

Supporting information for

A Model Predicting the Maximum Face Slab Deflection of Concrete-Face Rockfill Dams: Combining Improved Support Vector Machine and Threshold Regression

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Table S1. Summary of Case History Data and Concrete Face Deformation Measurements of 71 In-Service CFRDs

No.	Dams	Country	Construction	H	Foundation and depth	IRS	SF (A/H2)	VR	FD		MP (year)
			Year	(m)					(m)	(%H)	
1	Namgang	Korea	2001	34	R	-	36.2	0.27	0.06	0.17	6
2	LiangHui	China	1997	35.4	G, 25m	VH	8.8	0.23	0.06	0.17	8
3	Meixi	China	1998	41	G, 30m	MH	22.2	-	0.13	0.32	10
4	White Spur	Australia	1989	43	R	VH	2.3	0.22	0.04	0.09	5.9
5	Dongbok	South Korea	1985	44.7	R	VH	3.5	0.27	0.04	0.09	7
6	Tongjiezi	China	1992	48	G, 71m	VH	-	-	0.12	0.25	8
7	Dahe	China	1998	50.8	G, 37m	M	4.1	0.21	0.13	0.25	8
8	Daegok	South Korea	2006	52	R	VH	3.7	0.25	0.01	0.02	1
9	Sungeikou	China	2009	52.1	G, 15.4m	H	10.2	0.2	0.17	0.32	2
10	Jangheung	South Korea	2005	53	R	VH	10.7	0.28	0.03	0.06	1
11	Pichi-Picun Leufu	Argentina	1999	54	G, 28m	M	9.1	0.19	0.16	0.3	8
12	Hanpinzui	China	2006	57	G, 45m	VH	4	0.22	0.13	0.23	5
13	Longxi	China	1990	58.9	G	VH	2.4	0.33	0.19	0.32	7
14	Yongdam	South Korea	2001	70	R	MH	8.8	0.32	0.01	0.01	6
15	Hengshan Dam	China	2006	70.2	G, 72.3m	MH	2.9	0.23	0.18	0.25	5
16	Sancheong (L)	South Korea	2002	70.9	R	VH	6.3	0.27	0.01	0.01	6
17	Cheng ping	China	1989	74.6	R	VH	2.8	0.28	0.19	0.25	10
18	Bastyan	Australia	1983	75	R	VH	3.4	0.23	0.07	0.09	9
19	Mackintosh	Australia	1981	75	R	M-MH	4.9	0.24	0.49	0.65	19
20	Pushi River	China	2012	78.5	R	VH	3.8	0.22	0.12	0.15	2
21	Zeya	China	1998	78.8	R	M-MH	3.7	0.25	0.14	0.18	15
22	Mangrove creek	Australia	1981	80	R	MH	4.5	0.26	0.1	0.13	4
23	Crotty	Australia	1990	83	R	VH	1.9	0.2	0.05	0.06	9
24	Cokal	Turkey	2010	83	R	MH	6.2	0.2	0.15	0.18	2
25	Puclaro	Chile	1999	83	G, 113m	M	2.4	0.2	0.12	0.14	5
26	Sugaroaf	Australia	1979	85	R	MH	11.5	0.3	0.16	0.19	15
27	Sancheong (U)	South Korea	2002	86.9	R	VH	3.1	0.27	0.01	0.01	6
28	Miryang	South Korea	2001	89	R	-	6.8	0.18	0.16	0.18	6
29	Kotmale	Sri Lanka	1984	90	R	MH-VH	7.4	0.27	0.1	0.11	2.5
30	Daao	China	1999	90.2	R	MH	3.6	0.21	0.23	0.25	8
31	Wananxi	China	1995	93.8	R	MH	2	0.26	0.1	0.11	5
32	Murchison	Australia	1982	94	R	VH	1.9	0.23	0.09	0.1	18
33	Xibeikou	China	1989	95	R	MH-VH	3.3	0.28	0.08	0.08	6
34	Panshitou	China	2004	101	G	MH	6	0.22	0.34	0.34	5
35	Nalan	China	2005	109	G, 24.3m	MH	2.9	0.19	0.16	0.15	6
36	Cethana	Australia	1971	110	R	VH	2.5	0.26	0.17	0.16	30

No.	Dams	Country	Construction	H	Foundation	IRS	SF	VR	FD	MP	
37	Glevarad	Iran	2012	110	R	VH	-	0.25	0.25	0.23	3
38	Chahan wushu	China	2009	110	G, 46.7m	VH	3.7	0.17	0.3	0.27	2
39	Miaojia Dam	China	2011	110	G, 48m	VH	2.5	0.2	0.3	0.27	1
40	Duonuo	China	2012	112.5	G, 35m	VH	2.2	0.21	0.23	0.2	2
41	Khao Laem	Thailand	1984	113	R	MH	8.3	0.29	0.13	0.12	14
42	Turimiquire	Venezuela	1982	115	R	MH	2.7	0.32	0.25	0.22	5
43	Potrerrillos	Argentina	2003	116	G, 35m	VH	3.1	0.21	0.3	0.26	6
44	Lower Pieman	Australia	1986	122	R	M	2.5	0.24	0.27	0.22	15
45	Reece	Australia	1986	122	G	VH	-	0.24	0.26	0.21	15
46	Shiroro	Nigeria	1984	125	R	VH	4.2	0.2	0.09	0.07	1.8
47	Cirata	Indonesia	1988	125	R	M-MH	3.9	0.24	0.35	0.28	10
48	Ita	Brazil	1999	125	R	MH- VH	7	0.31	0.51	0.41	4
49	Golillas	Colombia	1978	127	R	VH	0.9	0.24	0.16	0.13	7
50	Yinduzzi	China	2004	129.5	R	MH- VH	2.1	0.21	0.2	0.15	5
51	Shanxi	China	2000	132.5	G, 24m	VH	3.4	0.2	0.2	0.15	6
52	Jiudianxia	China	2008	136	G, 56m	VH	2	0.17	0.84	0.62	3
53	Los Caracoles	Argentina	2009	136	G, 28m	MH	4.5	0.23	0.41	0.3	4
54	Alto Anchicaya	Colombia	1974	140	G, 34m	VH	1.1	0.22	0.16	0.11	10
55	Segredo	Brazil	1993	145	R	MH-VH	4.1	0.37	0.34	0.23	8
56	Salva Hingna	Venezuela	2002	148	R	VH	2.45	0.33	0.1	0.07	13
57	Dongqin	China	2009	149.5	R	VH	3.7	0.19	0.6	0.4	3
58	Mesochora	Greece	1995	150	R	M	1.6	0.23	0.33	0.22	5
59	Xingo	Brazil	1994	150	R, G, 41m	M-VH	6	0.28	0.51	0.34	6
60	Malutang	China	2009	154	R	VH	2.4	0.19	0.28	0.18	3
61	Salvajina	Colombia	1983	154	G, R, 30m	MH-VH	2.4	0.21	0.06	0.04	7.5
62	Zipingou	China	2006	156	R	VH	4.8	0.26	0.25	0.16	6
63	Jilintai	China	2006	157	R	VH	3.1	0.23	0.24	0.15	7
64	Foz do Areia	Brazil	1980	160	R	MH-VH	5.4	0.33	0.78	0.49	20
65	Tankeng	China	2008	162	G, 30m	VH	3.7	-	0.17	0.1	5
66	Tianshenqiao	China	2000	178	R	M-VH	4.9	0.31	1.14	0.64	1.5
67	Hongjiadu	China	2005	179.5	R	VH	2.4	0.2	0.35	0.19	6
68	Sanbanxi	China	2007	185	R	MH	2.5	0.22	0.17	0.1	5
69	Aguamilpa	Mexico	1993	187	R, G	VH	3.9	0.18	0.32	0.17	7
70	Bakun	Malaysia	2007	205	R	VH	2.8	0.2	0.8	0.39	4
71	Shuibuya	China	2007	233	R	VH	2.3	0.22	0.28	0.12	3

Note: H is the dam height; G is the alluvium foundation; R is the rock foundation; IRS is the classification of intact rockfill strength; VH, MH, and M are the unconfined saturation compressive strength of 70–240, 20–70, and 6–20 MPa, respectively; VR is the void ratio; SF is the valley shape factor (A/H^2); A is the upstream slope surface area; FD is the the dam maximum face slab deflection at the measuring time; $FD(\%H)$ is the dam maximum face slab deflection index FD/H ; and MP is the measurement period (the time interval between the completion of the reservoir filling and the measurement time of the deformation).

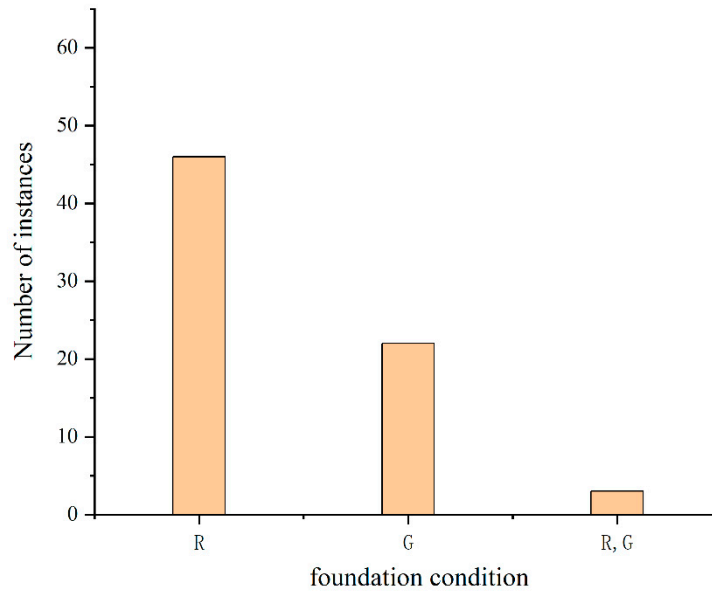


Figure S1. (newly added) Foundation condition statistics

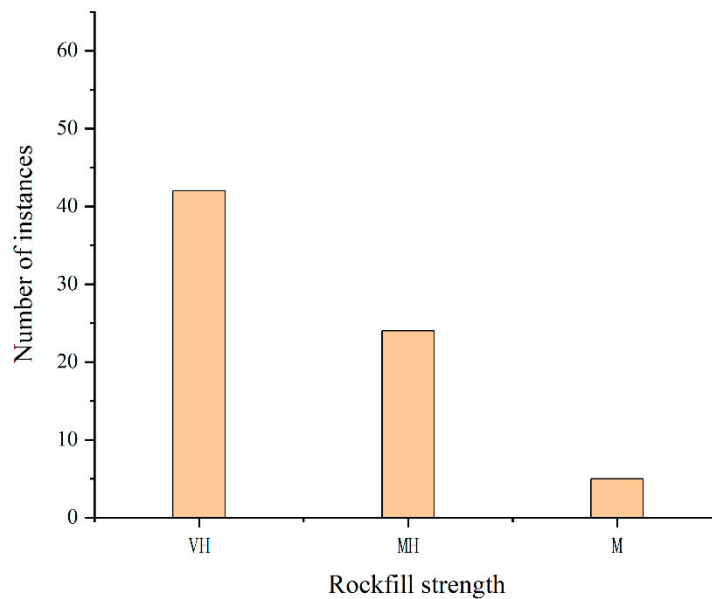


Figure S2. (newly added) Rockfill strength statistics

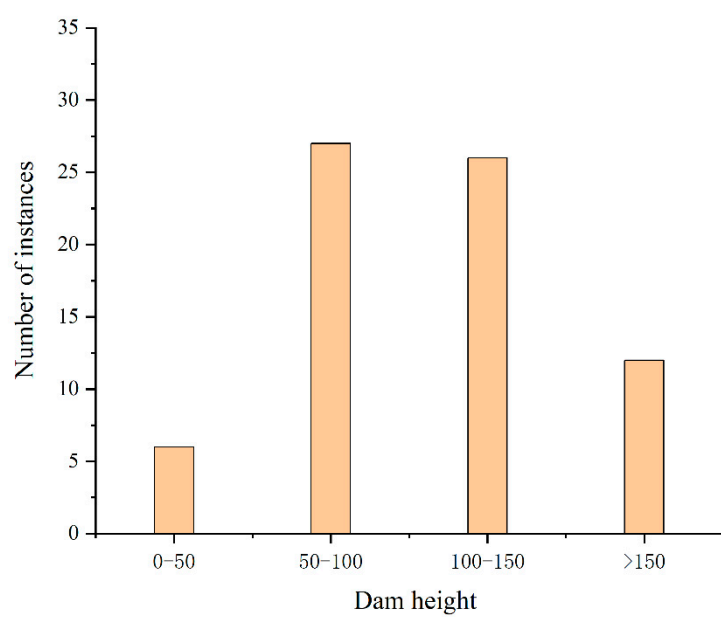


Figure S3. (newly added) Dam height statistics

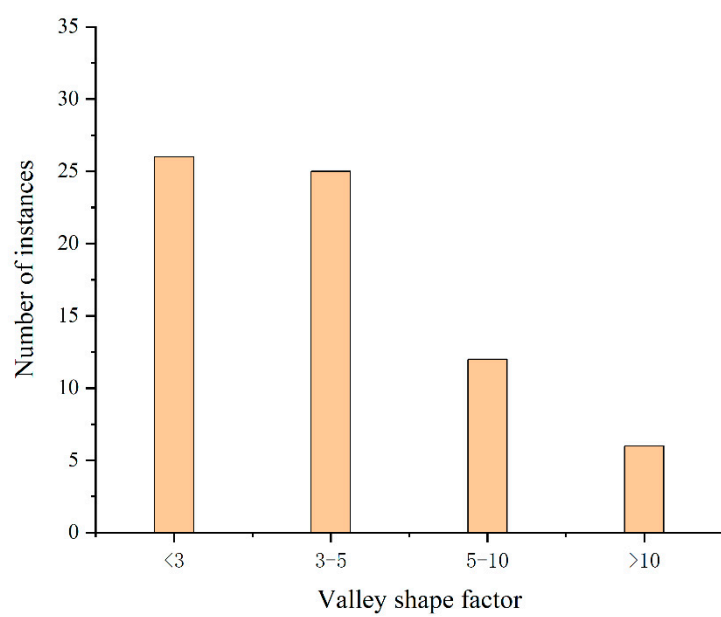


Figure S4. (newly added) Valley shape factor statistics

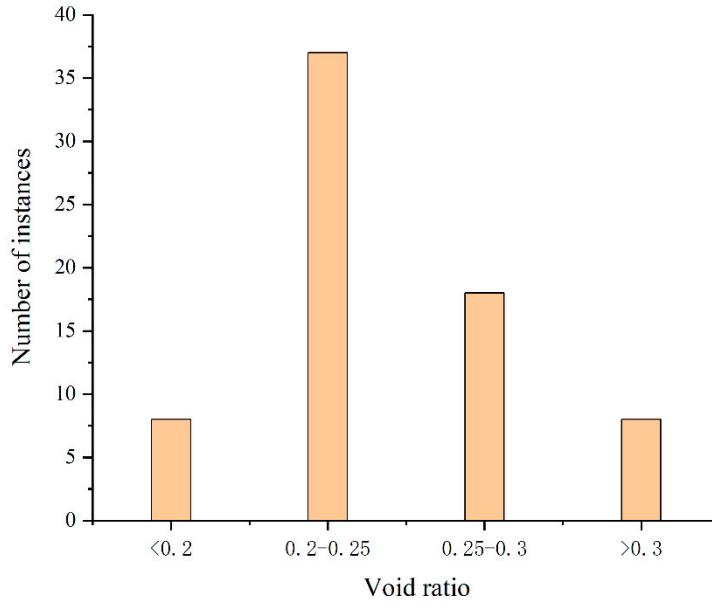


Figure S5. (newly added) Void ratio statistics

Text S1. (newly added) The basic theory of PSO

The basic theory of PSO is the iteration of random particle (random solution) to find the optimal solution. The particle updates its vi velocity and xi position using the following formula:

$$v_{id}^{t+1} = \omega \cdot v_{id}^t + c_1 r_1 (P_{bestid}^t - x_{id}^t) + c_2 r_2 (g_{bestid}^t - x_{id}^t) \quad (3-9)$$

$$x_{id}^{t+1} = x_{id}^t + v_{id}^t \quad (3-10)$$

where:

t — Number of iterations;

ω —inertia factor;

c_1, c_2 —learning factor;

r_1, r_2 —random number within [0,1]

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