REPAIRING THE BROKEN TRANSVERSE CONNECTION CABLES REINFORCED CONCRET BRIDGES BY EXTERNAL STRESS METHOD

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abstract: Many methods have been proposed for repairing bridge defect caused by the breaking of the prestressed transverse cables. The report deals with a most suitable method to replace the broken transverse cables. The cost of the proposed method is the same but the repair time is reduced to 50%.

1. EXISTING CONDITION:

There are many prestressed reinforce concrete bridges built before 1975 in Southern Vietnam. The length of span varies from 12.50m to 24.70m, the width for vehicle lanes from 7m to 8m, for footpath from 1m to 1.5m. Its cross sections include from 9 to 11 T beams. In the last ten years, some serious incidents have been occurred. Now, all the post-tension cables with 11.1mm diameter of the transverse beams were broken. So, there are many longitudinal cracks at the bottom of the flanges near the webs. Two edge beams in both sides lean toward outside. With the measure results at several times measuring, the maximum deflection and stress are 1.5 times bigger than usual case. The movement of vehicles is not smooth, each T beam works separately, the cracks appear more and more and gradually damage the deck.

2. STRENGTHENING THE TRANSVERSE BEAMS BY POST-TENSION TENDONS

The method focuses to making new transverse beams: Clean up the surface of concrete at the joints of the transverse beams and flanges (about 180cm - 200cm long) and pump a special concrete mortar with quick hardening and high strength. These new transverse beams have T sections, the depth is the same with old transverse beams, the width of the flanges is about 1.8m-2.0m. Along both sides of the web of the transverse beams, two post-tension tendons of 12.7 mm diameter or 15.2 mm diameter transfer the compression forces to the transverse beams so the transverse beams can carry moment and shear forces due to live load and make the main beams work together.

Attention:

- All the drill holes through the web of the main beams must be close to the neutral axis so the decrease of the second moment is smallest. The position of the drill holes should be 15cm from the bottom of the flanges. (see Figure 1)
- All the drill holes must be straight, no cracking.
- The anchorage must transfer all compression forces from two tendons (more than 100T) to transverse beams concentrically. To meet these demand, the anchorage have dimension of 100x200x200mm and made of steel plates 16-25mm thick. After finishing of tensioning, fix up the covering box and pump grout inside for corrosion protection (see Figure 2).
- The anchors transfer the compression forces to the bearing plates and then to the transverse beams. Between bearing plates and webs of the main beam is a layer of sikagrount.
- The tensile forces in tendons based on stress results of transverse beams can be calculated by space grillage model of beams.
- The deck slab need to be repaired also, a new pavement surface will be required and replacing the movement joints.

3. EVALUATIONS:

- Load capacity of the bridge: After strengthening, bridge were tested to check again the stress and deflection condition. Two trucks: 31.94T and 34.20T were located at the most critical positions (L/2, L/4), concentrically and eccentrically.
The strain, oscillation and deflection were measured by strain indicator P3500, Tastographe type A and level Ni 005 and Ni 007 with the precision of 0.05mm.
The measuring result of the load testing due to 33T trucks (average): The maximum tensile stress at the bottom of main beams is 53.77 Kg/cm^2 and deflection at mid-span is 10.50mm. The measured results of load testing of other new bridges or repaired bridges (Cast a new reinforced concrete surface 12cm thick on the bridge deck): The maximum deflection at mid-span can reach 12mm and the tensile stress at the bottom of main beam is 55Kg/cm^2 . Vertical oscillation cycle of main beam : f=0.2 sec. Impact factor: $1+\mu=1.152$ (see Figure 3).

- Another method is placing a reinforced concrete layer 12cm thick but the dead load increases about 350 Kg/m^2 so the moment due to beam weight increases about 26Tm/beam, about 30% of total moment due to dead load on each beam. This external post tension method does not increase any dead load.

- The tension processing of cables and repairing the joints of transverse beams does not prevent the traffic much because it can be done underneath bridge deck and using quick hardening concrete for the joints of transverse beams.

- The cost of post-tension method and the cost of placing a reinforced concrete layer 12cm thick on the bridge deck are nearly the same but the construction time of post-tension is half smaller than the other

REFERENCE

Bui Duc Tan (1996) Methods of Repairing Concrete Bridges in Southern Provinces of Vietnam, **RITST Journal**, Hanoi.

Nguyen Xuan Dao, Vu Manh Lang, Bui Duc Chinh (1996) The Need of quickly applying the outcomes of ODA project "Vietnam: Bridges Testing and Evaluation" **RITST Journal**, Hanoi.

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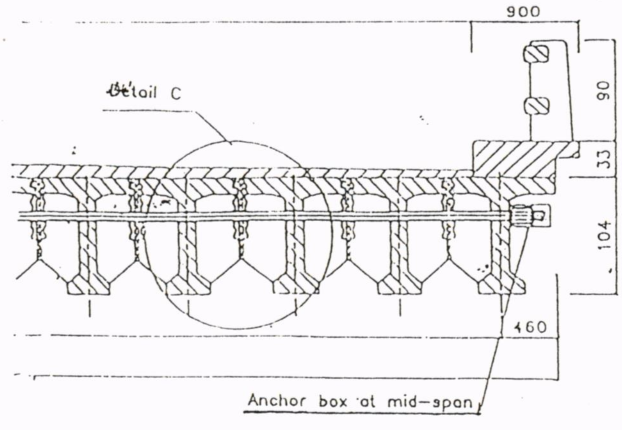

DETAIL C

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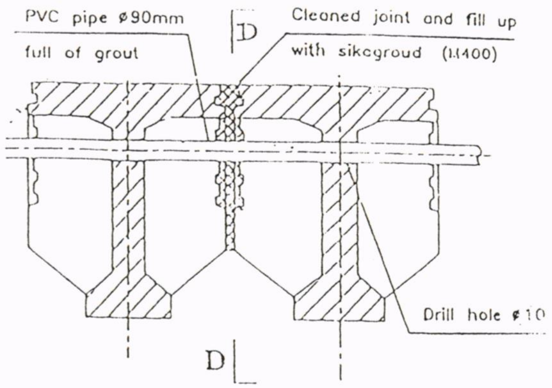

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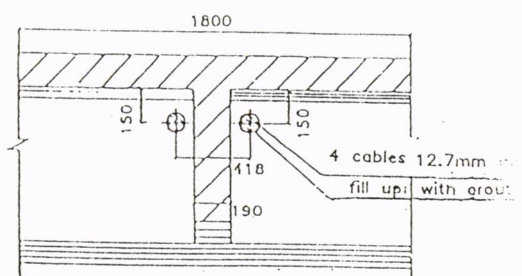
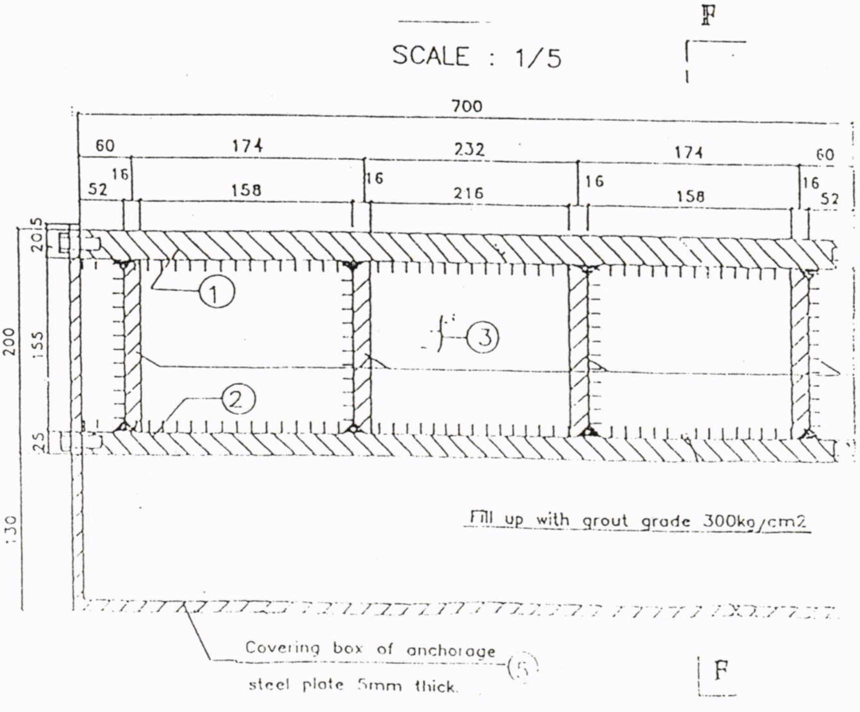


Figure 1: MID-SPAN CROSS SECTION (Near the transverse)



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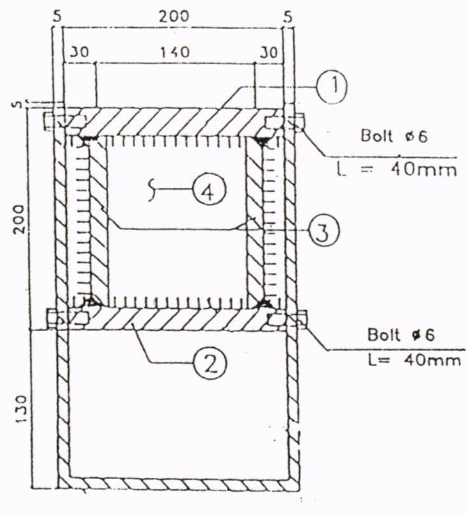
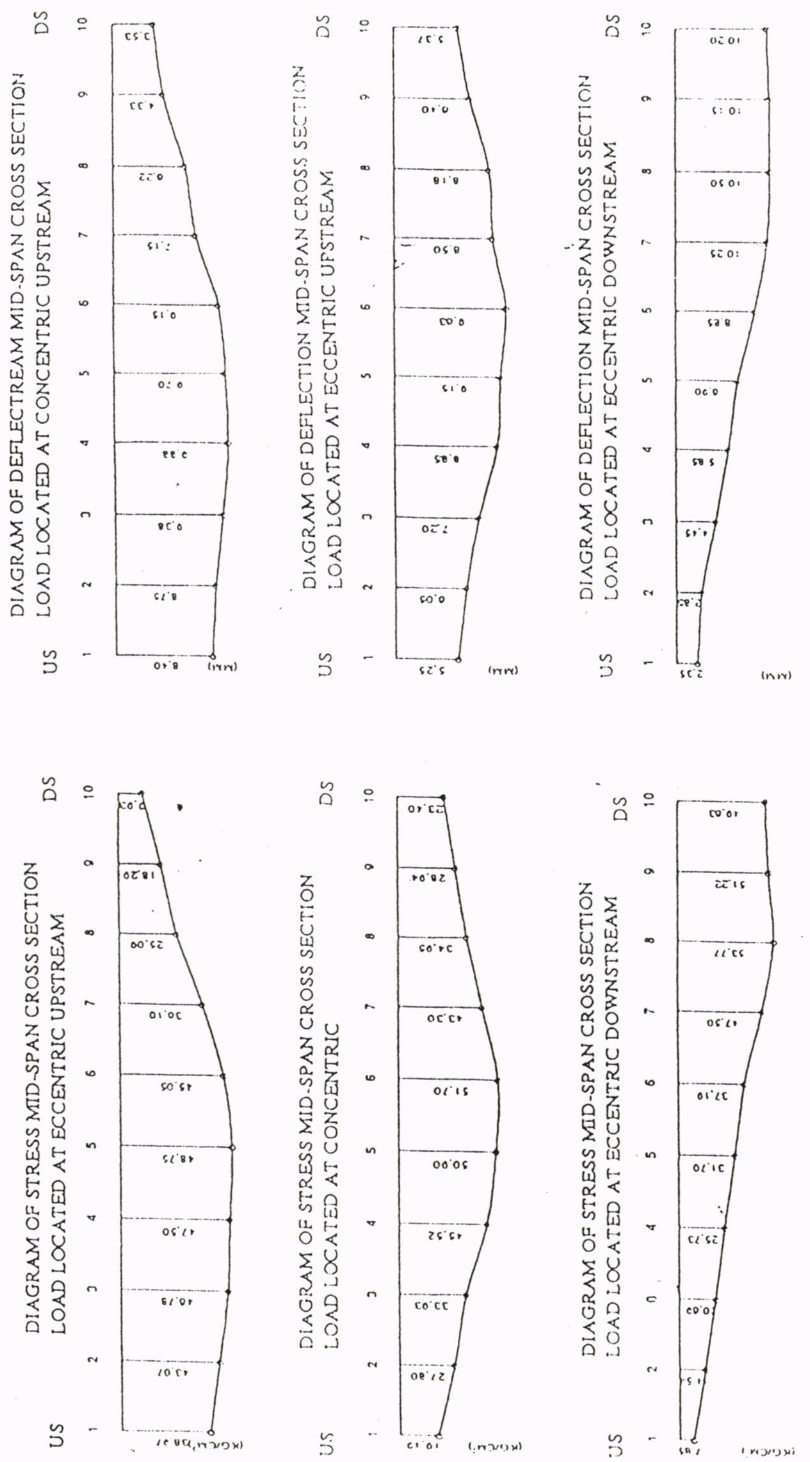


Figure 2: ANCHORAGE IN DETAIL



NOTE
- Unit of stress : kg/cm^2
- Unit of deflection : mm

Figure 3: DIAGRAM OF INTERNAL FORCES