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STRUCTURAL SYSTEM IDENTIFICATION OF PEDESTRIAN BRIDGES BY OBSERVABILITY METHOD

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Summary

The condition assessment of pedestrian bridges might be overlooked due to the small scale of these structures. A short list of accidents is provided to justify the necessity of condition assessment on pedestrian bridges. In this paper, the structural system identification by observability method is applied in two traditional arrangements of pedestrian bridges. In the simply supported beam example, the symbolical expressions of the estimation for bending stiffnesses are derived first. The validity of the method is justified by the accurate estimations using error-free measurements. However, as the real-life measurements are inevitably polluted by errors, the effect of measurement errors is thoroughly studied according to measurement errors in a particular measurement, loading cases and errors in all measurements. The simulation errors of the method is also demonstrated by a two-span continuous beam. The results show that the loading case is important regarding the accuracy of the estimations.

Keywords: structural system identification; static; pedestrian bridges; stiffness method; observability method

1. Introduction

The condition assessment for pedestrian bridges is normally overlooked. It is not easy to have a sufficient recognition of the condition of structures without a proper tool. SSI by observability method (OM) is a parametric method to identify the stiffness parameters of structures from static response.

2. Description of SSI by observability method

Once any displacement, bending stiffness, axial stiffness is observed, then this information might enable more variables to be identified. The observed information in the previous step is successively introduced as input data in SSI by OM.

3. Application of SSI by OM in a simply supported pedestrian bridge

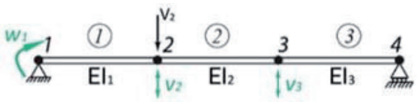

Fig.1 The analyzed simply supported pedestrian bridge

The symbolical expressions of the interested parameters are provided as

$$EI_1 = \frac{-(8M_1 - M_2 - M_3 - M_4 + 2V_2L + V_3L)L^2}{18(v_2 - w_1L)} \quad (8)$$

The deviation in the estimations with 5% measurement errors are presented in Fig.5

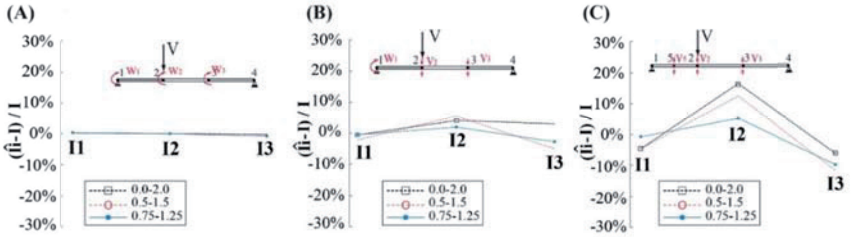

Fig.4 Percentage deviations in the estimations with 5% random errors in (A) set 1 {w_1, w_2, w_3}; (B) set 2 {w_1, v_2, v_3}; (C) set 3 {v_2, v_3, v_5}.

4. Simulation errors in SSI by observability method

Fig.5 provides the accuracy of the estimation of inertias along the beam and the moment diagram.

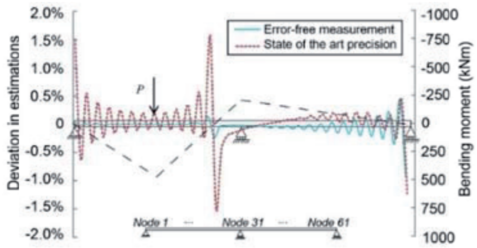

Fig.5 Accuracy of the estimation of inertias along the beam and the moment diagram

5. Conclusion

The effects of measurement errors and simulation errors in SSI by OM are studied in two typical structural arrangements for pedestrian bridges. The effects of measurement errors on the accuracy of the estimations are investigated regarding errors in a particular measurement, load locations and errors in all measurements. It is found that : (1) The estimation via SSI by OM is sensitive to the errors in a particular measurement; (2) the closer the load to the measurements, the smaller the effect of errors; (3) when only rotations are used, the estimations are unbiased; When more deflections are used, the deviations in the estimations are higher. In the analysis of simulation errors, it is found that the curvature is vital to the accuracy of the estimations. It is recommended that sufficient loading cases should be used to achieve accurate estimations.

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7. References

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