

Stage 1 Design

16.12.21

Location: Manchester City Centre

Stage 1 Blue Roof Design, Portugal Street East, Manchester

We have reviewed the information provided for the Portugal Street East Project and would offer the following comments.

- EPG has undertaken calculations based on using the Permavoid system as manufactured by Polypipe Civils Ltd. The calculations will be based on the Critical Duration Storm Event of 100-year storm event with 40% added to peak flows to model Climate Change.
- The FEH calculation methodology has been used for rainfall modelling.
- We have assumed that the area available for the blue roof is equivalent to 80% of the area provided by the engineers/client on drawing C-26-004_P1 Proposed Drainage Blue Roof General Arrangement
- The Permavoid blue roof system is a specialist system with dedicated components that have all been designed to work holistically as a structural attenuation system in conjunction with proposed waterproofing and surface finishes of roofs and podiums. The Permavoid blue roof element is made up of 85mm and 150mm interlocking geocellular units that can be combined to produce deeper attenuation systems (85mm, 150mm, 235mm, 300mm, 450mm, etc.). The Permavoid incorporates high compressive strength and bending resistance within joints to create a horizontal structural 'raft' that is ideal for shallow attenuation of rainwater, particularly within loaded and trafficked areas. The modules have a very high void ratio (95% for 150mm, 92% for 85mm) to achieve highly efficient water storage capacity. The Permavoid components have been specifically designed to work with the blue roof system and includes, Outlets inspection chambers, Overflow inspection chambers, RWP diffuser catchpit chambers, treatment channels and gullies to name but a few.

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- The development has a maximum discharge rate of 22l/s.
- The results for the podium have been tabulated as follows.

	Roof B1	Roof B2	Roof B3
Catchment Area (m²)	710	1035	515
Blue roof Area (m²) (80% total roof area)	408	768	412
Discharge Rate (for 1 in 100 + 40% CC) (l/s)	0.9	0.7	1.8
Attenuation Depth (mm)	150	150	85
Storage Volume (m³)	58.14	109.44	32.22
No of flow control outlets	1	1	1
Flow control rate/outlet (l/s)	0.9	0.9	1.8
Orifice diameter (mm)	35	30	60
H_{max} (m)	0.141	0.131	0.083

- The key principle of the Permavoid blue roof is the SuDS treatment train. The Treatment train as set out in the SuDS Manual (authored by EPG Director Steve Wilson) states that silts and other contamination should be managed at source. Using the RWP catchpits, the outlet and inlet chambers/diffuser units capture silt and treat water at source. This minimises the risk of blockage and by extension the risk of surface flooding.
- Passive irrigation can be introduced to the blue roofs to allow the green roof element to become healthier and have greater access to water. The Permavoid units can contain irrigation cone units and will be wrapped with Permavoid 'W' Wicking Geotextile. Through the use of these Permavoid passive capillary inserts and Permavoid W wicking geotextile, a passive on-demand irrigation system could be provided for landscaped areas proposed on the development. The depth of water in the layer can be controlled such that a pre-determined proportion of the attenuated volume is retained for irrigation. This is easily achieved by either using membrane upstands to create

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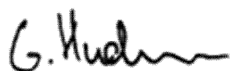
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reservoirs of water locally around the vegetation or by adjusting the discharge level at the outlet. The irrigation volume would be topped up by every rainfall event or routinely from mains or similar. In either case, the key benefits are that the irrigation is on-demand of the vegetation and the irrigation is from below, hence evaporative losses are massively reduced; hence the efficiency is much greater.

- Where the Permavoid is below the 'wicking' depth for the substrate a shallow 'floating' Permavoid passive irrigation layer can be installed at a higher level to the main Permavoid deck to ensure the substrate has a uniform moisture level.
- The Permavoid system has undergone full hydraulic and structural testing, to allow the project engineer and architect(s) to develop the blue roof attenuation system and landscape finishes with confidence.

Trust this is of assistance.

Kind Regards,

A handwritten signature in black ink, appearing to read 'G. Hudson'.

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Client: Polypipe Civils and Green Urbanisation

Project: Portugal Street East

Location: Manchester

Catchment: B1 1in100+40%

Catchment Details:

Buildings	710 m²	x 95 %
Dense surfacing	0 m²	x 90 %
Effective Area	674.5 m²	

Storage Details:

Length	510 m
Width	0.8 m
Depth	0.15 m
Porosity	95 %
Area Increase	0 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity		Required storage(m³)
	mm	mm/h	
5 min	20.2	242.7	13.587
10 min	29.7	177.9	19.856
15 min	37.1	148.4	24.761
30 min	49.5	99.1	32.751
45 min	57.2	76.3	37.523
60 min	63.0	63.0	40.927
2 hours	75.5	37.8	47.499
6 hours	98.1	16.3	54.407
24 hours	130.3	5.4	52.332

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	35 mm
Discharge rate	0.9 l/s

Result:

Outcome	Pass
Critical Storm Duration	10.15 hrs
Hmax	0.141 m
Required Volume	54.712 m³
Time to half empty	8.4 hrs

Client: Polypipe Civils and Green Urbanisation

Project: Portugal Street East

Location: Manchester

Catchment: B2 1in100+40%

Catchment Details:

Buildings	1035 m²	x 95 %
Dense surfacing	0 m²	x 90 %
Effective Area	983.25 m²	

Storage Details:

Length	960 m
Width	0.8 m
Depth	0.15 m
Porosity	95 %
Area Increase	0 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity		Required storage(m³)
	mm	mm/h	
5 min	20.2	242.7	19.850
10 min	29.7	177.9	29.068
15 min	37.1	148.4	36.315
30 min	49.5	99.1	48.283
45 min	57.2	76.3	55.593
60 min	63.0	63.0	60.927
2 hours	75.5	37.8	72.050
6 hours	98.1	16.3	88.650
24 hours	130.3	5.4	95.416

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	30 mm
Discharge rate	0.7 l/s

Result:

Outcome	Pass
Critical Storm Duration	15.75 hrs
Hmax	0.131 m
Required Volume	95.643 m³
Time to half empty	19 hrs

Client: Polypipe Civils and Green Urbanisation

Project: Portugal Street East

Location: Manchester

Catchment: B3 1in100+40%

Catchment Details:

Buildings	515 m²	x 95 %
Dense surfacing	0 m²	x 90 %
Effective Area	489.25 m²	

Storage Details:

Length	515 m
Width	0.8 m
Depth	0.085 m
Porosity	92 %
Area Increase	0 %

Rainfall Details - FEH Method:

Return Period	100 years
Climate Change Factor	40 %

Summer Storm Profile

Duration	Intensity		Required storage(m³)
	mm	mm/h	
5 min	20.2	242.7	9.818
10 min	29.7	177.9	14.264
15 min	37.1	148.4	17.675
30 min	49.5	99.1	22.987
45 min	57.2	76.3	25.916
60 min	63.0	63.0	27.801
2 hours	75.5	37.8	30.217
6 hours	98.1	16.3	31.422
24 hours	130.3	5.4	24.609

Outflow Details:

Infiltration rate	0 m/hr
Attenuation Control	Orifice Plate
Control Diameter	60 mm
Discharge rate	1.8 l/s

Result:

Outcome	Pass
Critical Storm Duration	5.08 hrs
Hmax	0.083 m
Required Volume	31.477 m³
Time to half empty	2.4 hrs