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Editorial

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Lionel Real de Azua (ARB Red Deer)

The number of natural disasters taking place across the globe has seen a recent increase of over 400% in the last year alone. There were 240 weather-related disasters in 2006, compared with 60 in 1980.

In the UK – 5 million people are at risk from flooding. In the USA, 80% of American homes at risk for floods are NOT covered by flood insurance.

As the NYC hurricane, the Cumbrian floods in the UK and the recent Oklahoma tornado has highlighted, urgent action is needed to either adapt existing homes or propose new design resilient homes for the five million Brits and four million Americans currently living with severe storm & flood risk.

However, the widespread complacency and slowness to act on the part of all the major players – government, infrastructure companies, utilities, builders, insurers, even householders – is creating a deadly time bomb if dynamic action isn’t urgently taken.

The Designing for disasters: flood resilient design collaboration took place in October 2013 in NYC, USA, during the week preceding the hurricane Sandy anniversary. Collaborating students from Oxford Brookes MArchD in Applied Design in Architecture program & NYIT’s BArch program, were given only four days to develop flood resilient structures for Brooklyn Naval Yard. The designs ranged from industrial pragmatism to playful kinaesthetic spectacle. Whilst the threat of flooding is a serious one, the ability to turning a threat into an asset is a highly sophisticated and resourceful response; arguably an essential competency for any architect aiming to succeed tomorrow’s construction market.

As educators, we believe that schools should ensure students are given the opportunity to address pressing social, civic and environmental issues during their academic careers. It is our conviction that, given the predicted growth of urban flooding, architects with expertise in designing for disaster resilience will be best placed to lead some of the most important strategic planning and implementation projects of the next 10-20 years. Designing international collaborations that give students the opportunity to directly respond to this challenge is therefore essential in enabling the next generation of architects to make a significant contribution to the flooding resilience solutions of tomorrow.
Developing The Floodprobe Tool

FLOOD DAMAGE ESTIMATION OF INDIVIDUAL NON-DOMESTIC BUILDINGS ACCORDING TO THEIR CONSTRUCTION

Dr. Nicholas Walliman
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Flood damage estimation
Flooding can have far reaching consequences, not only economic but also social and health related. As the range of damages is so large and many aspects will be very difficult to estimate, it is necessary to be selective in any method devised to estimate flood damage to buildings and limit the factors to those that can be realistically calculated.

The direct costs are directly related to the physical fabric of the buildings, the structure, construction and materials employed. These are relatively easy to survey and record accurately at various levels of detail by building specialists such as architects and surveyors. The contents of the building and their value and vulnerability to flood damage are more likely to be known by the building occupant, so are not considered here. Similarly, indirect costs of flooding can also best be estimated by the occupants according to the nature of their business and the effect of the flood on the services they provide.

Flood damage to buildings is dependent on several variables in relation to the flood events. The most commonly used is over-floor depth; with velocity, rate of rise, debris, contaminants, frequency of inundation and duration of inundation being also significant, but often ignored [1].

Variables relating to the building characteristics are the structural system, the materials of which the building is constructed, the drying characteristics of the materials, the types of construction used and the condition of the building prior to being flooded [2]. To this can be added the planning of the spaces within the building (basements, level of ground floor above ground etc.) and the services and their positions within the building (air conditioning equipment, circuit boards, boilers etc.).

On account of the variety of variables, a tool that can predict the extent of flood damage to a particular building could become very complex and difficult to manage, though oversimplification of the variables is likely to lead to inaccurate estimations. A balance must therefore be drawn between excessive complexity and accuracy in order that the tool will be both user friendly and sufficiently reliable to provide useful outputs.
**State of the art of flood damage estimation methods relevant to buildings**

Much research has already been carried out on flood damage prediction methods for residential buildings, with less research on non-domestic buildings. A review of these methods was carried out in order to avoid repeating research and for building on the state of the art in this subject. The most relevant methods to this project are described briefly below, and their possible usefulness for individual non-domestic building flood damage estimation is assessed.

ANUFLOOD methodology - Commercial properties classified by size and value class that reflects the vulnerability to flood damage of the business's contents [1].

HAZUS-MH Flood Model - damage curves for estimating damage to various types of buildings and infrastructure [3]. Expressed as a percentage of replacement cost, at block or individual building scale.


Damage and loss prediction based on and engineering evaluation system of building construction types - Schwarz and Maiwald [5, 6]. Classification of building construction types into vulnerability classes.

The above methods concentrate on building types that are too general with insufficient detail to make reasonably reliable cost calculations for individual buildings according to construction. The very different structures and constructions and building materials in non-domestic buildings, requires a detailed elemental approach.

**Discussion and development of individual building damage prediction tool**

Unlike domestic buildings, non-domestic buildings often feature several different types of construction within the same premises. This makes categorisation of buildings simply according to construction types insufficient. The approach to estimate damage was therefore done at an elemental level – e.g. wall, floor, ceiling, services etc., rather than a whole building level. This would gave a ‘menu’ that could be used to select the particular construction types used for the various elements of an individual building, and the particular building materials used, thus leading to far greater accuracy in the estimates of damage and consequent costs for repair or replacement.

A simple diagram of the principles of such a tool is presented in Figure 1.

![Diagram](Fig. 1)
The basic data required to be input into the tool by the user are:

- The flood characteristics of the event that is predicted
- Floodwater depth
- Velocity and debris
- Contaminant content
- Flood duration
- Identification of the main structural system
- The building divided by elements (external walls, floors, internal partitions, windows and doors, electrics, mechanical services, communications etc.). Each element is analysed according to the materials used and the layering of them. To simplify the range of options, a list of typical constructions has been devised from which a choice can be made.
  - Dimensions of walls, floors etc. and numbers of doors and windows that are affected by the selected flooding event.
  - Types of services, their positions and layout and the extent of these that are affected by the selected flooding event

The basic data that are contained in the tool are:

- A database of common elements of different constructions and materials
- A database of effects of flood damage to each construction and the % newbuild cost incurred by clearing up costs, repair/replacement of the affected area of the construction, assuming clean water
- An additional cost to add for mechanically assisted drying
- An additional percentage calculated to add for pollution of different types, i.e. hazardous and non-hazardous)
- An additional percentage calculated to account for the effects of high velocity and debris
- An additional percentage calculated to account for the duration of the flood
- A database of effects of flood damage to each of the different services installed according to their positions
- An adjustment factor calculated for regional differences (i.e. different countries).
- Costs expressed in Pounds or Euros.

**Tool calculations and output**

The tool calculates the actual cost of flood damage to individual building elements according to their construction and materials, the types of services and the nature of the flooding. The initial output, based on the database contained within the tool, predicts the cost of cleaning, repair or replacement and is expressed as a percentage of the new-build cost of each element. The percentage can be greater than 100%, reflecting the costs of demolition and disposal of materials, as well as cleaning costs prior to rebuilding. Additional percentages are added for pollution cleanup and sterilization and mechanically assisted drying. An adjustment for regional factors (country etc.) can then be made. An approximate indication of the actual cost of returning the building to use, depending on where it is and when the flooding occurs, can then be produced by the tool when it is combined with calculations using the areas, lengths or numbers of affected elements, the current or predicted rates of construction prices.
Relevance to Practice
The tool is aimed at building professionals with sufficient technical knowledge of the planning, construction and costing of buildings in question, such as architects, surveyors, facilities managers, quantity surveyors, and are comfortable with interpreting drawings and calculating areas of walls, floors etc. The output of the tool expresses the damage in cost form. This can then be used to compare the implications of different scales of flooding for different types of building construction, and to assess the value/cost of installing flood protection installations to the building and/or its surroundings to reduce the damage from future flooding. The tool can be used at the design stage or building use stage, and can facilitate planned upgrading as part of the maintenance and renewal cycle of the premises.

References


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Project 1 - The Dry Dock

Ashley Roberts, Charlotte Pollock, Jason Hall, Paul Scuderi

During Hurricane Sandy, the Brooklyn Naval Yard was affected by the flood water, but the repercussions could have been much worse. The many dry docks across the site were fortunately empty on the day of the hurricane, providing unintentional emergency reservoirs for the storm water - a welcome buffer between land and sea. This project proposes the creation of a large dry dock between piers J and K, with an adaptable barrier forming the boundary between river and dry-dock.

When the barrier is active during flood events it will block or control the flow of water into the emergency reservoir. When the barrier is inactive during normal river levels it will provide a year round public space for the nearby Williamsburg community. The barrier itself will fold out to create a floating platform and the empty reservoir will be used as an open air auditorium for outdoor performances.
1. Unrolled / Public Space - The barrier is unravelled and floats on the river, creating a public platform and allowing use of the auditorium space behind.

2. Curled / Water Blocking - The barrier completely blocks any water from penetrating into the dry-dock.

3. Lowered / Water Control - The barrier is curled and lowered below the level of the adjoining piers, therefore allowing the water to flow over it and into the emergency reservoir of the dry-dock, reminiscent of a waterfall.
Project 2 - The Mimo

Jason Miles Fowler, Chrysoula Fregala, Kathleen McBride, Steve Laris

The Mimo project acts as a prototype which revolves around human need in the event of disaster. Investigation was derived from reaction as a means of transporting and rehabilitating victims in an emergency mobilisation shelter, similar to that of football stadiums in hurricane Sandy.

The site acts as a stimulus for industrial methods, transportation of boats into the existing piers and a need to repurpose piers J & K leading to a set of design options based around the collapsible defences demonstrated in nature.
The site for this project is located at the far north end of Brooklyn naval yard on a brownfield site. A brownfield site is one that has had industrial use in the past leaving the soil highly contaminated, in this case high concentrations of heavy metals.
The proposal is for a willow tree pavilion, which will help to cleanse the site using various methods of phytoremediation, which is the process of using algae, plants and trees to suck up the heavy metals to stop the contaminants spreading when flooding occurs. The proposal will extract ground water through pipes, using convection current, where the water is purged of contaminants using a hybrid algae and electro-active polymer filtration facade. The clean water will go back in to the soil where the process can start all over again and over time cleanse the land completely. We have addressed the risk of damage from flooding by incorporating other flood defences such as breakaway walls and landscaping which will help with fluvial and pluvial flooding by absorbing water.
Project 4 - Co-Generation

Robert Tsang, Matthew Winning, Konstantinos Papaeliakonomou, Cali Conlin
The conditions of the Brooklyn Naval Yard have raised concerns over the past few decades since the discontinuation of its function as a Navy Yard. The majority of the site is prone to flooding, leaving many businesses which have set-up in the redundant buildings closing down; this has caused the site to be unpopulated and derelict.

Our main concern is to regenerate the Navy Yard by taking into account the local social, economic and environmental design. Our brief is to focus on the local cottage/small scale industries/businesses of the surrounding areas, to make sure that during incidence of floods and rising sea levels, businesses can still operate as normal. Raising with the flood water level or to a controlled level of safety the design will be resilient rather than a defensive proposal.

The form of the structure will be a modular network of workshop units which can be controlled by hydraulics, powered by waste steam from the Co-Generation power station located at the Navy Yard on Sands Street. When the modules are raised a water tank will be exposed to act as a flood water storage resilience device, minimizing the percentage of flood water entering the site. In days of ‘good’ conditions, the units can still be raised to create a space within this tank to allow public activities to be staged.

A network of these modular workshops will be implemented in phases as a reaction to increasing sea and flood levels and the need to maintain operational business even when severe weather has pasted but high water levels remain. They will be connected by public high-level walkways to make a network of streets which solve the 3 issues of React, Raise and Resilience.
Project 5 - 3D Printed 1st Aid

Jack Arnold, Christelle Tippett, Ryan McGrath

With climate change expressing its presence on earth dramatically in more recent years, should we as architects be adapting and transforming to this change? Should we purely be focusing on designing resilient buildings or transposing our design skills to producing a piece of architecture that will assist as a form of aid and relief for the people.
Our chosen site of the Brooklyn Navy Yard is a modern industrial estate which holds a collection of design disciplines; creating an unique community. Our chosen location and building within the site is the proposed new 3D printing factory (building 128) which will house a collaboration of 3D printing practices. We want the embedded element of 3D printing to be a key aspect; underpinning our design.

The site sits within an area which got heavily flooded during Hurricane Sandy, and with our proposed building being submerged under 6 foot of water we approached our design not as a form of building resilience but actually building and designing a form of disaster relief for every individual affected.

Our disaster relief will be a survival pack for one person, containing a selection of items need during a flooding disaster. These beacon of light will be transported from the 3D printing building by boats to the areas and people affected by the disaster.
Project 6 - Rescue Toolkit

Iva Stanisheva, Rodha Antwi, Emmanouil Afendkas, Sean Dickens

The aim of the collaboration workshop was to pick a site within the Brooklyn Navy Yard and to come up with a design which tackles flood resilience. Based on the information received regarding the damages from Hurricane Sandy, we found that one of the main issue were electricity shortages. This meant that in terms of emergency care, hospitals were unable to function sufficiently. A major factor regarding this was that patients were unable to be transferred between floors or out of a building because elevators were unable to operate. Our scheme looks for an alternative solution to this problem where we create a design which is a standalone self-sufficient module. This lightweight module is designed so that it can be dropped off on any rooftop, open up to create an emergency space and allows an elevator to drop down the side of a building operating via water and solar panels. Moving forward this toolkit is transferable as it is designed to work in any emergency situation and to be easily used by the receiver.

![Diagram of the Rescue Toolkit](Diagram)
NYIT Perspective

Frank Mruk
Associate Dean and Professor
New York Institute of Technology

Hurricane Sandy hit the New York Metropolitan area on October 29th 2012. The track of the storm, the resultant storm surge and the devastation was unprecedented in the New York area. Due to climate change and the trend of warmer air being increasingly carried by the gulf stream, some predict that getting 1-2 feet of sea level rise within the next 100 years is highly likely, increasing the odds of similar weather events reoccurring on a regular basis.

In New York we have seen other major disruptions including the September 11th attacks and the financial system meltdown. Add to these the possibility of things we are seeing increasingly around the world such as tsunamis, earthquakes, wild fires, the Arab spring, political upheaval, wars, etc. and it is no surprise that designing resilient systems which enable high velocity reorganization and regrowth is on everyone’s radar these days.

Within 2 weeks of the storm hitting, a group of students approached me stating that “we need to find an effective way to help”. Soon afterwards they organized ORLI (Operation Resilient Long Island). They toured and met with residents and community organizations on some of the hardest hit sites in Long Beach, Far Rockaway and New Jersey. They met with emergency management officials and local building department officials to assess the situation and produced a brochure for residents describing the rebuilding issues they will face (costs/benefits, base flood elevations, FEMA compliancy issues etc.). They initiated a rebuilding design charrette in the NYIT housing design studio and organized a symposium where they brought together numerous groups from NY, NJ and Long Island including universities, government officials, and communities to discuss the different strategies implemented in each region. Results of all this activity include the launching of the Comprehensive Coastal Communities (3C) competition and the TEDxNYIT - Meta Resiliency (the resiliency of resiliency) event. Another result was the Designing for disasters: flood resilient design collaboration with students from Oxford Brookes University which took place at the time of the Hurricane Sandy 1 year anniversary.

I want to thank the students at Oxford Brookes and NYIT for stepping up to the plate, for rallying their fellow students, professors, and outside professionals. Your efforts have proven that resiliency is not only a local issue and that the ability to quickly crowd source creative ideas globally is extremely relevant in today’s fast moving world.

After observing the efforts of these students in real time, I must say, I have great optimism for the future.
ORLI (Operation Resilient Long Island)

Daniel Horn & Alex Alaimo
Co-Chair, Operation Resilient Long Island (ORLI)
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Super-storm Sandy was an unprecedented natural disaster that reshaped the coastal communities of the Northeastern United States forever. In the midst of all the destruction, the crisis also brought about positive opportunities to rebuild more resiliently for the future. Sandy literally hit home for the students of New York Institute of Technology on Long Island and Manhattan. Classes were cancelled for weeks and the entire tri-state area came to a standstill. On top of all the infrastructural damage, many residents and students lost portions of their homes. Some even lost everything.

A few weeks later, when things were starting to return to normal, we spoke with our associate dean Frank Mruk, and began to lay the groundwork to start a student-led group. Within a few days we organized ourselves and began to hold meetings. We adopted the name Operation Resilient Long Island (ORLI) with our mission being to help our coastal communities using the methods and means available.

We had a unique opportunity as architecture students to respond in a positive way. We started our group with no set agenda or funding – only eager students willing to donate time to help our towns in need. One of the areas we toured was the West End neighborhood, the most affected from the storm surge. Scott directed us down Pennsylvania Avenue, showing us the flood water levels on the small one-story homes. He explained that any new construction has to comply with FEMA, mandating that the homes on ground level be elevated up to 12 feet above the street. This was the real problem. Raising the elevations will put the character of this established neighborhood in jeopardy. Over 800 homes were estimated to be over 50% damaged and would have to be raised or rebuilt.

After much work in the following weeks, we organized the 3C: Comprehensive Coastal Communities competition to crowd-source the problem to provide solutions for local municipalities. The competition re-imagines design-build to design-impact. We catalogued all the finalists into the 3C Playbook. It is a framework to implement local zoning guidelines that address the effect of raising homes and the effect on the character of their respective communities.

The winners and honorable mentions of the 3C competition are outstanding examples of how communities can become resilient over time. The first place winner, “Adaptive Urban Habitats,” reimagines the community of Red Hook, Brooklyn as a standardized kit of parts produced by local manufacturing facilities that can be deployed to infill vertically above existing neighborhoods. This strategy increases buildable space and density, protecting future development from rising sea levels and flooding while also being contextually sensitive. The second place winner, “Flexing with the Tide,” implements pre-fabricated modules which provides a flexibility that allows for mechanical equipment to be placed above base flood elevations. It also gives residents the chance to transition to more resilient housing designs with minimal modifications to existing structures.
Afterword

Matt Gaskin
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The School of Architecture, Oxford Brookes University has a long history of working in the field of development and emergency practice and resilience. One of the very first in the world to recognise the importance of this field the School has been educating students from around the world and across disciplines for over twenty years. The work of Design Studio Two run by Harriet and Lionel captures and forwards this important legacy and is the focus of this publication. The work contained explores and expands upon the link between theory and application, academic and practice, which resound with the educational needs and currency of the contemporary student of architecture.

Architecture is by its nature a collaborative profession and the proactive exchange of ideas underpins the method applied in the main. The addition of an Anglo-American collaboration, between Oxford Brookes and the New York Institute of technology, adds a further cultural layer to both the teaching and delivery of the work. Together the staff and students have produced a body of work that is both high quality and eye opening.

Resilience is an area the School holds close to its heart, both in terms of design studio and applied research. This publication demonstrates the rigour of our staff and student approach and their commitment to embracing forward thinking and complex issues. The editorial exemplifies the leading work that the School promotes in this area and our ambition to encourage our students to engage in lives of meaning and impact on a global level.