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Acoustic Performance of Sliding Façade Windows and Doors: Impact of Sealing Systems, Locks, and Integrated Roller Shutters

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- No information that could identify the products or clients was disclosed in this work, ensuring the confidentiality of the data.

Motivation

- The lack of scientific exploration in the area of acoustic performance of facade frames;
- This research is the begin of my doctorate research that is to develop a method for predicting the acoustic performance of facade frames;
- For the continuation of this research, we invite partners who are interested in collaborating by providing materials.
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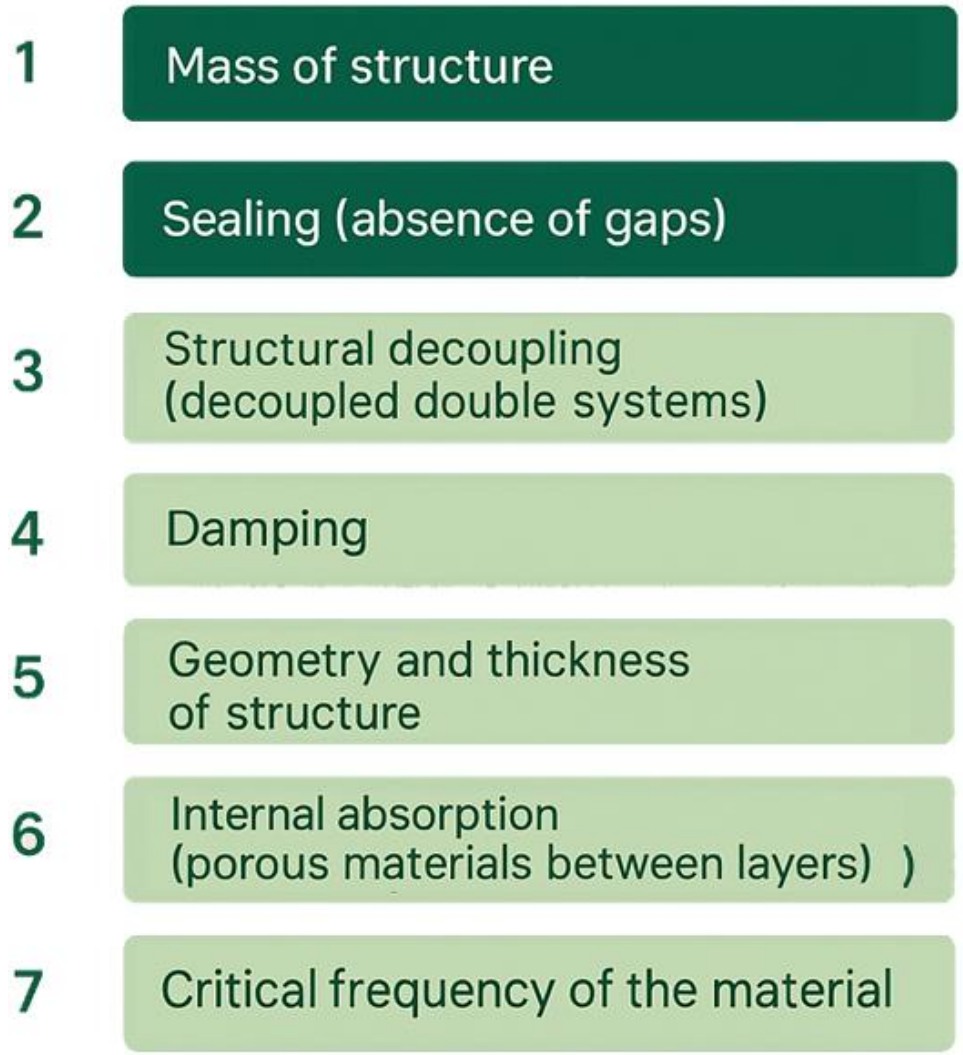
Introduction

- Frames (windows and balcony doors) are the most vulnerable element of the facade in acoustic terms;
- Low mass and the presence of moving components make them more susceptible to sound transmission and leakage;
- The ABNT NBR 10821-4 (2017) standard establishes the classification of the acoustic performance of frames;

Introduction

- To improving acoustic insulation, people often think of increasing the system's mass. This is a correct but incomplete concept;
- There are other factors that can significantly influence.



Introduction

- The effect of gaps is often overlooked by developers;

- The existence of gaps and their respective sealing components, such as brushes, foams and rubber gaskets, can significantly influence acoustic performance.

Previous Research

Reference	Condition / Typology	Effect on sound insulation (Rw / loss)
Belis & Bleecker	Low closing pressure	≈ –3 dB
Belis & Bleecker; NBS (USA)	Damaged sealings	–2 to –8 dB
Baring	1) No sealing (glass + louvered)	Rw ≈ 12 dB
	2) Additional glass without sealing	Rw ≈ 14 dB (+2 dB only)
	3) Glass with brush seals	Rw ≈ 25 dB
Nurzyński; Utida	Air permeability	Direct correlation with sound insulation

General remarks:

- Mass increase is largely ineffective without proper sealing.
- Gaps or sealing failures strongly compromise acoustic insulation.

Goals of This Work

- Objective: To categorize sealing components according to ABNT NBR 10821-4:2017 performance classes to assess their correlation with different performance levels.

Method

- Comparison of construction characteristics vs. Rw values
- Database: **396 laboratory tests** in IPT **(2017–2025)**
- Conducted under ISO 10140-2
- Scope: **Glazed sliding façade window frames** of aluminium, PVC and wood.

Method

Performance Classification of ABNT NBR 10821-4:2017:

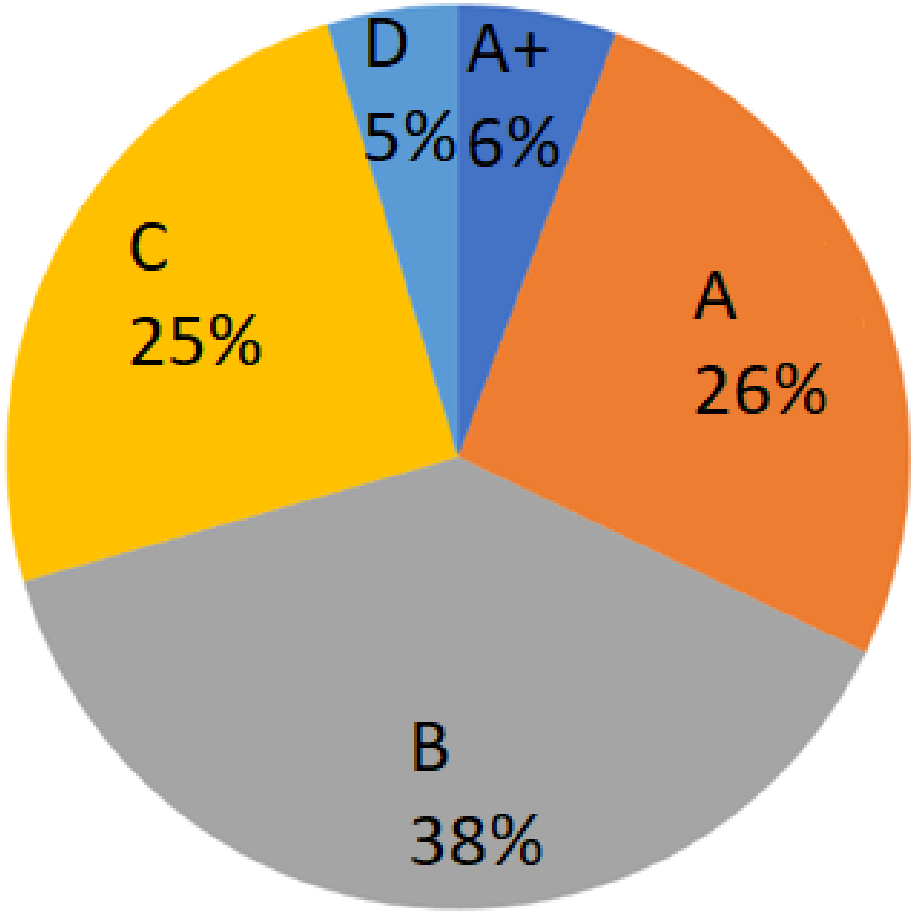
Class	Rw (dB)	Description
A+	Rw ≥ 36	Added by the authors for differentiation
A	30 ≤ Rw < 36	The maximum (35 dB) was also added by the authors for differentiation
B	24 ≤ Rw < 30	
C	18 ≤ Rw < 24	
D	Rw < 18	

Method

Element	Code	Description
Glass Type and thickness	C &"number"	Monolithic glass's thickness in mm
	L &"number"	Laminated glass and its thickness in mm
	I &"number"	Insulated glass and its thickness in mm
	LI &"number"	Laminated insulated glass and its thickness in mm
Sealing Elements[123]	E	Brush
	E1	Brush with barrier
	E2	Brush with a double barrier.
	E3	Brush with a triple barrier.
	E4	Brush with a quadruple barrier.
	R	Elastomeric profile
	P	Plastic foam
	Q	Foam core profile with polymer coating
Lock Types	KN	Latch-type lock
	UM	Shell-type lock
	SN	Crescent-type lock
	TN	Standard Cremone lock
	TL	Cremone lock with lifting or pressure mechanism
	W	No lock
Shutter Condition	XB	No shutter
	AB	Activated shutter
	DB	Deactivated shutter

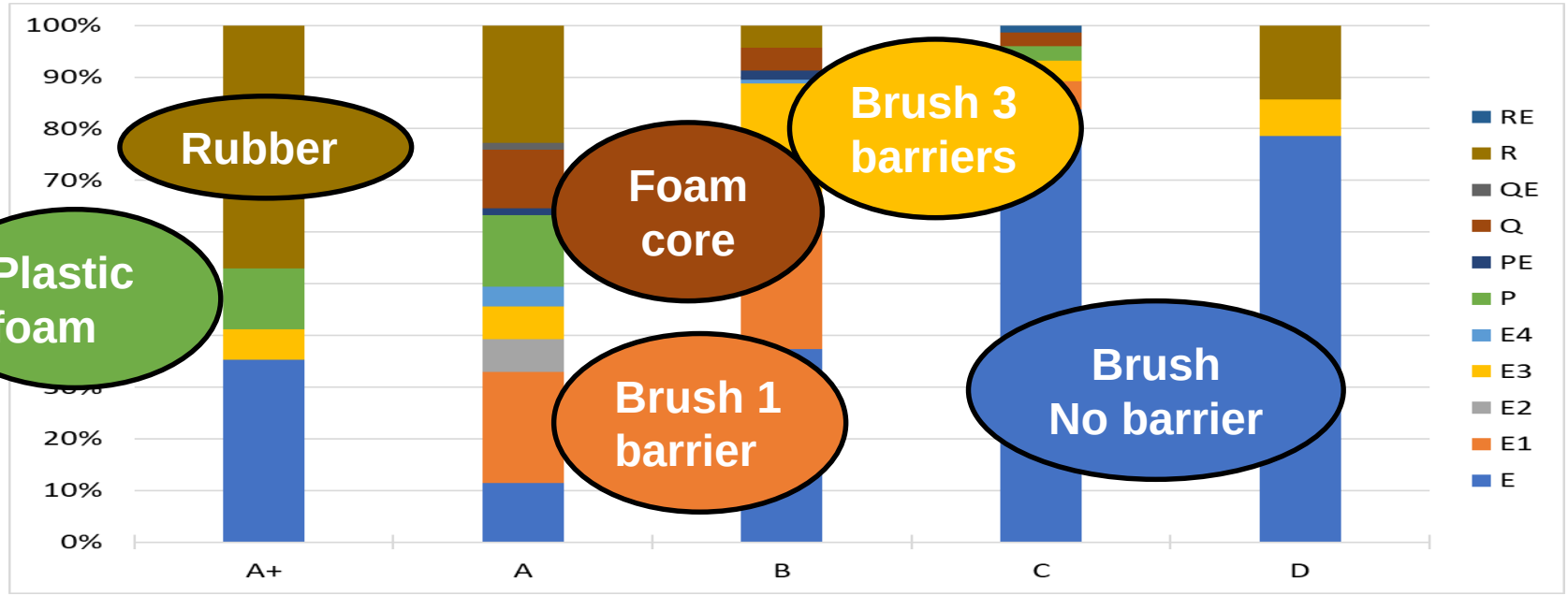
Results

General scenario of the acoustic performance of Brazilian windows from 2017 to the present



Results

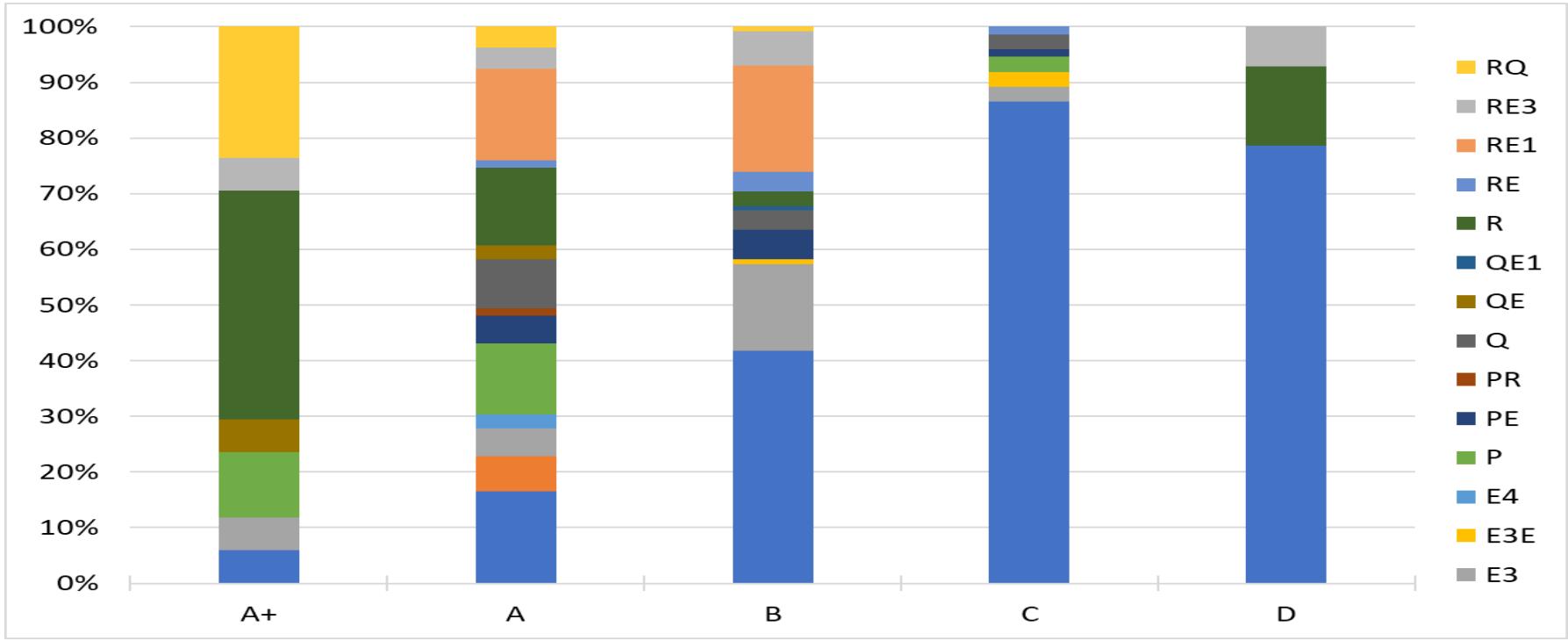
Sealing Between Sash Rails and Upper/Lower Tracks of the Frame



- Classes A+, A and B: Greater presence of **plastic foams**, **rubbers**, **foam core**, **brush+barriers and other combinations.**
- For classes C and D: majority presence of common brush

Results

Sealing Between Central Mullions of the Sashes

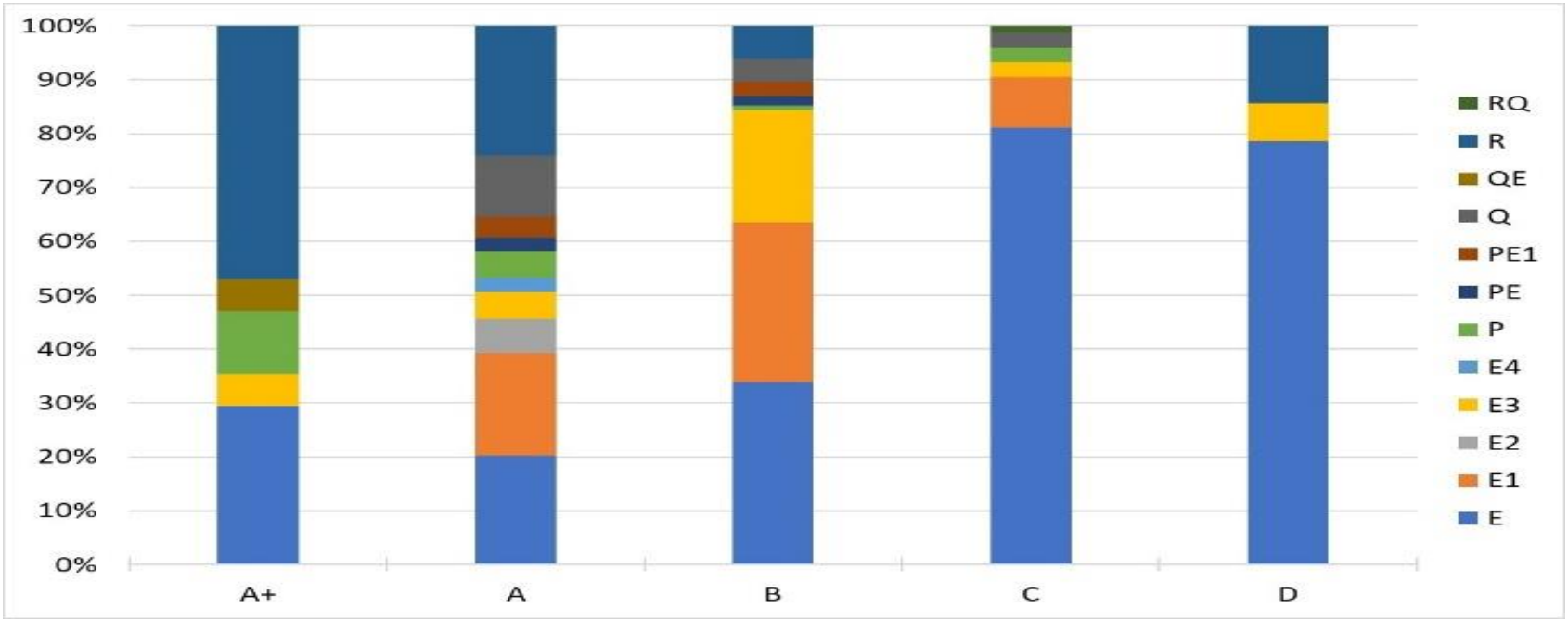


Similar results

- Classes A+, A and B: Greater presence of **plastic foams**, **rubbers**, **foam core**, **brush+barriers and other combinations.**
- For classes C and D: majority presence of common brush

Results

Sealing Between Sash Mullions and Frame Mullions



Similar results

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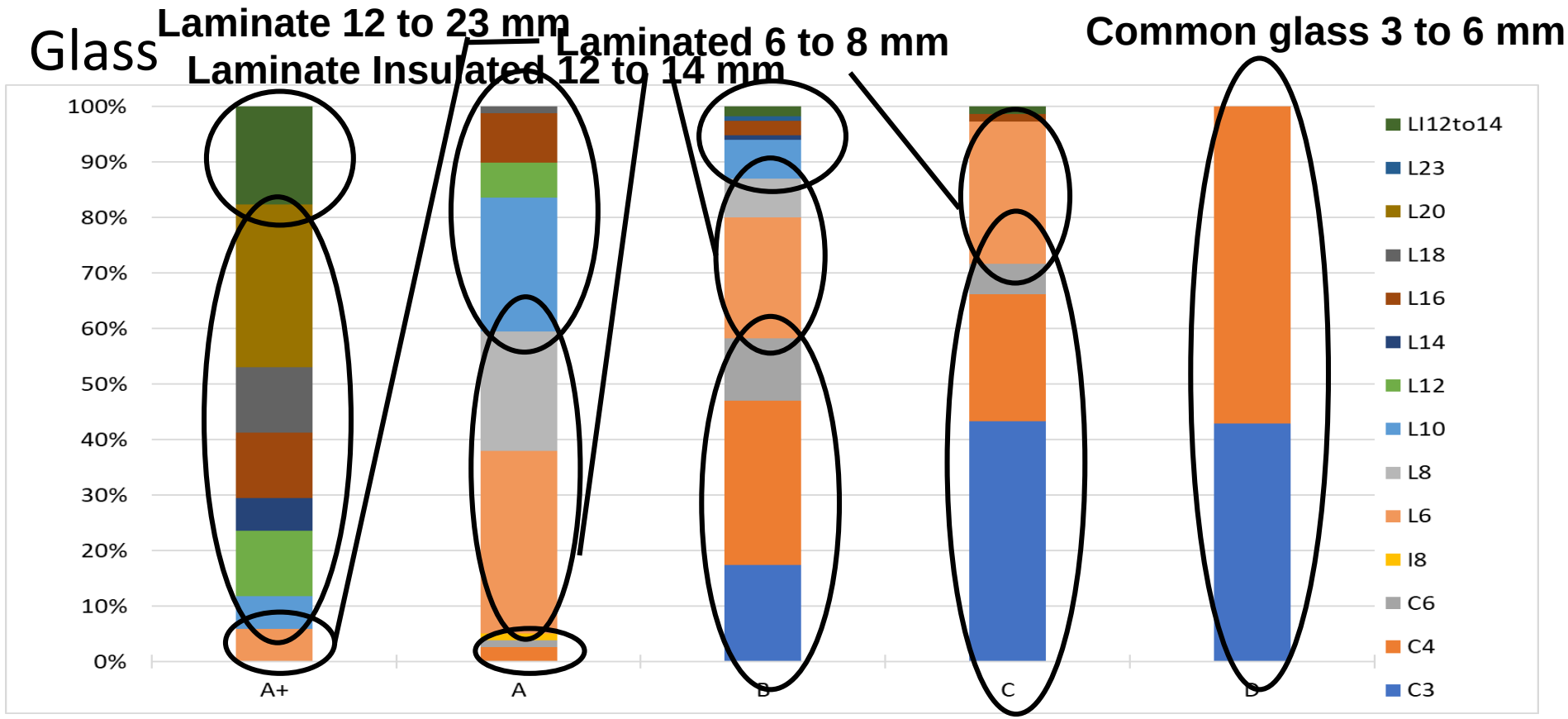
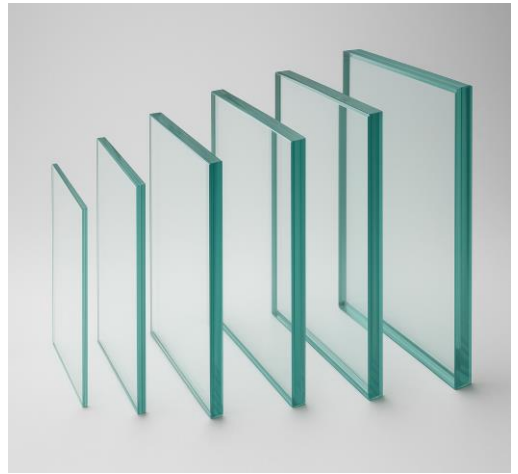
Results



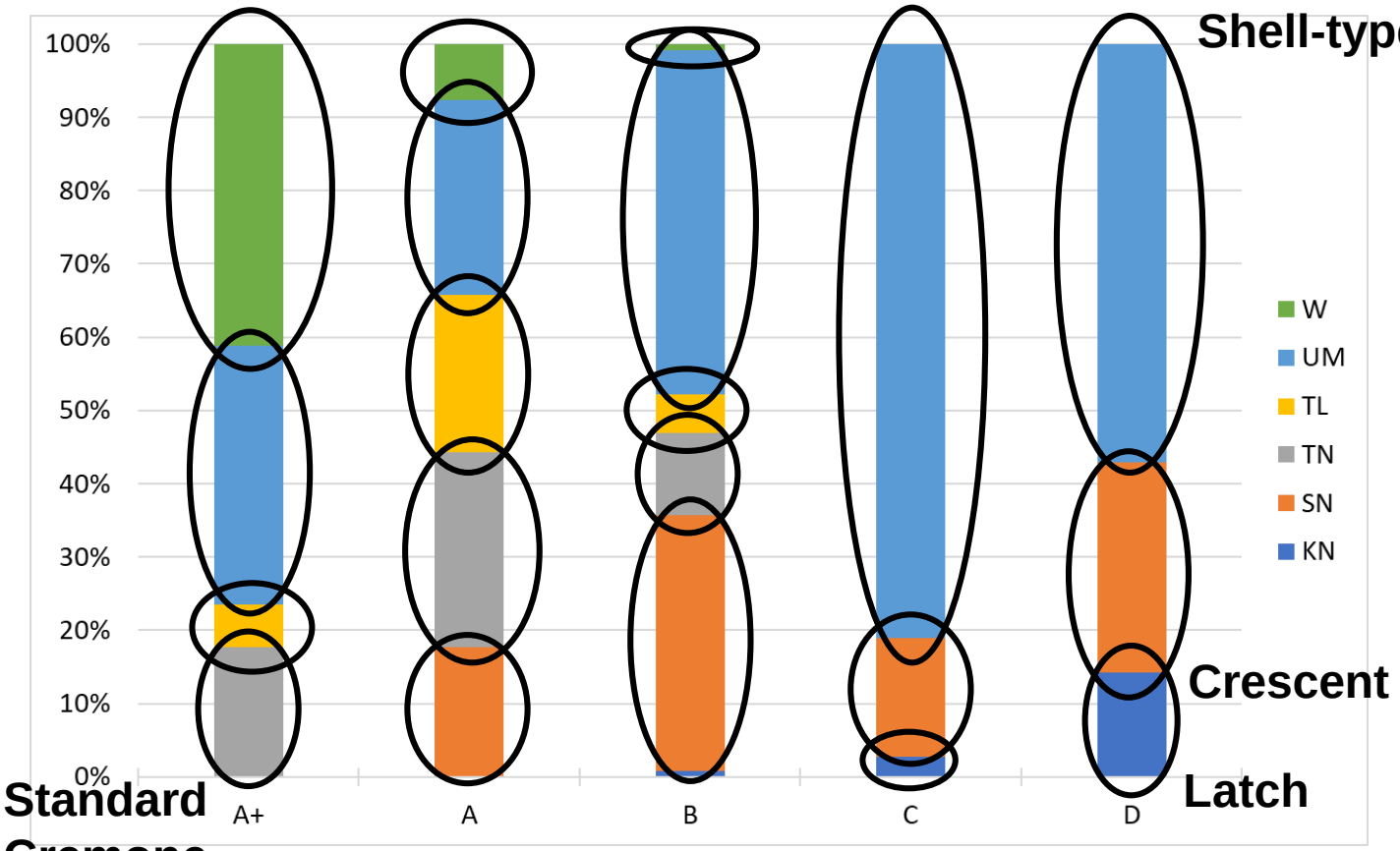


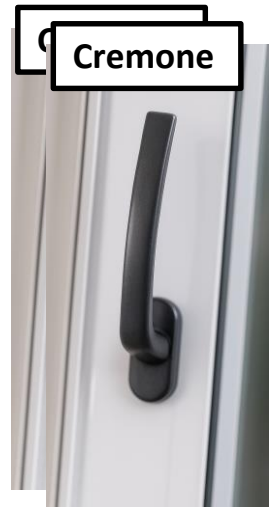
- Common glass and 6 to 8 mm laminated glass combined with good sealing can achieve high performance, competing with thicker glass.
- With poor sealing, thicker glass results in low acoustic performance.

Results

Locking Mechanisms

No locking mechanisms – heavy frames due to thick glass

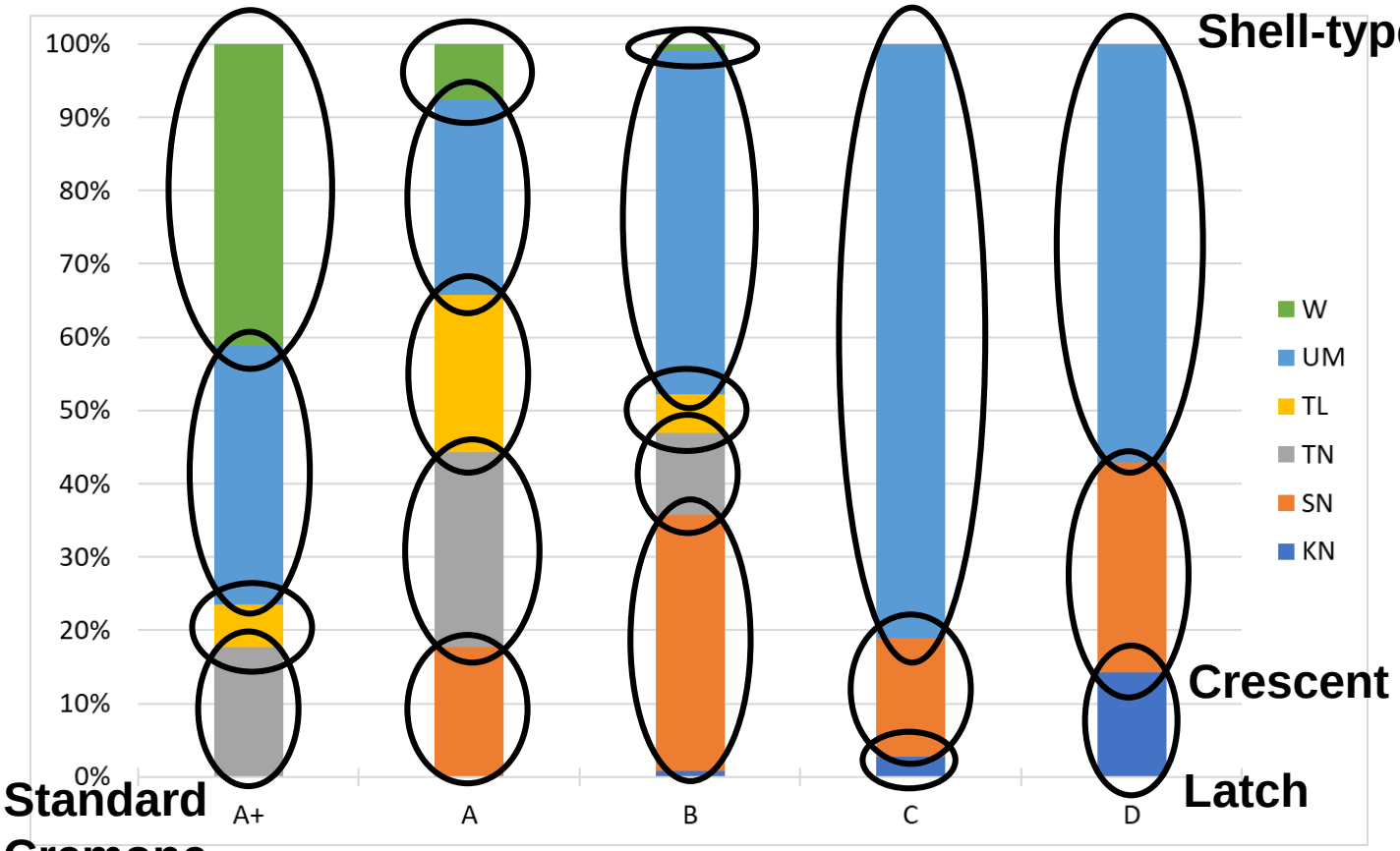




Results

Locking Mechanisms

No locking mechanisms – heavy frames due to thick glass

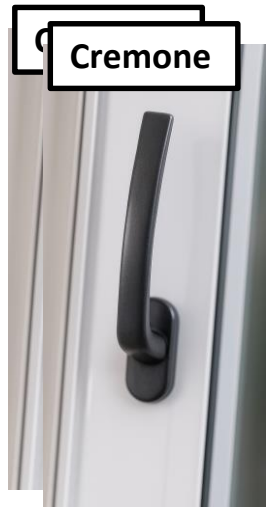


Shell-type

Crescent

Latch

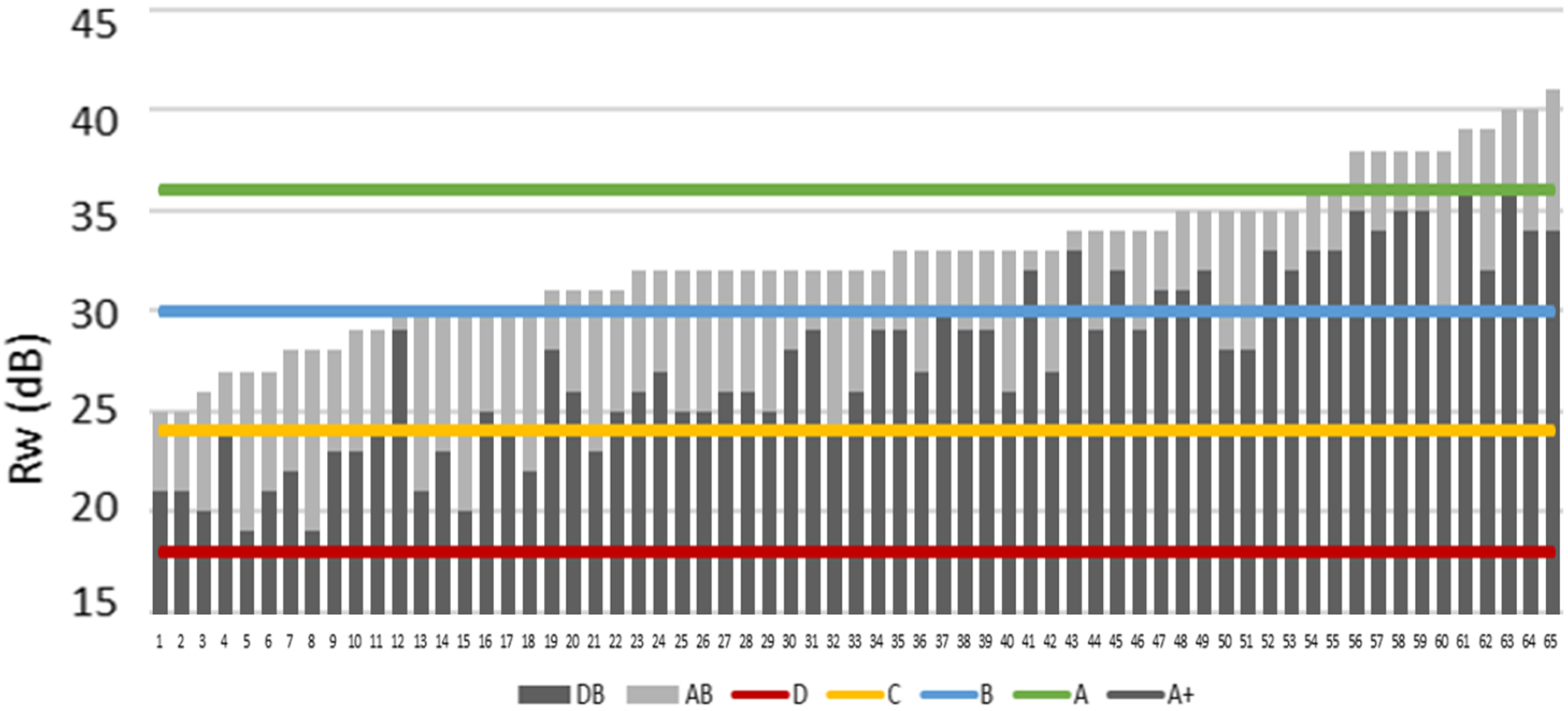
Standard Cremone



Lifting /pressure Cremone

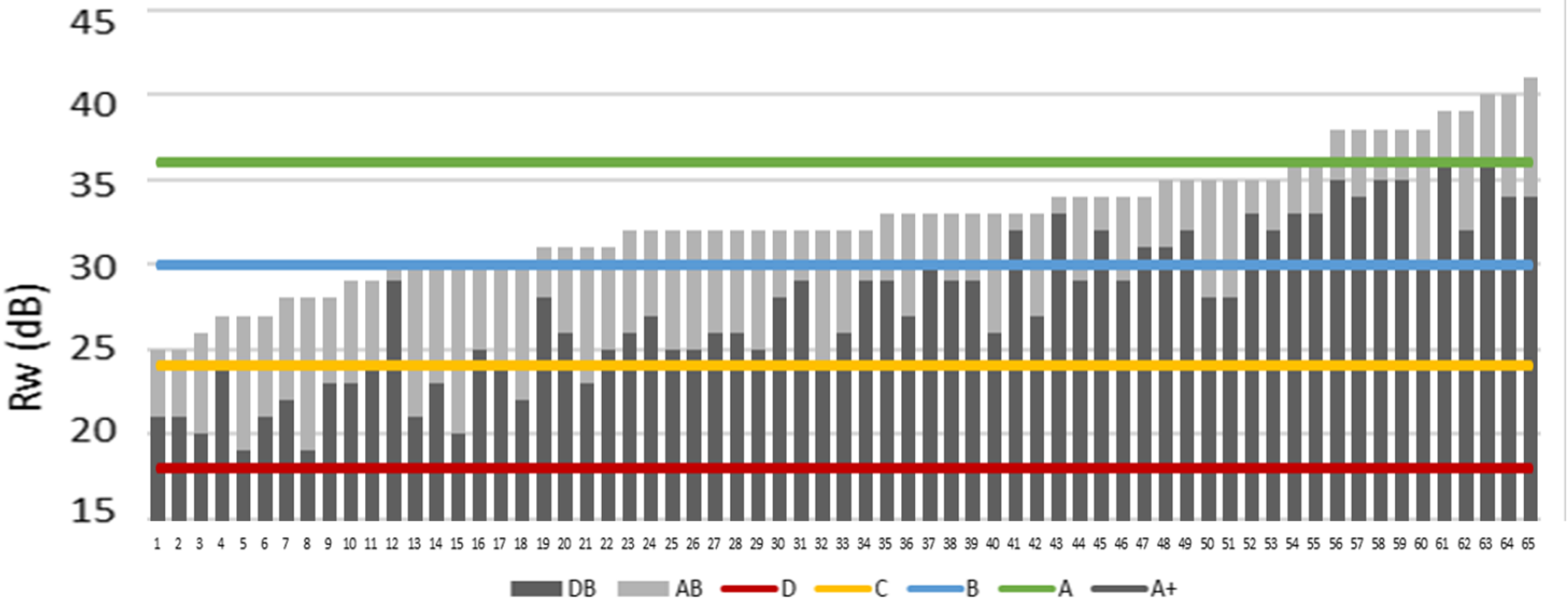
Results

Integrated Roller shutters



Results

Integrated Roller shutters



- Frames with shutters in class C have increases raging from 4 to 10, with an average of 7 dB
- Frames with shutters in class B have increases raging from 3 to 9, with an average of 5 dB
- Frames with shutters in class A have increases raging from 1 to 8, with an average of 4 dB
- One frames with shutters in class A+ has one increase of 4 dB

FINAL REMARKS

- **Classes A+ and A**: achieve better insulation with thicker laminated glass, elastomeric seals, and often cremone locks.
- **Classes C and D**: use thin glass (3–4 mm) and simple brush seals, resulting in low efficiency.
- **6 mm laminated glass**: offers a good balance between cost and performance, being common in higher classes.
- **Integrated roller shutters**: help reduce sound leakage, especially in lower-performance windows.
- **Recommendation for projects:** consider glass, seals, locks, and shutters together. Attention should be paid to the manufacturing and installation processes to avoid defects
- **Future research:** include mullions geometry and mass, seal dimensions, closing pressure, extra seals, and frame properties.

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