

Communication

History Made for Tomorrow: Hakka Tulou

Richard M. Yelland

Curtis Birch Inc., Santa Monica, CA 90401, USA; E-Mail: richardy@curtisbirch.com;
Tel.: +1-310-394-2020; Fax: +1-310-496-1309

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Abstract: The documentary film, *History Made for Tomorrow: Hakka Tulou* was an October 2010 release by History Channel International. This film is an in-depth study on the green building techniques and sustainable lifestyle of the Hakka people of Southern China with a focus on the ancient Tulou rammed earth structures. The television program follows West Virginia University research professor, Ruifeng Liang, as he initiates scientific studies to back claims that the rammed earth Tulou structures are “the greenest buildings in the world”, and Canadian architect, Jorg Ostrowski, of Autonomous Sustainable Housing Inc., who has been researching the ecological footprint of Hakka communities since August 2007, to promote them as “eco-villages” of best practices for planet Earth’s sustainability. The author is credited as Director, Writer, and Producer of this film. This paper is based on the script of the production.

Keywords: History Made for Tomorrow; Hakka Tulou; green building; sustainable lifestyle; Hakka people; rammed earth structures; eco-villages; sustainability; earth buildings; round houses

1. Introduction

The History Made for Tomorrow is a new community outreach program, created by History Channel International of A&E Television Networks (AETN), to showcase historic places where lessons can be learned to build a sustainable 21st century [1]. The Hakka people and their Tulou buildings were chosen as subject matter for the first episode of the series by the author and a team at History Channel International, led by Dr. Libby H. O’Connell, Chief Historian, and Christian Murphy, Vice President. The shooting of this documentary film took place at the World Heritage Fujian Tulou sites of Yongding County, Fujian Province of China, in July 2009 when an international research team

led by Dr. Liang of West Virginia University was conducting the field studies of Hakka Tulou structures (Figure 1). The research team consisted of engineers and architects from West Virginia University of the United States, Autonomous Sustainable Housing Inc. of Canada, MU Design of Japan, and Xiamen University of China [2].

Figure 1. The film production crew and Dr. Liang in the front of Zhenchenglou, Hongkeng Village, Yongding County, Fujian Province of China.



Curtis Birch Inc. is a Santa Monica-based production company, and has received many awards, including an Emmy® Nomination in the National Public Service category, and winner of Best Documentary for “Floating the Nathan Gocke Story” at 2011 Cannes Film Festival’s “American Pavilion Emerging Filmmaker Showcase”. Since 2000, Curtis Birch Inc. has been advancing the cause of sustainability in modern society, by promoting the lessons of ancient and present cultures in green living and eco-consciousness via development and production of educational content, backed by scientific research and technical data, for broadcast and other media channels.

The massive Tulou buildings made of earth, and home to the ancient Hakka people of China, are housing entire communities and providing defense against enemies [3]. Figure 2 shows an overview of Tianluokeng Tulou cluster that is located in Nanjing County, Zhangzhou City of Fujian province while Figure 3 shows multiple-ring structures inside Chengqilou that is located in Gaotou Village, Yongding County of Fujian Province. The Tulous are a feat of engineering, sustainable structures in the modern world. What centuries old secrets are locked in their earthen walls?

Welcome to Hakka Tulou, a place where history is made for tomorrow! Through the film viewers are able to witness and appreciate the unique architecture of the Hakka people. This paper serves as a supplementary document of the film production for the viewers and readers.

Figure 2. Overview of Tianluokeng Tulou cluster, Nanjing County, Zhangzhou City, Fujian Province.



Figure 3. Inner wood floor structures and multiple-ring buildings inside Chengqilou, Gaotou Village, Yongding County of Fujian Province.



2. What Is a Tulou?

Earth is the world's oldest building material and the greenest. Over three billion people live in buildings made of earth, an estimated 100 million in China alone. There are more than 23,000 Tulous across the provinces of mountainous southwestern China. Far from a primitive dwelling, the Tulou is a masterpiece of Hakka ingenuity and creativity.

Tulous can resist wind and earthquakes, take advantage of natural light, and defend against thieves. The Hakka people managed to establish architecture in China that would astonish the World. It is the work of a noble culture that dates back to the Han Dynasty of the 1st Century AD. As per the owner of Chengqilou, his ancestors have lived here for fifteen generations. Right now the youngest generation that lives here is the thirtieth.

Chengqilou, known as the King of Tulous, is over 300-years-old. Standing four stories high, it is half the size of the Roman Coliseum. With four inner rings of structure (Figure 3), it is home to nearly

200 families. Like most Tulous, Chengqilou integrates rammed earth walls and wooden construction with other local building materials.

A respect for ancestry is at the center of Hakka culture. The ancestral hall is the center of Hakka architecture. Figure 4 shows the ancestral hall of Zhenchenglou.

A total of 46 Tulou buildings in the Fujian province, including Hongkeng Tulou cluster, Chuxi Tulou cluster, Tianluokeng Tulou cluster, Gaotou Tulou cluster, were named in 2008 by UNESCO as World Heritage Sites, as “exceptional examples of a building tradition and function exemplifying a particular type of communal living and defensive organization in a harmonious relationship with their environment” [4]. An anniversary celebration of inscription of Hakka Tulous was taking place while the film production team was on site in 2009 (Figure 5). The Hakka are a proud people. They look to the future. A thriving tourism industry and the promise of further economic growth through ecotourism mean the destiny of the Tulous lies in the hands of the Hakka people.

Figure 4. The ancestral hall of Zhenchenglou.



Figure 5. The 2009 anniversary celebration of inscription of Hakka Tulous into World Heritage sites.



With the possibility of working in the Tulous, Tour Guide Zhuo Xiao-Yan has returned from the city and is now an ambassador, imparting, to those that visit, the wisdom of Hakka architecture and lifestyle. Inspired by her heritage, she is a voice for the future.

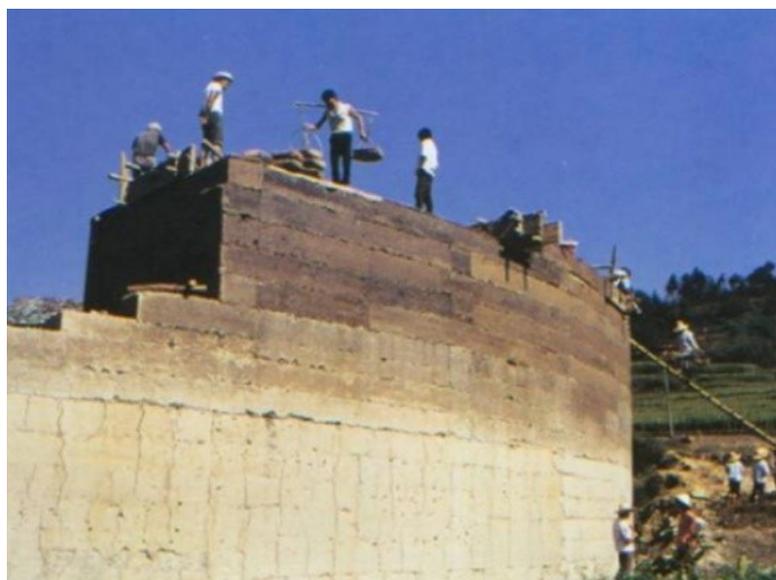
3. How the Tulou Is Built

Jorg Ostrowski, a Canadian architect and a leader in green building, is a champion of the sustainable Hakka architecture and lifestyle. “We find ourselves in Yongding County, Fujian Province, South China”, Ostrowski commented. “We are here because we want to learn from the green architecture that has been built and has been lived in for centuries. We can see the two natural building materials that the Hakka use from the local surroundings. We can see the wood lintels, so the wood from the forest. We can see the rammed earth wall. And as we come further down you can see the stone from the mountains, this is the building’s foundation to protect from the splashing back from the rain. So the main key element that brings all of the different Tulous together, the common denominator is one thing, and that is the rammed earth walls”.

Lin Jing-Fu of Yongding County has been building rammed earth walls since he was 16. He said, “For those of us who construct the Tulou walls, we learn from the knowledge of our elders”. The work of building rammed earth walls is an ancient art. “The earth we used for the walls in the past was all dug up from deep inside the rice paddies”. After pouring in pre-prepared red earth, the earth was rammed—forming one layer of wall which is approximately six feet long and two and a half feet high. Bamboo or fir branches were added for reinforcements. Four earthen layers are rammed to build one storey of the Tulou’s outer wall. Figure 6 shows a massive scale rammed earth wall under construction. Readers are referred to a paper by Su for details on the construction method [5].

Large Tulous can take up to one year per floor to build. “We can only do two layers of wall per day, We don’t dare go over three. If we do more, the rammed earth would naturally soften and collapse, because the sun has not yet dried it”, Lin continued.

Figure 6. A massive scale rammed earth wall of Hakka Tulou under construction.



One aspect of sustainability is durability. These rammed earth walls have lasted hundreds of years. For example, Fuxinglou, Hulei Town of Yongding County, is estimated to be 1300 years old and still inhabited to this day. Fuxinglou features 4 ft thick walls and like all Tulous, a fortified gate. The Kong family lives here and according to clan records, is direct lineage of Confucius. Figure 7 is a group photo of some members of the international team researching on Tulous with the Owner of Fuxinglou, Kong Mei-Chang. Surprisingly, radiocarbon dating test of wooden sample from Chengqi Tulou has successfully verified the building's age of over three hundred years [6].

Rammed earth walls not only stand the test of time, they leave virtually no carbon footprint.

Figure 7. Group photo of the international team members researching on Tulous with the Owner of Fuxinglou.



4. Strength of the Tulou

An international group of researchers, sponsored by National Science Foundation of the United States and led by Dr. Ruifeng Liang, is studying engineering design of Hakka Tulous to help refine contemporary green buildings. Dr. Liang, a research professor from the West Virginia University, was born in this area and grew up in a Tulou. Dr. Liang returns to his roots to bring the centuries old wisdom of his past to light. Liang studies the Tulou's rammed earth walls and wooden construction to determine the structure's strength and integrity, which are key parameters of any building's sustainability. Figure 8 shows ultrasonic devices being used to measure the strength of a rammed earth wall in a nondestructive manner. Here ultrasonic devices provide data that show the rammed earth walls behave like concrete [6–8]. “It looks very comparable. It's amazing. The signal is so strong, meaning the wall is so hard and strong”, Liang explained. Inside a Tulou building, Liang in collaboration with the team led by Dr. Ying Lei, who is also a descendant of Hakka, from Xiamen University of China does load tests at various points along the support structure. They find that the posts and beams circling the Tulou distribute loads evenly across the structure and then outward to the rammed earth walls. Even though these load-carrying members are jointed to each other through pinned connection (without a single nail in the entire building), the study reveals that the jointed

neighboring members have a high load-sharing effect in a manner similar to a fixed beam and all the surrounding horizontal and vertical members connected to the load carrying beam, have acted in partial unison and restrained the load carrying beam such that the boundary conditions surpass those of a fixed beam, offering extremely high stiffness [6].

Figure 8. Ultrasonic devices being used to measure the strength of a rammed earth wall.



Another vital component of sustainability is the Tulou's ability to withstand earthquakes. Hakka Tulous have survived material aging, natural weathering and strong earthquakes for hundreds of years. "The thick rammed earth walls integrated with internal wooden structures could be a critical factor contributing to their superior earthquake resistance", Liang explained. "Finite element analyses are conducted to better understand the structural response of a Hakka earth building under earthquake-induced load". But not even Liang's most cutting edge technology could explain how a rammed earth wall might even be able to repair itself after a great quake. It is reported that there was a strong earthquake in 1918. That earthquake created a huge crack in the earth wall of Huanji Tulou, located in Nanxi Village, Hukeng Town. The crack was about three meters long, 20 centimeters wide. But reportedly, that crack just amazingly self-healed, to the present five centimeters wide. Figure 9 shows the researchers from West Virginia University and Xiamen University are investigating the crack of Huanji Tulou. The rammed earth wall of Huanji Tulou was found unreinforced. "If the earth wall were reinforced with bamboo or fir branches, the cracking would not be induced", said Dr. Liang [8].

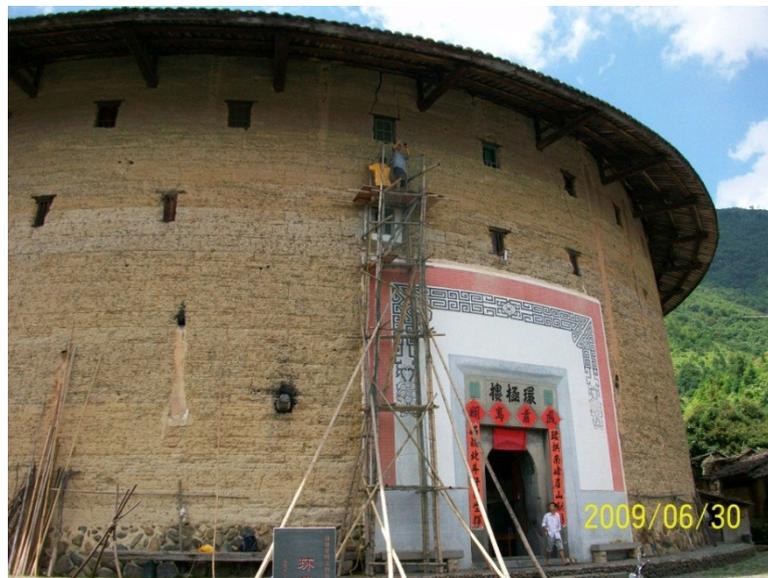
5. Comfortable and Sustainable Living

Quality of life is also an important factor in the viability of green buildings. Tulous offer comfortable temperatures year round—even without the use of electricity. "The best times in a Tulou are during dawn and dusk. The air is very cool and pleasant, and you can say it is warm in the winter

and cool in the summer, very temperate”, Zhuo Xiao-Yan said. What is it about their structure that helps Hakka Tulous moderate temperature?

Jorg explained, “You can see these lanterns moving. There is wind. There is circulation. There is ventilation in here. This is a very important aspect. The air is drawn in through the gates down low and the courtyard is open to the sky”.

Figure 9. The researchers are investigating the crack of Huanji Tulou.



The earthen walls also work as thermal regulators. When temperatures rise in summer, heat is drawn into the walls helping to cool the air... then as temperatures drop in the winter, heat is released for natural warming.

Japanese Architect, Minoru Ueda (pictured in Figure 10 with Dr. Liang), conducted a study to help to provide data. Minoru tracks the temperatures inside every day, year round, using data loggers with the goal of providing the scientific community with empirical proof that Tulou architecture regulates temperature throughout the seasons. Climate data generated both by Liang [6] and Ueda [9] independently do in fact demonstrate that the unique floor plan and thermal mass help the Hakka Tulou moderate temperature and humidity. Furthermore, after a rigorous environmental/sustainability study on the performance of Hakka Tulou, Ueda concluded that Chengqi Tulou built over 300 years ago, and still in-service, was highly ranked in a variety of types of evaluations using modern assessment tools, including the United States Green Building Council’s Leadership in Energy and Environmental Design (LEED) guidelines [9].

The Hakka people continue to refine their green lifestyle as they pass on the secrets of sustainable living from one generation to the next. Dr. Liang himself is the 25th generation of a Hakka family, meaning that his ancestors had first moved to this place around 500 years ago. “The lifestyle of the Hakkas is a sustainable lifestyle. Not only we live in the Tulous—the Tulous are actually a kind of sustainable architecture and our ‘greenest architecture’. We also plant our own rice paddies and our own vegetables. The energy we use also comes from the natural collection of light and hydropower. We practice the reemployment of our human waste and animal waste. It is truly a sustainable living-style.”, Liang explained.

“They use water for water mills. They are self-sufficient from a food point of view. They use local building materials, the ingredients in the rammed earth are local, they have achieved a great degree of sustainability already”, Jorg added. Hakka Tulous can be considered as “eco-villages” of best practices for planet Earth’s sustainability in their planning, design, construction, lifestyle, resource management, micro industries, renewable energy, recycling of human and animal waste, and a low ecological footprint.

Figure 10. Liang and Ueda standing in front of the Chengqi Tulou, where Liang was conducting the engineering evaluation of Tulous and Ueda was conducting the environmental assessment.



6. Conclusions

Hakka Tulous not only facilitate environmental sustainability, but endow the inhabitants with material, social and spiritual sustainability. These aspects of social-environmental sustainability of Hakka Tulou have been well covered by other researchers [10,11]. For example, Keith Lowe noted in his paper that they are closed to the outside, but open on the inside. Tulou create security and solidarity for the clan and contribute to the social stability. Daily movement around the inside of the structure reinforces the social order and the Confucian norms of behavior. Food and water supplies inside the structure ensure security of the clan in times of conflict, and some structures have school and workshops for daily productive work. Spiritual awareness is enhanced through the round and square patterns of the habitation, symbolizing the interplay between heaven and earth and reminding the inhabitants of their existence in a purposeful universe. Additional spiritual influences include the bagua footprint of the compound and the yin–yang location of the wells [10].

The Hakka people understand sustainability. They have lived in harmony with the nature around them for centuries, as reflected in Figure 11. To have a glance at Hakka architecture and lifestyle, a segment of this documentary television program can be found at [12]. In addition, to recognize the sustainability of Hakka village architecture that offers exemplary lessons for our modern world, the first *History Made for Tomorrow* Grant was awarded as seed money by A&E Television Networks (AETN) in October 2010 (Figure 12) to help save, preserve, upgrade and repopulate Hakka Tulou buildings in China for our common world heritage [1].

We visited the mini hydro generating plants in Hongkeng and saw that they are in need of being upgraded. Let's harness many more rivers and creeks that are not being harnessed right now. We can use the solar energy power and all that warmth for solar hot water collectors. We can collect rainwater. We can improve the roofing using local materials and green products to increase the security and the structure integrity of these buildings. So if we can bring in modern technology then we will clearly define a sustainable future for our planet Earth.

Figure 11. Hakka people living in harmony with nature, Chuxi Village, Yongding County.



The future is quite promising if we build on what we learned from Hakka through the collection of data. That knowledge will be utilized to develop global models for modern green buildings. This is the work that will pave the way for future technologies promoting sustainable preservation initiatives for the Hakka people and the rest of the World.

So we see a lifestyle and a building that have been maintained and sustained through history into present days, ensuring a history that is made for tomorrow.

Figure 12. The First *History Made for Tomorrow* Grant awarded to Fujian Tulou of China by A&E Television Networks (AETN).



Acknowledgments

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This opinion paper is based on the script of the *History Made for Tomorrow: Hakka Tulou* film, that the author has permission to use.

Conflicts of Interest

The author declares no conflict of interest.

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