

Retirement symposium and celebration of the career of Prof. Anil K. Chopra



Effect of live loads on the seismic response of pile-supported storage structures

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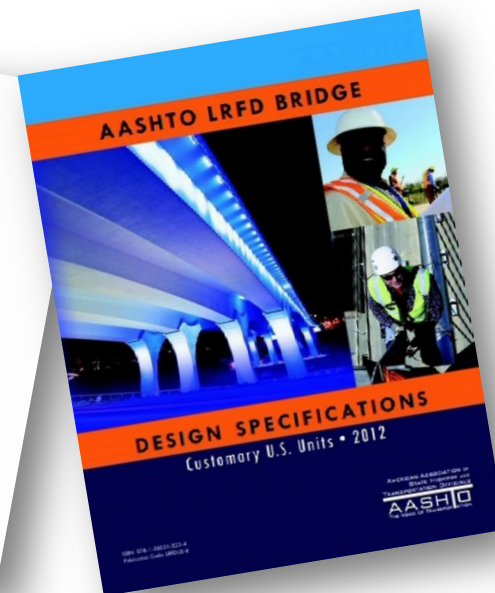
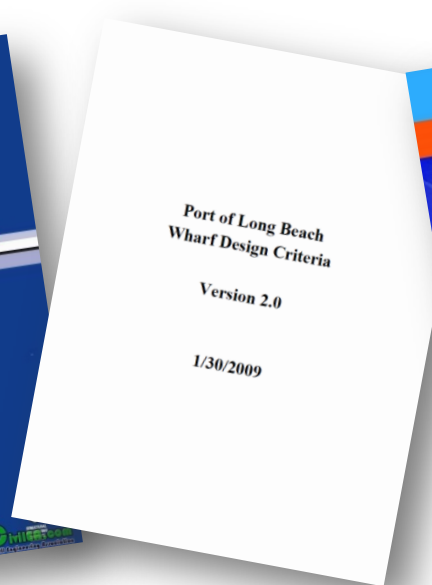
Oscar A. Ardila, Ingetec , Colombia



1 Research question

What percentage of quasi-permanent live load should be used as seismic mass?

- USA Building standards (ASCE 7–16): 25%?
- Port standards (POLA, POLB): 10%?
- Bridge standards (AASHTO): 0%?



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Pile-supported container yards

$DL = 20 \text{ kN/m}^2$ $LL = 40 \text{ kN/m}^2$ $\alpha = 2$



$DL = 7 \text{ kN/m}^2$ $LL = 12 \text{ kN/m}^2$



$DL = 6 \text{ kN/m}^2$ $LL = 7 \text{ kN/m}^2$



$DL = 4 \text{ kN/m}^2$ $LL = 5 \text{ kN/m}^2$

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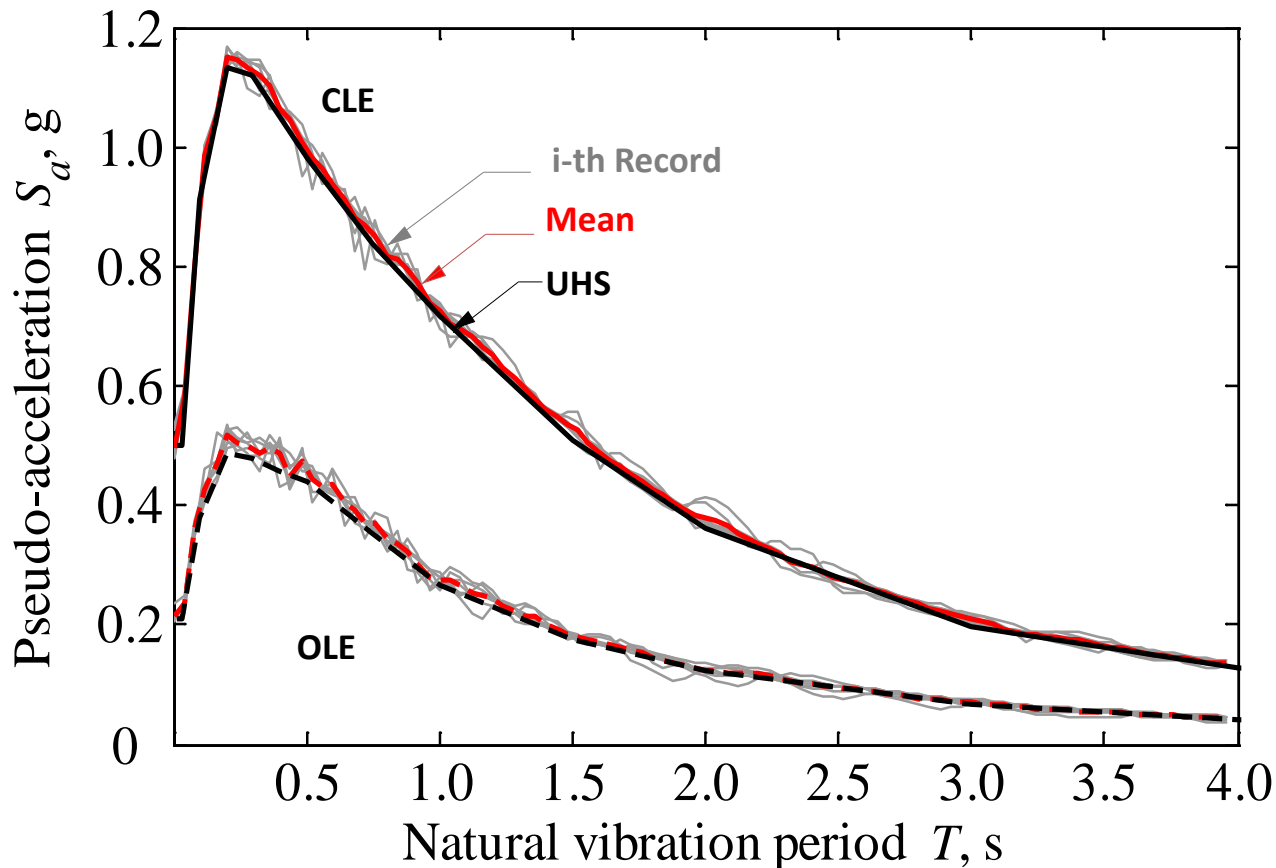
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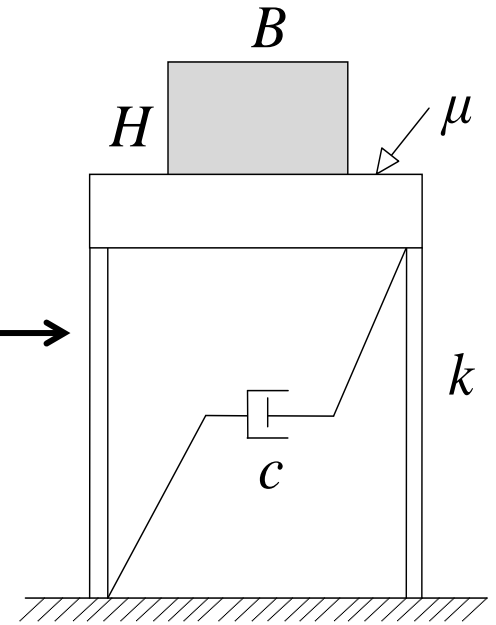
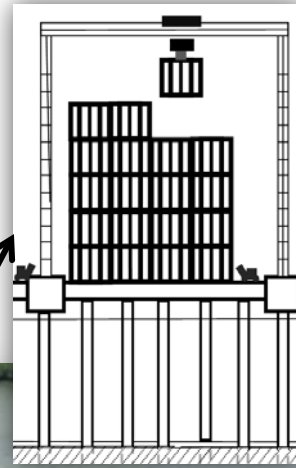
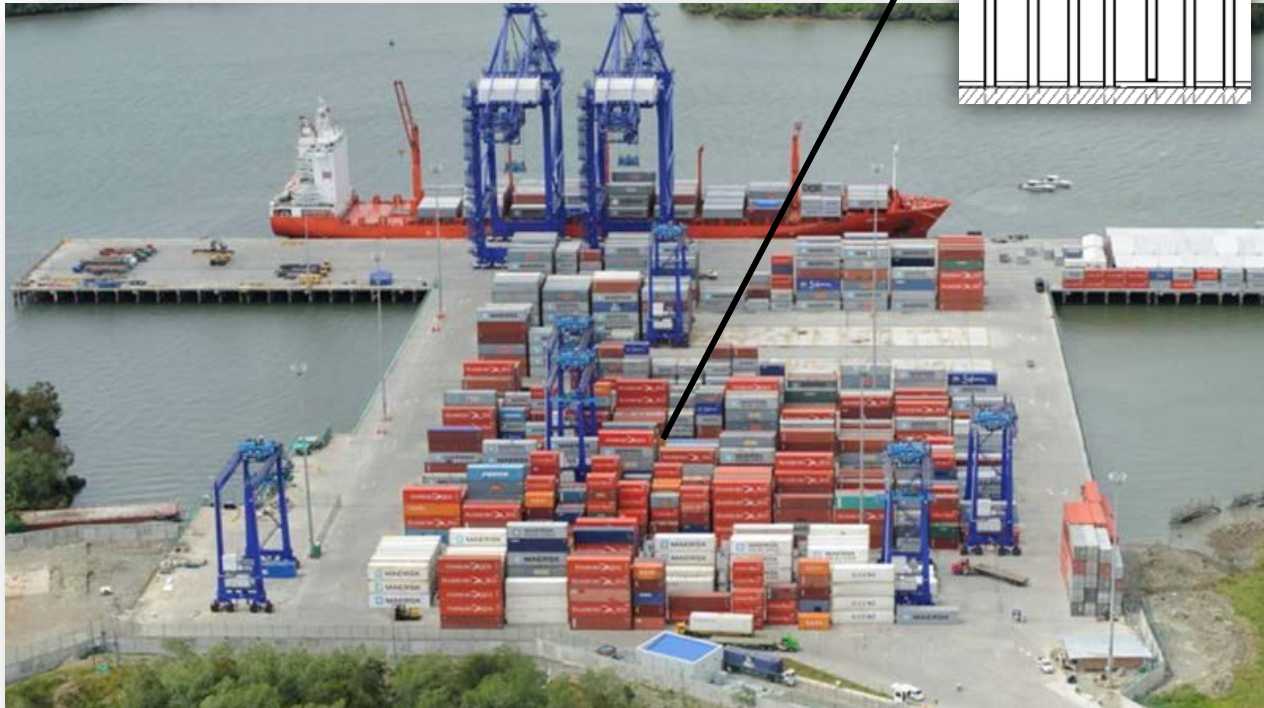
2 Ground motions

Operational Level Earthquake (OLE): $M_w = 6.0$ to 6.9

Contingency Level Earthquake (CLE): $M_w = 6.7$ to 7.1



3 Modeling



Introduction

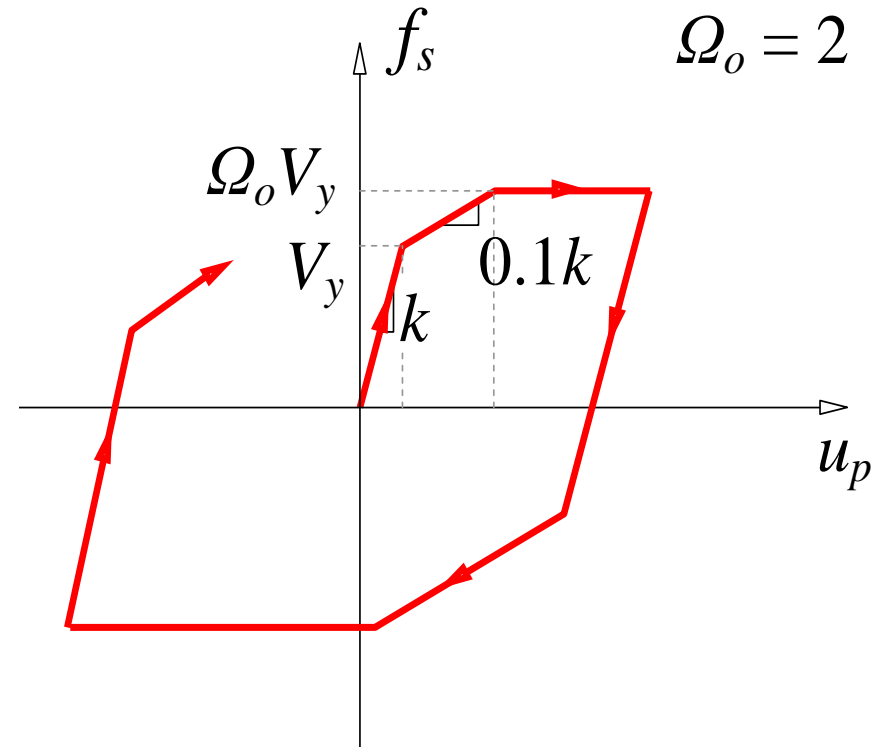
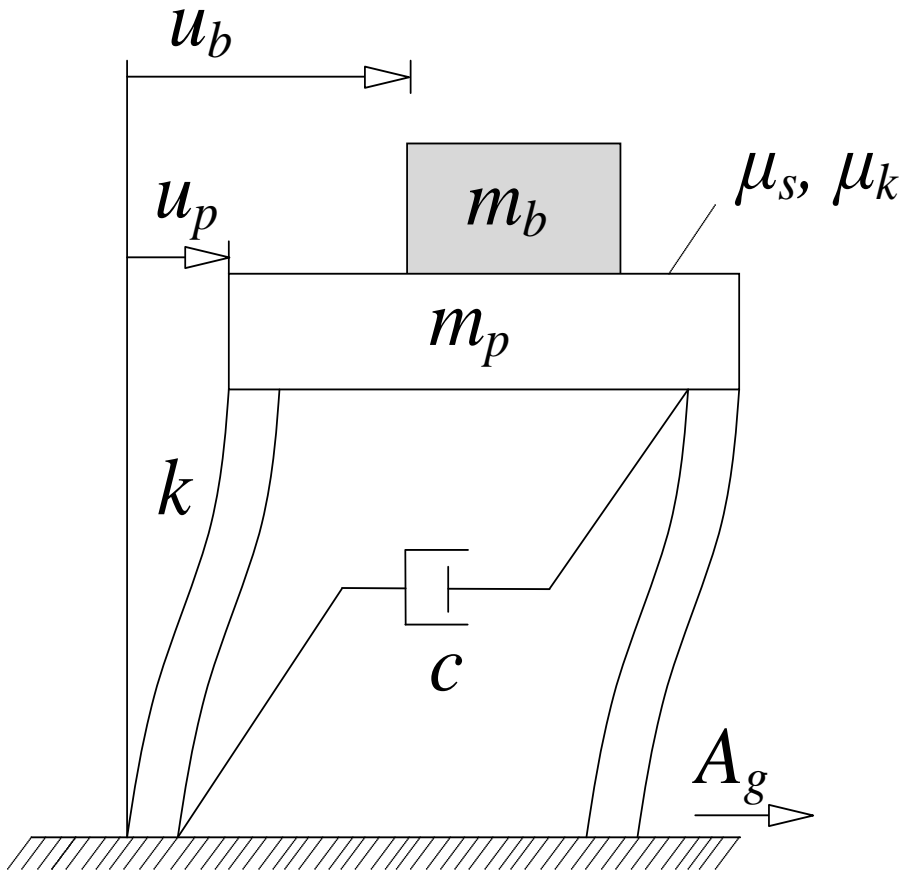
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Numerical models



Runge Kutta and ANSYS

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Scaled experimental model (elastic)

Characteristics



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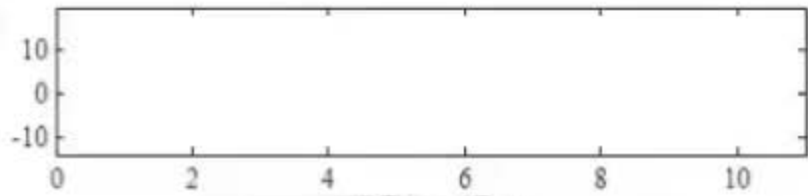
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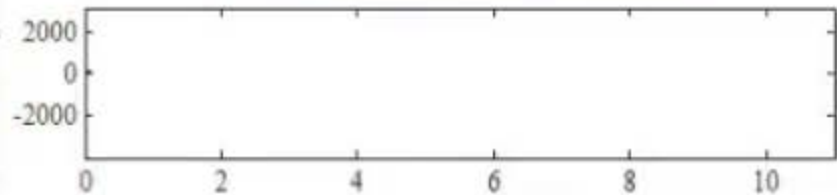
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Platform Drift [mm]

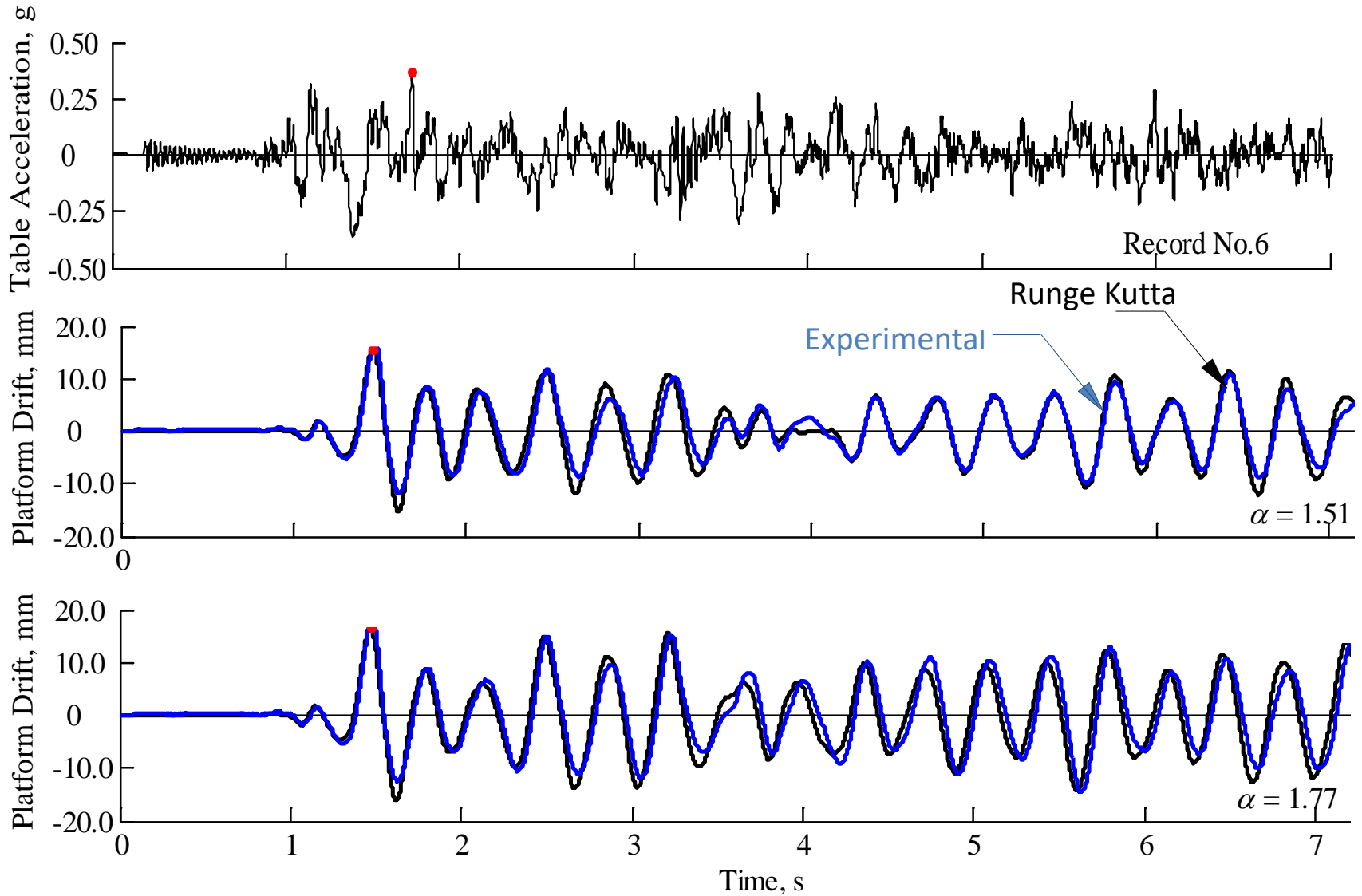


Acceleration [mm/s^2]



Tiempo [s]

Comparisons for elastic cases



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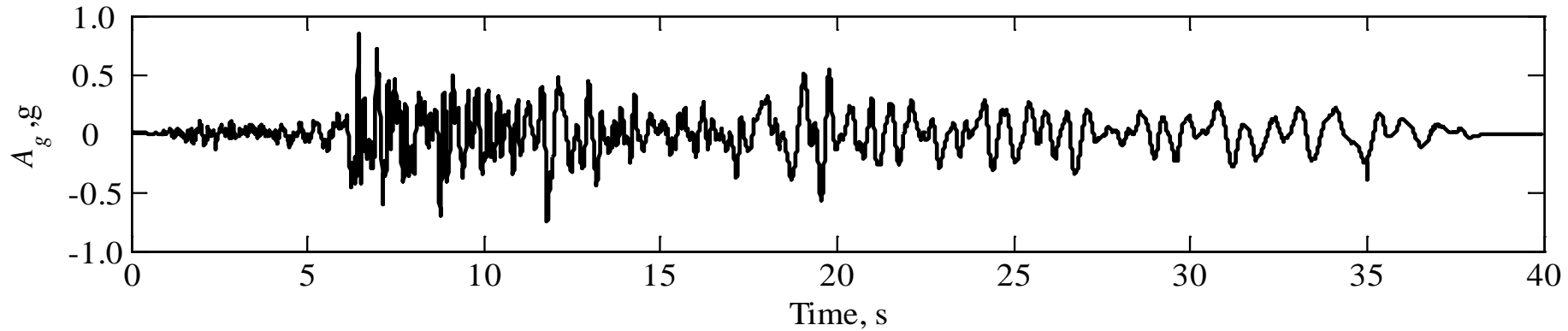
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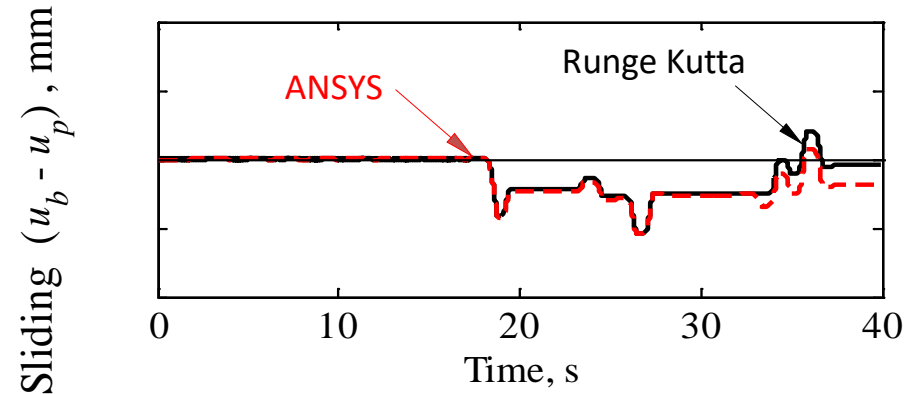
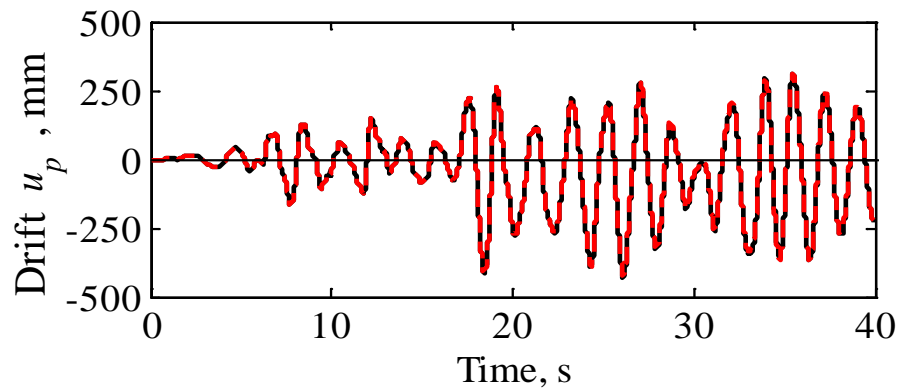
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Comparisons for inelastic cases



CASE : $\alpha = 2.0$, $C_v = 0.8$, $R = 1.4$, $T = 1s$



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4 Parametric study

Variables	Values	Total
T (structural Period)	[0.1,0.2, ..., 2]	20
μ (friction Coefficient)	[0.1, 0.2, ..., .7]	7
α (block-structure mass ratio)	[0.5, 1, ..., 2]	4
R (response modification factor)	[Elastic, 2, 3]	3
Records	7 OLE, 7 CLE	14

Total: 23520 analysis cases

$$DDR = \frac{\text{Drift for structure with sliding block}}{\text{Drift for structure with rigidly attached block}}$$

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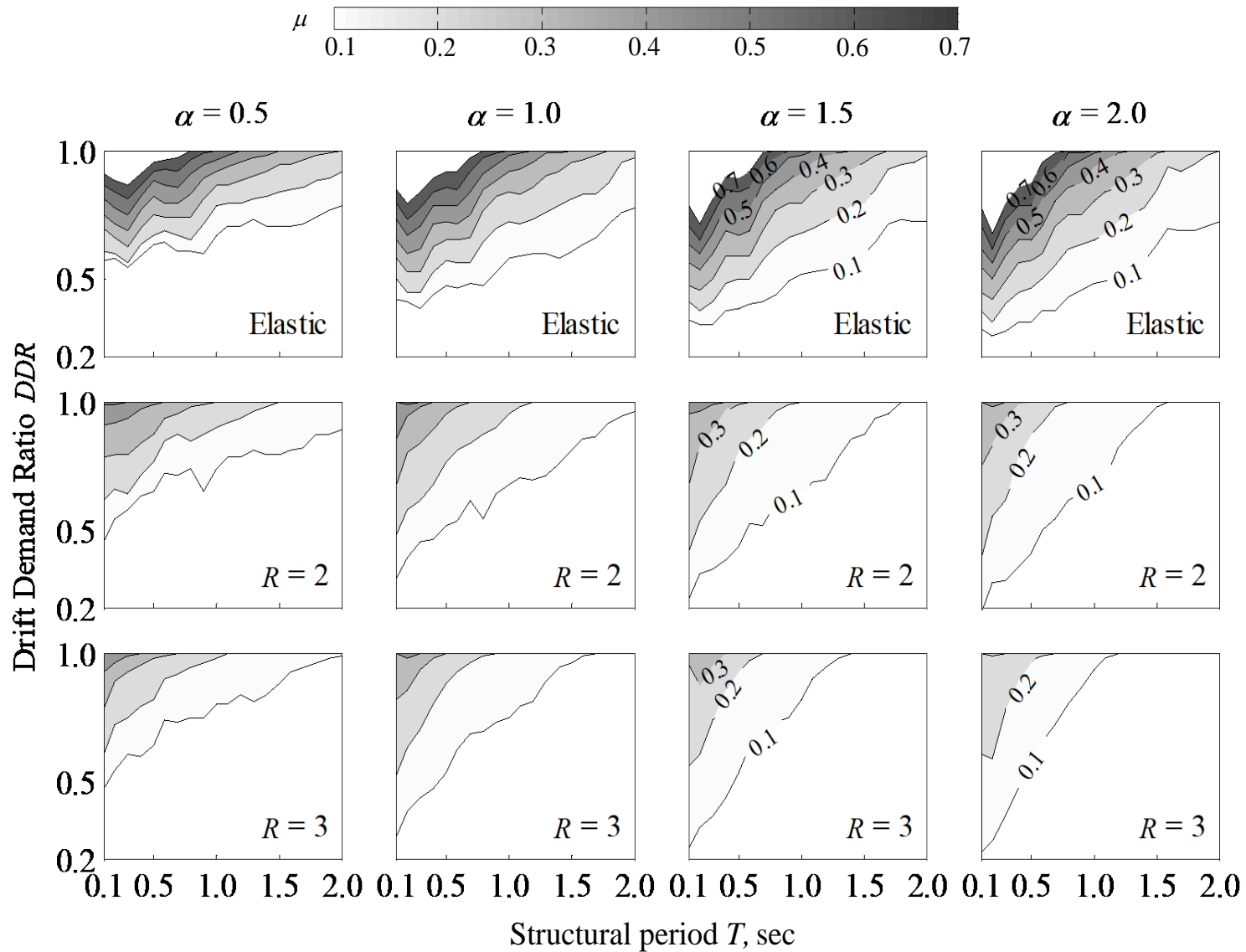
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DDR for various friction coefficients



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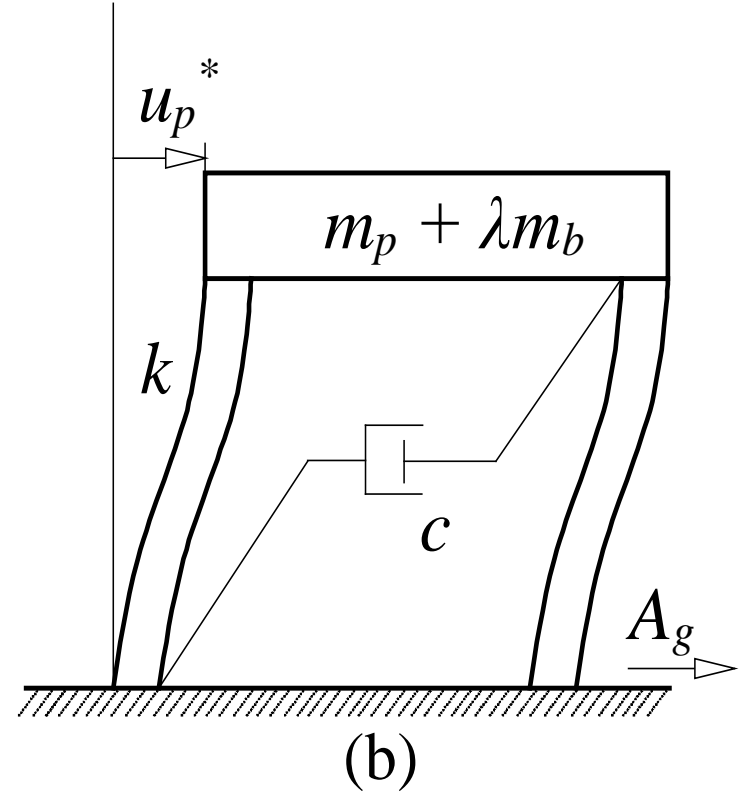
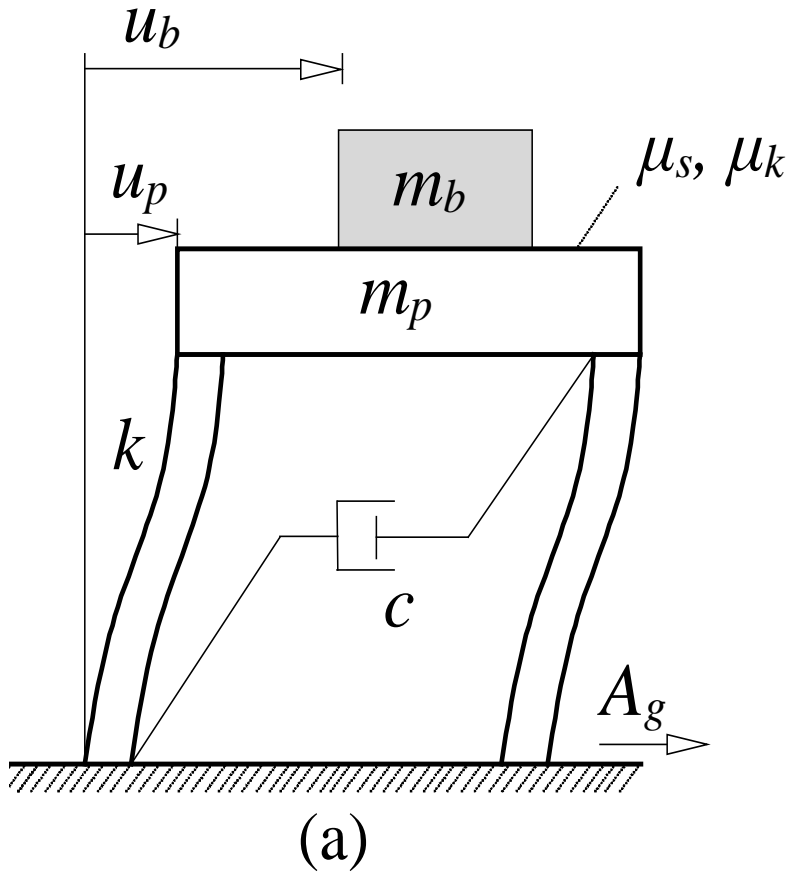
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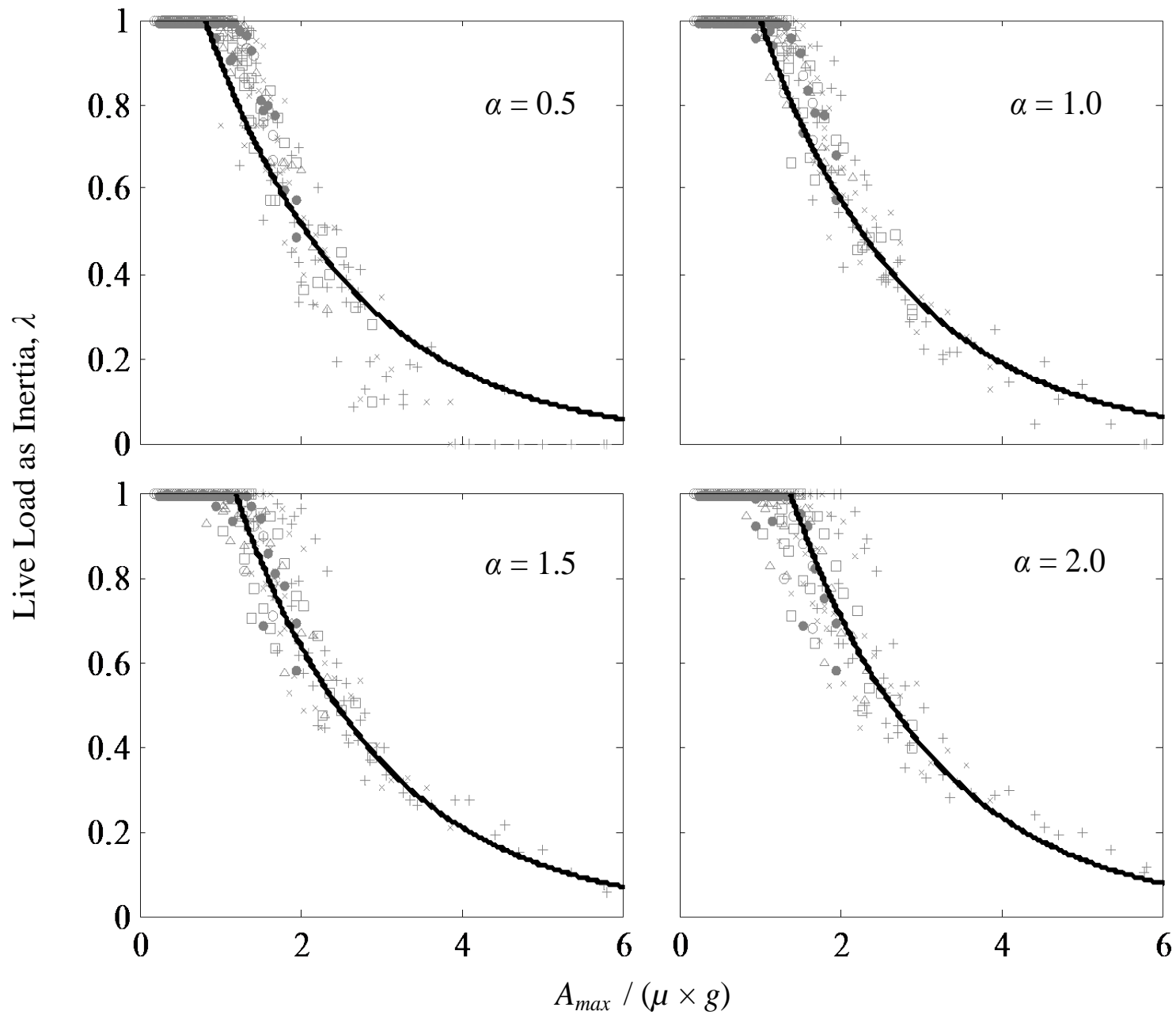
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Effective seismic mass



$$u_p = u_p^*$$



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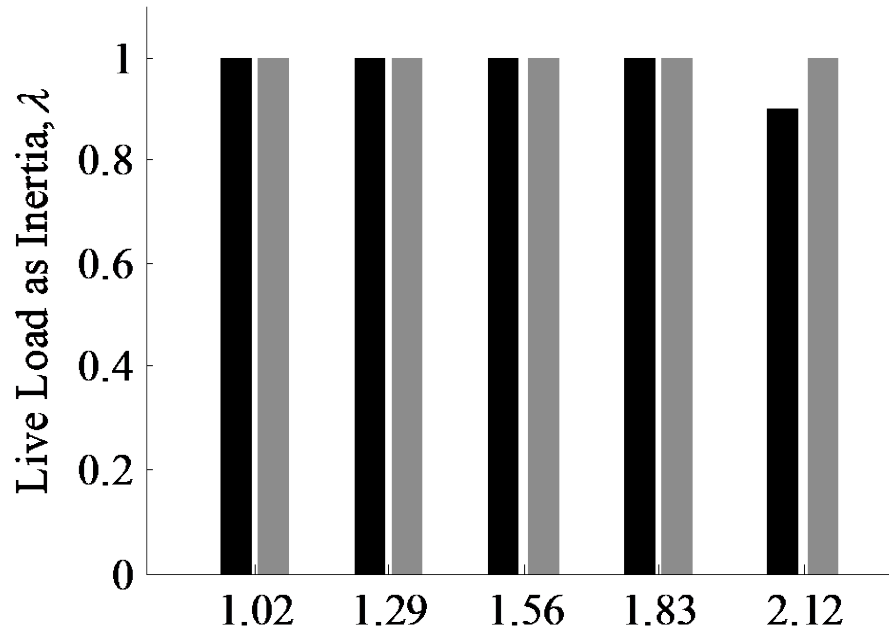
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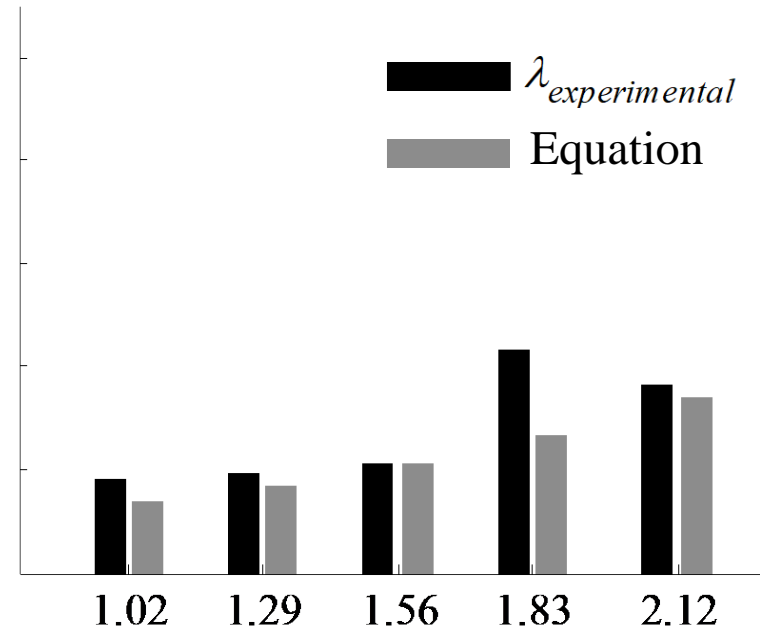
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Comparison with experimental results



(a)



(b)

Mass ratio, α

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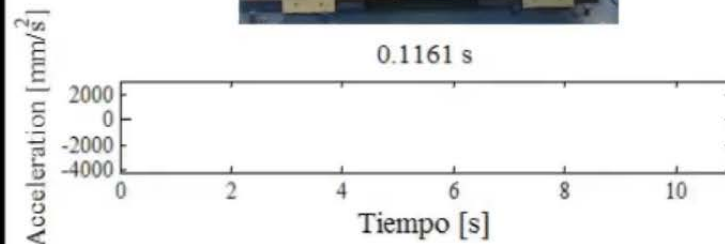
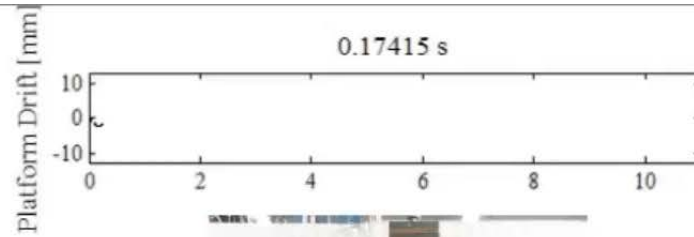
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How about rocking?



ScreenCast-O-Matic.com

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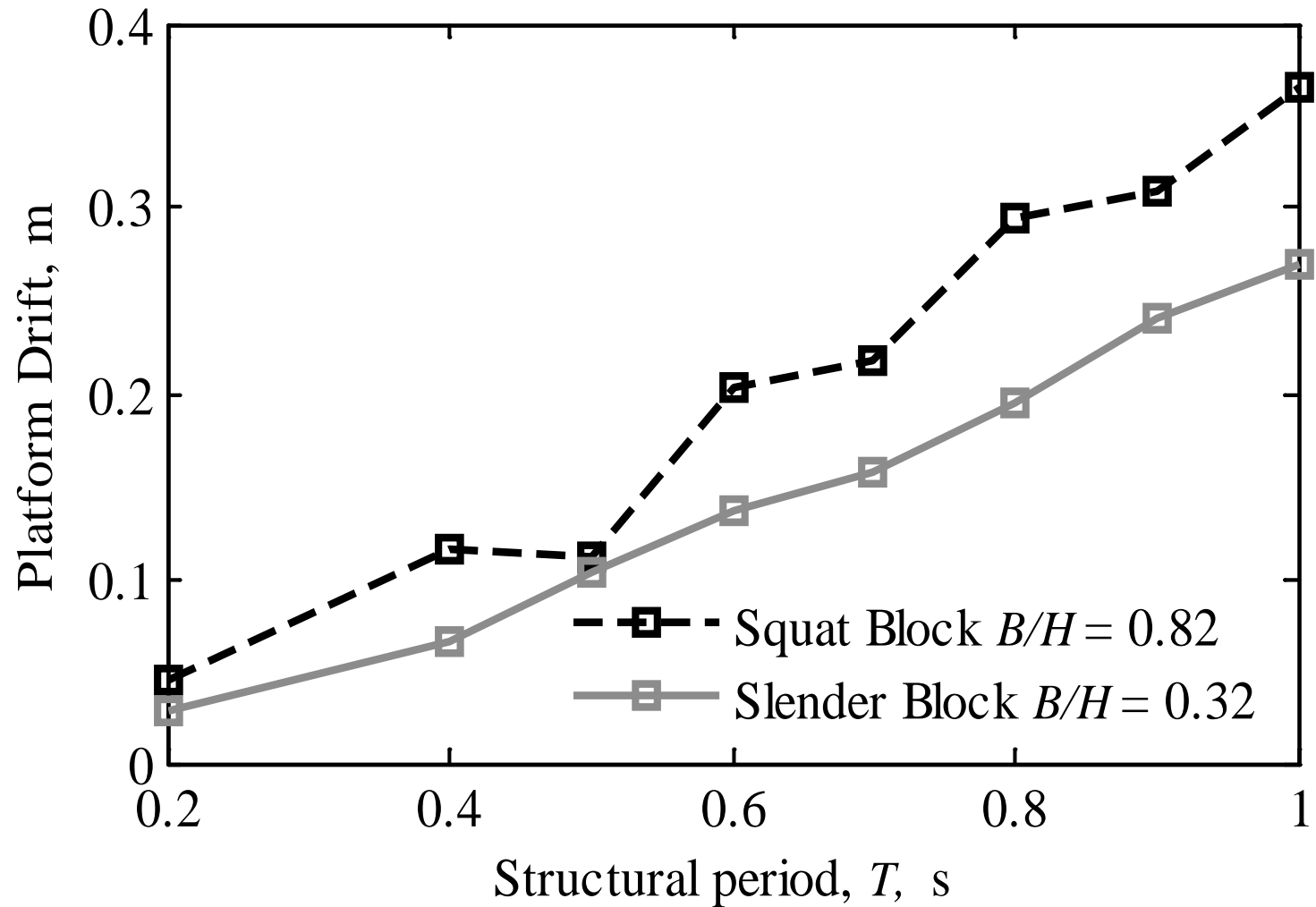
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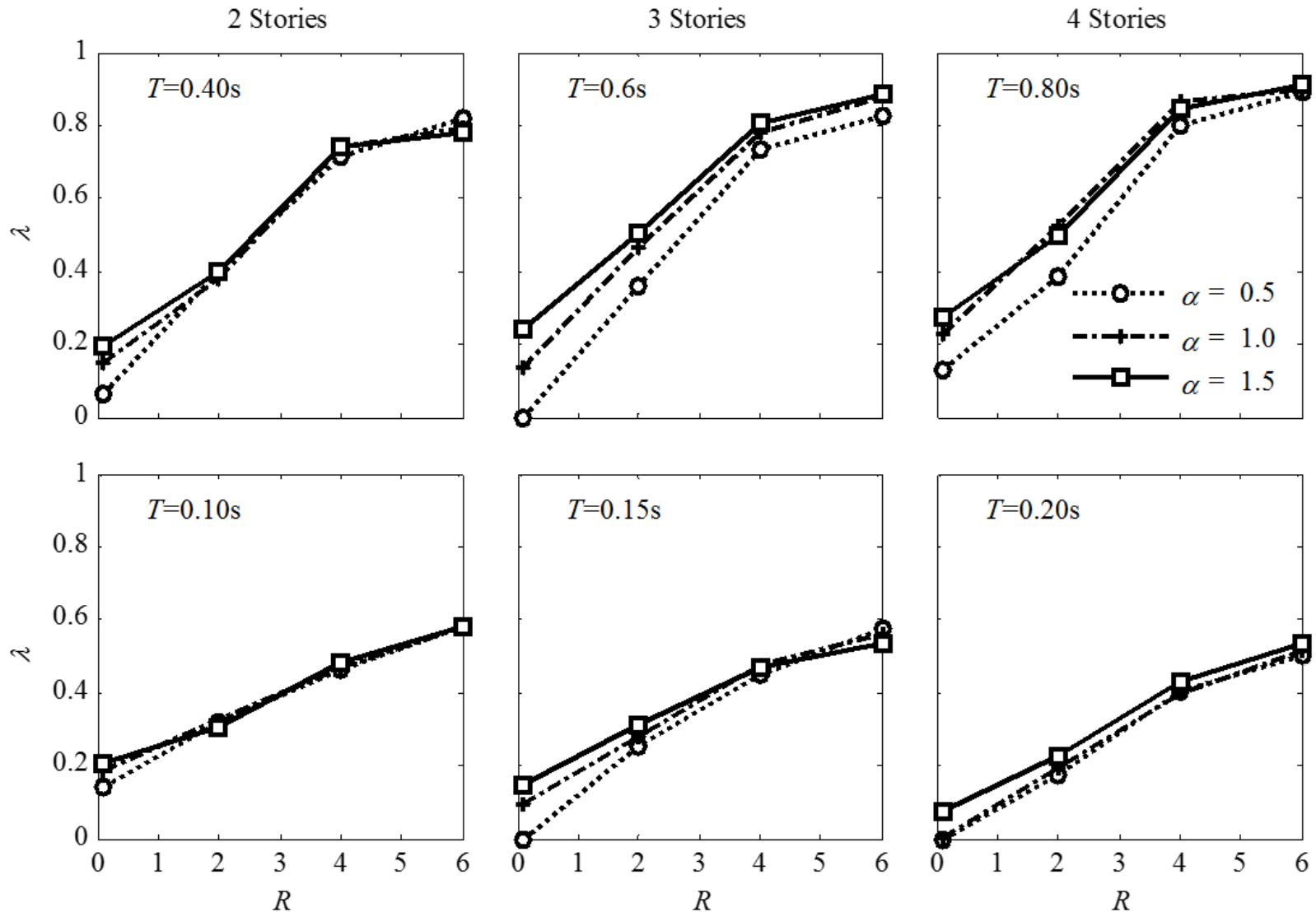
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Multiple-story structures?



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5 Conclusions



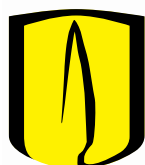
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