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ASSESSMENT OF BOUNDARY CONDITIONS FOR DYNAMIC ANALYSIS

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Dynamic analysis is often based on modal superposition. Natural frequencies and mode shapes are calculated by FEA. Uncertain model parameters are material properties, boundary conditions, connections, stiffness contributions of non-structural parts … Epistemic uncertainties can be reduced by FE-updating based on measured modal properties, often extracted by operational modal analysis.

Recent measurement campaigns reveal that supports designed to allow structural dilation (e.g. pot bearings for bridges) show a quite different behaviour during an operational modal analysis. This is due to the non-linear behaviour of these bearings acting differently during a small-amplitude vibration test and a large-amplitude static test or thermal expansion. This poses the problem of a correct assessment of the small-amplitude dynamic stiffness of bearings when analysing the serviceability of structures, e.g. the expected human-induced vibration levels of lively footbridges or the accelerations due to passing trains on bridges.
Soil-structure interaction can be another reason why static support conditions as adopted in the design phase differ from dynamic.
This amplitude dependent behaviour of bearings and/or soil-structure interaction effects jeopardize also the simultaneous use of static and dynamic measurement results for FE-updating.

The paper will illustrate the difficulty of assessment of boundary conditions for dynamic analysis of a number of bridges where recent measurement results are available, e.g. a viaduct in Calatayud, a footbridge in Brussels and a footbridge in Sevilla.