Journal of Constructional Steel Research 73 (2012) 128–138

Contents lists available at SciVerse ScienceDirect

Journal of Constructional Steel Research

Analytical investigation of cyclic behavior of laced built-up columns

A. Poursamad Bonab [a,*], B. Hosseini Hashemi [b]

[a] Department of Earthquake Eng., Science and Research Branch, Islamic Azad University, Tehran 14515/775, Iran
[b] International Institute of Earthquake Engineering and Seismology (IIEES), Structural Research Center, Tehran 19395/3913, Iran

A R T I C L E I N F O

Article history:
Received 1 January 2012
Accepted 9 February 2012
Available online 9 March 2012

Keywords:
Laced built-up column
Cyclic behavior
Ductility

A B S T R A C T

In this research, 18 laced built-up columns with various geometric specifications were analyzed under different levels of axial load and cyclic lateral load using the finite element method. This research was performed as a continuation of the experimental investigation on the cyclic behavior of the laced columns. This study evaluated the effects of column's geometrical parameters and various levels of axial loads on the cyclic behavior of laced columns. A compression of the results shows that there is generally good agreement between the experimental and analytical results. The analytical results showed that as the axial load increased, the ductility of the laced columns decreased significantly. Further, at high levels of axial load (i.e., loads higher than 50% of the columns' compressive capacity), ductility was very poor. It was found that during lateral loading there is a bending moment in addition to the axial force in the lacing bars and the main chords, which affects the columns' behavior. The slenderness ratio of the main chords between the connecters and the shape of the cross-section of the lacing bars (i.e., bending strength of the lacing bars) are the main geometrical parameters affecting the laced columns' ductility.

1. Introduction

A built-up column is a kind of compression member consisting of two or more longitudinal elements (chords), which are slightly separated and connected to each other at only a few locations along their lengths by means of connector-like lacings, battens or perforated plates. It is believed that the connector causes built-up members to behave as one integral unit to achieve maximum capacity. These members are frequently used as light compression members, such as truss members, bracing members and columns of light steel structures. The earlier studies by Engesser (1891) showed that shear deformations have an adverse effect on the axial buckling strength of columns. The reduction in axial buckling strength due to shear deformations is therefore much greater for built-up columns and hence depends upon the dimensions and configuration of the main chords and connectors. Many researchers have studied the theoretical effect of shear deformations on the buckling strength of built-up columns [1–14].

During seismic events, built-up columns are subjected to lateral cyclic loads and may not behave in an acceptable manner. Most codes use built-up columns as compressive members to sustain only an axial load [15–17]. Therefore, little research has been performed on the cyclic behavior of built-up columns. Kleiser [18] experimentally investigated the cyclic behavior of a kind of laced column that was composed of two 45-degree double-lacing plates for which four angles were used as the chord members with rivet connections. Sahoo and Rai [19] investigated the cyclic behavior of built-up battened columns. Lee and Bruneau [20] investigated the behavior of laced built-up columns under a cyclic axial load.

In the present paper, the cyclic behavior of the laced built-up columns with various geometrical properties was investigated

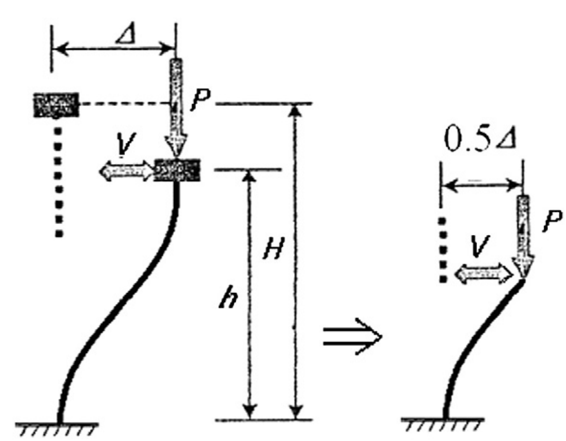

Fig. 1. Loading system applied to the column analysis.

* Corresponding author at: No 7, Otofat avenue, Laleh square, Tabriz, Postal Code: 5178735918, Iran. Tel.: +98 411 4425154; fax: +98 411 3814029.
E-mail addresses: alireza.poursamad@yahoo.com (A. Poursamad Bonab), behrokh@iiees.ac.ir (B. Hosseini Hashemi).

0143-974X/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jcsr.2012.02.005