



POLITECNICO
DI TORINO

Honors thesis

COURSE OF
Architecture Construction and City

Abstract

Acoustic performance-based design: exploration of the effects of different geometries and acoustical properties of an urban façade on the mitigation of chatting noise in a s

Tutor

Arianna Astolfi, Louena Shtrepi,
Cristina Calleri

by

Elena Badino

February 2018

Noise pollution in urban areas is a rising concern due to the growing number of vehicles and other sound sources located in the streets. The building fronts reflect these sounds multiple times, preventing them to leave the urban environment: this phenomenon, known as “street canyon” effect, exacerbate the perception of noise in the cities. These undesired sounds are reported to have a damaging effect on the well-being and health of the city inhabitants, and new solutions to address these issues are essential in the framework of sustainable design.

This Master thesis project aims to investigate the potentialities of building front design in mitigating the adverse acoustical effect of street canyons. Thanks to the new potentialities offered by the acoustic simulation systems and parametric design, several design options, concerning both geometrical and material features, have been considered and compared to identify the most favorable ones.

In particular, a building front in Turin is identified as case-study to explore how different design options can contribute in lowering the sound pressure level within the street canyon. The context of the selected building is characterized by high levels of noise during night times, due to people chatting in the streets. The conclusion drawn by this thesis are intended to provide insights that may support architectural designers in the development of building fronts located in other urban areas subjected to similar noise issues.

Performance-based design method is identified as the most appropriate approach to develop the project. According to this approach performance simulation systems are used as design tools: the assessment of performance is indeed the driving factor of the design process. The major benefits are reported when the assessment of the performances is introduced since the early design phases, when major changes are still possible and require a limited economical cost to be pursued.

Notwithstanding these advantages, performance-based design is still rarely applied in the acoustics. In the first part of the thesis, a collection of case-studies was gathered to analyze the limits of current application of acoustic performance-based design (APBD) and provide some possible suggestions to extend its use.

The thesis project focuses on the application of APBD in the early design phases: several façade design options were compared on the basis of the assessment of the acoustic performances, allowing to identify the most favorable ones. The acoustical effect of each variation was assessed by recording the sound pressure level over the façade of the reference building, at the ground level and on the façade of the building across the street.

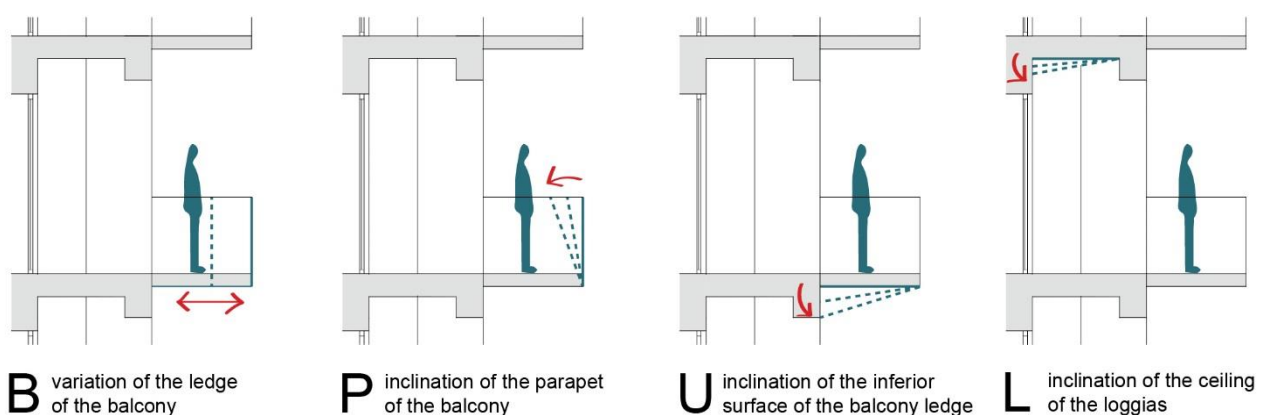


Figure 1 - geometrical variations proposed

A set of geometrical variations was proposed, featuring various balcony shapes and ceilings inclinations. The effect of these options was firstly assessed considering the sole effect of the geometrical variations, without accounting for the effect of different materials. In this phase 21 geometrical options were considered.

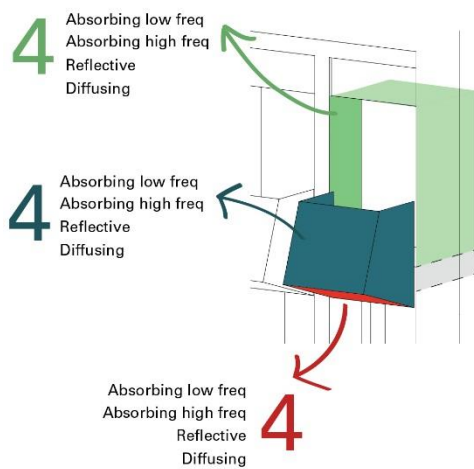


Figure 2 - material options considered

The following phase the geometrical options were analyzed in combination with a series of material options with different acoustical properties. In this phase 1152 options were analyzed.

In the last phase, it was investigated the acoustical effect generated by the variation of the materials applied to the surfaces of the building which were not considered previously, and to the street paving. The data extracted from this phase was used to compare the capability of architectural designers to that of the city administration in the enhancement of acoustic comfort in cities, reporting that the potential impact of the architectural designer is greater.

A set of preliminary guidelines was advanced on the basis of the findings, to support designers in the design process of façades located in acoustically-critical scenarios, promoting the awareness of the acoustic consequences of a set of possible design choices.