

## ANALYSIS OF MATERIALS USED FOR PRODUCTION OF NOISE PROTECTION BARRIERS

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**Abstract** - Wide range of materials is used in production of noise protection barriers. Selection of proper material affects many characteristics of barriers such as durability, acoustic properties, manufacturing and assembly costs, maintenance, aesthetics, etc. This article shows analysis of main advantages and disadvantages of the commonly used materials for noise protection barriers in order of its proper selection from the standpoint of design and production.

### 1. INTRODUCTION

Development of technology and industrialization in the 20th century was accompanied by the rapid development of transport and transport infrastructure. Consequence of this development was increase in noise levels as well as prolongation of the period in which the noise level is higher than allowed.

In order to decrease level of noise, developed countries have started setting up noise protection barriers as the most reasonable solution since middle of 20<sup>th</sup> century. Design of the barriers offers many choices to the designers, and this paper provides an analysis of the opportunities offered to the designers by the choice of materials used for construction of the barriers.

### 2. DESIGN CONSIDERATIONS

Noise barriers must fulfil many requirements in order to provide effective noise reduction. The main group of requirements are related to the acoustic properties of barrier.

Acoustical design considerations include [1]:

- Barrier material,
- Barrier locations,
- Dimensions and shapes of the barriers.

A second group of design considerations includes non-acoustical aspects [1]:

- Engineering requirements,
- Safety,
- Environmental requirements,
- Maintenance,
- Material selection.

In both groups of considerations, acoustic and non-acoustic, barrier materials are very important factor. In the text that follows, an overview of the most commonly used materials for noise protection barriers is given, as well as analysis of the advantages and disadvantages of their use.

### 3. BARRIER MATERIALS

In general, there are two types of noise barriers:

- Reflective type,
- Absorptive type.

As well as barriers, materials can be categorized in the same way. Most commonly used materials for production of noise barriers are:

- Concrete,
- Wood,
- Metals (steel and aluminium),
- Transparent materials,
- Earth berms.

#### 3.1 Concrete

Concrete is one of the most commonly used structural materials, and as such is used in the construction for noise protection. Concrete barriers can be prefabricated (which are relatively expensive) or can be cast in-situ.



Fig 1. Concrete noise barrier

Main advantages of concrete as material for noise protection barriers are [2]:

- Flexibility in design,
- Acoustically effective,
- Durable and weathers well,
- Long design life.

Main disadvantages of concrete as material for noise protection barriers are [2]:

- High density which leads to large weight,
- It is often used without appropriate design,
- It can be difficult to ensure quality control with concrete cast in-situ

Strength of cement which is used must be at least 32.5 and mixture of aggregates must be in accordance with EN 12424, [3].

### 3.2 Wood

Wooden timber is often used for production of noise protection barriers. Not all types of wood can be used for barriers. Only coniferous wood (spruce, fir, pine) that is dried in the air can be used. Wood must be treated with proper chemical preservatives.

Main advantages of wood as material for noise protection barriers are:

- Treated timber can last up to 50 years,
- Aesthetically is often preferred by people,
- Simple and often easily available designs,
- Relatively fast construction times.

Main disadvantages of wood as material for noise protection barriers are:

- Acoustic integrity and shortened design life is a problem due to the prevalent use of inappropriate timber and poor design and construction,
- Timber is not easily cleaned, requiring painting over every time it occurs,
- Soil can rot timber and it is preferable that timber does not come into contact with soil.



**Fig 2.** *Wooden noise barrier*

Quality of wooden timber must be in accordance with EN 1611-1, [3]:

- Wooden structural elements, class G4.3,
- Back wall – wooden panels – class G.4.2,
- Front wall – class G 4.1.

### 3.3 Metals

Most often used metals in production of noise barriers are:

- Mild Steel,
- Stainless steel,
- Aluminium.

Mild steel is the least expensive and most common of all metals used in construction. It should be corrosion protected by hot galvanizing. Layer of zinc must be at least 76µm thick, [3]. It can also be coated with plastisols, bonded powders, and enamel paints or it can be produced as self protecting weathering steel. Aluminium and stainless steels are commonly used for absorption or deflection elements.

Main advantages of metals [2]:

- Can be made relatively lightweight and easy to fix,
- Dual leaf sheet metal systems or panels can be used for absorptive barriers using a perforated metal front face and a solid unperforated metal rear face. The cavity can contain fibre glass or other noise absorbing materials,
- Modular panel systems are available with the same advantages as modular concrete or timber panels.

Main disadvantages [2]:

- Surface finishes may not be visually suited to all locations,
- Relatively heavy framing and fixing may be required for steel panels,
- High rate of expansion in hot weather,
- Lightweight panels are easily damaged.



**Fig 3.** *Metal noise barrier*

### 3.4 Transparent materials

Main characteristic of transparent materials is to allow light to areas which otherwise be placed in the shadow of barriers. Panel material which are used for barriers are made of either glass or a clear plastic product such as Plexiglas, Lexan, or Acrylic. Glass panels are commonly made of single tempered or laminated tempered glass sheets. Both plastics and glass can be tinted. Transparent materials are noise reflecting and their use might be restricted where reverberation would cause problems.

Main advantages [2]:

- Allows for maintenance of views,
- Transparent panels can be used where a reduction in visual bulk is required,
- Improved public safety

Main disadvantages [2]:

- Expensive compared to alternatives,
- Glass easily broken, acrylic easily scratched;
- Glare from reflections of the sun or headlights,
- Plastics can be a fire hazard,
- High maintenance costs,
- Transparency can be affected by weather and temperature changes,
- Privacy of residential areas can be compromised.

### 3.5 Earth berms

Any type of earthy materials that provide stability can be used for earth berms. Quality of those materials must be in accordance with demands which are specified in specific technical conditions for groundwork.

Main advantages of earth berms [2]:

- Use of excess fill from road construction,
- Limited possibility for gaps developing, breakages or other acoustic integrity/maintenance issues,
- More aesthetically pleasing,

Main disadvantages [2]:

- Require a large amount of space,
- On certain ground, settlement may become an issue due to bund weight,
- May require more maintenance if grassed or inappropriately planted.



**Fig 4.** *Earth berms*

### **3.6 Other materials**

All other materials that are necessary for production of noise barriers like, adhesives, paints, etc.

## **4. CONCLUSION**

A wide range of different types of materials provides a rational choice of barrier materials with respect to acoustic and non-acoustic considerations as well as cost effectiveness.

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