

A Brief Analysis Of Seamless Bridge Expansion Joints

Tao Zhang

College Of Civil Engineering, Chongqing Jiaotong University, Chongqing 400074, China

Abstract

As an important affiliated member of the bridge, the bridge expansion joints are more and more attention. By comparing the different characteristics of bridge expansion joints, clear advantages of seamless bridge expansion joints. Than describe the type of seamless bridge expansion joints, and disadvantages of each type of bridge expansion joints may propose future directions and requirements.

Keywords

Bridge expansion joints, Polyurethane, Elastic concrete.

1. Introduction

With the development of transportation construction cause, The mileage of highway growth quickly. As an important part of the highway bridge, which is also increasing on the ten thousand a year, In recent years, China has successively bridge collapse accident occurred, not only make people feel worried, but also aroused great concern of government.

Bridge expansion joints is an important affiliated member of the bridge, it's set to satisfied the deck deformation, provided a bridge between the end of the beam, the hinge between the end of the beam position and the abutment or bridge. Its main role is to adapt due to changes in temperature and humidity, concrete creep and shrinkage, settlement and bridge abutments beam end rotation, etc. caused by deformation and ensure smooth deck, driving comfort. However, since the bridge expansion joints long-term exposure to the atmosphere, the environment was quite poor, the bridge structure is most easily damaged and difficult to repair the site, reducing the overall life of the bridge. And because of its large number of, destruction cycle is short, not easy to replace, disrupting traffic and other characteristics of the replacement, it has become the biggest headache for the highway management department of bridge maintenance work content. According to statistics, during maintenance of the entire bridge, where the bridge expansion joints caused by the damage repair costs accounted for 7% to 25% of the entire bridge maintenance costs. Therefore, the study of the bridge expansion joints technology, not only directly affects the smooth and comfortable driving, and more importantly, also affects maintenance costs and service life of the entire bridge structure.

2. Types and Characteristics of bridge expansion joints

Bridge expansion joint device is currently used by a wide range of domestic and international classification methods are not the same. Domestic type bridge expansion joints will be divided into five categories, namely: Docking, Steel type, Rubber plate, Steel-supporting and Modular. Applications through the advantages and disadvantages of existing entities similar analysis of the product, that the current bridge expansion joints the following problems should be solved.

(1) docking expansion joints: for stretching the amount of bridge construction is relatively simple, low construction cost, but at the time of the expansion joint filler thermal expansion will be squeezed out, while shrink out of filler and $\leq 40\text{mm}$ can not be restored, and because water resistance due to gravel debris occupy the gap and damage will also result in plate steel corrosion, affecting the life of the bridge;

(2) steel expansion joints: steel expansion joints in two forms, namely zinc metal plate U-joints and lap joints, these joints construction is simple, low construction cost, commonly used in walkways or small span bridge, but its durability, ride comfort and shock absorption is poor;

(3) Rubber Plate expansion joints: the rubber material density and ease of shock absorption, making it waterproof performance and reduce noise better performance, but the overall expansion joints such devastating, life is short;

(4) steel support expansion joints: These telescopic joints flexible, reliable sealing performance, long life, but the high cost, high quality installation, driving comfort is poor, difficult to repair;

(5) Modular Expansion Joints: good waterproofing and drainage performance, durability, but its structure is extremely complex, high cost, maintenance difficulties.

3. Types and Characteristics of seamless bridge expansion joints

The design principle of seamless bridge expansion joints can be generated to allow longitudinal displacement of a mechanical device support plate, and an elastomer material composed of a mixture of stone, the heat generated by the elastomeric material is composed of a variety of polymers plastic elastomer, with strong adhesion and high damping, with a variety of deck materials, such as asphalt bonding concrete, steel, cement, concrete and so on.

To reduce highway bridge expansion joints and conservation work on the passage of traffic, according to domestic and foreign research data, to cancel small steel bridge expansion joints is the future trend of development. Therefore, the market appeared more seamless bridge expansion joints, these joints has a good waterproof performance, simple construction, easy repair and maintenance, driving comfort and so on.

In recent years, research on seamless bridge expansion joints material continues constantly, especially in the study of binders. So far, at home and abroad have been invented Jointless wide range of materials used to fill the bridge, but different manufacturers of material properties vary greatly. Currently the application of more seamless joints There are two main types of materials: modified asphalt elastic concrete and polyurethane elastic concrete.

a. Modified Asphalt elastic Concrete

Modified asphalt elastic concrete modify to the asphalt, so that it has a large deformation. The asphalt concrete that has made at the same time the performance of conventional asphalt concrete, with good deformability. To ensure that the requirements of small and medium deformation bridge expansion joints. It is possible to ensure that vehicles traveling on the bridge during the flatness requirements. But modified asphalt at high temperatures easy to wear, more prone to rutting, and the high temperature and low temperature properties of the material conflict. That is to say, modified asphalt concrete can not satisfy the elastic deformation capacity requirements at low temperatures and under high temperature conditions the stability requirements. Alternating high and low temperature environment, traffic load repeated shocks, prone to damage, so short life, post-maintenance costs will be correspondingly higher.

b. Polyurethane elastic concrete

The so-called polyurethane elastic concrete, is to use polyurethane, curing agents and aggregate after a three-component mixing special curing mixture formation. Polyurethane concrete has good deformation capacity dynamic impact better dispersion of the wheel, which has excellent impact resistance, high durability, resistance to fatigue and wear characteristics, with excellent shear strength and impact properties, and have excellent flexibility characteristics. Which is far less than the modulus of elasticity modulus of concrete, with good deformability, using its ability to dissipate deformation dynamic impact wheels have to withstand prolonged magnitude ranging from complex dynamic loads and impact capabilities. So you can use polyurethane elastic concrete bridge expansion joints were processed. With the change of load and temperature expansion joints such as expansion and contraction or deformation of elastic concrete expansion joints will be with this body, shrink or stretch deformation, shrinkage and deformation, so that the deck remains flat; at the same time, protection of joints against wind and rain, acid rain and frost and other natural erosion, ensure the integrity of the bridge structure.

At present, the polyurethane elastomer concrete has been applied in engineering practice. It is not just for the new bridge expansion joints, replacement of expansion joints in some of the old bridge has also been applied, even in the advanced track in the stadium has also been applied. Because of the polyurethane elastomer is more excellent than each concrete term performance. But poor market performance polyurethane products coupled with concrete material and curing time is long and expensive, which BASF polyurethane elastic concrete price reached 600 dollar per linear meter.

4. The development of elastic concrete expansion joint

International research on seamless bridge expansion joints, are more inclined to study elastic-plastic binder material. Elastic-plastic binder material is mainly composed of asphalt and elastomeric polymer as a main material, and then add other dispersing agents, modifiers, softeners and antioxidants and other ingredients prepared from the need to have featured in display low-frequency elastic when subjected to loads instantly displayed as plastic when subjected to high temperatures slow force at low frequencies. At the same time it is essential to reduce the price of materials.

Develop high-performance elastic concrete bridge expansion joints is necessary to meet the functional needs of the structure of telescopic, but also has a comfortable environment, reliable and durable, easy maintenance and construction high Cost-effective and so on. Ideal high elasticity of concrete expansion joints should have the following characteristics:

- (1) Low cost and high performance concrete elasticity;
- (2) Compared to other types of steel bridge expansion joints, etc., with driving comfort, Pavement joints, prevent bump hidden features;
- (3) According to the site need to achieve concrete expansion joint Flexible controllable curing time, to ensure the completion of the construction in a short time, that is a brief interruption of traffic can be restored after the opening;
- (4) Stretching the amount of concrete to meet the high performance elastic simply supported single-span bridge stretching 40m or less the amount of demand that need to meet the needs of the majority of the bridge.

Overall, bridge engineering structural safety, reliability, and technical implications, have become the focus of attention of the international community bridge, bridge design and service capabilities and other aspects of life also put forward higher requirements. Bridge expansion joints as a conventional bridge design, construction, maintenance and management easy to overlook weaknesses, has gradually attracted people's attention. The research in this area will also continue to deepen, to satisfy the bridge performance while meeting driving comfort; the life of the bridge to meet the same time, meet the economic requirements.

References:

- [1] Zhang Haitao. highway bridge expansion joints Cause Analysis and Fast repair and replacement process [J] Communications Standardization, 2012 (02): 123-125
- [2] The Distance, Zhang Shuqin. polyurethane material Manual [M] Beijing: Chemical Industry Press, 2002
- [3] Marques Lima J, de Brito J. Management system for expansion joints of road bridges. Struct Infrastruct Eng 2007 [in press].
- [4] Marques Lima J. Expansion joints in road bridges — development of a management system. Masters in Construction Dissertation. Lisbon: Instituto Superior Técnico. Technical University of Lisbon; 2006 [in Portuguese].