



IMPLANTATION OF NOISE BARRIERS IN PORTUGUESE LANDSCAPE

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Abstract

Noise makes part of the environment that we live in, and has a great impact on the perception of character and quality of landscape. By creating noise barriers, some people may concentrate on the negative impact that barriers have on the landscape due to their scale, appearance or other undesirable qualities, the noise itself may well have an unfavorable effect on the people's enjoyment of the landscape and can have, therefore, an adverse effect on landscape quality, landscape character and the quality of life.

The purpose of this study is to give examples of some existing noise barriers in Portugal and to analyze how successfully, besides creating conditions for better acoustic comfort, they fulfill the conditions of an integration within the environment, by its composition and aesthetics solutions.

Keywords: Landscape integration; noise barriers.

1 Introduction

Man built roads to enable easier connection, communication, business....For instance the tourism in Portugal creates a significant part of economy income. The road corridor provides a window into the landscape, and the scenic and recreation values of roadsides are appreciated by the road users. Attractive roadsides encourage tourism and contribute to the economic well-being of towns and rural areas. As windows on the landscape, roadsides make a major contribution to the appreciation of scenic landscape [1]. But if these windows are closed by unattractive barriers, spread along the roads, what image of Portuguese landscape will tourist take home, after holidays? Not just speaking about tourists and visitors. We spent significant hours per week in the car, train, public transport. Why shouldn't we just

appreciate more the landscape beauty, while we are driving to work, or going for shopping. Noise barriers are protecting us from noise. But let's not allow them to protect us from the land we live in. We can use them as window frame, to creatively enhance the environment which is seen as well as heard along highways.

2 Designing Environmental Noise Barrier

The primary function of noise barriers is to shield receivers from excessive noise generated by road traffic. While the onus of mitigating road traffic noise lies with the road projects, noise barriers are considered the most reasonable noise mitigation measures available [2].

All too often noise barriers are built which provide little or no protection to the communities that they are intended to serve. They are others which, with a little more care in the design, could have provided significantly better screening than they achieve. To avoid these costly mistakes and to ensure that the greatest possible benefits are realized from every noise barrier, it is essential for designers to understand the basic principles of acoustic barrier theory [3]. Many factors need to be considered in the detailed design of noise barriers. A proper design of noise barriers should be considered from both acoustic and non-acoustic aspects.

2.1 Acoustical design factors

Acoustical design factors include barrier material, barrier locations, dimensions and shapes. But the second set of design factors is equally important.

2.2 Non-acoustical design factors

By trying to resolve one issue (in this case noise), other problems can appear, such as unsafe conditions, visual blight, maintenance difficulties, lack of maintenance access due to improper barrier design and air pollution in the case of full enclosures or deck over. With proper attention to maintainability, structural integrity, safety, aesthetics, and other non-acoustical factors, these potential negative effects of noise barriers can be reduced, avoided, or even reversed [2]. The aim of this article is to outline the importance of dealing with the visual impact that Noise barriers create in the landscape.

3 Visual Impact

Noise barriers can have a substantial effect on the visual environment of a highway and its surrounding environment. They are long continuous structures, often more than five meters high, made of various materials. They can significantly change the view from the road by blocking view of the roadside and creating a monolithic uniformity of walls instead of changing urban scenery. They also can change the view towards the road for the surrounding community [4]. Barriers should only be designed once studies of the local natural environment have been undertaken, including studies of materials, built forms and massing, colour and vegetative patterns and the historical context [3]. It is important to achieve a level of integration of all roadside elements with the surrounding landscape [1].

3.1.1 Aesthetical aspect

Making aesthetic judgments is always a difficult task, because each of us has very different ideas about what we like to look at [5]. The primary design consideration for the appearance of the noise barriers should be sculptural -the noise wall as a ribbon in space, where the important factors are scale, proportion and form [6]. In view of the linear nature of the noise barrier, simple plan vertical shape appears to be monotonous and creates a wall effect. The visual quality can be enriched through manipulation of the linear form, such as segmentation, curving and articulation of the surface texture and colour. The overall appearance of barriers could be further articulated through applying of architectural concepts such as rhythm, proportion, order, harmony and contrast. Such considerations are particularly useful where tall or extensive lengths of barriers are required in urban areas and where it may be desirable to break down the scale of an otherwise monolithic feature by using combination of contrasting materials [2].

4 Implantation of Noise Barriers in the Landscape

4.1 Compatibility with local features

To some extent, local residents would tend to accept the barriers which have relationship with its surroundings and are compatible with the appearance of the adjacent neighborhood. As a general rule, the character of the neighborhood should be looked into to provide a checklist of its distinguishing elements. For example in the urban context, the design of a barrier needs to capture something of the neighborhood, such as the prevalence of a particular material or style in buildings; for a leafy suburb a barrier incorporating planting might blend in more readily. For the rural and new town situation, it is preferable to have a 'natural' form to harmonize the local vicinity. The use of earthworks and planting should be developed to create a visual impression which seems to preserve the rural [2].

4.2 Integration of Barrier in the landscape

A primary goal in designing noise barriers is to integrate them into the landscape. Problems develop when barrier walls are placed on the landscape with little attempt to integrate them with the surrounding landforms or existing built elements such as bridge abutments, endwalls, and guardrails. As a result, barrier walls can appear as obtrusive objects in the environment. Barrier walls can be integrated with the landscape in two basic ways. The structure itself can be designed to appear to "grow" out of the landscape, or the landscape (plants and earth) can become part of the barrier structure. Wall endings can be designed to integrate barriers with the landscape. Gradually tapering or stepping them down to the ground level will give the appearance that the wall is literally growing out of the ground. Earth berms and plantings may also be used at wall ends to tie the barrier into the landscape [4].

4.3 Coordination with road furniture

In situations where existing structures such as bridges and guardrails are present, an attempt should be made to connect the wall end with the structure. This will provide visual continuity between highway structures [4]. However, the visual unity is often spoiled by uncoordinated elements such as road signs, lighting columns, gantries, safety fences and parapets. The design of a roadside barrier should complement the engineering design of the road and therefore needs to be developed as part of an overall concept. Consideration of visual impact

early on in the design process will help designers to avoid unnecessary conflicts. The designer should also take note of the compatibility of the rhythm of various elements along the road to determine the suitable module for the barrier [2].

4.4 Use of plants

Landscaping can be used in several ways to improve the aesthetics of highway corridors, and noise barriers in particular. Noise barrier walls can be softened through the use of plants that camouflage their hard edges (e.g. cap, base, and ends). Vines cascading over the top of walls and base plantings can be used effectively as softeners. The scale of barrier walls can be reduced by using plants to break up the expanse of wall surfaces and to reduce the relative height of the wall. Visual direction can be added through the use of plantings that accentuate horizontal or vertical lines. Creeping vines and low spreading ground covers emphasize horizontally while pyramidal, conical and columnar plants provide vertical elements, drawing the eye upward. Accent plantings can provide aesthetic stimulation for motorists. Plants can be strategically placed to frame views and objects.

Using plants native to a region makes aesthetic and economic sense. Urban development, agriculture and road construction destroys much of the original plant communities that existed prior to settlement. Restoration of the original plant community helps blend the roadway into the surrounding landscape and provides an interesting and aesthetic view of the road. Wild flowers and prairie grasses contribute a wide variety of textures and colors to the roadside landscape [4].

4.5 Art and Design

The efforts to improve the design of noise walls by adding art, or more accurately artwork, have been largely unsuccessful. This is because the artwork has typically been regarded as an applied finish to a wall designed purely on engineering grounds — the wall has been viewed by the artist as a canvas. In the context of any major construction activity — such as a highway — the design of the entire corridor must be seen from an urban design perspective as a work of art (or more accurately a piece of design) rather than as an assemblage of separate elements [6].

5 One barrier – two sides of impact

Noise barriers have two sides with radically opposed design requirements and this might well become the basis of a design methodology for noise barriers. In general, priority of design should be given to the protected side since the purpose of a barrier is to protect the environment enjoyed by the people. However, the design of barriers must take into account the visual effects of the traffic sides, recognizing their role as a backdrop to the motorists' view of the road [2].

5.1 The Road Users' Side

The road user experiences a length of barrier for a very short space of time and nearly always views the design at an oblique angle. The driver in general perceives only a broad impression of the design, its pattern of colour and its contrast with the surroundings [2]. Speed alters the peripheral cone of vision and the distance to the motorist's point of focus. In general, as speed increases, the cone of vision narrows and the focal distance increases. Likewise, at slower speeds, peripheral vision is expanded and the focal distance is closer to

the observer. Vision cones delineate the area within which objects are generally in focus. Objects outside these cones become blurred [4]. At 40 kilometers per hour detail may still be relevant, but at 110 kilometers per hour what is important to the viewer is an overall impression rather than the detail. Indeed it is highly inappropriate from a safety viewpoint to include detailed elements since these could distract a driver. On the other hand, if the visual experience is overly simplified this may induce monotony. Therefore the whole must be considered as a composition of structures and spaces which relates to the site at a scale able to be safely comprehended in motion [6].

5.2 The Protected Side

This is very different to the considerations made when designing a noise wall that will be viewed from an adjacent residence. Here the view must be considered, more or less, as a static composition with very different visual requirements. What is needed is quality detailing and an attractive composition of wall and landscape that will be seen by residents day in, day out. Similar requirements apply to the noise walls viewed from a pedestrian or cycle path, although here the progression through space — albeit at a much slower speed — is also relevant [6]. A barrier can drastically change the outlook for residents, who in addition to a loss of view may also suffer loss of daylight. A barrier is experienced by the residents as a feature which perhaps dominates the space, and such impact would remain unchanged unlike the impact of variable traffic volumes. A designer can provide a barrier which minimizes this potential intrusion by using attractive materials which display in plan and elevation. Planting incorporated within the barrier design will soften its overall impact by imparting a more natural character and relieving the monotony of a horizontal skyline [2].

6 Designing process- Inventory and Analysis

All landscapes are composed of patterns, textures and colors; they are a result of the way in which the surface of the earth is clothed by the vegetation or changed by the man's agricultural or non-agricultural activities, except in wilderness areas. It is very important to identify these factors, for they influence how we see landscape. If a pattern is broken or different texture or colors are introduced, we produce a different and perhaps alien landscape [5].

The purpose of the inventory and analysis is to 1) identify regional patterns and features that could potentially impact the visual quality of noise barriers and the freeway corridor; 2) to identify unique cultural, historical or natural features which could be used to set a theme for the design of a noise barrier/landscaping system, and 3) to identify prototypical situations relative to the location and function of noise barriers.

6.1 Physical Patterns

Firstly, we need to look at the landscape through which the highway passes and consider the various elements that make up that landscape — topographical features (hills, mountains, valleys, rivers etc), structures (bridges, towers, distinctive buildings, airports etc) and natural or developed patterns (woodlands, parks, playing fields etc) — in order to choreograph the visual experience of travelling along the road. At a large scale this involves aligning the road to expose the landscape character. At a detail scale opening up views through gaps in the walls, or using transparent barriers. Secondly, even where there are no obvious landmarks (for example passing through an area of relatively homogeneous landscape) it is possible to create choreography through the careful design of noise walls and other structural and

landscape elements. This provides a sense of pace and rhythm which can help to keep drivers alert [6].

6.2 Cultural Patterns

Cultural patterns and features refer to the location of traditional ethnic neighborhoods along the freeway corridor. This information can be used to extract location specific design characteristics which could be incorporated into the barrier design. One of the objectives of this study is to provide ideas on how to design noise barriers that better reflect the character of the neighborhoods in which they are located. Urban freeways occupy space formerly used for other uses, many of which contributed to the growth and livelihood of the city itself. Remnants of these earlier uses sometimes exist in areas adjacent to highways [4].

6.3 Land Use Patterns

The analysis also revealed patterns of use distinguished by adjacent development as viewed from the roadway. The density and age of development contribute significantly to the character of specific locations. Three general types of residential development can be identified as a means to better define an area's character.

6.3.1 Urban character

Urban character of the landscape refers to older residential areas of the city. The freeway cuts through these established neighborhoods resulting in dense residential development immediately adjacent to the corridor. The design character of these areas is associated with man-made geometric forms, hard edges, hard surfaces, vertical lines, and contrast in forms. An appropriate barrier could be constructed of hard materials, using geometric configurations, with a varied top profile and vertical orientation. Plants are used to provide architectural enhancement, shadow patterns, accents, bold forms, and visual contrast.

6.3.2 Suburban character

Suburban landscape character refers to areas of lower density and newer housing. The design character is associated with a mixture of geometric, man-made forms, horizontal lines, and amorphic, naturalistic forms. Older suburbs have a more dense, urban character while newer suburbs have retained wooded areas and lower density developments. An appropriate barrier could be constructed of a mix of materials from concrete to wood, using a mix of geometric and curvilinear configurations with a varied top profile. Plants are used primarily to blend, soften and reduce the scale of the wall.

6.3.3 Rural character

Rural landscape character refers to areas which appear to be undeveloped open space and/or low densities when viewed from the highway. It is unlikely that areas exhibiting actual rural character will be potential candidates for noise barriers. The design character is associated with soft, flowing forms. An appropriate barrier could be constructed of natural materials (wood, stone), using curvilinear configurations and a definite horizontal emphasis. Plants are used to blend the wall with the landscape. Naturalistic planting designs using informal layouts, indigenous plants and muted color schemes would be most appropriate.

7 Current State of Noise Barrier Design in Portugal

Analysis of Examples of Environmental Noise barriers in Portugal

7.1 Analysis of chosen barriers

7.1.1 Example n°1 Noise barrier along the on the A2



Figure 1 – Example of a barrier along the A2

7.1.2 Example n°2 Noise barrier along the IC1



Figure 2 – Example of a barrier along the IC1

7.1.3 Example n°3 Noise barrier along the A22-IC4



Figure 3 – Example of a barrier along the A22-IC4

7.1.4 Example n°4 Noise barrier along the A43-IC29



Figure 4 – Example of a barrier along the A43-IC29

7.1.5 Example n°5 Noise barrier along the A43-IC29



Figure 5 – Example of a barrier along the A43-IC29

7.1.6 Example n°6 Noise barrier along the IC21



Figure 6 – Example of a barrier along the IC21

7.1.7 Example n°7 Noise barrier along the A22-IC4



Figure 7 – Example of a barrier along the A22-IC4

7.1.8 Example n°8 Noise barrier on the IC8



Figure 8 – Example of a barrier on the IC8

7.1.9 Co Example n°9 Noise barrier along the A2



Figure 9 – Example of a barrier along the A2

7.1.10 Example nº10 Noise barrier along the A1



Figure 10 – Example of a barrier along the A1

8 Conclusions

As we can see barrier design is a complicated process. The best results are likely to be achieved through the coordinated services of qualified acousticians, civil and structural engineers, landscape architects and architects. The purpose of this paper was to show the importance and need of improvement of design of noise barriers in Portugal. We think that the development of an “Environmental Noise Barriers Design Guidelines“, created specifically for Portuguese territory, would encourage an attractive and efficient system of noise control throughout the area.

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