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TITLE: CONCEPTION ECOLOGIQUE: VISIONS AND REALITES

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INTRODUCTION

In Germany in the 80's we had a very innovative phase concerning ecological housing and water management. Various experimental projects had been executed including decentralised waste water treatment and reuse. In the early 90's the access to waste water was blocked through the influence of the various lobbies. Fortunately this lobbies did not show much interest in dealing with storm water.

Until the mid-90's, all storm water was treated as contaminated surface runoff and diverted away in drainage systems. Drainage took precedence over infiltration. However, with the amendments in the state water laws, the water resource management objectives became reversed, and decentralised infiltration began to take precedence over drainage.
Storm water management in urban areas is basically subdivided into that for private plots and that for public property, including streets public squares, parks, or other open areas. It is primarily carried out through retention, reuse, and infiltration. Drainage of storm water as wastewater can now be seen as outdated. Storm water management intended to relieve the sewer network, infiltration to enhance groundwater recharge, and on a limited scale, the storm water collection for reuse, are finding increasingly more application in modern development projects.

In recent years new water management and treatment technologies have been developed and demonstrated in projects. This is true especially for singular concepts using either rainwater management technologies or wastewater treatment in different locations. No experience exists in the operation of integrated decentralised installations including the potential for energy generation. The goal of the recently initiated research on ECOSAN (ecological sanitation) is to gain experience in comprehensive design and implementation of singular technologies aiming at quasi-autark concepts requiring only a minimum of public water, waste and energy management services. These concepts should prove to function in different types of settlements and urban structures as well as in various regional conditions and demands.

THE EARLY INTEGRATED WATER CONCEPTS

(1) Project Vijayanagar Steel City, India

The French architect, Roger Anger, designed in 1978 the VIJAYANAGAR STEEL CITY in India, which was to accommodate a work force of up to 250.000 people in a new steel plant.
The city was located in an area that is almost a desert, next to a village that is about 3500 year old and the only source of water was an irrigation channel that flowed nearby.
The architect had visualised a green city as well as a large lake - a tropical beauty with an abundance of water.
The provision of water for this venture proved to be very challenging. To meet the water demand the treated wastewater had to be reused for irrigation within the new city as well as in the ancient village.

During the study of the masterplan all problems of the water supply had been solved, except the problem of hygienization of the treated wastewater.
At that time there was no technical option available to remove the pathogens from the effluent. During that time the German botanist Dr. Kathe Seidle had observed that macrophytes where able to remove pathogens from wastewater and she had designed the first treatment plants using reeds and bullrush.
During five years of research in the Technical University of Berlin the author developed a root zone treatment plant, to treat wastewater up to the EU standards of bathing water quality. The technology became the base for the treatment of wastewater as well as stormwater in the following projects.

(2) Project Broendbystraße 40, Berlin-Lichterfelde

In 1985, the Berlin project “Ökohaus Broendbystraße 40” implemented, among other ecological technologies, a system of storm water harvesting and waste water treatment by means of a clivus multrum compost toilet (for toilet and organic household waste) and a root zone treatment plant for the grey water (10 PE). The treated effluent is reused for irrigation and the balance is discharged into an open water course. This system continues to be successfully operated today with very satisfactory results. (Architects: Ökohaus)

(3) Project IBA Block 6, Berlin-Kreuzberg

Within the framework of the Internationale Bauausstellung (International Housing Exhibition), Berlin 1987, a pilot project in the area of experimental housing and town planning, with a strong ecological emphasis, was to be implemented in Block 6 under the auspices of the Federal Ministry of Regional Policy, Building and Urban Construction (Bundesministerium für Raumordnung, Bauwesen und Städtebau).
The objective of this demonstration project is maximum conservation of water resources through measures of reducing the drinking water consumption and environmental pollution caused by waste water. The rainwater was harvested in a rainwater pond.
The domestic sewage of 73 apartments in this pilot project is pumped from a collector pit outside the building into a root zone treatment plant for biological treatment. Research on the performance of the treatment plant has shown a reduction in the pollution load to below the standards of bathing water quality (of the EC), as well as successful reuse of the effluent for irrigation and toilet flushing. This project has received an award from the President of the Federal Republic of Germany in a national competition. (Landscape Architect: H. Loidl)

STORMWATER HARVESTING AND REUSE PROJECTS IN GERMANY THE DESIGN OF ZERO RUNOFF SETTLEMENT

(4) Project Berliner Straße 88, Berlin-Zehlendorf

In 1992 the construction of project Berliner Straße 88 was begun. The storm water from 160 housing units is collected in three cisterns making up a total storage capacity of 650 m³. The water is then reused for irrigation. The runoff is discharge into an artificial water course and a storm water pond of 1.000 m² (1.500 m³, max, depth 3 m). The pond water is recycled through the water course by solar and wind energy and continuously cleaned in a root zone treatment plant (the water percolates horizontally to the rootzone of a 1 m depth reed bed). The excess water is infiltrated through ground water recharge units. No storm water leaves the premises. (Landscape Architect: U. Grünberg)

Project Schweriner Hof, Berlin-Hellersdorf

This project was recognised as an exemplary model of an ecological project in the Habitat II Conference in Istanbul in 1996. The storm water runoff from the roofs is stored in a 600 m³ cistern and reused for irrigation and for the regulation of a rain water pond.
The external water, as well as the surface runoff, is infiltrated through an infiltration trench system into the ground, which was actually declared to be unfit for infiltration. (Landscape Architect: H. Loidl)

(5) Project Landsberger Tor, Berlin-Marzahn

In this large project (30 ha, 1.800 units), the storm water runoff from the roofs is infiltrated into an infiltration trench system. The storm water runoff from the roads is collected in a conventional storm water drain and discharged into a storm water treatment and infiltration facility, located in a public park. The facility consists of a separate unit for mechanical treatment, a rain water lake, and a root zone treatment plant for the biological treatment. The outflow is infiltrated through ditches. The total surface area of the facility is 5.000 m². The project design is the outcome of an international competition. (Landscape Architect: Gruppe F)

(6) Project "Teltow-Mühlendorf"

This project area is 29 ha, comprising 1.800 housing units. (Architect: Zeidler Roberts Partnership)

Terrain Modelling

This newly developed concept assumes that all of the storm water and the necessary excavation is to stay on the project site. Using the displaced earth (250 000 m³), the terrain has been modelled so that the surface water can be diverted to a centrally located pond, resulting in a rise of about 1 m in the ground level in the centre of the project. A considerable environmental stress has been prevented by not hauling away the excavated earth, which would have require approx. 25 000 truck loads.

Storm Water Disposal for Traffic Ways

The major goal of this design is to minimise the interference of the natural water regime within the project area. In spite of the high percentage of paved and otherwise sealed areas, the precipitation remains within the boundaries of the project. The storm water runoff from sidewalks, bicycle paths, parking lanes, pedestrian walkways, green areas and playgrounds is conveyed to the subsoil through local infiltration. The runoff from the streets is intercepted in lateral gutters and conveyed to three storm water purification facilities and, after being extensively biologically treated, fed to a central storm water pond. Surplus storm water is infiltrated when complete filling of the pond forces water over the edge into infiltration trenches located in the banks. The overflow is also biologically treated prior to the infiltration in vegetated filters.

Storm Water Disposal on Residential Lots

The precipitation from all rooftops is stored in cisterns and from there made available to the residents to be used as non-potable water substitution. The surplus water is to be led to infiltration trenches. The pond water will be circulated through four natural-looking channels (flowing brooks), which run through the residential areas. The resulting cooling effect on the immediate surroundings, as well as the enhancement of the living conditions through simultaneous aeration of the lake, are the primary goals of the design concept.

Summary of Technical Data

Catchment Area	**A [in ha]**	**Precipitation* [in m³/yr.]**
Size of Project Area (approx.):	27,9	163.634
Area covered by streets	5,8	33.841
Including:		
Bicycle paths and sidewalks	1,9	10.909
Street greenery	0,7	3.812
Public streets	3,8	22.404
Private streets	2,0	11.437
Roof area	4,5	26.393
Open areas (public parks)	1,6	9.091
Open areas (private)	16,1	94.309

Project Data	**Quantity Unit**
Inhabitants:	3.000
Living units	1.850
Infiltration trench length (not including bank of pond)	9.000 m
public	6.000 m
private	3.000 m
Cistern volume	4.500 m³
Non-potable water capacity	290 m³/h
Volume of lake	23.000 m³
Surface area of lake	8.600 m²
Surface of rootzone treatment facilities	1500 m²

*...average year

(7) Project "Former Airfield Böblingen-Sindelfingen"

In this 85 ha project, the entire storm water runoff is proposed to be collected, treated and reused as a substitute for drinking water used in recreation, irrigation, toilet flushing, washing machines and still further uses where drinking water quality is not required. The excess water is discharged to a river bed.
The basic aim here is that all of the storm water will be reused within the project area. (Architect: Mory Osterwalder Vielmo, Landscape Architect: Kienle)

(8) Project " Südlicher Mittelpfad" MTC DaimlerChrysler AG

In the city of Sindelfingen 40.000 people are employed by DaimlerChrysler AG to produce 4.000 cars daily. In the Mercedes-Benz-Technology-Centre (MTC) 6.500 designers and technicians are working on the development of new cars.
The company plans to expand the MTC over an area of 26,9 ha including the construction of new buildings with 250.000 m² floor area and to employ up to 4.000 new staff. Based on the Town Development Plan designed by the architects Mory Osterwalder Vielmo and the landscape architect Kienle only 9,4 ha will be built-up and the remaining 17,5 ha will be a landscaped park.
It is proposed to undertake the following ecological measures that include the harvesting of the entire runoff from the roads, yards and roofs, including a major public road, treating it with natural treatment methods and to create a new large lake of 1 ha in the proposed park.
The surplus of treated water shall be pumped over a hill to feed a drying riverlet.

THE PRESENT DESIGN OF ECOLOGICAL SANITATION

(9) Project B31, Reinbek – "Living Space"

The project area of 4,2 ha offers the space for about 200 people in 40 - 50 flats. (Architect N. Roderjan, Landscape Architect: R. Herms)

The project will demonstrate new concepts, technologies and products for minimising wastewater, separation of faeces, urine and water and reusing treated wastewater. Furthermore the potentials of reuse of rainwater can be demonstrated. The decentralised generation of electricity and heat will include the use of organic wastes and leftover wood from logging activities.

The project comprises of the following elements:

1. Drinking water supply by rehabilitating the existing deep ground water well on the site,
2. Minimising wastewater by modern sanitation technologies (separation toilets, dry toilets, separation of urine and faeces, urine will be used for soil improvement)
3. Remaining wastewater being treated at the treatment plant on the project site (anaerobic treatment of sludge, rootzone treatment) for reuse in irrigation.
4. Rainwater run-off collected in a pond and in a balancing tank for drinking water substitution for toilet flushing, washing machines and for groundwater recharge.
5. Anaerobic treatment of organic waste, use of methane gas and sludge from waste water treatment for energy production.
6. Block heating and power generating plant that produces energy from renewable resources (methane gas, wood pellets, solar energy)

(10) Project "International City of Auroville", India

The International City of Auroville is designed by the French Architect Roger Anger.
This township is to inhabit 50.000 people within a circular area with a diameter of 2,5 km, and be surrounded by a 1,25 km wide greenbelt.
The geographic centre of the township is located on a gentle hill, 52 m above sea level, 5 km from the coast of the Andaman Sea, and 200 km south of Madras. When the first settlers arrived, the hill was devastated by centuries of deforestation. Huge gullies had been caved out. The land had been cleared

and the red earth was exposed to the torrential monsoon rains. The construction of Auroville began in the centre, which is to be created into a park with a spherical building, 30 m in diameter, an amphitheatre, and an old banian tree surrounded by a large lake. In the early 1970’s, the place was not fit for human life, with no shade and no water. The first settlers had to control the erosion by “bunding” and reforestation, as well as provide the basic infrastructure and water supply. This has just recently been achieved. In the meantime, the population in the surrounding areas has grown, along with their ability to extract groundwater.

Since the early 1990’s, sea water intrusion into the coastal aquifers has been reported.

Under this threat, an alternative water management scheme was developed by the author in 1992 in order to safeguard the very existence of the city. It is planned to base the entire water supply on the precipitation. The rain water is to be harvested from the roofs and stored in cisterns. The remaining surface runoff, including that from the roads, is to be captured and stored in large reservoirs within the greenbelt. After purification, it will be lifted up to the large central lake. After further purification in the lake, the overflow will be infiltrated beneath the park into the first aquifer which lies above sea level. From there, the water can be tapped by wells throughout the city. The harvested storm water is not sufficient to meet the full demand for irrigation.

Therefore, the entire waste water has to be treated to meet bathing water quality standards and reused for the irrigation of agricultural lands within the greenbelt.

THE FUTURE

The present development is towards the autarcic building in a city without sewers and pipes.

The future buildings and cities shall be designed by architects with a vision. The realisation of these visions shall be the task of the engineers.

The materialisation of these visions require politicians, mayors and developers who can visualise the future and who can make it become a reality.