Talking about the Application of Structural Mechanics

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Abstract: Building structural mechanics plays an increasingly important role in the field of architecture. This paper makes a brief discussion on structural mechanics of buildings. Combining structural mechanics with material science, the experimental simulation is carried out in the application of civil engineering. The results show that the research has important practical value.

Keywords: Civil engineering; Structural mechanics; Structural materials; Research

1. Introduction

At present, foreign universities still focus on the teaching of basic theory of structural mechanics and the cultivation of students'hand-calculating ability, and have not yet carried out research on relevant experiments of structural mechanics. There are few studies on the course construction of structural mechanics experiment in China. Six universities have carried out the related construction of structural mechanics experiment. Wuhan University has published the textbook "Structural Mechanics Experiments", and designed 29 basic experiments for students to choose. Harbin Polytechnic University has set up a teaching and research team of experimental structural mechanics, and carried out the construction of experimental structural mechanics curriculum platform, with experimental teaching as the main part and classroom teaching as the supplement . Shenyang Architectural University has set up an experimental platform based on the teaching characteristics of structural mechanics course and the existing laboratory conditions, and actively prepared to open structural mechanics experimental course. Hefei University of Technology is actively exploring the teaching of experimental structural mechanics on the basis of learning the experience of other universities in structural mechanics experimental courses and combining its own foundation. Yangzhou Universityreformed the course experiment teaching of civil engineering specialty, established a series of open experimental teaching platform for undergraduate civil engineering specialty, and integrated the experiment of material mechanics, structural mechanics, civil engineering materials, soil mechanics and concrete into the basic experimental course of civil engineering specialty[1-4].

The structural mechanics team of the Department of Construction Engineering of Dalian University of Technology, together with Yantai University and Yantai Xintiandi Experimental Technology Co., Ltd., has developed a teaching platform for structural mechanics. In 2016, a patent for invention was granted (as shown in Fig. 1). The experimental platform (as shown in Fig. 2) integrates structural mechanics model, loading device and measuring device. To achieve integration. The platform is a four-column portal frame structure with self-reaction force. H-shaped steel beams are used for upper and lower crossbeams. Linear guideways are installed on the upper and lower crossbeams and columns. The guideways are hidden in the section steel. A movable car is installed on the guideways. The car can be installed with bearings, loading cylinders and so on. It can apply vertical load, horizontal load and node bending moment to the experimental model at many points. It can also be used in the spatial structure model experiment to realize multi-point and multi-direction tension and pressure loading. It can systematically complete the relevant verification experiments of the basic theory of structural mechanics, and carry out some comprehensive design experiments. After several years of exploration, the team has developed and improved fourteen experimental topics and corresponding experimental reports. Professor Chen Tingguo, the leader, started the elective course of experimental structural mechanics for the first time in autumn 2016. A total of 20 hours, 25 students took the course. According to the analysis of examination results, the elective course of experimental structural mechanics was selected. The students'performance is generally better [5].

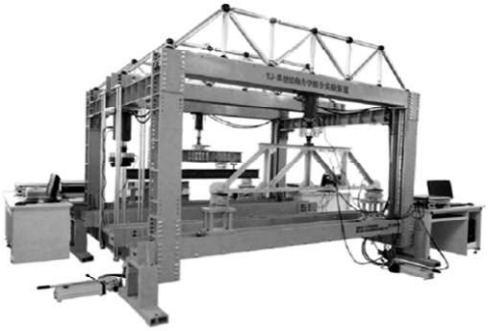

Figure 1. Experimental platform of structural mechanics

At present, the technologies used to fabricate composite honeycomb structures include interlocking assembly process , pultrusion process , narrow honeycomb ribs fabricated from unidirectional or corrugated plates and pasted on the panel. Among them, the interlocking assembly process has the advantages of simple operation and high material utilization compared with other processes. 205 kg/m3, 150 MPa, 3.6 MPa at room temperature, 263 MPa and 7.5 MPa after drying at 130 C. It is prepared by hot-pressing tank process . Flat compression performance is an important performance of composite sandwich structure, and the flat compression performance of composite sandwich structure depends on the flat compression strength of the core. Multistage composite honeycomb structure is fabricated by unidirectional carbon fiber reinforced resin matrix composites, and the direction of fibers in the material is along the direction of compressive stress in the core, so that the fibers in the composite honeycomb structure can give full play to the maximum utilization ratio of load when it is subjected to out-of-plane compressive load. Therefore, it can be inferred that this multi-stage composite honeycomb structure has high out-of-plane compressive strength and out-of-plane compressive strength. Through theoretical deduction, the horizontal pressure performance of multi-stage composite honeycomb structure is predicted theoretically, and the horizontal pressure test is carried out. The results of the theoretical prediction are verified by the test results. Through the analysis of the experimental results, some conclusions are drawn for the design of multi-stage composite honeycomb structure.

2. Brief Introduction to the Principle of BI-SA Software Layer-to-Layer Combination Simulation

In view of the typical horizontal distribution characteristics of asphalt pavement, the theory of elastic layer system has become the basis of its structural analysis. Since Burmister's first public report in 1943, this theory has developed vigorously. With the popularization of modern computer technology, computer programs based on this theory have emerged in succession. Many programs can consider the incomplete continuity of interlayer bonding. This paper analyses and chooses BISAR 3.0 software developed by Bitumen Business Group. The ability and characteristics of simulating pavement interlayer bonding are briefly introduced below.

Goodman mechanical model is often used to represent the mechanical properties of interlayer Semi-bonded interface at home and abroad.

$$\tau = k\Delta u \tag{1}$$

In the formula_-is the shear stress on the contact surface.

K - is the interlayer binding coefficient.

U - is the relative horizontal displacement of the upper and lower structural layers. When the bonding state of the interface between the first layer is semi-bonded, the formula is used.

The interlaminar bonding conditions for the axisymmetric problem of space over the interface are obtained as follows:

$$\sigma zi = \sigma zi + 1\omega i = \omega i + 1$$

$$\tau zri = \tau zri + 1 = ki(ui + 1 - ui) \tag{2}$$

In the formula, K is the interlaminar bonding coefficient in Goodman's mechanical model. I and I + 1 in stress，displacement I and u component subscripts represent the first and I + 1 structural layers in the elastic layer system, respectively.

Reduced shear spring flexibility can be used in BISAR 3.0 program

Reduced shear spring compliance ALK (m as a single characterization of interlaminar bonding status, the relationship between the value and friction parameters, shear spring flexibility can be seen respectively (3), (4):

$$ALK = \alpha 1 - a \cdot a \tag{3}$$

$$AK = ALK \cdot 1 + \nu E \tag{4}$$

The symbols of each variable in the formula have the same concrete meaning as those mentioned earlier.

3. Measures to Improve the Interface-Grassroots Interlayer Combination

Previous theoretical analysis shows that when other conditions remain unchanged, the horizontal tension strain along the driving direction at the bottom of the surface layer, the horizontal tension stress along the driving direction at the bottom of the base layer and the vertical compression strain at the top of the soil foundation increase by about 558.1%, 48.1% and 48.5% respectively compared with that under the completely continuous state. However, the vertical compressive stress on the top of asphalt pavement has no obvious effect. According to this conclusion, we can take pertinent measures in design, construction and maintenance to improve and prevent the adverse effects of poor combination between surface and base on semi-rigid base asphalt pavement. In the aspect of design, spraying permeable oil on the base and laying the underlying seal can effectively improve the bond between the asphalt surface and the base, and enhance the waterproof and impermeability of the pavement structure. In construction, we should ensure the laying quality of the penetrating layer and the underlying seal layer so that it can play its role; before the surface layer construction, we need to use forest fire extinguishers and other equipment to clean the working face in advance, and we should make the surface clean, free of floating and loose particles, so as to reduce the pollution of the interface between the surface and the grass-roots layer. In terms of maintenance, according to the queuing situation of the serious influence of interlayer combination on design indexes, priority should be given to preventive maintenance measures against fatigue cracking of asphalt pavement, strengthening the repair of fatigue cracks of asphalt pavement, and paying attention to reflective cracks caused by rutting caused by permanent deformation of soil foundation and fatigue cracking of inorganic binder stabilized layer. Sew.

4. Concluding Remarks

The three-point bending properties of multistage composite honeycomb structures were studied. According to the theoretical prediction formula, the failure mechanism diagram of multi-stage composite honeycomb structure under three-point bending load is made, and the failure mode of the structure under three-point bending load is predicted theoretically. At the same time, the three-point bending performance was tested, and the theoretical prediction results were verified by the experimental results. It was found that the experimental results were the same as the theoretical prediction results. It is found that the main failure mode of multi-stage composite honeycomb structure under three-point bending load is surface core debonding failure.

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