Passive and active bridge monitoring

Chun-Man LIAO [1], Felix BERNAUER [2], Celine HADZIIOANNOU [3] and Daniel FONTOURA BARROSO [1]

[1] Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin Germany
[2] Ludwig-Maximilians-University, Munich, Germany
[3] University of Hamburg, Hamburg, Germany

Kontakt E-Mail: chun-man.liao@bam.de, fbernauer@geophysik.uni-muenchen.de, celine.hadziioannou@uni-hamburg.de, daniel.barroso@bam.de

Kurzfassung

Prestressing techniques are commonly used in civil infrastructures such as long-span bridges to maintain the structural performance in their designed lifetime. However, the pre-stress loss cannot be avoided. Thus, the bridge monitoring becomes important in civil engineering. A preliminary investigation of the coda wave interferometry (CWI) method for identifying the pre-stress loss in a large-scale prestressed bridge model is presented. The passive and active measurements have been carried out in in-situ test at the structure – BLEIB. As a result, the wave velocity change reveals the influence of the pre-stress change and the correlation coefficients contribute to develop local damage detection.

Passive and active bridge monitoring

Chun-Man Liao[1], Felix Bernauer[2], Celine Hadziioannou[3] and Daniel Fontoura Barroso[1]

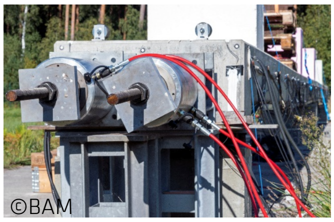
[1] Bundesanstalt für Materialforschung und –prüfung (BAM), Berlin, Germany
[2] Ludwig-Maximilians-University, Munich, Germany
[3] University of Hamburg, Hamburg, Germany

Abstract
This research is to perform passive and active measurements on a large-scale prestressed concrete bridge model under the outdoor condition. Multi sensors were applied to this test structure – BLEIB, which is located at the BAM test site. The experimental evaluation of ultrasonic wave propagation and seismic noise recordings were considered for revealing the bridge damage condition, as a basic for developing a reliable bridge monitoring system.

Experiment setup

Loading test.
Various loads by iron bars: 300, 600, 900 kg.

Vibration test.
Hammer hit by free-drop weight.

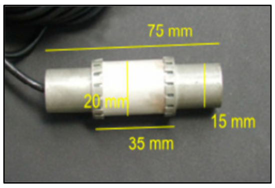


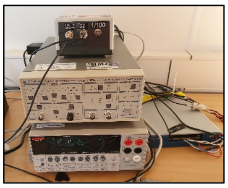
Prestressing test.
Built-in post-tensioning system.

Prestressing test.
Prestressing forces Adjustment.

Sensors and measurements

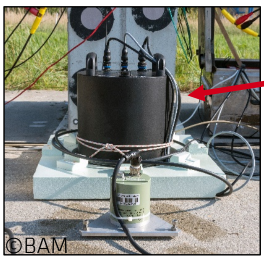
Active monitoring by ultrasonic measurements
- **Ultrasonic wave velocity change**
- **Detection of prestressing force change**

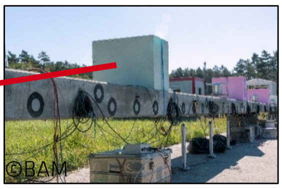




Left: ultrasonic transducer ACSYS S0807 [1] embedded in concrete. Right: ultrasonic monitoring system.

Passive monitoring by vibration measurements
- **Eigenfrequencies vs. load effects**
- **Eigenfrequencies vs. prestressing force change**



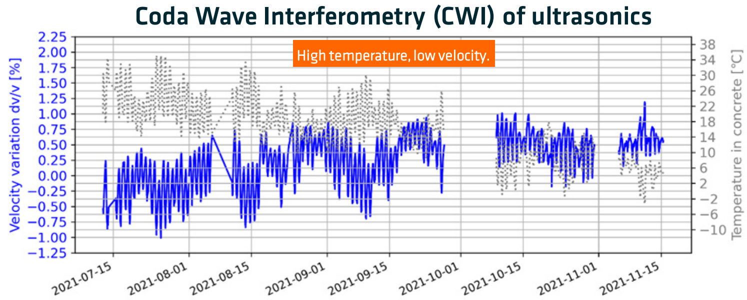


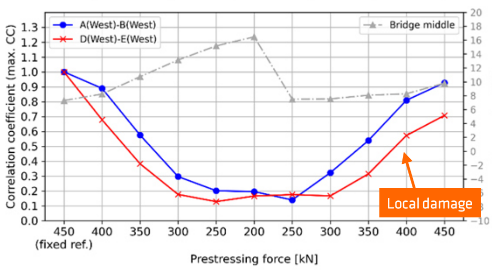
Left: broadband seismometer for bridge vibrations in 3D translation and 3D rotation. Right down: geophone sensor.

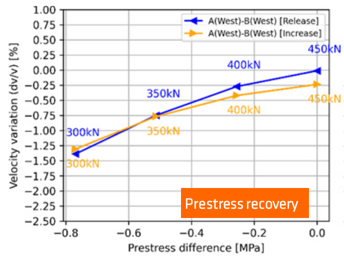
[1] Niederleithinger, E., Wolf, J., Mielentz, F., Wiggenhauser, H., & Pirskawetz, S. (2015). Embedded Ultrasonic Transducers for Active and Passive Concrete Monitoring. Sensors (Switzerland), 15(5), 9756–9772. https://doi.org/10.3390/s150509756

Evaluation

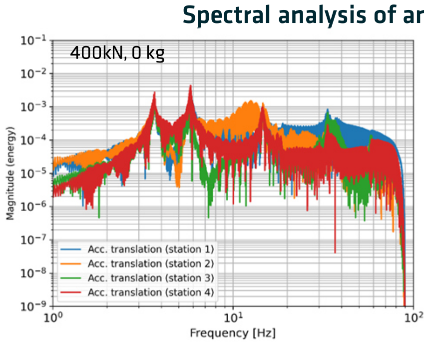
Coda Wave Interferometry (CWI) of ultrasonics

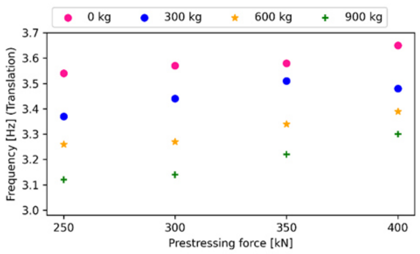






Spectral analysis of ambient noise recordings





www.bam.de

Contact:
Dr.-Ing. Chun-Man Liao
Chun-man.liao@bam.de
Bundesanstalt für Materialforschung und -prüfung

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG
Deutsche Gesellschaft für Zerstörungsfreie Prüfung e.V.
DGZfP-Jahrestagung 2022