

Project of an urban lysimeter at the Union Brewery, Ljubljana, Slovenia

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Abstract: An urban lysimeter was constructed to measure infiltration parameters within a Pleistocene alluvial gravel aquifer in a highly urbanized and industrialized environment. A photograph of the execution of the boreholes, an example of the detailed construction drawings, a sketch of the installed probes and a geological cross-section are presented.

Key words: urban lysimeter, Pleistocene alluvial gravel aquifer, borehole projections, measuring probes

INTRODUCTION

The basic idea was to construct an urban lysimeter and to measure infiltration parameters within a Pleistocene alluvial gravel aquifer in a highly urbanized and industrialized environment. The lysimeter station is located at Union Brewery in Ljubljana (Figure 1).



Figure 1. Location of the Urban Lysimeter

Boreholes were drilled on the left and right side of the 8,5 m deep construction, which has walls reinforced with jet grouting. The jets caused barriers for drilling, so it was necessary to make precise geodetic measurements in order to be able to project boreholes which could meet our demands.

RESULTS AND DISCUSSION

42 boreholes with lengths from 6 to 8 m were drilled at 0.30, 0.60, 1.20, 1.80, 3.00 and 4.00 m depths (measured from the bottom of a 0.66 m thick railway gravel bed, therefore from the initial ground surface). A further six boreholes were drilled under an asphalt surface at depths of 0.60, 1.20 and 1.80 m.

Under the railway track (a seldom used industrial track) six boreholes were drilled at each depth - three for water sampling and three for measurements of physical parameters. Under the asphalt surface only two boreholes were drilled at each of three depths - one for combined sampling/measurements and one for measurements only.

As an example the right upper level line RI is demonstrated in Figure 2. The projection of a series of six boreholes (RI/1-6) is illustrated.

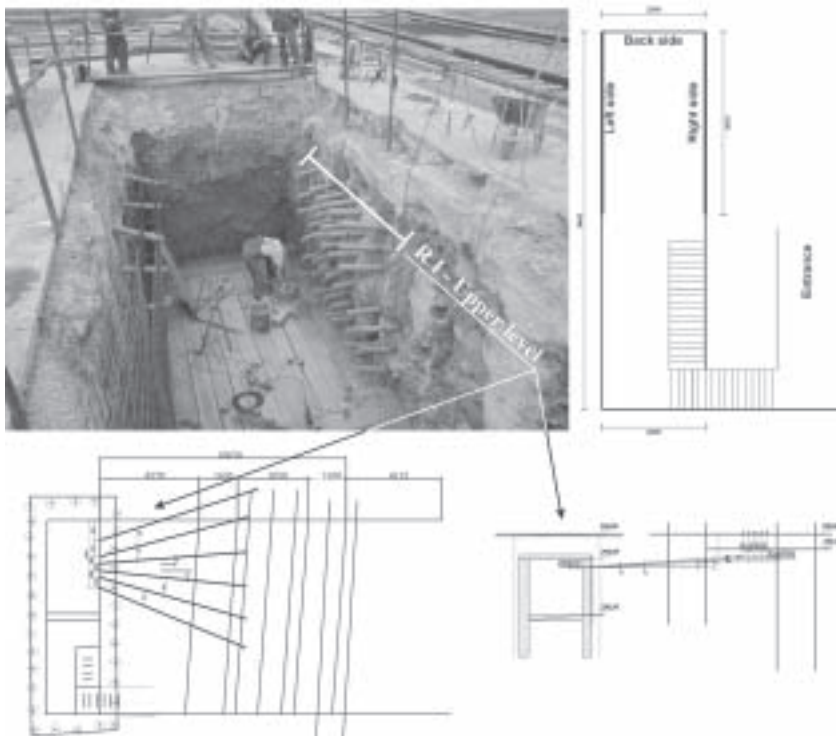


Figure 2: Example of the construction: the upper level boreholes RI/1-6

Before the installation of the probes, the geodetic measurements were repeated to determine the precise position of each measuring or sampling point.

The comparison between the projected and real length, inclination and direction of the upper level boreholes RI/1-6 are shown in Table 2. This demonstrates that with an appropriate

drilling technique, permanent work supervision and most importantly, an exact setting of the drilling unit inclination and direction, it is possible to realize the very precise net of sampling and measurement points, even when boreholes are 6-9 m long.

Table 1. Comparison between projected and real lengths, inclinations and directions of the upper level boreholes RI/1-6

<i>right side</i>		1		2		3		4		5		6	
		A	B	A	B	A	B	A	B	A	B	A	B
R I	length (mm)	6869	7111	6579	6563	6329	6251	6259	6315	6375	6510	6631	6755
	inclination (°)	2,8	4,0	3,0	2,8	3,1	3,2	3,1	4,2	3,1	3,1	2,9	3,1
	direction (°)	18,0	18,0	13,0	15,0	3,0	4,5	-7,0	-6,0	-16,0	-15,8	-25,0	-22,5




The completed urban lysimeter was equipped with a UMS environmental monitoring system. UMS supplied the lysimeter with sensors, a data recording system and a sampling system. As indicated in Table 2, on the right side of the lysimeter each column is equipped with a single type of measuring probe: tensiometers, TDR probes or suction cups. On the left side of the lysimeter three positions contain a twin probe assembly consisting of a tensiometer probe and a suction cup.

Table 2. Position of measuring probes installed in the lysimeter measuring boreholes

<i>right side</i>		1	2	3	4	5	6
0,3	R I						
0,6	R II						
1,2	R III						
1,8	R IV						
3,0	R V						
4,0	R VI						

<i>left side</i>		6	5	4	3	2	1
0,6	L I						
1,2	L II						
1,8	L III						

Legend:

-  - installed tensiometers
 -  - installed TDR probes
 -  - installed suction cups
- 0.3, 0.6, ... - depth from the ground
 4.0 - probes
 R I/1, ... L III/6 - probes

CONCLUSIONS

The construction of the urban lysimeter, which has already been fully equipped, is the first step to the recognition of the role and behaviour of the upper unsaturated groundwater zone in the alluvial gravel aquifer in the highly urbanized environment.

The detailed geological cross-section at the end of the boreholes on the right side of the lysimeter, together with the scheme of the measurement and sampling points, will be very useful for interpretation of the data acquired within the foreseen short and long term monitoring (Figure 3).

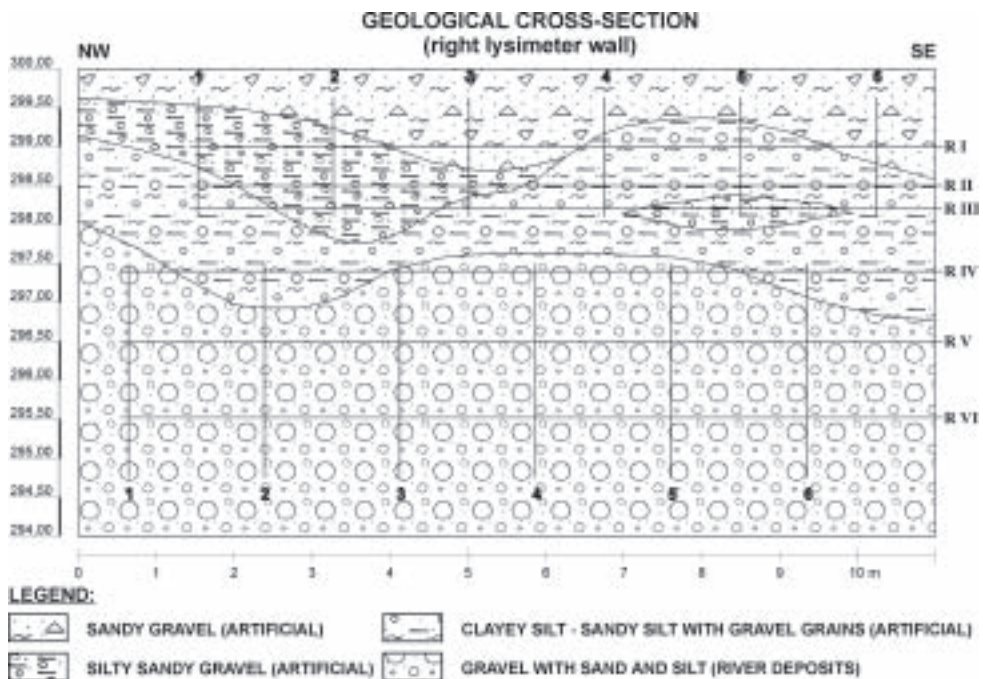


Figure 3. Geological cross-section on the right side of the lysimeter at the end of the boreholes, with scheme of measurement and sampling points

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