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Fujian earth castles. Knowledge and typo-morphological analysis for the protection and design of the study case: Yue Zhuangzhai

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Abstract

The work of documentation of part of fortified architecture in rammed earth and wood, typical of Fujian region in south-eastern China, represents the start of a research and cooperation project between DiCEM Department at Università degli Studi della Basilicata and Fuzhou University, determined by a MAECI co-funding project named "Youth Exchanges", for the cultural mobility of Italian and Chinese students[1]. Generally, three types of fortified vernacular architecture can be found in Fujian region, China: *Tulou*, *Tubao* (soil castle), and *Zhuangzhai*. Even though they are all residential buildings built in rammed earth, they are different historically, geographically, functionally and typologically.

Keywords: Documentation, renewal, rammed earth, Fujian.

1. Differences in development history

Zhuangzhai and *Tubao* share the same archetype of *Wubao* (坞堡), which can be dated back to as early as the Tian Feng Years (王莽天凤年, 14 AD-19 AD). The first *Tubao* in Fujian was built in the late Sui and early Tang Dynasty (580 AD-630 AD) and *Zhuangzhai* was started to build in the Tang Dynasty (618AD-907AD), which took shape in the late Song Dynasty (thirteenth century) and came into form in the Ming Dynasty (1368 AD-1644 AD), at the end of which, the multi-layer courtyard style started, with a multi-angle defense system. During the Qing Dynasty (1636 AD-1912 AD), *Zhuangzhai* flourished and started to disappear after the Republic of China established (1912 AD). Although the date of *Tulou*'s origin is controversial, we believe that *Tulou* originated in the middle and late Ming Dynasty (sixteenth-seventeenth centuries) by our field investigations and historical archive studies. Therefore, *Tubao* are the oldest and *Tulou* are the latest development among the fortified structures in Fujian Province.

2. Differences in Locations

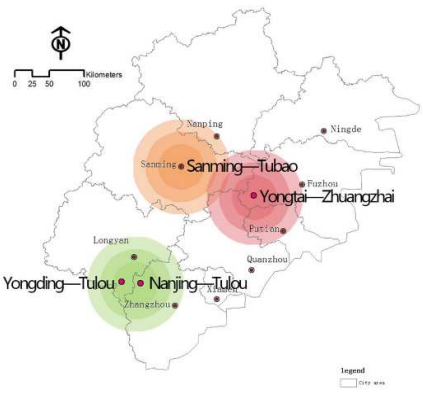


Fig. 1. Locations of *Zhuangzhai, Tulou* and *Tubao.*

As shown in Fig. 1, both *Tubao* and *Zhuangzhai* are scattered in the central Fujian and northwest Fujian, with Sanming and Yongtai as their centers respectively. *Tulou* are further down to the southwest, scattered around Yongding and Nanjing regions.

We used GIS to analyze the distribution of 152 *Zhuangzhai* within Yongtai county and found that: Firstly, the average nearest neighbor analysis (z-score value -0,83) indicates that *Zhuangzhai* has an apparent tendency of agglomeration. Secondly, the multi-distance spatial cluster analysis found that *Zhuangzhai* shows agglomeration at the scale of 10km. Thirdly, nuclear density analysis by sampling the 1-3km searching radius shows that they mainly concentrated on the northwest side of Dazhang River, including Dayang Town and Tongan Town, Xiajia Township and Pangu Township are the densest. The number of townships such as Songkou Town, Changqing Town, Fukou Township, Gaiyang Town, Qingliang Town, Danyun Township and Baiyun Township rank second (Figs. 2 and 3). Finally, the elevation analysis over the nuclear density map show the correlation between the location and the topographical and geomorphological characteristics. Most *Zhuangzhai* located on mountain areas with altitude of 590-1300 m, only a small part *Zhuangzhai* are located below 480 m above sea level in the valley and basin areas along the Dazhang River and its branches.

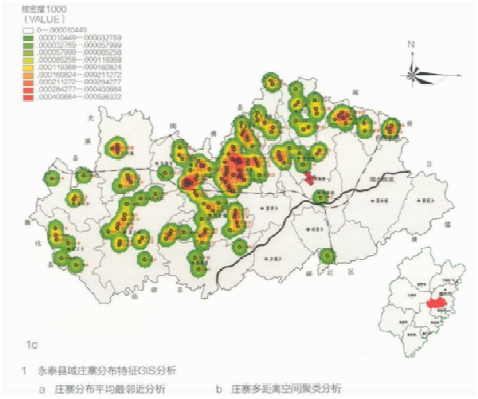


Fig. 2. Analysis of nuclear density of *Zhuangzhai* in Yongtai County (Zhang, BH *et al.*, 2019).

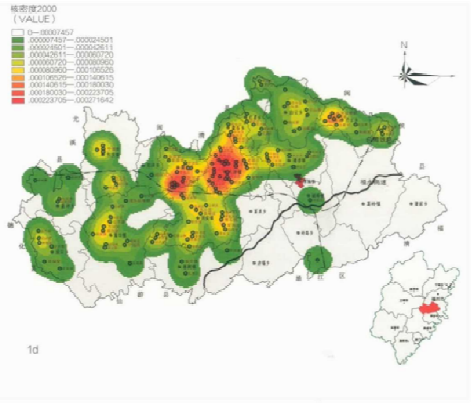


Fig. 3. Analysis of nuclear density of *Zhuangzhai* in Yongtai County (Zhang, BH *et al.*, 2019).

The five most popular locations of *Zhuangzhai* include: tableland, hillside, terrace, inside the field, and riverbank, which all close to the water sources and have a wide view (Fig. 4). In times of trouble, residents can take refuge in the building in time and sustain for weeks.

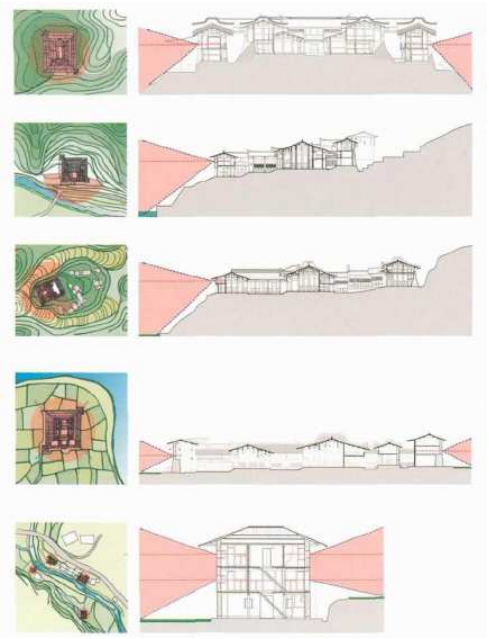


Fig. 4. Five most popular locations for *Zhuangzhai*: tableland, hillside, terrace, inside the field, and riverbank (top down).

3. Differences in functions

The priority of design for *Zhuangzhai, Tubao* and *Tulou* is very different. From the function point of view, *Tulou* are built mainly for daily living, defense is supplementary. We can tell this from the facts that *Tulou* use the outer ring buildings for both living and defense, while *Zhuangzhai* and *Tubao* both use the outer ring buildings for defense only, and their dwellers live in the inner courtyard dwellings behind the outer ring. *Tubao* are mainly built to defense, and its function of living and ritual worships go secondary. As such, the living facilities in *Tubao* are not necessary to be complete. Some *Tubao* do not have water wells, and dwellers can only get water through the gaps in the stone walls or from the mountain streams. Compared with *Tulou* and *Tubao*, *Zhuangzhai* is more defense and living balanced. Water wells and kitchens are necessities, and with the thoughtful considerations of social order, natural lighting, ventilation, drainage and other systems, they are more convenient and comfortable to live-in.

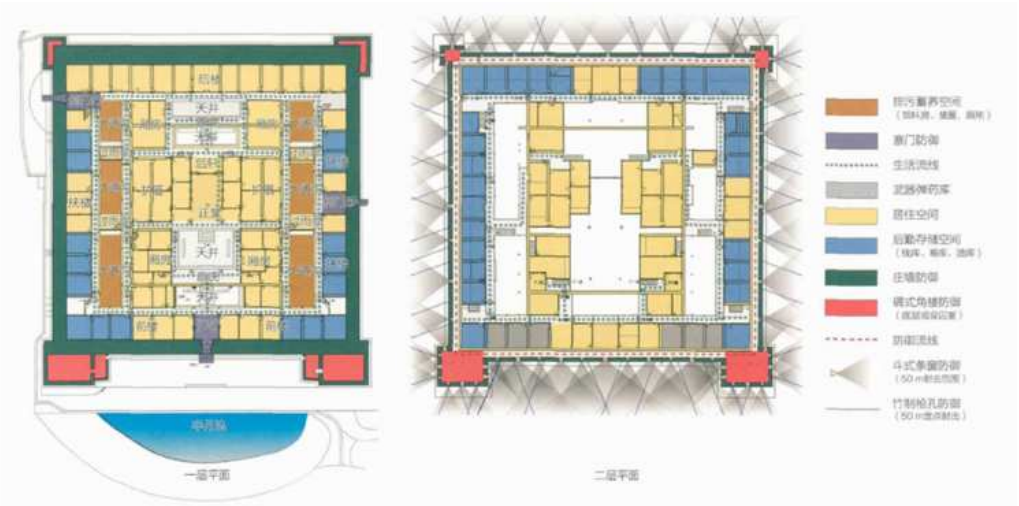


Fig. 5. Functional scheme of *Chengzhai Zhuangzhai* in Danyun Township, Yongtai County.

4. Differences in typology

4.1. The layout

Regarding the general layout, all three can be divided into internal and external parts. *Tubao* are the combination of the outer corridor and the inner courtyard dwelling or the determinant dwelling, while the inner dwellings of *Zhuangzhai* are either courtyard dwellings or outer-enclosed dwellings. *Tulou* are circular buildings with either single-ring or multi-ring.

4.2. The Watchtowers

There are watchtowers built in the corners of *Zhuangzhai*. A typical watchtower is convex and has three floors, the highest has four. There are turret holes in stone walls of the ground floor, on top of which is a gallery. Wooden ladders are put on the third floor. All three outer walls have bucket windows with equal distance and bamboo-made shooting holes pointing to different directions to defend the gate and the corners of the fort. *Tubao* have watch towers like *Zhuangzhai*, but built without stones and thus smaller in size. Some *Tulou* have floating watchtowers on the top floor only, and normally have no watchtowers built on the ground.

4.3. The Gate

Most gate of *Zhuangzhai* are rectangular, few are arched. The depth of the entrance is moderate and covered with the top stone to prevent attacks. *Tubao* gates are very strong. Most are arched, narrow and deep (up to 4-5 m).

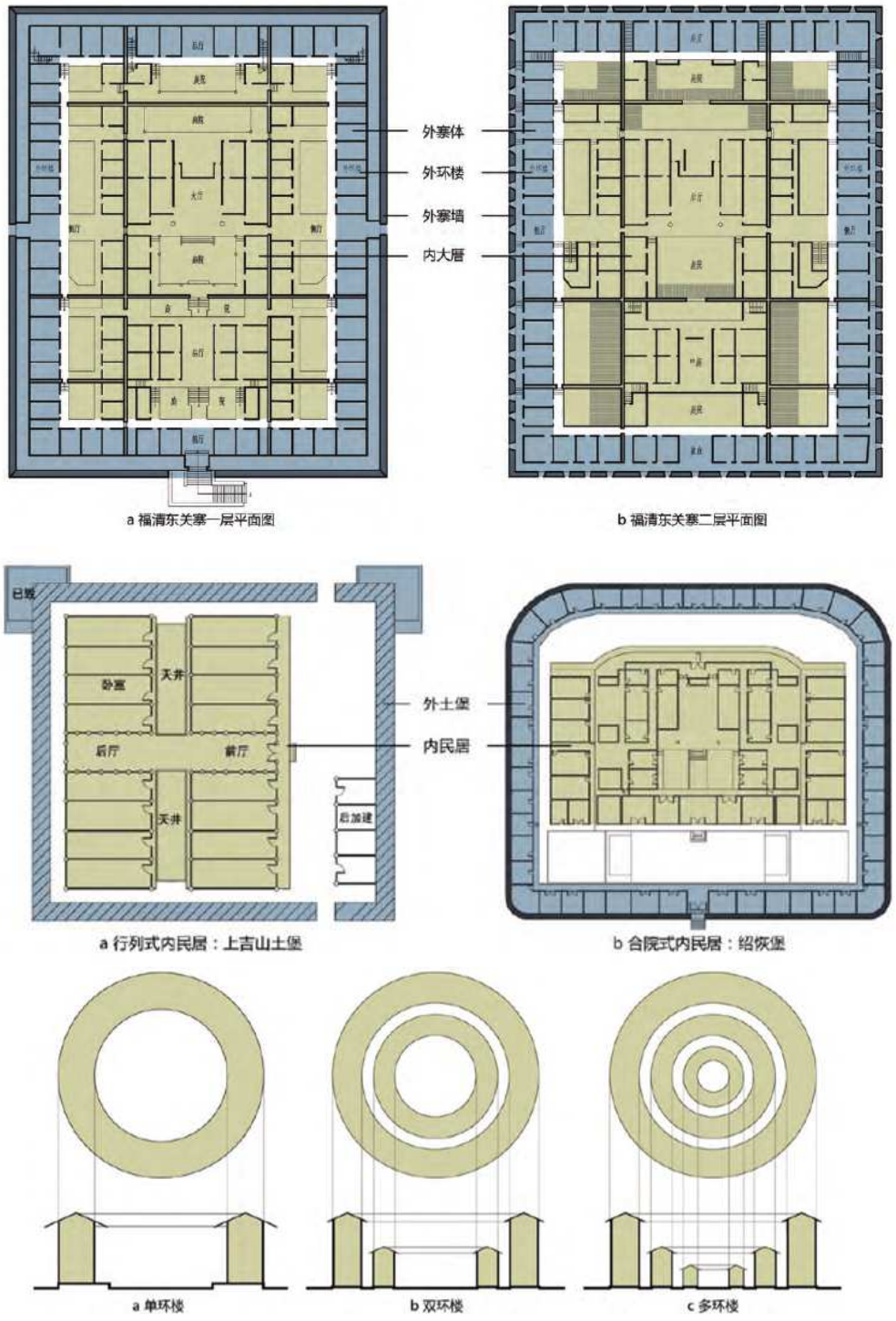


Fig. 6. The layout of: a) *Zhuangzhai*; b) *Tubao*; c) *Tulou*.

The *Tulou* gate are more decorative covered with stone carvings and paintings. They are framed by an inner layer of stone pillars and lintels. Its outer layer is constructed with fine stones mainly in square-and-circle combination. The thick hardwood door is covered with iron sheets, and locked with a horizontal bar. Over the entrance there are water tanks to put off fires.

4.4. The Structure

The outer structures of both *Zhuangzhai* and *Tubao* are independent from the dwellings inside. Therefore, the overall structure of the fortified can be divided into two parts: one is a structure consisting of an outer loop with a two-story corridor and a roof truss; the other is the buildings on the central axis. The exterior walls of *Tulou*, however, are dependent load-bearing walls, supporting buildings inside.

5. The case study for a regenerative design project: *Yue Zhuangzhai*

Tulou, Tubao and *Zhuangzhai*: three types of residential settlements with common characters, but each with its own history and constructive tradition to be investigated and to be disseminated. If *Tulou*, already listed on the UNESCO list since 2008, and *Tubao* "have already told their stories", the *Zhuangzhai* remain a typology still not many investigated.

This is the reality that we have decided to investigate, study and design. Research work has developed, not only on the constructive principles of Chinese architecture, but also on the profound influences that symbols, beliefs and philosophies have had on it. These arrangements cross the "three ways", the three perfections, the magic square and the *feng shui*, from architectural precepts to its typologies, up to the insights on the parts and constructive elements of fortified architecture in rammed earth with wood and stone.

The *Yue ZhuangZhai*, in YongTai district, has the name of the family that founded it in the eighteenth century and that still inhabits it in part. The current situation presents several additions and demolitions that modified the original plan. The entrance and the main façade were demolished in the 1970s, to realize a road linking neighboring villages. The original square plan was structured with a succession of three courtyards along the main axis and two lateral courtyards facing the family rooms on two levels, distributed by balconies. The second central courtyard houses the ancestors' altar. The defensive character of this architecture is given by the thickness of more than 2 m of the perimeter wall and by the presence of two defense towers placed along the diagonal of the building. The wall stands for 3 m, made by large blocks of river stone and for another 2 m built with the technique of rammed earth.

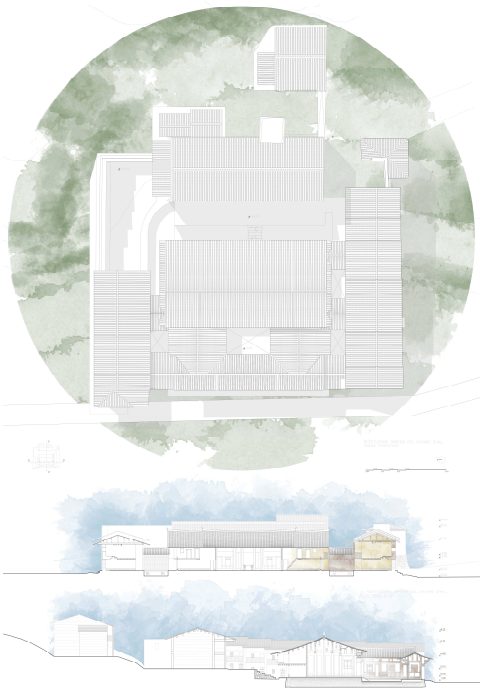


Fig. 7. Graphic elaboration of the Yue *Zhuangzhai* survey activities. Roofs plan and sections.

All the internal structures, the mezzanines, the vertical connections and the sloping pitched roofs are made with twines and local wood joints. The interest of protection and enhancement of these extraordinary artifacts lies in their uniqueness in close relationship with materials and land morphology of the place with which they establish a geometric-formal relationship. The research project and the experimentally design experience, identify characteristics and

forms of a possible sustainable maintenance program of the heritage, in relation to the rural landscape and its urban structure.

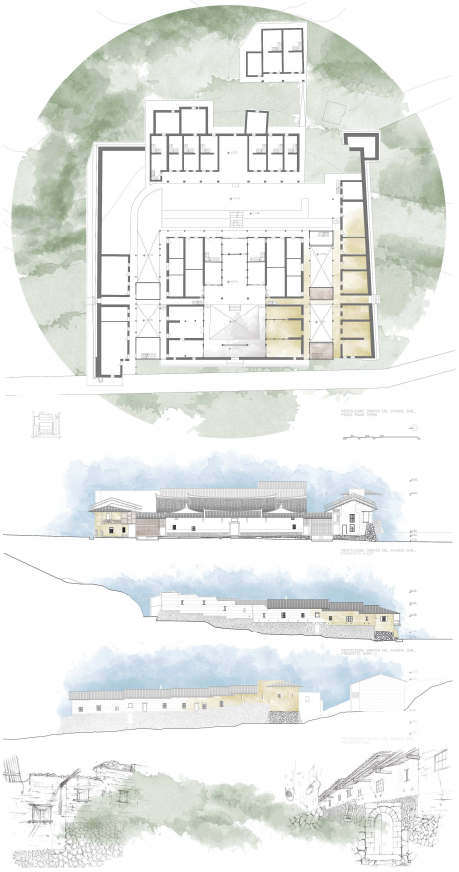


Fig. 8. Graphic elaboration of the Yue *Zhuangzhai* survey activities. Ground floor plan, facades and sketches.

6. Conclusions

The design experimentation started during the workshop and developed in the master thesis experiences[2], focused on reconstruction and restoration of some parts in ruins and some demolished, making use of tools and methods of architectural composition, restoration and urban regeneration. Knowledge and Design have often overlapped in respect of the local tradition between the western cultural approach of our formation and the more general shared of the types and models in the complex history of the ways of inhabiting the Earth. We tried to understand the needs of the territory and translate them into architecture and to interpret a way of life that represents a complex reality to be explored, valued and witnessed.

In this journey, which is all about understanding and appropriating diverse cultures, designing, thinking and building in distant landscapes, fully represents through the project, a testimony of continuity of collective works of an ancient tradition.

Notes

[1] The project winner of the co-funds by Italian Ministry of International Affairs (MAECI "*Scambi giovanili* 2018") was named: "Models of contemporary architecture in excavated landscapes. Sustainability and technological innovation. Case Studies between Basilicata and China". Scientific coordinator: prof. Arch. Antonio Conte. The project has been co-funded also by UNIBAS Rector, prof. Aurelia Sole, by the DiCEM Department and by FZU Rector, prof. Xiao-Hui Chen.

[2] Master Thesis name "Fujian Zhuangzhai: rammed earth fortified architecture as primary elements of the territory". Students name: Anna Lovino, Mara Manicone, Francesca Sbano. Supervisor: prof. Antonio Conte. Chinese tutors: Xin Wu, Chong Zhao. Italian tutors: Marianna Calia, Roberto Pedone.

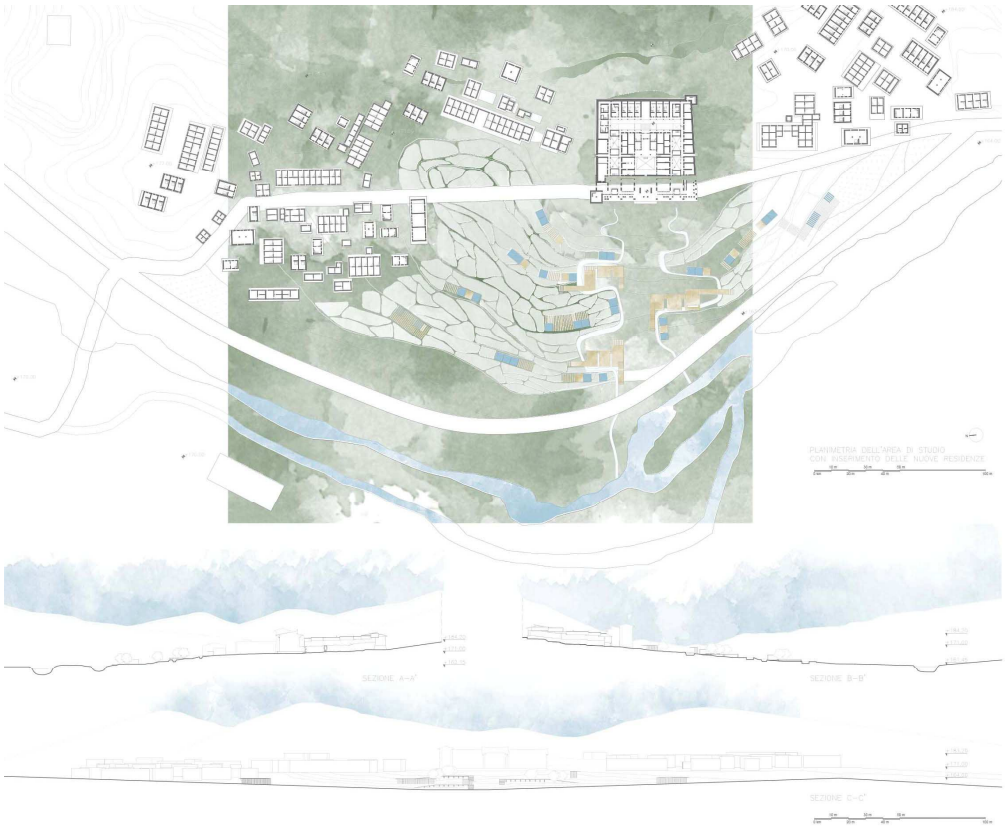
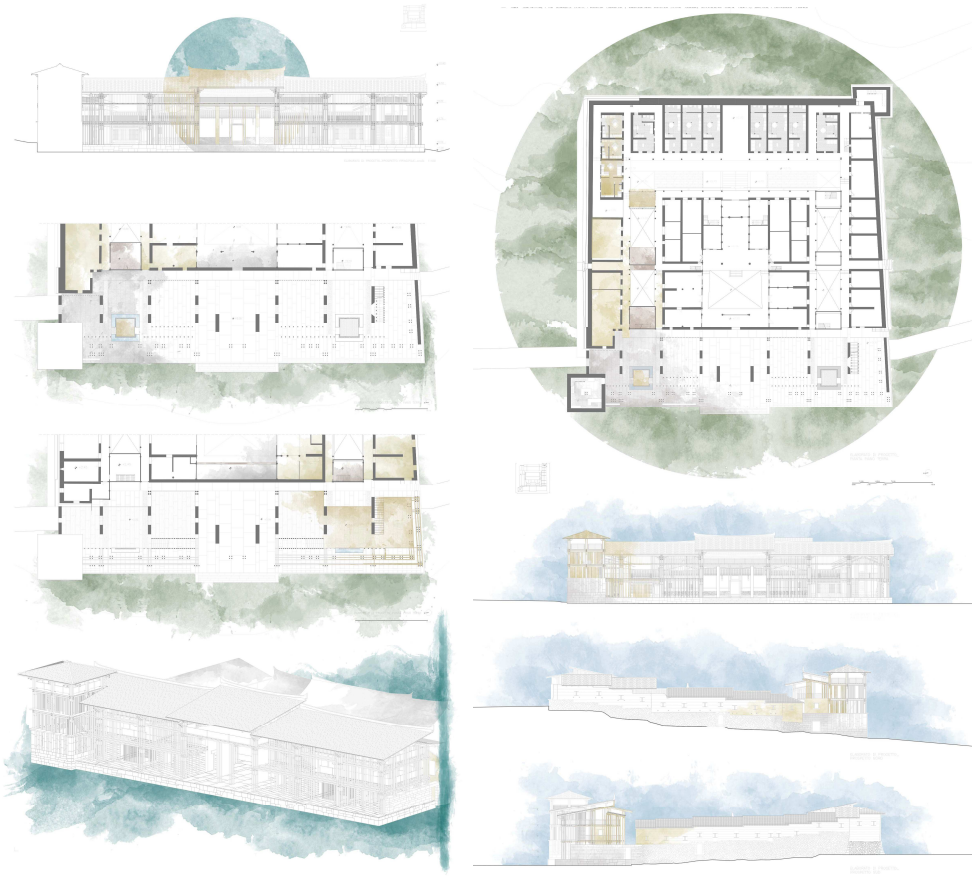


Fig. 9. Masterplan of the renewal project of the external area of the Yue *Zhuangzhai*.

Fig. 10. Axonometric view of the reconstruction project of the Yue *Zhuangzhai*.



Figs. 11-12. Graphic elaboration of the Yue *Zhuangzhai* project activities. Plans, sections, facades and axonometric view of the hypothesis of reconstruction of the destroyed front and of the entire new *zhuangzhai* shape.

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