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Strengthening for an Existing RC Gerber Bridge Using External Cables

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Abstract

In Japan, a lot of continuous reinforced concrete (RC) gerber girder bridges which were constructed in 1950~60's, at present play an important role of ground transportation. However, these bridges will be required an urgent rehabilitation work since they have severe damage and shortage of loading capacity due to long-term deterioration as well as increase in design vehicle load.

This study describes a new technique for strengthening an existing continuous reinforced concrete gerber bridge, which benefits from requiring minimum traffic disruption. The proposed strengthening system aims at reducing the excess live shear load at the gerber hinge by lifting cantilever girder up, not to introduce compressive stress into the girder such as ordinary external prestressing methods. In this system as shown in *Fig.1*, the external tendons are arranged along the whole length of bridge, and deflected by the deviator attached the additional lateral beam beside the gerber hinge, and anchored by the concrete anchor block constructed on the extension of the bridge as earth anchored system. In order to prevent the reduction of cable tension by the friction, a steel device is installed in the underside of concrete deviator (*Fig.2*).

The proposed system has been first adopted in the strengthening of Titose Bridge, which is the 177.2 m long seven-span continuous reinforced concrete gerber girder bridge, completed in 1955. On-site construction was conducted with little traffic interruption by the work with hanging scaffold under the bridge. Prestressing was done from both sides of the suspended girder divided 3 blocks, and from one side of anchor girder, respectively. Prestressing for 3 suspended tendons and 2 anchor tendons were simultaneously done by using 10 hydraulic jacks so that the horizontal

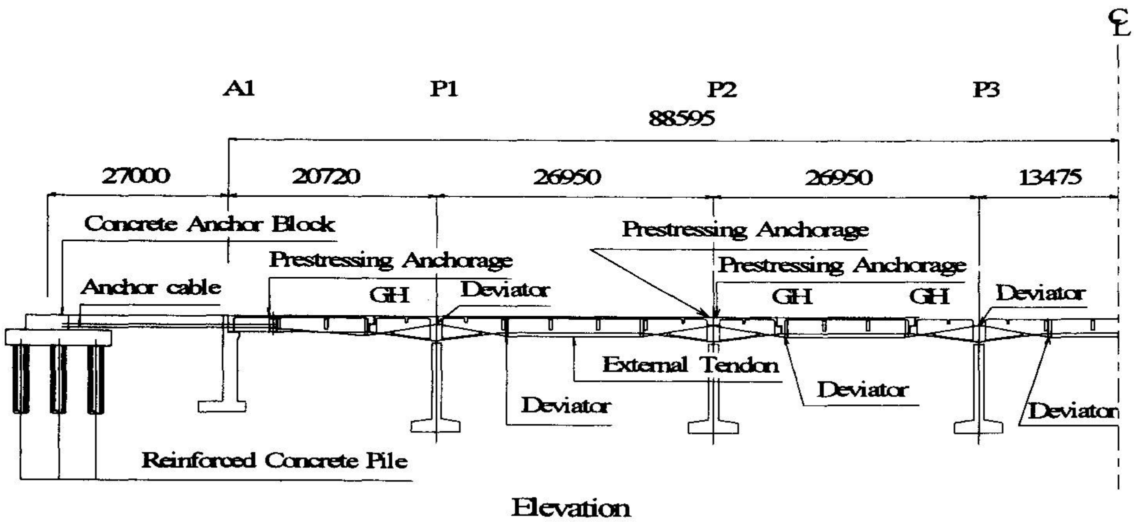

Fig.1 : Cable Layout for Continuous Concrete Gerber Girder Bridge

force may not occur into the bridge piers due to unbalanced cable tension. Assuming the friction coefficient μ=0.3 /rad to be an upper limit for the effect of deflected tendons at the deviator, the prestressing work was conducted in the range of 0<μ<0.3 /rad by elongation control of each tendon. This work was executed in two nights from 22 to 5 o'clock with an overall stop of traffic, including the field tests.

The strengthening effect was confirmed by the field test on the bridge which was carried in parallel to the work. As examples of the test results, *Figs. 3* and *4* show the reduced reaction at each gerber hinge, and comparison of girder deflections between before and after strengthening work, respectively. From the results, the following are confirmed: (1) the effectuality of the proposed strengthening system, (2) validity of the adopted design and analytical model, and (3) validity of the construction procedure. In addition, it can be said the application of PC technology to the new field in the point of using PC tendons with the purpose except for stress introduction means.

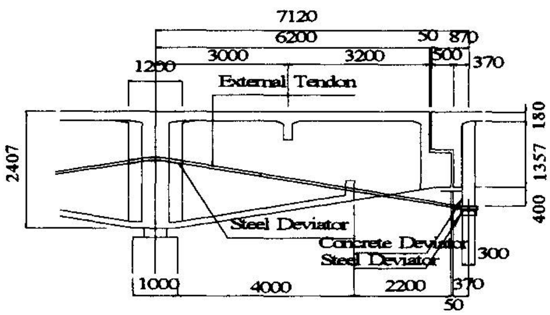

Fig.2 : Cable Arrangement at Gerber Hinge

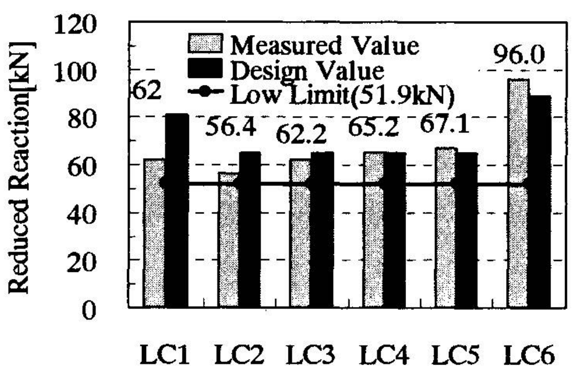

Fig.3 : Reduced Reaction in Gerber Hinge Support

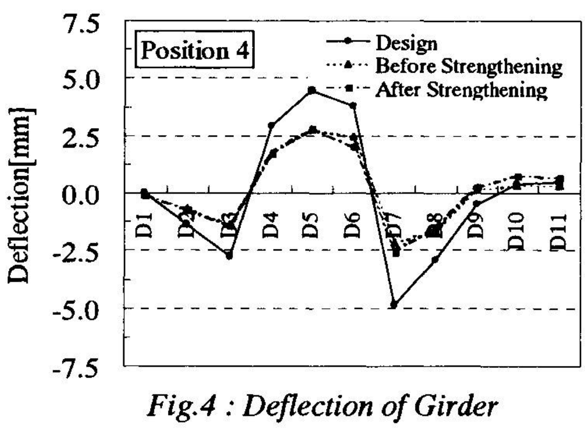

Fig.4 : Deflection of Girder