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Lampiran 1. Hasil pengujian berat isi agregat halus

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN

POLITEKNIK NEGERI MANADO

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HASIL UJI BERAT ISI AGREGAT

Jenis material : Pasir ex Amurang

PEMERIKSAAN		LEPAS	PADAT
		I	II
Berat Mould	(W_1)	7,860	7,860
Berat Mould + benda uji	(W_2)	21,345	22,128
Berat benda uji	($W_3 = W_2 - W_1$)	13,485	14,268
Berat Mould + air	(W_4)	17,780	17,780
Berat air / isi mould	($V = W_4 - W_1$)	9,920	9,920

HASIL PEMERIKSAAN			I	I
Berat Isi agregat =	$\frac{W_3}{V}$	(kg / dm^3)	1.359	1.438
Rata-rata			**1.399**	

Lampiran 2. Hasil pengujian berat jenis agregat halus

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BERAT JENIS DAN PENYERAPAN AGREGAT HALUS

ASTM C 29

Jenis material : **Pasir Amurang**

PEMERIKSAAN		I	II	Satuan
Berat benda uji jenuh permukaan kering (SSD)	(B_j)	500	500	gram
Berat benda uji kering oven	(B_2)	477.1	480.5	gram
Berat Piknometer berisi air	(B_3)	665.6	670.0	gram
Berat Piknometer + benda uji + air	(B_1)	972.1	976.0	gram

PEMERIKSAAN			I	II	Rata-rata
Berat jenis bulk/ov. =	$\frac{B_2}{(B_3 + B_j - B_1)}$		2.466	2.477	2.471
Berat jenis ssd =	$\frac{B_j}{(B_3 + B_j - B_1)}$		2.584	2.577	**2.581**
Berat jenis app. =	$\frac{B_2}{(B_3 + B_2 - B_1)}$		2.797	2.754	2.775
Penyerapan =	$\frac{B_j - B_2}{(B_2)}$	X 100 %	4.800	4.058	4.429

Lampiran 3. Hasil pengujian analisa saringan pasir

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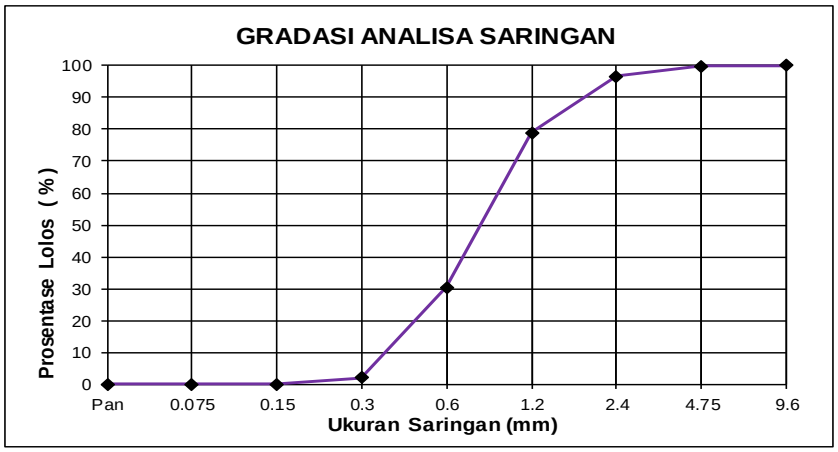
ANALISA SARINGAN AGREGAT HALUS

Diameter/lubang ayakan (mm)	Tertahan	KUMULATIF	% Kumulatif	
	Gram		Tertahan	Tembus
19	0	0.00	0.00	100.00
12.3	0	0.00	0.00	100.00
9.6	0	0.00	0.00	100.00
4.75	0.95	0.95	0.19	100
2.4	15.16	16.11	3.25	97
1.2	87.8	103.91	20.93	79
0.6	241.39	345.30	69.56	30
0.3	141.02	486.32	97.97	2
0.15	9.95	496.27	99.98	0
0.075	0.12	496.39	100.00	0
Pan	0	496.39	100.00	0
JUMLAH	496.39		291.88	
			2.92	



Lampiran 4. Hasil pengujian kadar lumpur pasir

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PENGUJIAN KADAR LUMPUR PASIR

Material : **Pasir ex Amurang**

Nomor Contoh		**I**	**II**
Berat Benda Uji Kering Oven sebelum di cuci (gram)	W1	500	500
Berat Benda Uji Kering Oven setelah di cuci (gram)	W2	495.36	494.97
Kadar butir Lolos ayakan no 200 (%)		0.937	1.016
		0.976	

Lampiran 5. Hasil pengujian kadar organik pasir

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HASIL PEMERIKSAAN KADAR ORGANIK AGREGAT HALUS

AASTHO T21, ASTM C29

Jenis material	**:**	**Pasir ex Amurang**				
Nomor Contoh					**I**	**II**
Volume Sampel					130	130
Volume Sampel + Larutan NaOH 3%					200	200
Warna Larutan setelah 24 Jam dibandingkan dengan warna standar					**No. 2 Lebih Terang dari Warna Standar**	**No. 2 Lebih Terang dari Warna Standar**
Keterangan :					**Standard Colour No. 815 Tester. For ASTM C-40**	

Lampiran 6. Hasil pengujian berat jenis fly ash

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
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ISO 9001:2008
LicNo:QEC2478

BERAT JENIS FLY ASH

Mengacu pada SNI 2531 : 2015 (ASTM C.188-95 (2003), MOD)

KETERANGAN		PENGUJIAN	
		I	II
Massa botol + kerosein (gr)	M1	320.36	310.67
Massa botol + fly ash + kerosein (gr)	M2	384.36	374.67
Bacaan awal (ml)	V1	0.2	0.4
Bacaan akhir (ml)	V2	23.1	23.2
Densitas Fly ash (gr/cm3)	$\frac{M2-M1}{V2-V1}$	2.795	2.807
Rata-rata (gr/cm3)		2.80	

Lampiran 7. Hasil pengujian berat jenis trass

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN

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PEMERIKSAAN BERAT JENIS (Gs)

(ASTM D 854)

Pekerjaan	: Penelitian	Sampel :	Trass	
Lokasi	: Desa Koka, Minahasa	Dikerjakan :	Sutikno, dkk	
Tanggal	: 10 Desember 2019	Diperiksa :	Fery Sondakh, ST., MT	

No. piknometer		1	2	3	4
Berat piknometer	W1 (gram)	30.33	25.68	28.78	29.47
Berat piknometer + tanah kering	W2 (gram)	60.24	60.90	60.55	60.45
Berat tanah kering	Ws = W2 – W1 (gram)	29.91	35.22	31.77	30.98
Berat piknometer + tanah kering + air	W3 (gram)	147.24	143.97	146.36	148.38
Berat piknometer + air	W4 (gram)	130.82	124.78	128.92	131.79
Temperatur	(°C)	30.00	30.00	30.00	30.00
Faktor koreksi temperatur	(K)	0.9986	0.9986	0.9986	0.9986
Berat piknometer + air terkoreksi	(W5)	130.64	124.61	128.74	131.61
Berat jenis tanah	Ws /[(W5 – W1) – (W3 – W2)]	2.248	2.221	2.245	2.181
Berat jenis tanah rata-rata (Gs)		2.22			

Lampiran 8. Hasil pengujian hidrometer fly ash

ANALISA HIDROMETER

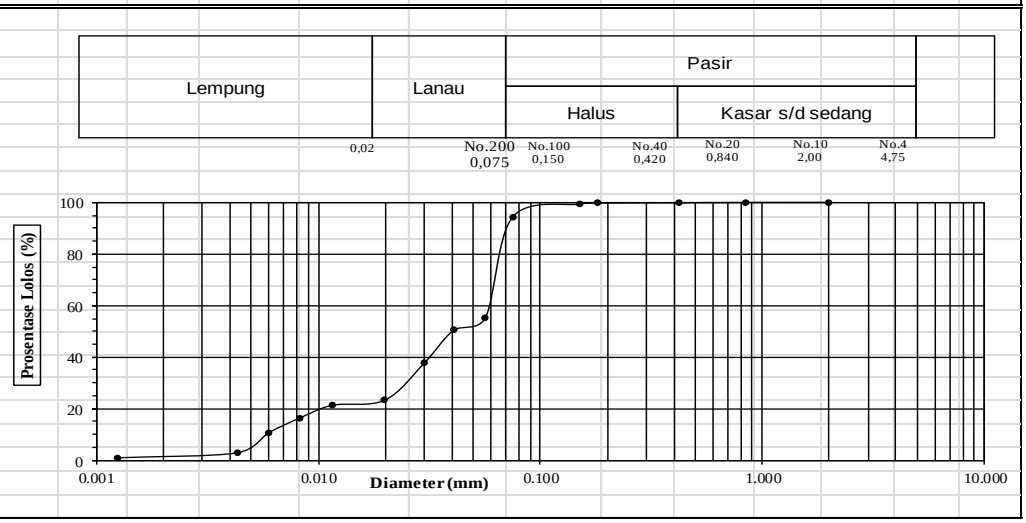
Proyek :
Lokasi :
Kedalaman :
Sampel : Fly ash
Tanggal : 11 Desember 2019

Koreksi terhadap nol Hidrometer : 4
Koreksi Meniscus : 0.50
Berat Jenis Tanah (Gs) : 2.80
Berat contoh tanah : 50.00 gr

Waktu Pembacaan	Selang Waktu	Temp.	Koreksi Ct terhadap suhu (C°)	Bacaan Hidrometer	Bacaan terkoreksi	Terkoreksi oleh Meniskus	a	L	L / t	K	D	% Lolos
	t (min)	(°C)		(Ra)	(Rc)	(R)	(Tabel)	(Tabel)		(Tabel)	(mm)	
	0			0.00								
	0.5	28.00	2.50	30.00	28.50	30.50	0.97	11.30	22.60	0.0119	0.057	55.29
	1	28.00	2.50	27.50	26.00	28.00	0.97	11.70	11.70	0.0119	0.041	50.44
	2	28.00	2.50	21.00	19.50	21.50	0.97	12.80	6.40	0.0119	0.030	37.83
	5	28.00	2.50	13.50	12.00	14.00	0.97	14.00	2.80	0.0119	0.020	23.28
	15	28.00	2.50	12.50	11.00	13.00	0.97	14.20	0.95	0.0119	0.012	21.34
	30	28.00	2.50	10.00	8.50	10.50	0.97	14.60	0.49	0.0119	0.008	16.49
	60	28.00	2.50	7.00	5.50	7.50	0.97	15.10	0.25	0.0119	0.006	10.67
	120	28.00	2.50	3.00	1.50	3.50	0.97	15.70	0.13	0.0119	0.004	2.91
	1440	28.00	2.50	2.00	0.50	2.50	0.97	15.90	0.01	0.0119	0.001	0.97

ANALISA SARINGAN

Ayakan	D (mm)	Berat tertahan	Jumlah berat tertahan	Tertahan (%)	Lolos (%)
No. 10	2.00	0.01	0.01	0.01	99.99
No. 20	0.84	0.01	0.02	0.03	99.97
No. 40	0.42	0.09	0.11	0.15	99.85
No. 80	0.18	0.09	0.20	0.27	99.73
No. 100	0.15	0.31	0.51	0.70	99.30
No. 200	0.08	3.95	4.15	5.70	94.30



Lampiran 9. Hasil pengujian hidrometer trass

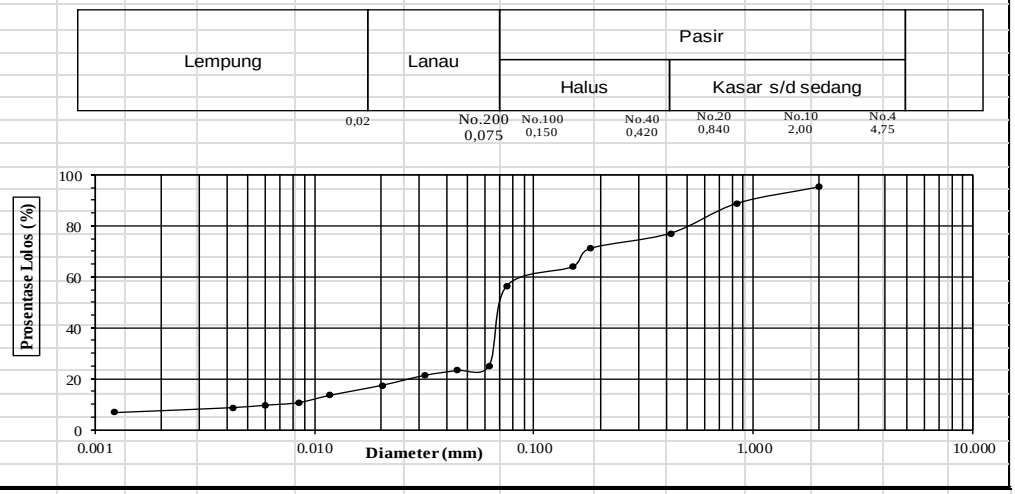
ANALISA HIDROMETER

Proyek :											Koreksi terhadap nol Hidrometer :	4	
Lokasi :											Koreksi Meniscus :	0.50	
Kedalaman :											Berat Jenis Tanah (Gs) :	2.22	
Sampel :	Tras 2										Berat contoh tanah :	50.00	gr
Tanggal :	11 Desember 2019												

Waktu Pembacaan	Selang Waktu	Temp.	Koreksi Ct terhadap suhu (C°)	Bacaan Hidrometer	Bacaan terkoreksi	Terkoreksi oleh Meniskus	a	L	L / t	K	D	% Lolos
	t (min)	(°C)		(Ra)	(Rc)	(R)	(Tabel)	(Tabel)		(Tabel)	(mm)	
11 Des 2019	0			0.00								
	0.5	28.00	2.50	14.50	13.00	15.00	0.97	13.80	27.60	0.0119	0.063	25.22
	1	28.00	2.50	13.50	12.00	14.00	0.97	14.00	14.00	0.0119	0.045	23.28
	2	28.00	2.50	12.50	11.00	13.00	0.97	14.20	7.10	0.0119	0.032	21.34
	5	28.00	2.50	10.50	9.00	11.00	0.97	14.50	2.90	0.0119	0.020	17.46
	15	28.00	2.50	8.50	7.00	9.00	0.97	14.80	0.99	0.0119	0.012	13.58
	30	28.00	2.50	7.00	5.50	7.50	0.97	15.10	0.50	0.0119	0.008	10.67
	60	28.00	2.50	6.50	5.00	7.00	0.97	15.20	0.25	0.0119	0.006	9.70
	120	28.00	2.50	6.00	4.50	6.50	0.97	15.25	0.13	0.0119	0.004	8.73
	1440	28.00	2.50	5.00	3.50	5.50	0.97	15.40	0.01	0.0119	0.001	6.79

ANALISA SARINGAN

Ayakan	D	Berat tertahan	Jumlah berat tertahan	Tertahan	Lolos
	(mm)			(%)	(%)
No. 10	2.00	3.49	3.49	4.80	95.20
No. 20	0.84	4.74	8.23	11.31	88.69
No. 40	0.42	8.47	16.70	22.95	77.05
No. 80	0.18	4.38	21.08	28.96	71.04
No. 100	0.15	5.16	26.24	36.05	63.95
No. 200	0.08	10.73	31.81	43.71	56.29



Lampiran 10. Hasil pengujian kekuatan tekan 7 hari mortar geopolimer tahap I

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
8M-1.5-0.4	1	274.71	2.98	8M-1.5-0.45	1	285.82	3.02	8M-1.5-0.5	1	277.27	1.89
	2	283.8	2.43		2	289.9	4.00		2	282.57	2.04
	3	283.43	2.70		3	286.46	2.76		3	283.58	2.06
Rata-rata			**2.70**	Rata-rata			**3.26**	Rata-rata			**1.99**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
8M-2.0-0.4	1	273.36	5.48	8M-2.0-0.45	1	277.23	5.78	8M-2.0-0.5	1	284.53	2.49
	2	271.07	5.72		2	279.8	4.97		2	279.9	3.03
	3	275.2	5.56		3	282.58	5.38		3	292.57	3.37
Rata-rata			**5.59**	Rata-rata			**5.38**	Rata-rata			**2.96**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
8M-2.5-0.4	1	281.98	7.32	8M-2.5-0.45	1	289.22	9.47	8M-2.5-0.5	1	277.75	7.67
	2	279.82	9.79		2	301.57	10.99		2	280.65	8.18
	3	282.15	7.52		3	289.33	9.39		3	274.08	10.41
Rata-rata			**8.21**	Rata-rata			**9.95**	Rata-rata			**8.75**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
10M-1.5-0.4	1	296.86	7.08	10M-1.5-0.45	1	276.13	4.98	10M-1.5-0.5	1	285.1	4.24
	2	302.12	6.54		2	280.06	4.67		2	287.87	2.60
	3	295.47	6.96		3	278.8	4.81		3	281.44	4.38
Rata-rata			**6.86**	Rata-rata			**4.82**	Rata-rata			**3.74**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
10M-2.0-0.4	1	287.52	10.57	10M-2.0-0.45	1	279.01	5.23	10M-2.0-0.5	1	269.06	5.54
	2	290.39	10.00		2	278.97	6.59		2	267.6	6.58
	3	301.54	10.40		3	278.34	5.79		3	266.5	
Rata-rata			**10.32**	Rata-rata			**5.87**	Rata-rata			**6.06**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
10M-2.5-0.4	1	301.69	15.31	10M-2.5-0.45	1	285.01	12.60	10M-2.5-0.5	1	279.52	11.70
	2	300.18	14.47		2	279.48	10.27		2	272.76	7.05
	3	295.44	14.68		3	251.03	8.72		3	274.87	
Rata-rata			**14.82**	Rata-rata			**10.53**	Rata-rata			**9.38**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
10M-3.0-0.4	1	286.42	13.60	10M-3.0-0.45	1	279.42	10.40	10M-3.0-0.5	1	266.26	8.20
	2	288.31	11.80		2	279.1	9.10		2	267.13	8.00
	3	286.14	10.00		3	278.4	9.60		3	269.77	9.20
Rata-rata			**11.80**	Rata-rata			**9.70**	Rata-rata			**8.47**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
12M-1.5-0.4	1	292.6	4.25	12M-1.5-0.45	1	298.52	4.59	12M-1.5-0.5	1	294.9	3.08
	2	286.74	5.32		2	300	3.26		2	292.91	2.33
	3	296.4	5.54		3	299.02	5.60		3	224.15	2.97
Rata-rata			**5.04**	Rata-rata			**4.48**	Rata-rata			**2.80**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
12M-2.0-0.4	1	272.5	7.32	12M-2.0-0.45	1	312.71	4.21	12M-2.0-0.5	1	306.52	7.00
	2	274.09	6.28		2	297.4	5.85		2	295.43	6.53
	3	267.04	7.33		3	309.4	9.25		3	301.54	7.45
Rata-rata			**6.98**	Rata-rata			**6.44**	Rata-rata			**6.99**

Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
12M-2.5-0.4	1	263.97	8.95	12M-2.5-0.45	1	297.4	11.77	12M-2.5-0.5	1	319.92	9.53
	2	274.16	8.36		2	306.41	10.46		2	313.32	10.00
	3	270.3	10.01		3	300.68	5.50		3	309.49	8.27
Rata-rata			**9.11**	Rata-rata			**9.24**	Rata-rata			**9.27**

Lampiran 11. Hasil pengujian kekuatan tekan mortar geopolimer tahap II

7 hari				28 hari				60 hari			
Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
A	1	286.74	18.00	A	1	276.31	18.00	A	1	273.12	18.00
0% T	2	274.21	16.00	0% T	2	289.17	14.00	0% T	2	263.61	16.00
	3	278.13	14.00		3	291.19	18.00		3	287.32	20.00
Rata-rata			**16.00**	Rata-rata			**16.67**	Rata-rata			**18.00**

7 hari				28 hari				60 hari			
Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
B	1	276.84	18.00	B	1	273.08	24.00	B	1	257.33	30.00
10% T	2	252.22	16.00	10% T	2	279.23	24.00	10% T	2	261.39	22.00
	3	269.63	20.00		3	288.33	24.00		3	260.3	24.00
Rata-rata			**18.00**	Rata-rata			**24.00**	Rata-rata			**25.33**

7 hari				28 hari				60 hari			
Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
C	1	264.88	18.00	C	1	259.18	28.00	C	1	256.03	26.00
20% T	2	260.65	14.00	20% T	2	252.25	28.00	20% T	2	257.08	28.00
	3	248.4	12.00		3	255.61	20.00		3	250.18	26.00
Rata-rata			**14.67**	Rata-rata			**25.33**	Rata-rata			**26.67**

7 hari				28 hari				60 hari			
Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa	Kode Benda Uji	No.	Berat gr	Kuat Tekan Mpa
D	1	228.62	10.00	D	1	248.14	28.00	D	1	222.11	24.00
30% T	2	235.6	8.00	30% T	2	234.78	18.00	30% T	2	236.62	26.00
	3	238.29	12.00		3	243.36	20.00		3	237.35	28.00
Rata-rata			**10.00**	Rata-rata			**22.00**	Rata-rata			**26.00**

Lampiran 12. Hasil pengujian penyerapan dan porositas mortar geopolimer

Hasil Pengujian penyerapan

Kode benda uji	No. benda uji	Berat basah A (gr)	Berat kering oven B (gr)	Penyerapan (%)	Rata-rata
A	1	268.05	225.04	19.11	18.92
0 % Trass	2	271.93	228.61	18.95	
	3	257.96	217.3	18.71	
B	1	255.8	215.78	18.55	18.66
10 % Trass	2	269.21	226.92	18.64	
	3	264.47	222.64	18.79	
C	1	264.73	223.54	18.43	18.43
20 % Trass	2	247.95	209.22	18.51	
	3	280.64	237.11	18.36	
D	1	239.01	200.52	19.20	19.19
30 % Trass	2	244.66	205.36	19.14	
	3	242.83	203.63	19.25	

Hasil pengujian porositas

Kode benda uji	No. benda uji	Berat dalam air A (gr)	Berat kondisi SSD B (gr)	Berat kering oven C (gr)	Porositas (%)	Rata-rata
A	1	135.65	251.03	226.37	21.37	21.35
0 % Trass	2	136.49	252.42	228.18	20.91	
	3	132.98	245.69	221.16	21.76	
B	1	153.38	286.69	258.92	20.83	20.89
10 % Trass	2	136.47	254.02	229.59	20.78	
	3	141.51	265.61	239.49	21.05	
C	1	127.25	247.49	223.29	20.13	20.39
20 % Trass	2	124.5	239.99	216.39	20.43	
	3	126.07	243.51	219.3	20.61	
D	1	125.5	247.72	220.38	22.37	22.48
30 % Trass	2	120.19	241.57	214.24	22.52	
	3	110.52	224.14	198.51	22.56	

Lampiran 13. Hasil pengujian ketahanan mortar geopolimer dalam larutan sodium sulfat

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus 1 gr	2 gr	3 gr	4 gr	5 gr	Berat akhir gr	Kehilangan berat gr	%
A	1	229.05	244.65	233	241.91	245.87	248.35	222.49	6.56	2.86
0% T	2	238.48	255.3	242.19	252.54	257.05	258.12	231.56	6.92	2.90
	3	242.41	257.12	244.51	253.89	258.05	261.45	235.58	6.83	2.82
Rata-rata										**2.86**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus 1 gr	2 gr	3 gr	4 gr	5 gr	Berat akhir gr	Kehilangan berat gr	%
B	1	236.13	254.37	247.06	251.29	255.7	255.45	232.37	3.76	1.59
10% T	2	231.04	247.23	240.34	247.49	249.66	251.24	227.56	3.48	1.51
	3	246.01	264.66	257.66	263.35	267.87	268.68	242.87	3.14	1.28
Rata-rata										**1.46**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus 1 gr	2 gr	3 gr	4 gr	5 gr	Berat akhir gr	Kehilangan berat gr	%
C	1	221.31	243.68	238.16	236.91	237.36	241.25	218.94	2.37	1.07
20% T	2	223.51	245.22	241.77	239.43	240.12	244.15	221.21	2.30	1.03
	3	218.76	240.67	234.32	233.47	234.07	238.07	216.59	2.17	0.99
Rata-rata										**1.03**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus 1 gr	2 gr	3 gr	4 gr	5 gr	Berat akhir gr	Kehilangan berat gr	%
D	1	203.1	227.02	219.02	217.31	216.56	224.91	199.41	3.69	1.82
30% T	2	213.94	237.9	231.68	230.28	230.39	235.17	210.84	3.10	1.45
	3	220.78	245.49	237.06	235.04	237.5	243.13	217.9	2.88	1.30
Rata-rata										**1.52**

Lampiran 14. Hasil pengujian ketahanan mortar geopolimer dalam larutan air tawar

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus					Berat akhir gr	Kehilangan berat	
			1 gr	2 gr	3 gr	4 gr	5 gr		gr	%
A	1	237.05	249.39	238.07	241.2	250.95	253.53	228.35	8.70	3.67
0% T	2	255.18	266.24	256.06	257.72	268.45	270.49	245.71	9.47	3.71
	3	225.10	238.74	227.21	228.37	238.66	236.35	216.6	8.50	3.78
Rata-rata										**3.72**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus					Berat akhir gr	Kehilangan berat	
			1 gr	2 gr	3 gr	4 gr	5 gr		gr	%
B	1	244.82	258.50	248.11	253.82	262.23	260	238.55	6.27	2.56
10% T	2	253.88	269.93	257.62	260.43	270.4	269.03	246.97	6.91	2.72
	3	227.06	240.88	231.51	234.99	241.83	242.99	221.02	6.04	2.66
Rata-rata										**2.65**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus					Berat akhir gr	Kehilangan berat	
			1 gr	2 gr	3 gr	4 gr	5 gr		gr	%
C	1	221.94	239.74	233.88	232.64	231.42	236.83	217.97	3.97	1.79
20% T	2	224.54	242.78	237.12	236.66	235.66	241.15	220.01	4.53	2.02
	3	216.68	233.21	230.47	228.87	227.4	232.81	212.96	3.72	1.72
Rata-rata										**1.84**

Kode benda Uji	No. benda uji	Berat awal gr	Berat tiap selesai siklus					Berat akhir gr	Kehilangan berat	
			1 gr	2 gr	3 gr	4 gr	5 gr		gr	%
D	1	203.21	220.82	215.63	216.38	213.65	220.62	198.51	4.70	2.31
30% T	2	207.16	226.03	222.66	220.89	219.91	224.67	201.76	5.40	2.61
	3	208.64	227.80	221.36	222.06	221.28	228.25	203.16	5.48	2.63
Rata-rata										**2.52**

Lampiran 15. Perhitungan proporsi campuran mortar geopolimer

Perhitungan proporsi campuran mortar geopolimer

A. Berat Jenis

Material	Fly ash	Trass	Pasir	NaOH	Air	Na_2SiO_3
berat jenis (gr/cm3)	2.8	2.22	2.58	1.2713	1	1.6111
berat jenis (kg/m3)	2800	2220	2580	1271.3	1000	1611.1

B. Perbandingan berat material (gr)

Mix	Fly ash	Trass	Pasir	NaOH	Air	Na_2SiO_3
0% T	300	0	600	43	107.5	107
10% T	300	60	540	43	107.5	107
20% T	300	120	480	43	107.5	107
30% T	300	180	420	43	107.5	107

Perbandingan berat material (kg)

Mix	Fly ash	Trass	Pasir	NaOH	air	Na_2SiO_3
0% T	0.3	0	0.6	0.043	0.1075	0.107
10% T	0.3	0.06	0.54	0.043	0.1075	0.107
20% T	0.3	0.12	0.48	0.043	0.1075	0.107
30% T	0.3	0.18	0.42	0.043	0.1075	0.107

C. Perbandingan volume material (m3)

Mix	Fly ash	Trass	Pasir	NaOH	air	Na_2SiO_3	Total Vol.
0% T	0.000107	0	0.000233	3.38E-05	0.000108	6.64E-05	0.000547
10% T	0.000107	2.7E-05	0.000209	3.38E-05	0.000108	6.64E-05	0.000551
20% T	0.000107	5.41E-05	0.000186	3.38E-05	0.000108	6.64E-05	0.000555
30% T	0.000107	8.11E-05	0.000163	3.38E-05	0.000108	6.64E-05	0.000559

D. Volume material untuk 1m3 campuran (m3)

Mix	Fly ash	Trass	Pasir	NaOH	air	Na_2SiO_3	Jumlah
0% T	0.1957	0.0000	0.4248	0.0618	0.1964	0.1213	1.0000
10% T	0.1944	0.0490	0.3797	0.0614	0.1950	0.1205	1.0000
20% T	0.1931	0.0974	0.3352	0.0609	0.1937	0.1197	1.0000
30% T	0.1918	0.1451	0.2913	0.0605	0.1924	0.1189	1.0000

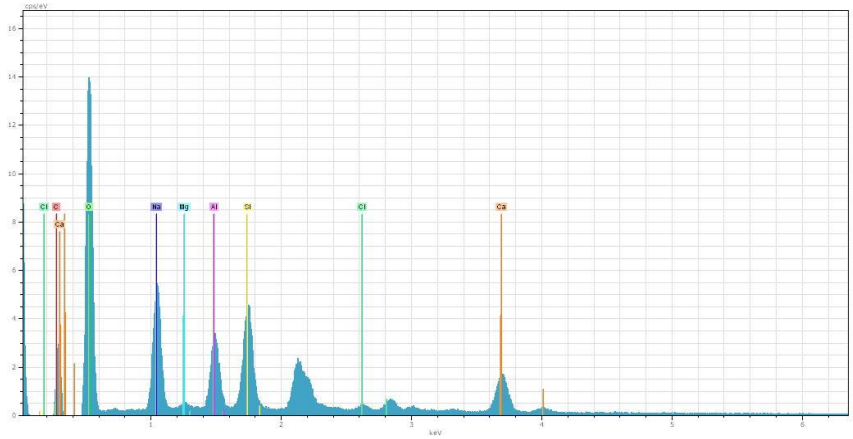
E. Berat material untuk 1m3 campuran (kg)

Mix	Fly ash	Trass	Pasir	NaOH	air	Na_2SiO_3	Jumlah
0% T	548	0	1096	79	196	195	2114
10% T	544	109	980	78	195	194	2100
20% T	541	216	865	77	194	193	2086
30% T	537	322	752	77	192	191	2072

Lampiran 16. Hasil analisa EDX mortar A (0% trass) umur 7 hari

MORTAR A (0% trass)
umur 7 hari

calibration image 6744Date:3/8/2021
1:16:36 PMImage size:512 x
384Mag:999.99994xHV:10.0kV

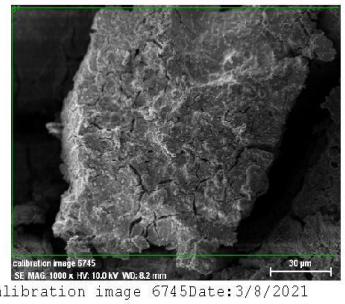


37 Date:3/8/2021 1:17:10 PM HV:10.0kV Puls th.:4.19kcps

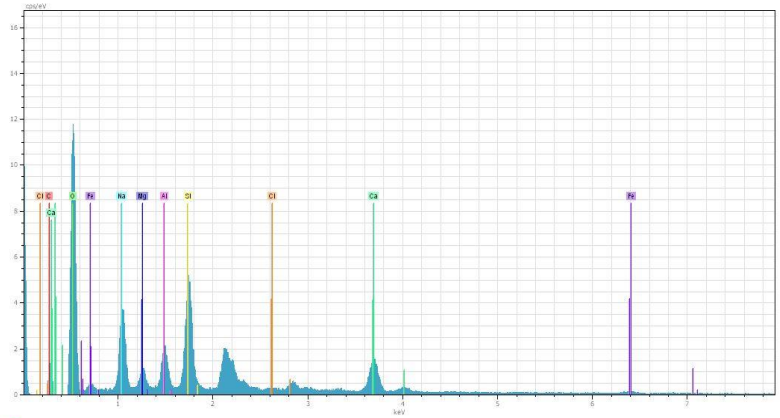
El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
O	8	K-series	78.41	78.41	80.07	24.7
C	6	K-series	9.79	9.79	13.31	3.9
Ca	20	K-series	3.68	3.68	1.50	0.2
Si	14	K-series	3.24	3.24	1.89	0.2
Na	11	K-series	3.11	3.11	2.21	0.2
Al	13	K-series	1.42	1.42	0.86	0.1
Cl	17	K-series	0.34	0.34	0.16	0.0
Mg	12	K-series	0.00	0.00	0.00	0.0
		Total:	100.00	100.00	100.00	

Lampiran 17. Hasil analisa EDX mortar A (0% trass) umur 28 hari

MORTAR A (0% trass)
umur 28 hari



calibration image 6745Date:3/8/2021
1:25:34 PMImage size:512 x
384Mag:1000xHV:10.0kV



37 Date:3/8/2021 1:26:35 PM HV:10.0kV Puls th.:3.62kcps

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
O	8	K-series	78.33	78.33	84.16	25.1
C	6	K-series	5.24	5.24	7.50	2.8
Fe	26	K-series	4.31	4.31	1.33	0.3
Si	14	K-series	4.24	4.24	2.59	0.2
Ca	20	K-series	4.10	4.10	1.76	0.2
Na	11	K-series	2.46	2.46	1.84	0.2
Al	13	K-series	0.88	0.88	0.56	0.1
Cl	17	K-series	0.24	0.24	0.12	0.0
Mg	12	K-series	0.21	0.21	0.15	0.0
		Total:	100.00	100.00	100.00	

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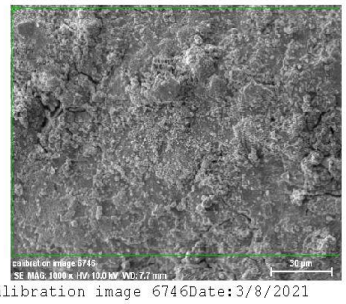
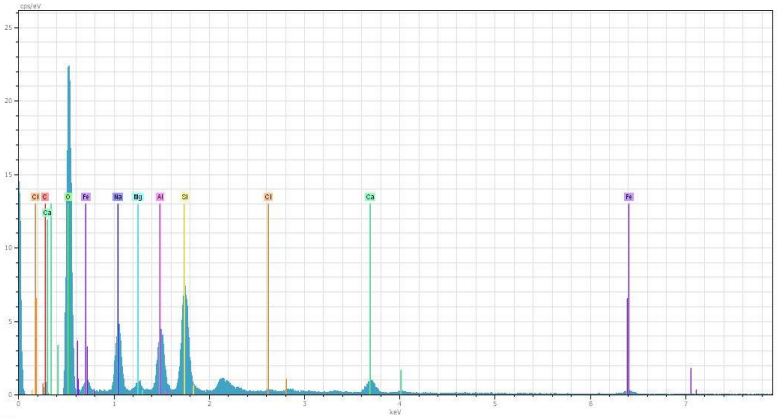
Lampiran 18. Hasil analisa EDX mortar B (10% trass) umur 28 hari

MORTAR B (10% trass)
umur 28 hari

BRUKER



calibration image 6746Date:3/8/2021 3:26:10 PMImage size:512 x 384Mag:1000xHV:10.0kV



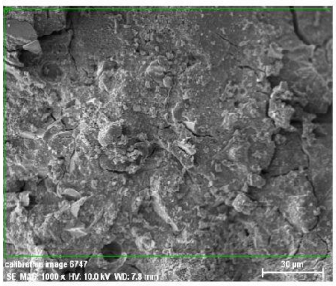
37 Date:3/8/2021 3:26:27 PM HV:10.0kV Puls th.:4.60kcps

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
O	8	K-series	55.68	62.38	76.38	6.6
Si	14	K-series	10.24	11.47	8.00	0.5
Fe	26	K-series	9.58	10.73	3.77	0.6
Na	11	K-series	4.87	5.45	4.65	0.3
Al	13	K-series	4.03	4.51	3.27	0.2
Ca	20	K-series	3.41	3.82	1.87	0.2
C	6	K-series	0.90	1.01	1.64	0.3
Cl	17	K-series	0.30	0.34	0.19	0.0
Mg	12	K-series	0.27	0.30	0.24	0.0
		Total:	89.26	100.00	100.00	

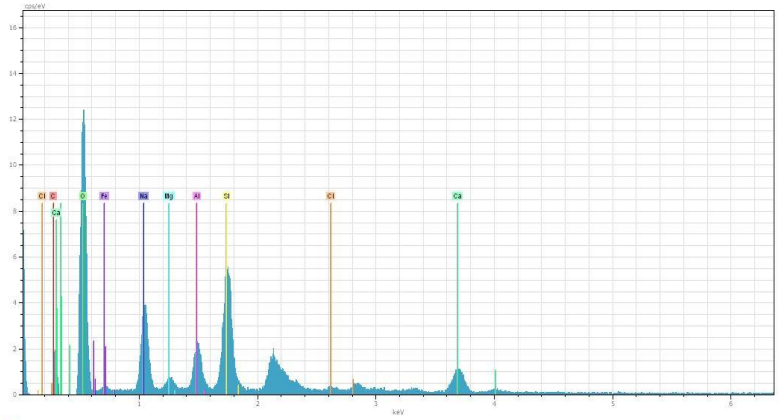
Lampiran 19. Hasil analisa EDX mortar C (20% trass) umur 28 hari

MORTAR C (20% trass)
umur 28 hari

BRUKER



calibration image 6747Date:3/8/2021
3:38:41 PMImage size:512 x
384Mag:1000xHV:10.0kV



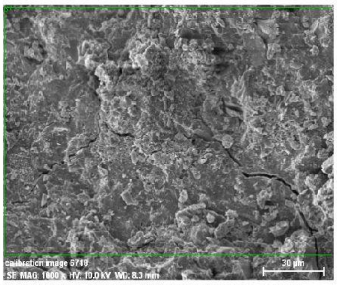
37 Date:3/8/2021 3:39:03 PM HV:10.0kV Puls th.:3.52kcps

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
O	8	K-series	74.87	74.87	80.61	24.3
C	6	K-series	6.49	6.49	9.31	3.4
Si	14	K-series	6.26	6.26	3.84	0.3
Fe	26	K-series	3.69	3.69	1.14	0.3
Ca	20	K-series	3.57	3.57	1.54	0.2
Na	11	K-series	3.21	3.21	2.41	0.2
Al	13	K-series	1.38	1.38	0.88	0.1
Cl	17	K-series	0.39	0.39	0.19	0.0
Mg	12	K-series	0.12	0.12	0.08	0.0
		Total:	100.00	100.00	100.00	

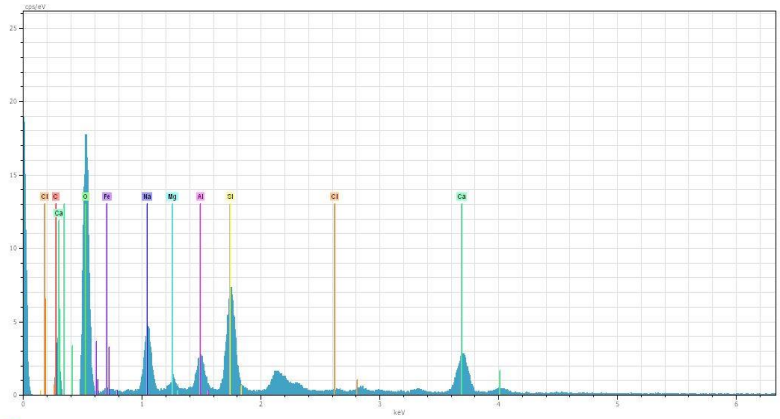
Lampiran 20. Hasil analisa EDX mortar D (30% trass) umur 28 hari

MORTAR D (30% trass)
umur 28 hari

BRUKER



calibration image 6748Date:3/8/2021 3:47:07 PMImage size:512 x 384Mag:1000xHV:10.0kV



37 Date:3/8/2021 3:47:50 PM HV:10.0kV Puls th.:4.98kcps

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error [%]
O	8	K-series	44.77	61.60	71.57	5.6
Ca	20	K-series	8.00	11.01	5.11	0.3
Si	14	K-series	6.29	8.66	5.73	0.3
C	6	K-series	5.21	7.16	11.09	1.0
Fe	26	K-series	3.90	5.36	1.79	0.3
Na	11	K-series	2.93	4.03	3.26	0.2
Al	13	K-series	1.21	1.67	1.15	0.1
Cl	17	K-series	0.21	0.29	0.15	0.0
Mg	12	K-series	0.15	0.21	0.16	0.0
		Total:	72.69	100.00	100.00	

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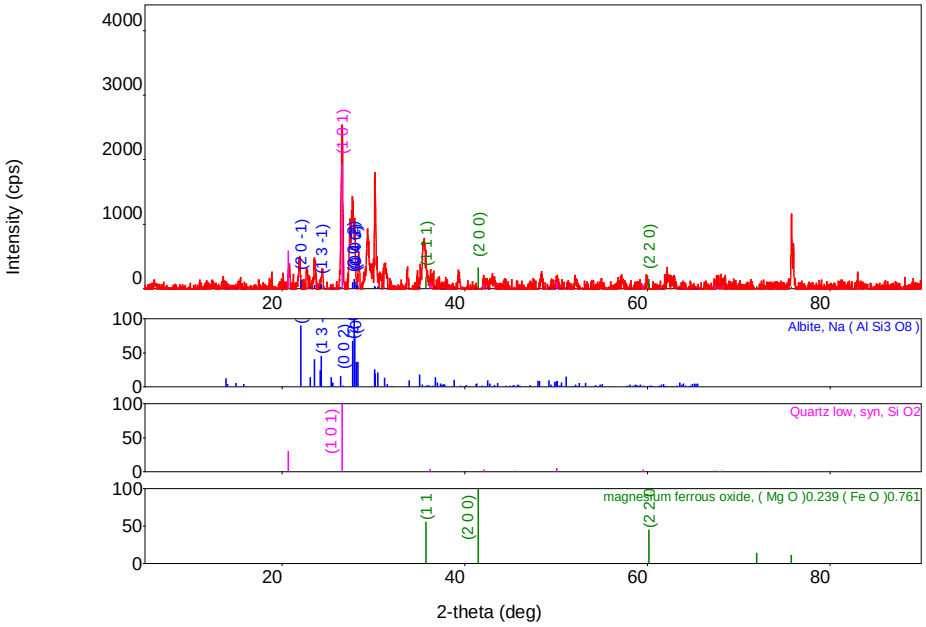
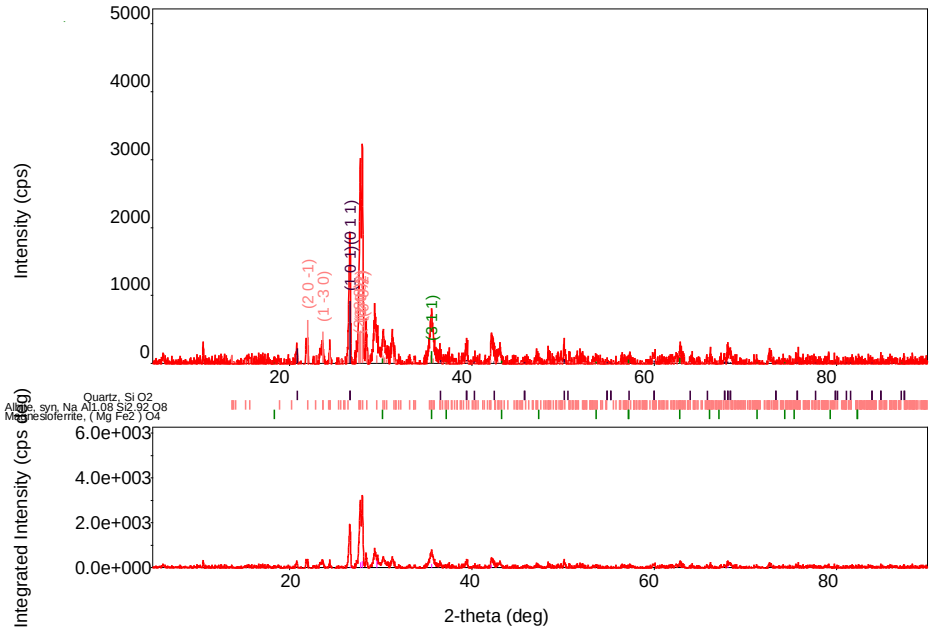
Lampiran 21. Hasil analisa XRD mortar A (0% trass) umur 28 hari



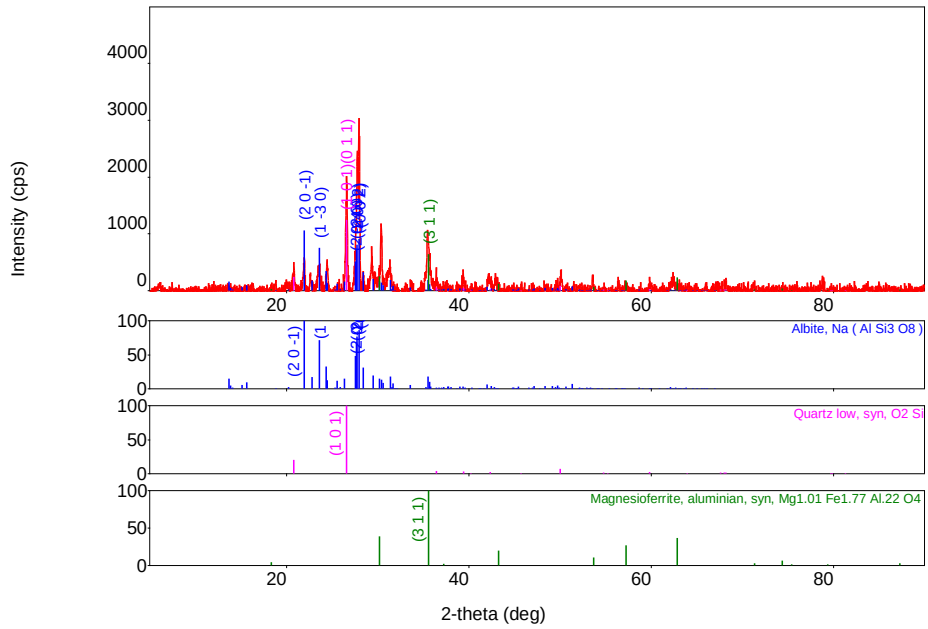
Phase name	Formula	Content(%)
Albite	Na (Al Si3 O8)	43(3)
Quartz low, syn	Si O2	41(9)
magnesium ferrous oxide	(Mg O)0.239 (Fe O	15.5(7)

Lampiran 22. Hasil analisa XRD mortar B (10% trass) umur 28 hari



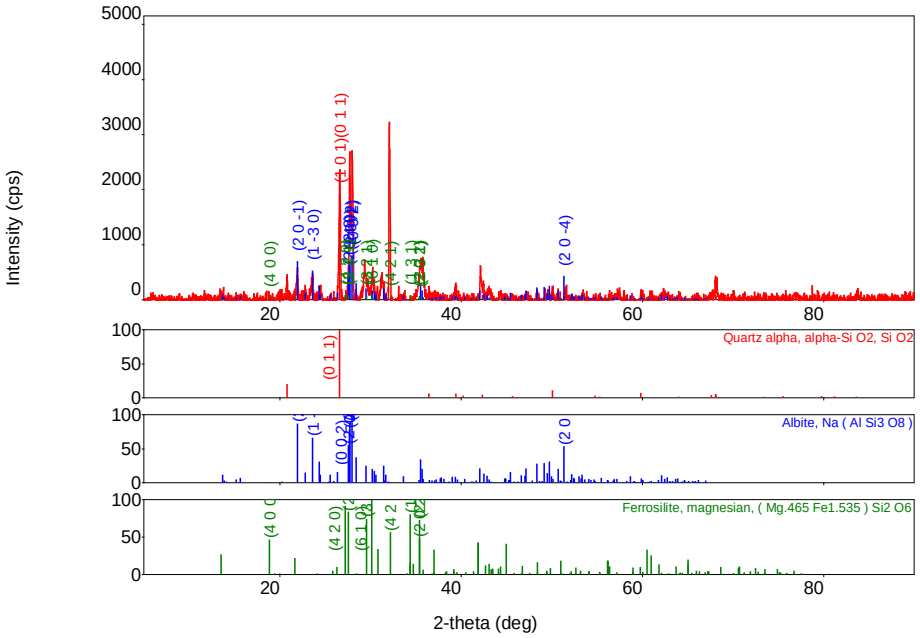
Phase name	Formula	Content(%)
Quartz	Si O2	21(3)
Albite, syn	Na Al1.08 Si2.92 O8	67(6)
Magnesioferrite	(Mg Fe2) O4	12(3)

Lampiran 23. Hasil analisa XRD mortar C (20% trass) umur 28 hari



Phase name	Formula	Content(%)
Albite	Na (Al Si3 O8)	61(5)
Quartz low, syn	O2 Si	22(2)
Magnesioferrite, aluminian, syn	Mg1.01 Fe1.77 Al.22 O4	17(3)

Lampiran 24. Hasil analisa XRD mortar D (30% trass) umur 28 hari



Phase name	Formula	Content(%)
Quartz alpha, alpha-Si O2	Si O2	30(3)
Albite	Na (Al Si3 O8)	58(4)
Ferrosilite, magnesian	(Mg.465 Fe1.535) Si2 O6	12.1(19)

Lampiran 25. Hasil analisa XRF fly ash

SAMPLE ANALYSIS REPORT — THERMO FISHER SCIENTIFIC
ARL QUANT'X EDXRF ANALYZER — UNIQUANT(TM) STANDARDLESS METHOD

C:\UQed\USER\Quant'X\Job\JOB.620 2021-04-19
FA# oks

Quant'X Rh end window 50kV
C:\UQed\USER\Quant'X\Appl\AnySampleAir.kap 2008-06-13
Calculated as : Oxides Matrix (Shape & ImpFc) : 4|Ca..
X-ray path = Air Film type = No supporting film
Case number = 0 All known
Eff.Diam. = 13.0 mm Eff.Area = 132.7 mm2
KnownConc = 0 %
Rest = 0 % Viewed Mass = 1000.000 mg
Dil/Sample = 0 Sample Height = 7.54 mm

Compound	m/m%	StdErr	El	m/m%	StdErr
SiO2	32.48	0.56	Si	15.19	0.26
CaO	26.72	0.39	Ca	19.10	0.28
Fe2O3	24.99	0.36	Fe	17.47	0.25
Al2O3	9.38	1.10	Al	4.97	0.58
SO3	3.87	1.43	Sx	1.55	0.57
TiO2	1.03	0.23	Ti	0.62	0.14
K2O	0.96	0.12	K	0.79	0.10
SrO	0.341	0.034	Sr	0.288	0.028
BaO	0.158	0.018	Ba	0.142	0.016
Nb2O5	0.0226	0.0032	Nb	0.0158	0.0022
MoO3	0.0154	0.0037	Mo	0.0103	0.0025
Y2O3	0.0086	0.0043	Y	0.0068	0.0034
Sb2O3	0.0065	0.0012	Sb	0.0054	0.0010
In2O3	0.0060	0.0009	In	0.0050	0.0008
SnO2	0.0059	0.0013	Sn	0.0046	0.0010
RuO4	0.0058	0.0020	Ru	0.0044	0.0015

KnownConc= 0 REST= 0 D/S= 0
Sum Conc's before normalisation to 100% : 55.5 %
Total % stripped Oxygen: 39.825

Lampiran 26. Hasil analisa XRF trass

SAMPLE ANALYSIS REPORT — THERMO FISHER SCIENTIFIC
ARL QUANT'X EDXRF ANALYZER — UNIQUANT(TM) STANDARDLESS METHOD

C:\UQed\USER\Quant'X\Job\JOB.619 2021-04-19
T oks

Quant'X Rh end window 50kV
C:\UQed\USER\Quant'X\Appl\AnySampleAir.kap 2008-06-13
Calculated as : Oxides Matrix (Shape & ImpFc) : 1|Teflon
X-ray path = Air Film type = No supporting film
Case number = 0 All known
Eff.Diam. = 13.0 mm Eff.Area = 132.7 mm2
KnownConc = 0 %
Rest = 0 %
Dil/Sample = 0
Viewed Mass = 1000.000 mg
Sample Height = 7.54 mm

Compound	m/m%	StdErr	El	m/m%	StdErr
SiO2	78.99	0.87	Si	36.93	0.41
Al2O3	6.49	1.01	Al	3.43	0.53
Fe2O3	6.37	0.12	Fe	4.46	0.09
K2O	3.99	0.10	K	3.31	0.08
CaO	3.08	0.14	Ca	2.20	0.10
TiO2	0.719	0.060	Ti	0.431	0.036
MnO	0.168	0.019	Mn	0.130	0.015
ZrO2	0.0774	0.0068	Zr	0.0573	0.0050
SrO	0.0395	0.0032	Sr	0.0334	0.0027
BaO	0.026	0.011	Ba	0.023	0.010
Rb2O	0.0138	0.0042	Rb	0.0126	0.0038
Nb2O5	0.0116	0.0025	Nb	0.0081	0.0018
Y2O3	0.0090	0.0041	Y	0.0071	0.0032
MoO3	0.0078	0.0036	Mo	0.0052	0.0024

KnownConc= 0 REST= 0 D/S= 0
Sum Conc's before normalisation to 100% : 55.1 %
Total % stripped Oxygen: 48.953

Lampiran 27. Hasil pengujian berat jenis NaOH dan Na2SiO3

Kementerian Perindustrian
REPUBLIK INDONESIA

Badan Penelitian dan Pengembangan Industri
BALAI RISET DAN STANDARDISASI INDUSTRI MANADO
Jalan Diponegoro Nomor 21-23, Manado 95112
Telp: (0431) 852395-852396, Fax: (0431) 852396

Kepada Yth. :
Sandri Linna Sengkey
Perum PLN Bahu

LAPORAN HASIL ANALISIS
Report of Analysis

ASLI
ORIGINAL

Balasan Surat Tanggal : 16 Oktober 2020
Reply to your letter dated :

No./*Number* : 1801/BPPI/Baristand-Manado/MS/XI/2020
No. Analisis : 380/2/BJ/LB/X/2020
Analysis Number

Manado, 5 November 2020

Yang bertanda tangan dibawah ini menerangkan bahwa hasil pengujian fisik
The undersigned certifies that physic examination

dari contoh : **Berat Jenis**
of the sample(s)
cap :
marked
diambil dari :
taken from
yang kami terima tanggal : 16 Oktober 2020
received

disegel : -
mark on seal
oleh : -
by
adalah sebagai berikut :
resulted as follows

No.	Parameter	Hasil Analisis		Satuan	Metode Analisis
		NaOH 10 Molar	Na_2SiO_3		
1.	Berat Jenis	1,2713	1,6111	bbt/bbt	SNI 01-2891-1992 Butir 1

Perhatian
Hasil-hasil pemeriksaan ini tidak untuk diumumkan dan hanya berlaku untuk contoh-contoh tersebut diatas.
Pengambil contoh bertanggung jawab atas kebenaran contoh dari partai.

ML/ek

Manajer Teknis,

Meiske S.Y. Lumingkewas

Lampiran 28. Surat keterangan pengujian XRD

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN

UNIVERSITAS NEGERI MAKASSAR

LABORATORIUM MIKROSTRUKTUR JURUSAN FISIKA
Kampus: FMIPA Parang Tambung
Telp. (0411) 840622, Hp. 081 342 211 874

SERTIFICATE OF ANALYSIS

No. 025/UNM/LM/2021

Applicant	**: Sandri Linna Sengkey**
Study Program	**: S3 Teknik Sipil Universitas Hasanuddin**
Sample Name	**: Geopolymer**
Sample received	**: 1 March 2021**
Sample Analyzed	**: 4 March 2021**
Sample Quantity	**: 4 specimens**

ANALYSIS

These samples were measured and analyzed in our laboratory with RIGAKU MINIFLEX II XRD & PDXL2 software, and the results are explained in the attachement.

The result of this analysis is only valid for the sample analyzed.

Makassar, 5 March 2021

Approved by,

Drs. Subaer, M.Phil., Ph.D
Head of UNM Microstructur

Laboratory

Lampiran 29. Surat keterangan pengujian laboratorium

SURAT KETERANGAN

Yang bertanda tangan di bawah ini:

Nama : Ventje Berty Slat, ST., MT

NIP : 196302151990031002

Jabatan : Kepala Laboratorium Uji Material Jurusan Teknik Sipil Politeknik Negeri Manado

Dengan ini menyatakan bahwa:

Nama : Sandri Linna Sengkey

No. Pokok : D013171025

Program : S3 Teknik Sipil Universitas Hasanuddin

Telah melaksanakan penelitian pengujian material, kuat tekan, penyerapan, porositas serta durabilitas pada Laboratorium Uji Material dengan judul disertasi:

"Studi Kekuatan dan Durabilitas Mortar Geopolimer Berbahan Fly Ash dengan Trass Sebagai Bahan Substitusi Agregat Halus."

Sejak Pebruari 2019 – Januari 2021

Demikian Surat Keterangan ini dibuat dan diberikan kepada yang bersangkutan untuk dipergunakan sebagaimana mestinya.

Manado, 24 Mei 2021

Kepala Laboratorium Uji Material

Ventje Berty Slat, ST., MT

Nip. 196302151990031002

Lampiran 30. Dokumentasi pengujian di laboratorium