

## General and Safety Notes Building Regulations Approval

Most structural alterations will require Building Control approval and must be examined by a Building Inspector prior to covering up pertinent elements of the works. It is the client's/ client's representative's and contractor's responsibility to ensure that applications and inspections have been carried out.

Design calculations contained herein have been carried out in lieu of prior instruction and meet with previously agreed/ prescribed dimensions. Any variations must be reported to the Engineer.

## Planning Permission

Planning permission may or may not be required in connection with the work described herein, and a suitably qualified architect or planning advisor should be consulted before commencement of work.

## Party Wall Agreements

Prior to carrying out any works within the demise of the Party wall, the client, clients representative &, nominated contractor shall ensure suitable guidance has been sought and that where necessary, a Party wall Notice has been issued and responses received in writing.

## Safety

This information is provided in the expectation that those appointed to carry out the work are suitably qualified and experienced contractors. If there is any doubt about aspects of the specification, the engineer should be contacted before commencement of work on site.

The contractor is expected to ensure full familiarity with the material requirements of this design package. Appropriate works should be pre-arranged to make allowance for the various structural elements and materials specified within this series of calculations.

Excavations in excess of 1.2 metres deep or in unstable ground should not be entered by any person unless a system of shoring or ground support has been installed.

Any variations from the following design should be reported to the Client/ Architect and Engineer for agreement prior to continuation of works..

Any unsafe systems of work, or unsafe site practises should be reported to the Client/ Architect and Engineer.

The above does not mitigate any responsibility as indicated by the Construction, design and management regulations, 2015. It is the responsibility of the Client to ensure the CDM 2015 regulations are applied, where necessary, during the construction phase and that all pre-works have been completed, including the dis-semination of all pertinent information to relevant parties engaged in the proposed works.

## Temporary Support

Installation of beams, lintels or other supporting structures should be undertaken only with the provision of suitable temporary support to the structure above. Attention should be paid to the nature of the supported loads (from the calculations) and the capacity of props, shores and needle beams as appropriate. If in doubt about the requirements, contact the engineer before commencement of work.

## Dimensions etc.

The dimensions given in these documents are for design purposes only and should be checked on site before construction. Beam sizes are given for identification of the section and the span dimension is between centrelines of supports (i.e. neither the length of the beam nor the opening width, unless clearly stated otherwise). Any variations should be reported to the appointed Engineer prior to works being carried out or materials ordered.

The formation of supporting elements, fixings, connections, straps, buckles and permanent supports must be carried out such that they fully replicate the design details contained in this report. Any variations must be reported to the Appointed Engineer.

## **Material Specifications:**

Material grade strengths must be as specified in this design. Failure to adhere to the enclosed specifications shall lead to defects within the finished structure.

## **Finishes:**

Materials should be provided with adequate finish to maximise longevity of structural elements. Steel structural elements must be finished to British Standards, with coating systems designed to meet given environmental conditions. Softwood timbers should be suitably pre-treated to achieve sufficient dimensional stability, whilst being offered long term protection from decay and insect infestation. Concrete, where reinforced, must be provided to the correct grade, with additives where specified and cover to reinforcement within 5mm of the specification given herein.

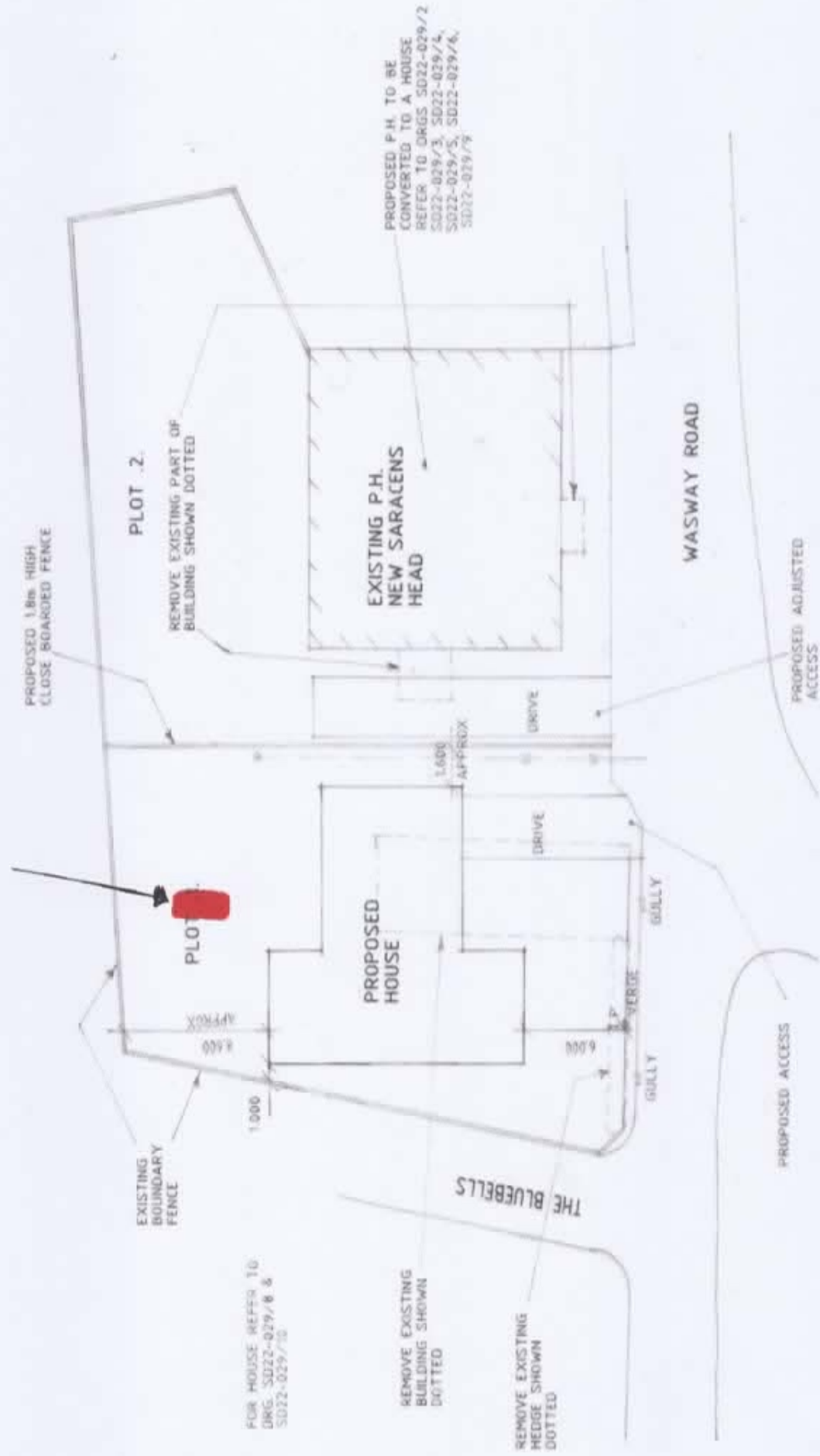
## **Fire:**

Structural elements shall be afforded sufficient protection against fire, meeting the requirements of the building regulations as a minimum.

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# Percolation Test



## **DESIGN RAINFALL (THE WALLINGFORD PROCEDURE)**

### **DESIGN RAINFALL**

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.02

#### **Design rainfall intensity**

|                                                      |                                                        |
|------------------------------------------------------|--------------------------------------------------------|
| Location of catchment area                           | Norwich                                                |
| Storm duration                                       | D = <b>5 min</b>                                       |
| Return period                                        | Period = <b>100 yr</b>                                 |
| Ratio 60 min to 2 day rainfall of 5 yr return period | r = <b>0.410</b>                                       |
| 5-year return period rainfall of 60 minutes duration | M5_60min = <b>20.0 mm</b>                              |
| Increase of rainfall intensity due to global warming | p <sub>climate</sub> = <b>0 %</b>                      |
| Factor Z1 (Wallingford procedure)                    | Z1 = <b>0.38</b>                                       |
| Rainfall for 5min storm with 5 year return period    | M5_5min <sub>i</sub> = Z1 × M5_60min = <b>7.5 mm</b>   |
| Factor Z2 (Wallingford procedure)                    | Z2 = <b>1.85</b>                                       |
| Rainfall for 5min storm with 100 year return period  | M100_5min = Z2 × M5_5min <sub>i</sub> = <b>13.9 mm</b> |
| Design rainfall intensity                            | I <sub>max</sub> = M100_5min / D = <b>167.3 mm/hr</b>  |

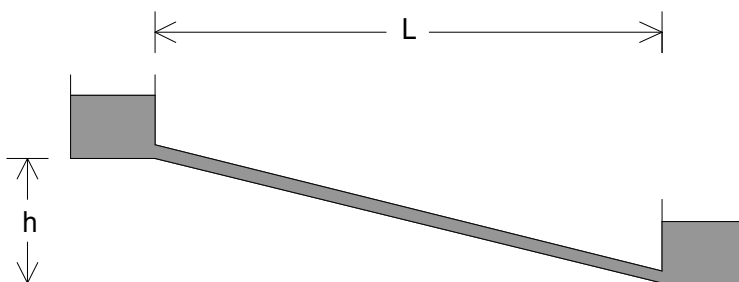
#### **Maximum surface water runoff**

|                                        |                                                                               |
|----------------------------------------|-------------------------------------------------------------------------------|
| Catchment area                         | A <sub>catch</sub> = <b>180 m<sup>2</sup></b>                                 |
| Percentage of area that is impermeable | p = <b>100 %</b>                                                              |
| Maximum surface water runoff           | Q <sub>max</sub> = A <sub>catch</sub> × p × I <sub>max</sub> = <b>8.4 l/s</b> |

## **DRAIN & SEWER DESIGN**

### **DESIGN OF A SURFACE WATER DRAIN**

TEDDS calculation version 1.0.04



#### **Drain design details**

|                              |                                                                   |
|------------------------------|-------------------------------------------------------------------|
| Design flow rate             | Q <sub>design</sub> = <b>8.00×10<sup>-3</sup> m<sup>3</sup>/s</b> |
| Length of the drain          | L = <b>15.0 m</b>                                                 |
| Fall along length of drain   | h = <b>0.100 m</b>                                                |
| Gradient of drain            | i = h / L = <b>0.007 (1 in 150)</b>                               |
| Minimum flow velocity        | V <sub>min</sub> = <b>0.750 m/s</b>                               |
| Minimum pipe diameter        | D <sub>min</sub> = <b>100 mm</b>                                  |
| Surface roughness            | k <sub>s</sub> = <b>0.6 mm</b>                                    |
| Mean hydraulic depth factor  | m = <b>0.25</b>                                                   |
| Kinematic viscosity of fluid | ν = <b>1.31×10<sup>-6</sup> m<sup>2</sup>/s</b>                   |

(Library item Drain design details)

#### Using the Chezy equation

Constant  $c = 56$   
 Diameter of pipe required  $D = ((Q_{\text{design}}^2 \times 16) / (\pi^2 \times m \times c^2 \times i \times 1\text{m/s}^2))^{0.2} = \mathbf{115\text{ mm}}$   
 Nearest pipe diameter  $D_{\text{chezy}} = \mathbf{150\text{ mm}}$   
 Flow velocity using Chezy  $V_{\text{chezy}} = c \times \sqrt{(m \times D_{\text{chezy}} \times i \times 1\text{m/s}^2)} = \mathbf{0.885\text{ m/s}}$

#### Using the Eschritt equation

Diameter of pipe required  $D = (Q_{\text{design}} \times 1000 \times \sqrt{(1/i)} / 0.00035\text{ m}^3/\text{s})^{0.382} \times 1\text{mm} = \mathbf{120\text{ mm}}$   
 Nearest pipe diameter  $D_{\text{eschritt}} = \mathbf{150\text{ mm}}$   
 Flow velocity using Eschritt  $V_{\text{eschritt}} = 26.738 \times (D_{\text{eschritt}} / 1\text{mm})^{0.62} \times 1\text{ m/s} / (\sqrt{(1/i)} \times 60) = \mathbf{0.813\text{ m/s}}$

#### Using the Colebrook-White Equation for pipe running full and partially full

Design pipe diameter  $D_{\text{design}} = \max(D_{\text{chezy}}, D_{\text{eschritt}}, D_{\text{min}}) = \mathbf{150\text{ mm}}$   
 Constant  $Z = \sqrt{(2 \times (g_{\text{acc}} / 1\text{m/s}^2) \times (D_{\text{design}} / 1000\text{mm}) \times i)} = \mathbf{0.140}$   
 Flow velocity  $V_{\text{full}} = -2 \times Z \times \log((k_s / (3.7 \times D_{\text{design}})) + ((2.51 \times v) / (D_{\text{design}} \times Z \times 1\text{m/s}))) \times 1\text{m/s}$   
 $V_{\text{full}} = \mathbf{0.814\text{ m/s}}$   
 Flow rate running full  $Q_{\text{full}} = V_{\text{full}} \times \pi \times D_{\text{design}}^2 / 4 = \mathbf{14.4 \times 10^{-3}\text{ m}^3/\text{s}}$   
**PASS - Maximum flow rate is greater than design flow rate**

#### From Hydraulics Research Tables 35 and 36

Depth as proportion of D  $x = \mathbf{0.533}$   
 Flow velocity at design flow rate  $V_{\text{design}} = \mathbf{0.835\text{ m/s}}$   
**PASS - Design velocity is greater than 0.750 m/s**

## DESIGN OF SOAKAWAYS

### SOAKAWAY DESIGN

#### In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.05

#### Design rainfall intensity

Location of catchment area **Norwich**  
 Impermeable area drained to the system  $A = \mathbf{190.0\text{ m}^2}$   
 Return period **Period = 100 yr**  
 Ratio 60 min to 2 day rainfall of 5 yr return period  $r = \mathbf{0.410}$   
 5-year return period rainfall of 60 minutes duration  $M5_{60\text{min}} = \mathbf{20.0\text{ mm}}$   
 Increase of rainfall intensity due to global warming  $p_{\text{climate}} = \mathbf{20\%}$

#### Soakaway / infiltration trench details

Soakaway type **Rectangular**  
 Minimum depth of pit (below incoming invert)  $d = \mathbf{1035\text{ mm}}$   
 Width of pit  $w = \mathbf{2000\text{ mm}}$   
 Length of pit  $l = \mathbf{10000\text{ mm}}$   
 Percentage free volume  $V_{\text{free}} = \mathbf{50\%}$

#### Soil infiltration rate (BRE digest 365)

Length of trial pit  $l_{\text{trial}} = \mathbf{1500\text{ mm}}$   
 Width of trial pit  $b_{\text{trial}} = \mathbf{1000\text{ mm}}$

|                                                   |                                                                                                                                                     |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Depth of trial pit (below invert)                 | $d_{\text{trial}} = \mathbf{2000 \text{ mm}}$                                                                                                       |
| Free volume (if fill used)                        | $V_{\text{trial}} = \mathbf{100 \%}$                                                                                                                |
| 75% depth of pit                                  | $d_{75} = (d_{\text{trial}} \times 0.75) = \mathbf{1500.00 \text{ mm}}$                                                                             |
| 50% depth of pit                                  | $d_{50} = (d_{\text{trial}} \times 0.50) = \mathbf{1000.00 \text{ mm}}$                                                                             |
| 25% depth of pit                                  | $d_{25} = (d_{\text{trial}} \times 0.25) = \mathbf{500.00 \text{ mm}}$                                                                              |
| Test 1 - time to fall from 75% depth to 25% depth | $T1 = \mathbf{84 \text{ min}}$                                                                                                                      |
| Test 2 - time to fall from 75% depth to 25% depth | $T2 = \mathbf{168 \text{ min}}$                                                                                                                     |
| Test 3 - time to fall from 75% depth to 25% depth | $T3 = \mathbf{300 \text{ min}}$                                                                                                                     |
| Longest time to fall from 75% depth to 25% depth  | $t_g = \max(T1, T2, T3) = \mathbf{300 \text{ min}}$                                                                                                 |
| Storage volume from 75% to 25% depth              | $V_{p75\_25} = (l_{\text{trial}} \times b_{\text{trial}} \times (d_{75} - d_{25})) \times V_{\text{trial}} = \mathbf{1.50 \text{ m}^3}$             |
| Internal surface area to 50% depth                | $a_{p50} = ((l_{\text{trial}} \times b_{\text{trial}}) + (l_{\text{trial}} + b_{\text{trial}}) \times 2 \times d_{50}) = \mathbf{6.50 \text{ m}^2}$ |
| Surface area of soakaway to 50% storage depth     | $A_{s50} = 2 \times (l_{\text{trial}} + b_{\text{trial}}) \times d_{\text{trial}} / 2 = \mathbf{5.000 \text{ m}^2}$                                 |
| Soil infiltration rate                            | $f = V_{p75\_25} / (a_{p50} \times t_g) = \mathbf{12.8 \times 10^{-6} \text{ m/s}}$                                                                 |
| Wetted area of pit 50% full                       | $a_{s50} = l \times d + w \times d = \mathbf{12422878 \text{ mm}^2}$                                                                                |
| <b>Table equations</b>                            |                                                                                                                                                     |
| Inflow (cl.3.3.1)                                 | $I = M100 \times A$                                                                                                                                 |
| Outflow (cl.3.3.2)                                | $O = a_{s50} \times f \times D$                                                                                                                     |
| Storage (cl.3.3.3)                                | $S = I - O$                                                                                                                                         |

| Duration, D (min) | Growth factor Z1 | M5 rainfalls (mm) | Growth factor Z2 | 100 year rainfall, M100 (mm) | Inflow (m³) | Outflow (m³) | Storage required (m³) |
|-------------------|------------------|-------------------|------------------|------------------------------|-------------|--------------|-----------------------|
| 5                 | 0.38             | 9.0               | 1.89             | 17.1                         | 3.24        | 0.05         | 3.19                  |
| 10                | 0.53             | 12.6              | 1.95             | 24.7                         | 4.69        | 0.10         | 4.59                  |
| 15                | 0.64             | 15.3              | 1.99             | 30.4                         | 5.78        | 0.14         | 5.64                  |
| 30                | 0.81             | 19.4              | 2.02             | 39.2                         | 7.45        | 0.29         | 7.16                  |
| 60                | 1.00             | 24.0              | 2.01             | 48.3                         | 9.18        | 0.57         | 8.61                  |
| 120               | 1.20             | 28.9              | 1.98             | 57.2                         | 10.86       | 1.15         | 9.71                  |
| 240               | 1.43             | 34.4              | 1.93             | 66.6                         | 12.65       | 2.29         | 10.35                 |
| 360               | 1.59             | 38.1              | 1.91             | 72.6                         | 13.79       | 3.44         | 10.35                 |
| 600               | 1.77             | 42.4              | 1.87             | 79.3                         | 15.07       | 5.73         | 9.34                  |
| 1440              | 2.20             | 52.8              | 1.79             | 94.6                         | 17.97       | 13.76        | 4.21                  |

|                                           |                                                                                                           |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Required storage volume                   | $S_{\text{req}} = \mathbf{10.35 \text{ m}^3}$                                                             |
| Soakaway storage volume                   | $S_{\text{act}} = l \times d \times w \times V_{\text{free}} = \mathbf{10.35 \text{ m}^3}$                |
|                                           | <b>PASS - Soakaway storage volume</b>                                                                     |
| Time for emptying soakaway to half volume | $t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f) = \mathbf{9\text{hr } 1\text{min } 33\text{s}}$ |
|                                           | <b>PASS - Soakaway discharge time less than or equal to 24 hours</b>                                      |

Apportion Volume to Crates and Rubble

$$C + R = 20.7$$

$$1.0C + 0.3R = 10.35$$

$$C = 10.35 - 0.3R$$

$$10.35 - 0.3R + R = 20.7$$

$$0.7R = 10.35$$

$$R = 14.78 \text{ m}^3$$

$$C + 14.78 = 20.7$$

$$C = 5.92 \text{ m}^3$$

$\therefore$  12 No Crates, each  $0.5 \times 1.0 \times 1.0$   
and  $14.8 \text{ m}^3$  of rubble required

Date:

END  
ELEVATION

~600

1100mm

G.L.

INVERT

GEOTEXTILE

RUBBLE

GEOTEXTILE

1000  
CRATES

1000

2000mm

SIDE  
ELEVATION

~600

1100

INVERT

Geotextile

RUBBLE

GEOTEXTILE

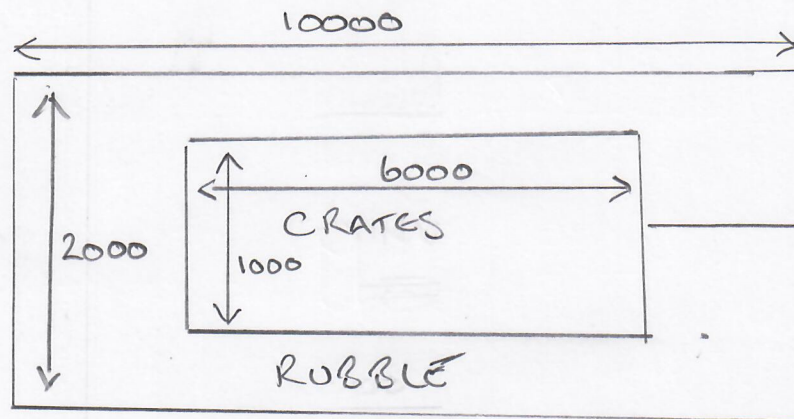
CRATES

6000

10000

Date:

PLAN  
View.



Date: