

Surface treatments for traffic noise barriers

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A large number of various materials are used to make traffic noise barriers. The choice of a particular texture for the surface treatment of the barrier depends on many factors, such as the aesthetic appearance of both sides of the barrier, structural characteristics, maintenance requirements, type of material used to construct the barrier, etc. Therefore, surface treatments for barriers must also be considered. Surface treatments include textures, colors, graffiti, and coatings. The paper provides a classification of surface treatments for traffic noise barriers and guidelines for their use.

Keywords: Traffic sound barriers, Texture, Colours, Coatings, Graffiti

1. INTRODUCTION

Traffic noise barriers are an effective solution for reducing noise pollution caused by high traffic areas. These barriers are constructed using a wide range of materials, each with different textures and finishes. The choice of surface treatment for a sound barrier depends on several factors, such as aesthetic appearance, construction characteristics, maintenance requirements, and the type of material used.

In addition to selecting the appropriate material for noise barriers, it is equally important to consider surface treatments. Surface treatments include textures, colors, coatings, and graffiti, which can enhance the effectiveness of a noise barrier and improve its overall appearance. Proper surface treatments can help to minimize sound reflection and absorption, reduce corrosion and damage, and improve the visibility of barriers for motorists and pedestrians. [1]

This paper provides a classification of surface treatments for traffic noise barriers, along with guidelines for their use. The classification is based on the different types of surface treatments that are available, including the benefits and drawbacks of each type.

Overall, this paper aims to provide a comprehensive overview of surface treatments for traffic noise barriers, with the goal of helping designers and engineers to select the most appropriate surface treatments to improve the effectiveness and appearance of sound barriers in different environments.

2. SURFACE TREATMENTS

The choice of a specific texture of the surface treatment depends on many factors, such as the aesthetic appearance of both sides of the barrier, construction characteristics, maintenance requirements, type of material used to construct the barrier, and more. Therefore, surface treatments of the barrier must also be considered. Surface treatments include textures, colors, graphics, and coatings [2]. The classification of surface treatments for sound barriers is shown in Figure 1.

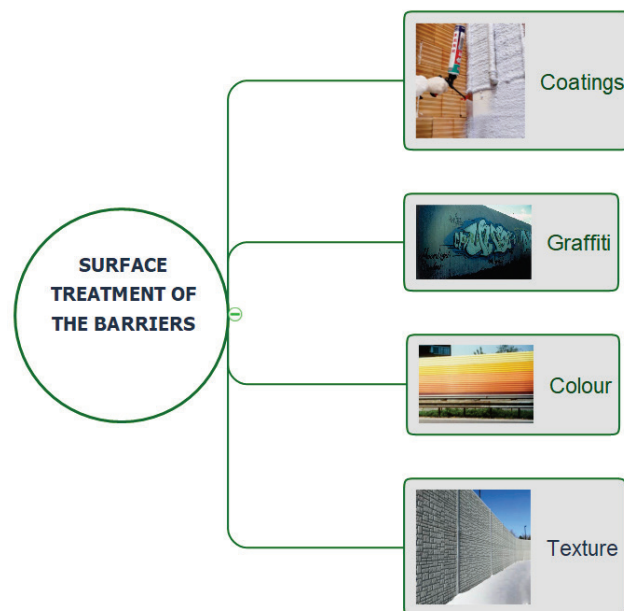


Figure 1. Classification of surface treatments for sound barriers

2.1. Texture

There are a large number of surface textures available for use in the construction of sound barriers (Figure 2). These various textures can be applied to panels as well as poles, caps, etc. Different surface textures are obtained by using different combinations of surface treatments. Depending on the type of material used to construct sound barriers, different textures can be obtained.

When the material for constructing a sound barrier is concrete, textures of smooth surface and surface of stone aggregate can be obtained, as well as textures obtained by drawing lines, manually applied techniques using rakes and brooms, pressing, application of inserts, veneer, and Stucco finishing layer.



Figure 2. Surface treatment textures of barriers [1]

A smooth surface is obtained by using classical concrete finishing techniques. In the case of vertically formed panels on one or both sides, after the concrete has hardened, a finishing treatment is necessary, which includes filling voids and "grinding" the concrete with a thin cement mixture (Figure 3).



Figure 3. Concrete barrier with a smooth surface [1]

The texture in the form of the surface of a stone aggregate is achieved by using a selected type, color, and gradation of the aggregate in the concrete mix of the barrier (Figure 4). The aggregate is chosen based on its aesthetic appearance, but it must also meet all the requirements regarding strength, size, shape, etc. This exposed surface of the aggregate is easiest to achieve at the bottom, i.e., on the lower side of the prefabricated panel. On the upper side of the panel, it is harder to achieve this process, and worker experience and quality control monitoring are necessary.

To achieve different looks of relief surface texture, different types of molds are used. Molds are made of thin materials that can be made of rubber, wood, metal, or other materials and have one flat side, while the other side has a "mold" with the desired surface appearance. These molds can be used multiple times and are most often applied to the lower side of the panels of cast prefabricated materials. Newer methods enable finishing texture processing on both sides of the panel.



Figure 4. Concrete barrier with a surface in the form of a stone aggregate [1]

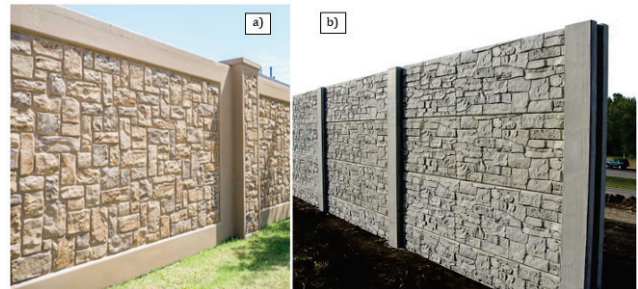


Figure 5. Texture of a concrete barrier obtained in a mold: a) [3] (b) [4]

Hand-applied finishing techniques using rakes and brooms (raking, sweeping) are applied to the upper side of prefabricated panels (Figure 6), and they can produce different manually created patterns.



Figure 6. Final processing of the concrete barrier by raking [1]

Finishing by imprinting represents the imprinting of a pattern onto the upper surface of a horizontally poured panel, using specialized techniques. The appearance of a brick-like surface texture can also be achieved (Figure 7). Such treatment is somewhat more difficult to perform than other treatments. During the stamping process, the aggregate in the panel must have sufficient thickness to allow for stamping.

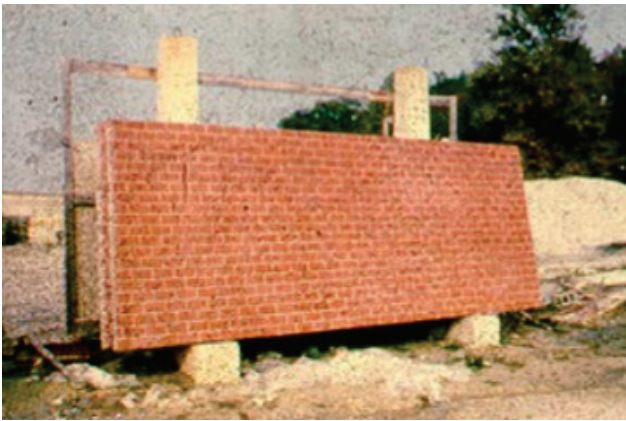


Figure 7. Texture in the form of a brick obtained by embossing [1]

The use of panel inserts can provide a unique aesthetic appearance of surface texture (Figure 8). These inserts are produced separately and then placed in a recess of equal size and shape inside the prefabricated panel or embedded in the panel during the pouring process. Adequate attachment between the insert and panel must be ensured to protect against noise. Mechanical fastening or chemical bonding techniques are most commonly used.



Figure 8. Panel inserts attached to a concrete barrier [1]

Veneers are a specially produced material that is applied to the surface of the concrete barrier. Some veneers may contribute to sound absorption, but their use is mostly for aesthetic reasons. Examples of veneers include thin brick, ceramic tiles, and porous composite materials. As in the previous case, adequate attachment must be provided.

Stucco, a final layer of cement material, is directly bonded to the concrete barrier without any additives and can provide different types of texture to the concrete surface. However, the appropriate cleanliness and roughness of the surface of the concrete barrier must be achieved to ensure an adequate surface for sticking this final layer.

When the material used for making a sound barrier is built from blocks, the texture of the surface can resemble that of a stone aggregate, which is achieved through line extraction, veneer, broken edges, and Stucco methods. In terms of texture for stone blocks used in building, there are considerably fewer textures that can be obtained compared to the various textures of stone aggregates that can be obtained in a concrete panel, as there is a smaller range of aggregates used in the production of concrete blocks.



Figure 9. Sound barrier made of masonry blocks with broken stone edges [5]

Line extraction molds can also be applied to concrete blocks, but to a significantly lesser extent than in concrete. Veneers can be applied to concrete blocks in a similar way as to concrete panels. Broken stone edges are often used to achieve a rough textured surface in concrete blocks (Figure 9).

Stucco texture can be applied to masonry blocks in a similar manner as with concrete panels (Figure 10).



Figure 10. Sound barrier made of masonry blocks with Stucco texture [1]

When using bricks as a material for constructing a sound barrier, the type of brick, mortar, and bond pattern must be considered. The type of brick includes all classic types of standard brick, of which there are hundreds of varieties that can be used in the construction of sound barriers (Figure 11). Bricks can be stacked in multiple layers with mortar or in combination with walls made of concrete or concrete blocks. When it comes to the type of mortar, there are many different colors and types available for gluing bricks together. Various bond patterns are used in the construction of brick barriers. The variety of brick dimensions, colors, styles, mortar, and bond patterns provides the opportunity to create unique and interesting patterns.



Figure 11. Surface texture - brick barriers [1]

When the material for making a sound barrier is metal, surface texture can be obtained with mechanically

shaped forms and embossed surfaces. Surface treatments are generally similar on both sides of the panel, but there is a possibility to achieve different shapes on each side of the barrier. Embossed surfaces imply less relief prints on metal panels.

When the material for making a sound barrier is wood, surface texture is provided by: orientation of

boards, slats, grain, lamination, and type and orientation of posts. Different visual appearances can be obtained with different orientation of wooden boards used in the construction of sound barriers. There is a possibility of using a horizontal, vertical, diagonal, and combined configuration. Also, boards of different dimensions can create an interesting appearance.

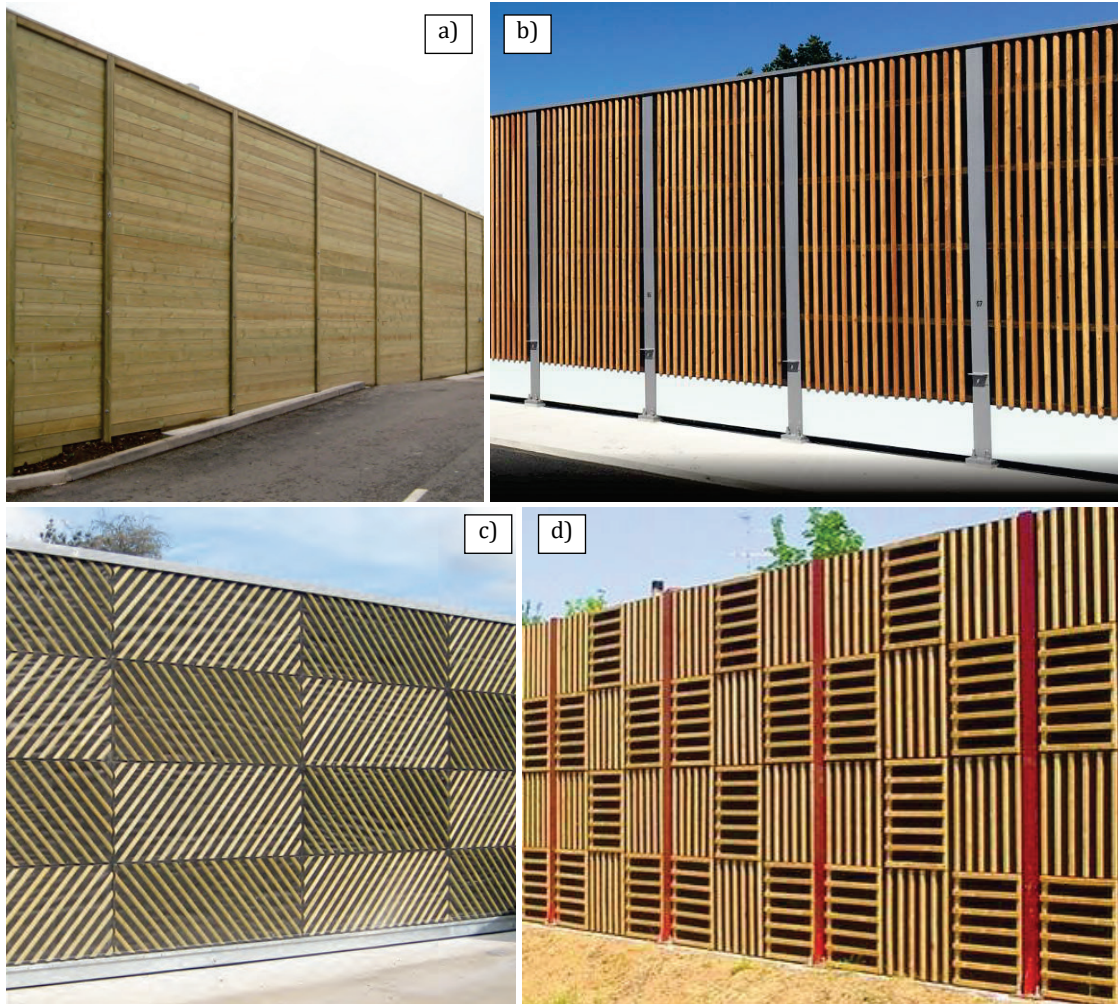


Figure 12. Texture of wooden barriers obtained by different orientation of board placement: a) horizontal [6], b) vertical [7] c) diagonal [6] d) combined [8]

Graininess involves selecting the grain and roughness of the wood, which can create an appropriate surface texture. Lamination refers to different design codes of laminated panels by ensuring the appropriate orientation of the laminated component elements (Figure 13). This creates a similar surface on both sides of the barrier.



Figure 13. Lamination - wooden barrier [1]

When the material for making a sound barrier is a transparent panel, the surface texture is limited to aesthetic

design types (patterns, designs) that can be applied to such barriers [9].



Figure 14. Surface texture - transparent barriers [9]

Surface textures of plastic panels are limited to shapes and textures that can be achieved through the shaping process of panel components, and in composite materials, surface textures depend on the availability and limitations of certain components used to form the exterior surface of the barrier.



Figure 15. Surface texture – composite material barriers [1]

2.2. Color

Many barrier systems comprise acoustic panels which can be produced in a range of colours. It is of general consensus that the appearance of a barrier can be toned down to help it merge with its surroundings, or made to stand out as a striking and highly visible addition to the environment by the use of colour [10].

The color of sound barriers is included in surface treatment techniques. The desired color of the barrier can be achieved using two general techniques or their combination:

- natural color of the material used for building the sound barrier (with the possibility of adding a transparent coating) and
- applying paint, stain, pigment coating, or integral pigment that is added to the material used for building the barrier

For concrete and masonry blocks, there are various options for coloring. The color of natural concrete ingredients can be changed by adding pigments. Additionally, surface-applied stains affect the color. Pigmented panels with a surface color of the appropriate shade can also be used. When it comes to bricks, the color is limited to the color of the material used for building the barrier.

Metal barriers are generally protected with corrosion-resistant coatings and then painted. With aluminum and stainless steel, there is a possibility of retaining the natural color of the metal. Steel barrier elements can also retain a galvanized finish as a color. When wood is used as a material for building the sound barrier, there is a great choice of natural colors. Each type

of wood has a certain color, and most woods can also be painted to achieve the desired color [10][11].

The color of plastic barriers is usually obtained by pigmentation of the emulsifiers used in the shaping process of barrier elements. A scratch-resistant coating can also be added for protective purposes. The desired color of a sound barrier made of recycled rubber is typically achieved by using polyurethane coatings because recycled rubber material cannot be pigmented. With composite materials, colors depend on the possibilities of the components used to form the outer surface of the barrier.

An interesting and challenging problem with colour in temperate zones is the changes of season. This is particularly an issue in rural locations where a colour chosen to blend into its surroundings in summer may be overly conspicuous during the winter months. Colour, like any other design criterion, should be chosen for a particular reason and not be chosen arbitrarily, or simply because it is available [9].

2.3. Graffiti

Sound barriers in the environment often provide an irresistibly empty canvas for graffiti. The only effective way to deter graffiti is to use plantings. Where it is not possible or appropriate to plant vegetation along barriers, alternative solutions must be found. Various methods have been developed to reduce damage to barriers and facilitate cleaning. The two basic types, which relate to the type of surface they protect, are [8]:

- anti-graffiti coatings and
- anti-graffiti film

Anti-graffiti coatings can be applied to most surfaces in the form of a sprayed or painted layer, making it easier to remove the color, typically by spraying with hot water under high pressure. Anti-graffiti films are applied to glass and acrylic transparent barriers. The film is transparent, protects the surface from scratches and paint, and is easily removed and replaced with a new one.

One possible way to deter graffiti is with an anti-graffiti design on the barriers (Figure 16). There is also a problem with the integration of anti-graffiti into the local environment. There is also the possibility of advertisements on barriers, which could lead to the potential use of barriers for advertising.

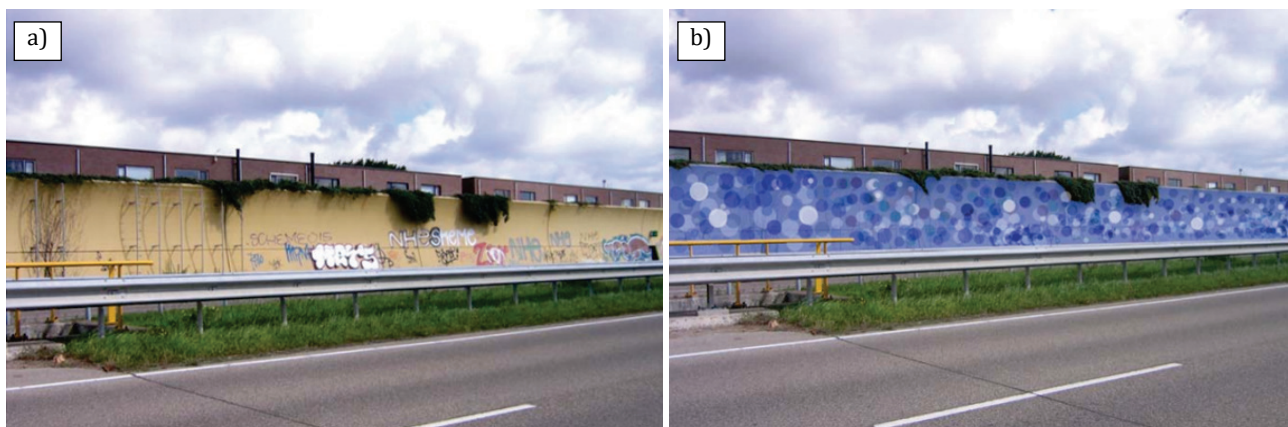


Figure 16. Examples of graffiti and anti-graffiti on sound barriers [9]

Another way to deter graffiti is through special barrier constructions, such as those that have an internal core containing panels, and rows of steel profiled mesh that protect the core and prevent graffiti, or their visibility.

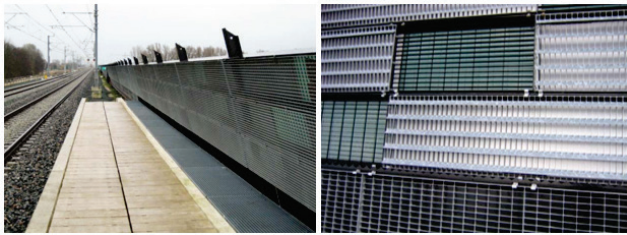


Figure 17. Examples of anti-graffiti barriers [9]

2.4. Protective Coatings

Coatings are primarily applied to concrete barriers or barriers made of masonry blocks for protective and/or aesthetic reasons. Protective reasons are the most common reasons for applying such coatings. They provide protection against wind, rain, ultraviolet light, and potential vandalism, various damages, and graffiti drawings. When it comes to aesthetic reasons, they relate to improving the appearance of the barrier. In some cases, adding a transparent protective coating can enhance the color and give shine to the surface [9].

These coatings can be transparent or pigmented. Transparent coatings are usually applied to surfaces where the color of the barrier is made of natural material, such as stone aggregate or brick. Pigmented coatings are usually applied to natural concrete surfaces. The application of coatings is mainly done by spraying, although roller or brush application can also be used.

Anti-graffiti coatings can be permanent, allowing multiple removals of graffiti by high-pressure water without replacing the coating. The other type of coating is partially or completely removed together with the graffiti and must be reapplied.

Coatings in the form of paint, in addition to providing the desired color of the barrier, can also provide a certain degree of protection. They can be water or oil-based. They can be applied in the factory of prefabricated materials before their installation or on-site during the installation of panels.

3. CONCLUSION

Noise barriers represent an effective solution for reducing traffic noise levels. A wide range of materials are used to construct noise barriers, each with its own characteristics and advantages. However, in addition to selecting materials, it is equally important to consider surface treatments for noise barriers. Surface treatments can take the form of textures, colors, coatings, and graffiti, each of which can improve the effectiveness and appearance of the barriers. Proper surface treatments can help minimize sound reflection and absorption, reduce corrosion and damage, and improve the visibility of barriers for motorists and pedestrians. Moreover, it must be emphasized that to achieve a visual and acoustic effect, combinations of materials, textures, colors and protective coatings are most often used.

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