



# A Virtual Reconstruction Methodology for Archaeological Heritage in East Asia – Practical Experience from the Re-relic Program in China

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## Resumen

*El este de Asia se caracteriza tanto por su abundancia en patrimonio arqueológico como por su diversidad metodológica a la hora de llevar a cabo reconstrucciones y representaciones de dicho patrimonio. El programa Re-reliquia en China reconoce la singularidad del patrimonio arqueológico en el este de Asia y ha desarrollado una metodología adaptada para la reconstrucción virtual, científicamente sólida para la interpretación pública. El examen teórico y la experiencia de campo en los próximos años contribuirán a la comprensión global del valor y la técnica en la reconstrucción virtual, al prestar atención a los principios de la Carta de Sevilla.*

**Palabras Clave:** PATRIMONIO ARQUEOLÓGICO; ASIA DEL ESTE, CARTA DE SEVILLA; PROGRAMA DE RECONSTRUCCIÓN VIRTUAL RE-RELIQUIA.

## Abstract

*There is as much abundance of archaeological heritage in East Asia as there is diversity in the methodology for its reconstruction and representation. The Re-relic program in China recognizes the uniqueness of archaeological heritage in East Asia and has developed a tailored virtual reconstruction methodology that is both scientifically robust and popular for public interpretation. The theoretical consideration and field experience over the years shall contribute to the global understanding of the value and technique in virtual reconstruction, while testifying to the very principles of Seville Charter.*

**Key words:** ARCHAEOLOGICAL HERITAGE; EAST ASIA; SEVILLE CHARTER; RE-RELIC PROGRAM; VIRTUAL CONSTRUCTION.

## 1 EAST ASIAN ARCHAEOLOGICAL SITE

### 1.1 Introduction to East Asian Architecture

East Asia can be considered a common culture mellenia ago. As early as 200BC, there was already frequent communication among what is today China, Korea and Japan in terms of culture, economy, science, language and religion. Under the prevailing influence from the leading culture of China, the building technique in East

Asia gradually merged into one system, which has cast a lasting effect on architecture over the centuries and to the modern day. Architecture in East Asia maintained its major characteristic of a timber frame that takes the place of load bearing walls in a stone building, giving it a delicate appearance. Although there is a great diversity in detail and style, the main structural system is identical. It is for this reason that there is an established common ground for archaeology and architectural history in East Asia.



Figure 1. Horyuji, ca. 711, earliest surviving evidence of architectural features in East Asia, Nara, Japan

### 1.2 Common Characteristics in East Asian Architecture: Timber-framed Structure

Although the building types in East Asian range from Palace, Temple, Housing, Garden, Tomb, Pagoda to Grotto, the influence of a timber-framed system is at all their foundation. Generally, a timber-framed building is consisted of three parts: a stone foundation at the bottom, a wooden frame that stands upon it, and a tile roof above. The three parts are systematically integrated by an architectural methodology that gradually developed and summarised into treatises and building codes, such the *Yingzao Fashi* (State Building Standards, ca. 1100) in China, and *Shyomei* (Guidance for Masters, ca. 1605) in Japan.

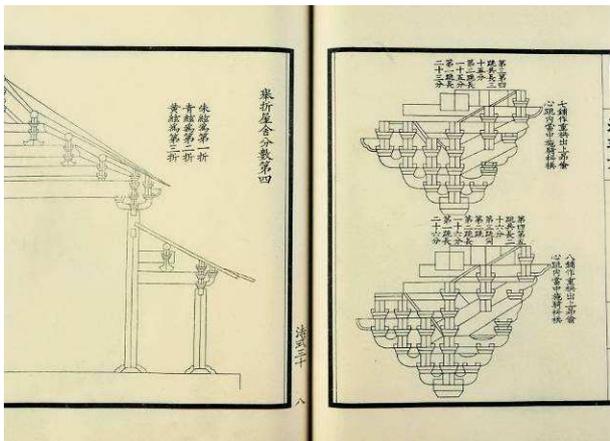


Figure 2. Yingzao Fashi, ca. 1100, brackets as the modular system for the building, Northern Song Dynasty, China

Such technique, which successfully came down to this day, is still widely practised. In 2009, the Traditional Architectural Craftsmanship for Timber-framed Structures from China was inscribed in the Representative List of the Intangible Cultural Heritage of Humanity, again demonstrating an interconnected culture in East Asia.

### 1.3 Unique Features of Archaeological Sites in East Asia

Besides the convenience in construction, timer structure is also known for its vulnerability to worm, fire, and moisture. *Horyuji* in Japan has been repaired and reassembled no less than four times until the 20th century and this is how it managed to survive. However, buildings cease to be reconstructed when maintenance is interrupted due to wars, social upheaval or econmical turmoil. Because of this, a large amount of structure couldn't make it to this day, and most of the time only the stone foundation is left.

Although the main body scarcely remains, the archaeological site, combined with a solid theoretical foundation of research on building codes, contains a lot of information for interpretation, which provides the solid ground for rigorous reconstruction.

### 1.4 Contemporary Practice in the Conservation and Utilization of Archaeological Site in East Asia

It is common to publish the result from archaeological research in the form of representations. After proper treatment to the site, many types of representation is performed to show to the public what has been learnt. This includes structural shelters where the site can be both protected and represented, or simulations prepared to capture the shape of pillars on the foundation. Neither the original nor simulated representation is good enough for people to understand, where as in the West, the archaeological site of stone and brick structure is

relatively easy to interpret. So for archaeological sites of timber-framed structures in East Asia:

- a) The archaeological site proper is what actually carrying authentic historical information, but what is inherently connected with it is no longer visible;
- b) Preserving the site itself is insufficient for public understanding who lacks adequate knowledge to interpret it;

In some cases, the reconstruction is done to a full level. The *Anapji* pond and its surroundings (originally built in 674AD) within the national park in South Korea is completely rebuilt according to archaeological findings in 1974. The entire garden, fresh with new material, is applauded as the symbol to historical glory and becomes a tourist attraction.



Figure 3. On-site Reconstruction of a Pavilion at Anapji Pond, ca. 674, Gyeongju National Park, South Korea

Again, in 1998, *Suzakumon* (Gate of the Vermilion Bird) in Nara, Japan was reconstructed in a similar vein, using historical archive and relevant buildings for reference.

Although highly controversial to the Authenticity principle in international charters, such methodology is very popular in East Asia. Regardless of probably criticism, the pragmatical considerations is that a physical reconstruction may intervene the site to a large extent, but it can also be reconciled with historical philosophy of a rebirth, thus reviving the tradition.

However it may be justified in East Asia, the conflict with common sense in heritage conservation should be properly dealt with, so that a greater consensus be built for the career of conservation in the world.

## 2 COMMITMENT AND OBJECTIVE OF THE *RE-RELIC* PROGRAM IN CHINA

### 2.1 Initiative and Philosophy

To address these specific issues for the archaeological sites of perished timber-framed structures, a professional team was built with the title *Re-relic*, implying the purpose of the group to reconstruct from relics and represent what it implies.

To distinguish itself from previous practices, the *Re-relic* program deliberately chose virtual reconstruction as the principal measure for the following advantages:

- a) The international principle of least intervention to the archaeological site is duly respected;
- b) A virtual reconstruction is capable of showing all the detailed information enough, with multiple hypotheses for discussion which demonstrates the scholarly rigor.
- c) The output can be disseminated in many possible ways, thus providing maximum public participation;

### 2.2 Objective

From the above consideration, the *Re-relic* program has made its objective to: comprehensively conserve and represent heritage to support academic research, archaeological excavation, conservation projects, regular management and public participation with a multitude of traditional and modern technological measures. To achieve this, a combined effort of architectural historians,

heritage conservators, archaeologists, computer scientists and IT experts will be required.

With established principles for the virtual reconstruction of timber-framed structures, the program needs an actual case to implement and verify the validity of the methodology.

### 3 FRAMEWORK OF THE VIRTUAL RECONSTRUCTION OF *YUANMINGYUAN*

#### 3.1 History of *Yuanmingyuan*

*Yuanmingyuan*, known in history as the “Garden of Gardens”, is an imperial garden dating back to 1707, and continuously enlarged over 150 years. It is a living museum of the state-of-art gardening art in China. In 1860, *Yuanmingyuan* was almost destroyed in foreign warfare and never rebuilt since.

These unique features of *Yuanmingyuan* has made it a perfect choice for a pilot program to realise the purpose of *Re-relic* program.

#### 3.2 Fundamental Research for Reconstruction

For the start, the virtual reconstruction of *Yuanmingyuan* must be as rigorous as possible, given the large amount of research already accumulated among archaeologists and architectural historians over decades. To ensure maximum validity, the program first elicited a hierarchy of the different levels of fidelity in evidences:

- a) Archaeological Survey: Current condition of the archaeological remains is of primary importance both in terms of heritage conservation and the basis for virtual reconstruction. Given the fact that the whole building is an integrated design, any part can be of great significance. Therefore, even the smallest component such as broken tile must be collected and documented.



Figure 4. Current Condition of Jiuzhouqingyan

- b) Historical Photos: Although photography was introduced to China rather late, the historical information that photos provide is only second to the physical remains if it is available.
- c) Historical Archive: The imperial garden is also known for an abundance of official document concerning architectural design. *Yangshi Lei* Archive, inscribed in Memory of the World Register in 2007, is crucial for the reconstruction in that it keeps a scrupulous record of the last details of the buildings in *Yuanmingyuan*, most of the time when a major repair or reconstruction is implemented. It includes both scaled drawings from paints and textual records like inventories. Even though the collection is scattered around the world, and some only survive in fragments, it is the most reliable document.

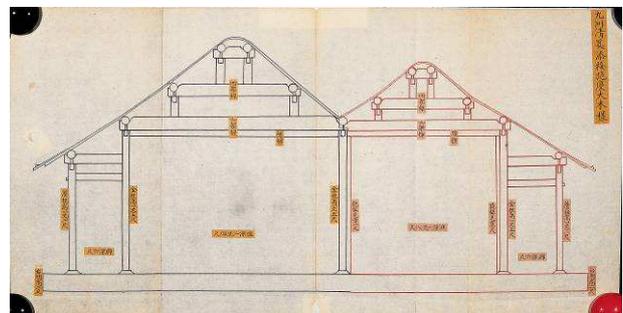


Figure 5. *Yangshi Lei* Archive of a Building in Jiuzhouqingyan; the Height and Diameters are Marked with Text Boxes in Yellow

- d) **Artistic Paintings:** The emperors had commissioned series of paintings for *Yuanmingyuan* at times, such as the *Forty Scens of Yuanmingyuan*. The artistic rendering of a site shows many details not always available in 2D depictions, and its validity proved by comparison to archaeological research. However, the size and proportion of components are not as exact as is recorded in drawings.



Figure 6. Silk Painting of Jiuzhouqingyan

- e) **Historical Literature:** Literature and poem ranks last in credibility. Although its contribution might be minor, they are enormous in number.

### 3.3 Reconstruction Schemes

- a) **Master Plan and Divisions of Different Periods:** Having the vast span of time and area in mind, the *Re-relic* program divides the entire history into 13 periods, each with its specific evidences. Considering the spatial layout, the garden is further split into 110 tempo-spatial units to be individually reconstructed.
- b) **Specific Drawing Codes:** With comprehensive research, a special drawing code is developed and circulated among all team members, so that the output is compatible for everyone.
- c) **Individual Buildings:** All reconstruction must specify the evidence used, and

according to the credit they contribute, an authenticity rating is determined for each work. Besides, all CAD drawings must be marked with the historical period of the reconstructed structure while also showing changes in the landscape. In case of conflicting evidences exist, multiple proposals must be produced and judged by open discussion.

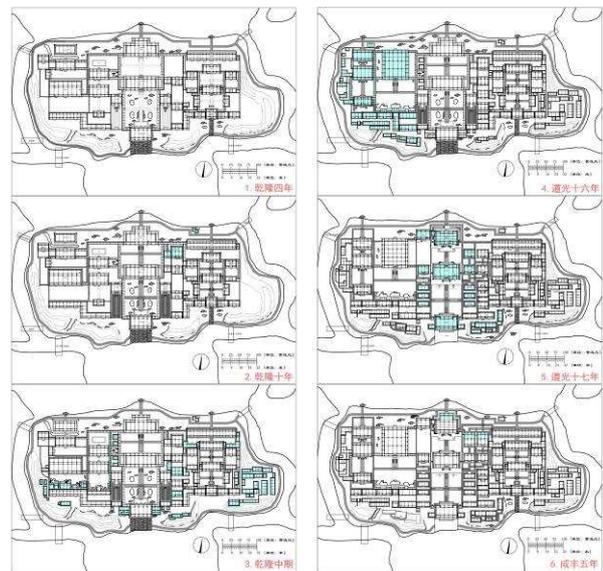


Figure 7. CAD Drawings of Jiuzhouqingyan at 6 Different Periods, with Changes Marked in Cyan

- d) **Modeling and Rendering:** Based on the CAD drawing, the structure is translated into 3D form, again keeping periodical informations in different strata. The architectural elements, based on well grounded research, are given realistic textures from buildings that survive with identical features. Even the sculpture around the building is reconstructed from similar existant models. The surrounding landscape and vegetation is also reconstructed based on historical records. All these together contribute to a maximum level of validity in reconstruction as well as realism in visual rendering.

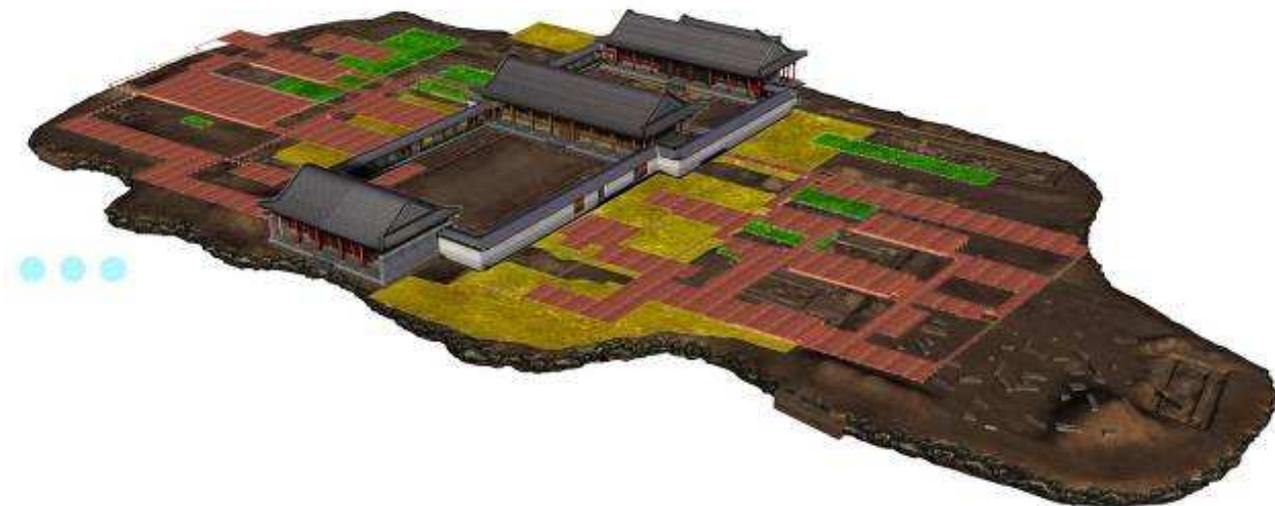


Figure 8. 3D rendering of Reconstructed Jiuzhouqingyan; Foundations at Various Periods are Marked with Different Colors



Figure 9. Reference Sculpture Captured for Reconstruction



Figure 10. Vegetation Used in Reconstructed Landscape

- e) Review and Transparency: The final output is then brought to an interanl meeting, and checked against each evidence used. After it get approved, the result is again published on the web for wider discussion. Whenever there is a valid feedback, the model is revised.

### 3.4 Virtual Reconstruction for Participation



Figure 11. Re-relic Website, Showing Jiuzhouqingyan where Visitors can Make Comments

With the advantage of virtual models, the result of reconstruction can be published in a variety of ways including videos, panoramas, and renderings on the network and microblogs for a greater audience. This cutting edge technology brings archaeology to the public in an unprecedented close distance to the good of heritage interpretation and education.



## 4 COMPARISON TO THE PRINCIPLES OF SEVILLE CHARTER

The *Yuanmingyuan* framework is a comprehensive model for the virtual reconstruction of timber-framed structure in East Asia. Comparison with the principles of Seville Charter shows many common characteristics.

### 4.1 Objectives

The *Yuanmingyuan* process shares with the Charter the aim to improve research in related disciplines. They both champion the application of digital methods and value the provision of an assessment for the quality of reconstruction. A guideline for public interpretation is also what the final output is intended.

### 4.2 Principles

The similarities in principles deserves further discussion. The *Yuanmingyuan* program embraces interdisciplinarity and started a new model for cooperation among architectural historians and other professionals (article 1.1). Complementarity (3.3) is a critical factor for timber-framed structure in East Asia since the major of the building is lost and virtual reconstruction is the optimum choice. The

Authenticity Rating (4.2) is an outstanding feature and respects Historical Rigour (5.2) along with the landscape reconstructed (5.3). Scientific Transparency (7.1) makes the whole endeavor a worthy campaign for the academia.

### 4.3 Contribution of the *Re-relic* program

The Construction Technique of Traditional Timber-framed Structure is at the very core of the entire program. The team recognizes the significance of a continued implementation of intangible heritage and deliberately applies it in a virtual manner. The inheritance of such knowledge deserve special attention where the archaeological remains are insufficient for a greater understanding of cultural heritage.

## 5 CONCLUSION

It is inspiring to know there is much commonality between East Asia and Europe in the rationale of virtual reconstruction. With experiences from on-going projects which is specially concerned with timber-framed structures, an international charter that covers both may be expected in the future. It shall incorporate the intangible heritage of the construction technique brought back to life in the digital age.

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