Bamboo plants as a noise barrier to reduce road traffic noise

Invited paper

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• How does sound with acoustical shielding work
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Introduction - Possible Kinds of Vegetation

Vegetation barriers can give some effect in shielding noise sources.

It may not deliver the highest results in sound damping but they do have extra advantages:

- Air quality
- Ecological values
- Acceptance by society

People do not appreciate noise barriers not only on noise reduction, but also based on their appearance. A vegetation screen is much more positively appreciated.
Possible Kinds of Vegetation

- Road traffic noise
- Noise energy in the frequency range 250-1000 Hz.
- Evergreen vegetation
- Size/dimensions of the leaves (and of the stems as well) is important
- Dimensions of the complete vegetation (height, width and length)
- Planting schedule
- Type of soil
- Maintenance
- Costs
Possible Kinds of Vegetation

A selection by the students of Wageningen University resulted in four species:

• Holly
• Bamboo
• Viburnum/Arrowwood
• Willow

The Willow needs a soil filling between the sides of a screen.
Possible Kinds of Vegetation

Based on literature the noise reduction was determined

To reach a noise reduction comparable to a massive screen, a thicker fence is necessary

A ‘screen’ with a 6 meter thickness

The noise reduction in literature between 3.5 and 30 dB(A)
Possible Kinds of Vegetation

Bamboo was chosen from a practical point of view

• Rapid growth
• Frost resistance
• Salt resistance
• Little defoliation (traffic safety).
Possible Kinds of Vegetation

Chosen for the bamboo sort:
Fargesia Robusta in combination with one row of Nahira Drake

- Approximately 5 meter
- Robust
- Frost, salt and disease resistant
- A dense growth offers the highest reduction in noise

To prevent overhanging plants, one row of Nahira Drake, a stiff upright bamboo species, will be planted on the side of the road.
Noise barriers

The diffraction of the noise.
• Based on the detour of the sound ray
• Reduction is also dependent on the curvature of the noise over the screen

The noise insulation.
• A limited isolation will ensure that the effect is less because there is also a noise contribution the leakage transmission
• Very relevant for bamboo screens
Noise barriers and reflections

This has to do particularly with the acoustic absorption of the barrier.

Reflections on the screen at the opposite side of the road

Reflections as a result of the double-sided placement of barriers

The reduced effect of the screen by reflections on vehicle and screen
Research on Sound Isolation

The sound isolation through the vegetation is the most significant aspect:

• A restricted function or with no function at all

• Noise measurements on an existing bamboo grove with a height of approximately 5 meters and a thickness of 2.5 meters
Measurements

\[ D_{\text{bamboe}} = \frac{[ (L_{p,1} - L_{p,2}) - (L_{p,3} - L_{p,4}) ]}{2.5} \text{ [dB/m]} \]
Measurement results

Damping through the vegetation per octave band frequency of a bamboo grove with a thickness of 6 meters.
Shielding effects of a massive screen and of a bamboo barrier along a provincial road with two single lanes.

The effect of the screening with a massive barrier of 3 meters along a provincial road with two single lanes, 80 km/h-road

The effect of the screening of the bamboo barrier along a provincial road with two single lanes, 80 km/h-road
Shielding effects of a massive screen and of a bamboo barrier along a highway.

The effect of the screening with a massive barrier of 3 meters along a major road, 130 km/h with 2x2 lanes

The effect of the screening of the bamboo barrier along a major road, 130 km/h with 2x2 lanes
Extra noise reduction and RESWING

- Refraction of sound by windinduced gradients
- A lower diffraction effect due to affecting the transmission over barriers
- Caused by the presence of strong gradients in the horizontal component of the wind speed in the zone above the barrier top
- A strong downward refraction of sound into the acoustic shadow zone

The top of a bamboo ‘noise barrier’ will cause less gradients in the horizontal component of the wind speed in the zone above the barrier top. So we expect less RESWING effects.

Source: Comparing downwind shielding of noise walls and berms, Timothy Van Renterghem, Dick Botteldooren InterNoise 2012
Extra effect and possible advantage

The noise levels of the traffic noise will be masked by the rustling of bamboo.
Measurements for validations

- Various wind directions
- Various wind speeds
- Various meteorological situations
- Various traffic flows

⇒⇒ Long term measurements

Proposal for microphone set up

Also air quality measurements
Summery and Conclusions

• A real possibility to use living green noise barriers along roads
• Expected to be more positively appreciated
• The most critical factor, is the sound isolation by leakage transmission noise
• A noise barrier of 5 meters and a thickness of 6 meters has a noise shielding effect comparable to a massive noise barrier of 3 meters
• Expectation that the effect of bamboo is better than calculated because of less RESWING effects
• Extra advantages: air quality, masking effects
Thanks for your attention

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