Architectural heritage under threat: Disaster and the difficulty of conservation: A case study of Kinmen Island, Taiwan

Yi-Jen Tseng*
Abstract

Kinmen, Taiwan, also known as Quemoy, is an island located off the coast of China’s southern Fujian Province. Over forty years of governance under martial law ensured slow development of the island and unexpectedly helped to preserve a large number of traditional villages and architecture. Yet prevailing weather patterns combined with the island’s flat topography makes much of this significant cultural heritage vulnerable to typhoons, which commonly occur from July to October. In addition, many historic buildings are vacant or poorly maintained and are susceptible to other threats such as storm and fire. In September 2016, a powerful typhoon, Meranti, damaged nearly half of the designated historic buildings on the island. This incident revealed the issues of low disaster prevention awareness and weak post-disaster recovery capacity of the small island.

On Kinmen island resources and expertise are limited. There are many challenges associated with management and maintenance of historic buildings. In this context, this paper considers disaster prevention and recovery of architectural heritage. As a way forward, it explores several strategies to improve disaster prevention and management in Kinmen.

Key words: Quemoy, Heritage Management, Typhoon, Traditional Architecture

Introduction

Taiwan’s Kinmen Island lies 10 kilometres from Xiamen in southern Fujian Province, China. It consists of twelve islands with the total land area measuring 150.5 square kilometres. In 1949, China split into two political camps, the Nationalists and the Communists. These two political parties faced off against each other along the coasts of Kinmen and China, resulting in the famous Quemoy Crisis of the Cold War era (Ministry of National Defence, 2009). Kinmen, a long-time border outpost from the 13th to the 19th centuries, was turned into a military frontline, deterring communist expansion as part of the force led by the United States (Szony, 2008). This opened a new chapter for Kinmen as a de facto battleground governed by martial law. Military requirements and activities were prioritised in all aspects of the life on the island during a period that lasted 43 years until the repeal of the martial law in 1992.

In the second half of the 20th century, while many cities around the world experienced economic growth and development, Kinmen remained largely underdeveloped due to military restrictions. As a result, much of the traditional architecture from the 18th and 19th centuries survived, along with newer Western-influenced buildings of the early 20th century. In 2019 the island has 234 legally protected architectural heritage sites. This represents a tenth of all
heritage within Taiwan. Additionally, over 3000 historical buildings are not formally protected, despite being of cultural significance. It would not be an exaggeration to consider the entirety of Kinmen Island a treasure trove of cultural heritage.

Considerations regarding conservation of Kinmen’s historic buildings are discussed as follows:

(1) Kinmen’s topography is primarily flat. Typhoons, which are common in July to October, threaten not only the natural environment but also traditional architecture.

(2) Most traditional buildings are constructed of brick with clay walls and red tile roofs. These materials are less wind- and rain-resistant compared to modern building materials, and consequently historic buildings are exposed to higher risks of damage in stormy weather.

(3) A lack of maintenance and other issues, like water penetration, termite infestation, and vegetation growth, would impact the historic fabric and the building’s condition.

(4) Regular maintenance and repair are essential for keeping those factors under control and for the building’s safety.

(5) From the 1990s, the number of poorly maintained and dilapidated houses have increased in Kinmen. This is due to three main reasons. Firstly, during the war years, many families fled their homes and never returned to the island. Secondly, residential buildings and structures confiscated by the military were later vacated after the period of martial law ended. Thirdly, the economy of the island has resulted in many residents relocating to other cities for pursuing better opportunities. For vacant or poorly maintained heritage structures, contingent disasters will often cause severe damage.

In September 2016, a strong typhoon hit Kinmen and damaged nearly half of all designated historic buildings. This incident highlighted the lack of preventative measures for disaster with regard architectural heritage and the community’s lack of disaster preparedness and prevention. It has also demonstrated that post disaster recovery is slow. This article aims to take the unique history and current situation of Kinmen’s historic buildings and examine the issues of disaster prevention and obstacles in conservation.

Natural disasters and built heritage

Taiwan is in a region that is frequently severely impacted by natural events, including earthquake, fire, typhoon, and flood, some of which have caused overnight destruction to architectural heritage sites. However, Kinmen is geographically situated near the coast of China, outside of the seismic zone that Taiwan is located within. Few disastrous earthquakes have occurred in Kinmen or been recorded historically. In terms of fire, only minor incidents have been reported in historical buildings. The most common natural disaster that threatens cultural heritage in Kinmen are typhoons, or floods caused by the excessive rain they bring.

Typhoons and Storms

Typhoon is ranked first among all the natural disasters that afflict Kinmen. Just as the for the rest of Taiwan, Kinmen, located at 24° N and 118° E, is met with frequent typhoons between July to October each year. The strong winds of typhoons often lead to damage and loss, as does heavy rain induced by the south-western air current that causes floods in lower terrains.

Of the nine movement patterns of typhoons, identified by the Central Weather Forecast Bureau of Taiwan, Pattern Seven, which moves northward above the Taiwan Strait and heads directly to Kinmen without being weakened by the high mountains in Taiwan, has caused the greatest damage to Kinmen. Typhoons that follow this path north along the west coast of Taiwan or directly above the Taiwan Strait carry high humidity. They are usually extremely solid if their structures are not broken by higher terrains and often cause devastating impacts in southern Taiwan as well as Kinmen. According to the meteorological records, six out of the fifty-five typhoons that struck Kinmen between 1958 and 2017 followed this route. Even though the frequency seems low, two of the worst typhoons in Kinmen history, Typhoon Dan in 1999 and Typhoon Meranti in 2016, were categorised as Pattern Seven. During these two typhoons,
both infrastructure and traditional houses were substantially damaged, and a considerable number of trees were uprooted or damaged. In addition, excessive rainfall including sudden cloudbursts accompanying the typhoons caused villages in lower latitudes to flood. Traditional houses were damaged and vacant or under-maintained buildings further deteriorated. Some collapsed entirely.

**Damage Prevention Awareness for Kinmen’s Historic Buildings**

Small islands such as Kinmen have developmental restrictions. These restrictions include limited developable land, sensitive ecosystems, and economic and resource dependency on larger cities in Taiwan or China. Disasters at one geological location can trigger island-wide effects, resulting in larger and longer-lasting impacts. Small islands also have a slower post-disaster recovery rate due to low self-conservation capacity. Limited resources and supplies due to constraints on human capital and transportation compound recovery timeframes.

Historic buildings in Kinmen and Taiwan have lower resistance to disasters than modern architecture because of their building technology, materials, and cultural factors, and therefore they are exposed to higher risks in the face of unexpected disasters such as typhoons. Lack of maintenance also induces latent hazards, including termite infestation and wood decomposing fungi. Over time, such agents cause historic building to become increasingly vulnerable to disasters.

Preventative measures to reduce the impact of natural disasters are crucial for heritage conservation. When natural disasters take place, the ability for small islands to protect their heritage lies in their capacity for prevention and protection, including structural reinforcement, damage control, and after the event, in emergency restoration.

There are 163 historic villages on Kinmen Island. Of these 50 remain better conserved with a higher concentration of traditional architecture than the remainder. With Kinmen Island’s high density of traditional villages and historical buildings and its geography and environment-specific disasters, the prevention and conservation issues could be categorised into two types:

**(1) Characteristics of Kinmen’s Traditional Architecture and Villages**

Kinmen’s traditional architecture is characterised by red tile roofing and wooden structural frames. The walls are made of bricks or blocks that combine clay and other substances. Without maintenance, leakage and termite infestation become common occurrences. If struck by windstorms, roofs are easily damaged. If preventive measures and repairs of small problems are not undertaken as a matter of routine, over time the structure and roofs become weak and prone to collapse. In addition, Kinmen’s traditional architecture is often densely built with an average site coverage ratio of over eighty per cent. This density makes it necessary to take steps to prevent the spread of fire and limit the impact of collapsed walls on nearby structures during windstorms or floods. Worse, most roads and alleyways in traditional villages are winding and pedestrian-accessible only, presenting difficulties for post-disaster conservation.

There are many vacant or collapsed traditional buildings in Kinmen, where little maintenance and repair takes place. Such structures have a high rate of disaster-related accidents and damage, which are often hard to discover or manage right away. Another common threat of hazards is out-dated infrastructure, such as old or malfunctioning utility lines and lack of fire safety facilities.

Traditional Kinmen villages and architecture are typically located on flat terrain where natural protective barriers are lacking. Typhoons represent the most impactful disaster, and related preventative works are critical.

**(2) Challenges in Daily Maintenance**

In the more recent past, Kinmen suffered severely from artillery bombardments. Most destruction of the environment and architecture was caused by shelling. This may have led to the lack of a proactive attitude and awareness when it comes to naturally caused disasters. The difficulty in maintenance can also be attributed to historical factors, such as war and
limited economic opportunities. Substantial outbound migration has also resulted in a high concentration of senior populations in villages, which also presents challenges for disaster prevention and conservation practice.

Figure 1: High concentration of traditional architecture in Qionglin settlement, Jinhu. (Source: Photograph by the author).

Destruction resulting from Typhoon Meranti in 2016

Typhoons and their General Impacts

The intensity of a typhoon is classified by the maximum wind speed near the centre. According to the Taiwan Central Weather Bureau, there are three levels of intensity for typhoon: light, medium, and strong. The devastating Medium Typhoon Dan in 1999, travelled up the Taiwan Strait and hit Kinmen directly. In 2016, Typhoon Meranti took a similar route, except as a Strong Typhoon, and devastated Kinmen once again. According to the data provided by the Central Weather Bureau, its radius was of a Level 7 storm in the Beaufort scale at 220 km, and a Level 10 storm at 80 km. Its average wind speed was Level 14 when passing over Kinmen, with the highest wind speed reaching 60 m/s, qualifying it as Level 17, the highest intensity in the Beaufort scale. Severe damage was reported from every location the typhoon passed through, which included Kinmen Island and the nearby Xiamen, China.

Powerful winds accompanied by heavy rainfall brought unprecedented destruction to Kinmen. On the night of September 14, the island experienced a power outage after the typhoon damaged most of the electrical facilities. Transportation was also hindered due to the large number of roadside trees that fell. Starting from the morning of September 15, after the typhoon left, local authorities immediately undertook a post-typhoon damage review and began to repair and recover essential infrastructure and facilities, such as water pipelines, electricity, and transport. Yet, the scale of damage was beyond the existing human power and resources of the municipality. The Kinmen County Government had to seek support from the army, the central government, and other cities (China Times, 2016).

Primary losses from the typhoon included collapsed buildings, fallen trees, broken signs and tin roofs, and damaged utilities and pipelines. According to an official assessment, a total of 1,984 hectares of sorghum, the main crop of Kinmen, and other crops were impacted. Damages were estimated at USD 3.5 million (NCDR, 2016). Forty-one thousand shade trees fell. If hedge plants are included, the number would rise to 5 million, totalling USD 65 million in losses to trees. A
staggering 24,286 households, 78% of the total number of households, were affected by the blackout. Twenty-three individuals received minor injuries (Kinmen Daily, 2016). Fortunately, the amount of rainfall was only 122.5 mm, more than the 116.4 mm September average in Kinmen (CWB, 2018), and did not cause serious flooding.

Figure 2: Path of Typhoon Meranti (Source: Central Weather Bureau).

**Typhoon Damage to Built Heritage**

Under the force of Typhoon Meranti’s Level 17 gale, traditional houses and historic buildings in Kinmen experienced severe destruction. Considering the 234 historic buildings in Kinmen’s five townships, this study categorises the degrees of damage of these buildings into four levels: A (no damage), B (light damage), C (moderate damage), and D (severe damage). According to our survey, 107 buildings fall under damage levels B through D, constituting 48% of all 225 buildings. In damage degree D there were 40 cases, that is, 18% of the total heritage building stock.

**Table 1: Number of Typhoon Meranti Damaged Historic Buildings by Location**

<table>
<thead>
<tr>
<th>Level</th>
<th>Jincheng</th>
<th>Jinning</th>
<th>Jinsha</th>
<th>Jinhu</th>
<th>Lieyu</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (no damage)</td>
<td>46</td>
<td>5</td>
<td>39</td>
<td>21</td>
<td>7</td>
<td>118</td>
</tr>
<tr>
<td>B (light damage)</td>
<td>15</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>C (moderate damage)</td>
<td>14</td>
<td>4</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>39</td>
</tr>
<tr>
<td>D (severe damage)</td>
<td>10</td>
<td>3</td>
<td>17</td>
<td>5</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>85</strong></td>
<td><strong>14</strong></td>
<td><strong>77</strong></td>
<td><strong>33</strong></td>
<td><strong>16</strong></td>
<td><strong>225</strong></td>
</tr>
</tbody>
</table>

Typhoon Meranti caused considerable damage to all the following aspects of Kinmen’s historic buildings, including:

1. Loosened or fractured tiles: In Kinmen’s traditional architecture, the average thickness of the red clay tile measures about 0.3-0.6 cm. For the roof, a minimum of three layers of tiles are used. Each layer is bonded with plaster. The plaster provides both tile adhesion and traction and keeps them fixed on the roof. In the event of natural deterioration or peeling plaster, the adhesiveness and the resistance to the wind pressure of the typhoon is reduced. As a result, the tiles will loosen, move, or break,
causing rainwater to enter the structure and decaying the wooden framework or inflicting termite infestation. (Fig. 3)

(2) Roof collapse: This represents the worst form of damage to a traditional building. Trees uprooted by the typhoon may cause a roof to collapse. Roof timbers weakened by natural deterioration or termite infestation could also cause the roof to fail under strong wind gusts. Where roofs have not been well maintained, a typhoon can cause significant destruction. (Fig. 4)

(3) Disintegration of walls: Brick and clay walls that are originally damaged are likely to further disintegrate when exposed to heavy rainfall and strong winds. Tree falls can also cause damage to the walls.

(4) Deterioration of plaster walls: The traditional lime coated walls are susceptible to deterioration by rain and other external forces. The strong wind of Typhoon Meranti caused the surface of many buildings to peel, exposing the internal structure to rain.

(5) Damage to decorative and architectural elements: Parapets or railings are located on the higher parts of a building. Similarly, decorative and architectural elements on the top of a memorial archway (paifang) often protrude from the structure. The points where these elements join the main form are usually weaker and prone to damage by storms, causing these parts to detach and fall. (Fig. 5)

(6) Doors, windows, and lighting fixtures: Damage to door, window glazing, and the lighting fixtures caused by strong gusts can occur. Unsecured doors, window panels, or latches can be blown off and break.

(7) Environmental damage: This includes damage to the setting or surroundings of historical buildings. For instance, if a giant banyan tree next to a historic building were to collapse. (Fig. 6)
**Emergency Disaster Evaluation**

After a typhoon, according to Article 27 of the *Cultural Heritage Preservation Act* by the Taiwan government, ‘When there is a necessity to have emergency conservation of a monument because of major disaster, the owner, user or manager of the said site shall, within thirty days after the disaster, submit an emergency conservation plan, and within six months after the disaster, submit a conservation plan’. Complying with the law, the Cultural Affairs Bureau of Kinmen County undertook the following three phases of damage review and emergency measures with the support of our research team:

1. **Phase I: Preliminary Review.** This phase comprised a rapid review and classification of damages. Immediately after the typhoon, an inspection team was formed to document the condition and location of damage with basic statues, and photos were also taken. This work was carried out by National Quemoy University. All 250 sites of heritage buildings were reviewed within three days after the typhoon officially departed. The team classified damage according to four categories, Levels A through D. The purpose was to help the relevant authorities to manage and prioritise future recovery and conservation.

2. **Phase II: Second Review.** This phase comprised an advanced damage evaluation of the 107 heritage structures classified as Levels B through D at the preliminary review. This ensured the emergency repair and conservation plan could be submitted within thirty days. The content of the evaluation work included: suggestions for emergency measures to rectify damage and loss; budgets needed for removals; emergency enforcement; support; protection of fallen parts; preliminary evaluation; and suggestions for future repairs and conservation; and understanding the willingness of the owners or guardians of the buildings to repair or restore their structures, as well as the support they wished to receive from the municipality.

   Participating in this phase was the Cultural Affairs Bureau of Kinmen County, members of relevant specializations and organizations, local traditional architecture craftspeople, and construction companies. To carry out the process, the workforce was divided into four teams, based on the number of historic buildings which needed second review.

3. **Phase III: Repair or Conservation Plans.** Based the conclusion of Phase II, emergency measures were undertaken. Meanwhile, an application was submitted to authorities in the central government to request funding for the conservation work. Within six months of the disaster, a repair and conservation plan was officially submitted.

   The phases of emergency repair and conservation were the first-time contingency measures for the cultural heritage had been adopted in Kinmen. The first phase was assisted by the volunteer inspection team from National Quemoy University. The second phase was initiated by the Cultural Affairs Bureau of Kinmen County. Even though the inspection team and the bureau lacked experience, the first two phases were completed successfully. The third phase was ‘funding application and heritage restoration’. After receiving the applications from the Cultural Affairs Bureau of Kinmen County, the Ministry of Culture from the central government arranged a group of experts to survey and investigate on site in mid-November 2016. However, due to the numerous amount and various types of the applications, the funding was insufficient, and the local county government failed to execute the repair and conservation plans. Only a few historic buildings, which were open to public visitation, were repaired and conserved by October 2017.

**Challenges of disaster prevention and conservation for built heritage on Kinmen Island**

Today, as climate change impacts the world, the number and frequency of natural disasters is expected to grow. For small islands, such as Kinmen, the protection of environment and heritage is becoming ever more challenging. Typhoon Meranti was the most devastating natural disaster in the history of Kinmen. After this typhoon, many damaged historic buildings remain...
unrepaired today. This accentuates the issues of inadequate training for disaster prevention and predicates post-disaster repairs and conservation under limited resources of the island.

**Lack of Disaster Prevention Awareness amongst the Public**

Before Typhoon Meranti, most Kinmen residents failed to take preventative measures to avoid potential damage. The destructive power of the typhoon was vastly underestimated. Measures that could have been taken include securing and reinforcement of weaker parts of the building, such as doors, windows, roofs, and other fragile areas. Trees adjacent to buildings also could be trimmed to lessen the threat to structures.

**Authority in Charge Lacked Disaster Management System**

Kinmen has many designated historic buildings yet lacks an appropriate management system to maintain and conserve them. Such structures have a very low resistance to disaster. At the same time, the authority overseeing these properties, the Cultural Affairs Bureau of Kinmen County (the Bureau), is yet to accumulate enough experience in disaster prevention and conservation management. In the case of Typhoon Meranti, the Bureau was not conscious of the likelihood of damage and failed to alert the guardians of these buildings to prepare in advance. Moreover, in the immediate aftermath of the disaster, no responsive measures were taken, such as post-disaster mobilization, information circulation, disaster management, and other emergency repair and conservation work, due to the lack of awareness and resources.

**Limited Experience of Architectural Craftspeople and Administrative Bureaucrats**

One single typhoon severely damaged nearly half of the designated historic buildings in Kinmen. The conservation plan was submitted by the inspection team and applied for the financial support from the Ministry of Culture. The high technical difficulty and relatively low profit margin on historic conservation works was, however, a low incentive for participation by traditional architecture craftspeople and construction companies. Most contractors prefer the regular traditional house rebuilding projects. Consequently, one year after the repair and conservation plan was activated, many of the damaged buildings remained unrepaired with unspent funding returned to the central government. This predicament was further hampered by shortages in traditional craftspeople and human resources.

**The Frequency of Natural Disasters**

In the recent years, climate change has seen drastically increasing frequency and impact of natural disasters. Both the natural environment and built heritage are threatened. For small islands, the absence of natural barriers and sea level rises present greater challenges. Kinmen is not yet threatened by sea level rise, as are other small islands in the South Pacific Ocean, yet the frequency and intensity of typhoons is expected to become a more common issue. In anticipation of more frequent natural disasters, better preventative measures are one of the more effective solutions to reduce risk to and loss of heritage assets.

**Growing Number of Designated Historic Buildings**

In contrast to the rapid development of cities in Taiwan and coastal areas of China between the 1970s and 1980s, Kinmen managed to preserve a large amount of architectural heritage. Nonetheless, Kinmen has faced development pressure since the repeal of martial law in 1992. The rapid withdrawal of the army left many buildings formerly on loan to the military under-maintained, of which many are historically significant structures that are now quickly disintegrating. In recent years, the government and a group of interested people have advocated to conserve historic buildings by designating more as statutorily listed heritage items. However, the government’s administrative human resources are insufficient, and the number of craftspeople in traditional architecture is decreasing. Even when the number of listed historic buildings in Kinmen is increasing, the severe resource shortages in the aspects of natural disaster prevention, management, maintenance and conservation are still issues to be confronted. Our governmental agencies need to be aware of these situations and provide better funds and professional craftspeople through the adjustment of their systems and approaches, in order to meet the requirements of heritage conservation.
Conclusion

The flat topography of Kinmen makes it especially vulnerable to typhoons. The lack of management and maintenance and the absence of proper disaster preventative measures means that many historic buildings are exposed to high risks of destruction in the event of natural disasters.

Global attention on disasters risk management for cultural heritage has gradually expanded from the focus on preservation and conservation of a single structure into discussions over the ‘wise use of heritage’. Risk preparedness is considered an aspect of sustainable development and the management of cultural environments. Risk analysis and mitigation ensure the best use of valuable resources, which represent the best solution for sustaining the life of cultural assets (Stovel 1998). Measures aligned with risk preparedness could avoid or reduce damage and loss of cultural heritage in the event of disasters. This concept has slowly gained traction around the world.

Kinmen Island is modest in size yet has a high concentration of cultural heritage. The recent natural disaster and the subsequent recovery measures revealed a general lack of understanding of the significance of cultural heritage by both authorities and the public alike. This resulted in unpreparedness both before and after the disaster. Heritage significance, management, conservation and long-term sustainability must be thoroughly planned for and understood. In preventing disaster-inflicted damage, risk analysis needs to be periodically planned and conducted. This includes understanding the range of hazardous factors and preparing plans for risk management (Alcira & Arnold 2000). This would enable advanced preventive action and increase the efficiency and effectiveness of the post-disaster repairs and conservation plan.

The allocation of resources for repairs and conservation in the aftermath of disaster should also be taken into consideration as part of the overall risk preparedness. With the inevitability of natural and human disasters in mind, a holistic approach that considers four phases of work - prevention, response, rescue, and recovery (Silva 2003) - are essential for establishing enough disaster prevention and conservation plans and setting the correct direction for the future of cultural heritage protection and sustainable development.

The post-disaster recovery for Typhoon Meranti in Kinmen was divided into three phases. The first two phases of preliminary review and second review were well-completed and consistent with the purpose of disaster recovery. However, the third phase of repair and conservation was not accomplished. The result highlighted the lack of experience and preparation for the post-disaster recovery. Numerous historic buildings remain damaged and unrepaired on Kinmen. In the future, the heritage which might be affected and damaged by natural disasters should incorporate the concept of risk preparedness - prevention, response, rescue and recovery - into its conservation plan. By implementing the plan of disaster prevention and arousing the awareness and mobilization of local people, the correct direction of heritage conservation and sustainable development will be established.

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