	3	15.24	15.19	29.99	29.98	12.68	2333.1352	415	40.7115	
		15.20		29.98						
		15.14		29.96						
10%	1	15.21	15.21	30.04	30.05	13.1	2399.2666	445	43.6545	41.2020
		15.20		30.06						
		15.22		30.05						
	2	15.05	15.07	30.04	30.02	12.88	2405.1412	405	39.7305	
		15.10		30.02						
		15.06		30.01						
	3	15.04	15.04	30.18	30.08	12.92	2417.4138	410	40.2210	
		15.05		30.05						
		15.03		30.02						
20%	1	15.08	15.09	29.98	29.98	13.08	2440.6171	520	51.0120	48.3960
		15.12		29.95						
		15.06		30.01						
	2	15.08	15.07	29.97	30.01	13.18	2462.5285	490	48.0690	
		15.06		30.01						
		15.07		30.04						
	3	15.00	15.02	30.14	30.13	12.36	2314.9496	470	46.1070	
		15.04		30.11						
		15.02		30.15						

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Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
30%	1	15.13	15.09	29.94	29.92	12.92	2413.1945	545	53.4645	54.2820
		15.09		29.92						
		15.06		29.91						
	2	15.22	15.20	29.95	29.97	12.96	2384.4049	550	53.9550	
		15.18		29.97						
		15.19		29.98						
	3	15.08	15.07	30.04	30.04	12.84	2397.6680	565	55.4265	
		15.07		30.02						
		15.05		30.05						
40%	1	15.20	15.17	30.15	30.13	12.90	2369.5854	635	62.2935	62.9475
		15.14		30.12						
		15.16		30.13						
	2	15.06	15.04	30.23	30.24	12.98	2416.0580	640	62.7840	
		15.04		30.25						
		15.02		30.26						
	3	15.12	15.13	30.22	30.24	12.90	2372.9471	650	63.7650	
		15.14		30.24						
		15.13		30.25						
50%	1	15.03	15.04	30.13	30.14	12.40	2316.7833	670	65.7270	64.7460
		15.06		30.15						
		15.02		30.14						
	2	15.17	15.15	30.16	30.16	12.64	2326.1607	650	63.7650	
		15.14		30.15						
		15.13		30.16						
	3	15.20	15.17	30.21	30.19	12.62	2313.0401	660	64.7460	
		15.15		30.17						
		15.16		30.18						

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14 Days

Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
0%	1	15.08	15.10	30.01	30.03	12.46	2318.2427	410	40.2210	39.4035
		15.10		30.04						
		15.11		30.03						
	2	14.97	14.98	30.06	30.06	12.52	2363.9974	395	38.7495	
		15.00		30.05						
		14.96		30.08						
	3	15.04	15.02	29.98	30.00	12.50	2350.5326	400	39.2400	
		15.01		30.02						
		15.02		29.99						
10%	1	15.16	15.15	30.04	30.04	12.58	2322.8297	445	43.6545	44.1450
		15.15		30.06						
		15.14		30.03						
	2	15.12	15.11	30.20	30.17	12.54	2317.6905	455	44.6355	
		15.10		30.17						
		15.11		30.15						
	3	15.23	15.24	30.05	30.03	12.80	2336.3969	450	44.1450	
		15.24		30.03						
		15.25		30.02						
20%	1	15.13	15.13	30.13	30.14	12.98	2394.5306	520	51.0120	52.1565
		15.15		30.14						
		15.12		30.14						
	2	15.04	15.06	30.05	30.03	12.88	2408.6005	540	52.9740	
		15.06		30.03						
		15.07		30.02						
	3	15.11	15.13	30.17	30.16	12.94	2387.6716	535	52.4835	
		15.13		30.16						
		15.14		30.14						

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Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
30%	1	15.17	15.17	30.21	30.19	13.10	2402.0717	600	58.8600	59.1870
		15.15		30.18						
		15.18		30.17						
	2	15.12	15.13	30.15	30.15	12.90	2380.0313	595	58.3695	
		15.14		30.13						
		15.13		30.16						
	3	15.07	15.05	30.11	30.12	12.82	2391.8056	615	60.3315	
		15.05		30.13						
		15.04		30.11						
40%	1	15.13	15.14	30.13	30.14	12.78	2355.5591	660	64.7460	65.5635
		15.15		30.13						
		15.14		30.15						
	2	15.06	15.05	30.04	30.04	12.68	2374.2210	670	65.7270	
		15.05		30.03						
		15.03		30.01						
	3	15.15	15.13	30.02	30.03	12.76	2362.3066	675	66.2175	
		15.13		30.04						
		15.12		30.03						
50%	1	15.06	15.03	30.06	30.04	12.20	2287.7642	710	69.6510	68.8335
		15.00		30.04						
		15.04		30.03						
	2	15.12	15.11	30.11	30.12	12.56	2324.8577	705	69.1605	
		15.11		30.12						
		15.11		30.11						
	3	15.07	15.07	30.14	30.15	12.68	2356.5434	690	67.6890	
		15.09		30.17						
		15.06		30.15						

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28 days

Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	Area (cm2)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
0%	1	15.11	15.11	30.15	30.15	179.42	12.50	2310.7599	430	42.1830	42.5100
		15.11		30.16							
		15.12		30.14							
	2	15.04	15.05	30.05	30.05	177.97	12.56	2348.2361	455	44.6355	
		15.07		30.07							
		15.05		30.04							
	3	15.03	15.04	30.02	30.04	177.74	12.46	2333.9324	415	40.7115	
		15.04		30.05							
		15.06		30.04							
10%	1	15.02	15.03	30.02	30.04	177.50	12.50	2344.2808	425	41.6925	46.2705
		15.05		30.04							
		15.03		30.06							
	2	15.07	15.05	30.26	30.24	177.97	12.52	2326.0521	540	52.9740	
		15.04		30.23							
		15.05		30.24							
	3	15.12	15.13	30.03	30.03	179.79	13.08	2422.6165	450	44.1450	
		15.13		30.04							
		15.14		30.02							
20%	1	15.14	15.15	30.16	30.15	180.27	13.16	2421.3269	570	55.9170	55.0995
		15.15		30.15							
		15.16		30.14							
	2	15.08	15.07	30.15	30.15	178.37	12.62	2346.4302	550	53.9550	
		15.06		30.14							
		15.07		30.17							
	3	15.06	15.04	30.02	30.04	177.74	13.16	2464.5052	565	55.4265	
		15.03		30.05							
		15.04		30.06							

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Red tile waste proportion	no.	Ø (cm)	Ø average (cm)	height (cm)	height average (cm)	Area (cm2)	weight (kg)	density (kg/m3)	Load (kN)	f'c (MPa)	f'c average (MPa)
30%	1	15.14	15.13	30.14	30.14	179.79	13.10	2417.7330	650	63.7650	63.9285
		15.12		30.13							
		15.13		30.14							
	2	15.06	15.04	30.05	30.04	177.74	13.00	2434.8117	665	65.2365	
		15.04		30.04							
		15.03		30.03							
	3	15.05	15.03	30.02	30.04	177.50	13.02	2442.0739	640	62.7840	
		15.03		30.04							
		15.02		30.05							
40%	1	15.04	15.05	30.05	30.04	177.89	12.92	2417.9532	710	69.6510	69.8145
		15.06		30.04							
		15.05		30.02							
	2	15.02	15.03	30.01	30.03	177.50	12.94	2427.8771	705	69.1605	
		15.05		30.03							
		15.03		30.04							
	3	15.12	15.12	30.14	30.13	179.47	12.60	2330.0726	720	70.6320	
		15.11		30.13							
		15.12		30.12							
50%	1	15.05	15.05	30.04	30.03	177.89	13.08	2448.4404	735	72.1035	71.9400
		15.06		30.02							
		15.04		30.03							
	2	15.04	15.04	30.06	30.06	177.66	12.50	2340.9042	740	72.5940	
		15.03		30.05							
		15.05		30.06							
	3	15.12	15.13	30.13	30.13	179.79	12.72	2347.8600	725	71.1225	
		15.14		30.13							
		15.13		30.14							

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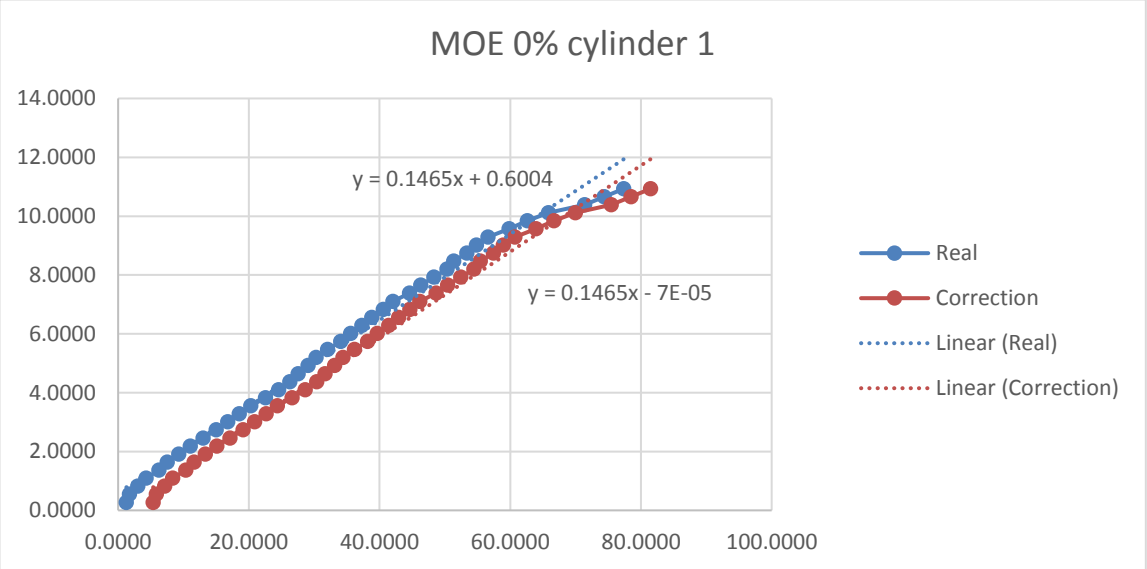
D. MODULUS OF ELASTICITY DATA

0% - cylinder 1

compressive strength =	42.1830	fp =	10.9316
A =	17942	ep =	0.0008
Po =	199.7		
correction =	4.0983		
modulus =	13418.8383		
mod theory =	30525.7673		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	5	0.0025	0.2733	1.2519	5.3502
1000	9806.7100	7	0.0035	0.5466	1.7526	5.8509
1500	14710.0650	12	0.006	0.8199	3.0045	7.1028
2000	19613.4200	17	0.0085	1.0932	4.2564	8.3547
2500	24516.7750	25	0.0125	1.3664	6.2594	10.3577
3000	29420.1300	30	0.015	1.6397	7.5113	11.6096
3500	34323.4850	37	0.0185	1.9130	9.2639	13.3622
4000	39226.8400	44	0.022	2.1863	11.0165	15.1148
4500	44130.1950	52	0.026	2.4596	13.0195	17.1178
5000	49033.5500	60	0.03	2.7329	15.0225	19.1208
5500	53936.9050	67	0.0335	3.0062	16.7752	20.8735
6000	58840.2600	74	0.037	3.2795	18.5278	22.6261
6500	63743.6150	81	0.0405	3.5528	20.2804	24.3787
7000	68646.9700	90	0.045	3.8260	22.5338	26.6321
7500	73550.3250	98	0.049	4.0993	24.5368	28.6351
8000	78453.6800	105	0.0525	4.3726	26.2894	30.3877
8500	83357.0350	110	0.055	4.6459	27.5413	31.6396
9000	88260.3900	116	0.058	4.9192	29.0436	33.1419
9500	93163.7450	121	0.0605	5.1925	30.2954	34.3937
10000	98067.1000	128	0.064	5.4658	32.0481	36.1464
10500	102970.4550	136	0.068	5.7391	34.0511	38.1494
11000	107873.8100	142	0.071	6.0124	35.5533	39.6516
11500	112777.1650	149	0.0745	6.2857	37.3060	41.4043
12000	117680.5200	155	0.0775	6.5589	38.8082	42.9065
12500	122583.8750	162	0.081	6.8322	40.5608	44.6591
13000	127487.2300	168	0.084	7.1055	42.0631	46.1614
13500	132390.5850	178	0.089	7.3788	44.5669	48.6651
14000	137293.9400	185	0.0925	7.6521	46.3195	50.4178

14500	142197.2950	193	0.0965	7.9254	48.3225	52.4208
15000	147100.6500	201	0.1005	8.1987	50.3255	54.4238
15500	152004.0050	205	0.1025	8.4720	51.3270	55.4253
16000	156907.3600	213	0.1065	8.7453	53.3300	57.4283
16500	161810.7150	219	0.1095	9.0185	54.8322	58.9305
17000	166714.0700	226	0.113	9.2918	56.5849	60.6832
17500	171617.4250	239	0.1195	9.5651	59.8398	63.9381
18000	176520.7800	250	0.125	9.8384	62.5939	66.6922
18500	181424.1350	263	0.1315	10.1117	65.8488	69.9471
19000	186327.4900	285	0.1425	10.3850	71.3570	75.4553
19500	191230.8450	297	0.1485	10.6583	74.3615	78.4598
20000	196134.2000	309	0.1545	10.9316	77.3660	81.4643



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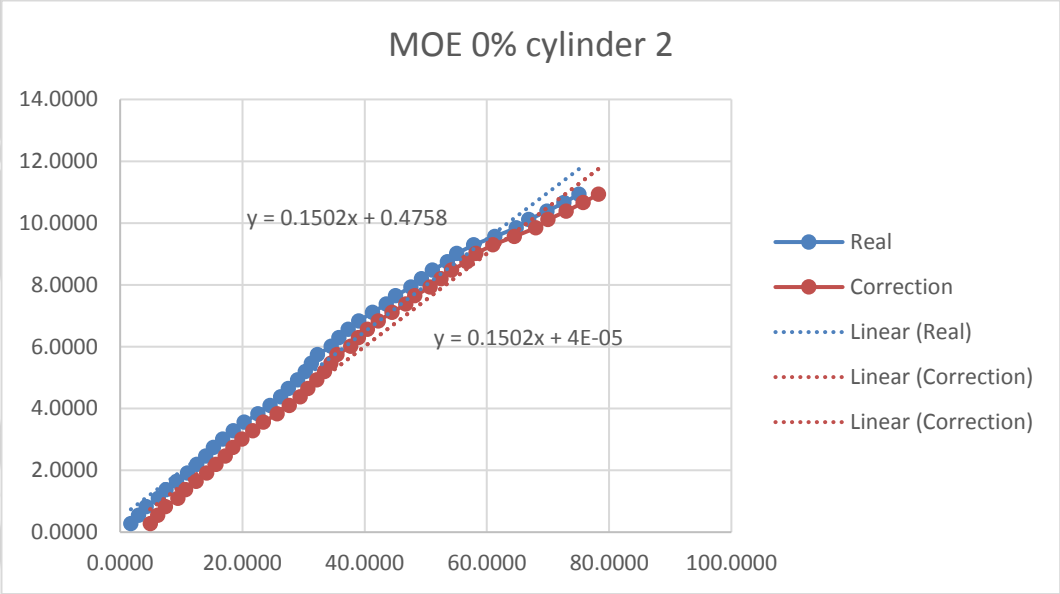
0% - cylinder 2

compressive strength =	44.6355	fp =	10.9316
A =	17797	ep =	0.0008
Po =	199.8		
correction =	3.1678		
modulus =	13971.3318		
mod theory =	31400.6082		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	7	0.0035	0.2733	1.7518	4.9195
1000	9806.7100	12	0.006	0.5466	3.0030	6.1708
1500	14710.0650	17	0.0085	0.8199	4.2543	7.4220
2000	19613.4200	25	0.0125	1.0932	6.2563	9.4240
2500	24516.7750	30	0.015	1.3664	7.5075	10.6753
3000	29420.1300	37	0.0185	1.6397	9.2593	12.4270
3500	34323.4850	44	0.022	1.9130	11.0110	14.1788
4000	39226.8400	50	0.025	2.1863	12.5125	15.6803
4500	44130.1950	56	0.028	2.4596	14.0140	17.1818
5000	49033.5500	61	0.0305	2.7329	15.2653	18.4330
5500	53936.9050	67	0.0335	3.0062	16.7668	19.9345
6000	58840.2600	74	0.037	3.2795	18.5185	21.6863
6500	63743.6150	81	0.0405	3.5528	20.2703	23.4380
7000	68646.9700	90	0.045	3.8260	22.5225	25.6903
7500	73550.3250	98	0.049	4.0993	24.5245	27.6923
8000	78453.6800	105	0.0525	4.3726	26.2763	29.4441
8500	83357.0350	110	0.055	4.6459	27.5275	30.6953
9000	88260.3900	116	0.058	4.9192	29.0290	32.1968
9500	93163.7450	121	0.0605	5.1925	30.2803	33.4481
10000	98067.1000	125	0.0625	5.4658	31.2813	34.4491
10500	102970.4550	129	0.0645	5.7391	32.2823	35.4501
11000	107873.8100	138	0.069	6.0124	34.5345	37.7023
11500	112777.1650	143	0.0715	6.2857	35.7858	38.9536
12000	117680.5200	149	0.0745	6.5589	37.2873	40.4551
12500	122583.8750	156	0.078	6.8322	39.0390	42.2068
13000	127487.2300	165	0.0825	7.1055	41.2913	44.4591
13500	132390.5850	174	0.087	7.3788	43.5435	46.7113
14000	137293.9400	180	0.09	7.6521	45.0450	48.2128

14500	142197.2950	190	0.095	7.9254	47.5475	50.7153
15000	147100.6500	197	0.0985	8.1987	49.2993	52.4671
15500	152004.0050	204	0.102	8.4720	51.0511	54.2188
16000	156907.3600	214	0.107	8.7453	53.5536	56.7213
16500	161810.7150	220	0.11	9.0185	55.0551	58.2228
17000	166714.0700	231	0.1155	9.2918	57.8078	60.9756
17500	171617.4250	245	0.1225	9.5651	61.3113	64.4791
18000	176520.7800	259	0.1295	9.8384	64.8148	67.9826
18500	181424.1350	267	0.1335	10.1117	66.8168	69.9846
19000	186327.4900	279	0.1395	10.3850	69.8198	72.9876
19500	191230.8450	290	0.145	10.6583	72.5726	75.7403
20000	196134.2000	300	0.15	10.9316	75.0751	78.2429



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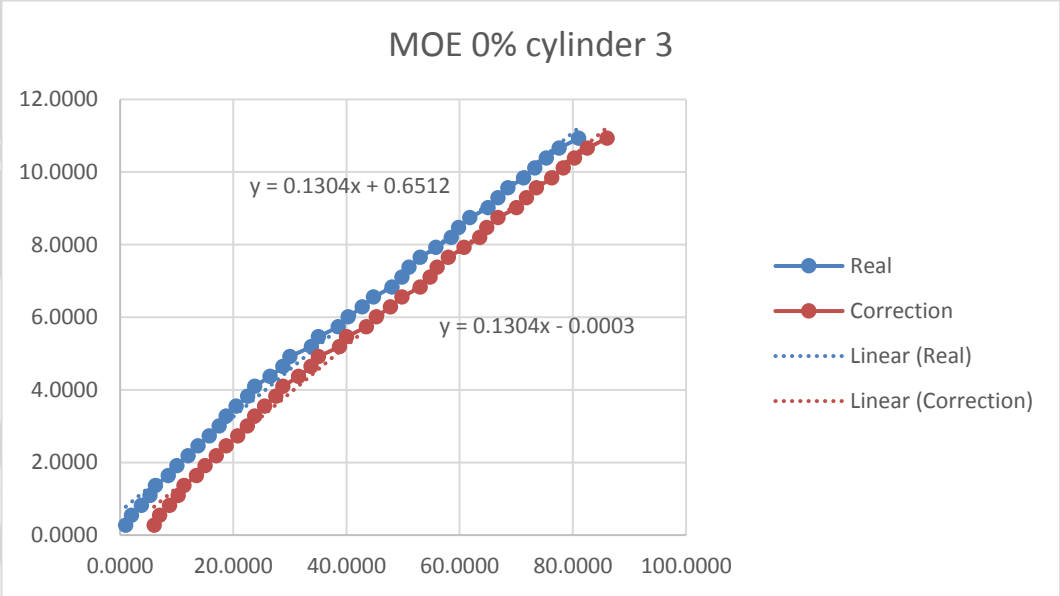
0% - cylinder 3

compressive strength =	40.7115	fp =	10.9316
A =	17774	ep =	0.0009
Po =	199.9		
correction =	4.9939		
modulus =	12706.0458		
mod theory =	29988.6151		

Load		Strainometer (ΔP)	0.5 ΔP x 10^-3 (mm)	stress (f) Mpa	strain (ε) x 10^-5	correction x 10^-5 mm
kgf	N					
500	4903.3550	4	0.002	0.2733	1.0005	5.9944
1000	9806.7100	8	0.004	0.5466	2.0010	6.9949
1500	14710.0650	15	0.0075	0.8199	3.7519	8.7457
2000	19613.4200	21	0.0105	1.0932	5.2526	10.2465
2500	24516.7750	25	0.0125	1.3664	6.2531	11.2470
3000	29420.1300	34	0.017	1.6397	8.5043	13.4981
3500	34323.4850	40	0.02	1.9130	10.0050	14.9989
4000	39226.8400	48	0.024	2.1863	12.0060	16.9999
4500	44130.1950	55	0.0275	2.4596	13.7569	18.7507
5000	49033.5500	63	0.0315	2.7329	15.7579	20.7517
5500	53936.9050	70	0.035	3.0062	17.5088	22.5026
6000	58840.2600	75	0.0375	3.2795	18.7594	23.7532
6500	63743.6150	82	0.041	3.5528	20.5103	25.5041
7000	68646.9700	90	0.045	3.8260	22.5113	27.5051
7500	73550.3250	95	0.0475	4.0993	23.7619	28.7557
8000	78453.6800	106	0.053	4.3726	26.5133	31.5071
8500	83357.0350	115	0.0575	4.6459	28.7644	33.7582
9000	88260.3900	120	0.06	4.9192	30.0150	35.0089
9500	93163.7450	135	0.0675	5.1925	33.7669	38.7607
10000	98067.1000	140	0.07	5.4658	35.0175	40.0114
10500	102970.4550	154	0.077	5.7391	38.5193	43.5131
11000	107873.8100	161	0.0805	6.0124	40.2701	45.2640
11500	112777.1650	171	0.0855	6.2857	42.7714	47.7653
12000	117680.5200	179	0.0895	6.5589	44.7724	49.7663
12500	122583.8750	192	0.096	6.8322	48.0240	53.0179
13000	127487.2300	199	0.0995	7.1055	49.7749	54.7688
13500	132390.5850	204	0.102	7.3788	51.0255	56.0194
14000	137293.9400	212	0.106	7.6521	53.0265	58.0204

14500	142197.2950	223	0.1115	7.9254	55.7779	60.7718
15000	147100.6500	234	0.117	8.1987	58.5293	63.5231
15500	152004.0050	239	0.1195	8.4720	59.7799	64.7738
16000	156907.3600	247	0.1235	8.7453	61.7809	66.7748
16500	161810.7150	260	0.13	9.0185	65.0325	70.0264
17000	166714.0700	267	0.1335	9.2918	66.7834	71.7773
17500	171617.4250	274	0.137	9.5651	68.5343	73.5281
18000	176520.7800	285	0.1425	9.8384	71.2856	76.2795
18500	181424.1350	293	0.1465	10.1117	73.2866	78.2805
19000	186327.4900	301	0.1505	10.3850	75.2876	80.2815
19500	191230.8450	310	0.155	10.6583	77.5388	82.5326
20000	196134.2000	324	0.162	10.9316	81.0405	86.0344



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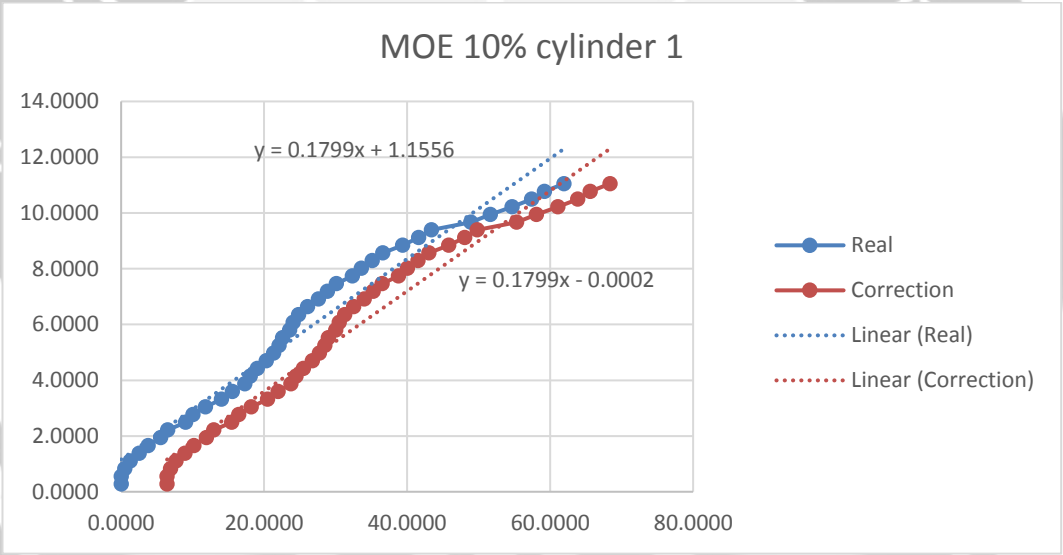
10% - cylinder 1

compressive strength =	41.6925	fp =	11.0498
A =	17750	ep =	0.0007
Po =	199.4		
correction =	6.4236		
modulus =	16164.2992		
mod theory =	30347.7730		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2762	0.0000	6.4236
1000	9806.7100	0	0	0.5525	0.0000	6.4236
1500	14710.0650	2	0.001	0.8287	0.5015	6.9251
2000	19613.4200	5	0.0025	1.1050	1.2538	7.6773
2500	24516.7750	10	0.005	1.3812	2.5075	8.9311
3000	29420.1300	15	0.0075	1.6575	3.7613	10.1849
3500	34323.4850	22	0.011	1.9337	5.5165	11.9401
4000	39226.8400	26	0.013	2.2100	6.5196	12.9431
4500	44130.1950	36	0.018	2.4862	9.0271	15.4506
5000	49033.5500	40	0.02	2.7625	10.0301	16.4537
5500	53936.9050	47	0.0235	3.0387	11.7854	18.2089
6000	58840.2600	56	0.028	3.3149	14.0421	20.4657
6500	63743.6150	62	0.031	3.5912	15.5466	21.9702
7000	68646.9700	69	0.0345	3.8674	17.3019	23.7255
7500	73550.3250	72	0.036	4.1437	18.0542	24.4777
8000	78453.6800	76	0.038	4.4199	19.0572	25.4807
8500	83357.0350	81	0.0405	4.6962	20.3109	26.7345
9000	88260.3900	85	0.0425	4.9724	21.3139	27.7375
9500	93163.7450	88	0.044	5.2487	22.0662	28.4898
10000	98067.1000	90	0.045	5.5249	22.5677	28.9913
10500	102970.4550	94	0.047	5.8012	23.5707	29.9943
11000	107873.8100	96	0.048	6.0774	24.0722	30.4958
11500	112777.1650	99	0.0495	6.3536	24.8245	31.2480
12000	117680.5200	104	0.052	6.6299	26.0782	32.5018
12500	122583.8750	110	0.055	6.9061	27.5827	34.0063
13000	127487.2300	115	0.0575	7.1824	28.8365	35.2601
13500	132390.5850	120	0.06	7.4586	30.0903	36.5138
14000	137293.9400	129	0.0645	7.7349	32.3470	38.7706

14500	142197.2950	134	0.067	8.0111	33.6008	40.0244
15000	147100.6500	140	0.07	8.2874	35.1053	41.5289
15500	152004.0050	146	0.073	8.5636	36.6098	43.0334
16000	156907.3600	157	0.0785	8.8399	39.3681	45.7917
16500	161810.7150	166	0.083	9.1161	41.6249	48.0484
17000	166714.0700	173	0.0865	9.3923	43.3801	49.8037
17500	171617.4250	195	0.0975	9.6686	48.8967	55.3203
18000	176520.7800	206	0.103	9.9448	51.6550	58.0785
18500	181424.1350	218	0.109	10.2211	54.6640	61.0876
19000	186327.4900	229	0.1145	10.4973	57.4223	63.8458
19500	191230.8450	236	0.118	10.7736	59.1775	65.6011
20000	196134.2000	247	0.1235	11.0498	61.9358	68.3594



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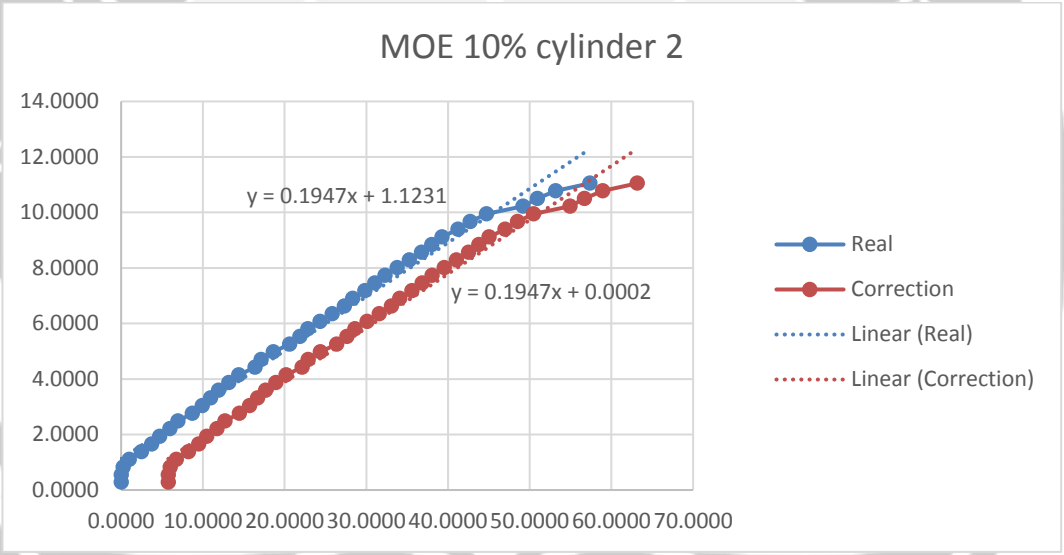
10% - cylinder 2

compressive strength =	52.9740	fp =	11.0498
A =	17797	ep =	0.0006
Po =	201.3		
correction =	5.7684		
modulus =	17498.9979		
mod theory =	34208.1227		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2762	0.0000	5.7684
1000	9806.7100	0	0	0.5525	0.0000	5.7684
1500	14710.0650	1	0.0005	0.8287	0.2484	6.0167
2000	19613.4200	4	0.002	1.1050	0.9935	6.7619
2500	24516.7750	10	0.005	1.3812	2.4839	8.2522
3000	29420.1300	15	0.0075	1.6575	3.7258	9.4941
3500	34323.4850	19	0.0095	1.9337	4.7193	10.4877
4000	39226.8400	24	0.012	2.2100	5.9613	11.7296
4500	44130.1950	28	0.014	2.4862	6.9548	12.7232
5000	49033.5500	35	0.0175	2.7625	8.6935	14.4619
5500	53936.9050	40	0.02	3.0387	9.9354	15.7038
6000	58840.2600	44	0.022	3.3149	10.9290	16.6973
6500	63743.6150	48	0.024	3.5912	11.9225	17.6909
7000	68646.9700	53	0.0265	3.8674	13.1644	18.9328
7500	73550.3250	58	0.029	4.1437	14.4064	20.1747
8000	78453.6800	66	0.033	4.4199	16.3934	22.1618
8500	83357.0350	69	0.0345	4.6962	17.1386	22.9070
9000	88260.3900	75	0.0375	4.9724	18.6289	24.3973
9500	93163.7450	83	0.0415	5.2487	20.6160	26.3844
10000	98067.1000	88	0.044	5.5249	21.8579	27.6263
10500	102970.4550	92	0.046	5.8012	22.8515	28.6198
11000	107873.8100	98	0.049	6.0774	24.3418	30.1101
11500	112777.1650	104	0.052	6.3536	25.8321	31.6005
12000	117680.5200	110	0.055	6.6299	27.3224	33.0908
12500	122583.8750	114	0.057	6.9061	28.3159	34.0843
13000	127487.2300	120	0.06	7.1824	29.8063	35.5746
13500	132390.5850	125	0.0625	7.4586	31.0482	36.8165
14000	137293.9400	130	0.065	7.7349	32.2901	38.0585

14500	142197.2950	136	0.068	8.0111	33.7804	39.5488
15000	147100.6500	142	0.071	8.2874	35.2707	41.0391
15500	152004.0050	148	0.074	8.5636	36.7611	42.5294
16000	156907.3600	153	0.0765	8.8399	38.0030	43.7713
16500	161810.7150	158	0.079	9.1161	39.2449	45.0133
17000	166714.0700	166	0.083	9.3923	41.2320	47.0004
17500	171617.4250	172	0.086	9.6686	42.7223	48.4907
18000	176520.7800	180	0.09	9.9448	44.7094	50.4778
18500	181424.1350	198	0.099	10.2211	49.1803	54.9487
19000	186327.4900	205	0.1025	10.4973	50.9190	56.6874
19500	191230.8450	214	0.107	10.7736	53.1545	58.9229
20000	196134.2000	231	0.1155	11.0498	57.3770	63.1454



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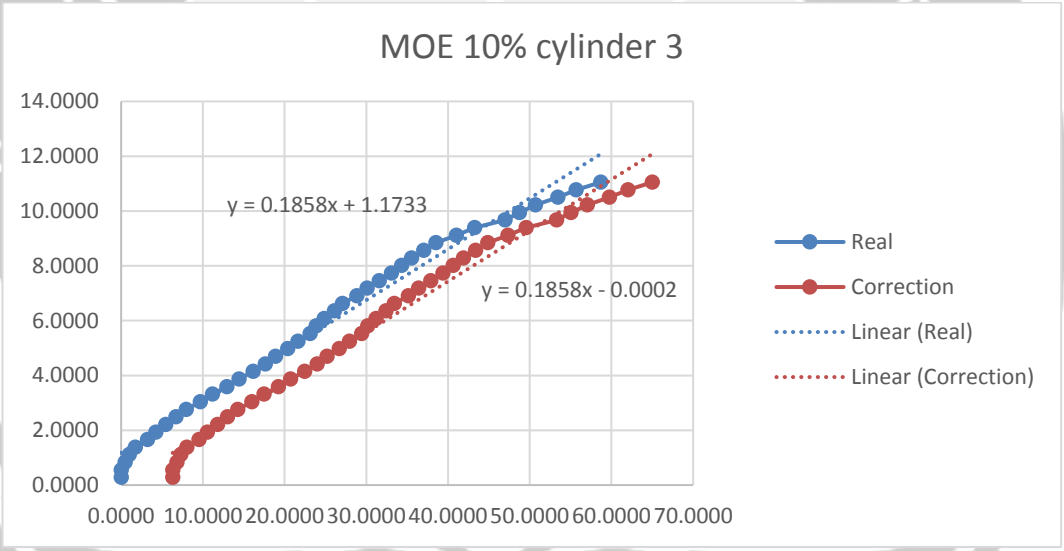
10% - cylinder 3

compressive strength =	44.1450	fp =	11.0498
A =	17979	ep =	0.0006
Po =	201.1		
correction =	6.3149		
modulus =	17001.7726		
mod theory =	31227.6008		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2762	0.0000	6.3149
1000	9806.7100	0	0	0.5525	0.0000	6.3149
1500	14710.0650	2	0.001	0.8287	0.4973	6.8121
2000	19613.4200	4	0.002	1.1050	0.9945	7.3094
2500	24516.7750	7	0.0035	1.3812	1.7404	8.0553
3000	29420.1300	13	0.0065	1.6575	3.2322	9.5471
3500	34323.4850	17	0.0085	1.9337	4.2268	10.5416
4000	39226.8400	22	0.011	2.2100	5.4699	11.7848
4500	44130.1950	27	0.0135	2.4862	6.7131	13.0279
5000	49033.5500	32	0.016	2.7625	7.9562	14.2711
5500	53936.9050	39	0.0195	3.0387	9.6967	16.0115
6000	58840.2600	45	0.0225	3.3149	11.1885	17.5033
6500	63743.6150	52	0.026	3.5912	12.9289	19.2437
7000	68646.9700	58	0.029	3.8674	14.4207	20.7355
7500	73550.3250	65	0.0325	4.1437	16.1611	22.4760
8000	78453.6800	71	0.0355	4.4199	17.6529	23.9678
8500	83357.0350	76	0.038	4.6962	18.8961	25.2109
9000	88260.3900	82	0.041	4.9724	20.3879	26.7027
9500	93163.7450	87	0.0435	5.2487	21.6310	27.9459
10000	98067.1000	93	0.0465	5.5249	23.1228	29.4377
10500	102970.4550	96	0.048	5.8012	23.8687	30.1836
11000	107873.8100	100	0.05	6.0774	24.8633	31.1781
11500	112777.1650	105	0.0525	6.3536	26.1064	32.4213
12000	117680.5200	109	0.0545	6.6299	27.1009	33.4158
12500	122583.8750	116	0.058	6.9061	28.8414	35.1562
13000	127487.2300	121	0.0605	7.1824	30.0845	36.3994
13500	132390.5850	127	0.0635	7.4586	31.5763	37.8912
14000	137293.9400	133	0.0665	7.7349	33.0681	39.3830

14500	142197.2950	138	0.069	8.0111	34.3113	40.6261
15000	147100.6500	143	0.0715	8.2874	35.5545	41.8693
15500	152004.0050	149	0.0745	8.5636	37.0462	43.3611
16000	156907.3600	155	0.0775	8.8399	38.5380	44.8529
16500	161810.7150	165	0.0825	9.1161	41.0244	47.3392
17000	166714.0700	174	0.087	9.3923	43.2621	49.5769
17500	171617.4250	189	0.0945	9.6686	46.9915	53.3064
18000	176520.7800	196	0.098	9.9448	48.7320	55.0468
18500	181424.1350	204	0.102	10.2211	50.7210	57.0359
19000	186327.4900	215	0.1075	10.4973	53.4560	59.7708
19500	191230.8450	224	0.112	10.7736	55.6937	62.0085
20000	196134.2000	236	0.118	11.0498	58.6773	64.9921



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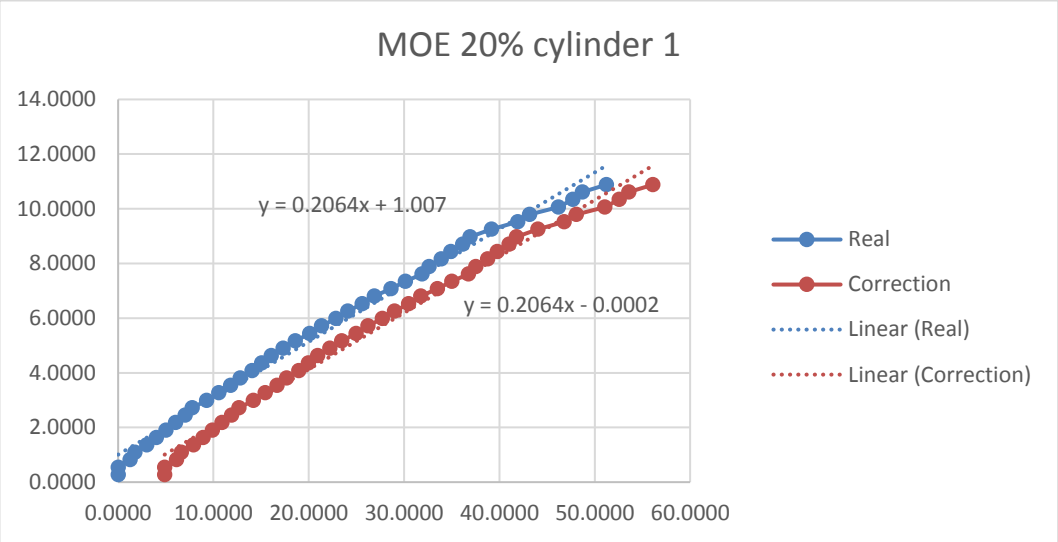
20% - cylinder 1

compressive strength =	55.9170	fp =	10.8800
A =	18027	ep =	0.0006
Po =	199.2		
correction =	4.8789		
modulus =	19399.6212		
mod theory =	35145.5051		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2720	0.0000	4.8789
1000	9806.7100	0	0	0.5440	0.0000	4.8789
1500	14710.0650	5	0.0025	0.8160	1.2550	6.1339
2000	19613.4200	7	0.0035	1.0880	1.7570	6.6359
2500	24516.7750	12	0.006	1.3600	3.0120	7.8909
3000	29420.1300	16	0.008	1.6320	4.0161	8.8949
3500	34323.4850	20	0.01	1.9040	5.0201	9.8990
4000	39226.8400	24	0.012	2.1760	6.0241	10.9030
4500	44130.1950	28	0.014	2.4480	7.0281	11.9070
5000	49033.5500	31	0.0155	2.7200	7.7811	12.6600
5500	53936.9050	37	0.0185	2.9920	9.2871	14.1660
6000	58840.2600	42	0.021	3.2640	10.5422	15.4210
6500	63743.6150	47	0.0235	3.5360	11.7972	16.6761
7000	68646.9700	51	0.0255	3.8080	12.8012	17.6801
7500	73550.3250	56	0.028	4.0800	14.0562	18.9351
8000	78453.6800	60	0.03	4.3520	15.0602	19.9391
8500	83357.0350	64	0.032	4.6240	16.0643	20.9431
9000	88260.3900	69	0.0345	4.8960	17.3193	22.1982
9500	93163.7450	74	0.037	5.1680	18.5743	23.4532
10000	98067.1000	80	0.04	5.4400	20.0803	24.9592
10500	102970.4550	85	0.0425	5.7120	21.3353	26.2142
11000	107873.8100	91	0.0455	5.9840	22.8414	27.7202
11500	112777.1650	96	0.048	6.2560	24.0964	28.9753
12000	117680.5200	102	0.051	6.5280	25.6024	30.4813
12500	122583.8750	107	0.0535	6.8000	26.8574	31.7363
13000	127487.2300	114	0.057	7.0720	28.6145	33.4933
13500	132390.5850	120	0.06	7.3440	30.1205	34.9994
14000	137293.9400	127	0.0635	7.6160	31.8775	36.7564

14500	142197.2950	130	0.065	7.8880	32.6305	37.5094
15000	147100.6500	135	0.0675	8.1600	33.8855	38.7644
15500	152004.0050	139	0.0695	8.4320	34.8896	39.7684
16000	156907.3600	144	0.072	8.7040	36.1446	41.0235
16500	161810.7150	147	0.0735	8.9760	36.8976	41.7765
17000	166714.0700	156	0.078	9.2480	39.1566	44.0355
17500	171617.4250	167	0.0835	9.5200	41.9177	46.7965
18000	176520.7800	172	0.086	9.7920	43.1727	48.0516
18500	181424.1350	184	0.092	10.0640	46.1847	51.0636
19000	186327.4900	190	0.095	10.3360	47.6908	52.5696
19500	191230.8450	194	0.097	10.6080	48.6948	53.5737
20000	196134.2000	204	0.102	10.8800	51.2048	56.0837



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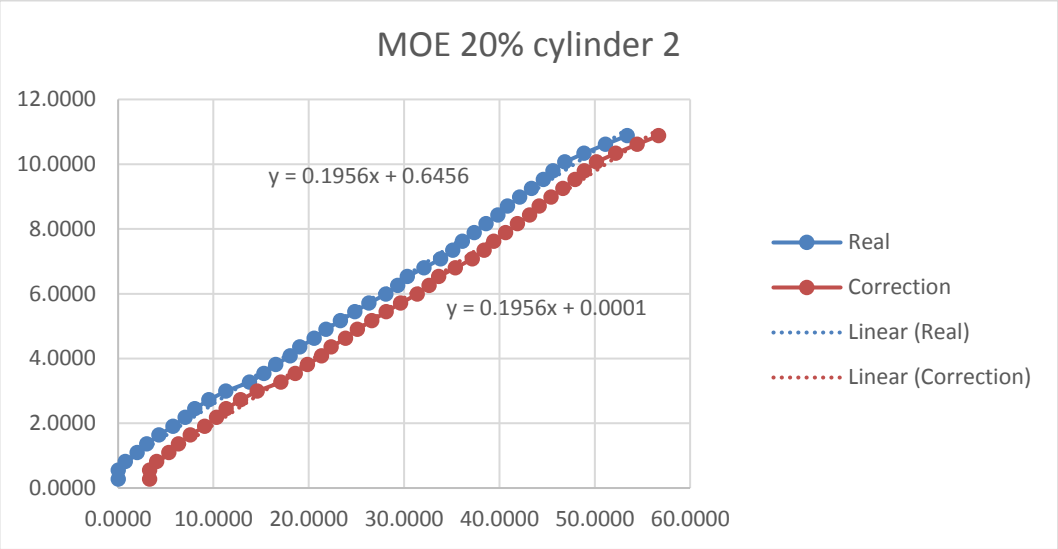
20% - cylinder 2

compressive strength =	53.9550	fp =	10.8800
A =	17837	ep =	0.0006
Po =	199.5		
correction =	3.3006		
modulus =	19194.1475		
mod theory =	34523.4116		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2720	0.0000	3.3006
1000	9806.7100	0	0	0.5440	0.0000	3.3006
1500	14710.0650	3	0.0015	0.8160	0.7519	4.0525
2000	19613.4200	8	0.004	1.0880	2.0050	5.3056
2500	24516.7750	12	0.006	1.3600	3.0075	6.3081
3000	29420.1300	17	0.0085	1.6320	4.2607	7.5613
3500	34323.4850	23	0.0115	1.9040	5.7644	9.0650
4000	39226.8400	28	0.014	2.1760	7.0175	10.3182
4500	44130.1950	32	0.016	2.4480	8.0201	11.3207
5000	49033.5500	38	0.019	2.7200	9.5238	12.8244
5500	53936.9050	45	0.0225	2.9920	11.2782	14.5788
6000	58840.2600	55	0.0275	3.2640	13.7845	17.0851
6500	63743.6150	61	0.0305	3.5360	15.2882	18.5888
7000	68646.9700	66	0.033	3.8080	16.5414	19.8420
7500	73550.3250	72	0.036	4.0800	18.0451	21.3457
8000	78453.6800	76	0.038	4.3520	19.0476	22.3482
8500	83357.0350	82	0.041	4.6240	20.5514	23.8520
9000	88260.3900	87	0.0435	4.8960	21.8045	25.1051
9500	93163.7450	93	0.0465	5.1680	23.3083	26.6089
10000	98067.1000	99	0.0495	5.4400	24.8120	28.1126
10500	102970.4550	105	0.0525	5.7120	26.3158	29.6164
11000	107873.8100	112	0.056	5.9840	28.0702	31.3708
11500	112777.1650	117	0.0585	6.2560	29.3233	32.6239
12000	117680.5200	121	0.0605	6.5280	30.3258	33.6264
12500	122583.8750	128	0.064	6.8000	32.0802	35.3808
13000	127487.2300	135	0.0675	7.0720	33.8346	37.1352
13500	132390.5850	140	0.07	7.3440	35.0877	38.3883
14000	137293.9400	144	0.072	7.6160	36.0902	39.3908

14500	142197.2950	149	0.0745	7.8880	37.3434	40.6440
15000	147100.6500	154	0.077	8.1600	38.5965	41.8971
15500	152004.0050	159	0.0795	8.4320	39.8496	43.1502
16000	156907.3600	163	0.0815	8.7040	40.8521	44.1527
16500	161810.7150	168	0.084	8.9760	42.1053	45.4059
17000	166714.0700	173	0.0865	9.2480	43.3584	46.6590
17500	171617.4250	178	0.089	9.5200	44.6115	47.9121
18000	176520.7800	182	0.091	9.7920	45.6140	48.9146
18500	181424.1350	187	0.0935	10.0640	46.8672	50.1678
19000	186327.4900	195	0.0975	10.3360	48.8722	52.1728
19500	191230.8450	204	0.102	10.6080	51.1278	54.4284
20000	196134.2000	213	0.1065	10.8800	53.3835	56.6841



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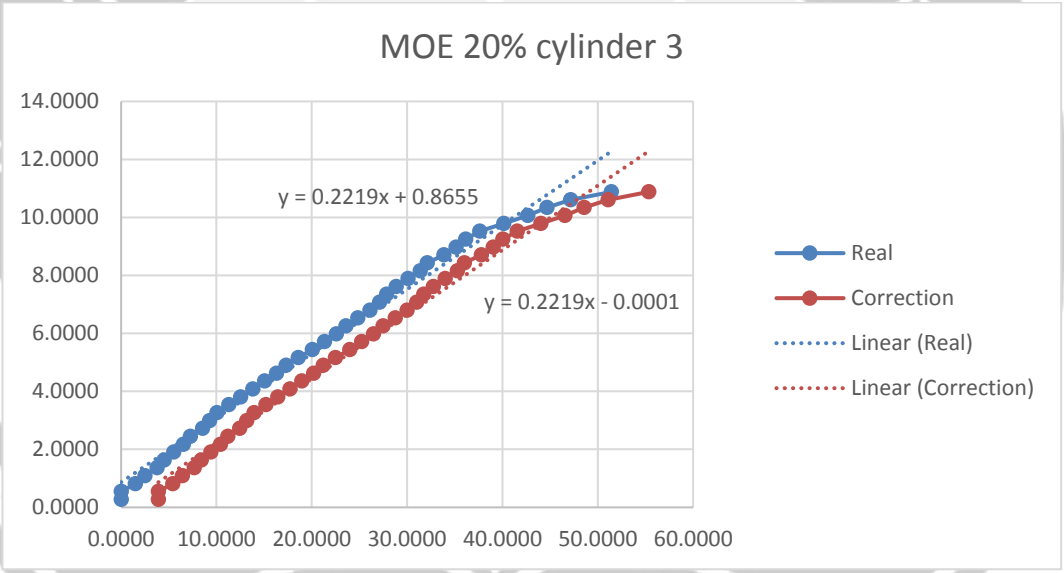
20% - cylinder 3

compressive strength =	55.4265	fp =	10.8800
A =	17774	ep =	0.0006
Po =	199.3		
correction =	3.9004		
modulus =	19663.7334		
mod theory =	34991.0186		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2720	0.0000	3.9004
1000	9806.7100	0	0	0.5440	0.0000	3.9004
1500	14710.0650	6	0.003	0.8160	1.5053	5.4057
2000	19613.4200	10	0.005	1.0880	2.5088	6.4092
2500	24516.7750	15	0.0075	1.3600	3.7632	7.6636
3000	29420.1300	18	0.009	1.6320	4.5158	8.4162
3500	34323.4850	22	0.011	1.9040	5.5193	9.4197
4000	39226.8400	26	0.013	2.1760	6.5228	10.4232
4500	44130.1950	29	0.0145	2.4480	7.2755	11.1759
5000	49033.5500	34	0.017	2.7200	8.5299	12.4303
5500	53936.9050	37	0.0185	2.9920	9.2825	13.1829
6000	58840.2600	40	0.02	3.2640	10.0351	13.9355
6500	63743.6150	45	0.0225	3.5360	11.2895	15.1899
7000	68646.9700	50	0.025	3.8080	12.5439	16.4443
7500	73550.3250	55	0.0275	4.0800	13.7983	17.6987
8000	78453.6800	60	0.03	4.3520	15.0527	18.9531
8500	83357.0350	65	0.0325	4.6240	16.3071	20.2075
9000	88260.3900	69	0.0345	4.8960	17.3106	21.2110
9500	93163.7450	74	0.037	5.1680	18.5650	22.4654
10000	98067.1000	80	0.04	5.4400	20.0702	23.9707
10500	102970.4550	85	0.0425	5.7120	21.3246	25.2250
11000	107873.8100	90	0.045	5.9840	22.5790	26.4794
11500	112777.1650	94	0.047	6.2560	23.5825	27.4829
12000	117680.5200	99	0.0495	6.5280	24.8369	28.7373
12500	122583.8750	104	0.052	6.8000	26.0913	29.9917
13000	127487.2300	108	0.054	7.0720	27.0948	30.9952
13500	132390.5850	111	0.0555	7.3440	27.8475	31.7479
14000	137293.9400	115	0.0575	7.6160	28.8510	32.7514

14500	142197.2950	120	0.06	7.8880	30.1054	34.0058
15000	147100.6500	125	0.0625	8.1600	31.3598	35.2602
15500	152004.0050	128	0.064	8.4320	32.1124	36.0128
16000	156907.3600	135	0.0675	8.7040	33.8685	37.7689
16500	161810.7150	140	0.07	8.9760	35.1229	39.0233
17000	166714.0700	144	0.072	9.2480	36.1264	40.0268
17500	171617.4250	150	0.075	9.5200	37.6317	41.5321
18000	176520.7800	160	0.08	9.7920	40.1405	44.0409
18500	181424.1350	170	0.085	10.0640	42.6493	46.5497
19000	186327.4900	178	0.089	10.3360	44.6563	48.5567
19500	191230.8450	188	0.094	10.6080	47.1651	51.0655
20000	196134.2000	205	0.1025	10.8800	51.4300	55.3304



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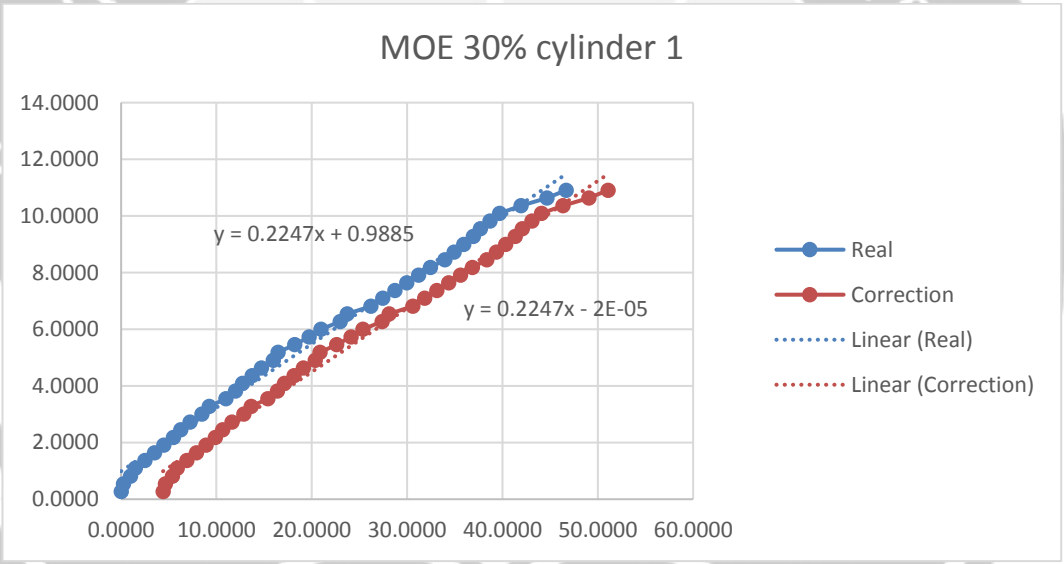
30% - cylinder 1

compressive strength =	63.7650	fp =	10.9091
A =	17979	ep =	0.0005
Po =	200.3		
correction =	4.3992		
modulus =	21357.1790		
mod theory =	37530.9053		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2727	0.0000	4.3992
1000	9806.7100	1	0.0005	0.5455	0.2496	4.6488
1500	14710.0650	4	0.002	0.8182	0.9985	5.3977
2000	19613.4200	6	0.003	1.0909	1.4978	5.8970
2500	24516.7750	10	0.005	1.3636	2.4963	6.8955
3000	29420.1300	14	0.007	1.6364	3.4948	7.8940
3500	34323.4850	18	0.009	1.9091	4.4933	8.8925
4000	39226.8400	22	0.011	2.1818	5.4918	9.8910
4500	44130.1950	25	0.0125	2.4545	6.2406	10.6398
5000	49033.5500	29	0.0145	2.7273	7.2391	11.6383
5500	53936.9050	34	0.017	3.0000	8.4873	12.8865
6000	58840.2600	37	0.0185	3.2727	9.2361	13.6353
6500	63743.6150	44	0.022	3.5454	10.9835	15.3827
7000	68646.9700	48	0.024	3.8182	11.9820	16.3812
7500	73550.3250	51	0.0255	4.0909	12.7309	17.1301
8000	78453.6800	55	0.0275	4.3636	13.7294	18.1286
8500	83357.0350	59	0.0295	4.6364	14.7279	19.1271
9000	88260.3900	64	0.032	4.9091	15.9760	20.3752
9500	93163.7450	66	0.033	5.1818	16.4753	20.8745
10000	98067.1000	73	0.0365	5.4545	18.2227	22.6219
10500	102970.4550	79	0.0395	5.7273	19.7204	24.1196
11000	107873.8100	84	0.042	6.0000	20.9685	25.3677
11500	112777.1650	92	0.046	6.2727	22.9656	27.3648
12000	117680.5200	95	0.0475	6.5454	23.7144	28.1136
12500	122583.8750	105	0.0525	6.8182	26.2107	30.6099
13000	127487.2300	110	0.055	7.0909	27.4588	31.8580
13500	132390.5850	115	0.0575	7.3636	28.7069	33.1061
14000	137293.9400	120	0.06	7.6364	29.9551	34.3543

14500	142197.2950	125	0.0625	7.9091	31.2032	35.6024
15000	147100.6500	130	0.065	8.1818	32.4513	36.8505
15500	152004.0050	136	0.068	8.4545	33.9491	38.3483
16000	156907.3600	140	0.07	8.7273	34.9476	39.3468
16500	161810.7150	144	0.072	9.0000	35.9461	40.3453
17000	166714.0700	148	0.074	9.2727	36.9446	41.3438
17500	171617.4250	151	0.0755	9.5454	37.6935	42.0927
18000	176520.7800	155	0.0775	9.8182	38.6920	43.0912
18500	181424.1350	159	0.0795	10.0909	39.6905	44.0897
19000	186327.4900	168	0.084	10.3636	41.9371	46.3363
19500	191230.8450	179	0.0895	10.6363	44.6830	49.0822
20000	196134.2000	187	0.0935	10.9091	46.6800	51.0792



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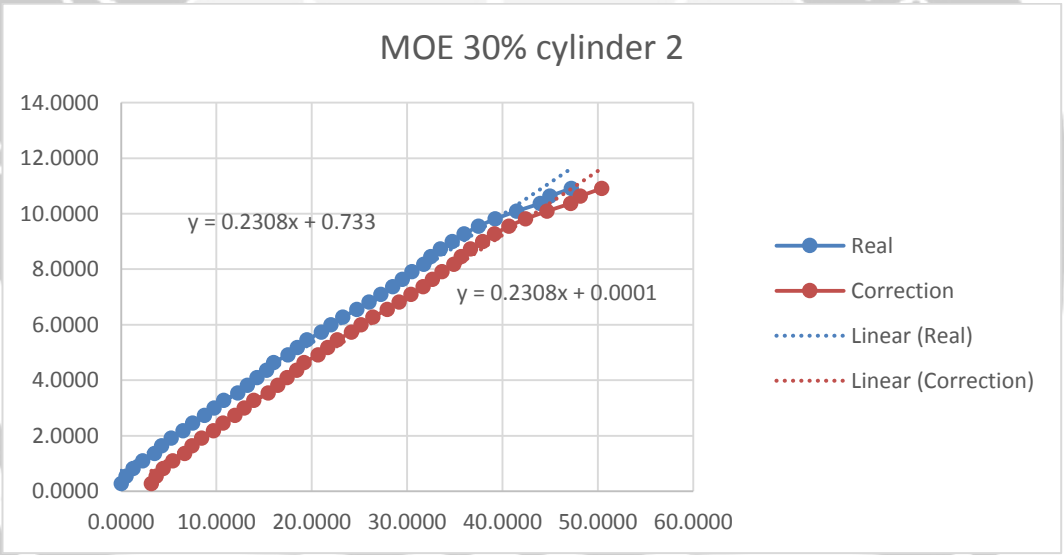
30% - cylinder 2

compressive strength =	65.2365	fp =	10.9091
A =	17774	ep =	0.0005
Po =	200.1		
correction =	3.1759		
modulus =	21643.9972		
mod theory =	37961.4842		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2727	0.0000	3.1759
1000	9806.7100	2	0.001	0.5455	0.4998	3.6757
1500	14710.0650	5	0.0025	0.8182	1.2494	4.4253
2000	19613.4200	9	0.0045	1.0909	2.2489	5.4248
2500	24516.7750	14	0.007	1.3636	3.4983	6.6742
3000	29420.1300	17	0.0085	1.6364	4.2479	7.4238
3500	34323.4850	21	0.0105	1.9091	5.2474	8.4233
4000	39226.8400	26	0.013	2.1818	6.4968	9.6727
4500	44130.1950	30	0.015	2.4545	7.4963	10.6722
5000	49033.5500	35	0.0175	2.7273	8.7456	11.9215
5500	53936.9050	39	0.0195	3.0000	9.7451	12.9210
6000	58840.2600	43	0.0215	3.2727	10.7446	13.9205
6500	63743.6150	49	0.0245	3.5454	12.2439	15.4198
7000	68646.9700	53	0.0265	3.8182	13.2434	16.4193
7500	73550.3250	57	0.0285	4.0909	14.2429	17.4188
8000	78453.6800	61	0.0305	4.3636	15.2424	18.4183
8500	83357.0350	64	0.032	4.6364	15.9920	19.1679
9000	88260.3900	70	0.035	4.9091	17.4913	20.6672
9500	93163.7450	74	0.037	5.1818	18.4908	21.6667
10000	98067.1000	78	0.039	5.4545	19.4903	22.6662
10500	102970.4550	84	0.042	5.7273	20.9895	24.1654
11000	107873.8100	88	0.044	6.0000	21.9890	25.1649
11500	112777.1650	93	0.0465	6.2727	23.2384	26.4143
12000	117680.5200	99	0.0495	6.5454	24.7376	27.9135
12500	122583.8750	104	0.052	6.8182	25.9870	29.1629
13000	127487.2300	109	0.0545	7.0909	27.2364	30.4123
13500	132390.5850	114	0.057	7.3636	28.4858	31.6617
14000	137293.9400	118	0.059	7.6364	29.4853	32.6612

14500	142197.2950	122	0.061	7.9091	30.4848	33.6607
15000	147100.6500	127	0.0635	8.1818	31.7341	34.9100
15500	152004.0050	130	0.065	8.4545	32.4838	35.6597
16000	156907.3600	134	0.067	8.7273	33.4833	36.6592
16500	161810.7150	139	0.0695	9.0000	34.7326	37.9085
17000	166714.0700	144	0.072	9.2727	35.9820	39.1579
17500	171617.4250	150	0.075	9.5454	37.4813	40.6572
18000	176520.7800	157	0.0785	9.8182	39.2304	42.4063
18500	181424.1350	166	0.083	10.0909	41.4793	44.6552
19000	186327.4900	176	0.088	10.3636	43.9780	47.1539
19500	191230.8450	180	0.09	10.6363	44.9775	48.1534
20000	196134.2000	189	0.0945	10.9091	47.2264	50.4023



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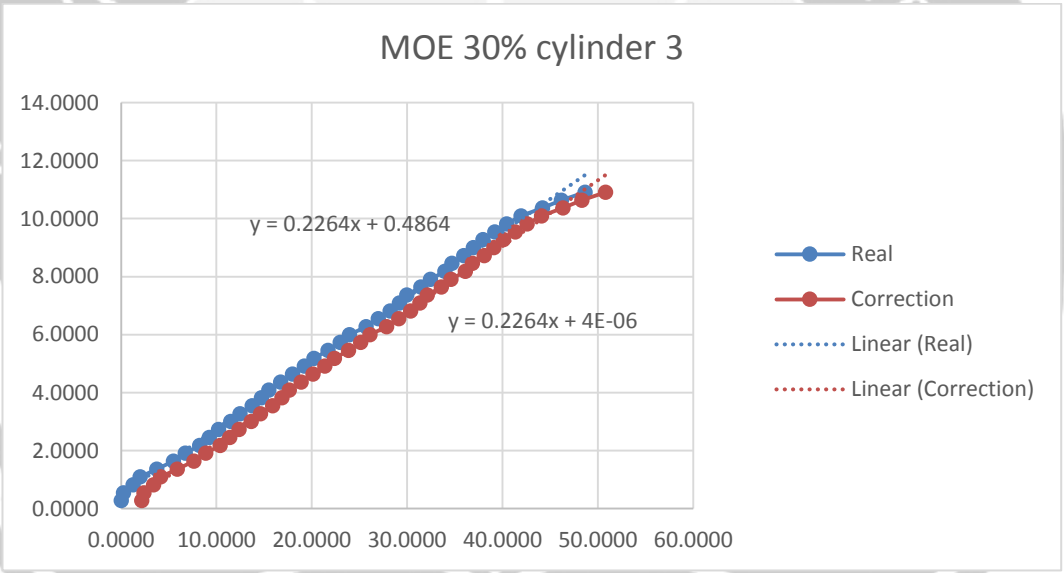
30% - cylinder 3

compressive strength =	62.7840	fp =	10.9091
A =	17750	ep =	0.0005
Po =	200.3		
correction =	2.1484		
modulus =	21463.8210		
mod theory =	37241.0870		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2727	0.0000	2.1484
1000	9806.7100	1	0.0005	0.5455	0.2496	2.3980
1500	14710.0650	5	0.0025	0.8182	1.2481	3.3965
2000	19613.4200	8	0.004	1.0909	1.9970	4.1454
2500	24516.7750	15	0.0075	1.3636	3.7444	5.8928
3000	29420.1300	22	0.011	1.6364	5.4918	7.6402
3500	34323.4850	27	0.0135	1.9091	6.7399	8.8883
4000	39226.8400	33	0.0165	2.1818	8.2376	10.3861
4500	44130.1950	37	0.0185	2.4545	9.2361	11.3846
5000	49033.5500	41	0.0205	2.7273	10.2346	12.3831
5500	53936.9050	46	0.023	3.0000	11.4828	13.6312
6000	58840.2600	50	0.025	3.2727	12.4813	14.6297
6500	63743.6150	55	0.0275	3.5454	13.7294	15.8778
7000	68646.9700	59	0.0295	3.8182	14.7279	16.8763
7500	73550.3250	62	0.031	4.0909	15.4768	17.6252
8000	78453.6800	67	0.0335	4.3636	16.7249	18.8733
8500	83357.0350	72	0.036	4.6364	17.9730	20.1215
9000	88260.3900	77	0.0385	4.9091	19.2212	21.3696
9500	93163.7450	81	0.0405	5.1818	20.2197	22.3681
10000	98067.1000	87	0.0435	5.4545	21.7174	23.8658
10500	102970.4550	92	0.046	5.7273	22.9656	25.1140
11000	107873.8100	96	0.048	6.0000	23.9641	26.1125
11500	112777.1650	103	0.0515	6.2727	25.7114	27.8598
12000	117680.5200	108	0.054	6.5454	26.9596	29.1080
12500	122583.8750	113	0.0565	6.8182	28.2077	30.3561
13000	127487.2300	117	0.0585	7.0909	29.2062	31.3546
13500	132390.5850	120	0.06	7.3636	29.9551	32.1035
14000	137293.9400	126	0.063	7.6364	31.4528	33.6012

14500	142197.2950	130	0.065	7.9091	32.4513	34.5997
15000	147100.6500	136	0.068	8.1818	33.9491	36.0975
15500	152004.0050	139	0.0695	8.4545	34.6980	36.8464
16000	156907.3600	144	0.072	8.7273	35.9461	38.0945
16500	161810.7150	148	0.074	9.0000	36.9446	39.0930
17000	166714.0700	152	0.076	9.2727	37.9431	40.0915
17500	171617.4250	157	0.0785	9.5454	39.1912	41.3396
18000	176520.7800	162	0.081	9.8182	40.4393	42.5878
18500	181424.1350	168	0.084	10.0909	41.9371	44.0855
19000	186327.4900	177	0.0885	10.3636	44.1837	46.3321
19500	191230.8450	185	0.0925	10.6363	46.1807	48.3291
20000	196134.2000	195	0.0975	10.9091	48.6770	50.8254



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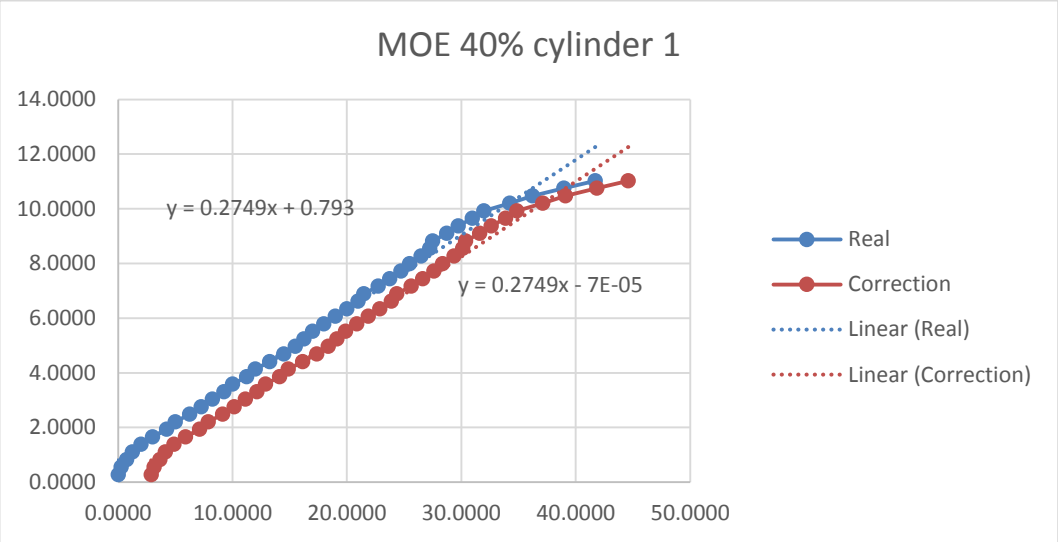
40% - cylinder 1

compressive strength =	69.6510	fp =	11.0256
A =	17789	ep =	0.0004
Po =	200.2		
correction =	2.8847		
modulus =	24724.9445		
mod theory =	39224.8721		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	2.8847
1000	9806.7100	1	0.0005	0.5513	0.2498	3.1344
1500	14710.0650	3	0.0015	0.8269	0.7493	3.6339
2000	19613.4200	5	0.0025	1.1026	1.2488	4.1334
2500	24516.7750	8	0.004	1.3782	1.9980	4.8827
3000	29420.1300	12	0.006	1.6538	2.9970	5.8817
3500	34323.4850	17	0.0085	1.9295	4.2458	7.1304
4000	39226.8400	20	0.01	2.2051	4.9950	7.8797
4500	44130.1950	25	0.0125	2.4808	6.2438	9.1284
5000	49033.5500	29	0.0145	2.7564	7.2428	10.1274
5500	53936.9050	33	0.0165	3.0320	8.2418	11.1264
6000	58840.2600	37	0.0185	3.3077	9.2408	12.1254
6500	63743.6150	40	0.02	3.5833	9.9900	12.8747
7000	68646.9700	45	0.0225	3.8590	11.2388	14.1234
7500	73550.3250	48	0.024	4.1346	11.9880	14.8727
8000	78453.6800	53	0.0265	4.4102	13.2368	16.1214
8500	83357.0350	58	0.029	4.6859	14.4855	17.3702
9000	88260.3900	62	0.031	4.9615	15.4845	18.3692
9500	93163.7450	65	0.0325	5.2372	16.2338	19.1185
10000	98067.1000	68	0.034	5.5128	16.9830	19.8677
10500	102970.4550	72	0.036	5.7884	17.9820	20.8667
11000	107873.8100	76	0.038	6.0641	18.9810	21.8657
11500	112777.1650	80	0.04	6.3397	19.9800	22.8647
12000	117680.5200	84	0.042	6.6154	20.9790	23.8637
12500	122583.8750	86	0.043	6.8910	21.4785	24.3632
13000	127487.2300	91	0.0455	7.1666	22.7273	25.6120
13500	132390.5850	95	0.0475	7.4423	23.7263	26.6110
14000	137293.9400	99	0.0495	7.7179	24.7253	27.6100

14500	142197.2950	102	0.051	7.9936	25.4745	28.3592
15000	147100.6500	106	0.053	8.2692	26.4735	29.3582
15500	152004.0050	109	0.0545	8.5448	27.2228	30.1075
16000	156907.3600	110	0.055	8.8205	27.4725	30.3572
16500	161810.7150	115	0.0575	9.0961	28.7213	31.6060
17000	166714.0700	119	0.0595	9.3718	29.7203	32.6050
17500	171617.4250	124	0.062	9.6474	30.9690	33.8537
18000	176520.7800	128	0.064	9.9230	31.9680	34.8527
18500	181424.1350	137	0.0685	10.1987	34.2158	37.1005
19000	186327.4900	145	0.0725	10.4743	36.2138	39.0985
19500	191230.8450	156	0.078	10.7499	38.9610	41.8457
20000	196134.2000	167	0.0835	11.0256	41.7083	44.5930



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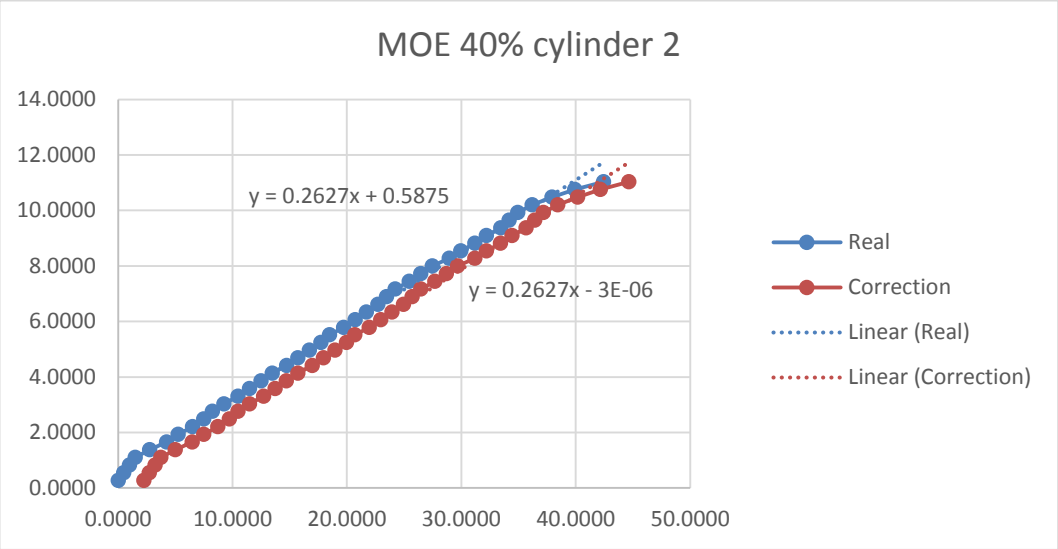
40% - cylinder 2

compressive strength =	69.1605	fp =	11.0256
A =	17750	ep =	0.0004
Po =	200.4		
correction =	2.2364		
modulus =	24692.5048		
mod theory =	39086.5123		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	2.2364
1000	9806.7100	2	0.001	0.5513	0.4990	2.7354
1500	14710.0650	4	0.002	0.8269	0.9980	3.2344
2000	19613.4200	6	0.003	1.1026	1.4970	3.7334
2500	24516.7750	11	0.0055	1.3782	2.7445	4.9809
3000	29420.1300	17	0.0085	1.6538	4.2415	6.4779
3500	34323.4850	21	0.0105	1.9295	5.2395	7.4759
4000	39226.8400	26	0.013	2.2051	6.4870	8.7234
4500	44130.1950	30	0.015	2.4808	7.4850	9.7214
5000	49033.5500	33	0.0165	2.7564	8.2335	10.4699
5500	53936.9050	37	0.0185	3.0320	9.2315	11.4679
6000	58840.2600	42	0.021	3.3077	10.4790	12.7154
6500	63743.6150	46	0.023	3.5833	11.4770	13.7134
7000	68646.9700	50	0.025	3.8590	12.4750	14.7114
7500	73550.3250	54	0.027	4.1346	13.4731	15.7094
8000	78453.6800	59	0.0295	4.4102	14.7206	16.9570
8500	83357.0350	63	0.0315	4.6859	15.7186	17.9550
9000	88260.3900	67	0.0335	4.9615	16.7166	18.9530
9500	93163.7450	71	0.0355	5.2372	17.7146	19.9510
10000	98067.1000	74	0.037	5.5128	18.4631	20.6995
10500	102970.4550	79	0.0395	5.7884	19.7106	21.9470
11000	107873.8100	83	0.0415	6.0641	20.7086	22.9450
11500	112777.1650	87	0.0435	6.3397	21.7066	23.9430
12000	117680.5200	91	0.0455	6.6154	22.7046	24.9410
12500	122583.8750	94	0.047	6.8910	23.4531	25.6895
13000	127487.2300	97	0.0485	7.1666	24.2016	26.4380
13500	132390.5850	102	0.051	7.4423	25.4491	27.6855
14000	137293.9400	106	0.053	7.7179	26.4471	28.6835

14500	142197.2950	110	0.055	7.9936	27.4451	29.6815
15000	147100.6500	116	0.058	8.2692	28.9421	31.1785
15500	152004.0050	120	0.06	8.5448	29.9401	32.1765
16000	156907.3600	125	0.0625	8.8205	31.1876	33.4240
16500	161810.7150	129	0.0645	9.0961	32.1856	34.4220
17000	166714.0700	134	0.067	9.3718	33.4331	35.6695
17500	171617.4250	137	0.0685	9.6474	34.1816	36.4180
18000	176520.7800	140	0.07	9.9230	34.9301	37.1665
18500	181424.1350	145	0.0725	10.1987	36.1776	38.4140
19000	186327.4900	152	0.076	10.4743	37.9242	40.1605
19500	191230.8450	160	0.08	10.7499	39.9202	42.1566
20000	196134.2000	170	0.085	11.0256	42.4152	44.6516



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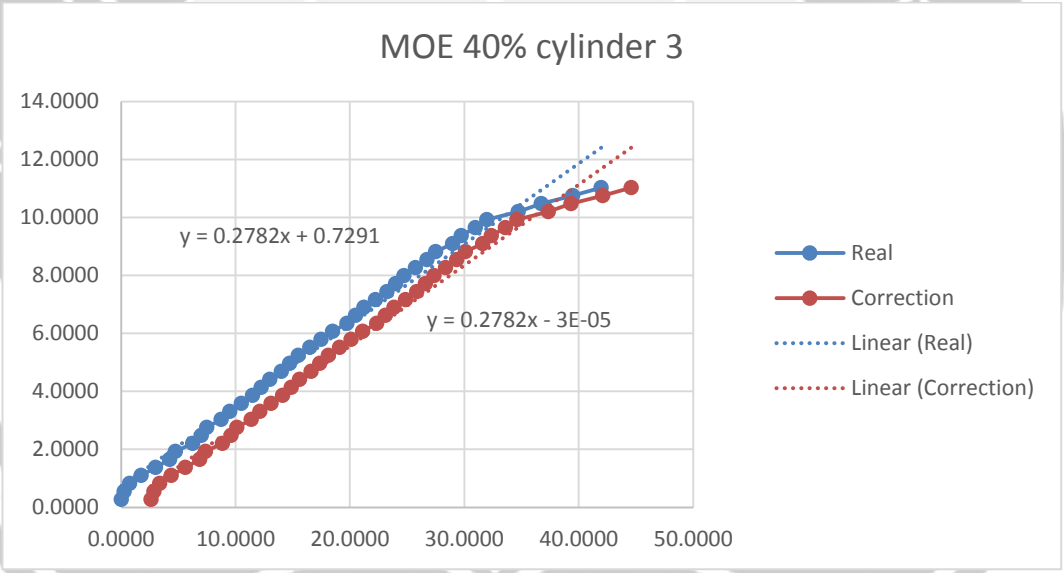
40% - cylinder 3

compressive strength =	70.6530	fp =	11.0256
A =	17947	ep =	0.0004
Po =	200.2		
correction =	2.6208		
modulus =	24732.7974		
mod theory =	39506.0093		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	2.6208
1000	9806.7100	1	0.0005	0.5513	0.2498	2.8705
1500	14710.0650	3	0.0015	0.8269	0.7493	3.3700
2000	19613.4200	7	0.0035	1.1026	1.7483	4.3690
2500	24516.7750	12	0.006	1.3782	2.9970	5.6178
3000	29420.1300	17	0.0085	1.6538	4.2458	6.8665
3500	34323.4850	19	0.0095	1.9295	4.7453	7.3660
4000	39226.8400	25	0.0125	2.2051	6.2438	8.8645
4500	44130.1950	28	0.014	2.4808	6.9930	9.6138
5000	49033.5500	30	0.015	2.7564	7.4925	10.1133
5500	53936.9050	35	0.0175	3.0320	8.7413	11.3620
6000	58840.2600	38	0.019	3.3077	9.4905	12.1113
6500	63743.6150	42	0.021	3.5833	10.4895	13.1103
7000	68646.9700	46	0.023	3.8590	11.4885	14.1093
7500	73550.3250	49	0.0245	4.1346	12.2378	14.8585
8000	78453.6800	52	0.026	4.4102	12.9870	15.6078
8500	83357.0350	56	0.028	4.6859	13.9860	16.6068
9000	88260.3900	59	0.0295	4.9615	14.7353	17.3560
9500	93163.7450	62	0.031	5.2372	15.4845	18.1053
10000	98067.1000	66	0.033	5.5128	16.4835	19.1043
10500	102970.4550	70	0.035	5.7884	17.4825	20.1033
11000	107873.8100	74	0.037	6.0641	18.4815	21.1023
11500	112777.1650	79	0.0395	6.3397	19.7303	22.3510
12000	117680.5200	82	0.041	6.6154	20.4795	23.1003
12500	122583.8750	85	0.0425	6.8910	21.2288	23.8495
13000	127487.2300	89	0.0445	7.1666	22.2278	24.8485
13500	132390.5850	93	0.0465	7.4423	23.2268	25.8475
14000	137293.9400	96	0.048	7.7179	23.9760	26.5968

14500	142197.2950	99	0.0495	7.9936	24.7253	27.3461
15000	147100.6500	103	0.0515	8.2692	25.7243	28.3451
15500	152004.0050	107	0.0535	8.5448	26.7233	29.3441
16000	156907.3600	110	0.055	8.8205	27.4725	30.0933
16500	161810.7150	116	0.058	9.0961	28.9710	31.5918
17000	166714.0700	119	0.0595	9.3718	29.7203	32.3411
17500	171617.4250	124	0.062	9.6474	30.9690	33.5898
18000	176520.7800	128	0.064	9.9230	31.9680	34.5888
18500	181424.1350	139	0.0695	10.1987	34.7153	37.3361
19000	186327.4900	147	0.0735	10.4743	36.7133	39.3341
19500	191230.8450	158	0.079	10.7499	39.4605	42.0813
20000	196134.2000	168	0.084	11.0256	41.9580	44.5788



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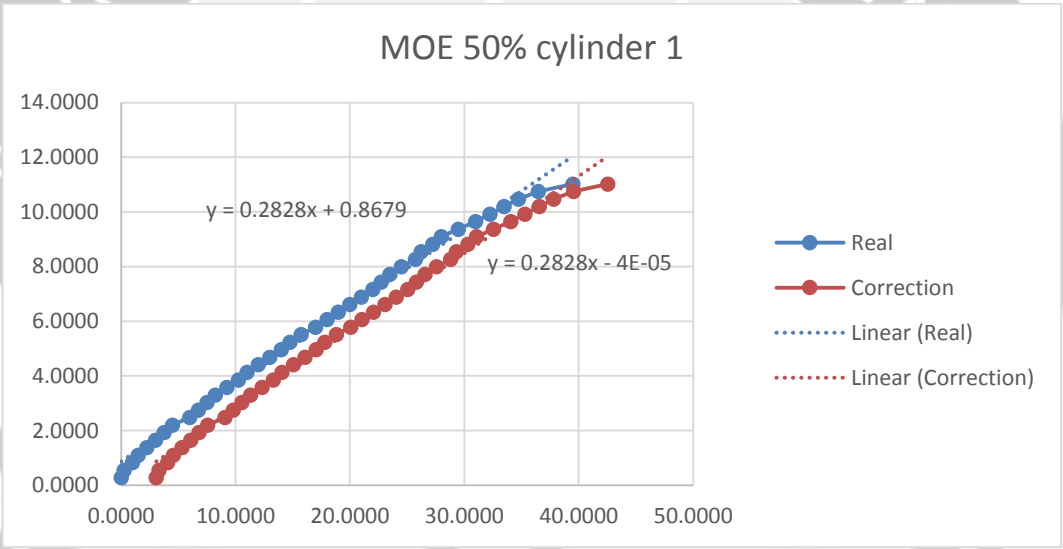
50% - cylinder 1

compressive strength =	72.1035	fp =	11.0256
A =	17789	ep =	0.0004
Po =	200.1		
correction =	3.0690		
modulus =	25912.5564		
mod theory =	39909.4765		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	3.0690
1000	9806.7100	1	0.0005	0.5513	0.2499	3.3188
1500	14710.0650	4	0.002	0.8269	0.9995	4.0685
2000	19613.4200	6	0.003	1.1026	1.4993	4.5682
2500	24516.7750	9	0.0045	1.3782	2.2489	5.3178
3000	29420.1300	12	0.006	1.6538	2.9985	6.0675
3500	34323.4850	15	0.0075	1.9295	3.7481	6.8171
4000	39226.8400	18	0.009	2.2051	4.4978	7.5667
4500	44130.1950	24	0.012	2.4808	5.9970	9.0660
5000	49033.5500	27	0.0135	2.7564	6.7466	9.8156
5500	53936.9050	30	0.015	3.0320	7.4963	10.5652
6000	58840.2600	33	0.0165	3.3077	8.2459	11.3148
6500	63743.6150	37	0.0185	3.5833	9.2454	12.3143
7000	68646.9700	41	0.0205	3.8590	10.2449	13.3138
7500	73550.3250	44	0.022	4.1346	10.9945	14.0635
8000	78453.6800	48	0.024	4.4102	11.9940	15.0630
8500	83357.0350	52	0.026	4.6859	12.9935	16.0625
9000	88260.3900	56	0.028	4.9615	13.9930	17.0620
9500	93163.7450	59	0.0295	5.2372	14.7426	17.8116
10000	98067.1000	63	0.0315	5.5128	15.7421	18.8111
10500	102970.4550	68	0.034	5.7884	16.9915	20.0605
11000	107873.8100	72	0.036	6.0641	17.9910	21.0600
11500	112777.1650	76	0.038	6.3397	18.9905	22.0595
12000	117680.5200	80	0.04	6.6154	19.9900	23.0590
12500	122583.8750	84	0.042	6.8910	20.9895	24.0585
13000	127487.2300	88	0.044	7.1666	21.9890	25.0580
13500	132390.5850	91	0.0455	7.4423	22.7386	25.8076
14000	137293.9400	94	0.047	7.7179	23.4883	26.5572

14500	142197.2950	98	0.049	7.9936	24.4878	27.5567
15000	147100.6500	103	0.0515	8.2692	25.7371	28.8061
15500	152004.0050	105	0.0525	8.5448	26.2369	29.3058
16000	156907.3600	109	0.0545	8.8205	27.2364	30.3053
16500	161810.7150	112	0.056	9.0961	27.9860	31.0550
17000	166714.0700	118	0.059	9.3718	29.4853	32.5542
17500	171617.4250	124	0.062	9.6474	30.9845	34.0535
18000	176520.7800	129	0.0645	9.9230	32.2339	35.3028
18500	181424.1350	134	0.067	10.1987	33.4833	36.5522
19000	186327.4900	139	0.0695	10.4743	34.7326	37.8016
19500	191230.8450	146	0.073	10.7499	36.4818	39.5507
20000	196134.2000	158	0.079	11.0256	39.4803	42.5492



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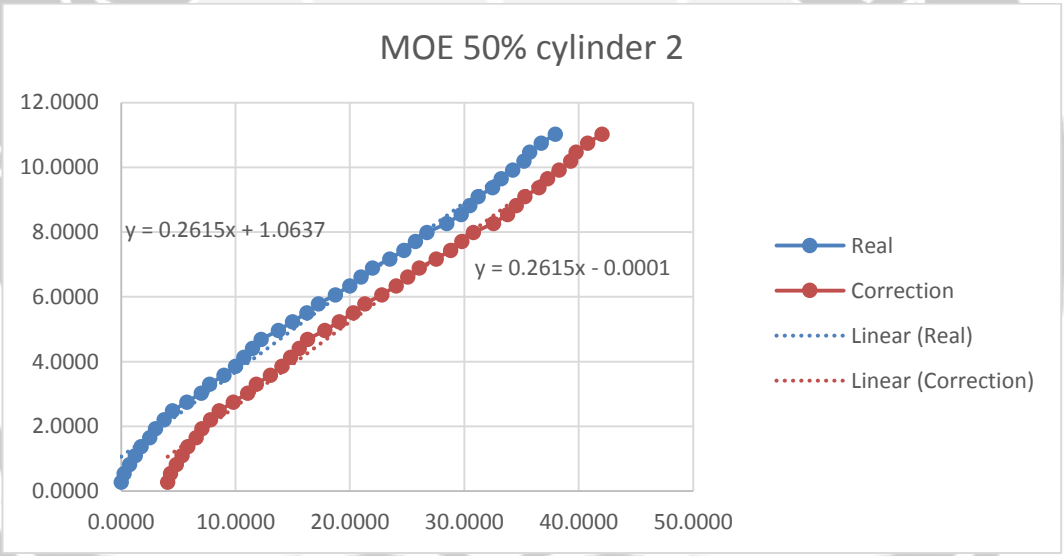
50% - cylinder 2

compressive strength =	72.5940	fp =	11.0256
A =	17766	ep =	0.0004
Po =	200.2		
correction =	4.0677		
modulus =	26232.8364		
mod theory =	40044.9929		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	4.0677
1000	9806.7100	1	0.0005	0.5513	0.2498	4.3174
1500	14710.0650	3	0.0015	0.8269	0.7493	4.8169
2000	19613.4200	5	0.0025	1.1026	1.2488	5.3164
2500	24516.7750	7	0.0035	1.3782	1.7483	5.8159
3000	29420.1300	10	0.005	1.6538	2.4975	6.5652
3500	34323.4850	12	0.006	1.9295	2.9970	7.0647
4000	39226.8400	15	0.0075	2.2051	3.7463	7.8139
4500	44130.1950	18	0.009	2.4808	4.4955	8.5632
5000	49033.5500	23	0.0115	2.7564	5.7443	9.8119
5500	53936.9050	28	0.014	3.0320	6.9930	11.0607
6000	58840.2600	31	0.0155	3.3077	7.7423	11.8099
6500	63743.6150	36	0.018	3.5833	8.9910	13.0587
7000	68646.9700	40	0.02	3.8590	9.9900	14.0577
7500	73550.3250	43	0.0215	4.1346	10.7393	14.8069
8000	78453.6800	46	0.023	4.4102	11.4885	15.5562
8500	83357.0350	49	0.0245	4.6859	12.2378	16.3054
9000	88260.3900	55	0.0275	4.9615	13.7363	17.8040
9500	93163.7450	60	0.03	5.2372	14.9850	19.0527
10000	98067.1000	65	0.0325	5.5128	16.2338	20.3015
10500	102970.4550	69	0.0345	5.7884	17.2328	21.3005
11000	107873.8100	75	0.0375	6.0641	18.7313	22.7990
11500	112777.1650	80	0.04	6.3397	19.9800	24.0477
12000	117680.5200	84	0.042	6.6154	20.9790	25.0467
12500	122583.8750	88	0.044	6.8910	21.9780	26.0457
13000	127487.2300	94	0.047	7.1666	23.4765	27.5442
13500	132390.5850	99	0.0495	7.4423	24.7253	28.7930
14000	137293.9400	103	0.0515	7.7179	25.7243	29.7920

14500	142197.2950	107	0.0535	7.9936	26.7233	30.7910
15000	147100.6500	114	0.057	8.2692	28.4715	32.5392
15500	152004.0050	119	0.0595	8.5448	29.7203	33.7880
16000	156907.3600	122	0.061	8.8205	30.4695	34.5372
16500	161810.7150	125	0.0625	9.0961	31.2188	35.2865
17000	166714.0700	130	0.065	9.3718	32.4675	36.5352
17500	171617.4250	133	0.0665	9.6474	33.2168	37.2845
18000	176520.7800	137	0.0685	9.9230	34.2158	38.2835
18500	181424.1350	141	0.0705	10.1987	35.2148	39.2825
19000	186327.4900	143	0.0715	10.4743	35.7143	39.7820
19500	191230.8450	147	0.0735	10.7499	36.7133	40.7810
20000	196134.2000	152	0.076	11.0256	37.9620	42.0297



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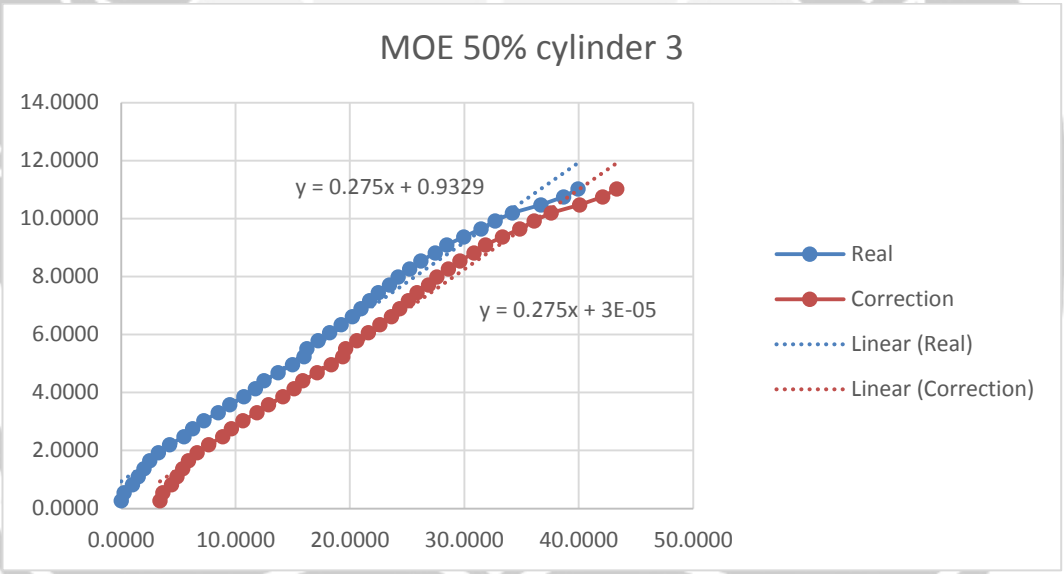
50% - cylinder 3

compressive strength =	71.1225	fp =	11.0256
A =	17979	ep =	0.0004
Po =	200.3		
correction =	3.3924		
modulus =	25444.1832		
mod theory =	39637.0537		

Load		Strainometer	0.5 ΔP x 10^-3	stress (f)	strain (ε) x	correction
kgf	N	(ΔP)	(mm)	Mpa	10^-5	x 10^-5 mm
500	4903.3550	0	0	0.2756	0.0000	3.3924
1000	9806.7100	1	0.0005	0.5513	0.2496	3.6420
1500	14710.0650	4	0.002	0.8269	0.9985	4.3909
2000	19613.4200	6	0.003	1.1026	1.4978	4.8901
2500	24516.7750	8	0.004	1.3782	1.9970	5.3894
3000	29420.1300	10	0.005	1.6538	2.4963	5.8886
3500	34323.4850	13	0.0065	1.9295	3.2451	6.6375
4000	39226.8400	17	0.0085	2.2051	4.2436	7.6360
4500	44130.1950	22	0.011	2.4808	5.4918	8.8841
5000	49033.5500	25	0.0125	2.7564	6.2406	9.6330
5500	53936.9050	29	0.0145	3.0320	7.2391	10.6315
6000	58840.2600	34	0.017	3.3077	8.4873	11.8796
6500	63743.6150	38	0.019	3.5833	9.4858	12.8781
7000	68646.9700	43	0.0215	3.8590	10.7339	14.1263
7500	73550.3250	47	0.0235	4.1346	11.7324	15.1248
8000	78453.6800	50	0.025	4.4102	12.4813	15.8736
8500	83357.0350	55	0.0275	4.6859	13.7294	17.1218
9000	88260.3900	60	0.03	4.9615	14.9775	18.3699
9500	93163.7450	64	0.032	5.2372	15.9760	19.3684
10000	98067.1000	65	0.0325	5.5128	16.2257	19.6180
10500	102970.4550	69	0.0345	5.7884	17.2242	20.6165
11000	107873.8100	73	0.0365	6.0641	18.2227	21.6150
11500	112777.1650	77	0.0385	6.3397	19.2212	22.6135
12000	117680.5200	81	0.0405	6.6154	20.2197	23.6120
12500	122583.8750	84	0.042	6.8910	20.9685	24.3609
13000	127487.2300	87	0.0435	7.1666	21.7174	25.1098
13500	132390.5850	90	0.045	7.4423	22.4663	25.8587
14000	137293.9400	94	0.047	7.7179	23.4648	26.8572

14500	142197.2950	97	0.0485	7.9936	24.2137	27.6060
15000	147100.6500	101	0.0505	8.2692	25.2122	28.6045
15500	152004.0050	105	0.0525	8.5448	26.2107	29.6030
16000	156907.3600	110	0.055	8.8205	27.4588	30.8512
16500	161810.7150	114	0.057	9.0961	28.4573	31.8497
17000	166714.0700	120	0.06	9.3718	29.9551	33.3474
17500	171617.4250	126	0.063	9.6474	31.4528	34.8452
18000	176520.7800	131	0.0655	9.9230	32.7009	36.0933
18500	181424.1350	137	0.0685	10.1987	34.1987	37.5911
19000	186327.4900	147	0.0735	10.4743	36.6950	40.0873
19500	191230.8450	155	0.0775	10.7499	38.6920	42.0843
20000	196134.2000	160	0.08	11.0256	39.9401	43.3325



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E. MODULUS OF RUPTURE DATA

Proportion of red tile waste	Beam number	Width (mm)	Height (mm)	Length (mm)	Area (mm2)	Weight (kg)	Density (kg/m3)	Load (kgf)	Load (kN)	MOR (MPa)	MOR average (MPa)
0%	1	99.7	102.1	499.7	10179.37	11.44	2249.0327	560	5.4917	3.5667	3.6161
	2	99.6	100.7	499.5	10029.72	11.04	2203.6609	550	5.3937	3.6047	
	3	99.5	102.0	500.1	10149.00	11.26	2218.4941	575	5.6388	3.6768	
10%	1	99.8	101.6	499.6	10139.68	12.52	2471.4831	680	6.6685	4.3693	4.3827
	2	100.4	101.2	499.8	10160.48	11.89	2341.3772	675	6.6195	4.3454	
	3	100.2	101.4	499.5	10160.28	12.96	2553.6645	690	6.7666	4.4333	
20%	1	100.5	101.3	499.8	10180.65	12.46	2448.7603	725	7.1098	4.6535	4.7103
	2	100.5	102.2	499.6	10271.10	12.40	2416.4750	745	7.3060	4.6980	
	3	100.1	100.5	499.3	10060.05	12.10	2408.9271	730	7.1589	4.7795	
30%	1	99.5	99.7	500.2	9920.15	11.90	2398.1980	860	8.4337	5.7559	5.6175
	2	99.4	100.3	500.3	9969.82	12.12	2429.8798	845	8.2866	5.5936	
	3	101.7	102.6	500.1	10434.42	12.02	2303.4527	890	8.7279	5.5030	
40%	1	99.5	101.4	499.7	10089.30	11.38	2257.2095	925	9.0712	5.9850	6.0338
	2	99.9	100.2	500.1	10009.98	11.76	2349.1852	950	9.3163	6.2697	
	3	100.8	101.1	500.3	10190.88	11.72	2298.7165	910	8.9241	5.8466	
50%	1	100.3	101.5	500.1	10180.45	11.49	2256.8162	1050	10.2970	6.7264	7.0757
	2	101.0	101.6	500.1	10261.60	11.98	2334.4516	1145	11.2286	7.2698	
	3	100.4	102.4	500.3	10280.96	12.14	2360.2310	1150	11.2776	7.2308	