

## **The Preservation of Heritage Buildings through the Weakening of Termite Attack**

by

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### **Abstract**

In Hong Kong, the present stock of heritage buildings is dwindling continuously largely due to termite attacks. Therefore it is critical to achieve preservation of heritage buildings through the method of weakening termite attacks in order to protect our traditional and cultural monuments, like Tin Hau Temple, antiquities in the Ping Shan Heritage Trail, etc. from further attacks. A quick reference to the related literature review gives some methods to exacerbating the problems of termite attacks. The methods include the baiting system, the barriers and the reduction of rising damp. The Pest Management companies in Hong Kong, however have different views which support or disapprove of the viewpoints of these literature. This paper aims to determine the building elements or parts in a heritage building that are easily invaded by termite and to suggest the most feasible method for its preservation. A survey from the members of Pest Management Association comes to a consensus that the termite problem in a heritage building can be cured by looking at some common building indicators. Termite is highly dependant on certain suitable conditions for their living. To categorically minimize these conditions for termite's living, it should then be possible to preserve a heritage building against termite attacks.

**Keywords:** Preservation Method, Heritage Building, Baiting, Joist Connection, Barrier, Damped Condition

### **Introduction - Overview of the Termite Problem in Hong Kong**

In Hong Kong, there are rare researches that focus on termite attacks. By the way, termite attack on building elements produces lots of economic loss in society; there are 94 declared monuments and 1,444 historic buildings in Hong Kong according to the Antiquities and Monuments Office. The economic loss is not just based on the cost of elimination of termite, but is mostly based on the cost of replacement. It is because when the building elements are being invaded by termite, the strength and durability of the building structure must be diminished. Hence, the envelope of a building and the building safety is also deteriorating. In an extreme case the whole building would collapse causing casualties. Besides, eliminating termites in one or two building elements cannot fully recover the building stability. It is necessary to replace the damaged parts of the building in a unique way to maintain the building safety. Hence, the writers claim that, the lack of awareness of termite attack in Hong Kong will make lots of economic loss in reality for the whole society and more research should be instilled to combat the problem.

### **Objectives of the Research**

In the research, the focus will be on the damages of building elements for heritage buildings and to determine the preservation methods. The reason of choosing heritage building for the main

target of the research is that, those heritage buildings are commonly and easily attacked by the termite attacks, since those heritage buildings are made by timber as the most indispensably building material. Moreover, in this research, the heritage building is not just only based on declared monuments, but also based on the non-statutory Chinese traditional buildings in Hong Kong. Due to the different uses of timbers, the damage of termites to traditional Chinese architectures and Western architectures are not same. For traditional Chinese architecture, timber is the most important element for the construction. For the Western architectures timbers were merely used for decorative purposes, termite damages are usually less severe than that in the traditional Chinese heritage buildings. Thus, the writer would like to emphasis on the traditional Chinese heritage buildings as the main target in Hong Kong.

### **Literature Review –**

#### **Which building elements in a heritage building are easily infested with termite?**

Tso (2005) states that, *“For the purpose of protecting the invaluable cultural significance, in formulating the termite control strategies, the aim of treatment should emphasize on the preservation of the physical fabric of the buildings that respect the authenticity and integrity of the cultural heritage.”* In fact, to protect the cultural and traditional buildings, weakening termite attack is the most important consideration. Identification of the kinds of damages and analyzing the corresponding termite control strategies commonly used in Hong Kong are the main concerns of the research.

In Hong Kong, termite affects the structural safety of the building, especially roof timber structures of heritage buildings. About 95% of the damage to buildings in Hong Kong has been caused by *Coptotermes formosanus*. Targets of termites include all the wooden materials, such as wooden floor, skirting, cupboard, closet, door frame, hosed reel box, pipe duct, lift shaft, expansion joint and places with water supply. Hence, in case the damp wooden material is without good protective treatment, termite would be easily found. Tai and Chen (2002) say that, *Coptotermes formosanus* love warm, wet, dark and stable condition. In other words, they hate cold, dry, bright and vibrating conditions. Therefore, the concentrated wooden material without good ventilation is most suitable for termite. Gao and others (1996) state that *Coptotermes formosanus* would not construct a nest without timber. Although this statement is quite biased, the fact is that, the relationship between *Coptotermes formosanus* and timber is very obvious and close.

Tai and Chen (2002) say that *building element (mostly timber) in dark and wet condition internally and door frame externally are easily damaged by termite*. For example, timber rafter, horizontal gate surround to the door, etc. All the external door frames are the primary targets for the termite’s invasion. By the way, termite may prefer to invade building elements with timber structure at the two ends; they are probably the attacking points.

Tso (2005) also indicates that, *the termites shun the light and eat tunnels through wood*. For a better explanation, the termites attack timber internally, since they are afraid of light. In other words, termite scares humans and uses internal passages to eat the timber. Termites build tunnels through wood hence reduce the strength of the wood. The building safety is reduced due to the internal vacuum of the timber.

Tai and Chen (2002) indicate that *in the mud-wood buildings, Coptotermes formosanus could build nests inside the mud-wall. The nests locations are commonly located at the connections with*

*timber beam and wall and the corner of the pedestal. The bottom of staircase, the connection with staircase and ground floor, the horizontal timber below the timber floor, the built-in wood cupboard and the pipe duct wall near the water pipes can find nests of termite.* To summarize, the building elements which are close to the damp, dark and poorly-ventilated conditions will attract termite. Hence, to have a good monitoring on those weak building elements in order to eliminate the termite attack becomes an important measure.

### **Literature Review-**

The methods to treat termite can be commonly classified as the preservation method and remedial method. Due to the fact that termite attacks can seriously damage the building elements in case of massive attack, the remedial method is not quite suitable in reality. In general, removing and replacing the affected building elements is the common remedial method. Hence, in order to protect envelop of a heritage building, preservation method is better than remedial method instead. Hence, the writers would emphasis on the preservation methods for a heritage building rather than on the remedial method, in order to keep the appearance of traditional Chinese buildings in Hong Kong.

There are mainly three preservation methods, which are baiting system, barriers and reducing humidity for the building elements.

For the baiting system, according to Su and others (2003), they indicate that, *the use of baiting system is that, if the whole nest and all of the supplementary nests could be destroyed then the threat of termite from a particular termite colony can be eliminated .... The only way to totally destroy a colony is to use a baiting system.* Bait is a food, or some substance, used to attract, entice or lure a specific organism to a desired location. Therefore, baiting for subterranean termites is not strictly "baiting", because the termites are not strictly "attracted, enticed or lured" to most baits. The deficiency may be with the baits used and not with the term.

In detail, the baiting system is not a toxic process. The "bait" leads to moulting (peeling skin) failure of the termites. According to ecology and biology of termites, when they peel skin, they will lose the ability to forage and feed, the failure will lead to no skin formed. Hence they become hungry which eventually starve them to death. As the whole nest was starved to death and eliminated, there is no chance for a mutation and no possible development of a resistance to the bait.

For barriers, according to Abe and others (2000), *the objective of barrier treatments is to exclude soil borne subterranean termites from structures. The barrier systems are usually placed before the installation of a building foundation.* Recently, physical barriers are getting more attention. The barrier composes of soil particles that are too large for termite to displace with their mandibles. Thus, there are too small for termites to pass between and confirmed. The physical barriers can be used most effectively as continuous horizontal barriers during pre-construction installation. According to O'Toole and others (2003), *the Termi-Mesh (one type of physical barriers), is a fine stainless steel mesh (Termi-Mesh Australia Pty Ltd, Malaga, WA, Australia) with mesh holes 0.66 x 0.45 mm that are too small for termites to pass through, but that allow water to pass through .....* One advantage of this method is that it is environmental friendly. In Australia, the combination of physical and chemical barrier is being used currently and commonly.

Reducing humidity of the building elements is one of the preservation methods. Due to the capillary from the base and the rising damp, dampness in building would attract the termite infestation actually. For simplicity, to lower paving which extend above damp proof cause or install

a new damp proof cause are the best methods for tackling rising damp.

Moisture vapor barriers can be an effective front line. According to Tim Hutton (1998), *the risk of condensation depends on vapor/ thermal resistance. To restrict diffusion of vapour-laden air into structure and component by vapor barriers, moisture barriers can be positioned close to warm side.* Therefore, make use of Moisture Barriers to reduce the invasion of damped condition inside the building, hence to reduce the termite infestation inside the building. This is one of the preservation methods for the termite invasion in a heritage building.

### **Questionnaires Survey**

At the time of conducting the survey, there are a total of 98 pest controllers of the Hong Kong Pest Management Association which operate the weakening of termite attack on properties. The questionnaire is initially dispatched through e-mail and by post to the targeted respondents and followed up with a phone call with an aim to increasing the response rate.

### **Analysis**

From the point of view of the respondents, they mostly adopt the baiting system since it is quite efficient for weakening the termite attack although they have different views for choosing the proper type of baiting system.

However, there is a contradictory view to reduce the rising damp compared to the literature review. They suggest the switching on of the de-humidifiers in order to reduce the damped condition in a building while the literature review indicates that, *moisture barriers can be positioned close to warm side to minimize the effect of rising damp.* For a detailed analysis, since the respondents are the pest's based staffs, they may not know the knowledge of rising damp or relative humidity in an erudite extent. They may be just known that the damped condition causes to the infestation of termite, but not the solution of the damped conditions. Therefore, they suggest the general concept to reduce damped condition, which uses open de-humidifiers.

### **Conclusion**

Due to a huge replacement cost for the termite attack, preservation methods must be adopted. Identifying the building elements that are easily attacked and the use of a suitable preservation system can cut out replacement cost.

In general, building elements like the connections with timber rafters and masonry wall, the corner of the pedestal, the bottom of staircase, the connections with staircase and the ground floor, the built-in wood cupboard, footing of column, the skirting near the entrance door, etc. can also find traces of termite nests. Thus, to conclude, building elements with the following would encourage termite infestation: suitable conditions which are damp, dark, poorly ventilated, warm, stable and quiet.

When termite attacks a heritage building, our ultimate aim is to protect the building safety by weakening the termite attack. In fact, a suitable baiting system is recommended for use. It can be used to eliminate the termite colonies within three months. Although there are some limitations for the use of the baiting system; like its avoidance during the rainy period, or the bringing of users awareness about termite chemicals, the writers still recommend using this baiting system since it is widely used in practice.

However, the writers suggest the following practices: prevention is better than treating; reduction in rising damp; regular monitoring for heritage buildings and better ventilation for the hidden corners are recommended to prevent the termite infestation.

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