REPAIRING AND UPGRADING PROJECT OF NGUYEN VAN TROI - BRIDGE IN DANANG CITY

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abstract: Nguyen Van Troi - road bridge was built by Americans in 1965. Since 1978 the carrying capacity of this bridge was decreased in consequence of a lot of broken down piles in the area of waterline and bridge deck. Before the implementation of repair and upgrading project in 1990 this bridge is the only one crossing the Han river in Da Nang for vehicles up to load limit of H13. Heavy trucks have to take a long way from Tien Sa port to reach Da Nang City. This increases transport cost and influences on economic and social development of Da Nang City and other neighborhood areas. A project has been carried out with two stages for repairing and upgrading the bridge.

1. INTRODUCTION

Nguyen Van Troi - road bridge (N.V.T - RB) was built by Americans in 1965 and had a rated live load of HS 20-44. This bridge consists of 12 N_0 . 36.6m and 2 N_0 37.0m tubular truss spans with 513m long and 2 lanes. The wide piers consist of welded steel tube frames supported on steel tube piles.

Since 1978 the carrying capacity of this bridge was decreased due to a lot of broken piles in the area of waterline and the deterioration bridge deck.

In 1978 the wood bridge deck was replaced by concrete ones. The deck consists of a number of pre-cast panels simply over layered on the longitudinal stringer beams. As a results, the increase of the dead load leads to the decrease of live load and changing the vibration with unaceptble value too. At present, he deck surface is in urgent need of replacement. Before the implementation of repairing and upgrading project in 1990, this bridge is the only one crossing the Han river in Da Nang for vehicles up to load limit of H13. So other heavy trucks have to take a long way from Tien Sa port by 40Km to reach Da Nang City. That makes waste as uneconomic transport and influences on economic and social development of Da Nang City and other neighbor areas.

2. IMPLEMENTATION OF THE PROJECT

The implementation of the project has been carried out in 2 stages : Repair for restore and repair for upgrading.

2.1- First stage (1991 ÷ 1994)

In this stage 13 piers with 104 piles was designed and repaired. For the strengthening design of the piles, which has been corroded because of rust. Firstly, investigation and inspection works were done. These were carried out by opening the jackets with holes 10cm x 10cm from up and down until not finding the rust on the face of the piles anymore.

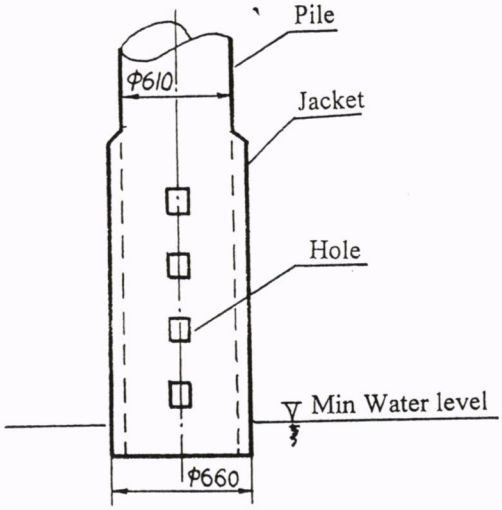

Figure 1: Sheme for opening the jackes to investigate the rust of the pile

(Figure 1). This position was ones for cutting of jacket. After taking off of the old jacket, the piles was cleaned by removing corrosion before painting again. After that every pile was strengthened with four curved plates with thickness of 12mm by bearing vertical welding corresponding to curvature of the piles surface. New jackets were erected for replacement of the old ones. Corrosion protection of these used the method of coating by Epoxy - Pek coal paint in the area of waterline. To protect the area under the waterline would be used by anode Protection (Protecteur). The anode protection by protecteur was made with compound from Al. Zn. In etc.. The measurement's result shows that voltage reach to -900mV and their lifetime is expected to reach > 10 years.

To check up the bearing capacity of the piles under live load H18 (Figure 3) the program SAP 4 wood be used for calculation of the pile - Structure (Figure 2)

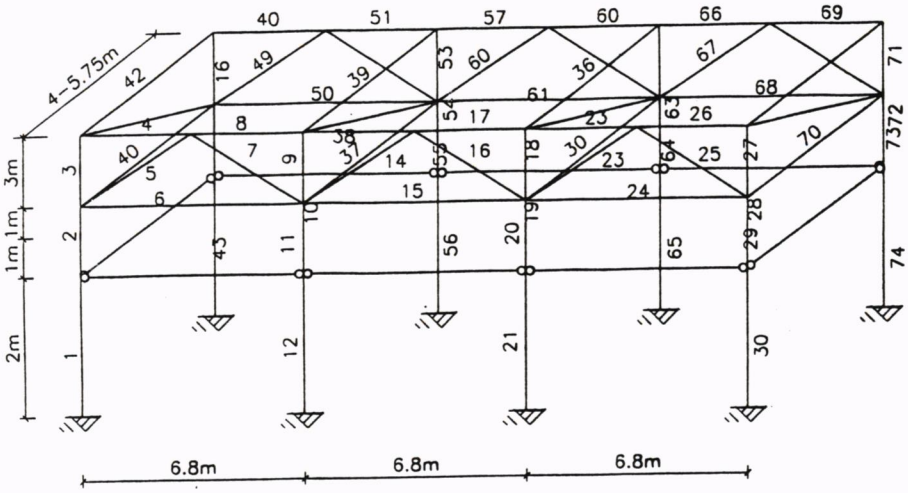

Figure 2 : Shame for applying SAP 4 to calculate the pile structure

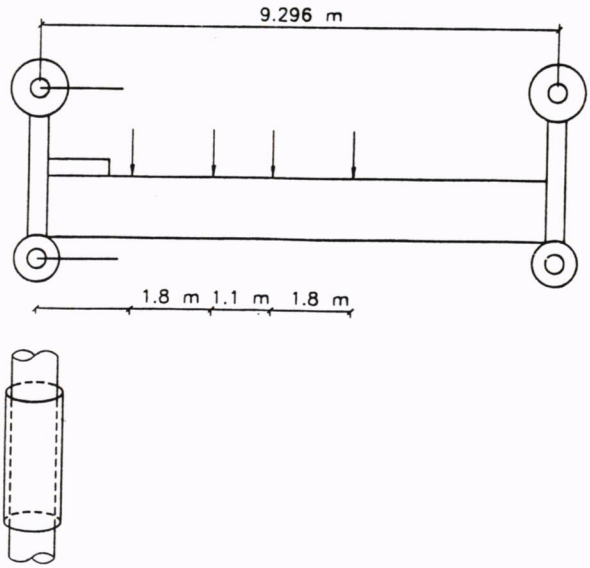

Figure 3 : Shame loading of H18 on cross section of the bridge

The calculation's result will be presented in table 1.

Table 1 - Calculation's result of the different options

Pile N_0	Stress in cross-section of pile before and after strengthening (KG/cm^2)		
	Before strengthening	After strengthening	
		in cross - section of piles	in cross-section of piles
3	500.4	392.5	40.2
4	670.1	500.8	101.4
5	701.7	532.0	102.0
6	401.1	392.1	40.0

From the calculation's result presenting in *Table 1* some following conclusions can be made:
- After strengthening, the stress in cross - section of the piles would be decreased (≈25%).
- For the piles 4 and 5 the stress is greater.

2.2- Second stage (1996 ÷ 1998)

2.2.1- Object of the work.

After finishing the repair for strengthening of the bearing piles, the second stage would be continued with repairing and upgrading the superstructure. The object of this work according to us. is only prolonging the service life of the bridge. Further more, with the results of calculation assessment and load testing made by RITST in 1994, the upgrading of loading capacity could reach to load criteria H18 in case the piers are perfectly strengthened and heavy concrete bridge deck plates are replaced the light ones etc. Besides using light bridge deck plates makes improvement of the value of the vibration. On the *Table 2* some calculated design parameters of the differentiate options of bridge deck structures was compared.

Table 2 - The compared design's paramagnets

		old option (wood bridge deck)	option with concrete bridge deck	option with light steel Orthotrope
Dead weight (T/m)	bridge deck	2.534	4.280	2.414
	bridge deck + framework	5.072	6.818	4.952
Cycle of vibration (s)		0.277	0.322	0.25

The calculation's results representing on the *Table 1* shows :
- The weight of the option with steel Orthotrope approximates to the old option by wood. so it has come of increase of life loading. prospect of H18. among them having truck with weight 30T. Besides the decreasing of dead weight makes changing the cycle of vibration from 0.322S to 0.25S. This corresponds with ones of the old disign, therefore the unfaroutable vibration of the bridge will be now improved.

2.2.2- Construction program

2.2.2.1- Research for applying Orthotrope.

In 1986 the Orthotrope was used for Thang Long bridge. But this was designed and made in former SovietUnion for Nguyen Van Troi bridge and at first there was some options of Orthotrope to propose. With the analysis results in consideration of joining between the Orthotrope and framework and of technological level as in consideration of traffic during montage on bridge, the Orthotrope with form was choice (Figure 4).

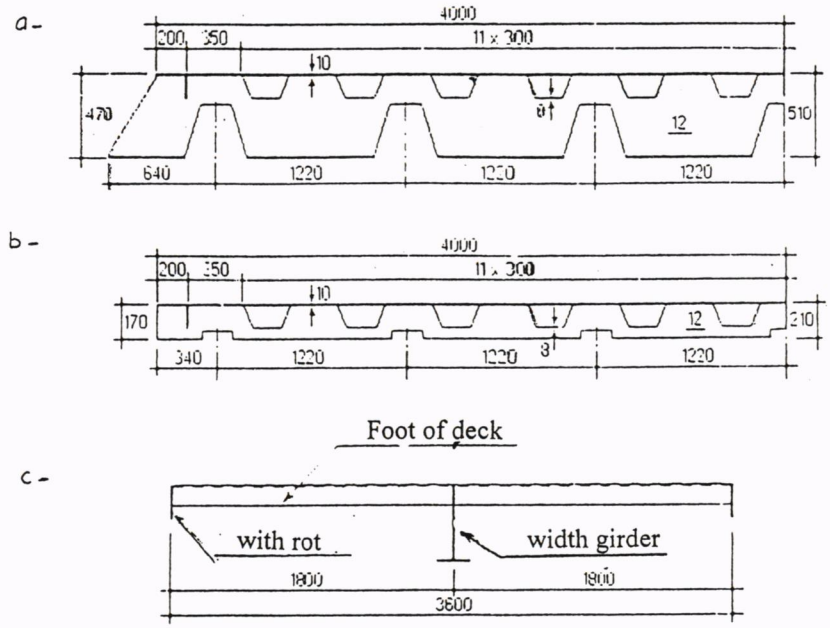

Figure 4 :
a- cross section on the width girder
b- cross section on the width rots
c- Longitudinal section of an element

The design of the bridge deck with steel Orthotrope was distributed among 2 part for two lanes. Every lane has 11 elements and every ones has the main dimension with the breadth 3.6m, the length 4m and thickness 10mm. The thickness of footdeck is 30cm and between widthways ones is 180cm. For water-rust resistance the Orthotrope would be covered with 3 layers overcoming Epoxi-zink paint on Orthortrope's face and farther Polymer and Asphalt 7cm. On the area of the Polymer's face the stones with module 1.0 ÷ 1.5 cm would be scattered to in crease the friction between Polymer's layer and asphalt.

The Orthotrope elements was manufactured by automatic welding technology. Two from 22 elements was made as investigation. Therefore during manufacturing they was carefully

measured to check up additional stress as to adjutant of the parameter of the wedding technologic overcoming weddings method weddings material, arrangement.

After finishing of the measurement the Orthotrope's elements would be transported to the bridge and the joining of the elements on the bridge would be used by automatic wedding's technology. For joining of the Orthotrope with framework would be used by bolt-high intensity. From this it has come of increasing of strain hardening of framework and bridge deck on the analysis's result of joining between steel Orthotrope with framework the correspond calculations methods would be purposed. For design the program SAP 90 was used and the finite elements was represented as "*shell elements*". To make the calculation simple and to decrease the substance this one by using of he program the Orthotrope would be calculated for every elements with approximate method. For applying approximate method there are some different adaptive model (*Figure 5*).

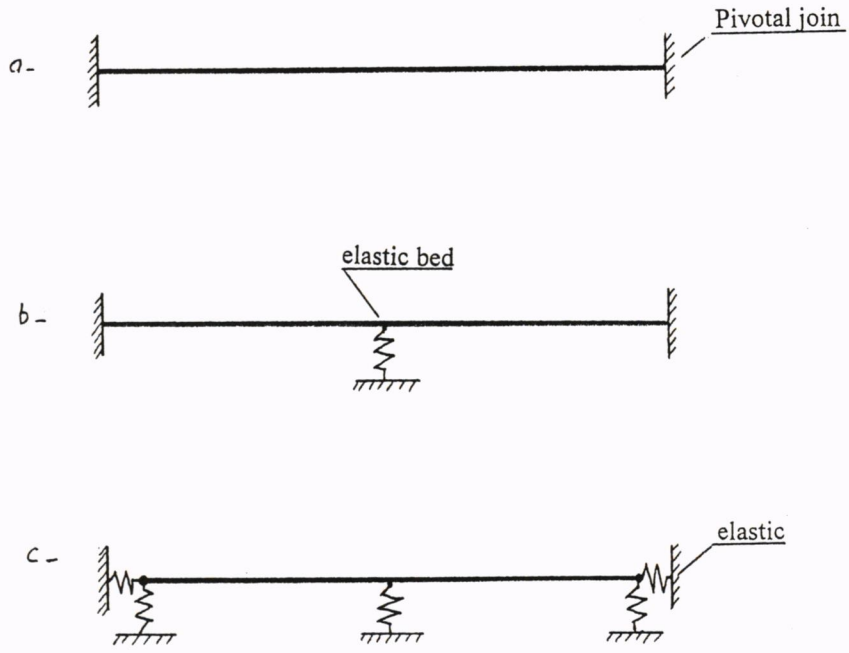

Figure 5 :

a- Model for joining Orthotrope's element with width girder as pivotal
b- Model for joining Orthotrop's element with width girder as pivotal and width rots as elastic
c- Model for joining Orthotrop's element with width girder as elastic and with with-rots as elastic

3. CONCLUSION AND RECOMMENDATION

The repairing and upgrading works were carried out from sub-structure to super-structure using many new technologies on structure and structural protection. All requirements on design were complied correctly according to current regulations.

After repairing and upgrading, Nguyen Van Troi contributes considerably to Da Nang transport. Now, heavy trucks do not have to bend to Hoi An. This brings about much economic effectiveness not only for Da Nang but also for neighbor areas.

Based on specifications of span No.1 worked out, it is proposed to have permission to design, fabricate and assemble 13 spans more. In order to gain the objectives of upgrading the whole bridge, 27 piles should be repaired by method applied before.

In present difficulty in budgets, analysis shows that if building a new bridge it will be very costly. Road Management Units should pay more attention to annual maintenance works. The maintenance should be the combination between small repair work and protection work as successfully applied before.