Analysis of Rural Housing Design Optimization Based on Value Engineering

Li Peng1*, Huimeng Wu2, Wei Wei3, Jianglin Ma 4, and Siyu Li 5

1 Department of Construction Management, Sichuan Agricultural University, Chengdu, Sichuan, 611830, China
2 Department of Construction Management, Sichuan Agricultural University, Chengdu, Sichuan, 611830, China
3 Department of Construction Management, Sichuan Agricultural University, Chengdu, Sichuan, 611830, China
4 Department of Construction Management, Sichuan Agricultural University, Chengdu, Sichuan, 611830, China
5 Department of Construction Management, Sichuan Agricultural University, Chengdu, Sichuan, 611830, China

*Corresponding author’s e-mail: 1210447863@qq.com

Abstract. The design stage is an important period to control the cost of rural housing, and the key to design optimization is to determine the optimization object. Based on the theory of value engineering and the analytic hierarchy process (AHP), this paper constructs the evaluation model of the rural residential value, measures the value of the rural residence, determines the specific project objectives to improve the rural residential design optimization, and takes a rural housing in Suining as an example. Find the key optimization objects, namely masonry engineering, beam and slab engineering, thermal insulation engineering, door and window engineering, exterior wall decoration engineering, etc. From the perspective of cost control, put forward corresponding improvement suggestions. The results show that the principle of value engineering plays an important role in the optimization of rural residential design scheme, that is, to determine the key object of optimization in the design stage, and to find out the countermeasures to improve the value according to the matching degree of function and cost, so as to provide a reference and feasible way for the cost control of rural residential design stage.

1. Introduction

The report of the 19th National Congress of the Communist Party of China put forward the strategy of rural revitalization. Since then, the construction of villages and towns has become the focus of China's current work. According to statistics, with the development of China's social economy, the per capita housing area in rural areas has increased from 44.8m2 in 2000 to 45.8m2 in 2016, and the per capita housing area has increased by 23.3% [1]. The standards and requirements for the construction of rural houses are also constantly improving with the improvement of residents' living standards. Residents are no longer only satisfied with the basic functions of living quarters, but more pursuit of suitability, applicability, aesthetics and conformity with local culture under the premise of satisfying basic safety.
These factors have led to the rising cost of rural housing construction, which will directly affect the implementation of China’s “The Strategy of Rural Vitalization”. However, in the current construction of civil buildings in China, there are some characteristics, such as emphasizing cost management in construction process, neglecting cost control in design stage, emphasizing cost calculation and neglecting optimization of schemes [2]. According to the data, more than 75% of the project economy depends on the design stage. 35~75% of the project investment is determined by the preliminary design stage, and the remaining 5~30% is determined by the construction drawing design stage [3-5]. We can see that about 95% of the project economy depends on the design stage. Therefore, controlling construction costs from the design stage is the key to reducing the cost of rural housing.

As a functional analysis-oriented system decision-making method, value engineering is widely used in enterprise management and engineering projects [6]. In the first 10 years of the application of value engineering in the US military construction industry, only one department of the Military Engineering Agency saved about $200 million [7-8]. In the design phase of the Ohio River Barrage, using Value Engineering to Propose New Improvement Scheme, which saves 19.36 million dollars without affecting its functionality[9]. It can be seen that value engineering has a significant effect in adjusting the matching between product function and cost. This corresponds to the existing problems in rural residential construction. Rational use of this method is an effective way to optimize rural residential design.

In China, the application level of value engineering in various fields is different. Although it is widely used in the architectural field and covers all stages of construction, it still lacks mature and effective application methods. The basic application value engineering of a residential project in Guangzhou directly finds out the required functions of the house, summarizes its corresponding influencing factors, and refines the functions, but does not refine some of the projects, which increases the difficulty of actual implementation [10]. Wang Jing [11] takes a foundation project in Hebei Province as an example. Using value engineering, the specific values of people, materials and machines are brought into the model calculation, which increases the feasibility of the research results, but the research scope is small and cannot fully reflect the advantage of value engineering in controlling the total cost of large-scale engineering projects. When the domestic construction industry uses value engineering, it fails to match functions and costs one-to-one, or the analysis of functions and costs is not comprehensive. Therefore, this paper closely combines the functions and costs of a rural residential building in Suining City, combines local characteristics, establishes an evaluation system to make functions and costs one-to-one, and quantifies functions, using value engineering theory to express internal relationship between function and cost, which to measure the value scale of the house. And from the perspective of cost control, find out the key points of the scheme optimization of the research area and even the optimizing design scheme of rural residential buildings in China, and it can improve the economics of the project.

2. Rural residential value evaluation system and model construction

2.1. The basic concept of value engineering

Value engineering is an emerging management idea and management technology that combines economics and technology to effectively reduce costs and improve economic efficiency [12]. Its main role is to analyse the function and cost of the product (or service) and explore what kind of organizational activities can be used to reduce the cost of the product and achieve rational allocation of resources while ensuring the necessary functions.

Therefore, the principle of value engineering is generally expressed as in equation (1):

\[ V = \frac{F}{C} \]  

(1)

In equation: “V” stands for value, “F” stands for function, and “C” stands for cost.

From the equation, the intrinsic relationship between value, function and cost can be clearly and intuitively seen. Therefore, there are five ways to increase the value of the research object:

• Improve function and reduce cost at the same time;
• Keep the function unchanged and reduce the cost;
• Function is improved, and the cost remains unchanged;
• The function is slightly reduced, and the cost is greatly reduced;
• The appropriate increase in cost is exchanged for a substantial increase in functionality.

2.2. Rural residential function and cost analysis

2.2.1. Functional analysis. Function refers to the performance or use of the product, which is inversely proportional to the cost. The better the function of a product, the higher the cost. Functional analysis is the core content of value engineering. The quality of analysis greatly affects the accuracy of value engineering results. The purpose of functional analysis is to reduce costs from the perspective of villagers' needs and satisfy the functions of living and housing.

Rural housing is different from urban residential housing. It is not only a place where farmers live, but also an important place for farmers to prepare for production activities, store production tools and materials, crop drying, raise poultry and so on. Therefore it has the dual nature of life and production [13]. With the development of the national economy, the living standards of farmers have been greatly improved. Their demand for residential functions has long been not limited to meeting the needs of daily life and labor production, and more and more attention to comfort, aesthetics, intelligence and other aspects of the pursuit. Besides this, the ideological concepts of the rural people are also significantly different from those of the urban residents. The concepts of the villagers are mostly more traditional, and they pay more attention to the customs and culture. In addition, coupled with the strengthening of the protection of local culture by the national government in recent years, more cultural characteristics are integrated into the rural architectural design, such as the Hui style's silk wall, Daiwa, Ma Tou wall, and the green bricks and tiles of the folk houses in Western Sichuan, all of which reflect the local customs and culture. Therefore, when analyzing the functions of rural houses, in addition to considering the functions that ordinary houses must have, such as safety, practicality, aesthetics and so on, it should also take into account the functions of facilitating production and conforming to local customs and culture.

| Features                      | Analysis                                                                                                                                                                                                 |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Safety and stability          | The most basic function of the house, which is reflected in the structural design of the house. It should be able to meet the structural load requirements, and has sufficient reliability and durability.                        |
| Living comfort                | Pursuing the comfort of life is the goal of living in the main body. It is reflected in the electrical and other infrastructure to facilitate people's daily life and living.                                      |
| Production suitability        | The indispensable function of rural residences refers to the ability to meet the production needs, provide people with places to store production crop drying, raising poultry, and engaged in productive labour. There are often indoor warehouses, outdoor courtyards, independent livestock sheds and so on. |
| Environmental adaptability    | Due to the different natural geography and climatic conditions of each place, their design priorities and plans vary from place to place. This paper mainly considers the adaptability to the local climate, and analyses it from the aspects of insulation and waterproofing. |
| Aesthetic appearance          | Modern residential housing pays more attention to the shape design, and rural housing is no exception. The pleasing appearance is often favored by more people.                                                  |
| Cultural fit                  | The countryside is the birthplace of excellent traditional culture. It carries unique folk customs and integrates rural regional cultural elements into architectural design. It is an important measure in the context of rural cultural revitalization. |
cost is the largest and is highly susceptible to the design plan. The fees, and taxes are affected by various rates and policies, and their impact is relatively fixed. Therefore, each specific sub-project of rural housing is the key object of cost analysis, which is helpful to find out the key to optimization and propose targeted optimization countermeasures. The cost analysis of rural housing should take the partial project as the important research object, and make a brief introduction to the influence of the cost of the divided project on the total cost.

2.3. Construction of rural residential value evaluation system

According to the functional analysis and cost analysis mentioned above, we can find the bridge between function and cost, such as safety, to achieve this function, we must consider the design of basic, main structure and other projects; to satisfy the aesthetic appearance, it is necessary to considering the decorative design, and so on, and by analogy, find relevant indicators, and link the function of residential design with the cost.

Therefore, based on the principle of representativeness, comprehensiveness and pertinence, this paper considers the correspondence between residential functional factors and cost composition. The construction value evaluation system is shown in Table 2:

| Target layer | Criteria layer | Indicator layer |
|--------------|----------------|----------------|
| Rural living Home value | Safety stability A | Basic engineering A1 |
| | | Masonry engineering A2 |
| | | Beam and plate engineering A3 |
| | Living comfort B | Water supply and drainage project B1 |
| | | Strong electricity engineering B2 |
| | | Weak current engineering B3 |
| | Production suitability C | Courtyard engineering C1 |
| | | Independent poultry house project C2 |
| | Environmental adaptability D | Waterproof and damp proof engineering D1 |
| | | Thermal insulation engineering D2 |
| | Aesthetic appearance E | Roof decoration project E1 |
| | | Door and window engineering E2 |
| | | Enclosing wall engineering E3 |
| | Cultural fit G | Exterior wall decoration engineering G1 |
| | | Interior decoration project G2 |

2.4. Construction of Rural Housing Evaluation Model Based on Value Engineering

2.4.1. Determination of the functional coefficient. The function is qualitative, its coefficient is more difficult to determine, and it needs to be quantified by certain mathematical methods. In value engineering, the method of determining functional coefficient is divided into subjective weighting method and objective weighting method. Subjective method includes FD scoring method and ring ratio scoring method, which is limited by the influence of subjective consciousness. Objective weighting method is to use objective information to determine the weight by statistical data analysis, and can guarantee the accuracy of the result [14]. In order to avoid the subjective arbitrariness of weight determination, this paper will adopt the objective weighting method-AHP to determine the functional coefficients. The specific steps are as follows:

1) Construction of judgment matrix
Questionnaires on the design of residential construction in rural areas, and interviewed relevant personnel engaged in rural construction, so that they can use the design criteria of the 1-9 scale method based on the existing experience and the design criteria. Perform a pairwise comparison between the same level indicators as the initial data, so as to determine the element value of the judgment matrix, and then forming a judgment matrix $A_x$.

### Table 3. Scale meaning

| Scaling | Meaning                                |
|---------|----------------------------------------|
| 1       | Two factors are equally important      |
| 3       | One factor is slightly more important than the other |
| 5       | One factor is significantly more important than the other |
| 7       | One factor is more important than the other |
| 9       | One factor is more important than the other |
| 2, 4, 6, 8 | Between the above two meanings       |

2) Maximum eigenvalue solution

Using the square root method to find the maximum eigenvalue $\lambda_{\text{max}}$ and the corresponding feature vector, the feature vector is normalized to arrive at the weight of one factor on another, and the equation is:

$$M_i = \prod_{j=1}^{n} a_{ij}, \quad i = 1, 2, \ldots, n$$  \hspace{1cm} (2)

$$\hat{W}_i = M_i^{1/n}$$  \hspace{1cm} (3)

$$W_i = \hat{W}_i / \sum_{i=1}^{n} \hat{W}_i$$  \hspace{1cm} (4)

In the equation: “$a_{ij}$” is the element in judging matrix; “$n$” is the number of rows in the matrix; “$M_i$” is the vector obtained by multiplying each row of the judgment matrix; $\hat{W}_i$ is a vector obtained by opening the n-th root of the component of vector $M_i$; $W_i$ is the normalized eigenvector of $\hat{W}_i$.

3) Consistency test

The judgment matrix must be tested for consistency to avoid contradiction in relative weights, test with consistency indicator CR, If $CR \leq 0.1$, the consistency test is passed, and the constructed judgment matrix is feasible. Otherwise, it is not feasible. The relevant equation is as follows:

$$CI = \frac{\lambda_{\text{max}} - n}{n - 1}$$  \hspace{1cm} (6)

$$CR = \frac{CI}{RI}$$  \hspace{1cm} (7)

| $n$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----|---|---|---|---|---|---|---|---|---|----|
| RI  | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

4) Functional coefficient

After the consistency test is passed, the weight of each level of the indicators can be obtained, and the comprehensive weight of the index is $b_i$. At the same time, consulting 5 relevant experts, and let them score each part according to the design plan (10-point system) and then getting the evaluation set $D$, combined with the functional weight to calculate the functional coefficient of each indicator.

$$F_i = \frac{b_i \times D_i}{\sum_i (b_i \times D_i)}$$  \hspace{1cm} (8)

### Table 4. Random index

| $n$ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----|---|---|---|---|---|---|---|---|---|----|
| RI  | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

### Table 5. Score sheet

| Evaluation level | Difference | General | Good | Excellent |
|------------------|------------|---------|------|-----------|
| Score            | 0−4        | 4−6     | 6−8  | 8−10      |
2.4.2. Determination of cost coefficient. In comparison, the cost of rural housing is quantitative because of itself, and the cost coefficient is easy to determine, that is, cost-to-cost ratio of each indicator to the sum of costs, as follows:

\[ C = \frac{c_i}{\sum c_i} \quad (9) \]

2.4.3. Calculation and evaluation of value coefficient. Based on the function coefficient F and the cost coefficient C obtained in the previous section, according to the value equation (1), the value V corresponding to each index can be calculated, and compared with 1 to evaluate and find out the key objects that should be optimized in the design stage.

| Value coefficient | Evaluation results |
|-------------------|-------------------|
| \( V \gg 1 \)     | The cost is too low, and its functional needs may not be guaranteed. Appropriate cost should be added. |
| \( V \approx 1 \)  | The cost of this design is appropriate for its function and is ideal. |
| \( V \ll 1 \)     | If the cost is too high, the cost should be reduced, otherwise it will cause unnecessary increase in cost or excessive function. |

3. Application examples

3.1. Construction Project Overview

The construction project is a small three-storey rural residential building in Suining City of Sichuan, with an area of about 194.94 m² and a building height of about 9.9 m. It is a brick-concrete structure with a strip-shaped concrete foundation. The main material of the wall is porous shale bricks. The windows are made of aluminium alloy windows and have an independent courtyard with an area of about 60 m² and a wall around it. The main cost of the project is about 320,000 yuan, the cost is about 1,640 yuan / m², and the cost of the courtyard is about 7,000 yuan / m².

3.2. Functional coefficient

3.2.1. Constructing Judgment Matrix. Through questionnaire survey and data collection, the judgement matrix \( A_x \) is established as follows:

\[
A = \begin{bmatrix}
1 & 3 & 3 & 5 & 6 & 6 \\
1/3 & 1 & 1/2 & 3 & 3 & 3 \\
1/3 & 1 & 1 & 3 & 4 & 4 \\
1/5 & 1/3 & 1/3 & 1 & 2 & 2 \\
1/6 & 1/3 & 1/4 & 1/2 & 1 & 1 \\
1/6 & 1/3 & 1/4 & 1/2 & 1 & 1
\end{bmatrix}
\]

\[
A_a = \begin{bmatrix}
1 & 2 & 3 \\
1/2 & 1 & 2 \\
1/3 & 1/2 & 1
\end{bmatrix}
A_b = \begin{bmatrix}
1/3 & 1/3 & 2 \\
3 & 1 & 3 \\
1/2 & 1/3 & 1
\end{bmatrix}
A_c = \begin{bmatrix}
1 & 2 \\
1/2 & 1
\end{bmatrix}
A_d = \begin{bmatrix}
1 & 1/4 \\
4 & 1
\end{bmatrix}
A_e = \begin{bmatrix}
1 & 4 & 3 \\
1/4 & 1 & 1/3 \\
1/3 & 3 & 1
\end{bmatrix}
A_f = \begin{bmatrix}
1 & 1/4 \\
4 & 1
\end{bmatrix}
\]
3.2.2. Finding the greatest eigenvalue and carrying on consistency check

Table 7. Maximum eigenvalue and consistency test result

| Matrix | $\lambda_{\text{max}}$ | CI | RI | CR | Test result |
|--------|----------------------|----|----|----|-------------|
| A      | 6.143                | 0.029 | 1.24 | 0.023 | by |
| $A_a$  | 3.009                | 0.005 | 0.58 | 0.008 | by |
| $A_b$  | 3.054                | 0.027 | 0.58 | 0.046 | by |
| $A_c$  | 2.000                | 0.000 | 0  | 0.000 | by |
| $A_d$  | 2.000                | 0.000 | 0  | 0.000 | by |
| $A_e$  | 3.074                | 0.037 | 0.58 | 0.063 | by |
| $A_g$  | 2.000                | 0.000 | 0  | 0  | by |

3.2.3. Calculating index weight. Calculating the comprehensive weight of each index, and the results are as follows:

Table 8. Functional weight

| Index | A  | B  | C  | D  | E  | G  | Comprehensive weight | Normalized weight |
|-------|----|----|----|----|----|----|----------------------|-------------------|
| A1    | 0.540 | 0.230 | 0.224 |
| A2    | 0.297 | 0.127 | 0.123 |
| A3    | 0.163 | 0.070 | 0.068 |
| B1    | 0.259 | 0.042 | 0.040 |
| B2    | 0.618 | 0.099 | 0.096 |
| B3    | 0.163 | 0.026 | 0.025 |
| C1    | 0.333 | 0.074 | 0.072 |
| C2    | 0.667 | 0.148 | 0.144 |
| D1    | 0.943 | 0.078 | 0.076 |
| D2    | 0.236 | 0.020 | 0.019 |
| E1    | 0.680 | 0.037 | 0.036 |
| E2    | 0.130 | 0.007 | 0.007 |
| E3    | 0.297 | 0.016 | 0.016 |
| G1    | 0.667 | 0.036 | 0.035 |
| G2    | 0.333 | 0.018 | 0.018 |
Finally, the functional coefficients of each index are calculated by five experts' scores and combined with functional weights. The results are shown in Table 9 below:

### Table 9. Function coefficient

| Index   | A1     | A2     | A3     | B1     | B2     | B3     | C1     | C2     |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| F       | 0.234  | 0.119  | 0.069  | 0.063  | 0.029  | 0.165  | 0.031  | 0.012  |
| Index   | D1     | D2     | E1     | E2     | E3     | G1     | G2     |
| F       | 0.021  | 0.069  | 0.035  | 0.007  | 0.017  | 0.035  | 0.020  |

### 3.3. Cost Coefficient

According to the construction drawings, the cost of each index in the evaluation system is calculated by using the relevant valuation software, and then the cost coefficient is determined. The results are shown in Table 10 below:

### Table 10. Cost Coefficient

| Index             | A1     | A2     | A3     | B1     | B2     | B3     | C1     | C2     |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Ci                | 138.34 | 390.19 | 226.32 | 61.59  | 119.93 | 20.50  | 104.30 | 79.93  |
| C                 | 0.074  | 0.209  | 0.121  | 0.033  | 0.064  | 0.011  | 0.056  | 0.043  |
| Index             | D1     | D2     | E1     | E2     | E3     | G1     | G2     |
| Ci                | 48.33  | 94.47  | 76.13  | 84.97  | 20.40  | 240.63 | 160.70 |
| C                 | 0.026  | 0.051  | 0.041  | 0.046  | 0.011  | 0.129  | 0.086  |

### 3.4. Value Coefficient

According to the calculated function coefficient and cost coefficient, the value coefficient of each indicator in this case can be obtained, as shown in the following table:

### Table 11. Value coefficient

| Index                          | Functional coefficient | Cost coefficient | Value coefficient |
|-------------------------------|------------------------|------------------|-------------------|
| Basic engineering A1          | 0.234                  | 0.074            | 3.163             |
| Masonry engineering A2        | 0.119                  | 0.209            | 0.571             |
| Beam and plate engineering A3 | 0.069                  | 0.121            | 0.568             |
| Water supply and drainage project B1 | 0.042         | 0.033            | 1.261             |
| Strong electricity engineering B2 | 0.090           | 0.064            | 1.402             |
| Weak current engineering B3   | 0.027                  | 0.011            | 2.460             |
| Courtyard engineering C1      | 0.067                  | 0.056            | 1.206             |
| Independent poultry house project C2 | 0.137            | 0.043            | 3.201             |
| Waterproof and dampproof engineering D1 | 0.083     | 0.026            | 3.220             |
| Thermal insulation engineering D2 | 0.016             | 0.051            | 0.324             |
| Roof decoration project E1    | 0.035                  | 0.041            | 0.869             |
| Door and window engineering E2 | 0.007                  | 0.046            | 0.158             |
| Enclosing wall engineering E3 | 0.017                  | 0.011            | 1.573             |
| Exterior wall decoration engineering G1 | 0.035        | 0.129            | 0.269             |
| Interior decoration project G2 | 0.020                  | 0.086            | 0.231             |

From the above results, it can be seen that the value coefficient of the water supply and drainage project B1, the strong electricity engineering B2, the courtyard engineering C1, the roof decoration project E1, and the enclosing wall project E3 is close to 1 in the construction of rural houses, and the cost of this part of the design scheme is appropriate to its function, which is ideal and can’t be
optimized. However, the value coefficients of the masonry construction A2, the beam and plate engineering A3, the thermal insulation engineering D2, the door and window engineering E2, the exterior wall decoration engineering G1 and the interior decoration engineering G2 are far less than 1, which indicating that the function is insufficient and the costs are very high. The allocation of the two projects is unreasonable, and they belong to the object of key optimization. In addition, the value coefficient of the basic engineering A1, the weak current engineering B3, the independent poultry house project C2, the waterproof and dampproof engineering D1 is much larger than 1, indicating that the functions have met the requirements or even exceeded the standards at lower cost. In such cases, the necessary functions can be retained, some functions can be reduced appropriately, and the cost can be further saved on the premise of meeting the basic functions.

3.5. Optimization recommendations

3.5.1. Masonry Engineering Optimization. In the case project, the upper main structure is brick-concrete structure, and the cost of masonry engineering is the most, and the filler wall material is the main factor affecting the cost. The outer wall and inner wall of the engineering design use shale porous bricks uniformly, and the unit price of shale hollow bricks is much lower than that of porous bricks. Although the shale hollow bricks have low strength, high brittleness and poor seismic performance, they are energy-saving, environmentally friendly and qualitative. It has good performance in many aspects such as light and thermal insulation. It is often used for partition walls, especially for kitchens, bathrooms and so on, which can reduce the life cycle cost of the house. Therefore, it is possible to use partial perforated bricks without affecting the structural load-bearing. Replacement of hollow bricks will reduce the thickness of the inner wall without load bearing, thus reducing the cost.

3.5.2. Independent poultry house optimization. The geographical location and production of the main crops affect the production applicability of most rural houses in Suining. Pigs, fruits and oils are the main agricultural products of Suining, and the corresponding pig sheds and crop storage rooms and courtyards need to be built outside the main subjects of the house. It fits the farmer's production and lifestyle. The functions of pig shed, such as ventilation and ventilation, large space for use, water lighting, and so on, need the combination of plane and space design, doors and windows projects and hydropower projects to meet.

3.5.3. Optimization of door and window engineering. The doors and windows of the house affect the lighting performance and ventilation of the building. In the project of this case, it only achieves lower door and window engineering functions with higher cost. Therefore, in the design stage, the number of windows and doors should be taken into account first, so as to avoid structural instability and waste of resources caused by opening too many openings under the condition of meeting reasonable needs; secondly, we should also pay attention to the material used when designing. Suining is a typical traditional village with a rich cultural heritage in central Sichuan. Wooden windows are one of its architectural features. The use of wooden windows not only reduces costs, but also makes the building more aesthetically pleasing and reflects local cultural characteristics.

3.5.4. Optimization of exterior wall decoration engineering. The value coefficient of Exterior wall decoration engineering is small, which is one of the key points in the design optimization of this project. The exterior wall of the house is mainly decorated with tile veneers. Although it is aesthetically pleasing and meets functional requirements, the cost is too high, resulting in low value. So it is necessary to consider using suitable materials to avoid excessive cost and waste. It is also necessary to prevent blind pursuit of the function of the economy. Compared with other indicators, the exterior wall decoration can best reflect the regional cultural characteristics. Therefore, when designing the exterior wall, we should also combine the customs and culture of the Suining area, such
as the popular Buddhism Guanyin culture in the local area, and adding Buddhist cultural elements to the decoration. Improving the cultural to fit and increase its value from the aspect of function.

4. Conclusion
Through the application of value engineering theory, this paper analyses the factors affecting the function and cost of rural housing, constructs the evaluation system of rural residential value engineering, and selects the analytic hierarchy process to determine the functional coefficient, which improves the accuracy of functional evaluation, and thus ensures the effective value of each index. Combining with the actual case, the relationship between function and cost is quantified, and the matching between them is clearly and intuitively reflected. The key objects of optimization in the design stage are found, and appropriate optimization strategies are proposed to reduce the cost under the necessary functional conditions. Practice has proved that in the background of new rural countryside construction, this method theory can not only meet the different special functional requirements between rural and urban housing to the greatest extent, but also improve the economics of housing and reduce the housing economic burden of farmers. In this way, the reasonable investment can be realized, the maximum benefit of resource combination can be obtained, and the optimal allocation of resources can be promoted. It is of great practical significance to the cost control in the design stage of rural housing.

References
[1] National Bureau of Statistics. (2017) China Statistical Yearbook. http://www.stats.gov.cn/tjsj/ndsj/2017/indexch.htm
[2] Yang, Y. (2015) Application of value engineering in cost control of construction engineering design stage. Architecture, Building Materials, Decoration, 14: 31-31.
[3] Bao, C.L. (2015) Design optimization and examples of building structures. Real estate guide, 11: 79-79
[4] Yu C.C. (2015) Cost management in design phase based on BIM under LCC theory. (Doctoral dissertation).
[5] Wan, L., Wang Q., Li Y.C., Tian P.Y. (2019) Application of BIM technology in cost control of construction projects. Value Engineering, 38 (01): 185-187.
[6] SAVE International, U.S. (1997) Government Value Engineering Requirement. http://www.value-eng.com/aboutgov.
[7] Male, S., Gronqvist, M., Kelly, J., Fernie, S. and Bowles G. (1998) International Benchmarking of Value Management: The Establishment of Best Practice, Value Manage, et. The Hong Kong. Institute of Value Management, Vol.4, No.3: 7-10, Vol.4, No.4: 9-12
[8] Binová, H. (2014) Value Engineering and its Application in the Design and Implementation of a Logistics Centre. Transactions on Transport Sciences, 2: 7-7
[9] Gregerson, J. (2014) Value Engineer Is Invaluable to clients. ENR: Engineering News-Record. No4, Vol.283.
[10] Liang Z.J. (2012) Application of value engineering in DXC residential project design stage. (Doctoral dissertation, South China University of Technology)
[11] Wang J. (2018) Research on cost management of foundation treatment project based on value engineering. (Doctoral dissertation).
[12] Lu H., Chen X.F. (2011) Application of Value Engineering in Construction Projects. Science and Technology Plaza, 3: 228-230.
[13] Zeng D.Q. (2018) A Brief Analysis of the Functions of New Rural Housing. Scientific and Technological Innovation, 20: 118-119.
[14] Yang H., Wan Z.L. (2005) Method of determining functional weight in value engineering. Journal of Xihua University: Natural Science Edition, 24 (2): 77-79.