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**DAMAGED
BOOKS**

Damaged books

Introduction

This booklet describes the most common types of damage to books. It will help you to identify different types of damage, recognise the causes of the damage, and understand what remedial work might be undertaken and by whom. It is not exhaustive and if there is any doubt about what action to take, you should consult an accredited conservator¹.

Books are made from a wide variety of different materials such as paper, leather, wood, and cloth. Book structures range from simple single-section pamphlets to complex multi-section codices. Identification of historic and contemporary materials and structures is not straightforward. Conservation methods and materials change and are under constant review. There are different remedial practices and conservation treatments available, so it is important that the right option is chosen and that the work is undertaken by appropriately trained staff or practitioners. The chosen option will also be influenced by the value, rarity, significance, fragility and use of the book.

The diagram overleaf shows the principal parts of a book. For definitions of terms used in this booklet please refer to the online glossary, *Bookbinding and the conservation of books* by Matt T. Roberts and Don Etherington².

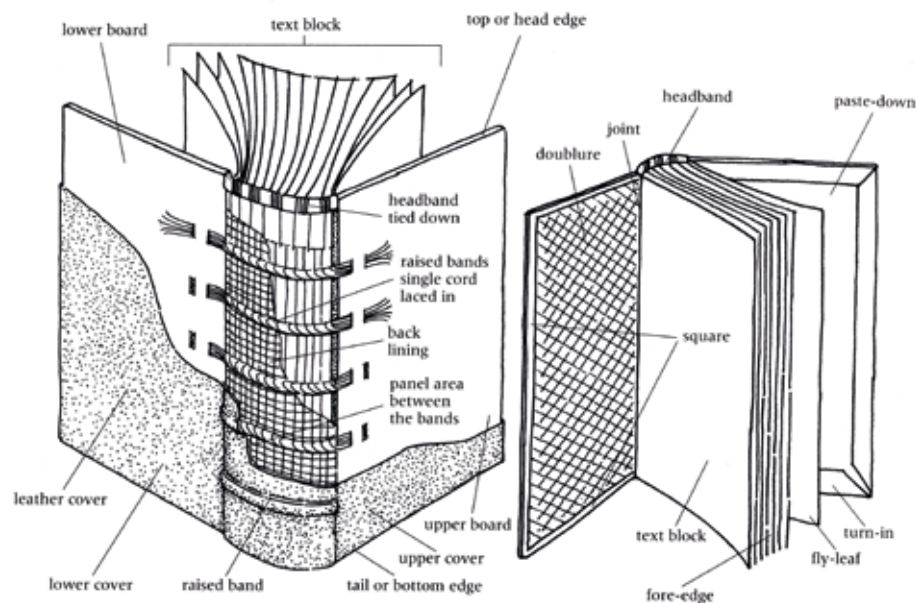
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¹ A conservator accredited by Icon, the Institute of Conservation or the Archives and Records Association. Refer to the online resources listed at the end of this booklet.

² Refer to the online resources listed at the end of this booklet.



Causes of damage

A book's condition is determined by internal factors, namely its constituent materials and structure, and external factors such as storage conditions and handling.

Internal factors

Internal factors will determine how well a book ages and how resilient it is to adverse external conditions such as substandard environmental conditions and poor handling. There are three common types of internal weakness:

- During the first half of the nineteenth century paper-making methods in Europe began to change. As the demand for paper increased handmade rag-pulp paper was superseded by machine-made wood-pulp paper. Whilst rag-pulp paper is very stable, machine-made wood-pulp paper is not: it deteriorates far more rapidly, especially in poor environmental conditions.
- Since the codex book form became predominant in Western Europe many books have been made with boards larger than the text block. When these books are stored vertically, gravity gradually pulls the unsupported fore-edges down and causes the text blocks to twist within the boards.

Eventually, either the text block will fall forward out of its binding³ or the joints between the spine and boards will split and the boards will become detached⁴. The weaker the structure, the quicker the text block will drop; older books may be fine whilst weaker, newer ones may not. This is a significant problem for heavy or thick books but most books will be affected over time.

- Hollow spines became prevalent in Western Europe during the nineteenth century and all books originally bound in bookcloth have them⁵. It is never good practice to remove any book from a shelf by the top of the spine or joints, but hollow-spined books are particularly susceptible to damage, as the covering material is not adhered to the text block and is likely to tear.

External factors

A range of external factors may damage books if not properly managed. The main ones are:

- Environment (relative humidity, temperature, pollutants, pests, mould, dust)
- Handling (removal from shelves, support during use etc.)
- Storage (shelving, arrangement on shelves).

It is important to determine the underlying cause of the damage in order to prevent more damage occurring in the future, e.g. mould may be the direct cause of damage to a book, but mould occurs because the storage environment is poor. The poor storage environment may be caused by building defects, equipment failure, poor air circulation etc. Brushing mould off a book without attending to the poor storage environment will only lead to more mould, and more time and effort will need to be spent cleaning. The following tables indicate the types of damage associated with a poor environment, poor handling and incorrect storage.

³ In a case binding, where the book cover (boards and spine) does not form an integral part of the book structure.

⁴ In books with the boards laced onto the text block.

⁵ In hollow back bindings there is a paper or card tube between the spine and the covering material. This allows the covering material to move away from the spine on opening. The spine cover retains its shape and the leaves can open more fully.

Environment

Factor	Level	Damage
Relative humidity (RH)	High (above 65%)	Mould growth and insect infestations. Rusting staples, pins and clips. Corrosion of iron gall inks ⁶ . Increased evidence of foxing ⁷ . Failure of adhesives, causing covering materials to lift.
	Low (below 40%)	Reduced flexibility, particularly of parchment, vellum and leather. If combined with high temperatures, embrittlement of binding materials, structures and leaves.
	Fluctuating	Distortion of bindings and text blocks, especially if books of different sizes are shelved together.
Temperature	High	If combined with low RH levels, drying, curling and distortion of paper. If combined with a high RH, accelerated mould growth.
	Low	Generally fewer problems unless close to freezing, when fats in leather congeal and reduce flexibility. Combined with moderate or low RH provides good storage conditions for many materials.
Light	All	All light, whether natural or artificial, causes damage and its effects are cumulative. Ultraviolet radiation causes bleaching, discolouration and the breakdown of organic materials e.g. flaking of leather, weakening of bookcloth, embrittlement and yellowing of paper. It is impossible to judge light levels accurately by eye and even on dull days light levels are often high.
Air movement	High	Abrasion and excessive movement of dirt around the building.
	Low	Increased risk of mould and insect outbreaks due to the formation of microclimates.
Pollutants	All	The major pollutants are ozone, dust and the oxides of sulphur and nitrogen. Gaseous pollutants weaken all organic materials.

⁶ Iron gall ink was the most common type of ink in Europe from the 11th century to the early 20th century.

⁷ It is thought that foxing is caused by metal impurities in paper and microbiological activity.

PAS 198:2012 Specification for managing environmental conditions for cultural collections gives further, detailed information about the vulnerability of different materials to a range of environmental factors.

Handling

Type of Handling	Damage
Removing books from the shelf by hooking the top or edges of the spine with fingers.	Splitting and eventual loss of spine covering material and endbands, especially in hollow back books.
Replacing books on shelves without ensuring that there is enough room and/or hitting shelf in the process.	Book corners will be damaged. Sometimes leads to text block damage, and damage to the bindings of adjacent books.
Opening books wider than the binding structure will allow or without supports. ⁸	Splitting of sewing thread or glues along spine and compression of covering materials, leading to complete breakdown of the structure.
Piling books up haphazardly or too high, on a shelf or when carrying.	Damage to bindings and increased risk of books falling, leading to detached covers and broken sewing.
Using ink pens, biros, fountain pens, felt tips etc instead of pencils.	Indelible or tenacious marks.
Inserting slips of paper to mark leaves but not removing them after use.	Chemical damage to leaves unless slips are acid-free and lignin-free. Dirt ingress causing staining and increased risk of mould/insects. Distortion of book structure.
Using Post-it notes to mark leaves.	Stains and sticky residues causing long-term damage, especially to leaves.

Prevention is the key to keeping damage to a minimum. Managing the environment and providing guidance to staff and users on good handling are essential. Guidelines should be clearly displayed and users should be encouraged to care for the material they are consulting. Good handling by both staff and users prevents a significant amount of damage.⁹ Shelving and the arrangement of material on it should be inspected on a regular basis. This simple exercise is commonly neglected. Staff should be trained to recognise problems, and these problems should be rectified quickly.

⁸ 120° is the maximum opening angle for most books. Only a few bindings can be opened to 180° without being damaged. Books with tight bindings should be limited to an opening angle of 90°.

⁹ Refer to the Preservation Guidance Series booklet *Handling library and archive collections* and the British Library videos *Using collection items*. Refer to the online resources listed at the end of this booklet.

Storage

Issue	Damage
Books leaning over.	Permanent distortion and eventually detached boards.
Shelf too full of books.	Distortion. Broken spines and joints when books are retrieved.
Shelf not full enough.	Distortion. Risk of material falling off shelves.
Books of disparate height or depth shelved next to one another.	Distortion of bindings and text blocks, cracked joints.
Books stored in piles that are too high or not graded up from largest item at bottom to smallest on top.	Distortion. Risk of material falling when books are retrieved.
Books stored fore-edge down.	Distortion. Severe structural damage.
Tall books (generally 45cm or more) stored upright.	Distortion. Excessive strain on bindings.
Books stored on shelving that is not deep enough.	Distortion. On mobile shelving there is a risk of protruding books hitting material on the opposite shelf.
Recess at ends of shelves.	Lost (hidden) books. Risk of mould growth in microclimate.
Lip on shelf or above it.	Risk of damage when books are retrieved, especially to tall books.
Protruding screws and shelf supports.	Scratched and/or indented binding.
Shelving without full-depth backs or full-height sides.	Distortion. Risk of books falling off shelf.
Rough or split shelves.	Abrasion.
Overlong shelf span.	Bowing shelf. Distortion. Risk of damage when material retrieved.

Selecting books for remedial work

Selecting what should be done to which books and when will depend on a number of criteria. There is a difference between a rare book in a special collection and a modern edition in a circulating library. The use of a book and its projected lifespan should be considered before selecting for remedial work.

Retention

Decide how long a book is to be retained. If available, refer to your collection development policy or retention schedule. Circulating books may be scheduled for disposal after a period of time or may become available in other (preferred) formats.

Use

If a book is regularly consulted, any damage is likely to be aggravated and it will become more expensive to deal with, so swift intervention is important. The decision to declare a book unfit for use is not straightforward. Often books are retained until they are literally falling to pieces. Too little time and funding to attend to the minor problems means that the minor problems soon become major problems. The use of automated self-service return systems such as book drops may lead to the swift deterioration of books. Each institution should have a clear policy defining when a book should be withdrawn from use. Books in circulating collections are particularly at risk because they are often used outside invigilated reading rooms/research rooms, therefore they should be inspected for signs of damage upon return. In simple terms, the sooner remedial work is carried out the lower the cost, the sooner the book will be available for use and the longer the book will remain in usable condition.

Stability

Some books may be susceptible to damage because of the materials from which they are made, because of weak structures or because of prior damage. Books covered in vulnerable materials such as textiles, should only be treated by a conservator. Deckle-edged¹⁰ or badly-trimmed pages collect dirt more easily than guillotined or ploughed edges¹¹ and are difficult and time consuming to clean without abrasion. Books that have previously been damaged by mould are more likely to be attacked again at RH levels lower than 65%. The function of any remedial work, whether carried out by a conservator or trained staff, is to stabilise material, allowing it to be safely handled. Often, there is no need to do more than this. If part of the covering material is missing, a book may be perfectly stable and

¹⁰ Deckle edges are the rough or feathered edges of untrimmed paper.

¹¹ Before the introduction of the guillotine in the middle of the 19th century the leaves of books were trimmed with a device called a plough.

may only require a protective enclosure to enable it to remain in use, rather than the replacement of the missing material. A book with detached boards may be reasonably stable and can be used with care, without much further harm. If the boards are correctly tied with tapes and the book is housed in a suitable enclosure, it should be usable for a long period of time. However, a book in excellent condition but with a detaching spine is at great risk of further damage through handling and may therefore be less stable than the book with more obvious damage.

Rarity, value, significance

Any early, valuable or rare books should only be treated by a conservator. In certain cases it may be better to leave damage unrepaired because it reveals information about the book's production, which may be of greater value than the text, e.g. manuscript spine linings and early printed waste. Such books should be protected in enclosures that are labelled with handling instructions. Enclosures will often need to be tailor-made to provide adequate protection and may incorporate special features such as storage portfolios for detached/replaced boards and/or pressure flaps¹².

Identifying and dealing with damage

No matter how good the preventive measures, there will always be material that requires some form of remedial work. The value, rarity, fragility, significance and use of the book should always be considered before taking action. The table below lists the most common types of damage and provides guidance on what action to take. Almost all remedial work should only be undertaken by or after training by a conservator. Even the most basic procedures, such as tying books up with tapes, will cause further damage if done incorrectly. If there is any doubt about what action to take, you should consult an accredited conservator.

The action taken will depend on budgetary constraints as well as the rarity, value, significance, stability and use of a book. If funds are limited, it may be better to spend it on staff training, equipment and materials, to enable a large number of books to be stabilised, rather than using up scarce resources conserving one book. Protecting material in need of further conservation through the use of protective enclosures may well be a part of this process until funds for interventive conservation work can be secured.

¹² Some books, especially those with parchment leaves will gape, often because they have lost their original fastenings. If a clasp or tie is not replaced the pressure flap will maintain the shape of the book.

Type of damage

Type of damage	Cause	Action
Surface dirt	Poor environment and/or housekeeping	If material is robust, cleaning can be undertaken under the supervision of, or after training by, a conservator. Fragile, e.g. torn material should be cleaned by a conservator. Refer to the Preservation Guidance Series booklet <i>Cleaning books and documents</i> , bl.uk/conservation/guides .
Ingrained stains	Poor environment and/or handling	If stains are causing deterioration of the binding or textblock, treatment may be possible by a conservator.
Discolouration	Inherent weaknesses in material, often exacerbated by poor environment	Treatment may be possible by a conservator if material is so weak that it is breaking down when handled.
Mould	Poor environment and/or housekeeping	Dry, inactive mould can be removed from external surfaces following training by a conservator and with suitable protective measures in place. Active mould, or where leaves are soft, weakened or sticking together, should be treated by a conservator. Refer to the Preservation Guidance Series booklets <i>Mould in library and archive collections</i> and <i>Cleaning books and documents</i> , bl.uk/conservation/guides .
Insect ¹³	Poor environment and/or housekeeping	Future insect damage can be prevented by controlling the environment and introducing an Integrated Pest Management (IPM) programme. Refer to the Preservation Guidance Series booklets, <i>Mould in library and archive collections</i> , <i>Cleaning books and documents</i> and <i>Managing pests in paper-based collections</i> , bl.uk/conservation/guides . Expert advice may be required for pest identification and treatment. Treatment of damage caused by pests should be carried out by a conservator.

¹³ Insect damage usually has a sharply-defined edge with curves, which makes it distinguishable from scuffing and mechanical damage.

Type of damage	Cause	Action
Distortion	Fluctuating environmental conditions; poor positioning of material on shelves	Steps to modify the environment or improve storage accommodation can be put in place in line with published guidance ¹⁴ . Refer to the Preservation Guidance Series booklets <i>Managing the library and archive environment</i> and <i>Library and archive storage furniture</i> , bl.uk/conservation/guides . Treatment to re-shape books should be carried out by a conservator.
Detached individual leaves, in sewn bindings	Poor handling	In some cases leaves may be pasted in after training by a conservator. If damage is extensive, the materials are vulnerable or the item is valuable, treatment should be referred to a conservator.
Detached individual leaves in perfect bindings ¹⁵	Poor book construction, handling, environment	Treatment should be carried out by a conservator.
Detached gatherings/ sections	Poor handling	The book may be housed in a protective enclosure as an interim measure or if use is very low. If there is any risk of text loss then resewing is necessary and this should be carried out by a conservator.
Torn leaves (paper)	Poor handling	For some material, if tears are not encroaching into text or images and are up to 2cm in length, and the paper is not discoloured, repairs can be carried out following training by a conservator. Significant tears, damage to discoloured or weak paper and repairs to folding or illustrated plates should be treated by a conservator.
Torn leaves (parchment or vellum)	Poor handling and/or environment	Treatment should be carried out by a conservator.

Type of damage	Cause	Action
Brittle leaves, often turning yellow or brown	Low-quality materials and sometimes poor environment	Treatment should be carried out by a conservator.
Missing areas of text block	Poor handling or part of production process	Treatment should be carried out by a conservator.
Torn dust jacket	Poor handling	Minor tears can be repaired following training by a conservator. Major tears, missing areas or brittle paper should be referred for treatment by a conservator.
Torn and lifting covering materials, endbands and labels (not parchment or vellum)	Poor handling, environment and/or storage	Covering materials may be pasted back into position following training. Complex repairs should be referred to a conservator. Major tears should be referred to a conservator. Complex repairs and those to parchment/vellum should be referred to a conservator.
Missing covering materials e.g. spine	Poor handling or environment	Book can be placed in a suitable protective enclosure. Any repairs or reinstatement of missing elements should be carried out by a conservator.
Loose or splitting joints and/or text block dragging on shelf	Poor handling and/or structure	Book can be placed in a suitable protective enclosure. A conservator can assist with making bespoke enclosures (which may be necessary with this form of damage, dependent on the style of enclosure used, e.g. book shoes). Treatment should be carried out by a conservator.
Detached boards	Poor handling or storage	Boards may be tied with cotton tape to keep material together (see section on protective enclosures and supports for method) or the book may be placed in a protective enclosure. If boards are to be reattached, this should be carried out by a conservator.

¹⁴ Refer to PD 5454:2012 Guide for the storage and exhibition of archival materials, London: British Standards Institution, 2012.

¹⁵ In a 'perfect binding' the loose leaves of the text block are glued together rather than sewn in sections. Commonly used for binding paperbacks.

Type of damage	Cause	Action
Broken sewing	Poor handling	Tying tapes can be used to keep material together or the book can be placed in a protective enclosure. All interventive repairs (e.g. re-sewing) should be carried out by a conservator.
Rusting staples	Poor environment	Following training by a conservator, staples may be removed from single-section material and the book may be sewn instead. As this involves a structural change undertake this procedure only after consulting curatorial staff. Refer to a conservator if removal from multi-section material or re-sewing/binding is required.
Removal of old repairs e.g. pressure-sensitive tape	Poor understanding of materials and/or structures	Any treatment should be carried out by a conservator.
Dry or flaking leather and/or red rot ¹⁶	Poor environment	Following training by a conservator, the book can be placed in a suitable protective enclosure (e.g. Melinex® wrapper). Treatment such as consolidation should only be carried out by a conservator.
Previously treated leather, either sticky or stained ¹⁷	Over application of dressing, inappropriate application of dressing	Any treatment should be carried out by a conservator.




¹⁶ Commonly found in 19th century leather bindings red rot causes the leather to disintegrate into powder.

¹⁷ The use of leather dressings is not recommended. They can cause dessication and discolouration of the leather and often leave a sticky residue.

Protective enclosures and supports






Sometimes referred to as packaging, there is a range of boxes, wrappers, supports and enclosures which may be used to protect books, either as a complete remedial treatment or as an interim measure to prevent further damage until the material can be treated by a conservator. Many can be made in-house, some can be supplied made-to-measure and others are made in standard sizes. Some books, such as textile and embroidered bindings, have characteristics that require bespoke boxes to be made. Placing material inside a protective enclosure provides a buffer against changes in temperature and relative humidity, and will provide some protection against dust, atmospheric pollutants and light (and some protection in the event of a flood). The most common types of protective enclosures are listed below.

Types of enclosure

Type of enclosure	Format and materials	Use
Phase box 	4-flap box, tailor-made from archival board ¹⁸ of varying thicknesses and with a fastening. Optional internal text block supports ¹⁹ .	To protect vulnerable material, e.g. books in several pieces; those in need of tapes but where the tape would touch the text block; those in need of tapes but with a damaged spine (e.g. flaking leather); material in excellent condition which should remain as such; limp material; books with deckle edges (to prevent dust deposition); to keep several slim items together; to support a book taller or deeper than neighbours.
4-flap wrapper 	4-flap enclosure, ready made from archival board or manilla paper, usually with several creases to allow for different thickness of material	Protection for slim material or loose leaves.
Phase wrapper 	3-flap wrapper, leaving spine of book visible, tailor-made from archival board of varying thicknesses with a tab fastening. Optional internal text block support.	Similar to a phase box but for use in historic interiors where the aspect of a room is important; to support a book taller or deeper than neighbours. If a spine is unstable and cannot be cleaned easily then a phase box should be used

¹⁸ The National Archives provides detailed information about the evaluation of archival board. Refer to the online resources listed at the end of this booklet.


¹⁹ Internal text block supports are usually made from inert polyethylene foam or archival board adhered with an appropriate adhesive.

Type of enclosure	Format and materials	Use
 <p>Fore-edge wrapper</p>	Wrapper covering boards and fore-edge of book, tailor-made from archival board and secured with tapes tied at the fore-edge.	Protects books during removal/ replacement and whilst on shelves. Used for limp bindings, books with clasps, books with textile ties (not to be confused with tapes). Useful in historic interiors but tapes make it unhelpful in most libraries ²⁰ .
 <p>Polyester pocket</p>	Ready made from static (0) or non-static (516) grade polyester (Mylar® or Melinex®) and sealed along 2 or 3 edges.	Protection for single-section or flat material (the former requires non-static polyester).
 <p>Polyester wrapper</p>	Tailor-made from static grade polyester and similar in format to a dust jacket but with a double crease along fore-edge of each board.	Protects books during removal/replacement and whilst on shelves. Also protects user from decaying covering materials. Used for limp bindings ²¹ , possibly for books with textile ties (if left untied) but please check with a textile conservator, books with red rot or deteriorating sprinkled bindings ²² , reversed leather (suede) bindings, especially if next to one another, and for books with dust jackets.
 <p>Tapes</p>	13mm wide cotton tapes, used in pairs. Unbleached, black or brown.	To tie up books with detached stiff board(s); must never touch text block and should be tied with a granny bow at the fore-edge.
 <p>Bookshoe</p>	Similar to a slip-case but without spine or head covered and with a text block support, tailor-made from archival board of varying thicknesses.	To support book with covers larger than text block, especially with splitting or weakened joints or where text block touches shelf; to support tailband on book with detached board(s); books with clasps; to support a book taller or deeper than neighbours; to aid handling when book spines that are wider than the rest of the book interlock when on the shelf.

²⁰ When books are in regular/unsupervised use staff and readers should be trained how to remove and replace material tied with tapes. Alternatively, use another type of enclosure.

²¹ Limp bindings have flexible cloth, leather, vellum or paper covers rather than stiff boards.

²² Sprinkled bindings have a speckled appearance created by ferrous sulphate or other colourants.

Type of enclosure	Format and materials	Use
 <p>New storage for textile / embroidered bindings</p>	Phase box made from archival folding boxboard with fastening, bespoke Plastazote® 'L' shaped text block supports, recto and verso supports and 4-flap Bondina® wrap.	To protect vulnerable material. All supports give 360° cushioning and protection. Wrap enables handling without touching vulnerable textile bindings.

Unlike archive boxes, most of the above are made to fit the book, so that it may remain on the shelf. However, they all take up space on the shelf (on average 3mm per enclosure), which can cause problems. More than one of the protective enclosures may be used for a similar problem and selecting the correct one will depend on the use of the item, whether it can be slid into the enclosure without damage, available space on the shelf and aesthetic considerations.

Remedial work: staff, training, cost

Staff selected to carry out remedial work should have good manual skills and a careful approach to the work. Paper repairs require particular care, as it is very easy to end up with dirt embedded in the repaired area or with weaknesses built in through the way in which a repair is carried out. Given time, straight-edged repair patches will cause paper which flexes, such as a leaf in a book, to break down along the edge of the repair. Incorrect alignment of the edges of a tear may result in stress fractures elsewhere in the leaf after a while.

The workspace should be a designated area for remedial work and should not be used for other purposes between times. The equipment and materials necessary to carry out a range of tasks are not usually overly expensive. However, as no remedial work should be carried out without training from, or supervision by, a conservator, there are also the attendant costs of professional fees. Training should be given at the beginning of a project and thereafter, both when new skills have to be demonstrated and to give refresher sessions to ensure that skill levels are maintained. Training costs should be agreed in advance and included within the budget. All remedial work should be carried out using high-quality materials.

Surrogacy is a useful preservation tool, which allows access to material, while protecting the original. Increasingly surrogates are available in digital format, but analogue formats such as microfilm and facsimiles are still used. A book may be too fragile to use/exhibit or its rarity/value might mean that its use must be restricted. When a damaged book has been withdrawn for remedial work/conservation treatment it may be an ideal time to create a surrogate.

Online Resources

Archives Damage Atlas

metamorfoze.nl/search/node/archives%20damage%20atlas

Bookbinding and the conservation of books (online glossary of terms)

<https://cool.culturalheritage.org/don/don.html>

ligatus.org.uk/lob/help

Institute of Conservation (Icon) (find a conservator)

icon.org.uk/resources/caring-for-your-collection/finding-a-conservator-you-can-trust.html

British Library Collection Care videos

bl.uk/conservation

The National Archives

The evaluation of archival box board

cdn.nationalarchives.gov.uk/documents/information-management/evaluating-archival-box-board.pdf

Preservation guidance series

Basic preservation of books and documents

Building a preservation policy

Caring for damaged books

Cleaning books and documents

Funding preservation and conservation projects

Handling library and archive collections

Library and archive storage furniture

Managing pests in paper-based collections

Managing the library and archive environment

Mould in library and archive collections

Moving library and archive collections

Preservation of photographic material

Salvaging library and archive collections

Understanding and caring for bookbindings

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