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Exploring the behaviour of cold-formed steel beams with web openings: A review of bending and torsion interactions

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Experiment Investigation on Strength, Stiffness and Ductility of High Strength Structural Steel to ISO 6892-1

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Abstract. High-strength cold-formed steel gains popularity in construction projects due to higher strengths and lighter weight. The increase in the mechanical properties of the steel was achieved by the cold-reducing process during the manufacturing of the sheet steels changed the grain structure of the steel under large deformation and elongation. However, the change of grain structure leads to lower ductility of the steel. This study was carried out to determine the strength and ductility of cold-formed steel by performing tensile test in accordance with MS EN ISO 6892 and check its conformity with Eurocode 3 requirements. A total of 12 test specimens were prepared, with the results were evaluated to the requirements of Eurocode 3. Fewer than 95% of the specimens complied with Eurocode 3 requirements due to their low ductility, indicating the brittleness of high-strength cold-formed steel.

INTRODUCTION

Metallic materials such as high-strength steels are widely applied in construction projects, especially to form structures due to their characteristics such as high durability, high strength-to-weight material and availability. Several parameters are observed to determine the metallic properties of the metals [1]. Usually, high-strength steels are customised through different thermomechanical processes into various forms due to the performance of the metallic properties of metal under different temperatures. The thermomechanical process that is commonly used in the steel industry includes hot rolling, cold rolling and annealing [2].

In recent years, high-strength cold-reduced sheet steels gained popularity in construction projects due to a few advantages such as the higher yield stress, ultimate strength and lighter weight compared to traditional hot-rolled steels [3]. Other than that, high strength cold-formed steel showed their advantages in high strength-to-weight ratio and the ease of installation aspects. Practically the high-strength cold-formed steel are used as secondary members in the construction industry as purlins and girts [4]. They also usually exist as hybrid steel panels and modular systems in mid-rise residential and commercial buildings [5].

Regular sheet steel needs to undergo an important process named cold thickness reduction to manufacture cold-reduced sheet steels. Basically, in the cold thickness reduction process, a series of rollers are applied on the cold rolling sheets until a desired thickness is obtained. This reduction process not only forms the sheet steels into the desired thickness but also remarkably increases the yield strength of the sheet steels closer to its ultimate tensile strength. As a result, the small difference in the yield point and tensile strength of the cold-reduced sheet steels are usually to be seen [6]. This is due to the rolling of the rollers on the sheet steels during the reduction process. During the rolling process, large deformations or elongations of the grain of the sheet steels will occur according to the direction of rolling and the difference in rolling direction will cause changes in the metallic properties of the sheet steels. The