工程力学
ENGINEERING MECHANICS
ISSN 1000-4750
CN 11-2595/O3
CODEN GOLIEB
Ei 收录期刊

工程力学 » 2012, Vol. 29 » Issue (11): 212-220 DOI: 10.6052/j.issn.1000-4750.2011.04.0203

无侧移变轴力框架柱稳定性的等效力法

田炜烽，郝际平，樊春雷，吴元莅

(西安建筑科技大学土木工程学院，西安 710055)

EQUIVALENT FORCE METHOD FOR THE STABILITY OF NON-SWAY FRAME COLUMN WITH VARYING AXIAL FORCE

TIAN Wei-feng , HAO Ji-ping , FAN Chun-lei , WU Yuan-li

(College of Civil Engineering, Xi’an University of Architectural Science and Technology, Xi’an 710055, China)

全文: PDF (8505 KB) HTML (1 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要

该文根据无侧移压杆的屈曲形态提出了以轴力对压杆跨中抗侧刚度的削弱来表征轴力负刚度的力学模型，并利用该模型阐释了无侧移框架计算长度系数的力学意义。在该模型的基础上，根据等效负刚度相等的原则，建立了无侧移框架柱中力与柱顶力之间的等效关系，推导了等效力系数的计算公式。通过该系数，可以将柱中力折算到柱顶，并直接通过规范查取计算长度系数验算框架柱的整体稳定，而不需要重新对计算长度系数进行折算。进一步提出了等效力法，该方法可以很好的解决无侧移框架柱的变多次轴力问题，具有很好的精度。算例计算结果表明：等效力法具有很好的精度和准确性，可供工程设计及理论计算使用。

关键词： 稳定 等效力法 无侧移框架 变轴力 负刚度

Abstract:

According to the buckling behavior of compression members, this paper propose a mechanical model, which use the weakening to the midspan lateral stiffness of the compression member by axial force to characterize the axial force’s negative stiffness. By this model, the mechanical meaning of the effective length for non-sway frame was elaborated. Based on this model and the principle of equal equivalent negative stiffness, the equivalent relationship between the top load and the intermediate load acting on a frame column was established, and then the equivalent load factor formula was derived. Through this factor, an intermediate load can be converted to a top load, so that the stability of a frame can be checked by the effective length gained from Code, without recomputation. Then, the equivalent force method is proposed. This method can solve the stability problem of a non-sway frame under multiple-varying axial force easily with a good accuracy, thusly it can meet the requirements of engineering applications. The results show that the equivalent force method can be used for engineering design and theoretical calculations with good precision and accuracy,.

Key words: stability equivalent force method non-sway frame varying axial force negative stiffness

收稿日期: 2011-04-07;

PACS: TU311.2 | TU318.2

基金资助:

国家自然科学基金项目(50878181)；陕西省自然科学基金青年基金项目(2010JQ7001)；陕西省教育厅专项科研项目(2010JK630)

通讯作者: 田炜烽

引用本文:

田炜烽,郝际平,樊春雷等. 无侧移变轴力框架柱稳定性的等效力法[J]. 工程力学, 2012, 29(11): 212-220.

TIAN Wei-feng,HAO Ji-ping,FAN Chun-lei et al. EQUIVALENT FORCE METHOD FOR THE STABILITY OF NON-SWAY FRAME COLUMN WITH VARYING AXIAL FO Engineering Mechanics, 2012, 29(11): 212-220.
链接本文:
http://gclx.tsinghua.edu.cn/CN/10.6052/j.issn.1000-4750.2011.04.0203

没有找到本文相关图表信息

[1]

[1] 铁摩辛柯, 盖莱. 弹性稳定理论[M]. 北京: 科学技术出版社, 1965: 49－70.

[2]

Timoshenko S P, Guelleh J M. Theory of elastic stability [M]. Beijing: Science and Technology Press, 1965: 49－70. (in Chinese)

[3]

[2] 尼斯特科. 杆系的稳定性[M]. 北京: 建筑工程出版社, 1956: 92－151.

[4]

Nisiteke H K. Stability of rods [M]. Beijing: Construction Press, 1956: 92－151. (in Chinese)

[5]

[3] 陈绍蕃. 钢结构稳定设计指南[M]. 北京: 中国建筑工业出版社, 2004: 145－190.

[6]

Chen Shaofan. Guide to stability design of steel structures [M]. Beijing: China Building Industry Press, 2004: 145－190. (in Chinese)

[7]

[4] 陈绍蕃. 厂房框架带牛腿柱的计算长度[J]. 建筑结构学报, 2007, 28(5): 54－60.

Chen Shaofan. Effective length of columns with corbel in mill building frames [J]. Journal of Building Structures, 2007, 28(5): 54－60. (in Chinese)

[8]

[5] 田炜烽, 郝际平, 丁戈, 付磊. 任意分布轴力作用下框架柱弹性稳定的实用解法[J]. 工程力学, 2012, 29(2): 74－80. 浏览

Tian Weifeng, Hao Jiping, Ding Ge, Fu Lei. A practical method for the elastic stability of frame column under random distribution axial force [J]. Engineering Mechanics, 2012, 29(2): 74－80. (in Chinese) 浏览

[9]

[6] GB 50017-2003, 钢结构设计规范[S]. 北京: 中国计划出版社, 2003.

[10]

GB 50017-2003, Code for design of steel structures. [S]. Beijing: China Planning Press, 2003. (in Chinese)

[11]

[7] 陈绍蕃. 现代钢结构设计师手册(上册)[M]. 北京: 中国电力出版社, 2006: 135－141.

[12]

Chen Shaofan. Modern steel designers manual (Ⅰ) [M]. Beijing: China Electric Power Press, 2006: 135－141. (in Chinese)

[13]

[8] Thorburn L J, Kulak G L, Montgomery C J. Analysis of steel plate shear walls. Structural Engineering Report No.107 [R]. Canada: University of Alb 1983.

[14]

[9] Kulak G L. Unstiffened Steel Plate Shear Walls. Chapter 9 of structures subjected to repeated loading-stability and strength [M]. London: Elsevie Applied Science Publications, 1991: 237－276.

[15]

[10] Limit States Design of Steel Structures. CAN/CSA-S16-01 [S]. Canada: Canadian Standard Association, 2002.

[16]

[11] 胡正宇, 曹平周. 变轴力等截面多跨连续杆件计算长度分析[C]. 中国钢结构协会结构稳定分会2002年学术交流会论文集, 2002: 191－197.

[17]

Hu Zhengyu, Cao Pingzhou. The analysis of the calculation length of the continuous constant section-cross column enduring the variational axis [C]. Proceedings of 2002 Colloquium Institute of Structural Stability and Fatigue China Steel Construction Society, 2002: 191－197. (in Chinese)

[18]

[12] 陈绍蕃. 两种压杆计算长度的讨论[J]. 钢结构, 2004, 1(19): 38－40.

Chen Shaofan. Discussion on the effective length of two sorts of compression members [J]. Steel Construction, 2004, 1(19): 38－40. (in Chinese

[1] 宋福春, 陈宝春. 钢管混凝土标准桁肋拱面外弹性稳定分析[J]. 工程力学, 2012, 29(9): 125-132.

[2] 蔡建国, 涂展麒, 冯健, 张晋. 初始缺陷对三向张弦梁结构整体稳定性影响研究[J]. 工程力学, 2012, 29(8): 220-226.

[3] 施刚, 刘钊, 张勇, 王元清, 石永久. 轴心受压等边角钢构件局部稳定受力性能随钢材强度变化规律的研究[J]. 工程力学, 2012, 29(8): 129-135.