Study on Improvement of SFRC Pavement on Fatigue Performance of Orthotropic Steel Deck

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Reducing local deformation and stress concentration of orthotropic steel deck

Outline

Due to the complicated structure of the *orthotropic steel deck*(OSD) and the weld joints between the diaphragm and the stiffened ribs, the stress concentration around the weld is very severe. SFRC(Steel Fiber Reinforced Concrete) is a new modified material that incorporate steel fibers into concrete, has been widely applied on steel bridge pavement.

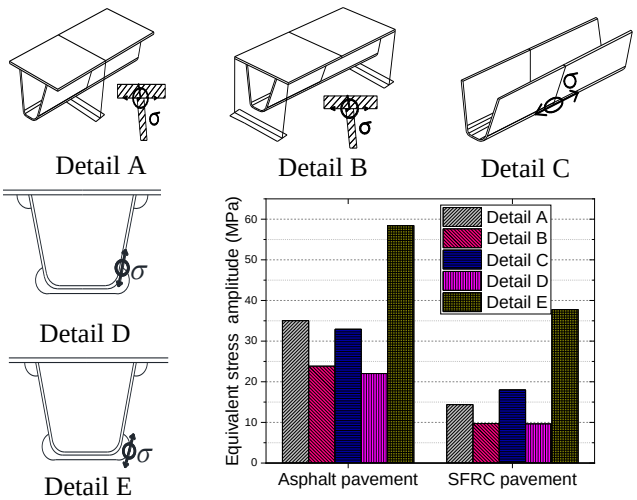
In this study, SFRC is used to replace the asphalt pavement.

- **Firstly, The model of steel bridge was verified by test,**
- **Secondly, the influence of various design parameters of SFRC on the fatigue details was analyzed.**
- **Finally, a new type of OSD pavement structure was proposed.**

Purpose of Study :
1.Clarifying the stress reducing effect of SFRC pavement
2.Improving the anti-fatigue performance by new methods

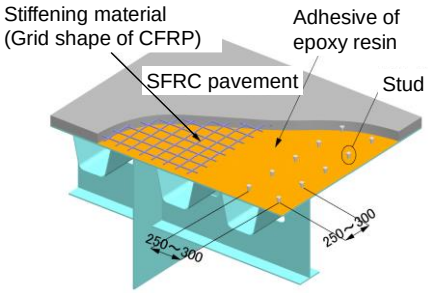
Finite Element Analysis

In this analysis, **5 critical welded details** are selected. And equivalent stress amplitude was calculated by *Miner's Rule and theory of S-N fatigue damage*. Then the compared analysis of OSD with SFRC and asphalt pavement was carried out.



Pavement Structure

The connection between the pavement and OSD is mainly composed of the adhesive of epoxy resin and stud, which protect the deck from rain corrosion and provide shear strength. And stiffening material is set up at bottom layer of the pavement where tensile stress is large, aimed to prevent cracking generated.



SFRC pavement mainly has the following advantages:

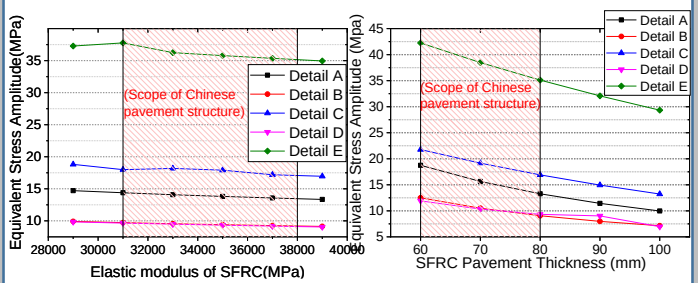
1. Combined with the deck to work together and effectively reduce the stress amplitude.
2. Improving the fatigue resistance of the bridges without changing the bridge structure.
3. Construction speed is fast.

Results

The results show that the equivalent stress amplitude of the details of SFRC paved OSD model, A, B, C, D, and E, is reduced by 58%, 59%, 45%, 56%, and 35%, less than asphalt pavement model, respectively.

Equivalent stress amplitude of detail E is the largest among the 5 critical details, which located in scallop of transverse rib. The maximum value of asphalt pavement and SFRC pavement is 58MPa and 38MPa, respectively.

Based on the Chinese specification and study, the model of different pavement thickness and elastic modulus was analyzed. The following figure shows that the thickness of the pavement layer is the key to effect the stress amplitude, rather than elastic modulus.



References

1) Murakoshi, Jun, et al. "Experimental Study on Performance Evaluation of Sfrc Overlays as a Measure to Improve Durability of Existing Orthotropic Steel Decks." Journal of Japan Society of Civil Engineers, Ser. A1 (Structural Engineering & Earthquake Engineering (SE/EE)) 69 (2013): 416-428.
2) Wang zhanfei, et al. "Influence of Pavement on Fatigue Performance of Orthotropic Steel Deck", Journal of Shenyang Jianzhu University (Natural Science),34(2018):257-266