



风汽车桥梁系统耦合振动及行车安全性分析

李永乐,赵凯,陈宁,廖海黎

1. 西南交通大学桥梁工程系, 四川, 成都 610031;
2. 中交公路规划设计院有限公司, 北京 100088

WIND-VEHICLE-BRIDGE SYSTEM COUPLING VIBRATION AND TRAFFIC SAFETY ANALYSIS

LI Yong-le,ZHAO Kai,CHEN Ning,LIAO Hai-li

1. Department of Bridge Engineering, Southwest Jiaotong University, Chengdu, Sichuan 610031, China;
2. China Communication Construction Company Highway Consultants CO., Ltd., Beijing 100088, China

- [摘要](#)
- [图/表](#)
- [参考文献](#)
- [相关文章](#)

全文: [PDF](#) (496 KB) | [HTML](#) (1 KB) 输出: [BibTeX](#) | [EndNote](#) (RIS) | [背景资料](#)

摘要 强风不仅是长大桥梁设计的控制性因素,而且直接影响到桥上车辆的运行安全。将自然风、公路车辆、桥梁作为一个统一的相互作用系统,在风-汽车-桥梁系统耦合振动分析的基础上,针对车辆侧倾事故和侧滑事故的评判准则,采用概率统计方法提高了风致车辆事故分析的可靠性。结合工程实例对强风作用下桥梁的动力响应和车辆的运行安全性进行了分析。计算得到了给定的车速条件下厢式货车的侧倾临界风速及干、湿、雪、冰四种路况情况下的侧滑临界风速,提出了适用于交通安全策略管理的强风天气条件下桥上车辆限速标准。

关键词: [公路风-车-桥系统](#) [耦合振动](#) [风致车辆事故](#) [行车临界风速](#) [迭代求解](#)

Abstract: Strong wind not only controls the design of long span bridges, but also directly affects the traffic safety of vehicles on the bridges. Based on the coupled vibration analysis of a wind-road vehicles-bridge system, the wind-induced vehicle accident analysis is improved, since the probability of a statistical method was adopted in the criterion of vehicles side-lurch accidents and side slipping accidents. In the case study, the dynamic response of a bridge under strong wind was investigated, and the safety operation of vehicles was evaluated. The traffic critical wind speed of side-lurch and side-slipping for the moving vehicles at dry, wet, snow, ice road conditions were calculated, respectively. Accordingly, the vehicle speed limit at strong wind conditions is proposed for the management of traffic safety.

Key words: [wind-road vehicles-bridge system](#) [coupling vibration](#) [wind-induced vehicle accidents](#) [traffic critical wind speed](#) [iterative solution](#)

收稿日期: 2012-05-09;

PACS:

基金资助: 国家自然科学基金项目(50508036); 教育部新世纪优秀人才支持计划项目(NCET-06-0802); 四川省杰出青年学科带头人计划项目(2009-15-406)

作者简介: 赵凯(1985-),男,河南商丘人,助理工程师,硕士,主要从事桥梁抗风与抗震方面的研究(E-mail: kai.zhao.wind@gmail.com); 陈宁(1986-),男,湖南嘉禾人,博士生,从事车桥耦合振动方面的研究(E-mail: chen-ning-520@163.com); 廖海黎(1956-),男,四川资中人,教授,工学博士,博导,主要从事桥梁、建筑风效应与抗风设计理论研究(E-mail: hlliao@swjtu.edu.cn).

引用本文:

李永乐,赵凯,陈宁等. 风汽车桥梁系统耦合振动及行车安全性分析[J]. 2012, 29(5): 206-212.

LI Yong-le,ZHAO Kai,CHEN Ning et al. WIND-VEHICLE-BRIDGE SYSTEM COUPLING VIBRATION AND TRAFFIC SAFETY ANALYSIS[J]. Engineering Mechanics, 2012, 29(5): 206-212.

链接本文:







服务

- ▶ [把本文推荐给朋友](#)
- ▶ [加入我的书架](#)
- ▶ [加入引用管理器](#)
- ▶ [E-mail Alert](#)
- ▶ [RSS](#)

作者相关文章

- ▶ [李永乐](#)
- ▶ [赵凯](#)
- ▶ [陈宁](#)
- ▶ [廖海黎](#)

没有找到本文相关图表信息

- [1] Chen S R. Dynamic performance of bridges and vehicles under strong wind [D]. Baton Rouge, USA: Louisiana State University and Agricultural & Mechanical College, 2004. 
 - [2] Guo W H. Dynamic analysis of coupled road vehicle and long span cable-stayed bridge system under cross winds[D]. Hong Kong, China: Hong Kong Polytechnic University, 2003.
 - [3] 韩万水. 风-汽车-桥梁系统空间耦合振动研究[D]. 上海: 同济大学, 2006. Han Wanshui. Three-dimensional coupling vibration of wind-vehicle-bridge system [D]. Shanghai: Tongji University, 2006. (in Chinese) 
 - [4] 韩万水, 马麟, 刘建新. 风环境下汽车-桥梁系统侧向空间耦合振动关系研究[C]//中国土木工程学会. 第14届全国结构风工程学术会议论文集, 2009. Han Wanshui, Ma Lin, Liu Jianxin. Lateral coupling relations between the vehicle-bridge-systems under cross wind[C]//China Civil Engineering Society. The 14th National Technology Conference on Wind Engineering, 2009. (in Chinese)
 - [5] 马麟. 考虑驾驶员行为的风-汽车-桥梁系统空间耦合振动研究[D]. 西安: 长安大学, 2008. Ma Lin. Three-dimensional coupled vibration of windvehicle-bridge system considering driver's behavior [D]. Xi'an: Changan University, 2008. (in Chinese) 
 - [6] 陈晓东. 大跨度桥梁侧风行车安全分析[D]. 上海: 同济大学, 2007. Chen Xiaodong. Analysis of vehicle safety under cross wind on long span bridge [D]. Shanghai: Tongji University, 2007. (in Chinese) 
 - [7] Li Yongle, Hu Peng, Zhang Mingjin. Wind tunnel test with moving vehicle model for aerodynamic forces of vehicle-bridge system under cross wind[C]//Cheng Chiiming. The 7th Asia-Pacific Conference on Wind Engineering. Taipei, Taiwan, China, 2009. 
 - [8] 李永乐. 风-车-桥系统非线性空间耦合振动研究[D]. 成都: 西南交通大学, 2003. Li Yongle. Nonlinear three-dimensional coupling vibration of wind-vehicle-bridge system [D]. Chengdu: Southwest Jiaotong University, 2003. (in Chinese) 
 - [9] 赵凯. 风-汽车-桥梁系统耦合振动分析及程序设计[D]. 成都: 西南交通大学, 2010. Zhao Kai. Coupling vibration of wind-road vehicle-bridge system and ITS program design [D]. Chengdu: Southwest Jiaotong University, 2010. (in Chinese)
- [1] —李小珍;张黎明;张 洁. 公路桥梁与车辆耦合振动研究现状与发展趋势[J]. , 2008, 25(3): 0-240.
 - [2] 张 鹏;朱昌明;张梁娟. 变长度柔性提升系统纵向-横向受迫耦合振动分析[J]. , 2008, 25(12): 202-207.
 - [3] 尚守平;任 慧;曾裕林;余 俊. 非线性土中单桩竖向动力特性分析[J]. , 2008, 25(11): 111-115.
 - [4] 彭献;刘子建;洪家旺;. 匀变速移动质量与简支梁耦合系统的振动分析[J]. , 2006, 23(6): 25-29.
 - [5] 舒歌群;梁兴雨. 基于自重影响的连续轴扭/弯耦合振动的研究[J]. , 2005, 22(2): 168-173.
 - [6] 李俊;沈荣瀛;华宏星. 非对称Bernoulli-Euler薄壁梁的弯扭耦合振动[J]. , 2004, 21(4): 91-96.
 - [7] 李永乐;廖海黎;强士中. 三塔斜拉桥抖振的耦合行为研究[J]. , 2004, 21(4): 184-188.
 - [8] 李小珍;蔡婧;强士中. 京沪高速铁路南京长江大桥列车走行性分析[J]. , 2003, 20(6): 86-92,2.
 - [9] 胡宇达;邱家俊;卿光辉. 汽轮发电机定子端区汇水管的磁弹性耦合振动方程与固有特性[J]. , 2003, 20(3): 98-103.