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A NEW TYPE OF NOISE SCREEN CONSTRUCTED FROM AND BY LIVING PLANTS *

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SUMMARY

Results are presented concerning sound abatement measurements of a new type of sound screen consisting of either still growing willow plants alone, or a combination of willow plants and a metal plate clamped between the plants. The combination of the metal plate with the plants has been found to behave as a conventional noise screen. The screen consisting of a double row of willow plants only shows sound attenuation in the high frequencies after one year of growth. In an actual situation along a highway good sound abatement results have been found. As a part of the landscape this type of willow-woven noise screen fits in very well and is accepted by the populace. Depending on soil characteristics different willow-species or other plant genera can be used or will be favoured when necessary.

INTRODUCTION

In 1979 the Nederlandse Stichting Geluidhinder (Dutch Noise Pollution Foundation), in cooperation with the Ministry of Health and Environment, organised a contest to invite designs for different types of noise screen. One of the winning designs was the so-called "Wilgenweefsel" (Willow-woven screen)**, which was designed by the landscape architect F.D.G. Prins (1).
A government grant was given to start a research project concerning this growing willow-woven screen in 1983. During 1983 and 1984 a screen was established along the A15 highway in Sliedrecht, and three types of experimental screens were planted in the Botanical Garden of the Nijmegen University to study visual, acoustical and pland physiological aspects of these screens. The three types in Nijmegen are the "metal-plate", the "single-row" and the "double-row" willow-woven screen. The main aim of these last types is to study the sound attenuation increase during expansion of the willow-plants during a number of growth seasons. The research is part of a project on sound propagation in vegetation (2), ground effect studies (3) and vegetation-characteristics (4,5).

MATERIALS AND METHODS

The design of the still growing willow-woven noise screen is given in Fig. 1. Along the highway in Sliedricht in 1983 100m and in 1984 an additional 300m have been planted. After some years of growth the temporary support (Fig. 1, no 5) can be removed, since the willows will develop a huge root-mass forming a natural foundation. The "single-row" screen planted in Nijmegen is much more in accordance with the original design. In dry summer the drain is used to provide supplements of water when necessary. Three willow-species are used in the screen: Salix alba, S. viminalis and S. triandra, which have been provided

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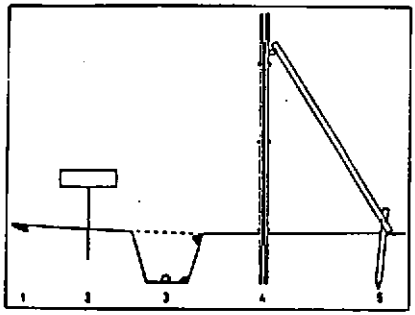

Figure 1.
Schematic outline of the construction plan of the willow-woven screen. 1. edge of the asphalt road; 2. bank and crash-barrier; 3. drain; 4. willow-woven screen with metal plate in between; 5. temporary support.

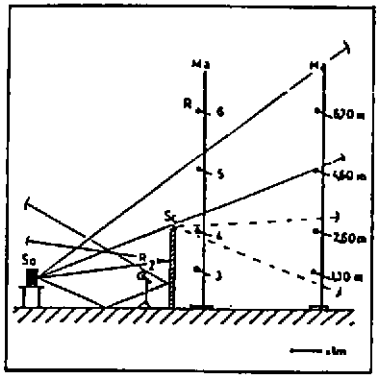

Figure 2.
Measurement of sound attenuation. So: sound source, 5 m in front of the screen; Sc: willow-woven screen; Ma: masts with receivers, number and height indicated; R: receiver.

from the numerous willow-coppices in the Netherlands. Fig. 2 summarises the acoustic methods to investigate the noise attenuation of the screens. The sound source (Fig. 2, So) is either a Dynacord D310 speaker or a Nivico-JVC point source turning with a frequency of 3 Hz. A reference microphone is used in all experiments (Fig. 2, R2). Reference measurements are carried out on grass fields adjacent to the screens in order to have comparable acoustic soil impedances. A full description of the measuring equipment and an analysis of the recorded sound levels is given elsewhere (6).

RESULTS

Fig. 3 shows the sound attenuation of two of the experimental screens in Nijmegen after the first growing season. In Fig. 3a the attenuation of the "metal-plate" screen is shown and in Fig. 3b the attenuation of the "double-row" screen is shown, both compared to the grass field reference experiment. For all receiver heights results are shown. In order to compare the results, Fig. 4 shows a combination of the measurements at two microphone heights.
Fig. 5 shows the sound attenuation of the "metal-plate" screen along the highway in Sliedrecht. The experiment was carried out at night to avoid traffic noise. The sound source used was the Dynacord speaker. A reference experiment was carried out above the adjacent field. Before and after the enlargement of the noise screen from 100m to 400m, sound levels were measured within 200m distance from the highway. Some results are shown in table 1. Full results have been published elsewhere (1).

From table 1 it is clear that the willow-woven screen with the clamped metal-plate functions as a conventional concrete or steel noise screen. A survey among the people living behind the screen has revealed that the population are well contented with the screen.

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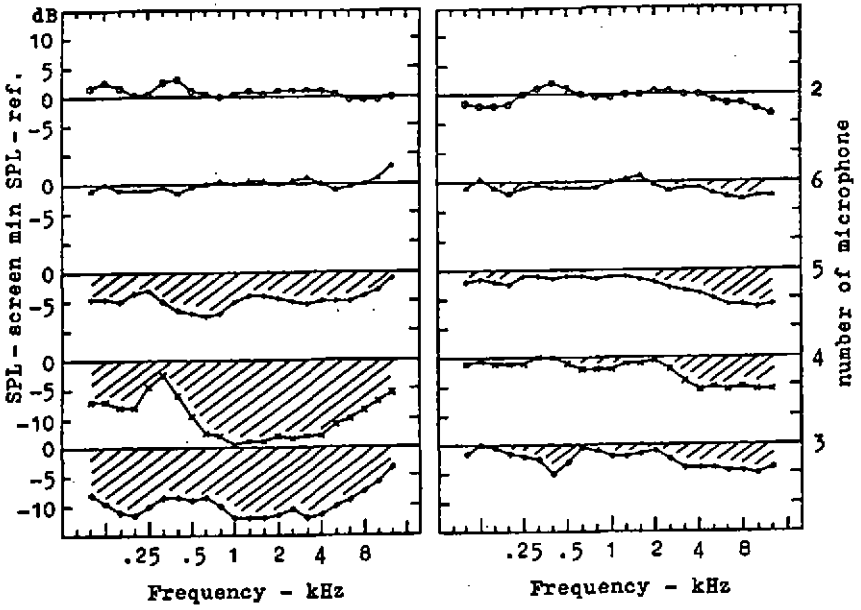

Figure 3a. Figure 3b.

Sound attenuation of two experimental willow-woven screens in Nijmegen. Arrangement according to Fig. 2. So: the Nivico-JVC point source 0.83m above the street-surface. Fig. 3a shows the attenuation of the clamped "metal-plate" screen; Fig. 3b of the "double-row" screen. The distance between Sc and Ma equals 5m.

Table 1.
Traffic noise levels before and after enlargement of the noise screen.

description of measuring site	distance (m) to road axis	Leq in dB(A),date:	
		831207	840214
behind the first 100m screen	23	67	67
behind the enlarged 400m screen	23	73	66
dwellings behind the first screen	110	66	63
dwellings behind the enlarged screen	90	67	64
in the residential area	175	60	59

DISCUSSION

Since the results of the "metal-plate" screen are comparable with conventional noise screens, this type of screen has now been accepted in noise abatement measures (7). Results for the experimental screens without a clamped metal-plate show that a "double-row" willow-screen already gives some attenuation in the high frequencies in the first year of planting (Fig. 4).

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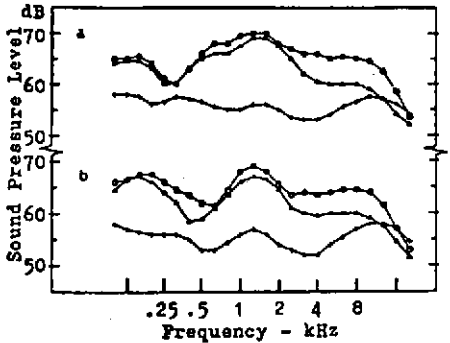

Figure 4.

Comparison of sound attenuation of the experimental screens for two receiver heights: cluster a : microphone height 2.60m; b: 1.30m above the soil surface.
o :grassfield and "single-row";
:"double-row" without plate;
+ :clamped "metal-plate" screen.

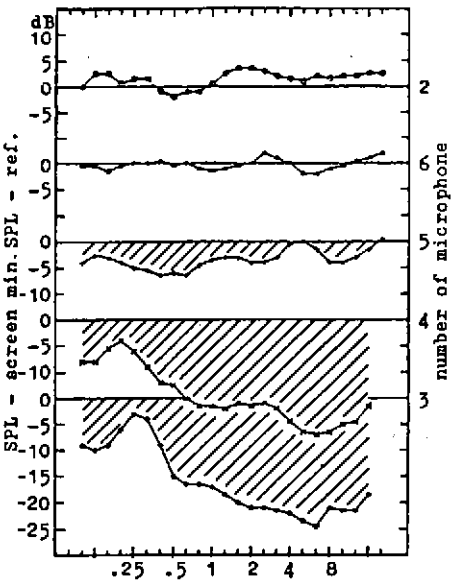

Figure 5.

Fig. 5: Sound attenuation of the willow-woven "metal-plate" screen in Sliedrecht. So: Dynacord speaker; distance Sc to Ma is 5m (Fig.2)

The sound attenuation will improve when, in the years to come, the willow-plants thicken during the growing season. The first results with Salix acutifolia, a species better suited to dry soil types, are encouraging. Other useful plant-species to be used are for example: Acer campestre, Alnus glutinosa, Fraxinus excelsior and Robinia pseudoacacia (1). In long term planning, a combination of these screen with vegetation belts and plantings may be useful, since these can attribute extra attenuation (8) and can be used to manipulate the microweather (9).

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