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Appendix A: Data Analysis

CBR change according to 425 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing425um[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.962[a]	.926	.917	3.27554

a. Predictors: (Constant), Passing425um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1075.767	1	1075.767	100.266	.000[b]
	Residual	85.833	8	10.729		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), Passing425um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	76.584	3.491		21.937	.000
	Passing425um	-.780	.078	-.962	-10.013	.000

a. Dependent Variable: CBR

CBR change according to 300 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing300um[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.944[a]	.891	.877	3.97953

a. Predictors: (Constant), Passing300um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1034.907	1	1034.907	65.349	.000[b]
	Residual	126.693	8	15.837		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), Passing300um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	75.538	4.194		18.013	.000
	Passing300um	-.851	.105	-.944	-8.084	.000

a. Dependent Variable: CBR

CBR change according to 75 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing75um[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.943[a]	.889	.876	4.00607

a. Predictors: (Constant), Passing75um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1033.211	1	1033.211	64.380	.000[b]
	Residual	128.389	8	16.049		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), Passing75um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	76.012	4.281		17.755	.000
	Passing75um	-1.251	.156	-.943	-8.024	.000

a. Dependent Variable: CBR

MDD change according to 425 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing425um[b]	.	Enter

a. Dependent Variable: MDD

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.952[a]	.906	.894	.013936

a. Predictors: (Constant), Passing425um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.015	1	.015	76.742	.000[b]
	Residual	.002	8	.000		
	Total	.016	9			

a. Dependent Variable: MDD

b. Predictors: (Constant), Passing425um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.105	.015		141.701	.000
	Passing425um	-.003	.000	-.952	-8.760	.000

a. Dependent Variable: MDD

MDD change according to 300 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing300um[b]		Enter

a. Dependent Variable: MDD

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.942[a]	.888	.874	.015161

a. Predictors: (Constant), Passing300um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.015	1	.015	63.604	.000[b]
	Residual	.002	8	.000		
	Total	.016	9			

a. Dependent Variable: MDD

b. Predictors: (Constant), Passing300um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.102	.016		131.570	.000
	Passing300um	-.003	.000	-.942	-7.975	.000

a. Dependent Variable: MDD

MDD change according to 75 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing75um[b]	.	Enter

a. Dependent Variable: MDD

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.976[a]	.952	.946	.009919

a. Predictors: (Constant), Passing75um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.016	1	.016	159.267	.000[b]
	Residual	.001	8	.000		
	Total	.016	9			

a. Dependent Variable: MDD

b. Predictors: (Constant), Passing75um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.108	.011		198.887	.000
	Passing75um	-.005	.000	-.976	-12.620	.000

a. Dependent Variable: MDD

OMC change according to 425 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing425um[b]	.	Enter

a. Dependent Variable: OMC

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.964[a]	.930	.921	.38272

a. Predictors: (Constant), Passing425um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.612	1	15.612	106.587	.000[b]
	Residual	1.172	8	.146		
	Total	16.784	9			

a. Dependent Variable: OMC

b. Predictors: (Constant), Passing425um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.238	.408		15.293	.000
	Passing425um	.094	.009	.964	10.324	.000

a. Dependent Variable: OMC

OMC change according to 300 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing300um[b]	.	Enter

a. Dependent Variable: OMC

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.951[a]	.904	.892	.44801

a. Predictors: (Constant), Passing300um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15.178	1	15.178	75.620	.000[b]
	Residual	1.606	8	.201		
	Total	16.784	9			

a. Dependent Variable: OMC

b. Predictors: (Constant), Passing300um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.344	.472		13.437	.000
	Passing300um	.103	.012	.951	8.696	.000

a. Dependent Variable: OMC

OMC change according to 75 µm passing

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing75um[b]	.	Enter

a. Dependent Variable: OMC

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.932[a]	.868	.852	.52576

a. Predictors: (Constant), Passing75um

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.573	1	14.573	52.719	.000[b]
	Residual	2.211	8	.276		
	Total	16.784	9			

a. Dependent Variable: OMC

b. Predictors: (Constant), Passing75um

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.363	.562		11.326	.000
	Passing75um	.149	.020	.932	7.261	.000

a. Dependent Variable: OMC

CBR change according to MDD

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	MDD[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.968[a]	.936	.928	3.04001

a. Predictors: (Constant), MDD

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1087.667	1	1087.667	117.692	.000[b]
	Residual	73.933	8	9.242		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), MDD

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-465.929	46.940		-9.926	.000
	MDD	257.071	23.696	.968	10.849	.000

a. Dependent Variable: CBR

CBR change according to OMC

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	OMC[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.976[a]	.953	.947	2.60783

a. Predictors: (Constant), OMC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1107.194	1	1107.194	162.804	.000[b]
	Residual	54.406	8	6.801		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), OMC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	126.532	6.583		19.221	.000
	OMC	-8.122	.637	-.976	-12.759	.000

a. Dependent Variable: CBR

MDD change according to OMC

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	OMC[b]	.	Enter

a. Dependent Variable: MDD

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.950[a]	.902	.890	.014191

a. Predictors: (Constant), OMC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.015	1	.015	73.731	.000[b]
	Residual	.002	8	.000		
	Total	.016	9			

a. Dependent Variable: MDD

b. Predictors: (Constant), OMC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.286	.036		63.808	.000
	OMC	-.030	.003	-.950	-8.587	.000

a. Dependent Variable: MDD

CBR change according to 425um passing & 300um retain, 300um passing & 75um retain, and 75um passing percentages

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing75, Pass425Ret300, Pass300Ret75[b]	.	Enter

a. Dependent Variable: CBR
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.971[a]	.942	.913	3.34967

a. Predictors: (Constant), Passing75, Pass425Ret300, Pass300Ret75

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1094.278	3	364.759	32.509	.000[b]
	Residual	67.322	6	11.220		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), Passing75, Pass425Ret300, Pass300Ret75

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	77.295	3.627		21.313	.000
	Pass425Ret300	-1.308	.615	-.257	-2.127	.078
	Pass300Ret75	-.258	.476	-.102	-.542	.608
	Passing75	-.945	.250	-.713	-3.774	.009

CBR change according to 300um passing & 75um retain, and 75um passing percentages

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Passing75, Pass300Ret75[b]	.	Enter

a. Dependent Variable: CBR

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.948[a]	.898	.869	4.10693

a. Predictors: (Constant), Passing75, Pass300Ret75

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1043.532	2	521.766	30.934	.000[b]
	Residual	118.068	7	16.867		
	Total	1161.600	9			

a. Dependent Variable: CBR

b. Predictors: (Constant), Passing75, Pass300Ret75

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	76.062	4.389		17.329	.000
	Pass300Ret75	-.448	.573	-.177	-.782	.460
	Passing75	-1.051	.301	-.793	-3.494	.010

a. Dependent Variable: CBR

Appendix B: Tests Summary

Summary

SAMPLE NO	Type of Material :	Particle Size Analysis (% Passing)								Liquid limit	Plastic limit	Plasticity Index	Proctor Compaction		CBR 98%@ MDD & OMC (%)
		Sieve size (mm)											MDD	MDD & OMC (%)	
		50.0	37.5	20.0	5.0		0.425	0.300	0.075				(Mg/m$^{3)}$	(%)	
1	Subbase material	100	100	98.9	70.5	41.3		17.4	12.5	32	25	7	2.040	8.5	59.0
		100	100	98.9	70.5	41.3	22.8	17.4	12.5						
2	Subbase material: 2 units+ 05% of 0.425mm sieve passing soil from type 2 soil	100	100	91.9	65.7	41.4		22.6	14.1						58.0
		100	100	91.9	65.7	41.4	24.6	22.6	14.1				2.043	8.6	
3	Subbase material: 2 units+ 15% of 0.425mm sieve passing soil from type 2 soil	100	100	90.8	56.4	32.0		25.0	17.2				2.025	8.9	52.0
		100	100	90.8	56.4	32.0	27.5	25.0	17.2						
4	Subbase material: 2 units+ 25% of 0.425mm sieve passing soil from type 2 soil	100	100	90.1	65.7	43.0		33.0	25.9	37	29	8	1.980	9.7	49.0
		100	100	90.1	65.7	43.0	35.2	33.0	25.9						
5	Subbase material: 2 units+ 30% of 0.425mm sieve passing soil from type 2 soil	100	100	90.8	69.3	51.9		41.8	29.8				1.977	9.9	44.0
		100	100	90.8	69.3	51.9	45.0	41.8	29.8						
6	Subbase material: 2 units+ 40% of 0.425mm sieve passing soil from type 2 soil	100	100	95.5	67.1	58.6		42.6	30.1				1.959	10.3	40.0
		100	100	95.5	67.1	58.6	49.7	42.6	30.1						
7	Subbase material: 2 units+ 50% of 0.425mm sieve passing soil from type 2 soil	100	100	91.1	79.6	62.5		49.0	31.2	38	29	9	1.972	11.1	38.0
		100	100	91.1	79.6	62.5	54.5	49.0	31.2						
8	Subbase material: 2 units+ 60% of 0.425mm sieve passing soil from type 2 soil	100	100	93	76.3	60.7		49.4	32.4				1.952	11.6	37.0
		100	100	93	76.3	60.7	54.3	49.4	32.4						
9	Subbase material: 2 units+ 75% of 0.425mm sieve passing soil from type 2 soil	100	100	94.4	74.3	58.1		46.8	31.9				1.940	11.8	30.0
		100	100	94.4	74.3	58.1	55.1	46.8	31.9						
10	Subbase material: 2 units+ 90% of 0.425mm sieve passing soil from type 2 soil	100	100	93.9	77.6	64.5		52.5	37.2				1.917	12.2	25.0
		100	100	93.9	77.6	64.5	59.3	52.5	37.2						

SAMPLE NO	Type of Material :		4 day soak Swell % for mould with 10 blows	4 day soak Swell % for mould with 30 blows	4 day soak Swell % for mould with 65 blows
1	Subbase material	Stock pile	0.21	0.11	0.11
2	Subbase material: 2 units + 05% of 0.425mm sieve passing soil from type 2 soil	5% Add	0.16	0.14	0.10
3	Subbase material: 2 units + 15% of 0.425mm sieve passing soil from type 2 soil	15% Add	0.16	0.14	0.10
4	Subbase material: 2 units + 25% of 0.425mm sieve passing soil from type 2 soil	25% Add	0.20	0.10	0.09
5	Subbase material: 2 units + 30% of 0.425mm sieve passing soil from type 2 soil	30% Add	0.18	0.14	0.10
6	Subbase material: 2 units + 40% of 0.425mm sieve passing soil from type 2 soil	40% Add	0.19	0.14	0.10
7	Subbase material: 2 units + 50% of 0.425mm sieve passing soil from type 2 soil	50% Add	0.22	0.15	0.11
8	Subbase material: 2 units + 60% of 0.425mm sieve passing soil from type 2 soil	60% Add	0.20	0.15	0.10
9	Subbase material: 2 units + 75% of 0.425mm sieve passing soil from type 2 soil	75% Add	0.23	0.18	0.12
10	Subbase material: 2 units + 90% of 0.425mm sieve passing soil from type 2 soil	90% Add	0.25	0.19	0.13

Appendix C: Soil Classification in Samples

USCS Soil Classification for soil samples

Sample No.	Gravel %	Sand %	Fines %			A-line PI=0.73(LL-20)		Group Symbol		Group Name
1	29.5	58.0	12.5	Gravel<Sand	Fines>12%	8.76 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
2	34.3	51.6	14.1	Gravel<Sand	Fines>12%	8.76 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
3	43.6	39.2	17.2	Gravel>Sand	Fines>12%	8.76 >7	Below A-line	GM	Sand≥ 15%	Silty gravel with sand
4	34.3	39.8	25.9	Gravel<Sand	Fines>12%	12.41 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
5	30.7	39.5	29.8	Gravel<Sand	Fines>12%	12.41 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
6	32.9	37.0	30.1	Gravel<Sand	Fines>12%	12.41 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
7	20.4	48.4	31.2	Gravel<Sand	Fines>12%	13.14 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
8	23.7	43.9	32.4	Gravel<Sand	Fines>12%	13.14 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
9	25.7	42.4	31.9	Gravel<Sand	Fines>12%	13.14 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel
10	22.4	40.4	37.2	Gravel<Sand	Fines>12%	13.14 >7	Below A-line	SM	Gravel≥ 15%	Silty sand with gravel

AASHTO Classification of soil samples

Sample No.	No. 200 sieve passing	LL Value of sample	PI Value of sample	No. 200 sieve Passing	LL	PI	Group Classification	Usual types of significant constituent materials	General Rating	Group Index GI
1	12.5	32	7	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
2	14.1	32	7	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
3	17.2	32	7	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
4	25.9	37	8	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
5	29.8	37	8	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
6	30.1	37	8	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
7	31.2	38	9	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
8	32.4	38	9	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
9	31.9	38	9	≤35 Granular material	≤40	≤10	A-2-4	Silty or clayey gravel and sand	Excellent to good	0
10	37.2	38	9	>35 Silt-clay material	≤40	≤10	A-4	Silty Soil	Fair to poor	0

Appendix D: Sample Questionnaire Form and Summary of Survey

Note: Refer Questionnaire Page 1

Note: Refer Questionnaire Page 2

Note: Refer Questionnaire Summary

Appendix E: Prediction of CBR Using the Model

CBR = 76.062 - 0.448 x(300µm passing and 75µm retain) - 1.051 x 75 µm passing

	Test No	300µm passing	75µm passing	300µm passing & 75 µm retain %	CBR value	Predicted CBR value by Equation
1	RDC/A15/Soil/037	26.8	13.3	13.5	32	56.0
2	RDC/A15/Soil/038	33.2	17.9	15.3	35	50.4
3	RDC/A15/Soil/062	24.6	8.3	16.3	37	60.0
4	735/S	25.0	21.0	4.0	34	52.2
5	733/S	14.0	8.0	6.0	31	65.0
6	719/S	31.0	30.0	1.0	33	44.1
7	729/S	13.0	8.0	5.0	30	65.4
8	725/S	22.0	15.0	7.0	30	57.2
9	716/S	24.0	19.0	5.0	36	53.9
10	709/S	21.0	17.0	4.0	30	56.4
11	702/S	22.0	15.0	7.0	30	57.2
12	692/S	35.0	28.0	7.0	40	43.5
13	687/S	17.0	12.0	5.0	31	61.2
14	786/S	18.0	12.0	6.0	35	60.8
15	687/S	5.0	4.0	1.0	35	71.4
16	747/S	24.0	19.0	5.0	32	53.9
17	702/S	22.0	15.0	7.0	30	57.2
18	692/S	35.0	28.0	7.0	40	43.5
19	687/S	17.0	12.0	5.0	31	61.2
20	683/S	29.0	22.0	7.0	32	49.8
21	656/S	10.0	7.0	3.0	30	67.4
22	675/S	16.0	14.0	2.0	32	60.5
23	676/S	18.0	18.0	0.0	31	57.1
24	672/S	24.0	4.0	20.0	32	62.9
25	671/S	24.0	4.0	20.0	40	62.9
26	653/S	3.0	1.0	2.0	31	74.1
27	640/S	10.0	7.0	3.0	46	67.4
28	645/S	20.0	14.0	6.0	36	58.7
29	642/S	22.0	15.0	7.0	30	57.2
30	639/S	17.0	14.0	3.0	32	60.0
31	635/S	14.0	9.0	5.0	36	64.4
32	637/S	14.0	2.0	12.0	31	68.6
33	630/S	18.0	13.0	5.0	36	60.2
34	621/S	20.0	15.0	5.0	43	58.1
35	628/S	13.0	10.0	3.0	32	64.2
36	615/S	22.0	12.0	10.0	30	59.0
37	605/S	17.0	11.0	6.0	31	61.8
38	597/S	19.0	13.0	6.0	40	59.7
39	581/S	18.0	13.0	5.0	36	60.2
40	569/S	10.0	8.0	2.0	38	66.8