Finite element models

Initial FE-model (design phase)

Before any measurements are done, the vibration serviceability of the construction can be assessed by creating a finite element model, based on the architectural plans.

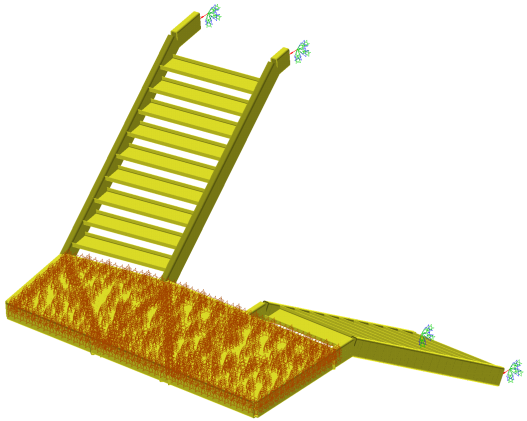

Figure 1: Finite element model and boundary conditions.

The initial finite element model was constructed using beam elements for the stair steps and the main structure. The steel plate and concrete infill at the level of the landing are modelled using shell elements, while the concrete infill at the stair steps and the parapet are taken into account as extra mass. Each of the flight ends has two pinned supports (with fixed translations and free rotations), representing the bolted connection to the upper and lower concrete floor.

Calibrated FE-model (post-construction phase)

After the construction was built, the vibration serviceability can be reassessed based on a finite element model which is calibrated by adapting model parameters such that an optimal correspondence is found between the experimentally identified and calculated modal parameters. For the vibration serviceability after construction, the measured damping will be taken into account.

For the calibration of this model the support stiffness are considered as updating variables. In the calibrated finite element model, each support is modelled with three translational springs and three rotational springs. To reduce the complexity of the calculations, the characteristics of the springs are assumed to be identical in the four supports and are listed in table 1.

Basic structure	Beam-elements
Platform	Shell-elements
Concrete at the platform	Shell-elements
Concrete at the stair steps	Mass
Parapet	Mass
Rotationstiffness R_x	7.78×10^5 Nm/rad
Rotationstiffness $R_{y,z}$	1.79×10^5 Nm/rad
Translationstiffness $U_{x,y,z}$	3.97×10^8 N/m

Table 1: Model info and spring stiffness of the supports at the calibrated finite element model.