International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 3; Issue 6; June 2016; Page No. 335-337

Discussion on FWD and beckman beam detection method

Deming Zhang

College of Civil Engineering Chongqing Jiaotong University, Chongqing, China

Abstract
Introduction by Falling Weight Deflectometer act (FWD) and Beckman Beam Deflection assay (BBD), and comparative analysis of the results showed that, FWD method in accuracy, detection efficiency, ease of operation and other aspects are better than Baker Man beam deflection detection method.

Keywords: deflection; falling weight deflectometer (FWD); Beckman beam deflection device (BBD)

1. Introduction

The road of vertical deformation under the action of vehicle load known as deflection. Pavement deflection in our country has been widely used in pavement design and the construction control and completion inspection and acceptance process and there are a lot of research results, but also used in the reinforcement design of old road. It is a basic control parameters of the whole process of highway construction, so the accurate detection of pavement deflection is of great importance to the smooth completion. Pavement deflection can reflect pavement overall stiffness and strength of each layer, and can understand the strength of soil base and pavement performance.

In the past for a long time in pavement deflection testing technology is far behind the developed countries, mainly in the road surface deflection detection accuracy and efficiency etc. It can't meet the requirements of highway construction. As in the aspects of the comprehensive development of highway construction in our country, People refer lessons from foreign experience and has introduced some advanced foreign technology and equipment. From the most commonly used Beckman beam deflection method gradually developed to the more secure, accurate, efficient and does not affect the functional performance of the pavement structure of drop hammer type deflection instrument detection technology.

2. Road deflection change rule

Road deflection changes, including vehicle, environment under the influence of the factors, is a complex process. Roadbed form and material properties of each layer, the construction process of construction quality, the temperature at which the traffic of vehicles, weather conditions, the testing staff levels and adopted by the testing equipment, etc, have a great influence to the change of deflection.

The changing process of asphalt pavement surface deflection is divided into three stages. By 1 to 2 years after completion of the road for the first stage. At this stage, because of vehicle load repeated rolling, pavement compaction gradually, and the subbase semi-rigid material as the growth of the age, strength also increases, which leads to the road surface deflection will reduce gradually, on the road about 2 years after completion at minimum deflection.

The road after the completion of 2 to 4 years for the second stage. In the second stage, in the second stage, the performance of growing road surface deflection. This is mainly due to increase the strength of the semi-rigid base has a very slow, and gradually tend to be relatively stable state; on the other hand, road asphalt layer material due to the effect of repetition of the vehicle load and water temperature, light combination, combined with the pavement mixture itself caused by mixing, construction of uneven, and the influence of such factors as the structure of the micro defects to expand by local stress concentration, and a small range of local damage, leading to sharply reduce overall stiffness of pavement structure, road surface deflection increases sharply. If improper design, construction process without strict control of construction quality, in this stage may appear local early damage of pavement.

The road after the completion of 3 to 4 years until the changes to limit damage status to the deflection of the third stage. In the third stage, the pavement in comprehensive under the influence of various factors lead to the problem of insufficient local strength is fully exposed, the energy stored by local internal defects is by the expansion of the defects and transfer, and gradually realized the energy balance of the whole system, thus inhibiting the damage to the further development of the internal structure. The overall stiffness of pavement structure, to achieve a low level is relatively stable. Therefore, road table deflection into the gradual change of a relatively stable stage. The structural fatigue damage stage of stable development, and continued on to the pavement structure fatigue damage.

3. Detection method

3.1. Beckman beam deflection tests

Beckman beam deflection testing, it is the most commonly used in current practice, as the construction acceptance and the reinforcement design deflection test method. Road deflection value table is the basic parameters of the pavement structure design. At the present stage in our country, testing generally represents the pavement deflection value of rebound deflection, rather than the total deflection.

For asphalt concrete pavement, the deflection testing was conducted in the asphalt concrete road surface, and road surface is influenced by the weather change is very big, the

summer high temperature of asphalt concrete pavement become soft, and winter low temperature of asphalt concrete pavement and harden brittle. So if in winter testing, due to road surface quality also can appear distortion. So you need to draw up a temperature for the detection of deflection standard state. It is worth noting that the deflection instrument on the position of the probe should be placed in the measuring point, namely the front wheel gap center 3 to 5 cm. Persons to be on behalf of the deflection value detection time on the road in the first year after the completion of the worst season.

At present, the later is better than that of our country highway construction development, the testing method and the basic parameters are based on Beckman beam method, table Beckman beam was used to measure the road deflection value, measured data parameters to a large extent influenced by artificial factors and testing conditions, of which the main problems are:

1. Under the action of automobile loading is usually only measured static road surface of the single point of (maximum) rebound deflection value, cannot be measured pavement structure under vehicle load could reflect the dynamic characteristics of the reality and the whole pavement deflection basin shape;
2. Due to adopts the lever principle of work, so when the scope of the deflection basin is bigger, protection of deformation has more significant influence on test results;
3. The whole detection process are manual operation, test result is strongly influenced by human factors;
4. According to Beckman beam deflection value obtained from tests, cannot correctly reflect the actual situation of pavement structure layer to determine the use of material properties;
5. The domestic material strength testing of pavement structure layer remain reliant on destructive methods, such as drilling, pit;
6. Test is slow, not convenient operation, and had a greater influence on the detection process of highway traffic, not suitable for a wide range of road network investigation and on the long-term observation;
7. Detection process is vulnerable to the interference of external factors, low reliability, with the improvement of road grade and pavement structure strength, deflection basin radius increases, affect the credibility of the measured result;

Over the years, our country in the pavement deflection testing evaluation adopts Beckman beam method, which is a maximum deflection of the road test table. For different pavement structure by using Beckman beam method measured deflection value could be the same, but the actual deflection and pavement will have a larger difference. Although this method is simple, but the whole detection process are manual operation, so the test results will be influenced by artificial factors, and the detection speed is slow, low accuracy and poor reliability, applies only to flexible pavement. On the other hand, it's detection principle is the foundation of other deflection testing methods, deflection meter price is low, can be used repeatedly, easy to implement. In order to more convenient and succinctly using Beckman beam method, and makes the calculation more standardized, accurate, reasonable and comprehensive evaluation of road usage, need further development.

3.2 Falling Weight Deflectometer

In recent years, using the method of FWD testing pavement dynamic deflection, which is used to calculate the modulus of resilience of highway surface, has become a hot topic of the world highway. FWD is compared with other deflection testing equipment, the main technical characteristics are：

1. Computer automatically collected data and can be continuous rapid detection, 1 h to about 60 time, suitable for large-scale, long distance detection;
2. The accuracy and precision, deflection resolution of 1 mu m;
3. Load range, can be between 0.7 ~ 12 t change;
4. FWD can accurately capture the deflection basin of more complete information, for the back calculation of modulus of pavement structure layer, determine its using performance provides the necessary foundation;
5. Loading system can be well simulated dynamic load, the test result is closer to the reality and the multi-stage loading can be;
6. Deflection basin by 1 set of sensors data fitting out as a result, the multilayer pavement structure make nondestructive testing and evaluation is possible;
7. FWD is not only overcome the Beckman beam deflection testing inherent shortcomings, and weight of portable instrument itself in operation, convenient detection.

At present Beckman beam method is still the most common pavement deflection testing method, the determination of the fixed vehicle loads, deformation of pavement surface, but this method is low efficiency and greatly influenced by external factors, the error is bigger, also can't calculate the strength of the pavement layer of each structure. Though FWD method can better compensate for these flaws, but the FWD and Beckman beam method of calibration work is very important, and FWD method for pavement thickness of each layer can be calculated by the road after the strength of each structural layer for FWD method must be combined with drilling and geological radar technology to better play a role.

4. Conclusion

In recent years, fast development of highway enterprise in China, especially in high grade highway construction, the traditional pavement testing and evaluation method cannot have satisfied our country highway construction and management of the actual requirements. FWD as the pavement in the advanced testing equipment, due to its obvious detection technology advantage, will be more and more get people's attention.

5. References

1. Zhiqiang Fan. Reflections on Pavement Deflection. J. Highway. 2011; (12):38-40.
2. Xudong Wang. Discussion on Asphalt Pavement Deflection Index. J. Highway and Transportation Research, 2015; 32:1-12.
3. Wenqiang Liu. Pavement detect problems and related new technologies. J. Communications Standardization. 2010; (224):13-16.
4. Jianjun Hao. Pavement Deflection measurement methods comparing. J. Shandong Transportation Research. 2016; (1):96-105.

5. Zhiguo Huang. Asphalt Pavement about deflection change analysis. J. Building Materials and Decoration. 2008; (1):138-140.
6. Tingbo Zhang. The highway pavement deflection change law problem deep analysis. J. Science and technology of China wealth. 2010; (12):35-38.