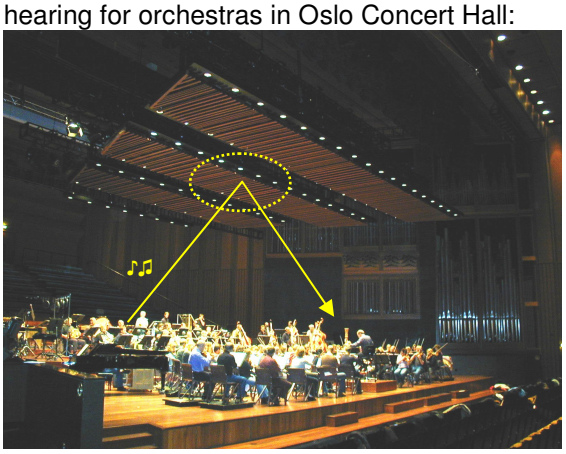
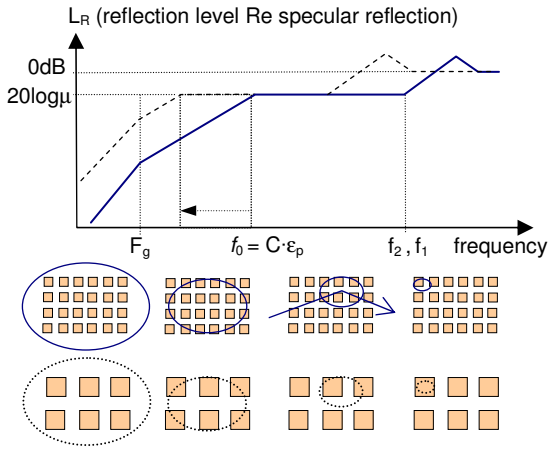
M Skålevik, Brekke & Strand Akustikk, Oslo Norway: www.akutek.info

Low Frequency Limits of Reflector Arrays

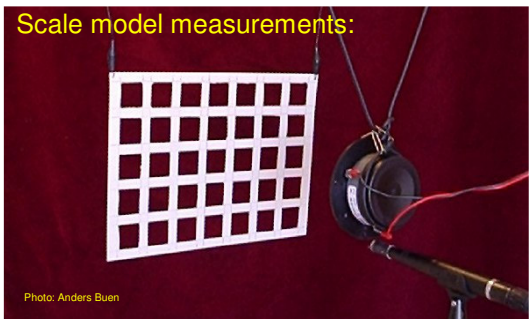
Panel array canopy for improved mutual hearing for orchestras in Oslo Concert Hall:



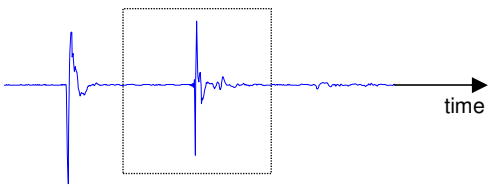
Hypothesis: (below) Cut off frequency f_0 is proportional* to the panel edge density ε_p. F_g, f_1 and f_2 are related to Fresnel Zone size (ellipses), and correspond to Rindel's limits;



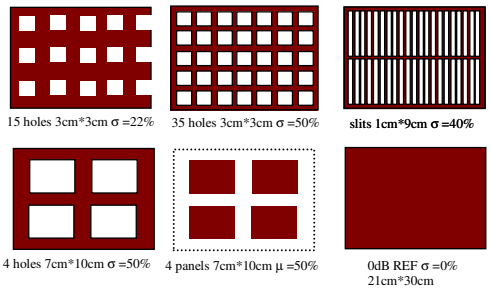
ε_p = panel edge length / panel area
μ = panel area / array area



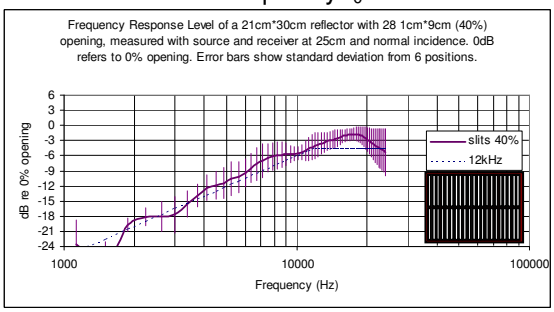
Reflector response extracted from IR:



Scale models tested:
Selection of scale models varying in edge density ε_p and panel density μ:



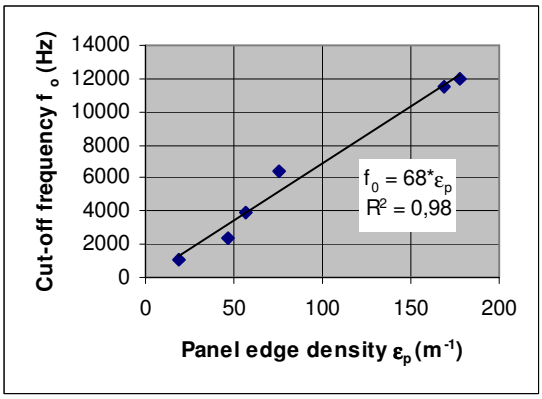
Result example: Reflector surface density μ = 0.6 and panel edge density ε_p=105m^{-1}; Best match cut-off frequency f_0 = 12kHz.



Trend from measurements (diagram below):

$$f_0 = 68 \cdot \varepsilon_p$$

where 98% of f_0 variance is due to ε_p variance.



Example of prediction from trend analysis:

Panel array of 50cm*50cm elements has panel edge density ε_p = 8.0m^{-1}

Prediction: Cut-off frequency f_0 =540Hz

* Theory predicts $f_0 = 41 \cdot \varepsilon_p$, see Proceedings