Master's Dissertation at the Div. of Structural Mechanics

VIBRATION REDUCTION BY SHAPING THE TERRAIN TOPOGRAPHY

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Background

The MAX IV project is the fourth synchrotron facility at MAX-lab in Lund, which already consists of MAX I, MAX II and MAX III. MAX-lab is run jointly by the Swedish Research Council and Lund University.

This new state-of-the-art synchrotron radiation facility is induced by the development of research at the nanometer level in many different areas. MAX IV will consist of an electron gun emitting electron pulses through a linear accelerator in to two storage rings, of which the largest one has a circumference of approximately 500 m. In the ring, the electrons are accelerated by magnets located on foundations on the floor. The high-frequency light (synchrotron light) emitted by the electron beam is used to perform measurements at a number of research stations throughout the ring.

Given the level of precision, there is an upper limit of vibrations in the facility of 26 nm RMS during 1 second for vibrations above 5 Hz. An active calibration system will take care of vibrations at lower frequencies.

MAX IV will be located in the north-eastern area of Lund where the existing ground consists of a layer of top soil from past farming activity covering a 12-17 m deep layer of various types of clay till. Underneath is the stiffer bedrock. The most concerning external source of vibrations is the nearby passing highway, E22.

Objective and method

The overall objective of this master's dissertation is to investigate one method, among others, for reducing the level of vibrations in MAX IV that may be utilized to meet the vibration requirement: Initial calculations imply that shaping the surrounding ground surface into a landscape of hills and valleys will reduce the incoming surface waves. Furthermore this is an aesthetically desirable solution, as the facility should serve the role as a landmark and a symbol of Lund as a technological capital.

Specifically, this dissertation aims at optimizing the shape of the surrounding landscape given the natural, mechanical and aesthetical constraints. Using Altair Engineering's HyperWorks software package, a finite element model of the ground will be established by use of the pre-processor, HyperMesh. Reference values of the response at evaluation points at different distances from a harmonic unit load will be obtained performing conventional steady-state analyses using HyperWorks' solver RADIOSS on a complete modeled landscape without hills. Different shape parameters will be assigned to the same model and optimizations of these shapes with respect to the response at the evaluation points will be carried out in the featured HyperStudy tool. Initially, a 2D profile will be investigated, followed by further optimizations in three dimensions.