An Empirical Study on the Influence Factors of Villa Courtyard Design Based on the Perspective of Living needs

Jinyu Wang¹, Nan Nan²*

¹Shi Jia Zhuang University of Applied Technology, Shijiazhuang 050081, China
²XuZhou University of Technology, Xuzhou 221116, China.

Abstract

Villa is a kind of high-end residential form in the suburbs or scenic areas with the functions of recuperation and enjoyment. Covering large area, villa's architectural style is generally consistent with the environmental and geographical location, and it usually has higher building level; compared with average houses, it also has such special places as the courtyard, which is suitable for the way of landscape design to achieve the goal of improving the overall design level of villa. With the continuous development of real estate and tourism, villa construction level is also rising, and gradually develops in the direction of the economization, making villa courtyard design more and more important. In essence, however, villa should provide the residents with the function of dwelling, which requires that people's living need be taken into consideration in the design of villa courtyard to achieve the optimal courtyard design result highlighting the delight of life and to enhance the overall design level of the villa. This paper first establishes the villa courtyard design quality extension superiority evaluation theory model, then expounds the indicators of living need in the design of villa courtyard in the environmental psychology perspective, and puts forward the train of thought of villa courtyard design to achieve the core aim of enhancing the villa courtyard design level.

Keywords: Living Need, Courtyard Design and Villa.

1. RESEARCH OVERVIEW

1.1 Research background

Villa can provide people with a high-quality life style different from that of traditional high-density residential areas, which is reflected neither in the special construction ways of villa nor in the indoor decoration. In traditional high-density residential areas, people spend most of their time indoors, and only a few of them are spent in the balcony or neighborhood. In the villa, in contrast, people can spend a lot of time staying in the courtyard, receiving visitors, chatting, and having entertainment; they can also grow plants, do exercises, etc., to give qualitative improvement to the quality of their lives. (Guo, 2010). Therefore, the design of villa courtyard is of especially significance. In the design of villa courtyard, on the one hand, it is necessary to ensure the aesthetic value of the courtyard, improve the aesthetic level of it, and provide the villa owners with visual enjoyment by landscape design; On the other hand, it is a need to ensure the satisfaction of living needs of the courtyard (Zhao, 2015). When in the villa, people usually spend a lot of time in the courtyard, and if the courtyard can hardly meet the living needs of the villa owners, the design level will be difficult to improve. It is thus very important to emphasize the satisfaction of the living needs of the villa owner from the aspect of environmental psychology so as to improve the overall design level of villa courtyard (Liang, 2015).

1.2 Literature review

As to the design of villa courtyard, naturalization is the best state, and many excellent design inspirations are closely related with nature. The design of villa courtyard is a gradual process, whose details need to be polished and processed by the spirit of craftsman to get the best design results. The maintenance of courtyard needs the carefulness of the villa owner; therefore, the design of courtyard not only should facilitate the use by the villa owner, but should give convenience to the management of it by people. The design of villa courtyard should be
combined with people's daily life, and provide service for people's lives (Zhang, 2015), as the villa courtyard is the key part of the villa's high-quality life. The combination of Chinese and western courtyard elements can be taken to effectively improve the aesthetic level of villa courtyard. The design of villa courtyard should satisfy the psychological needs of the villa owner by satisfying the space of individual activities, combining with nature, and embodying the sense of honor of noble life. (Liang et al., 2009). The New Chinese Style courtyard is an important direction of villa courtyard design, with strong aesthetic value and practicality. The current villa courtyards generally have certain deficiency, especially the incompatibility when compared with the surrounding environment, and it is difficult to take-into-account the aesthetic value and the practicality of villa courtyard design at the same time. The inadaptability of the design of the New Chinese Style courtyard and contemporary villa courtyard can thus be alleviated, and if properly designed, it can reflect the extremely strong aesthetic effect (Wang, 2013).

2. Villa Courtyard Design Quality Evaluation Model

2.1 Villa courtyard design quality extension superiority evaluation theory model

The extension superiority evaluation method is a scientific evaluation method which can be quantified by abstract indicators (Niu, 2015). This method uses a certain procedure and rules, and the basic steps are as follows:

First, determine the measurement indicators and the matter-elements to be evaluated of villa courtyard (Yang, 2015). The basic logic of extencics is the three elements: thing, matter, and relationship, and its fundamental element analysis theory also contains the matter element, the thing element, and the relationship element, which can be describes as R=(N,c,v).This evaluation method can directly feedback the internal relationship between quality and quantity, and analyze the change process of the indicators.

Its measurement condition is the collection M= (m₁, m₂, ..., mₙ),where, M₁= (cᵢ, Vᵢ) represents the characteristic element, and Vᵢ represents the quantified field value (i=1,2,...,n). And as to a thing or matter N, we can express

\[
\begin{bmatrix}
  n & C_1 & v_1 \\
  C_2 & v_2 \\
  M & M & M \\
  C_n & v_n
\end{bmatrix}
\]

to be evaluated (Yan, 2016); where, N represents one of the things or matters of the design quality of villa courtyard, and Vᵢ represents the measurement value of Cᵢ by N, or the actual data obtained from the investigation of N (Xu, 2016).

The weight coefficient of each indicator is determined after the collection of various aspects of villa courtyard. The formula is shown below:

\[ a = (a_1, a_2, ..., a_n), \sum_{i=1}^{n} a_i = 1 \]  

Where, \( a_i \) is the weight coefficient of indicator \( c_i \).

Then, a definite preference value should be set up. Suppose \( X=(a, b), M \in X \), then \( k(x) = \frac{b-x}{b-M} \) where, function \( K(x) \) represents the correlation function of \( x \) in \( X=(a, b), M \in X \). Suppose the correlation function of a certain object \( N_i \) on point \( M_i \) is \( k_i(N_i) \), then it can be proved that the correlation function of \( N_1, N_2, ..., N_m \) on point \( M_i \) is \( K_i = [k_i(N_1), k_i(N_2), ..., k_i(N_m)] \), where \( i=1,2,...,n \).

Then, normalize the obtained result, and the formula is:

\[ k_{ij} = \frac{k_i(N_j)}{\max k_i(x)} \quad (i = 1,2, ..., m) \]  

By analyzing the formula we can know that in the design quality evaluation of villa courtyard, after the normalization treatment of \( M_i \) by each object \( N_j \), the obtained value is \( k_i = (k_{i1}, k_{i2}, ..., k_{in}), (i=1,2,...,n) \).

The final step is to calculate the preference value. The normalization degree of \( N_j \) under different conditions \( M_i \),
\( M_2, \ldots, M_n \) is as follows:

\[
K(N_j) = \begin{bmatrix} k_{1j} \\ k_{2j} \\ M \\ k_{mj} \end{bmatrix} (j = 1, 2, \ldots, m)
\]  

(3)

Where, the preference value of a certain object \( N_j \) is:

\[
C(N_j) = ak(N_j)(a_1, a_2, \ldots, a_n) \begin{bmatrix} k_{1j} \\ k_{2j} \\ M \\ k_{mj} \end{bmatrix} (j = 1, 2, \ldots, m)
\]  

(4)

Compare the preference values of different objects, we can get \( C(N_0) = \max\{C(N_j)\} (j \in 1, 2, \ldots, m) \); therefore, we can conclude that the object \( N_0 \) is the optimal.

2.2 Determine the quality evaluation indicator weight of villa courtyard design by the analytic hierarchy process

Analytic hierarchy process (AHP) is a relatively common way to determine the weight of indicators, and the AHP is used to determine the weight of quality evaluation indicators of villa courtyard design. The steps are as follows:

First, set up the proportional scale. The analytic hierarchy process mainly compares the main influencing indicators, and its scale is shown in Table 1:

**Table 1** Schematic Diagram of Scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Importance</th>
<th>Explain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equally important</td>
<td>The two are equally important</td>
</tr>
<tr>
<td>3</td>
<td>Slightly important</td>
<td>One is a little more important than the other</td>
</tr>
<tr>
<td>5</td>
<td>Obviously important</td>
<td>One is obviously more important than the other</td>
</tr>
<tr>
<td>7</td>
<td>Strongly important</td>
<td>One is more important than the other</td>
</tr>
<tr>
<td>9</td>
<td>Absolutely important</td>
<td>One is more important than the other</td>
</tr>
</tbody>
</table>

Second, construct the judgment matrix. Determine the degree of importance of different influencing indexes by classifying and comparing them and construct the judgment matrix. The formula is as follows:

\[
\begin{bmatrix}
  a_{11} & a_{12} & \cdots & a_{1n} \\
  a_{21} & a_{22} & \cdots & a_{2n} \\
  \vdots & \vdots & \ddots & \vdots \\
  a_{n1} & a_{n2} & \cdots & a_{nn}
\end{bmatrix}
= \begin{bmatrix}
  a_{1i} & a_{1j} & \cdots & a_{1s} \\
  a_{ii} & a_{ij} & \cdots & a_{is} \\
  \vdots & \vdots & \ddots & \vdots \\
  a_{ni} & a_{nj} & \cdots & a_{ns}
\end{bmatrix}
\]  

(5)

The matrix in analytic hierarchy process must satisfy the following conditions:

\[a_{ij} \leq 1 \quad 2) a_i = \frac{1}{a_{ji}} (i, j = 1, 2, 3, \ldots, n)\]  

(6)

Finally, the matrix is calculated using the normalized method and introduced into the formula to obtain the final
weight coefficient.

Consistency check of quality evaluation matrix of villa courtyard design: Introduce the mutual comparison of each indicator into the matrix, calculate its maximum feature and vector, and conduct the consistency check. If the result is successful, it is shown that the vector is a weight vector, and if it is not, then it should be reconstructed for another comparison. Suppose the maximum feature value is \( \lambda_{max} \), and the formula is \( CR = \frac{CI}{CR} \), where, CR represents the consistency ratio, and CI represents the consistency indicator. The formula is as follows:

\[
CI = \frac{\lambda_{max} - n}{n-1}, \quad \lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} (\frac{A_{wi}}{w_i})
\]  

Obtain the overall judgement matrix by analysis based on the above conclusion, and the result is shown in Table 2.

<table>
<thead>
<tr>
<th>P-A</th>
<th>A1(Monomer design)</th>
<th>A2(Overall layout)</th>
<th>A3(Graph representation)</th>
<th>W(weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1(Monomer design)</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>0.626</td>
</tr>
<tr>
<td>A2(Overall layout)</td>
<td>1/3</td>
<td>1</td>
<td>2</td>
<td>0.238</td>
</tr>
<tr>
<td>A3(Graph representation)</td>
<td>1/4</td>
<td>1/2</td>
<td>1</td>
<td>0.137</td>
</tr>
</tbody>
</table>

The next step is to check the consistency of the matrix. First, obtain the value of \( \lambda \), and put the value into the following formula:

\[
CI = \frac{\lambda - n}{n-1}
\]  

Then put the value of CI into the formula \( CR = \frac{CI}{CR} \), where, \( CR = \frac{\lambda_{max} - n}{(n-1)} \), n is the order in this formula, and RI represents the average random consistency indicator. The list of values of RI is shown in Table 3:

<table>
<thead>
<tr>
<th>Order number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
<td>1.52</td>
<td>1.54</td>
</tr>
</tbody>
</table>

When \( CR<0.1 \), it can be proved that the matrix is consistent with the teaching evaluation indicator of college physical education, and the obtained results of the weight can have a great impact on college physical education. If \( CR>0.1 \), however, the matrix needs to be returned until the two are consistent.

3. INFLUENCING FACTORS OF VILLA COURTYARD DESIGN BASED ON LIVING NEEDS

3.1 Living needs indicators of villa courtyard based on environmental psychology

Environmental psychology is a theory that analyzes the relationship and interaction between people and their environment from the perspective of psychology. People living in an environment and stimulated by the environment will generate a feeling about the environment and the environment will give a certain influence onto people's behavior and even a pressure on people's mind. Villa courtyard is rather distinct with the natural environment in that its service object is human, thus it needs to have such characteristics as being comfortable, practical, and pleasant so as to create a better living space for villa owners. Therefore, villa courtyard design should pay attention to meet the aesthetic needs of the villa owners and their living needs, so that they may enjoy staying in the courtyard for longer time and feeling about the improvement of the quality of life their villa courtyards bring them. Maslow, the famous American scholar, once proposed a hierarchy of needs, dividing people's needs into five levels (Fan, 2016), as shown in Figure 1:
Maslow's hierarchy of needs intuitively reflects the needs of people at all levels. As to villa courtyard, it still works. However, as villa courtyard has certain particularity and it is a high-end residential form, it is necessary to adjust Maslow's hierarchy of needs and divide it into needs to meet the daily life and that to promote one's spirit; the specific classification is as shown in table 4:

**Table 4 Demand Level of Villa and Courtyard**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Concrete embodiment</th>
<th>Maslow's hierarchy of needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meet the needs of daily life</td>
<td>Sunshine, fresh air</td>
<td>Physiological needs</td>
</tr>
<tr>
<td></td>
<td>Steal or not be disturbed</td>
<td>Security requirement</td>
</tr>
<tr>
<td>Enhance your spiritual needs</td>
<td>Communicate with neighbors</td>
<td>Social demands</td>
</tr>
<tr>
<td></td>
<td>Respected by neighbors</td>
<td>Respect for needs</td>
</tr>
<tr>
<td></td>
<td>Natural and humanistic spirit</td>
<td>Self-actualization needs</td>
</tr>
</tbody>
</table>

Among them, the needs to meet the daily life include: to enjoy fresh air and abundant sunshine, etc., which are essentially physiological needs, and to be free from outside interference and adequate measures against theft, which are essentially security needs. In the aspect of improving one's spirit, the needs to be able to meet the function of communication between the host and his neighbors are essentially social needs; that to be able to be respected by the neighbors are essentially needs for respect; and finally, that to be able to make the host feel the spiritual and aesthetic nature of flowers, grass, and trees, and to reflect the humanistic spirit of the villa courtyard are self-realization needs.

In 1970, the United States looked into such problems of the nationals as the establishment of good goals and the life styles they want to live, and so on; the results are as shown in table 5:

**Table 5 The American goal or life**

<table>
<thead>
<tr>
<th>Goals and way of life</th>
<th>Proportion(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are more green plants</td>
<td>95</td>
</tr>
<tr>
<td>A good neighbor</td>
<td>92</td>
</tr>
<tr>
<td>Equipment rich prescriptions</td>
<td>84</td>
</tr>
<tr>
<td>Quiet solitude</td>
<td>82</td>
</tr>
<tr>
<td>Wear the clothes you like</td>
<td>82</td>
</tr>
<tr>
<td>Have plenty of spare time</td>
<td>59</td>
</tr>
<tr>
<td>A well decorated house</td>
<td>54</td>
</tr>
<tr>
<td>Work hard to make money</td>
<td>47</td>
</tr>
<tr>
<td>Upward mobility</td>
<td>38</td>
</tr>
</tbody>
</table>
From the information shown above we may know that, along with the continuous improvement of social economy, people's goals and the life styles they want to live are no longer limited to eating their fill and wear warm clothes, but have extended to the consideration of the value, emotion, and spirit of life. For ordinary people, their lives are no longer limited to physical needs, but have extended to the spiritual needs for more particularity; for villa owners who are at higher economic levels, their demands for villas courtyard must be more different. Therefore, in the process of villa courtyard design, it is necessary to not only consider the influence of villa courtyard on the villa owner's physiological and security needs, but consider the needs of them for interpersonal communication, leisure, self-realization, and other higher levels of needs (Yang, 2015).

3.2 Living needs indicators of villa courtyard based on natural environment

Naturalization is an important current architectural design idea which, by creating a natural feeling indoors, can not only improve indoor air quality and provide a better living environment for people, but also enhance the overall aesthetic interior design level and thus is of great significance.

There are three main levels of nature: first of all, the primitive nature, or the natural environment without artificial management, design or destruction, such as virgin forests (Tian, 2012). Secondly, a kind of nature transformed by people from the natural environment in order to improve their living environment, such as terraces, urban greening, and so on. Finally, the natural environment created by designers based on their ability, which has a higher aesthetic level and reflects the spirit and human particularity through reasonable layout. The third natural environment has certain particularity; although it is artificially created, the most important consideration is how to minimize the change to the environment so as to achieve the best aesthetic effect to the environment. Villa courtyard design is the best way to reveal the transformation of nature by designers, which may highlight both the natural features and the aesthetic characters of plants in the courtyard. In addition, natural landscape can also be brought into buildings (Xu, 2005). Famous Chinese thinker Lao Tzu once said: "The most upright man seems easy-going; real square has no corner; great wisdom appears stupid; mighty image is intangible." The best art should be close to nature and unembellished. In the design of villa courtyard, the use of natural landscape may help reduce the modification of the natural landscape and greatly enhance the aesthetic level of villa courtyard (Chuan, 2007). Meanwhile, this architectural style can make villas more dynamic and full of free, inspiring and flexible atmosphere. Compared with western classical architecture which focuses more on geometry and which seems less down-to-earth, Chinese traditional architectural styles can better meet the needs of villa owners (Yang, 2012).

4. CONCLUSIONS

4.1 Villa courtyard design should reflect the owner's living needs

Although villa is a kind of high-end residence and can reflect the life quality of the villa owner, essentially, it is still a part of the villa owner's life. Villa owners spend most of the time in the courtyard; therefore, the design of villa courtyard should reflect the living comfortability as well as the artistry and aesthetic features. On the one hand, a variety of accessories such as flowers and pavilions can be used to decorate the villa courtyard to shift the villa owners' interest onto the plant landscape, and on the other hand, the ecological stability of courtyard design should also be paid attention to, so that plants in the courtyard can be natured by the natural environment without too much water and insecticide, and the naturalness of the courtyard can be reflected; meanwhile, villa owners may spend less energy on taking care of the plants and let them grow freely (Peng, 2015).

4.2 Simple and warm style of decoration

Villa courtyard is a part of home, where villa owners can enjoy the scenery, have rests, accompany family members, and meet visitors. It thus has a wide range of functions. Therefore, the style of decoration should make the courtyard and the villa simple and warm. Usually, the use and reasonable arrangement of a variety of trees, stones, and courtyard furniture can provide the villa owners with the warm and comfortable feeling the same as that in the living room and promote the overall aesthetic and design level of villa courtyard.

REFERENCES


Hu. X.W. (2014). Hermit in the city, from the perspective of ergonomics research, art education villa garden design, 59(2).


Li H.Y. (2017). Everywhere adjacent virtual square side view, on the modern villa garden design in the application of architecture knowledge, 37(5), 8-11.


Shan W.J. (2016). The research on the relationship between garden design and householder heart demand. Taking the southern suburbs of Shanghai manor garden project as an example of modern decorative, (11), 80-81.


Zhang Q.Z. (2013). The spirit of the courtyard. Also on the design of the courtyard with flowers and harmony. flowers and trees bonsai (flower gardening), (7), 32-34.