Study on Combined With Computer Technology and Based on Settlement Standard Wind Load Test of Combined Mobile House

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Abstract. Lightweight modular mobile homes can be used under harsh environmental conditions, but are susceptible to wind loads. On this basis, the physical bearing capacity and settlement of the combined mobile house are studied by computer technology. In this way, the structural design load of the combined mobile house can be judged and tested, and the most unfavorable stress position of the structure can be determined. This paper first introduces the general structure of the combined mobile house, then designs and studies the wind load test of the combined mobile house by using computer technology, and analyzes the test results in detail.

Keywords: Assembled Movable Building, Wind Load, Settlement Standar, Computer Technology

1. Introduction
Assembly type activity room is generally simple and crude. As a kind of expandable, easy to dismantle and assemble, various forms of activity type and temporary assembly type activity room can be used for many times, with low site requirements and simple basic settings[1-2]. In addition, the assembled mobile house can be demolished and constructed repeatedly, so it has great advantages in economy and practice, and it can quickly provide use and save construction costs, and also has the advantages of standard design, simple structure, strong adaptability, etc., so it is widely used in various fields. Generally speaking, the assembled mobile house has several characteristics as shown in Figure 1 below.

Figure 1. Characteristics of assembled mobile house

However, under the strong wind load, the assembled mobile house is prone to damage, collapse and other accidents, resulting in serious losses and injuries[3-4]. It is necessary to pay attention to the settlement and...
stress of the assembled mobile house under the wind load, so it is of great practical significance to carry out the research on the test of the assembled mobile house under the wind load based on the settlement standard.

2. The common structure of assembled mobile house

2.1. The role and significance of wind load research on assembled mobile house

The light-duty assembled mobile house can be used in the worse environment area, and it can be used in the mobile house and warehouse in the open field area\textsuperscript{[5-6]}. These open areas are often not covered, so they are easy to be affected by the wind load. Based on this, the experimental research in this paper is to study the physical bearing capacity of the assembled mobile house. In general, the assembly type workshop is assembled by high-strength lightweight aluminium alloy frame and aluminium alloy polyurethane foam sandwich panel. Carrying out the research on the bearing capacity and deformation of the movable frame of the assembled movable workshop under the wind load, and analyzing its settlement, it is helpful to judge and inspect whether the structure of the assembled movable workshop meets the design load requirements, determine the most unfavourable bearing position of the structure, and determine the ultimate bearing capacity of the structure. In addition, through the experimental study, it is helpful to compare the load-bearing characteristics of the frame and the overall structure of the movable house, and provide the basis for the analysis of the actual load-bearing capacity of the movable house.

2.2. The common structure of assembled mobile house

There are brick concrete structure, assembled light steel structure, metal face sandwich plate structure and other simple structures in the assembled mobile house. First of all, as a traditional structural form, the wall stiffness of brick concrete structure is large, but the structure has the disadvantages of low material reuse rate and slow construction speed, so it is more and more uncommon. Secondly, the cement composite plate structure, which is easy to assemble and disassemble, low cost, can be reused for many times, but there are some problems such as weak support system, insufficient overall stability of the structure and so on. In addition, there are colour steel and aluminium alloy composite board movable rooms. This structure has good heat preservation and insulation performance, convenient installation and disassembly, and can be reused, so it is more and more common. However, its ability to resist strong wind and other disastrous weather is poor, so it is necessary to focus on its stress under wind load. The structural shape of the assembled mobile house studied in this paper is shown in Figure 2.

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{figure2.png}
\caption{Common structural shape of the assembled movable house}
\end{figure}

3. Experimental research on wind load bearing capacity of assembled mobile house

3.1. Test loading scheme

Use bolts to connect the ring beam of the mobile house with the ground beam made of channel steel, and use anchor bolts to connect the ground beam with the laboratory trench reliably. In order to prevent horizontal sliding of the structure, set horizontal support on the ground. The main measured data are vertical deflection, horizontal displacement, stress and column stress of roof truss. The main content of the test measurement is to install a force sensor at the end of the chain block to control the load applied to the structure. Strain gauges are attached to the strain measurement sections, which are the ends of roof truss. A measuring point is arranged on the symmetrical axis of the section, and the displacement includes the vertical displacement measurement and the horizontal displacement measurement of the roof truss. Coordinate paper is used to measure the vertical displacement of the roof truss, which is fixed on the support with constant position outside the structure. The vertical displacement measurement points are ridge and bottom chord nodes of
roof truss. Use a displacement meter to measure the horizontal displacement. The measurement point of the horizontal displacement is the house.

3.2. Wind load loading scheme
Based on the hydraulic loading method, the wind load is applied, and the load is applied by the hydraulic loader and evenly distributed to each loading point of the roof truss through the distribution beam. The distribution beam system of leeward wall and windward wall is the same. According to the size of the load on the distribution beam, the deflection of the beam is limited and the section size of the distribution beam is determined. The wall distribution beam system is classified. Each windward wall and leeward wall has a loading point, and each column is evenly arranged with a loading point. In order to simulate the concentrated load applied on the column and roof truss, the first level distribution beam contacts with the column and roof truss through the joint plate welded on the distribution beam. The wind load on the room surface is distributed to each loading point through the stage distribution beam. The loading point of wind load on the room surface is the same as that of snow load.

In addition, the wind pressure on the windward side of the assembled mobile house is provided by two hydraulic servo actuators fixed on the shear wall, and the load is applied on the first stage distribution beam. The two hydraulic servo actuators are loaded synchronously by computer control, and a pressure sensor is set at the end of the jack to control the output load. Due to the large weight of the distribution beam, the external eccentric load is applied to the structure, so the vertical directional sliding support is set at the lower part of the centre of gravity of the distribution beam. The shape factor of wind load is based on the load code of building structure, as shown in Figure 3 below.

![Figure 3. Value of shape factor of wind load for assembled movable house](image)

3.3. Wind load test results
Under the wind load of 0.4kN/m², the maximum vertical displacement of the framework of the movable house is 19.4mm, which occurs at the roof ridge of the whole movable house with the bottom chord node of the roof truss under the same snow load. Under the 0.42kN/m² wind load, the horizontal displacement of the movable house decreased from 148.3mm under the skeleton of the movable house to 19.2mm of the whole movable house, with a reduction rate of 87%. That is to say, after the panel is installed, the horizontal displacement of the house is effectively reduced, as shown in Table 1 below.

| Structure | Vertical settlement displacement | Horizontal displacement |
|-----------|---------------------------------|-------------------------|
|           | Load (kN/m²) | Maximum value (mm) | Load (kN/m²) | Maximum value (mm) | Reduction rate (%) |
| Skeleton  | 0.4 | 19.4 | 0.42 | 148.3 | 87.0 |
| Whole     | 0.4 | 19.7 | 0.42 | 19.2 | / |
|           | 1.1 | 49.3 | 0.71 | 41.2 | / |

Under the wind load and snow load of 0.4kN/m², the maximum stress in the framework roof truss of the movable house is 59.7mm, and the maximum stress in the whole roof truss of the movable house at the bottom chord node is 41.3MPa, and the stress reduction rate is 30.8%. Under the action of wind load of
0.42kN/m², the maximum stress in the framework roof truss of the movable house is 59.4MPa in the whole roof truss of the lower chord node of the roof truss on the winded side, 15.1MPa in the lower chord node of the roof truss on the leeward side, and 74.5% in the force reduction rate, as shown in table 2 below.

### Table 2. Maximum displacement and position of roof truss under load

| Structure | Vertical settlement displacement | Horizontal displacement |
|-----------|-------------------------------|-------------------------|
|           | Load (kN/m²) | Maximum value (mm) | Load (kN/m²) | Maximum value (mm) | Reduction rate (%) |
| Skeleton  | 0.4 | 59.7 | 0.42 | 59.4 | 74.5% |
| Whole     | 0.4 | 41.3 | 0.42 | 15.1 | / |

It can be seen from the above two tables that since there is only weak lateral support between the framework of the assembled mobile room, the framework of the assembled mobile room cannot be stressed alone during the loading process, but the interaction between the framework and the panel should be considered. Under different structural forms and loads, the bottom chord joint of the roof truss is the maximum stress section of the roof truss, which should be considered in the design. Comparing the internal force and deformation of the framework of the movable house and the whole movable house under the same load, it is concluded that the internal force and displacement of the movable house after the installation of the panel are greatly reduced, which shows that the panel effectively strengthens the overall stiffness of the structure, reflecting the skin effect of the structure.

### 4. Conclusion

Because of many advantages of the assembled mobile house, it has been more and more popular and applied. But under the strong wind load, the assembled mobile house is prone to damage, collapse and other accidents, resulting in serious losses and injuries. In this paper, through the experimental design and research under the wind load of the assembled structure movable house, it is found that the assembled structure movable house should be equipped with an assembled framework, additional horizontal beams or masonry reinforced brick ring beams to improve the wind resistance of the gable wall, and the ring beams and embedded bolts to improve the connection strength of the brick wall and the roof truss. In addition, bolts should also be used to connect the light-weight enclosure plates, purlins, roof trusses and other components to meet the performance requirements of fabricated structures.

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