The evaluation of inelastic buckling strength for HSB®800 welded structures

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Summary

High-performance steel for bridges with a ultimate tensile stress of 800MPa(HSB®800) was recently developed in Korea. By applying the TMC(thermo-mechanical control) process and optimizing chemical composition, HSB®800 can be produced to have not only high strength but also high toughness and good weldability. In general, welding is needed to join HSB®800 plates in fabricating a plate girder. The welding process results in high residual stress which influences the inelastic buckling strength of structures. In the previous research, the typically used residual stress models have been applied to investigate the behaviour of a structure having an ultimate stress of 800MPa without any verification. Therefore, in this study, the characteristics of residual stress in welded structures with HSB®800 was investigated by the sectioning method and a new residual stress distribution model for HSB®800 was proposed. Considering the obtained residual stress distribution model, geometric imperfection and stress-strain curve of HSB®800, the numerical analysis is carried out to evaluate the inelastic buckling strength for HSB®800 welded structures using ABAQUS.

Keywords: *HSB®800; residual stress; sectioning method; welding; buckling strength.*

1. Introduction

Steel bridge construction in Korea has grown rapidly since 1990 and took a 50% market share in 2003. From 2004, there was sudden decrease in steel bridge market share due to high price of steel plates and heavy competition with high strength concrete. In order to increase competitiveness of steel bridges, new high performance steel which is called HSB®(High performance Steel for Bridge) has been developed through the research sponsored by the Korea government. POSCO has produced HSB®500 and HSB®600 which have the tensile strength of 500MPa and 600MPa respectively since 2007. By applying the TMC(thermo-mechanical control) process and optimizing chemical composition, HSB has not only high strength but also high toughness and good weldability[1].

Table 1: Target properties of HSB®800(L,W).

	HSB®800 (L,W)	BHS700(W)	HPS690(W)	S690Q
Process	TMC	Direct QT	QT	QT
Max. Thickness	80 mm	100 mm	64 mm	100 mm
Min. YS	690 MPa	700 MPa	690 MPa	690 MPa
Min. TS	800 MPa	780 MPa	760 MPa	770 MPa
Toughness	47J@-20℃ 47J@-40℃(L)	100J@-40℃(Base) 47J@-15℃(HAZ)	48J@-34℃(FCM) 34J@-3℃(Non-FCM)	40J@-20℃(QL) 40J@-40℃(QL1)
Ceq	≤ 0.55 ≤ 0.60 (W)	≤ 0.84	≤ 0.76	≤ 0.57
Pcm	≤ 0.25 ≤ 0.27 (W)	≤ 0.30 (t<50) ≤ 0.32 (t<100)	≤ 0.33	≤ 0.30
Spec.	KS D 3868	JIS G 3140	ASTM A709	EN10025 Part6

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