



Waterproofing Systems for Flat Roofing
Market analysis and contribution to the improvement its selection and
application process

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Extended Abstract

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1. Introduction

In buildings, the roof is one of the most preponderant constituents, because the other constructive elements below it depend on its performance. For example, when the roof is no longer watertight, it may cause damage to other elements, such as the floor, walls. Over the years, it has been obvious the colossal development in the sector of civil construction, in which the roofs of buildings have evolved, both at the architectural level and in their own composition, that is, of the constituent materials.

One of the functions of the roof that is thought immediately is the tightness, which is assigned to the waterproofing materials, which can be traditional, as some bituminous membranes, or non-traditional, as products or liquid systems.

Liquid applied roof waterproofing kits (LARWKs) are approved based on the technical specifications of the European Organization for Technical Assessment (EOTA), the Guideline European Technical Approval of LARWKs (ETAG-005).

In this dissertation, with support of the acquired information, it is intended: to study how the waterproofing systems for roofing, applied in a liquid or paste form, are offered by manufacturers and retail companies; what their characteristics are; which ones stand out both nationally and internationally and which are subject to increased certification.

One of the purposes of this study is to help manufacturers to have an idea of where they should invest their efforts and understand the liquid waterproofing market. For this purpose, an inquiry was conceived for the technicians who play a role in the choice or application of the waterproofing of roofs, as well as for the residents.

In the end, it is intended to build a checklist as a proposed improvement to help in choosing the liquid waterproofing solution.

2. Roofing and waterproofing systems

The roof is one of the constructive elements which requires greater attention. Its execution is a task that requires specialized professionals, according to Picchi (1968), in which it is fundamental that there are no flaws, even if they are located, otherwise the performance will be compromised. Nowadays, with the increasing innovation that has been verified in the quality of materials, new waterproofing systems have emerged, which are increasingly effective both in the new design and in the repair of buildings.

For choosing the waterproofing system, some parameters, such as the technical criteria of the roof, physical agents, among others, should be taken into account. It should be noted that the cost of waterproofing, on the whole, corresponds to 1% to 3% of the total value of the construction phase (these percentages refer to the building construction in Brazil) - figure 2.1, (Righi, 2009).

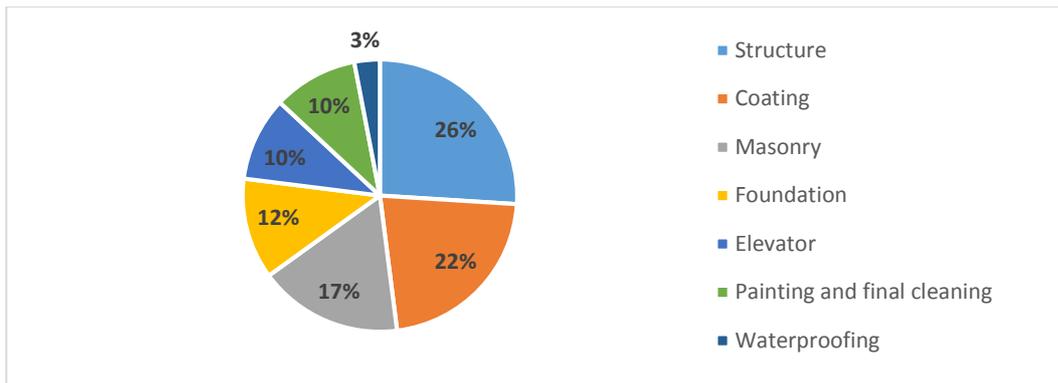


Figure 2.1 - Percentage of costs.

Both the control during the execution phase and the existence of a good design are crucial to the quality of the waterproofing system. The flat roofs are more prone to irregularities than pitched roof due to the complexity in the design and the reduced slope that hinders the flow of water.

The pitched roof in 2011 accounted for 93.1% of the Portuguese housing stock, corresponding to 6 264 286 buildings (INE,2012).

Rehabilitation has not followed very strict rules. For this reason, in the resolution of the council of ministers nº 170/177, the "*Projeto Reabilitar como Regra*" was developed with the objective of adjust the current technical norms of the new construction in the requirements and specificities of the rehabilitation works of buildings. Previously, according to article 6 of Decree-law no. 555/99 of 16 December (Pt), conservation works and those that do not involve changes in the shape of the roof were exempt from licensing for rehabilitation.

The flat roofs according to Monteiro (2016) are divided into several layers, such as: resistant support, thermal insulation, waterproofing layer and protective coating.

Walter et al. (2003) differentiates the anomalies that occur in the flat roofs according to those that occur in current surfaces and those that manifest themselves in singular points of the roof. In current surfaces, some of the most common anomalies are perforations, tearing, peeling of overlap joints, folding, prolonged water stays and cracking (Lopes, 2010). In the singular points the errors are, in their great majority, associated with the poorly executed shots and the inadequate capping of the crown.

According to Dias (2008) and Mascarenhas (2005), some of the agents that cause deterioration of roof waterproofing systems are: water, high and low temperatures, temperature variation, UV radiation, wind and chemical and environmental agents.

2.1 Legal framework of liquid waterproofing systems

The manufacturer may apply for CE marking, even where there are no harmonized standards. In order to do this, the manufacturer needs to check whether the product is covered by a European Technical Assessment Guide (ETAG or EAD) and, if it is not, it can request the preparation of a new guide to a technical evaluation body.

In the certification of roof waterproofing systems applied in a liquid or paste form, they use the technical specifications of the European Organization for Technical Assessment (EOTA), based on ETAG-005 (European Technical Approval Guideline for Liquid applied roof waterproofing kits).

The issue of ETAs can be read on the EOTA website, where there are two "types" of ETAs:

1. ETApprovals that follow the initial guidance (ETAG) or performance evaluations issued by agreement of the Approval Bodies. Valid until the end of 2018 [W1];

2. ETAssessments are issued based on the "ETAs used as EADs" or by EADs, representing the "new" performance assessments [W2].

This is due to the end of the validity of Regulation DPC 89/106, which lists the ETApprovals, and entry into force of PRC 305/2011 on ETAssessments in July 2013.

2.2 Waterproofing systems for roofs

Waterproofing systems vary according to the different types of roofs, the products, the application techniques, the accessibility of the roof, among other characteristics.

The Building Research Establishment states that the performance of the waterproofing system is influenced by the climate and exposure conditions, as well as by the expected durability of the materials.

The most common way is to classify systems as traditional and non-traditional (Sousa, 2009). Non-traditional products are presented in pasty / liquid or prefabricated form. The traditional systems are some bituminous emulsions and bituminous membranes (Lopes, 2010).

3. Market study of Liquid applied roof waterproofing kits

3.1 Issued ETAs

Liquid applied roof waterproofing kits (LARWK) cover a wide range of products and specific uses.

In a synthetic way, after a brief analysis of the waterproofing market, it was found that the LARWKs can be based on various compositions and their application on the roof surfaces can also be different, either by the use of a roller, brush or air gun. Its application can be hot or cold, depending on the system. Once the waterproofing product is applied, a set of chemical processes takes place leading to the formation of an elastic membrane, in the form of an adhered, semi-adhered or loose layer of the support.

The development of the ETAs of LARWKs has been gaining ground in recent years (figure 3.1). The period with the most publications was in 2013 and the first half of 2014, with a total of twenty-two ETAs. One of the possible reasons for the granting of a larger number of ETAs may be due to the manufacturers' uncertainty prior to the entry into force of the new regulation in 2013 (RPC 305/2011),

as evidenced by (Grow, 2015). Thus, the "old" EOTA (European Organization for Technical Approvals) ended and the "new" EOTA (European Organization for Technical Assessment) emerged.

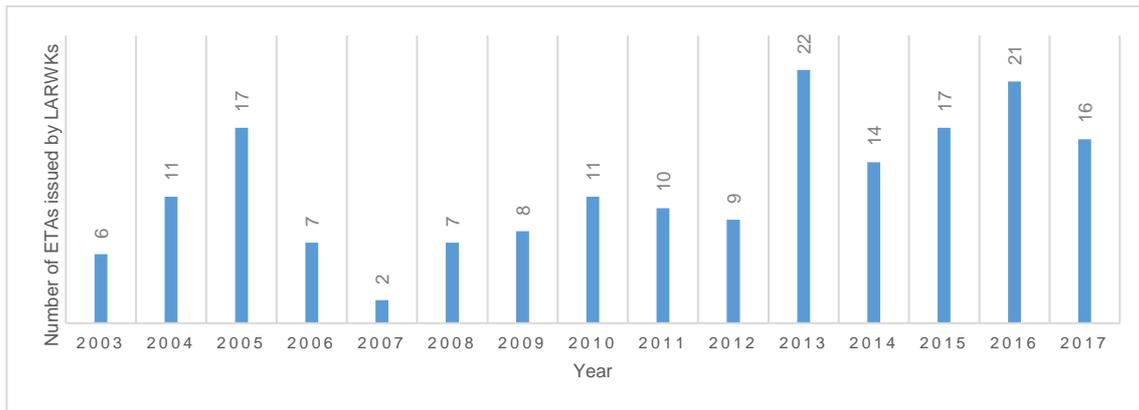


Figure 3.1 - Number of ETAs, based on ETAG-005, issued per year [W1].

3.2 Collection of data from the Portuguese market

Data were collected on a set of liquid and pasty waterproofing products and systems, based on manufacturers and retail companies that supplied them in Portugal.

The main objectives are: to realise how the trademarks supplied in Portugal make their products available on the market; know which components are the most commonly used LARWKS; check if they are certified; how information is provided by domestic and international manufacturers and retail companies; synthesize the characteristics of each type of LARWK.

All this analysis is based mainly on catalogues and data sheets of the systems made available by the manufacturers and, if it is the case, also in their European Technical Assessment (ETAs). Sometimes, some information provided by the retail companies on their websites was used, but with a critical spirit. The manufacturers that served as support were: Sika, Texsa, Weber, Rubson, Enke, Inpernoeroest, Imperialum, Krypton, Triflex, Seire and Alchimica. This study was based on the more detailed analysis of 22 liquid waterproofing products.

As note it is also mentioned the type of work in which the waterproofing systems are applied: 64% in new works, 77% in rehabilitation works, and 86% if considers rehabilitation works and waterproofing repairs. The concrete support is more compatible one (89%), followed by the bituminous products with 68% compatibility.

Most of these systems are composed of several layers with different thicknesses and where, most often, the first layer to be applied is a primer, so that there is a good connection between the SIL and the carrier. In most ETAs and manufacturers' catalogues it is specifically indicated which is the primer that should be applied.

All types of waterproofing, liquid or prefabricated membranes vary greatly in their resistance to environmental, chemical and UV exposure, depending on the base composition and whether or not there is the existence of a protective layer. It should be noted that the existence of pedestrians and vehicles traffic is also considerably dependent on the existence of a heavy protective layer.

In a brief analysis of ETA, some information about the system can be extracted and, therefore, verified if it satisfies the need of each work. Further information is also given in ETA, such as water vapour permeability, layer thickness, which is the primary used, as well as other information.

3.3 Collection of data in some European countries

In order to understand the European panorama, we selected some of the countries that issue more ETAs concerning LARWKs, which are: England, Germany, France and Spain.

Figure 3.2 shows the percentages of LARWKs with ETA issued by the analysed countries. Polyurethane is by far the most important, with 70% of the 111 ETAs mentioned.

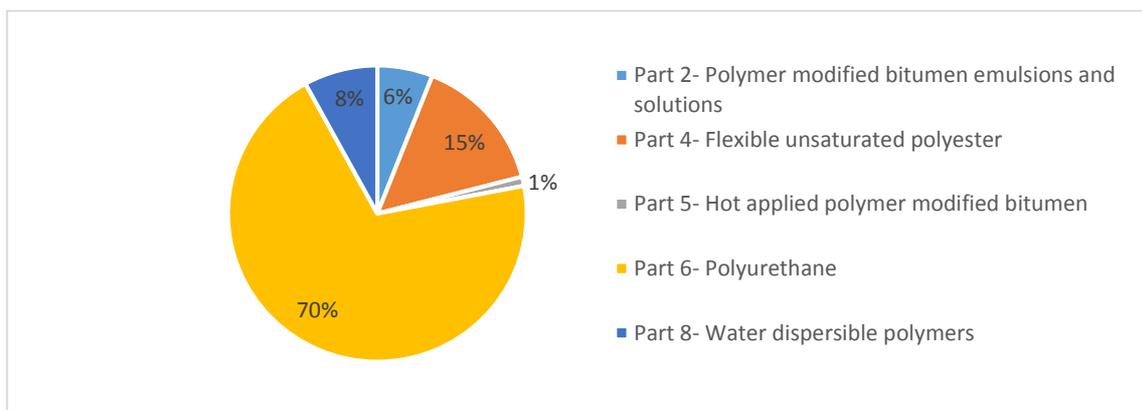


Figure 3.2 - Percentage of ETAs issued for each type of LARWK

There are several types of waterproofing systems, such as polyurethane, emulsions and bituminous solutions, liquid rubber, water dispersible polymers, among others. In the national and international market analysis, LARWKs that have the highest number of ETAs are those that have polyurethane as the basic waterproofing layer. It should be noted that each type of LARWK has different characteristics and forms of application (hot or cold). It should also be noted that there are liquid waterproofing kits that are used in conjunction with traditional waterproofing systems (membranes), both of which have the same chemical composition.

Polyurethane LARWKs are distinguished by single-component or bi-component. One such component is polyurea which has low permeability, high mechanical strength and supports higher temperatures than polyurethane. Systems of this type evaluated on the basis of ETAG-005 present high values in the accomplished validations.

4. Inquiry

During the dissertation, two inquiries were carried out. One of the questionnaires was made to a group of people that perform functions in the choice or application of waterproofing systems, with a total of 23 responses obtained. The other one was answered by residents and responsible for the condominium or its maintenance, making a total of 34 responses. The main objective was to understand

the opinion of these persons regarding some contents of waterproofing systems and roofing, thus helping the market to improve the selection process of liquid waterproofing systems.

The designed questions had, as their starting point, the analysis made to the national and international market, regarding the treatment of a set of catalogs of some manufacturers and other suppliers. In this paper, a number of issues emerged that were important to clarify, namely, what the two groups of respondents consider essential to know about this market, so manufacturers and retail companies should try to make an effort to improve the type of information they provide.

This survey aims to help manufacturers better their position and understand the national waterproofing market for both new and rehabilitation works, to support the development of a checklist proposal, and to develop ETAs of LARWK.

Flat and mixed roofs have gained importance in Portugal in the survey, with 82% of the persons that perform functions in this constructive element, stating to use this type of coverages.

From the survey it was noticed that the residents and those responsible for the condominium and its maintenance, when they need to obtain a LARWK for their coverage, they preferentially apply to the applicators and contractors. Manufacturers of LARWKs should make an effort to ensure that these stakeholders are well informed and know how to make a correct application.

The group of respondents, which includes the residents, would be willing to pay more for a certified system. But in relation to the group that performs functions in the area of waterproofing roofing, the preference for a LARWK containing an ETA, that is, a certified system, is no longer so clear. A poor indicator is that 60% of the people who are responsible for the implementation phase (applicators, contractors,...) have responded that they use LARWKs with ETA as a "last scenario" or only "a few times". Applicants are the actors in which the residents deposit almost their entire trust in the phase of having to repair a roof waterproofing.

As regards the elements that should be reinforced in the ETAs, they vary according to the role of the respondent, and it is common for the whole of the first group to have more detailed drawings for the single zones and data related with mechanical performance (flexibility, traction, wear, seismic). It is noted that those who play the role of the applicator find it important to have more information regarding the implementation of LARWKs.

It is important to mention that, with the exception of designers, who prefer LARWKs based on bituminous emulsions, all the other surveyed prefer polyurethane in both new and rehabilitation works. Almost all designers prefer waterproofing of bituminous membranes for both new and rehabilitation works. LARWKs based on bituminous emulsions get closer to the bituminous membranes and are sometimes applied together. Thus, this may explain the preference of the designers for the bituminous emulsions.

The rehabilitation and repair works of the materials that make up the roof are not subject to licensing, that is, there is no need for a project and the supervision of the works is entrusted only to the promoter of the work. Generally, the developers of the buildings in service are the residents or the condominium companies, which can be alarming because 74% of the respondents resort to roofing

specialists and only 15% to designers. It is imperative to create a detailed design of the construction element to achieve the desired performance over its lifetime.

The most commonly cited waterproofing products by construction specialists are liquid rubber and acrylics, which contain no part of the dedicated ETAG-005. The European Assessment Document (EAD) will be a new evaluation guide, which is foreseen for LARWKs and should contain new parts. In the questionnaire, these are the least used systems in new and rehabilitation works.

From the survey it was concluded that the choice of the waterproofing system depends on the function that each person performs in the work, confirming a divergence in the choice of the system, since some prefer LARWK with ETA, while others prefer them without the latter, not reflecting a unified criteria approach. Regarding the residents and those in charge of the condominium, their greatest concern lies in their durability. They also consider that the existence of a certificate is important, and when they have to participate in the choice of a system, they mostly resort to the applicators.

A large percentage of the residents and those in charge of buildings do not know what SILs are or their advantages and the type they know best are bituminous emulsions and liquid rubber.

For roof surveyors, in the rehabilitation works, LARWKs are used equitably to the bituminous membranes. However, for new constructions, the use of liquid waterproofing is negligible.

The confidence of the group of specialists in the waterproofing system depends on the experience they have in a certain system (30.4%) and in the opinion of the application teams (39.1%). In-situ non-traditional systems are more recent and applicators respond that they do not apply liquid membranes, together with the degree of confidence of the specialists. These are factors that may justify the low employability of LARWKs in new works.

The existence of a CE marking and the durability of a waterproofing system are very important, as was found in the respondents' replies.

Ideally, a greater number of survey responses should have been obtained. Even so, it was possible to conclude that the construction sector is sometimes adverse to innovation and choice of other solutions.

The proposal of the dissertation was the elaboration of a checklist which shows the characteristics and parameters of liquid waterproofing systems that should be examined during the analysis, comparison, choice and application phases.

5. Conclusion

From the market analysis it can be concluded that the existence of an ETA guarantees that the manufacturing process is rigorous and that the systems comply with the previously established requirements, allowing them to be labelled with the CE marking. It is still seen that there are several LARWKs and the task of choosing or indicating the ideal is, for the moment, complicated by the fact that there is a lot of dispersed information.

A major difficulty with LARWKs in Portugal, with ETA, is that many manufacturers do not provide the information in Portuguese.

Some of the manufacturers indicate which contractors are authorized to use the systems marketed by them, even providing a course to ensure a proper execution.

The objective of the survey was accomplished, having analysed the knowledge and concerns regarding liquid waterproofing systems as well as the confidence in certified assessments. Based on the main features of the systems discussed in the previous chapter, you can understand the most important parameters for those who choose, design or apply a LARWK, as well as for the property owners.

The proposal of the checklist, along with the European Technical Assessment (if there is one), ensures a certain homogeneity in the information provided by the manufacturers and facilitates the choice of the best solution.

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