

Maintenance of Prefabricated Highway Steel Bailey bridge (type-200)

Maintenance Guidance

Approval

Examine and verify

Compile

Jiangsu Bailey Bridge Co., Ltd, Engineering Department

Oct 28th, 2016

Maintenance Guidance of Steel Bailey bridge (type-200)

1. Points for attention about the steel bridge coming into service

1.1 The bold loading limit and speed limit signboards for this bridge should be set up at the both ends of the bridges. In this case, every vehicle should roll at a constant speed of 5km/h, the traffic loading for a single span is HS20, and overloading, unbalance loading, over-speed and emergency brake of a vehicle rolling on the bridge are impermissible. Vehicles each weighing below 200kN could roll on the bridge at the interval of 15m. Those weighing between 200 kN–500 kN must roll across the bridge one by one to avoid unbalance loading.



Loading limit and speed limit signboards bearing points for attention set up at the both ends of the bridges (for reference only).

1.2 Following regular inspections should be made with the bridge in use:

1.2.1 Observation system should be set up for the elevation and displacement of the bridge piers, bridge pier columns and pier capping. Any problem must be reported and solved in time immediately it is found. Regular inspection should be made to see whether there is differential settlement at the foundation of the pier, and it should be handled without delay if so.

1.2.2 Regular inspection should be made to see whether safety pins or all kind of bolts get loose.

It is suggested that we place emphasis on tightening and screwing up repeatedly the deck bolts and the inspections of other kinds of bolts and pins because when the bridge is in use, the steel decks have a direct contact with the traffic loading, and then the external force exerted by the loading is passed through the deck bolts on to the transoms, girders, male and female end posts and the bridge abutments in the end, as a result, the deck bolts are apt to get loose, directly resulting in mechanical noise.

The bolts used for this bridge are chord bolts (M30-sleeve46), vertical frame bolts (M20), horizontal frame bolts (M20), transom bolts (M24), deck bolts (M22) and sway brace bolts(monkey spanners 15 cun in length).

Regular inspections of the bolts should be made during the first month when the bridge comes into service, and then do so once every three months, next once half a year after one year of service until it goes out of service. If there are any overload vehicles pass across the bridge, inspections of the bolts should be made with them being tightened again on the principle of “handle special cases with special methods” in order to ensure the bridge is open to traffic with safety.

1.2.3 It is necessary to smear grease around the pins and bolts after they are inspected and tightened again in case rainwater should go into the gaps of the pin holes because although the bolts are galvanized, the zinc layer would wear out during repeating tightening. In addition, all of the screw threads of the bolts exposed to air should be smeared with grease to prevent them from rusting.

1.2.4 The measurement of the span center deflection should be made regularly to make sure whether it increases.

Its increase rate should be proportional to the degree of wear of the pins

and pin holes, and the increase should be small. Detailed inspections should be made and effective measures should be taken to deal with it if its rapid increase is discovered which indicates the damage to the pins or the pin holes or the top (bottom) chords of the panels.

1.2.5 Maintenance of steel decks

As the steel deck is the only part to have a direct contact with the traffic loading when the bridge is in use, its maintenance would have a direct effect on the bridge's service life. Therefore, the decks should be cleared up frequently; otherwise, the accumulated dirt remaining on the bridge which could increase the weight of bridge would wear out the decks directly.

Since the bridge is primarily used for the heavy-loaded muck cars, it is inevitable for the muck to fall onto the decks and crush, which would result in the checkered plates on the decks to cave in, even to crack. The steel decks should be cleared in time at the same time that inspection is made to see whether the decks crack, deform or get uneven. The first and fourth rows of decks could be interchanged with the second and third rows of ones if necessary. Alternatively new steel plates could be paved and welded at the damage location in place of the damaged decks.

1.2.6 During the construction and service period of the bridge, the loading on the bridge decks can not exceed the design loading, and large-area loading is impermissible.

2. Inspection and maintenance of the anti-corrosive coating

The steel structural members are apt to rust, especially in coastal regions. The regular maintenance of the bridge should be carried out in case the bridges rust. Its carrying capacity and service life is bound to decrease if it ever rusts; therefore, it is important for the bridges to go through the rust removal and painting.

Administrative Provisions For The Ministry of Communications Defense Traffic Reserve Equipment provides that "To carry out a full maintenance once every three years generally" in order to prevent rusting. In maintenance, close inspection should be made whether there is damage to the components, deformation, paint coming off, rusting. For the rusting parts, the dust, oil stain, rusty spot and so on must be cleaned out before painting. The paint should be even on the components and any relevant part should not be left out. It is impermissible to paint on rainy days and in the open where there are many mosquitoes.

2.1 Paint' s ineffectiveness

The paint surface turning gray, tarnishing or fading indicate that the paint will be ineffective soon. The paint' s chalking, rusting, falling off and cracking frequently occur.

Rusting can fall into rusty spot and scale crust, the former is needle-shaped, and the latter often swells because of the steel rusting. The iron hammer scale occurring because of the rusting has complex chemical composition which varies with the surrounding environment. Generally, the outermost layer is brown, the next layer is black, and the steel surface is innermost. The steel' s natural color is silver-gray which can not become visible unless rust removal is complete.

Chalking refers to the paint film' s tarnishing and discoloration by oxidation. The paint under ultraviolet ray and water vapor could be exposed on the steel surface, and its powder particle could cling to the hands immediately. Chalking often goes on inward layer by layer until the steel was damaged completely.

Paint' s falling off refers to the flakes on the steel surface resulting from paint film' s fragmentation to fall off or to corrugate. It often results from paint of bad quality, unclean steel surface, slightly wet priming paint and humid environment.

Most of the paint may crack owing to losing elasticity by oxidation. The early cracking is a potential threat because the cause for it is two different paint (the priming paint and the finish paint) and environmental influence.

By touching the paint surface with hand we can judge whether the paint film is ineffective or not, and rusting may exists if it feels uneven. Experiments about the paint' s ineffectiveness could be conducted by spraying water on paint surface. The paint film is in good condition if water drift away soon, on the contrary, it is ineffective if water penetrate into the film. Water penetration depth is ineffective thickness.

As to the components in store, if Paint' s ineffectiveness is found out, timely rust removal and painting make-up should be carried out according to the actual conditions in case rusting develop.

2.2 General Standard for repainting

2.2.1 The ineffective finish paint could be cleaned out when the priming

paint mostly in good condition comes out by rubbing the paint surface with one's fingers on account of the finish paint's intense chalking. Rust at every nook and cranny should be cleaned out and then the place where it lay before should be repainted twice with priming paint, with the gaps being filled. It is not necessary for the priming paint on other places to be cleaned out, which should be painted twice with finish paint after being polished.

2.2.2 The same method of work as above should be adopted if the finish paint cracks or falls off extensively with most of the priming paint in good condition.

2.2.3 The paint film at the place should be removed and the place repainted with the finish paint if the finish paint bubbles with the priming paint in good condition. They should be removed together and the place repainted with them if the priming paint bubbles too. The same method of work as the next article could be adopted if the steel under the bubbles have rust.

2.2.4 The finish paint, the priming paint, the rusty spots and the oxide skin at the rusting place should be cleaned out with the smooth metal surface exposed and the rusting place be repainted with the first two if the first has lost effectiveness partially and there is extensive rusting on the components' surface.

2.2.5 Rust should be cleaned out and then the place where it lay before should be polished before being repainted with them when steel surface comes out by rubbing the paint surface with one's fingers on account of the ineffective finish paint and the priming paint's intense chalking or cracking, or when steel rusts on a large scale as a result of the almost ineffective priming paint.

2.2.6 Special attention should be paid to the weld cracks on steel surfaces in painting.

The tiny weld cracks on steel surfaces are often covered up because of the paint film's elasticity, therefore, special attention should be paid to them (the magnifying glasses could be used if necessary) in the removal of the finish paint, the priming paint and the rusting. No one can presumptuously act on one's own when they are discovered, and it is imperative to timely report to the competent departments.

2.2.7 Paint

The paint for the assembled road steel bridge is required to have good anti-corrosion and weathering performance, and the priming paint should be matched with the finish paint because there are a great variety of

paints, each with different performance. It is better to substitute inorganic zinc paint which is chiefly characterized by good wear-resisting and anti-corrosion performance and 30-50years general effectiveness(once used) for the old-fashioned organic paint, but the main problem is that it is difficult for many factories to remove the rust because it must be cleaned out strictly by sand blasting and shot blasting, therefore, it is better for the capable factories to adopt inorganic zinc paint as far as possible, which could greatly reduce the purchaser's maintenance cost, effectively protect the bridge from rusting very soon and prolong its service life.

The paint thinners used for paint are various in view of a great variety of paint, and they should be produced matching with relevant paint. Generally speaking, mineral spirits and turpentine are used for oil paint, dimethylbenzene and synthetic thinner are used for alkyd paint, acetone and Epoxy paint thinner are used for epoxy paint, and it is impermissible to use gas, kerosene and diesel as paint thinner.

The paint thinner should be used when the paint is too thick in order to make it volatilize in film forming, and it should be little or not used if its overuse cause damage to the paint film. The usage amount of paint thinner can not exceeds two percent of paint's weight without paint factory's permission.

Table of GB painting standards for steel bridge

No.	Painting requirements	Painting thickness	Painting number	Note for reference standard
1	de-rusting by sandblast SA class-2.5			GB11373-89 GB8932-88
2	quick-drying red lead alkyd antirust paint	60um	1	TB/T1527- 2004GB GB6463-86
3	alkyd ready mixed paint	60um	1	
Total		120um	2	

2.2.8 Filling the gap

In connecting two member bars with each other and in connecting it with a gusset plate, it is difficult for the gaps on the connecting parts to be sealed because it is difficult for the connecting parts to be completely welded. The steel in the gaps is liable to rust because accumulated water would occur in it being exposed to air; therefore, the repairs are not

easy. The best way is to seal the gaps so that the steel surface in the gaps could not be exposed to air and then not rust by adding the fillers on the edge of the gaps then painting.

Now the common formula for the filler and the notice for use are introduced as follows:

A: Formula

Neoprene	100
Filling agent: Pottery clay	250
Calcium carbonates	50
Cross-linking agent: zinc oxide or magnesium oxide	10
Antioxidant: AN-phenyl- α naphthylamine	
B N-phenyl- β naphthylamine	2
Solvent: Benzene	150
Xylene	150
The total	702

B: The notice for use

- (1)The formulated filler in the shape of paste can be used immediately after being taken out. Its quality guarantee period is not long (over a summer period), and can be up to one year if kept under 10° C.
- (2)Rust and the dirt in the gaps and in the vicinity of them should be removed before filling the gaps in order to bring the filler into direct contact with metal surface, otherwise its adhesive force would be adversely affected.
- (3)A layer of polyisocyanate (JQ-1) could be smeared in advance at the specific area on metal surface before filling the gaps with fillers in order to strengthen the adhesive force between the fillers and the metal.
- (4)Everyone should be cautious of toxic substances in operation and not bring the filler into direct contact with his skin because benzene-containing solvent is toxic.

3. Safety points for attention in maintenance of the bridge

3.1. A detailed description of what to do, maintenance parts and requirements must be given to maintenance personnel.

3.2. Maintenance personnel should be young and vigorous without any physiological defects such as acrophobia. They should wear long overalls, safety helmets, life jackets with them tied with safety ropes during interior maintenance of the bridge, and it is impermissible to wear

slippers to work. Maintenance tools should be bound to them tightly in case of them falling into the river.

3.3 Maintenance of the bridge decks should be carry out when the bridge is open to traffic, and therefore in this process vehicles should roll at safe distance with one another in case of traffic accident.

3.4 If cross operation is necessary during maintenance, workers at a high level should keep a safe distance with those at a low level in case tools with the former should fall and accidentally injure the latter.

3.5 Maintenance should be carried out not in rainy and snowy days as far as possible.

4. Maintenance personnel and equipment allocation

The main construction equipment list

No.	Name	Specifications and models	unit	QTY	Note
2	Traffic vehicle	Minibus	pcs	1	Transportation in construction site
6	Hand tools	Exclusive to Type-200	set	1	Maintenance of the bridge
7	Paint	Anti-rust paint and finishing paint	set	1	
8	Auxiliary tools				Crowbar and extension bar

The main labor force list

No.	Type of work	Number of people
1	Construction worker	1
2	Safety officer	1
3	Maintenance personnel	8
4	Logistical support group	1
	Total	11

5. Emergency Response Plan about human injury high-place operation

As maintenance work is to be carried out through high-place operation, Emergency measures based on construction feature are set up as follows:

The greatest hazard for those who conduct high-place operation is to fall down from high place, and the on-site first aid's way varies with the injury severity. It is required in principle that first aid should be given decisively, correctly, promptly, thoroughly and deliberately.

Condition permitting, resorting to a hospital is considerable in order to get the injured treated in the shortest possible time. Condition not permitting in terms of giving emergency treatment to the injured, he should be taken to hospital with cardiopulmonary resuscitation on him if he get in a coma or shock without any breath or heartbeat. Being suspected of spinal fracture, the injured can not bend or stretch too much, and should be rolled to a stretcher by rolling method, or uplifted by three men with their hands to a board through horizontal movement.

In regard to a man who suffers from spinal fracture, a specially-assigned person should be arranged for to hold up the former's under jaw and occipital bone with force exerted along his body vertically, his head kept steady and things put on both sides of his head in case of his head's movement. If the injured is to taken to hospital by car, it is better to put him in a horizontal position with his feet in front and his head in the rear, or put him in a horizontal position perpendicular to driving direction in case of intracranial hemorrhage during it going downhill or braking.

6. Emergency Response Plan about operation at sea when someone falls into the river

If a maintenance worker falls into a river, the rescue worker must put on the life jacket first, and then swim swiftly near the former, and next make a careful observation of his position, and finally come to the rescue from behind the former, or put boards, life buoys, long rod and the like into the river for him to get out of water.

The first thing to do after bring the one falling into the river ashore is to make an accurate judgment about his consciousness and vital signs. If both are normal, his oral cavity and pharyngonasal cavity could get cleared of vomit and silt as the case may be, with him in intensive care in the wake of which. If he loses consciousness with vital signs, his oral cavity should get cleared of foreign matter (including false tooth) with him kept breathing easy and his tongue pulled out in case his respiratory

tract should be clogged. Mouth-to-mouth artificial respiration should be resorted to if he has no heartbeat for the sake of freeing him of asphyxia as soon as possible. In conducting it, air should be blown hard into his lung in order that the compressed air could enter his lung brimming with water.

The man who gives first-aid should stay at one side of the drowned man; holding up the latter's under-jaw, and nipping his nose. And then blow air gently into his mouth after taking a deep breath. And next relax his nostril when his thorax goes up a little, with his right palm pressing flat on the latter's lower segment of the sternum and his left hand put on the latter's right back of his hand to help him breathe. This process should be continued with regularity until he recovers from his asphyxia. Closed chest cardiac massage should be given at the same time to the drowned man who should be put in a supine position and whose head should be kept leaning backwards with a block of hard board under his back. The drowned man should be taken to hospital swiftly as he receives first-aid.

All in all, safety accidents of high-place operation are absolutely avoidable to achieve our aim of safety production as long as the construction organization awakes to the potential dangerous factors in terms of the maintenance personnel, working environment, maintenance equipment and material and operations management together with the targeted prevention and supervision and control.

7. Note

7.1 As the above maintenance contents, personnel and equipment allocation, safety protection and civilized construction are not elaborated on, each project department could draw up the details to implement according to its own department function and the existing technical advantage combined with the actual working conditions.

7.2 Please contact with the manufacturer for matters not mentioned herein.

Jiangsu Bailey Bridge Co., Ltd

Oct 28th, 2016

