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Project **43 Wells Road, Chilcompton, Wells**	Job No. **20/268**
Calculations for **SOAKAWAY DESIGN**	Sheet no. **1**
Prepared by **JHB**	Date **24 November 2020**

SOAKAWAY DESIGN FOR NEW BUILD DWELLING

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1. INTRODUCTION

These calculations relate to sizing of soakaways to receive flows from the roof of the new house to be constructed on the rear of 43 Wells Road, Chilcompton, Wells.

The impermeable surface area will be 142.8 m^2.

2. OBJECTIVE

The objective of these calculations is to establish the required capacities including dimensions of the soakaways to receive the run off flows from the roof areas (impermeable surfaces).

3. LAYOUT

On the Proposed Site Plan are shown outline details of the proposed dwelling and its location within the curtilage of the development site. The proposed soakaway is planned to be located 5m away from any of the buildings.

4. SOIL INFILTRATIONS

A sub soil investigation to establish a percolation was undertaken on 16th November 2020 in cloudy conditions. A 1.1m wide x 1.2m long x 1.8m deep pit was excavated in the vicinity of the location of the proposed soakaway.
The excavation revealed a sub-strata of clay with rock at the base. The pit was wet prior to the test due to substantial rain in the night and days before.
The pit was filled with water to a depth of 300mm. The water level was checked at 25 minutes, measuring 290mm, 45 minutes, measuring 270mm and 72 minutes, measuring 250mm. Over the time of 72 minutes the water dropped 50mm.
The pit was refilled with water to a depth of 460mm. The water level was observed at 22 minutes, measuring 320mm, and finally at 45 minutes, measuring 230mm. The overall water drop was 230mm.

Adopting the data with the performance of the refilled pit and assuming the loss from the pit was uniform, the infiltration rate 'f' is given by:

$$f = V / (A \times T)$$

Where:

V(m³) - Volume of water lost from the pit is given by:

1.1 x 1.2 x 0.5 = 0.066m³

A(m²) - Surface area through which water was lost from the pit.

Sides: 2(1.1+1.2) x 0.275* = 1.265 ** Average depth of water during time T*
Base: 1.1 x 1.2 = 1.320

Total = 2.585m²

T (seconds)- Time the water was lost from the pit

72minute x 60 = 4320secs

Therefore: f = 0.066/2.585 x 4320= **5.91017x 10^{-6}m/s**

5. SOAKAWAY DESIGN

The soakaway is to comprise a 1.5m deep x 1.0m wide to be surrounded by 100mm clean stone backfill to the working area around the core (95% free volume). The inflow will discharge into one inspection access point, with a pours distributor pipe linking the ends along the top of the granular fill. The calculations to determine the length of the soakaways will be based on the methodology used in the BRE Digest 365 - Soakaway Design (BRE 365) i.e the required storage of the soakaway(s) is the difference between the total volume of inflow and the total volume of outflow for the critical duration of a 1 in 10yr storm event.

Care has been taken to ensure the discharge of the rainwater from the roofs into the soil does not disrupt the existing sub-surface drainage pattern and therefore a trench soakaway system has been designed. The soakaway will be a minimum of 5m away from the building foundations.

a/ Inflow to Soakaway

The inflow 'I' is given by the equation: **I = A X R**

Where:

A - Allowable Impermeable Roof Area
Total Roof Area (impermeable surfaces) = 142.8m²

R - Total Rainfall

Design rainfall is derived from a 1 in 10yr return period event and its critical duration. Determination of the critical duration and its inflow is as follows:

From Fig. 1 in BRE365 the rainfall ratio for, r=0.32.

Utilising Tables 1 & 2 in the digest for factors Z1 & Z2 a table of storm rainfalls for a range of durations and resultant inflows are as follows:

Table A Inflow to Soakaway

Storm Duration 'D' min	**Z1** r=0.32	**M5-Dmin** =20mmxZ1	**Z2** Growth	**M10-Dmin** =R mm	**Inflow (I)** 101 x R m^3
10	0.496	9.92	1.22	12.1024	1.73
30	0.776	15.52	1.24	19.2448	2.75
60	1	20	1.24	24.8	3.54
120	1.236	24.72	1.24	30.6528	4.38
240	1.543	30.86	1.22	37.6492	5.38
360	1.746	34.92	1.2	41.904	5.98
600	2.066	41.32	1.19	49.1708	7.02

b/ Outflow from Soakaway

The outflow 'O' is given by the equation: **$O=a_{s50} \times F \times d$**

Where:

a_{s50} - internal surface area of the soakaway pit, excluding the base area, to 50% of its storage depth. The excavated pit to house the soakaway will be Lm long x 1.5m effective depth x 1.0m wide and therefore the allowable area:

a_{s50}= 2(L*1.5)+ 2(1*1.5) = 3L+3

f - Soil Infiltration Rate = 5.91017x 10^{-6}m/s

D - Storm Duration = D x 60 secs.

Therefore: O = (3L+3) x (5.91017x 10^{-6}m/s) x (D x 60) m^3

c/ Soakaway Storage Volume

The effective volume 'V' of the soakaway with 95% free volume of the stone backfill is given by:

V = {(1.0*1.5*0.95)} x L =1.425L m^3

d/ Calculation of Soakaway Length (L)

The required storage volume of the soakaway for a M10-D min run off is given by the following equation:

Inflow (I) - Outflow (O) = Storage Volume (V)

Inflow (I)* - (3L+3) X (5.91017x 10^{-6}m/s) x (D x 60) = 1.425L * *Value from table A for 'I'*

The results of calculation of the required soakaway lengths 'L' for the various storm durations 'D' considered in Table A, have been tabulated, and are as follows:

Table B
Soakaway Length

Storm Duration Min	Required Soakaway Length 'D' m
10	1.20
30	1.90
60	2.41
120	2.90
240	3.38
360	3.58
600	3.84

The results indicate that the critical duration is around 600 minutes for a 1 in 10yr storm event and the soakaway requires a minimum length of 3.84 meters, say **3.9 metres**

e/ Emptying Half Storage Volume

The time taken for the soakaway to half empty 'ts50' is given by the following:

ts50 = S x 0.5 / as50 x f = ((3.9 x1x1.5) x 0.5) / (3L+2) x (8.72126x 10^{-5}m/s)= 67334.69=**18.7hr**

The time taken is less than 24hrs and therefore satisfactory.

6. CONCLUSION

These calculations show that the soakaway construction as designed to serve the dwelling requires a 3.9m minimum length 1.5m deep x 1.0m wide surrounded by a clean stone backfill to provide the necessary storage for the critical storm duration of 600min.

A 3.9m length trench soakaway would be sufficient to collect the water from the roof areas shown to drain into the Soakaway.

As stated previously all working areas within the soakaway excavations will be backfilled with clean stone and each soakaway will be fed from a 100mm diameter porous pipe originating from a collection chamber receiving flows from the delivery pipework from around the buildings.

APPENDICES

A/ DRAWINGS

(3)001 - Site Drainage Plan