6. Measures against noise pollution

6.1. Noise affects our health

Noise pollution raised a critical problem in urban areas, a threat against psychic comfort and human health.

There are three types of protection measures that should be taken against the urban noise:

- **Administrative – legislative measures** against the noise, which consist mainly of regulating – legislative measures and actions of administrative character;

- **Active measures** fighting against the noise, which represent actions directly oriented to the sources of noise, having as goal the reduction of the intensity level of the noise that they generate;

- **Passive measures for noise attenuation**, which represent actions of constructive and urban planning character, taken in order to reduce the intensity level of the noise on its propagation way from the source to the receptor.

6.2. Administrative – legislative protection measures

Administrative – legislative protection measures impose:

a) Maximum admitted levels for various sources of noise, which can be respected by:
   - Different types of vehicles which can be admitted on various roads;
   - The restrictions of traffic hours;
   - The restrictions of operation hours for various urban functional zones.

b) The establishment of acoustic protection distances between residential areas and aerial, road and railway traffic.

As the traffic represents the main source of urban noise, the most effective administrative method for the reduction of acoustic pollution is the settlement and the optimization of the traffic.
6.3. Passive protection measures

To obtain acoustic comfort in urban environment it is necessary to adopt the principles of systematization and optimization of urban areas so that the noise level is at an admissible recommendable boundary at the receptor.

To ensure this desideratum it is necessary that the equivalent noise level “Lech” at 2.00 m away from the building and at a height of 1.50 m over earth should not exceed the values presented in table 6.1.

Table 6.1.

<table>
<thead>
<tr>
<th>Urban protected area</th>
<th>Admitted boundary of noise level out of the buildings [dB(A)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Residential area</td>
<td>50</td>
</tr>
<tr>
<td>2 Recreation area</td>
<td>45</td>
</tr>
<tr>
<td>3 Functional protected zones</td>
<td>45</td>
</tr>
<tr>
<td>4 Centre of district</td>
<td>55</td>
</tr>
<tr>
<td>5 City centre</td>
<td>60</td>
</tr>
</tbody>
</table>

These values can be obtained by architectural design using various constructive and functional criteria.

If after the adoption of urban solutions the value of noise level “Lech” imposed by the legislative requirements is not reached, it is necessary to apply constructive solutions. At the design stage, the orientation of the building and its façade should be taken into consideration in order to improve the insulation against traffic noise, to this purpose it is also possible to use artificial and natural acoustic screens.

To achieve an admissible acoustic urban climate, complex protection measures against noise pollution should be adopted at the systematization of the towns. Distinct urban areas (industrial, administrative, commercial, residential etc.) should be created as well as efficient, easy and fluent links between them. Parkings, airports, railway stations, commercial markets, schools, kindergartens, stadiums, etc., should be situated according to these links.

The location of functional units in a building should be done with regard to the protection of living and study rooms against traffic noise or another phonic pollution sources. This location must be correlated with the location imposed by natural illumination or cold winds.

The values for the admissible noise level for various type of streets (measured at the street pavement) are presented in table 6.2.
Table 6.2.

<table>
<thead>
<tr>
<th></th>
<th>Type of street</th>
<th>Equivalent noise level, Lech [dB(A)]</th>
<th>Peak noise level $L_{10}$ [dB(A)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Street of technical category IV, for local use</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>2</td>
<td>Street of technical category III, for gathering</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>Street of technical category II, for liaison</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>Street of technical category I thoroughfare</td>
<td>$&gt;75$</td>
<td>$&gt;85$</td>
</tr>
</tbody>
</table>

There are requirements for the number of storeys of the buildings on streets of technical category I (that means 6 – 8 traffic lanes) that take into consideration the admissible noise level at the front of the building (table 6.3).

Table 6.3.

<table>
<thead>
<tr>
<th>Number of storeys of the buildings (ground floor + number of floors)</th>
<th>Minimum distance (m) from the front of the buildings</th>
<th>$a^x$</th>
<th>$b^x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>left side</td>
<td>right side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>P</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>P + 4</td>
<td>P</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>P + 4</td>
<td>P + 4</td>
<td>85</td>
<td>50</td>
</tr>
<tr>
<td>P + (8 or 9)</td>
<td>P + 4</td>
<td>120</td>
<td>80</td>
</tr>
<tr>
<td>$&gt;P + (8$ or 9)</td>
<td>$&lt; P + 8$ or 9</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>P + (8 or 9)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $a^x$ – without traffic restrictions  

$b^x$ – without heavy traffic (tracks, tractors etc.), tramway or motor bus

Special measures have been adopted concerning the surface of the roads in order to reduce the traffic noise pollution. For example: on a street with macadam the noise is with 6 – 9 dB(A) higher than on a street with asphalt.

Areas with trees act as natural screens so that the noise level is reduced with 10 – 15 dB(A) in the case of a plantation of deciduous trees.

In case of traffic, acoustic screens represent the most efficient means for the reduction of noise on roads with buildings on both sides.

The efficiency of the screens depends on:

- Their geometrical dimensions;
• Their shape;
• Their position related to the noise source;
• Their transparence;
• The absorption of screens’ surface, etc.

The reduction of the noise level due to these screens can reach 10 – 20 dB(A).
The superficial density of the screen should be at least 10 kg/m² to the achievement of an insulation of 30 dB.

The acoustic screens are made from the following materials:
• Opaque materials: metal plate, wooden materials, reinforced concrete, bricks masonry, etc.;
• Transparent materials: glass, plexiglass, etc.).

But the most efficient screens are in fact the non-dwelling buildings disposed along the thoroughfare roads under the appearance of frontal piles. The reduction of the noise level in these cases is 25 – 30 dB(A). As screens are used various buildings (but no dwellings) adequately designed and isolated from the acoustic conditions.

Figures 6.1 – 6.4 present examples of acoustic screens.

![Figure 6.1 Screens with dissipating surface elements](image)

![Figure 6.2 Acoustic barrier from ceramic elements](image)
Figure 6.3 Wooden acoustic barrier

Figure 6.4 Concrete acoustic barrier
7. The flora in our dwellings

The human population is rapidly urbanizing; modern cities are actually increasingly dependent on the goods and services of nature. Up to 80% of the populations of high-income countries already lives in cities and towns and half of humanity will be urbanized early in the 21st century. In short, half the people and three-quarters of the world’s environmental problems reside in cities, and rich cities, mainly in the developed North, impose by far the greater load on the ecosphere.

Several trends in the relation humanity-nature determine the aspect of the 21st century:

- Population’s growth;
- Global warming;
- Decreasing of the rainfalls;
- Decreasing of the cultivable land;
- Decreasing of the fish resources;
- Narrowing of the forests;
- Decreasing of the plants and animal species.

These circumstances require a new approach to the problems in order to find a sustainable balance between the human needs and the natural resources. Following this, it is of primary importance to preserve and increase the amount of vegetation in our towns; this will lead also to an increase of animal spices in our towns and a better environment.

7.1. The vegetation in our towns

As it is well known, the trees are the lungs of our planet. They purify and renew the air that we breathe. Decreasing the trees’ areas in our towns, we disturb the balance between the CO₂ emissions and the oxygen. This leads to climate’s changes, increases the level of air’s pollution and affects our health.

Urban areas extend rapidly and the percentage of the built-up areas increases while this of the green areas decreases. People must realize that the preservation of parks and gardens
in their towns is of primordial importance. This can be achieved through legislative measures that should require:

- A preliminary planning of towns that should includes an inventory of the existing flora and fauna, a soil quality investigation and an inventory of archeological and historical objects and sites;
- An urban development plan that should develop uninterrupted “green” routes (ecological network) in the planning area, require the maintenance of landscape structures, include varied vegetation and aquatic elements and sufficient spaces reserved for trees;
- Layout of sites should: take into consideration the existing valuable vegetation (trees and bushes) and protect it, take measures for the maintenance of the groundwater level, select appropriate local type of vegetation and plot partitions (hedges).

7.2. The vegetation can protect our dwellings

7.2.1. Protection from wind

It is important to protect buildings from prevailing winds, especially in winter. Besides using building components to control airflow, it would be much better to use vegetation barriers.

Fences, bushes and trees acting as wind barriers create areas of relative calm on their leeward side. Solid fences provide very calm zones but at a very close distance, since the wind pattern will recover quickly after it has passed the barrier. Porous barriers of trees and bushes allow some air to pass through, which creates minor turbulence and a bigger calm zone.

Different types of trees give different protection from wind. Conifers offer year-round protection but obstruct sunlight in winter. Deciduous trees afford more shelter when they are in leaf in summer than they are bare in winter. Even in winter, however, the bare branches still cause some reduction of wind speeds.
As it was mentioned in chapter 3 (energy), it is important to choose south orientation for buildings. South facing openings operate as collectors of solar energy during winter, but shelters are needed to prevent direct solar radiation in summer. It is sometimes better to use vegetation as a barrier from summer solar radiation instead of built shelters.

In well-wooded areas, the trees intercept 60% to 90% of the solar radiation causing a substantial reduction in the daytime increase of the surface temperature of the ground below. The air below foliage remains cooler than elsewhere.

Here again, the different types of trees give different protection. Deciduous trees and bushes can bring important shading benefits. A horizontal trellis covered with deciduous vines such as the grape will provide the best seasonal protection for open spaces and roofs.
7.3. The vegetation creates aesthetic and comfort in our dwellings

Without flowers and green plants our homes would look gloomy and obscure. The vegetation makes our dwellings more aesthetic and cosy and improves our psychic comfort.

Glazed terraces, balconies and loggias could be used as greenhouses. Creeping plants could grow on the facades. Gardens give many opportunities for the cultivation of varied vegetation, their appearance could be improved through aquatic elements or ponds for frogs. Don’t forget to install nesting boxes for birds as the vegetation not only enjoy us, but it improves the possibilities to preserve birds and butterflies in our towns.
8. Assessment of the level of implementation of Sustainable Building in Bulgaria, Greece and Romania

The building sector contributes to the increasing of the environment’s pollution. As it was shown in the preceding chapters, the period is crucial for our planet. That is why it is important that environmental awareness be introduced in the building’s concept.

Regional overviews of requirements concerning building and heating systems, climate conditions, building practices, and the consequences for sustainable building technologies in the various fields of sustainable building (energy, water, transport, materials, waste, health, flora and fauna) were made in Bulgaria, Greece and Romania. These overviews show the strengths and weaknesses in relation to sustainable building within the different building practices in these countries.

8.1. The Bulgarian building

Bulgaria has no overall concept of sustainable building. People are primarily concerned for individual aspects such as energy efficiency, improving the efficiency of the transport system, problems connected with collecting domestic waste, etc.

Energy efficiency in buildings is a very important topic in Bulgaria. Homes were traditionally been well built, with living rooms and bedrooms oriented to the sunny side. Best-practice norms and regulations for building design have now been developed.

The government has realized that energy efficiency is a basis for sustainable economic growth and improved living conditions, and the need to implement European regulations in the run-up to EU accession, so several measures have been taken. The most important concerns new norms for designing thermal insulation, which came into force in April 1999 and set out four requirements for the building envelope, i.e.:

- External walls $U \leq 1,1 \text{ W/m}^2\text{K}$;
- Ground floors $U \leq 0,5 \text{ W/m}^2\text{K}$;
- Roofs $U \leq 0,3 \text{ W/m}^2\text{K}$;
- Windows $U \leq 2,65 \text{ W/m}^2\text{K}$.

Cold bridge detailing is compulsory. New norms for thermal insulation of buildings with low internal temperatures (12°C - 19°C) are in force since 2001, as well as new ways of estimating the energy required for heating. Today’s problems include the low efficiency of heating installations and the difficulties connected with using renewable energy sources in buildings.

Bulgaria has some good traditions of using sustainable building materials, including hollow bricks, external lime-cement plaster, internal sand-lime or gypsum-lime plaster, ceramic tiles for pitched roofs, timber structures for pitched roofs, wooden floors, natural stone, etc. With regard to thermal insulating materials there is a trend towards using more foamed plastics, as they are cheaper and easier to apply. Only
sustainably produced wood is used in Bulgaria, and strict legislation protects the main forest areas.

The most important parties to implement sustainable building in Bulgaria are the National Government (Ministry of Regional Development and Urbanisation, Ministry of Ecology and Water Resources), local authorities, homeowners and building experts (architects, designers, property developers, installers, and consulting companies). Local authorities are aware of the need to use water sparingly, separating waste collection, recycling, improving the efficiency of the transport system, etc. Most programmes are at urban level, but there is also interest in the problems of public buildings, particularly those concerning energy efficiency.

Many villages and older town centres are areas of “architectural interest”. Strict regulations apply to the style and materials used in new buildings, and traditional architecture style is compulsory in some areas.

As most homes in Bulgaria are privately owned, it should be easy to convince homeowners of the benefits of sustainable building. However, nowadays a single block of flats houses people from very different financial backgrounds and for this reason they have different behaviour.

Financial barriers are still major problem. High construction costs and the current difficult economic climate, mean that developers look for the most economic building method, particularly in blocks of flats. Those building new houses are usually wealthier – they want a better quality building, but are not interested in energy efficiency. The experts from the building sector are a very important group as they could promote new sustainable technologies and materials.

8.2. The Greek reality

In Greece the governing document for the energy performance of buildings is the “Thermal Insulation Regulation”. It is an old regulation that divides the country in three zones and specifies different thermal properties for each building element and each zone.

The Regulation sets indirect limits to the total area of windows by setting restrictions to the maximum allowed U-values for each element, wall and floor and for the building as a whole. The regulation does not cover cooling loads because in late 70ies, when it was designed, very few buildings in Greece had mechanical cooling systems.

Although, strict application at the regulation can be found only in recently constructed buildings, it is a fact that it helped in changing the construction patterns in promoting extensive use of double-glazed windows and insulating materials and increasing the awareness about energy savings and comfort.

Principles of bioclimatic architecture have been extensively used in traditional buildings. In northern Greece, where the climate is colder, walls are of thick stone construction, the windows are small and the entrance is usually oriented to the south.

In the islands, villages are built in a maze of narrow alleys formation shape in order to be protected from the north winds (and the pirates) and create as much shadow as possible.
In the last decades, fashion rather than the good practice of bioclimatic architecture influenced the architecture of new houses in rural areas more. Fortunately this trend is reversed in the last years.

In big cities, the land problem is acute. Orientation of the house and positioning of the windows is dictated by the orientation of the land. In the last decade, monster-glass-made buildings were constructed in Athens and other big cities. Most of these buildings proved to be uncomfortable and their construction rate of such buildings is reduced.

In conclusion, traditional Greek architecture is in line with the modern bioclimatic good practices. The last urbanization of Greece coupled with rapid economic development and dramatic change of people attitudes led to construction of buildings that are easy and cheap to build without considering climatic conditions and energy consumption.

The situation improves in the last years as people started being more interested in “quality” and better comfort. In addition, new more completed regulations are being prepared and the authorities are stricter in enforcing the existing ones.

8.3. Some Romanian building practices

The overview made in Romania shows that there are several good building practices in the country.

- There are good traditions regarding the orientation of building and the positioning of living areas on the sunny side.
- There are good trends to the improvement of the transport systems in the towns, but as in Bulgaria cycle routes and parkings are underestimated.
- At urban development level several measures have been taken in order to improve water supplying systems, but at dwelling level there is a lot of work that should be done in this direction.
- The use of environmentally harmful materials is limited.

As in Bulgaria, there is no overall concept of sustainable building. The energy efficiency of buildings is the most important topic for the country.

After 1989 Romanian government made efforts to create an adequate regulation framework for thermal insulation of buildings:

- Law Nº 10/1995 concerning the quality in buildings construction sector;
- Normative C 107/1-1997, concerning the calculation of the global coefficients for thermal insulation of buildings. The technical regulations of this normative establish the calculation method for the global coefficient of thermal insulation that gives the total heat losses by direct heat transmission through the building envelope surface, for a difference of temperature of 1 K between interior and exterior, referred to the building’s volume. Are added to this the heat losses for improving the internal air as well as the heat losses for additional cold air infiltrations. The stipulations of this normative are applied to all types of
dwellings such as: individual dwellings (one family houses, coupled or in a row, duplex type, etc.); multi-apartments dwellings; hostels and boarding school; hotels and motels. The stipulations refer both to new buildings and existing buildings that will be under rehabilitation and modernization works.

- Normative C 107/2-1997, regarding the calculation of the global coefficient for thermal insulation for buildings with other destination than dwellings. This normative is meant to establish the calculation method for the characteristic of global thermal-energetic efficiency of buildings with other destination than dwellings, not higher than ground floor plus 10 floors. This characteristic is called global coefficient of thermal insulation.

- Normative C 107/3-1997, concerning the thermal-technical calculation of buildings’ construction elements. This normative refers to the thermal-technical calculation of all construction elements of buildings during winter, except the construction elements with land contact. Normative C 107/5-1997 concerns the thermal-technical calculation of construction element with land contact.

As in Bulgaria, financial barriers are still major problem. An overall concept for sustainable building should be elaborated for the country. The government, the local authorities, homeowners and building experts should be involved to improve the environmental awareness in the building’s concept.

8.4. Conclusions

- Bulgaria, Greece and Romania have no overall concepts for sustainable building. In these countries the most important topic is the energy efficiency of buildings.

- Principles of bioclimatic architecture have been used in traditional buildings, but nowadays fashion influences the architecture of new buildings more than good practice.

- There is a lack of environmental awareness in the building’s concepts.

- All the concerned actors in the building process (government, local authorities, homeowners and associations of homeowners, experts from the building sector, consulting companies) must be involved in the process of implementation of Sustainable Building in Bulgaria, Greece and Romania.

- Financial barriers are one of the major problems, but many improvements can be done at the design stage and won’t increase the building’s cost. These improvements can be carried out using design tools for bioclimatic and solar architecture, optimization of the heating installations (e.g. through minimizing the pipes’ length), implementing more efficient transport systems through a better town planning, etc.

- Strategies for reaching a sustainable built environment should reflect varied regional conditions and priorities, and various implementation models.

- Quantified performance targets are required to make political commitments meaningful. Performance assessment systems and sustainability indicators can support this.
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