Rotterdam: Dynamic Polder City = Land + Water + Culture

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Abstract

The planning culture in the Netherlands is based on the experience of building cities on very wet and soft soils. The design of Dutch polder cities was from early on a balance between land and water: building site preparation. The relation between technological development and urban development can be ordered in six phases: natural (-1000), defensive (1000-1500), offensive (1500-1800), early manipulative (1800-1890), manipulative (1890-1990) and adaptive manipulative water management (1990-). Rotterdam is chosen to represent the heritage of the Dutch talent with regard to the design and construction of water and land into dynamic cities. This is important because awareness and knowledge about historical principles makes it possible to draw the line into the future.

Keywords: planning culture, water management, building site preparation, Rotterdam

1. Introduction

“God created the world, but the Dutch created Holland”. The Dutch have a rich and internationally renowned ‘fine tradition’ when it comes to the intense relationship between urban development and civil engineering. Their expertise and knowledge of hydrological laws and ingenious technology have helped them successfully to make land out of water: polders. The dynamics of the regional water system, which include groundwater and rainwater in combination with surface water, is crucial for the process of development and urbanisation of the Dutch polders. The Dutch cities are hydrological constructions, with a spatial layout that is strongly connected to the division of land and water: building site preparation. The relation between technical efficiency and the specific characteristics of the territory and from that the way cities and landscapes are designed is different in each era.

In the post-war era the characteristics of the territory are altered with the use of far stretched technology and the landscape and cities are designed with a high degree of rationality. The natural conditions of the territory are made subordinate to the thriving
principle of the man made culture, in Dutch the *Maakbaarheids* (man-made) principle. Technology can make everything, but is however very inflexible to changes. The current climate change puts pressure on the hydrological system and the technical part of that system can not go with the change. More and severe rainstorms, high temperatures and drought are very influential on the hydrological system: rivers flood or dry up and cities are flooded by rainstorms. In Rotterdam both threats are present; that is why a lot of attention is paid to the subject and even a climate director is installed. However, to be better equipped to handle the hydrological changes a clear view is necessary on the relation between the professions that are responsible for building on wet and soft soil and balance out land and water: civil engineering and urban design.

The different ways to deal with the conditions of the territory, the landscape as carrier of the hydrological system, to prepare it for building cities, have never been systematically investigated. The main gap is formed by the total lack of attention towards the fact that the Dutch have built their cities on wet and soft soil, very inconvenient for building, probably because it is so self-evident for the Dutch. About building site preparation only one publication is available, Segeren and Hengeveld (1984), which also states that a lot research is still to be done. The most important reference about water cities is written by Gerald L. Burke, *The making of Dutch towns* (1956) that offers a systematic typology of water cities, unfortunately only till 1700.

Rotterdam is an interesting case study to investigate the relation between the urban design (the culture) and the wet circumstances of the territory (balance between land and water). This is necessary because awareness and knowledge about historical principles makes it possible to draw the line into the future. The Dutch heritage and future is based on the relation between land and water, nature and culture; it determined the construction of the landscape and cities, the technology, the culture and prosperity.

This paper analyses urban expansions from different phases based on Van der Ham (2002, 31) whom defined these for the landscape and therefore altered for urban developments in: natural water management (until 1000), defensive water management (1000-1500), offensive water management (1500-1800), early manipulative water management (1800-1890), manipulative water management (1890-1990) and adaptive manipulative water management (1990 until today). For each phase a case study in Rotterdam is chosen to show the relation between land and water and how this influenced the urban development and how this can be formulated into a principle that offers a critical perspective onto the future.
2. Natural, defensive and offensive water management (-1800)

Until the eight century, the Dutch lowlands were uninhabitable marshlands where the forces of water and wind had free reign. How people dealt with the wet surroundings was by accepting the existing situation and adapting ways of living with it. Van Ham described this period of time until the year 1000 as being distinguished by ‘natural water management’, as nature ruled over culture (Van der Ham 2002). There were small initiatives to control the natural landscape by digging drainage ditches to grow crops in the fields, but for the people living in the lower Delta there were no means of protection from the water. This was mainly due to the lack of a community, people were living in small flocks together have little power in changing the natural conditions.

The Frisians were an exception: they were more organized (in for example fighting the Vikings) and did make an alteration to nature for their benefit: moulds. This first form of preparation for building sites in Friesland began from 900 A.C. The mounds were intended as refuges in times of high tides and the first buildings on them were the churches, as symbol of community, later they became larger and settlements arose.

All settlements in the Netherlands started on higher ground, along rivers, the sandy ridges at the coast and on the geestgrond [sandy soil between dunes and polder]. Settlements expanded in the eighth and ninth centuries for military, and later economic, reasons. Towns, or, more accurately, villages, were created on economic routes and military boundary lines.

Figure 1 The development of Rotterdam, 1000, 1340 and 1500 (Source: Atlas of Dutch Water Cities)

The physical characteristics of the settlements during the time of natural water management have two important spatial characteristics. First the situation of the settlements takes into account the most geographically convenient physical circumstances in the region. Secondly this location must be close to the water, but the water must not be part of the layout of the settlement (since that would make the settlement more vulnerable).

Van Ham placed the change in attitude from natural water management to defensive water management around the year 1000, when the dike was introduced as means of protection (Van der Ham 2002). This new technology directly affected the location and establishment of settlements. The situation of the settlements and their physical-geographical circumstances could be altered to facilitate living and the dike enabled water, in the form
of a harbour, to be introduced into the settlement. Many dike and dam cities were set up in the thirteenth and fourteenth centuries and the sites were prepared for building by raising them with debris.

2.1 Dam city

The conceptually most interesting type of water city of the defensive phase is the dam city, like Rotterdam, because of its integration of technological intervention with economical and social structures. Figure 1 is showing the development of Rotterdam. The first picture is around the year 1000; the peat area along the Maas and the Rotte is still under free reign of the water. The first mentioning of the settlement ‘Rotta’ is in 1028, but there were people living on the banks of the peat river Rotte, where it flows into the river Maas, centuries before that. In the second half of the eleventh century the first dike ring is built, but it does not offer the enough protection and the settlement Rotta is lost. In an article about the Rotte and its first settlement, Guiran studied the soil build up and proved that in the first half of the twelfth century people had already started to use piles and mats of woven ash wood to prepare sites for building (Guiran 2004, 91-97).

Around 1270 probably already the third dike ring is built (the Schielands Hogezeedijk), and there where it crossed the river Rotte the dam was constructed (Van der Schoor 1999, 21). Dam cities were established in the most rewarding places where smaller rivers flowed into a larger river. The dike at these points was the most important requirement for the creation of towns in the polders, because soil compaction and subsidence made these areas vulnerable to flooding. The dam had a water defence function, but with a drainage sluice it also took care of discharging river water from the smaller river onto open water. A combination of the scouring effect of the sluice water and the tidal movement were cleverly used to maintain the harbour at the correct depth and make the town accessible to seagoing ships.

The economic importance of water transport between the sea and the hinterland was embodied in the dam with its drainage sluice; these became the heart of the city. The drainage sluice was able to accommodate only relatively small ships, and the cargo from larger ships had to be transferred or traded on the dam. The dam would become a market, and the peat river estuary outside the dike a sheltered harbour. The dam town and the polder were therefore bound closely together, not only hydrological but also economical and social. In Rotterdam the spatial expression of this were the building of the central social venues on the Middeldam like the city hall and the house of the Count of Holland (Van der Schoor 1999, 21).
The principle of natural and defensive water management that offers a critical perspective onto the future is: adaptation. Living with nature offers quality and beauty that is maybe passed by in trusting in technology.

2.2 Polder city and *Waterstad*

The technology that marks the transformation to the next phase of offensive water management is the windmill that came into use on a larger scale around 1500. This phase is characterized by a new, pro-active, attitude towards the water: people started to develop technologies to control the water management conditions. With this new mechanism larger volumes of water could be moved and a more effective method was offered to keep larger scale areas and the cities dry. The availability of the new hydrological instruments, besides the mill also sluices and dams were built, changes the approach towards the water from defensive to offensive: The power of unity. This unity was also socially underpinned by the establishment of the Republic of Seven United Provinces and its army: the place where knowledge about wet and soft soils was developed. The power of unity represents the power of scale enlargement in society, city and water system; the protection from a plot grows into the protection of a polder, the protection of a polder into the control of rivers. The phase of offensive water management is the phase of the polder city, the literal representation of the power of unity.

The settlements of the two first phases, mould, river, coast, burcht, *geestgrond* (sandy soil between dunes and polder), dike, and dam towns, form the first important characteristic of the polder city: the higher levelled ‘dry core’ on which the settlement started. Prosperity and growth led to expansion of the surrounding wet soil, derived from peat or already prepared for cultivation, but not yet prepared to be built upon (Burke 1956).

Of the various dry cores on which the peat polder cities were developed, the dam town is the most meaningful. One could say that dike residents, who lived alongside a peat bog and controlled the water by building a dam together, were conceptually ahead of the peat polder cities. This is where the second important spatial characteristic can be seen: the need for ‘strict control’ as the result of the cautiousness with which an expansion of the polder city needed to be realised. First, the size of the expansion needed to be determined, which did not only need to comply with the requirements of that time, but for centuries to come as well. The second aspect was a technical plan in order to ensure that water could be discharged and controlled, and that the water in city canals would stay at a constant level. In most cases the start was initiated by building an encircling canal (outer canal), which was connected through the expansion area by means of a sequence of parallel canals. The outer canal was primarily built for drainage, but also had a military or defensive function and a transport function (access to warehouses) (Burke 1956). By means of sluices and
windmills the water level of the canal system was regulated and the excess water discharged. Then, the reclaimed land needed to be raised in order to obtain the required protection level, and it had to be consolidated and prepared for building. Mud excavated from the canals was used for raising the level, and was supplemented by ground, which often needed to be transported from far away. In the ground long foundation piles were driven in order to stabilise the housing in the deep-set stratum of sand.

In Rotterdam since the mid-thirteenth century a dike stretched out along the Hoogstraat (high street) with a dam in the Rotte providing the settlement with the name. The Rotte and the dam came under the control of the Water Board of Schieland that was established in the thirteenth century (Peilbesluit). Before the advent of the windmill the polder boards could only use direct discharge into the river to keep the water in the polders at the most convenient level for growing crop. This had a great influence on the way the city developed because the discharge rivers flowing through the settlement all had the same direction, north-south, steering the development. Also, the roads were laid out in the same direction, at right angles to the river (Van Ravesteyn 1928, 114).

When the settlement was granted town privileges in 1340, its burghers needed a ring of protecting water and two moats, Coolvest to the west and Goudsevest to the east, gave the settlement its characteristic triangular shape (Van Ravesteyn 1928, 134). However, this polder expansion turns out to be less attractive then the water side where business is centred along the Maas. So instead of building in the sinking polder like Amsterdam did, the people of Rotterdam decided to expand the city in the river Maas. Already in the thirteenth century people started to use the salting outside the dike for harbour activities (Van Ravesteyn 1928, 105). The layout of the new part of the city was very simple and before the sixteenth and seventeenth century there was actually no plan. The houses grew together following the shape of the river and the harbours. Parts were inside the dike and outside, making dikes an important urban element of the layout (Van Ravesteyn 1929, 22). The simple layout is directly related to the costs for building site preparation: the wider the house, the more expensive the foundation. The importance of the harbour is represented by its size. It was made very spacious and has been useful when the ships grew larger far into the nineteenth century. The result was a spacious Waterstad that had a high quality of environment (space and clean water), especially compared to the dense inner city north of the Hoogstraat. The fact that it was outside the dike and therefore vulnerable to flooding from the Maas, was taken for granted. Space and clean water became in the inner city more problematic every century and especially when industrialization took force (Van Schoor 1999, Van Ravesteyn 1929, Schadee 2000).
The phase of offensive water management is based in the principle of fertility. The Golden century shows great prosperity and the building of beautiful hydrological cities due to the social coherence and knowledge build up: the power of unity! It is the phase where the Dutch planning tradition is born and defining the genes of cooperation, looking ahead, balancing out nature and culture.

3. Early manipulative water management (1800-1890)

The new power of the steam engine kicked-off the phase of early manipulative water management. Early industrialisation turned the cities into places where people concentrated around jobs in the factories and harbours that grew and grew. The social and functional change of cities in this era, where people from the country side all of a sudden are packed together in dense neighbourhoods, can not be underestimated. The new power started a scale enlargement and acceleration that is still going on today. Again here it is tracing back the line that goes into the future. After the phases of defence en offence the new power now made it possible to intervene in the water system. The water could be moved with greater power and the movements where controllable as well. The building of channels, closing of sea arms and artificial lowering or raising ground water levels: everything became possible.

The contour and layout of the principal water city types that were expanded with a polder city in the prior phases were preserved far into the nineteenth century. After the Golden Century, when most of these expansions were built, the Republic suffered from political decay and economical stagnation and later on the French invasion. This downward development ended in 1814 when the monarchy was instated, but only after 1850 city development started again.

3.1 Waterproject

The first large scale city development in the Netherlands was the expansion of Rotterdam with the plan called Waterproject designed by military engineer and city architect W.N. Rose (1801-1877) see figure 2. The expansion was interwoven with the water task of the city: many people died from cholera due to the fact that the water in the inner city was much polluted. In the dense city the water was used for everything producing a very bad smell and bad living environments.

Rose’s answer to this problem was an independent water system for the city (independent from the country side where the water management goals had very different aims). Together with landscape architects J.D. and L.P. Zocher the Waterproject was designed as an ingenuous plan that combined the preparing of the surrounding wet and soft polders
together with a new water management system into an integrated urban design.
The first aim was to flush the waters in the inner city to improve the water quality. The second aim was the desperately necessary expansion. Rotterdam was digging harbour after harbour and many people where attracted to the provision of jobs this brought. Only the lowering of the groundwater level in the polders made it possible to build new houses there. To make the project also directly socially profitable Rose asked the Zochers to draw the plan with a park for walking for the poor and living quarters for the rich. This way he combined the most important urban tasks of that time all in a plan that on top of that integrates the characteristics of the territory, the technology available within an urban design. The location of the dike that was necessary to build an independent water system, and polder, was carefully situated from existing dike to dike. Along the dike a waterway was dug that collected all the water from the new expansion that flowed from the higher situated (dam city) inner city through ditches and culverts into these water ways. There was an intensive investigation done into the heights of the ground floor, see figure 3. At the side of the river the waterways were pumped by the new power, two steam engines, that pumped the water that was let into the inner city out again (see Hooimeijer et al. 2001, Berends 2001).

Figure 2 The Waterproject (Source: GAR)
Unfortunately the original problem of hygiene was not solved with the *Waterproject*; the flow was sufficient in principle, just too much rubbish was still thrown into the water. Only after the introduction of the sewer the hygiene in the city improved. The *Waterproject* represents the available technology and the urban planning tasks in the era of early manipulative water management. It also represents the practice of the building industry where in the final stage the general plan of the urban designer is filled in by the building practice. In the plan the building blocks where filled in following the polder pattern, the pattern of ditches that were dug to drain the polder. This century old structure represents the water system, the division of land and water, and the pattern of ownership, culture. In these areas the municipality builds sand strips under the planned roads and developers build the roads, where after the municipality takes over the maintenance. The houses are built on piles above the ground floor and due to the fact that the backyards are not raised the space in the basement can be used for living, usually as bedroom. This way of preparing an area for building influences the design and use of the city on all scales.

![Figure 3 The heights in the Waterproject (Source: GAR)](image)

The early manipulative phase stands in the light of the new power and introduces the principle of systemization. This principle gives way to a critical perspective on how urban tasks of dynamic cities can be integrated by tuning of natural, cultural and technical systems and made profitable into one urban plan. The *Waterproject* can still be considered as a learning example.
4. Manipulative water management (1890-1990)

At the end of the nineteenth century explosive urbanisation and technological prosperity put pressure on the polder cities. The manipulative era (1890-1990) is marked by the induction engine and electricity. This had an immense influence on the city and the water system. The car, industry and industrialized building processes and technology organize a new spatial order. This results in a situation wherein technically everything is possible and there is no connection the “natural” laws of the water system. The power that started with the steam engine accelerates in this phase.

The building of the sewer and drinking water infrastructure brings segregation between the systems for groundwater level control, the discharge of wastewater and the supply of drinking water. The larger part of the urban water system disappears underground. At the same time industrialisation brought the car claiming more and more space. Many open waters, which where smelling very bad or due to bad lightning people drowned in, were filled in: again a reduction of the ratio of open water in the city (De Vries 1996).

Even though the water structure of the polder city remained important for drainage, discharge and storage, it is no longer used as element in the urban design of the city. The possibility of spouting up a layer of sand to improve the wet and soft soils in the polder comes just at the right time when the industrial building methods enter the building practice. Blijdorp, an expansion of Rotterdam, is the perfect illustration of the first urban type that comes with this new method of building site preparation. The technological perfection after the Second World War delivers the second urban type, modernization, of this era of which Ommoord is exemplary. The third and last type comes about in the 1970s when partial sand layers are applied to keep some of the original landscape in the urban design. Zevenkamp is used as case for this urban type.

4.1 Blijdorp

The Dwelling Law (1902) made it mandatory for municipality larger than 20.000 inhabitants to make expansions plans. This law gave a boost to the profession of urban designer that at that time was still in a preliminary stage, cities were build by engineers and architects. Considering the way neighbourhoods were built, described in the former paragraph, it was very hard for the municipality to make a plan and keep all the developers to it. The first expansion plan for Rotterdam (1906), where Blijdorp was an important part of, is more a combination of the plans of the private developers than an independent urban design. Eleven years after this plan, after many more plans and a lot of misery trying to get the land owners and developers on the same page, the municipality decided to buy all the land and develop the area themselves. The added advantage of this decision was the fact that
they could prepare the whole site at once with the new technology of spouting up a layer of sand. The largest advantage of this decision was the fact that they did not have to agree on the urban plan before applying the layer of sand because any plan could be realised on it. Here the urban design and realisation is disconnected from the polder pattern, the pattern of land, water and culture. Building site preparation, the technology of balancing out land and water, becomes disconnected from the urban design (Gemeentewerken Rotterdam 1984, 14).

Figure 4 Blijdorp spouting up sand (Source: GAR)

Blijdorp is exemplary, in a period of 25 years many plans were developed and only after seven years that the south side van spouted up with sand the council approved of the finally realized plan. Figure 4 shows the spouting up of the north side of Blijdorp. The south side of the Schie was done in 1924. During the spouting of the north side they used water to make sure there would be no sand storms.

The disconnection of building site preparation from the urban design meant that the characteristics of the territory played no role in the design. This is clearly the case for Blijdorp; it resembles Plan South for Amsterdam by H.P. Berlage as a twin. The (car) infrastructure is the backbone of the plan and the water and green structure is like a shadow.

The manipulative era is signifies the principle of Maakbaarheid (man-made) by accelerating powers. The first urban type it delivers represented in Blijdorp is the result of the new method of building site preparation that disconnects nature from culture and urban design from the physical geographical conditions of the site. Yet, technology is not
perfected yet and the water system is still a part of the urban plan and of the hydrological system. This new technology brings a new organization of city development, start of a cultural change. This insight offers the critical perspective on the effects of industrialization.

4.2 Lage land and Ommoord

The urban scale enlargement and the disconnection of the urban design with the characteristics of the landscape cumulate in the post-war era. Water as an urban element becomes completely insignificant because next to the layer of sand the water system becomes completely artificial. This fits the paradigm of believe in a man-made culture that relies on technology and systematic approaches: the maakbaarheids principle. This was applied to society in terms of social cohesion, social facilities, and control on the city and also on the water system (Cornelis 2000). During this phase the spatial order of the Netherlands was fundamentally changed. The large projects of urban expansions, recreation, infrastructure and re-allotment of the agricultural pattern leaded to a completely different appearance of the landscape.

In his inaugural speech on November 12th 1975 titled Spel met water, grond en land [Game with water, soil and land] W.A. Segeren, extraordinary professor in water construction (polders) recognizes a direct relation between the location of the settlement and the way of life and the surroundings. After WWII the city expansions were localized then the soil and the water system were investigated and the civil and culture technical interventions determined to improve the soil conditions. Weak soils were strengthened with sand, calculations for foundation piles made and measures taken for the discharge and drainage of the build area (Segeren 1975, 7-9).

The urban designs could be uniform on any soil condition due to the technology of building site preparation: the spouting up of a layer of sand. There was no incentive to react on specific conditions with the urban design because all conditions became the same. At the same time the urban design was influenced by industrial building, the production of standard apartment buildings and ground bound houses used everywhere did not do any good to the characteristic locality of the urban expansions as well (Segeren 1975, 11).

In Rotterdam expansions were made on the south bank and east of the city: the dried lake Alexanderpolder. Lotte Stam-Beese (senior architect and urbanist at the Rotterdam municipality) and Jaap Bakema (independent architect and urban designer) made visionary plans for Alexanderpolder, the Lage Land, and presented these at the CIAM conference in Aix-en-Provence in 1953. They chose this site in collaboration with the director of the city development office Cornelis van Traa because a great task was put to design a sub-city in these low lying polders for the ever growing number of residents of Rotterdam. Rotterdam
could not expand north and because the city centre was moving to the west they considered the eastern expansion, even in the deep wet polders, as the best contra balance. The plan was extraordinary because they combine a radical way of building preparation, building on piles and lowering of the groundwater table, with an international vision on urban development.

Bakema’s concept of the ‘visual unit’, vertical city, was connected to the ‘district idea’. The district idea - where residential neighbourhoods merge harmoniously into a concentric and hierarchical whole - was a construction on the flat surface: the city map. The ‘visual units’ made this a three dimensional composition by introducing a sort of vast elementary sculpture in which architecture and urban design converge. In the plan for Alexanderpolder these ‘visual units’ were directly linked to the highway and functioned as autonomous urban units. The geographical circumstances of the deep lying polder and the poor soil condition were the reason for Stam Beese and Bakema to introduce the idea of these vertical neighbourhoods (Schild 1982, 139-197). By founding the highway and these ‘Mammoths’, as Bakema called them, on piles, the city was disconnected technically from its landscape that could be used for agriculture and recreation. These Mammoths, of vertical neighbourhoods are according to Bakema the best solution in dealing with the bad soil conditions in the Lage Land. People with an open state of mind and lifestyle could life in this city on piles with a view on the open agricultural landscape (Palmboom 1993, 38).

Eventually, when Stam Beese designed the executed plan for Lage Land only a very small part of the Mammoth concept remained in the shape of four large flats that are positioned in a mill wing.

Figure 5 Ommoord (Source: NAi)
The executed design of Lage Land is in two ways interesting. For building site preparation the choice was made to lower the groundwater table, in a time when usually the layer of sand was applied, and the dimensions of the urban design are very much related to the dimensions of the original polder pattern. Stam Beese was assigned to design a city that is endless; the polders in the Netherlands due to their rhythm and quantity have that characteristic.

After the Lage Land urban designer Lotte Stam Beese also made the design for Ommoord that is positioned in the same dried lake. She writes about the influence of bad soil conditions and the effect that applying a layer of sand has on the urban design:

The failure starts with the choice of the location of the new residential area. We have no good choice for a proper place,…[...]. The result is that due to the need for houses the residential areas come about with a rational-theoretical model, just like the Roma army camps, and miss the natural geographic that used to characterise former settlements: the valley, the river crossing or mouth, the presence of water or the safety of a mountain tip. The presence of the geographical characteristics and the internal coherence with them produced the urban design; it gave these settlements and their resident’s identity. Therefore it is not surprising that the current city expansions show great resemblance with the Roman army camps in lack of morphology. These camps also had no structural connection to their geographical situation, were independent and characterised by a singular function. Ommoord is built on the worst soil conditions possible. To be able to build there the whole area has to be drained with sand piles. This is not only very expensive but also restrictive in the detailing of the urban plan. For example a walking way on sandy soil in Drenthe can be made just by the people walking there, but here the walking way needs to ‘be made’ improved soil. The brick fence of playing areas needs a pile foundation in these conditions and is therefore too expensive. All these simple impossibilities produce an urban plan without an inoffensive character and become emphatically wanted and technically efficient. Added to this is the fact that technology always strives to perfection. But are we happy with ultimate perfection, with efficiency beyond efficiency? Why do children prefer to play in the mud and in messy places and do adults like to go to campsites and organise pick nicks?

The only positive side of the location of Ommoord is the river Rotte and the Rotte lakes. These are going to be expanded end better enclosed according the recreation plan ‘Rotte-meren’. This condition means some meaning of place to the new residence and a more plural functioning of the area. Already from the high flats the view on the landscape is stunning. The lack of a natural geographical environment, like described above, is visible in many new expansions: houses and flats are arbitrary lined up without taking the residents into a characteristically environment. […] Why all the fuss,
the disgust and dissatisfaction that is expressed in the media? The answer can only be that there is a consciousness about the lack of a residential environment for residents to feel at home. Everybody needs a home. (Stam Beese)

The urban identity that connects people did Lotte Stam Beese try to establish in Ommoord by the use of a green heart with facilities surrounded by the flats that had a view on the surrounding landscape. These parks were made with an irregular surface to make them more natural. This and the view was the compensation for the people in the flats that lacked their own outdoor space (Damen et al. 1993, 87). Figure 5 shows the urban design for Ommoord drawn over the original polder pattern.

This urban type of the manipulative era is thriving on perfection on technology disconnecting identity of place of urban developments as Stam Beese describes lucidly. The water can be done with technically and is completely disconnected from the urban plan. This did not add up to a desired urban quality and this era can be used to take a critical standpoint towards using technology to alter the physical geography of a site. Lage Land is a maverick in the post-war tradition since it is not heightened with a layer of sand and some characteristics of the land water parcelling is taken into the design. The plan that was made for the CIAM conference is a very interesting due to the fact that it makes a coalition between nature (keeping it as it is), technology (making use of concrete to build on) and the modernistic urban vision. This coalition can be exemplary for the future.

4.3 Zevenkamp

In the 1970s the post-war era was considered a time of technocracy and narrow minded views on social structures. There was a strong urge to free society from these conventions and a search was done into the real identity of the city. In reaction on technocracy and the man-made culture also respect for nature became a theme in the spatial order. The publication by Rachel Carson, Silent Spring (1962), opened the eyes on how man had a bad influence on nature. Also the report by the Club of Rome, Limits to growth (1972) and the oil crisis in 1973 put the causal relation between economical growth and the effects on the environment in a clear perspective (Meadows 1972). In the 1970 nature and ecology became more important in spatial planning and with this the landscape architect came as a new player. The landscape architect reintroduces water as a spatial element in the city. Also the search for the urban identity helped because it was found in the old water towns and plans for reopening filled in water came about. Even though Zevenkamp is spouted up with sand in the urban design an original landscape element, the ditch called the Ommoordse Tocht, was taken as backbone of the plan. The
ditch was dug out of the layer of sand to be the central axes of the plan along which the most important public space is situated. The new waterway is designed differently giving identity to the function of the surroundings it flows through. In the centre it is a canal with brick quays giving the area the identity of a dam city representing the social and economical heart of the expansion. This way, even though very artificial and hiding the hydrological system under a layer of sand, the urban design is making a connection to the original landscape and making use of the century old identity of Dutch towns.

The urban type of the 1970s is the return of physical geography (nature) in the urban construction and a new type of building site reparation to do so: partial sand layer. It is the first step towards a form that fits adaptive manipulative water management and new urban types.

5. Adaptive manipulative water management (1990-)

Adaptive and manipulative are of course contradicting terms, that is the reason to name the last phase this way because there is no consensus about how to spatially make the right adjustments in order to be climate proof. After 1973 the prelude towards the adaptive manipulative phase of water management sets in. It takes over twenty years to mainstream this societal and spatial new attitude towards the natural system and make it part of policy and practice. This process is still in progress enforced by the changes in the hydrological system. The territorial conditions are changing due to climate change. Especially the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) changed the view on the responsibility of men towards nature in 2007. The conclusions are quite clear about the impacts of climate change, the vulnerability of natural and human environments, and the potential for response through adaptation (Intergovernmental Panel on Climate Change 2008).

This technical approach of management of the manipulative era led to the current situation wherein the change of the climate (with more extreme storm water) causes flooding in the polder cities. The days of the use of pipes and pumps (the work of the civil engineers) are over. The water needs to be reintroduced into the urban design of the cities. This requires a spatial approach where fluctuations in water supply and ecological water systems have to be taken into account.

In the Netherlands the approach towards urban planning becomes one of liberal and de-central character. National reports set out very general guidelines and are more aimed at economics than spatial order. But then again, water is integrated as well in the national planning reports like Nota Belvedere (1999) and ‘Anders omgaan met water, waterbeleid in de 21e eeuw in de stad’ (2000) [Another way with water, water policy of the 21st
century]. The first is about increasing attention towards history and landscape and the second is the response on almost disasters in the 1990s how to change the attitude towards water. Both make a strong comeback for nature and culture on the national agenda.

5.1 Nesselande

In Nesselande water is introduced as the qualitative carrier of the plan. Starting point to ensure sustainability are the use of ecological sensible material, use of a city heating system, and subsidy for sun energy. The water quality is guaranteed by making an independent open water system for drainage and storage that is naturally cleaned. The inhabitants have to live by five rules to maintain the water quality: 1) no washing cars, 2) ecological material in the gardens, 3) dogs are only allowed in specially drained areas, 4) use of chemicals is prohibited, and 5) avoid use of fertilizer. Besides the overall importance of water to structure the area, this attempt to make the residents aware of the wet situation of their neighbourhood is bringing back a necessary social carry capacity to be able to change towards true adaptively.

Figure 6 Moulds in Nesselande (Source: Palmbout Urban Landscapes)
One of the districts in Nesselande is called Water City and is designed by Frits Palmboom and his office Palmbout Urban Landscapes together with H+N+S Landscape architects. Interesting in the perspective of building site preparation and the division between land and water within the urban design culture is the fact that the urban designers reintroduce the mould as a strategy to give open direction to the urban design. The ground floor of the lots is very low, 4.80 meter below mean sea level and are not heightened to have a direct relation between the water and the gardens. The roads are situated on dikes which are 80 centimetres higher than the lots. The lots are given moulds on the same level as the roads and connected to them to make infrastructure (road, water, electricity etc.) possible. The house needs to be situated somewhere on the mould but can make use of the high difference to make a spatially varied house. This way no restrictive rules are needed and the building site preparation has become an integrated part of the urban design, see figure 6.

The principle of vulnerability marks the era of adaptive manipulation. This is characterized by more consciousness about the vulnerability of natural system and also more perspective on what qualities, and chances, the water and the natural system can bring to the urban system. Urban interventions in the landscape are done with a critical perspective on the effects of these interventions.

5. 2 Zestienhoven

The most recent expansion plan of Rotterdam is Zestienhoven. Here a park, sports facilities and community gardens are situated next to Rotterdam’s airport. The urban design is therefore more a redesign to make it available for housing that it is a completely new plan for an empty area. This is part of the new strategy of Rotterdam to intensify the existing territory instead of expanding it (Gemeente Rotterdam 2007).

With the development of Zestienhoven water management was giving a leading role. Due to the fact that the area is very low and wet with a high degree of seepage that was probably the best and only starting point. From the water management point of view a few scenario’s where developed and the most optimum one (in relation to the costs and profits, functional and ecological aspects) was chosen and worked out in a master plan.

The urban design shows that the original polder pattern is brought back in an open water system that (alternating with an artificial underground system) forms a grid as a reminder of the polder pattern; these waterways are dug out of the layer of sand that is applied here. The building sites are raised with sand, to prevent seepage and get done with soil pollution. Around these fields the green structure is kept in tact. The ten percent of surface water is projected to secure a flexible water structure. Figure 7 is the preliminary plan that shows
the allotment and the water structure as a grid. Many houses are situated along the water. On the west side the park and the public gardens on the south side are persevered. The diagonal is the High Speed Train Line.

Figure 7 Zestienhoven (Source: dS+V)

Even though the master plan is based on the water system and the soil conditions, in the realisation of the plan municipal urban designer Mattijs van ’t Hoff and engineer at Public Works and project leader Peter Spakman encounter many problems that could have been prevented. The ten percent surface water that was demanded by the water board is situated at the south side of the area where there is a natural height difference. This was done to accentuate this height difference and make a close relation to the existing landscape. This south boarder is also part of the ecological and recreational main structure. However, when detailing the waterway it turned out that the seepage there is so severe that the building of a waterway can only be done when the soil is heavily sealed. Otherwise the soil will break open and salt water from deeper grounds will come up spoiling the water quality in the area. This issue was investigated in an earlier stage but according to Spakman the problems manifest themselves usually after thorough calculations that are only done in the implementation phase. Therefore it is important not to have a very specific master plan that is the result of the specific demands from the urban design, engineering and financial side of the project. It is better to make a more general master plan with guidelines from the sides of urban design, engineering and finance that will leave room for more specific demands in the implementation phase. The waterway turned out not feasible, bringing about a large technical and expensive
enterprise, and a new design for the ten percent surface water had to be made. In the meantime architectural historian Mariëtte Kamphuis investigated the area and came up with a historical map that offered inspiration for the solution of the problem (Kamphuis 2009). On the historical map on the location of the high seepage little islands are visible. These islands make sure that the grounds and not break open and are therefore the natural solution for the problem. It is therefore the logical spatial solution for the conditions belonging to the landscape characteristics of the area.

The critical view from the principle of vulnerability makes evident that hydrological conditions are like a time machine, a continuum that sets the agenda for the land use. Also, that the factor time needs to be incorporated into the organization of urban development, technology needs to be orchestrated and balanced out with the natural conditions of the site.

5. For the future

“Without a long start in history, we shall not have momentum needed, in our own consciousness, to take sufficiently bold leap into the future” (Mumford, 1961).

Surveying the historical relationship between the natural system and the design of polder cities one can only conclude a tightness that is exemplary for the future. The Netherlands is a water machine of which all cogs are connected to each other. The Dutch cities are hydrological constructions, with a spatial layout that is strongly connected to the rules of the water. Even a new argument could be set up: the practise of the Dutch urban design as it is today is based in the way the Dutch dealt with the water. But that is another paper.

The overview in six phases offers insight in a ‘fine tradition’ is and how this self-evident relation between water management and urban design is shaping through time. The main conclusion is that the hydrological system is timeless, forms conditions for human social infrastructure, shapes the dynamics of the city and sets out the line for the future. The landscape as a carrier of the hydrological system, the original balance between land and water should be developed in new ways of building preparation to design or redesign water cities.

The principles coming from each phase put forth the following hypothetical strategies for the future. From the adaptive principle a flexible mental and physical attitude and the introduction of the aspect of time to incorporate uncertainties is a productive strategy. The fertility principle shows that cooperation and boldness in making the most of the potential of the territory, taking the original waterscape into account and make spatial diversity by the use of technology and landscape, delivers hydrological cities, knowledge development and prosperity. The systemization principle shows that when the disciplines of engineering
and urban design work together the integration of tasks and solutions (spatial and technical) can be realized. A fourth dimension should be added to the toolbox of urban design, the dimension of water levels. The engineers should add the spatial consequences of the hydrological system for urban development. Both can, from different angles, contribute to new developments as urban engineers.

Finally the maakbaarheids principle and its opposition the vulnerability principle together make for a strategy that first of all must me aimed at consciousness. This consciousness about the impact of the technical system and the vulnerability of the natural system is crucial for new developments. With a critical eye on constructions and with sight on not only the vulnerability of natural system but moreover the quality that the natural system can offer urbanity the new balance can be found.

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