Urban Archipelago
Reconsidered

A New Metabolism in Tokyo Bay for Contemporary Coastal Urbanism

Caner Oktem

Bachelor of Architecture (BArch) High honours
Middle East Technical University, 2008

Master of Architecture (MArch)
University of British Columbia, 2012

Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Architecture Studies at the Massachusetts Institute of Technology

June 2016
© 2016 Caner Oktem. All rights reserved

The author hereby grants to MIT permission to reproduce and to distribute publicly paper and electronic copies of this thesis document in whole or in part in any medium now known or hereafter created.
thesis committee

James Wescott (Co-supervisor)
Aga Khan Professor, Department of Architecture

Fadi Masoud (Co-supervisor)
Lecturer of Landscape Architecture and Urban Design
Department of Urban Studies and Planning
Urban Archipelago Reconsidered
A New Metabolism in Tokyo Bay for Contemporary Coastal Urbanism
by Caner Oktem

Submitted to the Department of Architecture on May 19, 2016 in Partial Fulfillment of the Requirements for the Degree of Master of Science in Architecture Studies (SMArchS) Architecture and Urbanism Area

Abstract
Coastal areas are home to more than half of the world's population and many of its most populated urban areas. Coastal urbanism remains very much in demand despite major risk factors such as sea level rise, long-term shoreline erosion, storm surges, land liquefaction, and subsidence. City-building on reclaimed land is an ambitious form of development yet prevalent around the world, especially where an economic growth agenda is pursued aggressively against the availability of land resources.

This thesis develops a critical design agenda to respond to how pro-growth forces and environmental change can be negotiated towards a reconsidered coastal urbanism. The thesis argument is that coastal urban and territorial form should not follow a static master plan based on a risk model; instead, it should employ/follow a dynamic gradient of permanence and ephemerality in multiple time scales, following coastal succession as a design analogy.

Tokyo Bay is the site of experimentation. The world's largest metropolitan area has a long history of land reclamation debates and projects, which resulted in a highly articulated urban coast with reclaimed shorelines, and near- and off-shore artificial islands with a mix of uses. The on-going construction of the urban archipelago is an outcome of urban and regional metabolisms, where incinerated solid waste, dredged sediment, excavated soil, and demolished buildings are deposited to make new land.

Demand for post-industrial urban development and land reclamation is still alive in coastal Tokyo despite the vulnerabilities of flooding and seismic events. Large waterfront sites are now available for new development. The construction of permanent and temporary facilities in Tokyo Bay for the 2020 Summer Olympics offers an opportunity to develop a succession-based design strategy—not only for the 2020 peak condition, but also in anticipation of future transformations.

The design exploration establishes, via strategic cartography, a resiliency district framework based on a gradient of permanence and flexibility in the ground condition. The sharply delineated boundary between land and sea is rethought as a dynamic frontier zone of flexibility that adapts to flooding and sea level rise and as an active site for coastal deposition and submersion. A second, elevated ground level is proposed to serve as a pedestrian and emergency thoroughfare, as well as an extension of transportation and logistics infrastructure.

The Metabolist imaginary envisioned Tokyo Bay as a site of continuous urban growth towards a mega-scale climax state; ground was taken for granted and the possibilities of urban decline or reconstruction were hardly considered within the same design utopia.

This project argues for a New Metabolism in which the ground is conceived as an indeterminate landscape of change. The uncertainties of the ground are addressed by an 'artificial land' infrastructure which organizes and facilitates transformation over time.

Thesis Supervisors:
Fadi Masoud, Lecturer of Landscape Architecture and Urban Design - Department of Urban Studies and Planning
James Wescoat, Aga Khan Professor of Architecture - Department of Architecture
contents

thesis committee 3
abstract 5
contents 7
acknowledgement 9
dedication 11

Thesis: An Agenda for Contemporary Coastal Urbanism 12
Context: Contemporary Coastal Urbanism
Thesis: Coastal Succession as Design Analogy - Urban Form Follows Succession

Design Research: Tokyo Bay as a Site of Experimentation 20
A Cartographic Introduction to Tokyo Bay
Tokyo Bay as a Site for Urban Utopias
Project for A New Coastal Urbanism in Tokyo

Design Methodology: Archipelago of Gradients 54
A Transect of Sites
Mapping and Indexing Risks
A Transect for Permanence and Change
Urban Archipelago Revisited

Conclusion: A New Metabolism 122
Form Follows Succession
A New Metabolism
Epilogue: Ground as a Project for an Urbanism of Resilience

Bibliography and Credits 130
acknowledgement

On the occasion of this work, which marks yet another milestone in my life, I would like to take a moment to look back and express my gratitude to those who have been with me on my journey in learning and development.

I would like to thank my thesis advisors, James Wescoat and Fadi Masoud for their continuous enthusiasm and encouragement for my work, and their support and guidance throughout the research process.

I also would like to thank the MIT architecture and planning communities. I remain inspired by my talented colleagues I got to know during my time at the Institute. Without our interaction and debate, my experience would never have been this rich.

Of these people, I am especially grateful to my friends whose presence were and still is crucial to me as I faced a number of personal challenges over the last three years. Their companionship shone into my life and helped me grow as a person. I remain forever grateful to them for welcoming me in their lives.

I thank MIT Department of Architecture for its support, which made my journey to the Institute possible, and also for the opportunity to return to Japan for a much needed re-orientation to professional practice and for explorations in architecture and urbanism, which, eventually, inspired this thesis.

During my time at the Institute, I have been fortunate to work with faculty on a number of courses and projects as a research and teaching assistant: Azra Aksamija, Fadi Masoud, Brent Ryan and Andrew Scott. I would like to thank them for their trust, guidance and understanding.

I remain grateful to my prior undergraduate and graduate school communities at the Middle East Technical University, and at my alma mater, the University of British Columbia, for I was able to build my foundations and reach for opportunities for academic, professional and personal growth that broadened my horizons and took me on adventures I could never imagine.

As always, I am thankful for my friends and family around the world, especially my immediate family. I remain humbled and energized by their support and affection.
to the right place and the right time...

... for their presence that makes our journeys and cities fortunately possible and fulfilling,
and for their absence, that challenge us and our communities to learn and grow.
chapter one
Thesis: An Agenda for Contemporary Coastal Urbanism

"Steam Train in Yokosuka, Yokosuka" by Utagawa Hiroshige III (Date unknown; 1872 - 1894)
context: contemporary coastal urbanism

thesis: coastal succession as design analogy - urban form follows succession
Coastal areas are home to more than half of the world’s population and many of its most populated urban areas. Coastal urbanism remains very much in demand despite major risk factors such as sea level rise, long-term shoreline erosion, storm surges, land liquefaction, and subsidence.

City-building on reclaimed land is an ambitious form of development and is also prevalent around the world, especially where an economic growth agenda is pursued aggressively against the availability of land resources such as in China and Singapore.

Perhaps, a much discussed microgeography of urbanism on reclaimed coastal areas is Dubai, where the urban archipelago is being built to drawings of stylized palm trees or world maps on the sea, in this “city transformed by aerial vision.” However, the negative environmental impacts of the projects are manifesting already, and their overall sustainability is increasingly questionable.

---

Figure 1a
Dubai Palm Islands from the air (2015)
from Wikimedia Commons, by Skatcheker

Figure 1b
The Center Core of the Palm Jumeirah (2008)
from Wikimedia Commons, Photography by Alexander Heine
This thesis aims to develop a critical design agenda to respond to how pro-growth forces and environmental change can be negotiated towards a reconsidered coastal urbanism.

The thesis argument is that the contemporary urban archipelago and coastlines cannot be seen as outcomes of static delineations on land that are oblivious to risk, catering to pure functionalism or aerial imagery. Rather, they should be treated as dynamic frontier zones of the urban territory.

Coastal urban and territorial form should not follow a static master plan based on a risk model; instead, it should employ/follow a dynamic gradient of permanence and ephemerality in multiple time scales, following coastal succession as a design analogy.

In this context, the meaning of 'succession' is two-fold: coastal and urban succession, where an ecological dynamic governs both and links them together. Coastal succession refers particularly to the cyclical physical change in a coastal environment as its constituent sediments are eroded in one place and deposited elsewhere. It also entails the migration of a population within a coastal ecosystem to different areas of the littoral area as it changes physically. By analogy, succession refers to the similar cyclical changes in urban landscapes and the communities they support, in a way that echoes some of the base assumptions of the Chicago school of urban sociology.

---

5 Ibid. pp. 515-519.
Figure 2
Conceptual diagram of the thesis statement
Succession, in this context, refers to cyclical processes of material deposition and sea submersion in coastal areas. The two processes interrupt one another, therefore there is no ‘progression’ towards a climactic end state.  

Succession, also refers to cyclical urban transformation without a fixed end state.

Olympic games are great examples for inherently successional urban projects, designed to be put up and to be taken down. Much like the Tokyo 2020 Summer Olympic Games.

---


Figure 3a
‘Dolos’ blocks on the coast of Cape Town (2006)
[Image -90x90 to 702x702]

Figure 3b
Tokyo 2020 Emblems
from The Tokyo Organizing Committee of the Olympic and Paralympic Games, by Asao Tokolo
chapter two
Design Research: Tokyo Bay as a Site of Experimentation

"Sudden Shower Over Shin-Ōhashi Bridge and Atake" by Utagawa Hiroshige (1857)
A Cartographic Introduction to Tokyo Bay

Tokyo Bay as a Site for Urban Utopias

Project for A New Coastal Urbanism in Tokyo
This section will explain the motivations behind focusing on Tokyo and its urban coast as a case. The context is described using a series of maps towards the definition of an urbanism project.

With a population of 13.5 million in the city proper, and 37.8 million in its city-region Tokyo is the largest metropolitan area in the world.

Tokyo Bay, the marine hinterland of the mega-city has a long history of land reclamation going as far as the 16th century. The building of urban territory for infrastructure, industry, logistics and urban development accelerated during Japan's modernization.
Figure 4a
Steam Locomotive on the Yatsuyamashita Shore, Tokyo by Utagawa Hiroshige III (Around 1871)
from Tokyo Metropolitan Library

Figure 4b
Rainbow Bridge and Tokyo skyline seen from Odaiba Island, Tokyo (2010)
from Wikimedia Commons, by jawa8aun
Land reclamation in Tokyo Bay goes back as early as the 16th century.

Urban expansion into the sea initially relied on the ‘building’ of land on tidal flats.
Figure 5

Map: Tokyo Bay - Meiji Era Takafu Plan

Tokyo Bay: Takafu Plans in Meiji Era (1868-1912)
Industrial and infrastructural development, as well as waste management were major drivers for an accelerated land reclamation in 19th and 20th centuries, during Japan’s modernization.

This resulted in a highly articulated urban coast in very great proximity to Tokyo’s historic center, featuring reclaimed shorelines, and near- and off-shore artificial islands with a mix of conditions, ranging from mature urban fabric to tabula rasa land. 1

The urban archipelago is by no means in a fixed end state.

This on-going construction is an outcome of urban and regional metabolisms, where incinerated solid waste, dredged sediment, excavated soil, and demolished buildings - including that from areas affected by the Tohoku Earthquake - are deposited to make new land, most recently at the ‘Outer Central Breakwater Island.’ 2


Urban development on reclaimed land was frequently pursued for economic growth, and was facilitated mostly by prefectural and municipal governments around Tokyo Bay.

Powerful local governments are noted to play a major role in land reclamation projects in Japan, in the pursuit of economic objectives via quantitative planning measures. In the case of Tokyo Bay, Japan’s highest level administrative entities, ‘prefectures’ are the main developers for reclaimed land. This is especially valid for most of the Tokyo Metropolitan and Chiba shorelines.

The coast of the city of Yokohama, however, was mainly a municipal project.

---

Intended land uses for most land reclamation projects were industry, transportation, logistics and mixed-use development. On Tokyo’s waterfront, post-industrial development projects are emerging.

The main intended uses for reclaimed lands are industry and logistics.\(^4\)

However, mixed-use development and transportation infrastructure usually accompanies the industrial use, acting as a project argument to address urban issues of congestion or housing shortage. \(^5\)


\(^5\) Yoshimitsu and Malone.
Tokyo’s waterfront is in great proximity to the oldest central business district nodes. Most of the permanent and temporary facilities for the 2020 Summer Olympics, including the olympic village are sited in the area.
The urban coast of Tokyo, however, is also vulnerable to risks.

The vast majority of land gained from the sea are low-lying areas, susceptible to global sea level rise.
Figure 10: Map: Tokyo Bay - Low-Lying Areas
The area also lies between the deltas of Tama and Edo rivers, with those of Ara and Sumida rivers in between. The resulting risk of estuarine flooding is very much present in the older reclaimed areas in Tokyo.
With very few, recreational sandy beaches, Tokyo Bay mostly has embankments, seawalls and parapet walls as coastal management structures, supported by pump stations and flood gates.
Metabolism: Tokyo Bay as a site for urban utopias

Tokyo Bay was also the subject of urban form debate via physical planning and architecture in the 20th century. Of particular note is the discourse of Metabolism, which often envisioned architectural instruments to produce an ever-expanding urbanity: mega-scale infrastructure as the backbone for plug-in architectural objects.

Perhaps the most celebrated of these projects is Kenzo Tange’s Plan for Tokyo (1960), where, in contrast to radial schemes for Tokyo at the time, a linear bundle of transportation infrastructure was proposed for a phased plan of growth over four phases, in twenty years.


Ibid. pp. 143-169.
Figure 13a
Tange Plan for Tokyo Bay and Kenzo Tange (1960)
from Lin, by Akiio Kawasumi

Figure 13b
Illustrations of Growth for Tange Plan (1960)
from Lin, by Tange Associates
The hard infrastructure does not ‘cover’ every location at the urban archipelago. Furthermore, during the 3/11 Disaster, coordination issues led to the failure to get some of the floodgates operate in a timely manner.

Contrary to the inherent optimism of the Metabolist imaginary, the urban coast of Tokyo is very much vulnerable to risks.

The vast portion of land gained from the sea are low-lying areas, susceptible to global sea level rise. The rivers ending at Tokyo Bay represent estuarine flooding risks.

A possible major storm tidal surge was recently estimated to result in 7,600 deaths and loss of housing for 1.4 million people. The storm surge barrier system does not ‘cover’ every location at the urban archipelago. Furthermore, during the 3/11 Disaster, coordination issues led to the failure to get some of the floodgates operate in a timely manner.

As well, the Japanese government’s plans for building a continuous system of seawalls across the Japanese archipelago met criticism from citizens, given their failures 3/11 Tohoku Earthquake.

Figure 14a
Banks of Sumida River Before and During Typhoon ‘Roke’ (2011)
from the Metropolitan Government of Tokyo (2013)

Figure 14b
Tokyo Bay - Areas projected to be affected by sea level rise by 2100,
assuming global warming by 4 degrees centigrade
from Surging Seas (2015)
In addition to seasonal and long-term flooding hazards, a major earthquake is expected to affect Tokyo. Seismic impact and soil liquefaction risks are especially present in the urban archipelago.
Tokyo Skytree
Shinjuku Station
Tokyo Station
Shibuya Station
Shinagawa Station
Haneda Airport
Tokyo Bay

Figure 15a
Tokyo Bay - Differential earthquake impact intensity
from Japan Times (2013)

Figure 15b
Tokyo Bay, Tokyo - Liquefaction Risk from Nankai Trough Earthquake
from Asahi Shimbun (2013)
In fact, liquefaction already took place in Tokyo Bay during the 3/11 Tohoku Earthquake, even though the epicenter was far away.

Tokyo’s coasts and urban archipelago system are facing risks that undermine the permanence of its ground, which has been taken for granted so far.
Liquefaction during the 3/11 Tohoku Earthquake at Urayasu Island, Tokyo Bay

by Toshikazu Aizawa/Bloomberg
Demand for post-industrial urban development and land reclamation is still alive in coastal Tokyo despite the vulnerabilities of flooding and seismic events. Large waterfront sites are now available for new development.

The construction of permanent and temporary facilities in Tokyo Bay for the 2020 Summer Olympics offers an opportunity to develop a succession-based design strategy—not only for the 2020 peak condition, but also in anticipation of future transformations.

So this design-research effort aims to apply the thesis argument—coastal succession as a design analogy—as a landscape-oriented strategy for passive mitigation of risk, and a succession-based sequence of urban landscape forms.

This will take the form of a resiliency districting study for Tokyo Bay, with a particular focus on the islands and coasts situated along a transect cutting through the historic center of the city, coastal reclamation areas, near-shore and off-shore islands, one of which is under construction.
Figure 17

Urban - coastal transect, reclaimed areas and islands, and Tokyo 2020 facilities
The sharply delineated boundary between land and sea is rethought as a dynamic frontier zone of flexibility that adapts to flooding and sea level rise and as an active site for coastal deposition and submersion.
Figure 18

Thesis concept: Sharply delineated boundary versus dynamic frontier zone
The resulting form of urban coastal landscape is one with blurred edges rather than with those, delineated by hard-engineered coastal management.

The expression ‘coastline’ is a vestigial terminology. There is no ‘line’.

Instead, there is a ‘coast-zone’ – not permanently land or sea, where Anthropocene deposition and natural submersion processes act on.¹²

Figure 19
Thesis concept: Coast line versus coast zone along the urban - coastal transect
chapter three
Design Methodology:
Archipelago of Gradients
A Transect of Sites

Mapping and Indexing Risks

A Transect for Permanence and Change

Urban Archipelago Revisited
This section focuses on the design methodology and its application to Tokyo Bay.

The design methodology will first aim to consolidate various types of risk by indexed risk gradient. The aim is to arrive at a tracing of zones of permanence (either land or water) and temporality (both land and water). As echoed in the contemporary debate on design for resiliency, every place is both land and water.¹

This information is then superimposed on the catalyst sites on the urban archipelago and a mapping of resilience infrastructure of lifelines and critical facilities. The eventual goal is to propose a pattern for a scenario-based urbanism without a fixed end state, along the coastal urbanism transect, speculating urban form for critical moments in succession — present day, 2020, 2060, 2100.

The transect is proposed as an analytical device for the scope of this project. Rather than operating as a density transect in the New Urbanist sense,² it cuts through the variety of coastal urban landscape elements (reclaimed tidal flats, near- and off-shore islands) and aims to capture gradients of risk, land / sea, and old / new.

² As exemplified by Center for Advanced Transect Studies, at http://www.transect.org
Figure 20
Coastal Tokyo Land Reclamation in the 20th Century
based on data from MLIT (2010)
The uses initially intended for the sites along the urban coastal transect were industry and logistics.
Figure 21
Coastal Tokyo: Reclaimed Areas by Main Use Intended
based on data from MLIT (2010)
Over the last 18 years, the land reclamation efforts focused on the northern parts of Ariake Island, and the Outer Central Breakwater Island.
In the meantime, Harumi and Toyosu Quays, previously used for logistics became available for mixed-use urban development. Most recently, plans to develop the Tsukiji Fish Market site were announced.

In the Tokyo 2020 master plan, Harumi Quay will be the site for the Olympic Village. The new land on Ariake Island will have permanent and temporary Olympic facilities. The Outer Central Breakwater Island will be the temporary site for mountain bike events.
Figure 23
Coastal Tokyo:
from Google Earth (2015)
The transect also cuts through the variations in built fabric, and the gradient of urbanized to tabula rasa, across post-industrial sites in Tokyo's urban archipelago, including those for the 2020 Olympics.

Tokyo's historic center is surrounded by a high-density commercial zone. Presence of industrial uses grows towards the waterfront. A coarse-grain built fabric including big boxes, towers and logistics staging areas manifests.
Figure 24
Coastal Tokyo: Built Fabric and Land Use Zones
based on data from MLIT (2011)
Most of Tokyo Bay – be it reclaimed long ago and built up, or areas currently being reclaimed are low-lying and are usually subject to liquefaction hazard. This implies a great vulnerability to the global sea level rise, and the ‘Next Big One’ – a major earthquake expected to affect Tokyo Bay.
<table>
<thead>
<tr>
<th>Event / Process</th>
<th>Timeline</th>
<th>Areas Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020 Olympics</td>
<td>2015-2020</td>
<td></td>
</tr>
<tr>
<td>The &quot;Big One&quot; Expected Earthquake</td>
<td>2015-2020</td>
<td></td>
</tr>
<tr>
<td>Regular Typhoon Events</td>
<td>2015-2090</td>
<td></td>
</tr>
<tr>
<td>Super Typhoons</td>
<td>2015-2090</td>
<td></td>
</tr>
<tr>
<td>Sea Level Rise</td>
<td>2015-2090</td>
<td></td>
</tr>
</tbody>
</table>

Figure 25
Timelines and Transects:
Events and Processes Affecting the Urban Coastal Transect
Most of coastal Tokyo are low-lying areas, vulnerable to global sea level rise.

Banks of Ara, Sumida and Tama Rivers are also subject to estuarine inundation risks.
Island

---

Figure 26
Flooding Risk Areas and Urban Coastal Transect
Based on data from MLIT (2011)
With a small number of recreational sandy beaches, Tokyo Bay mostly has embankments, seawalls and parapet walls as coastal management structures, supported by pump stations and flood gates. This ‘fortification’ does not cover the entire archipelago, and has experienced operational issues discussed earlier.
Figure 27
Coastal Management Structures in Tokyo Bay
Based on data from MLIT (2012)
In a submarine trench earthquake scenario, coastal Tokyo is expected to experience a very high seismic intensity, with the immediate surroundings subject to high risk.
Distribution of Seismic Intensities

Submarine Trench / Genroku Type Kanto Earthquake (M8.2)

Figure 28

Distribution of Seismic Intensity - Submarine Trench Earthquake Scenario and Urban Coastal Transect

Based on data from Tokyo Metropolitan Government (2012)
In the same scenario, most coastal areas are subject to either moderate or high soil liquefaction hazard, which has greater variation compared to seismic intensity.

Risk is diminished only in inland areas.
Figure 29
Liquefaction Risk - Submarine Trench Earthquake Scenario and Urban Coastal Transect
Based on data from Tokyo Metropolitan Government (2012)
In a Tokyo-epicenter earthquake scenario, coastal Tokyo is expected to experience a very high seismic intensity, in more areas than in the submarine trench earthquake scenario.
Figure 30
Distribution of Seismic Intensity - Tokyo Epicenter Earthquake Scenario and Urban Coastal Transect
Based on data from Tokyo Metropolitan Government (2012)
Much like in the submarine trench earthquake scenario, a Tokyo-epicenter earthquake represents moderate or high liquefaction risk. In a risk-aware urbanism, ground cannot be taken for granted.
Figure 31
Liquefaction Risk - Tokyo Epicenter Earthquake Scenario and Urban Coastal Transect

Data from Tokyo Metropolitan Government (2012)
The Olympic facilities proposed for the 2020 games are also sitting on these areas.

While the permanent facilities on inland sites are less vulnerable to risk, the coastal ones are open to liquefaction and inundation hazards.
**Figure 32**
Tokyo 2020 Sites and Risk in Tokyo Bay
*Based on data from Tokyo Metropolitan Government (2014) and Japanese Olympic Committee (2013)*
Coastal Tokyo is the site for elements of a resiliency infrastructure: lifelines for emergency access and services, and critical facilities for disaster recovery efforts.

These locations call for a permanent land condition in the land / flexible / sea gradient.
Figure 33
' Lifelines' and Critical Facilities for Resilience in Tokyo Bay and the Urban Coastal Transect
Based on data from MFT (2006-2014)
Along the same urban coastal transect, various types of risks and conditions apply: Low-lying areas, estuarine flooding, seismic impact and soil liquefaction.

How could these factors be represented as a risk gradient for seasonal and long-term scenarios?
Risks and the Tokyo Bay Transect

Low-Lying / Estuarine Flooding Zones and Earthquake Impact Areas


Figure 34
Risks and the Tokyo Bay Transect

Based on data from Tokyo Metropolitan Government (2012) and MLIT (2011-2013)
The individual maps for risks can be represented as datascapes superimposed over Tokyo Bay.

A grid of sampling points registers the amplitude of datascapes.

When the amplitudes are added, a consolidated datascape is produced. This way, selected types of risks are indexed into a single gradient of change.
The resiliency infrastructure and various types of risk are read into the analysis grid. Resiliency infrastructure and risk consolidated into two maps, to serve as a basis for resiliency districts.

Figure 35
Process of consolidating individual datascapes for a resiliency district gradient pattern.
a transect for change
Figure 36
Indexical Mapping of Long-Term Risk Factors in Tokyo Bay and the Urban Coastal Transect

Based on data from Tokyo Metropolitan Government (2012) and MLI (2011).
Figure 37
Concentration of ‘Lifelines’ and Critical Facilities for Resilience in Tokyo Bay
Based on data from MEXT (2006-2014)
Figure 38
Pattern of Coastal Change for Coastal Tokyo
This section takes the consolidated indexical risk mapping, the intensity mapping for resiliency infrastructure, and the resulting pattern of coastal change for Tokyo, and applies them on the urban-coastal transect and the catalyst sites on it.

Then, a development scenario is examined along the transect for the 2020 peak moment, a post-earthquake 2060 and in 2100 when the global sea level rise has become especially present.

The discussion concludes with a closer look into the design implications of the resiliency districts framework.
Figure 39
Indexical Mapping of Long-Term Risk Factors in Tokyo Bay and the Urban Coastal Transect
Based on data from Tokyo Metropolitan Government (2012) and MLIT (2011)
Figure 40
Concentration of ‘Lifelines’ and Critical Facilities for Resilience Across the Urban - Coastal Transect
Based on data from MLIT (2006-2014)
Gradient of Change
Land and/or Water

Figure 41
Pattern of Coastal Change Across the Urban - Coastal Transect
Figure 42
Resiliency District Pattern for Coastal Tokyo
Figure 43
Catalyst sites on the urban - coastal transect
Change and Resiliency Districts

Risk

Tokyo Imperial Palace
Tokyo Station CBD
Tsukiji
Kachidoki
Harumi
Toyosu
Near-Shore Islands

Tsunamis and Land Gains on Tidal Flats
Figure 44
Long-term Risk Factors and Permanence / Change Gradient in Section
Development scenarios for the 2020 Olympic peak condition, 2060 and 2100

Figure 45
Beyond the planimetric resiliency district idea, ground, as a central concern for this urbanism, must be addressed in section as well, to provide further direction in the urban landscape form for the coastal gradient of permanence and flexibility.

This is best represented in a sequence of conceptual sections, through present day to 2100.

The areas that are to be permanently land should be ‘built up’ further to provide a slightly ‘higher ground’ in anticipation of sea level rise.
Figure 4.6
Design Strategies Across the Gradient of Change: Present Day
Given the risks associated with the ‘ground’ constructed by reclamation, building masses should be raised on piles that take to shear forces. The reference datum for this would be that of the transit stations in the archipelago. The reclaimed ground is a surface for logistics and recreation.
Immediate Future

Figure 4.7
Design Strategies Across the Gradient of Change: Immediate Future
This raised ‘second ground’ should be the principal level of access to buildings – representing a ‘mat’ condition. It should also extend over the flexible zone, towards the sea for access to transportation.
Near Future

- Establish the 'second ground' as the principal level access to buildings
- Extend 'second ground' into the flexible zone and to the sea
- Provide infrastructure access

Mean Sea Level, 2000
Mean Sea Level, 2016

Transit Station Level
The ‘second ground’ should be porous. It will also provide additional means of egress for Olympic facilities.
Figure 49
Design Strategies Across the Gradient of Change: 2020
The temporary Olympic facilities are to be built on the flexible zone. Once taken down, they become ‘metabolized’ as coastal deposition.
Design Strategies Across the Gradient of Change: 2060

Figure 50
Arena egress on both reclaimed ground and second ground.
Reclaimed ground as a recreational and logistics surface.
Dismantled arena becomes coastal deposition for wave impact.

2060
Buildings damaged by earthquake, possibly the ‘next big one’ also get metabolized. Perhaps as an artificial reef.

By 2100, the sea level has risen, and the second ground adapted to the new mean sea level.
By 2100, the pier section of 'second ground' adjusted to the new mean sea level.

Earthquake debris from the expected 'Big One' becomes an artificial reef.

Figure 51
Design Strategies Across the Gradient of Change: 2100
The second, elevated ground level is proposed to serve as a pedestrian and emergency thoroughfare, as well as an extension of transportation and logistics infrastructure.

In this risk analysis- and mapping-based thesis, the primary emphasis is on the methodology, while design implications are indicative. In any case, the design implications of this methodology could be summarized as:

+ Deep-protected pile foundations\(^1\)
+ The strategy for the ground reclaimed from the sea is selective deposition on areas expected to remain as 'land', and the use of ground as a park or for logistics.
+ The strategy for the 'second ground' level is to use it as a main circulation means, providing access to infrastructure for transit and evacuation.
+ In the layered coastal condition, the flexible zones will be the sites for temporary facilities for Tokyo 2020, and will then remain for recreational or logistics use.\(^2\)

The reclaimed ground and the supporting 'second ground' level embody strategies similar to those outlined in USGBC's New Orleans Principles: Urban linear parks on the periphery, creative means for evacuation and strategic use of demolition waste for building higher ground where necessary. \(^3\)

---

Figure 52
Conceptual Sketch: Design Strategies Across the Gradient of Change
chapter four
Conclusion:
A New Metabolism

"Fishing Boats in Tsukada Bay, from Eitai Bridge" by Utagawa Hiroshige (1832-34)
Form Follows Succession

A New Metabolism

Epilogue: Ground as a Project for an Urbanism of Resilience
Perhaps, it is now time to step back and consider the inherent meaning of the concepts of gradients of change and 'second ground', in relation to the discourse of urbanism for Tokyo Bay and beyond.

This project proposes an urban coastal gradient: Instead of a supposedly determinate coastline, it is a flexible zone of succession for Anthropocene deposition of sediment and submersion under water.

The point of departure for the gradient is the archetypal coastal section: land, sea, and a flexible zone in between, where coastal succession takes place.

This is then taken as a design analogy in an urbanistic process where the main objective is to develop a mapped gradient of change proposed to guide the form of a resilient coastal urban landscape.

As an outcome of mapping, and indexing of cartographic data, the gradient is an abstract structure first and foremost, very much like a grid applied on the urban landscape.

It is important to note that as with all products of representation modes and processes, the gradient has inherent bias stemming from the very process of abstraction and reduction, e.g. the precision and accuracy of the source data about risk, as well as the software environment and algorithms that were used to index and consolidate data.
It is an exciting coincidence that Superstudio — in the quest of negating the architectural object towards an all-encompassing environment — drew their famous grid over a beach in a conceptual proposition.\(^2\) This, however, represents a moment frozen in time. Any grid would be immediately altered by wind erosion and human action, and more substantially erased by tides, ruptured by quakes.

The gradient of change proposed in this thesis would be a constructed condition, entailing the critical construction of new reclaimed land and new development, a phased retreat from vulnerable areas, and a critical deposition of new sediment - all subject to environmental impact.

It is meant to serve as a blueprint for a resiliency district pattern, but the indexical mapping process that led to its creation also allows for re-considerations and alterations of the gradient in the future: The sea level will rise, flooding will happen, the expected major earthquake will take place, and the urban fabric and waste will be metabolized into land. As environmental impact and change happens, new data sets will be available for the reconsideration of the current gradient.

The Metabolist imaginary envisioned Tokyo Bay as a site of continuous urban growth. Ground was taken for granted and the possibilities of urban decline or reconstruction were hardly considered within the same design utopia.

One particular designer among the Metabolists, Arata Isozaki, envisioned the city in an archaeological picturesque, or reconstruction from ruins.

Isozaki's urban project is incomplete: Only the idealized climax state or the complete ruin is studied, without the transformation stages in between or beyond.

The Metabolist concept of the 'artificial ground' found its place over an infrastructure corridor and hub of determinate form - Shinjuku Station - in the work of Maki and Otaka.

Now in Tokyo Bay, the artificial ground is proposed over an indeterminate landscape of ground / water in perpetual transformation beyond the short-term climax state of the 2020 Olympics.

This project argues for a New Metabolism in which the ground is conceived as an indeterminate landscape of change.

The uncertainties of the ground are addressed by an 'artificial land' infrastructure which organizes and facilitates transformation over time.

---

Figure 54a
Montage “Incubation Process” (1962) by Arata Isozaki Atelier
Lisa, p. 122

Figure 54b
Shinjuku Station Project (1960) by Fumihiko Maki and Masato Otsuka
Lisa, p. 33.
As we conclude, it is meaningful to take one more step back and reflect on the meta-level themes, beyond Tokyo Bay.

This thesis frames ground as a project for a resilient urbanism. The ground reclaimed from the sea is conceptualized as a gradient of temporalities. Then a porous ‘second ground’ is proposed as a means of infrastructural support over the landscape of urban form.

The landscape-minded urbanism effort relies on the agency of critical mapping, prioritizing landscape as a means to organize the urban environment. This figural and literal claim of territory is a means to address the urban landscape form directly as a whole, instead of the policy-based approaches, such as in the Tokyo Disaster Plan or spot interventions, as in Rising Currents.

The contemporary project on the urban coast is not a project of architectural urbanism, where the main elements of the project are objects. Instead, it is a concurrent project of ground, and by unavoidable co-existence, of water.

---

Design Strategies for the Ground Across the Gradient of Change
"Hase on a Clear Day at Enoshima" by Toyokuni II (ca. 1832–1836)
Bibliography and Credits

Including Extended Bibliography Items


Geospatial Data Sets

Dataset category and year is noted on each map where applicable.

Geospatial information was sourced from:


Image and Illustration Credits

1. a) Dubai Palm Islands from the air (2015)
   from Wikimedia Commons, by Skatebiker
   https://en.wikipedia.org/wiki/Palm_Islands#/media/File:Dubai_Palm_Islands_from_the_air.jpg

   b) The Center Core of the Palm Jumeirah (2008)
   from Wikimedia Commons, Photography by Alexander Heilner
   https://en.wikipedia.org/wiki/Palm_Islands#/media/File:Palm_jumeirah_core.jpg

2. Conceptual diagram of the thesis statement

3. a) Figure 3a
   ‘Dolos’ blocks on the coast of Cape Town (2006)
   from Wikimedia Commons, by Adam Brink
4. a) Steam Locomotive on the Yatsuyamashita Shore, Tokyo by Utagawa Hiroshige III (Around 1871)
   from Tokyo Metropolitan Library
   http://www.library.metro.tokyo.jp/portals/0/edo/tokyo_library/english/upimage/big/052.jpg

   b) Rainbow Bridge and Tokyo skyline seen from Odaiba Island, Tokyo (2010)
   from Wikimedia Commons, by javachan

5. Map: Tokyo Bay - Meiji Era Tidal Flats

6. Map: Tokyo Bay - Land Reclamation by Type

7. Map: Tokyo Bay - Land Reclamation by Developer

8. Map: Tokyo Bay - Land Reclamation by Purpose

9. Map: Tokyo Bay - Land Use Zones

10. Map: Tokyo Bay - Low-Lying Areas

11. Map: Tokyo Bay - Inundation Risk

12. Map: Tokyo Bay - Coastal Management by Type

13. a) Tange Plan for Tokyo Bay and Kenzo Tange (1960) by Akio Kawasumi
   Lin, p. 145

   b) Illustrations of Growth for Tange Plan (1960) by Tange Associates
   Lin, p. 160
b) Tokyo Bay - Areas projected to be affected by sea level rise by 2100, assuming global warming by 4 degrees centigrade from Surging Seas (2015) http://choices.climatecentral.org/
Map URL: https://shar.es/ldsM95

15. a) Tokyo Bay - Differential earthquake impact intensity from Japan Times (2013)
http://www.japantimes.co.jp/news/2013/12/19/national/up-to-23000-may-die-in-major-tokyo-inland-quake-government-prediction/
b) Tokyo Bay, Tokyo - Liquefaction Risk from Nankai Trough Earthquake from Asahi Shimbun (2013)

16. Liquefaction during the 3/11 Tohoku Earthquake at Urayasu Island, Tokyo Bay
by Toshiyuki Aizawa/Bloomberg

17. Urban - coastal transect, reclaimed areas and islands, and Tokyo 2020 facilities

18. Thesis concept: Sharply delineated boundary versus dynamic frontier zone

19. Thesis concept: Coast line versus coast zone along the urban - coastal transect

20. Coastal Tokyo: Land Reclamation in the 20th Century
based on data from MLIT (2010)

based on data from MLIT (2010)
22. Coastal Tokyo:
   from Google Earth (1997)

23. Coastal Tokyo:
   from Google Earth (2015)

24. Coastal Tokyo:
   from Google Earth (2015)

25. Timelines and Transects: Events and Processes Affecting the Urban Coastal Transect

26. Flooding Risk Areas and Urban Coastal Transect
   Based on data from MLIT (2011)

27. Coastal Management Structures in Tokyo Bay
   Based on data from MLIT (2012)

28. Distribution of Seismic Intensity - Submarine Trench Earthquake Scenario and Urban Coastal Transect

29. Liquefaction Risk - Submarine Trench Earthquake Scenario and Urban Coastal Transect

30. Distribution of Seismic Intensity - Tokyo Epicenter Earthquake Scenario and Urban Coastal Transect

31. Liquefaction Risk - Tokyo Epicenter Earthquake Scenario and Urban Coastal Transect
32. Tokyo 2020 Sites and Risk in Tokyo Bay
   Based on data from Tokyo Metropolitan Government (2014) and Japanese Olympic Committee (2013)
33. ‘Lifelines’ and Critical Facilities for Resilience in Tokyo Bay and the Urban Coastal Transect
   Based on data from MLIT (2006-2014)
34. Risks and the Tokyo Bay Transect
   Based on data from Tokyo Metropolitan Government (2012) and MLIT (2011-2013)
35. Process of consolidating individual datascapes for a resiliency district gradient pattern
36. Indexical Mapping of Long-Term Risk Factors in Tokyo Bay and the Urban Coastal Transect
   Based on data from Tokyo Metropolitan Government (2012) and MLIT (2011)
37. Concentration of ‘Lifelines’ and Critical Facilities for Resilience in Tokyo Bay
   Based on data from MLIT (2006-2014)
38. Pattern of Coastal Change for Coastal Tokyo
39. Indexical Mapping of Long-Term Risk Factors in Tokyo Bay and the Urban Coastal Transect
   Based on data from Tokyo Metropolitan Government (2012) and MLIT (2011)
40. Concentration of ‘Lifelines’ and Critical Facilities for Resilience in Tokyo Bay
   Based on data from MLIT (2006-2014)
41. Pattern of Coastal Change Across the Urban - Coastal Transect
42. Resiliency District Pattern for Coastal Tokyo
43. Catalyst sites on the urban - coastal transect
44. Long-term Risk Factors and Permanence / Change Gradient in Section
45. Development scenarios for the 2020 Olympic peak condition, 2060 and 2100
46. Design Strategies Across the Gradient of Change: Present Day
47. Design Strategies Across the Gradient of Change: Immediate Future
48. Design Strategies Across the Gradient of Change: Near Future
49. Design Strategies Across the Gradient of Change: 2020
50. Design Strategies Across the Gradient of Change: 2060
51. Design Strategies Across the Gradient of Change: 2100
52. Conceptual Sketch: Design Strategies Across the Gradient of Change
   from Shaik and Macel, p. 200
54. a) Montage “Incubation Process” (1962) by Arata Isozaki Atelier
   Lin, p. 122
   b) Shinjuku Station Project (1960) by Fumihiko Maki and Masato Otaka
   Lin, p. 33
55. Design Strategies for the Ground Across the Gradient of Change
Intertitle Image Credits

1. “Under Mannen Bridge at Fukagawa” by Katsushika Hokusai (ca. 1830) – page 4
   From the Boston Museum Fine Art

2. “Cushion Pine at Aoyama” by Katsushika Hokusai (ca. 1830) – page 6
   From the Boston Museum Fine Art

3. “Steam Train in Takanawa, Tokyo” by Utagawa Hiroshige III (Date unknown; 1872-1894) – page 12

4. “Sudden Shower Over Shin-Ohashi Bridge and Atake” by Utagawa Hiroshige (1857) – page 20
   From the Boston Museum Fine Art
   http://www.mfa.org/collections/object/sudden-shower-over-shin%C3%B4hashi-bridge-and-atake%C3%B4hashi-atake-no-y%C3%B6dachi-from-the-series-one-hundred-famous-views-of-edo-meisho-edo-hyakkei-252218

5. “Returning Sails at Azuma-bashi Bridge” by Utagawa Hiroshige (1840-42) – page 54
   From the Boston Museum Fine Art

6. “Fishing Boats in Tsukuda Bay, from Eitai Bridge” by Utagawa Hiroshige (1832-34) – page 122
   From the Boston Museum Fine Art
7. "Haze on a Clear Day at Enoshima" by Toyokuni II (ca. 1832–1836) – page 130
   From the Boston Museum Fine Art

8. "Tsukuda Island in Musashi Province" by Katsushika Hokusai (ca. 1789-1868) – page 146
   From the British Museum
   http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=783975&partId=1
"Tsukuda Island in Mutsu Province" by Katsushika Hokusai (ca. 1789-1868)