Resilient Architecture

Spaces of innovation for the city

Lucy Humphrey

Byera Hadley
Travelling Scholarships
Journal Series
2017

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Climate breakdown and biodiversity loss are the defining issues of our time. This research explores how resilient architecture can create new spaces of innovation in the city, allowing architects to explore responsible practices, reduce harm, and work towards a livable future.

1

Preface

Since the research and writing of this report between 2017-2019, the global context relating to architecture and climate has significantly changed.

We have lived through a global pandemic (2020-2023) and witnessed the accelerating impacts of climate breakdown across the world, with increasingly frequent and more severe droughts, floods, storms, wildfires and displacement through sea level rise. In 2018, the IPCC's report on climate inaction and the potential consequences contributed to broadening climate awareness and alarm. In the same year, Jem Bendell's 'Deep Adaptation' paper was released, presenting a stark assessment of the current climate science and state of the planet, suggesting the potential for societal collapse due to climate breakdown in the near-term future[1]. This contributed to the creation of international climate action movements such as Extinction Rebellion (founded 2018), Architects Declare (founded 2019) and ACAN (Architects Climate Action Network, founded 2019).

By 2024, international media outlets reported 2023 as the hottest year on record[2]. July 2024 marked the 13th consecutive month of global temperatures reaching 1.5˚C above pre-industrial levels[3] (the "safe limit" internationally recognised by the Paris Agreement[4]), and in late July 2024, the four hottest days on record were recorded[5]. These temperature changes show increases above pre-industrial averages that may not have been seen on Earth for over 100,000 years[6]. It has been widely acknowledged that countries have failed to act, and meet their obligations under the Paris Agreement. Collectively, we appear to have failed to limit global temperature rise to 1.5˚C above pre-industrial levels. We are currently projected to be on track for at least 3˚C warming[7], and may be approaching (or have passed) tipping points that will create dangerous feedback loops. The Guardian's interviews with hundreds of climate scientists[8], published in May 2024, support the views presented in Bendell's Deep Adaptation, with some proposing major societal disruption may occur within the next five years[9].

There are increasing calls from those working in climate science, research, activism and government, among others, who are speaking out about the likely consequences of climate inaction. In July 2023, UN Secretary General António Guterres announced, "The era of global warming has ended; the era of global boiling has arrived. Leaders must lead. No more hesitancy. No more excuses. No more waiting for others to move first. There is simply no more time for that."[10] If collapse due to climate breakdown is both inevitable and likely (because the accelerating impacts of climate change cannot be reversed), and we're approaching tipping points that may trigger additional warming and disruption, the notion of 'resilient architecture' takes on a more urgent meaning. Practice will be upended, and this context suggests the need for radical changes to the profession, including architectural education, practice, policy and research.

In light of the climate science, and decades of peer reviewed research, reporting and analysis, and those professionals who are putting their careers on the line to speak out, we must uncover ways in which architects can help to prepare communities, improve resilience and reduce harm. Our planet is changing, and our futures may be unpredictable and unstable. Resilient architecture could provide critical support and enable regenerative communities to emerge – designed with the primary values of care, repair and Connecting to Country. We could explore ways to provide local and independent food and clean energy systems, climate refuges (considering both humans and non-humans) and create new circular bio-regional economies. Resilient architecture could mean new social infrastructures and shared assets, and new roles for architects which go beyond the creation of physical buildings. Given our national and global carbon budgets[11] and the need to rapidly decarbonise in all sectors, we might ask – **what do we really need to build?**

This reflection is intended to frame this report in the context of rapidly changing conditions. It promotes an assessment that it is time to leave any notions of "sustainability" behind. Within our current colonial, patriarchal and extractivist systems and practices, there is nothing to be sustained. It is time for deep adaptation[12], and for re-imagining less harmful systems, processes and material practices.

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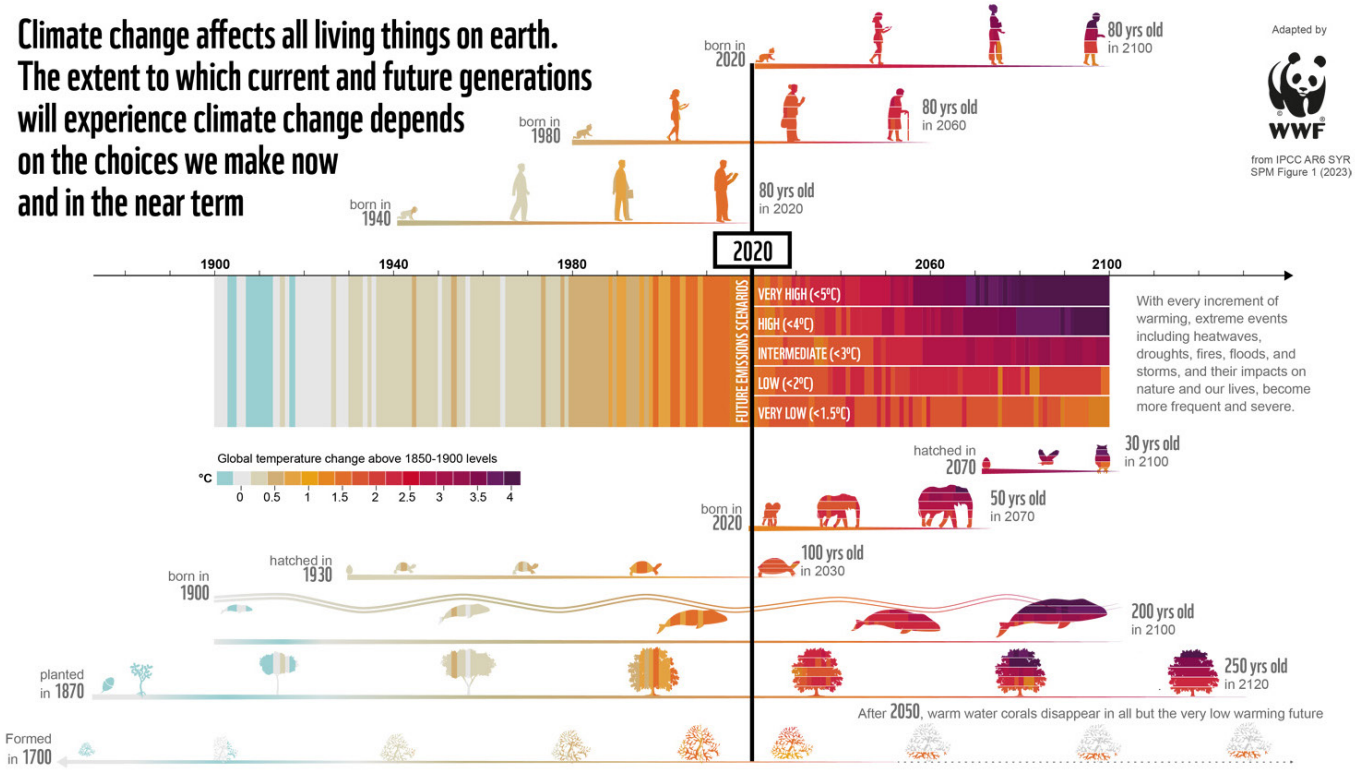

Image: IPCC AR6 2023

Source: https://wwfint.awsassets.panda.org/downloads/wwf_ipcc_timeline_graphic.jpg

2

Introduction

This report examines resilient architecture through four projects that demonstrate creative responses to re-thinking the city, in response to the climate and biodiversity crises. Through empirical research, international travel for site visits and interviews, and an in-depth study of published project materials, the research investigates whether resilient architecture can create new spaces of innovation and agency for architects. This is achieved by comparing and contrasting architectural responses to specific aspects of climate change impacts demonstrated in four case studies.

In the context of accelerating climate breakdown, and an understanding of how it will affect our lifestyles and places of habitation, urban or architectural "resilience" has been explored. This considers a definition of resilience as "the capacity of individuals, institutions, businesses and systems within a city to adapt, survive and thrive no matter what kind of chronic stresses and acute shocks they experience"[13]. Architectural resilience enables buildings to withstand political, social, economic and environmental shocks, but beyond this, can also play a crucial role in influencing public opinion and inspiring action. The production of creative resilient architecture – which proactively or defensively addresses contemporary social, economic and environmental pressures - demonstrates how architectural projects can embody solutions and capture the public imagination. This is seen as being critical to climate action – as decades of scientific reporting and information sharing has failed to enact meaningful change.

To address climate change we need an unprecedented and global scale of action across all sectors of society, and a consideration of resilience is critical to the future of architectural practice. This is important in the face of rapid global urbanisation which has resulted in half the world's population now living in cities, forecast to increase to almost 70% by 2050[14]. By 2050 the number of mega-cities with over 10 million inhabitants is forecast to increase from 44 (2024) to 67[15]. This will increase the susceptibility of cities to increasingly complex social, economic, political and environmental challenges, which may be amplified by sudden and severe climate events. In response, resilient spatial strategies or 'actions' can allow architects to critically respond to fundamental questions of how to provide shelter, and allow creative city-making in a context where there is a growing focus on mitigating and adapting to climate breakdown.

The challenge of climate breakdown is complicated by the lack of certainty in the future and timing of climate impacts, which will be geographically varied, and unequally distributed[16]. In response, this research considers a broad spectrum of resilient 'actions' through projects that vary in scale, typology and strategy, but have common threads which provide insights for how architects might design for changing futures. This research is situated within a wider context of the international acknowledgement of the twin climate and biodiversity crises, where international organisations such as the UN (United Nations) and the IPCC (Intergovernmental Panel on Climate Change) have stressed the need for rapid decarbonisation and a radical transformation of our societies. This extends from the level of individuals, to nations and international policy. With this mounting pressure, and our obligations under the Paris Agreement, Australian architects have a responsibility to consider how an understanding of climate resilience may impact their design practice.

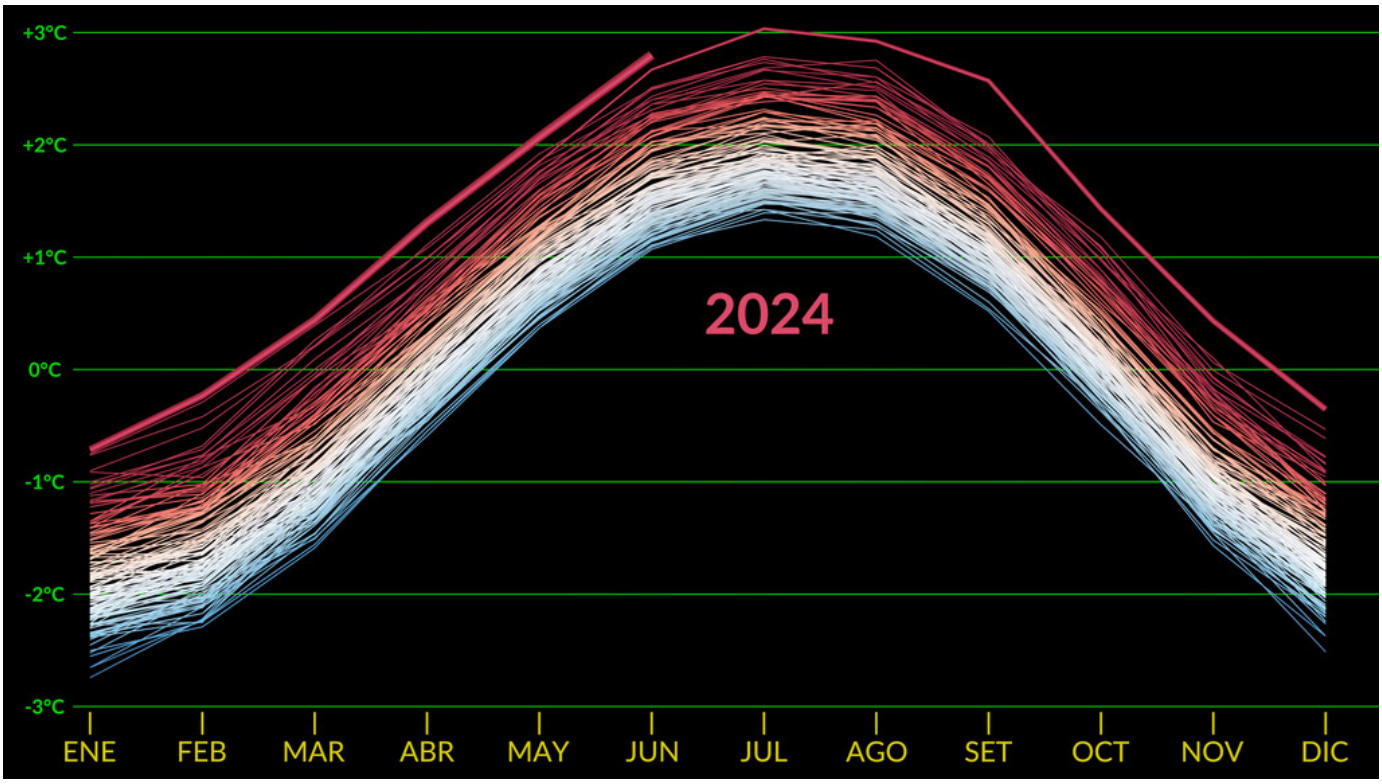

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Image: NASA Global Temperature visial analysis 1800-present (July, 2024)

Source: https://svs.gsfc.nasa.gov/5191/#section_credits

Over the past 10 years, the term 'resilience' in relation to architecture, cities and urban planning has gained popularity, and has been reproduced in media, industry conferences, design competitions and exhibitions. The idea of the 'resilient city' has also gained momentum, buoyed by organisations such as 100 Resilient Cities (now Resilient Cities Catalyst) with its agenda to "help cities around the world become more resilient to the physical, social, and economic challenges that are a growing part of the 21st century"[17].

Melbourne was the first Australian city to join the network in 2013, followed by Sydney in 2014, and both cities published comprehensive resilience strategy documents in 2016 and 2018 respectively. Research found that the resilient cities project was able to "generate some innovative policy and practice dialogues and demonstrate the benefits of whole-of-city thinking"[18] and the city's resilience strategies outline a series of 'actions' for the evolution of these cities, in the facing of changing conditions, including climate breakdown.

Architects must not ignore the impacts of these conditions on their current and future practice, and should consider their responsibility to plan for the future life of their buildings in a context of climate breakdown. This is accompanied by the increasing awareness of carbon emissions in the construction and operation of buildings, understood as embodied and operational carbon, and the importance of considering the creation of both circular and longer-life buildings (with a lifespan greater than 60 years), to justify the emissions associated with building activities.

As the case studies show, architects may not necessarily have focused on the idea of resilience in their work, but they should become aware of the creative opportunities and responsibilities that arise from thinking differently about materials and methods of construction, building lifespan, challenging land use and planning conventions, and exploring alternative models of funding and procurement. Challenging the status quo of architectural practice and procurement will be a crucial step in being able to deal with future conditions, where our cities are expected to become hotter, denser, more populated and consumptive, and more socially and politically complex.

In response to this context, the travel and research undertaken for this project examines how an understanding of resilience can provide opportunities for creative and proactive responses to the impacts of climate breakdown in urban areas. As we consider what agency architects have to respond to the climate crisis, the question of scale becomes critical. The spectrum of projects is presented as small, medium, large and extra-large to allow a comparative assessment of size, reach and risk. These case studies uncover important questions about how Australian architects might respond and discover new ways to innovate, provide flexibility and inspire pubic action.

By gaining a deeper understanding of architectural resilience, we uncover the potential to create new spaces of innovation and agency for architects. Resiliency is a broad term but when thought about in terms of a proactive and creative approach, it can offer guidance on how to shape architectural practice for the future. In working for the public good, architects must be at the forefront in leading change in planning policy, and challenge the way buildings are made and used, to ensure our cities and environments can face the increasingly complex impacts of the climate and biodiversity crises.

3

Background

"I have asked you here to sound the alarm. Climate change is the defining issue of our time – and we are at a defining moment. We face a direct existential threat."

UN Secretary General
António Guterres, 2018

With a majority consensus between climate scientists and governments worldwide[19], climate change is "the defining issue of our time and we are at a defining moment"[20]. From the spectrum of small individual actions to global policy, the discussion around climate change adaptation and improving the 'resilience' of societies and cities is growing. Due to complex and often uncertain forecasts about the potential impacts of climate breakdown, it is critical for architects to understand our responsibilities in this rapidly changing context, and what action can be taken to create more resilient or 'future-proof' built environments. Indeed, we may question whether future-proofing is even possible, and how we might focus on adaptation and supporting those who are most vulnerable.

We must consider how these challenges will impact future architectural practice, moving past any notions of "environmental sustainability" in terms of the possibility of sustaining the current destructive systems of material extraction, fossil fuel energy and carbon-intense economies. We must recognise that "sustainability" within our current systems is no longer viable, and we must work towards understanding the capability of architectural projects to withstand social, political, economic and environmental shocks. A building may be perceived as 'green', self-sufficient and exemplary in terms of its environmental design or performance, but susceptible to failure in the case of extreme events or chronic stresses. One perspective is to see this responsibility as an opportunity – what if resilient design leads to more creative, less harmful and more enjoyable cities? Can resilient design facilitate regeneration, and provide care and repair of both built and natural environments? We must acknowledge architecture as bound to the global real estate economy – and consider how architecture perpetuates the inequality of climate impacts, and how we can practice more responsibly. Current climate data projects that we are on track to surpass 1.5°C global warming above pre-industrial levels[21](which may occur by 2025), with a possible 3˚-6˚C global temperature rise by 2100[22]. The consequences of these higher figures are expected to be severe[23]. We should acknowledge that climate change is a symptom of broader societal issues[24], and of the destructive consequences of the behaviours, patterns of consumption, and practices of our modern societies (now widely recognised within the professional as colonial, patriarchal and extractive systems[25]). Climate change has been mapped by the Stockholm Resilience Institute as one of nine 'planetary boundaries', in their research analysing nine processes "that regulate the stability and resiliency of the Earth system"[26]. In 2023 they reported that we are currently beyond the 'safe operating space' in six out of nine boundaries.

In 2024 NASA reported that 2023 was the hottest year on record since 1880, with the five warmest years being the five most recent years[27]. The Paris Agreement called for significant international cooperation and action to curb warming to 1.5-2˚C above pre-industrial levels[28], and the UN stated that "limiting global warming to 1.5ºC would require rapid, far-reaching and unprecedented changes in all aspects of society"[29]. In late 2018 the UN's Intergovernmental Panel on Climate Change report[30] stressed the limited amount of time we have left to act, and the particular threats that cities will face, including super-storms and sea level rise. In 2023, the UN Secretary General announced that "we have now reached the period of global boiling"[31], and that immediate and radical action was required. Importantly, the IPCC's 2022 report on the state of the climate called out the construction industry – widely acknowledged to contribute up to 40% of global emissions[32] - as "lagging behind all other sectors" in climate action and reform[33].

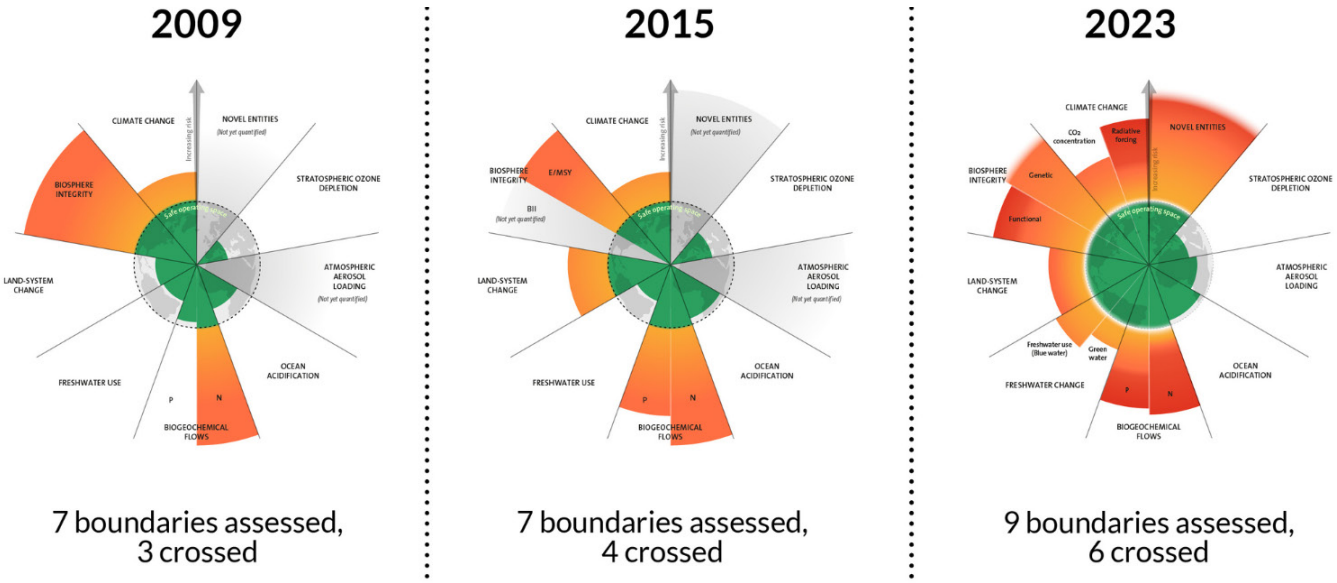


Image: Planetary Boundaries over Time, Stockholm Resilience Institute, 2023
Source: https://www.stockholmresilience.org/research/planetary-boundaries.html

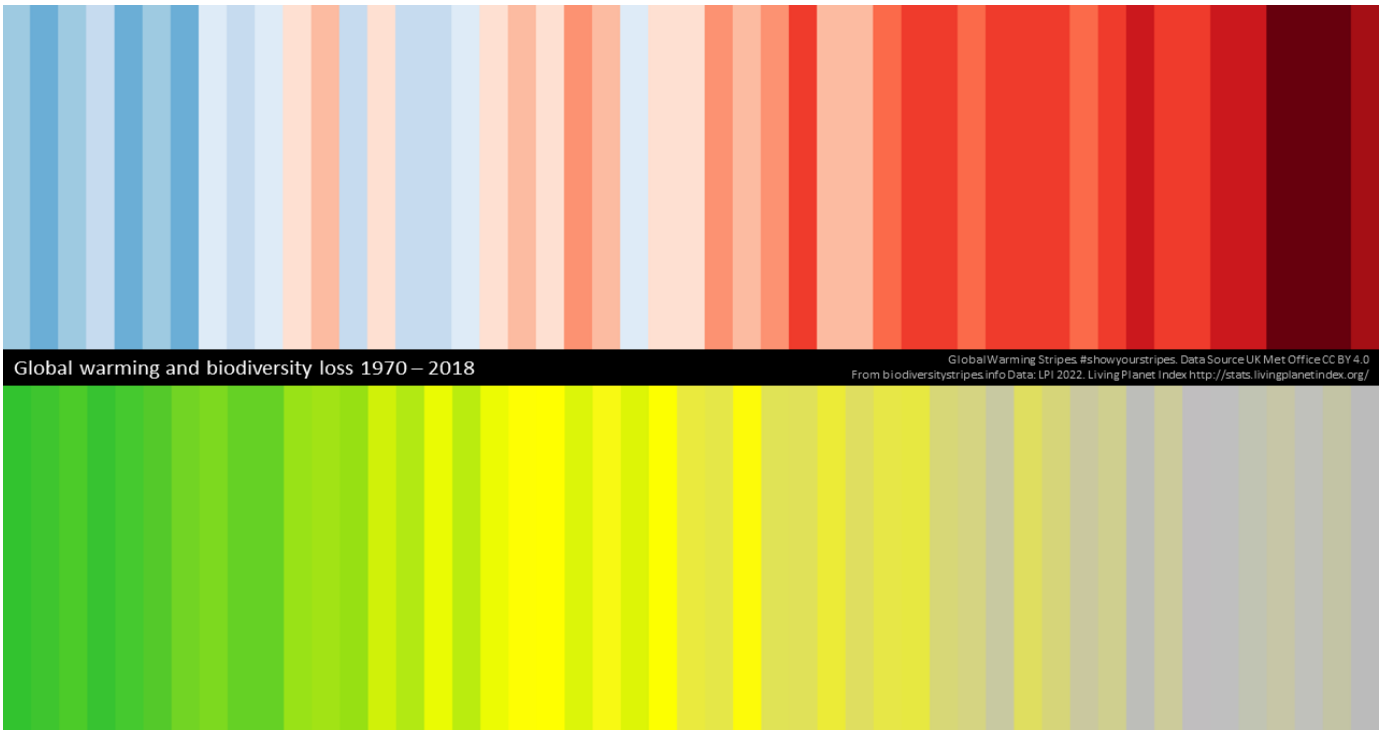


Image: Global Warming Stripes & Biodiversity Stripes, #ShowYour Stripes campaign
Source: https://biodiversitystripes.info/globalbiowarming

What if resilient design leads to more creative and enjoyable cities? Or what if architecture perpetuates the inequality of climate change impacts?

If these reports are not convincing enough, one of the most well recognised climate data graphics created is by Professor Ed Hawkins, with the #ShowYourStripes campaign[34]. This provides visual data representing both global warming and biodiversity changes based on the available records. The climate warming stripes correlate directly to global biodiversity loss, with almost 70% decline in global biodiversity since 1970[35]. There can be no greater cause for action.

With the UN Secretary General describing climate breakdown as posing a "direct existential threat" to our existence[36], there is increasing pressure for architects to re-think our approach to the provision of housing, public space and social infrastructure in the city, as well as our own architectural agency. The world population is expected to reach 8.6 billion by 2030[37], where the majority of people are projected to live in urban areas, with 50% of the global population living in cities in 2020[38].

Over the next five years, a substantial growth of cities and an increase in the number of mega-cities will put increasing pressure on architects, planners and built environment professionals to deal with urban issues on an expanding scale. In Australia, the Australian Institute of Health and Welfare reports that in 2023, 73% of people live in cities[39], and over 85% of Australians live within 50km of the coast[40]. These areas are the most at risk from climate impacts such as droughts, floods, storms, sea level rise and increased migration.

Climate-related impacts will accelerate the social, political and environmental challenges that our cities face, and will put increased pressure on the mobility, food security, livability and social equality of our cities. A map presented by The Economist presents the potential conditions created by 2-2.5˚C warming, showing larger coastal areas of Australia as being less habitable (deemed outside of the 'historical human niche')[41].

In response to this context, resilient design has been explored through numerous real and fictional architectural proposals – including what has been described as 'climate mega structures' that present a new genre of architectural project[42]. These are described to "operate at the scale of neighbourhoods, cities or regions"[43], some feasible to build today, and others approaching the speculative realm of climate geoengineering[44]. Organisations such as Rebuild by Design, focused on "re-imagining the way communities find solutions for today's large-scale, complex problems" have led the way with international design competitions that lead to the potential for built projects and necessary funding[45]. But a criticism is that capitalist forces and a focus on growth and profit can prevent effective action, and contributes to worsening climate breakdown. In his recent book 'Extreme Cities: The Peril and Promise of Urban Life in the Age of Climate Change', Ashley Dawson argues that resilient projects such as coastal protection efforts "effectively constitute a new form of disaster capitalism, one in which highly remunerative real estate development overlaps with engineering mega-projects whose spectacular character is clearly designed to attract speculative capital investment"[46].

These investments can take priority over establishing long term stability or protection for lower socio-economic groups, and obscure important conversations around the need for cities to rapidly decarbonise, adapt to a changing climate, and even relocate. With waterfront cities facing major challenges in protecting their coastlines from inundation from storms and floods, the obvious alternative is to retreat. But with a typical focus on growth and short-term gains, it is difficult to undertake

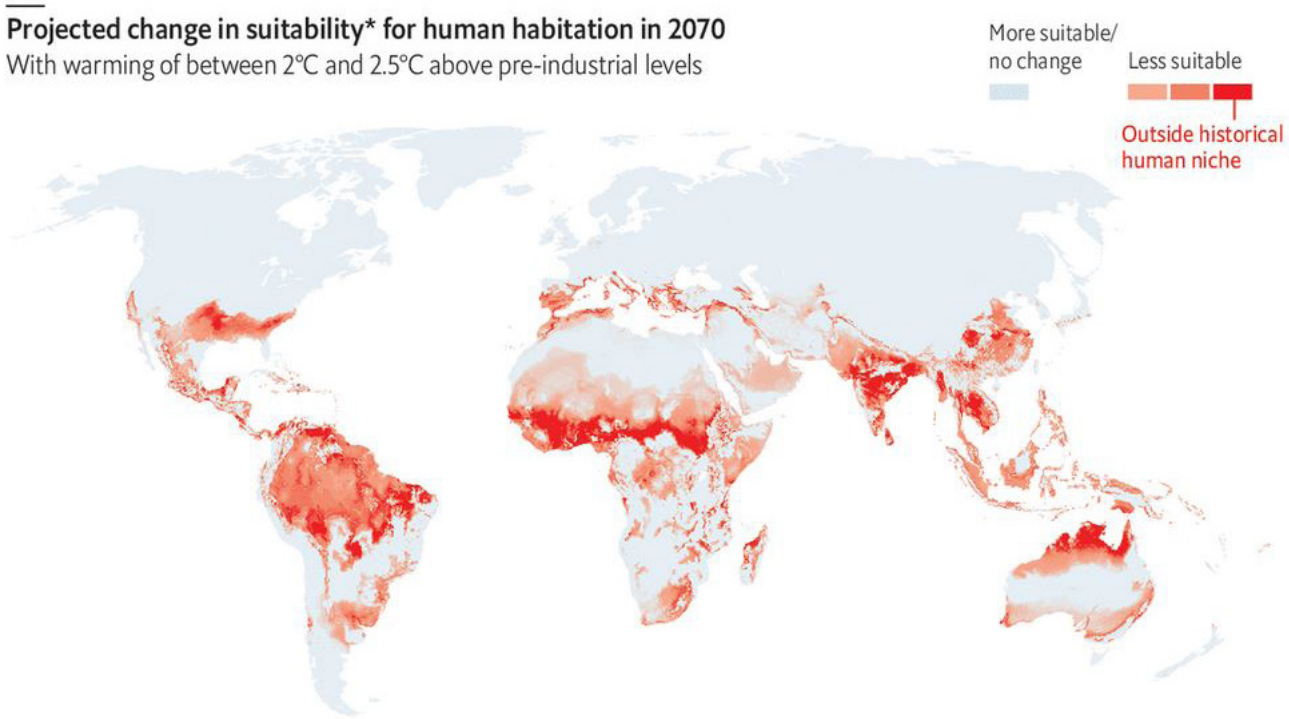


Image: Future of the human cliamte niche, IPCC AR5 2020
Source: https://www.thelowdownblog.com/2023/06/how-climate-change-may-force-one-third.html

a realistic assessment or consider relocation as the best course of action. In this way, there is a danger that "resilient" projects may reinforce existing power structures, and Dawson argues that "adaptation will necessitate letting some of those old structures and ways of thinking become obsolete"[47] and that "a truly resilient city is one that places equity and realistic necessity above short-term profit gains."[48]

It is essential that architects understand these challenges in order to fulfill their role in working for the public interest. The architecture and construction industry play a major role in contributing to global greenhouse gas emissions[49], so we have a professional obligation to act, and contribute to both climate mitigation and adaptation. Architectural 'resiliency' extends to the viability of the construction industry itself, with a deep questioning of its own (colonial, patriarchal and extractivist) practices, and subsequent impacts on our future.
It is vital that architects consider changes in practice while we still have time, and understand how thinking about resilience can enable us to contribute towards meaningful action across all scales of professional practice, teaching, research and policy. Responding to the climate and biodiversity crises will require "an unprecedented effort from all sectors of society"[50] and architects need to be flexible, innovative and climate literate, to keep up with the increasingly complex demands on our built environments. As architect and educator Sophie Pelsmakers has stated – ***"Everything needs to change"***[51].

4

Case Studies

Four case study projects were chosen to examine resiliency at a range of scales that vary in size and influence, from the individual house, to the scale of the street, the city and the global. These were examined through empirical research, literature reviews, site visits and interviews in order to uncover unique opportunities they present for understanding and deploying resilient architectural strategies and typologies. The case studies present unusual and innovative ways to tackle social, political and environmental issues with creative approaches that challenge conventional modes of procurement, construction or land use. They provide benchmarks for creative resilient architecture and reveal the possibility for new building typologies and procurement methods that challenge the status quo.

It is important that resilience is now considered together with the newer principles of 'regenerative design', to address climate mitigation, deep adaptation[52], and the care and repair of both built and unbuilt environments. Resilience should be considered in relation to newer architectural competency requirements such as Designing for Country and Connecting with Country, and the importance in decolonising methods of practice and procurement. This includes learning to put significantly greater value on our forests, protect diversity, restore soil health, and reduce the pollution of our air, ocean and waterways.

Resilience should also extend to 'soft' social infrastructures, with the potential for new roles for architects in the creation of circular and bio-regional economies, and building a stronger focus on material re-use, repair and recovery, and the support and transformation of local communities, labour practices and material industries.

The case studies provide insights into key issues in contemporary city-making, including housing (affordability, performance and security of dwellings), energy (in consumption and production of materials, and building lifecycles), infrastructure (transport, food security and mobility), and sea level rise (impact on waterfront settlements). By examining this broader range of actions and scales, the research investigates how architecture and spatial interventions can challenge relationships between architects, planning policy, and current / future building users. Changes in design practice, planning and policy need to occur to allow rapid and meaningful climate action across sectors, with stronger interdisciplinary alliances. Understanding a range of 'resilient' actions at different scales can also contribute to discussions around the permanence and agency of architecture, and our changing responsibilities in the context of the climate and biodiversity crises.

The case studies present innovative examples in their embodiment of different forms of architectural resilience. They include four international projects by emerging and established practices, with contrasting approaches and philosophies. They inform a critical study of the ability for architects to consider 'resilience' as a tool to proactively address climate change and city-making in their design practice, and present the following opportunities for resilient design:

1. Architectural objects that are self made

Design that can provide flexibility, mobility, living off grid or lower the cost of building. At a small scale, this can offer architectural solutions that provide more resilient housing, and expand informal cities beyond the control of normal urban planning or building regulations. They suggest a need to rethink current

planning and procurement frameworks to accommodate and stimulate local innovation.

2. Architectural objects which make the use of urban space more flexible

Design which overturns conventional thinking of urban planning in making long-lasting structures which limit the flexibility of land use and material. The use of temporary architecture makes buildings more resilient by their portability and use of materials, and questions the traditional use, occupation and ownership of land in the city, while allowing flexibility in responding to changing conditions through relocation.

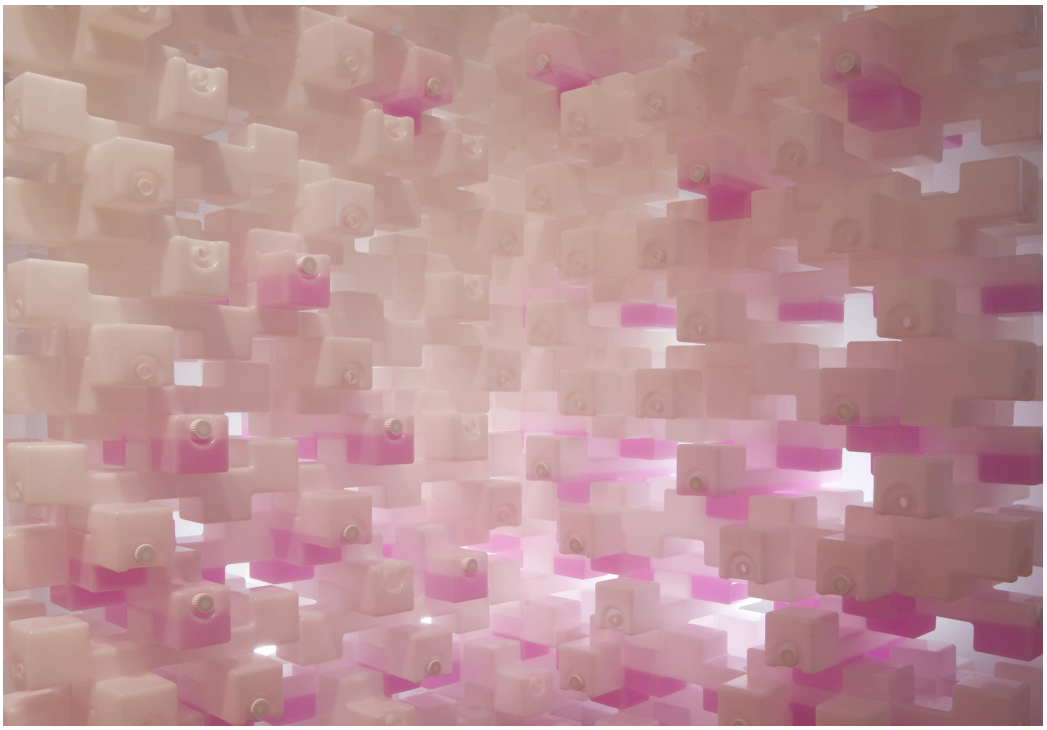
3. Architectural objects which respond to yet-to-be-developed solutions and policy, in response to emerging risks

Design which makes visible the urban risks associated with climate change and coastal rising sea levels, which can act as a catalyst for further thinking and innovation. This involves projects at a city scale, which might typically be approached as 'hard infrastructure' but enable new typologies to emerge where a new layer of protection and amenity / program can be offered simultaneously (climate mega structures).

4. Architectural objects which respond to global problems

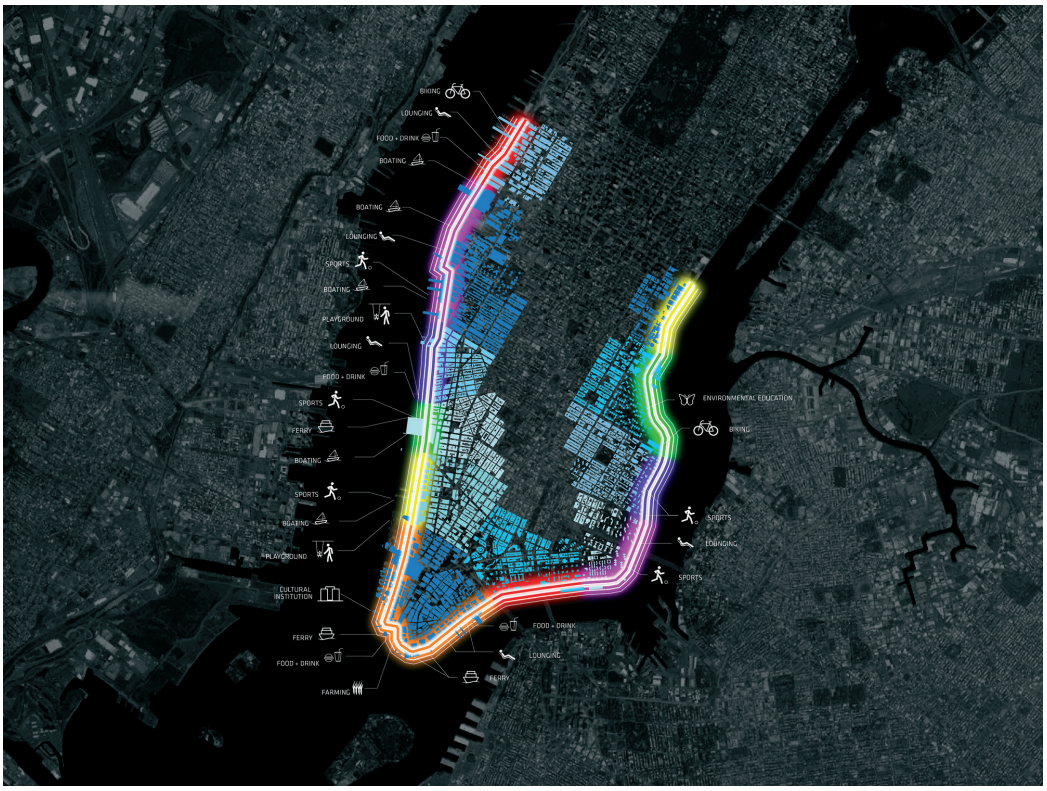
Design which captures and comes to signify a global problem and the need for a global solution. This characteristically involves mega-projects, in terms of the effort to gain support and commitment to these questions, at the level of government and international collaboration. These projects are the most far reaching and also the most susceptible to risk due to loss of funding, change in management / ownership and external social, political, environmental and economic pressures, but can be seen as having planetary or species significance.

The case studies provide internationally recognised examples of how architects have uncovered spaces of innovation through resilient architecture. They highlight what aspects of architectural practice and building procurement need to change, in order to allow us to effectively respond to the challenges of climate breakdown and contemporary city making. The notion of 'resilient design' requires us to rethink the built environment[53], and the projects demonstrate both adaptive and resistant (or defensive) modes of building resilience. By examining these four case studies through the lens of resilience, opportunities are uncovered for architects to innovate, have greater agency and impact.

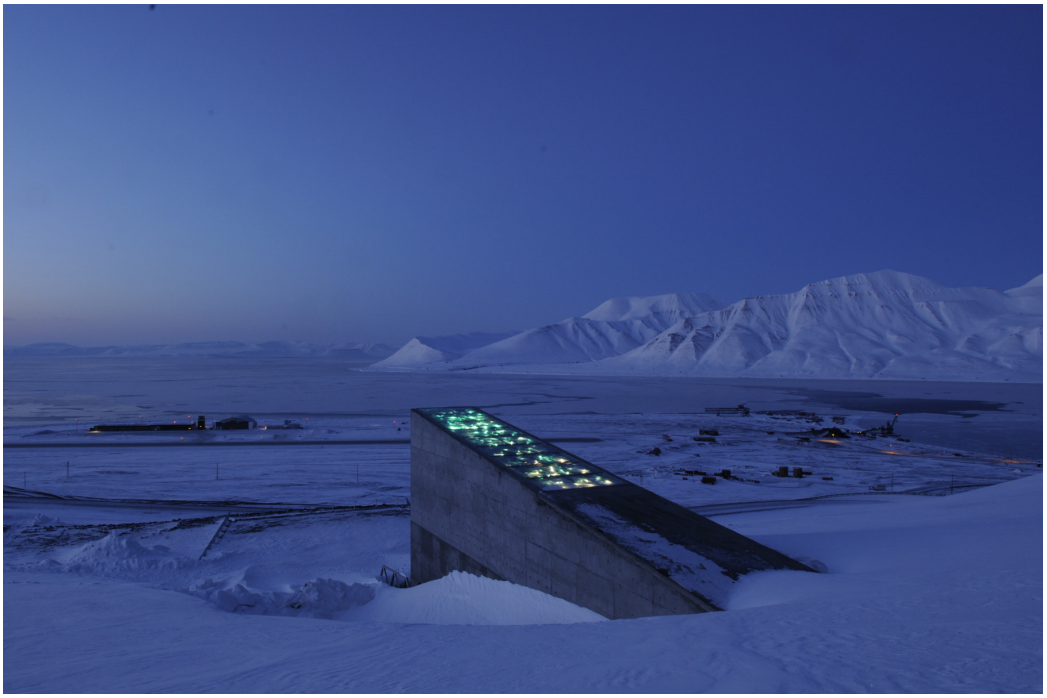


Case Study 1:
Architectural objects which are self made
Project: Waterbranch House, Japan (multiple locations)
Image courtesy of Kengo Kuma & Associates

Case Study 2:
Architectural objects which make the use of urban space more flexible
Project: Yardhouse, London, UK
Image courtesy of Assemble



Case Study 3:
Architectural objects which respond to yet-to-be-developed solutions and policy, in response to emerging risks
Project: The Big U / Dryline, New York, USA
Image courtesy of BIG



Case Study 4:
Architectural objects which respond to global problems
Project: The Global Seed Vault, Svalbard (Territory of Norway)
Image courtesy of The Crop Trust

4.1

Case Study
Water Branch House

Water Branch was explored as a responsible and active 'trans-structure' that provides balance through a responsive relationship with the surrounding environment.

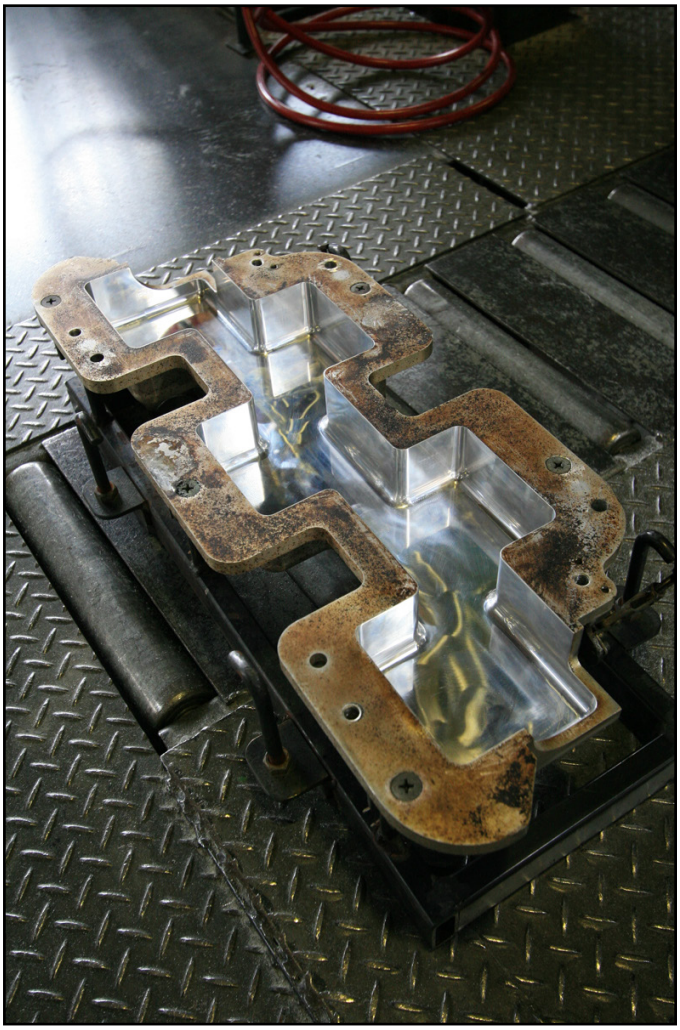
Case Study 1 – Water Branch House

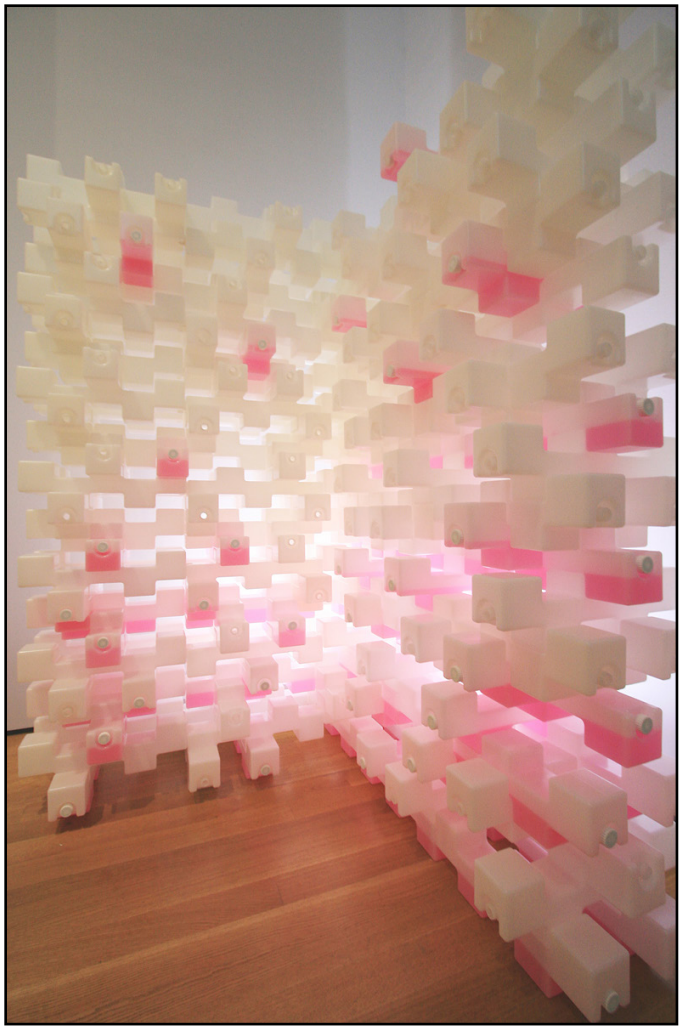
Typology	SMALL
	Architectural objects that are self made
Project	Water Branch House / Series
Location	Installed in multiple exhibitions
Architect	Kengo Kuma & Associates
Client	Self-directed / exhibition
Floor area	1.5 - 35m2
Cost	<$50 000 USD
Principle Use	Emergency shelter
Issues	Housing, mobility, migration
Design	2007-2008

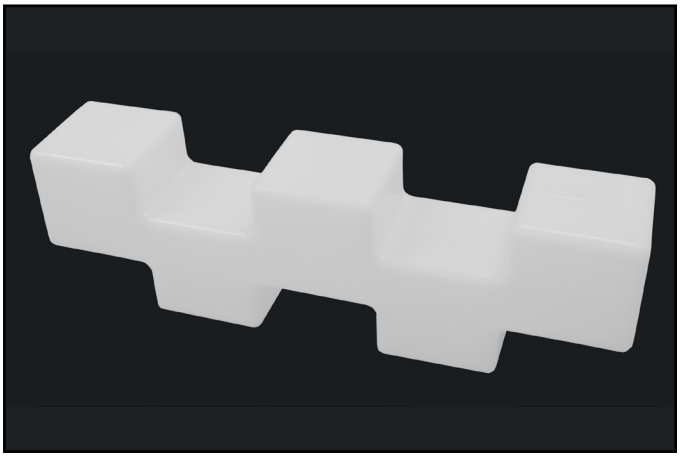
Kengo Kuma is one of the leading architects in Japan and a central figure in contemporary architecture. Based in Japan, his studio Kengo Kuma Architects and Associates (KKAA) has offices based in Tokyo and Paris, and since 2009 he has led the Kuma Lab based in the Department of Architecture in the Faculty of Engineering, at the University of Tokyo. His work has been described as a "reinterpretation of Japanese architectural elements for the 21st century" which "has involved serious innovation in uses of natural materials, new ways of thinking about light and lightness and architecture that enhances rather than dominates."[54] The practice is known for material exploration, innovation and unconventional uses of natural materials and construction systems, with experiments in architecture made of modular or repeated parts which often form both the structure and skin of a project. The Water Branch project was originally conceived in 2007 for a trade show exhibition stand, as a backdrop for a photography exhibition. It has since been developed and deployed in a variety of forms including exhibitions for Tokyo Design Premio Milan (2007), MOMA's Home Delivery: Fabricating the Modern Dwelling (2008) and Kengo Kuma: A Lab for Materials (2018). The aim was to create a small and autonomous housing prototype that allowed self-sufficient living, with a simple prefabricated system that could provide a dynamic integration of passive lighting, heating and cooling as a sustainable small scale housing model.

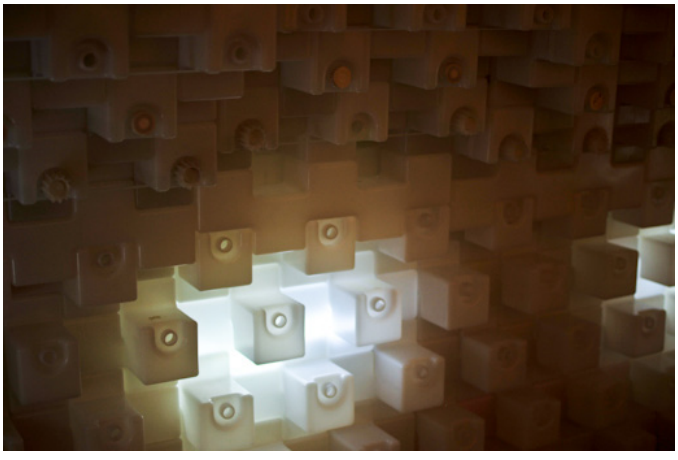
The system utilizes specially designed 'Water Block' modules, with custom made PET moulded plastic tanks designed to be mobile and re-fillable with water or soil. KKAA describes the origin and inspiration coming from the plastic tanks used for construction and road barriers[55], starting with "a plastic box with a simple cube shape"[56]. This was developed into a longer format block made with five staggered cubes each sized 100x100mm, which allowed one repeated module to be composed into walls, arches or roof structures. Connected using a simple screw joint, they can be combined to create a variety of shapes and convex or concave forms. The office describes the three principles of the Water Branch as being:

1. The weight of a Water Branch can be adjusted by the volume of liquid it contains
2. Each branch has screws on both sides, which may be endlessly connected to adjacent branch
3. The block shapes become a masonry-like structure by connecting concave to convex. When many are joined together, a forest-like structure appears[57]









Above : Water Branch project images courtesy of Kengo Kuma & Associates

KKAA describe that this building structure can function as “a type of environmental device”, where cold or warm water can be circulated in the modules and throughout the floor, walls and roof[58]. Going beyond its initial design as a partition wall system for a trade show, in the project’s development for exhibition at MOMA the objective of the design became “to achieve a new type of integration that could replace modern building systems in which the structure, interior decorations and equipment are vertically divided”[59]. This creates a “self-sustaining structure” that can provide resilience in the case of natural disasters, and can operate independently of external infrastructure and site services if combined with a solar heat collection system[60].

With open ended potential, the use of these modules could range from being furniture to housing, with the individual blocks designed with a purposeful sense of human scale, and the ability to be easily assembled and dis-assembled by individuals by hand. The modules are designed to be able to be filled with water, but other types of liquid, soil or concrete filling have also been tested. This is a step towards an autonomous and self made system that combines thinking about material efficiency, structure, spatial qualities and environmental conditions.

The project represents the potential for a self-built, mobile and off-grid dwelling typology, with flexible interior spaces that enables inhabitants to create spaces for temporary or longer term habitation. In the essays ‘Small Architecture’ Kuma describes the appeal of going off grid and living independently, which is an idea that is becoming increasingly relevant in today’s societies. Following the Water Branch House project, KKAA completed a similar project utilising translucent plastic blocks as an external wall system, the Beijing Teahouse (2010-2014). This project explored a ‘reinvention’ of a typical Siheyuan style building in front of the Forbidden Palace in the centre of Beijing, China, with four types of modular polyethylene blocks used a new type of ‘brick’ to reference the traditional construction in the area. Similar to the effect of a traditional paper wall, the blocks provide insulation and diffuse light which present similar atmospheric and environmental conditions to the Water Branch system.

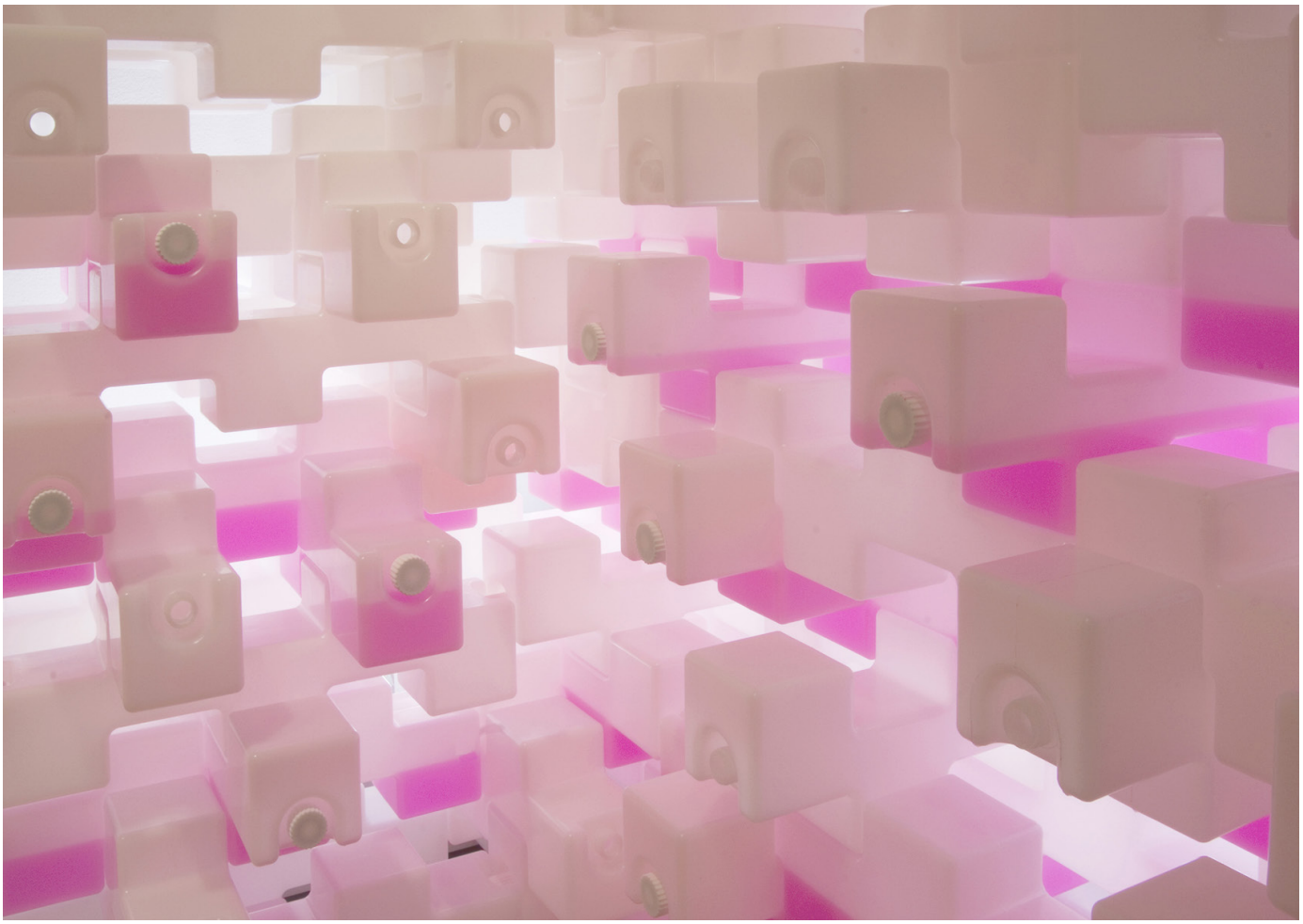
The project demonstrates the practice’s ongoing experimentation with this material and the idea of the creation of a living ‘skin’ that allows passive environmental control, and explores the potential of plastic as a domestic building material. The plastic materiality of the Water Branch House has come under scrutiny, as it contrasts with KKAA’s other material explorations that often have a more natural and tactile sensibility such as the use of paper, earth, ceramics and wood. The Water Branch explores PET as a material which has the potential be biodegradable, but as it has not been deployed in a real world housing or disaster relief scenario, it has not had inhabitants to test its systems in real life. With continual developments in new materials, the potential for bio-plastics or other forms or recycled plastic materials, there is potential for the project to further evolve.

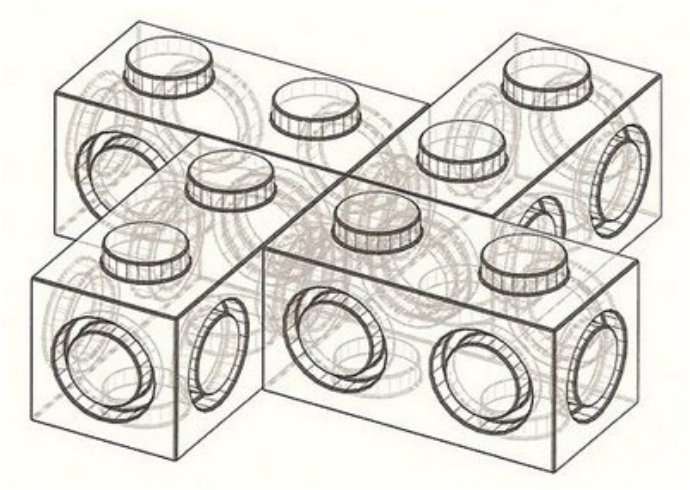
The potential habitation of the structure has been explored through studies at the Kuma Lab (Tokyo University), but after recent events such as the 2011 earthquake and tsunami that devastated the east coast of Japan, the project was not yet ready to be utilised for disaster relief housing.

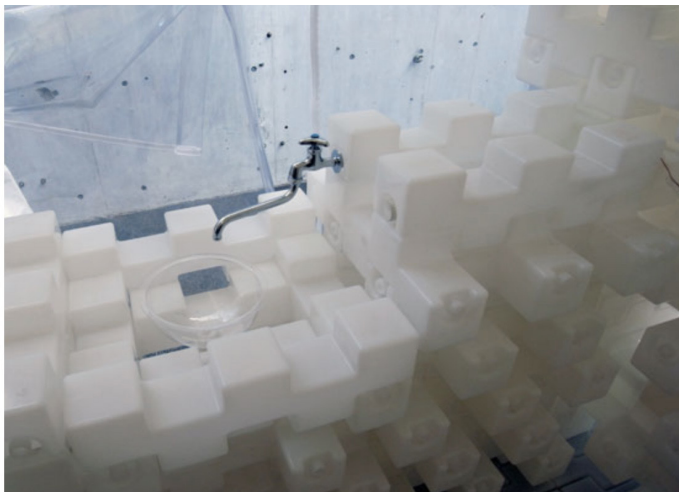
Similarities can be drawn with the aims of Shigeru Ban’s emergency shelter structures that utilise cardboard tubes, which have been tested in multiple disaster relief scenarios in Japan, Nepal, Ecuador and New Zealand. It is unclear whether the potentials of the Water Branch system have not yet been fully realised due to the costs of producing the custom made PET blocks, technical and structural difficulties, or an aversion for building with plastic parts. In its potential for a new type of residential application, despite possible concerns about dwelling inside a plastic environment, the interior and spatial experience the Water Branch House is rich and textured, This is achieved through the repeated pattern of the interlocking blocks (reminiscent of a staggered brick façade) and a luminous interior quality created by the translucent surfaces of the blocks. There is the potential to add colour or mixed materials to create a more organic interior atmosphere, or to line the internal or external walls to partly conceal the blocks but retain the thermal performance and qualities of light.

Beyond its material construction, the Water Branch House has been explored as an innovative example of ‘liquid engineering’ as outlined in Matyas Guyai’s recent publication ‘Trans Structures: Fluid Architecture and Liquid Engineering Response-able Innovative Structures’. As part of his research at the University of Tokyo and Kuma Lab, Gutai explored the Water Branch as a responsible and active ‘trans-structure’ that provides balance through a responsive relationship with the surrounding environment. He describes that “man-made stability and longevity is based on the illusion of strength, however when it comes to Nature, it is more based on adaptability and continuous change”[61]. Gutai describes the Water Branch as “a unique project in which engineering and technology is united in one hybrid structure”, following years of research and development. Importantly, he describes “the Water Branch not only defined a trans-structure system by integrating water and plastic shell, but also was capable to benefit from the potential of the new structural system to define a new lifestyle and spatial atmosphere”[62]. This is based on the ease of the structure’s assembly and re-use, and the way that it provides an alternative means of thermal mass and insulation. Gutai describes that where the bricks connect together to form a ‘stream’, by connecting to a geothermal heating or cooling system (available throughout Japan), it allows an “ideal fusion” of a lightweight structural core and an ability to respond to environmental conditions by using external energy sources.”[63]

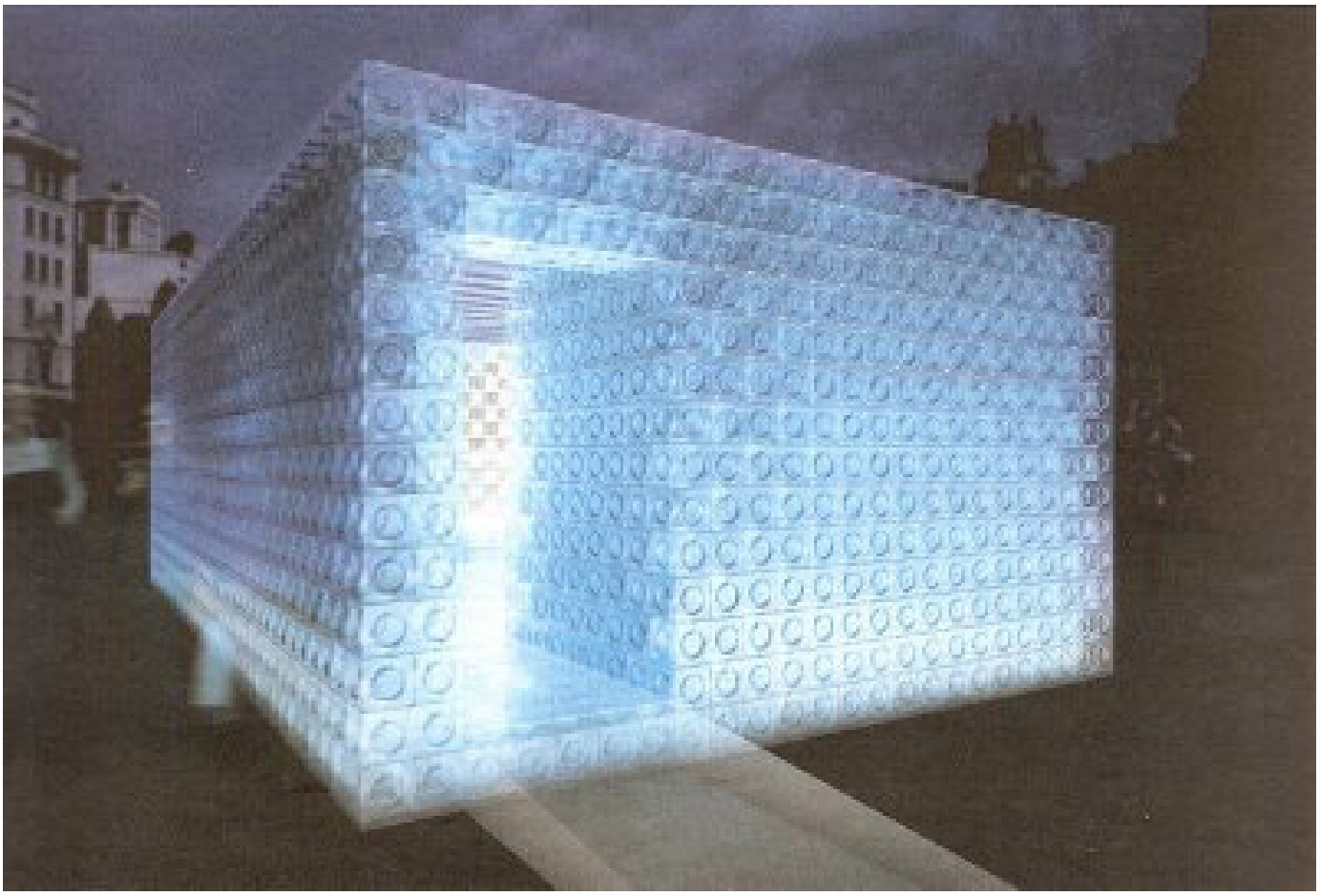
Importantly, the vision of the project went beyond temporary housing for disaster affected areas, where “the final goal was to define a self-sufficient housing system which is capable to aim for a different lifestyle in Japan.”[64] The project seeks to “define a new lifestyle and spatial atmosphere”[65] and so although it has not yet been deployed, it serves as an inspiration for experimental architecture that combines structure, technology and adaptability, and explores the power and resilience of architecture made by small parts.







Above : Water Branch project images courtesy of Kengo Kuma & Associates & Designboom



Above : Water Branch project images courtesy of Kengo Kuma & Associates

"I really agree with the idea of architecture which is made by small parts. I believe small parts can make flexible and resilient architecture."

Tomoko Sasaki, Tenhachi
Architect & Interior Design

INTERVIEW: TOMOKO SASAKI, TENHACHI ARCHITECT & INTERIOR DESIGN (FORMER ASSOCIATE AT KENGO KUMA ARCHIETCTS)

LH: The Water Branch concept began as a small set of interlocking modules. It evolved into a larger system and housing prototype, through ongoing research and exhibition opportunities. What was your involvement?

I think there are three steps in the Water Branch development. The first plastic container structure exhibition was for 'Tokyo Design Premio' in Milano in 2007. The second exhibition was 'MOMA Home Delivery Fabricating the Modern Dwelling' in New York in 2018. And the third was 'Kengo Kuma Studies in Organic' at Gallery Ma in Tokyo in 2009. I had been in charge of the second exhibition - the Water Branch House was made by KKAA staff and Tokyo University students, and I was in charge of making the material about the Water Branch House for the exhibition book, Studies in Organic.

LH: In the final Water Branch House the blocks were filled with water, allowing them to create a passive environmental system – so one element provides the structure, insulation, heating and cooling. How did the evolution of the structural system influence the environmental design?

Kengo Kuma invented the small plastic block for the first time at the exhibition, 'Tokyo Design Premio' in 2007. This exhibition was a collaboration with photographer Mika Ninagawa, and Kengo Kuma created the screen wall for his photographs. KKAA then joined the competition for MOMA's exhibition 'Home Delivery Fabricating the Modern Dwelling' in 2008. KKAA submitted the Water Block project, which was for transporting food and fabricating houses for disaster areas. After we had won the competition, we started to create a new system of Water Block. The Water Block was a brick, so it was hard to create a roof. We had tried to make a new block which could create roofs, and which can create architecture, which is not only structure but also plumbing. After a lot of research, we finally made the new water block. It is longer than the first water block and has 5 joints. This new block can make a beam and column using the same system, so we named this new block the "Water Branch". With the Water Branch, the original competition concept was to provide rescue in disaster areas, sending food and water using the Water Branch blocks and then constructing prefabricated houses with these containers. We expected the Water Branch system had various possibilities by connecting the containers - I think the water circulation system was a great development for this container concept.

LH: Did the evolution of the Water Branch House rely upon collaborations with universities, such as the Kuma Lab at Tokyo University?

For the third exhibition KKAA staff, Taku Nishikawa and students of Kengo Kuma Laboratory were in charge of the project. Here we had the chance to make the Water Branch House, and they studied how people could live in the house - they studied the heating and insulation system with the Tokyo University environment laboratory.

LH: The idea of the water block came from a temporary emergency housing solution – where plastic units are used as storage containers and then building blocks for disaster relief. Was the project revisited after the events of the Great East Japan Earthquake and tsunami in 2011?

Above : Water Branch project images courtesy of Kengo Kuma & Associates

After the East Japan Earthquake in 2011, unfortunately we could not send the Water Branch House to the disaster affected areas. There are still many issues to solve for its practical use. Kengo Kuma has made a house using plastic blocks in Beijing (the Beijing Tea House) and I think this is the first challenge of the practical use of the plastic brick container.

LH: Was the design of the Water Branch container influenced by traditional Japanese timber building techniques?

I think we are not consciously referring to the idea of Japanese timber building techniques. But maybe it was natural for us to be influenced by Japanese timber systems. There were some clear aims in designing the Water Branch system; easy to assemble and disassemble, no nails needed to build it (similar to a LEGO), block or Japanese timber joint system, it can be made into a roof, and able to be developed into a structural frame system.

LH: The Water Branch House has been seen only in exhibition spaces. Do you think people can adapt to living in this type of plastic architecture?

When I think of the interior feeling, the existing plastic is not yet enough to be used for a finished interior in some respects. Plastic is not a natural material, and it does not have a texture which makes people relax. But I think there is the possibility for it to be adapted to make people comfortable in the future, with a new type of 'eco plastic'. KKAA tried to make the Water Branch using a bio-plastic, which can decompose 100% back into soil, in collaboration with Du-Pont. But they were not successful in making the block form with this material.

LH: Since leaving KKAA you have established your own practice called TENHACHI. Has your office pursued any similar projects?

I have had my own office since 2015, and I have not yet had the chance to do a project like the Water Branch House. But I really agree with the idea of architecture which is made by small parts. I believe small parts can make flexible and resilient architecture. If I have the chance, I would like to try to make architecture with small scale parts.

LH: Do you think architects today have a responsibility to address climate change in their projects?

Yes, I think so. For example, today it is impossible to live without an air-conditioner in the city. But this increases CO2 emissions, which contributes to climate change on earth. Architects have to try to reduce CO2 and must try to make better eco-housing.

4.2

Case Study Yardhouse

Yardhouse provides a "barn like timber frame... with generous scale, light quality and ceiling heights desirable for creative uses at a fraction of the cost of a conventional new build."

Assemble

Case Study 2 – Yard House

Typology	MEDIUM Architectural objects which make the use of urban space more flexible
Project	Yardhouse
Location	Stratford, UK
Architect	Assemble
Client	London Legacy Development Corporation with Assemble
Floor area	250m2
Cost	$105 000 USD
Resilient issues	Affordability,adaptability, development
Design	2012-14

Assemble are one of the UK's most well-known emerging architecture and design practices. Their international success grew following the award of the 2015 Turner Prize for Art for the Granby Four Streets community project in Liverpool, and they have since undertaken a series of local and international commissions that celebrate the importance of making, the potential for creative adaptive re-use, and the power of collective action. Known as being a socially minded, hands on and multi-disciplinary collective working across the fields of art, architecture and design, the studio has completed a range of diverse projects including the re-invigoration of houses and community spaces in Toxeth, Liverpool, the Baltic Street Adventure Playground in Dalmarnock, the creation of 'maker spaces' such as the Blackhorse Workshop and Granby Workshop in Liverpool. They have a growing number of larger scale commissions including the recently completed Goldsmiths Contemporary Art Centre in London and the Material Institute fashion school in New Orleans. With members of the practice only recently gaining their architectural registration with RIBA, Assemble's work has been celebrated for its focus on craftsmanship and production, and a connection with local communities with the creation of workshop space, community space and creative studios that foster a range of industries within the city.

With the collective formed in 2010, Yardhouse was an early project conceived as a temporary structure and affordable workspace that occupied a vacant lot in Stratford, East London while new development was in transition. Located in Sugarhouse Yard, it was funded by the London Legacy Development Corporation as "a pilot for the provision of new creative workspace in Olympic Park."[66] The temporary building formed part of a space to became known as 'Sugarhouse Studios' and provided 16 x 12m2 studio plots that could house approximately 30-60 occupants at a time. By being let as affordable space, Assemble note that it was oversubscribed by 10 applicants to every space[67], and encouraged a creative working culture where studio and workshop space was combined.

The architects describe the project aim was "to create a sociable and collaborative work environment"[68], but it also served as a

Above : Yardhouse project images (top: concrete tile detail, bottom: frame under construction)

model where the practice, with a deeply entrenched culture of making their own projects and cross-disciplinary craft, could create their own dynamic workshop space and foster a culture of making while generating income through rent. They note that the cost of the building, as a self-built and income generating asset, was carefully managed and was achieved through the use of readymade and off the shelf materials, simple and efficient construction methods, and completing the build themselves on site. This allowed a "generous scale, light quality and ceiling heights desirable for creative uses at a fraction of the cost of a conventional new build" with a construction cost of only £291/m2[69]. In this way, Assemble see that "the project presents extraordinary value for money" and allowed them to offer studio spaces for affordable rents, while allowing them to recoup the costs for the project within two years.

Assemble describe the space as being extremely simple, arranged with three bays over two stories, a "generous" double height communal area and individual studios offered without wall partitions. Each tenant could adapt the space to suits their needs, by combining bays or adding their own custom made walls for privacy. The "barn like timber frame" was clad in prefabricated Kingspan insulated panels, and the main façade was clad in coloured concrete tiles that were made by hand on site. This colourful shingle pattern façade gave the project notoriety and demonstrated a clever use of self made building components to achieve a high quality design outcome with a small budget. Assemble describe that the "unlikely scale and intricacy of this facade formed a backdrop for the active public yard"[70] and effectively softened the industrial nature of the site, contributing to the vibrant studio atmosphere.

After two years in operation, in 2016 the building was put up for sale for £150,000, and after being sold to a private buyer was dismantled and is planned for re-assembly in the near future. In collaboration with the prestigious estate agent The Modern House, the sale was advertised with a description of the structure as "instantly recognisable for the handmade concrete tiles in a variety of pastel colours that cover its façade" and "a much admired building" which gave buyers "an exciting chance to purchase a flexible and substantial structure that would suit a wide variety of uses"[71]. The intended portability of the structure was stressed, where "the architects conceived the project to demonstrate how plots with short-term vacancies can be used to provide temporary workplaces, which can be demounted and reassembled elsewhere at the end of the tenancy. It was always intended to be transferable to other sites and contexts."[72]

Following the sale, Sugarhouse Studios was relocated to Bermondsey, London and the project has become seen as a prototype for constructing flexible, temporary architecture. It is also an important example of a building that can generate income not only through its use, but its portability. Without necessarily having an explicit focus on sustainability or resilience, the project offers an exciting example of how city sites under transition or undergoing development may be infiltrated by emerging creative industries, and used more productively to enable local production and various activities to continue and flourish.

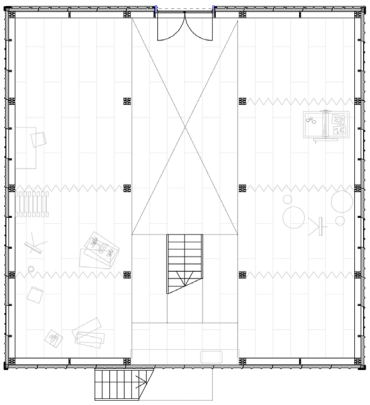
As city development world-wide is increasingly dominated by a speculative residential market, the project draws attention to Assemble's insistence on the importance of 'making' in the city and the need to foster local craft, trade and production industries in order to allow them to survive.

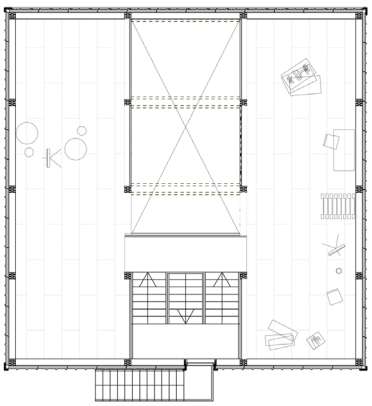
Since being awarded the prestigious Turner Prize in 2015, Assemble's early projects such as Yard House and Granby Four Streets have received much international attention and praise. The social and ethical focus of the practice has been widely discussed, where their work often involves temporary and performative interventions that enable a high level of community participation and engagement. Their projects appear to be extremely grounded in local contexts and have overwhelmingly social ambitions, with a focus on being self-made, adaptive and celebrating hand-made material craft. As a collective founded by 8 members in 2010, the practice now has between 16-20 permanent members and has completed a large number of 'temporary' projects. These have included not only creative studio and maker spaces but also community and public activations involving cinema, theatre and playscapes that allow various degrees of 'audience' participation and occupy the urban landscape in unconventional ways.

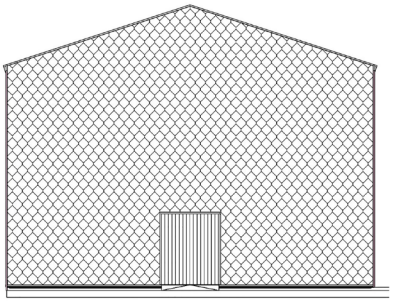
Assemble have been described as being "made up of idealists who want to effect real social change" with projects that "emerge through deep community engagement and are designed to provide economical solutions to issues affecting those who will be living in or using them"[73]. The Yard House model proved to be a simple and effective prototype for the group to invest in a creative building project that could provide affordable studio space, provide new creative relationships and networking, and provide workshop and making space that has become a trademark of the practice. It also demonstrates how architect-led development can provide positive building alternatives in the city, which are economically and socially viable. In terms of resilience, the project challenges the question of how buildings should be made for the future and how long they should last – where the ability to move and adapt may become a critical strategy for dealing with various climate change impacts in future. It also draws attention to the need to foster certain industries and provide spaces in which they can continue to operate – and challenges the impacts of residential development which then come into conflict with other non residential uses and can disrupt local economies and business networks.

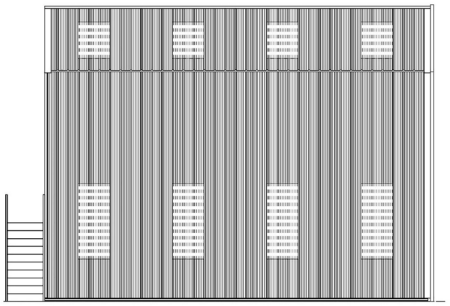
Although Assemble stress that their practice does not always focus on questions of social engagement or sustainability, the appeal of their projects marks a shift in thinking where the idea of collective, collaborative practice has re-emerged, along with an interest in temporary, socially engaged projects. A focus on participation and public involvement is balanced by their collaborative and entreprenuerial creative process, and their active involvement in exploring materials, construction and production to the extent that through their projects they have made their own building facades, sanitary ware, tiles and dinnerware for both the project and a retail market. The success of Yard House demonstrates how small, self directed and self built projects have the power to inspire action and become icons for a new wave of socially minded architecture and aesthetics.

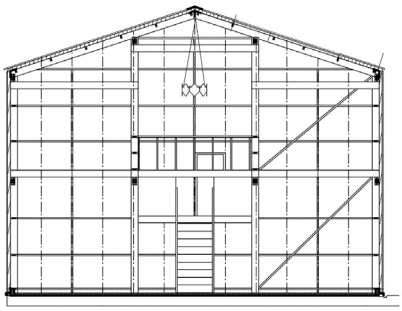
Above : Yardhouse project images (interior) courtesy of Assemble

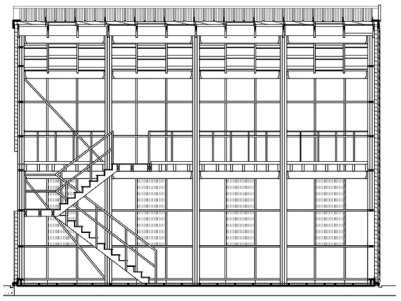












Above : Yardhouse project drawings courtesy of Assemble

"I think there is a kind of romanticism to timber buildings, because it feels like it's something that everyone understands. You could make the same building probably as efficiently out of steel, but somehow it's not quite the same message."

Mathew Leung, Assemble

INTERVIEW
MATHEW LEUNG, ASSEMBLE UK (2018)

LH: This research examines resilient architecture and Yardhouse was chosen to explore the idea of a medium scale project that makes the use of urban space more flexible. It overturns conventional thinking of urban planning with a temporary structure that makes itself resilient by its portability and use of materials. Assemble used a site that was in transition and developed it, and then sold the structure. Will it be rebuilt?

It will be, it's just a matter of when. It's something we have struggled with since having claimed it as a prototype, in trying to find the right conditions for it. We've had a lot of approaches, but we've not really worked out how we should be best involved. In a way it's almost better if someone takes it away as a package.

LH: Is it more like an artwork where you can sell it and then it has a life of its own?

Yes, and we came up with a couple of options. What we could do is try to license the design – we've done all of the hard work. We could look at opportunities which are on a case by case basis. We could also just put the designs up online. And in the end we decided on somewhere in between –we should just see who approaches us. I think it could be made into a better prototype and a better design, and be pushed a lot further.

LH: In terms of using different materials that could last for longer? Did you plan for it to be sold and rebuilt?

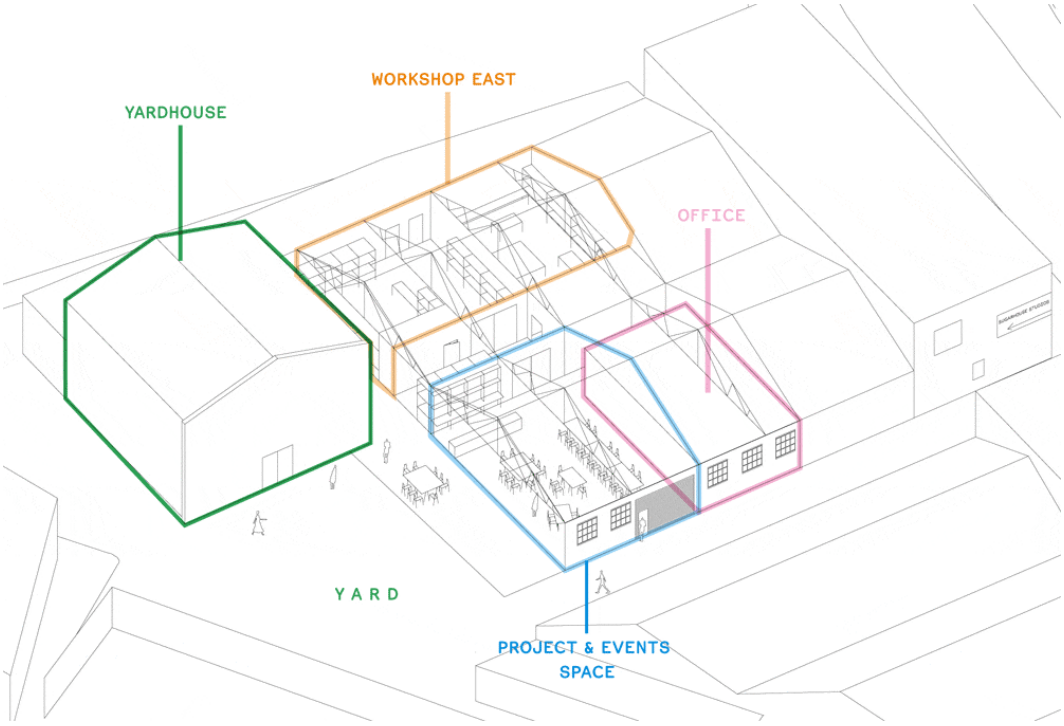
We did plan for it to be able to be taken down. The slab was already there, there's very little in terms of wet works, the only thing is that the kingspan has to be kept off the ground. There's a double brick layer which goes down and basically it's all glued and screwed, so it's very easy to take apart. But I think there are a few things like ventilation that could be improved. It could also be designed better for transport, as it's a little bit too tall. It's great as a building but some of the longer pieces are 9m which are a little bit too long for a truck.

LH: Do you plan to find other sites and using that model, refine the prototype and go from there?

It depends on the opportunity. I think for longer term opportunities it wouldn't really make sense to use that system. Because the idea is that it's very lightweight – in some ways it's not actually that adaptable. It works quite well in particular circumstances - we have drawn up a series of scenarios, where you could do a super long one, or a super skinny terrace one. I think for the longer term projects there are other more appropriate ways of building. There's definitely a space for it within the projects which are interim, but probably slightly longer, more like 10 years. Because the way that we did it, it did break even in two years, but that's because there were a lot of things like services that were already there.

LH: Did you talk about sustainability in the inception of the project, or was it more about how you use it as a temporary space that could be rented to different tenants?

I guess materially we do talk about sustainability. But we don't have that many conventional new build projects where



Above & right: Yardhouse project images courtesy of Assemble

that's something which is easily quantifiable. Lots of the ways we talk about sustainability tend to be more about lifespans or lifetimes of projects. And for lots of projects that we're talking about like Blackhorse or Granby, it's about how you set up for the longer term. Some of it is about how you can make good on the original capital investment. For Yardhouse I think there is a kind of romanticism to timber buildings, because it feels like it's something that everyone understands. You could make the same building probably as efficiently out of steel but somehow it's not quite the same message. It doesn't even need to be about the materials, it's about the story of the building. There are particular projects which are more focused on sustainability or attack that idea of sustainability much more from the material side. There's one that we built for Café Oto, where they said; we've got a lease on this piece of land, we haven't got any money, but we've got loads of people who want to help. So that one was essentially built out of sacks that were piled and stapled together, that were made from the earth they're sitting on. And in the end you slash the bags and return it. There are some projects that attack it like that, but not all of them take the idea of material sustainability so literally.

LH: For Yardhouse by making the key external element – the concrete tiles – you could achieve something very high quality without a large budget. With your other projects to what extent do they rely on being self made?

Quite a lot I would say, and it's both a strength and weakness. You saw the Goldsmith's Façade –it's not that we want to build everything ourselves, because we realise there are limits to that approach in terms of scale, quality and longevity. But there's a thing about being involved in the building process beyond just the drawing which appeals to us as designers. And it might be because we're also not that experienced. In a way we probably have the same problem that a lot of other people do, where you read a specification, get a few material samples, but the originality or the particularity of it doesn't come out. So it is something that we struggle with as the scale goes up. But we're trying to find smaller ways to do that or ways in which the realisation of the project might be less conventional, so that we can have some form of input.

LH: With the Granby Four Streets project and the Turner Prize award, Assemble were described as "architects working as artists", which relates to this image of making a lot of your work.

With new clients or projects, how important is 'making' to the philosophy and identity of the practice? To what extent has it become an essential trademark?

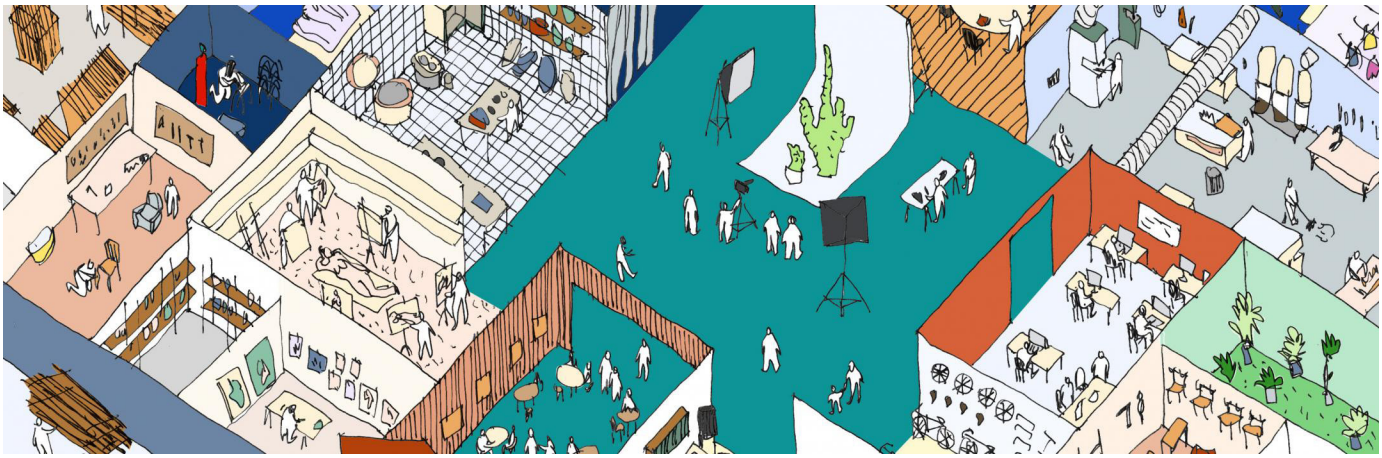
I think it has become integral to the way we describe ourselves. And in practical ways that does mean, for example, having that huge space in the front of the studio is a kind of luxury that we felt was an important way that we practice. We had lengthy discussions about it and in the end it felt like we're at that point where it could get bigger, it could grow, we could have different disciplines – we've got more metal workers and ceramicists now - and that would help our way of practice. So it does feel like self-consciously we decided that was important. And I think externally in terms of image it's probably one half of how people think about us. The other half is that people think that we're socially engaged and always embedded in context. Which is true for some projects, and totally inaccurate for others. It depends on the people and the project, but it does feel like people come to you because they think you can make something and it would be unique or different.

LH: You start to have the image of artist versus architect. But having registered architects in the practice now, can you can take that conversation off the table as to whether you're really artists or architects?

It's just not that important to us. What's important is that we approach particular problems or projects in ways which are maybe more flexible than a single discipline approach. Having said that, three quarters of us studied architecture, so the dominant methodology is one that you learn in architecture school. The solutions that we seek tend to be spatial because that's how we think as designers. But increasingly we get involved earlier on in projects and that feels like it's really helpful. So Blackhorse is one in which the spatial configuration of it is relatively simple, and the recruitment of it, finding the right staff, and setting up the structure of the company was just as important.

LH: And it's momentum building as well?

Exactly – telling that story, that's then as important as the physical design. And there's a number of projects like that in the office where we've been involved in a much earlier stage and that's really helped us find a role which is partly architectural designer, who has a scope in which they're able to deliver, and a sphere in which they're able to make



Byera Hadley Travelling Scholarships Journal Series

promises within. And then there's a little bit outside of that with all the other bits that we do, where we can stretch it a little bit.

LH: And how do you get involved earlier - is it because people are bringing you on in a different way? Some of the earlier projects were more unusual, it's like you're in unchartered territory – where your role is a little bit looser?

Lots of people asked after the Turner Prize whether we had loads more work. The simple answer is that we got more emails. But also what it did was it put us in a slightly different position where people would approach us with projects which weren't necessarily crying out for a spatial solution, but felt like it probably was something about building at the end. We're working at the moment in New Orleans looking at a Fashion & Music School, and we've been involved much earlier in the process. And I feel like that's the kind of project that has come into our inbox, and wouldn't have done so without that kind of exposure.

LH: I read that when Assemble was shortlisted for the prize, you were concerned about whether it would have a positive or negative impact on the Granby Four Streets project?

I think firstly it was quite confusing, because it's not something that we were expecting or which anyone had warned us about. Secondly, we don't know how to navigate that world. It's a very specific kind of world, contemporary art, and we weren't sure how that would impact the people that we were working with or how it would impact the project. In the end we felt like it was something which had a positive impact, because it belonged to quite a few people, including the people working on the CLT (Community Land Trust). And the fact that it was awarded collectively meant we could say it was a bit broader.

LH: In terms of the idea of temporary vs permanent projects, about 50% of your projects have been temporary. Was that a conscious strategy or is it about taking opportunities as they come? Has this allowed more experimentation?

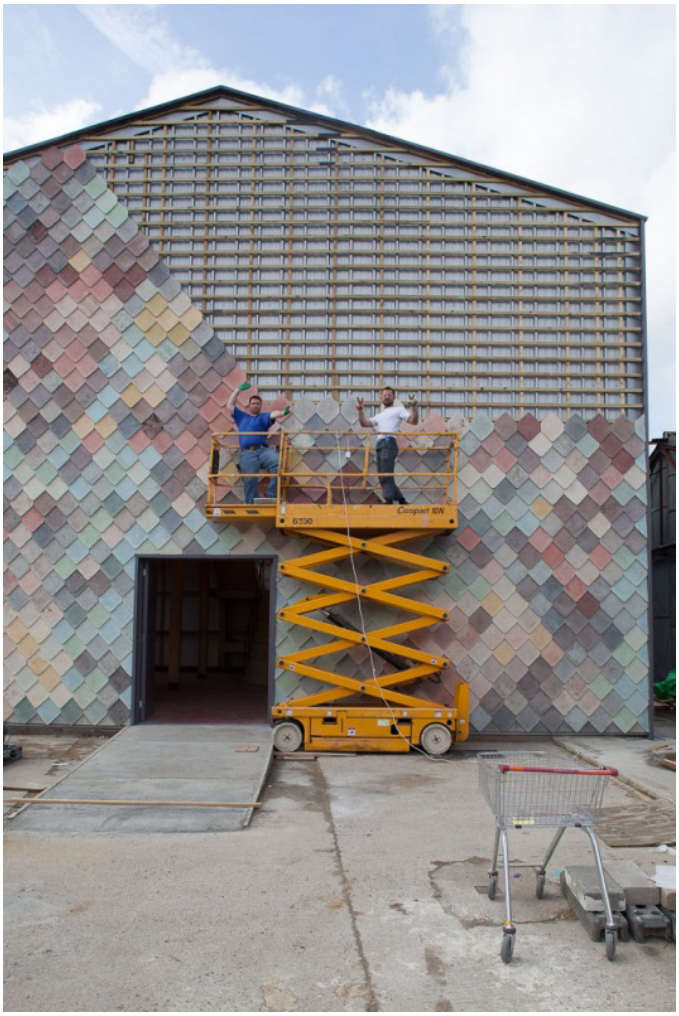
Not a conscious decision, definitely opportunity, and opportunity with permission. Which is the difference compared to small scale permanent buildings. The standard trajectory of design and architecture practices is that you do small private commissions, in which you find the right client who gives you that permission. And many people find that's not how it works until you build a larger scale public project. Part of it is that it is a business, so we do take on projects not all of which are on the website, but that which we know we can deliver to a high standard. And some of those are temporary - a lot of them happen to be temporary. We would like to do more large scale permanent projects, because they have a big influence on their audience, probably a longer term influence. But equally we enjoy some of those temporary projects, especially when they are led by the right people and we're working with the right partners. It's a valid type of project – I think lots of people are dismissive of temporary projects because of the way lots of them have been commercialised, and that language has been used by others who don't have the same aims or agility, but borrow that language. I still think there's some really great temporary projects.

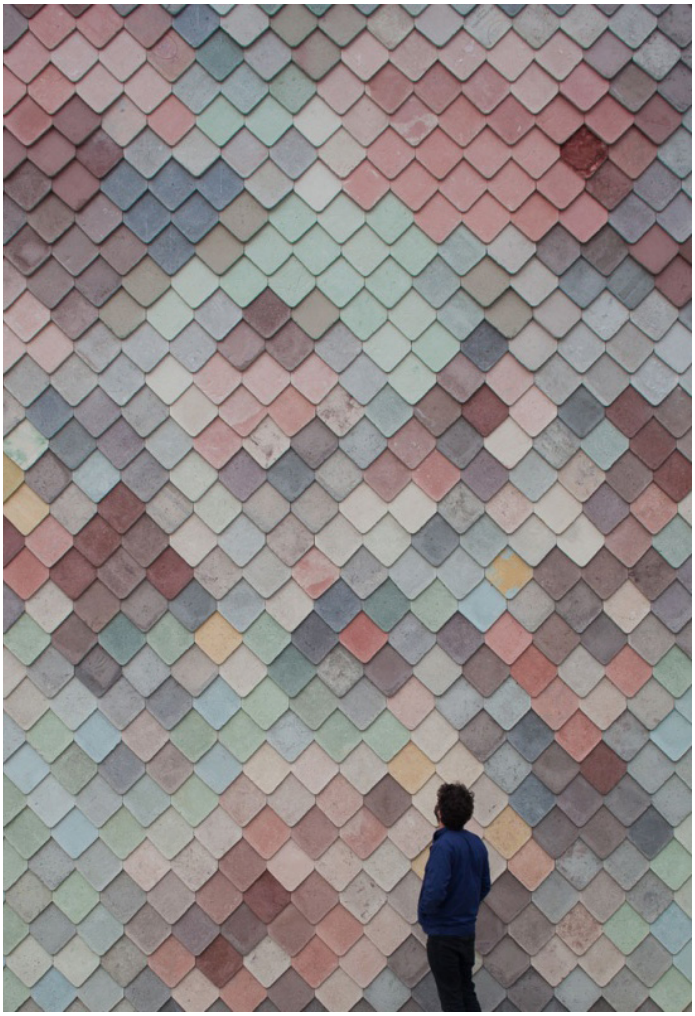
LH: It's interesting that in terms of resilience, temporary projects seem to be more powerful because they're small, faster and easier to make. But of course you want to make permanent buildings as well. Do you talk about the lifespan of buildings and what they should be – traditionally we would think of 50-100 years more, but do you think that is changing?

I think inevitably it has changed, not necessarily in a good way, but in the way that capital investment works. In traditional development sold off plan, single purpose against loan financing means it has to be sold very quickly. It's obviously a much bigger question about where the majority of things sit on the spectrum. I don't think there's necessarily an issue with buildings being built for 50-100 years, that's a good thing. I think that in reality lots of buildings being built for 25-50 years aren't going to last that long, and it isn't about the quality of the building but because of the way that the place that the building holds within the city and that kind of collective conscience is not the same. Larger scale rearrangements of the city happens relatively frequently, and that is the dominant force, much more so than what we would like buildings to be. We would love to build buildings for 100-200 years – the dream client would be someone who'd steward that, give you that budget and protect it and be socially conscious. And also who was robust enough in order to never have to worry about the wider economic forces.

LH: The social aspect of your work is widely discussed. You seem to choose projects based on social value instead of profit. With Yardhouse as a model, is there a strategy to keep setting up your own studios and workshops? As with Sugarhouse Studios, is that something you will continue to do and expand as another business activity, or out of necessity?

I think it's grown organically, from the first point at which we said maybe we should stop trying to have a workshop at the back and let it out to someone who knows what they're doing. But I think there is an issue with the kind of project by project, hand to mouth business model of architecture as a whole, in which it's very difficult to do work that you want to do because of the financial pressures. And because of the fact that each one of those projects that you take on is susceptible to things outside of your control and it's very difficult to plan for. In a basic kind of business planning sense, diversity in your income makes a lot of sense. And if that diversity gives other things that you want to do, that make you money, then it's perfect. The expansion of studios is I think is good for us, and good for the people who use them. And I think it's generally good for the economy. I think that we are trying to make it more strategic, and having longer term spaces which we can negotiate, and set up longer term spaces for making, would make us feel as though it achieves something which is more than just a





Above & right: Yardhouse project images courtesy of Assemble

time in a part of the city. That you kind of create or sustain a character for that bit of the city.

LH: Or reinvigorate pockets by enabling a making culture that grows organically by itself?

Again there's another thing about making, now that we're 10 years down the line, it's kind of the same thing with temporary structures, in that it's been around for ages. Collective practice, temporary projects, people making things has been happening for 50 years or longer. And it has become something which people refer to without positioning their language. And lots of the stuff we're talking about is not office space. It's generally the kinds of uses that people think are incompatible with residential city centres, and we'd like to challenge that. But increasingly its becoming more peripheral. There will be a point at which if the current trend continues, that making only becomes a hobby, and everyone lives in London and works outside of London. And I think on a broader point mixed cities are really important. We don't claim to be making a huge in-road into that but we feel like at least these buildings are contributing in some way even if it's small.

LH: And as these buildings disappear and development spreads, how do you re-infiltrate the middle of the city?

I think there are some interesting people working in the public sector who do prioritise those things. They don't necessarily have the power to change everything but I think a lot of them are advocating for the right things. I think generally there is an issue in planning policy in which by necessity it's quantitative, but it's actually very difficult to see 'no net loss of work space' in Hackney Wick, which was the London Legacy Development Corporation policy, as having had a positive impact. Obviously it's great that there is still all that space there, but the conditions for that work have changed so dramatically that it's not possible to retain those types of activities. I think the biggest issue is about the conditions or the qualitative points, which haven't yet found their way into a one line policy in which everyone can say, actually we've retained this kind of work – all the mechanics are still here. I'm still optimistic.

LH: In terms of the scale of projects, does Assemble have rules for the scale at which you work?

We definitely don't have a limit to size. We operate and are more familiar with small to medium scale projects, but we'd like to step up in scale of projects so that as a practice we can a) have more influence and b) internally be able to plan those better. But very small projects do often come along and we will often do those despite saying we won't. In terms of the other end of the scale, what would be really great in the future is to be able to partner with people who work at that larger scale. You don't want to be doing it for the first time when it's a 15 million pound building. You want to be able to know which bits of the envelope you can push.

LH: London is undergoing development at a rapid pace, and the conversation around climate change and how it will affect cities is growing. Is this a topic in your studio, do you talk about how as architects we might respond to these external pressures?

We probably don't talk about it as much as we should. The ecosystems or the economies that we're talking about tend not to be working at that scale. It's something which I think is a really serious conversation but somehow still hasn't made its way through. Everyone does their recycling or has food waste bins. But it still has hasn't found its way to the point at which it is the critical issue – the top of everyone's mind. The difficulty is, in some cases it feels like it's appropriate to push for a responsible, ecologically viable solution. And in some cases it's not even part of the conversation. It's something that we should take more seriously as a responsibility because we are quite loose in our approach.

LH: Do you think architects have a responsibility to think more carefully about how projects are made and the future of their projects?

I think the second point is something which we've talked about a lot as a practice, in relation to how it's sustained either in terms of organsiation or operation. In the first point about how things are made, we tend to focus on the legibility of how things are made, as a way to describe architecture as something which is made. As opposed to saying the primary thing about how the choice of material should be how it performs, or where it was sourced. That is important, but a lot of the time its more about that this thing should have a character of being made, so that people understand that the city, that bits of the cities are made. Like the Armitage Shanks bowl, we were doing one which was glazed and marbled slip and were amazed when we went there that they do a lot of the finishing by hand. I don't know what percentage of market share they have, but they still have to go around by hand and do a lot of the finishing - that's one of the biggest sanitaryware manufacturers in the UK. So we do talk about a lot of those things, but the focus is not always overtly on the sustainability of materials as the primary thing.

4.3

Case Study
The Big U / Dryline

"BIG's world is an optimistic vision of the future where art, architecture, urbanism and nature magically find a new kind of balance. Yet while the rhetoric is loud, the underlying messages are serious ones about global warming, community life, post-petroleum-age architecture and the youth of the city."

Brian Edwards, The Architectural Review

Case Study 3 – The Big U / Dryline

Typology	LARGE Architectural objects which respond to yet-to-be-developed solutions and policy, in response to emerging risks
Project	Big U / The Dryline (or the Eastside Coastal Resiliency Project)
Location	New York City, New York, USA
Architect	BIG (Bjarke Ingels Group) with One Architecture, Starr Whitehouse, James Lima Planning + Development, Green Shield Ecology, AEA Consulting, Level Agency for Infrastructure, ARCADIS and Buro Happold
Client	The City of New York and US Department of Housing & Urban Development
Cost	$500M USD+
Resilience issues	Sea level rise, infrastructure, coastal settlements, social equity
Design	2014-2023 (Stage 1)

BIG (Bjarke Ingels Group) is a multi award winning Danish architecture practice whose unconventional approach combines dynamic forms with sustainable principles and 'bold sociological concepts'[74]. Having founded the practice in 2006, BIG has won multiple international competitions and in 2016 its founder was named one of the 100 Most Influential People in Time Magazine.[75] Having designed numerous projects ranging in scale from public pavilions and recreation facilities to towers, museums and power plants, BIG is well known for their particular graphic style, a bold use of colour and form, and compelling storytelling which enables innovative and radical project ideas to be realised. The Architectural Review describes that the practice has "abandoned 20th-century Danish modernism to explore the more fertile world of bigness and baroque eccentricity... BIG's world is also an optimistic vision of the future where art, architecture, urbanism and nature magically find a new kind of balance. Yet while the rhetoric is loud, the underlying messages are serious ones about global warming, community life, post-petroleum-age architecture and the youth of the city."[76]

Ingels describes their projects as pursuing a "hedonistic sustainability", with a focus on renewable energy and sustainable principles, while understanding "It's not about what we give up to be sustainable, it's about what we get. And that is a very attractive and marketable concept"[77]. The practice is currently working on a number of city-scale projects involving urban resilience, with designs for waterfront communities and multi million dollar climate protection strategies.

The Big U was the winner of an international design competition led by Rebuild By Design in 2014, which called for proposals to improve the resiliency of waterfront communities.

Above & right: BIg-U project image courtesy of BIG

The proposal is designed to safeguard Lower Manhattan from the impacts of our changing climate, with a focus on storms and floods. Conceived in response to the devastating impacts of Hurricane Sandy in 2013, this project by BIG in collaboration with One Architecture presents a city mega-project with new urban flood infrastructure to protect 10-miles of Manhattan's low-lying waterfront. This is an area that houses over 220,000 residents and is home to a $500 billion business sector.[78] Hurricane Sandy caused widespread damage across New York City, where massive flooding led to a closure of streets, subway systems and buildings, and revealed which communities were most at risk to sea level rise and inundation. Rebuild by Design states "Hurricane Sandy devastated not only the Financial District, but 95,000 low-income, elderly, and disabled city residents. Infrastructure within the 10-mile perimeter was damaged or destroyed, transportation and communication were cut off, and thousands sat without power or running water."[79] With growing awareness that these events are likely to continue, NASA forecasts that global sea level rise could reach 1000cm by 2100[80], but more recent studies expect it is 'likely' to be 100cm and others suggest it could reach between 100-200cm by 2100[81], alongside more frequent and extreme storms.

The project directly addresses this threat, but instead of being a civil engineering project, it is disguised as a series of interventions that provide communities facilities, recreation spaces and improved access to the waterfront. The BIG U (formerly called 'The Dryline', referencing New York's second most visited attraction The Highline) provides a city-scale response to the climate crisis, with the project to be delivered with the Council of New York City, and supported by public and private funding. The project award was $335M and the U.S. Department of Housing and Urban Development (HUD) has contributed $511M toward its implementation (including Rebuild by Design and National Disaster Resilience Competition Funding). New York City has contributed $305M in capital funding to support the first project phase, called the East Side Coastal Resiliency project (ESCR) and the Lower Manhattan Coastal Resiliency project (LMCR)[82]. The key financial supporter of the original competition was the Rockefeller Centre, with the Rebuild by Design organisation originally created by President Barack Obama's 'Hurricane Sandy Rebuilding Taskforce' in 2013, as a way "to develop ideas capable of dramatically improving the physical, ecological, and economic resilience of coastal areas"[83].

The competition has been praised for creating regional and cross disciplinary collaboration between local and state governments, non profit organisations and educational institutions, and its connection with local and regional stakeholders to "develop locally responsive proposals to improve the tenacity of waterfront communities."[84] The Big U has already been awarded multiple prizes, including the 2015 AIA Institute Honour Awards for Regional & Urban Design and the Community Development Award in 2014.

Conceptually, the Big U will provide critical flood protection while offering new parks, public spaces, community buildings, recreation facilities, museums, improved connectivity along the waterfront and opportunities for public art. It offers an innovative example of how climate resistant urban infrastructure can be re-interpreted to provide additional spaces for local communities, with extensive landscaping and improved amenity across the city's foreshore, targeting diverse socio-economic groups. Beginning at West 57th Street, it loops down around the foreshore to The Battery and back up to East 42nd Street, with a continuous series of built interventions that "provide protection tailored to respond to individual neighborhood typology as well as community-desired amenities."[85] Following BIG's notion of 'hedonistic sustainability', in presenting the project Ingels playfully asks, "What if a sustainable city is more enjoyable than a non sustainable one?", and with the BIG U conveys an optimistic message paired with the office's bold visual imagery. Flood gates, sea walls and berms are disguised by a series of site specific strategies, and extensive community consultation has enabled a navigation of complex project conditions with numerous partners and stakeholders. Lead by BIG (Bjarke Ingels Group) with One Architecture, the project collaborators include Starr Whitehouse, James Lima Planning and Development, Green Shield Ecology, AEA Consulting, Level Agency for Infrastructure, ARCADIS and Buro Happold. Ingels describes the process as follows; "Of course we are experts in design. But we're not experts in what are the local demands of the people living in the different neighbourhoods; the people in the neighbourhoods are. We're not experts in flood protection; the flood protection engineers are. So there's a whole array of expertise that we have assembled in this team. And our role is in a way is to try to take all of those different inputs and sort of join it in a synthesis or a design solution that is informed by all of this knowledge."[86] Interestingly, one of the key issues with the community in consultation so far has been concern for the loss of usable parklands during construction, and a desire to maintain outdoor recreation spaces which are well used.

The project has been broken down into three 'separate but coordinated' plans for delivery which represent fields for "integrated social and community planning[87]. These three distinct city 'compartments' were identified through consultation with local, municipal, state and federal stakeholders and strategically "each has a benefit-cost ratio greater than one; and each is flexible, easily phasable, and can be integrated with in-progress developments along the City's waterfront."[88] These are the East River Park, Two Bridges and Chinatown and Brooklyn Bridge to The Battery where each provides a physically separated flood protection zone with "separate opportunities for integrated social and community planning processes for each."[89] These are designed "to work in concert to protect and enhance the city"[90] but each able to stand on their own in the case of an weather extreme event. The project organisers describe the three phases as[91]:

EAST RIVER PARK

A proposed Bridging Berm will both protect the area from storm surges and rising sea levels, and offer waterfront access for relaxation, socializing, and enjoying river vistas by providing pleasant, accessible routes over the highway into the park. Additionally, salt-tolerant trees and plants will provide a resilient urban habitat.

TWO BRIDGES AND CHINATOWN

Deployable walls attached to the underside of an elevated highway can flip down to mitigate flooding. Decorated by

Above: The Big-U / Dryline project images courtesy of BIG

neighborhood artists, the panels will create an inviting ceiling when not in use, while integrated lighting will transform a currently menacing area into a safe community destination.

BROOKLYN BRIDGE TO THE BATTERY

The Battery Berm weaves an elevated path with a series of upland knolls to form unique landscapes. The plan envisions transforming the existing Coast Guard building into a new maritime museum or environmental education facility featuring a "Reverse Aquarium" where visitors can observe tidal variations and sea level rise.

In examining Stage One, the LMCR (Lower Manhattan Coastal Resiliency Project) Is broken down further into five components; the Two Bridges Coastal Resilience, The Battery Coastal Resilience, Battery Park City Resilience Projects, Interim Flood Protection Measures (IFPM), and The Financial District and Seaport Climate Resilience Master Plan[92], with construction set to begin between 2019-2021. The East Manhattan Coastal Resiliency project will run in tandem, covering the area from the Lower East Side to East 25th Street. It aims to protect 2.2 miles of Manhattan's East Side and improve access to the waterfront, in an area housing more than 110,000 residents[93]. Recently presented plans include concepts for an outdoor amphitheatre, fitness centre and elevated park, with additional recreational areas such a basketball courts, increased tree cover and solar lighting.

Despite the widespread project support and recognition, the BIG U is still vulnerable due to the scale of construction, the extent of community engagement and planning approvals, and susceptibility to future changes in funding. Currently the available project funding will allow the completion of Phase One, and the architects have been actively lobbying for future investment with a focus on the high value precinct of Lower Manhattan including The Battery. This includes BIG's presentation of the scheme re-imagined as 'Humanhattan 2050' at the Venice International Biennale of Architecture in 2018. Here the Observer writes "Lower Manhattan could be the first to test out an innovative system that is being proposed as a way to protect cities from rising sea levels and future storms…the project not only proposes new infrastructure to safeguard the waterfront for the next hundred years, it will also make these spaces more accessible and enjoyable."[94] Here the proposal further expands the boundaries of Lower Manhattan with the concept of MOMA (MOre Manhattan), where waterfront development provides a continuation of the landscaped parks, berms and community infrastructure that doubles as flood protection while adding reclaimed landscaped area to the city.

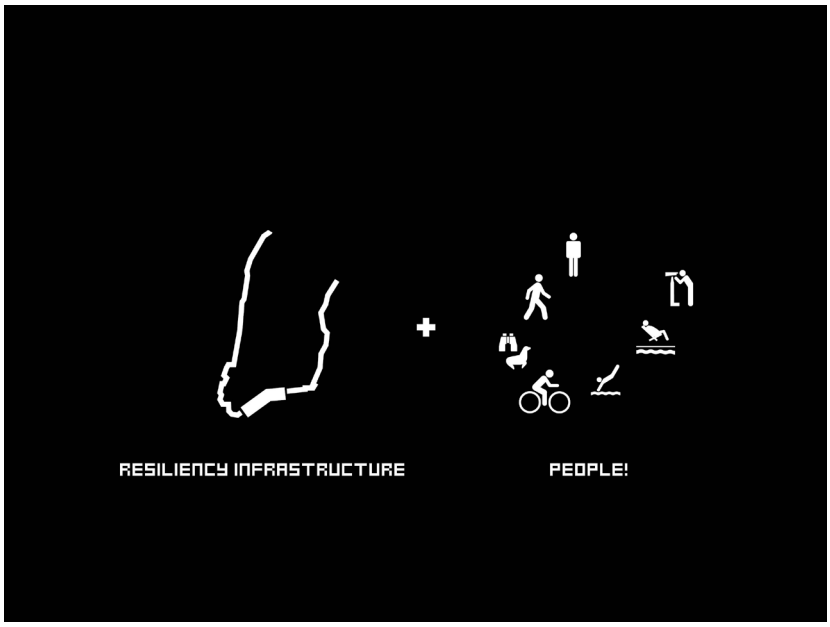
BIG has since undertaken similar commissions such as the Islais Hyper Creek project with One Architecture and Sherwood for the Bay Area in south east San Francisco. With a similar vision, the project not only addresses risk from storm and coastal flooding, but "serves as an opportunity to bring the existing industrial ecosystem into the next economy."[95] The project is a result of the Resilient by Design Bay Area Challenge which posed the question: "Can the Bay Area come together to shift its course and build a more resilient region before a big disaster hits, and can we address other regional challenges along the way?"[96]

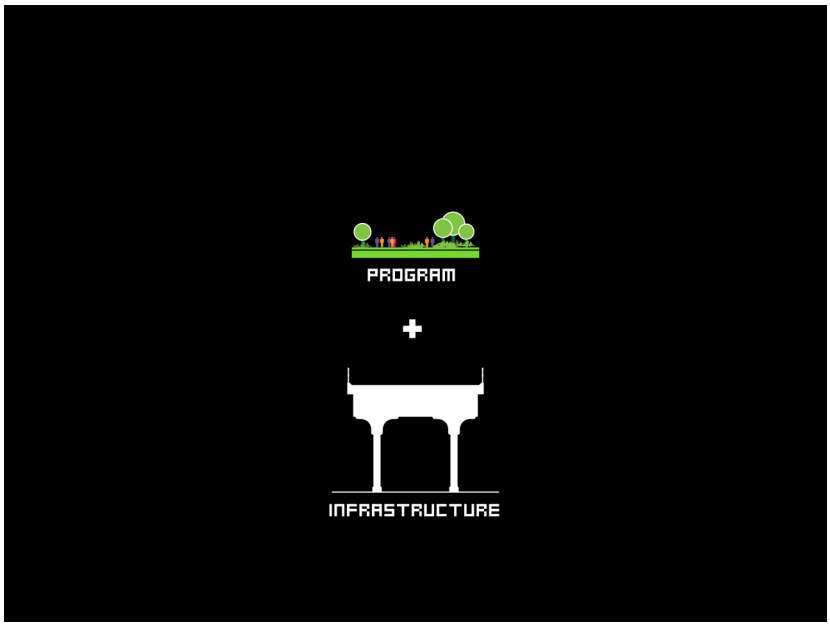
Modelled after Rebuild by Design and their "proactive design challenge" for improving the resilience of waterfront communities, this San Fransisco led initiative is an example of how city-scale projects of this nature may increase in number over the coming years, with each one building knowledge around tactics for community engagement, planning logistics, funding mechanisms and cross disciplinary collaboration, to realise the ambitions of projects of this scale. Resilient by Design cites the Rockefeller Foundation's 100 Resilient Cities initiative, which "identified a need for greater regional collaboration to address climate adaptation"[97] and states that "despite the looming threat of climate change, there was no comprehensive regional plan to deal with the sea level"[98]. This new series of large scale international design competition is attracting leading architects worldwide, but the strategies are still 'offensive' resilience measures to protect and reinforce existing communities with a focus on adaptation and infrastructure, instead of considering a relocation of high risk communities.

Both the Islais Hyper Creek and Big U projects emphasise the need for a wide network of collaborators, strong community support and the integration of local knowledge. There is undoubtedly an urgent need to take proactive measures to safeguard waterfront communities against increasing storms and floods, but the projects need support from the local through to regional and federal governments in order to be effective. The projects' success will rely on their ability to inspire local communities to act and support the projects through the necessary consultation and planning periods, and the ability to secure extensive funding from both private and public sectors. They serve as examples of mega projects which can capture the public imagination, and bring the issue of climate change resilience and city-wide building adaptation to the fore.

It is becoming a reality that populated coastal areas may need to either adapt or relocate, and with the significant cost and difficult logistics of either alternative, these projects are building knowledge and creating benchmarks for cross-disciplinary collaboration, connections between local communities and local, state and federal governments, and challenging existing planning rules might facilitate the rate of change that needs to occur. The critical issue along with funding is timing – as until they are completed, the projects remain at risk due to the large number of external factors that may compromise them, and the potential for extreme storm and flood events to occur at any time.

The first stage of The Dryline, incorporating "a 3.8km long flexible flood barrier comprising walls, gates, berms and raised parkland", was opened in mid 2023. It has been praised for "Blending a robust flood protection barrier with infrastructure enhances social amenity and encourages local communities to thrive."[99]





Above: The Big-U / Dryline project images courtesy of BIG

"I've always been very skeptical of environmentalism that is based on inspiring fear. And because I think it's a losing proposition. We came up with a term we call 'hedonistic sustainability'. That sustainability doesn't have to be about cold showers. It doesn't have to be about how much of our current quality of life are we willing to sacrifice in order to afford being sustainable. But rather what if a sustainable city is more enjoyable than a non sustainable one?"

Bjarke Ingels, BIG Founder

COMPILED INTERVIEWS
THE BIG U / DRYLINE / HUMANHATTAN

GLOBAL HOLCIM AWARDS 2015 JURY INTERVIEWS

Mohsen Mostafavi
Dean, Graduate School of Design (GSD), Harvard

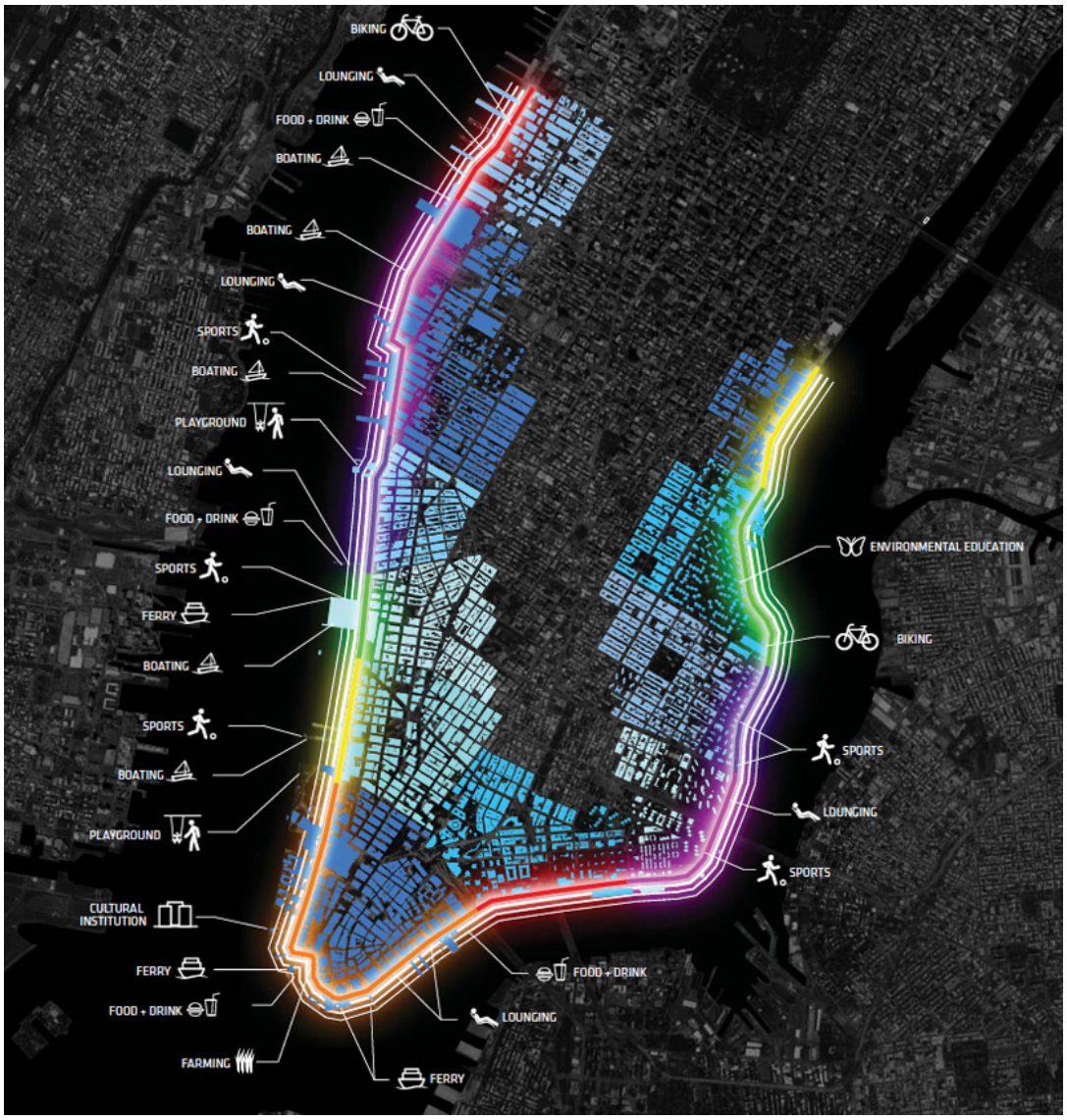
"The BIG U project for the redesign and really the protection of Lower Manhattan is the recipient of the Bronze Medal because it obviously is dealing with a very important topic today which is that of the discussion or issues of climate change and the topic of risk and resilience. How one really constructs new forms of resilience in our cities that are not again just pure forms of defensive infrastructure but that they also provide new types of spaces, new opportunities for public participation and in this case their proposal really creates a new series of public spaces; parks, spaces of promenade, spaces of activity, which are on the one hand open to all the citizens, at the same time it has been thought through carefully at a technical level so that it actually produces or creates local resilience in terms of many districts or many neighbourhoods. So if there is flooding for example that it can be contained. So it takes into consideration a number of technical ideas but actually turns those into the formation of, or the creation of a new infrastructure, which that can also act as a model for development in other parts of the world. In a way it's a very good example of utilising infrastructure for the formation of new types of public space."

Meisa Batayneh Maani
Founder, maisam architects and engineers, Jordan

"For me the New York project was a project that was very daring, very visionary, and for a city to come with a bold decision to deal with a catastrophe similar to (Hurricane) Sandy, and to do it in a collaborative effort the way they have, I think it is definitely a big move. We all know what that will entail in terms of making it happen. It will take a lot of leadership, it will take a lot of strong backing from the government, from the different stakeholders, to stand behind such a project. Now it will be phased of course as we can see, and that in that it will be relevant to the neighbourhoods that it actually surrounds. The big idea is talking about a halo of light and life that will protect the city of New York from the water floods and disasters. But the way it was dealt with it was more dealing with the water as if it would be welcomed - not welcomed as such - but it would be embraced, instead of being pushed back. So in that I found that this project was unique."

Bjarke Ingels
BIG Founder & Creative Director

"Of course we are experts in design. But we're not experts in what are the local demands of the people living in the different neighbourhoods; the people in the neighbourhoods are. We're not experts in flood protection; the flood protection engineers are. So there's a whole array of expertise that we have assembled in this team. And our role is in a way is to try to take all of those different inputs and sort of join it in a synthesis or a design solution that is informed by all of this knowledge. In a way you can call it 'information driven design'; that each and every design decision we make is informed by specific knowledge, by specific information."



Above: The Big-U / Dryline project images courtesy of BIG

CITY LAB MIAMI CONFERENCE 2016

Bjarke Ingels, Founding Partner of BIG, with The Atlantic's Steve Clemons, at The Atlantic's CityLab Summit

SC: The title of this session is Can The Dryline Save New York?; and here you've got 10 major blocks that you've buffered and created a line. ANd I'm interested in when you began to put this project together, how you began to think about what you were going to save, what the concept was and how expansive it would be?

BI: "I think we have considered the dryline as we have nick-named as it as what you could call a piece of social infrastructure. And its literally a term from the 70s that normally refers to the amount of kindergartens and healthcare centres that a city has. But we actually mean it much more literally. That we all know that a piece of infrastructure like a highway or a bridge can have a negative impact on the environment. You know, the way that a highway can separate one neighbourhood from the another, or the way that a bridge can cast a shadow on the space underneath. But we thought what if we can actually devise of a piece of infrastructure, like the infrastructure for resiliency, in a way that it actually comes with positive, premeditated social and environmental side effects. So we looked at the High Line here in New York which is essentially a piece of decommissioned infrastructure, its former rail yard tracks, that have now become the second most frequented park in New York. And what thought like what if we don't have to wait until the train tracks shut down? Or what if we don't have to wait until the flood wall is no longer a flood wall? What if we can design the flood protection for Manhattan in such a way that it actually comes with all these positive social side effects. And you mentioned Jane Jacobs and Robert Moses and we actually mean it quite literally. Because if you look at RM he actually created a lot of the very important public projects of NY, including the highways, the parks and a lot of the public housing. But always with a very top down approach so it often had a devastating impact on the local environment. And at some point he tried to run the Trans Manhattan highway through Greenwich Village. And he encountered resistance from Jane Jacobs, who in a sort of David Goliath moment rallied the local community, and defeated the plans and saved the village. So we thought for this project of this magnitude to protect Manhattan from flooding, it really needs to become a love child of the two. Because to resist an incoming flood you need 10 miles of continuous hard engineering, but to make it socially successful, it needs to happen rooted in a close dialogue with the local community."

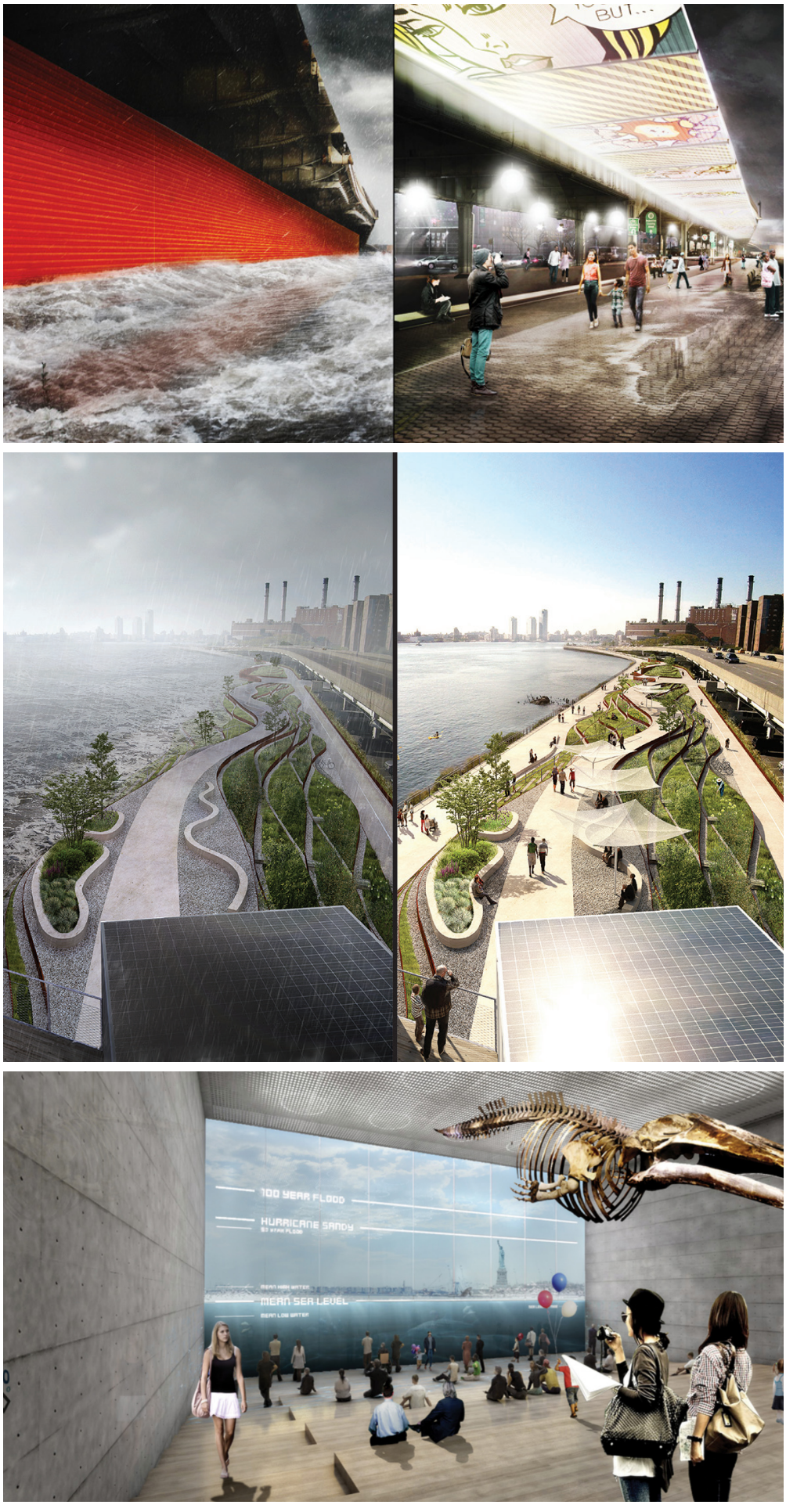
SC: I'm showing the audience now one of the pictures of the big red wall that is anticipating one of these big floods. And I guess part of the question I have is what size, what scale of flooding does your system anticipate? I know I've read in Denmark you plan for every 500 years. We in American infrastructure, particularly in New York, often look at every 100 years. But one of the friendly criticisms of this beautiful project is that this might deal with a Hurricane Sandy, but as we have more climate change effects, that this might not be something that does the trick?

BI: "I mean we are planning towards what you call a 100 year event. So in that sense we are leaning up against the best scientific advice that we can get. But of course it's a political decision how far into the future do you want to plan? But also since you are on the image of the orange wall - so people don't fear that we want to build a giant orange wall in front of the east side of Manhattan, what this image is showing is actually the 'after' image of a 'before and after' image series, where we're actually suggesting that you can simply mount artworks if you like, or like murals, underneath the FPR, the elevated highway, and in the case of a flood, and that's what you're seeing here, those panels can actually come down and the back side becomes the flood protection. So that on the everyday all we are doing is actually making the underside of the FDR a little more beautiful. But then that underside can actually flip down and protect the city from flooding. So it also has, there's like some elasticity and some flexibility in the approach."

SC: Some have described your work here Bjarke as "climate security as leisure amenity". And I'm sort of interested in whether or not this design that you've brought up, whether it none the less lulls a community not to take things like climate change and really the very drastic hard choices that lie ahead as seriously as they might. What is your response to that critique?

BI: "Of course I think you have to do both. You know, of course making flood protection doesn't mean that we shouldn't care about our environment. It just means that we somehow today have to live with the consequences of our lifestyle of the last 50-100 years. However the thinking is that I've always been very skeptical of environmentalism that is based on inspiring fear. And because I think it's a losing proposition. We came up with a term we call 'hedonistic sustainability'. That sustainability doesn't have to be about cold showers. It doesn't have to be about how much of our current quality of life are we willing to sacrifice in order to afford being sustainable. But rather what if a sustainable city is more enjoyable than a non sustainable one? And one of our first projects in Copenhagen was the Copenhagen Harbour bath. And that's basically because Copenhagen harbour has become so clean, the water has become so clean that you can swim in it. And that means that a clean harbour is not just good for the fish, it's actually incredible for the citizens living in that city, that they don't have to sit for hours to get to the Hamptons, they can actually jump in the port in the middle of the city.

So in that sense I think that there's a lot of examples where an environmentally progressive city or a resilient city can actually also be a more enjoyable city. And in that sense we were thinking if we are building this whole flood protection for many millions or even billions of dollars, and it's only going to be enjoyed that one moment when the next Sandy arrives, what if we can use or leverage those dollars to actually also enhance the connection from the city to the water, and make the make the waterfront more amenable



Above: The Big-U / Dryline project images courtesy of BIG

and enjoyable. So it's more like a question of reaching or hitting as many targets with a single element."

SC: I wasn't going to ask you about cost but since you raised the question of dollars - we are sitting here looking at a really gorgeous 'reverse aquarium' that The Guardian newspaper described as 'a symbol of your implacable optimism'. I love this idea, but what is all of this going to cost? And whos going to pay for it?

BI: "So right now we are working on the East River portion, which is the first couple of miles along the East River Park. And that has been funded with a combination of federal and city funds. And then right now we're starting to take a look at you could say like the bottom of the U. Which is basically from two bridges, basically via Manhattan Bridge all the way down to the south tip of Battery Park, and including all the way to Battery Park City. And there the funding there is some public funding, but there the idea is also to leverage the fact that you actually have a lot of wealth and a lot of prosperous businesses on the south tip to try to see if we can make some of the funding in more of public and private partnership. But the whole east river portion is already funded."

SC: I was at Battery Park the other day and I saw quite a bit of construction going on down there. Are they already working with you and your designs, are these already begun to be built in to a larger concept?

BI: "Not yet. I know that the Battery Park is already making some upgrades. Also you saw Worry Park in the video talking about how she lost everything. So they have actually already begun some reinforcements on their own. But the idea is that once we get there, to actually reimagine the topography of the Battery Park to make the Battery Park itself a major part of the fortification of Lower Manhattan. It's also where you'll get the biggest waves because you'll have the water coming in through the mouth of the Hudson. So that also means that even though it's going to be miles of continuous waterfront protection, the strategies depend very much upon the type of event that we are designing against, and also the type of landscape or urban condition that we're dealing with."

SC: I'm very conscious that we're sitting on the edge of the world here in Miami. And that Miami is struggling and thinking a lot about some of these issues. We have Mayors from all over the world here who are thinking through many of their own resilience questions. And I'm interested in what insights you have from doing this project, from interacting with the community, trying to put a design forward that would be useful outside of New York applied in other situations either from climate or other challenges?

BI: "I think it's very important and i think that's where the dryline has succeeded so far at least in its inception is that rather than simply coming with all of the hard engineering and basically dropping a big piece of flood protection infrastrutcure, flood wll, on the waterfront, we actually targeted and engage directly with representatives of the different community groups; the different NGOs, different housing projects on the east side, to engage in a dialogue to actually ask them about their experiences during Sandy and also what would be their wish list. Basically in the thinking if we're going to move some around, if we're going to plant some new trees, if we're going to fortify your waterfront, what other sort of wishes should we fulfill while doing so? Now that we have the toolbox open are there any other things we can do? And in that sense I think we've been met with an accommodation because the local community could see that we were not just trying to fortify the waterfront, we are were also trying to make their neighbourhood a more enjoyable one. And I think in that sense I think all of the sort of upcoming necessary investments in resiliency that all the mayors that you're sitting with are going to be facing is of course a major challenge but I think also an amazing opportunity to fix some of the things that are normally quite hard to mobilise the community around and that are normally hard to raise the necessary funding for. So in that sense this idea of social infrastructure that you combine hard utility and necessity with the sort of enjoyment and amenity at the same time."

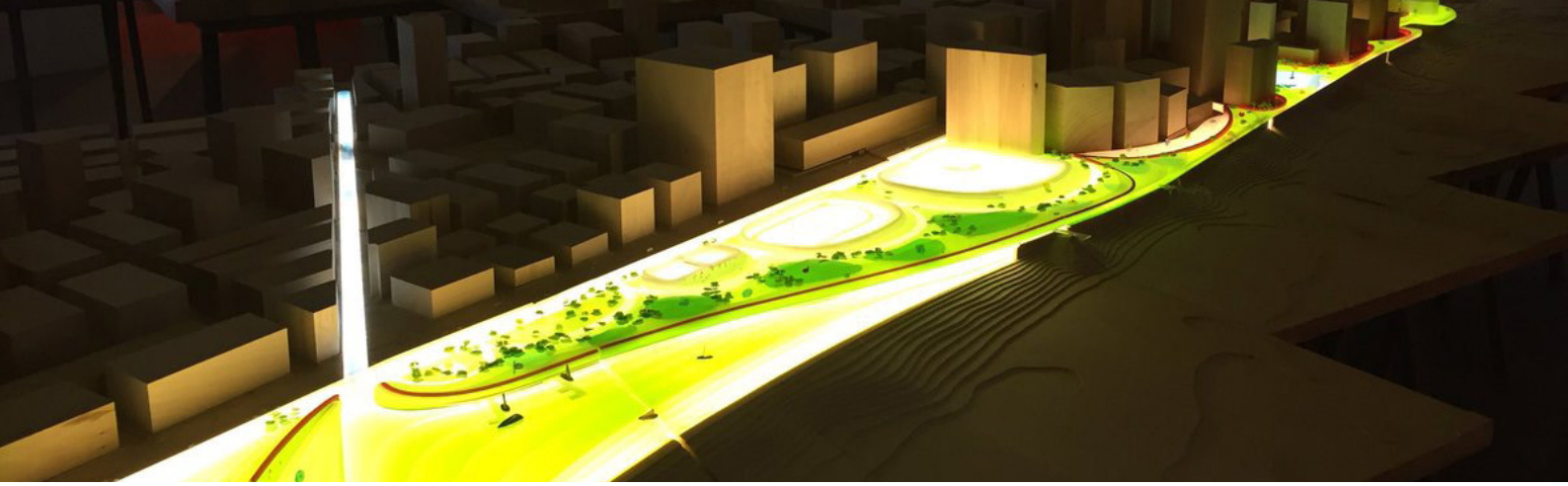
'HUMANHATTAN' AT THE VENICE INTERNATIONAL BIENNALE OF ARCHITECTURE 2018

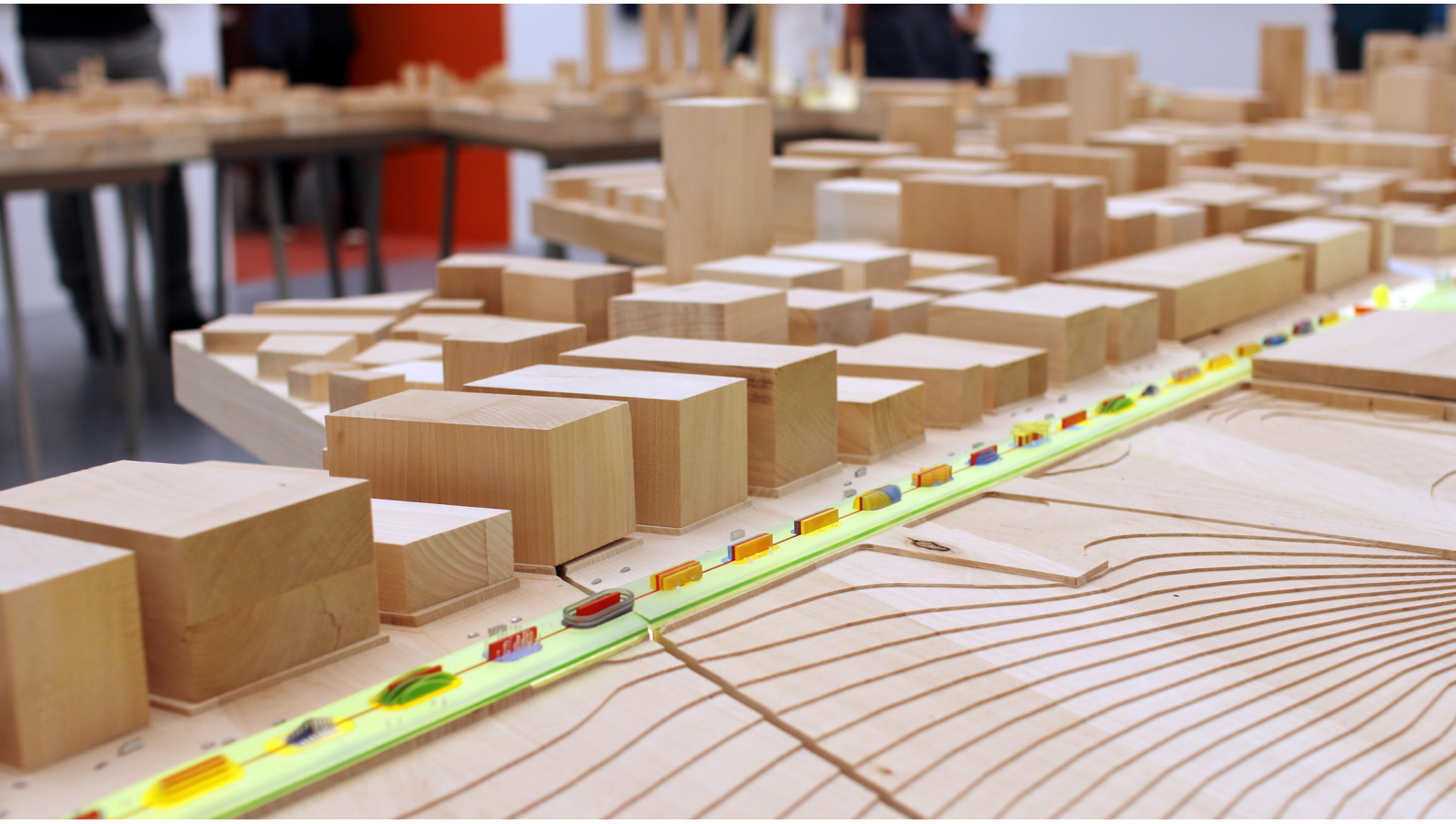
Description

"Humanhattan 2050 is on display at the Italian Pavilion of the Venice Architecture Biennale and presents a mix of BIG's Rebuild by Design concepts, including the East Side Coastal Resiliency Project, running from East 25th Street south to Montgomery Street, independent visions, and interpretations of the potential for Manhattan to accommodate both climate change and growth in the future, while returning the waterfront to its people, rather than to industry and cars. From Manhattan, to Humanhattan!"

Bjarke Ingels
BIG Founder & Creative Director

"This project is what we are calling HuManhattan 2050. And it's basically the efforts we are doing to make Manhanttan more resilient. But also to make the life of the city more connected to the water around it. So the first third until after the WIlliamsburg Bridge is basically the project that has actually been tendered right now and that is breaking ground in this coming year. And here there are parks that are designed in such a way that they are capable of withstanding the next Hurricane Sandy. From then on and around including to Battery Park City it's a project we've nick-named MOMA - More Manhattan - where we're basically proposing to extend Manhattan a little bit into the Hudson River, and make a few new neighbourhoods, that are going to create so much value, that we can actually finance the parks and the waterfront that are not only going to make the waterfront more enjoyable but also make it resistant and resilient when the next hurricane comes. So it's in a way trying to harness the necessity to create a more enjoyable and a more human Manhattan."





Above: The Big-U / Dryline project images courtesy of BIG

4.4

Case Study
Global Seed Vault

"The Vault balances on a continuum between extreme points: the practical necessity and virtue of gathering and securing the world's seed diversity, and the equally negative and dreadful signal it gives off by telegraphing that this is really necessary, drawing attention to the current dangers seeds have to be protected from."

Dyveke Sanne

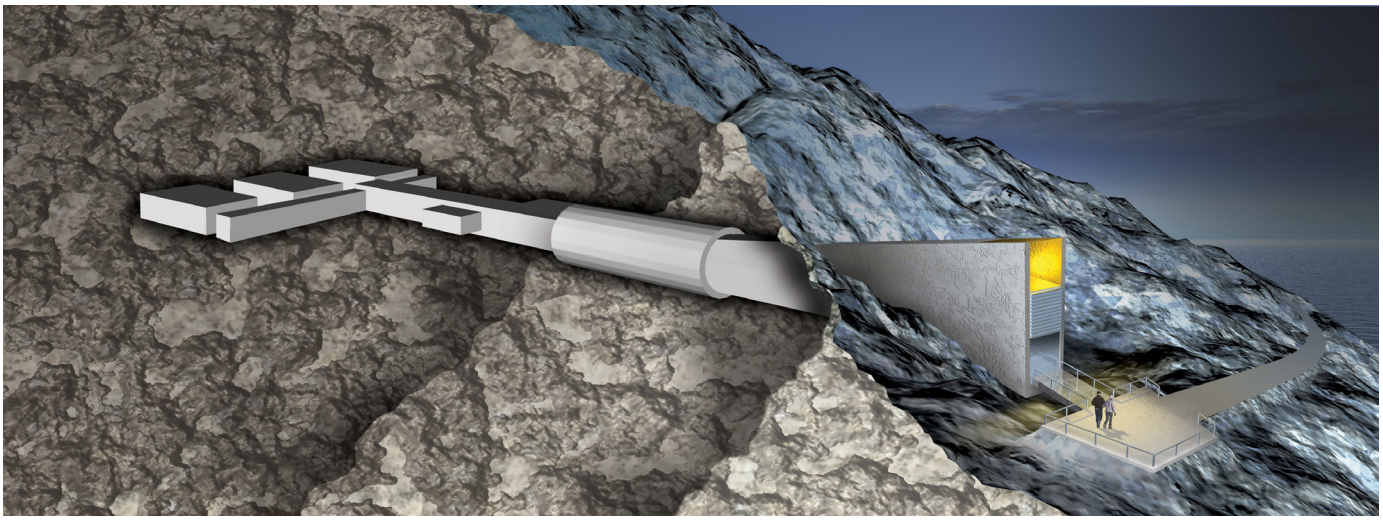
Case Study 4 – Global Seed Vault

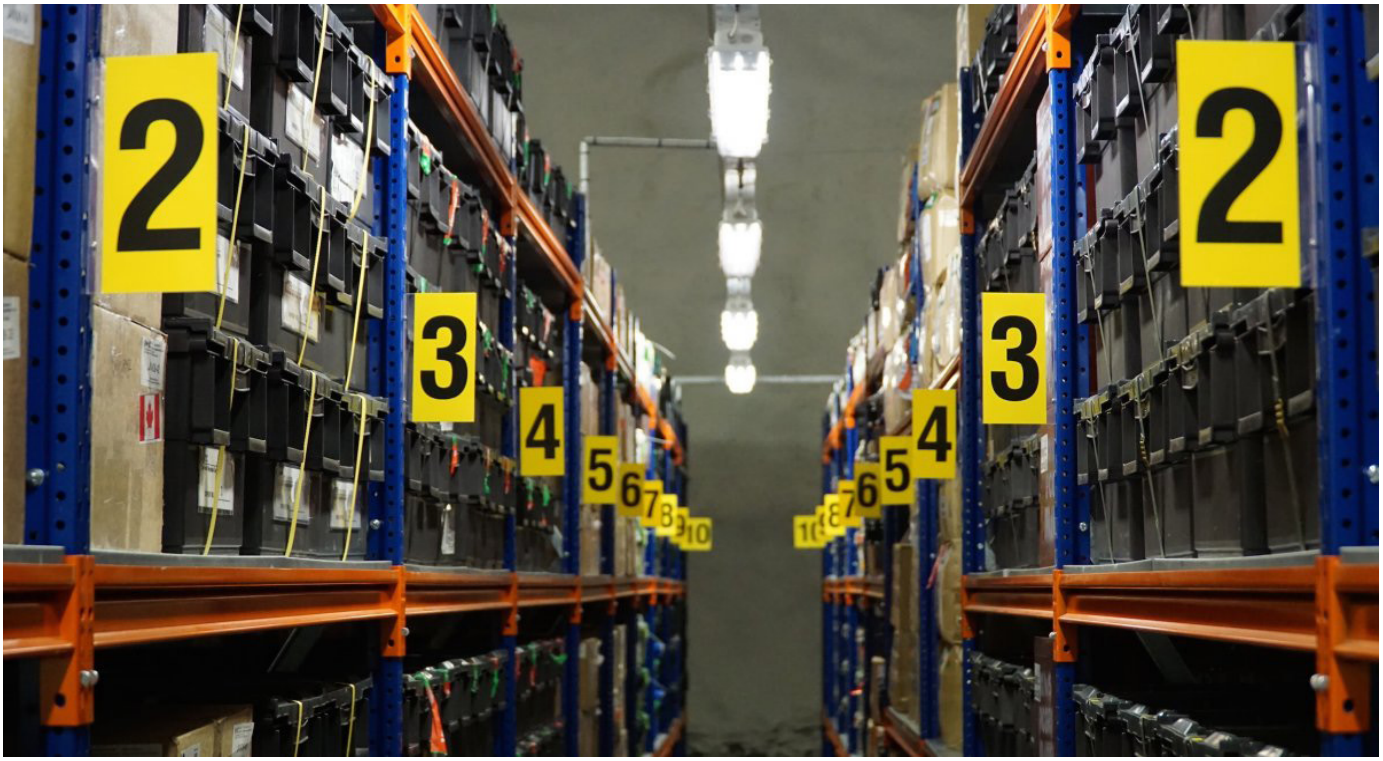
Typology	EXTRA LARGE Architectural objects which respond to global problems
Project	Svalbard Global Seed Vault
Location	Longyearbyen, Svalbard (Territory of Norway)
Architect	Peter W. Søderman, Barlindhaug Consult AS
Client	Kingdom of Norway, Ministry of Agriculture and Food & The Crop Trust
Floor area	1000m2
Cost	$9M USD
Resilience issues	Food security, infrastructure, population growth, war
Date	2007-2008

The Global Seed Vault is a subterranean storage vault with the capacity for storing 4.5 million sample deposits, or up to 2.5 billion seeds. Designed as a second backup for seed vaults around the world, the vault is located on the Arctic island of Svalbard. Having been described as a 'doomsday vault' which stores a priceless sample of the world's non-genetically modified food crops, the Crop Trust describe; "Deep inside a mountain on a remote island in the Svalbard archipelago, halfway between mainland Norway and the North Pole, lies the Global Seed Vault."[100] The project was designed by Peter W. Søderman at Barlindhaug Consult AS, a Norwegian practice based in Tromso whose portfolio include many large scale urban and multi residential developments. The external concrete entrance to the vault features a commissioned artwork by Norwegian artist Dyveke Sanne, and the facility's entrance has become an iconic image for both the arctic and climate change, set against the ethereal backdrop of Svalbard's mountainous landscape.

In 2008 the Vault was named No. 6 in TIME's Best Inventions. Importantly, it operates as an autonomous seed bank and provides a long-term international storage facility "built to stand the test of time and the challenge of natural or man-made disasters" which "represents the world's largest collection of crop diversity."[101] As of 2019, the Global Seed Vault holds approximately 980,000 samples, and in future could provide a critical food source for large populations as seeds are lost or become extinct. The facility is utilised in the case that a primary backup vault suffers losses, damage or is affected by political, operational or technical challenges – such as war, a loss of power or a lack of maintenance.

The purpose of the vault is "to provide insurance against both incremental and catastrophic loss of crop diversity held in traditional seed banks around the world"[102], and it offers "fail-safe protection" for one of the most important natural resources on Earth. The facility is overall 145.9m long and 1000m2 in size, excavated into the sandstone rock of the 'Plateau Mountain' near the settlement of Longyearbyen, with the size of the each vault room approximately 10m wide by 27m long and 6m high[103]. Seed samples are deposited in special four-ply foil packages in sealed boxes, and stored on shelves inside each vault room.





Above: The Global Seed Vault,
Images courtesy of The Crop Trust

In this controlled environment, low temperatures and moisture levels keeps the metabolic activity of the seeds low, and makes the samples "viable for decades, centuries, or in some cases thousands of years."[104] The surrounding rock, permafrost and depth of the vault rooms also ensures the "continued viability" of the seeds if there is a power failure or rising external temperatures due to climate change, as the vault rooms can remain naturally frozen with a consistent temperature of -18˚C.

In June 2017 the project received international attention due to unexpected water ingress caused by permafrost melt at the site, which led to a water breach inside the entrance tunnel and triggered urgent repair works. The entrance has subsequently been rebuilt, and the renovation signalled the alarming rate of environmental change in the Arctic in recent years, with increased rain and temperatures causing unexpected changes in the permafrost. The project was designed following a careful selection of the site and a feasibility study including detailed forecasts of climate change impacts in the area, to ensure the vault remains secure for future generations. The design of the includes a long entrance tunnel that separates the vault rooms from the entry, with 24 hour monitoring and an operational team based in Svalbard who can provide emergency support on the ground. Although the seed storage area remained completely safe, the water breach elevated the public awareness of the project, and perhaps its status as an icon for both protection against and vulnerability to the impacts of the climate crisis, and the alarming rate of environmental change that is occurring in the Arctic.

The idea for the vault was originally posed by The Crop Trust's former Executive Director Cary Fowler, who recognised the vulnerability of the world's genebanks and began promoting the idea of establishing a global seed vault to serve as a backup storage facility located in Svalbard.[105] This idea was made possible after the passing of The International Treaty on Plant Genetic Resources for Food and Agriculture in 2001, which set a standard for the international sharing of seeds and established "a global system to provide farmers, plant breeders and scientists with access to plant genetic materials."[106] The project itself was funded and delivered by the Kingdom of Norway, and now operates under a three party agreement between the Norwegian Government, the Nordic Genetic Resources Centre (NordGen) and the Crop Trust. Importantly, the depositors retain control and ownership of the samples they deposit and only they can access the stored material[107]. They are also responsible for removing and re-depositing any samples that need updating. The Seed Vault is owned and administered by the Ministry of Agriculture and Food the Kingdom of Norway, and is "established as a service to the world community"[108]. Support for the ongoing operations of the vault are provided by the The Crop Trust, who assist with funding for the preparation and shipment of seeds to the facility, as well as providing support to other primary gene banks around the world. The vault building itself is then operated by the Nordic Genetic Resources Center (NordGen) who maintain a public online database of the samples in storage, with an International Advisory Council overseeing the operations and management of the facility. In this way, the facility has as a stable, well funded and international support network which allows it to be 'autonomous'and provide a high level of security for its priceless collection.

With this system of management, the vault stores duplicate copies provided by individual depositors, and involves a wide network of gene bank operators from around the world. There are approximately than 1750 gene backs operating globally, but many are at risk due to the potential for natural disasters, the outbreak of war, or a lack of management or funding to support the necessary facilities. The Crop Trust stresses that "the loss of a crop variety is as irreversible as the extinction of a dinosaur, animal or any form of life"[109] and so "the Vault is the ultimate insurance policy for the world's food supply, offering options for future generations to overcome the challenges of climate change and population growth"[110]. The success of the Vault not only relies on the engineering and design of its facilities, but also the ongoing collaboration between the Norwegian Government, NordGen and The Crop Trust in order to ensure the facility can continue to operate for the foreseeable future. They believe that "it will secure, for centuries, millions of seeds representing every important crop variety available in the world today. It is the final back up."[111]

The remote island of Svalbard was identified from the project's inception as an ideal site for the vault, which was originally proposed in an abandoned coal mine. The structure is excavated into the side of a mountain and protected by thick rock and a layer permafrost, where samples can remain frozen in the event of loss of power for extended periods of time. Despite being geographically remote, Svalbard is accessible by commercial passenger plane so depositors and operational staff can easily access the facility. It has been located above projected sea level rise marks at an elevation of 130m, and is in an area which is stable and with low humidity. The location is near the settlement of Longyearbyen where there is a university, research facilities and personnel on the ground, who are available to monitor or attend the facility at short notice. Importantly, following the Svalbard Treaty of 1920 the island of Svalbard is a also a demilitarised zone, recognised as being under the sovereignty of the Kingdom of Norway, which should provide political stability for the foreseeable future.

Since opening in 2008, the vault has become an unwilling tourist destination, where visitors are compelled to visit the iconic entrance despite it not having any official tourist offerings. As a 'public building' project in Norway, the building was required to have a public art component and KORO (Public Art Norway) commissioned artist Dyveke Sans to create the work 'Perpetual Repercussion' which frames the vault's main entrance door and roof with a series of reflective acid proof steel, prisms and dichronic mirrors and custom feature lighting. As a conceptual and site-specific piece, this adds to the allure of the vault and what has become a defining image for The Crop Trust and Svalbard.

The artwork was awarded the Norwegian Lighting Prize in 2009, and the project attracts frequent requests for use as a backdrop for other artworks, documentaries, films and commercials. In creating the work the artist explains, "It became a kind of wakeup call for me, realising that it is possible to go through life without knowing anything more about the most basic thing of all – the food we sustain ourselves on."[112] The artist describes the work as " Signalling the position of the seed vault at all

times, the light becomes a complementary opposite to the dark cave buried in the permafrost on the mountainside”[113]. Food security is a major global issue that is not frequently discussed in mainstream media, but the mission and function of the vault serves as a reminder of the vulnerability of our ecosystems and human agricultural history. The message of the vault challenges us to consider our actions – as the history of modern humankind is arguably a history of agriculture – which is here being safeguarded for future generations. Sanne describes that “we have inherited and cultivated an anthropocentric way of thinking, where humankind presides over nature by virtue of our ethical primacy. Now we know where this has led us.”[114]

The powerful connection this project has with the public is another example of a work that can inspire the public imagination and provide compelling storytelling to face issues of resilience and climate change, here with a focus on food security. As an ‘offensive’ and protective resilience measure, although the work was carried out as largely an engineering project, the small public gesture of the doorway with Sanne’s reflective, shimmering artwork is a call to action. Sanne describes that the mirrored surface can be understood to represent the copies of the seeds, as well as prompting a self reflection, considering the actions that have led us to the climate crisis we face. The effect of the work, either in the darkness of the winter or the long summer nights, is to make the vault appear almost porous and shattered- as if it is penetrable. She describes: “One question is: should you impose public art on people? Sometimes you shall. The Seed Vault is one example of such an imposition, because everyone should know about it. The Seed Vault doesn’t leave anybody who really grasps it untouched.”[115]

“The Vault balances on a continuum between extreme points: the practical necessity and virtue of gathering and securing the world’s seed diversity, and the equally negative and dreadful signal it gives off by telegraphing that this is really necessary, drawing attention to the current dangers seeds have to be protected from. George Bataille described in The Accursed Share the way in which the gift is positive and negative at the same time, because it binds the recipient to return ut with an even more valuable gift. In a way the Seed Vault is a gift to all of us, which binds us to return it with an even more significant one. It is the gift that no one wants.”[116]

Currently there are no plans or need for a second global seed vault, as the project has double the storage capacity of its original brief and already operates as a second backup for genebacks world-wide. But it does set a benchmark for global vaults of other kinds, such as the long term storage of germplasm, other tissues or resources. The project serves as an example of a visionary project delivered by a forward thinking government, and supported by global partners who provide an international network of collaborators with a shared aim and global vision. For a fraction of the cost of the BIG U, the project offers priceless protection for the world’s food crop diversity and offers benefits for current and future generations.

" The Seed Vault is protecting 10,000 years of agricultural history. I think that's something that people really care about."

Cierra Martin, The Global Crop Trust

INTERVIEW CIERRA MARTIN, THE GLOBAL CROP TRUST (2019)

LH: I'm an architect and have an interest in climate change from an architecture and urban standpoint. After visiting Svalbard I became interested in the Global Seed Vault because of the way people have such a strong connection to it. It is an iconic building in itself, but people seem to be taken by it from a more emotional point of view?

CM: Absolutely - I get this all the time because not many people understand crop diversity. It's a topic that you don't hear about very much, but the Seed Vault is something that captures people's attention immediately, as soon as you talk about this bunker for seeds in the middle of the Arctic. And then they see a picture and it gets even more exciting. I do think you're right - there's an emotional connection and maybe that's because the Seed Vault is protecting 10,000 years of agricultural history. I think that's something that people really care about and it's also a really amazing building.

LH: The Seed Vault is an ambitious project, which involved a partnership between the Global Crop Trust, the Crop Diversity Trust and the Norwegian Government. How did the project come about, and who initiated it?

CM: It was actually our former executive director Cary Fowler. It's interesting because it gets very complicated when you talk about sharing germplasm (or seeds) across countries, and the first idea came about in the 70s where it was proposed to put a backup for seeds from Gene Banks in an abandoned coal mine in Svalbard. That was something that Cary was very vocal against, at the time there wasn't really a platform for the international sharing of seeds and the timing wasn't right for the establishment of a facility like this. Then when the Plant Treaty came into force, the International Treaty for Plant Genetic Resources for Food and Agriculture (the ITPGRFA) that was established in 2004, that created an agreement for sharing seeds. Because the treaty came into force that suddenly made this Seed Vault possible because there were rules and a standard for sharing seeds internationally. That was what laid the groundwork for the Vault, and then Cary was instrumental in lobbying and speaking to the Government of Norway about why the Seed Vault was really important. A lot of people saw its value and in 2006 construction started, and the Vault opened in 2008. The Government of Norway really took a leadership role - they funded and own the Seed Vault. They're clearly committed to having this as a long-term storage facility.

LH: In terms of the site selection, the vault is located on the remote island of Svalbard in Norwegian Territory. There are a number of reasons the site is suitable in terms of access, the permafrost ground conditions and its cold climate. Was Svalbard always the focus in terms of the location for the vault?

CM: Yes, Svalbard was always a focus for the location for several of the reasons that you just mentioned. It's really cold - it's important because if you lose power to the facility, then ambient air temperature will keep the seeds, in that point inside the mountain, at about negative 4 degrees Celsius. The seeds like very cold temperatures in order to thrive for a long time. They die eventually so need to be re-grown, but if kept in cool, dark, dry locations they have a higher longevity and that was a big reason for Svalbard

because the Vault is mechanically cooled. The Vault room itself is at negative 18, but you could have seeds that are viable for hundreds of years at negative 4. There're also more polar bears in Svalbard than there are people so that adds a level of security. It's the farthest North you can fly on a commercial airline, so it's remote but it is still accessible, so makes it easy for our partners and ourselves to go up to the Vault a couple of times a year in conjunction with seed deposits. There's also The Svalbard Treaty, outlining that the island of Svalbard is not necessarily owned by any Government. So it makes it the ideal location for a facility that's supposed to be for the world.

LH: In the planning of the project, how long did the process take from conception to completion in 2008?

CM: When the treaty came into force in 2004 that laid the groundwork for establishing the Seed Vault, and between 2004 and 2006 those discussions were happening. Then in 2007 the Norwegian Government revealed the architectural design for the Vault and they publicly announced their support for funding. That work began in late 2006 / early 2007 and construction began in March of 2007. It lasted until September when the Seed Vault was officially completed, and then was opened in February of 2008. We just had a 10 year anniversary.

LH: The collection and storage of seeds involves a collaboration between a large number of national and international partners. Is there a strategy in place for how it is handed over from generation to generation, and how ongoing management of the facility is planned for its long term future?

CM: There's a feasibility study that goes into the long-term projections for the Seed Vault in terms of the facility itself and access to seeds. It goes to the fundamental purpose of the Vault because a lot of people think that it's this doomsday vault that people could access in apocalyptic times if there is ever a need for seeds - and that's really not the case. The Seed Vault is a backup facility for Gene Banks only. So for a Gene Bank to deposit seeds into the Vault, they have to first have a copy of the seeds in their collection, and they have to send another copy to another seed bank as their first back up. The seeds that are sent to the Seed Vault are actually the second backup of those seeds. The Vault was created with the realization that these Gene Banks are really vulnerable, because just like any other public building, a flood could happen, a fire could happen, or a lack of funding could lead to the power being shut off. And then if something happens to the material in that Gene Bank, and there's no backup in place, then you lose it for good. A lot of these seed banks are holding material that's no longer grown for several reasons, where it's no longer available in the wild, so it's really important and if they don't have a backup it puts all of that material at risk. It's something like an animal that once it's gone, you're not going to be able to get it back. Only depositors can request their seeds back, and only the managing partners. The Seed Vault is managed by three partners - the Norwegian Government, the Crop Trust and the Nordic seed bank Nordgen. There's part of the Norwegian Government called Statsbygg which does 24-hour monitoring of the Vault, done remotely to make sure the temperature is at the right level and that everything is secure. The depositors send their seeds to Nordgen a couple of times a year, who puts the seeds in the Vault and are responsible for logging the material into a database online and making sure that everything is in the right order on the shelves and in the Vault room. Individuals can't request any of the material, even the Crop Trust or Nordgen - we receive the boxes, but we don't open them. It's a safety deposit box for seed banks, they maintain ownership at all times of the material. In terms of the long-term plans for organizing this, they're responsible for taking their material out at a certain point and regenerating it, and making sure the seeds are viable, and putting fresh viable seeds back in the Vault. So it really establishes a global service for these seed banks. It's kind of a hands off approach, we don't have any permanent staff in Svalbard, it's not supposed to be a visitor's center or something that people can go into regularly.

LH: In terms of climate change effects and the physical resilience of the building, it is designed like a bunker. It's more like a piece of engineering and the main architectural element is the doorway, which is all that people can see. Addressing climate change effects and resilience were core elements of the design brief - how were benchmarks set for the project within this uncertain context?

CM: There was a feasibility study that was published in 2008, but it was done prior to the construction of the Seed Vault, which looked at the forecast for climate change on Svalbard and presented a worst-case scenario projection. To make sure the facility that is being built would be viable and feasible well into the future, no matter what happens in terms of sea level rise or changing temperatures. That's publicly available and goes into detail on the measures, explaining how the Vault is built into the mountain. That was something that really drove that discussion and also the construction. As you know in 2017, there were reports about flooding in the Vault. But actually it wasn't flooding - that is a poor translation from Norwegian to English - the word in Norwegian means 'water coming in'. There's a one hundred and thirty meter long tunnel that runs into the mountain, and water was coming into the tunnel, and we had pumps working 24/7 to pump water back out. The reason the story broke out was because construction was happening in 2017 to fix this. It was really no problem for the vault, there was no problem for the seeds because they're in a Vault room that's past two doors after the tunnel. They remained safe the entire time, but we didn't like the fact that water was coming in. Plans are underway right now, which started in 2017, to create a watertight tunnel. The entire tunnel is being replaced, and next year the Seed Vault opens officially again. It's open now (seeds are still being deposited) but we're doing an unveiling of the new channel in 2020.

LH: Is it correct that the water ingress was due to the permafrost conditions changing much more rapidly than expected?

CM: That's exactly right - the permafrost around the Seed

Vault hadn't established itself as we projected. Because in the summer it's warmer and melting that occurs usually refreezes, and doesn't cause any issues. Because of the unseasonably warm summer that didn't happen as we projected, and that's why the water came in, and although it wasn't really a problem it was something that we didn't want to happen. So we decided to make a watertight tunnel.

LH: It sounds like the building has a number of systems in place and that was just one indicator, so you could identify the problem, before it became a problem? And the Seed Vault is monitored 24 hours a day?

CM: There're several systems in place so that if something were to happen it's flagged immediately upfront and doesn't become a problem. The Statsbygg building managers monitor it 24/7 and they have people that live in Svalbard. So if for some reason something were to go wrong in the middle of the night, we can deploy people immediately. There are sensors that constantly check humidity levels and temperature in that room. There has been a new report published about 'Climate in Svalbard in 2100', a Norwegian report commissioned by Miljo-Direktoratet. That gives you an idea of what they're thinking for the future because it shows things are going to happen more rapidly than we initially expected in terms of the increased temperatures.

LH: The vault is described as "a kind of insurance policy for other gene banks", by providing copies of deposited seeds in case of natural or man-made disasters. Given the value of almost 1 million seeds currently stored in the vault, and the significance of this collection for future generations, are there plans to build a third 'backup' vault?

CM: It's estimated that globally there's 2.1 million unique accessions of crops that exist around the world that are important for food and agriculture, and there's a lot more material than actually exists in seed banks. But there's a lot of duplication, so when we created plans to build the Seed Vault there was only supposed to be one Vault room which has the capacity to store over two million seeds. And that was going to be enough to conserve all the unique material in the world forever. But the construction company realised that for just a small amount more, it would be easy to build more rooms because there's more space than initially thought - so there's actually three vault rooms. And each of the rooms has the capacity to store over two million seed samples, so it's plenty of room to store every single unique accession and more.

LH: So it allows three times the capacity?

CM: Yes, it's three times the capacity. So there's no need for another Seed Vault like the Svalbard Global Seed Vault. But there's some crops that cannot be stored in the Vault. If a crop is vegetatively propagated like banana, they're not stored in seed form. You can store the seeds but you're not going to get the same thing every time you grow out that seed, so you have to store the plant tissue in liquid nitrogen. It's a process called cryopreservation; you take a little piece of tissue, put it in a test tube and drop it into a vat of liquid nitrogen, and it can stay like that forever. There's a feasibility study being done on the feasibility of creating a cryo-backup for these crops that can't be stored through their seeds. But we don't have concrete plans for that facility, it's just something that's being looked into.

LH: The Global Seed Vault has become a famous landmark, despite the fact that visitors cannot enter. Did you foresee the project becoming so iconic? All that's visible is the entry and artwork by Dyveke Sans - was that a strategic decision to engage an artist and present the vault in this way?

CM: No, it's interesting and I didn't know this before working with The Global Crop Trust but all public buildings in Norway have to have a piece of public art in them.

LH: Even something like this, which is more like a piece of infrastructure?

CM: Yes, apparently so. It's great that the Government of Norway is promoting public art and that's why there's art in the entrance of the tunnel; the title is '*Perpetual Repercussions*'. There's fibre optics and mirrors, with lighting built into it. In the daylight the light shines from the sun and casts light in all directions, and at night it lights up and it's like a beacon to the world - of everybody coming together to support our food system really.

LH: So the art was almost accidental, but it's become part of the iconic image of the Vault, which is the entry.

CM: Absolutely. When the Seed Vault was established, I don't think we ever thought it was going to be this iconic. We're all very glad that it is and it gives us a really good opportunity. The Seed Vault is just one small piece of a much larger system of sharing and saving crop diversity, but it's something that doesn't get a lot of good international attention and the Vault has really helped to elevate that message. People are intrigued by it and they're excited about the Vault, and that gives us an entry point to talking about the importance of this material in a larger perspective. So we're really grateful for the Seed Vault being so iconic, and it is really the "doomsday" vault - that nickname - that made it escalate in the news. People gravitate around that, they like the idea of there being something in place for apocalyptic times. Even if that's not really the purpose of the Seed Vault, it helped to bring it to everybody's attention.

LH: It's become a postcard image for Svalbard as well. I understand they hold tours to the vault doorway, but it is never going to have any kind of public component?

CM: No - because our only goal is to make sure that the seeds are safe and so there will never be visitors allowed into the Seed Vault. We allow media sometimes under certain conditions, typically once or twice a year, and always there's measures in place to ensure that everything is very secure. The only reason we allow high-level media in is that we can disseminate the importance of the Vault to people around the world. But even that is about to become stricter in 2020 when the Vault is open again. So it's kind of on lockdown, and it's not because there's anything hiding,

but because we don't want people to be in there. It's a seed storage facility, on the inside it's very basic - it's not supposed to be a tourist attraction.

LH: You spoke about how the process of bringing seeds in and out is managed and how depositors maintain control of the seeds. And for the long term future, the same organizations are forecast to remain in place. Is there any possibility this process could shift, and to what extent does the vault's operation rely on everything staying the same?

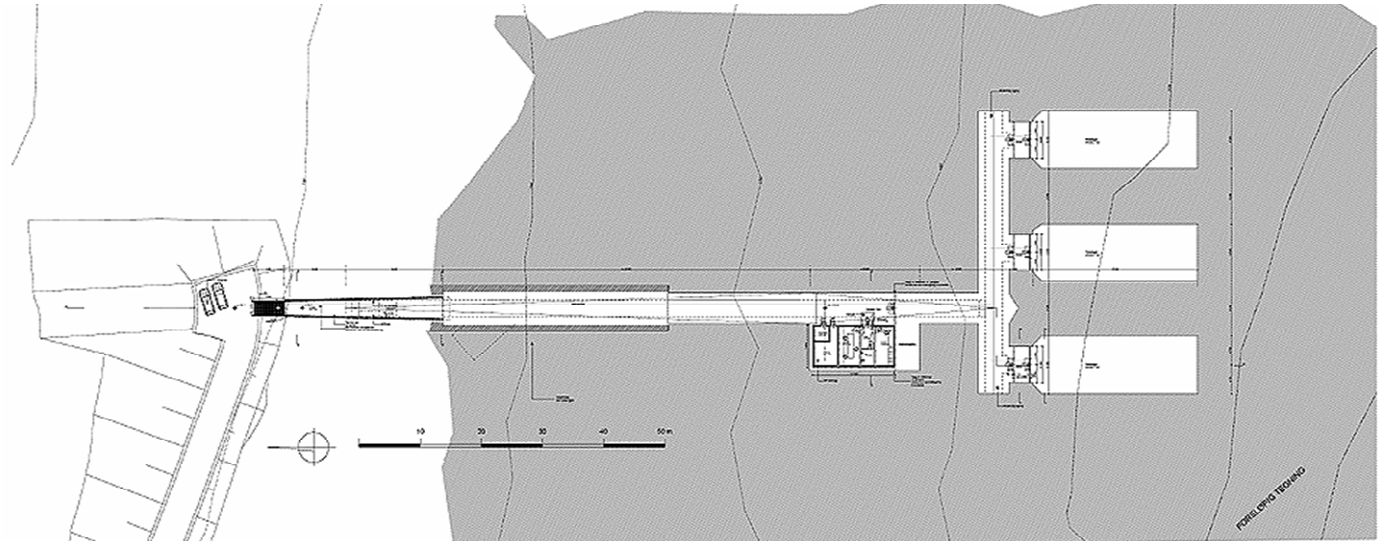
CM: The Seed Vault was designed to not need constant management. It can survive on its own without any work from us, we don't have people on site. There's nothing that needs to be maintained day in and day out because everything is monitored remotely, and we do have local people there if needed. It's owned and administered by the Kingdom of Norway, that's something that's pretty concrete and that's not ever going to change. The partners in the organization of the Seed Vault also aren't going to change. I think the three parties that administer the Vault are secure, and also the establishments like the seed banks themselves that have deposited material. A lot of them are international collections, so they're on a pretty secure footing. I can't tell you what's going to happen 200 years from now, but the Seed Vault itself can run on its own. It's not forever because the seeds have to be taken out and re-grown, but our hope is that as time goes on, say 50 years from now, that as people leave there's going to be knowledge transferred. Crises are going to continue and there are strategies in place for depositors to take the material out, re-grow it and send it back. Of course we don't want people to have to take out their material from Svalbard, because it is supposed to be the safety backup and if a backup is needed that means that something happened to the initial collection. But we know that it works. In 2015 we had to make the first withdrawal from the Seed Vault because of the war in Aleppo. The seed bank there wasn't harmed but the managers were no longer able to share their material with other users around the world, and that's the primary function of a Gene Bank. Firstly it's to conserve material, but it's not any good to anybody if it's not being used, so they send material out and that process they couldn't do. So they moved to re-establish their collection, and it was easier and better for them to go to the Seed Vault and retrieve all of their material at once. We know because of that, that the Seed Vault functions like it should. They've taken out materials more than once and they're re-depositing that material back to the Vault in several smaller shipments. It's really a testimony to how the Vault operates and that it's not only important for our future, but it's important now.

LH: Given the experience around the Vault and the way it's been received, do you think built environment professionals (such as architects and engineers) have a responsibility to think about creating more resilient buildings for the future?

CM: Really interesting question. We certainly see the importance of resiliency in all things, especially when it comes to food and agriculture. The Crop Trust are based in Bonn, Germany. We are a small team of 30 but our science team works with the 11 international Gene Banks as well as select National Gene Banks on quality standards. We're raising an endowment fund of 850 million dollars, and part of that money goes out every year to supporting new seed banks. One big thing is that the collection needs to be up to certain quality standards in order to receive that funding in perpetuity, and part of that is related to the building, their management of seeds, the different storage facilities that they have and how they're monitoring them. And I think the more sustainable and the more resilient these things are the better, because it's always better to do things right the first time, then have to go and redo them again.

LH: I'm interested in that especially for an organization like yours, you're focusing on crop resiliency. In Bonn you may not have been affected by climate change events, but I was interested to know if that's something you are thinking about in your own places of work and the buildings you occupy?

CM: It certainly affects the seed banks that we work with. We provide funding and technical expertise to them when they need it. For example, the AfricaRice Gene Bank recently moved and we supported that because their original facility was no longer a feasible location The E-Carta collection had to move in 2015 for civil conflict reasons, not for environmental reasons. We realised the vulnerability in the fragility of these seed banks, especially when they're in locations that are affected by climate change more so than other parts of the world. And that's why the Seed Vault was established. Because we realised that the world isn't going to remain the same, and there needs to be a backup for this material because it's really important. We provide support for the original collection itself, so that's something that's a concern for the Crop Trust. We also support the safety backup for when things don't go as planned, so we're involved in both areas.



Above: The Global Seed Vault plan
Below: The Global Seed Vault repairs, 2017
Images courtesy of The Crop Trust

"The power of architecture right now should not be overlooked. Because it's not a question of small changes – it's how we deal with it, and it has a lot to do with how we live and how we feed ourselves.I think that design and architecture, and art in its own way, a sort of slow working second hand way, the overall opening of eyes – the possibility of actually making a difference is on the doorstep.

Dyveke Sanne, Artist

INTERVIEW
DYVEKE SANNE (2019)

LH: I became interested in this project after a residency in Svalbard - there were artists, scientists and people from different disciplines who were fascinated by the vault and your artwork. Everyone wanted to see it – and when I started thinking about the topic of resilient architecture and climate change – it was interesting that it's become quite difficult to understand what our personal and professional responsibilities are.

DS: Exactly. We have those discussions here as well – our daughter is turning 25 and she went for four years to the AA school in London, and my husband is an architect. So we are in the same field and we have lots of discussions – not necessarily about architecture as such, but about what are we going to live on, how are our living conditions going to be, all of these things that hang together. And like you say it becomes quite difficult. I think there is a shift, and that young architects today know what they're up against. We have seen that shift coming more and more, and I've also seen it since I've worked with the seed vault. It was 11 years ago and the most shocking thing to me was to understand how much I really didn't understand about climate change (and nobody else did either). I remember Cary Fowler talking about it, I was holding a lecture in Svalbard about my artwork and he was talking about crop diversity. He talked about 'the perfect storm', and it was of course starting to happen, otherwise the vault wouldn't have existed. But now it's so real, it's reported every day in the newspapers, it's young people all over Europe protesting - they sit down and don't want to go to school. They say we don't want to do it anymore this way, because we don't have time.

LH: The Global Seed Vault is an ambitious project delivered by the Norwegian Government and The Global Crop Diversity Trust. What was the selection process for the artwork commission?

DS: This is a building that was entirely built and paid for by the Norwegian government, belonging to the Department of Food and Agriculture. It is a state building (StatsbigStatsbygg), and there is a certain amount of money that used to be put aside for public art, a percentage of the building sum. Since the building did not cost as much as you would think, the commission was not very large. When it is a building that belongs to the state, there is state agency for public arKORO (Public Art Norway) have money to grant and a structure to appoint an art consultant, and a person to run it as a supervisor and deal with financials.one or two art consultants for a project. The art consultant is most of the time an artist but could also be an art historian or art curator or related to the art business.. There was a committee which consisted of the will in these cases always be one of KORO's own people supervising and overlooking the whole process from planning to finalised project. In the case of the Seed Vault, the art committee consisted of one art consultant, a practising artist and experienced consultant (Chair of the art committee) one representative of the owner of the building (the state), aGovernment's Food and Agriculture department), one representative of the state building department (an architect),Architect and project leader at Statsbygg), and the architect of the vault (Peder Søderman, Barlindhaug Consult A/S), and). I was at the time a representative from the Government from the Food and Agriculture department. The art committee consisted of 5 people and the supervisor from KORO. I had been a

consultant and chair of the a long time project myself, so I knew a bit about running and executing projects in public space, also from a more formal angle. The art committee for other projects, and it's never a commission that someone haswould always work on an art plan that would seek to explore and put a label on – it's free for you as an artist to the art work in context by relating it to time, space and concept. This is a tool for everyone involved as it stresses the limitations as well as the possibilities that would follow any work of art in public space. The artists own thinking, artisti language and take on the commission is however always open and left to the artist to articulate and develop. In this caseThe whole process, from a prequalification, an invited competition and then execution of a project most of the time takes between one to two years. Sometimes you would be asked directly, without the process of a competition. In big projects, like the one I was working on as a consultant at the time, we would initiate for many artists to take part in different projects, permanent and temporary, and we would initiate different ways of getting artists to qualify for the projects, from open anonymous competitions, over prequalification- and invitations to invited competitions and directly invited artists. In the case of the Seed Vault I think they didn't have much time, because I was contacted in the late summer / beginning of autumn, and I mounted everything in Svalbard in January, so it was that short a span. They can hold a closed competition where they invite people, have a prequalification and selection, or they can invite people to do the work. In this case I think time was very limited, they had looked at lots of artists and the committee had landed on me. At that point I didn't have a web page but KORO had a lot of information about me. from previous projects I had done. I worked as a professor at Art and Public Spacefor 20 years at Oslo National Academy of the Arts, butin the end as a professor at the relative new programme at the Art and Craft department; Art and Public Space. I have now retired from that job so I have more time on my hands and am working on my own art projects.

LH: The vault is located on the remote island of Svalbard in Norwegian Territory. Were you familiar with the site, did you visit to plan the artwork, or was it more of a conceptual response?

DS: I had never been there but I was very familiar with it. As you would be, as a Norwegian - and mesmerised by it. But I'd never been there, and because of the short time span, and because I understood that it was not an in situ site but an ex situ site, I put myself in the position of being ex situ. Normally however little time I would have I would always go and see a site. It's extremely important for me, it's just crucial. But since it was already something that's not really real for most people but such an important message to get through, I thought that I would put myself in that position and think about it. It's the only place I have been working or have had some sort of an impact on with an art project that I've not visited before. Immediately when I was selected we went to Tromso and had meetings there. They presented me with the project and I went back home and started to work on it (normally at that point you would meet with the committee at the location). Then I went home and made a draft for it, I worked a lot on it. I used to work 50% at the art school so I had time – I don't think I could have done it now. I went to the workshop when I came from school at 6pm and I came home at 3am. It was very intense. And I think that was very important since I wasn't able to go to the space.

LH: So the creative process was less than a year for concept, prototyping and manufacturing?

DS: Yes, for everything. Normally I can spend two years on a project like that. But I can also work very fast - and I did. I started very small and in the end I made a few prototypes. It just so happened that my father ran an engineering firm that specialised in metal work, about an hour and a half drive from here, and they produced it for me. And if they hadn't had time to do that, it wouldn't have happened. Because when you get to know what you're doing and you contact people to work with you, it takes a while. So that's why it could happen so fast, because he was able to do it. It was my father, someone he worked with and me, who were doing it together. I made the prototypes and mounted all the lights, and nearly cut my hands to pieces. When I got the commission they said that I did not have to finish it before the opening in February 2008. But I said if I'm taking this job I will finish it, otherwise it doesn't make sense. The first thing I really knew and understood right away is that this is not an in situ site for people to visit. This is something for the internet – this is something that has to somehow reflect in a way that can make a difference on the internet. And conceptually, that's why I had a text that was very important that was connected to it, and in the beginning it was there all the time when it was presented. There were lots of comments about the text, people picked up things and talked about it on the internet, so that was in the beginning equally important. That was interesting – I was almost childishly persistent in always presenting the text, because otherwise it can be open to anything, it's very abstract. In the text there were passages about the copy, and the obligation to the seeds that have to be seeded as copies, and not 'suicide seeds'.

LH: The vault relies on protection from the surrounding permafrost and thick rock – but in 2017 there was unexpected water ingress in the entry tunnel, leading to building modifications that are currently underway. Did you design any features to protect the artwork from damage? And what is the expected lifespan of the work?

DS: I knew about the water issue and I was very busy at the time it happened. All of a sudden I got a letter from KORO saying the state had confirmed that they were not going to touch the entry where my artwork was. Because it had become such a token, such a sign of the seed vault. I think they will make modifications beside it - they could have torn it down but they are not touching it. That is also telling, that sometimes if things become a symbol, it can be important – and in this case it's an artwork. You ask about how long will it last – it's a lot to do with the construction. On top of the vault there is a concrete roof where we pre-drilled 6-8 huge holes for big bundles of fibre optics, and there is a 4.5cm space for my work to go. Which everyone thought was a big space – in the first drawings I thought it was 3m I could fill with something – but it was 4.5cm, so that was

Above: The Global Seed Vault,
Image courtesy of The Crop Trust

a real challenge. I was thinking that you can make a lot of things reflect and go all sorts of ways if you have a lot of space, but all of a sudden I had 4.5cm. On top of that are glass panes and there was a firm in Tromso producing the glass, and the frame and legs for the glass to sit on. It all had to be adjustable because this was going to be mounted in Svalbard in a precarious climate. There was no fiddling, it all had to be spick and span and really ready for being mounted with no delays. Because you couldn't possibly deal with that, you didn't have hands to work with, you had mittens.

LH: What were the challenges of installing the work, given the remote site location and strict environmental controls in the Arctic? How many people were involved in the making and installation of the piece?

DS: Everything was so carefully planned for, and I think that would have been impossible if it was not my father's firm and me who did it together. Everything had its own lifting system, every pane, and there were thirteen panes all together. On top of the glass, there were frames and I didn't know who was supposed to produce them because the glass company dealt with that. I happened to call around a couple of days before I left, and it turned out they didn't manage to make the frames or legs. That was a big surprise. My father was also an inventor – so I talked with him all night, we talked it through – and he constructed it in welded acid proof steel. We had to coordinate with the glass people from Tromso, and had to lay down the artwork triangles and then put down the glass right away so it was protected. My father's firm made the legs and frames and they came on the plane after me to Svalbard. It just so happened there was a terrible wind – and we had a huge crane to crane in the frames and glass, and couldn't do it for nearly a week. I had also smashed my thumb in a car door but everything was alright when we started. I had to do all of the fusing of the cables on my own. I have very few pictures from this whole process – the only time I used my camera was to see whether there were polar bears. Otherwise I was working the whole time. I had to fuse the bundles of fibre cables because if you glue them, after 10-20 years they become a brownish grey. These are fused with heat, and I learned how to do it two days before I went. I borrowed an aperture but it didn't work exactly that way up there because it was so much colder, so I had to invent my own system. In the end I made it, and I was up there 2-3 years ago and the light was as bright as before. The 6 bundles of cables each go to a halogen fibre optic light source, and I assume that they soon will be replaced with LED light sources. I provided them with lots of metal halogen lightbulbs, but it will be more sustainable to have LED because they last for a very long time. They are placed where the coolers are, which is about 1.5 floors up from the vault, by the entrance in the tunnel. So it's pretty sustainable because there's no heat – because it's fibre optic and the fibres go to a different room where the heat source is. It should last as long as the seed vault.

LH: Climate change effects and physical building resilience were core elements of the vault's design brief. Was there a defined artwork brief or were you given creative freedom to respond?

DS: Absolute freedom. But yes there was a brief, or an art plan, as I described before. I hadn't done anything similar to this, and I never do two things the same. They didn't have a reference that they thought 'we want something like this'. I suppose it was just from the light work and reflections in my other works that they saw. And they wanted something that gave a strong signal somehow.

LH: The vault is described as "a kind of insurance policy for other gene banks", by providing copies of deposited seeds in case of natural or man-made disasters elsewhere. Given the intergenerational value of this project, was it difficult to approach the commission and finalise your concept?

DS: To me, because I had the freedom it wasn't difficult, it was challenging. It was very interesting. Like with all projects it's not exactly difficult but I find it challenging, that's why I never do the same project. Whatever projects I do, they have the same content somehow, but they look very different. I was taking in what this was all about and of course that was very shocking and heavy. That's the first thing that I do, I spend a long time, I never sketch anything but fill myself up with whatever it is. I talk to people, I read things, and then I put the lid on and wait for something to pop up. That's how I work… It's like a cooker. I didn't feel pressure – that doesn't work. When you work with pressure, if you feel pressure you can't do it. You might at some point feel that this is really heavy, but then you have to just forget about it. Because you have to be completely free. Of course it might have been different if I was a very young artist, but I have worked with many things and with a lot of different people, and I'm also educated, I've worked for the National Academy of Art for 20 years. It's very interesting because it's something I am very aware of being a supervisor for students at all levels. That particular feeling is not constructive. Then you become scared, and you have to be able to follow whatever aims set you off to do this, because otherwise you can't do it.

LH: Were there any particular environmental controls you were given?

DS: There's always a form that you have to complete, which is about the environmental hazards of your work, that you have to work within. All projects initiated from KORO have a form you have to fill out and also the local counties follow that.

LH: When we visited the arctic they told us we musn't change the environment in any way, and that anything we did must be temporary. But in this case it was a new building so inevitably they were changing that part of the environment?

DS: It was not in my jurisdiction - it was the building itself. And it had to have some sort of light I suppose. But of course one is thinking about the pollution of light, and also I was thinking a lot about the colour of the light. I was very unsure of that because I'm very careful with the pollution of light, I'm very preoccupied with that thought.

LH: Can you talk about the artwork title - Perpetual Repercussions. It seems to have many layers; describing the dynamic effect of the polished steel mirrors, glass and carbon fibre lighting, and the changing light conditions on Svalbard. Also broadcasting a kind of warning; symbolising the gravity of the vault, which provides a backup of the world's seeds to preserve crop diversity, and questioning the actions which have led us to needing the vault in the first place. Did you have the sense of this piece as a warning, that challenged people had to consider their actions?

DS: Oh yes. The title and the work are about the same thing to me. Of course 'perpetual' remains to be seen, but why it's there is because it has to do with our own durability and of course in this case the seeds, their biodiversity for eternity. It has to do with that perspective, that it goes on and on and doesn't stop, it's not something you can finish. I could really talk about it for a very long time, I'm very engaged with it. I'm not English so I never would have thought of that title if I hadn't for 25 years lived with an Englishman. There are probably facets of that title that I don't grasp. And yet there is a lot of other stuff that I don't grasp. That's also my thing, that we really don't grasp things, do we? This thing that we know what to do but we don't do it. And we can only for short periods of time understand or have this sort of whole understanding – and then we lose it again. I talk about this when you pick up a stone in spring, and you see all the ants collecting eggs, and you see the structure of a society. And then it's gone. You can't figure it out the structure. You put the stone back, you lift it up three days later and it's there again. But the same thing happens and it goes so fast you can't really understand it. And I think it's exactly the same with everything around us - we grasp bits and pieces. And I think art has a possibility to grasp something else. I grasp something when I read an article, or when I read the last UN report on climate change. I grasp something, I don't grasp it all. And when I see an art piece somewhere that moves me somehow, I can grasp something, but I can't grasp it all.

LH: You described the vault as being "positive and negative at the same time – it is the gift that no one wants". Many people, probably due to media reporting, see it as a 'doomsday' vault, but The Crop Trust describe it more positively as a 'safety deposit service' that is independent and active, as seeds have already been withdrawn and re-deposited. It's not a time capsule but a live piece of infrastructure. Has your feeling about the project changed since first producing the artwork?

DS: Exactly. I keep thinking that it's stronger as a signal, because the reality is rapidly changing. Of course it has it's uses, I always understood that. But still there's a lot of things that we need to do. First of all we need knowledge and we need to be aware of it. And in that aspect I think it's still the signal of it that people understand, that there's something going on there. Why do we need the vault? There's still people that don't know as much about it as we do. There's still people that don't believe in climate change. And then the vault – the sign of the seed vault is that it's actually working. The war in Syria has created a situation that the seed bank there was destroyed, and one needs to bring the seeds back. And that's what it's made for. But for each and every one of us it's still a signal that we have to do something. Cary Fowler talked about the perfect storm, and that it's going to be 1-5 degrees hotter and then you cannot really grow things. And now it's actually happening, things are changing, there is a steady rise of temperature. And Svalbard itself, which is just so strange to think about, is one of the hottest spots that has changed the most in the whole world. The winter it's now nothing – it was so cold when we mounted this work - and now the ice is melting and it's raining there all the time. And the vault is right there, and I think that, in addition to everything else, is for everyone a strong signal. People can't do much about it, and they can't do much about the war in Syria and the seeds being placed there, but they can grasp it and do something. So that's why I think it's still a signal.

LH: I think a signal is a great way to describe it.

DS: Because it is also ex situ. People can't really go there - most people can't go there. But when I was there with my colleagues 2-3 years ago, they told us at the hotel we stayed in that a few people had come from Japan and they had stood there and cried outside the vault. Because it evoked huge emotions. And I was also crying when I was there. It was so hard to do all the work, and when we were back for the opening it was a celebration, it was so much to take in. I didn't see it when I made it - the boys that helped me at the vault, they promised to put the light on when they saw the plane leave. And they did. And that's all I saw from the plane, it was snowing a lot, and I just had this image of it and that's all I had until I came back.

LH: Can you talk about the lighting design for this work?

DS: When I went back I was there in the dark again, I've only seen it in the dark – it takes you, because it sort of fills you. You asked about the colour of the light and to explain; if you take a train here in winter they're electric, and suddenly when there's a little dent in the electric line there will be a spark. And that spark is turquoise, exactly like that. And that's what made me think of it. Because when you sit there in the train and it's very cold (it's only happening when it's really cold), you're in this wonderful working train and then you have this spark and it reminds you that you're vulnerable. You get a resource from somewhere else and that's what makes you move, and it could stop at any time, and potentially you could freeze to death. That potential thing about everything hanging together – as a matter of fact, this work in the night time depends on electricity. But I was very unsure of whether or not I should do that – I was pretty sure that I shouldn't, and that I should modify the light to be just white. But when I got there and I saw the surroundings and that there was lots of white light, and also yellow light, it made me decide that this somehow has to stick out of the ordinary. So I worked a lot to get the light right and to get the reflections.

LH: The vault has become a famous landmark and captured the public imagination. I understand the artwork was a requirement as a 'public' building, to have

though it might not exactly address these questions, it can open other doors so that you are able to understand these questions better. My projects tend to revolve somehow around these things because it's really on top of my mind the whole time. I think art can't have a layer of instruction. But artists are living today and they are also occupied with the challenges of the day – not just climate change but human rights, new colonialism, the oppression of thinking, it can take many forms but it all belongs to the contemporary. It's also because this is so complex, it needs a lot of different voices, to face the reality of today. It also needs some very swift actions.

LH: Architects often talk about architecture as art. For me I think they are different because of the question of responsibility and freedom. Architecture is generally tied to a brief, a site and a client and you have many obligations and instructions. But art is not like that?

DS: Yes you can say that. But the power of art is on a different level. The power of architecture right now should not be overlooked. Because it's not a question of small changes – it's how we deal with it, and it has a lot to do with how we live and how we feed ourselves. All these things hang together and I see this through my daughter's eyes. I think architecture and art are much closer somehow than design and art. I think that design and architecture, and art in its own way, a sort of slow working second hand way, the overall opening of eyes – the possibility of actually making a difference is on the doorstep. I don't know if there might be a difference between Europe, America and Australia in these matters. But I see here that first of all you have to work sustainably – that is no question, it's getting stricter and stricter. I think a lot of things are happening so fast, and a lot of things have to change really fast now. Art is important although it doesn't have an immediate impact. That is a crossroad in these times – that art works kind of slowly. And we don't have much time to deal with these things, so as artists we might have to work on different levels.

Above: The Global Seed Vault,
Image courtesy of The Crop Trust

a public artwork component. Did you foresee this project becoming so iconic, where your work has become a defining image for Svalbard and the Arctic?

DS: Yes and no. I understood that this is not an ordinary art in public space work. I thought nobody will come here (it turns out quite a few people have been there), but it's going to be on the internet and spread in a different way. So I took that into account when I first of all didn't go there. And also when I did the models and sketching for the work I took that into account, that it would be spread everywhere. Of course the whole concept of the vault is in itself is so important and special, I really grasped that. And I think everyone that worked on it really did. It was kind of a scary path to walk down in a content sense, and challenging to figure out, and also with the very little space I had, how I should do it. But I did a lot of research and I try to understand things, and then I don't sketch anything until I wake up and I have something to start with. And then I start and make lots of models and try out things. Here I was trying out a lot of physical things about the reflections and the angles. I sort of understood that this would be important, I knew the place was really important. And the more I read about it the more important I thought it was. And also the images of it with the text, in the beginning, I thought that could make a difference. And all of the people - the international public, all the people to begin with that contacted me were from different places. They still keep contacting me, people making films and books and all sorts of different things. KORO has certain rules about using an art piece in a picture, and I said that this is about the picture, so I must have a different rule for this work because I want it to be shared as much as possible. This is about what the contents of the seed vault is. So I want people to be able to use these pictures, except for commercial reasons.

LH: So you retain artistic copyright and have a say about how images of the vault are used?

Yes, and I'm also a member of KOROBONO, who overlooks how artist's work is used. I explained to them the issue in this case, that people can use it on their home page, discuss it, put it in books, as long as they don't advertise anything else than what I writethe Vault is all about. And it should be used as much as possible, so I put that clause in, which I had to argue for because normally it's not like that. Since it's an ex situ thing, then it was important to me that people should use it for whatever its worth - but not for selling other products. Lots of films are being made, artists are making it into other types of artworks, on average it's about every third week that people contact me. So I did understand that when I made the project, since I made this agreement with Public Art Norway. You know that was 11 years ago, and there was internet but not as we see it today.

LH: The topic of resilience is often met with scepticism – climate change remains a difficult topic as forecasts are uncertain, future impacts are unclear, and the action required in the present moment is overwhelming. Have you developed any sense of climate advocacy through art following this project? Do you see any relationship to works such as Olafur Eliasson's Ice Watch given the themes?

DS: I can see it as a similar thing, even though they are about different things. It has a lot of signs that are similar – in one case you transport things to Svalbard, which is the art piece physically. And in Olafur Eliasson's case he goes there and picks up the original, and puts it somewhere else. So it has almost a different signage to it. In his case it's a stranger to a new place, in my case it's something strange to the original place. It has of course a signage to it and lots of people work with environmental art. Olafur Eliasson's piece of ice was in the sea already, so it's changing the environment, and putting it somewhere else where it melts and changes the environment. My project changes the environment as well, because you bring foreign things to Svalbard. But in the big picture it has a lot to do with it, and lots of other artworks - some are more drastically involved. It's a lot about the same things from different aspects, with different layers.

LH: I'm thinking about our individual and collective responsibility to address climate change, to create better futures. You have described that "Even though art and activism can be very close, if art gets close enough to activism it can become powerless. You can lose the vantage of art itself." Seeing the public reaction to vault, do you think artists and designers have a responsibility to think about advocacy, and inspiring more resilient futures through their work?

DS: I have thought a lot about that being an artist. And I think that art can't really be directed. That would be counterproductive to art. Also because it picks up on this huge complex of what it is to be a human being in these times. I'm speaking about good art - art that moves somebody somehow – which has this aspect. And it can be on a very individual stage, a very individual point of view, that moves something in you that makes you move something else. Because we have all these blockages and what I think art can do, at its best, is to open some of these blockages so that we can grasp the world where it is, and can take action. But the action is not within the artwork itself. You asked if I had changed my attitude towards that, and I haven't. But I think that designers have the possibility. To design our houses, to design how we grow our food, because that's also about practical design. Because everything we have to change – our mobile phones for example, communication platforms, are so complex. And for those who design those things it's not about the surface design, it's about the real sustainability of the design these days. And in architecture school they work with it, and designers can make a real difference. How can we design our environment to start to eat vegetables rather than meat? What you represent in the world with your thoughts, and how young people now are addressing these things is extremely important. I think that art can help to 'educate' – it's not really education I'm talking about – it's how to be able to be a whole human being in this time. What do you do? How can you be, and how can those doors be opened to become a whole human being? Art is working much slower, and with different things. But to change understanding I think art can be very important. Even

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Observations & Findings

This research examines opportunities for resilient architecture in the contemporary city, within the context of the global climate and biodiversity crises. With climate breakdown and biodiversity loss as defining issues of our time, understanding opportunities and responsibilities for architects to create more resilient projects is paramount. Four case study projects were examined to demonstrate a spectrum of responses to re-thinking the city, ranging from small to large, with the capacity to serve an individual, a community or populations of millions. Through empirical research, international travel and interviews, the research findings demonstrate how resilient architecture can create new spaces of innovation and agency for architects. Importantly, resilient projects can make a key contribution to demonstrating solutions and providing support for communities, and can capture the public imagination, with a need to rapidly increase motivation for climate action across all aspects of society.

The case study investigations analysed the projects' procurement, construction and use, to identify opportunities for resilient architectural approaches. The range of scales allowed a comparative assessment of size, reach and risk, with project briefs ranging from unsolicited experiments to international and government funded initiatives, catering for a broad range of users. The size and use of the projects show, on the smaller scale, the advantages of speculative proposals and temporary buildings. On the larger scale, the compelling narrative of collective action and intergenerational impacts are evident. The broad range of actions provides examples of architects working across scales, from modular components to mega structures, and shows how 'resilient' (and now more so, regenerative) approaches could be adopted by any architectural practice. This thinking can be applied to all projects from residential housing to workplaces, public spaces and infrastructure. Given the urgency of action needed to address climate breakdown, and the pressures of rapid urbanisation and decarbonisation in our cities, it's valuable for architects to understand opportunities for innovative solutions. We must also define what aspects of design, planning, policy and construction processes need to change in order to implement them.

Definitions and greenwashing

The 100 Resilient Cities organisation (now Resilient Cities Catalyst) defined urban resilience as "surviving and thriving, regardless of the challenge"[117]. In considering the increasing popularity of the term 'resilience' over the past 10 years, its definition has been applied across disciplines with varied meanings and risks becoming a generic term (like sustainability), used to promote diverse or even opposing agendas, or potential greenwashing.

Importantly, professional discourse around climate action and achieving 'true net zero' has shifted towards ideas of regeneration – whose definition may be linked with learning from and integrating with nature, and 'zero carbon' or 'carbon negative development'. This presents a new approach to creating buildings that are more deeply connected to their site's ecologies and broader interconnected environmental systems, and that have positive impacts on their surrounding environment. Again, these terms are susceptible to mis-use and greenwashing, and in Europe new legislation was enacted in 2024 to address "all sustainability claims that relate to a product, a brand, a company or a service in a business to consumer context"[118]. This has been done in an attempt to combat greenwashing and bluewashing through broad 'environmental

claims', and to prevent misleading advertising. There is growing recognition that current consumer behaviour, manufacturing and production, and most aspects of wealthy western societies are carbon-intensive and therefore have significant adverse impacts on people and the planet. Although this legislation has not yet been introduced in Australia, architects should be aware of the necessary changes in the way that our services are conducted and described.

In the case of this research, resilience was explored as a project 'action' which allowed the architects to creatively respond to urban challenges and disrupt existing conventions in how buildings are made, who for and for how long. By examining four exemplary international projects through the lens of resilience, a spectrum of actions was uncovered. This informs how architects can explore innovative approaches to the challenges of rapidly growing cities, increasing populations and a breakdown in stable climatic conditions. These actions included the ability to make and adapt your own structure, temporarily occupy land and relocate, provide shelter and protection alongside public amenity and recreation, and the ability to inspire and regenerate. The projects provide creative, flexible and replicable examples of how architects can engage with complex issues through built form.

Resilient strategies

The case studies demonstrate both adaptive and defensive resilience strategies. The smaller scale actions of the Water Branch House and Yard House utilise adaptive tactics – being propositional, speculative and challenging typical construction methods and lifespans for their building types. They provide alternative modes of occupation and dwelling, allowing their users to construct part or all of the structure themselves and relocate when circumstances change. As outlined in 'Extreme Cities; The Peril and Promise of Urban Life in the Age of Climate Change', Ashley Dawson argues the ability to relocate may become a critical option when waterfront cities become less habitable[119]. In contrast, The Dryline and The Global Seed Vault are defensive in their approach and have become international icons. The first provides physical safe-guarding of Manhattan's $500 billion business district[120] as an ambitious city wall and flood gate, and the second protects the world's priceless agricultural crop history in an extensive underground bunker. These strategies represent both risks and opportunities, with differences in accessibility, scalability, time to construct and funding opportunity.

Public imagination and climate action

Beyond their creative potential or physical defences, the case studies demonstrate the importance of creating a stronger public narrative for climate action, and how public sentiment can be shaped by architecture. The Dryline, intentionally comparing itself to the award-winning Highline (New York's second most visited cultural venue[121]), is outwardly optimistic in its presentation of new public facilities, parks and cultural centres which form part of the urban flood resistant infrastructure. It creates possibility for increased use and access to the waterfront, proving new space for activities and recreation along the waterfront's perimeter. This follows the proposition of BIG's founder Bjarke Ingels – "What if the resilient city is better and more enjoyable"? Although it's important to present optimism and hopeful solutions in climate-focused projects, there is a need for balance between gaining public support and funding, and recognising the potentially difficult and destructive future conditions we need to plan for.

On the global scale, the Global Seed Vault has become a defining image of the Arctic and a symbol of global cooperation. It gained notoriety as the 'doomsday vault', but is also a symbol of successful international cooperation, collaboration and hope. Its defensive subterranean structure is counterbalanced by the ephemeral artwork at the entrance, giving the vault iconic tourism appeal, and elevating the message of The Global Crop Trust. The building already functions as an active and important international facility in the present day, catering for impacts of recent extreme events and conflicts, as well as providing secure backup and storage for the world's non-genetically modified seed crops. It has already actively demonstrated the power of such projects both in their provision of critical social infrastructure, as well as strong storytelling potential.

Resilience and risk

The major challenge in the delivery and operation of both larger case studies has been mitigating risk. Due to their size, cost and the time and resources required for construction, they are more susceptible to failure; due to social disruption, lack of continued funding, changes to building management or political climates, or the demands of ongoing maintenance. Both projects, intended to safeguard multiple generations of people, have already faced challenges within their first 10 years. In 2017 the Global Seed Vault's tunnel was breached by water ingress and required full replacement, in an event that signified accelerated and unprecedented warming in the Arctic, due to melting permafrost around the entrance. The Dryline has only secured funding for and completed Stage 1 (the East River portion), and its future completion may be pending changes in US politics, climate policy and disaster relief funding.

In contrast, the Water Branch House and Yard House enable fast, flexible and comparatively low risk actions to be carried out by individuals or small groups, who are able to occupy them and experiment freely. If replicated at scale the projects could achieve a wider reach, and greater economy in their production, presenting solutions for emergency housing, affordable housing, and adaptable work spaces that can support local businesses, creative industries and small manufacturers who are increasingly pushed out of the city. Despite their small size, both projects have had a significant influence on the design industry through their promotion in exhibitions spaces such as MoMA, online design and social media platforms such as Dezeen and Instagram, which have given them a global presence and notoriety.

Changing procurement

In terms of project costs and procurement, generally the larger the project the more costly. At the time of researching, the question of building life cycle analysis and whole life carbon assessments were not considered. These analyses are now essential, given the conflicting requirements of equipping cities for climate mitigation and adaptation, and decarbonising

buildings. Notably, although the intergenerational and global significance of The Global Seed Vault is priceless, the actual project cost are far less than a typical 'climate mega structure', like the operable sea walls and urban landscape interventions of The Dryline. For less than 2% of the cost, the Vault provides a critical global facility. It demonstrates that, aside from being visionary, cross disciplinary cooperation and collaboration can allow climate risks to be addressed with more feasible budgets. This project demonstrates that critical and globally resilient infrastructure could be delivered with less cost and risk than city-scale projects such as The Dryline, which may be ineffective if the 'Big-U' around Manhattan is not completed before the next major storm event.

At the smaller scale, the Water Branch House and Yard House offer models for mass production or open source design sharing, as well as alternative methods of funding. Both provide the ability for the architects to profit from the project through independent development and sales. Both relied on the architects undertaking key aspects of production, prototyping and construction themselves, and although the end results were different (Water Branch remains speculative, whereas Yard House enabled the architects to generate revenue through rent and a subsequent building sale), they demonstrate the capacity for architects to generate their own work with specific agendas and project actions. These can be supported and amplified through exhibitions, alternative funding methods, and collaboration with other architects or universities to deliver the projects. Although the precedent for architects undertaking unsolicited projects is well set, these are still counter to typical economic models of architecture within the global capitalist focus on investment, returns and growth. Instead, the architects seek alternatives and in doing so challenge not only the procurement and construction process, but the way in which spaces are occupied, the lifespan of the buildings and the notion that buildings must be permanent to be valuable. Additional layers of sustainability and material innovation have made them unique and successful, and provide a balance between functional and aesthetic design, allowing them to become well known and influential within the design industry.

Responsibility and feasibility

In discussing these projects with the architects, collaborators and partners, it was evident that the responsibility for architects and designers to address the climate and biodiversity crises in their work is well recognised but not widely practiced. The interviewees supported the claim that climate breakdown should be the most important issue in our industry today, and that we all have a responsibility to act now. But they also recognized the difficulty for individual architects or projects to have an impact, whether working at small or large scales. The economic and client-driven nature of projects limits the architect's ability to act, unless there is scope to give funding and facilitate more experimental or 'risk prone' projects. The case studies highlight a number of issues around procurement, funding and planning which need to change to enable faster and more effective action across project scales. Aside from the complex economic, social, environmental or political pressures for any project, architects are also hindered by the length and processes of planning and building approvals, regulatory restrictions and in Australia, the discouragement or inability for architects to build their own work. This makes projects such as The Water Branch House or Yard House difficult to achieve in certain contexts, without architects having to rely on the support of external partners, contractors and consultants.

The smaller projects were delivered through self-funding or alternative funding sources, in part with a reliance on unpaid or 'volunteer' work. This included collaboration with universities, students or local networks to undertake the necessary research, prototyping, development and construction. This makes the scope for other architects to replicate these models difficult in some cases, and raises questions around how land should be used, and who can facilitate these types of projects. This is critical to facilitate less harmful, alternative construction processes (including developing practices in material re-use, bio-materials, design for deconstruction and circularity), to all rapid decarbonisation in the industry. Considering the resilient strategy plans for Melbourne and Sydney and the issues they address, these questions must be further explored. Architects can play a critical role in advocating for planning and policy changes, educating the public and clients, and preparing for climate adaptation. Architects can encourage less harmful choices, facilitate discussions and actively pursue project outcomes which promote positive change.

Action and hope

Each of the case studies successfully captured the public imagination, with promotion through exhibitions, news media, design publications and awards. Whether or not they intended to promote climate resilience, these projects demonstrate ways in which architects might rethink their design agendas, and the power that architectural narratives hold with the public. They reveal there are a wide variety of ways architects can incorporate climate resiliency into their work, and what links them are a series of common themes which allow an understanding of the power of 'creative' resilience. There's a need to balance risk with reach, for visionary leaders, and to question current planning and building regulations, and their suitability in light of the scale and speed of action needed to address climate breakdown. All of the interviewees agreed that climate change was a major issue that architects and designers must face, but felt that (in 2018), it had not yet reached a critical level of importance in the industry. In the years following, various professional climate action groups have emerged, including Architects Declare (2019) and ACAN (Architects Climate Action Network, 2019). These have helped to galvanise voices within the industry to promote accelerated decarbonization, the responsible use of materials, a removal of fossil fuel energy and appliances, and campaigs for planning and policy change.

However, meaningful change within the mainstream building industry has not yet occurred, and many practices may rely on future regulatory change, which will come too late. Given that we are likely to officially breach the 1.5°C temperature threshold before 2030[122], **the time for meaningful climate action within profession is now.**

6

Conclusion

The production of architecture is bound to local and international economies and the capitalist drives of growth and urbanization. It is a major contributor to global greenhouse gas emissions, resource consumption and waste, but in many ways is unable to act or change under existing systems of planning, legislation and procurement.

As the case study discussions show, more drastic changes are needed to face the climate and biodiversity crises. We need to address both climate mitigation and adaptation, with a more comprehensive exploration of future risks, and the conflicting obligations of providing shelter, social infrastructure and housing, while rapidly decarbonizing to reduce industry emissions. Change cannot be incremental, but must be transformational, and occur across all scales of practice.

The case studies present a set of actions which present a small snapshot of resilient projects can challenge and transform current practices, and the delivery and occupation of buildings. At the small scale, people will need to adapt to different living conditions and could upskill to self-build. At the medium scale, we may consider portability and relocation as serious alternatives to long term city dwelling in high risk waterfront areas. At the large scale, architects must become aware of the political and economic systems they are protecting, and question whether their spatial intelligence and ability to capture the public imagination - their storytelling potential - could be used to drive different types of projects and outcomes. And at the extra-large megacity or global scale, that cooperation and collaboration between governments, organisations and industries will be essential to achieve change at a meaningful scale.

As the UN climate panel has stressed, “limiting global warming will require ‘far-reaching and unprecedented changes’ to human behaviour”[123] – and architecture can play a critical role in its production, use and legacy.

This project contributes to a growing body of research about architecture’s relationship to climate. It presents opportunities for new approaches which demonstrate architecture’s potential to provide effective climate responses at a range of scales. With Australia being highly vulnerable to climate impacts and the concentration of our population in cities, understanding the possibilities for resilient architecture is essential for the future of the profession and the public good. The case studies show that actions can be taken at any scale, and that smaller projects or budgets do not necessarily limit a project’s significance or potential for influence.

Climate breakdown and biodiversity loss are defining issues in contemporary city-making and will put increased pressure on cities. They demand greater flexibility, deeper adaptation and faster rates of innovation, which is a call to action for us all. For these reasons, improving our understanding of resilient (and now, regenerative) architectural approaches is critical.

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Acknowledgements

I would like to thank the NSW Architects Registration Board for the opportunity to undertake this scholarship. In particular I would like to thank Prof. Dagmar Reinhardt, Prof. Lynne and Prof. Michael Humphrey for their recommendations to the Board and for their assistance in guiding the content of the research topic.

I would also like thank the architects and representatives who provided interviews and information for the projects forming the case studies; Mathew Leung of Assemble, Tomoko Sasaki of Tenhachi Architect (former Associate at Kengo Kuma Architects), BIG Architects, Dyveke Sans, and Cierra Martin of The Global Crop Trust.

Finally, I would like to thank the steering group members of Australian Architects Declare, and members of ACAN Australia, who have provided support and created safe spaces for discussion and knowledge sharing, to enable the development of this research.

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About the author Lucy Humphrey

Experience

As an architect with 15 years' industry experience since graduation from the University of Sydney, Lucy Humphrey worked with award-winning PTW Architects and Collins & Turner Architects before starting her own small practice in 2010. Lucy Humphrey Studio has undertaken a diverse range of projects including private residential commissions, site specific public installations, and commercial, hospitality and small public projects. Alongside her practice, she teaches as a Casual Academic at the University of Sydney and University of Technology.

In 2011 she co-founded the non-profit design organisation Archrival with architect Claire McCaughan, which focuses on architectural agency and explores collaboration through experimental public work and interdisciplinary design teams. The relationship between architecture, built environments and climate change has been a developing research interest, which culminated in participation in the Arctic Circle Residency in 2017. This intensive design and research residency enabled Lucy to pursue interests in the potential for strategic, site-specific design responses to the climate and biodiversity emergency, the potential to combine architectural practice with climate advocacy, and ongoing research into materials, climate adaptation and decarbonisation.

Climate Advocacy

Since undertaking the Byera Hadley Travelling Scholarship, Lucy Humphrey has gone on to develop her professional knowledge of the relationship between architecture and climate, and new skills and training in environmental, climate-focused design. In 2023, Lucy became a certified Passive House Designer, with training to enable the creation of certified low energy passive homes. In 2023 joined the Steering Committee of Australian Architects Declare as active contributor, and launched their monthly talk series 'Transitions', which explores topics around decarbonising and transitioning practice to a post-carbon world. She also became a founding member of ACAN Australia in 2023, as an interdisciplinary network of individuals working in the built environment who are working towards industry change. Also teaching

She is currently undertaking Regenerative Design Practitioner coursework with Regenesis Institute (2024) and will undertake the course 'Leading Through Collapse' with Jem Bendell and Katie Carr (2025). She is part of the core working group to deliver the Climate Forum 2024, working with Architecture Climate Futures, Parlour, Architects Declare and ACAN, to present discussions around climate action in Australia and encourage wider industry education and collaboration.

Lucy is committed to ongoing professional climate advocacy, and to dedicating her career to pursuing practice transformation and deep adaptation, in the face of the climate and biodiversity crises.

Biography

Having trained as an architect at the University of Sydney, Lucy Humphrey is an award winning emerging architect, director of Lucy Humphrey Studio and co-director of Archrival. In 2024 she split her art and design practice with the launch of Studio Ecology, which focuses on decarbonisation and climate neutral architecture, alongside professional advocacy and unsolocited projects exploring climate action and equity in the buitl environment.

Her work in architecture and design is focused on a responsible use of materials, site-specific responses and the intersection between architecture and environments. She increasingly explores the relationships between architecture and climate, regenerative design, and a deeper understandings of the broader ecologies and systems that connect with every project. Founded in 2009, her studios work across a diverse range of projects spanning residential, commercial and small public buildings to public art.

Humphrey has exhibited locally and internationally, including the 2nd Biennale of the Canary Islands (2009), Sculpture by the Sea (2009, 2013, 2015, 2017, 2019 & 2021), the Venice International Biennale of Architecture (2008 & 2012), Sydney Fringe (2011), Sydney Festival (2012), Sydney Art Month (2013), Art & About (2013) and Sculpture at Barangaroo (2016). Alongside her creative projects Humphrey teaches as a casual academic and has contributed articles for ArchitectureAU, Architectural Review Asia Pacific (AR) and Architecture Australia (AA).

Humphrey has been recognised with multiple awards including Sculpture by the Sea's Art Gallery of NSW Site Specific Prize (2009), Sculpture by the Sea People's Choice Prize and Kid's Prize (2013 & 2017), and Sculpture by the Sea Aarhus invited international artist & People's Choice Prize winner (2015). She has won the prestigious University of Sydney's Young Alumni Award for Achievement (2012), the Helen Lempriere Scholarship (2013), and was selected for the NSW Justice Department Public Art Commission (2015). She was finalist for the Lost at E Minor Young Creative Australians Award (2016), the QANTAS Spirit of Youth Awards (2016), and the NSW Emerging Creative Talent Award (2016). In 2017 she won the Byera Hadley Travelling Scholarship and was selected for the Arctic Circle Residency in Svalbard, Norway. In 2018 she was awarded the Perspective 40 Under 40 Award in the Architecture Category.

Her art and design practice is complemented by Archrival's non-traditional and experimental architecture portfolio. Archrival has been awarded the Sydney Fringe Award for Excellence (2011), NSW Planning Achievement Award (2013), IDEA Award (2014) and finalist in the Australian Urban Design Awards (2016). In 2012 they were selected for the Australian Pavilion exhibition 'Formations: New Practices in Australian Architecture' at the Venice International Biennale of Architecture.

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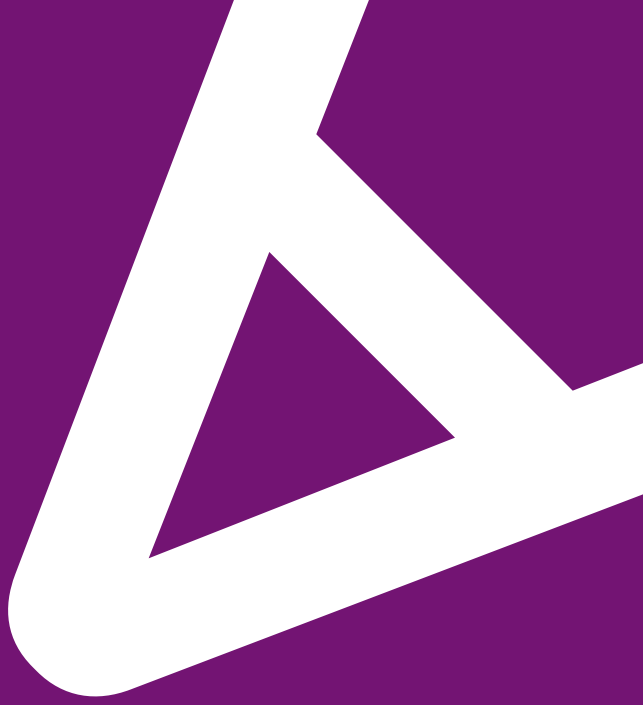

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A publication of the NSW Architects Registration Board 2015
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