

# 방음벽의 음향위상최적설계에서 강체와 다공성 재료의 배치에 관한 연구

## Research on the layout of both rigid and porous materials in the acoustic topology optimization for noise barrier

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1.

$$k_p = k_a (1 + 0.0978 (\frac{\rho_a f}{\sigma})^{-0.7} - i0.189 (\frac{\rho_a f}{\sigma})^{-0.595}) \quad (2)$$

가

$$Z_p = Z_a (1 + 0.057 (\frac{\rho_a f}{\sigma})^{-0.734} - i0.087 (\frac{\rho_a f}{\sigma})^{-0.732}) \quad (3)$$

Delany - Bazley

$$\frac{1}{\rho_e} = \frac{1}{\rho_a} + (\frac{1}{\rho_r} - \frac{1}{\rho_a}) \times \gamma_{e,1} + (\frac{1}{\rho_p} - \frac{1}{\rho_a}) \times \gamma_{e,2} (1 - \gamma_{e,1}) \quad (4)$$

### 2. FEM

2.

(1)

weak formulation

(5)

(2), (3) Delany - Bazley

$$\int_{\Omega} \frac{1}{\rho} \nabla \tilde{p} \cdot \nabla p d\Omega - \int_{\Omega} \frac{\omega^2}{\rho c^2} \tilde{p} p d\Omega = \int_{\Gamma} \frac{1}{\rho} \tilde{p} \nabla p \cdot \mathbf{n} d\Gamma \quad (1)$$

Min  $\phi(\gamma)$

$$\text{Subject to } \sum_{e=1}^{NE} \gamma_{e,1} v_e / \sum_{e=1}^{NE} v_e - \beta_{rigid} \leq 0$$

$$\sum_{e=1}^{NE} \gamma_{e,2} v_e / \sum_{e=1}^{NE} v_e - \beta_{porous} \leq 0 \quad (5)$$

$$\gamma = [\gamma_{1,1}, \dots, \gamma_{NE,1}, \gamma_{1,2}, \dots, \gamma_{NE,2}]$$

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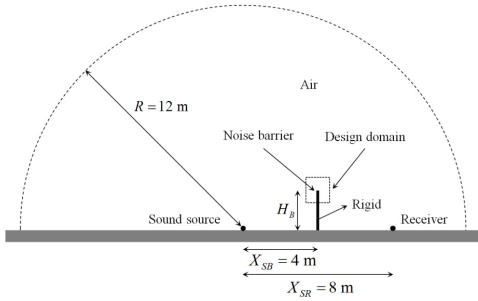


Figure. 1 Geometry of acoustic domain and design domain.

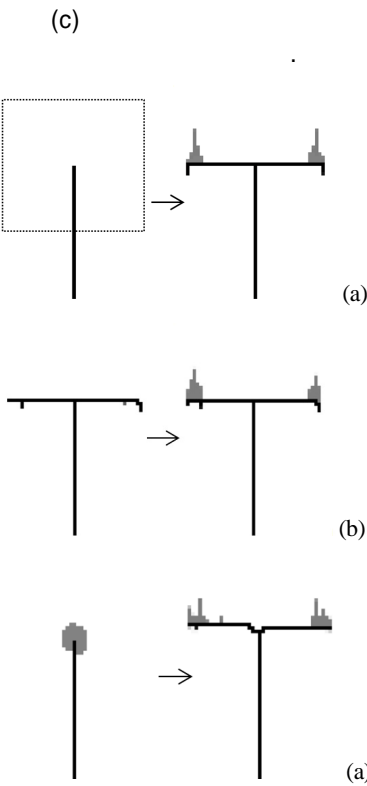
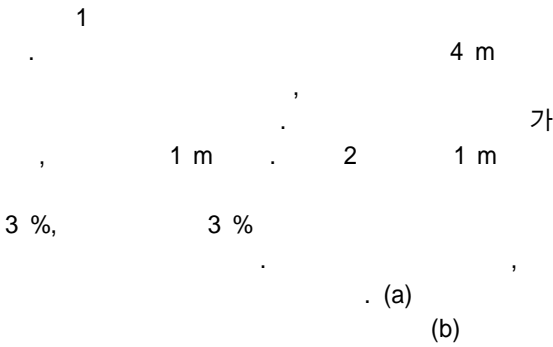


Figure. 2 Optimization results for 1 m height barrier.

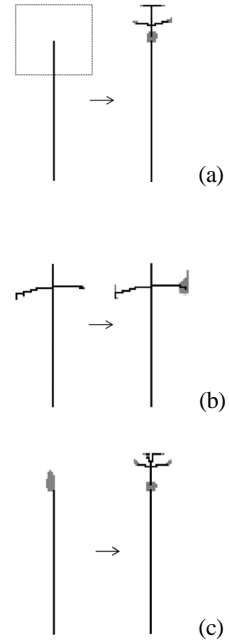
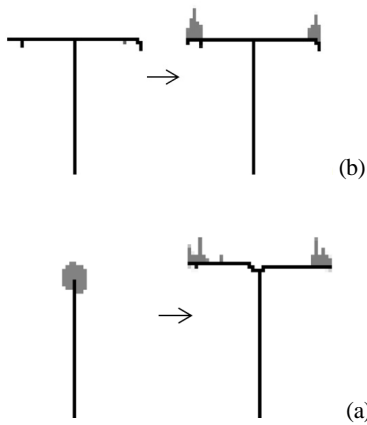
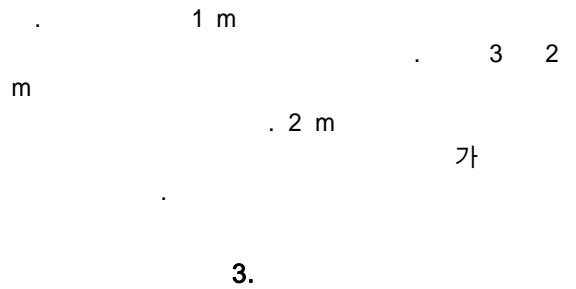


Figure. 3 Optimization results for 2 m height barrier.



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