Application Review of Container Building and Wood Building in Post-disaster Reconstruction

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Abstract. In recent years, China has encountered Wenchuan, Yushu, Taiwan earthquake and other major disaster events pushed the research of emergency building to the forefront. Judging from the present situation of post-earthquake reconstruction in China, it is not perfect in terms of emergency reconstruction and the design of buildings is also deficient to some extent. At present, the forefront of international research on post-disaster emergency measures is mainly focused on earthquake-prone countries, such as Japan and the United States. After the Wenchuan earthquake, the Chinese government quickly deployed post-disaster reconstruction and issued a series of regulations. The application of some light structures such as container and wood building in post-disaster reconstruction has gradually become the focus of scholars. R factor analysis method is adopted in this article, try to research on the design of the container and wood buildings combined with the practice of reconstruction, and has set up a variety of structure in the field of light structure architectural practice support as a case, a container and wooden buildings in the post-disaster reconstruction design strategies and explore possibilities for the future development, the application of the post-disaster reconstruction work after have a certain guiding significance.

Keywords: Post-disaster Reconstruction, Container Construction, Wood Construction, R-type factor Analysis

1. Introduction
The In recent years, from 2008 to now, earthquakes occur frequently in China, with the longmenshan earthquake zone in China's sichuan province and the geodesic zone in yunnan province being the most active, and the earthquake situation is still severe. Earthquakes tend to occur in remote rural mountainous areas, where poor transportation, economic backwardness and low population often pose huge challenges for post-disaster reconstruction[1]. There are many researches on light structures in China, but few researches on the application of light structures in the architectural design of earthquake zones. The sichuan fenchuan earthquake and the ya 'anlu earthquake are our bitter lessons, but also become a huge treasure house for us to learn, learn from and study the post-disaster reconstruction[2-3].
There have been a lot of researches on container building and wooden building at home and abroad. Container architecture has been used in foreign countries for a while. For example, Jure Kotnik's "container architecture" gives a basic introduction to container construction projects in foreign countries[4]. In 2011, a 9.0 magnitude earthquake occurred in Japan. In terms of protecting the people in disaster areas, a large number of containers were used as temporary housing from the perspective of safety, convenience and speed. Since 2008, China has gradually enriched relevant articles on container and wood in the field of construction [5-6]. However, on the one hand, the research on these two kinds of buildings is still confined to the buildings themselves without considering their applicability. On the other hand, most of the studies introduce the practice of subtle design from the practical professional level, and have little inspiration on the strategies and methods of structure in the architectural design level [7-8]. Therefore, in general, the research on container architecture and wood architecture is still one-sided, and the research results are often concentrated in one direction, so it is difficult to make breakthroughs, which leads to some research gaps in other aspects.

In order to fill this gap, r-type factor analysis and spss19.0 software were used in this paper to conduct quantitative analysis of container buildings and wood buildings, and to make a comprehensive and quantitative evaluation of the seismic effect of the two buildings. The seismic performance of container building and wood building in post-disaster reconstruction is calculated scientifically, which has important practical significance and guiding function for post-disaster reconstruction, and provides scientific data guidance for post-disaster reconstruction(PDR) in the future. Study of container architecture and wood used in the design of architectural structure system after the earthquake, to a large extent can play a perfect new train of thought of broadening the post-disaster, especially in the local residents' actual demand after a disaster and the study on the spiritual and cultural needs, discuss the possibility of the humanization and personalization, increase the design and evaluation method [9-10].

2. Method

2.1. R-type Factor Analysis Method

The method of extracting common factors from variable groups is called r-type factor analysis(FA). It is to calculate the eigenvalue of the matrix by linear transformation of the sample value matrix, and to use the new factors to reflect the overall change of the sample with the maximum amount of information. Characteristics of r-type FA method: first, the number of factors is far less than the number of original variables; Second, the factor can reflect most of the information of the original variable; Third, the linear relationship between factors is not significant; Fourth, the factor is named explanatory.

FA is a study by between multiple variables correlation matrix to find some internal dependencies can integrate all the variables of random variables, these factors called factor. Then, depending on the size of the correlation variable packet, which means that the same set of variables having a high correlation. FA is the starting point of most of the information to replace the original variables with less independent factor variables, which can be expressed by the following mathematical model:

\[
X_1 = a_{11} F_1 + a_{12} F_2 + \ldots + a_{1m} F_m \\
X_2 = a_{21} F_1 + a_{22} F_2 + \ldots + a_{2m} F_m \\
\vdots \\
X_p = a_{p1} F_1 + a_{p2} F_2 + \ldots + a_{pm} F_m
\]

Using FA method for container and wooden buildings in the application of PDR, from the reflection of post-disaster construction of several variables, through calculating, find a number of variables as a factor, and calculate the factor score, and then to container and wood buildings for further sorting and cluster analysis.
The collected data can be represented by a matrix $A$, can be expressed as:

$$A = \frac{a_y - \frac{1}{p} \sum_{i=1}^{n} a_y}{\sqrt{\frac{1}{p} \sum_{i=1}^{n} (a_y - \frac{1}{p} \sum_{i=1}^{n} a_y)^2}}$$

(2)

2.2. Establishment of Indicator System

PDR is a comprehensive activity, and the measure of building practicability should be correspondingly complete and fully reflect the overall situation of PDR. Therefore, you can choose eight statistical indicators that can fully reflect the PDR building and establish a corresponding statistical indicator system. The tangible index are as follows: $X1$: total number of victims; $X2$: total investment in PDR; $X3$: total damage; $X4$: total number of damaged buildings; $X5$: number of container buildings; $X6$: number of wooden buildings; $X7$: disaster Number of areas, $X8$: Number of buildings after the disaster. These eight indicators reflect the overall situation of the PDR from multiple aspects, and are raw measurable data collected through the FA.

3. Experiment

Step 1: Determine if the variables to be analyzed are appropriate for FA. SPSS18.0 is used for KMO and Bartlett tests on raw data. The closer the KMO statistics are to 1, the better the Influence of FA.

Step 2: Normalize the data to eliminate the effect of size differences in the data.

Step 3: Calculate the eigenvalue, variance contribution rate and cumulative variance contribution rate of the correlation matrix, and determine the number of factors according to the size of the eigenvalue.

Step 4: Load factor by orthogonal rotation matrix transformation having the largest variance obtained $m$ column vectors corresponding to $m$.

Step 5: The analysis of variance contribution rate by weighting each factor, derived container buildings and wooden architecture adaptive composite score in the PDR.

4. Discuss

4.1. Analysis of Test Results

The test results of KMO and Bartlett were used for judgment, and the results were shown in table 1. It can be concluded that: first, the value of KOM is 0.730, which belongs to the range applicable to FA, indicating that FA can be conducted. Bartlett sphericity test reached the significant level and was statistically significant, indicating that there was correlation between variables and common factors could be extracted. Second, the probability value of sig(significance) $p = 0.000 < 0.05$, rejecting the null hypothesis.

| Kaiser Meyer Olkin | Measure       | 0.730 |
|---------------------|--------------|-------|
| Bartlett            | Approximate Chi Square | 114.730 |
|                     | Df           | 36    |
|                     | Sig          | 0.000 |

After calculation, it can be seen that the total number of people affected by $X1$, the total investment in PDR of $X2$ and the total damage loss of $X3$ account, while the load of other indicators in $F1$ is small. The buildings affected by $X4$, the number of $X5$ container buildings, and the number of $X6$ wooden buildings occupy a large load in the second factor and $F2$. Similarly, in terms of the third factor $F3$, the number of $X7$ affected areas and the number of $X8$ post-disaster buildings occupy a large load.
4.2. Analysis and Evaluation
The weight of each part should be determined for the overall situation of PDR so as to obtain the scoring formula for the applicability of container buildings and wooden buildings in PDR. Therefore, with the variance of post-disaster construction adaptability scores as the weight, the comprehensive adaptability scores of container buildings and wood buildings in PDR were obtained. The types and proportions of PDR buildings in China are shown in figure 1.

![Post Disaster Reconstruction of Buildings](image)

**Figure 1.** Proportion of construction types in PDR in China

R FA model and SPSS19.0 software were used to study the application of container building and wood building in PDR. Through the analysis and calculation of eight indicators and comparative analysis, it can be concluded that the seismic performance of the same kind of building structure is different. Also is a wooden house, for example, in the IX degrees of intensity level for class B, and level of intensity area in VII for D. Framework results show better than other structures, vibration resistance, VII degrees fortification standard building frame structure, basic can resist IX degrees of intensity of earthquake. Generally speaking, container construction and wood construction have high applicability in PDR, but different tables should be considered according to different regions.

5. Conclusion
The collapse of a large number of houses in the earthquake of weichuan and the earthquake of shengshan caused great loss of life and property to the people. Container and wood buildings with its shock resistance, emergency, durability, economy, operability, adaptability and sustainability, and many other advantages highlighted in post-disaster selection of each structure, it is suitable for post-disaster temporary buildings design is also suitable for the architectural design of a permanent use, especially when both legendary and permanent both on the time dimension. There are still some problems in the post-earthquake practice and exploration stage. It is necessary to explore the temporary and permanent growth space of container buildings and wooden buildings after the earthquake.

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