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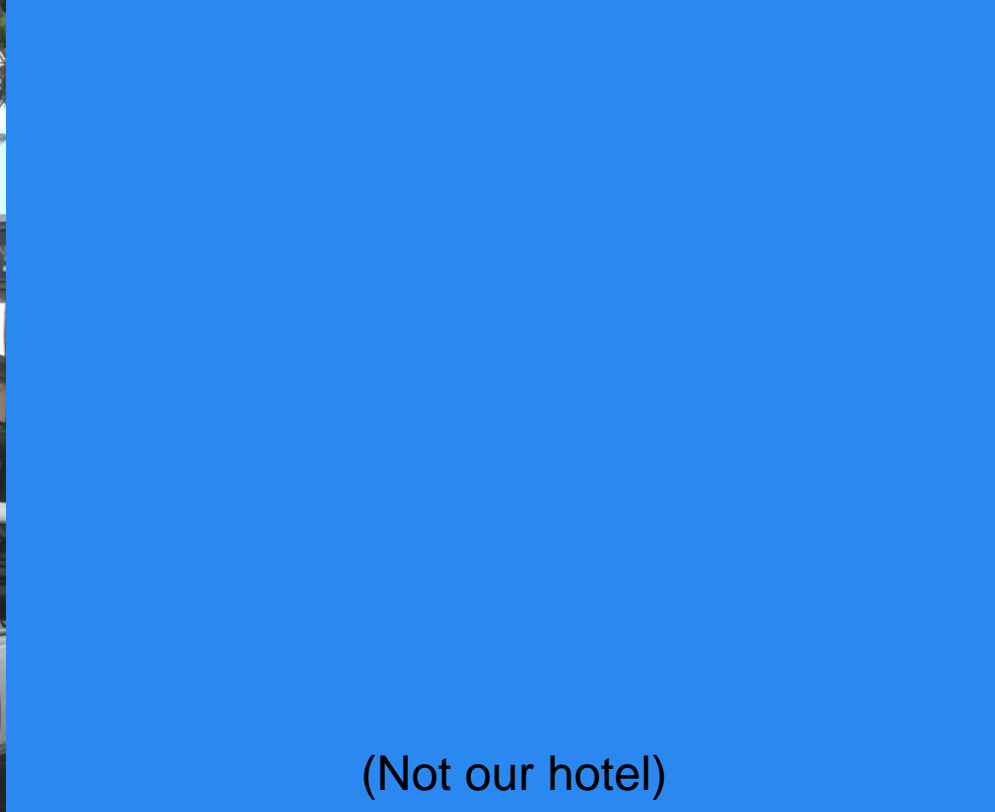


Best Views
(from the plane)





(Not our car)



(Not our hotel)





(Our dinner though)



Vibration Experiments on a Damaged Beam
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Motivation

As part of an initial investigation of structural health evaluation, laboratory experiments are used to determine potential parameters for damage detection. A structural change due to damage may be identifiable by examining vibratory characteristics including natural frequency and damping shifts.

Objectives

- Relate motions of undamaged and damaged structures
- Experimentally obtain time histories and frequency responses for a beam:
 - undamaged state
 - two incrementally damaged states
- Examine natural frequencies and damping shifts

Analytical Model Comparison

Tuned torsional stiffness (K_t) for 1st mode

Comparison of experimental results and model results

Implies non-linearity

Comparison of Undamaged and Cumulatively Damaged Conditions

Frequency Response

Experimental Setup

Support Condition

Mode	Natural Frequencies (Hz)		
	Pinned-free	Experimental	Fixed-free
1 st	0	3.11	3.85
2 nd	17.07	20.38	24.39
3 rd	55.30	58.89	68.29

Implies non-linearity

Damage Description

Damping Effects

Mode	Damping Ratio		
	Undamaged	Damage state 1	Damage state 2
1 st	1.58%	1.54%	2.17%
2 nd	0.85%	0.47%	0.62%
3 rd	0.07%	0.08%	0.18%

Preliminary Conclusions

- Change of natural frequency in measured frequency response may be an indicator of cumulative damage.
- Damping might also be an indicator.
- Trend behavior is not yet predictable.

Sources of Error

- Clamped motion
- Hand machining
- Clamped condition disturbance
- Non-linearity

Future Work

Extend this process to the damage behavior of a laboratory-constructed tower.

