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Results from the EMERISDA project**

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Effectiveness of methods against rising damp in buildings: results from the EMERISDA project

B. Lubelli, R.P.J. van Hees, J. Bolhuis

Abstract

Rising damp is a recurrent hazard to ancient buildings in Europe and its relevance is expected to increase in the future, due to climate changes. The presence of rising damp in walls does not only create an unpleasant climate in buildings, but it also enhances damage processes such as frost action, salt crystallization and biological growth, with possible consequences on the health of the inhabitants.

The relevance of this problem is reflected by the large variety of products on the market. The wide and differentiated offer and the scarce scientific information on the effectiveness of the methods make it difficult, (even) for professionals working in the field, to choose a suitable intervention on a sound basis.

The JPICCH-financed project EMERISDA (2014-2017) [1] aimed at evaluating the effectiveness of different intervention methods against rising damp. The project involved universities, research institutes, heritage agencies and companies (producers and contractors) in Belgium (BBRI, co-ordinator), Italy (CNR-ISAC, Università Ca' Foscari Venezia, Restauri Speciali s.r.l., Diasen s.r.l.) and The Netherlands (Delft University of Technology and the Cultural Heritage Agency of the Netherlands).

The research methodology included the use of an on-line questionnaire and experimental research in laboratory, on scale models and on-site. Both traditional methods, such as chemical injection, and more recent techniques, such as the so-called “electro-physical” methods have been investigated. [2]

The following results of the EMERISDA project are presented in this paper:

- Results from on-line questionnaire.
- Definition of an experimental procedure for the assessment of the presence of rising damp and of the effectiveness of the intervention.
- Prototype of decision support tool, which provides insight into the feasibility and risks of existing methods against rising damp and supports actors involved in conservation in the choice and application of the methods against rising damp.

Keywords: rising damp; assessment of rising damp; intervention against rising damp; decision support tool,

1.Introduction

Rising damp, i.e. capillary rise of water from the ground to the walls of a building, is one of the most recurrent threats to historic buildings (figure 1). The phenomenon of rising damp is more recurrent in ancient than new constructions, due to the fact that the ancient buildings have often masonry foundations and lack of a damp-proof course, i.e. of a layer hindering the water transport from the ground to the upper structure.

Capillarity is the mechanism governing rising damp in a wall [3,4]). Capillary forces can transport water from the ground into the wall, against the gravity forces. The maximum height of rising damp can theoretically reach, depending on the material, even the height of 15 m; however, in practice, due to the presence of boundaries between materials with different pore sizes (e.g. example mortar and brick) and of evaporation, the maximum level reached by rising damp in brick and stone masonry is generally limited to one or two meters.

The phenomenon of rising damp is quite slow; this means that damage to the building materials and structures may become visible only after several years from the construction. Changes in the groundwater level and the presence of salts [5] may also affect the height to which the water rises in the wall.

The high moisture content deriving from the presence of rising damp does not only create an unpleasant climate in a building, but it also considerably enhances decay processes, such as e.g. salt crystallization and frost action. Due to climate changes (increased amount of precipitations, rise of sea level and the variations in the ground water table [6-8]), the occurrence and the relevance of rising damp is expected to increase in the coming decades.



Figure 1. Wall affected by the presence of rising damp.

The relevance and extension of the rising damp problem is shown by the large offer of methods and products against rising damp available on the market [9]. Existing methods include mechanical cut of the wall (e.g. [10]), injection of chemical products (e.g. [11]), wall base ventilation (e.g. [12]) and electric methods (such as electro-osmosis, “electro-physical” methods etc.). Apart from methods aiming at stopping or reducing the moisture source, other solutions exist which are mainly tackling the symptoms, such as the use of special dehumidifying and/or salt resistant plasters [13,14] or veneer walls.

The large and varied offer of solutions, and the scarcity of scientific and independent information available on the subject, make it difficult for professionals and practitioners working in the field to choose a suitable method on a sound basis. In fact, despite the large diffusion of methods and products to stop rising damp, scientific literature on their effectiveness, in laboratory and in the field,

is scarce and not conclusive. Literature on laboratory research includes the study of fundamental aspects, such as the transport of immiscible and miscible fluids (water and injection products in organic solvents) in pores [15,16] and the electro-kinetic processes (e.g. [17]), as well as the study of the effectiveness of specific methods and products against rising damp. This second line of research largely focuses on the study of chemical injection products [18-20]. Only very few references compare diverse methods [11]. Moreover, laboratory results from different sources are hardly comparable, as they strongly depend on the used evaluation procedure. For example, the existing laboratory procedures for the evaluation of chemical injections (e.g. TNO [20], BBA [21], WTA [22], BBRI [23],) differ in size of the specimens, specimens' material(s), initial water saturation degree, use of salt solution or water for saturating the specimens and methods, techniques and criteria used for the evaluation of the effectiveness. Moreover, laboratory tests propose simplifications of the practice situation, which might invalidate the obtained results [24-26]. Examples are the use of a single material instead of a combination of materials and the use of a period of drying of the treated specimen before testing the treatment's effectiveness (thus simulating an almost impossible temporary removal of the moisture source from the wall).

If scientific literature on the effectiveness of the different methods and products in the laboratory is scarce and scattered, scientific literature on the long term behaviour of these products is even less informative. Apart for some exceptions, (e.g. [18, 20, 27]), single case studies, each treated with a different method or product, are investigated for an insufficient period of time, using different evaluation procedures and criteria (generally imprecisely reported) so that it is impossible to compare the results. Moreover, most of the existing literature concerns mainly relatively traditional methods, such as chemical injection. Other methods, such as the so-called "electro-physical" methods have been scarcely investigated, despite their increasing diffusion in the European market.

Scientific research on the effectiveness of solutions against rising damp in the field is limited by several factors: first of all the long-term monitoring needed for a reliable evaluation of the interventions, fact which often leads to budget depletion before reaching a definitive assessment of the effectiveness of a method or product. Besides, the combination of different interventions (e.g. chemical injection and special dehumidifying or salt resistant plasters etc.) common in the conservation practice makes it arduous to point out the actual effectiveness of the treatment against rising damp.

The absence of detailed documentation on the interventions (including details of the procedure used, such as injection pressure, pre-grouting or pre-drying of the masonry etc.) is another fact contributing to lack of reliable and complete information on field interventions. This problem is even bigger when considering interventions in not listed buildings, with no or limited historical or artistic value.

2. The JPICH financed project EMERISDA

In 2014 the JPI-financed project EMERISDA (2014-2017) [1] has been set up with the main aim of providing a scientifically based evaluation of the effectiveness of different methods against rising damp and to define decision support instruments for a conscious choice and successful use of these methods in the practice of conservation.

The project involved universities, research institutes, heritage agencies and companies (producers and contractors) in Belgium (BBRI, co-ordinator), Italy (CNR-ISAC, Università' Ca' Foscari Venezia, Restauri Speciali s.r.l., Diasen s.r.l.) and The Netherlands (Delft University of Technology and the Cultural Heritage Agency of the Netherlands).

The research methodology involved:

- The use of interviews and on-line questionnaires [28], aiming at unravelling the criteria followed by owners, persons responsible for conservation and architects when choosing a suitable intervention method against rising damp, the methodology used for the assessment

of the effectiveness of the treatment and the degree of satisfaction about the different methods.

- Experimental research in laboratory, on scale models and on-site. Both traditional methods, such as chemical injection, and more recent techniques, such as the so-called “electrokinetic” methods have been investigated.

Some of the main results of the EMERISDA project, shortly discussed in this paper, are:

- Overview of intervention methods against rising damp, criteria for their choice and degree of satisfaction, as derived from the on-line questionnaire (section 3).
- Definition of an experimental procedure for the assessment of the presence of rising damp and of the effectiveness of the intervention (section 4).
- Creation of a prototype decision support tool, which provides insight into the feasibility and risks of existing methods against rising damp and supports actors involved in conservation in the choice and application of the methods against rising damp (section 5).

Other papers, part of this same special issue, discuss in detail the assessment of the effectiveness of chemical injection products (tested on scale models and in case studies [29] and “electro-kinetic” devices (tested on case studies) carried out in the EMERISDA project [30].

3. Results from on-line questionnaire

The on-line questionnaire [28] has been developed with the aim of getting insight in the way the problem of rising damp in building is tackled in every day’s practice. Specifically, an answer to the following questions has been looked for:

- Is the presence of rising damp assessed before an intervention and how?
- What is the diffusion in the field of the different methods for tackling rising damp?
- What are the criteria for choosing an intervention method?
- Has the effectiveness of the intervention been determined afterward and how?
- What is the satisfaction degree of the users of the building for each of the methods?

The response was lower than expected. In total, 51 participants filled out the questionnaire: 31 Dutch cases, 12 Belgian cases and 8 Italian cases were collected. The main difficulty was to reach the owners of the buildings as, for privacy reasons, the contractors would not provide the contact details of their clients.

It should be mentioned that some important limitations apply to the results deriving from the questionnaire:

- The number of cases is limited and thus statistically not significant.
- Most of the Dutch cases were provided by the producer/seller of the methods. Therefore, some methods might be overrepresented while others might be missing, as no information was available. In all cases the questionnaire was filled in by the users.

However, despite these limitation, the collected results still give some insight in the practice of conservation when dealing with the problem of rising damp in buildings.

Assessment of the presence of rising damp

In most cases the presence of rising damp was assessed prior to the intervention. In most cases, quantitative or qualitative methods were used. In about one fifth of cases, the presence of rising damp was assessed only visually. In many cases the company responsible for the diagnosis is also selling (one or more types of) intervention methods to tackle rising damp.

Intervention method and criteria for its choice

Figure 2a confirms that many different methods are applied in practice to tackle the problem of rising damp. When interpreting this graph, it is important to take the following considerations into account:

- The “electro-physical” method is overrepresented. Many of the participants of the questionnaire were contacted via producers or sellers of “electro-physical” methods.
- Often, a combination of methods is used. In these cases, it is difficult to assess the effectiveness of each single method, because it is not clear to which extent each of the methods contributes to the total effectiveness.

Regarding the criterion for the choice, one fourth of the participants chose the method based on good experiences reported by others (figure 2b). In many cases, the users followed the advice of the company performing the investigation and selling one or more types of intervention methods. Another important factor in the choice of the method is its easiness of execution: this is especially true in the case of “electro-physical” systems.

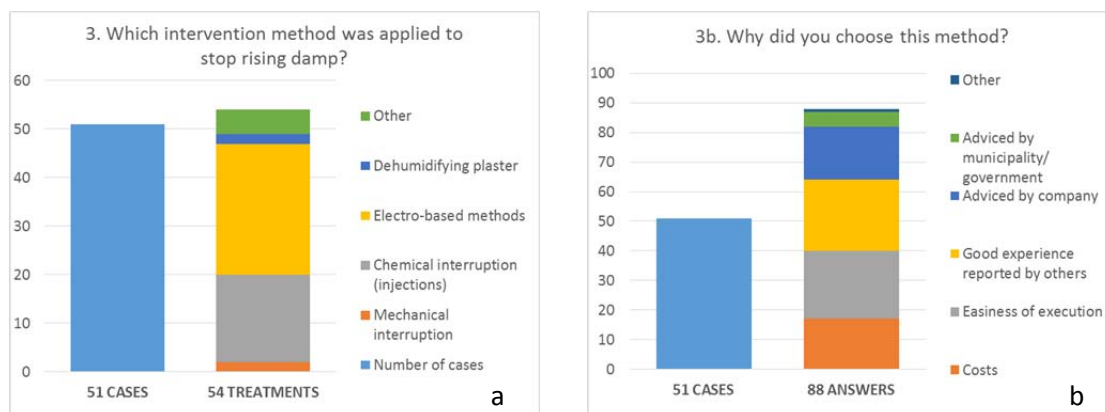


Figure 2. Type of intervention method (a) and criteria for the choice (b), as resulting from the interviews.

Assessment of effectiveness

In 61% of the cases, the effectiveness of the intervention method was assessed after the intervention. In the cases where the effectiveness was measured, most interventions were found successful according to the measurements. It should be mentioned that in most cases the effectiveness was determined by the producers/sellers of the treatment themselves; only rarely is an independent research party involved. In many of the cases where an independent party did measurements, these measurements were part of the EMERISDA project. Besides, in many cases, next to the intervention against rising damp, additional interventions (e.g. painting, new plasters) were carried out, which may affect the results.

Degree of user satisfaction

Most users report that the intervention is, in their opinion, effective. Some users are satisfied with the results even though the measurements show no decrease in moisture content, while others are not satisfied despite the positive results shown by the measurements.

Users were asked to grade the comfort level they experienced in the building, both before and after the intervention. The average mark for the comfort after the intervention indicates an improvement of the comfort. Surprisingly, this does not always correspond to a measured decrease in moisture content in the wall.

Almost 50% of the users report that damage has reappeared after the intervention.

4. Experimental procedure for the assessment of the presence of rising damp

In the project an experimental procedure, based on the gravimetric method [e.g. 31-33] already developed in previous research, has been further defined: criteria for the choice of the sampling

locations, details about the measurement procedures and the interpretation of the results have been specified in order to facilitate the comparison between the data collected by the different partners in the project.

Choice of sampling locations

The gravimetric method proposed for the assessment of the presence of rising damp consists in drilling powder at different depths and heights in the wall, along a vertical profile (figure 3). The sampling locations should, whenever possible, be chosen at places where rising damp is possibly present, but other sources (such as rain water penetration, leakages, etc.) are excluded. Interior walls with foundations are therefore a suitable choice). Comparison between locations with and without damage can be useful.

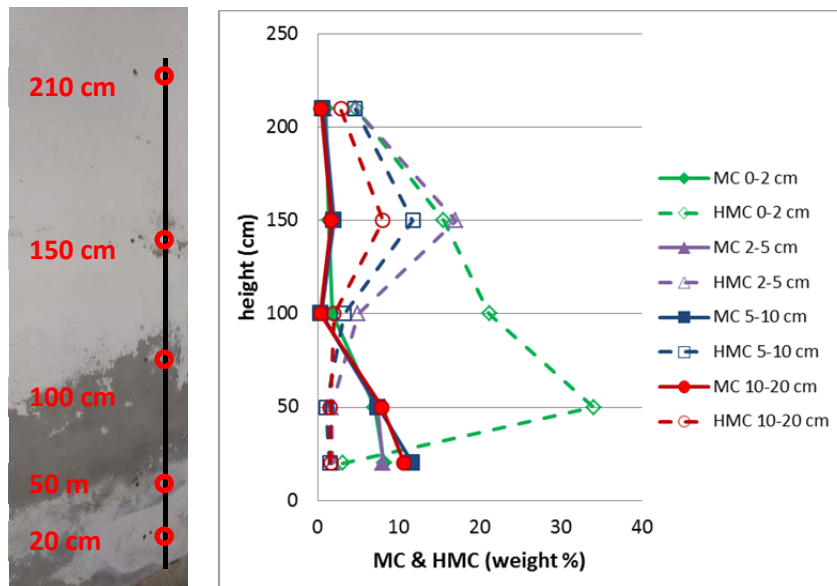


Figure 3. Example of sampling at different heights along a vertical profile and MC and HMC results showing the presence of rising damp and salts.

Measurement procedure

Samples should be collected in air- and vapour tight bags or bottles. The weight of the sample is recorded before and after drying and the moisture content (MC) is calculated as follows:

$$MC [\%] = 100 * (\text{weight}_{\text{wet}} - \text{weight}_{\text{dry}}) / \text{weight}_{\text{dry}}$$

Then the same samples are placed in a climatic cabinet at 95% RH. After a period 4 weeks, the samples are measured again and the Hygroscopic Moisture Content (HMC) is calculated as follows:

$$HMC [100] = 100 * (\text{weight}_{95\%RH} - \text{weight}_{\text{dry}}) / \text{weight}_{\text{dry}}$$

The HMC gives an indication of the presence and amount of hygroscopic salts [e.g. 34]. This second step is thus needed to assess the presence of hygroscopic salts and their contribution to the measured MC. As most soluble salts have a RH of equilibrium lower than 95% RH [35,36], using this RH will allow to include the effect of most salts. The period of 4 weeks has been chosen in order to have a reliable indication of the presence of hygroscopic salts without the need to necessarily wait for the samples to reach a constant weight, which may take a long time in case of large samples and large amounts of highly hygroscopic salts.

Interpretation of the results

For the assessment of the presence of rising damp, both MC and HMC should be considered.

If the MC is higher than the HMC, this generally (some exceptions may exist for very humid environments) means that a moisture source is present, other than the hygroscopic effect of the salts. High MC values, which decrease higher up in the wall and increase in depth, are a sign of the presence rising damp (this does not necessarily mean rising damp from ground water). Generally, rising damp from ground water is accompanied by the presence of hygroscopic salts: in this case the MC and HMC profiles cross each other at the maximum height reached by rising damp.

The effectiveness of the intervention against rising damp can be assessed by repeating the sampling using the same procedure at the same locations after some time, e.g. one year, from the intervention. As seasonal variation in the ground water level are common, it is preferable to sample in the same period of the year. A reduction of the MC in the wall (generally accompanied by an increase of the HMC at the surface of the wall, due to drying of the wall and transport of salts at the surface) is an indication that the intervention has been effective. The time needed for drying and the final MC reached in the wall will depend on several factors (type of intervention, initial MC, thickness of the wall, presence of salts, environmental conditions, etc.).

5. Prototype of decision support tool

Aim

The Decision Support Tool has been developed to help architects, contractors and owners of buildings in the choice of a suitable intervention method against rising damp, depending on the specific situation. The tool is not meant to provide an advice, but to facilitate the comparison between different possible interventions and to provide an overview, as much as possible complete, of advantages, limitations and risks of each option. In fact, despite the fact that literature on the available methods against rising damp is available, no tool exists yet to support the decision process. At the moment the developed Decision Support Tool is still in the process of validation and fine-tuning and, in the future, it can be made available to the public on the web.

The tool has been set up to be as flexible as possible, also to allow for future improvements. Each question can be answered independently; if a question is not answered this does not preclude the possibility of using the tool.

The tool has been developed using Excel software, so that it would be easily accessible for most of the potential users.

Structure

The tool is a simple file consisting of several sheets (including a manual for the use of the system and a glossary).

The first sheet ("Likeliness") proposes a few simple questions to check whether rising damp is likely to be present (figure 4a). In the case the answer is affirmative, the second sheet ("Confirm") guides the user through the sampling and interpretation of the results (figure 4b).

The third sheet "Techniques" is the one facilitating the comparison between different intervention methods. This sheet consists of a series of questions (reported in lines) about the specific situation; the questions are subdivided in 4 groups:

- wishes and requirements of the user: the user may e.g. ask for solutions which do not require maintenance or he may have a limited budget at disposal.
- cultural heritage aspects (mainly relevant in the case of monuments): these questions deal with aspects such as reversibility and compatibility of the intervention, regulations etc.
- properties of the wall to be treated: these questions address the technical quality of the masonry, e.g. the presence of voids, the thickness and the presence of claddings.
- Damage, moisture and salt content in the wall to be treated: these questions can be answered if investigation has been carried out according to the suggested procedure.

The different intervention methods and techniques are reported in columns, and are subdivided in 5 categories:

- interventions reducing the moisture supply at the base of the wall (e.g. sub-soil drainage);
- interventions stopping/reducing the suction of water in the wall (e.g. mechanical interruption, chemical damp-proofing);
- interventions enhancing evaporation (e.g. Knapen Siphons and similar, wall base ventilation, thermal methods);
- interventions which (claim to) affect the transport of water in the wall (e.g. active and passive electro-osmosis, other “electro-kinetic” methods);
- interventions tackling only (some of) the symptoms of rising damp (veneer walls, different types of restoration plasters, climate control systems). In this category also the option of “no intervention” is considered.

	A	B	C	D
1	1.	Is it likely to be rising damp?		
2				
3	Q1.1	Where is the problem located?	Basement	
4				
5	Q1.2	Do you see one or more of these damage types?	Yes	
6		- Moist spots		
7		- Detachment of plaster, peeling of paint		
8		- Loss of cohesion of brick, stone and/or mortar		
9		- Efflorescence of salts		
10		- Biological growth and/or mould		
11		Find reference images here		
12				
13	Q1.3	On which part of the wall do you see damage?	Bottom	
14				
15				
16				
17		Result		
18		RIISING DAMP IS POSSIBLE. If it's an interior (not earth-retaining) wall, the location of damage in the lower part of the wall matches the typical pattern for rising damp. If it's an exterior (earth retaining) wall, there could also be rising damp, but it could also be ground water which is coming through the wall horizontally. In any case, measurements are required to be certain if rising damp is present. Please proceed to step 2.		
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a

	A	B	C	D
1	2.	Can rising damp be confirmed?		
2				
3		Please collect powder samples according to the provided guidelines. If possible, collect samples from an internal wall WITH FOUNDATION. Otherwise, collect samples from an external wall WITH FOUNDATION. In any case, be sure to collect multiple samples at several heights along a vertical profile, and at several depths. Determine MC and HMC for all samples.		
4				
5	Q2.1	Did you take samples in an internal or an external wall?	Internal wall	
6				
7	Q2.2	Is the MC in depth, in the lower part of the wall, (much) higher than the HMC?	Yes	
8				
9	Q2.3	Is the MC, in depth, decreasing with height?	Yes	
10				
11		Result		
12		COULD VERY WELL BE RIISING DAMP. The moisture distribution in the wall suggests that moisture is indeed transported from below and that there must be an active moisture source other than hygroscopicity of the salts possibly present in the wall.		
13		Because you have sampled from an INTERNAL wall, it is not necessary to fill out the following questions. Please proceed to sheet 3.		
14				
15		Please fill out these questions if you have sampled in an external wall		
16				
17	Q2.4	Is there a good drainage of rain water?	Yes	
18				
19	Q2.5	Are the foundations below ground water level?	I don't know	
20				
21		Result		
22		The following information could be relevant for you:		
23		- Rain water is properly drained, so this should not be a problem.		
24		- If the foundations are in the ground water, they are permanently saturated and there will be moisture transport upwards through the wall. However, even if the foundations are not in the ground water, capillary transport through the soil might still cause rising damp.		
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b

Figure 4. Screenshot of the sheets “Likeliness” (a) and “Confirm” (b)

By answering a question, in the table a short text will appear for each of the possible interventions. The background colour of the cell will indicate whether the intervention can be considered suitable (green), suitable with some restrictions (yellow) or unsuitable (red) (figure 5). Based on the answers, and thus being aware of advantages, limitations and risks of each technique, the user can easier make a choice in the specific situation.

In the future, next to validation and further fine-tuning of the system, an option could be created to allow the user to attribute a relative importance to each aspect (e.g. in the case of a monumental building, cultural value issues may have a stronger importance than requirements imposed by the user of the building) and to calculate a weighed score for each of the possible options.

	A	B	C	D	F	G	H	I	J	K	L
1		working principle >			Based on stopping/reducing water transport higher up in the wall		Based on evaporation increase			Based on electrokinetic	
2					These methods are supposed to reduce rising damp by making water transport through the wall more difficult or even impossible.		These methods are supposed to reduce rising damp by increasing evaporation of the water already present in the wall. The source of the moisture is not altered.			These methods are supposed to reduce rising damp by the water level decreases.	
3		situation >		solution >	Mechanical interruption	Chemical damp-proofing	Knapen Siphons & Schrijver stones	Wall base ventilation	Thermal methods	Active electro-osmosis	Passive electro-osmosis
4	Owner requirements	Is it acceptable to have to do maintenance to keep the method working?		Yes	OK; no maintenance is required.	OK; no maintenance is required.	OK. Expect to have to clean the openings every so often, so the airflow is not blocked.	OK. In case of active ventilation, the devices might need maintenance.	OK; depending on heating method, device might need maintenance.	OK. Be aware that the effectiveness of the method might decrease when the water level decreases.	OK; no maintenance is required.
5		Do I need to stop rising damp completely?		Yes	OK; rising damp is completely stopped above the level of the interruption.	Attention: the effectiveness of this method depends on several factors. It is advised to check the effectiveness 6-12 months after the intervention.	Risk: this method is not meant to stop rising damp completely but to reduce the MC in the wall. The effectiveness of this method is low.	Risk: this method is not meant to stop rising damp completely but to reduce the MC in the wall. The effectiveness of this method is low.	Risk: this method is not meant to stop rising damp completely but to reduce the MC in the wall. The effectiveness of this method is low.	Attention: the principle is reliable but there are several limits and there is only very little experience in practice.	Risk: the effectiveness method has not scientific proven.
6		Do you have a large budget available for this intervention (initial costs + operation + maintenance)?		No	Risk; very high initial costs but no running costs or maintenance.	OK; moderate initial costs but no running costs or maintenance.	OK; moderate initial costs and no running costs or maintenance.	Attention: apart from initial costs, take into account the running costs for the mechanical ventilation devices.	Risk: apart from high initial costs, expect high running costs as well.	Attention: apart from initial costs, expect limited running costs (electric power) as well.	OK; moderate initial cost; running costs or maintenance.
7		Is it acceptable if you cannot use the room for some time while/after the intervention is carried out?		Yes	OK; keep in mind that the intervention is quite rigorous.	OK; be aware that, depending on the product/agent, you may not be able to use the room for a few weeks.	OK; the intervention does not take long to carry out.	OK; the intervention is on the outside and the wall is not affected.	OK; depends on the chosen method.	OK; during the intervention, you can not use the room.	OK; during the intervention, you can not use the room.
8		Is aesthetic damage (e.g. efflorescence, moist spots, biological growth) acceptable?		No	Attention: during drying of the wall, in the case salts are present, salt efflorescence or damage might occur above the level of the mechanical interruption, due to drying.	Attention: during drying of the wall, in the case salts are present, salt efflorescence or damage might occur above the level of the chemical interruption, due to drying.	Risk: if salts are present, the evaporation increase might lead to an increase of efflorescences and/or salt damage.	Risk: if salts are present, the evaporation increase might lead to an increase of efflorescences and/or salt damage.	Risk: if salts are present, the evaporation increase might lead to an increase of efflorescences and/or salt damage.	Attention: as rising damp is not stopped completely, the method tends to be contained with a plaster layer to prevent visible damage.	Attention: no change expected.
9		Is a change of appearance of the wall acceptable due to the intervention?		No	Attention: wall finishes (plaster etc) will have to be repaired. On a bare brick wall, a horizontal line will remain visible.	Attention: holes are drilled in the wall. The holes will be filled, but will remain visible on a bare wall. If a plaster layer is present, this needs to be repaired.	Risk: the siphons are in sight, changing the appearance of the wall.	OK; the wall itself is not changed. Depending on execution, mechanical ventilation devices might be visible.	Attention: depends on method.	Attention: electrodes are in sight. A plaster layer can be applied to hide them.	Attention: electrodes are in sight. A plaster layer can be applied to hide them.
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Figure 5. Screenshot of a section of the decision support tool

6. Conclusions

This paper reports some of the results of the JPICH project EMERISDA (2014-2017).

The results from the on-line questionnaire have shown that independent research for the assessment of the presence of rising damp as well as on the effectiveness of the interventions is only rarely performed in the daily practice of conservation/renovation. Surprisingly, the high degree of user satisfaction recorded does not always correspond to an effective intervention, as is shown by the fact that after a few years from the intervention, the problems often re-appear.

The measurement procedure proposed for the assessment of rising damp allows to assess in a relatively simple but reliable way the presence of rising damp and the effectiveness of an intervention. The method is little destructive and might thus be supplemented by non-destructive methods for the monitoring of the effectiveness of an intervention in time, especially when dealing with monumental buildings. Because of the time needed for a wall to dry, this method should preferably be carried out 1 or 2 years after the intervention. If a quick response is desired, the use of the newly developed prototype method, presented in [37], can be considered.

The prototype decision support tool developed in the project facilitates the comparison between different interventions and can help thereby the user to select the most suitable method in the specific situation. The tool proposes an approach allowing to consider different aspects in a decision process: in this way it helps to make clear the relevance of each aspect to all parties involved in a conservation/renovation project.

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