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Archive Buildings

BASIC RULES
FOR THE CONSTRUCTION AND FITTING OUT OF AN ARCHIVE BUILDING

5th revision – 2023

Inter-ministerial Service of the Archives of France

Preamble

A brief history

In 1966, Michel Duchein, curator, head of technical services in the Archives of France, published in Paris, in the International Council on Archives (ICA), a book entitled *Les bâtiments et équipements d'archives (Archive buildings and equipment)* at the initiative of the UNESCO Advisory Committee. This publication, the first of its kind on the subject, was a great success beyond national borders, because it met a real need, given the specific characteristics of this type of construction. In 1985, with the 1966 edition out of print and many new buildings having been constructed, a new revised edition was needed.
Les bâtiments d'archives, construction et équipement was published in 1985 by the Archives of France and the National Archives. This book, sometimes colloquially referred to as "The Duchein", was rightly considered a bible in archival circles because of the quality of its detailed descriptions of all the functions of an archive and all the spaces needed for it to function properly. For this reason, almost thirty-five years after its publication, this book is still a reference.
Following in Michel Duchein's footsteps, Rosine Cleyet-Michaud, head of the technical services of Archives de France, and Gérard Ermisse, head of the Heritage Inspectorate, updated from 1986 the body of recommendations issued by Michel Duchein.

Regular updates

The present rules constitute a sort of permanent update of the points that have changed since that publication, the main principles of use set out in which nonetheless remain valid.
The main areas of change listed below concern several technical and functional aspects.
Without going into detail now, it should be noted that as regards structures, self-supporting metal structures are now totally banned. The ceiling heights and floor resistances recommended by Michel Duchein have changed. Major changes have been made to the recommendations on air treatment for storerooms in light of developments in construction technologies and sustainable development.
From a functional point of view, the first thing to note is the increase in public access, particularly to educational workshops, exhibition rooms and conference rooms.
None of these rules can, of course, replace the regulations in force, particularly in the fundamental area of fire safety. They form the basis of the technical approval issued by the Interministerial Service of Archives of France (SIAF) for the construction or fitting out of buildings for the conservation of definitive archives, prior to the award of a State grant.

These updated rules form part of a continuous process of regular updating. The last version, in 2019, followed the opening of the National Archives designed by Massimiliano Fuksas in Pierrefitte-sur-Seine. In view of the planned extension of National Archives, an adjustment was needed to respond to today's increasingly pressing climatic challenges, reflecting and benefiting from the copious feedback on the many projects recently carried out.

The authors

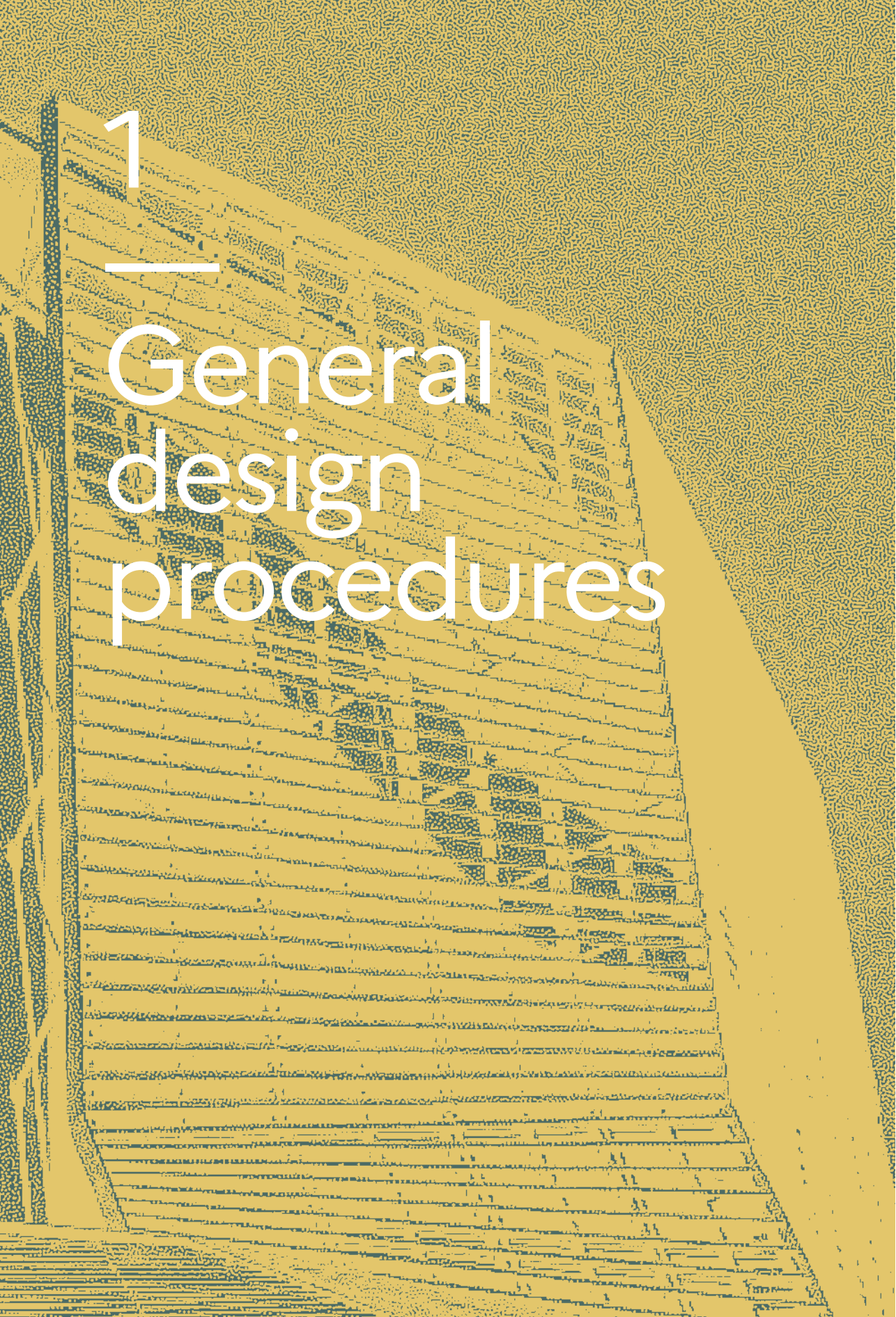
The authors of these rules are France Saïe-Belaïsch and Marie-Dominique Parchas. The general sections were updated by Alexis Leduc, Government-licensed Architect and Adviser to the SIAF, currently responsible for monitoring archive building construction projects at the SIAF.
Thi-Phuong Nguyen, currently an expert adviser on preventive andcurativeconservation with the SIAF, took charge of the air treatment part of the project, while Yann Brun, safety advisor to the safety, security and audit mission of the Inspection, Research and Innovation Delegation of the Directorate-General for Heritage and Architecture took charge of the safety part.
To complement this information, the three Archives of France publications, Les bâtiments d'archives 1986-2003, *Les archives dans la cité, architecture d'archives 2004-2012*, and *Architectures d'archives en France 2013-2020*, provide details of many of the buildings constructed or converted for the national and regional archives. The examples presented are intended to help project leaders think about their projects from both an architectural and a technical point of view.

Foreword: Acquire, Store, Arrange, Access

These are the four functions of an archive service. They must be reflected in the architecture of the building in which the service is housed. As mentioned above, archive buildings have continued to evolve in recent years for many different reasons. One aspect of these changes is the greater openness of the archives to the public, with documents being displayed in exhibition rooms and conferences and educational workshops being held. Architects are particularly interested in the design of archive buildings, which are recognised as genuine cultural facilities in the town or department. Another relatively recent development is the emergence of the notion of sustainable development, which has given these buildings a new aesthetic.
An archive building is made up of around two-thirds document storage areas and one-third areas for staff and the public. This type of building - which has already given archivists and architects plenty of food for thought in the past - is rather special, and a number of rules need to be taken into account when designing it.

One of the main functions of an archive building is to provide a protective setting for unique documents that need to be preserved, released and passed on to present and future generations. Despite the acquisition of other media (photographs, sound archives, audiovisual archives, films, objects, natively digital archives), paper is still the most important material in terms of volume, with leather and parchment (and even papyrus) in small proportions for the oldest archives. These organic materials react with their environment to create a balance, absorbing or releasing moisture. They also absorb pollutants. Documents such as acidic paper produced between 1860 and 1960 and certain types of packaging themselves release acidic or sulphuric pollutants. It is therefore essential to renew and filter the air to dilute these pollutants. This reactivity to the environment can lead to mechanical, chemical and biological changes, accelerating the ageing process. Similarly, photographic and audiovisual collections can release harmful substances. Furthermore, these media, as well as metals, especially lead seals, require special storage conditions.

For this reason archivists, preventive conservation specialists and architects join forces to protect this heritage wherever it is to be found.



1 General design procedures

The construction of an archive building is complex. It is therefore advisable to call on a programming consultancy to draw up the programme in advance. The assistance of a specialist in preventive conservation will also be very useful in talking to the various people involved and checking that all the procedures, air handling systems, furniture, lighting, etc. are suitable for conserving the various media. These preliminary studies will make it possible to fine-tune requirements.

During the project design and construction phases, it is also important to enlist project management assistance ("AMO" in the French abbreviation), particularly for air handling, and most especially in the case of a High Environmental Quality ("HQE" in the French abbreviation) project, to ensure that the project is monitored.

Such an approach allows potential shortcomings to be detected in that it leads to systematic audits being carried out in a context of sustainable development.

It can also be invaluable to have a project management assistance on board to ensure that overall costs are kept under control: in this respect, it is essential to include the costs of maintaining and operating the buildings after delivery. It is judicious to make this a criterion in the choice of project manager. It is also recommended that building maintenance issues be taken into account from the design stage.

In order to be able to compare offers effectively, it is essential to draw up a precise reference framework (response framework with objectives).

From the design stage through to the construction of the building, the director of the archive service is an essential partner (active participation in drawing up the programme, designing the reference system, choosing the various project management consultants and approving the preliminary drafts). He or she must also be able to monitor the site, attend meetings as the future user and receive the completed works file.

2 — Land and storage capacity

2.1 – Location

The chosen site must be healthy: dry, not subject to flooding (check for the presence of a water table and its level, the proximity of watercourses, drains, rainwater outlets, sewers, etc.).
It must not be exposed to the risk of landslides, subsidence or the shrinking and swelling of clay soils. To avoid having to deal with extremely costly problems at a later date, it is strongly recommend to have the nature of the subsoil and bearing capacity checked. The content of this geotechnical study is governed by standard NF P 94-500. If the building is located in a seismic zone, this consideration must be taken into account right from the design stage, with an appropriate structural principle, bearing in mind that the weight of the documents stored increases this problem.

It must be kept as far away as possible from:

- Any dangerous neighbourhood that presents a fire or explosion hazard or could become a strategic target in the event of conflict;
- Facilities that emit gases, smoke or pollutants;
- Any environment that favours crime and has an impact on safety and security.

If one or more of these criteria cannot be met, arrangements must be made or strengthened to minimise the natural and environmental risks.

Information on the above points can be found in the Risk Prevention Plans (Plans de Prévention des Risques – "PPR") available from the municipalities or, failing that, from the prefectures, as well as in the Communal Information Documents on Major Risks (Documents d'Information Communaux sur les Risques Majeurs – "DICRIM"). The list of major natural or industrial risks to which communes are exposed can also be consulted on the Géorisques website (www.georisques.gouv.fr)» (www.georisques.gouv.fr) of the French Ministry of Ecological Transition.

Buildings that are to be open to the public must also be easily accessible by lorries, coaches, private cars, public transport and non-motorised means such as walking and cycling, to which particular attention must be paid. They must also be designed to facilitate surveillance and hinder intrusion, while at the same time allowing specialist services (police, gendarmerie, fire brigade, emergency medical service, security company, etc.) to intervene quickly.

2.2 – Surface area

Although it is not possible to establish a precise relationship between the surface area of the land and the capacity of the building to be constructed, since this relationship varies according to the height and compactness of

the building, in principle, for a building with a capacity of 20,000 linear metres of static shelving, a land area of 3,000 m^2 is a minimum.
In the case of a new building, located outside a dense urban centre, it is desirable that the surface area of the plot allow for future extension of the building, in order to increase conservation capacity. The extension must be integrated into the design of the complex and represented on the graphic documents right from the tendering phase.

2.3 – Storage capacity

The storage capacity of the building, expressed in linear metres or kilometres, must be calculated on the basis of the archives currently stored, plus the projected increase, generally for the next 15 or 20 years.

Each department needs to carry out a study based on its needs in terms of linear metres:

- based on the average collection over the last 10 years;
- on an assessment, as far as possible, of the backlog remaining in the department (particularly where relations are under-developed);
- on the possible scientific re-evaluations to be carried out in the coming years.

The question of the community's demographic evolution (downward or upward) must also be studied to assess the capacity of the extension to be envisaged.
In any case, if the context allows, shared solutions should be favoured to optimise the use of built space. Finally, over the next 15 years, there is likely to be a gradual transition from paper to digital production, which obviously has to be taken into account in the projections made in order to estimate requirements as accurately as possible, bearing in mind also the need to plan for the collection of paper backlogs.

3 — Types of spaces and circulation areas

3.1 – Types of spaces or zones

In an archive building, there are five types of spaces or zones:

- Storage areas or repositories;
- Workplaces not open to the public: offices, meeting rooms, reception and processing rooms. These include rooms for accessioning, quarantine isolation, dust removal, packaging, storage of disposables (destruction zone), sorting and filing room; the various workshops (binding, restoration, photocopying, microfilming, photography, digitisation, etc.); relaxation area; server room if required.
- Premises open to the public: entrance hall, cloakrooms and toilets, reading room, exhibition room, rooms for group work, conference room, relaxation and light refreshments areas;
- Staff accommodation, with the possibility of one or two studio flats for a visiting student, trainee or researcher;
- Unloading area;
- Car park with charging stations for cars, bicycles and scooters, outdoor areas with short pedestrian access from the public highway.

3.2 – Traffic routes

There are two main categories of traffic circuit:

Circuits reserved for staff and documents

Arrival and processing of documents:
Unloading of documents (hall or dock) ▶ accessioning room ▶ quarantine and/or dust-removal (depending on the condition of the collections) ▶ sorting, intellectual processing and packaging room ▶ storerooms;
Departure of documents for disposal:
Sorting room or storerooms ▶ destruction zones ▶ shredder, or loading hall/dock for outsourced destruction.
Release of documents:
Storerooms ▶ transitional repository ▶ reading room ▶ transitional repository ▶ storerooms.
Nota: the transitional repository is the area between the reading room and the storerooms through which documents pass before or after being released to the public.

Public routes

Entrance hall ▶ reception (information desk);
Entrance hall ▶ cloakrooms ▶ reading room (passing through reception);
Entrance hall ▶ exhibition room, conference room, rooms for group work;
Entrance hall ▶ public toilets;
Entrance hall ▶ relaxation area;

Entrance hall ▶ bookshop, shop (possibly);
Entrance hall ▶ secretariat offices (with staff escort - circuit to be controlled).

All routes likely to be used by loaded trolleys (in particular the routes reserved for the above-mentioned personnel) must be on the same level in new buildings and must not have gradients of more than 6% in two metres in the case of refurbished buildings. Steps are prohibited.
Circuits open to the public must be accessible to people with reduced mobility and comply with the regulations set out in the French Building and Housing Code.
Traffic lanes likely to be used by loaded trolleys (staff only lanes) must be at least 1.50 m wide, as straight as possible and not include bends that are difficult for a heavily loaded trolley to negotiate. Circulation routes, particularly for the entire document circuit, must allow a pallet to pass through, with sufficient space to turn it around from time to time. Floor coverings must be able to withstand the wear and tear caused by the repeated passing of trolleys. The bottom part of corridor walls must also be protected.

3.3 – Vertical links serving repositories

Connections between the different levels will be provided by at least one lift, to transport both archive trolleys and people, a service staircase and an emergency staircase (for every 20,000 metres of shelving to be served, there should be at least one lift, preferably two).
The best location for staircases and lifts is at the junction of the storerooms and the administration areas.
Lifts must have a minimum payload of 750 kg; the cabin must be able to carry a trolley with the operator, and have minimum dimensions of 1.20 m (width) x 1.50 m (depth), so that a pallet can pass through with its pallet truck. The width of the door should be equivalent to the width of the cab, to facilitate handling. Particular care must be taken when adjusting the distance between the lift car and the landing to avoid even the slightest difference in level.
Service staircases must be at least 1.20 m wide.
An extra width in the corridors serving the storage rooms will make it possible to house a transit workstation for four or six storerooms, itself connected to the network.

4 — Premises open to the public

The premises open to the public are currently undergoing profound changes, with on the one hand a fall in the number of visitors to reading rooms (linked to the online availability of digitised archives on Internet sites, which now allow visitors to work remotely) and on the other a transformation of uses and services, as well as the development of off-site activities.
In addition to the reading room, premises must be provided for setting up or hosting permanent or temporary exhibitions, organising study days, conferences, seminars, workshops, musical or theatrical performances, archive readings and, of course, welcoming young people (classes, students) and their teachers.
The growing demand for administrative searches is also a major trend, requiring a specific system. As a result, archive services are having to meet increasingly diverse needs, which may involve hosting external facilities (public service centres, digital museums, etc.).
In addition to dedicated premises with specific layouts (reading room, exhibition room, auditorium, see below), there is a need for modular, flexible premises that can be adapted to different activities, different users and different attendance levels. These premises as a whole need to be enhanced, around the reading room, which remains the heart of the archive's on-site activities.

The work on proportions, geometry, natural light and materials will enable the spatial hierarchy of the public reception areas to be established by enhancing the visibility of the reading room, an emblematic feature of archive buildings, through visual transparencies from the hall or exhibition room. These interior views can be used to educate visitors unfamiliar with this type of cultural building.

4.1 – Conference and exhibition rooms

It is imperative to provide quality spaces that can offer a varied cultural programme. The public must be able to access the conference room and/or the exhibition room outside archive opening hours: access to these two types of premises, their location and their ancillary facilities (toilets, cloakrooms) must be designed accordingly.
The size of the exhibition room needs to be assessed in terms of its potential use (for schools only, for the general public) and, in this case too, the possibility of using existing public facilities. The use of the hall as an exhibition space should be avoided wherever possible for safety and conservation reasons. The space must be as modular as possible to offer maximum flexibility to set designers: it will have bare walls equipped with picture rails, a technical floor (with hidden sockets) and will be divisible into two spaces, with a high ceiling (3.50 m).
In auditoriums and conference rooms, it is necessary to install hearing induction loops as well as spaces for people with reduced mobility and their wheelchairs in accordance with current regulations.

Consideration is currently being given to the possibility of extending the duration of temporary exhibitions, but as there is as yet no consensus on this, the three-month period is still the one recommended for original archives. If it appears that these times may be extended, the following precautions to avoid damage caused by light and inappropriate climatic conditions will be even more important:

- It is necessary to limit both the intensity and duration of exposure to light as much as possible (particularly for documents containing coloured modern printing inks, acidic wood-based papers, coloured photographs, coloured drawings, prints or plans). A light level of 50 lux on any document exposed for three months is therefore recommended.
- No incandescent or other heat-generating light sources may be placed in or near display cases. Fluorescent lighting with diffusers and filters must be placed outside the display case. Light-emitting diode (LED) lighting or a fibre-optic system that can be used in the display case is preferred, provided that the light-generating source is positioned outside the case.
- Relative humidity must be kept under control. A certain amount of temperature variation is permissible as long as it remains limited. Rather than controlling the climate of an entire exhibition room, hall or any other space not originally designed for displaying works of art, it is advisable to do so only at display case level. Installing highly localised systems is simpler to implement, more effective in terms of results, and above all much less energy-intensive*.

*For further details, see Chapter 5.8 Climatic environment, Climatic instructions, Special case of display cases

It is also advisable to provide some display cases with burglar-proofing and alarms linked to the security control centre, as well as video protection, secure hanging and mounting of objects.
Lastly, a sufficiently large room should be provided close to the exhibition areas for preparing exhibitions, storing temporary exhibitions and display cases.

4.2 – Reading room and public reception areas

Since usages are changing, it is appropriate to think about them in an overall and modular way.

Due to the almost general decline in the number of readers in the reading rooms, it is necessary to adapt the size of the room to take account of this change, to the benefit of modular spaces or other public areas. In addition, readers must be able to consult original archive documents and digital files without having to move from one place to another. It would therefore be inappropriate to have separate reading rooms for different media. On the other hand, the solution of a single room with graduated spaces and environments (inventories and standard, original and digital works) is to be preferred.

In other cases, particularly for projects shared with other heritage departments, we could imagine a small, welcoming original consultation room, showcasing the originals that are consulted there, as well as other spaces suitable for other uses, more versatile and open, allowing a mix of users (film consultation, oral archives, documentation, etc.) Similarly, modular work rooms (workshops, labs, etc.) will be favoured, so that several users can work together.

In any event, users should be involved as much as possible in the design of these different reception areas, so that their needs can be heard and the areas and facilities adapted to meet these needs. Support in terms of ergonomic expertise and design is recommended.

As a guide, the working area for a reader consulting paper documents only is 100 cm wide x 80 cm deep; for computer-equipped seats, 140 cm wide x 80 cm deep; for consulting large-format documents, 140 cm wide x 100 cm deep, bearing in mind that a height of 90 cm means that documents can be consulted standing up and walked around, which is particularly useful for maps and plans.

In any case, users should be involved as much as possible in the design of these different reception areas.

In order to ensure that the entire reading room can be supervised in the best possible conditions, the readers' tables will be judiciously positioned (preferably perpendicular to the room's chairperson, with no reader's back to him or her) and the staff at the reception desk will be placed in an elevated position (preferably a step-high platform or high seat). An inclined surface must therefore be provided for staff with reduced mobility and for trolleys.

There should be no posts between the reader tables or blind spots.

To make it easier for people with reduced mobility to find what they are looking for, the furniture in the reading room will be of limited height (1.30 m maximum) so that a person in a wheelchair can reach it. Part of the document delivery counter must also be adapted for their use. Hearing induction loops are also to be installed in the reading room. These rules also apply to the reception area.

In addition, one or more tables should be installed that can be adjusted in height for wheelchair users (some electric wheelchairs are very bulky) or a table with a higher top. Part of the reading room should be equipped with departmental computers for consulting digitised or natively digital documents and for ordering documents. This part can be located at a distance from the reading room chair, while the consultation of original documents should be located close to the chair.

Readers' tables must have sockets for their personal computers. Sufficient space must be provided for the reader's laptop, as well as the space needed to consult documents.
The best lighting is natural lighting in the reading room, supplemented by general and individual lighting on the tables. The limited size of the devices must allow effective monitoring of the readers.

5

Repositories

Preliminary remarks

As a reminder, storerooms are storage facilities, not workplaces. They must be designed in such a way as to protect the collections from fluctuations in temperature and relative humidity, from external pollutants and those emanating from the collections themselves or from their packaging, and from direct light.
The presence of pipes containing liquids must be strictly prohibited in storerooms.

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Care must be taken to ensure that the air in these storage rooms is properly renewed and circulated, so as to avoid mould growth and condensation problems.

5.1 – Structure

The usual structure for archive storerooms is a concrete framework, independent of the shelving uprights. Self-supporting buildings are not sufficiently fire-resistant and their construction is no longer suitable for archive services.
Floors must be solid, to the exclusion of any slatted or grating system. However, in the case of refurbishments, the installation of static or mobile shelving with an intermediate metal floor may be considered on two levels, on a case-by-case basis, and in storerooms with a limited surface area, depending on the geometry of the premises.
The possible presence of posts should be considered in relation to the location planned for the furniture. These are not totally banned, but should be limited to facilitate storeroom layout. In addition, the beams must not impede air circulation.

5.2 – Exterior envelope

Insulation, thermal inertia and airtightness are the qualities sought after in storerooms, thanks in particular to external insulation. Widely used over the last twenty years, this system improves the energy performance of buildings and offers a number of advantages. This is a complex that envelops all the external surfaces, including the roof, and is made up of different technical layers: structure, insulation, vapour barrier, rain screen, air space and cladding. This assembly ensures the continuity of the envelope's

thermal insulation and reinforces the building's air- and water-tightness. It also offers a wide range of expressive exterior finishes, including stone, wood, terracotta, textured or tinted concrete, metal and even composite materials. Another advantage of this system is that it can be used for both new buildings and the renovation of existing buildings.
The principle of the «double skin» or «thermal space» complements the qualities of the external envelope. The construction of a second, insulated envelope inside the building, set back from the external walls, promotes climate stability and energy efficiency in the storerooms. The air contained between two walls forms a «climatic buffer» around the premises which, as well as providing excellent thermal protection, forms a technical vacuum that protects the storerooms against external aggression, leaks or infiltration, and facilitates the passage of networks. This system is valid in most climatic conditions, even tropical or mountainous, and also applies to existing and/or heritage buildings, preserving their façades.
To extend the «double skin», the access corridors to the storerooms will be closed by doors, preferably automated. These zones will form a transitional airlock, separating the storage areas from the work areas. For reasons of comfort and quality of use, these corridors will benefit from having a natural lighting point and automatically timed lighting when passing through unlit stretches, avoiding the need for systematic recourse to electric lighting.
The sun-breaker is another way of ensuring sustainable conservation. Commonly installed to project in front of the lintel of the openings it shades, it is made of parallel blades placed at an angle. This device can also be used to protect facades from the sun's rays, thereby limiting their heating by ensuring free circulation of air through natural convection. Particularly effective in overseas France, it is used in the project for the Departmental Archives in Mayotte, where photovoltaic panels replace the blades to ensure self-consumption by the storerooms.
If storerooms are located underground or under roofs, the risks are higher. Incidents of varying degrees of seriousness show that, despite protection that is deemed adequate, the risk of infiltration remains: overflowing sewers during storms, rising water tables, poorly sealed roofs or underpinned walls.

The principle of the «double skin» or «thermal space» complements the qualities of the external envelope.

The design of conservation areas should therefore give priority to protection against external aggression.

5.3 – Dimensions

For fire safety reasons, the maximum floor area authorised for storerooms is 200 m². This surface area has made it possible to create conservation areas on an appropriate scale, which has proved its worth both functionally and technically in terms of air treatment as well as structurally. It may, however, be adjusted upwards or downwards by up to 10% if justified by the geometry of the site. In the case of major new building projects for the National Archives or large departmental archive services, this surface area may be increased to 300 m², subject to the agreement of the SIAF.

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The recommended ceiling height is *at least* 2.60 metres. For good air circulation, at least 30 cm of free space must be left between the top of the shelving and the equipment (ducts, electrical and detection equipment, etc.). However, this circulation must not be hindered by overhanging beams. In tropical climates, a ceiling height of 2.80 metres is recommended.
In addition, documents must in no circumstances interfere with the operation of fire and intrusion detectors, particularly if there is no cover shelf (though these are recommended). Nor should they be placed too close to lighting to avoid any risk of fire.

5.4 – Floor overload

Due to the weight of loaded shelving, storeroom floors must be able to withstand the following loads for furniture 2.20 metres high:

- 900 kg/m² for static shelving;
- 1,000 kg/m² for static shelving for the heaviest 10% of the collections;
- 1,300 kg/m² for mobile shelving.

For further details, please refer to instruction DITN/RES/2004/001 dated 16 July 2004, relating to overloading to be taken into account in archive storerooms, available on the Archives of France website*.
A floor overload of 1,300 kg/m² can be planned at the outset for all the storerooms in order to anticipate the need to install mobile shelving in all the storage areas at a later date.

*https://francearchives.gouv.fr/file/fe8f-8f349725252d18dd6b5e-b268fa8048afd617/static_1101.pdf

5.5 – Quality and drying of materials

Avant les travaux, on veillera à ce que les matériaux du bâtiment ne libèrent plus ni composés volatils ni humidité préjudiciables aux collections, et que leur mise en œuvre (temps de séchage et d'évacuation des polluants) prenne

en compte ces contraintes. Il est par conséquent conseillé d'exiger avant le début du chantier une fiche de données de sécurité pour chaque produit avec un suivi par un AMO HQE.
Une attention particulière doit être portée aux problématiques d'assèchement des magasins. C'est pourquoi il est recommandé de commencer la construction par les magasins.
Il est ainsi recommandé de mettre en œuvre des techniques et de choisir des matériaux spécifiques : planchers alvéolaires préfabriqués, système constructif poteau-poutre de type « construction sèche » avec un remplissage en briques.
Pendant la durée du chantier, on effectuera des prélèvements au cœur du béton, afin de vérifier que la cible du minimum d'humidité est bien atteinte lors de la livraison du bâtiment. L'évacuation des eaux pluviales durant le chantier, ainsi que la mise en œuvre de courants d'air dans les magasins durant cette période, faciliteront le séchage des matériaux. Il est par ailleurs possible de louer, si nécessaire, pendant le chantier des déshydrateurs professionnels.
Finally, it is imperative that at least three months elapse between the commissioning of the air handling units and the arrival of the first documents, and that provision be made for the replacement of all the filters in the units at the end of this dry run. As the summer period is the most restrictive in terms of air treatment, it is strongly recommended to carry out the dry run during the summer.

5.6 – Exterior and interior openings

Fire access openings and smoke extraction hatches on storeroom fronts

Fire access openings to storerooms have a number of disadvantages:
- Reduced insulation and thermal inertia and creation of a microclimate;
- Risks of infiltration due to loss of air- and water-tightness (penetration of damp air, dust, insects, etc.)
- Risk of alteration of documents and bindings by light;
- Risk of information on labels being altered.

For these reasons, the presence of openings to storerooms must be limited to fire safety requirements. A windowless opening will be used, depending on the case, to integrate a smoke extraction system or for the passage of firefighters and will preferably be placed in line with the main circulation route. All these openings to the outside must be watertight, airtight and thermally insulated to a very high standard. The risks of intrusion through these openings must also be taken into account. Because of the lack of natural light in the storerooms, it is necessary for this to be present in the corridors and intermediate spaces serving them, and thus provide an element of reference and comfort in these windowless spaces.

Repository doors

The presence of openings in storerooms must be limited to fire safety requirements.

Storeroom doors must be at least 1 meter wide. A larger width (1.20 metres) makes it easier to handle large-format documents or models. Double-leaf doors (90 cm + 30 cm, for example) can be provided and are appreciated, for example, during exceptional handling operations.
Storerooms can be opened manually or by access control. The latter has the advantage of ensuring traceability. In all cases, an automatic door-closing system is a minimum requirement, given the need to maintain the principle of fireproof partitioning and climate control. This system will be slow-closing to facilitate trolley traffic.
To facilitate trolley entry and exit, the doors can be motorised, with alternative operation if the power supply is interrupted.
It is preferable to use wrap-around metal door frames rather than corner door frames to provide better protection for the walls against impacts from trolleys.
The use of portholes (firebreaks) on the doors offers the advantage of removing any doubt (fire, smoke) without having to enter the storeroom. Examples can be seen at the Departmental Archives of Aisne, Nord and Somme. These portholes provide some comfort and help staff to feel less isolated. They can also be used to monitor activity in storerooms, and provide a visual cue for staff in windowless storerooms.

5.7 – Shelving layout and characteristics

On this point, please refer to instruction DITN/RES/2008/005 dated 15 July 2008, relating to shelving in archive storerooms and available on the Archives of France website*.
This instruction should be used to draw up specifications for invitations to tender relating to shelving. A double-sided bay is constituted by two bays joined back to back.

*https://francearchives.gouv.fr/file/8e5405f9cbd41f3d6bda68bbf9bed57631468f4f/static_1867.pdf

The following points should be borne in mind in particular:

The recommended depth of the shelves is 35 to 40 cm. A depth of 30 cm is insufficient, especially when mobile shelving is used.
The width of the main aisle will be 120 to 150 cm, and that of the service aisle 80 cm between bays. The length of the (rows of) bays will be a maximum of 10 metres. The height of the highest (last accessible) shelf will be 180 cm from the floor, to allow documents to be handled without a stepladder. The use of

cover shelves is recommended to protect documents from dust and to avoid cluttering up the space between the shelves and the ceiling. They must not be used to increase the storage capacity of the storeroom.
Shelving should not be placed directly along exterior walls, especially in old buildings with little or poor insulation. In the case of new, well-insulated buildings, a width of 15 cm must be left between the end of the (row of) bays and the wall giving on to the outside. A space of 10 to 15 cm should be left between the floor and the lowest shelf. This may be increased in storerooms located on the ground floor and in basements to take account of flood risks.
The proportion of static and mobile shelving is determined by the needs and characteristics of the service. A proportion of 50% of each type of shelving is suitable but can be modified. It is advisable to retain a certain proportion of static shelving for documents that are frequently consulted, irregular format or heavier to handle. For example, one third static shelving and two thirds mobile shelving is a good ratio.

Note: the average storage capacity for a 200 m² repository is as follows:

- repository equipped with static shelving : 1,200 linear metres (6 lm/m²)
- repository equipped with mobile shelving: 2,100 linear metres (10.5 lm/m²)

This figure may vary depending on the type of collections held (contemporary documents in standardised boxes, registers, etc.) but can serve as a basis for a quick calculation - with an average of 5.5 shelves per bay for static shelving and 6 to 6.5 shelves per bay for mobile shelving, which generally holds documents in standardised boxes.

Metal shelving must be coated with a baked-on epoxy polyester paint. Galvanised steel shelves are prohibited, as this material can oxidise and rust.
For historical archives, a shelf strength of 100 kg/lm is recommended.
Cross-pieces installed at intervals between the two faces of the double-sided bays ensure the stability of the shelving.
The use of perforated uprights on the front of the bays is recommended to ensure good air circulation.
The use of folding shelves at the end of static bays or integrated retractable shelves makes it easier to carry out occasional searches in storerooms. They must be systematically folded down if evacuation is necessary. Mobile trolleys can also be used for occasional consultations. Shelves fitted with computer sockets can be placed along the length of a wall.
In tropical climates, the use of static shelving is highly recommended, as the air circulates better in this type of archiving furniture. This also avoids maintenance problems for mobile furniture.
Storeroom floors must be perfectly flat when mobile shelving is used. A check is therefore essential before the floors and filing furniture are finished. In the case of a new building, the rails will be embedded in a filling

screed poured over the excavated load-bearing floor. In the case of an existing building, the rails will be fitted in the same way as the finished floor. This should preferably be made of metal and its plenum accessible (removable panels). Wooden panels are not recommended. They carry the risk of releasing volatile compounds or causing damage and deformation. In this case, the judicious installation of an access ramp will also be necessary. For mobile shelving, the number of bays to be moved at the same time will be 7 to 8 maximum.
The use of electric mobile shelving is tending to develop because of the advantages it brings - first and foremost ease of handling - at a moderate increase in cost compared with manually-operated shelving. Its use is still minority, which means that feedback is limited. Shelving of this type has been installed, for example, in the Aisne and Nord departmental archive services, as well as in the deferred part of the National Archives storerooms and at the Contemporary Architecture Archive Centre, and after a running-in period, is giving satisfaction, subject to regular maintenance. In departments with a large volume of documents, the use of electric mobile shelving makes it easier to handle dense shelving that can be heavily loaded. When they are not in use (at night or at weekends), the bays are regularly separated, facilitating air circulation. In addition, the reduction in the number of static intermediate bays means that wider service aisles can be created to allow trolleys to pass through. Lastly, the mobile lighting on motorised shelving units provides targeted lighting between the shelving units being moved, to help users find the documents they are looking for.
The recommended depth for this type of shelving is at least 35 cm, as documents must never protrude from the shelving.

> **Note: The shelving work lot should be included in the project management assignment. The choice of conservation furniture has an impact on a number of work lots, including structural work, climate control, electricity and fire detection. Awarding this lot to the main contractor means that the layout of the storerooms can be optimally designed.**

It is advisable to request samples of the static or mobile shelving in the tender specifications for the shelving work lot, so that the proposed equipment can be tested. It is advisable to request a complete bay for the sample, complete with any accessories, including separators for registers. The contractor's bay will be retained until the site is handed over.
In the case of a new build or major refurbishment, it is also advisable to ask for one or two pilot storerooms (with static and/or mobile shelving) to be installed as soon as possible on site, in order to test the shelving and also to check the lighting conditions, ventilation ducts, doors, etc.
The service provider should be asked to have the resistance of the shelves certified by an independent body.

General remark

All automated, motorised systems (access, mobile shelving, ventilation, etc.) generate maintenance contracts. The cost of operation and maintenance must be anticipated and planned for by the local authority. The questions of day-to-day operation and long-term maintenance must always be addressed: what are the advantages in normal operation, and conversely, what are the disadvantages in the event of malfunction, due to a lack of regular maintenance?

5.8 – Climatic environment

This is an essential issue, because it goes to the heart of the mission of a heritage institution, which is to ensure the best possible preservation of the collections it makes available to the public. However, building standards relating to air treament in offices and other technical or tertiary premises are generally not adapted to the needs of heritage collections.
The emphasis should be on controlling humidity and maintaining a stable climate, although temperature variations should be accepted as long as they are not abrupt. Particular attention must therefore be paid to ensuring that the specific needs expressed in the programmes are met. A functional analysis is essential to check that the objectives are being met, and to understand and maintain the air handling system.
The recommendations given here are taken from the manual *Traitement de l'air dans les bâtiments d'archives - conception et gestion des équipements* (Air treatment in archive buildings - design and management of equipment), published in 2017 and available for consultation on the of France Archives website*. For further details, please refer to this book.

*https://francearchives.gouv.fr/file/2491fd07e6400aaaed4133589e08358761a78239/Version_FA_bdef_vcompressee.pdf

Recommendations

Minimum requirements
The choice of technical solutions for air treatment, as well as the climatic instructions to be adopted, must be based on the external climate of the site where the archive building is located, the inertia and airtightness properties of the building, the sensitivity, historical value and use made of the collections, as well as the financial and human resources available in the medium and long term. Before determining the storage environment likely to meet its needs, it is therefore important for the archive to assess its collections*.

*Norme NF ISO 11799 : 27 mai 2016 «Information et documentation - Exigences pour le stockage des documents d'archives et de bibliothèques».

To ensure that archive documents are properly preserved, it is nevertheless recommended to have at least:

- **A storeroom heating system** for buildings in mainland France.
- **Air renewal of 0.10 volume/hour in normal operation** It must be possible to stop the supply of outside air when climatic conditions

outside are very unfavourable (peaks of humidity and/or heat). To save on energy bills, it must also be possible to stop the supply of outside air when the building is unoccupied, at night for example. Conversely, extra ventilation (0.3 volume/hour recommended) must be easy to activate manually in the event of microbiological contamination or an abnormal rise in indoor relative humidity, following flooding for example). It is advisable to install a system to warn of extra ventilation at least 24 hours after it is activated, to prevent it from continuing to operate once the problems have been resolved.

The emphasis should be on controlling humidity and maintaining a stable climate, although temperature variations should be accepted as long as they are not abrupt.

- **Homogeneous air mixing at a recommended rate of 2 volumes/hour for new buildings; this is the most energy-intensive part of an air handling system** – *see insert on next page*. If high induction diffusion ducts are installed, this rate can be lowered as long as it allows efficient mixing throughout the volume of the storeroom.
  In existing buildings, a higher rate of 3 volumes/hour is generally recommended, but this is an average value that must be adapted to the thermal quality, airtightness and organisation of the storerooms. In all cases, therefore, and even more so for older buildings, it is advisable to check the efficiency of the mixing by means of in situ tests (smoke, tracer gas, temperature measurements, etc.).
- **Studies are under way to check whether it would be possible to link the stoppage of air circulation to that of fresh air supply when the building is unoccupied.** If such an operation is envisaged, the conditions and duration of the shutdown must be based on the results of in-depth studies of changes in climate and indoor air quality throughout the shutdown period. The programmed interruption of circulation is strongly discouraged for buildings with poor airtightness and low thermal inertia.
- Particle filtration of the air (G4 pre-filtration with a gravimetric efficiency test, preferably followed by F8 fine filtration with an opacimeter test, when the air handling unit is installed). The condition

of the filters must be checked regularly and the checks recorded in a maintenance schedule; the filters must be replaced as soon as the maximum pressure drop is reached.

In 2010, as part of a Conservatoire national des arts et métiers (National Conservatory of Arts and Crafts) engineering degree dissertation, a major energy study was carried out on the new National Archives building in Pierrefitte-sur-Seine. The aim was to study solutions for reducing energy consumption in the conservation building (storerooms) and satellites (ERP (establishments open to the public), offices and workshops). Using existing energy consumption data and the characteristics of the buildings, simulations were carried out using energy consumption calculation software, based on different air treatment scenarios. These show that air circulation alone accounts for almost two-thirds of total energy expenditure on climate control in storerooms.

① 18°C - 50% HR
Mixing 3 vol/h 24/24
Fresh air 0,3 vol/h 24/24
② 1 + temperature change: [16°C - 24°C]
③ 2 + change in relative humidity: [40% - 57%]
④ 3 + change in fresh air: 0,1 vol/h
⑤ 4 + fresh air off outside the range [5 - 11 g/kg dry air] + fresh air off at night between March and October
⑥ 5 + variations limited to 1% per day
⑦ 6 + change in mixing: 1.5 vol/h (high induction perforated duct)

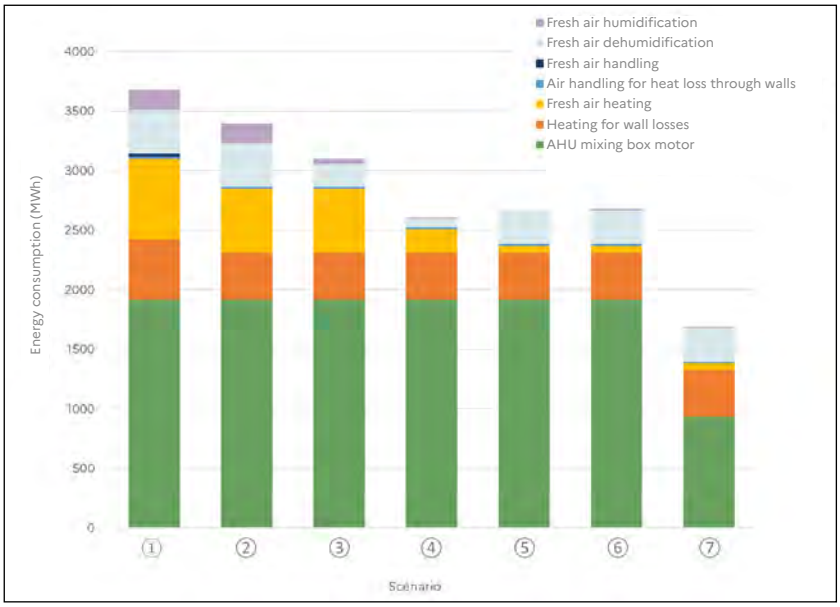


Figure 1: HVAC consumption as a function of instructions and air flow rates. Extract from the CNAM engineering dissertation "Energy study of the National Archives Centre in Pierrefitte-sur-Seine", François Catroux, 28 April 2011.

Climate instructions

Paper, cardboard, leather and parchment are materials with a high hygroscopic potential: they are capable of absorbing moisture from the air and rapidly desorbing the moisture they contain to balance with the ambient climatic conditions. Rapid, wide-ranging climatic fluctuations therefore cause dimensional variations which, if repeated, will lead to their becoming brittle. It is therefore important to maintain the most

stable possible ambient relative humidity and temperature in the storage facilities.
Relative humidity that is too low causes desiccation, especially of leather, parchment and tracing paper, while on the other hand relative humidity that is too high encourages mould growth and hydrolytic reactions (as in the case of acidic paper or film on acetate or cellulose nitrate).
High temperatures accelerate chemical reactions and therefore the ageing of materials. It is therefore preferable to store documents at low temperatures. However, in the absence of a mechanised system for regulating temperature and/or relative humidity, any change in temperature will inevitably lead to a change in relative humidity in the opposite direction. This means that, in the absence of a dehumidifier, a drop in ambient temperature leads to an increase in relative humidity, which can reach levels that are unsuitable for the proper conservation of collections.

As archives are particularly sensitive to variations in relative humidity, humidity management must always be prioritised over temperature management, not the other way round.

As archives are particularly sensitive to variations in relative humidity, humidity management must always be prioritised over temperature management, not the other way round. This means that it is permissible to allow the temperature to vary if this helps to maintain a stable and low relative humidity; the opposite is strongly discouraged.
Processing rooms (sorting, workshops excluding restoration workshops) and reading rooms are subject to frequent comings and goings, making it very difficult to maintain a stable climate and relative humidity in particular. As documents are not intended to be preserved there, humidity need not be monitored in these spaces. The climatic conditions will therefore correspond to those generally applied to ensuring people's comfort.
Not all documents are equally vulnerable to climate problems and pollutants. Older papers (rag paper) can withstand them more easily, whereas acid mechanical papers produced between 1860 and 1960, as well as leather, parchment and some photographic negatives and prints, are very vulnerable. Special precautions must therefore be taken in relation to vulnerable categories, which must be kept in the most stable and temperate conditions possible.

In the case of new buildings to optimise the preservation of archive collections, adoption of the following climatic conditions is recommended:

- Temperature between 16°C and 23°C
  Maximum variations of 2°C per week
  and 1°C per day are permitted;
- Relative humidity between 40% and 55%. Maximum variations of 5% per day and per week are permitted..

The calculation bases for sizing climatic equipment are:

- In winter: 17°C +/- 1°C and 45% RH +/- 5%
- In summer: 22°C +/- 1°C and 50% RH +/- 5%

In the absence of air treatment, in humid climates or for summer periods when relative humidity can exceed 65%, the installation of mobile dehumidifiers is a minimum requirement. In continental climates (heating in winter), the use of mobile humidifiers at the required times can remedy the problem of desiccation of collections. Mobile humidifiers or dehumidifiers must not be placed directly in the shelving. They are acceptable only if they correspond to specific needs (minimum and maximum levels reached over short periods). In fact, these devices are seen mainly as a troubleshooting solution.

When purchasing mobile dehumidifiers, particular attention should be paid to condensate drainage. This is done either manually, in which case the appliance must be fitted with a safety system that switches it off when the tank is full, or automatically, in which case the appliance must be connected to the waste water drainage system or discharged to the outside. Particular attention should be paid to the risks of flooding and short-circuiting in the event of manual evacuation.

In the case of existing buildings

- If the building and the conservation premises do not have good thermal inertia and insulation or good airtightness, and if, for whatever reason, work to improve these parameters cannot be envisaged, **the installation of a mechanical temperature and humidity control system is not recommended as it can be very energy-consuming and even counter-productive in use.** In this case, natural or mechanical ventilation* (installation of air-mixing fans) should be provided in the storage areas to avoid any problems of mould contamination. Under these conditions, the indoor climate will not meet the requirements for long-term preservation.
- If on the other hand the building and the conservation rooms have low thermal inertia and insulation but are airtight, it would be difficult to envisage doing without a mechanical climate control system (temperature and relative humidity), since any rise in the

*Mechanical ventilation is preferable because, unlike natural ventilation, it does not produce dust

interior temperature would cause the collections to emit very large quantities of humidity, which it would not be possible to evacuate quickly. This solution will be energy-intensive and costly.

Only a major refurbishment will make it possible to significantly improve the building's inertia and allow an appropriate climatic system to be adopted.

Only a major refurbishment will significantly improve the building's inertia and allow an appropriate climatic system to be adopted.

Special case of display cases
Like the processing rooms or the reading room, the exhibition areas are often open and subject to frequent comings and goings. It is therefore particularly difficult to maintain a stable climate in line with the conditions required for optimum conservation of the collections. To ensure that the objects on display can still benefit from acceptable climatic conditions at the lowest possible cost, the installation of display cases equipped with at least one system for regulating relative humidity, whether dynamic (adsorption dehumidifier, membrane-based dehumidifier, etc.) or passive (silica gel, hydrated salt, Propadyn®, etc.), may be entirely appropriate. These display cases must have a high level of airtightness; to ensure correct operation of the equipment used to regulate relative humidity, especially passive ones, the AER (air exchange rate) must not exceed 1 per day. The lower the AER, the easier it is for the humidity and temperature control systems to maintain the showcase climate at the desired conditions for the duration of the exhibition. The materials used to make the display case and any other devices installed inside it must be inert and must not emit volatile compounds likely to damage the objects on display*.

*XP X80-002 standard Conservation of cultural assets Recommendations for designing, fitting out, choosing and using a display case for cultural objects

Preliminary studies, building design and transfer of collections

Knowledge of outdoor weather conditions
It is important to be familiar with the external climatic conditions where the archive building is located in order to ensure that the air handling systems are correctly sized and the dehumidification (often in summer) and humidification (often in winter) capacities are sufficient. To do this, we need to take into account the average temperatures and relative humidity recorded over a whole year, as well as the minimum and maximum temperatures, as the climate control systems put in place must be able to continue to ensure optimal conservation of the collections during extreme climatic events.

Building design

During the design phase of a building construction or renovation project, it is now possible to use simulation tools (modelling) to check the relevance of the technical solutions chosen and calculate the energy consumption and greenhouse gas emissions they entail. The analyses must be based on data collected for empty, half-full and full storerooms, as the indoor climate should be regulated before the air is blown into the storerooms and not by the collections and their packaging. Paper, leather and parchment are hygroscopic materials that buffer fluctuations in ambient relative humidity by releasing or absorbing moisture, which causes dimensional variations that lead to embrittlement over time.

To avoid collections having to counterbalance fluctuating climatic conditions to the detriment of their integrity, it is therefore important to construct buildings that are as inert and/or thermally insulated and as airtight as possible.

Furthermore, as Pierre Diaz Pedregal has shown on pages 63-64 of his Petit manuel de climatologie appliquée à la conception des bâtiments d'archives (Little manual of climatology applied to the design of archive buildings), available on the France Archives website*, it is illusory to think that packaging can protect collections in the long term from the deficiencies of a building and/or an air handling system. Since the boxes are not completely airtight, the documents they contain end up in a state of equilibrium with the storeroom environment. Packaging can of course reduce fluctuations in relative humidity when they are rapid and small, but its role is essentially to protect collections from dust and light.

*https://francearchives.gouv.fr/file/47cc986f-fbb4b6b02960a1bcb-d2b4a6a890cc098/static_3376.pdf

Preparing for the transfer of collections

Moving collections is a delicate operation because, in addition to the risks of damage or theft associated with moving, transporting and handling them, the documents have to contend with changes in the climatic environment that can lead to large-scale mould growth.

During the design phase of the project, and well before the collections are moved, it is therefore important to carry out a health assessment of the collections in order to plan treatment such as dust removal, repackaging and disinfection, which will significantly reduce the risk of contamination of the new areas.

A climatic study will enable us to choose the most favourable period for the move, giving priority to that which causes the fewest possible thermal shocks, and during which the water content of the documents is the lowest (generally March/April), or by planning adaptation phases. As far as possible, any transfer of collections from a cold, damp room to a warmer room should be avoided. If such a move has to be made, the temperature of the target room should be lowered so that it is equal to or lower than that of the original room, or the collections should be transferred in small volumes so that the dehumidifiers can gradually absorb the humidity that the collections emit.

The drying time of the building materials must also be taken into account, and the collections should not be moved in until the building is completely dry.

Climate control

The complexity of the issue calls for specific control conditions. Thus, experience has shown that **the heating, ventilation and air treatment lot or contract component cannot be accepted like the other components, since the technical installations need to be tested over time**.
An acceptance protocol must therefore be drawn up. It is used to check that the system meets the programme's objectives, by monitoring certain points (particularly over time). Drawn up by the design office, this protocol will include at least the following elements: duration of the measurement, control of the measurement (using an external system for example), verification of external conditions, etc.
Similarly, this lot or contract component can be accepted only after a sufficient period of operation (three months, preferably during the summer), before the storerooms have been filled, with dynamic thermal simulations carried out in the meantime, assuming that the storerooms are empty or full. A project management team can also be called in to assist with thermal and hygrometric monitoring for a sufficiently long period after the new building is brought into service (one year to take account of periods that are too dry - winter - or too wet - summer). Continuous monitoring of temperature and humidity is essential; to achieve this, it is preferable to install sensors in the middle of the storerooms rather than at the air intakes. If a Centralised Technical Management (Centralised Unit) is installed, it must allow data to be consulted by the Archives department.
The Archive teams responsible for conservation should have thermo-hygrometers that are independent of the Centralised Unit. This additional equipment will be able to compensate for any malfunctions or breakdowns in the Centralised Unit; it will make it easier to obtain and use data and will provide comparable values for climatic analyses.
These devices must be carefully and regularly checked and calibrated.

Conclusions

Because some premises (computer rooms in particular), some media (photographic and audiovisual collections, etc.), and some climates (hot and humid or too dry) or buildings (highly glazed, poorly insulated, with low inertia and/or low airtightness) require air treatment, it seems difficult to exclude mechanised air handling systems altogether if we are to adopt optimum conservation conditions.
Nevertheless, in order to meet today's pressing energy-saving requirements, it is possible to adopt less drastic climatic conditions than in the past, without necessarily compromising the proper conservation of the collections. For example, rather than adopting strict temperature and relative

humidity values that are the same all year round, we can accept ranges that allow the storeroom climate to be adapted to external conditions, and adopt different instructions for different seasons. **However, care must be taken to maintain a stable climate at all times and to stay within the recommended ranges. Relative humidity must always take precedence over temperature.**

The quality of the building remains an essential parameter: good thermal insulation and air- and water-tightness, particularly in storerooms, must be ensured. If the building is insulated with a double wall, this must be ventilated to avoid the risk of condensation or mould growth.

Climatic instructions will therefore have to be defined on a case-by-case basis and following concerted consideration of the external environment, the nature and quality of the building, the financial and human resources available in the medium and long term, as well as the use, nature and sensitivity of the documents stored, and their expected lifespan.
On the basis of the data collected, the relevant technical departments will be able to carry out a study to determine the types of materials, the positioning of storerooms, and the mechanical processes for heating, ventilation, mixing, air supply, mechanical extraction and filtration that would make it possible to remain within the defined ranges, considering the use of air treatment and/or dehumidification with cold production only in situations where clearly no other solution is possible. The technical choices must be made in consultation with the users of the archive building.

It may also be worthwhile to provide separate regulation and smaller units for each storeroom; this has the advantage of affecting smaller areas in the event of a malfunction, and spreading out costs more evenly when replacing installations or spare parts. However, it must be borne in mind that this type of installation can be more energy-intensive than a centralised system.
It is important that the maintenance of these very specific installations (particularly humidity treatment) is entrusted to companies specialising in humidity treatment (as is the case for swimming pool management) and that they are not included in the work lot of premises where only comfort is concerned (offices, communal facilities, etc.). Similarly, maintenance personnel need to be permanent, since understanding these complex systems requires time and personal investment to master them.

*Certaines collectivité choisissent d'installer une salle blanche. On suivra dans ce cas les prescriptions du service informatique de la collectivité.

5.9 – Special repositories

Photographic, audiovisual and microfilm collections

Special storage facilities are required for certain categories of documents: microfilm, photographic, sound and audiovisual documents, digital media*, etc. Given the special conditions under which these documents

are stored, an appropriate air-handling system or possibly the use of refrigerated cupboards or cold rooms (depending on the volume) is essential, particularly for documents that are rarely consulted because they have been digitised, for example.
It is not always necessary to adopt very cold conditions for acetate and cellulose nitrate negatives if they show no signs of degradation. The use of a cold room (temperature below 12°C) is restrictive and energy-consuming, so it is important to carefully analyse whether such an installation is appropriate.

> **At these temperatures (below 15°C), dehumidification systems based on the principle of condensation are not effective and cannot reduce the relative humidity in the room to below 50%.**
> **At these temperatures, it is therefore necessary to use dehumidification systems based on the adsorption principle; these are used alone or in addition to the condensation system.**

When these documents are sent to the reading room, there may be problems of climatic shock and droplets of condensation may appear. This must be mitigated by ensuring a transition that allows them to gradually acclimatise to the conditions in the reading room after they leave the cold room: storage in one or two airlocks with intermediate climatic conditions, use of a hermetically sealed cool box, prior packaging in an airtight envelope.
Detailed procedures can be found in the "Reservations and storage conditions for cellulose nitrate media" and "Freezing cellulose nitrate media*" sheets.
One solution is to give priority to digitizing this type of document in order to remove the originals from the consultation.
When the walls of cold rooms are poorly insulated, problems of condensation and therefore the appearance of mould can occur on the part adjoining other rooms. To avoid this, the cold room's thermal insulation must be reinforced on all six surfaces (walls, floor and ceiling), which will also need to be fitted with an effective vapour barrier.
The air must be renewed or chemically filtered to remove pollutants emitted by degraded cellulose acetates and nitrates. This air must be dehumidified (RH 45%); the temperature must be adapted to the types and materials being conserved. A test period is also essential before the photos and films arrive. Care must be taken to control the levels of pollutants potentially emitted by the collections, and the materials used in these cold rooms must not themselves emit any.
For cold storage, the use of domestic ventilated refrigerators may be considered for small-volume documents, on the **strict condition that they are pre-packed in hermetically sealed bags (sealed or double-zipped), or in food tins with clip-on lids fitted with a seal.** These containers will contain humidity regulators (silica gel, for example) to prevent condensation.

*http://www.culture.gouv.fr/content/download/172866/1920785/version/2/file/Fiche%204_Reserves_v20sept2017.pdf

Large formats, maps and plans

Collections of maps and plans, large formats, posters and architectural and town planning models must be stored in one or more special storerooms configured according to their volume and size. Specific furniture will be acquired for their packaging (plan cabinets, roll holders, etc.).
It is desirable for these storerooms to have the most direct horizontal connection to the reading room if the collections are not digitised.
An interesting arrangement is to have a few lower units that can be used as worktops for plans, integrated in the middle of the other plan furniture. However, it must be easy to handle documents at height.
Finally, in the case of furniture with mobile (compact) plans, it is advisable to allow enough space for drawers to open in the service aisles.

6 — Special premises

As a general rule, it is important to avoid any break in the climate in areas where the collections circulate or are present, even temporarily (sorting rooms, reading rooms and transitional repositories, exhibition rooms, photographic, restoration or dust removal workshops, etc.). Similarly, windows should be fitted with IR and UV filters and blinds. A northerly orientation is preferable for rooms where collections are housed, even temporarily.

6.1 – Quarantine zone

To avoid any contamination of the collections stored in the storerooms, all newly-arrived collections should be isolated in a quarantine room, and identified before any dust-removal and packaging operations.
The quarantine area can be divided into two independent sections: one for isolating suspect items and the other for contaminated documents, which will be sent for disinfection if necessary. If the two areas are located in the same room, they should be separated by means of masking paper or polythene protective film placed in front of the shelves, for example; obviously mouldy documents should be wrapped in paper.
More than the temperature, the relative humidity of this quarantine space must be controlled and maintained at values below 50%, so that mould problems do not appear or worsen when documents are stored there. Ventilation must be self-contained to avoid contamination of other premises. This quarantine area will be subjected to negative pressure thanks to the installation of a controlled mechanical ventilation (CMV) with external exhaust, preferably at height. For reasons of energy efficiency, it should be possible to manually adjust the airflow rate of the ventilation system depending on how empty or full the room is and the state of health of the documents stored there.

6.2 – Workshops and miscellaneous premises

Dust removal and packaging workshops

Dust causes mechanical damage through abrasion, chemical damage through acidification and biological damage (moulds live there and find a nutritious substrate). It is therefore essential to have well-equipped areas (centralised* or mobile vacuum systems) to ensure that archive documents are dust-free. Moist substrates (RH>55%) must be dried beforehand. It is therefore necessary to control their humidity level (use of a dehumidifier or storage in a 50-55% RH zone). After drying and dusting, they can be packaged. As dust removal equipment can be noisy, protective equipment (helmets, earplugs) should be provided for operatives.
To avoid the risks of fatigue due to repetitive actions and the weight of vacuum cleaner arms, it is advisable to design this space with this in mind, while also taking into account the health risks associated with the presence of dust and mould. Mobile air filtration/decontamination equipment

*Centralised vacuum systems consist of a suction motor located in a technical room, from which a network of flexible tubes extends to the distributed appliances concerned.

can be installed permanently. They can be activated during dust removal operations.
For the reasons given above, the dust removal function should be physically separated from the packaging function by an airtight partition, which ideally should be glazed to let in light and views of the other work areas. The dust collection area can also have a view of the outside to provide good working conditions for staff. As these are premises where valuable documents may be kept, if the premises are on the ground floor and have windows facing the outside, the risk of burglary should be minimised by installing burglar-proof glazing, for example. To protect documents from the effects of light and heat, the glazing will be fitted with anti-IR and anti-UV filters and, if necessary, external blinds or sunshades.

Restoration, microfilming and digitisation workshops

The size and activities of the restoration, microfilming and digitization workshops (light, urgent work or extensive, specialised work) will be determined according to the size of the collections, their fragility and the presence of large formats, which should be moved outside the building as little as possible or ideally not at all.
The existence of photographic laboratories can be justified by the presence of major photographic collections and a well-developed cultural activities policy.
The resistance of the floors must be assessed in relation to the equipment used in these various workshops. For example, for bookbinding/restoration workshops, a resistance of 1,000 kg/m^2 is recommended. Similarly, specific technical requirements must be met in relation to specific risks (fire, flooding, presence of chemicals, etc.).
Archive buildings generally have a maintenance and DIY workshop. Depending on the department's activity, a specific workshop for preparing exhibitions can also be provided, as well as storage space for display cases and exhibition panels.

Packaging storage room

A room for storing the packaging required for sorting and processing is essential for the smooth running of the service and should be included in the programme.

Storage room for emergency equipment

Depending on the size of the department, a storage area for emergency equipment may be included in the programme. This equipment can also be loaned to neighbouring authorities if required.

6.3 – Sorting and processing room

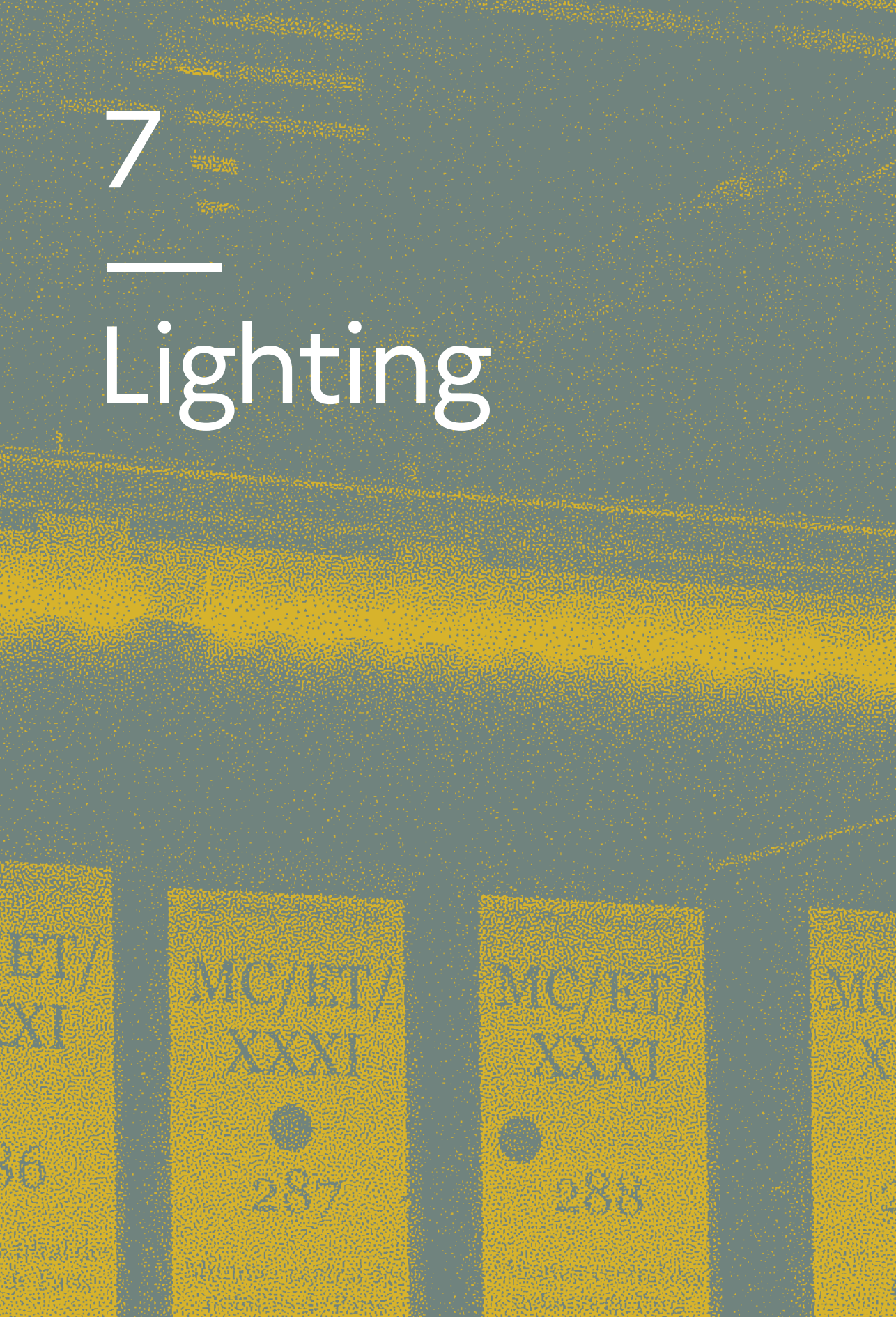
Depending on the size of the building, there may be:
- A sorting room located close to the arrival of documents, before they are put away in the storerooms;
- One or more handling rooms close to both storerooms and offices.
- It is also possible to integrate offices separated by glass partitions, if the operation of the department lends itself to this.

The climatic conditions in the sorting room must be adapted to the conservation of the documents, with temperature and humidity control. French windows must be fitted with anti-IR, anti-UV filtering glass and, if necessary, external blinds or sunshades.

6.4 – Staff accommodation

This is useful for safety and security reasons. Although telephone alarm transmission systems can be effective in some cases, human presence offers greater guarantees, as it enables very rapid decisions to be taken in the event of a disaster or intrusion.
Staff accommodation should be provided for the manager and the caretaker, as well as, if possible, for his replacement.
Depending on the size of the department or its geographical location, a studio for a researcher, trainee or other visitor is an interesting option to consider.

7 — Lighting



7.1 – In repositories

Artificial lighting in storerooms is also a source of deterioration for documents if it is intense, permanent and not fitted with anti-UV filters.
Illumination of the order of 200 lux at floor level at all points in the storeroom, and positioned according to the mobile shelving, is sufficient since staff do not remain there for any length of time.
In storerooms without portholes in the doors, an indicator light control system is recommended to prevent the lighting from being left on when staff are not present. However, this system must be backed up by a manual control to deactivate it if necessary. Fluorescent lamps with reflectors and UV filters are usually used. Halogen lamps produce UV and heat and can cause fires.
The use of LED lights and presence detectors in storerooms and/or in the passageways serving them helps to reduce energy consumption, and is currently being developed.

The position of the luminaires in the ceiling should be considered in relation to the type of shelving:

In the case of static shelving, the luminaires should be positioned on the ceiling above the secondary aisles, parallel to the shelving.
In the case of mobile shelving, overhead luminaires must be positioned at right angles to the furniture. One option is to integrate the lighting directly into the top section of the shelving ("on-board" lighting). This option needs to be taken into account early on in the design phase, because of its impact on the electrical lot or contract component. In addition to the general switches for each storeroom, a general circuit breaker can be used to switch off the lighting in all the storerooms when the service is closed. However, care must be taken to ensure that the climate control equipment continues to operate and that the emergency permanent lighting units, which comply with safety standards, are supplied to indicate the emergency exits.

In new buildings, the system is automated by the Building Management System (BMS), also known as Centralised Technical Management (CTM).

7.2 – In work premises and premises open to the public

In reading rooms, sorting and processing rooms and workshops, the lighting level must not exceed 400 lux. Fluorescent lamps fitted with diffusers and, if necessary, UV filters or incandescent lamps fitted with UV filters or light-emitting diodes (LEDs) are used, particularly for display cases.
In terms of natural lighting, particular care should be taken to avoid the greenhouse effect in highly glazed areas, especially in archive reading, sorting and processing rooms. Solar protection and openings to allow natural ventilation and cooling of the premises must be provided.
For exhibition rooms, see the specific paragraph on page 19

8

Floor and wall coverings

In all areas where collections are housed, floors, walls and ceilings must be treated in such a way as not to generate dust (in the case of untreated concrete) or volatile organic compound emissions over time. Consequently, wood and chipboard must be avoided and the nature of the components of plastic coverings, glues and paints must be checked.
A period of drying and evaporation of the VOCs must be allowed for after the coverings have been painted, including in exhibition areas.
The floors must be able to withstand the repeated passage of loaded trolleys and will be protected by a coating (industrial-type floor resin, epoxy) or by a dustproof slab finish (quartz concrete). If a hard floor covering is used, it should have the following characteristics: U4P3E1C0.
It is also essential to comply scrupulously with the manufacturers' installation instructions. Otherwise the risk of defects (cracks, blisters, etc.) is high and concerns large surfaces.
If mobile shelving is to be installed in an existing building, it is advisable to embed the rails in a metal floor, the plenum of which will remain accessible by opening a hatch. Laying an inset floor avoids the need to pour a concrete screed in an existing building, with all the disadvantages that this can bring (damp, overloading).

9 — Safety

As a safety measure, mobile phones and fire frequencies must be accessible in the storerooms. If the structure of the building makes it difficult to use a mobile phone, the installation of a radio system with walkie-talkie can be considered for internal communication and can be combined with a lone worker safety device.

9.1 – Fire protection and fire-fighting

Regulations governing archive buildings

Generally speaking, the limit of 200 m^2 on archive storage space laid down in the *Basic Rules for the Construction and fitting out of an Archive Building* is due both to compliance with regulations and to functional and technical uses. The principle of enclosing limited surface areas with two-hour firebreaks ensures a high level of safety for these heritage conservation premises. In theory, archive buildings are subject to the most stringent regulations, namely those applicable to establishments open to the public (ERP Etablissement recevant du public in the French abbreviation).

Conservation storerooms are subject to two sets of regulations, depending on whether or not the building in which they are located is open to the public:

- If the storerooms are located in a building open to the public for archive consultation, they are subject to ERP type S regulations, in accordance with the Order of 12 June 1995 supplementing the Order of 25 June 1980 as amended (fire safety in ERP).
- If the storerooms are located in a dedicated building, as in the case of conservation annexes, they are subject to the Labour Code.

Depending on the applicable regulations, storerooms may or may not be subject to obligatory smoke-extraction.

Storerooms subject to ERP regulations
In the first case, the fire safety regulations for ERP (article DF7) recommend smoke extraction in premises accessible to the public with a surface area of more than 100 m^2 and no opening to the outside (door or window). Smoke extraction can be by natural draft or mechanical draft.
This obligation is specified in the special provisions applicable to type S establishments. These provisions state (article S8) that archive premises are high-risk premises that are not accessible to the public (article CO27, sheet 3.08) **and may be cleared of smoke** after consulting the safety commission if their volume exceeds 1,000 m^3 (article S9 §3). The wording tends to suggest that the special-risk premises referred to in Article S8 do not have to be cleared of smoke if their volume is less than 1,000 m^3.
In conclusion, smoke extraction in windowless premises of more than 100 m^2 is left to the discretion of the departmental fire and rescue services

(**Service départemental d'incendie et de secours,** in the French abbreviation **SDIS**).

Storerooms subject to the Labour Code

In the second case, storerooms are subject to the French Labour Code (article R4216-13), which stipulates that **windowless premises over 100 m²** must be equipped **with** a natural or mechanical **smoke extraction system**. No mitigation measures are possible.

High-rise buildings must also comply with current regulations specific to this type of establishment, which impose more stringent requirements, particularly for fire extinguishing (in this case, an automatic extinguishing system must be installed). Similarly, when the total combustible mass exceeds 500 tonnes and the overall volume of the conservation areas exceeds 5,000 m³, the regulations governing Installations Classified as being for Environmental Protection ("ICPE") apply. A declaration of operation must be submitted to the Prefect before they are brought into service, and the provisions of the amended Order of 11 April 2017 on covered storerooms subject to heading 1510 are applicable*.

*Ministry of Culture, Factsheets and guides on fire safety, administrative sheet No. 4: administrative fire safety procedures in ERPs, 2022 : https://www.culture.gouv.fr/Thematiques/Securite-Surete/Securite-et-surete-des-biens/Fiches-et-guides-securite-incendie

Firebreak systems

The essential precaution is to isolate the storerooms from the work premises and premises accessible to the public by two-hour fire-resistant walls and floors, and by one-hour fire-resistant doors.

Where adjacent storerooms communicate with each other via a door, it is recommended that these doors have the same firebreak rating as the walls, namely two hours.

Although not required by regulations, doors and flaps should have the same fire rating as the walls, namely two hours.

For archive departments receiving fewer than 100 people, which are therefore medium-risk premises under current legislation, the walls must have a minimum one-hour and the doors must have a half-hour firebreak rating. However, it is strongly recommended not to differentiate between the storerooms of the different archive departments and to systematically provide two-hour fire-resistant walls and one-hour fire-resistant doors. In all cases, lifts and staircases must be enclosed in accordance with standards.

Fire detection system

An automatic fire detection system for each cell is essential, as it is the first level of protection. Given the nature of archival fires (dry fires with smoke development), the best detection system is a mixed heat and smoke system; however, smoke-only systems are also suitable. The activation of a visual and audible restricted alarm in the central equipment must trigger the control systems (automatic closing of doors and fire dampers, opening of smoke extraction vents, etc.).

Safety doors are fitted at all emergency exits. They must open from the inside by simply pushing.

Automatic fire extinguishing systems

As a general rule, automatic extinction is not implemented in archive services. The main reason for this is the small size of the storerooms and their isolation from each other, due to the existing firebreak systems: an efficient fire detection system combined with the manual use of fire extinguishers is in principle sufficient. The cost and maintenance requirements of an automatic extinguishing system are also a barrier.
Archives de France does not recommend automatic sprinkler systems because of the risks to documents from water if they are accidentally triggered. It is, however, possible to use "pre-action" systems filled with air, with the water only circulating in the event of manual operation and/or the triggering of several alarms. In any case, automatic extinguishing can only be used if the documents are packaged in waterproof boxes. An automatic extinguishing system using inert gas (such as Inergen or Argonite®) is also possible, but may only be used for a few specific premises (audiovisual storerooms, storage of valuable documents or computer rooms) due to its cost and the space required to store the gas. It is important to check that the gases used are not harmful to collections, people or the environment. Its use is recommended, for example, if it is felt that the response time of the fire and rescue services is likely to be long (for example, in departments that may be affected by forest fires, where saving the population is the priority). However, automatic extinguishing is compulsory in high-rise buildings. A water-mist extinguishing system has been installed at the National Archives in Pierrefitte-sur-Seine and the Val-de-Marne Departmental Archives in Créteil. Portable fire extinguishers must complement the detection systems. The presence of a network of fire hydrants should be studied with the departmental fire and rescue services, as provided for in the safety regulations. **Only water spray extinguishers without additives may be used on the collections.**
Right from the design stage of the project, collaboration is essential with the departmental fire and rescue services (“SDIS”) **- forecasting and prevention services - in every respect. This coordination must be maintained regularly throughout the building's operation.** Fire detection and fire-fighting equipment (hydrants, extinguishers) throughout the building must comply with current standards.

9.2 – Protection against water damage

Whether its origin is internal (burst pipes, seepage through openings, leaks) or external (flooding, poor maintenance of roofs and drains), water poses a major risk to the conservation of documents. Rainwater drainpipes should, if possible, be located outside the building or at least pass through ducts located outside the storerooms.
In addition to the usual precautions already mentioned, no pipes should be allowed in the storerooms, regardless of their location, and whether they

are rainwater, condensate from air handling units if air treatment has been installed, drainage of water from dehumidifiers, waste water, or even water supply pipes.
Flat roofs over storerooms are prohibited, to limit the risk of seepage.
Furthermore, if the building is air-conditioned, it is advisable to locate the air handling unit on the ground floor or in the basement, rather than high up. Its ease of access, and indeed its visibility, provide better guarantees for checking maintenance operations. If it is installed on the roof, it should be protected from the elements to prolong its life and avoid more frequent breakdowns. It is therefore necessary to provide retention and evacuation tanks in the event of flooding due to a malfunction in the installation.
In storerooms, shelves must also be placed 15 cm above the floor (a height that also protects the collections when the floors are being maintained) or at a height that corresponds to the flood risk analysis.
Finally, it is recommended that water detectors be installed in sensitive areas and connected to the security station or BMS.

In addition to the usual precautions already mentioned, it is advisable not to accept any pipes in storerooms, wherever they are located.

9.3 – Cultural heritage emergency preparedness and response

The construction of a new archive building or the extension/restructuring of an old building must be accompanied by the drawing up of a Cultural heritage emergency preparedness and response (Plan de sauvegarde des biens culturels, PSBC in the French abbreviation). This is a truly operational document for emergency situations.

The PSBC has three complementary components:

- the one that describes the preventive measures, which are part of a long-term approach, independently of a disaster;
- the one describing operational forecasting measures. This is the purpose of the PSBC, an emergency and crisis management plan;
- the one describing the measures for returning to normal.

The operational part of the PSBC, which describes the actions to be taken in the event of a disaster, must include, as a minimum, as recalled in note MINCULT/DGPAT of 10 June 2016*:

- access plans for the building and plans for each level, indicating

*https://francearchives.gouv.fr/file/312b-600826d7ebeb749dd1ad02f83368670880ae/1-Plan%20de%20sauvegarde_noteDGP_2016.pdf

sensitive areas (water, gas, hazardous products, etc.), emergency staircases, lift shafts, fire doors, the location of assets to be evacuated as a priority or protected *in situ*, servers and software to be backed up, emergency equipment, and areas for the withdrawal and handling of damaged assets;
- a list of people, departments and service providers to contact,
- the list of staff volunteering outside working hours and the list of external contributors;
- instructions and intervention sheets;
- the list of priority documents and their type, as well as their location on storeroom plans.

Access to the building must be facilitated by the daily management of keys that can be easily used in the event of a disaster or power cut, and by the rapid opening of external gates by external emergency services (fire brigade, gendarmerie, police, ambulance, etc.), whatever the time of day.

It is vital that this plan be prepared in close consultation with the fire brigade and be constantly updated. Regular drills should be organised to test the plan and for the teams to acquire a certain number of reflexes that will be useful in organising the response in the event of a disaster.

9.4 – Generator

Compulsory for high-rise buildings.
For other buildings, the usefulness of a generator should be examined from these two angles:
- emergency plans: in the event of a disaster, this equipment can be used to compensate for breakdowns: it can be used for lighting, draining water, dehumidifying, drying, etc.
- protection of security equipment (intrusion detection, video-protection, access control) and digital files: archive departments should contact the IT departments and comply with the measures they follow in terms of information systems security and the use of generators. In any case, the server room must be protected by a UPS.

The generator must be located in a safe area (outside the flood zone) that is easily accessible.

10

Security

The principle of security consists of putting in place a coherent and comprehensive system that takes into account all the security measures and systems, present or future (organisation, human resources, training and awareness-raising, technical and electronic resources), and that makes it possible to guarantee a satisfactory level of security for archives. To ensure protection against theft and burglary, please refer to the book published by the Ministry of Culture, General Directorate of Heritage, Archives de France, *La sûreté du patrimoine archivistique* (The security of archival heritage), by Yann Brun, available on the France Archives website*. The recommendations for rapidly developing preventive actions against malicious acts and for strengthening and raising the level of security in an archive service are summarised below..

*https://francearchives.gouv.fr/file/1742309db927b74dd57fdafea670fa9f1c568842/MCC-Vademecum2018-v4.pdf

10.1 – The building and its security

It is important to ensure that all security rules are respected:

- Mechanical protection, to dissuade, prevent or delay any attempt to enter or penetrate a guarded area;
- Intruder detection and video-protection, for rapid analysis of the attack, discreet and immediate transmission of the alert, effective dissemination by sound and light alarms;
- Safe and rapid intervention by security personnel and services.

In addition, presence-detecting night lighting should be installed at the entrances to the building in areas that are not easily visible, to act as a deterrent in the event of an intrusion attempt and to provide everyday practicality for building users.

Mechanical protection

The physical or mechanical protection of the site and buildings consists of a set of physical obstacles, generally passive, from the edges of the site to the perimeter of the building (fences, barriers, mesh, walls, palisades, retractable bollards, hedges, ditches, etc.).
All openings on the ground floor and, more generally, all those that are easily accessible (cellars, mezzanine floors) must be fitted with grilles, shutters, bars, burglar-resistant glass, etc.
Doors will be locked from the inside with high-security locks (non-copyable and non-pickable).

Intrusion detection and video protection

The installation of an intruder alarm system must take into account the specific features of archive services by combining volumetric detection (movement in the building), opening or glass breakage detection and specific point detection (on objects, heritage documents and object supports

such as display cases), and possibly, perimetric or peripheral detection around buildings.
However, intruder detection is only really effective if the building is permanently guarded and possibly connected to the national police network or a telematic link with a company specialising in remote surveillance.
Video protection acts as a deterrent, a surveillance aid and evidence in the event of malicious acts. To install such a system, the images must be capable of recognising a person or object and the recordings must cover at least 15 days. They must be sent either to viewing stations during the day (reception desk, room chair, manager), to a security station (on site or to a remote surveillance provider), or to a dedicated station or smartphone with people on call (particularly at night).
In particular, the cameras must be able to view the reading rooms, access points to sensitive or prohibited areas, the area around the building and exhibition areas.
It is important to carry out regular tests on electronic equipment and to take out a maintenance contract (preventive, curative and corrective maintenance in the event of breakdown or malfunction).

Safe and rapid intervention

It is advisable to have two living quarters (one for the head of the establishment, who is responsible for the collections and the safety measures to be taken, and the other for the caretaker), which will enable rapid intervention and the immediate alerting of the relevant services (police, gendarmerie, fire brigade, etc.) once any doubts have been cleared up.
If the importance of the service justifies it, day and night security should be provided in a room where the automatic control panels (intrusion, air treatment, fire, flood) are grouped together.

10.2 – Interior spaces and their protection

The aim is to control the flow of people, materials (e.g. exhibition materials) and documents (see Chapter 3, "Types of spaces and circulation areas"), to keep interior spaces secure and to reduce the number of access doors to "sensitive" or reserved spaces (storerooms, security control rooms, conservation rooms, destruction areas, sorting rooms and workshops, temporary exhibitions, work rooms not open to the public and IT rooms).
All doors must be kept locked or under access control, preferably automatic (with badge, tag, smartphone, electronic key or cylinder, etc.), in compliance with an access hierarchy, a key organisation chart and fire regulations, during the day or at night, and when no members of the public or operators are present. The presence of one or more secure electronic key management cabinets makes it easier to track and trace key movements, while guaranteeing that keys are used securely.
Uniform mechanical protection for openings into sensitive areas must be

systematically sought, with a match between the level of risk defined and the burglary resistance of all protection (three to five attachment points, burglary resistance of five to fifteen minutes).
For the most sensitive premises, mechanical protection can be supplemented by appropriate electronic equipment (detection, video protection, automatic access control, anti-intrusion system using fogging or chemical markers, biometrics, etc.).

10.3 – Protection of archive documents

Theft, damage or deterioration of archive documents in reading rooms is a risk for both archives and libraries. The role of staff is essential here: clear view of readers' tables, compulsory deposit of coats, bags and towels in the cloakroom, checking of readers' files and personal belongings as they leave the room, etc.
Surveillance mirrors, surveillance cameras and a special room for monitoring and recording equipment are recommended for reading rooms and other premises open to the public. The collections on display in the exhibition rooms will also require particular care and security.
It is also advisable to have one or two secure cabinets or a vault for the most valuable items, as well as for receiving works on loan for temporary exhibitions before they are installed in the secure display cases.
Absolutely prohibiting public access to storerooms and workplaces where documents are kept is a fundamental precaution. Access by external agents and/or employees of maintenance companies may only take place in the presence of a member of staff from the archive department, which means that the department's management must be informed of any work carried out on its premises (maintenance, repairs, etc.). In addition, a register must be kept of the entries and exits of people from outside the department, particularly when the public is not present or when the department is not in operation.
Given the nature of thefts from archives (generally involving isolated documents, sometimes just a single sheet), permanent human surveillance is essential from the room chair and by walking around in the reading room. Electronic detection using tags attached to documents is difficult to implement, except for volumes, registers or objects of considerable size, as well as library works. This is why it is essential for an

Absolutely prohibiting public access to storerooms and workplaces where documents are kept is a fundamental precaution.

archive service open to the public to have at least one or two commissioned and sworn officials, who are thus empowered to record certain offences committed against documents held by their service*.

For exhibitions or loans, enhanced protection measures are required (close detection of works with local audible alarms, video protection, secure hanging, base fixing, GPS beaconing and human surveillance during transport, etc.).

*On this point, reference is made to article L114-4 of the French Heritage Code and the dedicated page on France Archives: https://francearchives.gouv.fr/fr/article/232632760

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