CONTENTS

PROLEGOMENON

Historic urban environment needs more protection of its cultural heritage, but not only. An alternative approach to upgrade a historic environment that would respond more favourably to the nowadays city's needs is to design for heritage preservation, quality of open public space, environmental damage and so on. It is therefore important to shape new urban places within historic environment considering: time, history and innovative design.
Accordingly, urban planners and designers have critical roles on responding to current trends and concerns on public realm enhancements to improve accessibility, walkability and reduce car traffic and pollution. At the same time, they can create better places for socialisation, relaxation, urban safety against crime and terrorism, reduction of environmental threats and enhancement of cultural heritage.
But, what is much needed to take into consideration is climate change that never before has been such a determined issue in existing and new development. To face climate change within urban transformation in historic context is important to proceed with specific actions such as reduction of gas emissions, implementation of an integrative planning to mitigate extreme weather and so on. However, a key issue is to create a new 'form of urban transformation' that can make a stronger cultural, social and environmental urban context. Moreover, to design for health and well-being can also play an important role in transforming historic urban tissues.

This volume is a deeper feedback to the Special Session 'Urban Heritage in Times of Uncertainty', presented within the IV International Conference on 'Changing Cities. Spatial, Design, Landscape and Socio-economic Dimensions' and chaired by Dimitra Babalis and Tim G. Townshend.[1]
However, the discussion about the future of the Changing City is to address innovative ways on exploring transformation of urban heritage in current uncertain times which can increase urbanity, protect cultural heritage, improve urban safety.

The collection of the chapters in this volume provides on responding to urban uncertainty in view of the above-mentioned issues while presenting future perspectives to face such specific matters. A central question should be put: How do we see urban heritage can be central to the planning and design processes? Developing more sustainable and resilient historic environments requires a wide variety of both experimentation and innovation.
As the chapters reveal, the choice of clear urban strategies has a major role in promoting urban change that can offer a great added value in such a state of urban uncertainty. Notably, it is hoped to reach a major awareness on climate change to revitalise and protect sensitive urban spaces. However, this perspective requires a wider vision and local cooperation to deliver better design.

Dimitra Babalis
The Series Editor

[1] The IV International Conference on 'Changing Cities. Spatial, Design, Landscape and Socio-economic Dimensions' has been organised by the Lab of Urban Morphology and Design, Department of Planning and Regional Development, University of Thessaly and held in Chania, Island of Crete, Greece, 24-29 June 2019. The invitation to the Special Session 'Urban Heritage in Times of Uncertainty' was made by the Chair of Organising and Scientific Committees Prof. Aspa Gospodini.

INTRODUCTION

Making Change for Protection, Safety and Urban Quality

Dimitra Babalis
Tim G. Townshend

We live in an increasingly urbanising world treated by environmental pollution, climate change with related extreme weather events, terrorism and so on. Further, the rapid economic and social changes have been such a pressing issue while technology seems has been resulting in increasingly fluid and ambiguous spatial and human relationships. The responses should be understood in view of these overarching issues and should drive professionals forward adaptable planning and design solutions.
To deal with such specific matters that could be more appropriately considered by local authorities and professionals, the following questions should be raised:
How should designers respond to urban uncertainty? How can we ensure our urban heritage is protected against urban risks and climate change? How can we create places that increase urban quality, socialisation, equity and increase opportunities for change while maximise technological potential and minimise environmental damages?
This volume addresses current trends and challenges exploring on how we can transform our urban heritage in ways which increase urban resilience and sociability, improve urban safety, flood protection embracing innovation and technology. Moreover, historic urban environment should be protected and properly designed to provide climate change. Planning and design should integrate climate considerations with compact urban form and structure.
In particular, this includes:
• Urban strategies for climate change mitigation and adaptation with more greening to maximise micro-climates within the city
• Climate-responsive design at a local scale to protect urban heritage of core areas, historic waterfronts and sensitive landscapes
• Opportunities to innovate urban environment prioritising cross-sectorial strategies to reduce urban uncertainty
• Urban design for security and protection against terrorism
• Urban policy for social cohesion and well-being for long-term resilience.

Ideally, a supplementary planning and design research should be useful to better face current urban uncertainty but should also look at preserving and protecting elements and structures strictly relating to a sensitive historic environment and its future change. Knowledge, vision and strategy are essential for an effective approach to the cultural heritage and its protection. In detail, valuable heritage does not need to be excluded from regeneration process that will ensure its preservation.
It is therefore important to proceed on the basis of a clear understanding of urban heritage and its integrity, distinctiveness, physical quality and coherence. This can be the way to reach successful design and appropriate use of context. It is no coincidence that the best designed places in sensitive context are the most valuable and enduring.

Structure of the Book

PART I - *Urban Change for Experimentation and Sociability* provides a critical view in driving forward a new conception of urban transformation that should respond to current concerns around economic, social and climate change. Designers can use new tools and strategies to ensure urban change-related actions and on responding to specific issues that people care about. Further It emphasises how planners and designers should look beyond the site boundaries and try to incorporate with planning and design wider existing values and resources to create design in harmony with recent times.

Chapter 1 - *Pocket Parks for Changing Times and Urban Uncertainties* by Dimitra Babalis deals with new forms of public open spaces to meet community needs and new uses in historic environment. The regeneration of small-sized urban spaces such as small green strips, community gardens, courtyards, waterfront spaces and so on can create places of great community asset. Spaces for play, relaxation, socialisation and physical activity are vital for individual and community well-being; yet at the same time issues such as landscape protection and urban security can create challenges for the designer. The chapter examines how 'pocket park design' can be an inspirational idea to when set into a well-coordinated strategy for a city's small spaces with a greater awareness, self-sufficiency, flexibility, capacity and adaptation to both climate and social change. In this chapter, the use of the comparative method of analysis of examples drawn from across Europe it seeks to define characteristics, typologies and variety of pocket park design. Finally, it is argued that is necessary to establish concrete concepts and guidelines including a variety of design aspects for the creation of a new typology of pocket parks that can produce more successful spatial relationships and conditions at the societal level.

Chapter 2 - *The 'Garden City' as Buffer in Times of Uncertainty* by Grete Swensen and Sveinung Krokann Berg discusses on how urban heritage can be transformed to increase urban quality, sociability and urban safety. Particularly, the chapter puts major attention on the future of the 'Garden City' in times of scientific uncertainty and deep disagreement of existing values, the so called 'wicked problems'. However, it is argued that, nowadays, the choice of suitable planning policies and strategies can bring to acceptable solutions and successful cooperation among planners, designers and public stakeholders. Existing urban qualities such as green infrastructures and historic buildings can be survived to new city planning strategies when design guidelines are clear and public participation is successful. Further, the chapter discusses on environmental change and societal impacts when contemporary urban development takes place that should be characterised by sustainable urbanisation, mixed and area-effective use of urban space. Finally. It reflects on the case study of Lillestrøm, a small garden city located in the fringe of Oslo, and tries to put in evidence if visible qualities of the Garden City still can contribute to characterise its urban heritage. It also outlines specific aspects of contemporary planning that have transfer value for the creation of a more sustainable urban context to facing impacts of climate and social change.

Chapter 3 - *The Case Study of Paris in an Increasingly Uncertain Europe* by Annamaria S. de Rosa and Elena Bocci is part of a wider on-going research inspired by the paradigm of social representations and applying the 'modelling approach'. This contribution is aimed to study the system of attribution of meanings to the different spatial dimensions of 'underground' and 'over-ground' in the city of Paris; To analyse the differences in the social representations of 50 professional drivers in surface transport (trams, buses, taxis) and in subsoil (underground, RER). Expected differences are found in the articulation of the social representations of the overground and underground metropolitan city and different positioning of the professional groups of drivers in surface transport and in the subsoil. The chapter puts attention on contextualising the study in the light of the terrorist events in 2015, in the wider European scenario. Specific attention has been paid to the dimension of risk in the reading of data from a longitudinal point of view.

Particularly, some results obtained through the mental maps that indicated the districts perceived as more dangerous have been re-read in relation to the tragic events happened. Finally, it outlines that results of the psycho-social research can contribute to the wider debate for best urban transformations to improve urban safety.

Chapter 4 - *The Socio-economic Dimension of Ten European Capitals Through the Lens of Destination@-branding* by Annamaria S. de Rosa, Elena Bocci, M. Latini includes the media studies of a wider research to capture the 'virtual brand image' of ten European historical Capitals cities through the analysis of the commercial websites Booking.com and TripWolf. The city destination through Internet has been considered not only as an object of perception but also, more comprehensively, as an object of social representation. The descriptive results highlight - among others - the socio-economic dimension of the ten European Capitals. Structural results valorise the historical capitals in the different characterising dimensions, indicating the @-branding as an engine of development not only in the economic perspective, but also in that of identity. Pursuing policies aimed at 'quality tourism' would contribute to reconciling economic development and social identity with the themes of social cohesion and relationship between host and hosted.

PART II – *Heritage Protection: Urban Quality and Resilience* underscores the importance of the current perception of urban and architectural design that can take into consideration climate change. Nowadays it is crucial to integrate adaptation and mitigation conditions in urban regeneration and new development. With this conception, major design tasks should be included for the placement of new projects while other design issues should include physical security, site utilities, and landscaping. Furthermore, historic places such as waterfronts can offer new perspectives on responding to current trends for urbanity and sociability.

Chapter 5 - *The Shoreline and Climate Change: Investigating Strategies and Architectural Typologies against Uncertainty* by Snehal Hannurkar, Laura Eshuis, Irene Curulli, reflects on dramatic climate-related disasters regarding shorelines. The chapter is mainly focusing on architecture developing along water edges for flood protection relating to their specific location, the intensity of water and the climate zone where the flood occur. Particularly, new design strategies and architectural typologies have been developed along vulnerable shorelines to face the challenges and uncertainties relating to the climate change. In urban terms, flood protection systems along shorelines should be flexible within urban strategies and policies and goals of urban development.
Further, the chapter investigates on contemporary and innovative design concepts/typologies of 'shoreline adaptation' that are able to respond to urban uncertainty, while providing new urban scenarios. Some selected study cases are discussed and key elements are analysed to explain protection respecting existing conditions and the impact of regulatory requirements.

Chapter 6 - *The Role of the Built Heritage for the Imageability of the Waterfronts* by Serengül Seçmen, Handan Türkoğlu discusses on imageability as the most important quality that can determine sense of place and quality of historic waterfronts. Research considers mainly the value of built heritage of waterfronts setting the variables developed around the concept of imageability. In this chapter imageability is defined as the main condition to define part of the city very well recognisable that evokes emotions and various impressions. The Istanbul waterfronts are taking into consideration for evaluation and deeper understanding. Further, the chapter outlines that historical waterfronts including historical landmarks result stronger in terms of imageability in comparison with the modern ones. It is also stressed that waterfronts of highly imageable are those with water-dependent built heritage historical landmarks and water-related features. So, understanding built and natural elements of historic waterfronts should be considered as an integrated process to determine relations between places and its users. Finally, the presence of mandatory codes dealing with physical resources can lead to the need for a performance-based approach to successful design.

1

Pocket Parks for Changing Times and Urban Uncertainties

Dimitra Babalis

In recent years new forms of public open spaces are designed to meet community needs while new urban uses and rules have been emerged. The regeneration of small-sized urban spaces in historic environment such as small green strips, community gardens, courtyards, waterfront spaces and so on can create places of great urban asset. Spaces for play, relaxation, socialisation and physical activity, in fact, are vital for individual and community well-being; yet at the same time issues such as landscape protection and urban security can create challenges for designers.

This chapter examines how 'pocket park design' can be an inspirational idea to when set into a well-coordinated strategy for a city's small and sensitive spaces with a greater awareness, self-sufficiency, flexibility, capacity and adaptation to both climate change and people needs. The use of the comparative method of analysis of examples drawn from across Europe it seeks to define characteristics, types and variety of 'pocket park design'. Notably, it is argued that in the Historic City is necessary to establish concrete concepts and design guidelines for the creation of a new typology of pocket parks that can produce more successful spatial relationships and new urban conditions at the societal level.

Overview

In the last decades, Contemporary City has saw great changes in terms of urban structure and image.

However, in the past planning attitudes and processes have created urban and environmental risks, damage of natural ecosystems and biodiversity that contributed significantly to related problems such as heat islands, flooding and so on. In recent years, the economic global crisis generated also a deep social crisis that urban governance has struggled to address. New strategies and policies to tackle social inclusion/exclusion, urban security and environmental awareness have become a key issue. Environmental and urban resources need protection to meet community needs without compromising those of future generations as made clear by the theory of sustainable development and its succeeding amendments.

To this end, the future of the city and its transformation depends not only on the ability of those who design and manage its urban fabric but also on the participation of local people. Notably, small spaces could be of great opportunity for urban change such as to bring people together, create places for community cohesion and address broader issues (biodiversity, environmental damage and so on).

Furthermore, wider city's derelict and abandoned small spaces can be transformed either on a temporary or permanent basis to bring back urbanity. If a city park, or public square, can positively influence urban environment, a network of many small urban places, or many parks, actively can increase enjoyment, socialisation, health and well-being.

London - City Hall Area: relax pocket park (image: D. Babalis).

[1] The research study entitled *The evaluation of the residual spaces as a resource for urban quality. Pocket parks for all* was supported by the University of Florence and developed at the Department of Architecture (DiDA) from 2015 to 2017. (PSA. Year 2014).

Particularly, it is argued that attention should be paid to the potentiality of small space regeneration. Innovative strategies and designs should be explored and new models of urban transformation should be considered. A new typology of small urban spaces may usefully be created, especially to satisfy needs of historic environment.

The pocket park conception

Peterson (1969) discusses that the pocket park conception was born in New York during the first half of the 1960s, with a pilot project. Peterson reported on the experience of the three small parks, built in Harlem and outlined all the practical difficulties associated with their design and maintenance. He argued that where local support (through associations) was appeared, was easier to find people to work on it. Between 1964 and 1965 a New York a network of pocket parks were placed and today, the City has a variety of pocket parks. The 'Paley Park' is one of the most well-known of New York's pocket parks which is located within the Midtown Cultural District, surrounded by skyscrapers. The Paley Park was designed by Zion and Breene Associates, for the William S. Paley Foundation and was completed in 1967. The Park is one of the smallest urban parks in the City and is considered as a key meeting point for relaxation. It is accessible and directly connected to route ways while a waterfall is clearly visible from the entrance creating a pleasant urban environment.
Spinelli (2010) outlines the original definition of the 'vest pocket park' as open public space placed within an urban block and it is defined as a mini park with natural elements. Spinelli also argued clearly about the differences between the New York pocket parks and those in Europe, specifically these of Lyon and Copenhagen. He sustains that the European cases are well-planned and often included within urban planning.
Blake (2013) defines pocket parks as urban spaces of a very small size that should be distributed and embedded in public urban fabric, accessible to people and suitable to different local needs. Blake underlines pocket parks can be created on small free lots or abandoned small spaces and are often designed to a concept of local groups, associations or private organisations that have reclaimed abandoned spaces. Pocket park projects with no ongoing community support and public management can often fall into a state of deterioration.

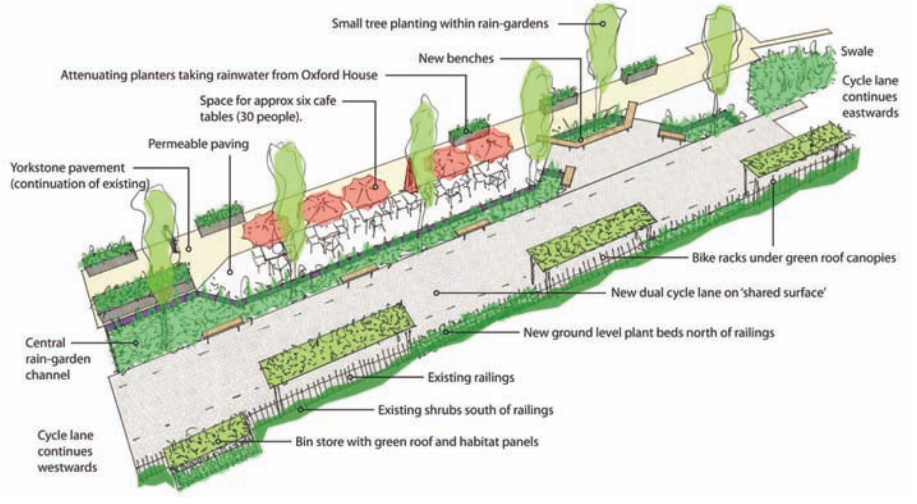
Surma (2013), argues that the pocket parks in Europe are small green oases, located in both core urban areas or in highly urbanised areas. They are often designed as part of a wider urban regeneration plan. Many are placed on single lots corresponding to abandoned buildings or small irregular plots of leftover land, while some are close to historic cores, monuments, markets and so on. A network of pocket parks can add value to a city's green infrastructure and therefore important for increasing biodiversity. Moreover, pocket parks have a broader role in terms of improving the viability of an urban environment by providing job opportunities and creating places for creativity and entrepreneurship, as well as health and well-being (Simon 2010).
According to Nordh et al. (2009) there is no commonly accepted definition of pocket parks. Although generally they are small-scale parks which respond to local needs and have natural elements. Their character and design vary considerably from a context to context. Nordh et al. have developed a significant research taking into consideration a number of small parks within Scandinavian cities in an attempt to identify parameters such as size, design, green components.
The research data are subsequently used to make a definition of a 'pocket park typology' including the following key elements:
• The dimension not less than 3.000 m2
• At least one side oriented towards a public road to facilitate accessibility
• The equipment and services available freely and free of charge for local people
• To be considered with a pocket park design the private-owned spaces such as outdoor bars or restaurants.

In summary, there is a variety of types of pocket parks of a specific urban configuration according to a number of urban dynamics and social needs: from playgrounds to places for relaxation and socialisation; from small green spaces to small temporary spaces for creativity; from small commercial spaces (market places) to small spaces for sport and well-being.

Pocket Parks and their key structuring elements

The main goal of the research study[1] undertaken at the University of Florence on which this paper is based represented an attempt to understand the key structuring elements of a pocket park.

London - Bethnal Green: Derbyshire Street Pocket Park to replace car parking lot @ Greysmith Associates Ltd (source: https://www.eastlondonlines.co.uk/2014/01/pocket-park-to-replace-car-parking-lot-in-bethnal-green/).



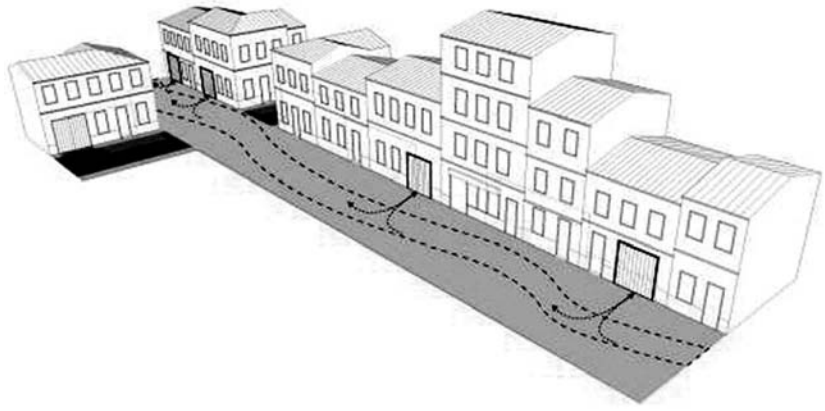
[2] The specific research on pocket parks within the research study mentioned in note 1 was fully coordinated and conducted by Dimitra Babalis. Particularly, the findings on pocket parks' key structuring elements and pocket parks' types have been identified by the author following an accurate comparative study of a number of case studies in Europe and USA.

Amsterdam - Westerpark: Playground pocket parks (image: D. Babalis).

Amsterdam - Westerpark: urban farming (image: D. Babalis).

London - Crossbones: urban farming (image: D. Babalis).

Bordeaux [Re]Centres Project - Marne-Kléber: a network of regenerated small spaces with trees and vegetation carried out by local community (source: Bordeaux 2030: vers le grand Bordeaux e Livret Bordeaux [Re]Centres).



[6] The term of 'Urban Acupuncture' has been developed by Finnish architect Marco Casagrande. This theory introduces a design thinking with the development of local innovative projects for extensive participatory transformation projects. Urban Acupuncture is likely presented as a sustainable urban regeneration method that highlights a long-term planning and design, especially in existing and sensitive built environment. See: BABALIS D., (2017) From River to Riverfront. Sustainable Masterplans and Connected Waterfront Urban Spaces along the Southside of the River Arno in Florence, pp 19-21.

[7] 'Bordeaux Metropole, Plan Local Urbanisme', PLU 3.1 (2015), pdf available at: http://www.bordeaux-metropole.fr/plan-local-d-urbanisme-plu/planlocal-d-urbanisme-plu

[8] 'The Bordeaux Plan [Re] Centers' has been launched by the 'Bordeaux Commune' in collaboration with the 'Communauté Urbaine de Bordeaux (CUB)' and thanks to a state contribution that co-finances targeted actions under the National Program of 'Réunion des Quartiers Anciens Dégradés' (PNRQAD).

[9] The PLU 3.1 of the City of Bordeaux is structured as follows: (a) *Rapport de présentation*, an introductory report, (b) *Projet d'Aménagement et de Développement Durable (PADD)*, the project for sustainable planning and development, (c) *Orientation and Action Program* (POA), which outlines the guidelines and regulations for the implementation of Metropolitan area planning policies (PLH) and Mobility (*Plan des Déplacements Urbains*, PDU), (d) *Proportion pour les quartiers*, complementary to the 'Rapport de Présentation', which includes several brochures prepared for some districts with particular attention in preliminary studies and pre-operative reflections/'Règlement' which defines the general and particular rules of land use.

[10] PADD's aims also to: (a) respect and preserve natural resources of the Bordeaux Metropolitan Area, (b) to develop sustainable mobility, (c) to enhance urban quality of the built environment.

Athens - Paleo Psichico: workout pocket park - fitness (image: D. Babalis).

Athens -Imitos: smart mini- park with solar photovoltaic path (image: D. Babalis).

5 The Shoreline and Climate Change: Investigating Strategies and Architectural Typologies against Uncertainty

Snehal Hannurkar
Laura Eshuis
Irene Curulli

Nowadays, the shoreline is the place where the most dramatic climate-related disasters occur. It is well-known the impact on humans, nature and man-made infrastructures of water level fluctuations, and the global temperature and rainfall increase.
Therefore, the distinctive edge between land & water is a conflicting area that experiences fluctuating flood patterns and is constantly in a state of uncertainty.
Architectural design developing along these edges is responding to this situation by evolving itself into a flood resilient one. It exhibits certain unique features which vary depending on the specific shoreline, the intensity of the water impact, and also the climate zone where the flood will occur. Accordingly, new design strategies and architectural typologies have been developed along the vulnerable shoreline so as to face the challenges and uncertainties posed by the consequences of climate change.
In urban terms, effective flood protection along the shoreline is a prerequisite for sustainable city development. However, the protection systems that are usually adopted are often impediments to urban development or they are in conflict with it. There is no doubt that protective measures are necessary to save people's life and their properties; however, these measures can create disruptions in the natural and cultural structure of specific environments. Consequently, the identity and attractiveness of these places is affected too.
This means that these unwanted side effects have a negative impact on the intended improvement. Thus, the following questions arise: how can water-related strategies of adaptation mitigate effect on natural and cultural environments? Which are the characteristics of existing architectural typologies able to withstand climate uncertainty?
This is the starting point of this chapter. We'll reflect upon three European case studies in order to explore their conceptual and material qualities that result from creative and thoughtful responses to possible disasters along rivers and sea coastline.
Our aim is to show that defence strategies and urban development can go hand-in-hand and are able to provide new scenarios that mitigate the impact of defence measures by integrating technical solutions into architectural and urban development strategies.
To start with, the understanding of the various types of floods, their impact on the shoreline and defense strategies which are commonly used will provide a vivid insight into the enigma of designing with a dynamic shoreline and climate uncertainties.

Flooding as consequence of climate change

The special report ' Global warming of 1.5˚C' published by IPCC in 2018, states that 'human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate.

Impacts on natural and human systems from global warming have already been observed (high confidence). Many land and ocean ecosystems and some of the services they provide have already changed due to global warming.'[1]

As predicted by the European Commission 2018, sea-level will rise, together with other projected effects of climate change such as changes in the dynamics and energy distribution of waters or on the frequency and intensity of storm surges. This will increase the risk of flooding and erosion in coastal areas, with significant consequences for the people, infrastructure, businesses and nature in these areas.
Therefore, floods posit a major threat to shoreline areas. Urban development along this conflicted edge is battling. In fact, shoreline happen to be the most densely populated areas and prone to huge damage to life and property. According to the European Commission (2018), around a third of the EU population lives within 50km of the coast and these areas generate over 30% of the Union's total GDP. In the United States, almost 40% of the population lives in relatively high population-density coastal areas, where sea level plays a role in flooding, shoreline erosion, and hazards from storms. Globally, 8 of the world's 10 largest cities are near a coast, according to the U.N. Atlas of the Oceans. (LINDSAY.R,2018)[2]

Types of floods and their impacts on the shoreline

According to the Flood Site Project 2008[3] developed by the government of UK, there are 3 types of floods and 5 sub-categories: Coastal, Fluvial (over-bank and flash) and Pluvial (ponding and urban).

Accordingly, the increase in water level determines different levels of impact on the shoreline that vary from slight erosion to life threat and properties damage.
This chapter focuses on case studies that are located next to a river and the sea, thus undergoing to coastal and fluvial floods. These floods have a higher impact compared to the other types in terms of intensity and anticipated depth, to which we must add loss of life and economic damage.
With regard to design strategies of development along the shoreline, it is necessary to specify two different approaches according to the scale of intervention. One regards large coastal areas, already urbanized or proposed for future development.
In this case, strategies focus on immediate defence against flooding, with a large impact on both the natural and the built environment. The other one relates to the building scale and it identifies specific water-related architectural typologies (and their characteristics) for the achievement of building resilience.

Coastal defence has two goals: to protect the shoreline from floods and to limit coastal erosion. To this aim, the methods used can be distinguished in hard- and soft engineering. Hard engineering techniques consist of highly technical man-made solutions, they require maintenance, and are often costly. Usually developed by civil and environmental engineers, these flood protection structures determine the disruptions of ecological systems. Originally, these structures were used to minimize coastal flooding only.
On the contrary, soft engineering techniques are based on low tech-solutions that work with nature. They utilize ecological and environmental principles not only for flood protection but also for the reduction of erosion and stabilization of shorelines. Furthermore, soft engineering solutions enhance habitats and provide new aesthetics. Compared to the hard solutions, the soft ones are less expansive and require low maintenance. However, they are subject to erosion and cannot be considered permanent structures.
The descriptions below explain the characteristics of both hard and soft engineering methods and highlight pro and contra of their implementation along flood-risk shorelines.

Hard engineering methods
• *Seawalls*: massive structures at the foot of cliffs or dunes, that protect from both erosion and flooding. They are often located at exposed coasts. There are various types of seawalls. The disadvantage of seawalls is that their structure reflects some of the beach energy, which results in beach degradation in front of the wall, and it more or less accelerates erosion in the coastal profile. A dike can also be considered a type of seawall.
• *Revetments*: similar to seawalls, they consist of sloped structures. Revetments on shorelines reduce the dynamic force of tidal action and protect from erosion, but not against flooding. Therefore, they can be considered either supplementary to a seawall or independent structures on less exposed locations.

[1] Report released by IPCC-' Global warming of 1.5°C An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.', 2018 , published by IPCC Switzerland.© 2018 Intergovernmental Panel on Climate Change. Electronic copies of this Summary for Policymakers are available from the IPCC website www.ipcc.ch. Retrieved on 22 September 2019 from https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

[2] Lindsey.R, 2018, Climate Change: Global Sea Level, retrieved from https://www.climate.gov/news-features/understanding climate/climate-change-global-sea-level on 20 Dec 2018.

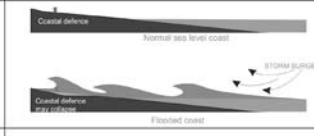
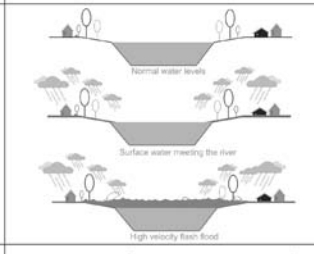
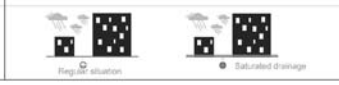
[3] Flood site project 2008, Retrieved from http://www.floodsite.net/juniorfloodsite/html/en/student/thingstoknow/hydrology/floodtypes.html on 20 Dec 2018.

• *Groynes*: wooden- low walls, placed in the sea. They capture sand and keep it from drifting, thus they build-up a larger beach in front of an eroding area. The downside is that groynes remove a lot of sand from further down-drift, which thins out the beach of other parts of the coastline making them more exposed to erosion.
• *Gabions*: rocks in mesh that reduce wave impact. However, this method is not that effective.
• *Rock armour*: large boulder piles on a beach, in front of a cliff or seawall. They absorb waves energy and help building-up beach areas. A disadvantage is that rock armour is expensive to implement and maintain
• *Coastal Barrage*: dam-like structures that are partially submerged and help controlling tidal flow. An advantage is that they can be used to induce hydro-electricity. Disadvantages are: high costs of implementation and maintenance and strong environmental impact.

Soft engineering methods
• *Beach nourishment*: the beach is widened by sand suppletion: sand is extracted from elsewhere and sprayed onto the designated area to artificially build up the beach.
• *Beach stabilization*: dead trees are planted into the sand to stabilize the beach. This measure prevents erosion, and as the beach widens, wave speeds slower and erosion is prevented.

• *Dune regeneration*: consists of either restoration of the dunes or creating new ones. Dunes absorb wave energy, and therefore protect inland areas from floods, protect coastal ecosystem, reduce shoreline erosion, while maintaining views and access to the waterfront. Dunes can be stabilized with living plants. Human activity, if not confined to specific parts of the dune, can cause erosion.
• *Managed retreat*: it occurs in selected areas that can deal with erosion and flooding. Therefore, water can flow into these designated areas, helping store and release of floodwater. Although these areas are often considered of low values, they enhance new habitat. In fact, new beaches and salt marshes can develop in these areas as consequence of erosion.
• *Marshlands*: consist of marshes, swamps, bogs, etc. that can break up waves and reduce their speed. Marshlands form a transition between the aquatic and terrestrial ecosystems and are dominated by herbaceous plants. Marshlands reduce erosion and can function as a buffer zone between water and inhabited land, so that in the event of flooding risk areas are further protected.[4]

The methods discussed are the most common ones, but also combinations of different methods occur. The coastal strategy adopted for the project in Katwijk aan Zee, in The Netherlands, is a case in point. We'll analyse it in the following sections of this paper.

Type of flood	Illustration of Conflicted edge	Impact level	Characteristic	Increase in water leve
Coastal flood		Minor	A slight amount of beach erosion will occur but no major damage is expected.	
		Moderate	A fair amount of beach erosion, economic damage will occur	>0.6 m upto >3m
		Major	Serious threat to life and property, Large-scale beach erosion will occur, Safety precautions & evacuation necessary.	High velocity impact by waves
Fluvial floods: i) River flood Over bank flooding		Minor	Disrupted connectivity Damage of property	
		Moderate	Disrupted connectivity Life threat and property damage Safety precautions & evacuation necessary	>0.6 m upto >3m
		Major	Serious threat to life and property, Will destroy everything in its way Safety precautions & evacuation necessary.	Slow rising high velocity water flow
ii) River flood Flash flooding		Major	Dangerous type of flood Serious threat to life and property, Will destroy everything in its way Safety precautions & evacuation necessary Dams and dikes can be destroyed	>0.3 m upto 3m and above Quick rising Intensely high velocity water flow
Pluvial floods: I) Ponding		Moderate	Not life threatening Can cause significant property damage	upto 1m
ii) Urban flood				

Types of floods and their impact. (drawing based on information from Flood site project 2008).

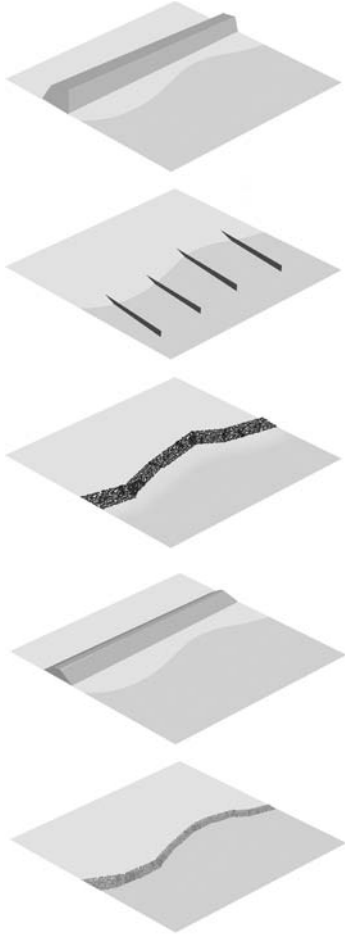
[4] Cross, C. (2016) "The difference between soft and hard engineering", retrieved from https://www.theswimguide.org/2016/09/22/difference-soft-hard-engineering/ on 30-01-19
Jackson, A (2014, july 6) "Coastal management", Retrieved from https://geographyas.info/coasts/coastal-management/ on 29-01-19
"Revetment", (2007, december 11) retrieved from http://www.marinespecies.org/introduced/wiki/Revetment on 30-1-19.

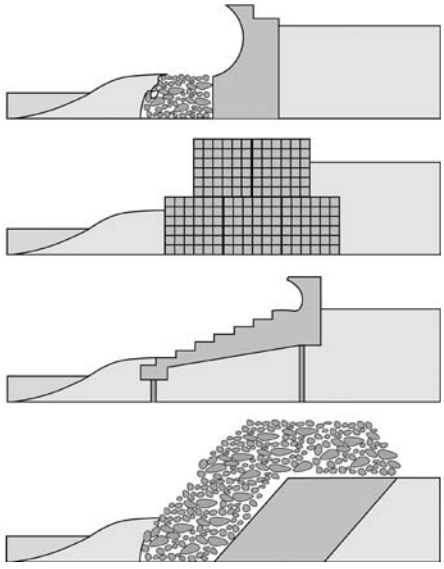
[5] Document released by the government of UK 'Improving the Flood Performance of New Buildings Flood Resilient Construction' 2007. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf on 20 Dec 2018.

Hard Engineering methods: Seawall, Revetment, Groynes, Gabions, Rock armour.

Types of seawall: curved concrete, gabion, stepped and curved seawall, rubble mound seawall.

Comparison table between erosion and flood prevention by 'hard' and 'soft' engineering methods.





Hard engineering methods	Erosion	Flooding
Seawall	●	●
Revetments	●	
Groynes	●	
Gabions	○	
Rock Armour	●	
Coastal Barrage	●	●

Soft engineering methods	Erosion	Flooding
Beach nourishment	○	○
Beach stabilisation	●	○
Dune regeneration	●	●
Managed retreat	○	○
Marshlands	○	○

Flood resilient design typologies

Contrary to the coastal defence strategies, the strategies related to the building scale focus on the inner properties of buildings so as to make them resilient, thus enabling them to accept/reject flooding impact.

Flood-prone countries, like the UK, are regulating flood resilient designs. As mentioned in the RIBA Policy note 2018, UK climate change risk assessment makes it clear that the UK faces enormous challenges in keeping pace with the extreme flood events in the next 30 years.

A previously released the document by the Government of the UK- 'Improving the Flood Performance of New Buildings Flood Resilient Construction' 2007[5] specifies a set of design properties and strategies that resilient buildings should incorporate to guarantee safety over their proposed lifetime. This means that resilient buildings should be able to minimize life threat and property damage and also withstand the impact of the flood.

These goals combine with two specific water-related strategies to undertake in the design: namely '*water exclusion strategy*' and '*water entry strategy*.'

According to the first one, the emphasis is placed on minimizing water entry whilst maintaining structural integrity and using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3 m). This strategy can be considered as a resistance measure, but it is also part of the general aim to achieve overall building resilience. At the urban scale, the water exclusion strategy applies either by raising the defence line or by advancing the defence line through land reclamation.

In the second one, water entry strategy, emphasis is placed on allowing water into the building, facilitating draining and consequent drying. Standard masonry buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. Therefore, this strategy is favoured when high flood water depths are involved (greater than 0.6m). In general terms, this strategy can be named as an 'accommodation' strategy. At the urban scale, it applies either by storing floodwater or by raising ground plains.

According to Pelsmakers (2014)[6], flood resilient design typologies can be broadly categorized into:

• Buildings with sacrificial basement /Ground floor
• Building on stilts
• Floating buildings
• Flood resilient or wet proofed buildings

These design typologies were developed according to the type and behaviour of the flood, the intensity of its impact and the specific site-climate characteristics.

The materials used in these building designs, their construction techniques, their shape, and spatial organization, all have to be carefully chosen on the basis of the resilience they offer to a particular kind of flood. Furthermore, it can be observed from the study of these building types that appropriate building techniques, construction materials, the shape of the building and the spatial organization play a crucial role in making them resilient for a certain type of flood. To the latter listed categories belong the two flood resilient housing typologies that will be analyzed in this paper.

Study cases

Beyond engineering: an integrated approach for Katwijk aan Zee, NL

Katwijk aan Zee is a moderately large village along the coast across the North Sea. The Netherlands has a moderate sea climate, and thanks to the influence of the North Sea experiences mild summers and winters, and precipitation throughout the year.

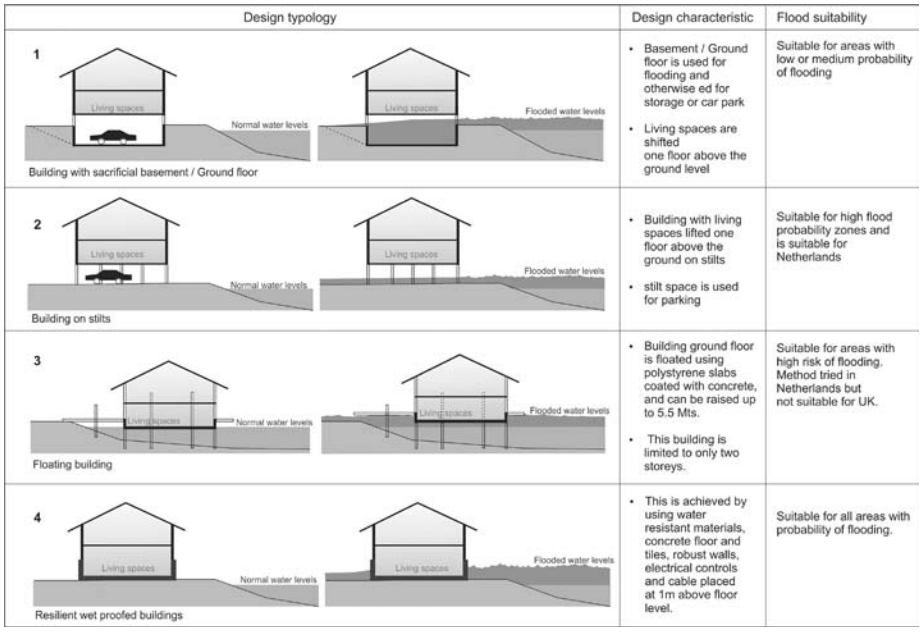
Safety is the main reason of this project. The coastline of Katwijk aan Zee is the last weak link in Holland's coastal defense and was therefore issued for improvement (dike reinforcement) by Rijkswaterstaat (Dutch National Water Board). According to Dutch safety regulations, the coastal defense should be able to withstand a one-in-10000-year superstorm.

When a heavy storm or flood would occur in the current situation, there is a likely risk of flooding for the *buitendijkse* (outside of the dike) part of Katwijk, but there is also a risk for the rest of Katwijk and also the *Randstad*. As this is a potential danger to a large number of people and one of the most economically important areas for the country, this is an important and therefore necessary improvement.

Besides the safety matter, the village has a parking shortage and its economy highly depends on the activities/relationship of the village with its coastline.

Flood resilient typologies (source: by the authors, based on information from Pelsmaker 2014).

[6] Pelsmakers. S, 2014, Living with water: Four buildings that will withstand a flood. Available at: https://theconversation. com/living-with-water-four-buildings-that-will-withstand-flooding-23536; retrieved on 20 Dec 2018.



Therefore, the coastline is the place where an interesting duality comes to existence: that of safety demands, due to climate change, and that of societal demands. This condition poses both as a challenge and as an opportunity for the elaboration of a design proposal that addresses both aspects.
The development of the design consisted of a complex process that included a wide range of stakeholders and resulted in an integrated design able to provide coastal defense (according to current safety standards), added new functions, maintained the dune landscape, and finally, it incorporated societal demands and people's desires to maintain the connection between the village and the shore.
Taking into account the coastal defense reinforcement, the importance of visual connections to the shore and the need to maintain the identity of the dune landscape, the designers elaborated a proposal that satisfies all those demands. The use of the standard dike was not an option as its height would have interrupted the required visual connection. Therefore, the new coastal defense was designed as low as possible by combining hard- and soft engineering methods, namely a dike-in-dune setup. In order to protect the coastline from the water, the new defense used the same amount of sand volume as a regular dune requires, but spread it over a much wider area. Thus, the beach extends seaward and has a low slope. The dike can then be hidden under relatively low sand dunes, in some points staying similar to the current height (+7.5m NAP). So, the visual connection between the shore and village(+7.5m to +8.5m NAP) remains almost unaltered. On the north and south side of the city center the dunes reach the height of +11m NAP.
The dike itself stretches 900 meters, but the total coastline reinforcement is 1500 meters long. To be able to apply this dike-in-dune method, a very large amount of sand was acquired and transferred to the site through a large sand suppletion operation. It consisted of three million cubic meters of sand. The technical operation also provided an opportunity for the local inhabitants. To compensate the community for the natural environmental loss, the plan proposed an underground parking, hidden under the dunes. The parking is part of the inner 'ring' of the coastal defense, with a 500 meter length for 663 parking places.[7]
The parking entrances are shaped to mimic natural dunes and are covered with grass. Large glass panes mark the entries and allow daylight into the underground spaces.

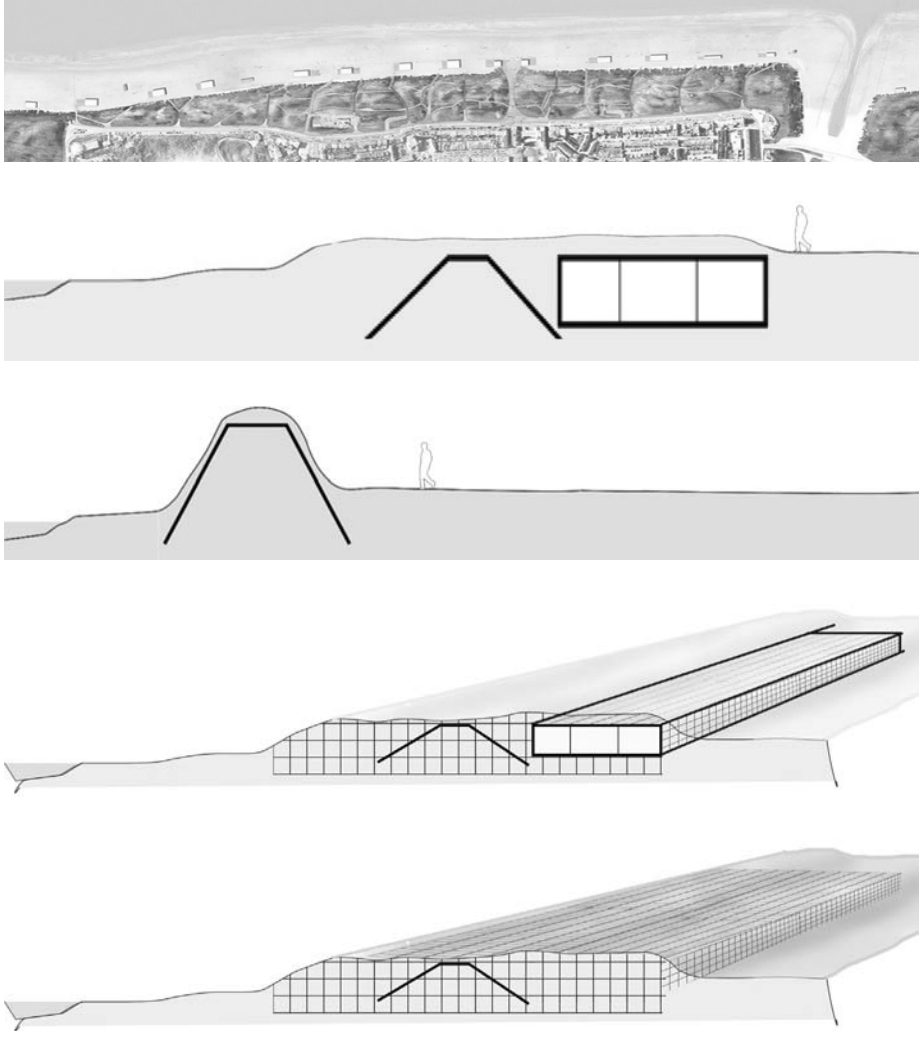
Site plan of the design proposal (source: OKRA landschapsarchitecten from https://www.okra.nl/projecten/kustversterking/ on 19-01-19).

Section of a Dike-in-dune + parking garage solution. Estimated proportions.

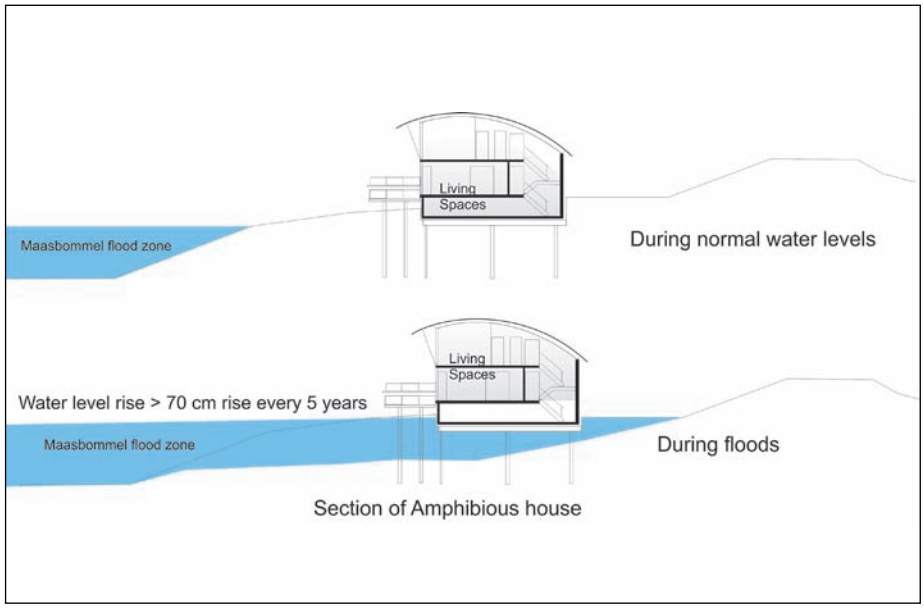
Section of a regular dike construction. Estimated proportions.

Diagram of dike-in-dune volume.

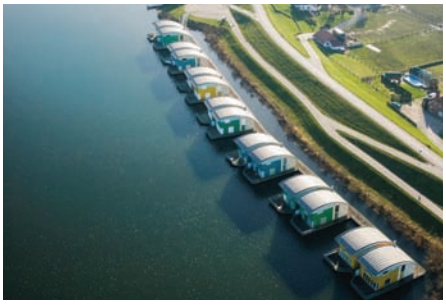
Diagram of added parking garage showing the sand volume it saves.



Location:	Bovendijk, Maasbommel, The Netherlands
Building type:	Housing
Year built:	2006
Client:	De Gouden kust bv: Dura Vermeer Infrastructuur in cooperation with Watersportcentrum Maasbommel
Architect:	Factor Architecten bv
Edge description:	Along the River Meuse
Potential water rise:	>70 cm per 5 years
Type of flood:	Fluvial flood
Source of information:	Factor Architecten bv



Section of Amphibious house

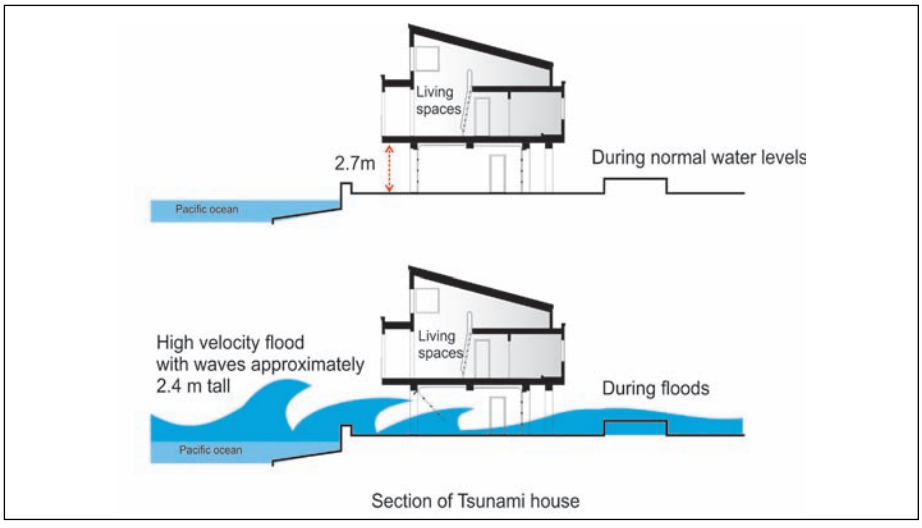


Flood conflicted edge of Tsunami house (source: Illustrated by the author, based on the information provided by Design Northwest architects, USA).

Maps showing the island's proximity to Pacific Ocean and the project site (source: adapted image from Google maps).

Views of the Tsunami house in its context and of the interior space (source: Design Northwest architects, USA, Photographer Lucas Henning).

Tsunami house project data.



Section of Tsunami house

Location:	Camano Island, Puget Sound USA
Building type:	Housing
Year built:	2013
Client:	Not disclosed
Architect:	Nortwest Architects
Edge description:	Coast of Pacific ocean, Camano Island
Potential water rise:	Federal Emergency Management Agency (FEMA) placed the property in a Zone V, meaning there was the potential for not only flooding but also tall waves up to 2.4 m.
Type of flood:	High-velocity coastal flood, potential threat of Tsunami waves
Source of information:	Nortwest Architects