Benefits of Using HSC for Improving Tensile Stresses on I-Type Prestressed Concrete Girders

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Summary

The most effective factors that improve sections and elongate spans of prestressed concrete girders are the shape of sections and the strength of concrete. Furthermore, increasing the concrete strength more significantly enhances the allowable tensile strength on the top and bottom fibers than increasing the flexural strength of girders. However, even though problems exist in the manufacturing and quality control on the site, due to the lack of precedents and conservative views of specifications, applications of high-strength concrete have several limitations in the design stages. Especially, for the I-type PSC girders that are most widely used in the superstructural systems of expressway bridges, restrictions of allowable stress levels hinder the enhancement of longer spans and lower heights of superstructures of bridges to a greater extent than the effects of flexural strengths. Hence in this study, to evaluate the HSC application effects for PSC girder especially about allowable tensile stress, flexural tests of four I-type PSC girders are fabricated with two experimental variables; design strength (40 MPa and 60 MPa), and prestressing steels by increases allowable tensile stress. The test results showed that allowable tensile and compressive stresses can be increased and a higher prestressing force can be applied by using high strength concrete, which can also enhance the flexural strength and reduce the section of the members.

Keywords: high-strength concrete; prestressed concrete; I-type girder; allowable tensile stress; structural test

1. Introduction

Concrete which is used in prestressed concrete (PSC) structures should have a higher strength than that used in reinforced concrete (RC) members when tensioning with high prestressing or when using the pretension systems for increasing bond strength [1]. The PSC beams behave linearly elastic in the service loading stage compared with RC structures. PSC girders are designed to use full sections effectively, hence by using high strength concrete, more slender and lower sections can be designed.

High strength concrete (HSC) is classified in the KCI or ACI codes as a concrete with strength of over 40 or 42 MPa, respectively [2-3]. However, in the European, North American, and Japanese specifications, a higher strength concrete is applied to PSC girders. Although high performance and multi functional concrete technologies are being actively developed, widespread applications of the HSC in the bridge construction field are taking a long time. These problems are caused by difficulties of quality control, lack of precedents, and conservative views of specifications, etc.

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