

Veneer Force and Bridges without Disrupting Traffic Reinforcement Technology

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Abstract. In this paper, "the board by force" plate girder bridge as the research object, proposed plate girder bridge Fissure assessment index grading disease; introduced without disrupting traffic hinge joints reinforced plastic injection force veneer bridge construction technology; for a 5-15m hollow slab bridge Veneer Force Beam hinge joints were reinforced plastic injection, the use of the use of space finite element analysis software MIDAS / Civil build bridges finite element model, hinge joints for plastic injection after Reinforced veneer slab deflection force and deflection adjacent slab differential analysis and calculation, through field testing appearance after the bridge hinge seam reinforcement, and real-time monitoring and after Reinforced veneer slab deflection and force changes in the adjacent slab deflection differential case, the effect of strengthening the force veneer bridge hinge joints reinforced plastic injection method for verification.

Introduction

Plate girder bridge in the event of damage to the hinge joints disease [1], the stringers will be partially or completely lost the ability to transverse links, severe or even hollow Veneer Force [2] phenomenon, Veneer Force is a common and harm large bridge disease, slab bridges veneer force changed the whole upper structure force system [3], weakening its structure carrying capacity, affect operational safety of the bridge. Fissure disease presence of the adjacent stringer displacement difference will increase, making the traffic flow, the bridge function is affected, driving comfort, safety and durability has been significantly reduced, so long, in a vehicle under the influence of cyclic loading, force its monolithic hollow side plates to form a permanent step [4]. There are methods for reinforcing hinge joint breakdown resurfacing steel mesh, additional anchor coupling plate, additional transverse shear reinforcement and prestressing tension [5] However, these methods are not only complex process and requires the construction of diplomatic relations, the impact of the bridge normal operations. This paper presents a constantly post construction, reinforced plastic injection pressure and veneer construction method of bridge hinge joints by force, combined entity bridge reinforcement Disease case, verify Fissure dispensing reinforcement method of reinforcement effect.

Plate Girder Bridge Fissure Disease Classification

Press Hollow Slab Fissure disease severity, and in accordance with relevant regulations [6-7] were assessed for disease classification hinge joints, respectively, hinge joints diseases are described, and given the different levels of disease Fissure Treatment measures Fissure assessment divided into five grades.

Intact (1): Fissure in good condition, pointing concrete non-shedding, no bottom plate whitened traces of water seepage, cracks in the deck no response. Disposal measures: normal conservation.

Mild disease (2): pointing concrete partial loss, but no bottom plate whitened traces of water seepage, cracks in the deck no response. Disposal measures: Patch pointing.

Usually the disease (3): local Fissure concrete cracking, water seepage with white, no cracks deck response, have a tendency to force the board. Disposal measures: seepage site Fissure dispensing.

More severe disease (4): Fissure concrete cracking, water seepage white, vertical and horizontal seam bottom plate appears, mapping out the cracks in the deck, have a tendency to force the board. Disposal measures: Fissure plastic injection + horizontal linkages.

Severe disease (5): Fissure concrete cracking, water seepage white, between a car plate obvious scratch move to form a step, Fissure lane bridge above the mapping out of cracks and crack networks rut, forming a fracture zone. Disposal measures: Fissure plastic injection + replacement bridge deck.

Reinforced Plastic Injection Pressure Fissure Implementation Steps

The first step: Fissure grade evaluation. For the presence of disease Fissure bridge, we first need to assess ranks Fissure disease. According to statistics Fissure disease and hollow hinge joints disease severity, we can rank into five. Specific assessment indicators in Table 1. Pressure dispensing reinforcement Fissure Fissure bridge extent of the damage which belong to three to five. For two (inclusive) Fissure Fissure temporarily do not have to be cleaned and engineering methods, such as plastic injection, just pointing to the disease can be repaired.

Step two: Clean the hinge joints. Firstly, electric hammer and other tools to clean the concrete bottom hinge joints, and then use a tool such as an electric wire brush to clean both sides of the slab sediment, oil and so on. If conditions permit, the best use of water cannons from the bottom of the inner hollow slab cleaning and clean sand, debris, grease and other debris inside the slab. Ensure paste face clean, dry and free of grease, to ensure reinforcement effect. For larger height of the slab, and the hinge joints filled with glue, it can be equally spaced along the beam length direction drilling, to reduce the height of the plastic injection, plastic injection to increase the surface to ensure the glue filling degree.

The third step: borehole seal. After cleaning the hinge seam along the bridge to the injection hose and the overflow pipe laying to facilitate the colloid in the range along the bridge is full of dense. After the completion of the laying of the pipeline should hinge joints sealed to prevent dispensing glue dirty, according to the disease situation Fissure Sealing Sealing can choose wood or PVC plastic plate sealers.

Step four: plastic injection pressure. Of the hinge joints sealed cavity pressure plastic injection construction, construction from one end to the other end. Each channel hinge joints were twice plastic injection. After the first two hours after gluing the seams should be sealed seam is completed, and so there is a certain strength sealing compound and then be cured plastic injection, at high ambient temperatures the spring and summer season, the second plastic injection pressure should be after the first injection and then glue least six hours later. In autumn and winter low ambient temperatures, the second plastic injection pressure should be after the first injection plastic then after a minimum of 10 hours. Note that after the first guarantee colloid substantially cured, and then a second plastic injection, in order to avoid under pressure, the occurrence of leakage of plastic.

Step Five: erection support. After dispensing, curing should be avoided during the colloid disturbance, so as not to affect the tightness of colloid and slab. Room for Disease bridge plate dislocation larger erection should consider supporting under the slab in order to ensure that the curing effect colloids.

Step Six: increased horizontal linkages. Beam after dispensing is complete, the bottom plate using lateral plate paste, carbon fiber, the bottom plate hanging shotcrete (increased cross section) and other measures to strengthen horizontal linkages secondary reinforcement. Steel and reinforced concrete to be surface cleaning process is to ensure that the adhesive quality of the premise, the adhesive layer of

pressure is the key to ensure the quality of the bond. Steel sheet thickness of more than 5mm structure, the injection pressure should be used adhesive bonding.

Fissure Disease Strengthened Computing

That there is a bridge Bridges Veneer Force and Damage of the upper beam structure 8 5 hole 15 meters of an assembled hollow pull design load for the car - super 20, trailer -120; Deck net width: Net -12 + 2 × 0.5 meters (crash barrier).

Based on field test results, the bridge is the main diseases: Right to 1-4 pieces 1-1 # # Fissure water seepage, wherein # 1-1, # 1-3 Fissure failure and seepage through the long white, 1-1 #, # 1-3, # 1-4 board for the board by force.

According to the original bridge design drawings, using space finite element analysis software MIDAS / Civil and using grillage method [8-9] to establish full bridge finite element model. Hollow concrete slab with 40 #, 30 # Fissure adopt concrete bridge deck pavement thickness of 10cm, 3cm asphalt concrete + 7cm waterproof concrete components. Full bridge finite element model shown in Figure 1:

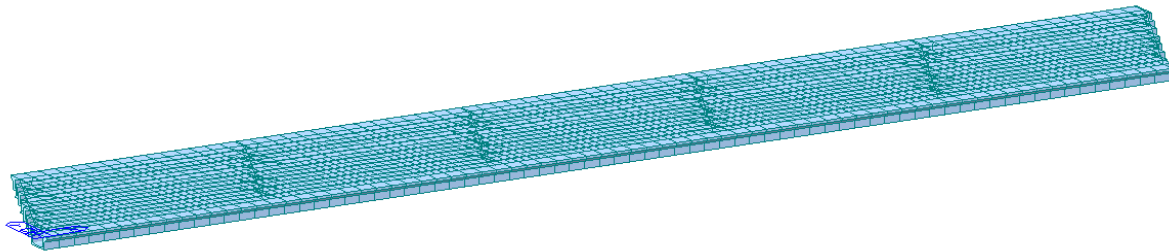


Fig 1. Full bridge finite element model

Bridges across the cross section of each stringer deflection and deflection difference in the following table:

Table1 Bridges across the cross section of each longitudinal beam deflection and deflection difference

State bridge	Number stringer(m m)	1#	2#	3#	4#	5#	6#	7#	8#
The original bridge	Deflection	1.91	2.52	3.53	4.16	4.17	3.63	2.62	2.03
	Pro Deflection difference		0.61	1.02	0.62	0.01	0.54	1.01	0.59
Defective bridge	Deflection	0.24	3.01	3.55	5.14	4.78	4.03	2.90	2.26
	Pro Deflection difference		2.77	0.54	1.59	0.36	0.75	1.13	0.64
After reinforcement	Deflection	1.93	2.02	2.50	3.53	4.12	4.15	3.61	2.61
	Pro Deflection difference		0.10	0.48	1.03	0.59	0.03	-0.54	-1.00

From Table 1 it can be concluded Hollow Slab in the original design of the structure, the lateral deflection is more evenly distributed, hinge joints occur after the damage caused by the force of the board, will become non-uniform distribution of the lateral deflection, and the maximum increased from 4.17mm to 5.14mm, 1 # edge beam, although there veneer force disease, but because of the edge beam # 1 in the outermost lane, less traveling vehicle, it appears the minimum deflection is normal.

Field test data collection: when the vehicle load, 1-3 # Fissure serious disease, 1-3 maximum deflection plate # -2.2mm, with an adjacent slab deflection difference between the maximum value of 1.66mm, and the calculated value 1.59 mm basically.

Contrast bridge span deflection before and after reinforcement section deflection curve after reinforcement is more smooth and # 1-1 and # 1-3 are hinge joints were reinforced stringers partial deflection # 1 difference between the side also It will be smaller, improve the situation by force direct bearing plate girders.

In summary, the potting compound reinforcement of measures to strengthen the hinge joints between the lateral coupling plate girder, and can meet the requirements without interrupting traffic, potting compound reinforced hinge joints technology for improving the mechanical characteristic of the bridge will be apparent, the above calculations initially confirmed the validity of its hinge seam reinforcement.

Reinforcement Effect Evaluation

Press the hollow beam reinforced hinge joints extent of disease, respectively, from the qualitative and quantitative aspects of the disease Fissure Fissure evaluate the effect of reinforcing and strengthening effect given Fissure evaluation. Fissure reinforcement effect evaluation as follows:

Table 2. Hinge joints diseases classification assessment index

Assessment Scale	Qualitative description	Quantitative Description	Strengthening effect
1	intact	Fissure no disease	good
2	bette	Fissure there is only a partial loss phenomenon pointing	better
3	Fissure slight seepage	Fissure seepage length $<L/2$	general
4	Veneer Force, Fissure serious seepage	Fissure seepage length $\geq L/2$ Dislocation between the slab $<L/6000$	Poor
5	Veneer serious force, severely damaged deck pavement pit	Fissure seepage length $\geq L/3$ Dislocation between the slab $\geq L/6000$	bad

Note: L for the bridge span.

On a bridge using pressure dispensing reinforcement disease Fissure and transverse cross-stitch bonded steel plates, strengthening horizontal linkages. After a number of bridges strengthening appearance, and the results showed that after bridge strengthening Fissure good appearance, without cracks and water leakage, and no new traces of water seepage, and no new cracks in the bridge, strengthening good effect.

To verify the dispensing Fissure bridge reinforcement reinforcing effect, the difference between the maximum deflection of the beam and slab veneer that span deflection and the maximum value of the longitudinal force adjacent slab reinforcement were real-time monitoring [10]. Continue to monitor the use of dynamic deflection cross under the bridge continuous monitoring approach. Respectively Veneer Force and the adjacent slab span girder bottom plate board of the layout of a displacement meter.

After testing, the front lock # 1-3 maximum slab deflection for -2.2mm, 1-2 #, 1-4 # hinge joints in good working order, the biggest difference between the adjacent slab displacement -1.161mm respectively, -1.149 mm; 1-1 #, 1-3 # Fissure serious disease, adjacent slab maximum displacement difference -1.654mm respectively, -1.745mm.

Each plate deflection comparing before and after reinforcement: # 1-2 before reinforcement plate -1.039mm, 1-3 # plate -2.2mm, 1-4 # plate -1.051mm; # 1-2 after reinforcing plate -0.672mm, 1-3 # plate -1.021mm, 1-4 # plate -0.681mm. After each reinforcing plate deflection are reduced, decreased by 35.3%, 53.6%, 35.2%, displacement of each plate is significantly reduced than before reinforcement displacement value, indicating that this method of reinforcement Beam Deflection

have a very good improvement, and slab strengthened synergy force of the lateral distribution of bridge is also very good overall improvement.

Conclusion

By the force of a bridge board diseases carried Fissure Fissure reinforced plastic injection pressure, and after Reinforced veneer slab span force and maximum deflection difference between adjacent slab deflection to analyze and calculate real-time monitoring and on-site, too the following conclusions:

(1) Fissure dispensing reinforcement method can strengthen the coupling between the transverse plate girders, reinforced plastic infusion technology Fissure force characteristics of the bridge there is a very good improvement.

(2) Fissure dispensing reinforcement method to improve the structure of the force, were significantly reduced after the deflection bridge reinforcement, bridge stiffness increased.

(3) Fissure dispensing reinforcement method without interrupting traffic, the process is simple, convenient and quick construction. Of plate girder bridge Veneer Force diseases are better reinforcing effect.

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