

Appendix

Table A2 Material characteristics of expanded clay

Table A3 Performance indicators of the green roof for investigating differences between events with 20-year RP, including 1.4 CF. 16:00-min blocks with 1.0 mm/min intensity, mean rainfall depth = 15.9 mm and std = 0.5 mm for all 35 runs. When no data was available for the inflow, 0 was assigned.

Table A4 Performance indicators of the green roof for events with the same intensity in different durations.

ID	Intensity	Depth	Duration	Number of blocks	Return Period			Return period CF=1.4			Notes
					TRO	OSL	BER	TRO	OSL	BER	
-	[mm/min]	[mm]	[mm:ss]	[-]		[YYYY]		[YYYY]			
TRO 1	1.7	12	07:00	9	200	20 - 25	100	20	5	5 - 10	-
TRO 2	1.0	16	16:00	8	200	5 - 10	100	20	2	5	16 min with 1 mm/min intensity
TRO 2a	1.0	16	16:00	7	200	5 - 10	100	20	2	5	2 min with 2.6 mm/min followed by 14 min with 0.8 mm/min
TRO 2b	1.0	16	16:00	8	200	5 - 10	100	20	2	5	14 min with 0.8 mm/min followed by 2 min with 2.6 mm/min
TRO 2c	1.0	16	16:00	6	200	5 - 10	100	20	2	5	7 min with 0.8 mm/min followed by 2 min with 2.6 mm/min and 7 min with 0.8 mm/min
TRO 2d	1.0	16	16:00	6	200	5 - 10	100	20	2	5	2 min with 2.6 mm/min three times
TRO 3	2.6	9	03:30	9	200	100 - 200	100	20	10	5 - 10	-
TRO 4	0.8	20	26:00	6	200	5 - 10	100	20	2	5	-
OSL 1	1.7	23	16:00	5	>>200	200 - >200	>>200	>200	20	200 - >200	-
OSL 2	1.0	45	44:00	3	>>200	200 - >200	>>200	>200	20	200	-
BER 1	1.7	16	09:00	6	>200	50 - 100	>200	50	5 - 10	20	-
BER 2	1.0	28	23:00	5	>200	20	>200	50	5	20	-

	Unit	Expanded clay 0-6 mm	Method
Particle density	g/cm ³	0.92±0.03	*Porous plate
Particle density	g/cm ³	0.89	Calculated
Bulk density	g/cm ³	0.43±0.00	*Porous plate
Bulk density	g/cm ³	0.39±0.06	**FLL
Porosity	% v/v	53.7±1.5	*Porous plate
Porosity	% v/v	56.2±0.3	**FLL
Wilting point	% v/v	6.5±1.5	*Porous plate
Field capacity	% v/v	9.1±0.5	*Porous plate
Maximum water holding capacity	% v/v	30.1±1.8	**FLL
Hydraulic conductivity	cm/h	105.2±28.3	***Darcy's law

* Porous plate apparatus method, the laboratory of the Norwegian University of Life Sciences in Ås

** (FLL, 2008)

***Flow of a fluid through a porous medium

Starting Outflow [mm/min]	Initial Relative Water content [mm]	Peak Relative water content [mm]	Peak Runoff [mm/min]	Peak Attenuation [-]	T50 [min]	Centroid Delay [min]	Peak Delay [min]
TRO 2: 8x 16:00-min blocks with 1.0 mm/min intensity, mean=16.25, std= -							
0.00	8	23	0.04	96%	492	411	6
0.04	24	38	0.12	88%	79	92	3
0.11	37	48	0.30	70%	30	35	4
0.18	45	54	0.63	38%	13	16	2
0.21	49	56	0.76	25%	10	12	2
0.22	50	57	0.81	20%	10	11	2
0.23	51	58	0.84	17%	9	10	2
0.23	51	58	0.84	17%	9	10	2
TRO 2a: 7x 16:00-min blocks with 1.0 mm/min intensity, mean=15.73, std=0.12							
0.00	10	22	0.03	99%	480	421	20
0.03	24	36	0.10	96%	83	103	17
0.09	37	47	0.29	89%	31	39	16
0.15	44	51	0.48	82%	15	21	16
0.18	48	54	0.62	77%	11	14	15
0.20	51	55	0.67	74%	9	11	15
0.31	54	57	0.74	72%	7	7	15
TRO 2b: 8x 16:00-min blocks with 1.0 mm/min intensity, mean=15.80, std=0.06							
0.00	9	24	0.04	99%	702	483	6
0.03	24	38	0.12	95%	80	93	3
0.10	37	48	0.33	87%	28	34	4
0.18	45	54	0.69	74%	11	15	3
0.21	49	56	0.83	69%	9	11	3
0.28	51	58	0.95	64%	7	8	3
0.40	54	59	1.04	61%	5	6	3
0.74	57	59	1.22	54%	2	2	3
TRO 2c: 6x 16:00-min blocks with 1.0 mm/min intensity, mean=15.75, std=0.04							
0.01	23	38	0.08	97%	113	137	31
0.08	38	51	0.29	89%	33	37	10
0.18	48	58	0.73	72%	10	12	7
0.22	52	60	0.87	66%	8	8	6
0.25	54	61	0.96	63%	7	7	6
0.37	55	61	1.08	59%	5	5	4
TRO 2d: 6x 16:00-min blocks with 1.0 mm/min intensity, mean=16.15, std=1.16							
0.00	13	26	0.04	99%	361	454	3
0.04	28	39	0.12	95%	66	79	2
0.11	40	49	0.32	88%	32	34	3
0.19	47	54	0.62	77%	12	15	2
0.22	51	56	0.71	73%	10	11	2
0.37	54	57	0.81	70%	6	6	2

Starting Outflow	Initial rel. water content	Peak rel. water content	Peak Runoff	Peak Attenuation	T50	Centroid Delay	Peak Delay
[mm/min]	[mm]	[mm]	[mm/min]	[-]	[min]	[min]	[min]
TRO 1: 9x 7:00-min blocks with 1.7 mm/min intensity, mean=12.12, std=0.16							
0.00	2	12	0.01	99%	-	512	17
0.01	14	24	0.04	97%	188	352	6
0.04	25	35	0.10	94%	67	81	3
0.09	35	44	0.20	88%	31	36	2
0.16	44	51	0.47	73%	14	19	3
0.23	49	56	0.76	56%	8	11	2
0.22	50	58	0.78	55%	8	11	2
0.24	51	57	0.85	51%	7	10	3
0.24	52	58	0.88	49%	7	10	3
TRO 2: 8x 16:00-min blocks with 1.0 mm/min intensity, mean=16.25, std= -							
0.00	8	23	0.04	96%	492	411	6
0.04	24	38	0.12	88%	79	92	3
0.11	37	48	0.30	70%	30	35	4
0.18	45	54	0.63	38%	13	16	2
0.21	49	56	0.76	25%	10	12	2
0.22	50	57	0.81	20%	10	11	2
0.23	51	58	0.84	17%	9	10	2
0.23	51	58	0.84	17%	9	10	2
TRO 3: 10x 3:30-minutes blocks with 2.6 mm/min intensity, mean=9.26, std=0.01							
0.01	18	26	0.05	98%	120	176	3
0.04	26	34	0.09	97%	56	65	3
0.08	34	41	0.17	94%	29	33	3
0.14	41	47	0.26	90%	18	22	3
0.18	45	51	0.45	83%	11	14	4
0.18	46	52	0.45	83%	11	14	4
0.18	47	53	0.51	81%	10	13	4
0.19	48	53	0.50	81%	10	12	4
0.19	48	54	0.51	81%	10	12	4
0.32	54	57	0.82	69%	6	7	4
TRO 4: 6x 26:00-min blocks with 0.8 mm/min intensity, mean=19.83, std=0.75							
0.00	3	22	0.04	94%	786	458	5
0.04	22	38	0.15	81%	79	90	3
0.11	35	49	0.38	49%	28	36	3
0.17	42	52	0.52	31%	16	19	2
0.17	44	54	0.56	25%	15	18	2
0.26	50	56	0.67	10%	10	10	2
OSL 1: 6x 16:00-min blocks with 1.7 mm/min intensity, mean=27.79, std=0.14							
0.00	8	33	0.10	94%	246	366	2
0.08	32	52	1.00	42%	25	39	2
0.22	46	58	1.55	11%	8	10	1
0.25	49	60	1.64	5%	8	9	1
0.19	48	61	1.59	11%	8	10	1
0.33	52	62	1.70	2%	7	7	1
OSL 2: 3x 44:00-min blocks with 1.0 mm/min intensity, mean=44.79, std=0.14							
0.00	7	47	0.26	75%	162	281	4
0.12	36	57	0.90	12%	23	35	2
0.20	48	60	1.01	2%	12	13	-2
BER 1: 6x 9:00-min blocks with 1.7 mm/min intensity, mean=15.98, std=0.62							
0.00	9	22	0.03	98%	821	436	17
0.03	24	37	0.10	94%	83	101	3
0.10	37	49	0.30	83%	31	37	4
0.19	46	56	0.92	47%	9	14	2
0.26	51	58	1.19	32%	7	9	2
0.38	54	60	1.40	21%	6	6	2
BER 2: 5x 24:00-min blocks with 1.0 mm/min intensity, mean=23.32, std=0.12 (mean=21.71, std=3.21)							
0.00	14	30	0.07	93%	145	228	5
0.07	30	50	0.44	61%	40	49	3
0.23	44	56	0.85	16%	11	13	2
0.36	49	58	0.95	9%	7	7	1
0.45	51	59	0.98	3%	6	6	1

REFERENCE

FLL 2008 Guidelines for the Planning, Construction and Maintenance of Green Roofing: Green Roofing Guideline. Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau, Landscape, Research, Development & Construction Society, Bonn, Germany.