BROAD CHANNEL - STEPPING UP
Architecture as a connecting element in flood resilience

Graduation report
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Master Architecture
Delta Interventions studio

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# BACKGROUND

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Introduction

This graduation project is triggered by the impact of Hurricane Sandy on the New York region. By its diameter of 1800 km (see Figure 1.) Hurricane Sandy became the largest Atlantic hurricane on record. On October 29 2012 Hurricane Sandy made landfall on Eastern Seaboard of the United States of America. This event had a severe impact on the New York region as the region was largely unprepared for events of this magnitude. The National Hurricane Center estimated 53 direct deaths in the New York region, approximately 305 thousand houses were damaged or destroyed, 2 million households had a power outage and total damage in the region amounted 19 billion dollar.

With sea level rising and increasingly extreme climate, storm events like Hurricane Sandy are likely to happen again, creating an urge to improve the resilience of the region against future storm surges.

This graduation project explores the role architecture can play in improving the resilience of its surrounding against future storm surge. At first an understanding of the storm event and local conditions is essential to come to durable solutions in the preparation for future storms. Based on this, the project outline is set.

After leaving the Caribbean, Hurricane Sandy was diminishing in strength. Two pressure systems, the Jet stream above the continent and a blocking high pressure area above the Atlantic ocean directed Sandy towards the East Coast of the United States of America and made it increase in strength (see Figure 2.). Sandy did not stand out in its force when compared to earlier hurricanes that made landfall near New York. But the path perpendicular to the East Coast resulted in a push up of water over a large area. The path in combination with strong surface winds in direction of the coast this turned out to be devastating.

Figure 1. Satellite image of Hurricane Sandy

Figure 2. Path of Hurricane Sandy
Due to the funnel shape of the New York Harbor Estuary, open in the direction of the Atlantic Ocean, the push up of water reached extreme levels (see Figure 3). Tidal conditions contributed to these extreme water levels as the moment of landfall coincided with high tide. Result was a storm surge that flooded most of the low lying areas in the Estuary. Both saltwater and wave force, depending on the exposure of the location, contributed to the devastation. Although the build environment proved to be unprepared, human loss could be limited as the region has a well functioning warning system. The inhabitants of zones at risk were warned and evacuated.

In the aftermath of Hurricane Sandy the consensus for change and improvements against future storm surge grew rapidly. Research and design institutions were challenged to come up with solutions. The Delta Interventions studio and this graduation project react on this call. Therefore the locations affected by Hurricane Sandy were visited with the Delta Interventions studio to gain insight on the forces at play (see Figure 4). Most of these locations turned out to be build on historic landfill and former wetland areas, hereby neglecting the risk and consequences of building in such low lying areas. One of such locations that got my interest was Broad Channel, a small island community in the middle of Jamaica Bay. Within this community the presence of water can not be missed and is visible everywhere. Its residents highly value this close relation to the water and the wide views that contrast with the dense urban fabric of New York.
Broad Channel

Although the Broad Channel community lives in close relation to Jamaica Bay, with most houses providing a view over the water and having private pontoons for boating activity, most households were not prepared for the risk of living close to a large water body. Even the areas in Broad Channel that do flood during spring tide on a regular basis show no signs of solutions to deal with these inconvenient situations. Result was that the inundation levels caused by Hurricane Sandy did have a devastating effect on the community. In addition to that, with some sides of the community exposed to the larger open water bodies of Jamaica Bay, the moderate waves that could build up added up to the devastation (see Figure 5.).

What strikes me most is the fact that even a community that lives in such a close relation to water shows no signs of being prepared for the risk it entails.

Figure 5. Flood map of Broad Channel during Hurricane Sandy
The images on the right illustrate this contrast. The idyllic daily settings and the devastation caused by Hurricane Sandy on the build environment seem to be two totally different worlds. They show on the one hand the strong relation with Jamaica Bay and on the other hand the inability to react on the forces of nature. This static setting of the community makes it highly vulnerable for the dynamic forces at play in the Jamaica Bay.

Figure 6. Bird-viewing in Jamaica Bay

Figure 7. View from Broad Channel

Figure 8. Typical image Broad Channel

Figure 9. Severe flooding by Hurricane Sandy

Figure 10. Devastation in Broad Channel

Figure 11. Impact on life and communities
Jamaica Bay

Past events have proven that the Broad Channel community is tightly related to the conditions of Jamaica Bay. In the recent years the importance of the ecological conditions gained awareness, Hurricane Sandy only accelerated this process.

Sea level rise, harvesting or eradication of native flora and fauna, loss of sediment, pollution impacts, and physical alterations combined led to a downward spiral that made Jamaica Bay an hostile environment during storm events. A healthy salt marsh has a mediating effect on extremes, a bay with some salt marshes does not. Restoring these qualities is both beneficial for the safety of the urban areas surrounding the bay as for the ecosystem with local values on a continental scale.

Consequence for achieving this goal is a need for change in how the urban environment relates to the bay. During Hurricane Sandy the bay got littered with debris, overflowing sewer systems and leaking fuel tanks adrift.

The following pages will briefly discuss the history of Jamaica Bay.
Jamaica Bay

History

The following description of Jamaica Bay stands in sharp contrast with the current situation: Jamaica Bay is “…so full of marshes and islands as to render its navigation utterly impossible except to vary light-draft vessels with local pilots on board. No intelligible description can be given of the islets and numerous channels among them. (U.S. Coast PilotCoast and Geodetic Survey, 1904)

What once was an extensive estuarine ecosystem (see Figure 13.) got drastically changed over time. Its original qualities are still present but in small numbers and often failing to sustain healthy levels.

Jamaica Bay proves to be important for and connected to many elements such as:

- Habitat: fish and horseshoe crabs spawning and rearing; bird feeding and nesting, sanctuary for migrating birds.
- Water quality enhancement: filtering, nutrient and pollutant absorption and uptake.
- Recreation: birding, walking, painting, fishing.
- Storm and flood protection: wave attenuation, storm surge reduction.
- Climate regulation: carbon sequestration.

The changes in twentieth century (see Figure 14.) by the attempt of turning the bay into an industrial harbor and hardening the borders of the bay with urban developments made clear that these values were not yet understood back in time.
Jamaica Bay
History

When we compare Jamaica Bay when still largely untouched with the situation now big differences can be seen. Some statistics make these changes more insightful in the type of changes.

The total surface area of Jamaica Bay got nearly halved from 101 square kilometer to 53 square kilometer nowadays. This loss accounts mostly for its outer borders, essential for fresh water inflow and sediment acquisition. In the same time the water volume of Jamaica Bay increased by 350 percent. (NYC DEP, 2007) In the last forty years 620 acres of salt marsh were lost (Hartig et al., 2002)

The effect of the alterations and ecological degradation to the bay over time can be seen in the tidal tables as well. Relative to the coastal tide, the tidal range of Jamaica Bay increased by 30 cm over the last century. Result is a spring tidal range that exceeds the mean tidal range by 20%, an increased range of high waters by 50% and an increased range of low waters by 50%. These effects are mainly caused by dredging and filling, removing the buffers that can dampen extremes.
Jamaica Bay
History

Human activity has also dramatically changed the island what is now know as Broad Channel. Since the presence of the first settlers in the 17th century for the harvest of oysters, clams, shrimp, and fish is the island has been altered. In particular, the rail and road connections from the mainland to the beaches of Rockaway gave Broad Channel a new look. These roads had to be positioned safely above the water level. This required huge amounts of sand to be dumped along these tracks which resulted in the Broad Way Boulevard being the highest part of Broad Channel. These connections were also indicative for a change of the activities at Broad Channel. Due to the closeness to the mainland and its proximity to New York, Broad Channel became hugely popular as exclusive retreat for city dwellers and formed the borders for what is now know as Broad Channel. Despite the negative impact of human activity in Jamaica Bay, the presence of the Broad Channel community also had a positive effect on the bay. The community successfully challenged the construction of an industrial port and further expansion of JFK airport into the bay.
PROJECT OUTLINE

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Aim

After a thorough analysis of the elements at play in and around Broad Channel I did set the aim of my graduation project on improving the resilience of an entire community against storm surge with an architectural project. This challenged me to look further than to design a building that could withstand storm surge to a set level or relate to water as a self containing entity. (see Figure 21.)

The motivation behind this aim is the realization that so many existing urban regions are dealing with the challenge of flood risk. Even though, the awareness of flood risk and the possibilities to take action in decreasing the risk is often not present. Realization of this necessity comes in most cases too late, namely after a storm surge. Therefore I want to explore how an architectural project can be connected to a community to improve its resilience.

Figure 21. Tidal range and storm surge levels

Improve the resilience of the Broad Channel Community against future storm surge
**Method**

There are various methods in achieving resilience against storm surge. Even the word resilience already suggest a direction of action namely: to recover from an event fast when circumstances turn back to normal. The location changes temporarily and after the event everything goes back to normal again. It accepts that the build environment will be temporarily occupied by a storm surge and aims at decreasing the impact of this occupation.

The strategy of protecting for example will mean that large areas must be surrounded by barriers to keep the water out. This has a negative effect on the spatial qualities and is still no guarantee for the hinterland to be safe. (see Figure 23.) In countries where institutions as regional water boards are missing, maintenance and planning of protective measures can hardly be integrated. In most cases it also undermines the motivation of living in close relation to water. This does not mean that strategies like protect and retreat are fully ruled out. Often the solution can be found in the combination of strategies.

**Figure 22. Various approaches in dealing with storm surge**

**Figure 23. Shortcomings of strategies**
Method

An architectural project can not provide physical protection to an entire community. What it can achieve is sharing the many characteristics that support resilience and create engagement for resilient living. With the aim to get the community into action and thus bringing about a change over the time and so making the community more resilient against storm surge. Hereby the original motivation to live in Broad Channel is retained; living in close relation to the water. (see Figure 24.)

Education by providing data and information are inadequate because it only leads to knowledge. To create change, experience is an important factor. This is magnified directly after a storm surge and fades over time.

Expensive buy out
Destroying community
Politically impossible
Decreases tax base

Water remains quality for living
Wetland mediates storm surge
Continuos innovation in resilience
Ecological values improve

When experience is linked to knowledge, support for decisions and action arises. That’s why I want to link various experiences within the architectural project and associated them with the knowledge provided in order to create a joint commitment to develop a lasting relationship with Jamaica Bay. Thereby developing ways of living that are adapted to its dynamics.
Goals

To increase the resilience of the Broad Channel community I formulated three leading goals for the design process. These goals originate from the overall aim of the project and are based upon the established methodology. Of interest is that these three goals will be translated into the architectural design.

- At least one educational function must be present from which exchange of knowledge takes place to both visitors and the Broad Channel community.
- To create engagement by experience, social binding functions must be present. These connect the community with the building and bring the community in contact with knowledge about resilient living along with it. This also entails the need for functions, other than the educational function, that attracts visitors.
- Thirdly the building should be designed in such a way that it remains in function and is able to support the direct surrounding immediately after a storm surge. Meaning that the building must be designed to sustain storm surges. Together, these three goals form the starting point of the architectural design.

Engagement    Research    Resilience

1 Educate and form consensus for resilient living
Provide knowledge and tools for more resilient and sustainable living.

2 Strengthen community by adding social functions
This generates a better organisation and cooperation within the community, also during and after a disaster.

3 Provide relief after a disaster
Central point from where aid can be provided and organized.

Figure 26. Methodological steps in creating a resilient community

Figure 27. Three main goals of the project
Target groups

The three goals of the project are linked to three main target groups. Each of these three target groups has an interest in the involvement of the other. (See Figure 28.)

- First target group is the Broad Channel community accounting for about three thousand inhabitants. By their central position in Jamaica Bay, the community has a fantastic location to offer from which the bay can be experienced. Over time the community can become an example for resilient living where other communities can draw inspiration from. Their direct benefits of the project are the addition of social functions and the positive impact of the project on the resilience of the community.

- Second target group is the Science and Resilience Institute at Jamaica Bay. This is the group that creates knowledge and is able to share this knowledge with both visitors and Broad Channel community. Being able to work on site and in direct connection with Jamaica Bay, field trips, excursions and events can be organized. Also the consensus about new ideas can be inventoried among the public.

- Third target group are the visitors, under this name fit various more specific groups. These may be visitors from the immediate vicinity of the bay, students who visit the Center as part of their educational trajectory, nature lovers or daytrippers. This group will add critical mass to the project and has the potential to generate a positive flow of activities in Broad Channel.
Program

The first two functions could already be identified after formulation of the three goals. However, a fitting social function for the Broad Channel community still to be found in addition to the educational function and knowledge function. For this I was inspired by the brainstorm sessions that the Broad Channel community board had communicated. (See Figure 29.) This shows the desire for some functions that are in line with the set goals. These are an indoor sports function and a meeting space, possibly with podium. These functions can be brought together under the combined function of a multipurpose hall. The multipurpose hall can be used for sports and community events as well for seminars and public events organized by The Science and Resilience Institute at Jamaica Bay. This combination allows a sports function to be cost-effective for a relatively small community.

The three basic functions are connected to each other by a central foyer and eatery, serving all functions. (see Figure 30.) As a result, a building program is formulated that can support a variety of settings depending on the use or event at that time.

In addition to these main functions supportive functions and specific functions are added in support of the initial design goals. (see Figure 31.) Altogether this forms the program for the Broad Channel Resilience Center.
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Location requirements

The project outline dictates a number of requirements for a suitable location of the Broad Channel Resilience Center.

- Firstly the center must have a direct connection to the Broad Way Boulevard (see Figure 32.) As the center must be easily accessible by car and public transport.

- On the south side of Broad Channel tollbooths create a possible border for visitors, therefore the access to the center must be on the north side of the tollbooths.

- Due to its public character the center must be positioned on the edge of the Broad Channel Community. Placing the center in contact with community without intruding.

- The center must have a strong relation to the various characteristics of Jamaica Bay. This adds educational possibilities and supports the functions of the center.

- As the center advocates the importance of the ecosystem the impact of the construction on the location must be kept to a minimum.

Two locations answer to most of the requirements (see Figure 33.) Sunset Cove & American is most suited as a large part of the location is degraded and contaminated by former activities. Restoration and redesign of the site can be achieved along with building the Broad Channel Resilience Center.

The following pages will set out the chosen project location.
Location history

Originally the entire location consisted of salt marshes veined with numerous tidal creeks. Most inhabitants of Broad Channel made their living off the ecological riches of the bay, such as oyster harvesting and fishing.

Around 1928 a lot of changes took place on what is now Sunset Cove & American park. With the dredging of canals in Jamaica Bay large amounts of sand were dumped on the south side of the location. Dredged sand was also used to raise strips of land intended for housing on the north side of the location. A start was made with the construction of Broad Way Boulevard, the road to connect the mainland with the Rockaway peninsula.

Around 1951 the location was bustling with human activities now that Broad Channel was easily accessible by car over Broad Way Boulevard. The north side of the location was developing as a rationally structured neighborhood. Unlike the inhabitants of Broad Channel that lived there before the connecting road was completed, new inhabitants were attracted by the spatial qualities and leisure possibilities of Jamaica Bay. Several leisure activities, for both locals and day trippers, were developed on the location. A marina was created by excavating the area what is now Sunset Cove. A carousel stood along Broad Channel Boulevard. And on the southern part of the location a swimming pool and boy scouts clubhouse were build.
Location history

The marina has been expanding its activities since the 1940’s. This was only possible by illegal landfill on former salt marsh. After court action the marina was ordered to decrease in size in 1998. No changes were made and the marina remained unchanged (see Figure 37.) After several court actions the leases were terminated in 2009 ordering the eviction and demolition of all marina activities.

The marina left behind a total of 7 acres with contaminated fill on what originally was historic salt marsh. Other loc issues are the low lying parking lot that regularly floods after rainfall.
Location partition

The legislative partition of the location is taken into account in the design process. Therefore an inventarisation of the possibilities through conversations with the involved parties was made.

The National Park Service does not want to have anything build in their legislative area as most of it is made up of historic salt marsh. There are possibilities for walking trails along the edges of the marsh to foster activities like bird-viewing and ecological education.

The other three areas that made up the rest of the location can be seen as one location to a certain extend. The American Ball Fields remain in place and requires a connection to a road for medical emergencies.

The following pages will give impressions of the location at its current setting.
Impressions

The north side of the location is bordered by houses characteristic for Broad Channel. Most houses in Broad Channel are constructed of wood, are free standing, are one to three storeys high and have a pitched roof. The height of the ground floor above the water level varies for each house as the bulkheads along the water are erected individually.

In Sunset Cove, the bay west to the location, wooden piles and a sunken boat are a reminder to the previous use. In the distance orange screens mark the locations of marsh restoration projects in progress. These projects are initiated by the United States Army Corps of Engineers and the New York City Department of Parks & Recreation.
Remainders of the marinas bulkhead contrast with the natural shoreline. With the outgoing tide parts of the mudflats are revealed in front of the marsh grass, mostly consisting of Spartina Alterniflora.

The southern side of Sunset Cove is the only part of the location that remained largely untouched over the years. Only the borders are raised with the sediment dredged for the realization of the marina. Spartina Alterniflora along the edges thrives as it lies protected from wave action.
Impression

On the west side of the location lies Big Egg marsh. This marsh was one of the first locations in Jamaica Bay where a large scale marsh restoration took place. As this part is under jurisdiction of the National Park Service it has been protected over time against the expanding activities on Sunset Cove park and American Ball fields.

Dense and contaminated landfill makes it nearly impossible for anything to grow on the location.

Figure 43. View over Big Egg marsh

Figure 44. View over landfill and Sunset Cove
Looking towards Broad Way Boulevard leftovers of coastal forest in the back and some lower vegetation on the edges border the East side of the location. Therefore most the roads and houses surrounding the location are hidden.

As most of the location is affected by human activities, neglecting the ecological qualities of the location, it now offers the possibility for the Broad Channel Resilience Center to be build without negatively impacting the direct surrounding.
Impressions

The south side of the location has a beach character and has a higher elevation due to sand storage from dredging activities. This adds up to the various ecological zones the location already counts. The shoreline is often used for ecological education and fishing.

The direct surrounding of the marina boat parking already shows great potential of what it could become in terms of vegetation and wildlife habitat.
Orientation

Besides the potential of restoring the various ecological qualities, the location also offers unique views. Sunset cove, as the name already reveals, has open views over Jamaica Bay towards sunsets in the West.

Another quality is the unobstructed view towards the Manhattan skyline towards the North-West (see Figure 52.). This view clearly frames the location in its context, exemplifying the contrast between the vastness of Jamaica Bay and the dense urban areas surrounding it.
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Landscape design

The location can be divided in different zones depending on their height in relation to the water level. The height in relation to the water level is decisive for what kind of vegetation will grow on that specific location. This knowledge is used in the landscape design and positioning of the Broad Channel Resilience Center.

At first a generic zoning plan identified the existing heights (see Figure 54.). Hereby the excavation of the contaminated soil of the former marina is already taken into account.

Based on this schematic the landscape is designed with the goal to implement the various characterizing ecological zones that can be related to salt marshes. These include: mudflat, low salt marsh, high salt marsh, grassland, coastal shrub, coastal forest, upland forest, fresh water pond, sandy beach, sand dunes. Presence of these zones gives added value for ecological education to form a complete understanding of Jamaica Bay.
In the first years, the depth of the waterways will still result in considerable fluctuation. A future healthy bay with shallow inlets and multiple connections to the ocean make the difference between high and low water smaller. A healthy salt marsh has the potential to dampen extreme water levels. In spite of the protective effects of this natural system, extremes are not fully excluded. In order to protect the ecological zones on the location that are less resistant to flooding by salt water, a berm is implemented into the landscape. This berm can protect these zones against moderate exceedings of the standard water levels.

By being positioned over the berm, the Broad Channel Resilience Center is connected to the different environmental zones. This means that a part of the center is in contact with the tidal conditions in the bay and a part lies sheltered between the so-called upland forest.
**Concept**

Primary goal is to allow the visitor of the Broad Channel Resilience Center to experience a strong connection with the landscape. This goal is reflected in the concept of the roof as a continuous element that physically connects the center to the bay. (see Figure 57.) Hereby the center is anchored to the location.

The height of the building increases in line with the vegetation. From the water level, to mudflat to marsh grass to coastal forest and eventually to coastal upland forest. The roof will provide an overlook over these zones at the different levels.

Another landscape element to which the building is anchored on the site is the berm. The building is placed on the berm and offers the visitor the opportunity either to enter the building or continue their walk over the building.

Both sides of the berm are subject to different conditions. The lower part has to cope with the variable water levels of the tide where the upper part will only be in contact with water during extreme surge situations. The roof surface functions as a continuous connecting element.

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*Figure 57. Building becomes part of the landscape*
*Figure 58. Building height in line with ecological zones*
*Figure 59. Building anchored on berm*
*Figure 60. Different conditions differ the facade*
The public sloped roof provides diverse views over the direct surrounding and Jamaica Bay. A better overview is offered as you climb higher on the roof. This gives unique perspectives that can also provide insight into the challenges that Jamaica Bay and the Broad Channel community are facing. This experience is of additional value to the educational functions of the building.

The center is oriented towards the West, where it has unobstructed views. In the direction to the East the vast views are blocked at the lower levels by vegetation or surrounding buildings. The highest point of the center is well above these buildings and offers views over Broad Channel and the other side of the bay. Allowing the visitor a full panorama over the whole bay. Despite the high standing point, the visitor is still strongly linked to the environment by continues roof that connects to the landscape and the exposure to the natural elements.

While walking up, the roof surface widens with the views to be tapered towards one single point that provides the full overview. The connection to the water is narrow and widens as it rises, this contributes to a robust appearance where the building is in direct contact with the water of the bay.
Routing

Entrances

From the parking-lot a direct path leads to the entrance of the Broad Channel Resilience Center. The path lies in extension of the slanted facade and brings the visitor on berm level, which is 1.5 meter higher in relation to the parking-lot. On arrival at berm level a number of possibilities present themselves. One can enter the center through the inviting entrance in the glass facade that stands in contrast with the robust character of the rest of the building. The glass facade offers a view through the foyer in line with the berm. Another possibility is to walk up the stairs through the opening of the roof to enjoy the various views over Jamaica bay. Direct sunlight trough the opening of the roof lights the stairs, inviting the visitors to step up! One can also continue the walk over the berm to the north side of Sunset Cove.

The entrance on the south side not only provides the possibility to continue walking over the berm through the center, but also gives the possibility to visit the center directly from the playing fields or after a walk on the southern part of the site. It also provides an ideal gathering place for educational excursions that are linked to the education room. As you get closer to the entrance, you also get closer to the building (see Figure 64.) The slowly broadening overhang of the roof surface provides a smooth transition between inside and outside. Hereby the roof presents itself as a continuous element, the continuous suspended ceiling emphasizes this the more. The windows support the angle of inclination by following the roof line.
Routing

Roof

The roof is accessible from both sides of the center via a broad inviting stairway which stands out by the direct light through the opening in the roof and facade. The visitor is still outside and in contact with the natural elements, in the same time the visitor is behind the robust facade. From here it is possible to directly walk across the roof, although the various paths are inviting for a further exploration. The terrace of the eatery is also passed by and invites for a drink. Hereby the eatery provides visual connections to the other functions within the center to foster spontaneous interaction. Another connecting element are the skylights in the roof above the exhibition and foyer which allow to peek inside and so arouse the curiosity of the visitor. In addition to the roof offers space for informal events and activities on the grass.

When walking up the stairs on the south side an instant view on Jamaica Bay and the Manhattan skyline is offered upon arrival on terrace level. (see Figure 66). From the terrace paths guide the visitor to the different levels on the roof.
Functions

Foyer

The foyer functions as a central point within the Broad Channel Resilience Center, whence all the functions are directly accessible. The functions present themselves visually to the visitor in the foyer, and so invite the visitor to use other in first instance not intended functions within the center as well. The most important function of the Broad Channel Resilience Center, the exhibition, stands in open relation to the foyer. So when one comes to watch a basketball match a visit to the exhibition is easily made. The lobby allows different users to engage in an informal interaction regardless of their purpose of visit. The reception with a small shop within the lobby serves as contact point to assist visitors when necessary. The round openings in the roof and the visibility of the stairs to the roof enhance the relationship between inside and outside.
Functions
Restaurant

The restaurant, like the foyer, has a connecting function between the different user groups. From the foyer, both the restaurant and terrace are directly visible (see Figure 72). Due to its higher position within the center, above the danger zone, large window openings that offer views to the surroundings are possible. The restaurant opens up to both the roof and the multipurpose hall, allowing visitors to watch both a sports match or enjoy the scenery.

Figure 71. Impression restaurant
Figure 72. Relation foyer with restaurant
Figure 73. Restaurant centrally placed
The multipurpose hall serves two purposes. The Broad Channel community has no possibility of indoor sports in the vicinity. Due to the size of the community a sports hall will not be used intensively and therefore too expensive. The combination of a sports function which can also be used as an event space serves both the educational functions of the Broad Channel Resilience Center as the community. This also means that the community develops a strong connection to the center. A visit to the educational functions is a small effort with a weekly visit to the sport facilities and makes a stronger link between resilient living and everyday life. As both should be tightly related for a continue awareness of the living environment and foster action for a more resilient community.

The choice for the dimensions of the hall is based on the minimum dimensions of a basketball court, the most played indoor sport in America.

Above the locker rooms is a fixed tribune from where the sporting events can be viewed. This tribune is connected to the restaurant from where there is a view into multipurpose hall as well.

During events the telescopic tribune under the permanent tribune can be extended so as to create a setting for a conference or lecture. Often at these events, the relationship between event space and catering are important. With the extension of the telescopic tribune a direct relationship is created between the restaurant and the multipurpose hall. (see Figure 76.)
Functions
Exhibition

As mentioned earlier, the exhibition space has an open relationship with the lobby so that the visitor is invited to take knowledge of ways to improve their community against storm surge. An important element in the exhibition is the tidal room (see Figure 77). The tidal room provides insight on the daily tide levels with the water moving up and down against the acrylic window. On the wall the levels of previous storm surges are written. This exemplifies the huge difference between the everyday situations and during a flood event. Often these scales are hard to imagine, especially when the memory of a previous storm surge fades. This room underlines the relevance of the exhibition and the importance to take action.

Figure 77. Impression tidal room

Figure 78. Relation foyer with exhibition

Figure 79. Position tidal room
Functions
Office

Access to the back office and office space are, as well as the other functions, directly accessible from the foyer. As the nature of the offices is less public the access is placed less in sight than in the case of other functions. By placing the office at a higher level, same as for the restaurant, large windows that overlook the bay and Broad Channel are possible. This gives the researcher a direct relation to the area for which research is conducted. The researcher also has the possibility to directly observe how new plans are received and investigate the consensus under the visitors or what is known by the visitors. In this way the center accommodates the different parties and allows them to benefit from each other in achieving a common goal: improving the resilience against future storm surge.
Zoning

The roof is visible as a continuous element throughout the center. The various functions are reflected in the materialization of the interior. The construction grid reacts on the zoning of functions and their spatial properties (see Figure 83.), from left to right: exhibition space, service zone with foyer and eatery, multipurpose hall and office.

Figure 82. Various functions under continues roof

Figure 83. Construction grid
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Construction multipurpose hall

For the free span of the multipurpose hall a storey high truss is applied, spanning the hall over the shortest direction. Between these two trusses lightweight cellular steel beams are placed with thereon a composite steel concrete floor. The cellular steel beams allow space for installation purposes.

Figure 84. Construction principle multipurpose room

Figure 85. Storey high truss supporting cellular beam ceiling
Climate concept

The buildings installations are designed for two situations; the standard daily situation and the situation immediately after a storm surge for which the building is designed to function independently.

The building has two separate rooms for climate control. The positions are so chosen that they lie at an ideal distance from the functions where they are most needed.

The technical area for the water-related installations is positioned at the level of the multipurpose hall. Directly adjacent are the water tanks for rainwater storage and drinking water storage. Also, the space in direct connection with geothermal storage.

Above the multipurpose hall the technical room for air related installations is positioned. The functions that have the highest demand for ventilation; the multipurpose hall, the eatery/kitchen and the office space are positioned in close proximity.

Figure 86. Climate concept
Climate concept solarthermal roof

Above the multipurpose hall a solar thermal roof is located. This roof is pitched towards the south to achieve an ideal energy efficiency. In this roof two sustainable functions are architecturally integrated. The basic roof finish consists of a metal sheet roof, placed between them are PV cells that generate enough electricity to keep the essential functions of the center operational when disconnected from the grid. PV cells lose efficiency as they heat up, this happens especially when the sun intensity is highest and the energy production could be optimal. By dissipating this heat, the PV cells maintain optimum efficiency. The heat is removed through conduits under the metal sheets (see Figure 88.) and depending on demand used for heating or geothermally stored.
Details

The facade package is designed so that no condensation will occur within the facade. The outer concrete layer functions as water retaining and vapor barrier. In case of flooding the salt water is prevented to penetrate the outer layer. This is especially a necessity at the parts where the facade is in contact with the water of Jamaica Bay on daily basis. To ensure the structural soundness and watertightness an integrally insulated cast-in-place concrete wall is used. Consequence for the openings is the calculation of tolerances (see Figure 89.)

The thick package of the vegetation roof damps extreme temperatures and provides space for installations under the suspended ceiling.

All openings are made of anodized aluminum frames to be corrosion resistant and contrast with the concrete facades. The skylights are designed in the same way, with a smooth uninterrupted inner circle to emphasize the concept of punctuating of the roof and to allow sunlight to be reflected to the functions below.

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Abstract – Sea levels are rising and Earth’s climate is becoming more extreme. These changes threaten the safety of millions of people living in coastal deltas. Floods already cause large disruption and will probably become one of the most urgent problems of this century (Roaf et al. 2005). This paper discusses the ways of dealing with urban settlements in low lying coastal areas and their risk of flooding. Firstly the common strategies of protecting against flooding are reflected. These are hard infrastructure projects, displacement of the population at risk and insurance of property combined with temporal evacuation. The shortcomings of these strategies are pointed out considering Earth’s changing climate. Hereby the cases of New Orleans in the Mississippi delta and Broad Channel, New York in Jamaica bay are set out to reflect upon the failure of relating to the natural environment, exemplified by flooding in the past. Both locations lay in a coastal wetland landscape and have been flooded by extreme weather events.

Following on these findings the paper calls for a change in strategies for maintaining a safe and sustainable living environment in the future. Although the urgency of new strategies seems apparent to most experts and designers in the profession, this understanding still seems to be missing among the public. The tool ‘seeing, understanding, acting’ is introduced to engage the public in new strategies, supporting an ongoing awareness and active stance in adapting to changing conditions. Applying such new strategies will change the way the built environment relates to the natural environment and in particular to water. So that living in close relation to the number one life source will still be possible in a safe and sustainable way.

Key words – flood risk, estuary, climate change, resiliency strategies, living with water, ecological urbanism, engaging communities

1 Introduction

Water is of enormous importance for us humans, it is our primary life source. We also depend on it for its rich natural resources, possibility for trade and transport, recreational value and liveliness. All these qualities made that over 360 million people live in close proximity to large water bodies, such as rivers, deltas, seas and oceans, vulnerable for flooding (Hoornweg 2012). With Earth’s climate changing at unprecedented rates our proximity to water becomes a growing threat. Besides sea level rise due to increasing temperatures, extreme weather occurs more frequent. Floods already cause large disruption and will probably become one of the most urgent problems of this century (Roaf et al. 2005). We will need to react on these upcoming changes to prevent natural disaster and disruption of our living environment. To do so is to provide an answer to the question; how can we still be living in close relation to water in a sustainable way without being disrupted by changing water levels and extreme weather events?

The paper will analyse common ways of dealing with the threat of flooding; at first discussing hard infrastructure projects following by insurance of property combined with temporal evacuation and displacement of the population at risk. Hereby the flooding of New Orleans in the Mississippi delta caused by hurricane Katrina and of Broad Channel, New York, in Jamaica bay caused by hurricane Sandy are set out to reflect upon the shortcomings exemplified by flooding in the past. Following on these findings the paper brings new strategies to light, questioning traditional approaches and offering alternatives in dealing with the changing conditions of our natural environment. To gain understanding, support and new initiatives from the public, the importance of incorporating a tool as ‘seeing, understanding, acting’ to engage communities in new strategies is emphasized.
2 Common strategies

The occurrence of floods is the most frequent among all natural disasters on Earth. In 2010, about 178 million people were affected by floods. The total losses in the years 1998 and 2010 exceeded $40 billion (The World Bank, 2012). Floods also cause other kinds of losses that are less easy to quantify but still meaningful, such as lost memorabilia, destruction of historic monuments and cultural assets, environmental degradation, and the hidden cost of trauma (Mileti 1999). Although floods have an increasing impact on us, we must not forget that flooding is a natural process. The impact of floods is largely caused by our own activities and choices, in particular urban development inside or near the floodplains, ‘the low-lying areas adjacent to rivers, lakes and oceans that are flooded periodically at intervals of varying frequency’ (Interagency Floodplain Management Review Committee 1994).

Urban development increases the risk of flood damages by increasing the speed and force of water flows across the landscape, and by placing more development in its way. Still water is often seen as a force threatening us, even though we neglect and disturb natural patterns and systems (Bosher 2008).

Three common strategies are used as an answer on this threat: fortification to harden edges; resilience to bend but not break; and retreat, to move out of harm’s way (Washburn 2013). With a changing climate these strategies are no longer self-evident; shortcomings of these strategies are pointed out. Understanding the shortcomings of common strategies is necessary to provide a body of knowledge for new strategies.

2.1 Hard infrastructure projects

Projects such as dikes, seawalls, canals, drainage systems are designed to withstand events of a particular magnitude and have been a way of protecting against floods for centuries. Even though these projects are subject to design flaws and other shortcomings, they often function sufficient as long the climate is stable (Faber 1996). When climate is changing with increasing speed and uncertain effects, the limitations of these projects become clear; hard infrastructural projects are static while the natural environment changes (Oppenheimer 2011). Result is a shortened functional lifespan although the construction costs remain the same, making projects less feasible.

Secondly these projects are largely isolated and are incapable of using the benefits nature can achieve in flood protection. By relying on these projects a distance is created in the relation to the natural environment, forgetting the characteristics of the system we are living in (Slobbe E. van, et al. 2013). A project such as a seawall does not work against erosion in the direct surrounding. Where natural systems are often able to accrete land, seawalls are not. Same goes for canalizing and enwalling water flows, they eliminate buffers that slowly let go of peak water discharge. This makes that water moves at higher speed, making it unable for sediments to settle and provide land accretion. Not only give peak discharge problems during the event itself, it as well makes that in dry periods no water is stored, causing draught and silting of groundwater in coastal areas.

Thirdly nature is often a threat to these projects. Trees can drain dikes in periods of drought, rodents weaken dike constructions. This means they will require maintenance and surveillance and therefor they need to be fully integrated in policy and governance to be working as planned. Simply building a flood barrier gives a false sense of safety (Whiston Spirn 2012) and adding up to their potential dysfunction; it disconnects people both visually and physically from their natural living environment. (see illustration 1.)

Illustration 1. Flood wall (n.d.)

2.2 Insurance and evacuation

Another strategy is accepting that once in a while property is at risk. Instead of adapting or defending the focus lies on temporary leaving the hazardous location and repairing the damage that is done afterwards. This is a strategy traditionally used in the US. It works in a stable climate where disaster happens at regular and acceptable intervals. With an increase of extreme weather, damage is increasing too. This resulted for the US alone in a quadrupled amount of damage over the period 1980-present. From 2011 to 2013 the federal government spent $136 billion on natural disaster relief in general which comes down to a total cost of $396 per household per year (Ovink 2013). Nowadays the insurance system often seems a tool to force people out of zones endangered by flooding (Birch and Wachter 2006). Extreme insurance rates make living in zones of high risk for flooding expensive or impossible to insure and so to face the risk of losing or damaging your property without being insured. It seems more like a punishment method to prevent
people from living in these flood prone zones. Broad Channel in Jamaica Bay is one of those locations where insurance rates increased exponentially. This places the people unable to pay such insurance rates at high risk. Even though leaving Broad Channel is often no option as it is a strongly connected community and it is still a high valued location to live.

2.3 Displacement of the population at risk.
Settlements have always been established close to large water bodies. The origins of these settlements lie often in zones close to water yet high enough to be safe from flooding. When these settlements grow the available grounds that are naturally safe from flooding will be insufficient. Economic and other local benefits make that expansions are made on floodplains. Often not taking the underlying natural system in account (Stevens et al. 2009).

Abandoning vulnerable areas is a traditional adaptation strategy. But mostly this is the last option when no alternatives are left and a location becomes not survivable (Roaf et al. 2005). Reason is that displacement has an immense financial and emotional impact. This involves buying out in the best case but not everyone is so fortunate. Displacement disrupts and destructs communities and their social capital built up over the years. Even when it is enforced on a small scale and gradually it is hard as a community looks like any other for most of the year. People connect, settle and come to love their living environment.

Especially in wealthy and densely populated countries displacement should not be the first option. Abandoning means that we do not learn anything from our environment and refuse to continue evolving our way of life. Our way of life cannot be static in a changing world, or we will become refugees of our own way of living.

3 Living in floodplains
In design and planning for cities and landscape, climate change is in most cases not integrated yet (Birkmann et al. 2010). We have been designing for a static world, as we have had a long period of stable climate. However this need to change as climate changes will strongly affect our living environment. Landscapes need to become more resilient and cities less vulnerable to extremes. This makes it important for designers to create new ways of future living which are sustainable, safe and prepared for change (Interagency Floodplain Management Review Committee 1994).

To come to these solutions a better understand in the conditions and failures of building in floodplains especially wetland estuaries is essential. The case of New Orleans and the location of my graduation project Broad Channel are reflected upon.

3.1 The case of New Orleans
A large scale flooding occurred in 2005 when hurricane Katrina hit the coast of Louisiana causing 80% of New Orleans being flooded and many properties destroyed. This was not the first time that flooding occurred, in 1992 hurricane Andrew caused destruction as well. After Andrew the problems were recognized and a vision was developed on a sustainable future for the coast (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998). At first the levees designed to protect city extensions from flooding formed a problem. They prevented sediment coming down from the Mississippi river to settle on the floodplains and cultivate marshland. Blocking sediments resulted the sinking of land behind the levees and subsidence overtaking the marshlands resulting in land loss (Plewke 2010). Secondly canals cause saltier water and stronger tides as seawater can more easily invade land through these canals putting the marshland under water for a longer time. This weakens the marshlands and make them more vulnerable for extreme weather events that damages the marshlands more substantial and erodes shores (Mathur and da Cunha 2006). Erosion affects and exposes New Orleans so that original defences are insufficient in protection. This makes the circle round; building higher levees in response to erosion will cause an even faster deterioration of the natural protection which will need to be compensated by even stronger levees.

Investing in understanding the natural systems and acting according to that can break the cycle of making New Orleans more vulnerable to flooding. One can think about closing off the canals by water locks to provide a quick fix and allow certain areas to flood temporary to buffer water discharge. New Orleans right now is a city that separates itself from the landscape by levees. Another possible way for New Orleans is to relate to its natural landscape as a settlement in a field of flows, with the Mississippi not just as a canal but as a dominant flow in a landscape of flows (Mathur and da Cunha 2006). These other flows accommodate overflows and buffer water discharge in extreme situations. The difference in seeing the city and plan according makes a big difference; New Orleans as a settlement on the Mississippi or as a settlement in a fluid terrain.

3.2 The case of Broad channel
Broad Channel is the only island community in Jamaica Bay, New York and is surrounded by coastal wetland. Coastal wetlands usually are true sanctuaries for wildlife. But they as well have a protective function against extreme weather events and erosion, in healthy condition they accrete land
by catching run off sediment. They are coastal stabilisers by absorbing tidal, wave and wind energy. Shellfish and the flora filter pollution and carbon dioxide to a certain extend. And still they have spatial quality for recreation and living. When taken care of these ecosystems are effective tools to mitigate extreme conditions for a safer living environment (EPA 2006). So far human interventions didn’t even come close to match such a layered and diverse system providing flood control, groundwater replenishment, shoreline stabilisation, storm protection, sediment and nutrient retention and export, water purification, biodiversity, wetland products, cultural value, recreation and tourism, climate change mitigation and adaption, spatial quality, all in one.

All that needs to be done is to make sure the natural environment is healthy so it can build on. This is where it basically went wrong as stated in the post Sandy report (2013, p.6): ‘Superstorm Sandy revealed that we have created a defenceless built environment’. Until early 1900 Jamaica Bay was an extensive estuarine ecosystem. But over the last century, urban and industrial development did change this ecosystem due to pollution, building, dredging and filling, over harvesting or eradication of native flora and fauna. (see illustration 2. and 3.) The original ability of Jamaica Bay to buffer and threshold extremes is deteriorated. And most settlements seem to have neglected the characteristics of the moving landscape.

These findings lead to the goal of my graduation project; to bring the qualities of the bay under attention by the public and provide knowledge for ways of living in and around the bay that are more in balance with the ecological system and extremes. This asks for a different way of building as hurricane Sandy did prove that Broad Channel was unable to deal with extreme water levels, in some cases even unable to deal with springtide. Instead of strengthening defences, a more fluid relationship between water, land and man-made structures is desired. Water must be seen as a part of the design so it will become part of the built environment and vice versa.

4 Towards a different approach
The case of the Netherlands is often an example for the world in how to live undisturbed and well protected in a low lying delta. The history of Dutch water management is dominated by the battle against water, keeping the water out and (re)claiming land. Now that it becomes evident that climate change causes new and different challenges to overcome, this familiar strategy is not always able to deal with that. A new strategy that incorporate climate change is the Dutch Adaption Strategy. The cooperation between the government, provinces, water boards and municipalities called Adaption of the Spatial layout and Climate (ARK) already shows a change in approach. They state that a climate proof spatial layout not only requires high resistance but as well resilience and adaptability. This terminology is translated as following:

- Resistance is to resist extreme circumstances.
- Resilience is the ability to recover from an event fast when circumstances turn back to normal. The location changes temporary and after the event everything goes back to normal again.
- Adaptability is the capability to deal with the increasing uncertainties of climate change, in size and pace.

It shows that resistance alone, mostly achieved by hard infrastructural projects, is not sufficient for a safe living. With increased peak run off from the rivers, increased sea levels and winter storms the historic response to heighten the dike would only increase the vulnerability as a small breakthrough could have a huge impact. Vulnerability will be lowered if integrated and multifunctional solutions...
are built whilst respecting natural processes rather than against it. Projects such as the 'sand engine' on the Delfland coast (Vriend et al. 2012) and the planned parking garage in a dune at Katwijk explore new possibilities for a more promising future (Raalten 2014). Especially the parking garage is a clear example of integrating standard necessities with local requirements where the boundaries between nature and built environment fade.

5 Seeing, understanding, acting
The urgency of coming up with new solutions and strategies can be seen in the field of architecture, urbanism and civil engineering and associated professions (Ryan 2010). Water becomes a more central subject in publications, events and exhibitions such as the 2nd International Architecture Biennale in Rotterdam, the exhibition H2O=life by that National History Museum in New York the Water Expo in Suzhou, China and the Rebuild by Design competition to name a few. Still the reaction after a flooding makes clear that the people in places at risk in most cases don’t fully understand what is happening, what causes it and how to react on it (The World Bank 2012). At these times anger and frustration at the loss of control of the distinction between water and land afford little room for considering another mode of settlement. ‘Levees remain the firm dividers and remain the driving force of settlement until the next flood’ (Ryan 2010, p. 15). People feel especially abandoned in places where an organisational system of planning and implementation is missing. One can question if living in the same area still has the qualities as before being flooded. Is one still able to fully enjoy the qualities of their living environment? A resident stated after hurricane Sandy: ‘we want to be free from the fear that every year may bring a storm that will destroy everything we have made, washing away a lifetime of investment like an afternoon’s sand castle’ (Washburn 2013b). This brings an even more important challenge to light besides the creation of adaptive strategies; to provide communities living in areas at risk of flooding with knowledge and tools. So that when they apply these measurements they can fully enjoy their living environment again. It is in the build environment and building scale where measurements are respectively easy to achieve. Buildings can be adapted so that the essential elements are safe above the flood level. This makes that the community is able to stay so that social relations are maintained.

To come to this point, three steps are formulated to create a backing for new strategies and provide possibilities for communities to prepare their living environment for climate change.

- First step is seeing; it provides the necessary experience, this can for example be done by actually experiencing a flood, architectural examples or by education.
- Second step is understanding; it provides the knowledge to actually understand why and how events are happening this way, understanding the underlying natural system.
- Third step is acting; designed solutions by professionals give tools and ideas to prepare and adapt to prevent disaster from happening.

It is only when these three steps are taken one can fully enjoy their environment without the fear of destruction. So that most days of the year one can enjoy the fantastic environment but on those few days one is able to react on the extreme conditions, able to sit out for a while to continue to its normal setting when the extreme conditions are over. These three steps form the basis of my design. By combining functions for the community of Broad Channel, the public and water related institutions of knowledge in one building an exchange of experience and knowledge can be supported. The multifunctional centre becomes a node of exchange of ideas and information so that the first two steps can be taken within the centre and the last step of acting is supported. The centre makes thinking about new solutions and strategies visible to the public, creating an ongoing involvement with the direct living environment and local communities.

6 Conclusions
Current used strategies designed for resiliency against flooding do fit a stable climate. Now that the climate is changing these strategies fall short. New approaches and strategies are needed to be able to follow the changes in climate and so to create a robust, sustainable, adaptable, multifunctional living environment. Understanding the common strategies and their shortcomings is the first step towards new solutions. In this process it becomes more and more clear that if we work together with our direct environment, our direct environment will work with us. This does not mean hard infrastructure projects on other traditional strategies are history, we will still depend on them. Strength of new strategies can be found in the combination of multiple layers, buffers and thresholds working together, able to mediate the extremes. The fact that these new strategies are better solutions to mediate effects of extreme weather conditions is not yet prominently apparent to the public. Same goes for the necessity of a robust and well-functioning ecological system, which is capable of adapting to climate changes. This needs to change; tools as seeing, understanding, acting can close the gap between the available solutions and the actual implementation to engage communities in
decreasing the natural threat on their build environment. And enable that each individual can take steps based upon the experience and knowledge provided. To fully enjoy living in close proximity to our number one life source.

Building a multifunctional centre on Broad Channel using this tool and implementing alternative solutions in the building’s design will create a constant awareness of possible flooding. By minimizing the dependency on common infrastructure the centre can as well function as a refugee/coordination centre in case of flooding. So that the centre becomes both an architectural example of building in a flood prone area, based upon the characteristics of the natural surroundings, and a node for the exchange of knowledge.

References


Living with water
Flood resiliency of communities in the Jamaica Bay estuary

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Research Methods

April 15th 2014
1 Introduction

The Delta Interventions graduation studio is an inter-disciplinary studio of architecture, urbanism and civil engineering. Focus of the studio is the sustainable relation between cities and water-landscapes in a changing climate. This involves safety, better water-systems, stronger spatial identities and a stronger cohesion between the built environment and the natural environment. The design location of the studio is the New York region, triggered by the impact of Hurricane Sandy based upon a layer approach, visits to affected locations and personal fascination forms the motivation for selecting a specific design location within the New York region.

Brook Channel, the only island neighbourhood in Jamaica Bay, is one of the locations affected by Hurricane Sandy in the New York region. Large parts of the neighbourhood were damaged or destroyed by inundation and wave force, especially to the tidal conditions. Still nobody thinks about abandoning the neighbourhood as it is, paradoxically, highly valued by its inhabitants for the close relation to the water, its vast views and proximity to New York.

This underlines the attractive power water has on people, not only as a primary source of life, also for its rich natural resources, possibility for trade and transport, recreational value and liveliness. All these qualities made that over 360 million people live in close proximity to large water bodies, such as rivers, lakes, seas and oceans, vulnerable for flooding. With Earth’s climate changing at unprecedented rates this proximity becomes a growing threat. Besides sea level rise due to increasing temperatures, extreme weather events become more frequent. Flooding already causes large disruption and will probably become one of the most urgent problems of this century (Roaf et al. 2005). The need is high to react on these changes to prevent natural disaster and disruption of the living environment.

In this paper the natural conditions of the bay and the effects of human activity over time will be set out. This will help to understand the functioning of the ecological system and the influence man-made structures have on this. The outcomes of this paper will form the basis for setting guidelines and parameters on which an architectonic design can react.

The Delta Interventions graduation studio is an inter-disciplinary studio of architecture, urbanism and civil engineering. Focus of the studio is the sustainable relation between cities and water-landscapes in a changing climate. This involves safety, better water-systems, stronger spatial identities and a stronger cohesion between the built environment and the natural environment. The design location of the studio is the New York region, triggered by the impact of Hurricane Sandy based upon a layer approach, visits to affected locations and personal fascination forms the motivation for selecting a specific design location within the New York region.
2 Building in the estuary

In design and planning for cities and landscape, climate change is in most cases not integrated yet (Birkmann et al. 2010). We have been designing for a static world, as we have had a long period of stable climate. However this needs to change as climate changes will strongly affect our living environment. Landscapes need to become more resilient and cities less vulnerable to extremes. This makes it important for designers to create new ways of future building which are sustainable, safe and prepared for change (Interagency Floodplain Management Review Committee 1994). To come to these solutions a better understand in the conditions of building in floodplains, in this case wetland estuaries, is essential.

Wetland estuaries usually are true sanctuaries for wildlife. But they as well have a protective function against extreme weather events and erosion, in healthy condition they accrete land by catching run off sediment. They are coastal stabilisers by absorbing tidal, wave and wind energy. Shellfish and the flora filter pollution and carbon dioxide to a certain extend. And still they have spatial quality for recreation and living. When taken care of these ecosystems are effective tools to mitigate extreme conditions for a safer living environment (EPA 2006). So far human interventions didn’t even come close to match such a layered and diverse system providing flood control, groundwater replenishment, shoreline stabilisation, storm protection, sediment and nutrient retention and export, water purification, biodiversity, wetland products, cultural value, recreation and tourism, climate change mitigation and adaption, spatial quality, all in one.

Until early 1900 Jamaica Bay was such an extensive estuarine ecosystem. But over the last century, urban and industrial development did change this ecosystem due to pollution, building, dredging and filling, over harvesting or eradication of native flora and fauna. The original ability of Jamaica Bay to buffer and threshold extremes is deteriorated. In the process most settlements have neglected the characteristics of the bay. Now that fluctuating water levels affect existing buildings on a more frequent and extreme basis these neglected characteristics become of growing interest.

Nowadays the following adaptations to fluctuating water levels can be found in Broad Channel: houses on piles mostly above the water or marsh and houses with an elevated first level. This can be simplified to one strategy against fluctuating water levels, that of raising a building. The variation of heights of the first floors of the houses show that a norm or regulation for building above a certain level is missing. One can find houses with the first level a full storey elevated next to one with the first level on ground level. Apparent is that houses with a direct relation to the water are often higher elevated than places where the fluctuations of the water levels is less visible. This unregulated and individual approach in defending yourself against flooding is characterizing for America. In America the municipality has a great deal of autonomy, making regional cooperation difficult. According to Rodin ‘The vulnerabilities are regional… Yet we have individual community rule, and very little incentive to get out of that.’(Shorto 2014) This makes architecture a more important discipline of improving resiliency against flooding in America than for example in the Netherlands, where most planning and flood resiliency measures takes place on a larger scale.

3 Adaptation for resiliency

These findings lead to the goal of my graduation project; to bring the qualities of the bay under attention by the public and provide knowledge for ways of building in and around the bay that are more in balance with the ecological system and extremes. So that the public can experience the vastness, remoteness and close relation with water in the heart of Jamaica Bay and thereby creating awareness of the value of Jamaica Bay. This asks for a different way of building as hurricane Sandy did prove that Broad Channel was unable to deal with extreme water levels, in some cases even unable to deal with springtide. The close relation of the neighbourhood with Jamaica Bay is both a quality and a threat which seems contradicting. Eliminating the threat by building dykes results in eliminating the quality of the neighbourhood as well. Instead of strengthening defences, a more fluid relationship between water, land and man-made structures is desired. This is emphasised by many in the past centuries. Hippocrates describes the importance of ‘airs, water and places’ for individuals and
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communities, so does Vitruvius in describing how the build environment should respond to the seasonal patterns. In the fifteenth century Alberti advocated in his treatise: ‘…nor anything (should be) undertaken that might immediately come into conflict with Nature. For so great is Nature’s strength that, although on occasion some huge obstacle may obstruct her, or some barrier divert her, she will always overcome and destroy any opposition or impediment; and any stubbornness, as it were, displayed against her, will eventually be overthrown and destroyed by her continual and persistent onslaught.’ (Pearson 2011, 42) It magnifies the importance of understanding and acting considering the natural environment and its driving forces.

This strategy is leading in the design of a flood proof multifunctional knowledge centre. It enables the centre to serve multiple purposes. Both the public and locals can experience the qualities of the bay in multiple ways. When this will be connected to the knowledge how the bay works, it can be valued both for its recreational an ecological qualities as for its qualities in mitigating storm surges.

To fully experience the bay the different ecological zones are of importance. Three water related building typologies are introduced, each one reacting in a different way with the surrounding. All three typologies play with slowly opening up towards the nature, showing their specific qualities to the public. Different experiences follow up on each other, organized by the ways of protecting against flooding and position in the landscape. The experience of the centre makes that one, aware or unaware, gains knowledge about possibilities in improving resiliency. In the same time the building expresses the characteristics of the natural environment. Embedding itself in the environment as if it destined to be in this place because it did adapt itself to the specific conditions of the location and surrounding ecological system.

The routing of the centre is based on the same principle of experiencing the different levels and characteristics of the surrounding. The exposition starts by going down to the lowest point with the least openings to the outside, giving the experience of being cornered in by water and close to the meeting of the building with the forces of water. When one continues the exposition by going up, every step reveals more and further out views of the surrounding.

It shows that protecting against flooding does not necessarily mean close off or create a distance to the direct surrounding. Doing so would devaluate the quality of living in such location as the close relation to the bay is eliminated. Especially when considering that most of the time there is no reason to be high above the ground or be closed off from the water.

4 Research Methodology

First phase of the research is carried out to form an understanding of the natural environment and to make it possible to construct parameters for further research on building scale and architectonic thematic. Further research is characterised by the application of two episteme, typology and phenomenology.

The focus on typology is applied by looking at the buildings in the bay and their relation to changing water levels throughout history. Since the first inhabitants of the bay, Native Americans, the relation of built structures with water changed tremendously, same goes for the supporting infrastructure. The Native Americans avoided the fluctuating water levels of the floodplains by the use temporary occupation, a sustainable solution, but unimaginable for current way of living. During the colonisation the abundance of natural resources in and around the bay made that the first houses were built on the edges between the highest pieces of land and water, close to the water but still height enough to be safe from flooding. The houses were built on stilts, floating barges were used as well to serve the same purpose. Up until this moment the inhabitants of the bay lived in close relation to the water, still allowing the landscape to change over time and maintain itself. With the embankments, landfills, channelling and modern infrastructure this came to an end in the nineteenth century. No longer did every building have a direct relation with the bay. Economic and other local benefits make that expansions are made on low lying areas. Often not taking the underlying natural system in account (Stevens et al. 2009). The slightest change in the bays water levels directly pose a threat to these buildings.
Water related building typologies such as temporary buildings, buildings on stilts and floating buildings are able to cope with fluctuation water levels up to different extents. This list is completed with theoretical research. For the design I categorized these in three main typologies namely: floating, amphibious and fixed buildings, whereby the fixed typology can be divided in elevating and flood proofing. Goal is to implement these typologies in the design of my graduation project relating to their specific location in the bay, creating a showcase for sustainable water related buildings in the bay. Using different typologies related to fluctuating water levels alone will not guarantee an increased awareness of the characteristics of the bay. Each typology must provide a specific experience related to its location in the landscape and way of reacting on changing water. This leads to the episteme of phenomenology, the study of perceptual experience, to make the visitors aware of the characteristics of the bay and the possible adaptive ways of building considering fluctuating water levels. Case study research of adaptive architecture in the delta provided insight in various architectural possibilities of connecting an architectural project to the landscape. With the focus on how natural conditions influence design choices and the way these can be expressed. As each typology differs in its relation with the landscape so it must differ in the experience of the visitor; making the project way more meaningful than a building that happened to answer to a programmatic brief.

5 Conclusions

The impact of climate change on our living environment becomes more and more clear over time and most likely will be of growing influence in many professions. Therefore it is highly relevant for me, as an architecture student, to gain understanding and position in this process. Broad Channel is not the only neighbourhood facing a high risk of flooding. The neighbourhoods in the direct surrounding will most likely face the same risk in the near future, taking sea level rise and more extreme weather into account. These changes in climate are already and will eventually influence more deltas and coastal regions worldwide. More and more areas that never faced water hazards will have to deal with it. As Anne Whiston Spirn states ‘Humans’ survival as a species depends upon adapting ourselves and our…settlements in new, life-sustaining ways, shaping contexts that acknowledge connections to air, earth, water, life, and to each other, and that help us feel and understand these connections…’ (1998, 26). Therefore it is essential to look at places that are already dealing with these changing conditions, reflect on how sustainable and durable the relation to water is shaped and invest in new solutions.

My graduation project is a reaction on this knowledge. A multifunctional knowledge centre is designed based on a research focused on the characteristics of the estuarine ecosystem of Jamaica Bay, building typologies related to fluctuating water levels and the experience of the relation between landscape, in particular water, and man-made structures. The used principles should not incidental but a contribution to the ongoing discussion and development on the way we build in relation to water. Not only does it create awareness in an early stage it as well influences the way we think and make our choices for the future.
Bibliography


