Extra Edge Damping as a Way to Improve Sound Insulation of Window Structures

Aleksey Nikolaevich Puzankov, Dmitry Lvovich Shchegolev, Vladimir Aleksandrovich Tishkov and Vladimir Nikolaevich Bobylev

Nizhny Novgorod State University of Architecture and Civil Engineering, Nizhny Novgorod, Russia.

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The article presents the experimental data of research of sound insulation of window structures using supplementary damping along the perimeter of the translucent portion of the protection with a strip of non-transparent vibration-damping material (edge damping). The authors considered a method for calculating double translucent protective structures with edge damping. They gave versions of possible design solutions for these protective structures.

NOMENCLATURE

IGU — insulating glass unit
ISO — International Organization for Standardization
NNGASU — Nizhegorodsky Gosudarstvenny Arkhitekturno-stroitelny Universitet (Nizhny Novgorod State University of Architecture and Civil Engineering)

1. INTRODUCTION

Nowadays the increasing sound pollution of urban areas makes it critical to improve sound insulation of outer protective structures of residential and public buildings, particularly those of windows. There are several ways to increase the sound insulation of windows without significantly increasing the material consumption and complexity of the design. Let us consider one of them.

2. WAYS TO INCREASE SOUND INSULATION USING THE ADDITIONAL DAMPING

Extra damping of glasses of protection is widely used in modern window structures, and specifically to improve their sound insulation. There are several methods to use extra damping to improve the sound insulation properties of translucent protection:

- method No.1 — damping with a transparent film on the outer surface of the pane;
- method No.2 — damping with a transparent material connecting two layers of the pane (triplex);
- method No.3 — use of non-transparent damping material in certain areas of glazing (e.g., along the perimeter of the structure).

The impact of damping methods No.1 and No.2 has been discussed by many researchers, in particular, by D.V. Murygın, A.A. Kochkin, J.G. Lilly, N. Garg, U. Keller, J. Schimmelpenningh and others. In these and other researches, the results proving the efficiency of these ways of damping for improving sound insulation of various types of translucent enclosing structures are presented.

The third method is now scarcely studied, despite the fact that its application may allow to significantly improve the sound insulation due to the slight reduction of translucent area of the structure. In his paper I.I. Bogolepov discussed the double polymethylacryl structure in which a special elastic material applied on the perimeter of the glazing, served for the acoustic separation of protection plates and prevention of occurrence of sound bridges; however, the effect of this material as a damping one has not been discussed.

Currently, there are effective self-adhesive damping materials based on different types of polymer mastics having a loss factor \( \eta = 0.3–0.4 \). It is proposed to use such materials for pasting the perimeter of the transparent portion of the protection. These materials are relatively inexpensive and their costs are low, since the glass area to be covered with these materials is small. Such materials include, in particular, “BiMast Bomb” \(( \eta = 0.4 \)) , which is proposed to be used in subsequent experimental studies of the method.

3. THEORETICAL STUDIES OF POSSIBLE INCREASE OF SOUND INSULATION USING ADDITIONAL DAMPING

Consider the theoretical possibility of pasting the strip of opaque vibration cushioning material around the perimeter of translucent walling (edge damping) to improve the design of sound insulation.

Since the single-layer translucent structures are practically not used in modern construction practice, the studies on the effect of regional damping on sound insulation of translucent walling should be carried out for the double structure with an air gap.

Theoretical studies of sound insulation of walling of buildings and structures in the NNGASU Laboratory of acoustics are carried out on the basis of the wave fields self-coupling theory (hereinafter — the WFSC theory) developed by a scientific school of Professor M.S. Sedov. Since there aren’t many materials on this subject in English sources, the following ground expressions describing the sound insulation of double walling with an air gap are demonstrated here.

According to the WFSC theory, the walling structure makes a wave motion under the influence of incident sound waves, which involves its own (free) and forced (inertial) waves.

Resonant passage of sound is determined by the degree of the wave fields self-coupling in front of and behind the walling and by the wave field made by own oscillations of the plate. The bigger the self-coupling of sound fields is, the more intense the sound will penetrate through the barrier. Inertial pas-