

## **Analysis of vibrations and noise in steel staircases**

**This master thesis was carried out as a joint project between structural mechanics and acoustics. We have analyzed disturbing noise and motion in steel staircases and presented possible measures to avoid these.**

In construction today there is an increasing demand for slender and lightweight structures. They are perceived as architecturally pleasing and are efficient in material use. Besides this, constructing slender and lightweight structures sometimes leads to vibrations, which may cause discomfort for the user. The discomfort could either be perceived as noise or that the vibrations are discomfoting. These problems are investigated in this master thesis, regarding acoustics and structural mechanics.

In the thesis we investigated an existing steel staircase where the user had identified noise from walking in the staircase. We performed analyses, both through measurements and computer modeling. First of all sound measurements while using the staircase were performed, to evaluate problematic noise. Furthermore, for example, we conducted measurements by hitting the staircase with a hammer. By measuring the force in the hammer and the motion in the staircase we could find a relation between force and motion. From the different analyses we could find what types of motions occurred and which of these that were probable noise sources when using the staircase.

When we had identified the problems in the staircase we could suggest proper alterations. The alterations regarded both the structure itself but also adjustments to the room surrounding the staircase. For example, a structural alteration was adding steel plates to weaker parts of the staircase. In the surrounding room we proposed adjustments such as sound absorbents and screens to experience the sound differently, thus being able to use the room more efficiently.

Conclusively we gave our recommendations on steel staircases. The recommendations covered both how to analyze problems when they are observed and how steel staircases and their surrounding rooms should be designed to avoid these problems.