Dimensioning of soakaways for stormwater infiltration at the EnergyFlexHouse site, Teknologisk institut

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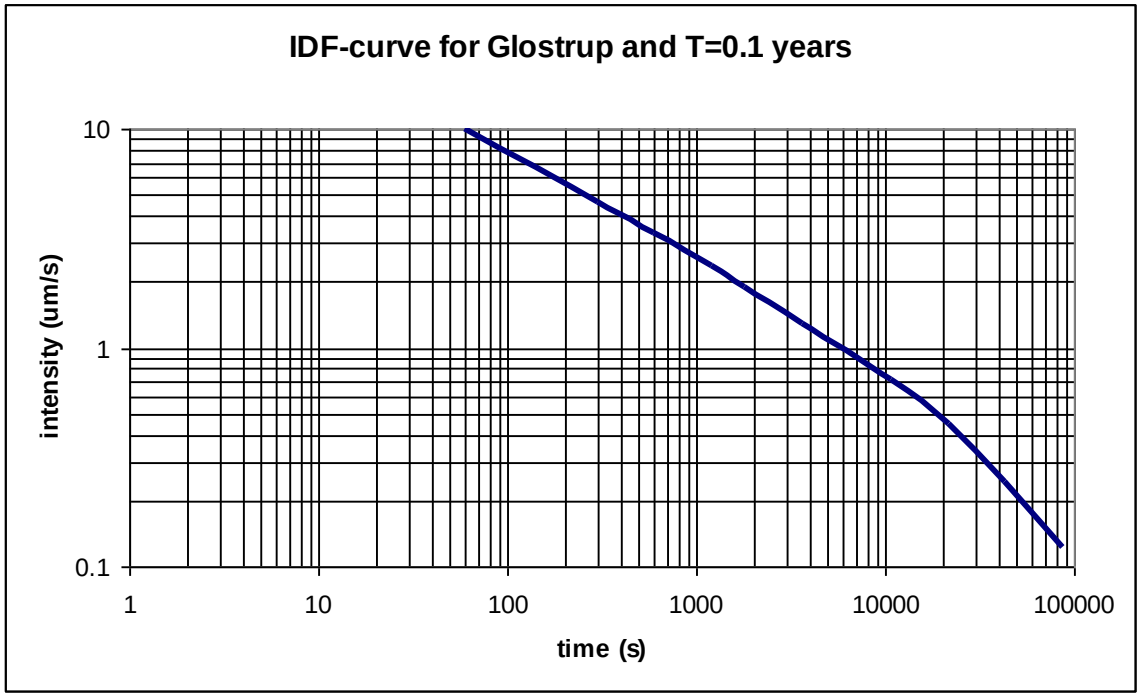
1. Introduction

This document presents the results of a preliminary dimensioning for two soakaways (number 2 and 3) at the EnergyFlexHouse site at Teknologisk Institut. The soakaways are equipped with an overflow structure that leads the water from both soakaways to a nearby rain garden. It is suggested that the rain garden be flooded relatively often, such as for instance once per month. This high overflow frequency is not covered by the general guidelines, which is why a slightly modified method will be used.

2. Method

The basis for the dimensioning is a return period of 0.1 years, corresponding to 10 overflows per year (slightly less than once a month). An IDF (intensity-duration-frequency)-curve for this return period has been created (see figure 1) using rain series from the DMI rain gauge in Glostrup, which is relatively near Taastrup.



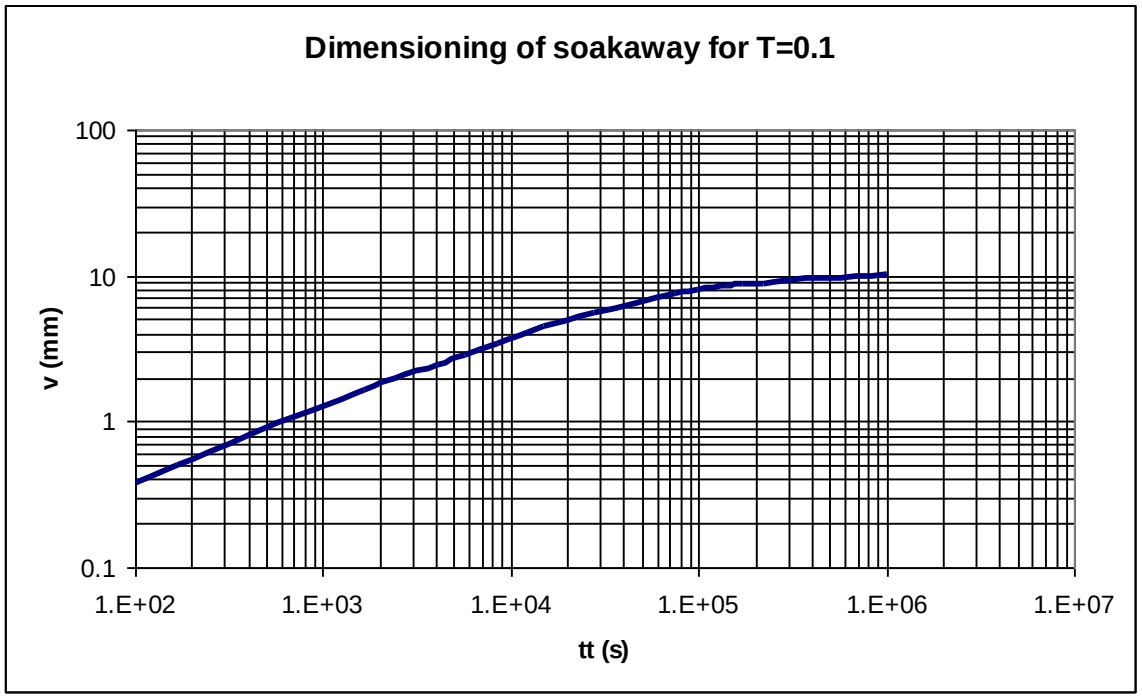
The soakaways are connected to the roofs of the three houses at the site, and the reduced areas for the soakaways are assumed to be 400 m^2 (Soakaway 2) and 625 m^2 (soakaway 3). Porosity of soakaway 2 is assumed to be 0.5 (leca stones) and 0.96 for soakaway 3 (plastic cassettes). Width and height of soakaways are assumed to be the same as in the original document “Håndtering af regnvand” (Rørcentret, 2008).

Based on the IDF-curve, a dimensioning chart similar to what can be found in the document "Nedsivning af regnvand i faskiner" (Rørcentret, 2005) was created (see figure 2). The two main differences are that the curve in figure 2 is based on rain data from Glostrup (not Måløv) and that the return period is different (T=0.1 years). In all other aspects the curves have been created in the same way.

3. Dimensioning

Based on figure 2 below, and assuming that the soakaways can be described as trench soakaways ("rendefaskine") the following results are obtained (see Rørcentret (2005) for details on calculations:

	t_t (s)	v (mm)	A_r (m)	Length (m)
Soakaway 2	$5*10^5$	9.5	400	6.3
Soakaway 3	10^6	10	625	5.4



However, for these lengths it is not evident that the soakaways can be approximated as trench soakaways (i.e.the condition length >> width is not fulfilled). An iteration process, where the estimated lengths are used to calculate a new emptying time, is therefore made based on rectangular soakway formulae (again see Rørcentret (2005) for equations and details). New emptying times are $4.3*10^5$ s and $8.1*10^5$ s respectively, which according to the graph below does not change the result in any significant way. The preliminary results thus give the following dimensions for the soakaways:

	Length (m)	Width (m)	Height (m)	Porosity (-)
Soakaway 2	6.3	1	1.2	0.5
Soakaway 3	5.4	1	1.2	0.96

4. Discussion and conclusions

In order to verify the accuracy of the above dimensioning, simulations with a soakaway model and rain series from Glostrup will be made to see whether the desired overflow frequency criterion is met. Since the infiltration rate and hydraulic conductivity of the soil is highly uncertain, it would be wise to make simulations with other K-values as well to see how much this affects the results. Ideally, more precise measurements of soil properties should have been made, but this has not been possible due to time constraints and the currently very wet conditions on the field site. The plan is therefore at present to carry out simulations with various K-values as soon as possible in order to evaluate the sensitivity of the system to this parameter.

In addition to the above uncertainties, the groundwater level at the site is an aspect important to consider for the dimensioning. Previous measurements with permeameter and boreholes suggest that the groundwater level may be relatively high, at least during certain periods. (1 m below ground or less) This must be taken into consideration when dimenions are made, as the dimensions specify the need of storage volume available for stormwater. For instance, if half of the soakaway is estimated to be filled with groundwater, the soakaway should be twice as long.

Finally it has not been verified that the above method, which is used for general dimensioning of soakaways, can be used for a situation like this with low-permeability soils and frequent overflows. It is for instance likely that overflows will be caused not by a single “big” rain event but by several consecutive rains where the soakaway has not emptied completely between the rains. This is why a simulation with real rain series over a year or more is needed.

With all the above uncertainties in mind, the results from this dimensioning must be treated with care and site specific conditions be taken into account when decisions regarding dimensioning is made.

5. References

Rørcentret (2005): Nedsivning af regnvand i faskiner. Rørcenter-anvisning 009. ISBN: 87-988803-6-5

Rørcentret (2008): FlexHus TI: Håndtering af regnvand sept. 08, rev 071008. Notat af Hanne Jørgensen