STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.354	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.092	4-8	0.079

Total Area Contributing (ha) = 0.171

Total Pipe Volume (m³) = 33.322

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	29.000	3.000	9.7	0.016	4.00	0.0	0.600	o	225
1.001	22.000	2.000	11.0	0.018	0.00	0.0	0.600	o	225
1.002	15.000	1.450	10.3	0.000	0.00	0.0	0.600	o	225
1.003	31.000	3.000	10.3	0.022	0.00	0.0	0.600	o	225
1.004	27.500	0.900	30.6	0.055	0.00	0.0	0.600	o	225
1.005	18.500	0.125	148.0	0.000	0.00	0.0	0.600	o	225
1.006	7.500	0.050	150.0	0.060	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	64.03	4.11	97.475	0.016	0.0	0.0	0.0	4.23	168.3	2.8
1.001	63.50	4.21	94.475	0.034	0.0	0.0	0.0	3.97	157.8	5.8
1.002	63.16	4.27	92.475	0.034	0.0	0.0	0.0	4.09	162.7	5.8
1.003	62.47	4.39	91.025	0.056	0.0	0.0	0.0	4.09	162.8	9.5
1.004	61.44	4.59	88.025	0.111	0.0	0.0	0.0	2.38	94.5	18.5
1.005	59.99	4.87	87.125	0.111	0.0	0.0	0.0	1.07	42.6	18.5
1.006	59.42	4.99	87.000	0.171	0.0	0.0	0.0	1.07	42.4	27.5

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)
1.007	44.000	0.100	440.0	0.000	0.00	0.0	0.600	o	600
2.000	44.000	0.100	440.0	0.000	4.00	0.0	0.600	o	600
2.001	2.500	0.006	416.7	0.000	0.00	0.0	0.600	o	600
1.008	44.000	0.275	160.0	0.000	0.00	0.0	0.600	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	56.53	5.63	86.575	0.171	0.0	0.0	0.0	1.15	326.4	27.5
2.000	61.19	4.64	86.581	0.000	0.0	0.0	0.0	1.15	326.4	0.0
2.001	61.01	4.67	86.481	0.000	0.0	0.0	0.0	1.19	335.5	0.0
1.008	53.67	6.34	86.475	0.171	0.0	0.0	0.0	1.03	41.0	27.5

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008		86.800	86.200	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	30.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	120
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	2

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	60
Ratio R	0.354		

Online Controls for Storm

Hydro-Brake Optimum® Manhole: 11, DS/PN: 1.008, Volume (m³): 14.2

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	105
Invert Level (m)	86.475
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.295	4.9
Kick-Flo®	0.636	4.0
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	4.8	1.400	5.8	3.500	8.9	7.500	12.8
0.300	4.9	1.600	6.2	4.000	9.5	8.000	13.2
0.400	4.9	1.800	6.5	4.500	10.1	8.500	13.6
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.0
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.4
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		