



# The Phenomenology of Material Transgression: A Comprehensive Analysis of the Atypical Use of Finishing Materials in Residential Interiors

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## Abstract

*The study presents a comprehensive analysis of the practice of atypical application of building and finishing materials in contemporary interior design, with a focus on international markets. The analytical framework is constructed around the concept of material transgression, understood as the transfer of a material beyond its prescribed functional niche and beyond the usage scenarios consolidated by normative logic. The empirical component relies on two authorial case studies integrated into a set of shared conclusions: the use of moisture-resistant particleboard kitchen countertops of class P5 as window-sill elements, as well as the application of large-format porcelain stoneware to form cladding for window and door reveals.*

*The methodological outline of the study is developed in an interdisciplinary manner and integrates the toolkit of building physics, including the assessment of thermal conductivity, moisture migration, and the calculation of the dew-point position; approaches from polymer chemistry with an emphasis on formaldehyde emissions and the polymerization processes of adhesive systems; a cost context that examines the dynamics of inflation-driven changes in the construction-materials market; and provisions from the psychology of environmental perception, interpreted through the prism of sensory design. On the basis of statistical data, it is supported that such adaptation of materials constitutes not only an aesthetically motivated trend but also a rational economic strategy under conditions of rising prices for finishing materials. The results suggest, with argument-based precision, that engineering-correct implementation of the indicated solutions contributes to an increase in the service life of enclosure structures and simultaneously enhances the liquidity of real-estate assets.*

**Keywords:** Material Transgression, Adaptive Application, Finishing Materials, Building Physics, Moisture-Resistant Particleboard P5, Window-Sill Countertop, Porcelain Stoneware Reveals, Sensory Design.

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## INTRODUCTION

In 2024–2025, material choice in residential interiors often starts not from “taste”, but from constraints: price jumps, unstable supply, and the need for predictable maintenance. In practice, this changes the design logic. A client may accept a less “canonical” material if it is available, stable, and easy to keep clean. The market context matters, but the everyday question is simple: what detail will fail first—edge, joint, or moisture regime? [1].

At the global level, the trend toward environmentally oriented and sustainable materials is intensifying: the market is valued at 429.77 billion United States dollars in 2024 and is projected at 1395.50 billion by 2034 with a compound annual growth rate of 12.50% [3]. This trajectory reflects a shift in consumer and design paradigms toward solutions that ensure durability and environmental safety, even when their application implies departure from the canons of traditional renovation and requires stricter engineering verification.

Within the academic tradition, the notion of adaptive reuse has historically been fixed primarily to practices of building revitalization and the transformation of industrial territories [4]. In 2024–2025, a transfer of this principle is observed to the level of interior components and critical junction interfaces [6], where the rethinking of material functions becomes an instrument of both economic and operational rationality. Within the problem field under consideration, it is methodologically appropriate to describe material transgression as a process in which a material designed for one operational environment (for example, a kitchen work surface) is purposefully applied in another zone (a window opening), provided that suitability is confirmed by key technical parameters and, not infrequently, accompanied by superiority in performance relative to traditional solutions for the corresponding junction. The conceptual robustness of the phenomenon is ensured by the combination of three mutually complementary foundations: technical rationality, implying the use of a surplus reserve of strength and wear resistance (for example, the characteristics of floor-grade porcelain stoneware) in areas with lower mechanical load but increased requirements for hygiene and geometric stability (reveals); aesthetic integrity, associated with the tendency toward Total Look and the formation of an enveloping interior in which boundaries between planes and architectural elements are deliberately leveled [7]; and psychological comfort, supported by biophilic logic and a demand for tactility within the Craftcore direction, where imitations of natural textures on contemporary composites are perceived as preferable to visually and sensorily cold polymer-based solutions [8].

**The aim of this work** is to formulate a practical selection and installation logic for “off-label” interior materials in window-adjacent zones, and to test this logic on two applied

cases (P5 worktops as window sills; porcelain stoneware as reveal cladding).

**The contribution is not a new material or a new aesthetic claim.** It is a structured set of criteria and control points that links building physics, hygiene/emissions, and installation technology to typical failure modes at junctions.

**The working assumption is straightforward:** if cut edges are sealed, joints remain elastic and continuous, and moisture/airflow around the opening is not blocked, then these atypical solutions can perform at least as reliably as standard ones in comparable conditions. Where these conditions are not met, the same solutions become risky; those boundary cases are discussed explicitly.

The study uses two author case studies as the empirical base. For each case, the analysis followed the same steps:

- (1) define the junction and its exposure (temperature gradients, possible wetting, cleaning regime);
- (2) list candidate materials with normative identification (e.g., EN 312 P5; ISO 13006 B1a) and key properties relevant to failure;
- (3) map typical failure modes (edge swelling, debonding, microcracks, mould staining, emissions from cut edges);
- (4) specify installation control points (edge sealing method, sealant type, adhesive coverage, movement joints) and acceptance checks (visual continuity of joints, absence of voids, documented sealing of cuts);
- (5) compare the solutions using a small set of engineering and practical criteria (condensation risk, moisture uptake pathways, maintenance, reparability, and cost drivers for 2024–2025).

The approach is intentionally “engineering-light”: dew point calculations are used as a screening tool for condensation risk, not as a replacement for full hygrothermal modelling.

Several **limitations** should be stated upfront.

- Dew point calculations indicate risk but do not model the full junction; surface temperature depends on wall build-up, insulation continuity, thermal breaks, and airflow. For critical projects, hygrothermal simulation and/or on-site measurements are preferable.
- Emissions from wood-based boards depend on temperature, exposed cut area, and sealing quality. Declared E1/E0.5 class does not guarantee low real exposure if cuts are left open or sealants fail.
- The economic comparison is sensitive to region, period, and contractor pricing. Reported 2024–2025 cost shifts should be treated as context, not as universal constants.
- Case studies reflect residential interiors and typical indoor

climates; results should not be transferred to high-humidity spaces (poor ventilation, persistent RH above ~60–70%) without additional controls.

- The study focuses on durability and hygiene; it does not quantify long-term environmental impact (LCA) for each option.

## **CHAPTER 1. THEORETICAL AND METHODOLOGICAL FOUNDATIONS OF THE STUDY**

Material adaptation in interiors is appropriately interpreted not as a secondary decorative device but as an engineering-substantiated strategy in which the material environment is examined through the lens of operational requirements, building physics, and use scenarios. In the interpretation of Plevoets and Van Cleempoel, adaptation acquires the character of a design instrument that links a material's original properties to the new role of an element within space, thereby extending the boundaries of the traditional typology of finishing and furniture solutions [10].

Within the problem field under consideration, two mutually complementary directions can be traced. One type of adaptation is a shift in functional purpose without loss of structural logic: for example, countertop → window-sill desk, where the original geometry and load-bearing capacity are employed to form a work or everyday-use scenario at the window opening. Technical adaptation, by contrast, relies on the physico-chemical properties and technological regimes of the material to address problems of building physics: porcelain stoneware → reveal vapor barrier, where low water permeability and stability under temperature-and-moisture fluctuations are mobilized to reduce the risks of condensation, substrate wetting, and subsequent degradation of the junction.

The reconceptualization of material as a functional agent entails the need to account not only for mechanical and hygienic indicators but also for regularities of sensory perception. The contemporary interior is analyzed through sensory psychology, and empirical studies from 2024 demonstrate that tactile parameters of a surface—roughness, thermal conductivity, thermal effusivity, microrelief—can directly correlate with emotional responses and the subjective evaluation of environmental comfort [11]. In practice, material becomes not a neutral shell but an active component of the behavioral tuning of space.

The theory of sensory nudging describes a mechanism whereby materials that reproduce natural patterns (wood, stone, and the regularities of their grain and veining) are associated with safety and environmental predictability, which is statistically linked to a reduction in stress responses and an increase in psychological place attachment [12]. At the same time, the most important parameter is not the mere

fact of imitation but the degree of its perceptual validity, namely, the alignment of visual expectations with tactile feedback and with the acoustic characteristics experienced during contact.

High-quality textured polymer coatings, specifically high-pressure laminate plastics on a particleboard substrate under correct stabilization and an appropriately selected embossing profile, are capable of reproducing the tactile friction of natural wood with a level of accuracy sufficient to generate a sense of naturalness in everyday contact [13]. Such a solution reduces the tension between the demand for a wooden window sill and operational constraints: natural wood in the window zone is vulnerable to deformation and changes in geometry due to cycles of humidification and drying, whereas a high-quality imitation on a stabilized base provides visual-and-tactile comfort under controlled risks and predictable maintenance [15].

An additional dimension of adaptation is associated with the need for rigorous materialographic expertise of junctions: differences in coefficients of linear expansion, water absorption, vapor permeability, and thermal resistance can lead to latent defects (localized debonding, crack formation, delamination of adhesive seams) even when assembly appears visually correct. Therefore, adaptation must be accompanied by an assessment of material compatibility under the relevant moisture-and-temperature regime, the selection of adhesive and sealing systems according to deformation-capacity class, and the verification of sanitary-and-hygienic parameters (emission of volatile compounds, resistance to household reagents) for zones of intensive contact and heating.

From an engineering standpoint, the coupling of adaptation with the principles of sustainable design and the circular economy proves promising: reuse and functional redefinition of materials reduces demand for virgin raw inputs and lowers the carbon footprint, but simultaneously increases requirements for service-life forecasting and maintainability. In this context, what matters is not so much the perpetuity of a surface as the manageability of aging: the possibility of localized replacement, restoration of a protective layer, proper disposal, or secondary inclusion within another cycle of application.

Methodologically substantiated adaptation presupposes verification not only by calculated indicators but also by data on actual user experience of interaction with surfaces. A comprehensive assessment includes sensory metrics (a tactile roughness map, thermal response, touch acoustics), behavioral indicators (changes in use scenarios, duration of presence near functional zones), and instrumental methods for quality control of junction execution. Such a combination of engineering and perceptual optics makes it

possible to treat materials not as a static catalog of textures but as a dynamic system in which functionality, safety, and psychological comfort constitute a unified design field.

## **CHAPTER 2. CASE STUDY EXAMPLE NO. 1: HORIZONTAL TRANSGRESSION—KITCHEN COUNTERTOPS AS WINDOW SILLS**

The predominance of standard polyvinyl chloride window sills in mass residential construction is largely explained by their manufacturability and low cost; however, the operational and visual-and-sensory adequacy of such solutions often proves insufficient. Typical problems include limited stiffness, manifested in deflection under localized loads (supporting oneself with hands, placing household items), as well as a high susceptibility to surface damage: on budget modifications, scratches and dents form especially quickly, degrading appearance and accelerating soiling. An additional factor is the character of the plastic texture and gloss, which is frequently perceived as a marker of low material authenticity and comes into conflict with current interior scenarios oriented toward material honesty and tactile expressiveness.

Alternatives traditionally labeled as benchmark solutions—natural stone and solid wood—are not always feasible in applied design practice. Stone window sills require substantial financial expenditures not only for the material but also for fabrication and installation, and they impose requirements on substrate load-bearing capacity and on the correct organization of junctions. Wood, despite its high aesthetic value, enters an unfavorable moisture-and-thermal regime in the window-opening zone: cyclical exposure to condensation and temperature fluctuations increases the risk of warping, joint opening, and degradation of protective coatings, which shifts the product into the high-maintenance category and limits its use under typical conditions.

A rational engineering-and-aesthetic alternative is the adaptation of sheet materials originally developed for kitchen cabinetry—postforming and edge-banded panels based on moisture-resistant particleboard. This strategy relies on the high technological predictability of kitchen surfaces: they are designed for contact with moisture, household chemicals, moderately intensive abrasive impacts, and regular sanitary cleaning. The transfer of this logic into the domain of window sills makes it possible, simultaneously, to increase the stiffness of the element, improve tactile characteristics, and ensure visual integration with the furniture planes of the interior through a unified language of textures and decors.

A key condition for the success of such adaptation is associated with the correct selection of the base board, because it is precisely the core that determines moisture resistance and geometric stability under prolonged exposure to elevated humidity. The use of standard furniture-grade

particleboard of class P2 in the window zone constitutes a typical design error: when in contact with condensation and periodic wetting, swelling processes accelerate within the material, bond strength in the internal structure decreases, and the probability of edge destruction and delamination increases, which leads to premature failure of the product. For window sills, only boards compliant with EN 312 type P5 are permissible, namely structural boards for use in humid conditions [16].

It should additionally be taken into account that P5 moisture resistance is not an absolute form of protection; rather, it establishes a normative level of resistance under specified testing regimes. Consequently, the structural scheme of the window sill must minimize pathways for moisture ingress into the board. The most vulnerable zones are the end faces, the interfaces with the reveals, and fastening areas, where local breaches of sealing can produce capillary uptake. Therefore, mandatory measures include sealing of end-face sections, the correct selection of edging material and adhesive system, and the formation of water-draining geometry, specifically the control of slopes and a drip edge, in order to prevent prolonged retention of moisture at the window line.

From a materials-science perspective, it is important to treat the window sill as a multilayer system: the base board, the decorative-and-protective surface layer (postforming and high-pressure laminate), the edge band, and sealing layers form an integrated ensemble in which failure of any component reduces the durability of the entire junction. Even when P5 is used, the risk of degradation increases in cases of mismatch between deformation coefficients of the surface layer and the substrate, insufficient elasticity of the adhesive seam, or low resistance of the sealant to thermal cycling and to ultraviolet exposure in the insolation zone. Accordingly, the specification must include not only the board class but also surface-layer parameters for wear resistance, resistance to household reagents, and thermal stability.

Finally, the operational effect of the adapted solution manifests not only in physical durability but also in perceptual stability: the surface preserves homogeneity of texture, tactile warmth, and visual integrity, which reduces the sense of temporariness and increases the quality of spatial perception. As a result, the window sill ceases to be a secondary construction element and becomes a functional plane with predictable characteristics, suitable for scenarios of storage, short-term work, and the placement of plants and household items without accelerated wear and without the operational traces typical of polyvinyl chloride.

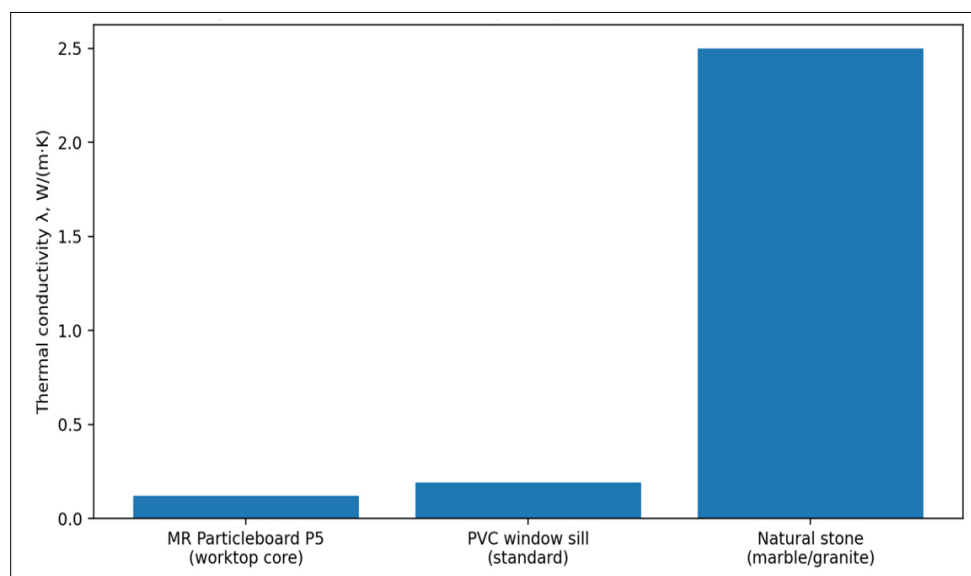
Below, Table 1 will present the results of a comparison of the physico-mechanical characteristics of materials for window sills.



**Table 1.** Comparative physico-mechanical characteristics of materials for window sills (compiled by the author based on [16, 19, 21]).

Characteristic	Particleboard P5 (Moisture-resistant countertop)	Polyvinyl chloride window sill (Standard)	Natural stone (Marble/Granite)
Base	Wood particles + melamine-urea-formaldehyde resins	Polyvinyl chloride (hollow-core)	Natural mineral
Density (kg/m <sup>3</sup> )	640 – 700	~1400 (walls)	2600 – 2800
Moisture resistance	High (swelling < 10% within 24 h)	Absolute	Medium/High (depends on porosity)
Flexural strength (N/mm <sup>2</sup> )	11.0 – 16.0	Depends on stiffening ribs	10 – 20
Thermal conductivity (W/m·K)	0.10 – 0.15	0.19	2.0 – 3.0
Tactile perception	Warm	Neutral/Cold	Cold

To visualize the thermophysical differences among typical window-sill materials, an additional comparison of the thermal conductivity coefficient  $\lambda$  is provided. The  $\lambda$  value determines the intensity of heat transfer through the plane of the window sill and affects the cold-surface effect, as well as local heat losses in the window-unit junction zone (see Fig. 1).



**Figure 1.** Thermal conductivity comparison for window-sill materials (compiled by the author based on [16, 19, 21]).

The chemical-and-technological robustness of P5-type boards in a humid environment is determined not only by increased density and an optimized chip fraction but, above all, by the nature of the binder. For the manufacture of P5, melamine-urea-formaldehyde resins (MUF) are used, in which melamine functionally modifies the polycondensation network, increasing hydrophobicity and reducing the structure's sensitivity to humidity fluctuations [22]. Unlike paraffin additives, which are used in a number of moisture-resistant particleboards as a surface water repellent, the MUF system establishes structural moisture resistance: the strength of the internal bond is preserved, including indicators at the level of  $IB > 0.45 \text{ N/mm}^2$  after cyclic V313 testing, which is critical for junctions exposed to repeated wetting and drying [16].

The practical significance of this difference becomes evident in the failure mode. When hydrophobizing additives prevail without sufficient chemical robustness of the binder, gradual degradation of interchip bonds is observed, accompanied

by growth of residual deformations and edge chipping; with MUF modification, resistance increases throughout the full volume of the board rather than only in the near-surface zone. This reduces the probability of latent defects in the most heavily loaded sections of the window sill, specifically in the support, fastening, and reveal-interface zones, where stress concentration coincides with the maximum moisture impact.

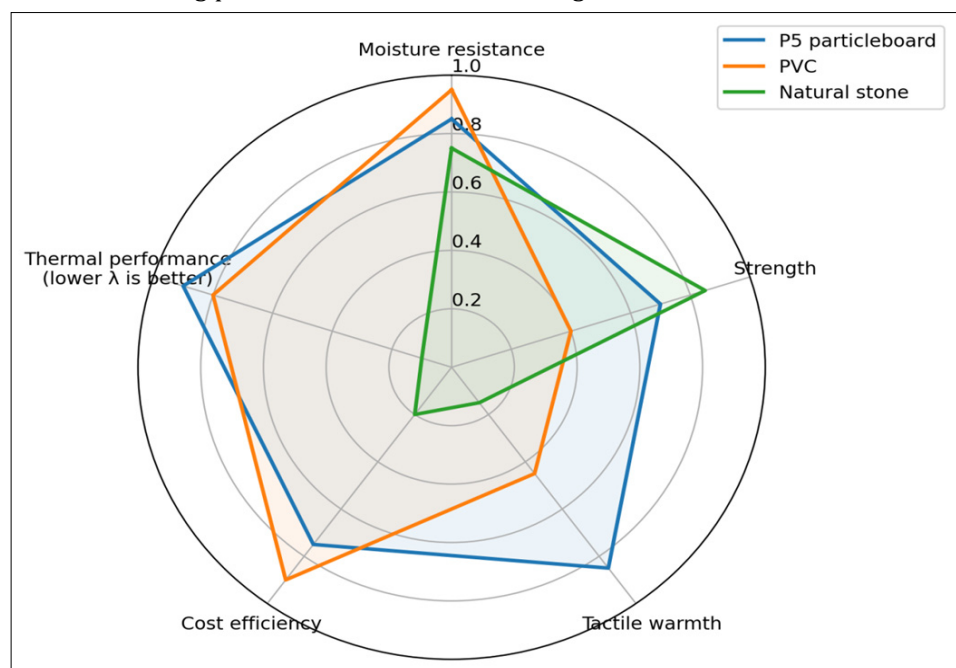
The thermophysical behavior of a window sill should be considered as part of the thermal envelope and as an element that influences the convective scheme at the window opening. The window-sill plane participates in the transfer of warm air from the radiator to the insulated glazing unit and back, and also in shaping the temperature field within the junction zone. In this context, the window-sill material determines not only the magnitude of heat transfer but also the risk of localized overcooling of the junction. Thermal-conductivity data show that the thermal conductivity of particleboard (0.15 W/m·K) is 15–20 times lower than that of natural stone

(3.0 W/m·K) [19]. In winter conditions, a stone window sill can function as a pronounced thermal bridge, intensifying heat removal through the sill support profile and the junction zone, which increases heat losses and provokes discomfort in the near-window area, especially when the installation joint lacks sufficient thermal decoupling.

Low thermal conductivity and comparatively low thermal effusivity of wood-particle composites generate a warm to touch effect: the surface is perceived as tactilely warm and does not produce a pronounced sensation of cooling upon contact. This parameter extends beyond subjective aesthetics because it is directly linked to ergonomics and use scenarios. Within the logic of the expanding window seats format, namely the organization of a resting place at the window in

apartments with low window sills (450–500 mm from the floor), a particleboard P5 countertop with a thickness of 38 mm proves functionally preferable: brief sitting on the plane is permissible without a risk of overcooling and without the obligatory use of insulating pads, which broadens the range of everyday scenarios and increases the element's real utility.

Because the selection of a window-sill material is determined not by a single parameter but by a set of operational and perceptual criteria, this chapter uses present them in the form of a normalized profile in Figure 2. Normalization (0–1) makes it possible to compare moisture resistance, strength, tactile warmth, cost efficiency, and thermal-engineering rationality within a single scheme and to show the trade-offs among solutions.



**Figure 2.** Normalized (0–1) performance profile of window-sill materials (compiled by the author based on [16, 19, 22]).

An additional thermophysical aspect is associated with the management of condensation risks. Deep window sills, including those reaching 600 mm, can potentially screen the convective flow from the radiator to the glazing and may impair heating of the lower zone of the window unit. Therefore, when designing an adapted window-sill plane, it is methodologically appropriate to consider the geometry of grilles, the presence of convection slots, and the temperature-and-humidity regime in the reveal zone and at the sill support profile. Otherwise, even with a material that is warm to the touch, an increase in moisture retention time on cold sections of the junction is possible, along with a higher probability of biodeterioration of the reveal's finishing layers.

The environmental safety of wood-based composites is traditionally linked to formaldehyde emissions, and in the near-window zone the heating factor from the radiator can intensify the release of volatile compounds. At the same time, modern boards from European manufacturers (Kedr, Skif, Kronospan) are declared in emission classes E1 or E0.5

(≤ 4–8 mg/100 g of dry board) [16]. The critical source of problems is more often localized not in the body of the board but in exposed end faces and cuts formed during fitting: an untreated end face simultaneously increases moisture absorption and serves as a diffusion channel for volatile compounds, reducing both the sanitary stability and the durability of the product.

Therefore, the technological adequacy of the solution is determined by the sealing protocol, which should be treated as a mandatory part of the construction rather than as a cosmetic operation. Data indicate that edge sealing can reduce emissions to background values [23]. Visible end faces are appropriately clad with edge banding (acrylonitrile butadiene styrene, polyvinyl chloride, high-pressure laminate) using polyurethane adhesive, namely polyurethane reactive hot-melt adhesive: unlike standard ethylene-vinyl acetate hot melt, the polyurethane system polymerizes under the influence of ambient moisture, forming an insoluble, heat-resistant seam of high hermeticity, described in manufacturing practice as

a zero joint line [25]. This effect is important not only for aesthetics but also for blocking capillary uptake of moisture at the edge zone, where swelling of the composite is most often initiated.

Concealed end faces at the interfaces with the window and the wall require a separate protocol: treatment is performed with neutral silicone sealants or with polyvinyl acetate adhesive of water-resistance class D3 or D4 with full coverage of the particleboard structure [26]. The method of application is technologically significant, namely rubbing the compound in to fill pores between chips; a simple superficial coating does not ensure reliable sealing of capillaries and

leaves diffusion pathways for moisture and emissions [26]. As an additional barrier layer, laboratory testing also records high effectiveness of aluminum tape, demonstrating emission blocking up to a 90% reduction under correct application [27].

Because, in practice, key risks (swelling, edge degradation, increased emissions from exposed cuts) are concentrated in end-face zones, protective measures should be fixed not as recommendations but as mandatory elements of the structural scheme. Table 2 systematizes typical barrier solutions for visible and concealed end faces, their function, and quality-control parameters.

**Table 2.** Barrier measures for the edges of P5 particleboard: impact on moisture absorption and emission (compiled by the author based on [23-27]).

Joint/Operation	Material/System	Function	Expected effect	Quality control
Visible edge face	ABS/PVC/HPL edging + polyurethane reactive hot-melt adhesive	Sealing of capillaries + thermally resistant seam	Reduced risk of edge swelling; stability under heating	Visually zero seam line, absence of unbonded areas
Hidden edge face (abutment to slope/frame)	Neutral silicone / polyvinyl acetate D3-D4 (complete rubbing-in)	Encapsulation of the particle structure	Reduced moisture exchange and diffusion from the edge face	Continuous layer without dry pores
Cut edges after fitting	Sealant/varnish + local edge banding (if feasible)	Restoration of barrier performance after cutting	Reduced formation of a channel for moisture and volatile organic compounds	Inspection of the edge face for uniformity of coating
Additional barrier (optional)	Aluminium tape on edge faces in concealed zones	Vapour and gas barrier	Strong reduction of diffusion through the edge face (with correct application)	Tight adhesion without wrinkles or delamination

To increase the reproducibility of the solution in design and construction practice, it is methodologically appropriate to define a checklist of key installation control points. This makes it possible to translate material adaptation from a designer device into an engineering-verifiable technological procedure. Table 3 records the sequence of operations and typical defects that arise when the protocol is violated.

**Table 3.** Technological checklist for the “countertop → windowsill” installation (P5) (compiled by the author based on [23-27]).

Stage	Critical parameter	Standard/target value	Typical defect in case of non-compliance
Board selection	Class according to EN 312	P5 (humid conditions)	Swelling, delamination (P2)
Geometry	Thickness/rigidity	28–38 mm (as per the design project)	Deflection, vibrations
Edge faces	Edge-face barrier performance	Complete sealing of all cut faces	Edge deterioration, moisture ingress through suction
Abutment to the frame	Sealant + seam continuity	Continuous, elastic seam	Leaks, capillary suction
Slope/drip edge	Water drainage	Eliminate standing water near the frame	Prolonged wetting of the edge face
Thermal contour	Convection from the radiator	Do not block the flow (grilles/slots if necessary)	Increased condensation near the glass/profile

It is recommended to document atypical application as an engineering solution rather than as a stylistic device: for each junction, operating conditions are described in advance (humidity, temperature cycles, ultraviolet load, contact with household chemicals), along with failure criteria and a method for post-installation quality control. This approach is consistent with the practice of moisture management as a systemic factor in the design and operation of buildings: what matters is not individual materials but the totality of details capable of preventing wetting and ensuring drying of the junction [5, 9].

Within the specification, it is necessary to rely on the normative identification of materials in order to exclude marketing interpretations. For moisture-resistant wood particleboards, it is correct to reference EN 312 and to indicate type P5 as load-bearing boards for use in humid conditions, so that it is clear that this is a standardized category with defined testing requirements. For porcelain stoneware and porcelain, it is correct to indicate the classification criterion under ISO 13006: group BIa with water absorption  $E_v \leq 0.5\%$ .

It is also necessary, when working with window-interface junctions, to treat moisture and condensation control as the primary risk: even an ideal material will not compensate for weak ventilation and prolonged moisture retention on cold surfaces. As external scientific support, it is appropriate to refer directly to the World Health Organization, where the link between dampness and mould and health risks is emphasized, and where the need to prevent available moisture is identified as a key condition for mould growth. In practical terms, this means verifying whether the window sill obstructs convection and providing solutions that help the junction dry rather than lock moisture inside the assembly.

Further, for wood-based composites (countertops and window sills), it is recommended to treat end faces and cut edges as critical zones that simultaneously govern both moisture uptake and the system's actual sanitary profile. To substantiate the sanitary component, it is appropriate to link to the chamber-testing method EN 717-1 and the E1 level (often cited as an approximate reference of  $0.124 \text{ mg/m}^3$ ), emphasizing that design control is achieved not by declaring a class but by minimizing exposed cuts and ensuring high-quality sealing [32, 33].

It is also advisable, for porcelain stoneware on reveals, to formalize requirements for adhesive contact as an acceptance criterion. In industry standards for tile installation (ANSI A108.5), the rule of minimum coverage is widely applied: not less than 80% for interior dry areas and 95% for wet and exterior areas, with mandatory support of corners and edges, without voids that can become zones of water accumulation. This is convenient to include in construction supervision as a practical test through spot checks by removing tiles in control areas.

Alternative solutions should be formally consolidated in documentation as well: in a separate technical card or an appendix to the project, where materials are listed with normative identification, requirements for substrate preparation, installation control points, acceptance criteria, and operating and maintenance conditions. Within the logic of EPA guidance on moisture, this is especially important because many failures are associated not with an error in material selection but with deviations in details that were not fixed as mandatory.

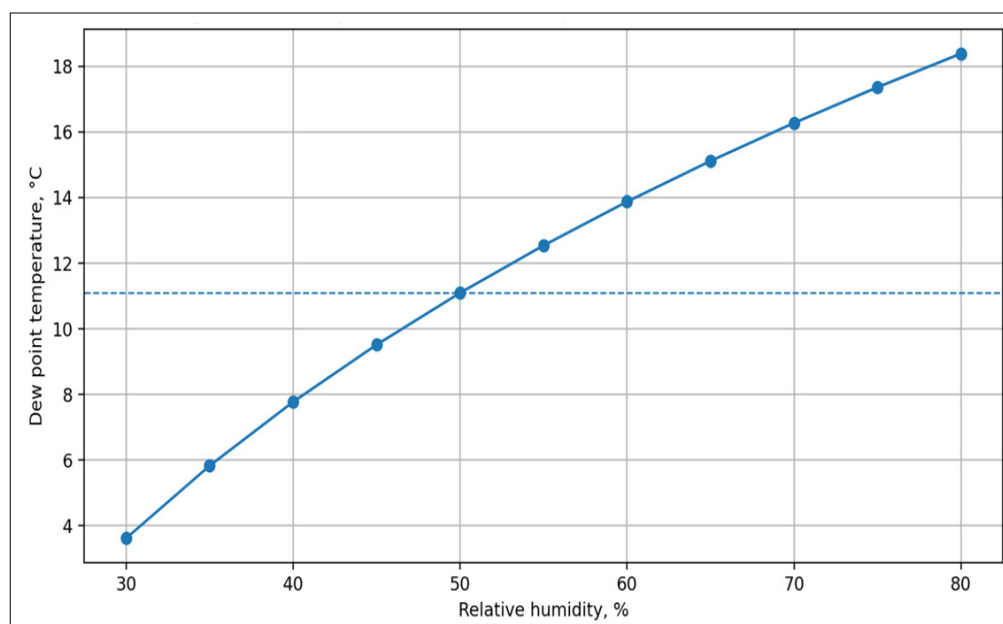
Special attention should be given to the interpretation of environmental friendliness in a practical sense: sanitary risk is determined not by the abstract presence of a binder but by the combination of the emission class, the temperature regime, the area of exposed cuts, and the quality of sealing. With the same board class, uncontrolled end faces, micro-defects of the edge band, and unstable sealants can produce a more unfavorable real emission profile than a correctly sealed system even under intensive thermal load. In this context, the constructive discipline of installation becomes equivalent in significance to the selection of a material according to its passport data.

### **CHAPTER 3. EXAMPLE OF VERTICAL TRANSGRESSION APPLICATION—PORCELAIN STONEWARE ON WINDOW REVEALS**

The junction between the window unit and the reveal belongs to the category of the most structurally and hygienically vulnerable zones of the contemporary interior, because several unfavorable factors coincide within it: geometric concentration of heat flows, heterogeneity of materials in terms of deformation characteristics, and high sensitivity of finishing layers to cyclic wetting. For traditional plastered reveals, the key degradation mechanism is the mismatch of coefficients of linear thermal expansion. Under seasonal and diurnal temperature fluctuations, this difference predictably leads to the emergence of microcracks along the interface line between the frame and the reveal, after which the crack network becomes a channel for moisture and air transfer, accelerating subsequent deterioration of the finish [30, 31].

In parallel, a thermophysical cause operates: the window-to-wall interface is a geometrically conditioned thermal bridge, where isotherms bend, lowering the temperature of the interior surface of the reveal near the frame. Under typical indoor microclimate parameters ( $22^\circ\text{C}$  and relative humidity 50%), the dew-point temperature is  $11.1^\circ\text{C}$  [34]. However, actual humidity in residential spaces fluctuates depending on season, ventilation, and vapor generation (kitchen, bathroom, drying laundry). Therefore, for the assessment of condensation risks, it is informative to present in Figure 3 the dependence of dew-point temperature on relative humidity at a fixed air temperature of  $22^\circ\text{C}$ . This makes it possible to interpret under which regimes even a moderately cooled reveal surface in the profile zone becomes an area of condensate formation.





**Figure 3.** Dew point at indoor air temperature 22°C (as a function of RH) (compiled by the author based on [34]).

For an applied interpretation of condensation risks, the range of relative humidity typical of residential premises under different operating scenarios is of primary importance. Table 4 provides calculated dew-point temperature values at  $T_{\text{interior}} = 22^{\circ}\text{C}$  for typical humidity levels, which makes it possible to assess the threshold conditions for condensate deposition on the reveal in the profile zone.

**Table 4.** Calculated dew-point values at  $T_{\text{interior}} = 22^{\circ}\text{C}$  (for assessing condensation on the reveal) (compiled by the author).

Relative humidity $\phi$ , %	Dew point tdp, °C	Practical interpretation for the reveal
30	≈ 3.9	Condensation is unlikely; a strongly cold surface is required
40	≈ 7.8	Risk is local near a thermal bridge in the case of a poorly designed joint
50	≈ 11.1	Your scenario in the text: a cold section near the profile is critical
60	≈ 13.9	Condensation is likely when the surface temperature is below ~14°C
70	≈ 16.4	High risk; ventilation/airflow/barrier solutions are required
80	≈ 18.6	Very high risk in the cold season at any weak joints

During the cold period of the year, the interior surfaces of the reveal adjacent to the profile are often cooled below this threshold, as a result of which condensate begins to precipitate precisely in the area of greatest thermal-engineering stress. Hygroscopic plaster systems readily absorb moisture, and wetting leads to an avalanche-like deterioration of thermal performance properties, because water conducts heat far more efficiently than air; the outcome is an increased probability of freezing, loss of adhesion, and biological damage involving species typical of humid zones, including *Aspergillus niger* [29, 35].

Under such conditions, cladding the reveal with a material having an extremely low water absorption rate functions not so much as a decorative substitution as a modification of the physics of the junction. Porcelain stoneware is characterized by water absorption of 0.05% [37], which makes it practically impermeable to water and substantially limits moisture

diffusion into the body of the reveal. When a properly selected tile adhesive is used, a barrier layer is formed that reduces the risk of wetting of the installation joint from the room side and, in functional terms, approaches the role of an additional vapor barrier. The sanitary effect is achieved because the precipitated condensate is not absorbed into the cladding and can be removed before a moist nutrient medium for micromycetes is formed; simultaneously, the likelihood of persistent staining and sealing of biological damage within the porous mineral matrix is reduced. An additional advantage is the high UV stability of ceramics: unlike a number of polymer sheet solutions and paint-and-coating systems, porcelain stoneware is inert to ultraviolet exposure and does not exhibit the characteristic yellowing on insulated facades.

The thermal-engineering rationality of porcelain stoneware cladding becomes especially evident when the junction is

considered comprehensively: the presence of a nonhygroscopic face surface reduces the duration of moisture contact with the reveal, which limits the increase in the effective thermal conductivity of the layer under operating conditions. At the same time, the requirements for the correctness of the construction build-up are increased: if the geometry of the reveal and the abutment does not provide solutions for temperature deformations and moisture drainage, the transfer of the problem can occur from the finishing zone into the adhesive layer and the substrate zone. Consequently, porcelain stoneware should be interpreted as an element of a system for managing moisture and deformations, rather than as an autonomous coating.

The installation of large-format porcelain stoneware on window reveals (for example, 60×120 cm), especially on the upper horizontal plane, imposes specific requirements on the adhesive system and the fixation methodology due to the mass of the tiles, impact-and-vibration effects during window operation, and the unfavorable orientation of loads. The reliability of a large format in the window zone depends to a high degree on substrate preparation and the adhesive application method. Preliminary priming of the reveal with deep-penetration formulations is necessary to equalize absorbency and stabilize the surface layer, which reduces the risk of localized dehydration of the adhesive and loss of adhesion [36, 41]. For laying a large slab, a combined method is structurally justified: the adhesive is applied with a notched trowel to the substrate and with an additional thin skim coat applied under pressure to the back side of the tile. This scheme ensures full-area contact and minimizes air voids, because any void in the reveal zone constitutes a potential micro-condensing cavity: a local zone of dew-point attainment can form inside the cavity, and water accumulation followed by freezing can initiate tile debonding and crack development.

For the upper reveal, the load scheme is fundamentally different: gravitational forces act in a pull-off mode, and dynamic effects when closing the sashes create impulse components of load. Even with thixotropy of the adhesive, until primary strength is achieved (typically 3–6 hours) mechanical fixation of the slab with telescopic braces or a system of props made of timber or a straightedge support is required [5, 9]. Refusal of temporary fixation is not only a technological risk but also a direct violation of safety requirements, given the mass of the large format and the plausible injury scenarios.

Deformation compatibility of the junction adjacent to the frame is ensured not by rigid abutment but by a properly organized damping joint. The tile must not bear tightly against the profile: a technological gap of 2–3 mm is left, which is filled with sanitary silicone sealant or acrylic matched to the grout color [14, 17]. This construction functions as a compensator

for thermal expansion and vibrational movements, reducing stresses along the interface of materials with sharply different coefficients of thermal expansion and preventing cladding detachment along the most critical line of connection.

A separate consideration is required for the question of the durability of sealing systems in the zone of insolation and temperature gradients. The long-term serviceability of the damping joint is determined not only by the type of sealant, but also by adhesion to specific substrates, resistance to plasticizer migration, and resistance to repeated heating and cooling cycles. In technological terms, correct joint execution presupposes ensuring cleanliness and degreasing of the contact surfaces, selecting primers when necessary, and controlling geometry (the depth-to-width ratio) so that the sealant operates in a deformation mode rather than in an edge-peel mode [24, 28].

The visual-spatial potential of porcelain stoneware on window reveals is associated with the effect of monolithization and a reduction in the number of articulation lines. The use of large formats (60×120 cm, 120×278 cm) makes it possible to clad a reveal with a single element without horizontal joints, creating the impression of a solid, massive volume and increasing the cleanliness of the architectural contour [18, 20]. The technique of using the same tile as on the bathroom walls or other dominant planes (the Total Look approach) optically blurs the boundary of the window opening, integrates the window into the overall volume, and reduces the visual noise characteristic of contrasting white plastic elements [7].

Additionally, it is appropriate to take into account that reducing the moisture load on the reveal is not only a function of the cladding, but also a derivative of the indoor microclimatic conditions. In zones of high vapor generation and under insufficient air exchange, the risk of reaching the dew point increases even with an externally correct construction. Therefore, the sanitary resilience of the junction over the long term is highest in those cases where a surface-barrier solution (nonhygroscopic cladding and sealing) is combined with controlled ventilation, proper operation of the heating device, and the absence of obstacles to convective airflow over the insulating glass unit. As a result, the reveal ceases to function as a moisture accumulator, and the adjoining junction retains mechanical stability and hygienic safety under conditions of cyclic operation.

#### **CHAPTER 4. COMPARATIVE ANALYSIS AND INTEGRATION FEATURES**

For the final assessment of the effectiveness of the proposed solutions, we will consolidate the data into a comparative matrix that takes into account economic, operational, and aesthetic parameters. Within Table 5, a matrix of the comparative analysis of materials for finishing window reveals is presented.

**Table 5.** Matrix of comparative analysis of materials for finishing window reveals (compiled by the author on the basis of [37-41]).

Parameter	Plastered reveal (For painting)	PVC sandwich panel	Porcelain stoneware (on C2TE S1 adhesive)
Material cost (RUB/m <sup>2</sup> )	Low (300-500) Excluding price growth for mixes	Medium (800-1500)	High (3000-8000) Including adhesive and cutting
Labour cost	High (multi-stage process, painter qualification)	Low (rapid installation)	High (tiler qualification, complex trimming)
Moisture resistance	Low (risk of mould, hygroscopicity)	High	Absolute
Mechanical strength	Low (chipping of external corners)	Low (indentation)	Extremely high
Ultraviolet resistance	Medium (pigment fading)	Low (plastic yellowing)	Absolute
Reparability	High (local repainting)	Low (panel replacement)	Low (difficult replacement of an element)
Aesthetic status 2024	Classic, Minimalism (requires maintenance)	Obsolete standard (Euro-renovation)	Premium, Architectural, Total Look

The analytical assessment records an atypical shift in the price balance in 2024. An increase in the cost of dry construction mixes by +25.9% [2], as well as growth in the price of skilled painting work, leads to a convergence of the final estimated cost of a high-quality plaster reveal and a reveal executed in porcelain stoneware. In the first case, the technological scheme presupposes the mandatory installation of corner profiles and reinforcing mesh, the application of multilayer putty compounds with subsequent painting using moisture-resistant paint-and-coating materials; the totality of these operations forms a significant share of costs comparable to cladding with a sheet tile material. If previously the use of tile on reveals was interpreted as an unjustified complication and excessive finishing, then under current price parameters, and also taking into account the operational resilience of the solution according to the make it and forget it principle and the absence of a regular need to renew the coating, a porcelain stoneware reveal is increasingly regarded as an economically justified investment.

## CONCLUSION

The conducted study demonstrates that atypical practices of using finishing materials in interiors during the 2024–2025 period have ceased to be episodic designer trials and have acquired the status of a reproducible engineering-and-economic strategy grounded in verifiable operational and cost-estimate bases. The technical viability of this approach is confirmed, in particular, in the replacement of traditional window sills with moisture-resistant P5-class countertops with a thickness of 38 mm and in the opting for porcelain stoneware instead of plastered window and door frames. In the first case, a functional superiority over common alternatives is recorded: the countertop-based construction provides more favorable thermal-insulation indicators and applied ergonomics in comparison with stone solutions. In the second case, porcelain stoneware cladding reduces the main weak points characteristic of plaster junctions in the window-adjacency zone, above all the risks of loss of airtightness and the development of biological damage.

The economic viability of nontraditional solutions manifests itself against the background of inflationary pressure in the construction sector, assessed at 12–14% per year, and the simultaneous rise in the cost of basic materials. Under these conditions, unified schemes of procurement and cutting demonstrate particular effectiveness, including the use of a single countertop slab for the kitchen and all window sills, which makes it possible to reduce total costs without degradation of the visual result. The final product combines properties associated with the premium segment (stone-like textures, tactilely pronounced wood surfaces) with a budget comparable to the mass market, due to optimization of the assortment and logistics of materials.

An additional, though not secondary, effect is the growth of psychological comfort of the environment: the use of materials with deep textures and low thermal conductivity in contact zones of the window sill to table type correlates with a current demand for sensorily rich spaces, which is associated with a reduction of the subjectively perceived stress background and an increase in the assessed quality of life.

The practical implementability of the described solutions directly depends on compliance with technological regulations, because it is precisely the quality of junctions and protective operations that determines durability and operational safety. For countertop elements, mandatory PUR sealing of visible edges and waterproofing of concealed cuts are critical, aimed at blocking formaldehyde emissions and preventing swelling. For porcelain stoneware cladding, the use of adhesive compounds of a class not lower than C2TE S1, the application of a combined application method, and the creation of damping joints near the window profile are fundamental. Taken together, the foregoing allows the phenomenon of material transgression to be considered as an emerging norm of professional design, where a deep understanding of the physicochemical properties of materials becomes a tool for overcoming the limitations of traditional construction practices.

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