PERFORMANCE ENHANCEMENT STUDY OF ACOUSTICAL PRIVACY SCREENS

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INTRODUCTION

Modular office furniture systems are used extensively in the design and layout of open office spaces. To enhance auditory privacy, modular privacy screens often incorporate acoustically absorptive elements to help reduce intelligible sound from being transmitted to adjacent workspaces or public areas.

Teknion Furniture Systems is involved in the design and manufacture of modular office furniture, including privacy screens. Each screen is based on a constructed metal frame, in which electrical or mechanical services for the workspace may be integrated. On either side of the frame, modular elements are clipped in, effectively making the screen a double-walled partition. Historically, acoustically absorptive elements have been constructed from a solid steel pan of variable thickness, containing fibreglass batt insulation of variable density, and faced with acoustically transparent cloth or vinyl. The study described herein was undertaken to identify alternative methodologies toward improving the acoustical performance of these elements, while maintaining the cost competitiveness of the finished product.

METHODOLOGY

Acoustically speaking, the design challenge was to identify new potential configurations for the acoustical elements which would improve the Noise Reduction Coefficient (NRC) of the screen without substantially diminishing its sound transmission performance. In the open office environment, much of the sound between workstations is transmitted *over* the screen, not *through* it. Thus the importance of the Sound Transmission Class (STC) value of a screen in an actual office installation is dependent on a number of factors, including the proximity of the talker and the listener to the screen, the heights of both the talker and the listener relative to the top of the screen, the type of ceiling in the office, and the frequency spectrum of the talker's voice. It is apparent that the STC of the screen need only be enough to prevent sound transmitted through it from being more important than sound transmitted over it.

To rationalize the importance of sound transmission from one side of the screen to the other, a "worst case" scenario was hypothesized in which a sitting male talker speaks directly at the screen (e.g. while using the phone) and is heard by a listener sitting directly opposite on the other side. Both talker and listener are assumed to be only 0.5 m from the screen, and 0.75 m below its top (for a 2 m high screen). The ceiling is assumed to be very high or very absorptive, and does not reflect any sound over the top of the screen. Under this scenario, the total A-weighted sound pressure level (LpA) reaching the listener's ears via both paths (i.e. over the screen and through it) may be calculated.

An analytic multiple-layer model was developed to predict both the NRC and LpA (as defined above) of various element configurations. Estimates of sound absorption and transmission through the panel were based on published models [1], modified to account for air absorption properties and panel leakage factors, and a more accurate model for sound propagation through bulk absorbing media [2]. Estimates of the resulting LpA utilized a typical male speech spectrum as described in [3], and well-known equations for diffraction over barriers. The model concentrated on the differences between a given configuration and the existing design (i.e. Δ NRC, Δ LpA) rather than the absolute values.

MODELLED CONFIGURATIONS

For brevity, only the important results are described below, for a standard single acoustical element (double and triple elements with higher performance ratings are also manufactured by Teknion).

<u>Benchmark (existing) Single Element:</u> 13 mm thick fibreglass batt, 24 kg/m^3 density, in nominal 13 mm deep 24 g steel pan.

<u>Increased Batt Thickness / Density:</u> Increasing thickness of batt to 16 mm provides Δ NRC of +0.04. Increasing density to 64 kg/m^3 without changing thickness also provides Δ NRC of +0.04. Increasing both thickness and density simultaneously provides Δ NRC of +0.12.

<u>Perforated Pan:</u> Only low percentage perforations are acceptable from the standpoint of sound transmission performance. Δ NRC considerably higher for some combinations of porosity and perforation hole diameter. Predicted improvements in Δ NRC range from +0.04 to +0.18, with corresponding increases in Δ LpA of +2 to +4.

<u>Batt Stood Off Pan:</u> 3 mm batt behind gap modelled. For both solid and perforated pan, additional improvement in Δ NRC predicted for some configurations.

<u>No Pan, Foil Backing on Fibreglass:</u> Substitution of solid steel pan by foil backing on fibreglass provides improvements in Δ NRC from +0.04 to +0.15, depending on fibreglass density. For some configurations, corresponding increase in Δ LpA may be unacceptable.

RESULTS AND DISCUSSION

Based on the modelled results and both economic and technical considerations, revised element configurations were selected which incorporated a slightly thicker fibreglass layer, in conjunction with a perforated back pan having low percentage, small diameter perforations. Modified prototype screens were tested in an ASTM accredited laboratory, and were found to exhibit NRC values on the order of +0.15 higher than the corresponding benchmark models. The prototype screens were also found to have STC ratings only 2 to 3 points lower than the corresponding benchmark models, which roughly corresponds to a 2 dB increase in LpA. As a 2 dB increase in transmitted sound is unlikely to be perceptible to most individuals, and the increased NRC will create a "softer" acoustical environment inside the workspace, the modified screens are hoped to be a popular item.

Teknion begins full production of the modified acoustical screens in January 1998.

REFERENCES

[1] Beranek, L.L., Ver, I.L., *Noise and Vibration Control Engineering*, Sec. 9.7, Wiley & Sons Inc., 1992.

[2] Bies, D.A., Hansen, C.H., *Engineering Noise Control*, Appendix C, E & FN Spon, 1996.

[3] ANSI S3.5, American National Standard Methods for the Calculation of the Articulation Index.