# MODEL-BASED TMD DESIGN FOR THE FOOTBRIDGE "Inwilerstrasse" IN SWITZERLAND AND ITS EXPERIMENTAL VERIFICATION

Authors: Felix WEBER[1], Florian OBHOLZER[2], Peter HUBER[2]

Affiliation: [1] Maurer Switzerland GmbH, 8118 Pfaffhausen, Switzerland – F.Weber@maurer.eu

[2] Maurer SE, 80807 Munich, Germany – F.Obholzer@maurer.eu, P.Huber@maurer.eu

**Summary**

The TMD system of the footbridge "Inwilerstrasse" near Zug in Switzerland was model-based designed for the first vertical bending mode, the expected human excitation, assuming the inherent damping of 0.3 % and ensuring the acceleration limit CL1 (0.50 m/s$^2$) of HIVOSS (Figure 1). After the installation of the locked TMDs, first, the bridge with locked TMDs was excited by five synchronized persons. From this test the inherent damping of 0.46 % was identified. From the measured eigenfrequency 1.99 Hz of the bridge with locked TMD mass the eigenfrequency 2.04 Hz of the bridge without TMD mass was computed. Based on this value the TMD frequency was optimized by adjusting the TMD mass. Then, the bridge with optimized and activated TMD was excited by the same five synchronized persons. The maximum recorded acceleration of 0.117 m/s$^2$ was hardly perceptible. In order to assess the efficiency of the TMD the tests with locked and activated TMDs were re-computed using the same dynamic model of the bridge with TMD as used for the TMD design and using the identified bridge inherent damping and eigenfrequency. To obtain precise match between tests and simulations only the dynamic load of one person had to be adjusted. The pedestrian loading model of Bachmann et al. 1987 assumes 800 N. The identified value turned out to be 595 N. Assuming the average body mass of 78 kg the force of 595 N means that synchronized persons use approximately 80 % of their body mass for excitation. The re-computations demonstrates that the TMD design based on a dynamic model of the bridge in modal coordinates, the TMD as additional degree of freedom and the pedestrian excitation model according to Bachmann et al. 1987 yields precise results if the excitation force amplitude of one person is correctly estimated. The test results clearly show that TMDs are very effective in reducing inacceptable high accelerations of slender footbridges to a level that is hardly perceptible.

*Fig. 1. Footbridge "Inwilerstasse" near Zug in Switzerland (left) and installed TMDs (right)*

**Keywords:** Ambient vibration testing; simulation; forced vibration testing; inherent damping; Tuned Mass Damper (TMD).

https://doi.org/10.24904/footbridge2022.003
Distributed by structurae

footbridge
adrid2020
creatingexperience