PROPOSED HOUSING DEVELOPMENT

WHARNCLIFFE ARMS
CARLTON
BARNSLEY

PERMEABLE PAVING DESIGN

Updated 08-11-16

HM DESIGN
10 The Green York YO26 5LR 07919 031289

1. INTRODUCTION

A development is proposed at the site of the Wharncliffe Arms of new housing. The development requires a new access road off Dam lane and it is proposed that this access road is adopted by the local authority to become a public highway.

This report provided the background information and design of this road as a permeable pavement. It is intended to provide sufficient information for approval in principle to permeable paving being used on this access road and adopted under a section 38 agreement.

2. HIERARCHY OF SURFACE WATER DISPOSAL

The building regulations provides a requirement that surface water from developments should be disposed of by infiltration, to watercourse or to sewer in that specific order of suitability. In addition, Yorkshire Water want to see evidence that infiltration has been tested for and discounted before they will permit a surface water connection to the public sewerage system. This is particularly pertinent for highway water, as highway has no right of connection to the public sewerage system.

3. INFILTRATION TESTING

A comprehensive testing of the ground for infiltration has been carried out and documented with the Drainage Strategy and Percolation Test Report.

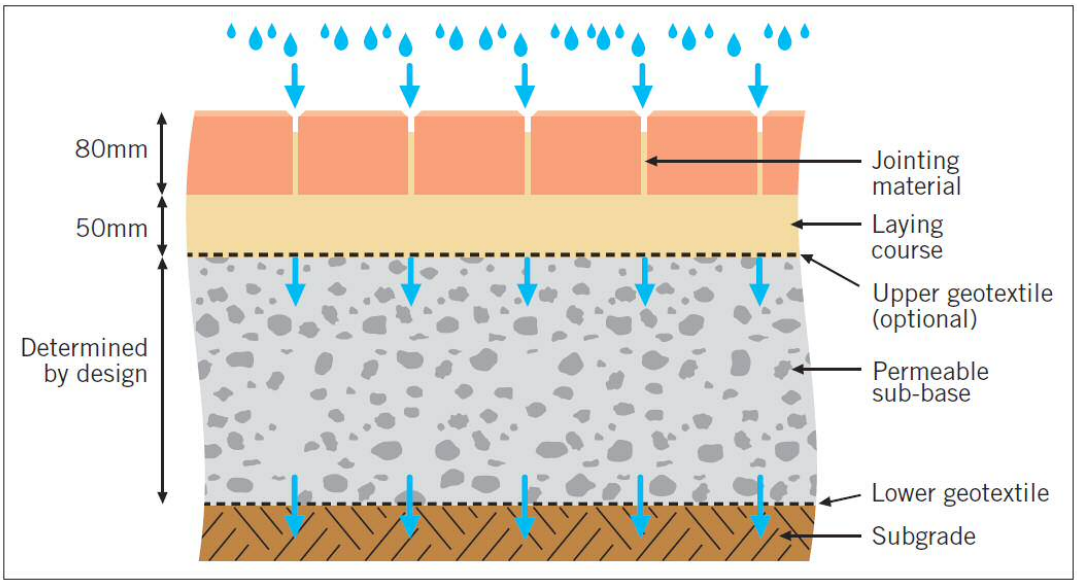
Test holes were excavated down to 1.5m deep for the houses and 0.5m deep for the road. All test holes were dry and above ground water levels.

The testing of two test holes within the proposed road area produced infiltration coefficient values of 0.05 and 0.027 m/hr. These values are suitable for using infiltration as a method of surface water disposal. To standardise the road design, the lower value of 0.027m/hr. The test holes on site had no ground water ingress and were all dry after 24 hours of each test. As such, the ground water is at least 1m below the proposed formation level of the road.

4. PERMEABLE PAVEMENT DESIGN

To design the road pavement the publication 'Guide to the Design and Construction of Concrete Permeable Pavements' published by Interpave will be used.

The total infiltration permeable paving will be used for this scheme, as per the detail below.



The depth of the permeable subbase is determined by the structural and the hydraulic requirements of the site and the traffic category.

Structurally, the pavement needs to be strong enough to support the required use and strengthen the subgrade. Hydraulically it needs to have sufficient storage for a 1 in 100 year storm event plus 30% climate change.

5. PAVEMENT STRUCTURAL DESIGN

From the Interpave publication, the suggested permeable subbase would be 275mm - 300mm thick. This would be made up of a course graded aggregate and a hydraulically bound aggregate. For a residential scheme the road is usually placed first and used as an access to the development. With permeable paving it is important to protect the course graded aggregate from being filled with mud or fines. Therefore, it is required here that the hydraulically bound aggregate is replaced with bituminous base of 130mm.

Immediately prior to the permeable block paving and laying course being constructed, the bituminous layer would be cleaned and then 75mm holes core drilled out on a 750mm orthoginal grid. This allows the bituminous layer to become permeable. The holes should be filled with laying course material.

The standard detail from Barnsley MBC for a block paved road, requires a 50mm bituminous layer above 340mm subbase, giving an overall thickness of 390mm. For the permeable paving it is suggested, for structural strength, that the pavement is 130mm bituminous base (as in the Interpave guidance) with 260mm course aggregate below. Therefore, the overall pavement would be:-

80mm Permeable concrete block paver
50mm Laying course
130mm Dense bitumen road base.
260mm course aggregate.

Geotextile layer on subgrade.

Overall pavement thickness 520mm.

6. PAVEMENT HYDRAULIC DESIGN

The flatter the pavement the better for hydraulic performance. However, it is suggested that a cross fall of 1 in 60 is used.

The long fall of this road is 1 in 24.

The pavement should be capable of storing and allowing infiltration of surface water after a 1 in 100 year plus 30% climate change storm. This is tested using the microdrainage program with the following parameters.

Long fall 1 in 20. Crossfall 1 in 60.
Width of carriageway 5.5m and overall width of highway 6.9m.
Rainfall 19mm
R=0.373

The calculations have been run for 10m lengths of road. This shows that the course aggregate should be increased to 325mm to provide the full capacity of surface water during the 1 in 100 year plus climate change storm.

The microdrainage calculations are attached to the rear of this report.

7. COMPARTMENTS OF COURSE AGGREGATE

Because the road is on a slope, the course aggregate needs to be placed into compartments every 10metres. This should take the form of a concrete check dam, through the course aggregate up to the soffit of the bituminous layer. This will stop the water within the course aggregate migrating to the lowest part of the access road.

8. CONCLUSIONS

- This proposed access road can be constructed satisfactorily in permeable paving.

- The suggested pavement is:-

    - 80mm concrete block pavers
    - 50mm Laying Course
    - 130mm bituminous layer
    - 325mm course aggregate
    - Geotextile Layer

- The preliminary details of the site layout and construction details, for approval by BMBC are provided on drawings YH374/HD/1 and 2.

Report by

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Updated 08-11-16

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Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 72 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	59.665	0.225	0.2	1.0	O K
30 min Summer	59.704	0.264	0.3	1.4	O K
60 min Summer	59.729	0.289	0.3	1.7	O K
120 min Summer	59.742	0.302	0.3	1.8	O K
180 min Summer	59.743	0.303	0.3	1.8	O K
240 min Summer	59.739	0.299	0.3	1.8	O K
360 min Summer	59.727	0.287	0.3	1.6	O K
480 min Summer	59.714	0.274	0.3	1.5	O K
600 min Summer	59.701	0.261	0.3	1.3	O K
720 min Summer	59.689	0.249	0.2	1.2	O K
960 min Summer	59.668	0.228	0.2	1.0	O K
1440 min Summer	59.634	0.194	0.2	0.7	O K
2160 min Summer	59.599	0.159	0.2	0.5	O K
2880 min Summer	59.575	0.135	0.1	0.4	O K
4320 min Summer	59.544	0.104	0.1	0.2	O K
5760 min Summer	59.524	0.084	0.1	0.1	O K
7200 min Summer	59.511	0.071	0.1	0.1	O K
8640 min Summer	59.501	0.061	0.1	0.1	O K
10080 min Summer	59.494	0.054	0.1	0.1	O K
15 min Winter	59.684	0.244	0.2	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	117.218	0.0	17
30 min Summer	78.317	0.0	31
60 min Summer	49.937	0.0	54
120 min Summer	30.767	0.0	86
180 min Summer	22.850	0.0	120
240 min Summer	18.379	0.0	154
360 min Summer	13.462	0.0	222
480 min Summer	10.795	0.0	286
600 min Summer	9.088	0.0	350
720 min Summer	7.892	0.0	412
960 min Summer	6.311	0.0	538
1440 min Summer	4.597	0.0	778
2160 min Summer	3.342	0.0	1128
2880 min Summer	2.662	0.0	1496
4320 min Summer	1.929	0.0	2204
5760 min Summer	1.533	0.0	2936
7200 min Summer	1.281	0.0	3672
8640 min Summer	1.107	0.0	4400
10080 min Summer	0.978	0.0	5080
15 min Winter	117.218	0.0	17

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	59.725	0.285	0.3	1.6	O K
60 min Winter	59.751	0.311	0.3	1.9	O K
120 min Winter	59.762	0.322	0.3	2.1	O K
180 min Winter	59.759	0.319	0.3	2.0	O K
240 min Winter	59.752	0.312	0.3	1.9	O K
360 min Winter	59.733	0.293	0.3	1.7	O K
480 min Winter	59.714	0.274	0.3	1.5	O K
600 min Winter	59.696	0.256	0.3	1.3	O K
720 min Winter	59.679	0.239	0.2	1.1	O K
960 min Winter	59.651	0.211	0.2	0.9	O K
1440 min Winter	59.610	0.170	0.2	0.6	O K
2160 min Winter	59.570	0.130	0.1	0.3	O K
2880 min Winter	59.546	0.106	0.1	0.2	O K
4320 min Winter	59.517	0.077	0.1	0.1	O K
5760 min Winter	59.501	0.061	0.1	0.1	O K
7200 min Winter	59.491	0.051	0.1	0.1	O K
8640 min Winter	59.487	0.047	0.0	0.0	O K
10080 min Winter	59.484	0.044	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.317	0.0	31
60 min Winter	49.937	0.0	58
120 min Winter	30.767	0.0	92
180 min Winter	22.850	0.0	130
240 min Winter	18.379	0.0	166
360 min Winter	13.462	0.0	236
480 min Winter	10.795	0.0	304
600 min Winter	9.088	0.0	368
720 min Winter	7.892	0.0	432
960 min Winter	6.311	0.0	556
1440 min Winter	4.597	0.0	794
2160 min Winter	3.342	0.0	1148
2880 min Winter	2.662	0.0	1500
4320 min Winter	1.929	0.0	2204
5760 min Winter	1.533	0.0	2936
7200 min Winter	1.281	0.0	3608
8640 min Winter	1.107	0.0	4272
10080 min Winter	0.978	0.0	4976

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.007

Time (mins) From:	To:	Area (ha)
0	4	0.007

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Model Details

Storage is Online Cover Level (m) 60.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.02700	Width (m)	5.5
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	22.9	Slope (1:X)	24.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	59.440	Cap Volume Depth (m)	0.310

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