Application of High Strength Steel in Moment Resisting Frames

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Abstract

Production of High strength steel (HSS) with well ductility and weldability has been developed in recent 50 years. Usage of HSS did not expanded, because civil engineers were not familiar with them. Until their characteristic and their performance in cyclic loading are not being studied, their final usage will not be expanded. So in this research, rigid connections have been modeled by finite element software Ansys and have been applied to quasi-static cyclic loading. The results show that, using HSS reduced ductility only 30 percent and this reduction can be counteracted by increasing allowable stress in High strength steel.

Keywords: high strength steel (HSS), rigid connection, Ductility, finite element program.

1. INTRODUCTION

It is more than a century that steel has been confirmed as a structural material. In recent years, with advancing in technology, demand of industry for a high quality material leads to production of high strength steel with high ductility. So, extended researches have been performed by metallurgical scientists for modification of current steel. The first goal in this research was production of steel with higher strength and ductility and good weldability. To produce such high strength steel, multiple mechanisms were used for increasing steel strength. As illustrated in Fig. 1, the main mechanisms are solid solution formation, ferrite grain size, adding microalloy elements [8].

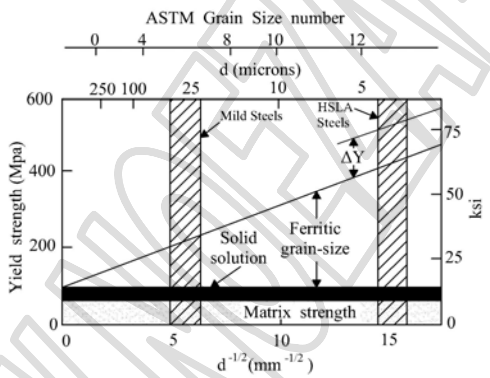

Figure 1: Effect of different mechanism [8]

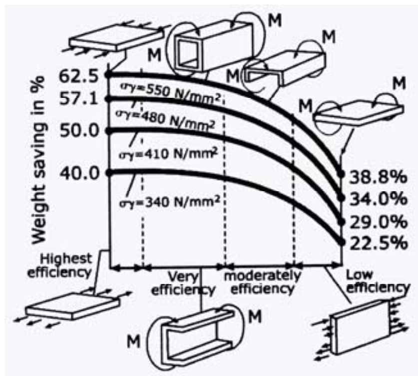

Figure 2: Effect of different loading

Solid solution can not increase strength too much, because carbon can't be solved in ferrite well. 1950s researches showed that refining ferrite grain size by adding Aluminum can increase yield strength steel up to 300_{Mpa}. Another mechanism has been illustrated in Fig. 1 by ΔY is sediment formation. In this mechanism, by adding a little amount of microalloy elements like Titanium, vanadium, nickel to structural steel, yield strength can be increase up to 500_{Mpa}. These elements are known as microalloy elements and this type of steel that have high strength and well ductility are called HSLA. Also, thermo mechanical control processing can be used as a supplementary factor for chemical combination for achieving higher strength that is accelerated cooling for refining ferrite grain size [8].

Usage of high strength steels has benefits and disadvantages. The benefits are reduction of weight and constructional expense. HSLA has higher yield strength, but the young module is equal to mild steel and it does not make any sense in buckling mode. Also limitation on slenderness of members that is imposed by high yield strength, may lead to uneconomical design. Performance of high strength steel is much better