

# Study on the Fire Defense Problems in Traditional Settlements in Southwest China ——Taking Shangri-La in Yunnan as the Example

劉弘濤<sup>1</sup>·王璇<sup>2</sup>  
Hongtao Liu<sup>1</sup> and Xuan Wang<sup>2</sup>

<sup>1</sup> Associate Professor, Southwest Jiaotong University, School of Architecture  
(West section, High-tech Zone, Chengdu, Sichuan 611756, China)

<sup>2</sup> Postgraduate, Southwest University of Science and Technology, School of Civil Engineering and Architecture  
(No.59, Qinglong Road, Fucheng District, Mianyang, Sichuan 621000, China)

In recent years, frequent fire of traditional settlements happened in southwest China. Based on fire happened in Shangri-La in Yunnan, this paper has analyzed the reasons of the fire which has caused massive damage, and the related issues about fire defense in traditional settlements in southwest China. Results show that climate, building materials and narrow space are main reasons of the large-scale fire spreading. The key of the problem that fire of traditional settlements occurred frequently in southwest China is that the traditional fire prevention technology has been lost, however, effective modern fire prevention technology and management system has not been established yet.

**Keywords:** *traditional settlements, fire, Shangri-La*

## 1. Introduction

On May 4, 2012, a fire broke out in Ciqikou town of Chongqing city; On March 11, 2013, there was a fire in Guangyi street of Lijiang city; On January 11, 2014, Shangri-La in Yunnan province fired; On January 25, 2014, Baojing in Guizhou province fired; On April 6, 2014, there was a fire in Suhe street of Lijiang city, and so on.

Frequent occurrence of the fire happened in southwest area during these years makes us realize that the hidden danger of fire is a huge threat to the historic district which wooden architecture dominated. These traditional villages regarded as precious cultural heritage in China develop during hundreds of years until now when they have suffered devastation.

The traditional settlements in southwest China are chosen as the research object for the following reasons:

a) The vast region scope, special climate characteristic and complex terrain structure make hidden danger of the fire in southwest area be more than others in China and make it easier to accelerate spread of the fire;

b) There is particularly deep cultural background in traditional settlements in the southwest China where most traditional settlements are not devastated and keep the traditional views of relatively complete, and among the traditional villages published by government, the number of that in southwest area is about 43%

of the total, due to reasons such as inconvenient transportation, relatively backward economic development, and so on;

c) There are numerous nationalities in Southwest area, forming lots of distinctive ethnic groups, becoming original eco-building museum in the world, and bringing a large number of traditional firefighting methods of historical value to the Southwest.

Because disaster is severe in the southwest, plus the complex terrain, special climate, numerous nationalities and deep cultural background, the traditional settlements here are particular and representative. As a result, it is necessary to save a large amount of wooden structure building's traditional settlements to reveal the prominent problems of frequent fire in southwest traditional settlements and to explore the method to improve safety of the fire defense. Therefore, this paper will take the fire disaster of Shangri-La in Yunnan as the example to analyze the related issues about fire defense of the traditional settlements in southwest.

## 2. The fire disaster of Shangri-La ancient city

### (1) General condition of Shangri-La ancient city

Shangri-La ancient city is located in the northwest of Yunnan province, and belongs to the Jiantang town, Shangri-La County, Diqing Tibetan Autonomous Prefecture (Fig. 1). Dating back more than 1,300 years of history, Shangri-La ancient city is not only the best and largest Tibetan settlements in China but the hub of Tea-Horse Road as well, and was approved by the Chinese government for the Historical and Cultural Famous City in Yunnan province in 2001 (Fig. 2).



Fig. 1 Position of Shangri-La town<sup>1</sup>



Fig. 2 The ancient town of Dukezong: before the fire<sup>2</sup>

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<sup>1</sup> Made by the author

At 1:10 on January 11, 2014, a fire broke out in the Shangri-La ancient city of Shangri-La County, and was extinguished after lasting for more than 10 hours (Fig. 3). According to statistics, by January 13, 2014, total number of the affected households is 335, of which there are 242 houses burned, 43 houses demolished, and 50 houses removed the roof of them (Fig. 4).



Fig. 3 The ancient town of Dukezong: in the fire<sup>3</sup>

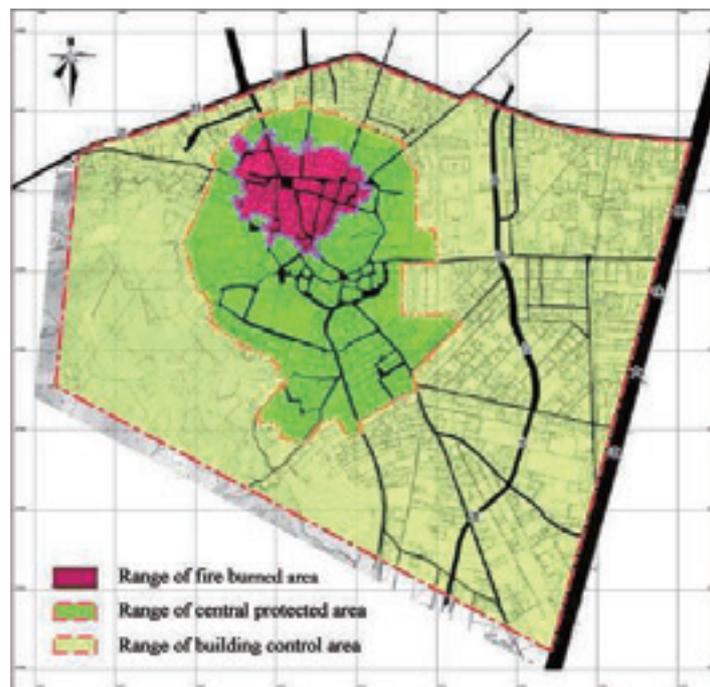


Fig. 4 The fire spreading area<sup>4</sup>

## (2) Reason analysis of the large fire spreading area

According to the survey of the fire disaster situation in Shangri-La (Table 1), this paper speculates the reasons why Shangri-La suffered massive damage in the fire are as following:

- a) In ancient city, most houses of earthen and wooden structures are highly combustible, and the fire

<sup>2</sup> <http://society.yunnan.cn/images/attachement/jpg/site2/20140117/1c6f6502e98f14433c7b18.jpg>

<sup>3</sup> <http://img1.cache.netease.com/henan/2014/1/13/2014011309262072002.jpg>

<sup>4</sup> Research Center for Historical and Cultural city of Beijing Tongheng Unban Planning and Design Institute, Faculty of Architecture and City Planning in Kunming University of Science and Technology, Restoration of Dukezong Ancient City after the Fire——Construction Planning of the Residential Restoration and Reconstruction.

resistance rating of that is low;

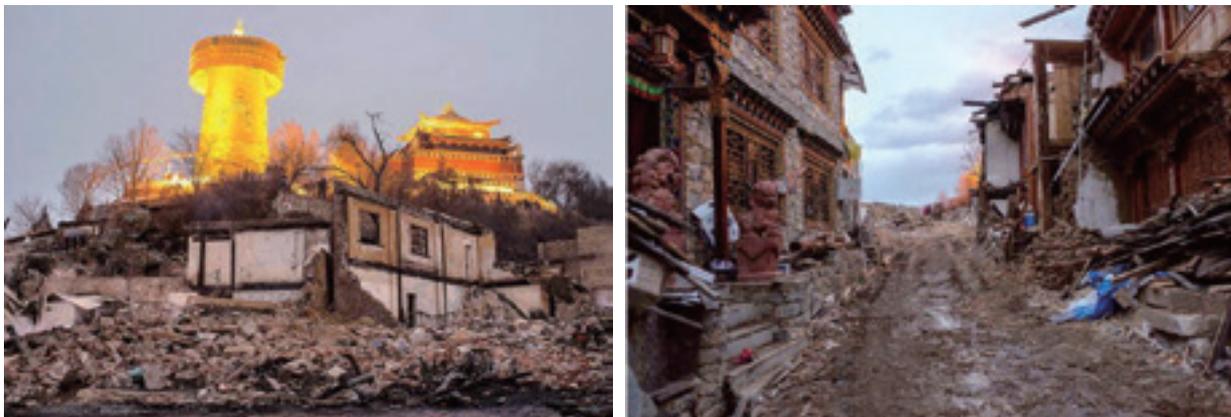
b) The roads are so narrow in the region, and many of them are only about 3 meters wide, that the large firefighting truck couldn't get into core of the affected area;

c) The temperature was so low at the time that the fire hydrant has been frozen, and the pressure of water supply for the fire defense facilities has been insufficient.

**Table 1 Situation of the fire in Shangri-La ancient city<sup>5</sup>**

Fire causes	Fire area (m <sup>2</sup> )	Burning building	Affected household	Burning time (h)	Rescue personnel
Careless use of fire	65706.67	242	335	10	2134

The houses in the ancient city are based on civil structure, of which beam, column and other major components are made of flammable materials. At the same time, the dense building and the roof adjacent to each other without the firewall, this cannot meet the fire requirement. Furthermore, Shangri-La is dry in the winter, and the wind there was strong and disordered when the fire broke out that day, which not only accelerated the spread of the fire, but also increased the difficulty to put out the blazes. In addition, the fire infrastructure is also relatively weak in ancient city, for example, the fire defense facilities such as smoke sensor, spray and fire extinguisher etc. are not be set in shops. Meanwhile, buried depth, diameter and capacity of the water supply pipeline for fire defense cannot meet the demand of fire extinguishing, and the problems came forth that there is insufficient fire-fighting water supply in the process of fighting the blaze (Fig. 5).



**Fig. 5 The ancient town of Dukezong: after the fire<sup>6</sup>**

According to the current cultural heritage protection system in our country, the traditional settlements with the heritage status include: world heritage, all levels of cultural relics protection units, historical and cultural famous village, Chinese traditional villages, etc. All kinds of relics have many specific requirements about fire defense in relevant protection plan.

But seeing from the view of modern safety standards of fire defense, there are many congenital deficiency of the layout and characteristics of traditional settlements. For example, most traditional dwelling houses are made of wood and brick whose rate of the fire resistance is low; at the same time, the eaves and gallery are adjacent to each other causing that fire prevention space cannot reach the standard; moreover, the

<sup>5</sup> Made by the author

<sup>6</sup> [http://www.sinonet.org/news/china/2014-01-14/312478\\_3.html](http://www.sinonet.org/news/china/2014-01-14/312478_3.html)

traditional streets range along the terrain leading to blocked the fire channel, etc. As all mentioned above, there are great fire hazards in the traditional dwelling houses of Shangri-La ancient city, one of them is the Shanpian House, the unique residential form in Zhongdian district, which is based on Abies Fabri. The roof of it extends about 2 meters length that is almost connected to the adjacent buildings. But this type of resident is easily to cause the spread of flames.

Because of the congenital deficiency, can we reform it according to the current fire defense criterions? It's a pity that answer is certainly not. According to the current codes such as *Code for building design for fire protection* and *Code for design of timber structure*, the fire protection distance between new buildings and the existing historical buildings need to reach 6 to 12 meters. Meanwhile, the width of traditional block as the fire passage should be at least 4 meters and ensure its coherent unobstructed. If we transform historical block guided by this requirement, traditional historical style and features of the block will be badly damaged. In short, it means that there is incompatible contradiction between traditional settlements as the part of cultural heritage and the current firefighting technology.

Although some involved parties had noticed this contradiction in some laws and regulations and attempted to crack them. For example, in 2008, the State Department published *the protection regulations of famous historical and culture cities, town, village*, which put forward “The fire control facilities and fire passage of the scope of core protection of historical and cultural blocks, the famous towns, the famous villages..... Because of the protection demand of historical and cultural blocks, the famous town, and the famous villages, these places unable to set up fire control facilities and fire passage in accordance with the standards and norms, the fire prevention security scheme should be formulated by the city or county people's government public security fire control institutions and the corresponding urban planning departments.” However, this requirement was not answered in *Fire protection law* revised by the National People's Congress at the same year and in subsequent *the detailed rules for the fire protection law*.

Therefore, at present, in the process of the protection and utilization of most historical blocks or traditional settlements, we often face awkward situation, if it involves the situation that many new buildings or function of them are changed. Although the fire department could understand the problem, they have no laws to practice, and it is hard for them to find the effective balance between fire control technology improvement and heritage conservation.

### (3)Traditional firefighting methods of Shangri-La ancient city



Fig. 6 Shanpian House in Shangri-La ancient city<sup>7</sup>

<sup>7</sup> <http://m.keyunzhan.com/knews-412267/>

During process of struggling between man and fire in the thousands of years, we have accumulated rich experience in practical fire defense. Such as Shanpian House which is in Shangri-La (Fig. 6), there are thick walls and small windows, and the possibility of the fire spreading through the window to adjacent building is very small. Although there are highly flammable roofs and simple structure where pitched roof is erected on the flat roof with chair, which can not only facilitate the snow to melt, but be easy to dismantle buildings on fire to avoid contiguous burned. Once one house is on fire, the Tibetans may remove the roof of surrounding buildings quickly to isolate the source of fire.

In addition, the experience accumulation of firefighting mainly is reflected in the fire control management which emphasize on personnel prevention rather than technology prevention. In the ancient city, everyone pays attention to the damage of the fire, and they manage it carefully; once fire breaks out, the first thing for them is to obey a unified command to extinguish fire of the burning building or demolish of all buildings around it, and anybody is not allowed to move or rescue their own belongings secretly, otherwise the one would be punished; furthermore, those who cause fires would get severe punishment. These simple and practical management measures are written in the local traditional convention, and handed down from one generation to another. Until today, it is still important village bylaws.

#### **(4)The firefighting problems in traditional settlements**

Compared to the problems in history, the firefighting problems we faced today is much more complicated. As a matter of the fact, in most regions, The fire defense problems in traditional settlements are not only shown as the conflicts between the norms of modern fire defense and the characteristics of traditional settlement but also as many threats and difficulties. These unfortunate situations could be seen in the ancient city of Shangri-La.

From the prospective of traditional building and planning, the ancient city of Shangri-La is an area with fortification against earthquakes and Shanpian House is secured with Mahuang nails, increasing the difficulties for the roof dismantlement to separate the fire sources; Moreover, the collisions between the population growth and the limited land in ancient cities and ancient villages have led to the increasing building density in the natural segregation areas which sparsely covered before, with ponds and vegetable plots, make those areas surround by buildings and fire could hardly be controlled once breaks out (Fig. 7).



**Fig. 7 The adjoining buildings into pieces<sup>8</sup>**

Judging from the experiences of traditional application of fire control, during the process of firefighting, firemen will keep local people away from the areas on fire for their safety. However, the effective

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<sup>8</sup> Provided by the Zhenyuan County Bureau of Cultural Relics

experiences of natives to remove the roof and separate the fire sources could not be adopted since the most of the firemen are outsiders.

At the same time, there are many loopholes in the ancient cities modern firefighting techniques applications. Take the old city of Shangri-La for instance: As we found, smoke, sprinklers and other fire-fighting facilities are not set in the shops there, besides, a large number of merchants even are not equipped with a fire extinguisher, some tenants' fire safety awareness are indifferent, failed to extinguish the initial fire; due to the low winter temperatures in Shangri-La, lack of heating facilities and electric heating are extensively use in the brick, civil structure houses, lead to huge security risk; According to reports, the fire water supply pipes network buried depth, diameters, fire water tanks' capacity could not meet the needs of the fire extinguishing, hydrants are frozen(Fig. 8); Streets like Sifang Streets set up stairs in environmental remediation ,influencing the passage of fire engines (Fig. 9); when removing the roof of the building, some materials are deposited on the fire exits, which influence the access of the fire engines; lack of the small fire-fighting equipment, make it difficult to access the alleys; furthermore, judge from the insurance compensation, most merchants are lack of the awareness of buying insurance, proportion of purchasing fire insurance is very low.



**Fig. 8 Frozen water supply facilities<sup>9</sup>**



**Fig. 9 Stairs affect the passage of fire-engine<sup>10</sup>**

In addition, seeing from the fire situation of Shangri-La, the current status of the development and conservation of the traditional villages also makes new difficulties for disaster prevention. For example, traditional villages are generally remote, routine fire police could not arrive in a short time; moreover, a great number of young labors of these villages are perennial migrant workers and excessive commercialization of tourism, which causes the hollow villages and less permanent population during the off-season, all of these will make the initial fire could not effectively control; although the farmhouse is an important tourist restaurant format of traditional villages, the extensive use of the gas tank with no plans distribution inevitably increase the difficulty of fire control, once the fire was out of control, just like starting of a lot of hidden time bombs.

### **3. Conclusions**

In short, the main fire defense problems in traditional settlements in southwest China is that the

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<sup>9</sup> Photographed by the author

<sup>10</sup> Photographed by the author

traditional fire prevention technology has been lost, however, effective modern fire prevention technology and management system has not been established yet and there are many loopholes in it. Hence, it is essential for traditional settlements in the southwest to build the modern firefighting technology and management system which not only maintains authenticity of the cultural heritage, but improves safety of the fire defense as well. In practice, according to different characteristics of the traditional settlements, we should combine traditional and modern methods of the firefighting, meanwhile, emphasize both personnel prevention and technology prevention to build fire safety system adapted to different types of traditional Settlements. For the protection of Chinese traditional settlements, this is an extremely necessary work in the future.

**Acknowledgment:** We would like to thank the various people who provided useful advices and helpful assistance during the whole writing process. Special appreciation goes to the all members of Liu Hongtao Studio (劉弘濤研究室), for their intelligent insights and rigorous analysis. This article is part of the Liu Hongtao Studio (劉弘濤研究室) research results.

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