

Effect of Improvement by Applying Undermatching Weld Materials on Fatigue Strength of Load-Carrying Fillet Welded Cruciform Joints Made of High Strength Steel

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Summary

Effects of the improvement by applying undermatching weld materials on the fatigue strength of the weld root of load-carrying fillet welded cruciform joints made of high strength steel were investigated through fatigue tests. Specimens were made of JIS SM570 steel plates with 17mm thick. Three types of weld material were used. 10% overmatching weld materials, 10% undermatching weld materials, and 20% undermatching weld materials were used. Test results indicate that fatigue strength of the weld roots can be improved by applying undermatching weld materials. By applying 20% undermatching weld materials, fatigue strength increased by one classes of the JSSC fatigue design recommendation.

Keywords: undermatching weld material; fatigue strength improvement; load-carrying fillet welded cruciform joints; high strength steel.

1. Introduction

The application of high strength steel is effective in decreasing the weight and may also reduce the cost of steel bridges. However, it is known that fatigue strength of welded joints made of high strength steel are weaker than that of mild strength steel. One of the reasons of this may be that notch sensitivity of high strength steel is higher than that of mild strength steel. Therefore, it is important to improve fatigue strength of welded joints made of high strength steel to apply high strength steel effectively.

One of improvement methods is an application of the undermatching weld materials for the welded joints. This method expects the reduction of the notch sensitivity at the welding [1]. Kyon et al. showed the possibility of the improvement of the fatigue strength of the weld toe and root [2]. However, quantitative investigations for the application of the undermatching weld materials, especially investigations of the effects on the weld root, have not been performed enough.

In order to investigate effects of the improvement by applying undermatching weld materials on the fatigue strength of load-carrying fillet welded cruciform joints made of high strength steel, fatigue tests were carried out. The focus was on effects of the application of the undermatching weld materials on the fatigue strength of the weld root.

2. Specimens and testing method

The configuration and dimensions of the specimens are shown in Fig.1. Specimens were made of JIS SM570 steel plates with 17mm thickness. The mechanical properties and chemical compositions of the steel used in the specimens are shown in Tab.1. The specimens were fabricated by applying CO₂ gas metal arc welding process using singlepass weld with fillet welding. Fig.2 shows a macro test result of the specimen. As shown in Fig.2, the weld roots were contained in the specimens.

Three types of weld material were used. 10% overmatching welded materials (O+10) and two undermatching weld materials were used. 10% under-match material (U-10) and 20% under-match material were prepared.