BIRKHÄUSER

# WATER AS CATALYST

# Int | AR

**Interventions | Adaptive Reuse** Vol. 08

**Department of Interior Architecture,** Rhode Island School of Design

# Int | AR

**Interventions** | **Adaptive Reuse**

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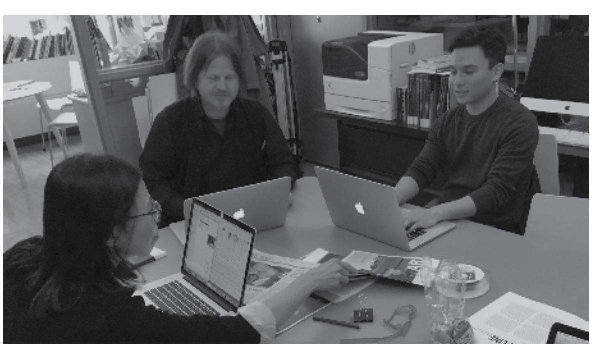
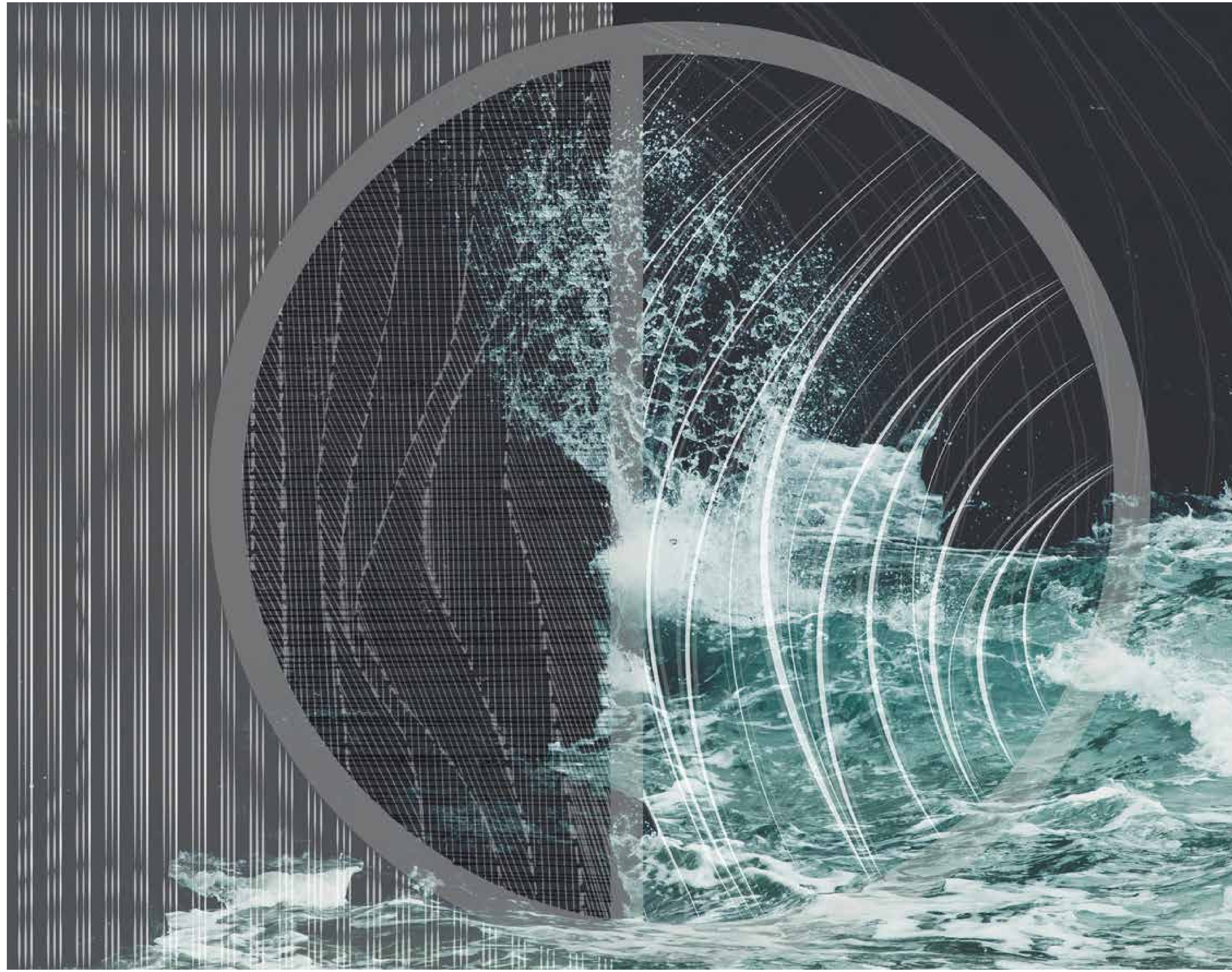


# CONTENTS

# BETWEEN RESILIENCY AND ADAPTATION

by CATHERINE JOSEPH

*Each time there is a coastal storm event, architecture's position becomes that of a militaristic, tactical defense system. The storm is the opposing military; the high winds are the artillery fire; the storm surge is the cavalry; and the flooding is the infantry, swarming the ranks of architecture for one final defeat. Humans have been trained to see buildings as safe spaces: safe from climatic variations, both daily and seasonal; safe from most of the forces that nature repetitively exerts; safe from perceived dangers that roam our immediate referential universe. It is easy to envision architecture's position as victim of a militaristic climatic attack. What is more difficult to imagine are the ways that architecture can truly defend itself against such forces.*[1]



Contemporary visions of architecture maintain the perspective, for the most part, that our buildings are designed and constructed to be eternal. As architects, we rarely visualize their demise, or the situation in which our design will meet its end. Demise for the sake of a philosophical architectural death is not the intent, nor is it a necessary outcome. Rather, the loss of a structure can be the result of a latent function that is designed to provide some benefit in its demise or its transformation.

In coastal scenarios — particularly those with threat of tropical storm damage — this might be a useful tactic to employ. Visualizing a building's end of life and anticipating potential modes of failure allows architects to design the building to either withstand the assault, or in a more incongruous case, to fail functionally in order to serve some protective purpose.

Just as one might interrogate material and elevation strategies in studies of flood mitigation and recovery, here too, the underlying cause for destruction must be identified and addressed. To understand the waterborne forces of tropical storms, one must first understand the basics of the destructive energy in water.

**[destructive energy in water]**

The National Oceanic and Atmospheric Administration defines a storm surge as an "abnormal rise of water generated by a storm, over and above the predicted astronomical tide." The atypical rise above standard tidal levels is an effect of both offshore meteorological conditions and localized winds.[2] To understand the potentially destructive capabilities of storm surges, it is useful to consider the conveyance and transference of energy within a storm system. Typically, waves are the result of wind passing over the surface of the water, transferring energy from air to water. Wave height is determined by the speed and duration of the wind, and the bathymetry of the water body. The waterborne forces that can cause architectural damage are a direct result of the energy input from the wind that is transferred first to surface waves, then to land. The energy that a wave contains is directly proportional to the square of the wave height. Thus, as wave height grows, as during a tropical storm, the energy contained in those waves grows exponentially. Significantly, although the storm surge undoubtedly brings a great deal of water mass with it, it is the transmission of energy, not mass, which is the focus here.[3]

**[stronger is safer]**

The destructive capacity of tropical storms is a given. Often, the most significant damage is caused by massive flooding. However, when Hurricanes Katrina and Sandy devastated New Orleans and New York, respectively, the initial disaster was caused by deadly storm surges. Similarly, when Typhoon Yolanda (Haiyan) struck Tacloban, Philippines in November 2013, the storm surge was the primary cause of the widespread destruction.[4] Since then, proposed strategies and policies have generally adopted a "stronger is safer" approach to coastal design. A 350-mile ring of protection around New Orleans — consisting of bigger, stronger levees, gigantic flood gates, and massive sea walls — was awarded $14 billion in federal aid.[5]

This effort to divorce architecture from its potentially destructive surroundings seems, at first, to be a logical solution. But what happens when these constructions fail, as during Hurricane Katrina? What happens where protective infrastructure is not a likely investment, as in Tacloban? Or when people have no option except to build exactly as before, with the poorest living over water because they cannot afford to own land? Architecture consistently falls victim to such events, amplifying the hardship and victimization of the people who see that architecture as safe space. Bulking up the coastline is an impulsive response that seeks to dominate nature and keep its dangers, and its many benefits, away from society.

**[the sacrificial mindset]**

The sacrificial mindset seems rather grotesque, but buildings are not living beings. Understanding their sacrifice means understanding the ways that we can alter our design process in order to accommodate an adaptive strategy. Although buildings themselves are not living beings, it is important to consider them to be part of a living ecological system. Achieving this means considering them as more than a one-time construction whose life-span is eternal and unchanging. Change is intrinsic to living systems; uncertainty, dynamism, and perceived imbalances are necessary characteristics of these systems.[6] If a system's response to a stimulant maintains a level of uncertainty, this implies an uncertainty in the effects that response will then provoke. In short, fluctuations within a system will occur, and it is this uncertainty that is typically neglected by architects.

Felix Guattari, in *The Three Ecologies*, discusses three complementary domains of ecology: social, mental, and environmental. Of great importance is Guattari's rejection of the notion that the psyche, the socius, and the environment are three separate entities that are acted on separately. Nature, he says, is inseparable from culture, and the relationship of anthroposystems, ecosystems, and referential universes must be considered transversely. This method of thinking across ecologies instead of within each allows contemporary designers to reconsider and reorient their strategies. It allows design to focus on the relationship of different entities instead of their individual, isolated functions.[7] This reorientation might also be categorized as systems thinking, as one is designing for anticipated events based on known relationship characteristics.

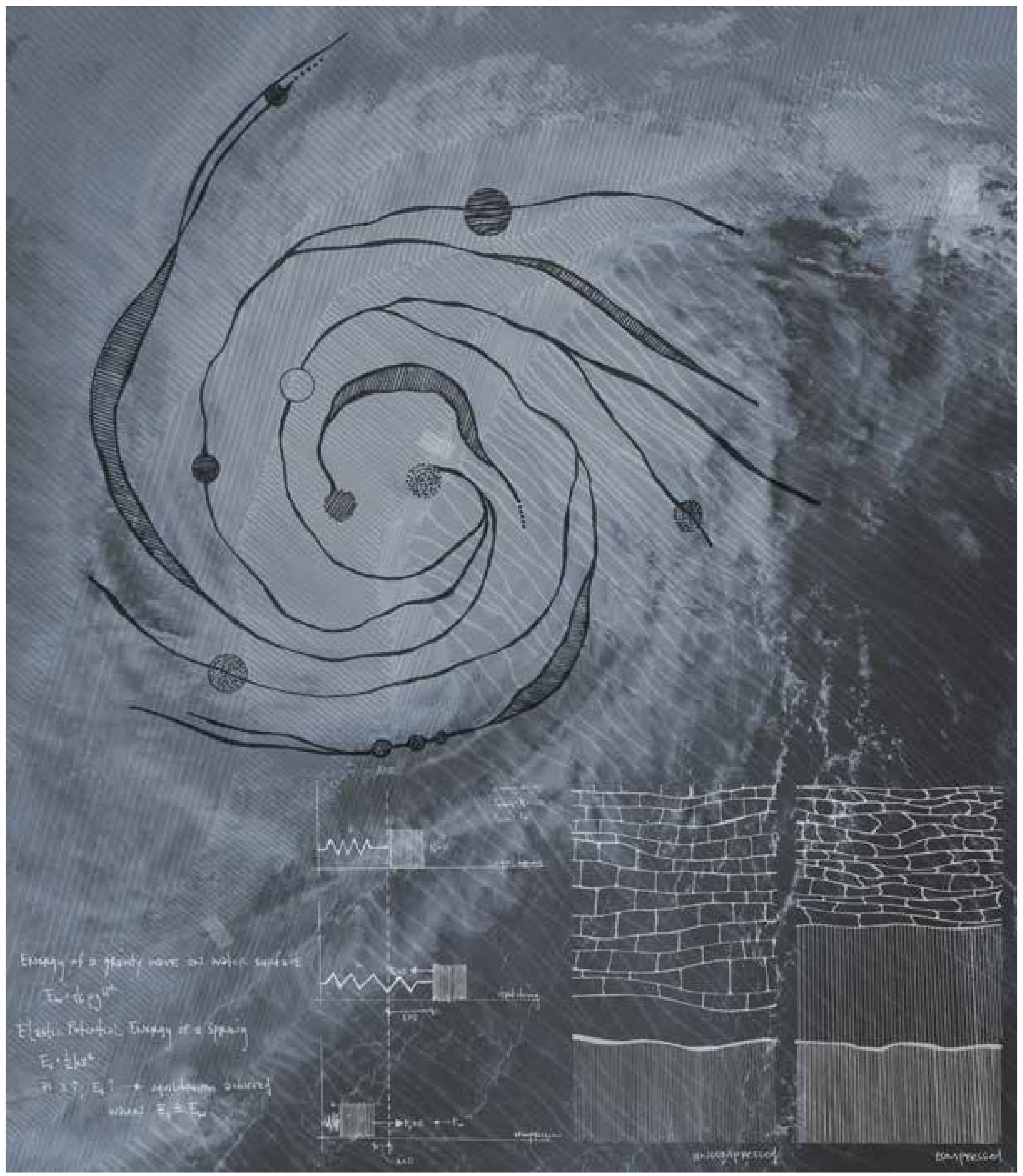
Ecological and systems thinking do not permit absolute control of the relationships among disparate systems and the events these relationships cause. Instead, they allow the considered analysis of interactions and permit speculative strategies that accommodate likely occurrences regarding potential reactions and affects. In adopting this mode of thought, we find that theories of resilience in ecology accept fluctuations and change as part of the process of equilibrium, not as an exception to it. Inherent in the acceptance and embodiment of this type of ecological thinking, and within any subsequent design strategy, is the acknowledgment of processes of constant change and adaptation within a system.

In acknowledging the dynamism of ecological systems, we see that the demise of certain components is inevitable. One might then question if that anticipated demise might be designed for, that the inevitable failure might be made functional. Designing for functional demise goes beyond the typical engineering design strategy of "design for failure." In designing *for* failure, engineers anticipate the multiple potential failure modes and the design accounts for each so that the design does *not* fail in that mode. There are a few engineers, however, who design their work to strategically fail. More specifically, failure here means that the design intelligently succumbs to applied forces instead of withstanding them.

**[crumple zones]**

Crumple zones of automobiles represent one type of design in which failure is embedded in the everyday function of the component or system. The components of the crumple zone of the car are staged such that the failure is a result of a certain event. More specifically, their demise is a function of the amount of force that is applied, and that they absorb. This embedded protection is a latent feature of automobiles. Most of us have likely owned automobiles in which this latent potential was never utilized (happily so). Although this latent potential exists silently for the life of the automobile, a more thorough thought exercise reveals that in order to design for the potential of a devastating collision, engineers must acknowledge fully that such an event could occur. The existence and considered design of the crumple zone itself acknowledges the grave danger that humans accept when they travel at high speeds in automobiles.

Consider an automobile moving at a constant rate toward a stationary object — another car, a tree, a telephone pole. In the time before the collision, there are no physical warning signs or indications that the body is moving towards demise (the human occupants, of course, can foresee the collision, but the automobile cannot). At some point, however, those moving bodies will collide and incur significant damage. This damage, in the form of kinetic energy, is ideally absorbed by the crumple zone. The folding of the crumple zone releases the energy of the collision as both heat and sound, decelerating the objects in the collision and protecting its human occupants. In this instance, the transfer of energy between the colliding bodies destroys the designed element, but activates its latent protective function.[8]




Architects might adopt a similar approach in rethinking designs for coastal protection, particularly in regions where the threat of water-borne destruction is a known, anticipated entity. In such an instance however, the crumple zone strategy might be applied to the stationary object (in this case, architecture) as protection from the moving body (here, storm surge). One might first consider designing for energy exchanges that can be predicted and calculated. Two such conditions have been identified and assigned the preliminary monikers of *Conversion* and *Absorption* for the sake of this text. In one, the force applied is absorbed through resistive measures that are somewhat more refined than a wall. In the other, kinetic energy is converted to potential energy and expended in a controlled manner during the storm event.

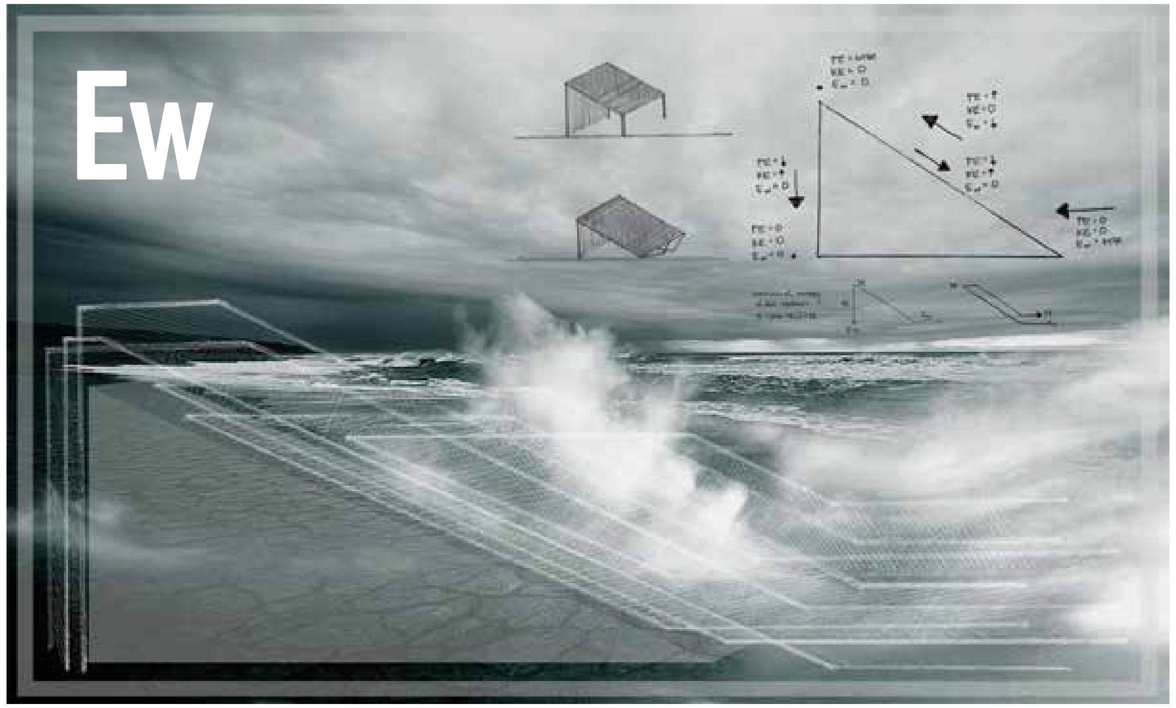
**[conversion systems]**
Conversion systems include those in which the transformation of energy is a means of dissipation and coastal protection. These might include water-turbines, or alterations to the bathymetry of the sea floor in order to affect the potential of a surge forming. Architecture may also provide some level of protection, if these alterations or energy-harvesting technologies are not viable. In its simplest form, the Conversion system might consider the conversion of kinetic energy to potential energy, which can then be expended in a controlled, intentional manner. The most basic example of this, one of the four simple machines, is the Inclined Plane. Very simply, as the wave front moves in, the wave's kinetic energy is expended as it moves up the inclined plane. The energy is converted to potential energy, which can be expended as the water moves back out to sea, or when the water drops over the upper edge of the inclined plane.

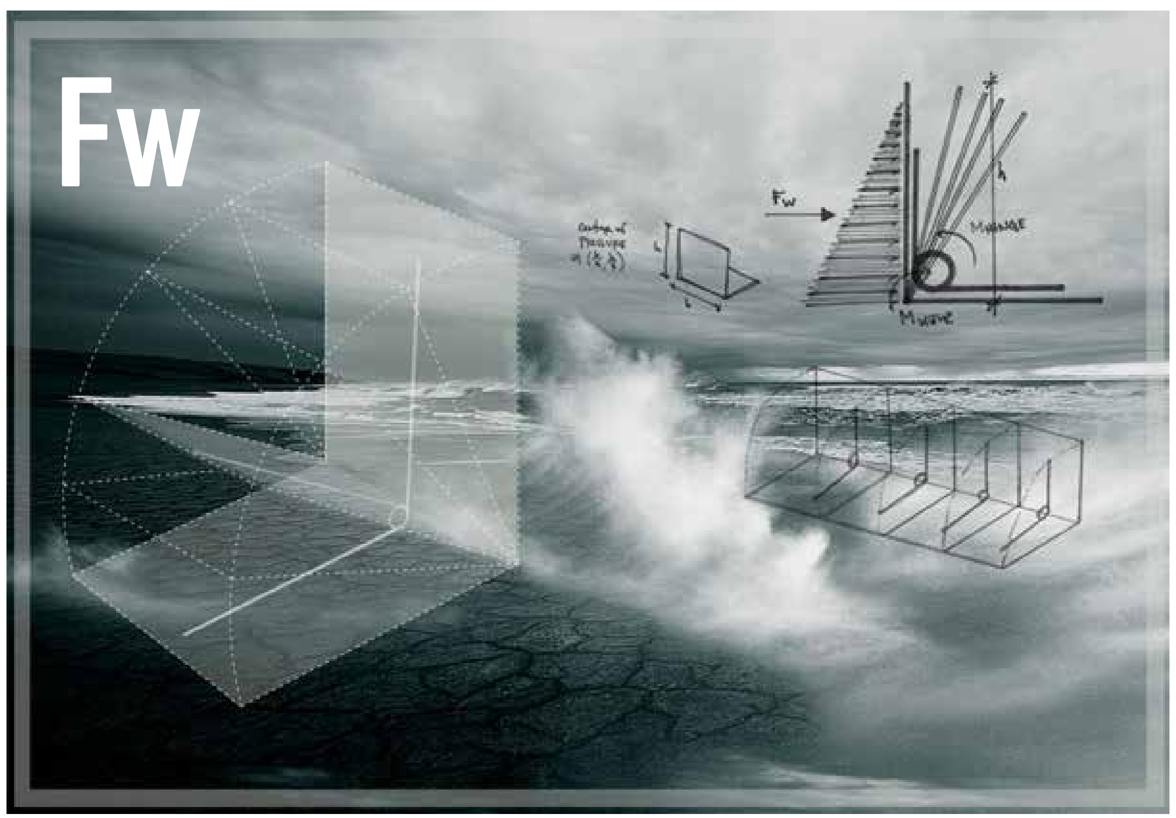
**[absorption systems]**
Absorption systems of protection operate via designs that integrate resistive constructions in which force can be absorbed. Consider a spring. Just as the energy contained in a wave is proportional to the square of the wave height, the energy contained in the spring, or the spring-loaded construction, is proportional to the square of the displacement distance. This energy, produced when the wave or storm surge causes displacement of the construction, is potential energy. Thus, the kinetic energy of the wave is converted to potential energy in the spring that can then be expended calmly. Given the rhythmic nature of the waves within a storm event, one can imagine a similar rhythm to the build-up and expenditure of potential energy within the Absorption system. As a wave front moves in, the kinetic energy is converted to potential energy within the system, and in the time between the wave fronts, the energy is expended in a controlled manner, allowing the system to recharge for the next incoming wave front.

The Conversion and Absorption systems of protection might take any number of forms. Only a few very literal, preliminary iterations have been shared here. The two Absorption systems are a spring-loaded hinge, and a compressible/expandable cellular structure. The Conversion system is the integration of inclined plane characteristics into architectural designs. These systems have been sketched in the accompanying images. To describe them further would require a presentation of the physics that characterizes them. This has been discussed previously. The integration of energy conversion and energy-absorption into coastal architectural design warrants further consideration as a method of ensuring safety.[9]

**[design for functional demise]**
Design for functional demise raises the question of social adaptation and social resilience. Social resilience is defined by Wu and Wu as the ability of a community to withstand, and to recover from external environmental, socioeconomic, and political shocks or perturbations.[10] Perhaps the most pertinent question regarding social adaptation with regards to architecture is: can social resilience be designed? Or must adaptive cities and architectural reinvention be deployed strategically within communities that already exhibit social resilience? If the composition of our built environment were to change, would it be necessary to teach humans to adapt, or would we innately adapt to the new spaces?

In this regard, again, Felix Guattari provides insight. His essay, "The Three Ecologies", highlights the importance of consistent and perpetual reinvention, seeming to encourage reinvention based on varying rhythms of repetition, the cadence of which will deter an entrapment in deathly repetition (which, of course, is different than the repetitive nature of reinvention). He discusses emergence and re-emergence, seeming to encourage reinvention based on varying rhythms of repetition, the cadence of which will also deter "deathly entrapment." He describes the effort




TOP
**Inclined Plane**
BOTTOM
**Hinge**

of repetition as 'mechanical,' bringing to mind visions of tedious but repetitive and effective mechanistic processes. He vocalizes support for continued inventiveness and the perpetuation of innovative practices. It is this alternative experimentation that can both respect the singular nature of the psyche and work towards the proliferation of an agency that can exist simultaneously as autonomous and collective.[7]

More significantly, however, Guattari presents a philosophy that relies on a level of social and cultural resilience that is unique to specific regions. This resilience is necessary for an amplified, perpetual reorganization and reinvention of our built environment. It is a repetition that is wholly different than Guattari's mechanical repetition, as it is a repeated reinvention of the built environment according to the conditions that exist at the time of rebuilding. The level of resilience and reinvention is a social expectation. One might consider that Guattari's mechanical repetition is currently how we engage in architecture, and is furthermore relevant when we design for coastal habitation. The question becomes, what sort of reinvention must architecture undertake to adapt to the changing regional characteristics and the needs of people who inhabit our buildings?[7]

Guattari's idea of repetitive rebuilding suggests the potential for a projective and progressive regeneration through the reconfiguration and development of what existed before. This way of thinking, reflecting the previously discussed ecological and systems thinking, amplifies the ideas that processes of disorganization and reorganization help society tend towards social order. This sort of thinking lies outside of what we currently think of as resilient architecture or coastal storm protection.

To say that architects must face the impending (and current) effects of a slowly shifting climate and thestorm events that accompany the phenomenon, is a statement that clearly underscores the potential of the field and the designers and practitioners that compose it. Architects, urban planners, and designers have an opportunity to rethink the way that our built environment functions, and the ways that we can further it to serve the people who inhabit and care for it. Anticipating and accepting potential damage and demise is necessary to design in anticipatory and conscientious ways. It requires understanding that damage or destruction cannot always be prevented, but that architects can design ways to transform the energy inputs and to mitigate the effect of the destructive forces. It hints at a design strategy that embeds latent adaptive and reactive performance into architecture. It speculates on an architectural design strategy that challenges notions of permanence, function, and safety.

ENDNOTES:

1 The topics presented here do not ignore policy and economic strategies, although this paper does. Instead, the ideas is to look beyond to tactical design methods that might provide additional protection during storm surge events, particularly in areas where retreat is not an economic or culturally viable option.

2 NOAA. "Storm Surge Overview", *National Hurricane Center | National Oceanic and Atmospheric Administration*. <http://www.nhc.noaa.gov/surge/>. (August 27, 2015).

3 Note that flooding as a destructive event is not addressed here. Rather, it is the forces associated with moving water (i.e. storm surges) that will be addressed.

4 "Mapping the Destruction of Typhoon Haiyan", *The New York Times*. November 11, 2013. <http://www.nytimes.com/interactive/2013/11/11/world/asia/typhoon-haiyan-map.html>

5 John Schwartz, "How to Save a Sinking Coast? Katrina Created a Laboratory", *The New York Times | Science*. August 7, 2015. <http://www.nytimes.com/2015/08/08/science/louisiana-10-years-after-hurricane-katrina.html?_r=0>.

6 Chris Reed, and N. Lister, "Parallel Genealogie.," *Projective ecologies*. (2014).

7 Félix Guattari, The Three Ecologies. 1989, Trans. Ian Pindar and Paul Sutton. (New Brunswick, NJ: Athlone P 2000).

8 Christopher Erickson, "Crumple Zones in Automobiles," Sourced through the American Institute of Physics. (accessed July 28, 2015).

9 Note that these proposals are for temporary structures, not for residential or other more permanent structures. Also note that the proposed temporary structures assume that all people have been evacuated to a secure, inland evacuation center at the time the storm event reaches the coast.

10 Jianguo Wu, and Tong Wu, "Ecological resilience as a foundation for urban design and sustainability." *Resilience in Ecology and Urban Design*, 2013, pp. 211-229.

# PROJECT CREDITS, INFORMATION AND BIBLIOGRAPHIES

### EDITORIAL

Project Name_Projecting Change

Image Credits: Neethi Abraham, Angelica Carvahales, Udeeta Jain, Mengran Jiang, Vinoti Kabara, Krishna Lingutla, Sneha Mathreja, Hana Mehta, Gloria Ramirez, Eshank Rishi, Eder Romero, Yinghua Tan, Rohit Vantaram, Ananya Vij, Plub Warnitchai, Mengyue Zhou

### BREATHE, LOOK, STAND UP

Project Name 01_ DC ExchangeProject_Site_ McMillan Slow Sand Filtration site_ Location_ Washington DC_ New use 01_ Community center, marketplace, performance_ Project Name 02_ People's Liberation Army No. 1102_ Location_ Shenyang China_ Original architect_ Communist Party China_ Rehabilitation architect_ META-Project_ New use 02_ Exhibition space, mini theatre

Image Credits_ Figure 01,02, 08_ McMillan slow sand filtration site, Washington, DC, Lewis Francis; Figure 03 –07_ Public Folly, Shenyang, China, META-Project; Figure 09_ Courtesy of Lindsay Winstead

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### THE TEARS OF THE U.S.S. ARIZONA

Project Name_ A tomb that lives; Location_ Pearl Harbor, Hawaii

Image Credits_ Figure 01_ View of USS ARIZONA taken from Manhattan Bridge on the East River in New York City on its way back from sea trials. December 25, 1916, Library of Congress Prints and Photographs Division Washington, D.C. 20540 USA http://hdl.loc.gov/loc.pnp/pp.print; photographer_Enrique Muller, Jr. / E. Muller; 1916; Wikimedia; Figure 02_ A TOMB THAT LIVES Monument proposal, illustration by author; Figure 03_An aerial view of the USS Arizona Memorial, U.S. Navy photo by Photographer's Mate 3rd Class Jayme Pastoric, Wikimedia

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### THE EDGE OF CONDITION

Project Name 01_ Three Mills_ Bromley-by-Bow_ River Lee_ London, England_ Project Name 02_ The White Building_ Lee Navigation Canal_ Hackney Wick_ Stratford, England,_Project Name 03_ The Marine Engine House_ Wlathamstow Reservoirs

Image Credits_ All images courtesy of the authors; Figure 01, 02_Three Mills Island, London_ Figure 03_ White Building_ Hackney Centre Wick_ Stratford_ Figure 04_ The Sinking Future Post Apocalyptic Flood Survival Centre.

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### BACK TO THE FUTURE

Image Credits_ Figure 01_ The Big U, Courtesy of Bjarke Ingels Group; Figure 02, 03, 05) by Julia Casol; Figure 04_ Courtesy of H+N+S Landscape Architects; Figure 06_ Dijkdoorbraak bij Bemmel, 1799, Christiaan Josi, naar Jacob Cats (1741 – 1799), 1802, source: Rijksmuseum, Amsterdam

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### THE OYSTER BLOCKS PROJECT

Project Name_ The Oyster Blocks Project

Image Credits_ Figure 01 – 07_ courtesy of the author

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### THE HAMMAM OF ERBIL CITADEL

Project Name_ Hammam of Erbil; Location_ Erbil, Iraq

Image Credits_ Figure 01 – 04_ courtesy of the authors

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### (re)MADE BY WATER

Project Name_ New World Mall, Bangkok, Thailand

Image Credits_ All images courtesy of the author; Figure 01_ Mall; central court, Photograph by Perfect Lazybones; Figure 02_ Floating market in Bangkok, Photograph by Georgie Pauwels: Figure 03_ Mall, escalators, Photograph by Olga Saliy: Figure 04_ Mall, koi, Photograph by Olga Saliy; Figure 05_ Mall, escalators, Photograph by Olga Saliy.

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### T-HOUSE

Project Name_ T-HOUSE, theoretical project; Location_ Hains Point, Washington, D.C.

Image Credits_ Figure 01 – 08_ courtesy of the authors

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### THE BLUE LINE

Project Name_ blue developments; Location_ Battir, Palestine; Qeparo, Albania



Image Credits_ Figure 01- illustration by author

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### ENVIRONMENTAL IDENTITY

Project Name 01_ Caiaques kayaks; Location_ Pinheiros River, São Paulo, Brazil; Artist_ Eduardo Srur; Project Name 02_Pets; Location_ Tietê River in São Paulo, Brazil; Artist_ Eduardo Srur

Image Credits_ All photos courtesy of Eduardo Srur; Figure 01_ Caiaques, kayaks, Pinheiros River, photo_ Eduardo Nicolau; Figure 02_ Caiaques, kayaks, Pinheiros River, photo_Alexandre Schneider; Figure 03_ Pets, Tietê River, photo_Eduardo Srur; Figure 04_ Pets, Tietê River, photo_ Almeida Rocha

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### A METROPOLITAN PARK OF WATER

Project Name_ Metropolitan Water Park project, Location_ Saragossa, Spain

Image Credits_ Figure 01_ Bridge Pavilion & Third Millennium Bridge, Río Ebro, Zaragoza, España, Source_Pabellón Puente y Puente del Tercer Milenio, Author_ Juan E De Cristofaro from Zaragoza, España, CC-BY-SA-2.0; Figure 02_Google Earth aerial view of Zaragoza, Spain; Figure 03_ Plano topográfico de la ciudad de Zaragoza del siglo XVIII, Wikimedia;

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### BETWEEN RESILIENCY AND ADAPTATION

Image Credits_ All images courtesy of the author; Figure 01_ by author, background_ by Aleks Dahlberg at www.unsplash.com; Figure 02_ by author; Figure 03, 04_ graphic by author, background_ by Frantzou Fleurine; www.unsplash.com

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### WATER AS MEDIUM

Project Name 01_ Water tower in Delft, Architect_ Rocha Tombal; Location_ Delft, NL; Project name 02_ Water tower in Brasschaat, Architect_ Crepain-Binst Architects; Location_ Brasschaat, Belgium; Project name 3_ Water tower Sint-Jans convent, Overijssel; Architect_ Zecc Architects; Location_ Overijssel, NL

Image Credits_All images courtesy of the authors_ Figure 01_ typological evolution of the water tower, Source: Inge Donné; Figure 02_ Water tower in Delft (NL), photo by Christiaan Richters; Figure 03, 04, 05_ Water tower in Brasschaat (BE), Crepain-Binst Architects, photo_ Crepain Binst; Figure 06, 07_ Water tower Sint-Jans convent, Overijssel (NL), Zecc Architects, photo_ Stijn Poelstra, http://www.stijnstijl.nl/;

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