

Waterproofing systems for roof protection in homes

Sistemas de impermeabilizantes para protección de cubiertas en viviendas

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Abstract

Based on the impact of climate changes, our concern arises in this scenario and the entire building is exposed to different climatic agents such as the rain itself, which can negatively impact the overall performance of the construction. Waterproofing is an essential requirement for buildings for residential, commercial and industrial use. Aspects such as the geometry and the materials with which the structural roof systems (slabs) were obtained play a fundamental role when choosing the most effective waterproofing system to incorporate into the building. Therefore, our main approach is to list the various waterproofing systems most used today for the protection of housing roofs since a knowledge of these systems will trigger a correct procedure, control and care in waterproofing, which results in a conservation of the building.

Resumen

A partir del impacto de los cambios climáticos, se desprende nuestra preocupación ante este escenario ya toda edificación está expuesta a diferentes agentes climáticos como lo es la lluvia misma que puede impactar negativamente en el desempeño integral de la construcción. La impermeabilización es un requerimiento esencial para las edificaciones de uso residencial, comercial e industrial. Aspectos como la geometría y los materiales con los cuales se establecen los sistemas estructurales de cubiertas (losas) juegan un papel fundamental al momento de elegir el sistema de impermeabilizante más efectivo para incorporar a la edificación. Por lo tanto, nuestro principal planteamiento es enlistar los diversos sistemas de impermeabilización más empleados el día de hoy para protección de las cubiertas de viviendas ya que un conocimiento de estos sistemas desencadenará un correcto procedimiento, control y cuidado en las impermeabilizaciones lo que derive en una conservación de la edificación.

Geotechnical, Architecture, Project

Impermeabilización, Sustentabilidad, Materiales

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Introduction

Nowadays, the filtration of water within the architectural project generates adverse impacts on the functionality of the project and on the health of the occupants.

The basic function of a waterproofing is to prevent the flow of water through the different layers that make up the waterproofing system [1].

Due to the negative impacts produced by the migration of water within a building, the use of waterproofing agents is essential to prevent seepage and thus ensure good performance of the building.

Waterproofing agents are substances that cut off the passage of water, preventing its passage, and are used to cover materials that must remain dry. Its operation is to eliminate or reduce the porosity of the material, filling leaks and isolating moisture. [2].

The structural elements through which the water seeps into the architectural space are especially: the roof (slab), walls and floor system, therefore a thorough analysis of these systems must be carried out to identify a possible scenario of water seepage.

Figure 1 shows ceiling leaks producing stains that spread over the entire surface.



Figure 1 Roof filtration
Source: Own elaboration

Figure 2 shows the leaks in the walls producing stains and generating aesthetic tricks.



Figure 2 Filtration in walls
Source: Own elaboration

Figure 3 shows the efflorescence of concrete due to the crystallization of the hydrated or sulphated salt atmosphere in explosion in the air.

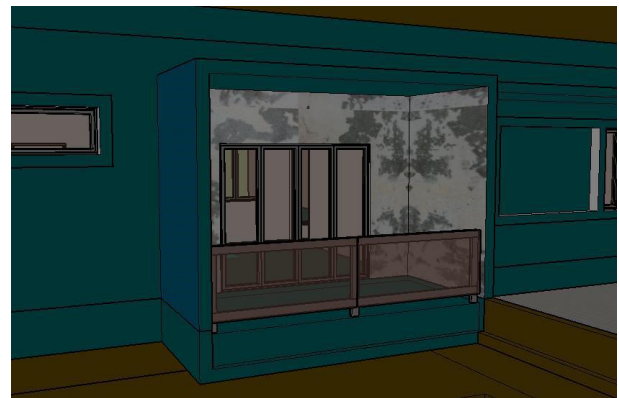


Figure 3 Efflorescence in concrete
Source: Own elaboration

In this research we will place emphasis on roofing systems since it is the most important element in buildings, since it fulfills several of the functions that a construction must perform, and this in turn must fundamentally fulfill the following characteristics: tightness, impermeability, resistance, durability and insulation [3].

The roof is the element or sets of elements that constitute the upper enclosure of a building, between the lower surface of the top floor and the finish with the exterior [4].

For the inhabitants of a house, the decision to apply some type of waterproofing varies depending on the surface, the cost, the durability, the application and the guarantee, which often leads them to make an imprecise decision and even the do not apply any treatment, if you do not have adequate information before making the decision [5].

The waterproofers are of traditional natural or synthetic origin. In the natural ones we have those of mixtures with lime and alum stone and, within the synthetics, the use of petroleum derivatives. There are several types of waterproofing, but today the most sought after is acrylic waterproofing, for its durability and for being completely non-toxic, so it can be used in any environment. There are different types of waterproofing, the most recommended are those of high quality, durable, and with an aesthetic finish. Waterproofing systems are the set of elements that, combined with each other, guarantee that there is no leakage and humidity in buildings [6].

Methodology

Waterproofing is a basic requirement for all types of architectural project structures such as residential, commercial and feverish projects, with the aim of achieving protection against climatic agents. Therefore, it is important to identify the materials most used in Mexico that make up the roof structural system (slabs) and the performance of the different waterproofing systems when applied to the roofs.

Materials used in Mexico in the formation of roofs (covers).

In Mexico, the problem of housing deterioration is mainly due to the following causes: A. the occupational and income structure of the population B. Population growth C. Speculation on the elements that make up the home (land and materials). Next, Table 1 shows the materials used in the conformation of housing roofs in Mexico according to the INEGI 2015 census [7].

Building material predominant in roofs	Percentage%
Concrete slab	75.3
Corrugated fiber cement sheet (fixed roof)	0.1
Palm or straw	0.4
Madera o tejamanil	2.3
Roof with beams	0.5
Roof tile	2.2
Waste material	0.3
Cardboard Sheet	1.2
Metal foil	13.0
Asbestos sheet	4.7

Table 1 Materials used in the conformation of roofs (covers) in Mexico
Source: *Census INEGI 2015*

In Table 1 we were able to identify the most used materials that constitute the roofs (slabs) in Mexico as structural systems, widely highlighting the use of reinforced concrete and metallic elements, hence the importance of identifying the type of waterproofing existing in the market and its performance in this type of materials.

Types of roofs according to their geometry

The various roof geometries present in house-room architectural projects include pitched roofs, roofs, flat roofs, roofs with different inclination directions, and special roofs. The typology of these architectural envelopes can influence the speed or slowness with which the water flows into the architectural project.

Inclined cover. An inclined roof is considered as a constructive solution based on a slope, made up of different inclined planes that favor the elimination of water.

A base plate is available on the structural support to support the final finishing layer. The function of this last layer is to facilitate drainage, guaranteeing that water does not enter the interior and helping to ventilate the roof [8].

Figure 4 shows the representation of sloping roofs in various construction planes.



Figure 4 Inclined cover
Source: *Own elaboration*

Flat roofs are characterized by having a slope that does not exceed 3 degrees, they are the most common within the construction, within climates where the rains are periodic. Water evacuation:

Rainwater must drain based on the slope (minimum that is incorporated) through downpipes, gutters and / or other systems that are incorporated into the roof system. Figure 5 shows the flat roof representation.



Figure 5 Flat roof
Source: Own elaboration

Covered with two or more waters

This type of roofs is identified as limiting elements that are interactions of skirts that form converted angles that divert rainwater in different directions [9]. Figure 6 shows the representation of roofs with more than two gables, in different directions.

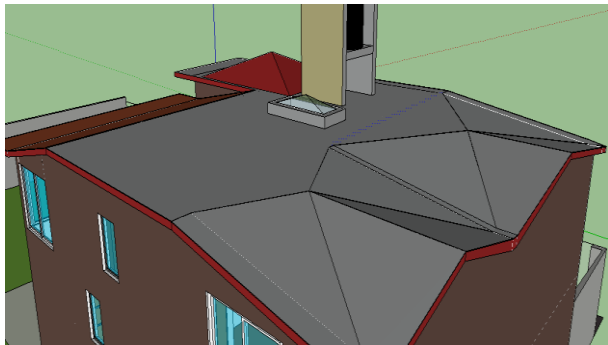


Figure 6 Roof with different inclination directions
Source: Own elaboration

Special roofs are structural systems that are established by means of structural steel systems and are used due to the uniqueness of the architectural envelope (curve, turns). Figure 7 shows the representation of special covers.

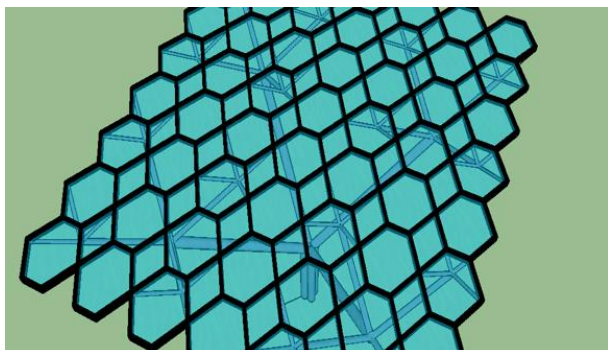


Figure 7 Special covers
Source: Own elaboration

Waterproofing systems

There are numerous waterproofing systems that are used to protect the roofs of architectural projects from rainwater seepage. Figure 8 shows the waterproofing systems [10].



Figure 8 Waterproofing systems and materials
Source: Own elaboration, (Jalal et al, 2018)

Traditional waterproofing

The bricks that are laid on the roof are used as a traditional form of waterproofing. On the roof, this brick structure system is called a petatillo.

This construction system is widely used in Mexico and is quite effective in preventing the passage of water and humidity [11].



Figure 9 Traditional waterproofing based on petatillo brickwork
Source: Own elaboration

Cementitious waterproofing

Portland cement-based waterproofing is one of the oldest materials used as waterproofing systems. Due to the particularities of the material, for example, the minerals that make it up favor resistance to water seepage.

The function of this type of waterproofing is to reduce the porosity of the cement, making it more waterproof. They can be applied in different ways, one of them is to add this waterproofing to the concrete when it is being mixed, which when drying will close the pores reducing capillarity, increasing the impermeability of the concrete without affecting its resistance [12].



Figure 10 Cementitious waterproofing
Source: Own elaboration

Asphalt waterproofing

Asphalt waterproofing is generally brown or black in color and refers to its name since it is made from asphalt, mineral fillers, natural fibers and solvents. This type of waterproofing is characterized by its adaptation to all types of surfaces exposed to the elements.

Currently there are different versions of asphalt waterproofing, for example, solved can have different uses:

As waterproofers, they work perfectly on vertical and horizontal surfaces of concrete, sheet, masonry, partition, asbestos, cement and wood, among others, it should be noted that each surface has a specific waterproof system.

As a waterproof coating, as it is flexible and durable, it is useful in areas in contact with humidity such as: foundations, bathroom trays, retaining walls and flower beds, among others [13].



Figure 11 Asphalt waterproofing
Source: Own elaboration

Liquid membrane-based waterproofing

The polyurethane membrane consists of a liquid membrane, composed of synthetic resins in an aqueous dispersion, without solvents and free of volatile organic substances. Cold applied which dries generates a waterproof coating.

This type of waterproofing can be applied on roofs, whether horizontal or sloping, vaults, etc., exterior walls, very useful for filling and puncturing cracks.

Liquid waterproofing membranes, also known as liquid membranes, are applied like paint and when they dry, they form an elastic membrane with great waterproofing capacity [11].

Polyurethane is also used for areas of the flat roof and exposed to the elements; they offer greater flexibility. This type of material is very sensitive to moisture content due to this the application has to be very careful when evaluating the moisture of the concrete slab, otherwise flaking can be easily observed [14].



Figure 12 Waterproofing with a liquid membrane base
Source: Own elaboration

Ecological waterproofing

The most common types of ecological waterproofing are based on recycled materials, such as tire-based waterproofing systems are mainly composed of rubber, which is a hydrocarbon obtained from trees in the tropical zone. Where with the tire waste, crushed rubber is extracted to process it with additives that create a highly permeable coating. Other materials that can be used in ecological waterproofing is unisel and thereby positively favor the environmental impact [15].



Figure 13 Ecological waterproofing
Source: Own elaboration

Acrylic waterproofing

Acrylic waterproofers consist of an elastic waterproof coating based on acrylic resins with excellent resistance to weathering and microspheres that improve thermal insulation capacity.

These waterproofers are a fast, safe and effective way to prevent roof leaks, since they are made from various resins that, when drying, become an excellent waterproof layer.



Figure 14 Acrylic waterproofing
Source: Own elaboration

Conclusions

Waterproofing is a fundamental component for the protection of buildings against climatic agents. With the appropriate waterproofing system together with the quality of the implementation processes, we will ensure mitigating the infiltration of rainwater within the building, taking into account values such as the geometry and material of the roof (slab) and the location of the project (climate).

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