

TIME BOMB: PLANNING FOR DISASTER IN CHRISTCHURCH

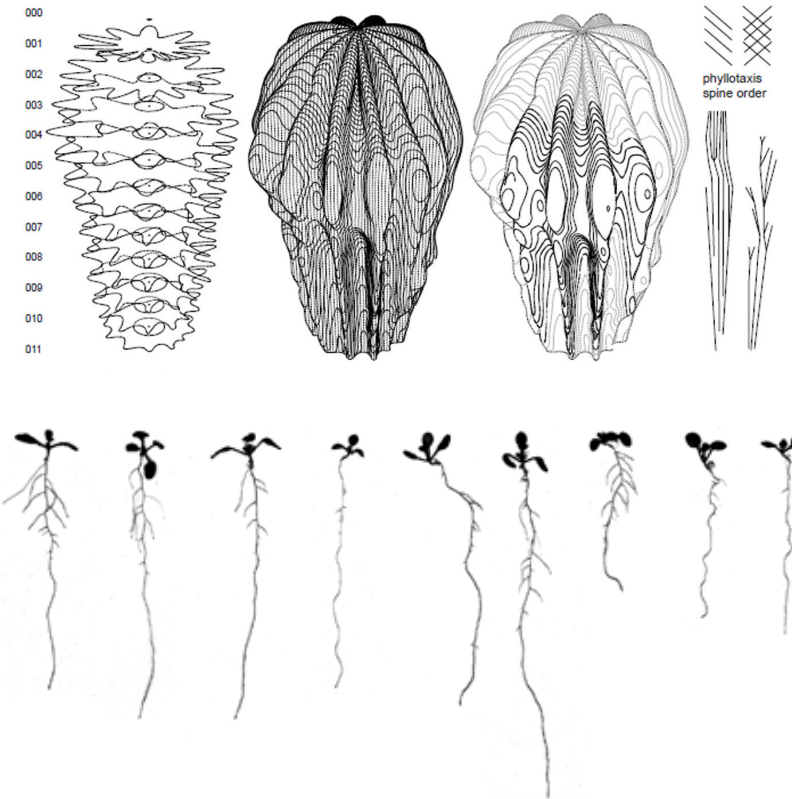
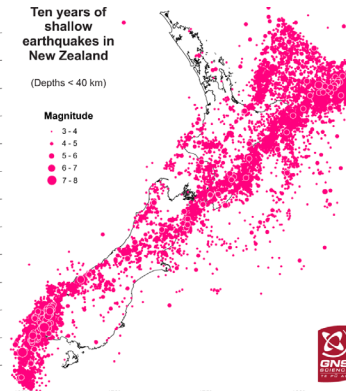
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THESIS

Architects and engineers are consistently developing new structural systems and methods for construction. Unfortunately, not all of these systems are optimal for regions prone to natural disasters, such as earthquakes. Systems exist in these areas to try and make use of past methods and apply them to new construction as a solution. The problem is that a system designed for use in California may not be ideal for construction in Japan. Some systems will fail and others will succeed. A common question is whether or not structures in high risk areas should be designed precisely for that area of construction. Specifically for earthquakes, greater tectonic consideration should be made in both the placement of foundations and how the structure meets it. Disaster prone regions have several solutions to minimize destruction. Pouring massive foundation walls, foundation isolation, and structural pendulums are only a few solutions to the issues caused by earthquakes. Most of these solutions act independently of the structure in the larger architectural design, but a perfect solution does not have to work that way. An area that would benefit from further research and development is the use of natural systems in architectural design. Natural systems have most frequently been applied for aesthetic or highly theoretical purposes, however natural structural systems are beginning to be understood and applied at a building scale. The focus of this thesis is the integration of existing earthquake design with a natural structural system being used to prevent widespread devastation in volatile tectonic locations.



SUBJECT

It is expected that restoration in Christchurch, New Zealand will take 50 to 100 years to fully recover from the 2011 earthquake. The 6.3 magnitude earthquake that struck the Canterbury region destroyed much of the city and the surrounding suburbs. The earthquake left 10,000 homes needing to be demolished and over 100,000 damaged. Post-earthquake Christchurch left 80% of the greater area without power or access to basic resources. Warnings went out to conserve water and use rainwater whenever possible. Many were left with no place to go and overcrowding of public buildings acting as shelter left much of the downtown congested. Fifteen thousand people have left the city with much of the emigration being caused by homelessness and a shattered economy. Even today, two years later, the population is still dropping.

The need for housing and utilities is the largest issue with the Christchurch recovery plan. Much of the population lives on the edge of the downtown area in single family dwellings. Each plot has its own structure and utilities. Shared structure and infrastructure could have been used to ease the issues resulting from the quake. The design of self-sufficient multifamily homes could be indispensable in a disaster situation. Sharing a natural structural system designed to take the force of an earthquake along with the opportunity to harvest the natural resources of the Christchurch area could be beneficial in maintaining the population during and after a disaster.

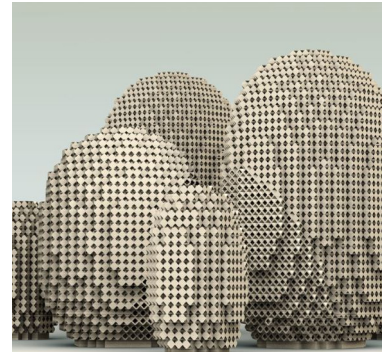
The development of the proposal addresses the issues of urban planning and sustainable design both within the realm of earthquake design. The programmatic development addresses issues that come about from planning for a disaster that may not occur for hundreds of years. This “what-if” scenario

is necessary when deciding on design necessities. Where the building is located, how it is accessible, and what it can provide all need to be addressed during design development. Sustainable design issues that arise are how to prevent utility shortage. Integrating methods of energy and water storage for future use are key in the event of a disaster when there is a shortage of both.



METHODS

The development of the thesis will be done through the investigation of natural systems for structural design, understanding how an earthquake occurs, considering the ways a building meets the ground, and what role a building takes over time. Computational tools will be used to understand the growth and patterning of systems in nature. Continued use will help develop the structural system in a way that large amounts of information can be processed and understood in context of one another. Understanding how an earthquake works will be done through site specific research in post disaster Christchurch. Understanding what caused the devastation and the ways the city was affected will help in the continued development of the structural system. The issues of building touching ground will be developed throughout the design phase through understand the role of the different parts of the building. The role of the skin versus the program versus the structure need to be fully understood to properly address the context of the building and ground in the design. Development of this will occur alongside site selection. The primary methods for the development of this project will be computational and fabrication tools to test and understand the choices being made. Extensive research will be done to understand the site and tectonics to properly apply the knowledge to the design.



PointCloud



Warped Cells



Subtract Cells



Remainder Cells



Subtract Holes

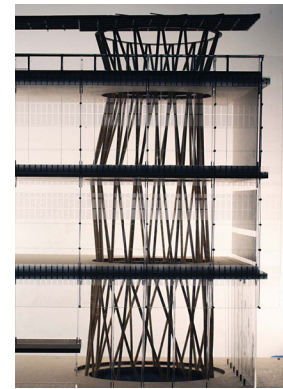
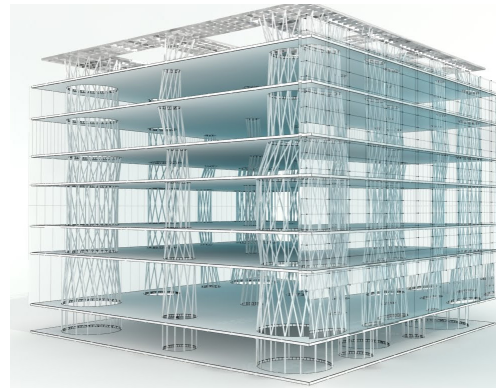


Unfolded Cells

PRECEDENT

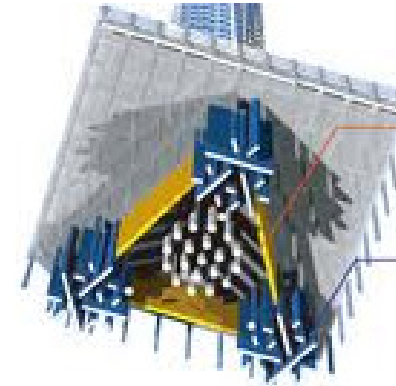
Sendai Mediatheque

Investigation will focus on the relationship of the structural system to the skin and floor plates of the building for the properties it used to survive the 2011 Japanese earthquake.



Tokyo Sky Tree by Nikken Sekkei

The sky tree foundation system was designed to take potential forces from multiple directions in the event of an earthquake with a series of columns and foundation walls to support the



Low Country Island Cabin by Woolen Studio

The cabin is researched to understand the process of design for multiple disasters. The cabin is designed to take hurricane winds, flood waters, and seismic activity. The cabin is also a strong precedent for building/ground relationship



SCHEDULE

SEMESTER 1

Focus: Computational Design

SEPTEMBER

Precedent Study
System Study
Christchurch Research

OCTOBER

System Design
Site Research
Christchurch Urban Study
Programmatic Development

NOVEMBER

Sustainable Design Research
Structural System Integration
Site Application
Housing Design Development
Phase 1 Production

DECEMBER

Present

SEMESTER 2

Focus: Sustainable Design

JANUARY

Site Evaluation
Structure Evaluation
Sustainable System Development

FEBRUARY

Systems Integration
Programmatic Development
Structural Design

MARCH

Continued Sustainable Design Development
Continued Program Design Development

APRIL

Production

MAY

Present