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Svečana sala Građevinskog fakulteta

Gostujuće predavanje

Novi trendovi u rešavanju problema vibracija međuspratnih konstrukcija

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Title:

Update on state-of-the-art of vibration serviceability of building floors for 2024 and beyond

Synopsis:

The vibration serviceability of building floors is of crucial importance as it became the governing design criterion for modern building floors determining their shape, size and embodied carbon. Every vibration serviceability problem can be rationalised into vibration source, path, and receiver. There is a considerable level of uncertainty related to each of the three sub-problems.

In particular, the vibration path i.e. the mass, stiffness and damping of the floor structure is increasingly uncertain with the advent of the new generation of ultra-lightweight floors, such as cross-laminated timber and modular floors. Also, both humans and sensitive processes are the key receivers of vertical floor vibration. The effects on them are increasingly difficult to predict and assess. The existing guidelines developed 40-50 years ago are not fit for purpose. Of the three sub-problems, the vibration receiver is by far the least understood.

Historically, structural engineers designing buildings tended to deal with many structural design uncertainties by the generous use of cheap construction materials, as no better approach existed. However, with the need to stop wasting materials in climate emergency and the stated uncertainties that can render floor vibration design predictions unreliable and useless, the new active mass damping technology, that has just been launched in the UK, is potentially a game-changer. The mass-produced CALMFLOOR® mechatronics product means designers can avoid both the use of additional materials and the need for significant structural modifications, such as precious span reduction, simply to control tiny, but very perceptible by humans, floor resonant vibrations.

The update will therefore cover:

- Description of experimentally observed peculiarities in vibration serviceability of ultra-lightweight floors (e.g. CLT floors, floors in modular buildings) and why they cannot be designed using standard design guidelines for footfall-induced floor vibration.*
- Introduction of the new CALMFLOOR active mass damping technology that is now commercially available with the rapid growth of worldwide installations to achieve vibration serviceability of long- and ultra-long-span floors without structural modifications.*
- The need for and way forward using the new VSimulator research facility in the UK to establish a new generation of vibration serviceability criteria for buildings. This is particularly so for the human perception of vertical vibration of building floors which has to be based on objectively measured cognitive performance rather than the currently prevailing subjective assessment.*

About the speaker:

Aleksandar Pavić's particular expertise is in the vibration serviceability of slender civil engineering structures, such as long-span floors, footbridges and grandstands, which are occupied and dynamically excited by humans.

He believes that the best laboratory is full-scale, real world with plenty of unique prototypes of large civil engineering structures. He made his professional academic career by modelling, testing and monitoring full-scale (foot)bridges, floors, grandstands, staircases, long and tall structures, and utilising the knowledge of how these structures behave in the real world.

Aleksandar is a trained structural engineer, holds the Chair in Vibration Engineering and leads the Vibration Engineering Section research group which transferred to the University of Exeter in May 2013, after 20 years at the University of Sheffield. He is a director of VSimulator at the University of Exeter, the only 6-degree-of-freedom vibration serviceability simulator in the world which opened two years ago and cost £7m to develop between 2017 and 2022.

His (co-)authorship and contribution have been recognised in state-of-the-art design guidelines in the UK and internationally:

- The Concrete Society (Technical Report 43, Appendix G: Vibration Serviceability of Post-Tensioned Concrete Floors) in 2005,
- The Concrete Centre (A Design Guide for Footfall Induced Vibration of Structures) in 2007, and
- The Steel Construction Institute (Design of Floors for Vibration: A New Approach) in 2007.

Aleksandar also co-authored and helped with experimental validation of arguably worldwide most advanced design guidelines on crowd dynamic loading of grandstands published by the UK Institution of Structural Engineers in 2008. He sat on the International Standardisation Organisation committee that developed ISO10137, the key international standard pertinent to the vibration serviceability of buildings. He currently chairs the British Standards Institution committee updating the key BS6472 "Guide To Evaluation Of Human Exposure To Vibration In Buildings".

Aleksandar's expertise is sought after by the industry. He is a Managing Director of Full Scale Dynamics Ltd, a university spin-off company specialised since 2008 in commercial testing, monitoring and performance assessment of full-scale civil engineering structures. He is also a Business Development Director of FSD Active Ltd, a 2020 start-up company that brought the novel CALMFLOOR technology to market.