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Theoretical analysis of stress of asphalt mixture bridge deck pavement based on design index

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Abstract: At present, the specification for the design of asphalt mixture bridge deck pavement is missing, so it is of great significance to research on it. In order to study the design theory of asphalt mixture bridge deck pavement, the bottom tensile strain of asphalt mixture layer and the permanent deformation of asphalt mixture layer as the design index of asphalt mixture bridge deck pavement have been selected. Combined with a specific simply supported slab bridge, the mechanical properties and influencing factors of asphalt mixture bridge deck pavement based on the design index have been analyzed. Firstly, the section characteristic calculation basis of fatigue checking calculation is proposed by using the standard method, and the fatigue section characteristic of simply supported solid slab bridge is analyzed. Considering different load positions, the calculation method of fatigue stress under design load and ultimate load is proposed, and the fatigue stress is calculated. According to the equal strain principle, the bottom stress of asphalt mixture is calculated. Secondly, based on the assumption of plane section, the strain calculation formula of rectangular section with two parameters under temperature load is deduced. Using the derivation formula, the stress distribution of the section under the action of uniform temperature and gradient temperature is calculated, and the general stress distribution law is obtained. Finally,take Specification for design of highway asphalt pavement (JTG D50-2017) for reference to calculate the permanent deformation of asphalt mixture bridge deck pavement; Compared with the field measured value, the theoretical calculated value is less than the field measured value, which may be related to the insufficient compaction of asphalt on the bridge deck.

Keywords: bridge deck pavement; Asphalt mixture; Design index; Stress analysis;

1. Introduction

Compared with cement concrete pavement, asphalt pavement has attracted much attention for its superior performance since its birth. For the research of asphalt pavement, many research results have been obtained, including asphalt pavement materials, stress theory of structural layer, temperature field distribution, design method, etc., and "Specifications for Design of Highway Asphalt Pavement "(JTG D50-2017) has been issued. However, the research on asphalt mixture bridge deck pavement is relatively few, and the asphalt mixture bridge deck pavement of steel structure bridge is recognized as a world problem.

At present, the research on asphalt mixture bridge deck pavement has achieved certain research results. Most of the research is based on the experimental analysis and numerical simulation of asphalt pavement, and the theoretical analysis research is less. In comparison, the research on asphalt mixture bridge deck pavement is less, and it has not formed a theory. Especially for the theory of bridge structure pavement, "Specifications for Design of Highway Asphalt Pavement "(JTG D50-2017) is widely used, It is far from the actual situation of the bridge structure, which leads to suffer frequent diseases of asphalt bridge deck pavement. Therefore, this paper selects the bottom tensile strain of asphalt mixture layer and the permanent deformation of asphalt mixture layer as the design index of asphalt mixture bridge deck pavement. Taking a concrete simply supported slab bridge as an example, the mechanical performance of asphalt mixture bridge deck pavement is deduced and analyzed based on the design index,It is of great significance to put forward and improve the design theory of asphalt mixture bridge deck pavement.

2. State of the art

At present, the research on asphalt mixture bridge deck pavement has achieved some research results. Generally speaking, most of researches are based on experimental analysis and numerical simulation, and the research results are scattered and no theory has been formed. For example, Li Jianhui [1] analyzed the main technical characteristics of epoxy asphalt mixture pavement, tested and analyzed the relevant parameters during construction process, but It lacked the relevant research on the design of epoxy asphalt bridge deck pavement structural layer. Chen et al. [2] analyzed and deduced the solution of elastic multi-layer system under the condition of incomplete bonding of asphalt pavement structure interface, but it lacks the support of test data and is not suitable for bridge deck pavement. Wang Min, Xiao Li, Wang Tao, Lan Chao [3] established the analytical formula method of flexural tensile modulus of steel deck pavement material by using the five point loading test model of composite beam, and compared the calculation results with the finite element method, which is lack of comparative analysis considering the insufficient compaction of actual deck pavement. Sun et al. [4] proposed a three-dimensional (3D) multi-scale modeling method to study the response of asphalt pavement under the coupling action of temperature and stress field. Due to the difference between pavement structure and bridge deck structure, this method is not suitable for asphalt mixture bridge deck pavement. Jiang Mengya, Wang Shenyan, Ling Ziyang, Yang Yang [5] used Burgers model to conduct numerical simulation analysis on epoxy asphalt concrete bridge deck pavement, but there is a lack of comparison and verification of actual engineering data for the relevant conclusions.

Considering the dual effects of pavement roughness and deformation, Ma et al. [6] proposed an improved solution method by decoupling the vehicle asphalt pavement coupling system into two subsystems and solved them independently to study the dynamic response of the vehicle asphalt pavement coupling system. However, this method is significantly different from the vehicle bridge coupling vibration and cannot be directly applied to asphalt mixture bridge deck pavement. Cheng huailei, Liu Liping, sun Lijun [7] introduced a method to determine the on-site modulus master curve of asphalt mixture pavement by taking the steel bridge deck pavement project as an example. This method is only applicable to asphalt mixtures with specific materials and specific proportion, which is difficult to be popularized and applied. Cao et al. [8] Based on the modulus inversion theory and the deflection basin equivalent principle, through the analysis of measured data, compared the equivalent resilient modulus of different structural layers in three different structures, deduced the equivalent resilient modulus of the top surface of the structural layer based on the inversion method, and corrected the existing theoretical formula. The asphalt pavement structure targeted by the above method cannot be directly applied to the asphalt mixture bridge deck pavement. Jiang Mengya, Yuan Zhaohui, Liu Zhennan [9] studied the low-temperature performance of the fine microstructure of epoxy resin asphalt concrete by taking the Cement Emulsified Epoxy Resin Asphalt (CAE) concrete for bridge deck pavement as the research object, but there is a lack of research on the low-temperature macro performance of CAE. Zhang et al. [10] proposed an improved pavement texture image segmentation algorithm to realize the nondestructive detection of aggregate distribution uniformity of asphalt pavement. This method is not applicable to other asphalt mixtures.

So, there are few theoretical analysis and research about it, especially the research work related to design theory of asphalt mixture bridge deck pavement is less. In this paper, the bottom tensile strain and permanent deformation of asphalt mixture layer are selected as the design indexes of asphalt mixture bridge deck pavement. Taking a concrete simply supported slab bridge as an example, the mechanical properties of asphalt mixture bridge deck pavement are deduced and analyzed based on the design indexes. Based on this, it can provide a basis for putting forward and perfecting the design theory of asphalt mixture bridge deck pavement.

The rest of this paper is organized as follows: In the third section, the anthor puts forward the fatigue conversion method of section, deduces the calculation method of temperature stress of asphalt mixture bridge deck pavement according to the equal strain principle, and puts forward the calculation method of permanent deformation of asphalt mixture layer of bridge deck pavement in combination with the specifications. the temperature stress and permanent deformation of asphalt mixture bridge deck pavement through the above methods are analyzed in the fourth section. At last, the author summarizes this paper and gives relevant conclusions.

3. Methodolog

For the composite structure composed of asphalt mixture surface and concrete slab, the function of asphalt mixture surface is to provide the surface function of bridge deck and have partial bearing function. In terms of mechanical analysis, the concrete slab is a one-way slab with simple supports at both ends; The asphalt mixture surface is a Elastically base plate supported on the concrete slab.

3.1 Load fatigue stress

According to section 6.7 of “Code for Design of Concrete Structures “(GB50010-2010), Equ.(1) and Equ.(2) can be used to obtain the compression zone height x0 of transformed-section and the transformed-section moment of inertia I_0^f ,which is corresponding to the bending moment $M_{\min}^f$ and $M_{\max}^f$.

$$\frac{bx_0^2}{2}+\alpha_E^f A_s'(x_0-a_s')-\alpha_E^f A_S(h_0-x_0)=0 \tag{1}$$

$$I_0^f=\frac{bx_0^3}{3}+\alpha_E^f A_s'(x_0-a_s')^2+\alpha_E^f A_S(h_0-x_0)^2 \tag{2}$$

According to the landing length of tire and the thickness of asphalt mixture pavement, the length of load pressure surface on concrete slab is calculated by a1× b1=0.4m×0.8m. The critical load position on slab top for the load stress calculation of design axle load and ultimate load (the critical load position is the center of slab span and the midpoint of free edge respectively) is shown in Figure 1 and Figure 2.

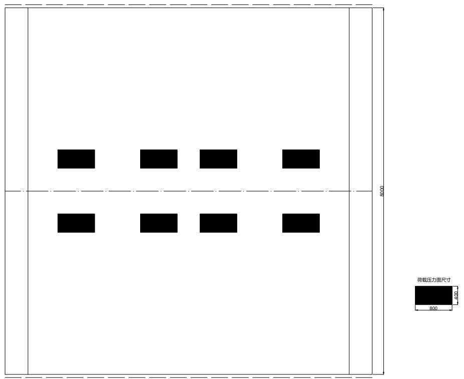


Fig.1 central load calculation model

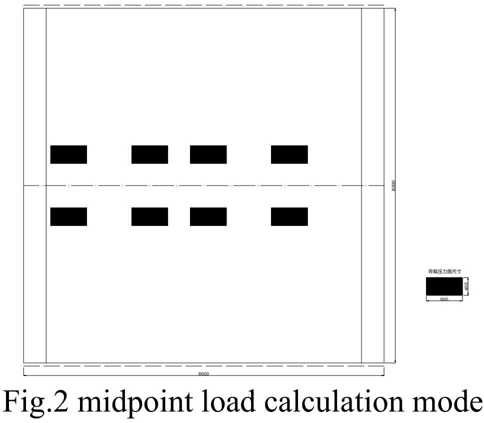


Fig.2 midpoint load calculation model

According to Appendix B of "Code for Design of Concrete Structures "(GB50010-2010), a long side of a single load action surface bty=0.8m is perpendicular to the slab span, and the effective distribution width of load on the simply supported slab is:

bcx=btx+2h=0.4m+2×0.1m=0.6m;

bcy=bty+2h=0.8m+2×0.1m=1.0m

bcx<bcy，bcy<2.2l=2.2×7.30m=16.06m，bcx<l=7.30m，

b=2/3bcy+0.73l=2/3×1.0m+0.73×7.30m=5.996m

The calculation result is d=1.05m<b/2=5.996/2=2.998m.

Considering the action of adjacent loads, the effective distribution width of load is b=8.0m.

The calculation and analysis shows that the equivalent distribution of the two load calculation models in Figure 1 and Figure 2 is the same. As shown in Figure 3 for details.

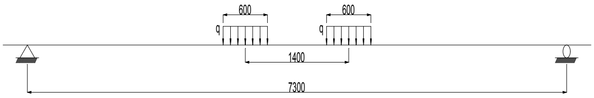


Fig.3 equivalent load calculation model (mm)

The load fatigue stress of concrete slab is calculated by formula (3):

$$\sigma_{\max}^{f}=\frac{M_{\max}^{f}x_0}{I_0^{f}} \tag{3}$$

where $M_{\max}^{f}$ is the fatigue bending moment, which can be calculated by combining the effective distribution width of the plate and the boundary condition of simply supported plate.

Assuming that the asphalt mixture bridge deck pavement is effectively bonded with the slab concrete, there is no interlayer slip, and the interfacial strain of the two materials is equal, the fatigue stress at the bottom of asphalt mixture layer can be obtained as follows:

$$\sigma_{\text{沥}}=\sigma_{\text{砼}}E_{\text{沥}}/E_{\text{砼}} \tag{4}$$

3.2 Temperature stress

In order to simplify the analysis, the rectangular section is taken for calculation (Figure 4), and the asphalt mixture is regarded as an elastic material without considering its viscoelastic properties.

Under temperature load (including uniform temperature load and gradient temperature load), the upper and lower layers of materials are closely connected without relative dislocation, and the section strain conforms to the plane section assumption.

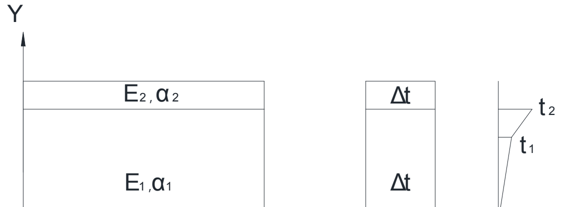


Fig.4 calculation section and temperature load

According to the equilibrium conditions, the resultant force N formed by self stress on the whole section and the resultant moment M to the neutral axis of the section are equal to 0,denoted as follows:

$$N=E_1\int_0^{h_1}\left[\alpha_1T(y)-(\varepsilon_0+\varphi y)\right]b(y)dy+E_2\int_{h_1}^{h_2}\left[\alpha_2T(y)-(\varepsilon_0+\varphi y)\right]b(y)dy=0 \tag{5}$$

$$M=E_1\int_0^{h_1}\left[\alpha_1T(y)-(\varepsilon_0+\varphi y)\right]b(y)(y-y_c)dy+E_2\int_{h_1}^{h_2}\left[\alpha_2T(y)-(\varepsilon_0+\varphi y)\right]b(y)(y-y_c)dy=0 \tag{6}$$

where T(y) is the section temperature distribution function, b(y) is the section width function and yc is the centroid of transformed section and ε0 is the strain at beam bottom (y=0) as well as φ is the curvature of section.

Under the action of uniform temperature Δt, from formula (5):

$$b\Delta t\left[E_1\alpha_1h_1+E_2\alpha_2\left(h_2-h_1\right)\right]-b\varepsilon_0\left[E_1h_1+E_2\left(h_2-h_1\right)\right]-\frac{b\varphi}{2}\left[E_1h_1^2+E_2\left(h_2^2-h_1^2\right)\right]=0 \tag{7}$$

Similarly, from equation (6):

$$E_2\Delta t\left(\alpha_2-\alpha_1\right)\int_{h_1}^{h_2}b\left(y-y_c\right)dy-E_1I\varphi=0 \tag{8}$$

Combining formula (7) and formula (8), we can get:

$$\varphi=\frac{E_2\Delta t\left(\alpha_1-\alpha_2\right)}{E_1I}\int_{h_1}^{h_2}b\left(y-y_c\right)dy$$

$$\varepsilon_0=\Delta t\frac{\left[E_1\alpha_1h_1+E_2\alpha_2\left(h_2-h_1\right)\right]}{\left[E_1h_1+E_2\left(h_2-h_1\right)\right]}-\frac{\left[E_1h_1^2+E_2\left(h_2^2-h_1^2\right)\right]}{\left[E_1h_1+E_2\left(h_2-h_1\right)\right]}\frac{E_2\Delta t\left(\alpha_1-\alpha_2\right)}{2E_1I}\int_{h_1}^{h_2}b\left(y-y_c\right)dy$$

Under the action of gradient temperature, from formula (5):

$$E_1\int_0^{h_1}\alpha_1T(y)b(y)dy+E_2\int_{h_1}^{h_2}\alpha_2T(y)b(y)dy-E_1\varepsilon_0A-E_1\varphi Ay_c=0 \tag{9}$$

Similarly, from equation (6):

$$E_1\int_0^{h_1}\alpha_1T(y)b(y)(y-y_c)dy+E_2\int_{h_1}^{h_2}\alpha_2T(y)b(y)(y-y_c)dy-E_1\varphi I=0 \tag{10}$$

Combining formula (9) and formula (10), we can get:

$$\varphi=\frac{\alpha_1}{I}\int_0^{h_1}T(y)b(y)(y-y_c)dy+\frac{E_2\alpha_2}{E_1I}\int_{h_1}^{h_2}T(y)b(y)(y-y_c)dy$$

$$\varepsilon_0=\frac{\alpha_1}{A}\int_0^{h_1}T(y)b(y)dy+\frac{E_2\alpha_2}{E_1A}\int_{h_1}^{h_2}T(y)b(y)dy-\varphi y_c$$

3.3 Permanent deformation of asphalt mixture layer

Asphalt mixture is a mixture system composed of asphalt and aggregate particles. Under the action of external load, aggregate particles overcome some weak adhesive force between asphalt membranes and make them interact. Due to the repeating load, this mutual dislocation is forced in a deeper and wider range, and gradually accumulates to form macro permanent deformation. The influencing factors of permanent deformation of asphalt mixture layer include asphalt and its dosage, aggregate type, gradation and porosity of aggregate, environmental and hydrogeological conditions, etc.

At present, the calculation specification of permanent deformation of asphalt mixture bridge deck pavement is missing. In this paper, referring to relevant specifications and literature [17], formula (11) is used to calculate the permanent deformation of asphalt mixture.

$$R_a=\sum_{i=1}^{n}R_{ai}\ ;\qquad R_{ai}=2.31\times10^{-8}k_{Ri}T_{pef}^{2.93}p_i^{1.80}N_{e3}^{0.48}\left(\frac{V}{V_0}\right)^{0.83}\left(\frac{h_i}{h_0}\right)R_{0i} \tag{11}$$

Where Ri and Ra are permanent deformation of asphalt mixture layer I and asphalt mixture layer (mm), respectively; n is the number of layers; Tpef is the equivalent temperature of permanent deformation of asphalt mixture layer (℃); pi is the vertical compressive stress on the top surface of the ith layer of asphalt mixture layer (MPa);Ne3 is the cumulative action times of equivalent design axle load on the design lane during the design service life or the period from opening to the first rutting maintenance; hi and h0 are the thickness of the ith layer and the thickness of rutting test specimen (mm), respectively; V and V0 are the initial void ratio of asphalt mixture layer after construction and void ratio of rutting test specimen (%), respectively; R0i is the permanent deformation of rutting test of the ith layer asphalt mixture when the test temperature is 60 ℃, the pressure is 0.7MPa and the loading times are 2520 times (mm); kR is the comprehensive correction coefficient.

4. Result Analysis and Discussion

There is a concrete simply supported slab bridge in a third class Highway (asphalt pavement), with a span of 8m (its calculated span is 7.30m) and deck width of 0.5m (anti-collision railing) +

7.0m (carriageway) + 0.5m (anti-collision railing). Its solid slab thickness is 0.5m, C40 concrete, HRB400 reinforcement, double-layer vertical reinforcement on both sides, HRB400 φ 22@100。Gravity expanded foundation and U-shaped abutment is adopted.

The deck pavement is made of asphalt mixture, with a thickness of 10cm (40mmAC-13 + 60mmAC-20 respectively). Bridge design load is Highway-grade II.

Elastic modulus of concrete and linear expansion coefficient measured by test are E1=3.25×1010MPa and α1=1.2×10-5, respectively. Elastic modulus of asphalt mixture and linear expansion coefficient measured by test are E2=9×109MPa and α2=1.0×10-4, respectively.

According to the traffic investigation and analysis, the design axle load of the road is 100kN, the heaviest axle load is 200kN, and the daily average equivalent axle number of the design lane is 3000.

According to the specification, the pavement structure Design reference period of third class highway is 10 years, the road has been completed and opened to traffic for 2 years, so the rest structural design period is 8 years. The average annual growth rate of traffic volume within the design service life is 5%. Calculated by the standard formula, the cumulative action times of design load on the design Lane in the remaining design reference period is:

$$N_e = \frac{\left[(1+\gamma)^t - 1\right]\times 365}{\gamma} N_1 = \frac{\left[(1+0.05)^8 - 1\right]}{0.05}\times 365\times 3000 = 1.0456\times 10^7$$

4.1 Fatigue load stress analysis

The transformed section results of fatigue calculation by formula (1) and formula (2) are x0=145.5mm/m，$I_0^f = 0.0068195m^4$ /m.

According to “General Specification for Design of Highway Bridges and Culverts” (JTG D60-2015), the local load of bridge structure and the earth pressure of culvert, abutment and retaining wall are calculated by 55 ton standard vehicle, Combined with relevant data, the fatigue bending moment is as follows:

$$M_{\max}^f = \left(140\times\frac{7.3}{2} - 140\times 0.7\right)\Big/ 8 = 51.625kN.m$$

The ultimate load stress is calculated by 200kN, the fatigue bending moment is as follows:

$$M_{\max}^f = \left(200\times\frac{7.3}{2} - 200\times 0.7\right)\Big/ 8 = 73.75kN.m$$

Using formula (3), the load fatigue stress of solid plate is shown in Table 1.

Table 1 load fatigue stress of solid plate

position	design load （MPa）	ultimate load （MPa）
center of Plate span	1.101	1.574
Free edge midpoint	1.101	1.574

Note: "+" in the table indicates compressive stress, "-" indicates tensile stress, the same below.

According to formula (4), the fatigue stress of bottom for asphalt mixture bridge deck pavement can be calculated. It is shown in Table 2 for details.

Table 2 load fatigue stress of asphalt mixture at the bottom

position	design load （MPa）	ultimate load （MPa）	Error(%)
center of Plate span	0.305	0.436	42.95
Free edge midpoint	0.305	0.436	42.95

Note: Error = (ultimate load - design load) / design load

According to the data in Table 2, under the design load and ultimate load, the difference of fatigue compressive stress of asphalt mixture bridge deck pavement between the center of bottom slab span and the midpoint of free edge is greatly, which is up to 42.95%. The calculation results again show that overload has a great influence on the stress of asphalt mixture bridge deck pavement.

4.2 Temperature stress analysis

According to "General Specification for Design of Highway Bridges and Culverts" (JTG D60-2015), the uniform temperature are Tmax =34 ℃ and Tmin=- 3 ℃, the gradient temperature are T1=14℃ and T2=5.5℃; The closure temperature of the structure is assumed to be 18±3℃.

The temperature stress calculation model are shown in Figure 5.

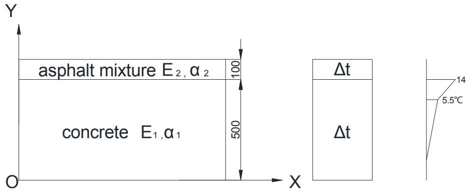
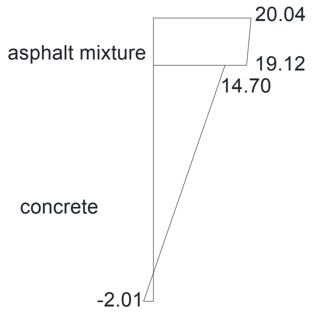
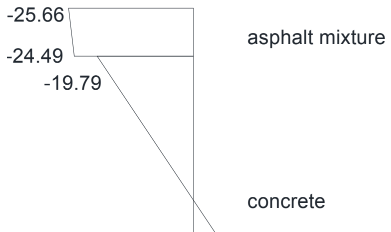


Fig.5 calculation section and temperature load

when Δt is 19℃, the upper layer of asphalt mixture is in compression and the lower layer of concrete is in tension; When Δt is-24℃, the upper layer of asphalt mixture is in tension and the lower layer of concrete is in compression. The section stress distribution is shown in Figure 6.



a） Δt=+19℃



b） Δt=−24℃

Fig.6 section stress distribution under uniform temperature load (MPa)

It can be seen from Figure 6 that the asphalt mixture layer is relatively thin, under the load of uniform temperature, the influence of stress on its top and bottom surfaces are small, which can be approximately considered as uniform distribution. Due to the difference of elastic modulus between asphalt mixture and concrete, the upper and lower stresses at the interface are different; The section stress of concrete solid slab presents a linear distribution, and the stress at the top and bottom is reversed.

Generally, under the uniform temperature load, the stress of asphalt mixture is very large, which is far greater than the ultimate stress of asphalt mixture.

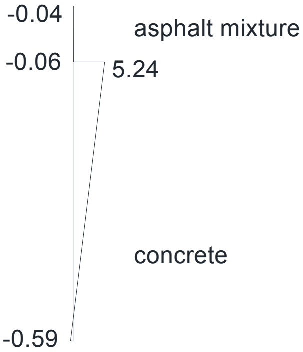


Fig.6 section stress distribution under positive gradient temperature load (MPa)

It can be seen from Figure 7 that under the positive gradient temperature load of concrete section only, the asphalt mixture bears small tensile stress, the interface stress of the two is reversed, and the concrete stress is much greater than that of asphalt mixture. The stress at the top and bottom of the concrete section is reversed, and the stress presents a linear distribution.

4.3 Load combination

Assuming load combination coefficient is 1.0. After load combination, the bottom stress of asphalt mixture bridge deck pavement is shown in Table 3.

Table 3 load fatigue stress of asphalt mixture bridge deck pavement at the bottom

position	design load（MPa）	ultimate load（MPa）
center of Plate span	19.425/-24.185/0.245	19.556/-24.054/0.376
Free edge midpoint	19.425/-24.185/0.245	19.556/-24.054/0.376

Note: the data combination form in the table is: fatigue load +positive uniform temperature/ fatigue load+negative uniform temperature/fatigue load+positive gradient temperature

4.4 Permanent deformation of asphalt mixture

The data in Table 3 shows that, under ultimate load, the bottom stress of asphalt mixture bridge deck pavement is greater than that under design load. Under the condition of fatigue load and negative uniform temperature, the tensile stress at the bottom of asphalt mixture is the largest; Under the condition of fatigue load and positive gradient temperature, the bottom compressive stress of asphalt mixture is the smallest.

Considering the load combination, the stress of asphalt mixture is very large, which is far greater than the ultimate stress of asphalt mixture.

100mm asphalt mixture bridge deck pavement is divided into five layers. Regardless of the difference between construction porosity and rutting specimen porosity, formula (11) is used to calculate the permanent deformation of asphalt mixture. the specific results are shown in Table 4.

Table 4 calculation list of permanent deformation of asphalt mixture bridge deck pavement

layer	Layer thickness（mm）	z_i	R_{ai}(mm)
First	15	15	0.10750
Second	20	25	0.30584
Third	20	45	0.36966
Fourth	20	65	0.29759
Fifth	25	87.5	0.24838
Σ	100		1.32896

Note: the vertical compressive stress on the top surface of layer i in the table is calculated by the converted section without considering fatigue calculation, and the equivalent load calculation model is shown in Figure 3.

According to the data in Table 4, the permanent deformation of asphalt mixture bridge deck pavement is small. Compared with the field measured value (the bridge has been in operation for two years), the theoretical calculated value is less than the field measured value, which may be related to the insufficient compaction of asphalt on the bridge deck.

5. Conclusion

In order to study the design theory of asphalt mixture bridge deck pavement, the bottom tensile strain and permanent deformation of asphalt mixture layer are selected as the design indexes, and the simply supported slab bridge is selected as an example to analyze the mechanical properties of asphalt mixture bridge deck pavement based on the design indexes.

Using the standard method, the calculation basis of fatigues section characteristics is proposed, based on that, the fatigue section characteristics of simply supported solid slab bridge are analyzed. Considering different load positions, the calculation method of fatigue stress under design load and ultimate load is proposed and the fatigue stress is calculated. According to the equal strain principle, the bottom stress of asphalt mixture layer is derived.

Under the action of design load and ultimate load, the difference of fatigue compressive stress between the center of bottom plate span and the midpoint of free edge of asphalt mixture bridge deck pavement is large, it is 42.95%. Which is indicating that overload has a great impact on the stress of asphalt mixture bridge deck pavement.

Based on the assumption of plane section, the strain calculation formula of rectangular section with two parameters under temperature load is derived. Using the derivation formula, the stress distribution of section under uniform temperature load and gradient temperature load are calculated, and the general stress distribution law is obtained as follows:

The asphalt mixture layer is thin, and its top and bottom stress changes little under the uniform temperature load, which can be approximately considered as uniform distribution; Due to the difference of elastic modulus between asphalt mixture and concrete, the upper and lower stresses of the interface are different; The section stress of the concrete solid slab presents a linear distribution, and the top and bottom stresses are reversed.

Under uniform temperature load, the stress of asphalt mixture layer is very large, which is far greater than the limit stress of asphalt mixture layer.

Considering only the positive gradient temperature of concrete section, the asphalt mixture layer bears a small tensile stress, the interface stress between the two is reversed, and the concrete stress is much greater than the asphalt mixture stress. The stress at the top and bottom of the concrete section is reversed, and the stress presents a straight-line distribution.

Under the limit load, the bottom stress of asphalt mixture bridge deck pavement is greater than that of design load. Under fatigue load and negative uniform temperature load, the tensile stress at the bottom of asphalt mixture layer is the largest; Under fatigue load and positive temperature gradient load, the bottom compressive stress of asphalt mixture layer is the smallest.

Considering the load combination, the stress of the asphalt mixture layer is very large, which is far greater than the ultimate stress of asphalt mixture layer.

Compared with the field measured value (the bridge has been in operation for two years), The results show that the permanent deformation of asphalt mixture bridge deck pavement is small., the theoretical calculated value is less than the field measured value, which may be related to the insufficient compaction of asphalt on the bridge deck.

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