ELSEVIER

Journal of Constructional Steel Research 58 (2002) 253–274

JOURNAL OF CONSTRUCTIONAL STEEL RESEARCH

www.elsevier.com/locate/jcsr

Structural behaviour of bolted moment connections in cold-formed steel beam-column sub-frames

M.F. Wong, K.F. Chung*

Department of Civil and Structural Engineering, The Hong Kong Polytechnic University,Hung Hom, Kowloon, Hong Kong, PR China

Abstract

This paper presents an experimental investigation on bolted moment connections between cold-formed steel sections. A total of 20 column base connection tests and beam-column sub-frame tests with different connection configurations were carried out to assess the strength and stiffness of bolted moment connections between cold-formed steel sections. Among the tests, four different modes of failure were identified:

- Mode BFcsw: Bearing failure in section web around bolt hole
- Mode LTBgp: Lateral torsional buckling of gusset plate
- Mode FFgp: Flexural failure of gusset plate
- Mode FFcs: Flexural failure of connected cold-formed steel section

For those connections failed in Mode BFcsw, the moment resistances of the connections were typically found to be below 50 % of the moment capacities of the connected sections. For those connections failed in Modes LTBgp and FFgp, the moment resistances of the connections were found to be about 60% and 75% of the moment capacities of the connected sections. Among all, the moment resistances of those connections failed in Mode FFcs were the highest with a minimum of 85% of the moment capacities of the connected sections. Consequently, it is demonstrated that through rational design and construction, effective moment connections between cold-formed steel sections may be readily achieved. Engineers are encouraged to build light-weight low to medium rise moment frames with cold-formed steel sections.

* Corresponding author.
E-mail address: cekchung@polyu.edu.hk (K.F. Chung).

0143-974X/02/$ - see front matter
PII: S0143-974X(01)00044-X

Keywords: Bolted moment connections; Column base connection test; Failure modes

1. Introduction

Cold-formed steel sections are lightweight materials, suitable for building construction owing to their high structural performance and durability. They are widely used as secondary members, such as purlins in roofs, joists of medium span in floors, studs in wall panels, storage racking in warehouses, and hoarding structures in construction sites. Since 1990, there has been a growing trend to use cold-formed steel sections as primary structural members in building construction, such as low to medium rise residential houses and portal frames of modest span.

The most common cold-formed steel sections are lipped C-sections and lipped Z-sections, and the thickness typically ranges from 1.2 to 3.2 mm. Common yield strengths are 280 and 350 N/mm^2. Moreover, there are a whole range of variants of these basic shapes, including sections with single and double lips, and sections with internal stiffeners. Due to the thinness of cold-formed steel sections, local buckling is a predominant consideration in assessing their section capacities. Furthermore, as they are very weak in torsion, torsional flexural buckling in columns and lateral torsional buckling in beams may be critical. There are a number of codes of practice [1–4] on the design of cold-formed steel structures together with complementary design guides and worked examples [5–8] to assist practising engineers.

In building construction, cold-formed steel sections are usually bolted to hot rolled steel plates or sections to form simple and moment connections. However, despite their simplicity, simple connections between cold-formed steel sections have received relatively little attention. An experimental experiment [9,10] was reported recently to study the structural performance on simple connections between cold-formed steel sections using web cleats of folded cold-formed steel strips. A complementary set of design rules was also provided in accordance with BS5950: Part 5 and Eurocode 3: Part 1.3.

Much research work has been reported in the literature on the development of moment connections between cold-formed steel purlins in modern roof systems. A number of different connection configurations [11] with sleeves or overlaps were found in various proprietary systems which offer partial continuity along the purlins. Cold-formed steel moment connections in column bases and also in beam-column connections were also tested and the proposed connection configurations were suitable for portal frame construction [12–16]. Besides experimental investigations on bolted connections between cold-formed steel strips [17,18], advanced finite element modelling using three-dimensional solid elements with material, geometrical and boundary non-linearities were also reported in the literature [19–22].

It should be noted that most of the design recommendations on connections among cold-formed steel sections concern the load carrying capacities of individual fasteners such as bolts, screws, rivets and spot welds. Little information on the structural performance of the bolted moment connections among cold-formed steel sections