Acoustic Potentials of Urban Surfaces

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Background
Noise levels in larger cities have been increasing tremendously due to their growth and the concentration of population. These noise levels have to be controlled properly in order to reduce health hazards, lower the annoyance level for near habitants and work forces and improve life quality. For that purpose, the treatment of ambient sound by means of controlling sound transmission, diffraction, refraction and absorption from sources to receivers are of great importance. Besides reducing the sound radiation of sources, we can analyze and map the resulting sound fields and exploit the walls and surfaces of buildings or streets to reduce the sound level. But, it is a challenge employing currently existing surfaces with innovative concepts and technologies intelligently. Such acoustic urban design are shown in the following photos and illustrations. They reveal a perspective to the future, related ideas, technologies and products.

Categories of Noise Control using urban surfaces

### General
- **Kind**: Surfaces of Building, Traffic Area, Green Area, etc.
- **Function**: Protection, Capacity, Availability, Aesthetics, etc.
- **Orientation**: Horizontal, Vertical

### Acoustics
- Sound generation and sound radiation
- Sound transmission and sound diffraction
- Sound reflection and sound scattering
- Sound absorption

### R&D-Tools
- Sound mapping
- Sound scape (evaluation) and sound design
- Developing of innovative sound absorbers and obstacles
- Meta-Materials

### Example and potential
**Acoustic considerations on urban typologies**
Standardized, frequency-dependent calculations:
- VDI 2714
- Roads as a line source in octave bands
- Noise spectrum from pass by measurements of a car
  - including 4 reflections
- Establishing configurations (geometry, surfaces) and modifications, e.g. places, areas and types of sound-absorbing materials
- Horizontal and vertical considerations of environment and buildings

**Sound absorbing facades**
- Design possibilities
- Special case transparent microperforated elements
- Sound absorbing garage entrance
- Sound absorbing balcony

**Example and potential**

**Acoustic overall balance**
- Noise control outdoors
- Frequency-dependent sound absorption
- Vehicle noise (outside and inside)
- Signal noise of cars
- (For example, for the visually impaired)
- Road surface
- Frequency-dependent sound insolation

**Acoustic categories of urban surfaces**
- **Sound reflection and sound scattering**
  - Buildings
  - Elements and structures
  - Surfaces and materials

- **Sound absorption**
  - Surfaces and materials
  - Layers and structures
  - Openings and gaps

**Example:**
- **Sound absorption structures**
  - Perforated Elements without porous layer
  - multi-layer
  - complex structure

- **Sound absorbing facades**
  - With and without porous layer
  - porous layer
  - backside
  - microperforated elements

**Example and potential**

**Traffic**

**Ventilation**

**Sun shading system**

"Bad" or "Good" Noise

**Acoustic overall balance**
- Noise control of buildings against traffic noise
- Frequency-dependent sound insulation

**Design possibilities**

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