Proposal of an Equation of Stress in PS Strands at Flexural Strength

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Abstract

The PS strand which has a tensile strength of 1,860 MPa was commercialized in the 1980s, and the tensile strength of strand had not been increased for about the past 30 years. Recently, 2,160 MPa and 2,400 MPa high-strength PS strands were developed by Korea government in 2008 and 2011, respectively. Also, net tensile strain concept has been introduced in recent version of ACI 318. However, simple equations for designers to predict the stress in PS strands at flexural strength proposed at existing design codes such as ACI 318 and CSA A23.3 do not reflect the influence of these trends. This study examined the applicability of high-strength PS strands to existing design equations of stresses in PS strands at flexural strength proposed in ACI 318-14 and CSA A23.3-14. The results show that the existing equations over-estimate the stresses for flanged sections and high-strength PS strands. With the based on the results, modified equation was proposed.

Keywords: PS strand stress; high-strength PS strands; flexural strength

1 Introduction

1.1 Research Backgrounds

Recently, high-strength PS strands were developed, which have more increased tensile strength than that of existing PS strand. The 1,860 MPa PS strand was commercialized in the early 1980s, and there has been no increase in tensile strength for about the past 30 years. In Korea, 2,160 MPa high-strength PS strand was developed in 2008, and 2,400 MPa high-strength PS strand was developed in 2011 by Super Long Span Bridge R&D center. Use of high-strength PS strands reduces PS strand area and the number of anchorage, and it improves economics and workability. In case of a bridge, extending span range is possible and it makes more slender bridge. So the necessity of introduction of high-strength PS strands in PSC structures is increasing.

To apply the newly developed 2,160 MPa and 2,400 MPa high-strength PS strands in practice, standardization of the material, development of new anchorage system suitable for high-strength PS strands, and evaluating applicability of the design standards for high-strength PS strands are needed. As results of the effort, 2,160 MPa PS strand (SWPC7CL) and 2,400 MPa PS strand (SWPC7DL) were added in the KS D 7002 revised in 2011. Also, new anchorage systems for high-strength PS strands were developed by Super Long Span Bridge R&D center. However, current local and global design standards such as KCI, ACI, and CSA do not reflect properties of the high-strength PS strands. So, an evaluation of the applicability of the design standards for high-strength PS strands and revision of the design equations for the PS strands are needed.

Another change was the introduction of net tensile strain concept in ACI 318. The concept of a reinforcement index in the design code changed into concept of net tensile strain, and there is no limitation for the PSC members. Thus, for the heavily reinforced flanged sections, the existing