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Towards a typology of listening situations: The balcony as a sonic interface in evolution

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Abstract
This paper is an opening towards a comprehensive typology of listening that corresponds to the emerging forms of residential building interfaces. In this paper, we are focusing on Balconies as a main study object. In fact, ecological approaches in designing residential buildings (Concerto, HQE, eco-districts) produce highly developed architectural typologies of building facades under the form of double skin, deep balconies, large loggia, covered or semi covered terraces, that should be analyzed as such.

The main corpus on which this paper relies on is the research project *Esquis'Sons!* on « sustainable soundscapes » conducted by Cresson research center - ENSAG. The project is about studying the sound qualities of intermediate spaces such as Balconies, Loggias, Terraces and Corridors (BLTC). The project's main objective is to elaborate a ***catalogue of remarkable listening situations*** of these interfaces through crossing the physical form, sensory phenomena and social practices. Based on this database, the current article overall aim to elaborate a ***typology of listening situations*** that categorizes in homogenous types the new forms of sound composition corresponding to new architectural vocabulary that building facades afford.

Focusing mainly on three sustainable districts in France: Vigny-Musset, Caserne de Bonne and Trapèze-Ile-Seguin, the elaborated methodological protocol put together a collage of methods in situ and in vitro that are systematically applied to each BLTC: sound recording up to 10 minutes, acoustic measurements, architectural sketches with accurate dimensions, in addition to short interviews with the inhabitants. This typology shall strengthen the sound culture of architects and urban designers by showing the spatial and sound variations on both urban and architectural scales.

Keywords: sonic ambience, balcony, facades, typology, eco-district, sound affordance, interface

Esquis'Sons! Research Project: Building interfaces, Sustainable soundscape, urban densification

> " The balcony projects into the outside but floats above it. Unlike its cousins, the loggia or "the street in the sky", it is a cellular and isolated; yet by design it pushes beyond the individual compartment. Balanced precariously between these poles, the balcony serves as a laboratory where sometimes explosive mixtures of public and private, inside and outside, are tested" (Koolhaas, et al. 2014)

We are interested in a miniature space *i.e.* the balcony, considered an important architectural element of the habitat that provides a unique experience to the inhabitants. Defined as a platform that access the exterior, the balcony is a private space suspended above the public and collective realm. It marks several thresholds separating the interior and exterior, the private and public, the individual and collective spaces. This is why it has the status of an intermediate or in-between space. It is worth mentioning that the balcony is a generic term that refers to other forms of openings such as loggias, terraces and corridors (BLTC). The keen interest in this space is due to the fact that it introduces a new architectural vocabulary that has been developed in the so-called Eco-districts. We privilege a sonic approach for studying this architectural element for evaluating their potentials in different urban and climatic contexts in Europe.

For elaborating a new typology of listening, the main database on which this article is derived is the research project: "*Esquis'Sons! Tools to design sustainable sound environments*". This project was conducted to respond to a French national call for project on the theme « sustainable urbanism and sound environment» launched and funded by the ADEME - *Agence de l'environnement et de la maïtrise de l'énérgie*. The project is carried out by Cresson research center on sonic space and urban environment, Grenoble School of architecture - France[1].

In fact, the logic of sustainability favours new models of urban development and new forms of densification for limiting urban sprawl. In this optic, many municipalities at different scales build sustainable neighbourhoods labelled as eco-districts. These are considered as laboratories of experimentation or levers to build future sustainable cities. In order to encourage inhabitants to live in dense urban context and accept the idea of collective housing, it is necessary to propose extensions to the outside offering various potentialities of use: deep balconies, wide terraces, patios, courtyards, shared gardens, etc. These are spaces that negotiate their intimacy with public spaces due to their new forms and their emerging social practices. How to create new extensions attached to the apartment honoured with spatial, climatic and sound qualities? Indeed, the lived experience in the balcony depends not only on how inhabitants invest this space, but also on the constructed space (dimensions, materials, degree of exposure to public life) and the sound qualities of the street on which oriented this balcony. Reciprocally, the street receives the sonic events produced in the balconies.

The project *Esquis'Sons!* relates two main dimensions: on the one hand, the density as an important characteristic towards sustainability and, on the other hand, the social acceptance of densification. In this context, *Esquis'Sons* develops two hypotheses: the first stipulates that inhabitants, to whom the "ideal residency is a private house with garden" could accept more easily the density if the apartments propose extensions to the exterior spaces. The amelioration of the sound qualities of the BLTC will reinforce the social acceptability and may encourage people to live in dense urban context. The second hypothesis concerns the ability of these BLTCs in offering "variable uses" and opens multiple potentials to new categories of use due to a particular "*sound affordance*"[2]referring to the different potentials of use that the sound space permits (Augoyard, 1978).

From an operational point of view, the interest in the balcony as an architectural element, makes it possible to switch the reflection on sustainability from the urban scale to an architectural one that deals with the human body in motion (Chelkoff G. et al., 2003); a scale at which perceptions and representations of the environment are constructed in the ordinary actions of everyday life (Augoyard, 1978).

The research project – Esquis'Sons explores in 6 sustainable districts in Europe Germany (Französisches Viertel – Tübingen), Spain (Ecociudad – Sarrguren) , France (Vigny-Musset, Caserne de Bonne, Trapèze Ile seguin) and Sweden (Hammarby Sjöstad - Stockholm)

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[1] The Cresson research team was multidisciplinary composed of acoustician, **Nicolas Rémy**, as a scientific coordinator and the PI of the project, he is assistant professor at Volos School of architecture: Greece; **Grégoire Chelkoff**, architect and professor at Grenoble School of architecture: France, as the second scientific director of the research. **Jean-Luc Bardyn**, sound technician; **Noha Gamal Said**, architect and urban designer, assistant prof. at Ain Shams School of architecture and a researcher at Cresson- ENSA Grenoble; **Theo Marchal**, Architect DPLG, Assistant lecturer at ENSA Grenoble, PhD student at Cresson – AAU: ENSA Grenoble. **Hengameh Pirhosseinloo**: Architect DPLG, PhD student at Cresson- AAU: ENSA Grenoble.

[2] The theory of « affordances » developed by J. J. Gibson (1979).

the sound qualities of intermediate spaces located on the building facades. These sites were chosen due to their capability of affording remarkable and innovative architectural forms of BLTC and underlining the morphological evolution of this typology of spaces. For assuring a variety of urban morphology, the different eco-districts are chosen along a north-south axe in Europe that crosses different cultural, climatic and urban contexts. The chosen 6 case studies are meant to fulfil the following criteria which appeared to us fundamental and allow a cross analysis.

- The sites should be recent enough - constructed after 2000 – in order to propose an interesting architectural typology of BLTC in terms of forms, materiality, composition of facades. Yet, it is necessary that the apartments should be delivered since few years so that users have sufficient time span to be settled and to develop their proper usage pattern.

- These BLTCs must belong to classic and innovative urban forms, particularly in terms of environmental management, noise, diversity of urban development program.

- Finally, we have avoided the well-known eco-districts, because residents are often bored of answering questions for investigators, and this would certainly have caused problems to access the chosen apartments.

It is important to present the set of methods, both *in-situ* and *in-vitro*, that has been progressively applied during the project for elaborating the catalogue of remarkable listening situations.

Observation in-situ: it is about the first investigation of the different sites. This phase has led to spot 72 balconies with most innovative architectural forms or usage patterns;

In-situ sound recordings: For understanding the difference in listening and the impact of the spatial configuration - on both architectural and urban scales- on the sonic ambience, several sound recordings have been conducted in each balcony, each soundtrack lasts for 10 min. The different positions of the micro were chosen with the inhabitants in order to correspond to the real and recurrent use of the balcony: standing and sitting positions, in front of the handrail or near the facade. This phase is accompanied by architectural sketches with accurate dimensions in addition to short interviews with the inhabitants for understanding their usage pattern.

***Multiple sessions of collective listening*:** For understanding the specificity of each listening situation, inter-team collective listening sessions have been organized to exchange on how each researcher perceives each soundtrack. The sound perception crosses both the ambiance of the balcony and the surrounding soundscape to which the balcony is exposed.

Urban section as a representation tool:

the interest in urban section - as it integrates the vertical dimension - lies in its capacity to: first, show the topography of the site, building heights; second localize the sound in its urban context; third, Illustrate the urban morphology and the behavior of the sound propagation; forth, show the urban voids, their uses and their materials, and how they affect the soundscape of the street; and finally, visualize the sound interactions between public spaces and private spaces and the buildings' interfaces (Fig.1).

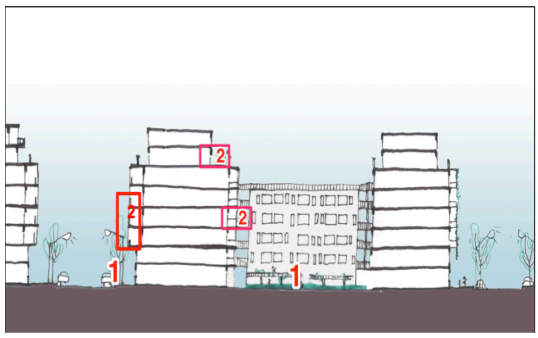

Fig. 1: Urban section & position of balconies under study

In Esquis'Sons research project, 72 remarkable listening situations have been identifies in the 6 districts. As we are privileging a sound approach, we called for the methodological analysis that layers the architectural form "*forms*", sound experience "formers" and space use "formalities", developed by Grégoire Chelkoff (Chelkoff, 2009). Based on this triad, we have developed descriptive sheet that details the sound characteristics of each listening situation.

Towards a typology of listening situations

Based on *Esquis'Sons!* database, this article main objective is to develop a typology of listening situations that aims to identify and categorize the different ways of hearing, being heard, produce sounds and the way one perceives the sonic ambiences of the balcony. The elaboration of a typology of listening is about comparing the different listening situations between them and organizing them into homogenous *types* that put the listener in similar sonic situation. Each type of listening may gather balconies with different spatial configurations, different emplacement on the facade and looking over different urban contexts. In the current paper, we have limited our analysis to 30 remarkable listening situations corresponding to three eco-districts in France.

Three representative eco-districts in France

In this context, we have chosen three eco-districts: **Caserne de Bonne, Grenoble, France (CB):** The ZAC (joint development zone) de Bonne is located in the city center of Grenoble on a former military compound. The new housing units are located in the south of the district, with various and innovative types of BLTC on the facades. The urban morphology is based on reviving the idea of courtyards. The courtyards are surrounded by buildings forming a U-shape with a shared central garden (Fig. 2 to the left).

Vigny-Musset, Grenoble, France (VM): The ZAC Vigny-Musset is a large-scale operation initiated by the municipality of Grenoble in the south of the city during 1990s. Following a contemporary urban design with its closed and semi-open islands formed by a central square green spaces, the district has a strong presence of interfaces such as balcony, terrace or loggia (Fig.2 in the middle).

Trapeze of Île-Seguin, Boulogne-Billancourt, Hauts-de-Seine, France (TIS): It is a renovation project on former Renault factories in Boulogne-Billancourt for constructing a new mixed-use district with a considerable balance between dwellings, offices and green spaces. The housing design presents a interesting forms of balconies, terraces, loggias and double skin façades. (Fig.2 to the right).

Fig. 2 The urban morphology of the three eco-districts: Caserne de Bonne to the left, Vigny Musset in the middle, and Trapèze Ile Seguin to the right.

Comparative analysis methodology

The main methodology of this article is to conduct ***a comparative analysis*** in two phases: the preliminary phase consists of a **lexical research** in which we have developed a cross-analysis study using the official website of the project *Esquis'Sons!*[3]. In this step, we have traced the *recurrence* of certain keywords referring to a specific listening situation for example: acoustic recession or exposure. The apparition of the keyword in the descriptive sheet may be found whether in the title, the general description of the sonic ambience, or in the form or the way we listen the space (former), or even in space occupation (formality).

The subsequent phase is more a comprehensive comparison and demands a clear understanding of the different *conditions of the sonic ambience* that produce each listening situation. It crosses different fundamental layers of database: *architectural form, visual perception, sound perception, temporal and cultural dimensions and usage patterns*. This phase helped deciding, for each listening situation, the proper category or type to which each balcony belongs.

The balcony: an architectural element in evolution

The first step towards elaborating a typology of listening is to list the different spatial configurations and to highlight the different emerging forms of interfaces that took place since the beginning of the 21st century. The spotted balconies can belong to recognized forms of balconies: such as balconies, loggias, terraces, and corridors (BLTCs), or, on the contrary prove a *metis form* of two or three main typology of form. Despite being well-known architectural expressions, it is important in our context to highlight the difference between them:

A ***balcony*** is defined as: *a balustrade or railed elevated platform projecting from the wall of a building*. The different definitions of balconies highlight its projectile aspect as a body projected or impelled forward, defining a situation of exposition.

A ***loggia***, is defined as: "*a gallery or arcade open to the air on at least one side*" or "*as a space within the body of a building but open to the air on one side, serving as an open-air room or as an entrance porch*". It is an enclosed space that is encased or embedded in the building façade, providing therefore a situation of *protection*.

A ***terrace*** is "an open, often paved area connected to a house or an apartment house and serving as an outdoor living area; deck"; "the top of a construction, used as a platform, garden, etc. "; or "a flat roof of a house"; "an open platform, as projecting from the outside wall of an apartment; a large balcony". The terrace represents the sense of a *platform*, i.e. an advance of a building settled on a structure and uncovered to the sky. It is more related to the ground floor or the roof with large dimensions when compared to the balcony.

A ***corridor***, *coursive* in French, "*is a gallery or passage connecting different parts of a building; hallway. It might be external or internal*" or "*a passage into which several rooms or apartments open*". The corridor points out an intermediate linear space that permits accessing to the apartment. It is also a shared space or semi-private space. Its linearity engages the body in motion.

Metis forms of balconies

It is important to highlight the new emerging forms of balconies that define the design of interfaces in eco-districts. By the form metis we mean a hybridization of two, three or more

[3] http://www.esquissons.fr/analyse-croisee.html

forms of that above-mentioned standard categories (BLTC). In fact, the primary exploration of the site helped spotting different metis forms of interfaces for example:

Loggia-terrace: it is a terrace which part of it is covered form both sides and the ceiling while another part is open laterally and vertically to the sky.

Double skin-loggia: it is a loggia located in a double-skin façade. Providing the ability to open or close the secondary façade, this form offers to space users the choice between exposure and protection.

Hybrid form of balcony: It combines more than two categories and they become more complex: we can refer to an interface in Caserne de Bonne, Grenoble, France. The balcony is part of a duplex apartment. The double-height loggia gives the impression of being in a terrace more that a loggia. In addition, the balcony can be protected from the sun by roller blinds that give it the balcony a sense of double skin. In addition, other part of the interface takes the form of balcony (Fig. 3).

Hybrid Balcony (CDB)

Long corridor for bicycles (VM)

Balcony-court (TIS)

Fig. 3: Metis and innovative forms of balcony in the three districts.

Typology of listening situations

The typology of listening is about identifying several types of sound situations that put the listener in particular ambient conditions. A typology crosses several criteria: the form of the balcony, its location on the facade, the surrounding urban configurations, the perception of the listener, the usage pattern and finally the temporal dimension. The elaboration of this typology is based a *sono-spatial* entry that crosses three dimensions:

- **Architectural form:** in which we study in detail the dimensions, materials, spatial configurations of each balcony. The architectural form is represented in detailed plans and sections;
- **Visual perception**: based on the position of the balcony on the façade, we study the visual perception that relates the balcony to the surrounding urban

environment ex. visual opening, height, relation to street, degree of exposure presented in urban section.

- **Sound perception:** this understanding of sound crosses some acoustic characteristics of the balcony and the sound sources coming from the surrounding environment. The sound perception includes certain objective acoustic measurements such as *Leq, Impulse response, space reverberation* and that identification of different sources of sounds, their way of propagation in the space.

The listening typology underlines *the specific conditions of sonic ambiences* that each interface offers. In other terms, this phase is about understanding the *sound affordance* of each balcony. From the understudy sample of 30 balconies, nine ***types of listening situations*** have emerged: between ***sonic exposure*** which involves a confrontation or an immersion in the sound environment, the ***acoustic recession*** which, on the contrary, allows a partial escape, the ***double listening*** which gives the choice to space user to alternate listening between the interior and the exterior, ***panoramic soundscape listening***, the ***cocoon*** linked to a nesting effect accompanied by a sensation of interiority, ***reverberation*** related to the use of reverberant materials or a specific urban configurations, ***sound screen*** related to the effect of filtration, ***sonic cascade*** phenomenon associated to a displacement of balconies positions on the façades where the listener is capable of hyper localizing the sound sources***, metabolism*** corresponding to the effect of *metabole* that refers to a form of dynamic stability of the sound climate.

In the following part, we shall detail two types of listening related to balconies: sonic cascade and double listening. We have developed those seemed to us the most relevant types that introduce new listening modalities of balconies. It is worth mentioning that it is possible that balconies with varied forms, facing different exterior environments, or initiating different space use or belong to the same listening type. On the contrary, balconies that belong to the same architectural typology may correspond to different types of listening. In addition, a balcony may blend several types of listening together (Fig. 4).

Sonic Cascade (Le cascade sonore)

The term cascade is defined in the dictionaries as the succession of waterfalls. It attributes what happens in an irregular rhythm. The cascade as a type of listening involves a change in the vertical level defining a descent and a rise of sound. The produced sound space is characterized by the hyper localization of many sonic sources coming from the surrounding balconies: top, bottom, on both sides, opposite side... The composition of sounds is both spatial and temporal because the minor presence of any sound source impacts the listening; sounds can appear and disappear in time and the sonic ambience can be more animated or more calm according in different times along the day.

Urban and architectural conditions that modulate the sound cascade

This mode of listening is more dependent on the spatial organization of several balconies, the *overlap* on the different floors. This type does not create continuous sound bands but develops rather dispersed sound fragments. The depth of the balconies constitutes an important factor, as the sum of balconies constitutes a vertical layer added to the façade creating therefore a sort a *micro-ambience* where sounds displace and reverberate in the space. This type of listening has been detected in an innovative form of corridor of a residential building located in Caserne de Bonne – Grenoble, France and designed by Edouard François (Fig. 5). The architect describes the collective corridor as a "*soft skin*"

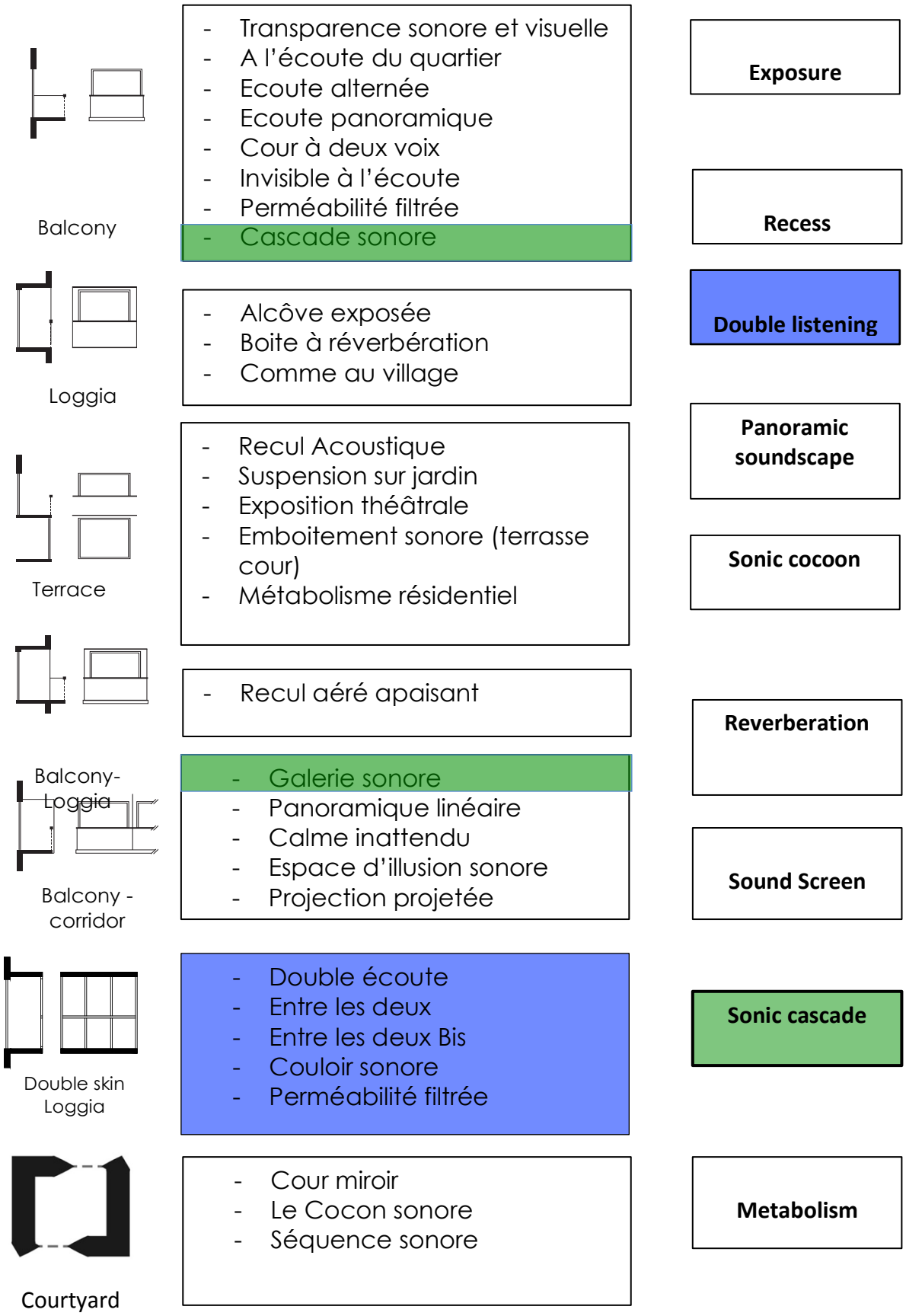

Fig. 4: The different architectural forms of BLTCs to the left, that develops remarkable listening situations (in the middle) that correspond to the different Types of listening (the column to the right).

covering the façade from the outside. It is an exterior wooden structure that leads to a very particular form of balconies shaped as private passages leading to the main entrances of the apartments. The different balconies are staggered along the façade. It is an exterior wooden structure. The whole structure constitutes an intermediate space between the building and the street. The sound space represents a cascade due to the overlapping form of both corridors and balconies. The partial coverage by the floor of the above balconies reinforces the visual and sound exposure. The sonic *interconnection* creates a network of identifiable sound sources that corresponds to the hyper localization sonic effect.

The whole structure constitutes an intermediate space between the building and the street. It is a hybrid space between the private and the public realms. The sound space represents a cascade due to the overlapping form of both corridors and balconies. The partial coverage by the above balconies reinforces the visual and sound exposure of the balconies. This interconnection creates a network of identifiable sound sources that corresponds to the hyperlocalization sonic effect. As one of the mnemo perceptive effects, The hy perlocalization is defined as: "*a perceptive effect linked to the sporadic character of a sound source that irresistibly focalizes the listener's attention on the localisation of emission. When the source moves, the listener continues to follow it*." (Augoyard & Torgue, 2005).

The innovative architectural form is phonically animated at certain moments of the day due to the different emerging uses: it is a space of short encounters, a place where people can eat on their balconies, work or socialize. In terms of sonic ambiences, this architectural element revives the image of a Mediterranean street where buildings' entrances constitute spaces of micro-sociability. This form produces a voluntary sharing of intimacy (Fig. 5).

Figure 5b: The external corridor of the residential building in Caserne de Bonne – Grenoble, France. Urban section and architectural drawings representing the corridor and the balcony. Caserne de Bonne - Grenoble, France. Designed by Edouard François. (Above) http://www.edouardfrancois.com/projets/logements/details/article/167/coming-out/#.WdG9PIZpHVo

The sonic cascade as a type of listening has been spotted in another urban context with completely different architectural configurations. The building is located in Vigny-Musset, the interface understudy is a balcony organized in a staggered form on the façade. The intimacy of the space in front of the interface puts the listener somehow in cascade sonic ambiance (Fig.6).

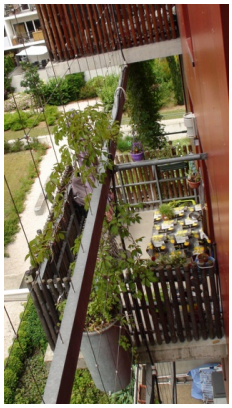

Figure 6: Residential building with double skin on the façade. Caserne de Bonne - Grenoble, France.

Double-Listening

In terms of sound, the situation of double listening offers to space users the ability to *choose* between two sonic ambiences: exposure to the sound atmospheres of the public realm, or, on the contrary, oriented towards the interior ambience i.e. be exposed to the sound space of the apartment itself and to the neighbouring balconies. The latter situation imposes a situation in which neighbours share their intimacy.

Urban and architectural conditions that modulate double listening

Double-listening occurs in most cases in double-skin loggias. This interface constitutes a buffer space between two layers of façades: the outer layer (secondary façade), which can be fixe or modularly; the inner one (primary façade) which delimits the different interior spaces of the apartment. The materials and the shape of the outer skin and their degree of porosity, for example dynamic and responsive skin made of wood, glass or metal. Another important architectural element that may have an important impact on forming the sound space is the separating walls between the different balconies. It impacts, by their height, their thickness and their materials, the sound insulation between balconies.

It is worth underlining the important sound affordance of this type of balconies and their ability to offer a degree of exposure or protection not only phonically, but also visually, thanks to the presence of the second façade. This is directly reflected on the usage pattern. In fact, during the observation phase, this type of interfaces give the strong potentiality in varying the use of the loggia: Gym, painting workshop, space for reading, eating, etc. Two sub categories of double-listening situations are identified during cross-analysis of BLTCs:

Selective listening: the interface offers a clear dual exposure due to a high degree of sound isolation of the second façade, for example double-glass walls. When windows are Open: the background sonic ambience is reverberated on the façade and become perceptible; the near sounds coming from the neighbouring balconies are indistinct as being *masked* by the sounds coming from the outside. In situations when windows are closed: the background ambience disappears and all the lateral sounds coming from the neighbouring balconies on

both sides become identifiable and submerge the sound space of loggia. This subcategory corresponds to a double-skins loggia, located on the 4th floor in Caserne de Bonne (Fig. 7).

This type of listening is related to the existence of a mouldable interface that ca produce the cut out effect *coupure*. The latter refers to a sudden drop in intensity associated with an abrupt change in the spectral envelope of a sound or a modification of reverberation (moving from reverberant to dull spaces, for instance), (Augoyard & Torgue, 2005) as defined in sonic effects. Unlike its definition as being an important process of articulation between spaces and locations and its ability to punctuate movement from one ambiance to another, the produced cut out effect in this context is not related to movement but the presence of secondary façade.

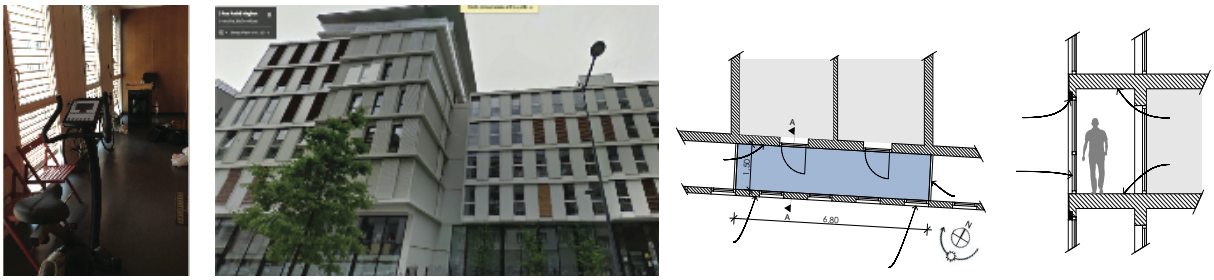

Fig. 7: Residential building with double skin balconies on the façade. Caserne de Bonne, France.

Amplifier sonorous corridor: The loggia can be closed completely by shutters. The partition walls between balconies does not reach the ceiling. When balconies exist along the façade, the empty space between the ceiling and the dividing walls allows sounds to propagate freely between the different balconies, creating a particular sound phenomenon, i.e. "*sonorous corridor*". As soon as the shutters are closed, one hears the presence of neighbors highly reverberated in the loggias of the same floor. The sound space is shared among neighbors of the same floor. This situation corresponds to double-skins loggia located on the first floor in Vigny-Musset (Fig. 8).

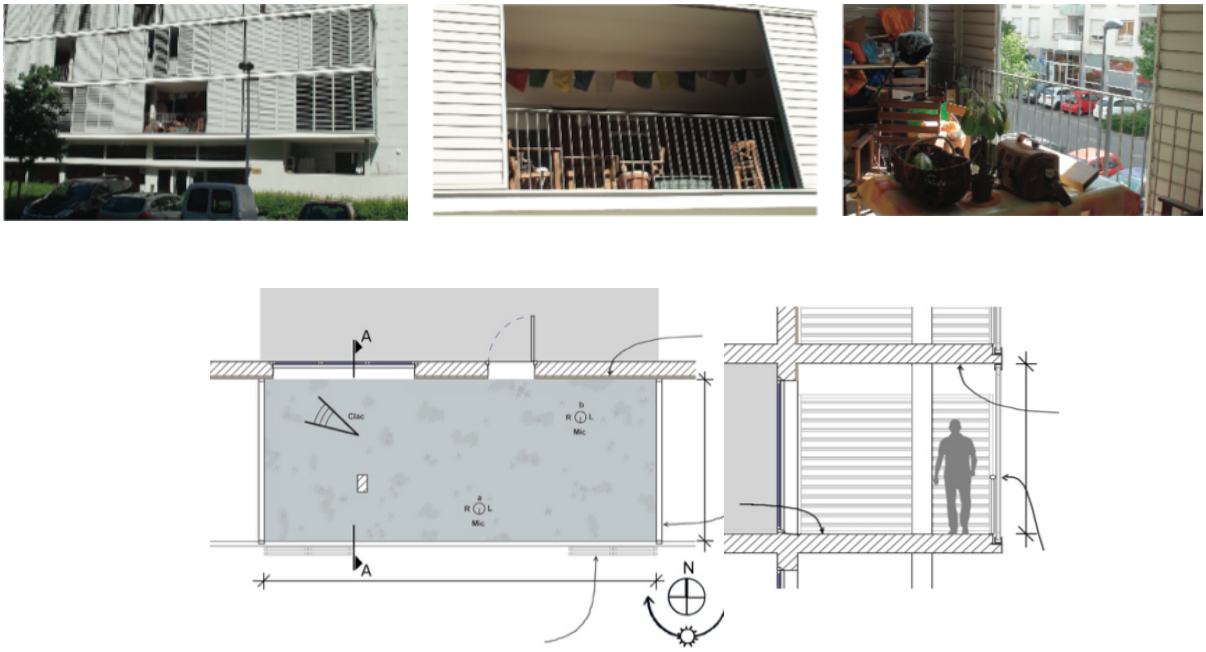

Fig. 8: Residential building with double skin balconies on the façade. Vigny-Musset - Grenoble, France.

Discussion

The purpose of our work was not to evaluate the sound qualities of all identified balconies along the year (summer, autumn, winter and spring) or even along the day (morning, afternoon and evening), but to be present in the sites when they are phonically animated, that is to say: at the end of spring and during the summer (avoiding the summer holidays); when balconies are occupied; at the hours of the day when the ambience is more animated by the presence of people: dinner time, getting out of schools, weekends, etc.

Despite the fact that our objective was to observe them in their current mode of operation or their ordinary situation, but we remained attentive to exceptional situations: Summer Festival, Music Festival, neighbourhood parties, football matches, etc. Although these events are not representative to the ordinary experience of the neighbourhood, it was interesting to study them due to the density and the intensity of the sound phenomena often associated with these events. These particular moments may reveal other phonic features of the neighbourhood: the sound transparency of the district i.e. its capacity to receive distant sounds, presence of social groups animating public spaces, intensive uses of the public facilities, a particular type of sociability, etc.

Conclusion

Contemporary eco-districts show more than ever a dynamic and rapid evolution that affects the production of intermediate spaces and their usage pattern. In fact, the spotted balconies or BLTC provide a new architectural vocabulary to design balconies that reinforce the quality of life in dense urban context. This architectural evolution results in emerging listening situations and in developing new situations of listening to the city. This article is an opening towards a typology of listening situations associated to the new forms of residential building interfaces. By studying the sound qualities of the intermediate spaces located on residential facades in these three sustainable districts in France and by making a comparative study between several new spatial and ambient configurations. Nine types of listening have emerged in this study that has been influenced, modulated and impacted by these new architectural forms. The above-mentioned types of listening can be enlarged and applied in the other districts in Europe.

A cross analysis study based on the trilogy (architectural form, visual perception and sound perception), allows describing the minimum conditions of existence of these new types of listening situations. The importance of elaborating this typology is build up and strengthen a sound culture for city designer and developers through relating the spatial and sound variables on both urban and architectural scale. If we are limited in this article to detail two types of listening: the sonic cascade and the double-listening, the rest of this typology can be developed in further research work.

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