Tanaka Award: Research Paper Category

Effect of Cable Rupture near Anchorage Zone on Load-Bearing Performance of PC Box Girder Bridge

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This paper clarifies, through experiment and numerical analysis, the load-bearing capacity of PC box girders that have suffered PC cable rupture due to chloride attack. One of the original aspects of this paper is that the effect of local PC cable rupture is experimentally investigated using 1/2 scale specimens consisting of three-dimensional PC box girders.

Evaluating the effect of partial rupture of PC cables in PC girders is not easy using simple models. The 1/2 scale specimens used in this study allow the effect of rupture near the anchorage, where the prestress is reduced, to be evaluated. The reduction in shear resistance caused by near-anchorage rupture and the effect of the supports on the load-resisting mechanism can be experimentally reproduced, which is difficult to achieve with smaller specimens.

The experimental results reveal that stresses are concentrated in the box girder cross section and that shear failure occurs suddenly in the case of rupture at one location. Further, overall box girder behavior may become ductile even with rupture at several locations if the stress concentration is mitigated depending on the positional relationship. Prestress is shown to be retained in regions beyond the anchorage if the sheath has been grouted, resulting in a three-dimensional load-resisting mechanism that cannot be evaluated using a one-dimensional beam; load resistance depends on the state of the remaining prestress, and both shear and flexure failure may occur. Numerical analysis by the finite element method successfully demonstrates the mitigation process of stress concentration and the failure mechanism.

As a result of these findings, the paper is considered to significantly contribute to the future maintenance of existing PC girders and is recognized as being a worthy recipient of the Tanaka Award in the Research Paper Category.