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RESEARCH PROGRESS AND APPLICATION PROSPECTS OF DAMPING DYNAMIC CHARACTERISTICS OF WOODEN BUILDING FLOORS

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Abstract: Wooden structure buildings are favored by people for their unique low-carbon, environmentally friendly, energy-saving and thermal insulation features, rapid construction, and high housing availability. Wood damping Characteristics and their importance to the vibration reduction design of wooden structure building floors, testing methods of wood damping parameters and the development of structural damping theory and damping characteristics of wood structure buildings Research and development approaches and prospects are expected to provide important support for improving the research level of structural damping dynamic characteristics in wooden structure buildings in China, and have good engineering application value.
Keywords: Wooden structure building; Floor; Damping characteristics; Research progress; Application prospects

1. TIMBER DAMPING CHARACTERISTICS AND ITS EFFECT ON WOODEN STRUCTURE BUILDING FLOORS THE IMPORTANCE OF VIBRATION REDUCTION DESIGN

Wood has always been valued for its unique environmentally friendly and natural properties. Favored by people, various wooden furniture and handicrafts emerge in endlessly. With the continuous improvement of living standards and economic capabilities, people's demand for housing The requirements for house quality are constantly rising, and wooden structure houses are characterized by their unique low Carbon environmental protection, energy saving and insulation, rapid construction, high housing acquisition rate and other successful features attracted people's attention. 2015. In March, the Ministry of Housing and Urban-Rural Development issued "About the Issuance of "Notice on Work Points in 2015 " proposes to vigorously promote green building materials Promotion and application; 2015 In August, the Ministry of Industry and Information Technology and the Ministry of Housing and Urban-Rural Development issued the "Action Plan for Promoting the Production and Application of Green Building Materials " on the promotion and promotion of wooden structure buildings. Requirements were further subdivided; 2016 State Council Office in September The Department's "Guiding Opinions on Vigorously Developing Prefabricated Buildings" once again Emphasis on advocating the development of modern wooden structure buildings where conditions permit build. With the continuous promotion of wooden structure buildings in our country, people are enjoying While enjoying the unique experience it brought, we also realized some practical problems, such as anti-corrosion and anti-ant, poor sound insulation of walls and vibration of floors. larger, etc., it is necessary to find out the cause and take corresponding measures to solve it. Solving these problems will provide strong support for the promotion of wooden structure buildings in our country. This article only deals with the problem of large floor vibrations. Exposition and discussion.

Material damping [1-3] refers to the mechanical vibration energy loss caused by internal factors such as friction between the grains of the material when the material vibrates. Phenomenon, usually the loss factor or damping ratio is used to express the material's Damping size. Material damping properties and internal organization and structure of materials It is related to the structure and is largely affected by the surrounding environment such as magnetic field, radiation, etc. The influence is closely related to temperature and vibration frequency [4].

North America, Europe, Japan and other countries have their unique population density, environmental environmental characteristics and strong support from national policies, the development of wooden structure buildings It is far ahead of China in terms of development, but the vibration problem of wooden structure floors has always been has always been their main research direction, namely: how to better solve wood Vibration resistance issues of structural buildings, how to set a value for wooden floor design Universally applicable design methods. Various research theories and design methods emerge in endlessly, and wood damping is among them because of its importance and uncontrollability. plays an important role, reflecting its basic dynamic characteristics as a structure Properties [5].

Vibration reduction of wooden structure building floors by structural damping dynamic characteristics Design is particularly important. The vibration reduction design method of wooden floor coverings has been through five Development stages:

1) The U.S. Federal Housing Administration (FFA) issued a review of single-family Minimum suitability standards for single-family and two-family dwelling units Uniformly distributed live load (UDL) deflection is used to reduce problems Floor vibration problem;

2) Onysko [6-12] After investigating the static deflection of more than 300 residential floor slabs, the concept of limiting concentrated load deflection was proposed. A theory adopted and developed by the Canadian Construction Materials Center (CCMC);
3) Ohlsson Difficult to obtain static response parameters Under the premise of satisfactory performance, it was the first to propose based on dynamic parameters Design: He believes that for the natural frequency 8 Hz Light building above The board should check whether the two parameters meet two conditions, namely: one surface, 1 kN at the center of the slab Static deflection under load is less than 1.5 mm; On the other hand, pulse peak speed < 100 [f (1) ζ -1] m/s. Target this Ohlsson_A method for calculating simply supported rectangular floor systems with four sides is proposed. The pulse peak speed formula and the natural frequency are lower than 40 Hz vibration Mode number calculation formula. This method was also adopted by the Swedish Building Research Council in the European Code [13];
4) 1990 In 2008, the study proposed the first-order natural frequency of the floor and the frequency-weighted root mean square acceleration. degree a rms The two calculation formulas of, and were adopted by BS 6472-1: 1 992 Pick use. Smith and Chui [14, 15] proposed two qualifications: f (1) >8Hz and frequency weighted root mean square acceleration <0.45m/ s 2;
5) Dolan [16] and Johnson [17] et al. proposed a method related to frequency with the support of a wide range of databases Relevant design standards, which simply define the fundamental natural frequencies of occupied and unoccupied floor slabs.
The development of vibration reduction design methods for wooden floors has not achieved a One of the most commonly used methods is wood damping. variables arising from the uncertainty of sex. like Smith design method Explain that the damping characteristics of wood and its structure, the moisture content of wood, the environment related to environmental factors such as ambient temperature and humidity [18]. And because of the processing technology For example, the connection method between the floor joists and the bottom plate will also affect the performance of the floor system. Damping has an impact, thus adding to the complexity of its testing [19].

2. TESTING METHOD OF WOOD DAMPING PARAMETERS AND ITS STRUCTURAL DAMPING THEORETICAL DEVELOPMENT

Since wood itself is an anisotropic material and is affected by its own The influence of water rate and external environmental factors, on the domestic resistance of wood. There are few studies on basswood. At present, Chen Shouqian has used the attenuated vibration method to measure the damping parameters of basswood, and uses it as a method to measure the damping of wood. A simple, fast and accurate method for parameters. With wooden structure With the promotion of architecture in China, the vibration problem of wooden floor structures has brought Research boom on wood damping properties. However, due to previous studies limitations, relevant research on wood damping still needs further development. Perhaps we can get more inspiration from other fields.
Charles.A.Conlomb (1736-18 06) [20] proposed the Coulomb damping theory. This theory is suitable for solving phases that require precise calculations. Related research situations. nineteenth century 60 S, W. Thomson propose introduced the widely used viscous damping theory and clarified that due to the solid Internal friction properties in a material are the same as viscosity in its viscous liquid Friction characteristics, and conclusions related to its deformation speed were obtained [21]. 1940, T.Theodoren and The hysteresis damping theory proposed by IEGarrick [22] believes that the damping stress of a structure is proportional to its elastic stress, and Same as its deformation speed. 1951 Year, EC Copoknh and N. O. Myklestad carried out confirmatory research on hysteresis damping theory It shows that the theory exists in infinite wide frequency band when damping is not considered. of Knot structure since vibrate frequency Rate value high At Test consider block Nigeria hour That value and other issues [23]. 1981 Wyatt_Physics to promote structural damping were developed Mechanism research and analysis, it is concluded that the friction resistance of the structure when the amplitude attenuates Conclusions about irregular and random distributions. In 1996, Suda.K [24] et al. launched a campaign against Japan 66 reinforced concrete building structures and 123 Small amplitude vibration test of steel structure, its relevant damping value is measured, and Conduct factor analysis to obtain the damping ratio of the building structure and its height. Inversely proportional to, directly proportional to its natural frequency and other main conclusions. In 1995, Huang Zongming [25] et al. in order to realize the damping force and recovery of steel frame structures To achieve the separation target of compound forces, dynamic and static test methods are used to determine the 3 Tests on small single-layer steel frames with one degree of freedom yielded ductility The distribution range of the reaction coefficient, the Rayleigh damping Category 3 8 different. The forms are summarized into four basic forms under the single degree of freedom system, and we get The relationship between the instantaneous circular frequency and damping of the system and concluded: when When the selected structural restoring force is consistent with the actual restoring force, the steel structure In a single degree of freedom system, there is no need to consider the vibration mode and appropriate damping The forms are all constant damping coefficient models, and the damping ratio can be taken as the natural vibration of the structure. damping ratio. In 2009, Professor He Yibin et al. [19] based on the materials and structures Considering the research considerations of studying the damping characteristics at the construction level, use the formula to derive As well as experimental assistance, the relationship between material damping characteristics, structural damping energy dissipation and structural component damping ratio was discussed, and in the existing damping ratio experiments Based on the improvement, the relationship between material energy dissipation coefficient, elastic modulus, compressive strength and reinforcement ratio was obtained, and finally the

component damping was obtained. The ratio is related to the damping energy dissipation coefficient of the material, the elastic modulus, and the cross-section of the component. Structure related to form, load type of member and maximum stress amplitude Argument. This lays the foundation for exploring the distribution law of damping throughout the structure. Base. In 2008, Wen Jinpeng [26] based on the resonance station under basic excitation According to the principle of retention, a uniform cantilever beam with a rectangular cross-section is used as the specimen. Carry out tests and inverse calculations to obtain the cantilever beam's m-order modal damping ratio. In order to ensure the test accuracy, the first test piece of one specimen is used. level and level 2 level The double cantilever specimen with a basic block is excited at the bending resonance frequency. It is concluded that the balance degree of the double cantilever beam has a significant impact on the damping identification accuracy, which provides theoretical support and direction for improving the test accuracy in the double cantilever beam specimen testing experiment.

It is obvious that due to reinforced concrete buildings and steel structure buildings It has the longest development time in China and occupies the main market share. The above basically reflects its high depth and breadth of research on issues such as floor vibration reduction and damping theoretical models, so its research foundation The results are worthy of reference and learning in the field of wood structure construction.

3. RESEARCH AND DEVELOPMENT APPROACHES ON DAMPING CHARACTERISTICS OF WOODEN STRUCTURE BUILDINGS PROSPECT

Wooden structure buildings have always been mainstream buildings in ancient times. The integrated development of various dynasties has become a treasure of our country's architectural skills. precious. Since modern times, the development of wooden structures has experienced 20th Century 50 years The prosperity of the late Dynasty, the 20th century In the 1970s, the shortage of forest resources and With the adjustment of national policies, wooden structure buildings have been excluded from mainstream buildings. In addition, it marks that wooden structure buildings have entered the "decline" in China. "period. Today, with the scientific research and academic exchanges in the field of wood structure construction at home and abroad, With the continuous deepening of flow work, North American and European countries with rich experience Experts have also set their sights on China, a land that has yet to be developed and has endless potential. In the field of wood structures, wood structure buildings have entered a new stage of development. Wood The floor in structural buildings is one of the most common structures, and it is also closely related to residential buildings. Structural systems with residents in close physical contact. Therefore, people are interested in wood The structural vibration and safety of the floor will have a more intuitive experience and feeling, and scientific and systematic solutions will be taken to solve the problem of the floor being stimulated by dynamic loads. To solve the problem of large vibration after excitation, we should focus on studying the resistance of wood. Ni dynamic characteristics and other technologies. For this reason, the author believes that my country has developed wood knot There are three main ways to research and develop the damping dynamic characteristics of structural buildings. First, in view of the advantages of wooden structure buildings, the National Building Master Management departments should strengthen organizational leadership and actively and effectively carry out cooperation with foreign countries. Construct scientific research and technology exchange activities in the field of construction to improve understanding of wooden structure construction The management and technical level of cutting-edge technologies such as the damping dynamic characteristics of building structures level, formulate relevant standards and put them into practice. Second, improve wooden construction Structural damping characteristics theory and testing research level. For example, to keep sending out develop appropriate structural damping models as the basis for theoretical research and guide Lead experimental research work. Since the damping in actual structures is affected by external The influence of boundary and internal conditions is very complex. Scientists are calculating Structural damping is often abstracted into a mathematical model, which can not only reasonably The reaction damping mechanism also greatly facilitates calculations. Over the years, from sticky Damping theory believes that the damping force is proportional to the deformation speed. Assume that the damping force is proportional to the elastic restoring force and is in the direction of the deformation speed. The same hysteresis damping theory was proposed, and then the Coulomb damping theory was Supplementary to mechanical vibration analysis, various damping models are constantly being developed. development, there has been no one universally applicable to all situations and will not be consistent with There is a model with conflicting elements in. In view of this, finding suitable wood The damping model for structural floor vibration testing is extremely important, and It is a hot topic for future research. Third, strengthen the relationship with the production field close contact. Our original intention to study the damping dynamic characteristics of wood is to To explore the relationship between the vibration of wooden floors and their damping characteristics, and then Provide correct guidance for experimental research and specification formulation. this In this way, the vibration reduction problem of structures such as wooden floors can be well solved, in order to Achieve the core purpose of improving occupant comfort. For example, the viscoelastic Damping material attached to the surface of the structure is a relatively simple and economical Methods to enhance energy dissipation of vibrating tissue and thereby reduce vibration; The related damping materials are effective and reasonable in the building structure. Placement has also become an important topic that domestic and foreign scientists are keen to study. Target.

To sum up, the author deeply feels the complexity of wooden floor vibration reduction design technology. complexity, and the importance of the role of wood's damping properties. because Therefore, we should learn from the structural damping theoretical model and damping The application results of the test method on reinforced concrete building

structures are Improve the research level of structural damping dynamic characteristics in wooden structures Provide important support in order to better support the implementation of my country's wooden construction field lay a solid scientific foundation for practical applications.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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