Model Tests on Influences of Defects on Response Characteristics of Bridge Abutments and Their Backfill Soils

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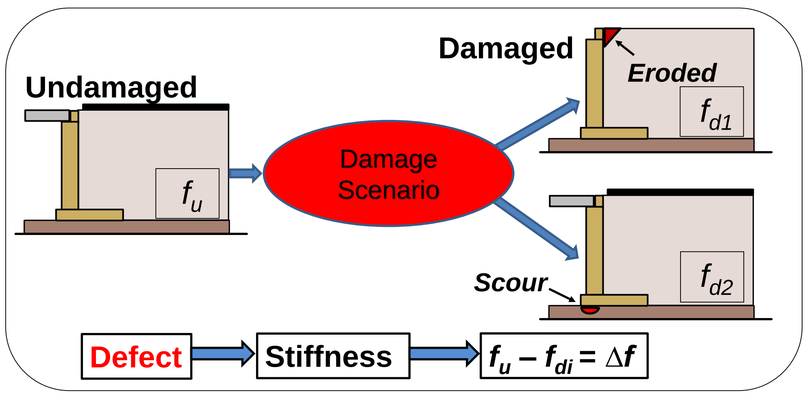
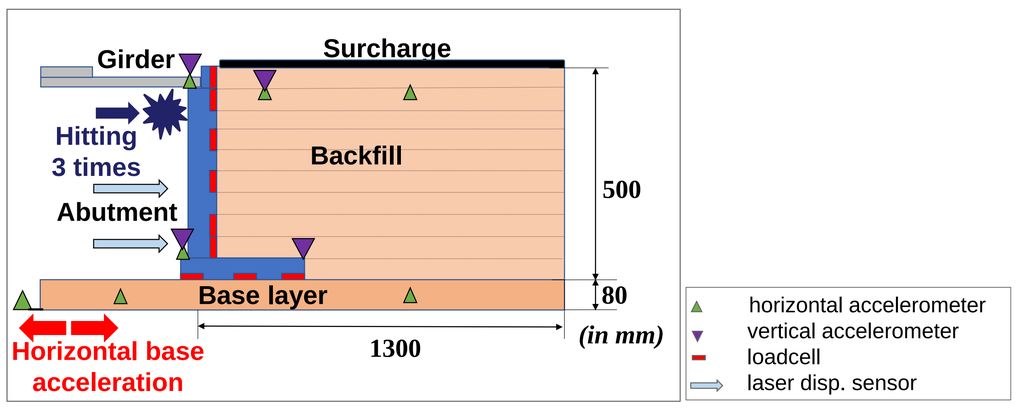
Introduction

Civil infrastructures are inevitably prone to deteriorations and aging because of the prevailing environmental and service conditions. Due to the limitations of visual inspection during structural assessment, a more attractive global method is dynamic testing, using the fact that dynamic response is a sensitive indicator of structural integrity of any structure. The shift in fundamental natural frequency is used as diagnostic parameter. A series of 1-g shaking table tests is conducted to excite the different modes of a small-scale bridge abutment with backfill, surcharge and girder, aimed at assessing the effects of damage (local scour and eroded backfill) on the responses characteristics.



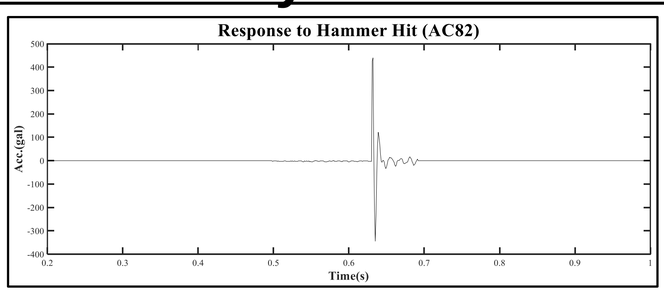
Method of dynamic testing

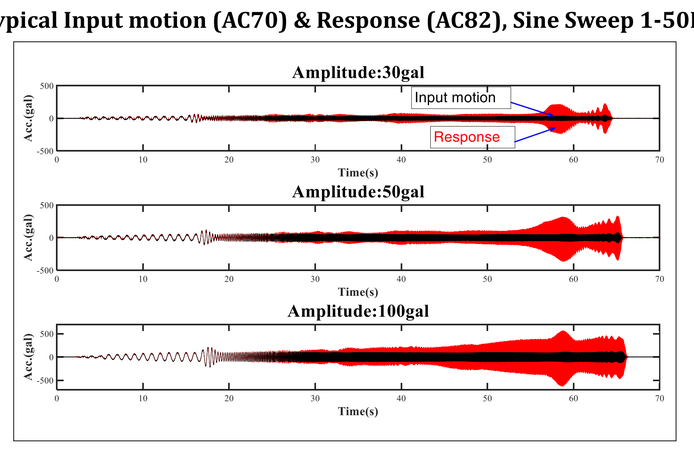


Small-scale bridge abutment model

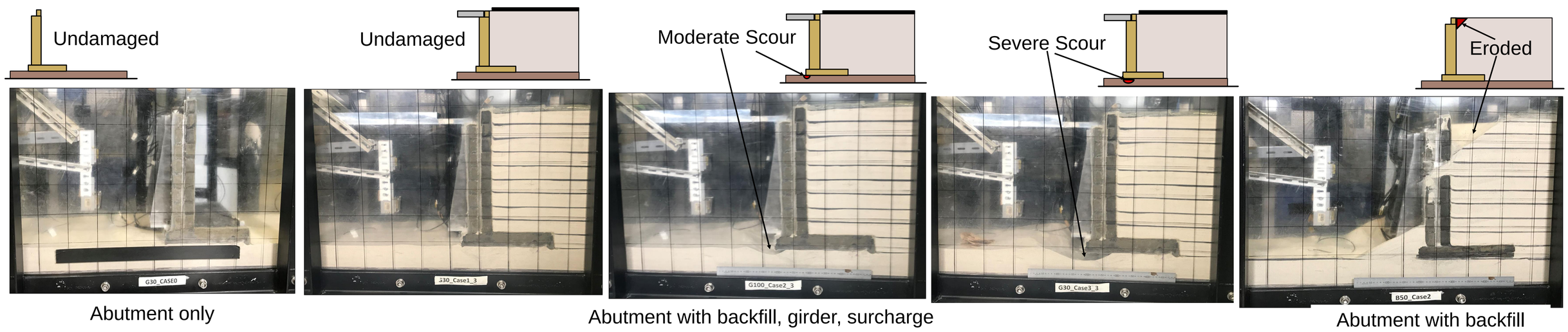
Test and Analysis Procedures

The input waves consist of sine sweep, pulse and random excitations. Fast Fourier transform algorithm and signal processing techniques facilitate the computation of the frequency response spectrum.





Different cases such as the abutment only, abutment with backfill, abutment with backfill and surcharge, and abutment with backfill, surcharge and girder are experimented with local scour or eroded backfill soil.



Abutment only

Abutment with backfill, girder, surcharge

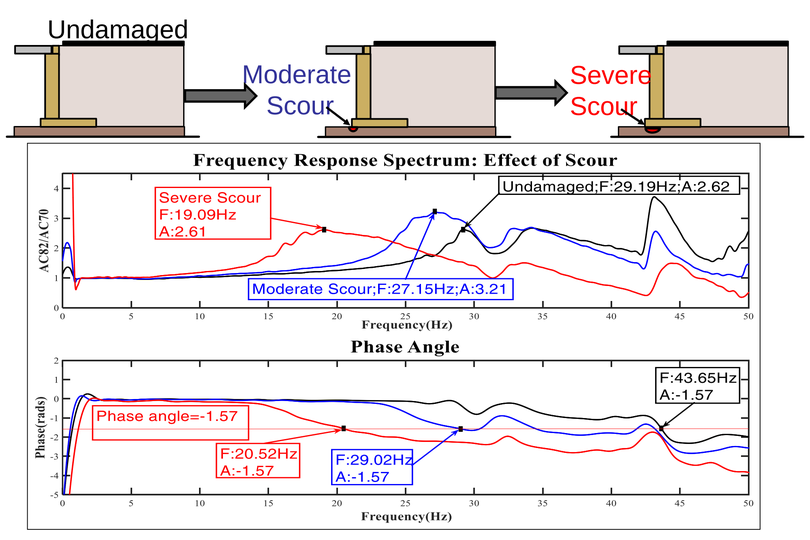
Abutment with backfill

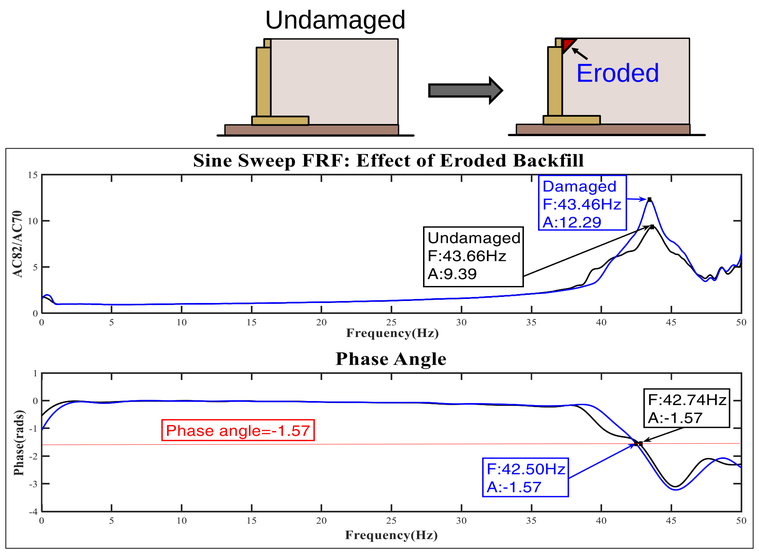
Frequency Response due to Defects

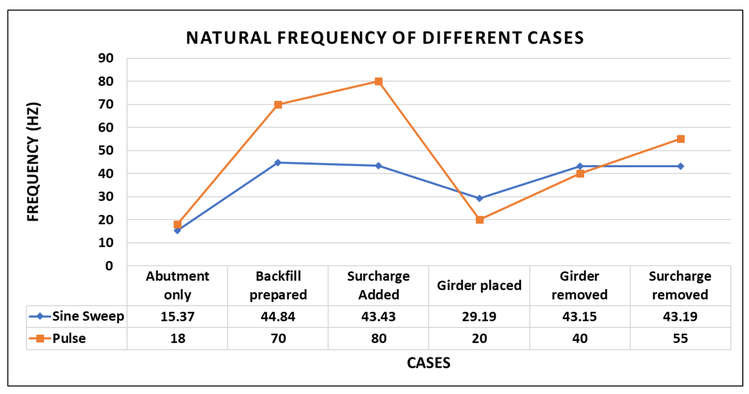
The response of the bridge abutment is sensitive to local scour showing significant drop in natural frequency as the damage level progresses from moderate to severe.

On the other hand, eroded backfill soil indicates very modest change in natural frequency due to the localized nature of damage found at a region of low earth pressure.

Finally, it is also observed from pulse and sine sweep excitations that the preparation of backfill or placing of girder shows a considerable shift in natural frequency while surcharge contributes to damping with relatively very small change in natural frequency.







	Abutment only	Backfill prepared	Surcharge Added	Girder placed	Girder removed	Surcharge removed
Sine Sweep	15.37	44.84	43.43	29.19	43.15	43.19
Pulse	18	70	80	20	40	55