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APPENDIX

A.1: Blasting data set of quarry A

Blast_ID	B	D	S	H	T	CCL	S/B	T/B	H/B	T/CCL	N _r	N _h	Q _e	Di	CPD	HD	RD	Vr	Th.PF	Act.PF	SD	PPV
B1	4.0	150	5.0	10	4	6	1.3	1.0	2.5	0.67	2	13	946.4	280	84.8	42	65	4800.0	0.22	0.20	30.4	3.40
B2	4.5	150	6.0	10	3.8	6.2	1.3	0.8	2.2	0.61	3	25	1174.5	350	88.6	17	25	10800.0	5.56	0.18	37.2	2.90
B3	4.3	150	5.5	10	3.5	6.5	1.3	0.8	2.3	0.54	2	15	833.6	300	90.5	42	65	6385.5	5.56	0.18	31.5	2.50
B4	3.4	110	4.7	10	3.7	6.3	1.4	1.1	2.9	0.59	2	16	992.2	200	47.9	25	65	4314.6	0.22	0.19	28.9	4.80
B5	3.2	110	4.5	10	4.2	5.8	1.4	1.3	3.1	0.72	2	22	1236.4	350	45.2	42	65	4752.0	0.21	0.19	52.1	1.40
B6	4.5	150	6.0	10	3.6	6.4	1.3	0.8	2.2	0.56	2	22	813.4	320	88.5	42	65	8910.0	0.15	0.13	34.0	1.60
B7	4.3	150	5.5	10	4.2	5.8	1.3	1.0	2.3	0.72	2	14	994.4	300	78.8	42	65	5676.0	0.16	0.14	33.8	2.90
B8	3.0	110	4.5	10	3.5	6.5	1.5	1.2	3.3	0.54	2	22	968.8	210	49.4	25	65	4455.0	0.22	0.20	29.9	4.20
B9	4.5	150	6.0	11	4.9	6.1	1.3	1.1	2.4	0.80	2	14	1054.5	270	92.0	42	65	7128.0	0.16	0.14	28.1	3.40
B10	4.0	150	5.5	10	3.8	6.2	1.4	1.0	2.5	0.61	2	15	782.4	320	92.2	42	65	5940.0	5.56	0.18	33.3	2.76
B11	4.3	150	6.0	10	4.2	5.8	1.4	1.0	2.3	0.72	2	12	844.5	300	89.4	25	65	5418.0	0.15	0.14	31.7	2.30
B12	4.1	150	5.5	10	4.3	5.7	1.3	1.0	2.4	0.75	2	15	718.9	400	84.7	42	65	6088.5	0.16	0.14	43.5	0.70
B13	3.5	110	5.0	10	3.5	6.5	1.4	1.0	2.9	0.54	2	13	980.8	220	50.6	25	65	4200.0	0.18	0.17	30.9	3.50
B14	4.5	150	6.0	10	4.1	5.9	1.3	0.9	2.2	0.69	2	16	1650.0	250	87.7	42	65	7290.0	0.15	0.13	26.7	4.20
B15	3.2	110	4.8	10	3.9	6.1	1.5	1.2	3.1	0.64	4	33	1188.8	310	47.5	42	65	7680.0	4.76	0.21	45.0	2.48
B16	4.3	150	5.5	10	3.6	6.4	1.3	0.8	2.3	0.56	2	16	1150.5	255	92.6	25	65	6385.5	0.22	0.19	26.5	4.20
B17	4.5	150	6.0	10	3.8	6.2	1.3	0.8	2.2	0.61	2	15	970.2	270	89.8	42	65	7290.0	0.18	0.16	28.5	2.30
B18	3.0	110	4.2	10	3.5	6.4	1.4	1.2	3.3	0.55	2	21	1348.8	350	49.8	42	65	4158.0	0.22	0.21	49.6	1.50
B19	3.5	110	4.5	10	3.7	6.3	1.3	1.1	2.9	0.59	2	24	1102.0	310	51.2	42	65	5670.0	0.24	0.22	43.3	2.74
B20	3.0	110	4.0	10	3.5	6.5	1.3	1.2	3.3	0.54	2	20	1050.0	400	50.6	42	65	3960.0	3.57	0.28	56.2	0.98
B21	3.5	110	5.0	10	3.8	6.2	1.4	1.1	2.9	0.61	2	21	1030.0	300	48.3	42	65	6300.0	0.19	0.17	43.2	2.40
B22	3.2	110	4.5	10	3.7	6.3	1.4	1.2	3.1	0.59	3	25	1377.5	350	51.5	42	65	5184.0	0.20	0.18	48.8	1.98

B23	3.0	110	4.0	11	4	7	1.3	1.3	3.7	0.57	3	25	1442.0	290	49.5	42	65	5280.0	3.85	0.26	41.2	3.79
B24	3.5	110	5.0	10	3.6	6.4	1.4	1.0	2.9	0.56	4	35	900.0	290	49.8	42	65	8750.0	0.17	0.16	41.1	1.90
B25	3.0	110	4.2	10	3.5	6.5	1.4	1.2	3.3	0.54	2	18	1164.0	260	52.4	42	65	3780.0	0.25	0.24	35.9	3.50
B26	4.2	150	5.6	10	4.1	5.9	1.3	1.0	2.4	0.69	2	20	843.0	310	89.5	42	65	7761.6	0.17	0.15	32.8	1.48
B27	4.0	150	5.5	10	4.5	5.5	1.4	1.1	2.5	0.82	2	15	1200.0	300	79.2	42	65	5940.0	0.15	0.14	33.7	2.18
B28	4.5	150	6.0	10	3.8	6.2	1.3	0.8	2.2	0.61	2	15	1195.1	395	94.1	42	65	7290.0	0.18	0.16	40.7	1.80
B29	4.1	150	5.0	10	4	6	1.2	1.0	2.4	0.67	2	17	1432.2	350	91.2	42	65	6150.0	5.26	0.19	36.6	4.10
B30	4.0	150	5.0	10	4.1	5.9	1.3	1.0	2.5	0.69	2	22	720.0	255	85.5	42	65	7200.0	0.22	0.20	27.6	2.77
B31	3.2	110	4.2	10	3.7	6.3	1.3	1.2	3.1	0.59	2	16	734.4	293	51.5	25	65	3628.8	0.23	0.20	40.8	1.50
B32	3.5	110	5.0	10	3.5	6.5	1.4	1.0	2.9	0.54	2	17	800.0	300	51.2	42	65	5250.0	0.16	0.14	41.9	0.85
B33	3.0	110	4.0	10	4	6	1.3	1.3	3.3	0.67	2	16	1191.4	370	45.8	42	65	3240.0	0.26	0.25	54.7	0.70
B34	3.0	110	4.1	10	3.8	6.2	1.4	1.3	3.3	0.61	3	23	950.0	310	49.5	42	65	4428.0	0.29	0.27	44.1	2.41
B35	3.5	110	5.0	10	3.5	6.5	1.4	1.0	2.9	0.54	2	19	749.7	350	51.2	42	65	5775.0	0.18	0.16	48.9	0.90
B36	3.0	110	4.0	10	3.5	6.5	1.3	1.2	3.3	0.54	2	17	1150.0	350	46.5	42	65	3600.0	4.76	0.21	51.3	1.00
B37	3.0	110	3.9	10	3.8	6.2	1.3	1.3	3.3	0.61	3	23	1692.6	380	50.2	42	65	4212.0	0.29	0.27	53.6	3.49
B38	3.5	110	4.5	10	3.9	6.1	1.3	1.1	2.9	0.64	3	26	844.0	285	47.5	42	65	6300.0	0.25	0.27	41.3	2.79
B39	3.3	110	4.5	10	3.5	6.5	1.4	1.1	3.0	0.54	2	15	844.5	260	50.6	25	25	4009.5	0.23	0.21	36.5	2.50
B40	3.0	110	4.5	10	3.3	6.7	1.5	1.1	3.3	0.49	2	18	993.6	250	52.2	25	65	4050.0	0.27	0.25	34.6	2.90
B41	3.1	110	4.0	10	4.2	5.8	1.3	1.4	3.2	0.72	2	17	700.4	290	47.5	42	65	3720.0	5.26	0.19	42.1	1.80
B42	4.0	150	5.0	10	3.9	6.1	1.3	1.0	2.5	0.64	2	17	950.3	240	88.3	42	65	5400.0	0.18	0.16	25.5	4.10
B43	3.5	110	4.5	10	4.2	5.8	1.3	1.2	2.9	0.72	2	21	865.2	280	45.2	42	65	5670.0	0.16	0.15	41.7	2.76
B44	3.0	110	4.2	10	3.5	6.5	1.4	1.2	3.3	0.54	2	14	635.8	250	50.6	25	65	3024.0	0.23	0.21	35.1	1.50
B45	3.2	110	4.2	10	4.2	5.8	1.3	1.3	3.1	0.72	2	23	1196.0	350	45.2	17	25	4838.4	0.24	0.23	52.1	2.18
B46	3.0	110	4.0	10	3.8	6.2	1.3	1.3	3.3	0.61	2	22	992.2	370	48.3	42	65	4320.0	0.26	0.23	53.2	1.80
B47	3.5	110	4.5	10	4.2	5.8	1.3	1.2	2.9	0.72	2	21	865.2	350	45.2	42	65	5197.5	0.17	0.15	52.1	0.76
B48	3.3	110	4.1	10	4.2	5.8	1.2	1.3	3.0	0.72	4	35	1596.0	290	45.2	42	65	6765.0	0.26	0.24	43.1	3.80
B49	4.2	150	5.5	10	4.1	5.9	1.3	1.0	2.4	0.69	2	14	788.2	400	85.8	42	65	5544.0	0.16	0.14	43.2	1.10

B50	3.0	110	4.0	10	3.5	6.5	1.3	1.2	3.3	0.54	2	18	820.8	260	52.2	42	65	3600.0	0.24	0.23	36.0	3.50
B51	3.5	110	4.5	10	3.5	6.5	1.3	1.0	2.9	0.54	2	16	755.2	280	50.6	25	65	4252.5	0.21	0.18	39.4	1.51
B52	3.0	110	4.1	10	3.9	6.1	1.4	1.3	3.3	0.64	3	23	947.6	310	48.5	42	65	4428.0	0.22	0.21	44.5	2.80
B53	3.2	110	4.2	10	4.1	5.9	1.3	1.3	3.1	0.69	2	17	750.0	350	49.1	42	65	4032.0	5.26	0.19	49.9	1.80
B54	3.5	110	5.0	10	3.6	6.4	1.4	1.0	2.9	0.56	2	17	717.4	250	49.8	25	25	5250.0	0.16	0.14	35.4	3.70
B55	3.0	110	4.0	10	4.0	6.0	1.3	1.3	3.3	0.67	2	21	915.6	280	46.7	42	65	3960.0	4.76	0.21	41.0	3.40
B56	4.5	150	6.0	10	3.9	6.1	1.3	0.9	2.2	0.64	2	21	1180.2	370	88.3	42	65	8910.0	0.14	0.12	39.4	2.76
B57	4.2	150	5.7	10	4.5	5.5	1.4	1.1	2.4	0.82	2	15	978.0	290	85.2	42	65	6463.8	6.67	0.15	31.4	2.90
B58	4.1	150	5.8	11	4.2	6.8	1.4	1.0	2.7	0.62	3	25	1955.0	310	95.8	42	65	10463.2	5.26	0.19	31.7	4.20
B59	3.2	110	4.1	10	3.9	6.1	1.3	1.2	3.1	0.64	2	16	819.2	309	47.5	25	65	3542.4	4.35	0.23	44.8	1.60
B60	3.5	110	4.8	10	4.1	5.9	1.4	1.2	2.9	0.69	2	19	844.4	350	46.0	42	65	5544.0	6.67	0.15	51.6	1.10
B61	3.2	110	4.5	10	3.6	6.4	1.4	1.1	3.1	0.56	2	13	626.6	310	49.8	42	65	3456.0	5.56	0.18	43.9	0.70
B62	4.2	150	5.5	10	4.2	5.8	1.3	1.0	2.4	0.72	2	16	942.4	350	84.0	12	65	6237.0	0.17	0.15	38.2	2.76
B63	3.2	110	4.2	10	3.5	6.5	1.3	1.1	3.1	0.54	3	26	1175.2	290	50.6	42	65	5376.0	0.23	0.22	40.8	2.90
B64	3.5	110	4.8	10	3.5	6.5	1.4	1.0	2.9	0.54	2	17	775.2	200	50.6	25	65	5040.0	6.67	0.15	28.1	3.40
B65	3.0	110	4.5	10	3.8	6.2	1.5	1.3	3.3	0.61	2	14	560.0	210	48.3	42	65	3240.0	0.19	0.17	30.2	2.79
B66	3.0	110	4.0	10	3.2	6.8	1.3	1.1	3.3	0.47	2	16	673.6	250	53.0	25	65	3240.0	0.22	0.21	34.4	1.48
B67	3.5	110	4.7	10	4.2	5.8	1.3	1.2	2.9	0.72	2	14	560.0	240	45.2	25	65	3948.0	0.16	0.14	35.7	2.80
B68	4.5	150	6.0	10	4.0	6.0	1.3	0.9	2.2	0.67	2	17	1431.4	350	86.9	42	65	8100.0	0.20	0.18	37.5	3.70
B69	3.5	110	5.0	10	3.2	6.8	1.4	0.9	2.9	0.47	2	20	824.0	260	53.0	42	65	5775.0	0.16	0.14	35.7	2.41
B70	3.2	110	4.2	10	4.0	6.0	1.3	1.3	3.1	0.67	4	35	1799.7	290	46.7	42	65	6720.0	0.28	0.27	42.4	4.70
B71	3.1	110	4.0	10	3.5	6.5	1.3	1.1	3.2	0.54	3	26	1185.6	300	50.6	42	65	4960.0	0.25	0.24	42.2	2.49
B72	4.5	150	6.0	10	4.2	5.8	1.3	0.9	2.2	0.72	2	17	958.8	285	84.0	25	65	8100.0	0.13	0.12	31.1	2.80
B73	3.5	110	4.8	10	4.1	5.9	1.4	1.2	2.9	0.69	2	16	835.2	250	46.0	42	65	4536.0	5.56	0.18	36.9	2.60
B74	3.2	110	4.1	10	3.8	6.2	1.3	1.2	3.1	0.61	2	13	530.4	300	48.3	25	65	3148.8	5.88	0.17	43.2	0.81
B75	4.2	150	5.6	10	3.9	6.1	1.3	0.9	2.4	0.64	2	14	827.4	240	88.3	42	65	5644.8	0.16	0.15	25.5	2.48
B76	4.5	150	6.0	10	3.5	6.5	1.3	0.8	2.2	0.54	2	18	1335.6	320	94.1	25	65	8100.0	0.17	0.16	33.0	3.50

B77	3.0	110	4.0	10	4.0	6.0	1.3	1.3	3.3	0.67	2	17	870.4	300	46.7	25	65	3600.0	0.25	0.24	43.9	1.50
B78	4.0	150	5.0	10	3.9	6.1	1.3	1.0	2.5	0.64	2	18	1173.6	240	88.3	42	65	6000.0	0.23	0.20	25.5	3.90
B79	3.0	110	4.0	10	3.8	6.2	1.3	1.3	3.3	0.61	3	24	1228.8	285	48.3	25	65	4320.0	0.29	0.28	41.0	2.40

A.2: Blasting data set of quarry B

Blast_ID	B	D	S	H	T	CCL	S/B	T/B	H/B	T/CCL	N _r	N _h	Qe	CPD	Di	HD	RD	Vr	Th. PF	Act. PF	SD	PPV
B1	3.0	115	4.5	10.0	3.6	6.4	1.50	1.20	3.33	0.56	2	17	665.0	46.0	140	17	42	1575.0	0.18	0.16	20.6	3.87
B2	3.5	115	5.0	10.5	3.4	7.1	1.43	0.97	3.00	0.48	2	18	742.5	47.6	160	17	42	5512.5	0.14	0.13	23.2	2.46
B3	3.5	115	5.0	9.0	3.3	5.7	1.43	0.95	2.57	0.59	3	25	913.0	49.2	180	17	25	6300.0	0.15	0.14	25.7	1.63
B4	3.5	115	4.8	9.0	3.4	5.7	1.37	0.96	2.57	0.59	2	15	547.8	48.1	150	17	25	4082.4	0.16	0.13	21.6	1.27
B5	3.0	115	4.5	9.5	3.3	6.2	1.50	1.09	3.17	0.52	3	24	1011.6	52.2	210	17	25	4617.0	0.23	0.22	29.1	1.12
B6	3.5	110	4.0	10.0	4.2	5.9	1.14	1.19	2.86	0.71	3	25	956.3	46.3	150	17	25	5600.0	0.18	0.17	22.0	2.94
B7	3.5	115	5.0	10.0	4.1	6.0	1.43	1.16	2.86	0.68	2	18	704.7	52.3	200	17	42	5250.0	0.15	0.13	27.7	3.14
B8	3.5	115	5.0	9.0	3.0	6.0	1.43	0.87	2.57	0.51	2	16	631.2	50.7	240	17	25	4252.5	0.16	0.15	33.7	2.41
B9	3.5	115	5.0	9.5	3.9	5.6	1.43	1.11	2.71	0.69	2	18	632.2	47.8	230	17	42	4987.5	0.15	0.13	33.3	1.58
B10	3.0	115	4.5	10.0	3.5	6.5	1.50	1.17	3.33	0.54	4	33	1158.6	47.5	260	17	42	6750.0	0.18	0.17	37.7	1.65
B11	3.5	110	4.8	10.5	3.4	7.1	1.37	0.97	3.00	0.48	2	15	676.8	47.3	190	17	25	4762.8	0.15	0.14	27.6	1.59
B12	3.0	110	4.4	10.0	3.0	7.0	1.47	1.00	3.33	0.43	3	26	929.0	49.3	200	17	42	5280.0	0.19	0.18	28.5	2.59
B13	3.5	110	5.0	9.0	3.4	5.6	1.43	0.98	2.57	0.61	3	26	890.5	43.5	300	17	25	6300.0	0.18	0.16	45.5	0.89
B14	3.0	110	5.0	10.0	3.2	6.8	1.67	1.07	3.33	0.47	2	17	614.0	46.0	250	17	25	4500.0	0.16	0.14	36.8	2.03
B15	3.5	115	5.0	10.0	3.3	6.8	1.43	0.93	2.86	0.48	2	16	660.0	55.3	290	17	25	4725.0	0.16	0.14	39.0	0.83
B16	3.5	115	5.5	10.0	4.4	5.6	1.57	1.25	2.86	0.78	3	24	825.6	49.7	140	17	42	6930.0	0.17	0.16	19.9	4.51
B17	3.0	115	4.8	10.0	3.5	6.5	1.60	1.17	3.33	0.54	2	15	542.1	49.5	210	17	25	3888.0	0.15	0.14	29.8	1.33
B18	3.5	115	5.2	9.5	3.6	5.9	1.49	1.04	2.71	0.62	4	36	1305.0	50.0	160	17	25	8645.0	0.17	0.15	22.6	3.24
B19	3.0	115	4.5	10.0	3.9	6.1	1.50	1.30	3.33	0.64	2	15	536.1	50.4	170	17	25	3645.0	0.16	0.15	23.9	2.54
B20	3.5	115	5.0	9.0	2.8	6.2	1.43	0.81	2.57	0.46	2	17	665.0	52.5	150	17	25	4725.0	0.15	0.14	20.7	3.16
B21	3.0	115	5.0	10.0	3.8	6.2	1.67	1.27	3.33	0.61	3	25	1003.0	52.8	160	17	25	6000.0	0.20	0.19	22.0	3.11
B22	3.5	115	5.0	9.0	3.0	6.0	1.43	0.85	2.57	0.49	2	17	612.2	53.7	200	17	25	4725.0	0.15	0.13	27.3	1.47
B23	3.5	115	5.0	9.5	3.2	6.4	1.43	0.90	2.71	0.50	2	16	564.0	54.1	240	17	25	4488.8	0.14	0.13	32.6	1.89
B24	3.0	115	4.8	10.5	3.5	6.5	1.60	1.17	3.50	0.54	2	16	660.0	49.6	260	17	25	4082.4	0.18	0.16	36.9	1.40

B25	3.0	115	4.5	10.0	3.9	6.1	1.50	1.30	3.33	0.64	3	25	881.3	51.9	310	17	25	5400.0	0.18	0.16	43.0	0.85
B26	3.5	115	5.1	10.0	3.8	6.2	1.46	1.07	2.86	0.60	2	17	673.5	53.1	190	17	25	5355.0	0.15	0.13	26.1	2.54
B27	3.5	115	4.5	10.0	3.9	6.1	1.29	1.12	2.86	0.64	2	16	560.5	51.8	350	17	25	4252.5	0.15	0.13	48.6	0.85
B28	3.5	115	5.0	9.0	3.8	5.2	1.43	1.09	2.57	0.73	2	15	543.8	44.2	150	17	25	4252.5	0.14	0.13	22.6	2.76
B29	3.5	115	5.2	10.0	4.1	5.9	1.49	1.18	2.86	0.71	4	33	1130.3	49.9	210	17	25	9100.0	0.13	0.12	29.7	3.45
B30	3.5	115	5.0	10.0	4.1	5.9	1.43	1.18	2.86	0.70	3	25	921.3	50.1	220	17	25	7000.0	0.14	0.15	31.1	2.46
B31	3.5	115	5.0	9.5	3.3	6.2	1.43	0.94	2.71	0.53	2	16	564.0	52.8	250	17	25	4488.8	0.15	0.13	34.4	1.14
B32	3.5	115	5.5	10.0	4.1	6.0	1.57	1.16	2.86	0.68	2	17	595.0	50.7	240	17	42	5775.0	0.00	0.11	33.7	1.85
B33	3.5	110	5.0	9.0	3.7	5.3	1.43	1.07	2.57	0.71	2	15	618.8	41.0	230	17	25	4252.5	0.17	0.15	35.9	2.15
B34	3.5	110	5.5	10.0	4.0	6.0	1.57	1.13	2.86	0.66	3	25	875.8	47.0	240	17	42	7700.0	0.14	0.13	35.0	3.15
B35	3.5	110	5.0	10.0	4.0	6.0	1.43	1.14	2.86	0.67	3	24	780.7	42.1	260	17	25	6300.0	0.13	0.12	40.1	2.94
B36	3.0	110	4.0	10.0	3.9	6.0	1.33	1.30	3.33	0.65	2	15	541.8	46.6	270	17	42	3240.0	0.19	0.17	39.6	0.95
B37	3.0	115	4.8	9.0	3.3	5.7	1.60	1.11	3.00	0.59	2	16	625.9	52.1	280	17	25	3499.2	0.20	0.18	38.8	1.02
B38	3.0	115	5.0	10.0	3.6	6.4	1.67	1.20	3.33	0.56	4	33	1009.1	51.4	210	17	25	7500.0	0.16	0.15	29.3	3.85
B39	3.0	115	4.5	10.0	3.8	6.2	1.50	1.27	3.33	0.61	3	26	942.5	50.1	240	17	42	5400.0	0.18	0.17	33.9	1.25
B40	3.5	115	5.0	9.0	3.3	5.7	1.43	0.94	2.57	0.57	2	17	548.3	49.7	260	17	25	4725.0	0.14	0.13	36.9	0.76
B41	3.5	115	5.5	10.5	4.2	6.3	1.57	1.20	3.00	0.67	2	18	706.5	53.6	250	17	25	6063.8	0.14	0.13	34.1	2.48
B42	3.5	115	5.0	10.0	4.1	5.9	1.43	1.17	2.86	0.69	2	16	571.8	50.4	300	17	25	4725.0	0.14	0.12	42.3	0.97
B43	3.0	115	5.0	9.0	3.9	5.1	1.67	1.29	3.00	0.75	2	17	701.3	43.8	240	17	25	4050.0	0.18	0.17	36.3	2.85
B44	3.0	115	4.5	9.5	3.6	5.9	1.50	1.20	3.17	0.61	2	15	573.8	50.2	320	17	25	3462.8	0.19	0.17	45.2	0.76
B45	3.5	115	5.5	9.0	3.3	5.7	1.57	0.94	2.57	0.57	2	16	661.8	47.6	160	17	25	4677.8	0.17	0.14	23.2	3.14
B46	3.5	115	5.5	9.0	3.9	5.1	1.57	1.11	2.57	0.76	2	18	585.5	45.3	240	17	25	5197.5	0.15	0.13	35.7	1.14
B47	3.5	115	5.0	10.0	3.4	6.6	1.43	0.96	2.86	0.51	3	26	939.9	54.7	150	17	25	7000.0	0.16	0.13	20.3	3.85
B48	3.5	110	5.5	9.0	3.5	5.5	1.57	1.01	2.57	0.64	3	24	840.7	42.7	190	17	25	6237.0	0.15	0.13	29.1	3.15
B49	3.5	110	5.0	9.0	3.3	5.7	1.43	0.94	2.57	0.58	2	15	541.8	44.5	260	17	25	4252.5	0.14	0.13	39.0	0.96
B50	3.5	115	5.5	10.0	4.0	6.0	1.57	1.14	2.86	0.66	2	18	686.2	53.7	220	17	25	5775.0	0.16	0.13	30.0	1.41
B51	3.5	115	4.8	10.0	4.1	5.9	1.37	1.18	2.86	0.70	3	27	900.7	50.1	210	17	25	6720.0	0.14	0.13	29.7	2.95

B52	3.5	115	5.1	9.0	3.4	5.6	1.46	0.97	2.57	0.61	2	15	618.8	47.6	150	17	25	4337.6	0.17	0.14	21.7	1.65
B53	3.0	115	5.0	9.0	3.3	5.7	1.67	1.11	3.00	0.58	2	18	641.7	48.4	180	17	25	4050.0	0.18	0.16	25.9	3.16
B54	3.5	115	5.0	10.0	4.0	6.0	1.43	1.14	2.86	0.67	3	26	939.1	51.1	200	25	42	7000.0	0.15	0.13	28.0	3.48
B55	3.0	115	5.0	10.0	3.9	6.1	1.67	1.30	3.33	0.64	2	18	600.5	46.8	300	17	25	4500.0	0.15	0.13	43.8	2.14
B56	3.5	115	5.0	9.0	3.9	5.1	1.43	1.11	2.57	0.76	2	17	684.3	43.6	250	17	25	4725.0	0.15	0.14	37.9	0.96
B57	3.0	115	5.0	10.0	3.8	6.2	1.67	1.27	3.33	0.61	3	24	800.6	46.8	150	17	25	5400.0	0.17	0.15	21.9	3.67
B58	3.5	110	5.5	10.0	3.3	6.7	1.57	0.95	2.86	0.49	4	33	1058.3	52.1	170	17	25	9625.0	0.13	0.12	23.6	4.16
B59	3.5	115	4.5	10.0	4.4	5.5	1.29	1.26	2.86	0.80	2	15	542.3	46.7	180	17	25	4252.5	0.14	0.13	26.3	2.71
B60	3.5	115	5.0	10.0	3.3	6.7	1.43	0.95	2.86	0.50	2	18	710.1	56.8	300	17	42	5250.0	0.16	0.14	39.8	1.21
B61	3.5	115	5.5	10.0	3.6	6.4	1.57	1.03	2.86	0.57	3	24	842.9	54.3	260	17	42	6930.0	0.13	0.12	35.3	2.15
B62	3.5	115	5.0	10.0	4.2	5.8	1.43	1.21	2.86	0.74	3	23	822.0	49.0	240	17	25	6300.0	0.14	0.13	34.3	1.85
B63	3.0	115	5.0	9.0	3.7	4.3	1.67	1.22	3.00	0.85	3	28	1015.0	40.3	150	17	25	5400.0	0.21	0.19	23.6	3.96
B64	3.5	115	5.5	10.0	4.2	5.8	1.57	1.21	2.86	0.73	2	18	706.5	49.2	200	17	42	5775.0	0.16	0.14	28.5	2.14
B65	3.5	115	5.5	9.5	3.3	5.3	1.57	0.93	2.71	0.62	2	16	599.2	44.7	210	17	25	4937.6	0.14	0.12	31.4	0.77

A.3: Blasting data set for quarry C

Blast_I D	B	D	S	H	T	CC L	S/B	T/B	H/B	T/CC L	N _r	N _h	Qe	Di	CPD	H D	R D	Vr	Th. PF	Act.P F	SD	PP V
B1	3.0	115	4.0	10.0	3.9	6.1	1.33	1.30	3.33	0.64	3	28	1449.8	450	61.3	17	42	4800.0	0.30	0.28	57.5	1.9
B2	3.5	115	4.5	11.0	4.4	6.6	1.29	1.26	3.14	0.67	2	15	871.8	345	63.0	17	42	4677.8	0.19	0.18	43.5	1
B3	3.5	115	4.5	10.0	4.5	5.5	1.29	1.29	2.86	0.82	3	29	1428.3	250	55.2	17	25	6930.0	0.21	0.20	33.7	3.5
B4	3.0	115	4.0	10.0	3.8	6.2	1.33	1.27	3.33	0.61	4	36	1885	420	56.3	17	42	6000.0	0.31	3.18	56.0	1.1
B5	3.0	115	4.0	10.0	3.9	6.1	1.33	1.30	3.33	0.64	2	17	803.25	300	49.3	17	42	3600.0	0.22	4.48	42.7	1.3
B6	3.5	115	4.5	10.0	4.2	5.8	1.29	1.20	2.86	0.72	3	25	1266	500	55.2	17	25	6300.0	0.20	4.98	67.3	1.1
B7	3.5	115	4.6	10.0	3.9	6.1	1.31	1.11	2.86	0.64	4	36	1913	250	55.0	17	25	8050.0	0.24	0.22	33.7	3.7
B8	3.7	115	5.0	10.0	4.0	6.0	1.35	1.08	2.70	0.67	3	27	1412.6	350	61.8	17	25	7400.0	0.19	5.24	44.5	2.1
B9	3.5	115	4.5	10.0	4.5	5.5	1.29	1.29	2.86	0.82	3	26	1280.5	320	51.3	17	25	6300.0	0.20	0.18	44.7	1.9
B10	3.5	115	4.5	10.5	4.1	6.4	1.29	1.17	3.00	0.64	3	27	1545.8	360	65.3	17	25	6615.0	0.23	4.28	44.6	2.1
B11	4.0	150	5.0	11.0	4.5	6.5	1.25	1.13	2.75	0.69	2	15	1113.8	450	91.3	17	42	5940.0	0.19	0.17	47.1	0.8
B12	3.0	115	4.0	10.5	3.9	6.6	1.33	1.30	3.50	0.59	4	37	2009.5	300	56.2	17	25	6300.0	0.32	0.29	40.0	3.8
B13	3.0	115	4.0	10.6	3.6	7.0	1.33	1.20	3.53	0.51	2	18	1010.7	250	59.4	17	25	3816.0	0.26	3.78	32.4	2.3
B14	3.5	115	4.5	11.0	4.3	6.7	1.29	1.23	3.14	0.64	2	18	1023.3	350	61.2	17	42	5197.5	0.20	0.18	44.8	1.2
B15	3.0	115	4.0	11.0	3.8	7.2	1.33	1.27	3.67	0.53	4	37	2007.6	400	55.2	17	25	7260.0	0.30	0.28	53.8	2.9
B16	3.5	115	4.5	10.0	3.9	6.1	1.29	1.11	2.86	0.64	2	16	849.92	350	62.0	17	42	4252.5	0.20	0.18	44.5	1.2
B17	3.5	115	4.5	10.0	4.4	5.6	1.29	1.26	2.86	0.79	3	25	1355.8	430	56.3	17	25	6300	0.22	0.20	57.3	1.3
B18	3.5	115	4.5	10.0	4.5	5.5	1.29	1.29	2.86	0.82	3	24	1178.9	360	55.9	17	25	5670	0.21	4.81	48.2	1.4
B19	3.0	115	4.0	10.0	3.9	6.1	1.33	1.30	3.33	0.64	3	26	1332.8	230	52.3	17	42	4800	0.28	3.60	31.8	2.9
B20	3.5	115	4.5	10.0	4.0	6.0	1.29	1.14	2.86	0.67	3	27	1464.2	400	60.1	17	25	6300	0.23	4.30	51.6	1.2
B21	3.6	115	4.8	10.5	4.3	6.2	1.33	1.19	2.92	0.69	2	17	937.38	190	61.0	17	42	5443.2	0.17	5.81	24.3	3.8
B22	3.2	115	4.5	11.0	4.0	6.0	1.41	1.25	3.44	0.67	2	15	727.8	265	52.0	17	25	4276.8	0.17	0.15	36.7	2.1
B23	3.6	115	4.6	10.0	4.4	5.6	1.28	1.22	2.78	0.79	2	17	884.34	150	55.1	17	42	4968	0.18	0.17	20.2	3
B24	3.1	115	4.0	10.0	3.9	6.1	1.29	1.26	3.23	0.64	2	15	768.45	420	53.6	17	42	3348	0.23	0.22	57.4	0.9

B25	3.0	115	4.0	10.0	3.8	6.2	1.33	1.27	3.33	0.61	2	18	906.48	375	61.2	17	42	3600	0.25	0.24	47.9	1.4
B26	3.5	115	4.6	10.5	3.7	6.8	1.31	1.06	3.00	0.54	2	17	890.12	329	56.0	17	25	5071.5	0.18	0.16	44.0	1.1
B27	4.0	150	5.0	10.5	4.0	6.5	1.25	1.00	2.63	0.62	4	34	2762.5	500	92.8	17	25	10500	0.26	3.80	51.9	1.1
B28	3.9	150	5.0	10.5	4.3	6.2	1.28	1.10	2.69	0.69	3	26	1930.5	250	85.6	17	25	8190	0.24	0.22	27.0	1.1
B29	3.0	115	4.0	10.0	3.8	6.2	1.33	1.27	3.33	0.61	2	16	789.76	350	55.0	17	42	3240	0.24	4.10	47.2	1.5
B30	3.0	115	4.0	11.0	3.9	7.1	1.33	1.30	3.67	0.55	4	35	1793.1	445	52.1	17	25	6600	0.27	0.25	61.6	3.1
B31	3.5	115	4.5	11.0	4.3	6.7	1.29	1.23	3.14	0.64	3	25	1379.8	265	61.2	17	25	6930	0.20	0.19	33.9	2.1
B32	3.4	115	4.5	11.0	4.3	6.7	1.32	1.26	3.24	0.64	2	16	916	175	60.3	17	25	4544.1	0.20	0.19	22.5	3.9
B33	3.0	115	4.0	10.4	4.3	6.1	1.33	1.43	3.47	0.70	2	18	922.68	175	54.1	17	25	3744	0.25	4.06	23.8	2.6
B34	3.2	115	4.5	10.5	4.0	6.5	1.41	1.25	3.28	0.62	4	37	2047.6	360	60.0	17	25	8316	0.27	0.25	46.5	1.2
B35	3.7	115	4.9	10.5	4.0	6.5	1.32	1.08	2.84	0.62	4	36	1845.4	450	55.2	17	25	9518.3	0.19	0.18	60.6	2.9
B36	3.0	115	4.2	10.0	4.0	6.0	1.40	1.33	3.33	0.67	4	35	1724.5	475	54.0	17	42	6300	0.27	0.26	64.6	1.8
B37	3.5	115	4.5	10.6	4.1	6.5	1.29	1.17	3.03	0.63	3	27	1430.5	500	58.9	25	42	6678	0.21	0.19	65.1	0.9
B38	3.5	115	4.5	10.0	4.0	6.0	1.29	1.14	2.86	0.67	2	18	919.44	400	55.0	17	42	4725	0.19	0.18	53.9	0.6
B39	3.5	115	4.5	10.0	4.2	5.8	1.29	1.20	2.86	0.72	2	15	750	250	56.3	17	25	4252.5	0.18	0.16	33.3	1.5
B40	3.0	115	4.0	10.0	4.5	5.5	1.33	1.50	3.33	0.82	5	44	1947	200	49.0	25	42	7200	0.27	3.70	28.6	4
B41	3.5	115	4.5	10.0	4.1	5.9	1.29	1.17	2.86	0.69	3	25	1250	450	62.0	17	42	6300	0.20	0.19	57.2	1.2
B42	3.5	115	4.5	10.2	4.1	6.1	1.29	1.17	2.91	0.67	2	17	871.42	410	55.1	17	25	4819.5	0.18	5.53	55.2	0.6
B43	3.5	115	4.8	10.5	4.0	6.5	1.37	1.14	3.00	0.62	3	26	1413.4	470	56.3	17	25	7056	0.20	0.18	62.6	1.1
B44	4.0	150	5.0	10.0	4.0	6.0	1.25	1.00	2.50	0.67	2	15	1096.8	500	85.7	25	42	5400	0.20	0.17	54.0	0.6
B45	3.9	150	5.0	10.0	4.0	6.0	1.28	1.03	2.56	0.67	5	42	3328.5	350	91.2	17	25	11700	0.28	3.52	36.7	4.2
B46	4.0	150	5.0	10.0	4.1	5.9	1.25	1.03	2.50	0.69	3	26	1852.5	500	86.3	17	42	8000	0.23	4.32	53.8	2.3
B47	4.0	150	5.0	10.0	4.3	5.7	1.25	1.08	2.50	0.75	2	16	1157.8	490	89.2	25	42	5400	0.21	0.18	51.9	0.8
B48	3.0	115	4.0	11.0	4.5	6.5	1.33	1.50	3.67	0.69	4	34	1649.7	480	56.1	17	42	6600	0.25	0.22	64.1	2.9
B49	3.0	115	4.0	11.0	4.3	6.7	1.33	1.43	3.67	0.64	2	18	922.14	200	55.4	17	25	3960	0.23	4.29	26.9	3.2
B50	3.0	115	4.0	11.0	4.6	6.4	1.33	1.53	3.67	0.72	2	15	770.4	200	53.2	17	42	3564	0.22	4.63	27.4	4
B51	3.5	115	4.5	10.5	4.3	6.2	1.29	1.23	3.00	0.69	2	16	868.48	200	56.3	17	42	4465.1	0.19	0.17	26.7	2.2

B52	3.5	115	4.5	10.5	4.0	6.5	1.29	1.14	3.00	0.62	4	38	1860.5	250	55.0	17	25	8268.8	0.23	4.44	33.7	2.4
B53	3.5	115	4.5	11.0	4.5	6.5	1.29	1.29	3.14	0.69	4	36	1849	440	56.0	17	25	8662.5	0.21	0.20	58.8	1.2
B54	3.2	115	4.5	10.2	4.3	5.9	1.41	1.34	3.19	0.73	2	16	867.36	150	61.1	17	25	3965.8	0.22	4.57	19.2	4
B55	3.0	115	4.1	10.2	4.2	6.0	1.37	1.40	3.40	0.70	3	25	1309.5	500	59.1	17	42	5018.4	0.26	3.83	65.1	1.3
B56	3.4	115	4.6	10.5	4.0	6.5	1.35	1.18	3.09	0.62	5	45	2390.4	490	56.3	17	25	9853.2	0.24	0.22	65.3	1.1
B57	3.0	115	4.0	10.6	3.7	6.9	1.33	1.23	3.53	0.54	3	28	1437	380	56.2	17	25	5596.8	0.28	0.25	50.7	1.1
B58	3.0	115	4.0	11.0	4.3	6.7	1.33	1.43	3.67	0.64	2	17	919.36	350	60.3	17	25	3960	0.23	4.31	45.1	1.6
B59	3.0	115	4.0	11.0	4.5	6.5	1.33	1.50	3.67	0.69	3	25	1234	225	51.9	17	25	5280	0.23	0.21	31.2	2.5
B60	3.5	115	4.6	11.0	4.3	6.7	1.31	1.23	3.14	0.64	2	18	924.48	320	59.7	17	42	5313	0.17	5.75	41.4	0.6
B61	3.5	115	4.5	11.0	4.5	6.5	1.29	1.29	3.14	0.69	3	26	1306.5	250	55.8	17	25	6930	0.19	0.18	33.5	2.5
B62	3.5	115	4.5	10.0	4.2	5.8	1.29	1.20	2.86	0.72	2	15	869.7	400	62.0	17	42	4252.5	0.20	0.18	50.8	0.7
B63	3.0	115	4.2	10.0	4.5	5.5	1.40	1.50	3.33	0.82	3	25	1414	500	61.2	17	25	5040	0.28	0.25	63.9	1.4
B64	3.0	115	4.0	10.3	4.1	6.2	1.33	1.37	3.43	0.66	3	29	1486.5	500	55.2	17	42	5438.4	0.27	0.25	67.3	1.5
B65	3.5	115	4.5	10.0	4.0	6.0	1.29	1.14	2.86	0.67	2	16	756	450	50.0	17	42	4252.5	0.18	0.16	63.6	1.3
B66	3.0	115	4.0	10.0	4.0	6.0	1.33	1.33	3.33	0.67	3	24	1182	330	55.2	25	42	4320	0.27	0.25	44.4	2.2
B67	3.2	115	4.5	10.0	4.2	5.8	1.41	1.31	3.13	0.72	3	25	1276.5	425	55.3	17	25	5760	0.22	0.20	57.1	2.2
B68	3.2	115	4.4	10.0	4.4	5.6	1.38	1.38	3.13	0.79	2	17	890.12	475	56.2	17	25	4224	0.21	0.20	63.4	0.6
B69	3.2	115	4.6	10.0	4.0	6.0	1.44	1.25	3.13	0.67	4	35	1896.3	400	57.2	17	25	7360	0.26	3.88	52.9	1.3
B70	3.2	115	4.5	10.0	4.1	5.9	1.41	1.28	3.13	0.69	4	39	2116.1	320	59.3	17	42	7920	0.29	3.40	41.6	3.7
B71	3.0	115	4.0	10.5	4.3	6.2	1.33	1.43	3.50	0.69	2	17	872.44	175	55.2	17	42	3780	0.23	0.21	23.5	4.2
B72	3.5	115	4.5	11.0	4.5	6.5	1.29	1.29	3.14	0.69	5	42	2073.1	450	53.2	17	25	10395	0.20	0.19	61.7	1.2
B73	3.5	115	4.6	11.0	4.4	6.6	1.31	1.26	3.14	0.67	2	15	737.55	380	56.3	25	42	4781.7	0.15	0.14	50.6	1.2
B74	3.5	115	4.6	10.5	4.4	6.1	1.31	1.26	3.00	0.72	2	16	819.68	250	59.9	17	42	4564.4	0.18	0.15	32.3	2.3
B75	3.0	115	4.0	10.5	4.0	6.5	1.33	1.33	3.50	0.62	2	17	920.89	200	59.0	17	42	3780	0.24	0.20	26.0	3.1

A.4: Validation data set for quarry A

Blast_ID	B	D	S	H	T	CC	S/B	T/B	H/B	T/C	N	N	Qe	CP	Di	H	R	Vr	PF	SD	PP	PCA	SSE	SR	PC	SS
						L				CL	r	h		D	D	D	D			V	-	-	E	A-	E-	
																					PPV	PPV		PF	PF	
B1	3.8	150	4.8	10.0	4.5	5.5	1.3	1.2	3.3	0.82	2	17	1108.4	74.8	260	42	65	5472.0	0.20	30.1	2.78	2.64	3.55	0.85	0.20	0.21
B2	4.0	150	5.0	10.0	3.7	6.3	1.3	0.9	3.3	0.59	2	15	934.5	81.3	300	25	42	5400.0	0.17	33.3	1.81	1.76	2.47	1.61	0.21	0.22
B3	4.0	150	5.5	10.0	4.2	5.8	1.4	1.1	3.3	0.72	3	25	1380	82.3	270	42	65	8800.0	0.16	29.8	2.78	2.60	3.92	0.85	0.19	0.16
B4	4.5	150	5.5	10.0	4.4	5.6	1.2	1.0	3.3	0.79	2	15	946.5	79.5	310	25	42	6682.5	0.14	34.8	1.85	1.94	2.41	1.61	0.15	0.17
B5	4.2	150	5.5	10.0	4.3	5.7	1.3	1.0	3.3	0.75	3	24	1084.8	82.2	400	42	42	8316.0	0.13	44.1	0.95	1.00	1.55	1.61	0.18	0.17
B6	3.8	150	5.2	10.0	4.1	5.9	1.4	1.1	3.3	0.69	3	27	1520.1	86.2	270	25	42	7904.0	0.19	29.1	3.26	3.16	4.30	1.61	0.21	0.18
B7	3.5	110	5.5	9.5	3.2	6.3	1.6	0.9	5.5	0.51	3	26	1320.5	61.2	300	25	42	7315.0	0.18	38.3	2.31	2.15	2.87	1.61	0.16	0.16
B8	3.4	110	5.0	10.0	3.5	6.5	1.5	1.0	5.0	0.54	2	18	743.4	55.2	280	42	65	6359.0	0.15	37.7	1.32	1.12	1.81	0.85	0.16	0.20
B9	4.2	150	5.5	10.0	4.5	5.5	1.3	1.1	3.3	0.82	4	35	2142	68.5	300	42	65	11550.0	0.19	36.2	2.65	4.44	5.13	0.85	0.21	0.10
B10	4.5	150	5.5	10.0	4.0	6.0	1.2	0.9	3.3	0.67	2	15	1021.5	80.2	395	17	25	6682.5	0.15	44.1	1.11	1.20	1.30	3.46	0.17	0.17
B11	4.0	150	5.2	10.0	4.1	5.7	1.3	1.0	3.3	0.72	2	16	1027.2	84.3	255	25	42	5616.0	0.18	27.8	2.68	2.36	3.41	1.61	0.18	0.20
B12	3.5	110	5.2	10.0	3.9	6.1	1.5	1.1	3.3	0.64	4	36	2131.2	70.2	370	25	42	9100.0	0.23	44.2	3.26	3.31	3.92	1.61	0.22	0.16
B13	4.0	110	5.5	10.0	4.3	5.7	1.4	1.1	5.0	0.75	3	26	1146.6	44.3	350	25	42	8800.0	0.13	52.6	1.21	0.91	1.24	1.61	0.14	0.12

B14	4. 0	15 0	5. 3	10. 0	3. 5	6. 5	1. 3	0. 9	5. 0	0.54	3	2 5	1250	50. 2	24 0	4 2	6 5	8480. 0	0.1 5	33. 9	2.9 5	3.1 6	3.5 9	0.8 5	0.2 1	0.1 5
B15	4. 5	15 0	5. 5	10. 0	4. 4	5. 6	1. 2	1. 0	3. 3	0.79	3	2 8	1943 .2	80. 2	29 0	1 7	2 5	10890 .0	0.2 0	32. 4	3.8 6	4.6 4	4.9 4	3.4 6	0.2 0	0.1 1
B16	3. 2	11 0	4. 7	10. 0	4. 0	6. 0	1. 5	1. 3	5. 0	0.67	3	2 4	1176 .8	50. 2	32 0	2 5	4 2	5414. 4	0.2 2	45. 2	1.8 8	1.7 7	2.1 3	1.6 1	0.2 0	0.2 1
B17	3. 5	11 0	4. 8	9.5 0	3. 5	6. 0	1. 4	1. 0	5. 0	0.58	2	1 8	820. 8	52. 7	26 0	4 2	6 5	4788. 0	0.1 7	35. 8	1.6 2	1.8 3	2.5 4	0.8 5	0.1 7	0.2 1
B18	3. 5	11 0	5. 0	10. 0	3. 8	6. 2	1. 4	1. 1	5. 6	0.61	3	2 5	1246 .3	40. 2	29 0	2 5	4 2	7000. 0	0.2 2	45. 7	2.1 3	1.9 9	2.3 0	1.6 1	0.1 9	0.1 7
B19	4. 0	15 0	5. 0	10. 0	4. 1	5. 9	1. 3	1. 0	3. 3	0.69	2	1 7	1012 .5	83. 5	30 0	4 2	6 5	6000. 0	0.1 8	32. 8	1.6 1	1.7 0	2.7 7	0.8 5	0.2 0	0.2 1
B20	4. 3	15 0	5. 2	10. 0	4. 2	5. 8	1. 2	1. 0	3. 3	0.72	3	2 6	1215 .2	82. 3	27 0	4 2	6 5	8944. 0	0.2 0	29. 8	2.7 5	2.8 1	3.7 7	0.8 5	0.2 0	0.1 8
B21	3. 5	11 0	5. 0	10. 0	3. 5	6. 5	1. 4	1. 0	5. 0	0.54	3	2 7	1163 .7	50. 2	35 0	4 2	6 5	7000. 0	0.1 7	49. 4	1.2 1	0.8 2	1.4 5	0.8 5	0.1 9	0.1 9
B22	3. 2	11 0	4. 8	10. 0	4. 2	5. 8	1. 5	1. 3	3. 1	0.72	2	1 6	723. 2	56. 3	25 0	4 2	6 5	4147. 2	0.1 7	33. 3	1.6 4	1.7 3	2.4 8	0.8 5	0.1 6	0.2 2

A.5: Validation data set for quarry B

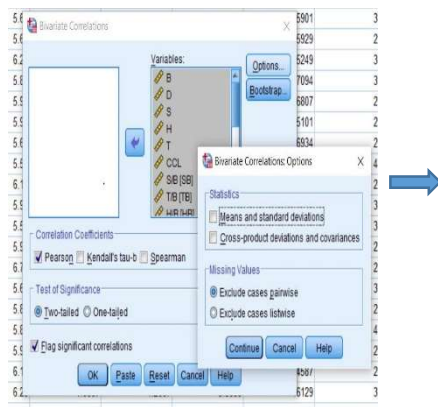
Blast ID	B	D	S	H	T	CC L	S/B	T/B	H/B	T/C CL	Nr	Nh	Qe	CP D	Di	H D	R D	Vr	PF	SD	PP V	PCA-PPV	SSE-PPV	PCA-PF	SSE-PF	SR E
B1	3.5	1.15	5.0	10.0	3.5	6.5	1.67	1.00	2.86	0.54	2	18	921.6	39.85	150	17	25	5250.0	0.23	23.76	3.68	3.41	2.66	0.24	0.23	2.79
B2	3.0	1.15	4.5	10.0	4.2	5.8	1.50	1.30	3.33	0.72	2	17	770.1	33.36	170	17	25	4050.0	0.15	29.43	2.90	3.19	3.21	0.18	0.19	2.04
B3	3.0	1.15	4.5	10.0	3.8	6.2	1.41	1.27	3.33	0.61	3	25	1178	41.40	200	17	25	5400.0	0.22	31.08	1.88	2.30	2.86	0.20	0.24	1.88
B4	3.2	1.15	4.5	10.0	4.0	6.0	1.29	1.25	3.13	0.67	2	15	693.8	47.26	300	17	42	3888.0	0.18	43.64	0.95	1.17	2.55	0.16	0.17	1.14
B5	3.5	1.15	5.0	9.5	3.5	6.0	1.43	1.00	2.71	0.58	2	16	724.2	47.26	150	17	25	4488.8	0.16	21.82	2.76	2.58	3.09	0.16	0.23	3.17
B6	3.5	1.15	5.0	10.0	4.5	5.5	1.56	1.29	2.86	0.82	3	26	1100	37.52	310	17	25	7000.0	0.16	50.61	1.96	2.39	3.66	0.20	0.20	0.91
B7	3.2	1.15	4.5	9.5	3.5	6.0	1.50	1.09	2.97	0.58	3	24	1158	42.15	160	17	25	4924.8	0.24	24.64	3.18	2.58	2.88	0.23	0.23	2.65
B8	3.0	1.15	4.5	10.0	4.0	6.0	1.29	1.33	3.33	0.67	2	15	738.8	41.25	290	17	25	3645.0	0.20	45.15	1.16	1.25	2.26	0.24	0.26	1.08
B9	3.5	1.15	5.0	10.0	3.5	6.5	1.67	1.00	2.86	0.54	2	17	860.5	47.26	210	17	25	5250.0	0.16	30.55	2.49	2.65	3.22	0.17	0.23	1.93
B10	3.0	1.15	4.5	9.5	3.5	6.0	1.29	1.17	3.17	0.58	2	16	760	30.58	240	17	25	3462.8	0.22	43.40	1.66	1.88	1.86	0.22	0.27	1.15
B11	3.5	1.15	5.0	10.0	4.0	6.0	1.67	1.14	2.86	0.67	3	27	1138	41.70	150	17	25	7000.0	0.16	23.23	3.43	3.84	3.92	0.16	0.20	2.89

B12	3.0	1.15	4.5	10.0	4.5	5.5	1.29	1.50	3.33	0.82	4	34	14.03	44.48	26.0	17	25	675.0	0.21	38.98	2.16	1.90	3.52	0.21	0.21	1.34
B13	3.5	1.15	5.0	10.0	4.0	6.0	1.67	1.14	2.86	0.67	2	17	76.94	44.48	32.0	17	42	525.0	0.15	47.98	1.69	2.15	3.30	0.17	0.23	0.99
B14	3.0	1.15	4.5	9.5	3.5	6.0	1.29	1.17	3.17	0.58	2	16	73.92	33.36	16.0	17	25	346.28	0.21	27.70	3.13	2.57	2.13	0.23	0.27	2.23
B15	3.5	1.15	5.0	9.5	3.5	6.0	1.67	1.00	2.71	0.58	3	25	11.25	46.52	15.0	17	25	665.0	0.17	21.99	3.38	3.18	3.81	0.18	0.21	3.13
B16	3.0	1.15	4.5	10.0	4.5	5.5	1.41	1.50	3.33	0.82	3	26	10.99	34.30	26.0	17	42	540.0	0.20	44.39	1.63	2.36	3.07	0.20	0.23	1.11
B17	3.2	1.15	4.5	10.0	4.0	6.0	1.29	1.25	3.13	0.67	2	16	76.0	33.36	25.0	17	25	388.8	0.20	43.28	1.52	1.98	2.24	0.22	0.25	1.15
B18	3.5	1.15	5.0	10.0	3.5	6.5	1.43	1.00	2.86	0.54	2	15	78.75	47.25	31.0	17	25	472.5	0.17	45.10	0.95	1.31	2.65	0.15	0.23	1.08
B19	3.5	1.15	5.0	10.0	4.5	5.5	1.67	1.29	2.86	0.82	3	24	10.38	32.15	19.0	17	42	630.0	0.16	33.51	3.57	3.74	3.88	0.21	0.20	1.68
B20	3.0	1.15	4.5	10.0	4.0	6.0	1.29	1.33	3.33	0.67	4	35	16.85	44.48	18.0	17	42	675.0	0.25	26.99	2.22	1.86	3.08	0.24	0.21	2.31
B21	3.5	1.15	5.0	9.5	3.5	6.0	1.67	1.00	2.71	0.58	2	15	76.88	30.58	21.0	17	25	448.88	0.17	37.98	2.67	3.06	2.89	0.19	0.23	1.40
B22	3.0	1.15	4.5	10.0	4.0	6.0	1.29	1.33	3.33	0.67	3	26	11.75	30.58	32.0	17	25	540.0	0.22	57.87	1.63	1.45	2.32	0.23	0.23	0.75
B23	3.5	1.15	5.0	10.0	4.0	6.0	1.43	1.14	2.86	0.67	2	16	68.99	43.00	30.0	17	25	472.5	0.15	45.75	1.48	1.91	2.98	0.15	0.23	1.06

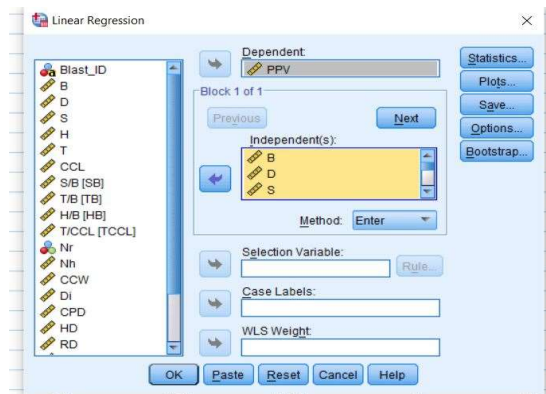
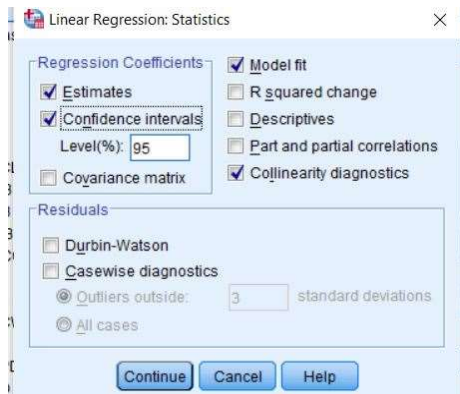
A.6: Validation data set for quarry C

Blast _Id	B	D	S	H	T	C CL	S_ B	T_ B	H_ B	T_C CL	N r	N h	Qe	Di	CP D	H D	R D	Vr	PF	SD	PP V	PPV- PCA	PPV- SSE	PF- PC A	PF- SSE	SR E
B1	3	11 5	4	11	4. 5	6.5	1. 33	1.2 8	3. 67	0.69	2	16	800	36 0	54. 2	17	42	356 4	0.2 2	48. 89	1.6 5	1.70	1.72	0.26	0.22	1.5 1
B2	3. 5	11 5	4. 5	10. 5	4. 3	6.2	1. 29	1.2 3	3. 00	0.69	4	37	2114. 55	32 0	62. 1	17	25	826 8.8	0.2 6	40. 60	1.4 1	1.36	2.74	0.26	0.25	1.8 3
B3	4	15 0	5	11	4. 3	6.7	1. 25	1.0 8	2. 75	0.64	3	27	2142. 45	22 5	89. 3	17	25	880 0	0.2 4	23. 82	3.1 2	3.19	3.39	0.22	0.24	3.1 4
B4	3. 8	15 0	4. 9	10	4. 4	5.6	1. 29	1.1 6	2. 63	0.79	2	16	1108	43 0	84. 2	17	25	502 7.4	0.2 2	46. 86	1.5 6	2.02	1.16	0.18	0.19	1.5 8
B5	3. 9	15 0	5	10	4. 5	5.5	1. 28	1.1 5	2. 56	0.82	3	26	1826. 5	25 0	84. 3	12	30	780 0	0.2 3	27. 23	2.6 1	2.80	3.12	0.21	0.23	2.7 4
B6	4	15 0	5	10	4. 1	5.9	1. 25	1.0 3	2. 50	0.69	2	18	1281. 42	50 0	90. 1	17	25	600 0	0.2 1	52. 67	1.0 8	1.73	0.52	0.18	0.19	1.4 0
B7	4	15 0	5	10	4	6	1. 25	1.0 0	2. 50	0.67	2	17	1262. 76	29 0	92. 2	14	42	600 0	0.2 1	30. 21	3.4 2	3.51	1.93	0.19	0.18	2.4 7
B8	3	11 5	4	10. 5	4. 2	6.3	1. 33	1.4 0	3. 50	0.67	3	26	1199. 12	42 0	51. 1	17	25	504 0	0.2 4	58. 77	0.7 6	0.80	1.31	0.26	0.21	1.2 5
B9	3. 5	11 5	4. 6	10. 5	4. 4	6.1	1. 31	1.2 6	3. 00	0.72	3	27	1461. 24	50 0	58. 4	17	25	676 2	0.2 2	65. 44	0.6 1	0.58	0.90	0.22	0.22	1.1 2
B10	3. 5	11 5	4. 5	10. 5	4. 5	6	1. 29	1.2 9	3. 00	0.75	5	48	2466. 72	45 0	54	17	42	109 15	0.2 5	61. 24	0.9 5	1.06	2.10	0.30	0.27	1.2 0
B11	3. 5	11 5	4. 8	11	4. 4	6.6	1. 37	1.2 6	3. 14	0.67	2	15	857.7	41 0	62. 1	17	40	498 9.6	0.1 7	52. 02	1.6 4	2.28	1.21	0.19	0.18	1.4 2
B12	3	11 5	4. 2	11	4. 5	6.5	1. 40	1.5 0	3. 67	0.69	3	24	1320	28 0	64	17	42	498 9.6	0.2 6	35. 00	2.2	2.14	2.98	0.26	0.24	2.1 2
B13	3	11 5	4	11	4. 3	6.7	1. 33	1.4 3	3. 67	0.64	2	16	789.2 8	32 0	54. 2	17	42	356 4	0.2 2	43. 46	1.9 6	2.11	1.86	0.25	0.20	1.7 0
B14	3. 5	11 5	4. 5	10. 5	4. 2	6.3	1. 29	1.2 0	3. 00	0.67	3	26	1335. 36	50 0	56. 3	17	42	661 5	0.2 0	66. 63	0.7	0.69	0.54	0.24	0.19	1.1 0
B15	3. 5	11 5	4. 7	10. 3	4. 2	6.1	1. 34	1.2 0	2. 94	0.69	5	45	2257. 65	34 5	56. 2	17	25	101 66	0.2 2	46. 03	1.3 2	1.16	2.63	0.25	0.23	1.6 1
B16	3. 5	11 5	4. 5	10. 4	4. 2	6.2	1. 29	1.2 0	2. 97	0.68	2	18	888.6 6	27 5	54. 4	17	25	491 4	0.1 8	37. 29	2.6 8	2.88	1.88	0.20	0.18	1.9 9

B17	3	11 5	4	10	4. 1	5.9	1. 33	1.3 7	3. 33	0.69	2	18	999.9	34 0	61. 2	17	42	360 0	0.2 8	43. 45	1.9 1	1.68	1.82	0.26	0.23	1.7 0
B18	3	11 5	4	10	4	6	1. 33	1.3 3	3. 33	0.67	2	16	900	49 0	60. 3	17	42	324 0	0.2 8	63. 13	0.6 3	0.62	0.50	0.26	0.20	1.1 6
B19	3	11 5	4	10	4. 4	5.6	1. 33	1.4 7	3. 33	0.79	3	24	1277. 04	44 0	58. 2	17	25	432 0	0.3 0	57. 68	0.6 5	0.38	1.47	0.26	0.23	1.2 8
B20	3. 5	11 5	4. 5	11	4. 3	6.7	1. 29	1.2 3	3. 14	0.64	2	17	892.5	50 0	59. 1	17	42	519 7.5	0.1 7	65. 02	1.2 1	1.23	0.28	0.22	0.18	1.1 3
B21	3	11 5	4	11	4. 5	6.5	1. 33	1.5 0	3. 67	0.69	2	18	924.6 6	45 0	55. 1	17	25	396 0	0.2 3	60. 63	1.0 2	0.86	1.16	0.25	0.24	1.2 1
B22	3	11 5	4	10	4. 2	5.8	1. 33	1.4 0	3. 33	0.72	3	24	1251. 6	40 0	56	17	25	432 0	0.2 9	53. 45	1.0 2	0.83	1.57	0.26	0.22	1.3 8
B23	3. 5	11 5	4. 8	10. 5	4. 3	6.2	1. 37	1.2 3	3. 00	0.69	2	18	891	34 5	54. 1	17	25	529 2	0.1 7	46. 90	2.1 5	2.60	1.60	0.17	0.20	1.5 8
B24	3. 5	11 5	4. 2	10. 5	4. 4	6.1	1. 20	1.2 6	3. 00	0.72	2	16	800	20 0	52. 3	17	42	416 7.5	0.1 9	27. 65	3.0 9	3.16	2.32	0.23	0.17	2.7 0
B25	3. 5	11 5	4. 5	10	4. 5	5.5	1. 29	1.2 9	2. 86	0.82	3	25	1235. 25	47 5	58	17	25	630 0	0.2 0	62. 37	0.5 1	0.67	0.87	0.22	0.20	1.1 8



		B	D	S	H	T	CCL	S/B	T/B	H/B	T/CCL	Nr	Nh
B	Pearson Correlation	1	.925	.958	.100	.252	-.198	-.309	-.828	-.988	.238	-.232	-.287
	Sig. (2-tailed)		.000	.000	.379	.025	.081	.006	.000	.000	.035	.039	.010
	N	79	79	79	79	79	79	79	79	79	79	79	79
D	Pearson Correlation	-.925	1	.898	.130	.313	-.248	-.366	-.705	-.907	.299	-.235	-.319
	Sig. (2-tailed)	.000		.000	.255	.005	.028	.001	.000	.000	.007	.037	.004
	N	79	79	79	79	79	79	79	79	79	79	79	79
S	Pearson Correlation	.958	.898	1	.126	.186	-.113	-.037	-.828	-.938	.165	-.219	-.281
	Sig. (2-tailed)	.000	.000		.269	.100	.322	.744	.000	.000	.145	.053	.012
	N	79	79	79	79	79	79	79	79	79	79	79	79
H	Pearson Correlation	.100	.130	.126	1	.391	.199	-.002	.111	.043	.168	.159	.087
	Sig. (2-tailed)	.379	.255	.269		.000	.079	.993	.332	.704	.138	.162	.446
	N	79	79	79	79	79	79	79	79	79	79	79	79
T	Pearson Correlation	.252	.313	.186	.391	1	-.823	-.248	.304	-.203	.972	.026	-.048
	Sig. (2-tailed)	.025	.005	.100	.000		.000	.028	.007	.073	.000	.821	.675
	N	79	79	79	79	79	79	79	79	79	79	79	79
CCL	Pearson Correlation	-.198	-.248	-.113	.199	-.823	1	.200	-.324	.233	-.931	.074	.105
	Sig. (2-tailed)	.081	.028	.322	.079	.000		.021	.019	.038	.000	.520	.357
	N	79	79	79	79	79	79	79	79	79	79	79	79
S/B	Pearson Correlation	-.309	-.366	-.037	-.002	-.248	.260	1	.146	.313	-.250	.052	.008
	Sig. (2-tailed)	.006	.001	.744	.983	.028	.021		.198	.005	.026	.651	.944
	N	79	79	79	79	79	79	79	79	79	79	79	79
T/B	Pearson Correlation	-.828	-.705	-.828	.111	.304	-.264	.146	1	.847	.301	.209	.328
	Sig. (2-tailed)	.000	.000	.000	.332	.007	.019	.198		.000	.007	.064	.043
	N	79	79	79	79	79	79	79	79	79	79	79	79
H/B	Pearson Correlation	-.988	-.907	-.938	.043	-.203	.333	.313	.847	1	-.221	.250	.299
	Sig. (2-tailed)	.000	.000	.000	.704	.073	.038	.005	.000		.050	.026	.007
	N	79	79	79	79	79	79	79	79	79	79	79	79



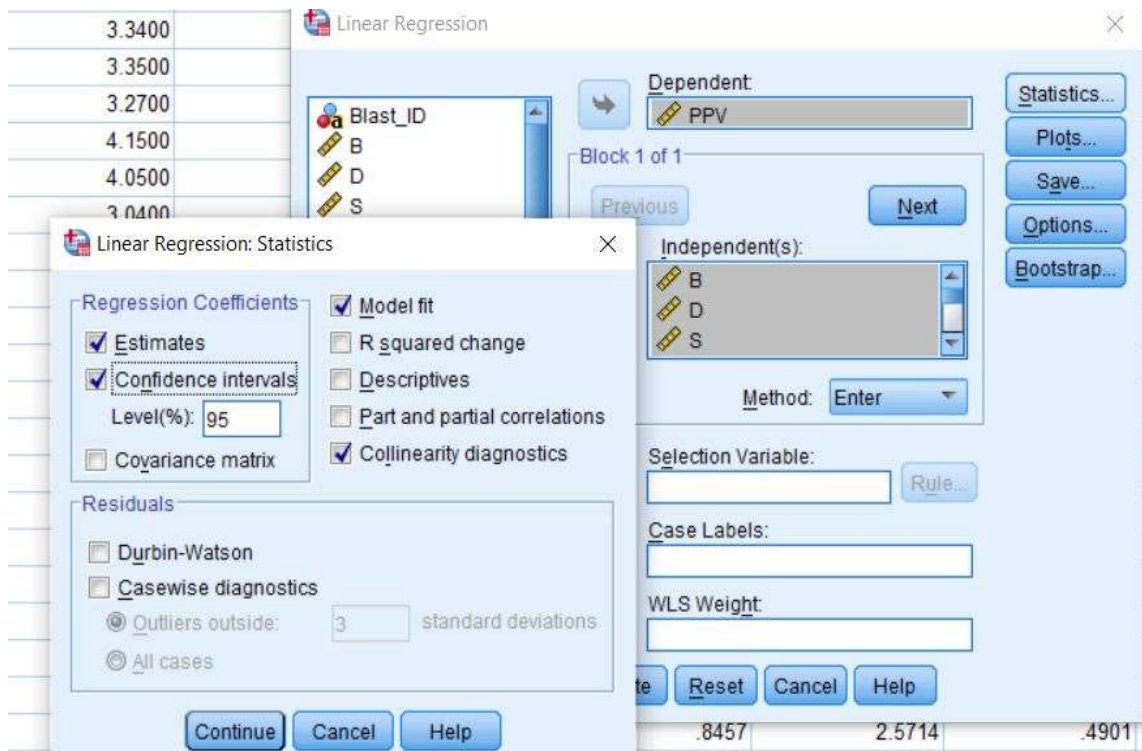
Model	Coefficients ^a						
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error				Beta	Tolerance
(Constant)	11.480	5.145		2.231	.029		
CCL	-.556	.621	-.165	-.896	.373	.104	9.656
S B	-1.312	1.013	-.086	-1.295	.199	.793	1.262
T B	.806	.816	.131	.989	.326	.201	4.976
T CCL	-1.975	2.613	-.155	-.756	.452	.384	1.940
Nh	.019	.016	.095	1.196	.236	.557	1.795
CPD	-.017	.008	-.314	-2.140	.036	.164	6.081
SD	-.127	.011	-.964	-11.503	.000	.513	1.950
Qe	.002	.000	.592	7.346	.000	.543	1.842

a. Dependent Variable: PPV

Model	Unstandardized Coefficients	
	B	Std. Error
(Constant)	11.480	5.145
CCL	-.556	.621
S B	-1.312	1.013
T B	.806	.816
1 T CCL	-1.975	2.613
Nh	.019	.016
CPD	-.017	.008
SD	-.127	.011
Qe	.002	.000

a. Dependent Variable: PPV

A.7: Sequential screenshots of SSE method



A.8: MLR technique after feeding the blasting design parameters

LIST OF PUBLICATIONS

1. Paurush, P., Rai, P., & Sharma, S. K. (2021). Selection of Blasting Design Parameters Affecting Peak Particle Velocity—a Case Study. *Mining, Metallurgy & Exploration*, 38(3), 1435-1447.
2. Paurush, P., Rai, P., & Sharma, S. K. (2021). Influence of blast size on the relation between ground peak particle velocity and scaled distance in open pit limestone mines—a case study. *Journal of Mines, Metals and Fuels*, 68(11&12), 354-361.
3. Paurush, Punit and Rai, Piyush, “Identification of blasting design parameters influencing the powder factor- a case study”, Institution of Engineers Series (D), Springer (Submitted after minor revision)
4. Paurush, Punit, Rai, Piyush and Sharma, Suresh Kumar, “Comprehensive evaluation of ground vibration induced by blasting in a limestone quarries” Current Science Journal (Under Review)
5. Paurush, Punit and Rai, Piyush (2021) “Prediction of Peak Particle Velocity induced by Blasting in Surface Limestone Quarry Using the PCA and Multi-Layer Perceptron Based ANN Techniques- A Case Study” 21st GEOMINETECH Annual Symp., New Equipment Technology Management and Safety in Mines and Mineral Based Industries, ENTMS, 23-24 Oct., 2021 Bhubaneswar (Conference Paper).