



Adapting to Climate Challenges in Architectural Education in Light of Feng-shui

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Abstract

This paper presents a synthesis approach to architectural education in adapting to climate with the emphasis of windstorms. Weather challenges have become a significant issue for our society in recent years. Thousands of people have lost their homes and lives. Even though natural hazards are beyond human control, occurring throughout history and continuing their appearance in the future, rapid developments throughout the world have broken the ecological balance and led to nature's revenge. To build a home on the beach, viewed as a luxury, not only jeopardizes the fragile coastal eco-systems, but also puts humans in danger during storms. Buildings designed without taking into account wind factors have been repeatedly destroyed during windstorms. These problems in practice reflect the weak points in education. The knowledge and training to deal with the climate and natural hazards are rarely found in the curriculums of architectural design.

Our ancestors adapted to climate and built their architecture to respond to nature for survival. Feng-shui, a Chinese practice used to harmonize people with their environment, advises people to avoid cold winds like you would thieves and to collect water like you would treasure. Vernacular houses in many cultures are the precedents of sustainable design. Western coastal fortresses were built on rocky terrains of a strategic defense point and often constructed with sunken courtyards. Protecting from windstorms and creating safe and comfortable living environments for their residents, these types of architecture provide clues for contemporary architects to explore new types of architecture survival in the areas with high risk of tornado, hurricanes or windstorms.

Learning from these case studies, a senior architectural studio taught by the author in the undergraduate Environmental Design Program at the University of Colorado Boulder has explored a synthesis approach to design with climate, particularly focusing on windstorms in Boulder, Colorado, which has some of the highest peak winds of any city in the United States. The students integrated scientific knowledge of natural hazards and wind patterns into their project, in various scales from the landscape analysis to the architectural design. With an integrated knowledge base, architects by the nature of their specialty are capable of creating solutions for new types of architecture that adapt to climate challenges. The requirements of sustainability have opened a new direction and opportunities for the future of architectural education and practice.

1. Introduction

Weather challenges have become a significant issue for our society in recent years. Thousands of people have lost their homes and lives. Hurricane Sandy 2012 in the United States killed 159 people and caused \$75 billion in damages; and Hurricane Katrina 2005 killed 1836 people and caused \$108 billion in damages [1]. Even though natural hazards are beyond human control, rapid development throughout the world has altered the ecological balance and led to nature's revenge. To build a home on the beach, a cultural luxury, not only jeopardizes the fragile coastal eco-systems [2], but also puts humans in danger during storms. Houses in coastal areas are built identical to inland homes and houses in high-risk regions for tornadoes are constructed similar to homes in low-risk cities. Buildings designed with disregard for wind factors have been repeatedly destroyed during windstorms. These problems in practice reflect the weak points in education. The knowledge and training to design for climate challenges and natural hazards are rarely found in the curriculums of architectural design. This paper presents a synthesis approach to architectural education in adapting to climate challenges with the emphasis of dealing with windstorms.



2. Vernacular Wisdoms and Precedents

The universe is moving in a circle. Good years and bad years come and go. Our ancestors experienced climate challenges. According to Chinese historical records of “后汉书,” in April of 119 AD, along the coast of the Bohai Sea (near Beijing,) windstorms dug more than thirty thousand trees from the ground [3]. Ancient Chinese people believed that such hazards occurred due to human misconduct, making Mother Nature angry. Honoring nature with care and respect, the ancient people adapted to climate challenges and built their architecture in response to nature for survival.

2.1 Feng-shui and Chinese Courtyards

Feng-shui, literally, “Wind” and “Water”, is the traditional Chinese practice used to harmonize people with their environment. According to *feng-shui*, people should avoid cold winds like they avoid a thief and collect water like a treasure. In the northern China, a favorable *feng-shui* site is in a mountainous area with potential for containment, enfolded by hills and protected from prevailing cold winds, open to the south, has a view to mountain peaks in the south, and has a meandering river passing through (Fig 1). Following this ideal *feng-shui* model, the traditional Beijing courtyard houses were designed to protect residents from windstorms and to accumulate *Qi*, the vital energy. Windows face the interior courtyard, while the exterior of the home has no window at all. The gate of the courtyard is set in the southeast corner to receive the living *Qi* from this direction [4].

The sunken courtyards of the cave dwellings in the Loess Plateau of the northern China provide storm protection. The layer of loess soil can reach 300 meters in thickness, offering a great opportunity for local people to dig out a courtyard with surrounding rooms. This is also an economical solution to building a home. This kind of dwelling meets requirements for ordinary quality of life. The sunken courtyards provide air and sunshine, and collect water that is then stored within the dwellings. They even provide space to feed animals and grow plants and fruit trees. The homes are accessible by road systems built to reach below ground level. This allows for transportation in and out of the village as well as provides access to the roofs of each home, which are yards for peasants to grind grains and winnow. Cave dwellings in China have a history for thousands of years; in 1980 about 100 million Chinese still lived in cave dwellings [5].



Fig 1. This ancient Chinese map shows an ideal *feng-shui* model for house site. (Tingyou Zou, *The Mountains and Water*, 1676, Chapter 3)



2.2 Tibetan Houses above 3000 Meters

Tibetan houses and villages are located 3,000 meters above sea level. The air is thin and the weather is unpredictable with frequent snowstorms. With dry weather and little rain runoff, the roofs are flat. The outside walls are thick and tapered up, giving the building a trapezoidal form that is more stable during snowstorms. To keep warm in winter and avoid harmful radiation from the sun, the windows are small and the interior is very dark. Corresponding to the building's form, the windows also take on the trapezoidal shape, an important element of Tibetan buildings. The windows in Tibetan houses are often designed with small openings angled down; this allows light to enter the space while maintaining interior warmth. To suppress evil factors, branches decorated with prayer flags are placed at the corners of the roof. Tibetans believe the color white can drive evil away. White also repels heat and strong radiation from the sun, while maintaining structural stability. These characteristics of vernacular houses are the result of adapting to the harsh climate and serve to sustain Tibetan architecture in the Qingzang Plateau [6].

2.3 Western Coastal Fortresses

Similarly, western architecture, particularly fortresses along the coast provide excellent examples of architecture not only for defense purposes, but also for protection from hurricanes and windstorms. Most fortresses are built on carefully selected sites, primarily chosen for its strategic defense points, and for its rocky terrain that doesn't wash away like a sand beach. Fortresses were often designed with sunken courtyards, allowing the military to lead normal lives. The existing fortresses in Europe and the U.S. have retained their shape for hundreds of years, which is a testimony to their strength after many hurricanes and windstorms. Setting back from the coastline is also important. As one of the country's first settlements (1620), Plymouth, Massachusetts is well known in the U. S. for its historical role [7]. When the pioneers from Britain landed on the coast, they built their residences and graves up on the hills, never directly along the attractive beach, considering their survival as the priority, a much wiser mentality than some contemporary views.

3. Practice in Design Studio Education

3.1 Case Studies

To challenge the problems in architectural education, a senior architecture studio taught by the author in the undergraduate Environmental Design Program at the University of Colorado at Boulder has explored design with adaptation to climate challenges. Design projects, including Community Cultural Center and Hostel, focused on the issues of windstorms in Boulder, which has some of the highest peak winds of any city in the United States [8]. Providing insight and clues, the case studies included the method of Chinese *feng-shui*, the design practice and setting of vernacular dwellings such as the Beijing courtyard houses, the loess cave dwellings, Tibetan villages, prehistoric American dwellings (Anasazi) in the US Southwest, and European fortresses.

3.2 Suitability Analysis

A suitability analysis of landscape planning was an emphasized component of this architecture studio. After investigation of the local site, students collaborated in teams to produce a suitability analysis. This study attempted to minimize the ecological impacts on water quality, wetlands, wildlife habitats, erosion, vegetation and to avoid setting on the wind risk areas such as northwest-facing slopes, crest of hills and wind tunnels; and sought to maximize the well being of site users by selecting south-facing slopes with good views, which also protects people from cold winds in winter and provides breezes in summer. The process of suitability analysis combined insights from both modern methods and the ancient principles of *feng-shui*.

3.3 Study Climate: Wind

Departing from the conventional architectural studio education that emphasizes the appealing forms and isolates architecture from other sciences, this studio studied the knowledge of climate particularly the wind patterns, wind blocks and wind tunnels, in order to create architectural spaces that avoid the risk during



windstorms and provide more breezes during summer. This study arranged in various scales from site selection to design issues.

3.4 Synthesis Design

The essential task of this studio is spatial design. Students integrated the knowledge and analyses of site selection, wind patterns and geographic conditions into their architectural and landscape design. Taking into account these comprehensive requirements positively, students created functional spaces with fresh and meaningful appearances. For example, student Christopher Mulford's hostel project fit well into the natural terrain and blurred the boundaries between landscape and architecture. The hostel was created as a unique place that allows visitors to follow trails leading onto the grass roof with the views of the Flatiron Mountains. The rolling form presents a potential design approach to protecting structures and people from windstorms (Fig 2).

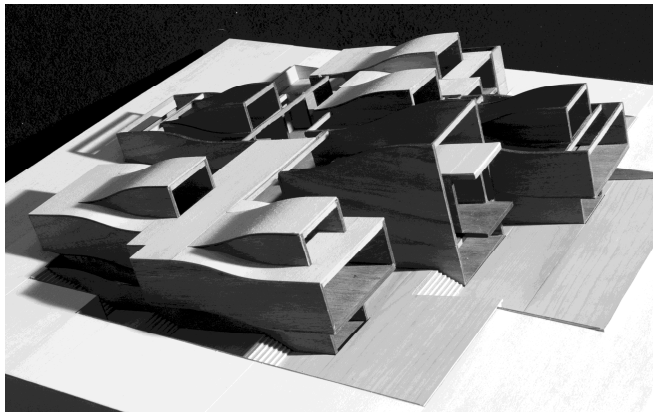


Fig 2. "Rolling Hostel" designed by student Christopher Mulford (Fall 2011).

4. Conclusion

The natural disasters of the 21st Century have forced an understanding that nature holds greater power than humans. The problems created by rapid developments and the mentality to conquer nature, has led to the study of natural consequences. Re-thinking the past is not to return back, but to create a better future.

4.1 Suggestions

Our education is now at a turning point. We are discovering the problems we have created. We need to further research why the problems occur and what will be the solutions. In architectural education, a curriculum that acknowledges adaptation to climate challenges is imperative to a synthesis approach to environment design. Practicing in architecture studio for a decade, the author suggests the following approach:

- First, we should have large-scale research on the local climate patterns and hazards, particularly in the site selection. Building on ecologically vulnerable areas, such as along coast or mountain peaks can have negative impacts on the environment and risk human lives.
- Secondly, we should research global precedents and ancient wisdoms in adaptation to climate, and include these contents in the curriculum of architectural design.
- Third, we should integrate the relevant knowledge of science and engineering solutions on the climate and natural hazards into the curriculum of architectural education. There is also need to develop the hazard code. Without taking into account climate challenges, thousands of people have been killed in houses that should have protected them.
- Fourth, we should synthesize the comprehensive knowledge of climate, engineering, and landscape analysis into architectural spatial design. With an integrated knowledge base, architects by the nature of their specialty are capable of creating solutions for new types of architecture that adapt to climate



challenges.

4.2 Synthesis Approach to the Future of Education

When it comes to dealing with nature, humans have behaved with two attitudes, defensive and offensive. Ancient people feared and respected nature's power, developed belief systems and religions in accordance with it, and also exploited nature with available techniques. With thousands of years of experience, ancient people observed nature's revenge on human exploitation. To sustain their civilizations, ancient people developed sustainable models, such as Chinese *feng-shui*, synthesizing their social and cultural values, rules of nature, and human development patterns, and applied these models to their vernacular houses. However, contemporary ideals have tended to divide the fields of education and practice into increasingly more "silo" specializations, in the pursuit of understanding. Isolating fields from their relevant elements and the environment of the systems, the "silo" approach, in turn, has created problems. In the 21st Century more and more scholars and professionals have endeavored to explore the interdisciplinary approach, putting things back together in order to gain better solutions. Applying an integrative and synthesis approach will be the direction of the future education and practice (Fig 3).

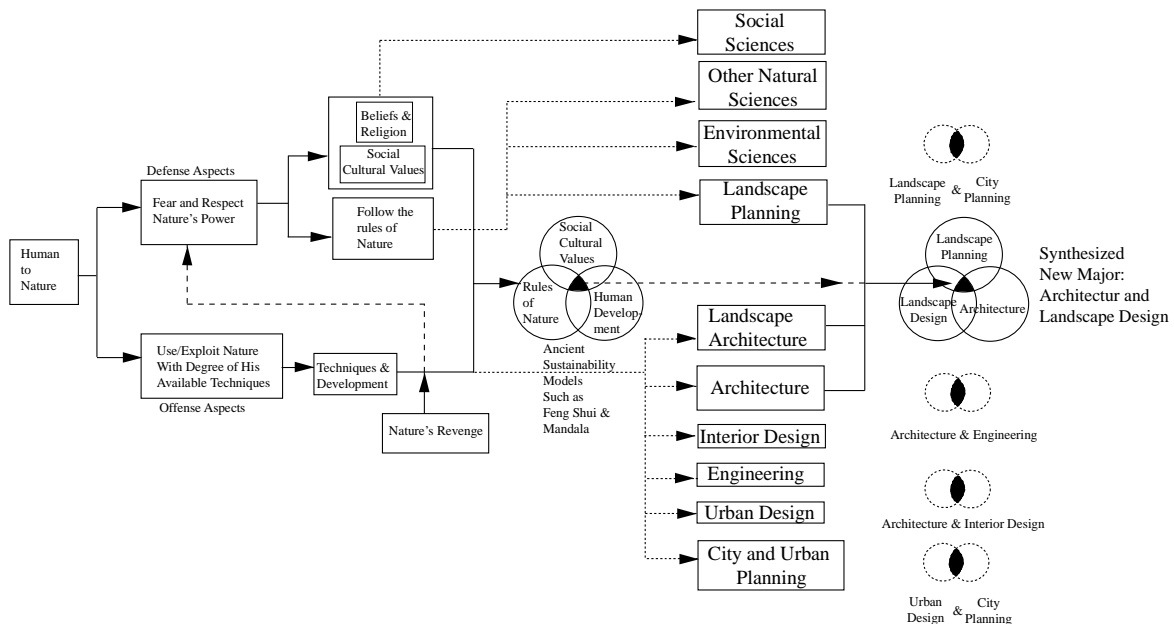


Fig 3. Synthesis approaches in the pass and in the future. (By Ping Xu)

Acknowledgments

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