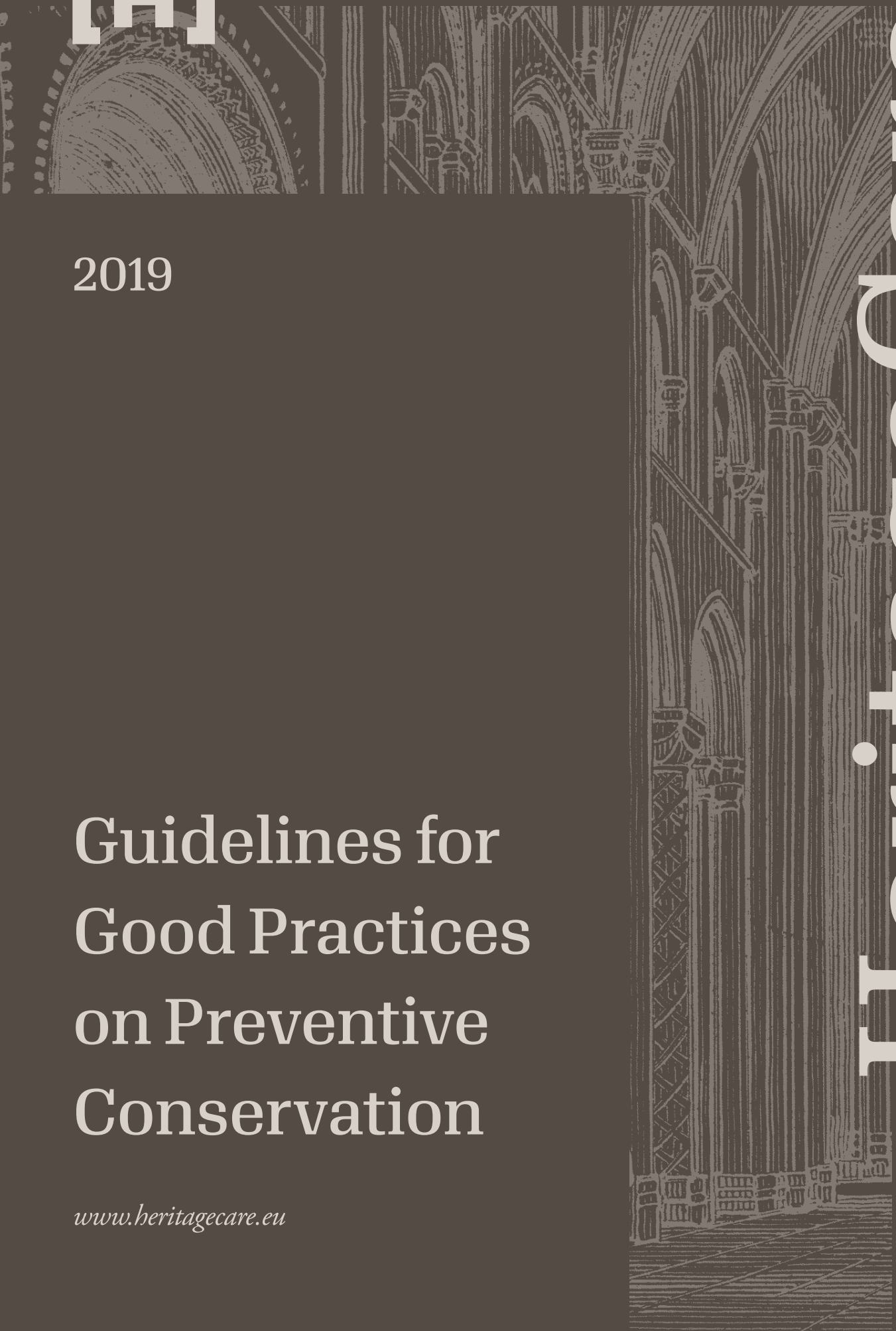

2019

Guidelines for Good Practices on Preventive Conservation

HeritageCare

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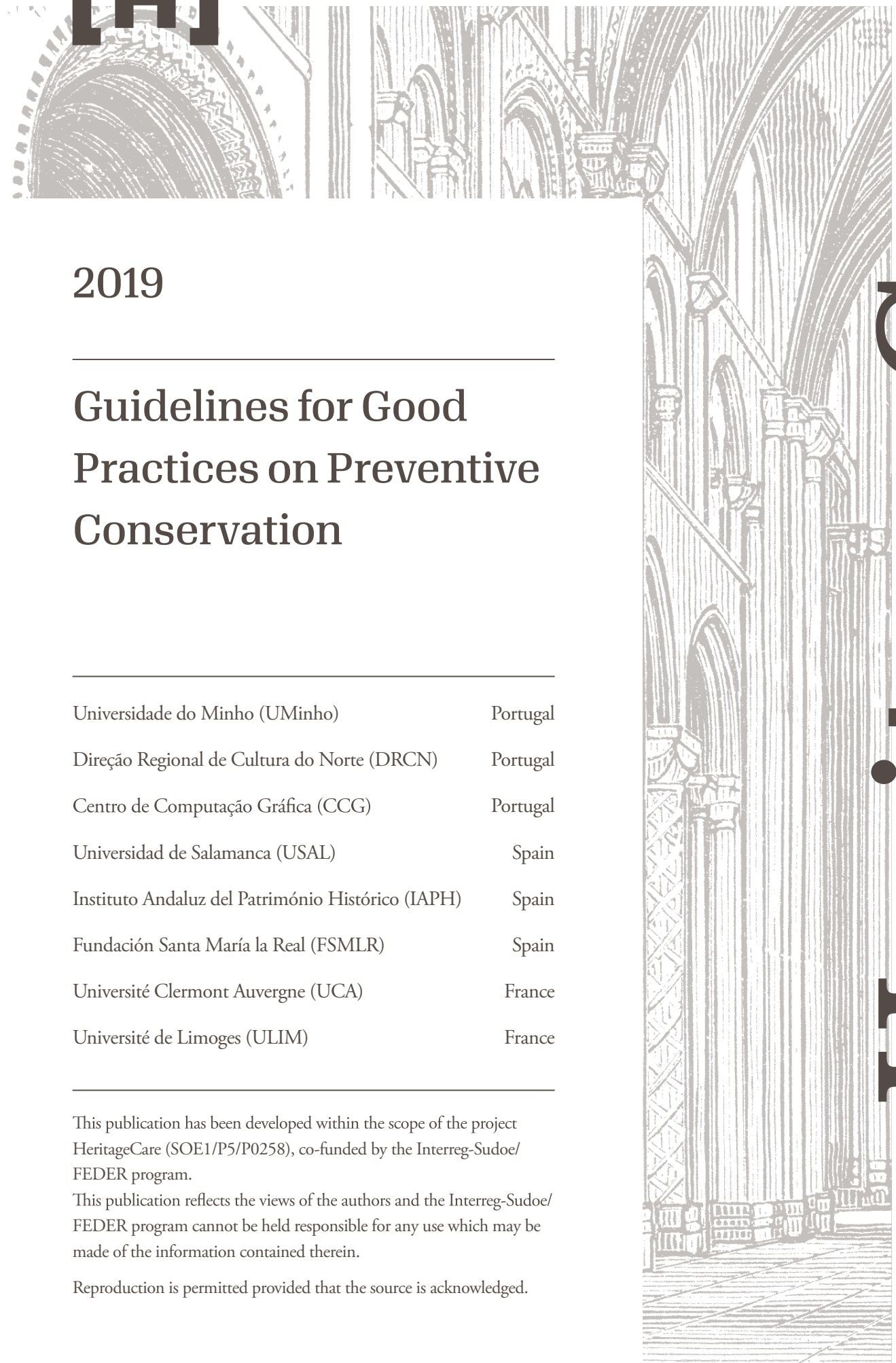

HeritageCare

2019

Guidelines for Good Practices on Preventive Conservation

Universidade do Minho (UMinho)	Portugal
Direção Regional de Cultura do Norte (DRCN)	Portugal
Centro de Computação Gráfica (CCG)	Portugal
Universidad de Salamanca (USAL)	Spain
Instituto Andaluz del Património Histórico (IAPH)	Spain
Fundación Santa María la Real (FSMLR)	Spain
Université Clermont Auvergne (UCA)	France
Université de Limoges (ULIM)	France

This publication has been developed within the scope of the project HeritageCare (SOE1/P5/P0258), co-funded by the Interreg-Sudoe/FEDER program.

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Abstract

The present work **Guidelines for Good Practices on Preventive Conservation** is one of the joint outcomes of the HeritageCare project. It is mainly addressed to owners and managers of historic buildings in Southwest Europe and it is intended as a general guide for preventive conservation of built cultural heritage enriched with practical recommendations as well as with clear and simple tips on common maintenance problems.

Resumo

O presente trabalho **Recomendações para as Boas Práticas em Conservação Preventiva** é um dos resultados do projeto HeritageCare. É dirigido principalmente a proprietários e gestores de edifícios históricos do Sudoeste Europeu, servindo como um guia geral para a conservação preventiva do património histórico construído, com recomendações práticas e com dicas claras e simples sobre problemas comuns de manutenção.

Resumen

El presente trabajo, **Recomendaciones para las Buenas Prácticas en Conservación Preventiva**, es uno de los resultados conjuntos del proyecto HeritageCare. Se dirige principalmente a propietarios y gestores de edificios históricos en el Sudoeste de Europa y está formulado como una guía general para la conservación preventiva del patrimonio cultural inmueble enriquecida con recomendaciones prácticas, así como consejos sobre problemas comunes de mantenimiento, expuestos de forma clara y sencilla.

Résumé

Les présentes **Directives pour de Bonnes Pratiques en Conservation Préventive** sont l'un des résultats du projet HeritageCare. Il s'agit d'un guide général principalement destiné aux propriétaires et aux gestionnaires de bâtiments historiques du Sud-Ouest de l'Europe, et il est conçu comme un guide général pour la conservation préventive du patrimoine bâti enrichi à la fois de recommandations pratiques et de petites solutions simples et claires pour les problèmes les plus courants de maintenance.

1 Guidelines for Good Practices on Preventive Conservation

1.1 Objectives

The **Guidelines for Good Practices on Preventive Conservation**, joint product of the HeritageCare project, aims to assist the daily activity of all entities, owners and managers of buildings with historical and cultural value, serving also as a practical handbook for both the HeritageCare inspectors and the general public.

Intended as a general guide *only*, this document provides a set of practical recommendations for the Preventive Conservation of Buildings and Assets with historical and cultural value in Southwest Europe. Its main objective is to give advice and guidance on how to implement regular and efficient maintenance plans together with straightforward tips on how to address common problems, highlighting the areas/portions that require the owners' special attention in a clear and simple way.

1.2 Scope

The **Guidelines for Good Practice on Preventive Conservation** was developed within the scope of the HeritageCare project (SOE1/P5/P0258), co-funded by the Interreg-SUDOE program, on the basis of the inspection-related experience and knowledge gained by the partners during the three years of the project, and supported by existing bibliography on this subject.

Please note that this guide provides a general overview of historic building maintenance and HeritageCare does not assume any responsibility for loss or damage resulting from reliance only on the information given in this general guide.

In case of doubts and/or specific issues, it is suggested to contact directly the HeritageCare services. In case of a legal protected monument (listed building), it is also mandatory to call upon the services of your own national Cultural Heritage Agency.

In **Portugal** the purpose of the Ministry of Culture within the Portuguese Government is to formulate, conduct, execute and evaluate a global and coordinated policy in culture, namely in the safe-

guarding and protection of cultural heritage, in the encouragement of artistic creation and cultural diffusion, in the qualification of the Portuguese cultural fabric and in the internationalization of Portuguese culture and language. In matters regarding the building heritage with legal protection, the regional entities supervised by the Ministry of Culture, namely the Regional Directorate of Culture of your region (DRC-Norte, DRC-Centro, DRC-Alentejo, DRC-Algarve) or the General Directorate of Cultural Heritage (DGPC) in Lisbon, should be always contacted in Continental Portugal. As for the Autonomous Regions, the respective Regional Directorates of Culture assigned to the Regional Governments of the Azores and Madeira should be contacted.

In **Spain** competences in the field of historical and cultural heritage are delegated to the regional governments. Nevertheless, the Spanish Ministry responsible for culture has been given the task of establishing several national, cultural and historical heritage programmes, one of which is the National Plan for Preventive Conservation, due to the importance of the implementation of a prevention strategy as a fundamental principle for the conservation of cultural heritage. Regarding official instruction and listed buildings, each regional government (namely «Comunidad Autónoma») has enacted its own law, even if the national law from 1985 is still in force. Many of the regional laws can include specific obligations related to Preventive Conservation of listed buildings. For example, the Andalusian law (Ley de Patrimonio Histórico de Andalucía, 2007) includes, in articles 21 and 22, the need to create a conservation project together with every intervention in listed building and, furthermore, the obligation of including a maintenance program on every conservation project. Other official institutions have also developed recommendations and guidelines (Instituto del Patrimonio Cultural de España, Instituto Andaluz del Patrimonio Histórico, Fundación Santa María la Real del Patrimonio Histórico). Last but not least, both the national building law (Ley de Ordenación de la Edificación, 1999) and the construction official code (Código Técnico de la Edificación) express the existence of the «book of the building» (a comprehensive book which includes maintenance and conservation recommendations for buildings' owners) as mandatory.

In **France** the State is responsible for ensuring the integrity of historical heritage listed as Historic Monuments, i.e. buildings or assets that are protected by law. The DRACs (Directions Régionales des Affaires Culturelles) are State's decentralized departments, established on the thirteen (13) French regions. The CRMH (Conservation Régionale des Monuments Historiques) within the DRAC, is responsible for the protection of the historic monuments, and for the authorization and control of conservation work; it is also responsible for the implementation of the Sixth Book of the

Heritage Code (Livre Sixième du Code du Patrimoine) which specifies the legal regime applicable to historic monuments. The architects to whom the owners of listed historic monuments can refer in order to ensure the direction and execution of conservation works are: the Chief Architects of Historical Monuments (ACMH), the Heritage Architects (AP) graduated from Chaillot School and the Architects holding the advanced specialization diploma in architecture (DSA-Architecture), mention of *architecture et patrimoine*.

1.3 General Definitions

The HeritageCare methodology relies on a proactive approach to Preventive Conservation driven by the motto «Prevention is better than cure». Through systematic on-site inspections and diagnosis of buildings with historical and cultural value, including monitoring of case-specific parameters and digital representation of the inspected artefacts, HeritageCare helps owners undertake the most appropriate actions on their buildings, thus minimizing ongoing deterioration processes and preventing the onset of future damages. By adopting preventive conservation measures, owners can limit the slow and imperceptible damage that has accumulated over time in their buildings.

A solid foundation for the success of Preventive Conservation when dealing with built cultural heritage is regular maintenance and caretaking of the building fabric together with its assets or collections. Periodic inspections and monitoring carried out by specialized personnel **should be always backed up by** the implementation of simple Maintenance routines by the owners. In a preventive conservation perspective, these routines are great management tools that can help reduce the need of major and expensive repairs, eventually contributing to save money.

Every historic building is unique. A maintenance plan should be specific and tailored to the requirements of *each* historic building for the purpose of preventive conservation. Still, the maintenance plan should be revised and updated annually in accordance with the conservation status of the building and its specific needs.

Preventive Conservation

«All measures and actions aimed at avoiding and minimizing future deterioration or loss. They are carried out within the context or on the surroundings of an item, but more often a group of items,

whatever their age and condition. These measures and actions are indirect – they do not interfere with the materials and structures of the items. They do not modify their appearance.
Examples of preventive conservation are appropriate measures and actions for registration, storage, handling, packing and transportation, security, environmental management (light, humidity, pollution and pest control), emergency planning, education of staff, public awareness, and legal compliance.» ICOM-CC (2008)

Conservation

«All measures and actions aimed at safeguarding tangible cultural heritage while ensuring its accessibility to present and future generations. Conservation embraces preventive conservation, remedial conservation and restoration. All measures and actions should respect the significance and the physical properties of the cultural heritage item.»

Restoration

«All actions directly applied to a single and stable item aimed at facilitating its appreciation, understanding and use. These actions are only carried out when the item has lost part of its significance or function through past alteration or deterioration. They are based on respect for the original material. Most often such actions modify the appearance of the item.»

Maintenance

Maintenance is a group of routine, periodic and non-destructive tasks necessary to slow down the deterioration process of a historic building. Maintenance implies regular inspections, routine cleaning and minor repairs that will help uphold the structural integrity of the building fabric and its artistic and decorative components, offering a sustainable approach to any conservation issue. **The main purpose of maintenance is to ensure building longevity, reducing costs and safeguarding the historic and artistic value (tangible and intangible heritage).**

Inspection

Inspection is a detailed survey of the building fabric along with its artistic and decorative components, aimed at identifying possible «pathologies» while trying to shed light on their causes and achieve a comprehensive overview of the conservation state of the whole artefact.

2 Maintenance

2.1 Basic Rules

Preventive Conservation is an on-going process that continues throughout the life of a cultural property and entails the implementation of adequate policies and maintenance procedures. Thus, Maintenance is one of the most important activities when you are involved in building Preventive Conservation. Moreover, Maintenance is very closely linked to sustainability. When appropriate maintenance is carried out on a historic building, materials last longer and fewer expensive repairs are required.

Although no building is maintenance-free and every built structure needs basic care to limit its material deterioration, *Maintenance is often considered a low priority by the owners*. Nevertheless, managing a building or a group of buildings with historical and cultural value in order to ensure their longevity is a hard task.

Theoretically, a well-maintained building should be waterproof, free from damage and safe, and to keep it that way the owner should assure regular assessment and early identification of potential damages, preventing serious loss and reducing repair costs. In this line of thought, **Maintenance is more successful when the owner has a plan, i.e. an agenda of routine and effective tasks that he can easily undertake to maintain and improve the quality and conservation status of his building.**

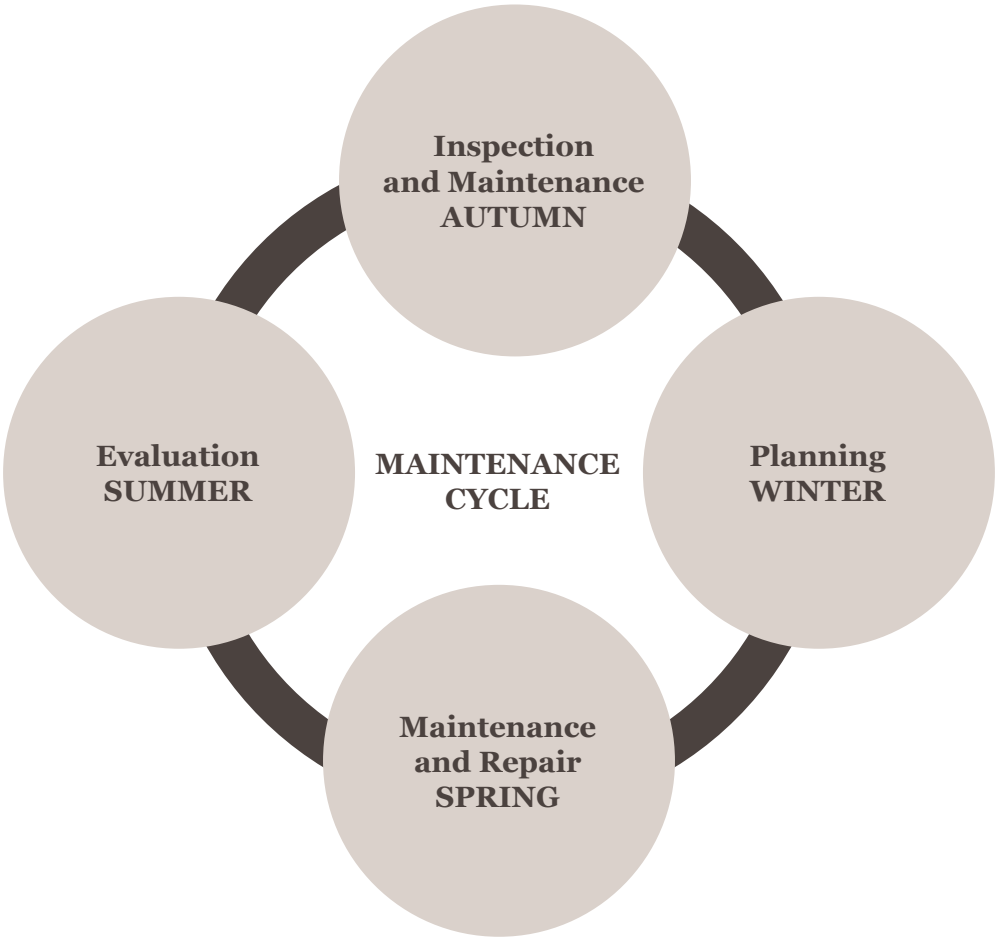
A *maintenance plan* should be structured as a schedule or annual calendar, with specific checklists in the form of reminders for assisting owners in the caretaking process of their properties. In fact, a maintenance plan is an upgraded «what-to-do» list featuring the building elements and/or materials to check, the tasks required for maintenance purposes and the frequency at which they should be done.

A plan that is too complicated or onerous will simply not get completed. Keep it simple!

A simple maintenance plan will help owners to know what they should do to maintain their buildings in good condition for a long time, while keeping an up-to-date report on the conservation state of all the building materials, structural elements, facilities, assets, and the like. This means they can track the conservation state of the entire construction system easier and more efficiently.

2.2 Maintenance Cycle Diagram

A maintenance cycle diagram is one of many methods that can be adopted to seasonally develop a systematic maintenance plan. It can be divided into tasks that should be done on a regular basis. A maintenance diagram has a large potential for improvement.
The owner just needs to keep making adjustments as the season progresses and the annual plan will become easier, methodical and smooth-running, resulting in a fewer surprises and less cost.



For instance, autumn - before the first rain - is the best time of the year to make a general site inspection, including walking around the building and taking note of any elements that might need additional attention. Any damage or risky situation observed during this first check-up should be dealt with before the winter season/rain season starts.

2.3 Maintenance Frequency

Maintenance is most effective when carried out regularly and continuously.

A reasonable frequency may depend on the conservation status of each building or structural element, asset or system.

However,

OCCASIONALLY*, the owners/managers should:

- Make sure the rainwater system is clean and clear.
- Inspect roof covering and rainwater systems during or after stormy weather; take action if and when damages or conservation issues are observed.
- Inspect roof covering after strong storms to determine if water has penetrated the building.
- Inspect roof covering after severe snowfalls to ensure removal of overhanging drifts which may pose a hazard.
- Inspect the building envelope and interior for cracks, material loss, and coating damages; take action if and when damages or conservation issues are observed.
- Inspect the fire safety equipment to ensure it is in place; and if the extinguishers are full.
- Test fire alarms to ensure they are working correctly.
- Make sure all the technical installations and equipment are tested and serviced by qualified personnel.
- Repaint and/or repair external wood and metal elements.
- Repaintand/or repair doors and window frames.
- Make sure the sanitary facilities are cleaned and the sewage network is serviced by qualified personnel.

***OCCASIONALLY** means once a year (annually) or twice a year (every six months).

REGULARLY, the owners/managers should:**

- Make sure that no candles are left burning inside churches and church yards.
- Make sure that lights and security alarm are turned on / off when exit or access thepremeses.
- Make sure all green areas are maintained (e.g. trimming the hedges, shriubs and trees, grass mowing) and vegetation growth is controlled (e.g. weed control).
- In hot humid climates and wetlands take the necessary measures to prevent pests' infestation (e.g. insect control, disinfection, rat extermination).
- Make sure surfaces are cleaned from biological contamination (e.g. birds droppings, rodents faeces, nests, spider webs).
- Inspect the building for hazards.
- Inspect outside areas for hazards to cars and pedestrians.
- Make sure the rainwater system (gutters and rainpipes) is clear of debris buildup.
- Inspect roof during winter months for presence of ice dams and icicle formations.
- Ensure all exit doors open easily and have no obstructions.
- Make sure all internal paths to exits are clear and not obstructed in any way.

REGULARLY**, the owners / managers should:

After the first check-up of the building carried out by the HeritageCare inspection team, the owner will be provided with a simple report where the main damages observed in the building are listed and classified based on their severity and priority of intervention, and appropriate maintenance and preventive conservation actions are recommended.

Depending on the overall conservation condition of building and on the remedial actions effectively carried out by the owner to fix the identified damages, every one to two years a second inspection with the HeritageCare inspection team should be re-scheduled in order to re-assess the building elements, assets and systems following the same protocol, thereby allowing a direct comparison of the building condition over time.

2.4 Buildings Maintenance

A *building* is a permanent structure with roof, walls (bearing and non-bearing) and a foundation system (including basements), floors and openings (doors and windows).

A *historic building*, besides being a built construction, is also a major expression of a community's tangible past, enhanced with architectural, historical and cultural interest as well as with special value due to particular past events or periods, or association with national historic circumstances and/or people, or simply because there might be interest in the adopted construction methods, design and existing assets.

Given the importance of the structure's authenticity and the material originality in the context of built cultural heritage, it is obvious that, whenever possible and feasible, **preserving an original element is preferred to a replica**. Yet, structural stability cannot be disregarded; thus, to ensure that a historic building maintains its integrity, it is of key importance that maintenance plays a leading role in the owner's plans and activities.

Fig.1. De izquierda a derecha y de arriba abajo: Santa Maria de Barrô church (Portugal), HeritageCare inspection 2018-06-15; Ancien prieuré (France), HeritageCare inspection 2017-10 24; Kiosque du parc des bourins (France), HeritageCare inspection 2018-05-28; Balneario de Nuestra Señora de la Palma y del Real (Spain), HeritageCare inspection 2018-03-01.

2.4.1 Building Maintenance Guidelines

Buildings are made up of a series of connected parts that fit together and give rise to a strong and solid structure. The **building envelope** (Fig.1) is generally the shell of the building that separates the interior from the exterior. The finishes and assets can also contribute to the value of a given historic building, and in most cases they constitute a consistent and indissoluble whole.

The main function of the **building envelope** is to protect the whole from the elements, for instance from **water** which is often the most damaging factor to a heritage building.
Stains on drywalls or plasters, mould or mildew (especially in corners), damp or wet stains (Fig.2), rotted wood frames, rust and corrosion on metal elements, peeling or blistering paint or plaster, salt deposits (efflorescence) on interior and/or exterior surfaces, dank and musty smells, they all are obvious signs of moisture problems in a building, particularly in basements, in storage rooms and other poorly ventilated rooms.

Fig.2. Parish church of Covas do Barroso (Boticas, Portugal), HeritageCare inspection 2018-11-04: water infiltration in the South chapel.

The **frame** of the building is its skeleton, namely the supporting structure of the entire body. Typical frame elements are columns, beams, floor joists, sub-floor, studs and trusses. Together with the foundation, the frame bears the load of the building. The frame is generally completely enclosed by other materials and therefore does not usually require any special maintenance, unless there are indirect damages caused by other systems' failure, like a roof covering infiltration,

or by mechanical factors, such as differential settlements and creep. Thus, the owner's maintenance tasks should be centred in the observation that no serious pathologies appear (particularly cracks and deformations) which could jeopardize the building stability. The causes of this type of damages are commonly linked to ground movements, presence of water, material expansion and shrinking due to abrupt changes in temperature, slow permanent deformation and creep due to long-term exposure of the materials to persistent loads/stresses.

The **foundation** of the building provides a stable surface on which buildings are constructed, allowing loads to be transferred evenly to the ground and anchoring the building against lateral forces, such as winds. Movements in a building often results in cracked walls and window panes, heaved floors and stuck doors. Heritage structures will have foundation types that range from boulders at the corners of a log structure to full basements under multi-storey buildings. Often, the more elaborate the foundation the more stable it is, but the more extensive will be the repair in case of problems.

Fig.3. Saint Antoine church (Egletons, South West of France) HeritageCare inspection, 2019-02-27: foundation's settlement linked crack.

For many historic buildings, most of subsidence-related problems have long since stopped. However, changes in the building's surroundings can often bring about further settlements and affect the statics of the system. *Changes are often gradual and not noticeable over a short period of time, thus an extended period of time is necessary to monitor the structure movements* (Fig.3). Events that may lead to renewed settling of the foundation include either changes in the amount of ground and surface water around the foundation, new constructions or excavations close to the building area, significant increase in the imposed loading conditions due to a change of the building function.

Roof covering exists to keep out the water and to prevent the deterioration of the building and its contents. Roof covering is the first defence line in preventing water from entering a building. Effective water drainage from the roof to the gutters and rain pipes can minimize the possibility of infiltration. Such a system needs to be maintained in order to retain its waterproof properties. For instance, the roof covering should be inspected to prevent deterioration and water damage at least twice a year; at the beginning of spring, during autumn and/ or before winter's heavy rain/ snow fall or tempests. Any damage or repair needed (e.g. loose roof tiles, broken pieces) should be executed as soon as possible by qualified and experienced personnel, to prevent further or more serious damages. Undetected damages to the roof covering and supporting structure can very quickly lead to water infiltration, damp, rot and insect infestation, ultimately leading to major repairs or to a complete roof recovering. Signs of lack of maintenance to the roof covering are damp and moss-covered exterior walls, broken slates or roof tiles, plants growing in the gutters, rain pipes and roof tiles (Fig.4), moisture stains on the interior and exterior walls, deterioration of mortars and plasters, just to name a few.

Fig.4. São Tiago Adeganha Church (Torre de Moncorvo, Portugal), HeritageCare inspection 2018-10-22: sacristy roof covering.

Rainwater systems, including gutters, rain pipes and below-ground drainage installations, are the key to the survival of the building, together with a waterproof roof covering. These systems ensure that rain is taken away from the building, thus it is vital to keep them well maintained through regular inspections. Such systems should be checked and cleaned at least twice a year (e.g. during spring and autumn); and with the same regularity, the gutters, valleys, rainwater heads, dry areas, channels, rain pipes and gullies should be cleaned and cleared. *This is a crucial part of the overall building maintenance procedure* and it is even more important for buildings with vegetation nearby. Any deficiency spotted in the rainwater systems should be immediately addressed to avoid that minor problems turn into serious damages. Blocked gutters may overflow and leak onto the walls causing damage to the masonry and interior of the building; excess water saturating the ground/foundation may encourage rising damp in the walls; and moisture inside the building may lead to fungal and insect infestation. Consequently, an effective and regular maintenance is a smart action that can allow owners to detect in due time possible damages and/or blockages in the rainwater systems, preventing further damages.

Gutters and rains pipes are a substantial part of a building water removal system, strategically directing all water accumulated from rain, ice and snow towards specific areas around the base of a building. Neglected or deteriorated parts will promote damage to the building exterior and interior elements. The gutters and rain pipes require regular inspection to keep them unclogged and free from damage by debris accumulation and damming. Indeed, a significant contributor to faulty gutters and rain pipes is accumulated debris, such as leaves, branches, birds' guano and insect hives that may block the water passages, causing slow drainage and overflow. This can lead to corrosion and ultimately to a breakdown of the fastening points of the gutters. Much like inspecting a roof, visual inspections of gutters and rain pipes can be helpful, particularly after a major rain storm, but only an up-close inspection will be able to detect accumulation or blockages. The gutters and rain pipes should be inspected at least twice a year (e.g. spring and autumn).

If the **drainage system** does not direct rainwater away from the building, and the below-ground drainage installations do not work properly, including rainwater gullies and grating, manholes, pipework, soak ways, septic tanks and land drains, it will lead to severe problems causing foundation instability and rising damp. Therefore, it is recommended to regularly clean the below-ground drainage system (at least twice a year) and to repair missing or/ and broken elements. Manholes should be annually inspected and all drains should be serviced at least every five years.

Proper below-ground drainage system is important to keep the building free from flooding and seepage (Fig.5). Water pools around the perimeter of a building will drain alongside the foundation and possibly enter through cracks in the foundation walls. Moreover, pipes from sewer or drainage systems that do not function properly may lead to sewage backing up into the basement and heaving of foundation systems.

Fig.5. Sainte Croix Church (Rosiers d'Egletons, South West of France), HeritageCare inspection, 2019-02-26.

The **exterior walls** produce the **building envelop** and overall character, giving it colour, texture and detail (Fig.6). It is important to undertake regular inspections and maintenance of the exterior walls of a historic building in order to preserve their structure and character.

There are three principal causes of wall deterioration: organic, mechanical and chemical. The organic causes result from direct impact of living organisms on the building structure (e.g. termite attack on wooden structures). Cracks or disintegration are recognizable mechanical damages, and their source can be ascribed to a powerful impact onto the building, to static, dynamic or exceptional actions, but also to the water forcing the building materials to break through expansion (e.g. freeze-thaw cycles). Chemical damage takes place when there is a material incompatibility or a localised air or moisture contamination.

When surveying the exterior walls, it is important to identify areas of deterioration and to recognize potential sources of future problems. This proactive approach enables the owner to take action early, minimizing existing damages and repair costs, while preserving the conservation state of his building.

Fig.6. De izquierda a derecha y de arriba abajo Ducal Palace and GTL medieval building (Guimarães, Portugal); Saint Pierre Church (Moustiers Ventadour, South West of France).

Wall claddings, **wood frames** and **coating systems**, in particular, are likely to need regular maintenance to remain waterproof, lasting and functioning. Exterior wall cladding should be checked and cleaned. The coatings should be painted or repainted every two to three years. In what concerns historic valued cladding and coatings (e.g. ceramic tiles / azulejo coverings), the owner should always seek advice from a professional conservator.

Doors and windows are the openings of a building and are often subject to harder use than any other elements; therefore, they require more frequent and careful examination and repair.

Windows in historic buildings are typically constructed with wooden frameworks; as such, they require periodic sealing and painting (Fig.7). Like other building components, the window primary enemy is the water and everything should be done to limit its harmful effects: for instance, examining the elements of the window frame and looking out for signs of rot and for places where paint has blistered, cracked or worn off. Paint is a protective coating; every effort should be made to ensure that affected areas are repainted as soon as possible. In those buildings where wooden window frames meet a masonry wall, that particular connection should be examined. If openings and cracks have developed, they should be sealed down.

Fig.7. Cantareira Traffic and Telegraphic Station (Porto, Portugal), HeritageCare inspection 20b8-02-20: window frame detail.

Stained glass windows require inspection by a qualified professional specialized in the conservation and restoration of stained glass. The condition of plain window glasses and sash glazing should be checked annually.

Doors are subject to constant use and need frequent attention (Fig.8). Most doors of historic buildings are made of wood and are subject to warping, swelling, cracking and decay. Owners must be aware that doors need to be painted to create a secure barrier. They should be painted on all sides, including tops

and bottoms because unpainted parts invite moisture and problems inherent with water wicking into wood. Hinges and hardware should be periodically checked for tightness and corrosion evidence.

Generally speaking, rough carpentry is concealed by wall and ceiling finishes. Check periodically for evidence of insects' infestation (e.g. holes and galleries from termites, and carpenter ants). Paint and varnish finishes on exposed exterior wood trims should be regularly maintained to prevent premature deterioration.

Fig.8. Chapel of the Cinco Llagas Hospital, currently Headquarters of the Regional Parlament of Andalusia (Sevilla, Spain), HeritageCare inspection 2018-10-23: door detail.

Church bell towers and under-roof spaces feature favourable conditions for the proliferation of pests' infestations. Bell towers represent the ideal environment for birds roosting or nesting and under-roof spaces are great places for wasp nesting/ insect hives. Hence, these areas need to be checked regularly for bird and/or insect ingress, and if an infestation is found, the owner should implement nonchemical eradication methods first and *seek professional help in order to know if and when applying chemical substances, i.e. insecticides*.

Remember that **bats are a protected species in Europe**; if detected, it is recommended to look for specialist guidance (e.g. in Portugal, the law prescribes to call the National Institute for Nature and Forests protection services for dealing with bat colonies).

Maintenance and good housekeeping are always the first preventive measures. If guano deposits (i.e. excrements and feeding/nesting remains left by birds and bats) are present, they should be cleaned regularly. Besides building material degradation, these organic deposits can pose human health hazards from allergic responses to viral zoonosis. Therefore, using respiratory protection and barrier-protective clothing is advised when cleaning infested areas.

In what concerns **building interior walls and ceilings** two main sources of degradation are generally expected: moisture and dust, which may cause biological colonization (i.e. mould and fungus), colouration, bleaching, moist areas and/or coating detachment. As for the **floors**, they can reveal moisture problems, deviations and deflections in shape, as well as material and mortar losses, warping and cracking.

The **staircases** are structural elements that should be maintained regularly, taking into account the material of which they are composed (i.e. masonry, metal, wood). In this case, recommendations similar to those given for the building **frame** can be applied (see pages 12-13). Additionally, tiles, wooden pieces and other coating materials should be periodically surveyed, looking for material loss, moist areas, deposits, discolouration or biological colonization, among other possibilities. Furthermore, metallic and wooden materials of railings and handrails should be checked and repaired, analogously to **doors and windows** (see pages 17-18). In particular, if they are made of iron, corrosion inhibition and paint should be applied when necessary; if in bronze, waxed protection will be needed; if wooden, they should be painted, varnished or waxed, depending on the original finishing.

Interior walls covering materials and finishes encompass flooring, walls, ceilings and interior coatings, such as paint and varnish. Damages to interior finishes are often indicative of more serious problems affecting the exterior building envelope or the technical systems within the building (i.e. rainwater systems, sanitary facilities, sewage network). Pay particular attention to peeling paint, deteriorating plaster, staining on ceilings and walls. If any of these symptoms occur, seek advice and consult qualified personnel.

For contextual meaning, consult the **Glossary of Constructions Systems & Elements** (Appendix 9).

2.5 Assets Maintenance

In Building Heritage, **Assets** - also known as **Movable Heritage** - is a term used to define natural or manufactured objects of heritage value and significance, ranging from art and archaeological artefacts to everyday objects, from single objects to a group of objects or to whole collections (Fig.9).

Additionally, a historic building might have assets that create an artistic, historical and/ or decorative unit with the building, thus becoming a cultural indivisible whole. To describe this unique heritage gender, in the mid-90s the term **Integrated Heritage** was created in Portugal. Even though it has inherent connection with the building, being part of the building history and being inseparable from its architecture, Integrated Heritage has per si its own cultural value. Wall paintings and frescos, stained glass, tiles and ceramic decorative walls, stuccos, gilded wood panels, are just a few representative examples of the great variety of Integrated Heritage present in South-western Europe.

The significance and complexity of the **Assets** (i.e. Movable and Integrated Heritage) in historic buildings are reflected in the amount of skilled work required for their conservation. As already remarked in the case of heritage constructions (see Section 2.4), *Maintenance plays an important role within the asset conservation process and should be led by specialized personnel, i.e. conservators*.

Fig.9. De izquierda a derecha: Portrait of the Father Fray Diego José de Cádiz at the Church – Basilique of the Gran Poder (Sevilla, Spain), HeritageCare inspection 2018-09-27 and a double funerary arch in Ançã limestone for Pedro Esteves and his wife Isabel Pinheiro tombs at the Nossa Senhora da Oliveira church (Guimarães, Portugal) HeritageCare inspection 2019-03-12: assets detail.

2.5.1 Assets Maintenance Guidelines

Most of deterioration processes affecting heritage assets occur due to the combination of four factors: inappropriate handling, unsuitable conservation treatments, adverse environmental conditions and poor housekeeping. A good preventive conservation program outlines how to tackle each of this condition, minimizing the need for deep conservation treatments.

Handling heritage assets without causing damage is an important aspect for their long-term preservation. If handled with no care, assets can be extremely vulnerable. Indeed, impact is among the most prevalent cause of damage observed in assets; the extent of damage depends on both the type of material the asset is made of and their prior condition. Furthermore, the natural salts and oils from hands can mark clean surfaces, thus heritage assets should not be handled with bare hands. It is worth noting that handling a historic asset can also have a potential effect on the health of the handler. Certain types of assets may present hazards that are inherent to their constituent materials and their degradation, or acquired during their use (e.g. mould in organic materials, powdery lead). Handlers should wear appropriate protective equipment such as thin and close-fitting gloves (latex or nitrile), dust masks and in special cases coveralls. *Handling assets with gloves is a practice that shows an attitude of care and respect for the heritage value of these objects.*

Conservation treatments are hands-on work performed in order to preserve and/or restore the assets historic materiality, thus inappropriate materials and methods can cause irreversible damages. *Only trained conservators should perform conservation treatments on heritage assets.* If a conservation treatment is required, the owner must ensure that the assets receive the most appropriate treatment for their preservation.

Environmental parameters, such as air temperature and *relative humidity* (RH), represent important state indicators in the context of preventive conservation. Keeping under control these parameters is therefore fundamental to understand the effective needs of a heritage building and guarantee the good conservation of both its fabric and the assets. Achieving optimal and stable climate conditions in the interior of a historic construction (or within part of it) is quite a hard task, but *acceptable threshold levels can be defined within a preventive conservation plan for the owners to understand when ambient parameters are below or above the recommended range.*

There is not a universally safe, risk-free RH for all materials, and the deterioration processes in which moisture plays a role can take place at any RH level. Nevertheless, it is possible to generalize that an RH above 75% for an extended period of time is dangerous both to building fabric and assets, as it increases for instance the risk of faster corrosion in metals (e.g. copper corrosion) or promotes decay and deterioration in organic materials (e.g. mould growth).

A swift variation in the moisture content can also lead to mechanical deterioration of the materials, resulting in swelling and shrinking, which can cause in turn wear, deformation and fracture. Also, an irreversible drying process may occur if the RH becomes too low, resulting in mechanical damage, for instance parchment book binders than cannot withstand handling.

The presence of moisture within a building favours biological deterioration, as micro and macro organisms become active and feed on organic materials. The increase and spread of insect infestation is one of the most damaging threats to organic materials. Insects are most destructive during their larval stage, when they are extremely difficult to detect, causing the most severe damage in a very inconspicuous way. Therefore, for preventive conservation purposes the owner should implement an active pest control plan, ensuring regular cleaning and checks of the storage areas, thus contributing not only to the hygiene of the building space, but also to pest surveillance and control. If any infestation is detected, it is strongly recommended to isolate the assets before the infestation spreads out.

Damage from light exposure is cumulative and irreversible. The effects of ultraviolet and visible radiations on sensitive heritage assets may result into material degradation (e.g. discolouration of paints and pigments, darkening or yellowing of supports, disintegration of cellulose polymers). Therefore, light-sensitive materials should be protected by filters and the intensity, time of exposure and proximity of the light source should be reduced.

Localized heating can also lead to severe damage in the asset materials (e.g. shrinkage and cracking from infrared rays; expansion or contraction due to temperature fluctuations). Placing assets near or under direct and intense sources of light, especially sunlight, should be avoided. Hence, windows should be screened with curtains or blinds to reduce the damaging effects of ultraviolet rays, and light sources should be filtered using UV filtering acrylic sheets.

Another crucial factor in the context of preventive conservation of heritage assets is the **housekeeping**, namely the management of household goods and spaces. Providing regular room cleaning, using products without additives harmful to the heritage materials, that is *to avoid using ammonia and chlorine*, choosing to vacuum instead of sweeping to clean the floors so as to avoid dust dispersion and contamination, are just a few examples of appropriate housekeeping.

2.6 Quarterly Maintenance Calendar

An annual maintenance plan is a smart and simple way to prevent the occurrence of damages in historic buildings and to solve or at least mitigate the existing ones. Having a routine schedule is important for keeping any building manageable; a schedule makes it possible to coordinate and manage the building maintenance smoothly, regardless of the building function and construction system.

A **Quarterly Maintenance Calendar** can be organized into a weekly or monthly schedule for detailed activities, such as daily housekeeping and cleaning, after major activities (e.g. a church wedding, a book premier, a music concert).

Consult **Appendix 1.** for an example of quarterly maintenance schedule as well as **Appendixes 2-7** for maintenance plan examples organized by building subsystem.

3 Health and Safety Issues

As for health and safety, a historic building can be a risk zone due to changes made throughout the centuries, like additions, alterations and/ or demolitions.

Although it is largely about common sense and prudence, health and safety is the law, so it must be followed thoroughly as required.

General areas should be assessed on a regular basis, quarterly or even more often for special features, such as mechanical and electrical equipment and storage areas.

Lighting, heating and fire extinguishers should be regularly inspected and serviced by certified personnel.

To help owners dealing with health and safety issues, a self-inspection checklist should be produced with YES or NO answers. Whenever the answered is NO, a corrective action should be taken.

Consult **Appendix 8** for an example of health and safety maintenance checklist.

4 Consult and Hire a Professional

While «*prevention is always better than cure*» and maintenance is always preferable to major repairs, we are all aware that repairs may not be always avoidable. A building may develop structural problems, materials will eventually wear out, older repairs may need retrofitting, there may be fungal or pest infestations. Hence, whenever an owner or manager needs to have his heritage building repaired, it is important to first identify the real causes of the observed damages in order to avoid inadequate interventions, repeated decay and consequent loss of the original fabric and its historic value.

As specified at the beginning (Section 1.3), **Preventive Conservation and Maintenance do not include *Conservation and Restoration*.**

Conservation is complex and demands the collaboration of relevant qualified professionals; any project involving direct actions on the cultural heritage requires a *conservator-restorer*.

This means that f*or specific and skilled Conservation and Restoration works (e.g. disinfestation, desalination, stabilization and consolidation); the owner must hire conservation professionals to execute them*. As a general rule, in order to take action against damages in historic buildings, it is always recommended to consult a heritage conservation professional that can provide guidance and assistance on suitable conservation and restoration methods.

In the case of listed buildings, i.e. legal protected buildings, each country - Portugal, Spain and France - has its own specific laws the owner must comply with. In this regard, it is advisable to seek help from your own country national Cultural Heritage Agency (for more information see Section 1.2).

5 Extreme Weather Events

Apart from the slow deterioration that occurs and accumulates on a daily basis, historic constructions are also exposed to disaster-related damages that occur occasionally due to extreme weather events. For this reason, it is important to be prepared against these unforeseeable circumstances. Of course, one cannot prevent damages before they occur, but being prepared against unexpected events and having a reliable **checklist** to support that preparation is a good way to ensure the needed protection.

So, be prepared!

Extreme Weather Preventive Checklist (example)

- ☐ Roof inspection: problems with the roof covering, blocked drains, gutters or downsprouts, inadequately secured equipment like ventilator and other additions.
- ☐ Relocate or securely fasten down outdoor machinery; anchor all outdoor structures impossible to relocate.
- ☐ Board up all large windows subject to possible breakage.
- ☐ Doors and windows inspection: check weak latches and hardware, making the needed repairs to prevente futher damage.
- ☐ Prepare for possible flooding: get sandbags to be placed at vulnerable building openings.
- ☐ Emergency generation and fire pump fuel tanks: fill them up.
- ☐ Data protection: back up all important computer data and protect the records from possible wind, debris and water damage.
- ☐ Inspection of all fire protection equipment: verify the working conditions of sprinklers valves, fire extinguishers, fire pumps, etc.
- ☐ (blank space to be filled in)

6 References

CCI - ICC. **Preventive Conservation Guidelines for Collections** <https://www.canada.ca/en/conservation-institute/services/preventive-conservation/guidelines-collections.html l>

Council of Europe, **Convention on Offences relating to Cultural Property Nicosia**, 19.V.2017 <https://www.coe.int/en/web/conventions/full-list/-/conventions/rms/0900001680710435 >

Council of Europe, **Preventive Conservation for Cultural Heritage** - ST 21 European Cultural Heritage Strategy for the 21st Century <https://rm.coe.int/strategy-21-preventive-conservation-of-cultural-heritage-in-less-than-/16807bfbb9>

European legislation on International Art and Heritage Law <https://www.eui.eu/Projects/InternationalArtHeritageLaw/European >

GUICHEN, Gaël. (1995) **La conservation preventive: un changement profond de mentalité.** *Cahiers d'étude*, ICOM-CC.

ICOM-CC (2008) **Terminology to characterize the conservation of tangible cultural heritage.** Resolution on Terminology for Conservation adopted at the 15th Triennial Conference, New Delhi. <http://www.icom-cc.org/242/about/terminology-for-conservation/#.XAqXVCm22PA>

IMC/Instituto dos Museus e da Conservação (2007) **Plano de Conservação Preventiva. Bases orientadoras, normas e procedimentos.** <http://www.patrimoniocultural.gov.pt/static/data/ljf/ipmplanoconservacaopreventiva.pdf>

IPCE/Ministerio de Educación, Cultura y Deporte (2011) **Plan Nacional de Conservación Preventiva** <https://ipce.culturaydeporte.gob.es/dam/jcr:2b2035de-685f-467d-bb68-3205a6b1ba70/pn-conservacion-preventiva.pdf>

LÓPEZ RUIC, C. y CUBA TAROADA, M. (2014) **Conservación preventiva para todos. Una guía ilustrada.** Agencia Española de Cooperación Internacional para el Desarrollo.

MICHALSKI, Stefan (2004) **Basic requirements of Preventive Conservation,** based on a section in «Care and Preservation of Collections» in *Running a Museum: A Practical Handbook*, P. J. Boylan, ed., Paris, International Council of Museums and UNESCO.

Ministerio de Educación y Deporte (2013) **Conservación preventiva: revisión de una disciplina.** *Revista Patrimonio Cultural de España*, nº 7.

ROGERSON, Cordelia, GARSIDE, Paul (2017) **Increasing the profile and influence of conservation—an unexpected benefit of risk assessments**, *Journal of the Institute of Conservation*, 40:1, 34-48, DOI: 10.1080/19455224.2016.1214848.

STORM project (2016) **Safeguarding Cultural Heritage through Technical and Organisational Resources Management**. Current practice for management and conservation of Cultural Heritage <http://www.storm-project.eu/wp-content/uploads/2017/04/D1.1-Current-practice-for-management-and-conservation-of-Cultural-Heritage.pdf>

UNESCO. **La conservación de los bienes culturales**. Colección «Museos y Monumentos».

Appendixes

Appendix 1. Maintenance Schedule Example

Quarterly Maintenance Schedule | 20____	
1st QUARTER	
JANUARY	Verify the positive drainage of the rainwater system to prevent ponding. Check the rainwater goods (top to bottom) during rainy days, look out for any obstructions. Clean it up if clogged.
FEBRUARY	Check the roof, ensuring that the roof tiles/slates are in place. If any damage is spotted, fix it immediately. Check gutters and downspouts for frost-related damages. If any damage is spotted, repair it immediately. Start planning for spring cleaning (April/May).
MARCH	Make an overall check of the roof conditions after winter. If any damage from snow, frost, strong wind, heavy rain or hailstorm is found, repair it as soon as possible. **Schedule the next HeritageCare inspection.**
2nd QUARTER	
APRIL	Give a thorough cleaning, making sure that all building areas are wiped and washed. Assets such as sculptures, altarpieces, furniture, floors and opening frames may be damaged by reckless cleaning actions. Be sure not to use chemical products and excessive water. Check the accessibility and safety of stairs, lifts, doorways and all routes that provide access to the building spaces. If obstructed, make them accessible. Clean courtyards, removing weeds and trimming vegetation if overgrown.
MAY	Clear gutters, downspouts and other rainwater goods. Make repairs if necessary. Prune and trim plants in the building surroundings, cut overgrown vegetation around the exterior walls and cut again the courtyard grass if necessary. Inspect the cooling system, check refrigerant levels and program the thermostat
JUNE	Look out for fungus, mould and dry rot inside the building. Look out for woodworms or dead beetles on exposed wood assets and floors. June is hatching time for beetles' larvae – look out for it. Check the integrity of birds' screens and window nets. Ventilate the building rooms during dry days by opening windows and doors. Keep clean the courtyard.

3rd QUARTER

JULY & AUGUST	Check the integrity of birds' screens and window nets. Ventilate the building spaces during dry days by opening windows and doors. Keep clean the courtyard. Ensure that all the fire and safety equipment have been inspected and serviced before any candlelit events.
SEPTEMBER	Replace broken light bulbs and check security lights. Inspect the heating and air conditioning system. Clean any garbage and waste accumulation in storage rooms and common areas. Keep clean the courtyard.

4th QUARTER

OCTOBER	Clean the courtyard from fallen leaves. Inspect the heating system and winterize the cooling system. Check if all the exposed water tanks and pipework are protected from the risk of freezing and insulated. Calibrate the thermostat, reduce set points and ensure that the boiler frost protection is working.
NOVEMBER	Check the rainwater goods (top to bottom) during rainy days, look out for any obstructions. Inspect flashings at critical locations (e.g. chimneys, skylights, wall perimeters, joints) to avoid water leaks. Seal gaps between windows, doors and exterior walls. Clean fallen leaves and dirt from gutters, downspouts and other rainwater goods. Clean the courtyard from fallen leaves.
DECEMBER	Inspect backup power sources to ensure proper operation in case of blackout. Verify that the frost protection of the heating system is on. Be ready for snow. If the weight of the snow becomes a concern, take steps to minimize it immediately. Check for ice dams and icicles. Maintain walkways shovelled, salted and ice-free.

Appendix 2. Roof Maintenance Plan*

ROOF MAINTENANCE	TASK	FREQUENCY
Slates, roof tiles and vertical cladding	Inspect for cracked, displaced and broken peices. Replace to match.	Twice a year
Sheet metal roof andcladding	Inspect condition of panels, joints and clips. Make temporary repairs to cracks and splits	Twice a year
General roof areas	Inspect from the ground and accessible high points and report any loss or damage to the roof coverings. Remove moss, leaves and other debris	Annually, and after stormy weather
Roof tiles	Inspect bedding and jointing between ridge tiles. Re-bed and repoint as necessary	Annually

*Adapted from Historic England's example

Appendix 3. Rainwater Goods Maintenance Plan*

RAINWATER GOODS MAINTENANCE	TASK	FREQUENCY
Perimeter drainage channel	Clear drainage channels of vegetation and debris.	Monthly, during spring and summer
Rainwater goods	Clear rainwater goods of debris and ensure overflows are clear. Rod if necessary. Check that stainless steel guards are secure. Inspect rainwater goods for cracks and leaks. Repair or replace any cracked sections.	Twice a year
Perimeter drainage channel	Inspect drainage channel for cracks and open joints. Seal with appropriate sealant.	Twice a year
Below ground drainage	Open up inspection chambers. Check if all gullies and gratings are free from silt and debris and that water discharges freely to mains sewerage or soakaway.	Twice a year
Roof tiles	Inspect from the ground and accessible high points and report any loss or damage.	Annually, and after/during stormy weather

*Adapted from Historic England's example

Appendix 4. External Walls Maintenance Plan*

EXTERNAL WALLS MAINTENANCE	TASK	FREQUENCY
Ventilation	Ensure that ventilation grilles, air bricks, louvres are secure and free from obstruction.	Twice a year
Windows and Doors	Inspect windows and make essential minor repairs to glazing. Check operation of hinges, bolts and locks and lubricate as necessary. Check security of locks.	Twice a year
External walls	Inspect from the ground and accessible high points and report any damage and signs of movement.	Annually, and after stormy weather
External walls copings and parapets	Remove any vegetation, ivy, etc	Annually
Brid screens	Check that tower, roofs and windows are bird-proof before nesting starts. Do not disturb bats.	Annually
Trees and foliage near walls	Check trees and large shrubs. Report any dead branches and signs of ill health, or root damage to the building or below-ground drainage	Annually

*Adapted from Historic England's example

Appendix 5. Building Interior Maintenance Plan*

BUILDING INTERIOR MAINTENANCE	TASK	FREQUENCY
Generally	Ventilate the building.	Monthly on dry days
Internal spaces	Inspect roof voids and internal spaces, particularly below gutters. Report on any evidence of roof or gutter leaks.	Annually, and during/after stormy weather
Internal structure and fabric	Inspect internal structure and fabric including roof timbers and cupolas, and report on any signs of structural movement or of damp, fungal growth and dry rot.	Annually
Exposed woodwork	Inspect exposed woodwork and surfaces below for signs of active beetle infestation. Report any beetles or fresh wood dust.	Annually
Roof and floor voids	Check roof and floor voids, inspect for signs of vermin, and remove. Avoid using poison when bats are roosting.	Annually
Chimneys	Sweep open flues.	Annually

*Adapted from Historic England's example

Appendix 6. Building Services Maintenance Plan*

BUILDING SERVICES MAINTENANCE	TASK	FREQUENCY
Lightning protection installation	Visually inspect the lightning conductor system including spikes, tapes, earth rods and all connections and fastenings.	Annually
Heating system	Service the heating system and update the service schedule.	Annually
Water	Ensure that all exposed water tanks, water pipes and heating pipes are protected against frost.	Annually
Fire fighting equipment	Service fire extinguishers.	Annually
Burglar alarm system	Test system and visually inspect wiring. Qualified engineer to service alarm.	Annually

*Adapted from Historic England's example

Appendix 7. Long-term Maintenance Plan*

LONG-TERM MAINTENANCE	TASK	FREQUENCY
	Inspect all wiring and electrical installations, including all portable electrical equipment, in accordance with the regulations/ law	Every 4 years
	Inspect upper levels of the bell tower	Every 5 years
	Inspect from the ground and accessible high points and report any damage and signs of movement.	Every 5 years
	Remove any vegetation, ivy, etc	Every 5 years
	Check that tower, roofs and windows are bird-proof before nesting starts. Do not disturb bats.	Every 7 years
	Check trees and large shrubs. Report any dead branches and signs of ill health, or root damage to the building or below-ground drainage	Every 7 years

*Adapted from Historic England's example

Appendix 8. Health and Safety Maintenance Checklist

Example,

GENERAL AREAS	Exterior adequate lighting	YES	NO
	Interior adequate lighting	YES	NO
	Hazard free areas in the yard, stairways and storage rooms	YES	NO
	Signs of water leakage or water-related damage	YES	NO
	Signs of mould attack	YES	NO
	Security monitoring of the building	YES	NO
MECHANICAL AND ELECTRICAL EQUIPMENT	Regular inspection of boilers, heating machinery and similar equipment	YES	NO
	Regular inspection of air-condition and heating equipment	YES	NO
	Regular inspection of the electrical system	YES	NO
STORAGE AREAS	Clean and declutter storage areas	YES	NO
	Fire doors present and kept closed	YES	NO
	Hazardous materials (e.g. chemicals) marked and kept secure	YES	NO
FIRE AND LIGHTING PROTECTION AND PREVENTION	Exit signs inspected and working	YES	NO
	Fire and burglary detection systems inspected and working	YES	NO
	Fire extinguishers inspected and working	YES	NO
	Adequate trash collection and disposal	YES	NO
BUILDING AND STAFF SECURITY	All doors and windows with appropriate locks	YES	NO
	Well-defined procedures for daily opening and closing	YES	NO
	Well-defined procedures for after-hours work and/or special events	YES	NO

Appendix 9. Glossary of Construction Systems and Elements

Sources

ICOMOS 2003. International Scientific Committee for Analysis and Restoration of Structures of Architectural Heritage

Cyril M. Harris, *Dictionary of Architecture and Construction*, 4th Edition, McGraw-Hill, 2005. ISBN: 0-07-145237-0

A

Adobe

A material composed largely of clay, silt, sand particles and water. Straw, manure and fragments of tile can be used to reduce shrinkage and to provide increased mechanical strength, durability and cohesion. Adobe can be formed into bricks, moulded in a wooden form and then sun-dried, or used as a plaster.

Adobe masonry

Masonry consisting of adobe units lay by course and usually bonded with mud mortar.

Arch

A curved structure that spans an opening and consists of wedge-shaped blocks (voussoirs) having their narrower ends toward the opening. Arches vary in shape, from those that have little or no curvature, such as a segmental arch or flat arch, to those that are acutely pointed, for instance a Gothic arch.

B

Beam

A structural element, usually horizontal, apt to carry transverse loads, e.g. a girder, collar beam, floor beam, etc.

Brick

A rectangular masonry unit made of fired or sun-dried clay. Bricks laid lengthwise in a wall are called stretchers; bricks laid crosswise to a wall are called headers. The various types of patterns common in laying bricks are referred to as bonds.

Brick masonry, brickwork

Composite material made of alternating brick courses and mortar.

Building

A relatively permanent and enclosed structure used for a variety of activities (housing, commerce, industry, worship, etc.) and distinguished from mobile structures and those not intended for occupancy.

Building element

An architectural component of a building, either structural or not (see construction element).

Building subsystem

A group of elements or set of parts working as a unit within a finished building and performing a specific function.

Building system

An assembly of integrated building subsystems satisfying the functional requirements of a building.

Buttress

An exterior masonry pier of great mass set at an angle to or bonded into a wall to strengthen or support it. Often, buttresses absorb lateral thrusts from roof vaults (see flying buttress).

C

Column

1. In structural engineering, a relatively long, slender and usually vertical structural element (e.g. a post, pillar, or strut) that works in compression by supporting and transferring the loads of the superstructure to the structural elements below.

2. In architecture, a cylindrical support consisting of a base (except in Greek Doric), shaft, and capital. The shaft can be either monolithic or built up of drums.
3. A pillar standing alone as a monument.

Concrete

A composite stone-like material formed by mixing an aggregate (such as stones of irregular shape or crushed rock) with cement (which acts as the binding material) and water, then allowing the mixture to dry and harden. Nowadays, Portland cement is used to make concrete. Lime, fly ash, air-entraining agents, or other admixtures may be included.

Concrete frame

A structural skeleton of concrete beams, girders, and columns which are rigidly joined.

Concrete masonry

Masonry made of solid casted concrete units, rectangular in shape, laid up in mortar or grout with other units as in normal stone masonry constructions.

Construction

1. The process of building or altering structures, including excavation, erection, assembly and installation of components and equipment.
2. A structure.

Construction element

A three-dimensional component of a construction system, e.g. column, beam, slab, wall, etc.

Construction survey

A detailed report of the present condition of a construction, including its appearance and structural integrity. Different techniques and equipment can be used for surveying purposes.

Construction system

The manner in which materials are combined together to construct the elements of a system.

Curtain wall

1. In ancient fortifications, an enclosing wall or rampart connecting two bastions or towers.
2. In a tall steel-framed construction, an exterior wall that has no structural function.

D

Dome

A vaulted roof structure spanning an area and resting upon a drum. Domes may vary in shape and complexity, ranging from hemispherical domes to sail or compound domes.

F

Flying buttress

An arched buttress usually sloping that extends from a buttress in order to counter resist the lateral thrusts of a roof or vault.

Floor

One story of a building upon which surface it is possible to walk.

Footing

That portion of the foundation of a structure which transmits loads directly to the soil. It may be widened in order to spread the load over a greater area to prevent or reduce settling.

Foundation

Any part of a structure, usually below ground level, designed to transmit the loads of the super-structure to the soil. Foundation may be shallow or deep, such as pile foundations.

I

Infilling

Material used to fill the spaces, within a frame, between structural members of a construction.

Iron

A ductile metallic element used to make iron pigs, iron alloys and steel. In its pure form, iron can be heated and hammered into shape (wrought iron), resulting in a very malleable material. If melted, mixed with other alloy ingredients, poured into a mould and allowed to cool (cast iron), the metal results in a very brittle material with high compressive strength but low tensile strength.

Iron construction

A structure characterized by cast-iron framing in combination with wrought iron, used primarily before the advent of steel-frame constructions.

Iron element

A metallic component made of cast iron or wrought iron, such as anchor ties, clamps and bars in masonry structures; tie-rods and trusts in truss roofs; joint plates in lattice trusses; U-straps, pins, nails and connectors in timber structures; etc.

Iron frame

A system of structural iron elements first developed at the end of the 18th century. An example of its application was the Crystal Palace built in London to house the Great Exhibition of 1851.

Ironwork

Objects or parts of objects made of cast iron or wrought iron; initially utilitarian, later often elaborate and ornamental.

J

Joist

One of a series of parallel beams of timber, reinforced concrete, or steel used to support floor and ceiling loads, and supported in turn by larger beams, girders, or bearing walls; the widest dimension is vertically oriented.

M

Masonry construction

Structure built with individual units set dry or bonded with mortar. Common materials for masonry units are stone, clay brick, adobe and concrete.

Masonry joint

Any joint between masonry units bonded with mortar.

Mixed construction system

Descriptive of a structure that combines more than one construction system, such as concrete or timber-framed structures with infill masonry walls.

Mortar

A plastic mixture of one or more binders (such as gypsum, cement, or lime), fine aggregates (e.g. sand) and water. Sometimes other additives may be included in certain proportions to give the mixture appropriate consistency and workability in the fresh state and adequate physical-mechanical properties when hardened.

Multi leaf masonry

Masonry made of leaves of different constitution. The most common is the three-leaf masonry made of two external faces and an inner rubble core.

P

Pier

A structural vertical member, usually in the form of a thickened rectangular section, designed to support concentrated load.

Pile

A relatively long concrete, steel or wood column, driven or drilled into the ground, which supports loads by bearing on firm material and/or by friction along its periphery.

Plank

A long, wide, flat and square-sawn piece of timber; the specifications vary, but often the minimum width is 20 cm, and the minimum thickness is 5 to 10 cm for softwood and 2.5 cm for hardwood.

R

Rammed earth

A building material usually consisting of clay, sand, gravel and water, which has been compressed and dried (historically tamping was done by hand with a long ramming pole).

Rammed-earth construction

Structure built either with solid walls or individual blocks of rammed earth.

S

Slab

1. The upper part of a reinforced concrete floor, which is carried on beams below.
2. A flat thick slice or plate of material such as stone, wood, concrete, etc.

Stone

1. A rock that has been cut shaped and sized for use in building construction or decoration purposes.
2. A solid aggregate of minerals naturally formed as a result of geological processes (sandstone, granite, marble, limestone, etc.)

Stone masonry, stonework

Masonry composed of field or quarried stone units bonded by mortar.

Structure

A combination of units constructed and interconnected in an organised way to provide rigidity to the whole.

Structural element

One of the supporting components forming a structural subsystem, for instance a pier, beam, or wall.

Structural subsystem

A group of interconnected elements or components working together to meet specific functional requirements, e.g. horizontal and vertical load-bearing subsystems, foundation subsystem, etc.

Structural system

The assembly of the load-bearing subsystems of a structure that support and transmit applied loads safely to the ground.

System

In building construction, an assembly of components and parts which are combined into single integrated units utilizing specific construction techniques.

T

Timber

1. Wood sawn into balks, battens, boards, etc., suitable for use in building construction, joinery and carpentry.
2. A heavy wooden beam used as a shoring or bracing system member.

Timber connector

A metal connector used to join timber elements in heavy constructions. Usually, it has a series of sharp teeth which dig into the wood as a bolt is tightened, thereby preventing lateral movement and decreasing the number of bolts required.

Timber-framed construction

A building whose structural system consists of timber elements (except for the foundation).

Truss

A structure composed of a combination of members, such as rafters, posts, struts, chords, diagonals, etc., usually set out in some triangular arrangement so as to constitute a rigid framework and support a roof, bridge or other structures.

V

Vault

An arched masonry structure that covers a space (bay) to provide it with a ceiling. Depending on the arrangement of arches, vaults may vary in shape, going from the simple barrel vault to the more sophisticated ribbed vault or fan vault.

W

Wall

A structure which serves to enclose (exterior wall) or subdivide (partition wall) a building, usually presenting a continuous surface except where penetrated by doors, windows, and the like. Walls designed to support imposed loads are called structural or loadbearing walls.

Prevention is Better than Cure

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Consejería de Cultura y Patrimonio Histórico
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