KUNZEL THEORY

Diagnostic examination of the problem

The element of evaluation to keep under control for effective and lasting protection of the structures is the reaction to the humidity of the coatings and building materials. First of all, we try to identify the various causes that lead to the formation of humidity and clarify their different degree of harmfulness. Humidity is always present - in the liquid state or in the form of vapour - thanks to microcracks, the capillarity of the soil and structures with rising humidity or condensation. While the steam enters and exits freely through the layer of materials, the water, once it has entered, can only escape in the form of steam. In addition, there is the phenomenon of condensation: the result of the accumulation of steam on the interface between the different layers of material, which increases the content of liquid water in the structure itself. The presence of moisture in the walls does not represent a threat if present in small quantities. High quantities are highly harmful: they carry polluting gases from the atmosphere or salts from the material or the ground, causing a series of problems, even severe ones.

The degrade can be: chemical, physical, biological, loss of thermal insulation.

Chemical degradation

Excessive internal humidity also causes a deterioration in the consistency of the walls. The water present acts as an intermediary for all the soluble salts present in the substrate or in the ground, causing significant destructive effects. In the presence of humidity, acid gases such as sulfur dioxide or carbon dioxide and salts (sulphates, chlorides and nitrates) interact with the calcareous binders, lime and calcium carbonate, making them soluble with a consequent deterioration of the consistency of the masonry. After water saturation or evaporation, the crystallization of the salts causes an increase in volume by developing a very high pressure to cause cracks in the structure

Physical degradation

The presence of water can change and, in extreme cases, destroy the properties of building materials. Frost, for example, increases the volume of water by about 10%. This expansion in the capillarity causes, under certain conditions, cracks and splits in the masonry.

Biological degradation

Another damage caused by persistent humidity inside the walls is the onset and proliferation of plant microorganisms, moulds, lichens, algae, fungi and moss. The establishment of these microorganisms can lead to the disintegration of the building material and reduce living comfort if the phenomenon occurs inside.

Loss of the thermal insulation

An excessively damp wall can lose up to 50% of its insulating power compared to a dry wall. This considerable heat dispersion, in addition to the reduction of living comfort, causes a higher energy cost.

Solutions and treatments

The ideal protective coating reduces water entry and guarantees breathability while ensuring the lowest possible water permeability and resistance to vapour diffusion. It must therefore be able to dispose of moisture (in the form of water vapour) in greater quantity than - or at least equal to - that produced and released from the support. To evaluate and measure the diffusion of water vapour through the walls and the films that cover them, conventions have elaborated the theory of Kunzel.

Künzel's Theory

Künzel's theory starts from the observation that a facade material does not suffer damage over time if its ability to release water through the diffusion process is more significant than its ability to absorb water by capillarity. The release of water is expressed as vapour permeability or resistance to diffusion, in practice as an equivalent air layer "Sd" in linear meters, and water absorption with the water absorption coefficient "w". For an efficient and functional facade protection system, the "Sd" value and the "w" value must be as low as possible. The water absorption coefficient "w" must be less than 0.5 kg / m2 * h0.5. Represents the resistance to water penetration where h is the time expressed in hours. The product of the two quantities Sd xw must be less than 0.2 kg / m2 * h0.5, when the water permeability of a coating is close to its maximum value, its resistance to vapour passage must be close to the minimum.

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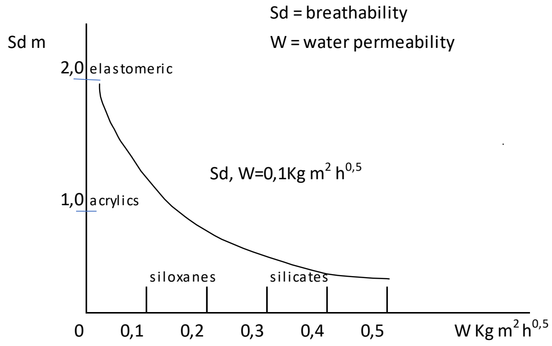
Kunzel's graphic with paint cycles



breathability and permeability classification

UNI standard classification 9396	breathability G/M^{2}D
high	150
medium-high	from <150 to 100
medium	from <100 to 60
medium-low	from <60 to 15
low	<15
EN standard classification 1062 (DIN 1062)	wather permeability degree W24 KG (M^2/H^{0,5})
I (high)	>0,5
II (medium)	0,1-0,5
III (low)	<0,1

Sd = Equivalent thickness of air (meters). Resistance to vapour diffusion. W = Water permeability Kg / m2 x √ h This formula, theorized by Künzel, expresses in scientific terms the fundamental concept that the water in a masonry must not enter, and if it does enter it must be able to exit.

Easystoone consolidating has the following values.

Sd = 0.0665 ± 0.0139 m

μ = 482

W = 0.032 ± 0.003 kg / (m2h0.5)

Kunzel index = 0.00213 value less than 0.2

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