Parameter Influence Analysis of Vehicle-Bridge Coupled Vibration Under Vehicle Jumping Impact (Postprint)

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Abstract

This study investigates the effects of vehicle jumping under various parameter influences on bridge vehicle-bridge coupling responses. A three-span variable cross-section continuous beam bridge is selected as the research object, wherein the variable cross-section beam is divided into finite micro-segments to derive the bridge vibration equation through force analysis. A quarter-vehicle model is adopted, and d' Alembert' s principle is applied to establish the vehicle vibration equation. The vehicle-bridge coupling vibration equation is subsequently obtained through simultaneous solution, with the Newmark-β method employed to solve the coupling equations. The results indicate that: after neglecting geometric nonlinearity, the stiffness of the suspension and tire systems shows no significant effect on bridge displacement response under jumping impact; higher vehicle velocity does not necessarily lead to more pronounced vehicle-bridge coupling displacement responses; vehicle mass has a significant influence on the coupling response, with heavier vehicles causing more severe bridge displacement responses.

Full Text

Preamble

This section introduces the mathematical notation and foundational relationships used throughout this paper. The initial set of expressions, $ $ through $ E; "IGID!S% STUV#4.,!(cid:159)(cid:160)¡# 9@.-><" &?A2 f&Y(cid:246)1>(cid:145)*(cid:cid:145)!¶•*(cid:145)(cid:192)z n8{L(cid:157)(cid:155) 9$ elaborate on the core theoretical framework and operational relationships. The notation system is further extended by $ /% -$ through $ N7C$, introducing specialized symbols and functional forms. Advanced mathematical concepts and derivations are presented in $ N 7C# RA)#

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..,– ∗ ..16$(cid:cid : 238)$| ∗ .16$(cid:cid : 238)$| ∗ .. Additional relationships and constraints are defined by $)# N7C$ to $%41:' >+-<2>)(<-+1.13' ;?.>2@)(-3
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/,' 0" 120" +3%>?@AB "2CDEEF $. The final series of expressions, $%%
! SD (cid:209) M(cid:145) $ through $@DS!! $, completes the mathematical preliminaries required for the subsequent analysis.

Note: Figure translations are in progress. See original paper for figures.