



# Research on the Sustainable Renewal of Fujian Tubao under the Double Diamond Model

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**Abstract.** Under the rapid urbanization, the survival of local traditional culture faces significant challenges. The Fujian Tubao, a type of traditional Chinese dwelling, is confronting severe tests in terms of its inheritance and development. This study, guided by the Double Diamond Model, explores sustainable paths for the preservation of the Fujian Tubao. Utilizing methods such as field surveys, literature analysis, and in-depth interviews, the study clarifies the concept and theoretical application of the Double Diamond Model. It investigates the feasibility of applying this model to the renewal design of the Fujian Tubao and constructs a relationship framework between the model and the Tubao's design updates. The study proposes a design process that includes "discovering problems," "defining problems," "design development," and "solution determination." Following this process, strategies for updating the Fujian Tubao were explored. The application of the Double Diamond Model has established a reuse-oriented design update process for the Fujian Tubao, expanding new ideas for its revitalization and protection, and providing potential methods for achieving sustainable development.

**Keywords:** Fujian Tubao; Double Diamond Model; Renewal and Conservation; Sustainable Update; Architectural Culture.

## 1 Introduction

In the Fujian region of China, due to its unique natural environment and social historical background, there are numerous defensive structures built primarily to fend off bandits and protect local communities. The Fujian Tubao is a quintessential example of these defensive dwellings. Located in the central part of Fujian, the Tubao are characterized by their tall and thick walls, unique architectural features, and strong defensive capabilities. However, as modern life progresses, the lack of internal living facilities in the Tubao has become increasingly apparent. The outdated living conditions no longer meet the needs of the residents, leading to a gradual exodus from these

structures since the 1960s. This migration has resulted in the Fujian Tubao slowly fading from historical prominence<sup>[1]</sup>.

In recent years, the Fujian government has implemented a series of regulations to protect and manage traditional dwellings within its jurisdiction. These measures have somewhat improved the living conditions of the Fujian Tubao and slowed down their rate of decay. However, relying solely on preservation in situ cannot fundamentally prevent the decline of the Tubao. This approach restricts the interaction between the Tubao and the outside world, severing the paths of cultural transmission. To change this situation, it is essential to restore the functional use of the Fujian Tubao, ensuring that the architectural space is protected through active utilization. Guided by the Double Diamond Theory, this study explores the process of updating and repurposing the Tubao. The aim is to discover sustainable paths for the preservation of the Tubao through the application of the Double Diamond Model.

## **2 Research Subjects and Methodology**

### **2.1 Research Subjects**

Fujian Tubao is a distinctive type of defensive dwelling unique to Fujian Province, characterized by its unique architectural style (Figure 1). Historical records indicate that the Fujian Tubao first appeared during the Song and Yuan dynasties. The construction of Tubao reached its peak during the late Ming and early Qing dynasties and gradually declined during the late Qing and Republican periods. The architectural forms of Fujian Tubao are diverse, including rectangular, circular, square front with a round back, and irregular shapes. The outer walls of the Tubao are extremely sturdy, with stone foundations and rammed earth walls that are up to three meters thick. The tops of the walls feature open defensive corridors known as "galloping horse corridors," with slit windows for both observation and shooting. Sanming is the central region for the distribution of Fujian Tubao. Based on the number of existing structures, Youxi County, Datian County, Yong'an City, and Sha County have the highest concentrations of Tubao<sup>[2]</sup>.



Fig. 1. Fujian Tubao (Image source: Photographed by the author)

## 2.2 Research Methodology

This paper aims to propose a sustainable renovation design process for the Fujian Tubao, guided by the Double Diamond Model, using field research, case studies, and literature analysis methods. Field investigation is the primary research method employed in this study. Through participatory observation, interviews, and residential surveys, we analyze the current state of protection and utilization of the Fujian Tubao to determine the feasibility of applying the Double Diamond Model to their renovation design. Additionally, literature analysis is utilized to gain a comprehensive understanding of the overall research status of the subject, thereby enriching the theoretical and data knowledge base.

## 3 Interpretation of the Double Diamond Model Concept

### 3.1 Essence of the Double Diamond Model

In the early 21st century, the Double Diamond Model was proposed by the UK Design Council to guide the resolution of various design problems. This model breaks away from the linear approach of discovering and solving problems, enabling a progressive design process. Under the guidance of the Double Diamond Model, designers' thinking undergoes divergent and convergent cycles multiple times, forming two or more diamond shapes until the optimal solution is reached. Centered around the "people-oriented" concept, the Double Diamond Model divides the thinking process into four steps: discovering problems, defining problems, developing solutions, and delivering solutions<sup>[3]</sup>.

**Discovering Problems:** Through macro-level research combined with a variety of methods and tools, conduct an in-depth analysis of the current state of the problem. Employ divergent thinking to list all existing issues and related elements as comprehensively as possible.

**Defining Problems:** Based on the analysis of the research findings, use convergent thinking to summarize, refine, and categorize all identified problems, pinpointing the core issues.

**Developing Solutions:** Using the identified core issues, apply divergent thinking to design potential solutions. Evaluate these potential solutions systematically.

**Delivering Solutions:** Analyze, test, and experiment with all potential solutions from the previous stage to verify each one. Select the optimal solution and complete the final delivery of the solution<sup>[4]</sup>.

## **3.2 The Significance of Choosing the Double Diamond Model as Guidance**

### **3.2.1. Deconstructing the Thinking Process and Clarifying the Thought Logic**

The issue of updating the architectural space of the Fujian Tubao involves knowledge from multiple fields, making it an extremely complex process. In the early stages of design activities, understanding the current problems is often vague, and design ideas can be quite chaotic. Guided by the Double Diamond Model, the design thinking process is deconstructed and divided into two core parts: discovering the right problems and finding the right design solutions. Each part is further broken down into detailed steps.

#### **3.2.2. Identifying Core Issues and Designing Optimal Solutions**

The Double Diamond Model encompasses two types of thinking: divergent and convergent. Through divergent thinking, it allows for a broader and deeper exploration of the current issues of the Tubao and potential solutions. Convergent thinking then refocuses on the key points to identify core problems and the optimal renovation plan. During the divergent phase, the model promotes unrestricted and non-judgmental idea generation. Subsequently, each problem or solution is evaluated, scientifically retaining or eliminating options to uncover the core issues and optimal solutions.

#### **3.2.3. Advancing the Visualization of the Design Process**

The Double Diamond Model transforms the invisible, abstract thinking process of design into two visible diamond models, making each step clear and interconnected. The processes of posing, eliminating, retaining, and modifying problems are all well-founded, resulting in conclusions that are more persuasive and credible (Yu, 2021). By revealing the "invisible" elements of the design process and dividing them into four stages, the Double Diamond Model promotes a more intuitive and streamlined design process.

## **4 Establishing the Relationship Between the Double Diamond Model and the Renovation Design of Fujian Tubao**

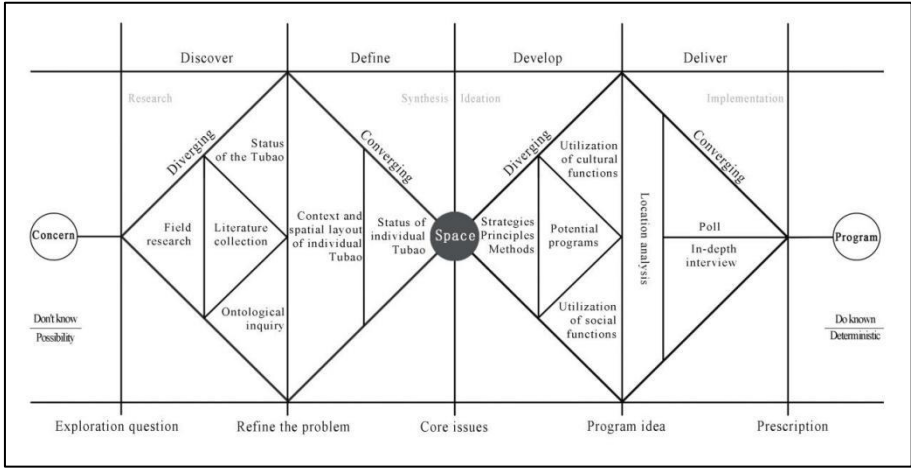
### **4.1 Feasibility of Applying the Double Diamond Model to the Renovation Design of Fujian Tubao**

The Double Diamond Model is an innovative tool based on systems thinking and service design concepts<sup>[5]</sup>. Its application can facilitate a more systematic and comprehensive approach to the preservation of Tubao. The design process followed by the Double Diamond Model aligns well with the steps required for the renovation of Tubao, ensuring the feasibility of applying this model to their protection.

By dividing the renovation process of Tubao according to the Double Diamond Model, we start in the first diamond by identifying the various existing issues of the Tubao (divergent thinking), and then focus on the core problems that urgently need resolution (convergent thinking). Moving into the second diamond, we propose multiple solutions for the primary issues faced by the Tubao (divergent thinking), and ultimately, based on research results, identify the optimal design solution (convergent thinking). Through this structured process of investigation and analysis, the Double Diamond Model provides an in-depth understanding of the preservation and renovation needs of the Tubao, offering directional guidance for future positioning and design goals, and developing more scientifically sound and effective renovation strategies.

### **4.2 Renovation Design Process for Fujian Tubao Based on the Double Diamond Model**

The Double Diamond Model is not static and can be adjusted and improved to address specific design problems. This paper proposes an adaptation of the Double Diamond Model to better suit the renovation design of the Fujian Tubao. By applying the thinking process of the Double Diamond Model, we establish a renovation design process for the Fujian Tubao. Modifications are made to the original model's steps of "Discovering Problems," "Defining Problems," "Developing Solutions," and "Delivering Solutions." The final updated process for Tubao renovation includes the steps: "Discovering Problems," "Defining Problems," "Design Development," and "Solution Determination" (Figure 2).



**Fig. 2.** Renovation Design Process for Fujian Tubao Based on the Double Diamond Model(Image source: Drawn by the author)

*(1) "Discovering Problems" Stage*

The "Discovering Problems" stage is the preliminary research phase for the Fujian Tubao. The research team conducted three field investigations over a total of 60 days, surveying more than 30 Tubao in Sanming City, Fujian Province. Using photography, mapping, and interviews with villagers, they recorded the historical information, spatial layout, and current preservation status of the Tubao. By analyzing historical materials such as local histories, county records, and family genealogies, they provided evidence for the historical evolution and construction process of the Tubao. This stage identified several common issues facing the Fujian Tubao today, which helped focus subsequent research on the most critical problems affecting their survival and development.

*(2) "Defining Problems" Stage*

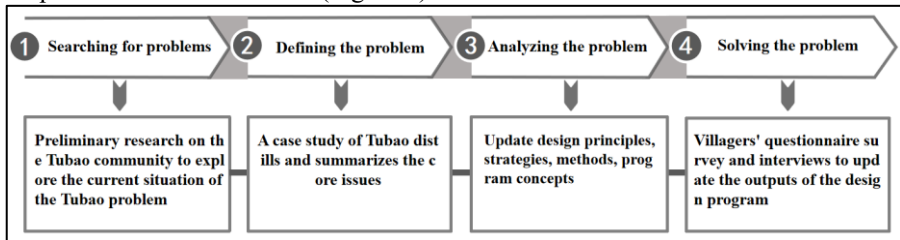
The "Defining Problems" stage involves consolidating and focusing on the various issues identified in the first stage. It aims to uncover the core contradictions behind the phenomena and select the most relevant information to determine the key problems [6](Wang, 2023). Based on the multiple issues discovered in the first stage regarding the Fujian Tubao communities, the research uses case studies to analyze the construction background, spatial layout, and current architectural status of individual Tubao. This approach allows for the extraction and summarization of current issues, ultimately defining the core problems of the Tubao.

*(3) "Design Development" Stage*

This stage involves the divergent ideation of solutions to address the problems defined in the previous two stages. Using case studies, the research follows the basic principles of architectural heritage protection and adaptive reuse. The strategies and methods for updating individual Tubao are summarized, resulting in a variety of potential multi-angle solutions.

#### (4) "Solution Determination" Stage

The "Solution Determination" stage is the final phase of the Tubao renovation design process, where the ideas generated in the previous stage are refined and consolidated. After identifying potential renovation design solutions for the Tubao, questionnaires and interviews are conducted with villagers to gather their opinions and suggestions. By integrating this feedback with considerations of architectural scale, spatial layout, and village location conditions, the most suitable methods for renovation and protection are determined (Figure 3).



**Fig. 3.** Four Steps in the Renovation Design of Fujian Tubao (Image source: Drawn by the author)

## 5 Conclusions

In recent years, with the rapid economic development and population growth in the Fujian region of China, most Fujian Tubao have been abandoned. Many of these dwellings have suffered from years of neglect<sup>[7]</sup>, leading to collapsed earthen walls and disassembled wooden structures. The reasons for this are twofold: First, with societal advancements and improvements in material living standards, the living conditions and facilities of Fujian Tubao can no longer meet the needs of modern residents. Second, a lack of ecological protection awareness, insufficient maintenance funds, and incomplete policies have led to the prolonged neglect and poor management of these dwellings<sup>[8]</sup> (Lin, 2021). Against this backdrop, this study applies the Double Diamond Model to the sustainable research of Fujian Tubao, exploring the feasibility and significance of using this model to guide the renovation design of Tubao. The study proposes a renovation design process for Fujian Tubao based on the Double Diamond Model. The results reveal that the Double Diamond Model offers three main advantages: advancing the visualization of the design process, designing optimal solutions, and clarifying thought logic. Following feasibility analysis, the study constructs the relationship between the Double Diamond Model and Tubao renovation design. The final renovation process for Fujian Tubao is determined to be four steps: "Discovering Problems," "Defining Problems," "Design Development," and "Solution Determination." "By applying the Double Diamond Model to the spatial renovation design of Fujian Tubao, this research aims to provide a suitable path for the sustainable preservation of Tubao<sup>[9]</sup> (Zhang, 2018). This ensures that while the Fujian Tubao are sustainably protected, they can also continue to serve functional roles in contemporary society.

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