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Foreword

Dear reader,

We have the great pleasure of introducing you to the second issue of 2024, dedicated to “Endbands: Structure, decoration, historical aspects, and conservation issues”. The scope of this issue is to highlight the crucial role of endbands in both the structural integrity and longevity of books, as well as the historic and cultural aspects. The two articles included in this issue are important contributions to the ongoing study of endbands, while providing insights of both Eastern and Western endband traditions.

The article by *Georgios Boudalis* “**A Study on the Causes and Types of Endband Deterioration in Byzantine and related Eastern Mediterranean Binding Structures**” highlights the importance of thorough documentation of deterioration patterns of the endbands, while revealing information of their original construction methods. The information surrounding the typology of endband damage can also be used as reference material for book conservators.

The article “**Unveiling Alcobaça endbands: A new ‘Romanesque’ variant**” by *Ana Tourais, Conceição Casanova and Isabel Pombo Cardoso* explores the Alcobaça endbands, in relation to their ‘Romanesque’ typology. The detailed study of the Alcobaça codices revealed the traits and particularities of their endbands, while highlighting a further need for systematic research on endbands of Western origin.

We would like to give special credits to our peer-reviewers who offered their specialized knowledge to maintain the high-quality standards of our publication. Also, to the ERC board and national representatives, along with webmaster Emanuel Wenger and social media administrator Penny Banou for their help in the dissemination of our periodical.

As always, many thanks to our wonderful proofreaders Katarina Kelsey, Mathilde Renaud, and Charlotte Wilkinson and for the final layout Anja Props. Finally, to Patricia Engel, for her devotion and guidance to the process of each publication.

Our final acknowledgement goes to the readers, as well as all the people who offer their services voluntarily, which form the periodical Conservation Update.

Our next issue, the first of 2025 will be dedicated to “**Inks: implications to conservation treatments**”. We welcome papers that provide conservation, history, technical issues, and other aspects related to the presence of inks on written material. Submissions must be sent by the deadline of December 20, 2024.

The second issue of 2025 will be dedicated to “**Photographic materials in archives, identification and care**”. We would be happy to receive papers that highlight the connection between paper and photograph conservation, as well as issues of identification and conservation strategies in archives.

We wish our readers all the best

Marta **Soliva-Sanchez** and Manto **Sotiropoulou**

We would like to share with you some words about how we chose this topic, “Endbands: Structure, decoration, historical aspects, and conservation issues”

As a conservator, I always considered endbands as an integral part of a book’s microstructure, mechanics and endurance, working alongside the binding method to safeguard the book from damage. Their overall presence on books, their variety and their rich decoration, are fascinating evidence of human ingenuity, evolving in parallel to other common uses of threads, that are indicative of worldwide cultural adaptations through the ages.

Manto **Sotiropoulou**

From an initial observation, it may appear that the endband is a mere decorative element with varying colours and designs. However, it plays a vital role in maintaining the book's structural integrity.

It is fascinating to see when the book is closed and opened the details of its attachment, construction, colours, type of thread, and how they adapt according to the fashions and needs in different parts of the world. The handmade endbands open an amazing world.

Marta **Soliva-Sanchez**

Unveiling Alcobaça endbands: A new ‘Romanesque’ variant?

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ABSTRACT

Recent research that focused on a specific technical element of Eastern Mediterranean bookbindings, the endbands, has provided valuable insights into clarifying their geographical origins and chronological evolution. In contrast, the study of western mediaeval endbands remains fragmented, despite indications of an underlying diversity with the potential to reveal clearer patterns within the subject. Under the scope of research projects like the Cistercian Horizons (PTDC/ART-HIS/29522/2017), the ‘Romanesque’ bindings of the codices from the Alcobaça collection emerge as particularly revealing cases. From a sample of 68 codices dated between the 12th and 13th centuries, 41 codices present distinctive endband features, which are described here in detail. Alcobaça’s mediaeval Cistercian *scriptorium* identity is likely emphasised by these endbands, which may represent a distinctive structural element in current scholarship. In addition, these findings underscore the importance of developing large-scale comprehensive research on bookbinding structural elements to further the study of material culture history of western mediaeval codices.

1. Introduction

Endbands are bookbinding components located at the head and tail of the bookblock spine. Made in various ways with numerous subcomponents, they can play a set of key structural functions: i) protecting the head and tail edges of the bookblock spine; ii) reinforcing the main sewing by securing the quires to one another at the head and tail of the spine; iii) strengthening the board attachment system at four different sites (two at the head and two at the tail, one on each side); iv) controlling the book's opening by providing a gentler arch that reduces strain on the sewing and prevents the book from opening fully flat; v) offering additional support to the caps of the covering material at the head and tail (Roberts & Etherington, 1994; Green, 2016, p. 158; Boudalis, et al., 2022; Boudalis, 2022, pp. 12-15). In addition to the structural function, endbands often served a decorative purpose since early times. (Roberts & Etherington, 1994; Boudalis, 2022, pp. 12-15) However, after the introduction of the press and the rising demand for books, the decorative role gradually became more important than the structural function, eventually replacing it entirely (Roberts & Etherington, 1994; Boudalis, et al., Endbands, 2022).

The structural and decorative functions of endbands, evidenced by their complexity, even when other structural elements of bindings are significantly simpler, gained the attention of some bookbinding scholars, who tried to describe the most widespread types.¹ In 2007, however, Georgios Boudalis, a leading expert in Eastern Mediterranean bookbinding, highlighted the absence of a

consistent large-scale chronological and geographical record of endbands. He expected that such a record would enable researchers to identify regional and evolutionary patterns (Boudalis, 2007, pp. 29, 49).² More than fifteen years later, Boudalis published the most comprehensive description of Eastern endbands providing researchers the most up-to-date overview of these structures (Boudalis, 2022).

While remarkably significant to the history of endbands and bookbinding, particularly of the Eastern Mediterranean tradition, his work does not address Western structures in detail. With regard to Western structures, there are two types of studies available: detailed descriptions of the most frequent structures, and characterization of individual case-studies. The correlation of the information contained in these studies, particularly of the specificities found on the individual case-studies, offers scholars the opportunity to identify and to define production patterns. For example, in the cases of Clairvaux and Clairmarais collections, Lévêque (2020, p. 200) states that 'albeit a relative diversity, the book production of some Cistercian abbeys may be distinguishable by their endbands'. Specifically, those from Clairmarais seem to lack tiedowns, in contrast to those from Clairvaux. Moreover, within the Clairvaux collection, the most abundant type does not use a core, but instead relies on what the author defined as a 'reinforcement sewing' securing the quires to a tab lining. (Lévêque, 2020, pp. 197-199 & Figs.83 & 93-96) Similarly, Honey (2020, pp. 79, 90-92) mentions a previously unrecorded endband from a Benedictine monastic production, where the sides of the tab extending over the sides of the boards are turned in.

¹ A few examples are Szirmai (1999), *Les tranchefiles brodées* (1989) or Greenfield & Hille (2017).

² Other publications on Eastern endbands are Hille & Merian (2011) or Boudalis (2016).

Unfortunately, this remains the only reported case so far. Despite these studies, distinguishing Western bookbinding productions in general, and endbands in particular, remains a challenging task as noted by several authors including Szirmai (1999, pp. ix-xi), Gullick & Hadgraft (2008, pp. 95-98) and Lévêque (2020, p. 55). In fact, a comprehensive study compiling the information on western mediaeval endbands dispersed throughout many publications, similar to Boudalis' work (2022), is still lacking.

Accordingly, in the Portuguese context there is a significant gap in the study of mediaeval endbands. Traditionally, the study of this element is closely connected to the wider study of the bindings and books on which they are found. Consequently, since endbands represent only a minor component (occasionally addressed) within a larger research framework, the available information is often limited to very brief descriptions.³ Although these descriptions suggest that the most common type is the 'Gothic' wound format, the few and brief published reports are insufficient to allow for a comprehensive understanding of the various production centres and their specificities.

This paper expects to contribute to the much-needed in-depth research on western and Portuguese mediaeval endbands, by 1) thoroughly describing a particular structure found in the 'Romanesque' bindings of the codices from the Monastery of Santa Maria de Alcobaça, the *Alcobacenses*⁴, and 2) comparing

these findings with extant literature records. Thus, for general comprehension, this paper begins with a brief review of the three main categories of western mediaeval endbands: 'Carolingian', 'Romanesque' and 'Gothic'. (Section 1) Section 2 presents the Alcobaça case study, and the methodology employed. This is followed by the detailed description of the key observations (Section 3). Finally, this paper provides a discussion and interpretation of the results framed within the context of current scholarship on western mediaeval endbands (Section 4) and its main conclusions.

The goals are to highlight the singularity and uniqueness of these endbands, likely distinctive of the Alcobaça mediaeval Cistercian *scriptorium*. Moreover, this work expects that Alcobaça constitutes an example that reinforces the potential for better defining patterns within western mediaeval endband production. Finally, this work aims to raise awareness and to promote further research into the relationships between the structural elements of western mediaeval codices and their regional and chronological origins.

1. Brief review on medieval endbands' technical elements

Before examining the specificities of the Alcobaça endbands, it is relevant to review the current knowledge about western mediaeval endbands. János Szirmai's *The Archaeology of Medieval Bookbinding* (1999) remains the most comprehensive work on the subject to date, serving as the primary comparative basis for this paper. Szirmai divides western mediaeval book bindings into three main groups,

³ This is for example the case of Seixas (2011) or Nascimento and Meirinhos (1997).

⁴ This study was conducted within the scope of the Cistercian Horizons (PTDC/ART-HIS/29522/2017) that took place between 2018 and 2022. Its goals were to study and characterise the medieval scriptorium from Alcobaça. More information is available on the project's website at: <http://cistercianhorizons.fcsh.unl.pt/pt/pagina-inicial/>. The study is being continued within a

succeeding ongoing PhD research 'Characterization and conservation of medieval bindings: the collection of Santa Maria de Alcobaça Monastery' (FCT-MCTES ref. 2021.05689.BD).

‘Carolingian’, ‘Romanesque’ and ‘Gothic’, categories also applicable to the endbands (Szirmai, 1999, pp. 95-172). As clarified by the author, these terms lack historical or art-historical significance and are solely based on terminology used to describe specific technical aspects of bindings (Szirmai, 1999, p. 98).

For ‘Romanesque’ endbands, Élodie Lévêque’s (2020) work, offers a more up-to-date contribution on the bookbinding structures of the Clairvaux collection, the Cistercian mother house of Alcobaça, thus sharing relevant connections with the collection addressed in this paper. Additionally, Aibigail Bainbridge’s (2023) newly published *colle-tanea* provides insights into many western mediaeval bookbinding features, including endbands, though from a more general perspective. Regarding terminology, most of the main components can be found in the Language of Bindings (Ligatus Research Centre). However, since many minor or specific components are missing, this paper primarily uses Szirmai’s terminology. Other important references on the subject, which include descriptions of the ‘Romanesque’ endbands type, are Greenfield & Hille (1986), Bibliothèque Nationale de France (1989), Clarkson (1993; 1996a; 1996b), Grosdidier de Matons et al. (1993), Lenz (2020a; 2020b) or Honey (2020).

A feature that can be considered distinctive of these three western mediaeval endbands is the introduction and use of tab linings⁵. This characteristic is consistently present in the ‘Carolingian’ and ‘Romanesque’ categories, whereas only remnants of this feature are evoked in some ‘Gothic’ formats.⁶

⁵ The few earlier Western examples that survived did not exhibit the use of tab linings, nor are they found in eastern traditions. (Szirmai, 1999, pp. 95-98; Boudalis, 2022).
⁶ Tab linings disappear in Gothic formats. However

The three groups can otherwise be differentiated by a few key features, each displaying enough representativeness, within its group. These key features include the type of sewing, the presence (or absence) of cores and their type, as well as the type of board attachment system.⁷ A basic model of each typology is represented in Fig.1.

‘Carolingian’ endbands often use unsupported link-stitch sewing, a technique which seems to have been rooted in the Coptic tradition (Szirmai, 1999, pp. 38-41 & Fig.3.6), with the thread laced-in to the wooden boards. (Fig.1, model 1) Alternatively, they could feature a herringbone sewing on double cord cores. The cores were laced-in to wooden boards using ‘Carolingian’ board attachment systems (e.g. vertical and V-shaped), as illustrated in Szirmai’s Fig.7.6. (1999, p. 105) These endbands were sewn through tab linings placed on the book’s spine, with matching widths. The tabs extended over the head or tail edges of the bookblock and varied in shape from curved to squared. (Fig.1, model 1) A significant number of cases observed by Szirmai (1999, p. 125), also displayed different types of perimeter sewing connecting the tab to the cover behind it, which had the same shape as the tab. (Fig.1, model 1) Occasionally, particularly in treasure bindings, fabric endband facing linings were sewn to the front side of the tabs with a coloured perimeter sewing (Szirmai, 1999, p. 126).⁸

there have been cases reported where similar shapes are retained by the back covers of some ‘Gothic’ formats. See for example Szirmai (1999, pp. 205-207; 213-214).

⁷ Other distinctive key features are associated with more specific endband types (particularly ‘Gothic’), that have no relation with the structures observed in Alcobaça, therefore will not be covered in detail in this paper.

⁸ For more details on ‘Carolingian’ endband formats see Szirmai (1999, pp. 121-127) or Gast (1983).

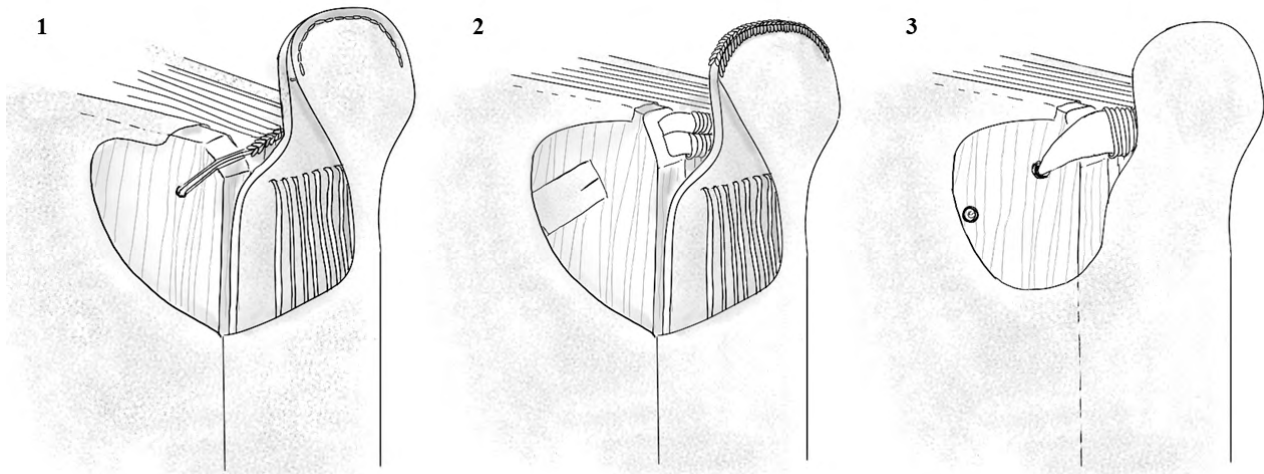


Fig. 1: Models of ‘Carolingian’ (1), ‘Romanesque’ (2) and ‘Gothic’ (3) endbands, based on Szirmai (1999, pp. 121-127; 159-162; 203-207). The image represents an example with common variations of the main endband components in these three styles — the sewing (a), the cores (b), the board attachment systems (c), the tab linings (d) and the perimeter sewing (e); (f) stands for the back cover. ‘Carolingian’ Model: Unsupported link-stitch sewing, laced-in thread, rounded tab lining, saddle stitch perimeter sewing. ‘Romanesque’ Model: Straight sewing on split alum-tawed support, long lacing, rounded tab lining, link-stitch perimeter sewing; ‘Gothic’ Model: Wounded endband on single support, short lacing entering from the outside of the board, no tab lining nor perimeter sewing.

‘Romanesque’ endbands exhibit greater structural diversity, differing from ‘Carolingian’ examples in several aspects. According to Szirmai, a key distinction is the type of cores. The author noted that ‘Romanesque’ endbands featured single or double, white-tawed skin cores, more frequently than the double cords typical in ‘Carolingian’ endbands. (Szirmai, 1999, p. 147) These cores were laced-in to the wooden boards using ‘Romanesque’ systems, such as long lacing. (Fig.4 on page 24) Unlike the ‘Carolingian’ endbands, all ‘Romanesque’ examples observed by Szirmai were supported (Szirmai, 1999, pp. 121-122; 159-160). The sewing systems varied, ranging from herringbone or straight sewing (Fig.1, model 2) on double cores to wound primary endbands, on single cores. The latter could be left plain or include a secondary sewing, most frequently in a cross-stitch pattern with coloured threads.⁹ Like ‘Carolingian’ endbands,

⁹ This is illustrated in Szirmai’s Fig.8.16 (1999, pp. 160).

‘Romanesque’ ones, seem to have always been sewn on tabs forming similar circular or square shapes, too. Their width could match that of the book’s spine, like ‘Carolingian’ examples (Clarkson, 1993, p. 192; Szirmai, 1999, pp. 122, 157-159), or it could expand to the sides of the boards. (Szirmai, 1999, pp. 122, 157-159; Lévêque, 2020, pp. 209-212 & Fig.108) In the rare case reported by Honey (2020, pp. 79, 90-92), the sides that extend to the boards surfaces are turned-in over the head and tail edges of the boards. Like some ‘Carolingian’ bindings, it is frequent to find the tabs connected to the covers with plain or coloured perimeter sewing. Among French bindings, there are reports of an additional piece of skin either edging or joining the cover and the tab lining with an edge sewing. (Grosdier de Matons, Hoffmann, & Vezin, 1993, p. 171 & Figs.7b and 8; Szirmai, 1999, pp. 161-162 & Fig.8.17.b; Lévêque, 2020, pp. 212-225 & Fig.112) In the French Clairvaux collection,

Lévêque observed a peculiar system not reported by Szirmai. According to Lévêque, this feature, prevalent among the 12th and 13th century codices of that collection, more closely resembles a reinforcement sewing on the head and tail than a true endband. It merely encircles the spinefold and the tab lining, changing over at one, both or neither station, without using a core or forming other structures. (Lévêque, 2020, pp. 197-199 & Figs.83 & 93-96) Consistent with overall trends, the facing of tabs with decorative fabrics become more common among ‘Romanesque’ endbands,¹⁰ which often feature additional decorative elements, such as the use of coloured threads, elaborate embroidery and colourful or patterned endband facing lining fabrics.¹¹

‘Gothic’ endbands exhibit the greatest diversity among the three groups. The one closest to the ‘Carolingian’ and ‘Romanesque’ structures, that is also one of the most common ‘Gothic’ formats, is the primary wound endband. (Fig.1, model 3) Like ‘Romanesque’ endbands, wound endbands were preferably done on single white-tawed skin cores, until cord cores regained popularity at a later stage. The sewing wound around the core, sometimes shows additional loops to accommodate the thickness of the quire (packed sewing). Lacing was done through typical ‘Gothic’ systems, such as the short lacing entering from the outside of the board. This endband format, while commonly used on its own, could also serve as the base for additional structures producing more complex endband formats, like the secondary sewing.¹² As men-

tioned before, ‘Gothic’ wound endbands seem to have abandoned tab linings, although their shapes were sometimes retained by the back covers of certain ‘Gothic’ endband formats.¹³ (Fig.1, model 3)

2. Experimental

2.1. Case-study presentation:

Alcobacenses

The codices *Alcobacenses* are a collection of 461 codices,¹⁴ dating from the 12th to the 18th century. Following the dissolution of monasteries, in 1834, these codices were later transferred from the Monastery of Alcobaça¹⁵ to the

esque’ structures, but could also incorporate newer sewing systems.

13 Numerous other formats of ‘Gothic’ endbands have been documented in bookbinding literature. These are not included in this brief review, as they display substantial differences from the previous ‘Romanesque’ and ‘Carolingian’ structures and do not seem to exhibit relevant connections with the Alcobaça structures. For more details on these and other ‘Gothic’ endbands see Jäckel (1975), Gast (1983), Bibliothèque Nationale de France (1989), Szirmai (1999, pp. 203-216) or Greenfield & Hille (1986).

14 BNP houses 461 codices, but several codices initially attributed to Alcobaça production have been ascribed to other origins. On the other side, codices held elsewhere have been identified as Alcobacenses. (Biblioteca Nacional de Portugal a; Barreira, 2016) Thus, the exact number of codices produced in the Alcobaça scriptorium is still under scrutiny.

15 The Monastery of Santa Maria de Alcobaça, also known as Monastery of Alcobaça, was a Cistercian Monastery founded in 1153, when D. Afonso Henriques, first King of Portugal, granted vast lands in the Portuguese region of Alcobaça, to Bernard of Clairvaux, the most prominent Cistercian house of the time. (Gomes, 2002, pp. 195-208) The monastery continued functioning as such until 1834, when religious orders were declared extinct by the Portuguese government. Throughout its long life it had significant socio-economic and cultural impact in the region. Notably, several scholars like Nascimento & Diogo (1984), Miranda (1996) or Guerra (2003) attested the existence of a monastic scriptorium where many books of the current collection must have been produced without major external influences, particularly those prior to the 15th century, when notices of Portuguese guilds connected to books start to emerge (Seixas, 2011) and greater external influences start to show within the codices.

¹⁰ This is illustrated in Lévêque’s Fig.127 (2020, p. 222).

¹¹ For further details on ‘Romanesque’ endbands see Bibliothèque Nationale de France (1989), Grosdidier de Matons et al. (1993), Clarkson (1993; 1996a; 1996b), Szirmai (1999, pp. 159-162), Greenfield & Hille (1986) Lévêque (2020, pp. 193-225), or Lenz (2020a; 2020b).

¹² This secondary sewing could be similar to ‘Roman-

National Library of Portugal (BNP), in Lisbon, where they are currently housed. The large number of codices with a common provenance and broad time span makes them a significant case study for examining evolutionary patterns across multiple fields.¹⁶

From the perspective of the mediaeval bookbinding researcher, a particular feature makes this collection especially noteworthy: around 60 of these codices attributed to the 12th and 13th century monastic production, and largely free of major exogenous influences, still preserve complete or nearly complete mediaeval bindings. Few collections worldwide preserve such a high number of bindings in such pristine condition and with known common origins.¹⁷ Therefore, the *Alcobacenses* offer a rare opportunity to more clearly define the binding typology and production methods of this period. Additionally, many of these codices are among the oldest known Portuguese books, some even dating back to the foundation of the Portuguese kingdom. (Instituto da Biblioteca Nacional e do Livro, 1994) This makes these bindings some of the oldest surviving national examples, positioning them as central to the history of early Portuguese bookbinding production.

¹⁶ To mention a few, previous works from different fields include: on liturgical texts Bragança (2008) or Barreira et al. (2021); on musical notation Ferreira & Araújo (2013); and on mediaeval illumination Miranda (1996) or Melo et al. (2008).

¹⁷ Lévêque considered that, at the present, only the collection of Clairvaux surpasses the number of mediaeval bindings of Alcobça (Lévêque, 2020, pp. 64-65, 563). However, despite the significant number of surviving bindings in Clairvaux, the codices no longer preserve most of the outer refurbishing materials like fastenings, bosses and even some covering elements, which limits our common understanding of complete binding features. From Honey (2020, p. 78), one can assume that a considerable number of English bindings also lost a significant portion of external materials. Indeed, Szirmai's (1999, p. 142) largest group from a known (English) location counted no more than sixteen codices.

However, aside from a major work published in 1984, by Aires Nascimento and António Diogo—which proposed a production chronology based on findings that resulted, almost exclusively, from the examination of the board attachment systems—these bindings have only been sporadically addressed.¹⁸ (Nascimento & Diogo, 1984) Consequently, the overall understanding of these bindings' features remained limited. Recently, within the scope of the Cistercian Horizons, 68¹⁹ bindings were selected and revisited for an in-depth study. (Tab.1) Results published elsewhere matched Szirmai's criteria and descriptions (1999, pp. 98, 140-172) attributing Alcobça bindings to a 'Romanesque' style. (Tourais & Casanova, 2024, p. 338) Specifically, most *Alcobacenses* have a herringbone sewing with a z-twisted thread, on white tawed split supports, laced-

¹⁸ Some examples are Barreira et al. (2016), Cavero et al. (2016), Castro et al. (2017) and Casanova (2022).




¹⁹ In the beginning of the Cistercian Horizons project, our team surveyed the online digitisations provided by the BNP (Biblioteca Nacional de Portugal b), in an attempt to identify those mediaeval bookbindings which preserved their most complete states, among the codices attributed to the 12th and 13th centuries. By then, our team identified sixty-four codices that fitted our criteria. (Tourais, 2021, pp. 2-3, 31) Due to several constraints, including Covid-19 pandemic, during the period of the Cistercian Horizons, our team restricted the sample to thirty codices, which offered a first overview of the collection's features. (Tourais & Casanova, 2024) In a succeeding PhD research project, the remaining thirty-four codices were added to the selection. Up to this moment, four other codices have also been included, making a total of sixty-eight books, which represent the sample used for this paper. Note that Nascimento (1984, p. 44) listed seventy-nine mediaeval codices *Alcobacenses*, which according to him preserved original mediaeval binding materials. This number is higher than the one we identified because our selection criteria were different; while Nascimento (1984, pp. 19-20) was looking for all the books with wood boards that did not display signs of major binding alterations, within the entire collection; we, on the other hand, were searching for the most complete bindings within the codices attributed to the 12th and 13th centuries, regardless they were original or not. For the first stages of the project, we opted to start with the smaller number which could be expanded as work progressed.

in through a round or long system. (Fig.4, on page 24)²⁰ This suggests that ‘Romanesque’ was likely one of the oldest bookbinding styles in the collection,²¹ produced in the *scriptorium* of Alcobaça. Notably, the dates of these codices (12th to 13th centuries) align with the typical range for this style (11th to 14th centuries) (Tourais & Casanova, 2024; Szirmai, 1999, p. 142). Moreover, previous studies revealed tendencies within several binding features, such as the sewing, the board attachment systems, and the cover structures, suggesting distinct moments of monastic production throughout the mediaeval period (Tourais & Casanova, 2024). Regarding the endbands, it was partic-

ularly interesting to find no exact match between the observed features of the ‘Romanesque’ Alcobaça codices, and the records of ‘Romanesque’ endbands in both national and international bookbinding literature.²² (Tourais & Casanova, 2024, p. 329) Although brief descriptions have been previously provided (Tourais, 2021; Tourais, Casanova, & Barreira, 2022; Casanova, 2022; Tourais & Casanova, 2024), a detailed comparison with extant literature, which could allow to position Alcobaça’s endbands within a broader context, is still lacking. This paper aims to address this gap, also clarifying some details that remained unclear in the previously proposed structure.²³

Table 1

List of Alcobacenses codices selected for the study. Retrieved from: Biblioteca Nacional de Portugal b

ID n.	Title	Author	Date of Production	Photo
Alc. 70	Collationes libri tres	Odo of Cluny	1201-1300	
Alc. 136	Liber quaestionum in Vetus Testamentum	Saint Isidore of Seville	1101-1200	
Alc. 145	Expositio in Evangelium Matthai; Explanatio Danielis prophetae	Godefridus Babio; Saint Jerome	1201-1300	










²⁰ Illustrations of the remaining elements are provided by Tourais in Figs.7 & A5-8 (2021, p. 17 & 48).



²¹ There is only one codex, Alc. 136, that raises a few doubts as to whether its binding represents an older local production, if it has a different provenance or if it has suffered later changes.

²² As mentioned in the Introduction, Portuguese studies on endbands are scarce and insufficient to draw comprehensive conclusions. Nevertheless the ‘Gothic’ wound format has been detected more frequently. (Nascimento & Meririnhos, *Catálogo dos Códices da Livraria de Mão da Mosteiro de Santa Cruz de Coimbra na Biblioteca Pública Municipal do Porto*, 1997; Seixas, 2011; Correia, 2014; Castro, Casanova, Oliveira, & Miranda, 2017) For the structures reported in international references, see chapter 1. None of these structures is an exact match of the one described in this paper.

²³ These are the doubts addressed on footnote 34.

ID n.	Title	Author	Date of Production	Photo
Alc. 146	Epistolae	Saint Ivo of Chartres	1201-1300	
Alc. 148	Dialogus contra Judaeos; Disputatio Judei cum Christiano	Petrus Alphonsi; Gilbert Crispin	1201-1300	
Alc. 153	Various works	Hugh of Saint Victor and Saint Cyprian; Saint Prosper of Aquitaine	1201-1300	
Alc. 154	De Arca Noe; Epistolae	Hugh of Saint Victor; Stephen of Tournai and Peter of Celle	1101-1200	
Alc. 155	Various works	Hugh of Saint Victor	1201-1300	
Alc. 159	Homiliae in Genesim, Exodum et Librum Regum	Origenes	1201-1300	
Alc. 177	Expositio super Epistolas Catholicas; Collationes	Saint Bede; John Cassian	1201-1300	
Alc. 183	Tractatus de Psalmo centesimo octavo decimo	Saint Ambrose	1201-1300	
Alc. 239	Liber de viduitate; Liber pastoralis curae	Bartolomeu, Bishop of Silves; Saint Gregory the Great	1201-1300	
Alc. 242	Tractatus super Lamentationes Jeremiae; Tractatus in expositione Ecclesiastis	Hugh of Saint Victor	1201-1300	
Alc. 244	Expositio in Ecclesiasticum	Pseudo-Hugh of Saint Victor	1201-1300	

ID n.	Title	Author	Date of Production	Photo
Alc. 245	Books of Jeremiah and Lamentations with the Ordinary Gloss	Rufinus of Aquileia	1201-1300	
Alc. 247	Commentarium in Apocalypsin	Beatus of Liébana	1201-1300	
Alc. 248	Various works	Remigius of Auxerre and Saint Martin of Braga; Anonymus; Others	1201-1300	
Alc. 263	Expositio in Regulam Sancti Benedicti; Sermon on St. Matthew 20:20	Smaragdus; Saint John Chrysostom	1201-1300	
Alc. 331	Retractationes; De Trinitate	Saint Augustine	1276-1300	
Alc. 333	Commentaria in Libros Regum	Rabanus Maurus	1201-1300	
Alc. 335	Epistolae	Saint Jerome	1176-1200	
Alc. 336	Expositio in Jeremiam	Saint Jerome	1101-1200	
Alc. 337	Explanatio super Ezechielem	Saint Jerome	1201-1300	
Alc. 338	Explanationes in Prophetas Minores	Saint Jerome	1201-1300	
Alc. 340	Historia scholastica	Peter Comestor	1201-1250	

ID n.	Title	Author	Date of Production	Photo
Alc. 341	Expositio in Evangelium Matthei	Godefridus Babio	1201-1300	
Alc. 347	Sermones de verbis Domini; Sermones de verbis Apostoli	Saint Augustine	1201-1300	
Alc. 348	Sermones in Epistolam Johannis primam; Commentarium in Epistolam Pauli Apostoli ad Hebraeos; Miraculum de corpore Domini	Saint Augustine; Saint John Chrysostom; Pontius Capellanus	1201-1300	
Alc. 349	Moralia in Job: Part 1 and 2	Saint Gregory the Great	1176-1200	
Alc. 350	Moralia in Job: Part 3 and 4	Saint Gregory the Great	1176-1200	
Alc. 353	Glossa Ordinaria to the Books of Leviticus Numbers, Deuteronomy, Joshua and Judges	-	1201-1300	
Alc. 355	Commentarium in Psalmos	Peter Lombard	1201-1300	
Alc. 356	Works; Glossa Ordinaria to the Book of Proverbs; Commentarius in Ecclesiastem	Saint Prosper of Aquitaine et al.; Saint Jerome	1201-1300	
Alc. 358	Sermones de Tempore; Sententiae	Saint Bernard	1201-1300	
Alc. 363	De institutis coenobiorum	John Cassian	1176-1200	
Alc. 369	Homiliae in Ezechielem	Saint Gregory the Great	1176-1200	

ID n.	Title	Author	Date of Production	Photo
Alc. 372	Expositio super Cantica Canticorum; Vita Sancti Bernardi; Sermones in anniversario Sancti Bernardi; Homiliae	Saint Gregory the Great; William of St-Thierry, Arnold of Bonneval and Gaufridus; Gaufridus; Leo the Great	1201-1300	
Alc. 375	Historia ecclesiastica; De fide catholica contra judaeos; De naturis rerum ad sisebutum	Eusebius of Caesarea and Rufinus of Aquileia; Saint Isidore of Seville	1201-1300	
Alc. 396	Bible	-	1201-1300	
Alc. 397	Bible	-	1201-1300	
Alc. 398	Bible	-	1201-1300	
Alc. 399	Bible	-	1201-1300	
Alc. 400	Explanatio in Isaiam	Saint Jerome	1201-1300	
Alc. 401	Commentarium in Epistolas Pauli	Peter Lombard	1201-1300	
Alc. 403	Defloratio librorum Sancti Augustini Prima-secunda pars	-	1201-1300	
Alc. 406	Expositio super Isaiam prophetam	Hervé de Bourg-Dieu	1201-1300	
Alc. 407	De concordia Evangelistarum Amonii; Interpretationes nominum in Evangeliiis	Zacharias Chrysopolitanus; Nicolaus Chrysopolitanus	1201-1300	

ID n.	Title	Author	Date of Production	Photo
Alc. 408	Expositio in Epistolas Pauli	Remigius of Auxerre	1176-1200	
Alc. 409	Expositio in Epistolas Pauli	Remigius of Auxerre	1176-1200	
Alc. 411	Homilies for Sundays and Feasts	Cistercian Order	1201-1300	
Alc. 413	Homily	Cistercian Order	1201-1300	
Alc. 414	Homily	Saint Rudesind	1201-1300	
Alc. 415	Liber ad Scarilam de fide incarnatione Filii Dei; Liber ad Ferrandum diaconum de quinque quaestionibus; De regula verae fidei; Historiarum adversus paganos; Quomodo sit capta Sanctarem civitas; Quomodo captum fuit Alcaser a Francis	Fulgentius of Ruspe; Paul Orosius; Goswin of Bossut	1201-1300	
Alc. 416	Various works	Saint Isidore of Seville; Saint Augustine; Paschasius Radbertus; Autpert Ambrose; Anonymus	1201-1300	
Alc. 418	Legendarium cisterciense	Zacharias Chrysopolitanus	1176-1200	
Alc. 419	Legendarium cisterciense	Cistercian Order	1176-1200	
Alc. 421	Legendarium cisterciense	Cistercian Order	1176-1200	
Alc. 423	Expositio in Lucae Evangelium	Saint Bede	1176-1200	

ID n.	Title	Author	Date of Production	Photo
Alc. 424	Glossarium latinum: A-H	Papias	1176-1225	
Alc. 425	Glossarium latinum : I-P	Papias	1176-1225	
Alc. 426	Glossarium latinum: Q-Z; De Arte Grammatica	Papias	1176-1225	
Alc. 435	Expositio in Tobiam; Expositio in Ezram et Neemiam; Expositio in libris Machabeoru	Saint Bede; Rabanus Maurus	1201-1300	
Alc. 441	Homily for Sundays and Feasts	-	1201-1300	
Alc. 442	Homily for Sundays and Feasts	-	1201-1300	
Alc. 443	Homily for Sundays and Feasts	-	1201-1300	
Alc. 444	Homily for Sundays and Feasts	-	1201-1300	
Alc. 445	Homily for Sundays and Feasts	-	1201-1300	
Alc. 446	Etymologiae De natura rerum ad Sisebutum	Saint Isidore of Seville	1201-1300	

2.2. Methodology

In addition to the literature review and state of the art presented above about ‘Romanesque’ endbands, an in-depth codicological

study was conducted to achieve the stated goal. This codicological study involved the direct examination of 68 selected codices, at the BNP. Data collected during this process was

recorded in a tool developed during the Cistercian Horizons project, which enabled further data analyses (Tourais & Casanova, 2024). To assist in the interpretation, a photographic record of the different features was undertaken, and historical models were reproduced. This methodology allowed the team to identify the different components and structures of the Alcobaça bindings, including their endbands. Several groups of endband structures were categorised and their prevalence within the collection determined. A dominant group emerged as particularly significant. This Alcobaça endband structure is described in detail, below. By comparing these findings with the literature review it was possible to position Alcobaça endbands within the broader framework of western mediaeval structures.

3. Results: The Alcobaça endbands

Out of the 68 codices *Alcobacenses* examined, all codices featured endbands—one at the head and another at the tail—both identical within each codex.²⁴ Furthermore, this study allowed to distinguish four main groups of endbands:

- Group A is markedly dominant, present in 41 codices.²⁵ It will be described in detail below.
- Groups B and C display features more commonly associated with later periods:
 - Group B: 12 codices²⁶ feature wound

endbands and ‘Gothic’ lacing systems (namely short lacings entering from the outside of the boards).²⁷ Some of these endbands also include tab linings.

- Group C: five codices²⁸ exhibit structures reminiscent of Szirmai’s descriptions (1999, pp. 203-206) of integral sewing, more common in ‘Gothic’ styles. This is consistent with the observations, as three of the five codices show a short lacing, entering from the outside of the boards, typical of ‘Gothic’ board attachment systems.

- Group D consist of 10 codices²⁹ displaying a miscellany of variations from the previous groups. These structures are not yet fully understood but may be linked to different moments of intervention/restoration as well as the reuse of materials, a pattern already observed in other components (Tourais & Casanova, 2024, p. 319).

This paper focus on group A for the following reasons: i) this group of endbands is the most abundant within our sample; (ii) the bookbinding features of the codices displaying this type of endbands align with the ‘Romanesque’ bookbinding style (which appears to be the earliest style produced in Alcobaça’s *scriptorium*), so its full description contributes to a comprehensive characterisation of the codices from this period; and iii) to the best of the authors’ knowledge, unlike groups B

²⁴ Most significant differences result largely from damage.

²⁵ Alc. 70, Alc. 145, Alc. 146, Alc. 148, Alc. 153, Alc. 155, Alc. 159, Alc. 183, Alc. 239, Alc. 242, Alc. 244, Alc. 248, Alc. 263, Alc. 331, Alc. 336, Alc. 337, Alc. 338, Alc. 340, Alc. 341, Alc. 347, Alc. 349, Alc. 350, Alc. 353, Alc. 355, Alc. 358, Alc. 369, Alc. 372, Alc. 375, Alc. 400, Alc. 401, Alc. 403, Alc. 406, Alc. 408, Alc. 409, Alc. 415, Alc. 418, Alc. 421, Alc. 425, Alc. 426, Alc. 435, Alc. 446.

²⁶ Alc. 177, Alc. 335, Alc. 363, Alc. 396, Alc. 411, Alc. 413,

Alc. 419, Alc. 423, Alc. 442, Alc. 443, Alc. 444, Alc. 445.

²⁷ AAn illustration of this system is provided by Nascimento & Diogo (1984) in the figures of p. 56.

²⁸ Alc. 333, Alc. 399, Alc. 414, Alc. 424, Alc. 441.

²⁹ Alc. 136, Alc. 154, Alc. 245, Alc. 247, Alc. 348, Alc. 356, Alc. 397, Alc. 398, Alc. 407, Alc. 416.

and C, the structures of group A are markedly different from any others described in current bookbinding and endband literature, as it will be demonstrate next.

At first glance, Alcobaça group A endbands seem to match ‘Romanesque’ descriptions. They have white (likely alum-tawed) cores laced into wooden boards and include tab linings among their main components. However, a closer look reveals particularities, which result in a complex and more robust structure.

According to the observations made there are two variants. These are formed by four main elements, and at least seven different steps in the construction process. The differences between the two variants happen in the last step, resulting in 7 ‘a’ and ‘b’. Among these seven steps, three incorporate sewing moments: step 1 constitutes the first sewing moment; step 5 constitutes the second sewing moment; and step 7, incorporates - in case of variant ‘a’ - the third and last sewing moment, and - in case of variant ‘b’ - the third, fourth and fifth sewing moments. The classification as ‘third’, ‘fourth’ and ‘fifth’ sewing moments in step 7b results from the need to distinguish them. In fact, since it was not possible to determine their exact order, it was decided not to incorporate them as additional steps. The elements, steps and moments are illustrated in Fig.2: numbers 1 to 7 represent the several steps for endband construction; number 8 represents the subsequent binding processes, namely the addition of the cover and furniture components. The elements are the core³⁰, the tab lining, the board lining (occasionally replaced with an integral primary cover), and the endband folded lining around

perimeter edges. The steps will be described in detail below.

Following the different production steps that such endbands would require, one would start with (step 1) the preparation of the core. In all the 41 bindings, the endband cores are made of thick white skin, likely alum-tawed. The shape of the core is illustrated in Fig.2. On the upper part of the core there is the first sewing, forming a braid pattern resembling Szirmai’s description of a two-step link-stitch, (1999, pp. 38-40) or Boudalis’s loop-stitch (2022, pp. 72-75). (Fig.3, model 3) This component, which for lack of a better term, we are referring to as ‘endband core with two-step link-stitch sewing on the top edge’³¹ (Fig.2, step 1), is not exactly a core in the traditional sense, as, overall, the link-stitch does not fully encircle the core, contrary to what happens in other typical formats such as wound endbands.³² (Fig.2, step 1) Moreover, the link-stitch sewing has no connection to the quires, though the likely alum-tawed core supports a second sewing done after the introduction of the tab lining. This second sewing ensures the connection with the quires step (as will be explained below, in step 5). Notably, this second sewing does not encircle the core, either. (Fig.2, step 5)

function to traditional endband cores. (See footnote 30) However, as will be demonstrated ahead, it also has distinct features and uses that may justify the proposal of a new term.

31 This name is different from our previous proposal ‘simple braided core’, to avoid confusions with previous works like that of Boudalis’ (2022, pp. 287-301) ‘Braided and Interlaced Family’.

32 There are eight cases (Alc. 146, Alc. 148, Alc. 153, Alc. 155, Alc. 242, Alc. 348, Alc. 372, Alc. 406) in which the core is significantly smaller than usual, and although this conclusion is based on partial observations, since the area is covered by other binding components, the link-stitch does seem to fully circle the core. It is possible that this is associated with a particular binding style of the collection, still under study.

30 The term to describe this component is still under scrutiny within the team. On one side it has a similar

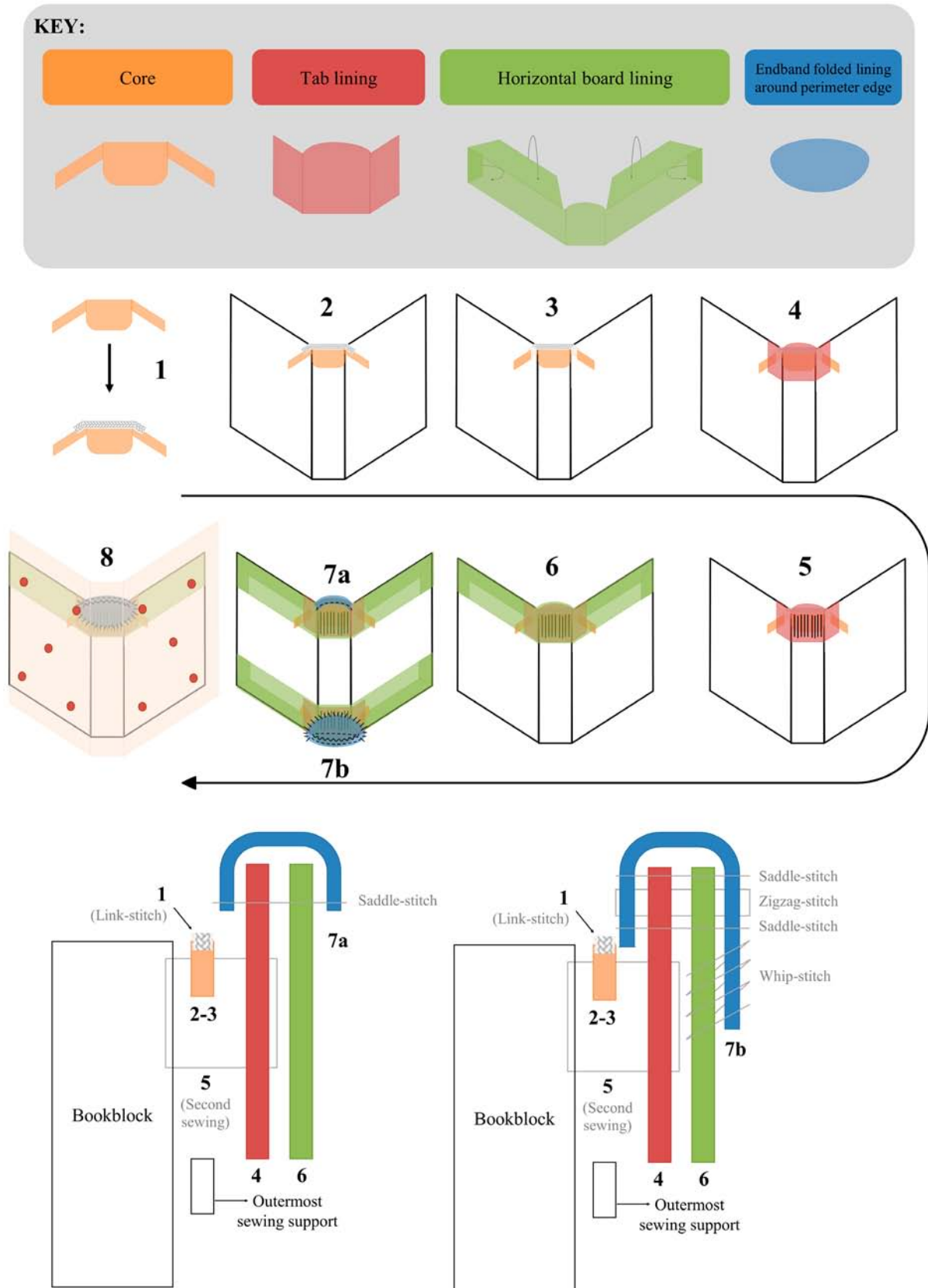


Fig. 2: Main elements and construction steps of the Alcobça codices' endbands. Below two cross-section schemes for step 7, variants 'a' and 'b'. The cross-sections include the respective elements (colours), steps (numbers) and sewing moments (grey lines). In both cross-sections: 1) step 1 incorporates the link-stitch done on the top side of the core - this is the first sewing present in both variants; 2) Steps 2 and 3 are represented together, because the lacing system cannot be portrayed in such scheme; 3) Step 5 incorporates the second sewing moment that secures quires, core and tab lining. In the left cross-section, the saddle-stitch (straight horizontal line) is part of step 7a, representing the third and last sewing moment of this variant. In the right cross-section, the saddle (straight horizontal lines), the zigzag (narrow rectangle) and the whip-stitches (diagonal lines) are part of step 7b. They represent the third, fourth and fifth sewing moments necessary to complete step 7, variant 'b'.

After preparing the core by adding the link-stitch sewing on the core's top edge, step 2 concerns placing the compound element against the spine of the book, with the link-stitch sewing aligned with the head/tail edge of the bookblock (or slightly beyond it). (Fig.2, step 2) Step 3 likely involves lacing the core's slips into the boards. (Fig.2, step 3)

In his reproduction models of tab endbands, Clarkson found it easier to lace in the core slips and secure the tab lining before completing the sewing. (1993, p. 192) This

finding aligns with the team's experiments. Therefore, it is probable that after placing the core in position, the third step would involve lacing the slips into the boards. However, this is difficult to prove because, in the reproductions, it was found that fixing the cores and tabs after sewing, although more challenging, did not prevent achieving the same level of perfection. Also, it was impossible to determine whether the sewing holes on the skins were made before or during the sewing process.

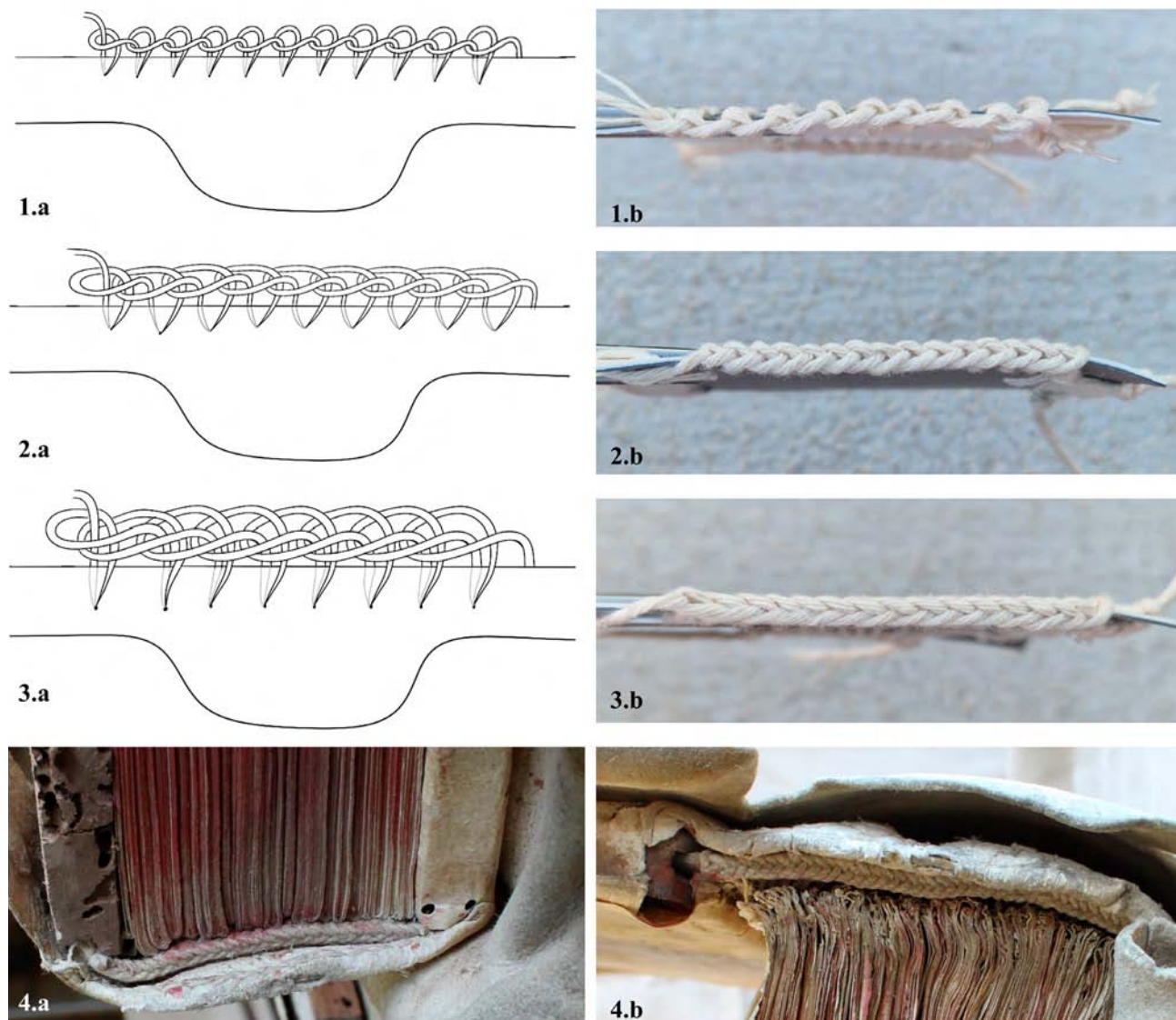


Fig. 3: Schemes (a) and models (b) of: Szirmai's simple link-stitch – 1; a variation of the two-step link-stitch, that encircles only half of the previous link, creating the same pattern but slightly looser; similar to Peterson's description as quoted by Boudalis (2022, p. 74) – 2; and Szirmai's two-step link-stitch (Szirmai, 1999, pp. 38-40) – 3. Below, Alcobaça endband two-step link-stitch sewing on the top edge of the core of Alc. 159 (4.a) and of Alc. 418 (4.b); visually they are more compact, thus closer to the two-step link-stitch sewing (3).

The lacing system of the Alcobacenses endbands is often difficult to observe, as it is hidden beneath several other binding components, such as endleaves and covering elements. Nonetheless, a few observed cases suggest that the lacing system, in most books,

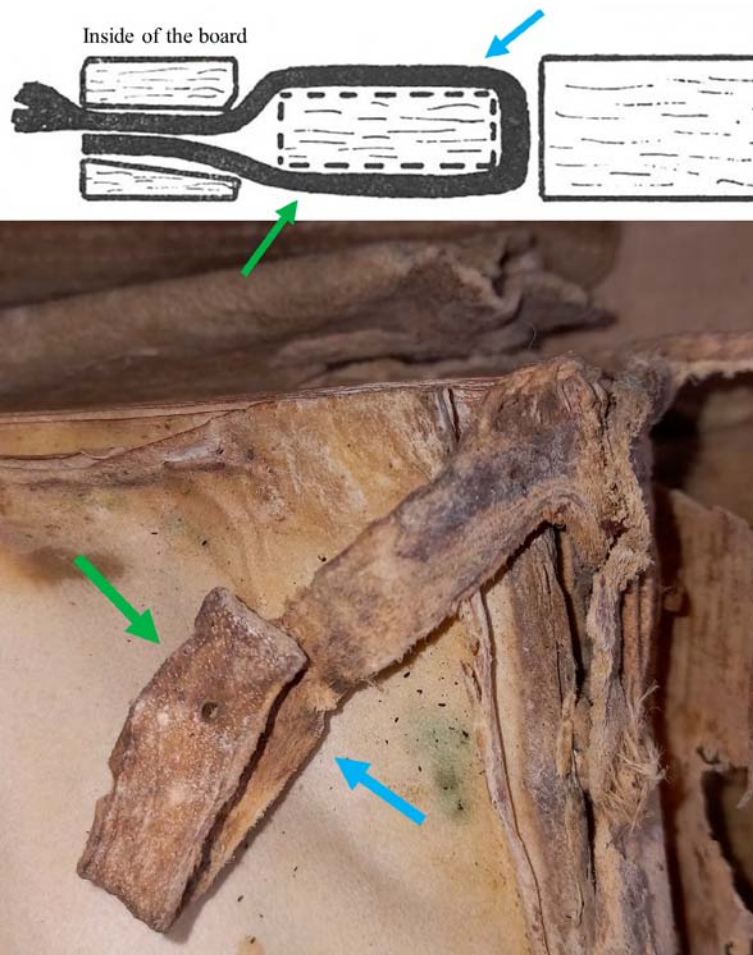


Fig. 4: Scheme with the two most common lacing systems observed in the Alcobça codices: the round (above) and the long (below). Under, on the left a detail image of Alc. 408 (left) showing the shape of the tailband core slips separated from the left/front board, which suggest the use of a round lacing system. On the right, a detail image of Alc. 340, where partial features of the Alcobça typical long lacing (e.g. hole pointed by black arrow), suggest that in this codex the lacing of the endband slips was probably done using this kind of long system. The grey vertical line on the long lacing represents the wedge used to secure the system in place, which is unnecessary (and therefore it is absent) in the round system.

is the same as that used for the main sewing supports, i.e. either the round or the long lacings. (Fig. 4) Interestingly, the link-stitch sewing on the top of the core extends beyond the width of the bookblock, so once the core slips are laced-in, part of the braid is laced along, entering the boards. (Fig. 5)



Fig. 5: Detail of Alc. 331 endband core with two-step link-stitch sewing on the top edge entering the board (white arrow). Also, note the circular wooden peg securing the board lining turn-in, on the left (black arrow).

In step 4, a tab lining made of another piece of white skin (likely alum-tawed, though slightly thinner than the core) is placed behind the core with the top sewing (Fig. 2, step 4).³³ The tab covers ca. 70 mm of the spine, which is enough to conceal the change-over of the main sewing, and sometimes extend to the nearest sewing support. It also extends about 15 mm beyond the edge of the bookblock, always with a rounded/curved shape.

³³ In a previous paper (Tourais & Casanova, 2024, pp. 328-331) we suggested that this tab lining would fold over itself and would then be sewn with plain stitches and a zigzag-stitch forming a round shape. However, observations hindered by the presence of the covering elements, the resemblance between the different pieces of skin and both the good or bad condition of the structures, raised doubts including in the shape of the tab lining, the relation between the tab lining and the board lining and attachment of both elements to the boards. Recent observations, namely of the codices that were not part of the first selection (see footnote 12), allowed to clarify these doubts and resulted in the structure described in this paper, which seems to be the most correct to date.

The shape and placement of the tab closely resemble Lévêque's descriptions (2020, pp. 209-212), although no board recesses to accommodate the tab were found. Additionally, unlike Honey's descriptions (2020, pp. 79, 90-92), the tab does not turn inward to the inner side of the board. In Alcobaça, the sides of the tab rest on the outer surface of the boards (approximately 30 mm on each side), and its corners and edges are likely secured to the boards with small wooden pegs. (Fig.6)

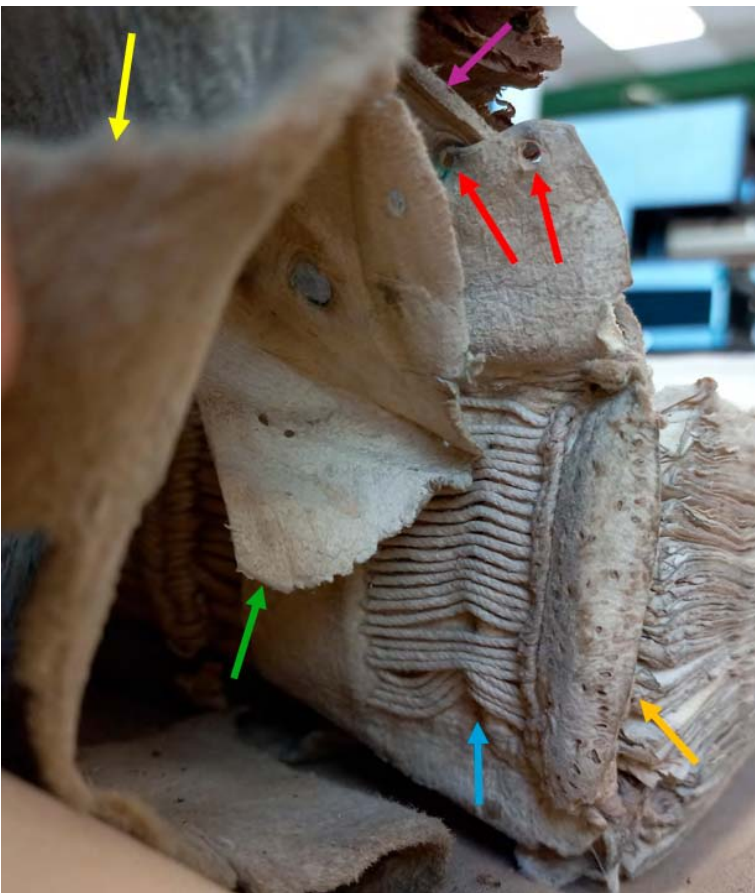


Fig. 6: Detail image of Alc. 425 tailband. Note the round shape of the tab lining (a). Two holes, deforming the skin suggests the use wooden pegs (b). Core (c), second sewing with change-over (d), board lining (e) and cover (f) are also visible.

As with some of the previous steps, it remains difficult to confirm whether the tab was attached before or after sewing. Nevertheless, based on the models produced, it was assumed that it was secured beforehand to facilitate assembly.

Assuming that the core with the top sewing and the tab lining were secured in place beforehand, step 5 involves making the second sewing moment. (Fig.2, step 5) This second sewing resembles what Lévêque (2020, pp. 197-199 & Figs.83 & 93-96) described as a 'reinforcement sewing', though in this case, it is sewn directly on the tab lining, without any core. (Fig.2, step 5) In Alcobaça case, the thread of this simple sewing passes through two stations located at the spine, rather than going over the edges of quires (unless the folds are torn). It encircles the quires, the lower part of the core, and the tab lining altogether, forming a sort of tie-downs. A change-over sewing was observed, typically at the outermost station.³⁴ (Fig.6) Two *Alcobacenses* (codices Alc. 263 and 348) feature changeovers at both stations, similar to the case-studies reported by Lévêque (2020, pp. 200-205). On the other hand, unlike her examples, situations in which the changeover was absent from both stations were not observed in Alcobaça. The placement and type of endband changeover sewing may represent a specific trend in Alcobaça's bindings, though not necessarily exclusive of this collection. However, due to challenges of examining beneath other binding components, the number of cases observed is too small to confirm this definitely. Those that can be considered the tie-downs of this type of endband seem to correspond to a 1:1 ratio with the number of quires, as the thread is always visible on the spinefold, unless otherwise damaged/altered.

Step 6 involves the addition of a horizontal board lining, behind the main body of

³⁴ This was clearly detected in codices Alc. 245, Alc. 248, Alc. 335, Alc. Alc. 338, Alc. 347, Alc. 349, Alc. 350, Alc. 358, Alc. 375, Alc. 397, Alc. 408, Alc. 415, Alc. 425, Alc. 446, and partially observed in codices Alc. 136, Alc. 183 and Alc. 416.

the endband described earlier. This lining is typically made from a material similar to thin alum-tawed skin or thick parchment. (Fig.2, step 6) In most codices, this board lining partially covers the outer face of the boards (ca. the same height of the tab lining) and turns-in at the fore-edges and head/tail of each board. (Fig.7) The turn-ins of these board linings create an effect similar to that of a primary cover.

A comparable result may arise from the structure described by Honey (2020, pp. 79, 90-92) where the sides of the tab linings, extending to the surface of the boards, are turned-in over the head/tail edges of the boards. Yet, a full primary cover, made of a similar material and serving a similar function, was observed in six of the 41 cases. (Fig.7) Tablinings and board linings (or, if this is the case, the primary covers)

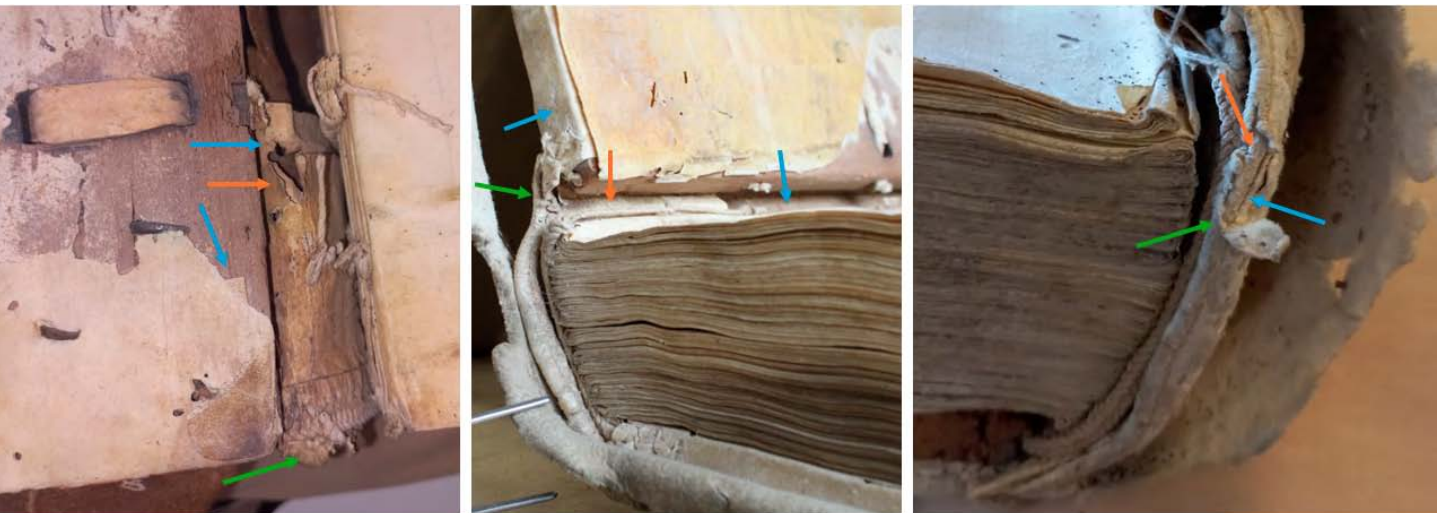


Fig. 7: Detail images of Alc. 349 (left), Alc. 372 (middle) and Alc. 331 (right) displaying different aspects of the Alcobaça endbands: tab linings (a); board linings (b), in case of Alc. 372 it is a primary cover; endband folded lining around perimeter edges (c). Note how in Alc. 331 the tab and board linings have the same round shape under the endband folded lining around perimeter edges.



Fig. 8: Image of inner side of Alc. 331 left board. Note the wooden pegs (white arrows) and the traces of a white powder (black arrow), denouncing the use of an old adhesive, and therefore possibly two ways of securing board linings.

may be secured to the boards with wooden pegs.³⁵ (Fig.8) More importantly, in the area of the spine that extends beyond the head/tail edges of the bookblock, these board linings (or the primary covers) mimic the round shape of the tab lining, forming an assembly quite evocative of both the ‘Carolingian’ and ‘Romanesque’ structures described in section 1. (Fig.7)

Lastly, unlike most of the previously documented structures in bookbinding and endband literature, at least 34 of the 41³⁶ codices

³⁵ Traces of a white substance, which came out as starch, after a single FTIR analysis, were used to paste the pastedowns, and possible, in some cases also the turn-ins of the cover linings, though this has not been fully clarified. (Fig.7)

³⁶ The remaining seven cases appear to have endband folded linings but raised some doubts.

have one last step: step 7, which involves reinforcing the structure with an extra piece of skin material. As explained before, there are two variants of step 7: ‘a’ and ‘b’. Variant ‘a’ was found in at least five (possibly eight) codices.³⁷ This variant evokes the French examples noted earlier, particularly those from the Clairvaux collection. (Fig.2, step 7) (Grosdidier de Matons, Hoffmann, & Vezin, 1993, p. 171; Lévêque, 2020, pp. 212-225) Lacking a more

precise term, in this paper, this element is referred to as ‘endband folded lining around perimeter edges’, as it entails a small lining, folded around the tab and the board lining (or primary cover). This element is then secured to the tab and board lining by a saddle-stitch (third sewing), similar to the French scholars’ findings. (Fig.2, step 7a and Fig.9) The alternative construction, step 7, variant ‘b’, was observed among at least 29 of the remaining 33

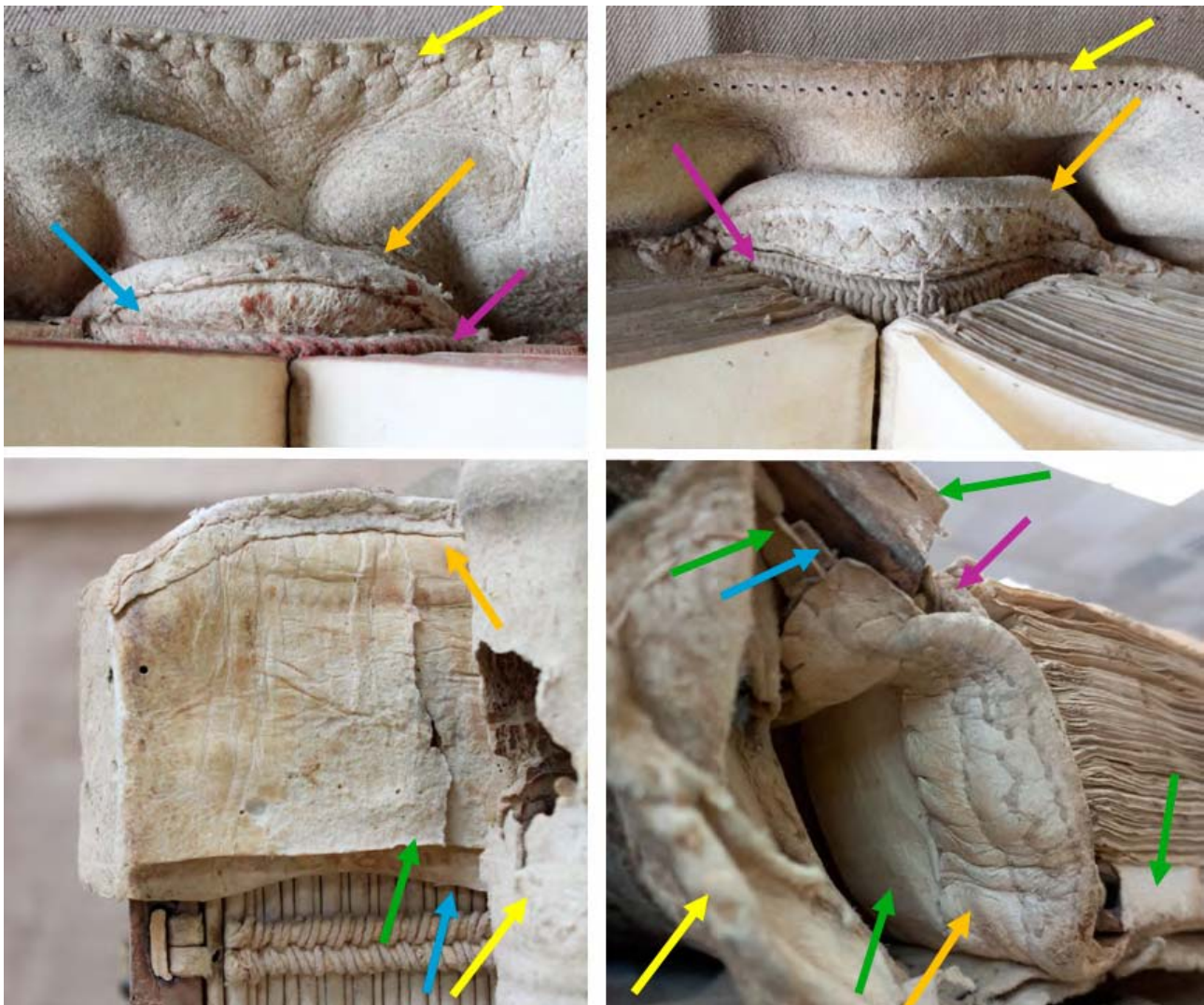


Fig. 9: Detail images of Alc. 159 (top and bottom left side), Alc. 369 (top right) and Alc. 340 (bottom right) showing the two types of endband folded lining around perimeter edges detected in the Alcobaça codices: the smaller with just the saddle stitch (Alc. 159) and the larger with a saddle, a zigzag and an whip-stitches (Alc. 369 and Alc. 340). The arrows indicate the endband core with two-step link-stitch sewing on the top edge (a), tab lining (b), board lining (c), endband folded lining around perimeter edges (d) and cover (e).

³⁷ Observed in Alc. 159, Alc. 248, Alc. 335, Alc. 408, Alc. 409; and possibly in Alc. 347, Alc. 350, Alc. 358.

codices (the remaining four codices are more damaged, making it difficult to interpret this feature). These also exhibit ‘endband folded linings around perimeter edges’, albeit the folded linings are considerably larger. (Fig.2, step 7b and Figs.9 and 10) Similar to the smaller alternative, the larger endband folded lining around perimeter edges folds over the rounded tab and board linings (or primary cover). However, in this version, the folded lining is not sewn solely with a saddle-stitch around the perimeter of the curve. In step 7, variant ‘b’ there is an equivalent third sewing moment, formed by a saddle-stitch around the perimeter of the curve that is also visible along the opposite side near the same level of the two-step link-stitch sewing on the top edge of the endband core. (Fig.2, step 7b and Fig.10) Plus, it also incorporates a zigzag-stitch (fourth sewing), running in-between the two saddle-stitches providing extra strength and having a pleasing decorative effect. (Fig.2, step 7b and Fig.10) Finally, at the outer side of this endband folded lining around perimeter

edges, in the extremity that extends towards the bookblock’s spine, there is a whip-stitch securing this element to the board lining (fifth sewing). (Fig.2, step 7b & Fig.10) In contrast to Szirmai and Lévêque’s descriptions already mentioned in section 1, the main covers of the Alcobaça books are not attached to these endband components. Nonetheless, it is important to note that many mediaeval bindings have lost their external components, and final covers may have been one of them. In Alcobaça, the board linings (or occasionally the primary cover) are secured to the endband structure precisely by this endband folded lining around perimeter edges and a final chemise-style cover,³⁸ made of heavy alum-tawed or tanned skin, is added afterward covering the entire structure and working as the last layer of protection and cushioning. (Fig.2, step 8) It is not possible to be certain whether this structure results from a local adaptation or whether some European cases represent instances where secondary covers may have been lost.

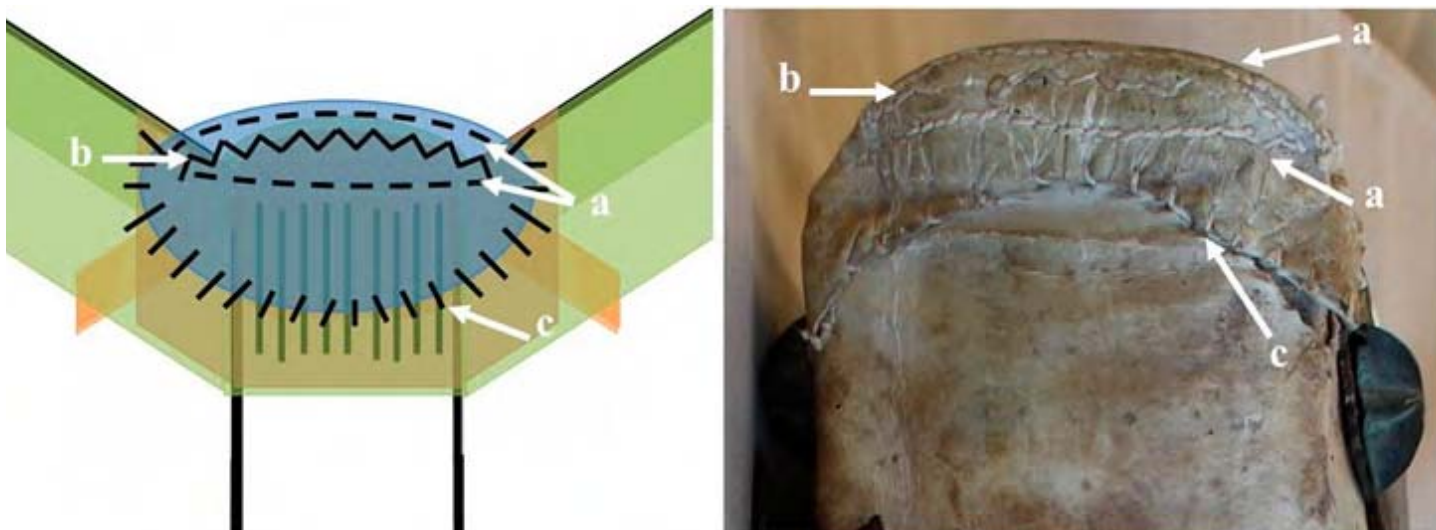


Fig. 10: On the left, detail of Fig.2 step 7 variant ‘b’, displaying the different stitches involved in this step: running (a), zigzag (b) and whip-stitches (c). On the right, a detail image of Alc. 242 tailband depicting the historical structure.

³⁸ A chemise format is illustrated in Clarkson (1993), in the Figures 1 (p. 184) and 13 (197).

4. Discussion

The comparison of the endband structures of Alcobaça with those documented in bookbinding literature revealed that certain features, such as the rounded tab lining, evoke typical western mediaeval structures (Clarkson, 1993, p. 192; Szirmai, 1999, pp. 122, 157-159; Honey, 2020, pp. 79, 90-92; Lévêque, 2020, pp. 209-212). The use of skin-based cores, combined with the round or long lacing format, suggests that Alcobaça endbands belong to the ‘Romanesque’ style, placing them among the earliest Portuguese bookbinding structures. As previously noted, most Portuguese structures reported to date align with the wound format, typical of the later ‘Gothic’ style. (Nascimento & Meririnhos, *Catálogo dos Códices da Livraria de Mão da Mosteiro de Santa Cruz de Coimbra na Biblioteca Pública Municipal do Porto*, 1997; Seixas, 2011; Correia, 2014; Castro, Casanova, Oliveira, & Miranda, 2017) Additionally, the endband folded linings around perimeter edges resemble some earlier accounts of French structures (Grosdidier de Matons, Hoffmann, & Vezin, 1993, p. 171; Lévêque, 2020, pp. 212-225). While such linings, especially those featuring the double saddle-stitch and zigzag-stitch in between (a notable difference from previous records), appear to be uncommon in western medieval endbands their overall similarity to French productions, suggests a plausible exchange of techniques, particularly within the monastic context. Nonetheless, further research is needed due to the limited grounds for comparison, especially when considering complete, pristine European bindings. Indeed, the lack of connection between the actual cover and the endband structures should be considered cautiously, as many mediaeval

European bindings have lost their outer components, potentially distorting our current understanding.

On the other hand, the endband core with two-step link-stitch sewing on the top edge introduces a remarkable difference, unrecorded so far but evocative of ancient practices. In truth, it resorted to a sewing technique that was known all-around mediaeval Europe for quite a few centuries by the time the Alcobaça production began.³⁹ Interestingly, instead of being applied directly to the bookblock, as was typical, the sewing was executed beforehand on a separate element—the core. There may also be connections to other ancient methods. For example, although resulting in a distinct structure, the entrance of the first sewing into the boards as the cores are laced (Fig.5), is suggestive of Clarkson’s descriptions of the perimeter sewing he found on English endbands, that extend on the cover over to the edges of the boards (1993, pp. 196-197). Alternatively, this could also draw parallels with early Eastern techniques, where the endbands were similarly extended and, in fact, sewn onto the boards (Boudalis, 2022). Therefore, it is tempting to consider this procedure an important (perhaps local) adaptation of older traditions, but this remains conjectural at this point. The second sewing, which connects the quires, is relatively standard, incorporating a change-over, somewhat similar to early descriptions of the main sewing, in some of the earliest surviving European examples (Szirmai, 1999, p. 96). On the other hand, the combination of saddle, zigzag, and whip stitches observed in step 7b appears to be a new finding. None of

³⁹ Both Szirmai (1999, pp. 38-40) and Boudalis (2022, p. 72) consider the link-stitch one of the earliest endband sewing techniques.

these stitches, whether used individually or in combination, are frequently documented in mediaeval endband records. While it is unlikely that experienced mediaeval bookbinders and craftsmen were unfamiliar with these stitches, the specific combination observed adds a decorative dimension to the endbands that have not been documented so far.

Nascimento & Diogo (1984) considered the knot⁴⁰ and the round board lacing systems present in the Alcobaça collection regional solutions. Indeed, to the best of our knowledge, neither technique has been found elsewhere. Could the complex endbands described here be another distinctive feature of the ‘Romanesque’ Alcobaça production? The evidence points in this direction and highlights the importance of conducting large-scale comparative research to uncover valuable new insights into European bookbinding traditions. Despite this progress, much remains to be explored, particularly regarding mediaeval bookbinding practices, with a specific focus on western mediaeval endbands. Alcobaça is a good example, and if its endbands can be considered an identifying feature, Lévêque’s statement—about book production of Cistercian abbeys being distinguishable by their endbands, despite a relative diversity—is applicable to yet another Cistercian House, Alcobaça, where, as mentioned, there are at least four different endband formats, one of which is notably predominant and seemingly characteristic of the local mediaeval *scriptorium*.

Nevertheless, some of the choices made by the Alcobaça binder(s) remain puzzling, particularly the decision to use such a labour-intensive, complex structure when

simpler alternatives were available elsewhere in Europe, including at Clairvaux, with which Alcobaça shared strong connections. Why choose such a detailed and demanding process? The effort and intricacy required to handcraft these endbands are among the most captivating aspects. Given the significant travel and exchange during this period, particularly within religious contexts, it seems unlikely that this was the only method known. The technical skills required to create these complex endbands suggest that other simpler options could have been adopted as well. Another explanation may be the religious context in which these endbands were produced, as in a way, one could argue, they reflect the Cistercian ‘Ora et labora’ philosophy. Traversing multiple layers of thick, white-tawed skin during the final stages of the process, with the endband folded lining around perimeter edges, was strenuous and demanding, as realised during the reproduction of the models. An argument that may support this line of thought is that, contrary to the overall tendency, Alcobaça persisted in the use of white raw materials, which perhaps through a Cistercian lens, may have some specific meaning or attribute. One might even speculate about a possible colour rejection.⁴¹ Given the richness of the materials used for text illumination (Barreira, Melo, Araújo, & Casanova, 2016, p. 4) and the wealth and prominence of the monastery (Gomes, 2002, pp. 208-215), it is unlikely that this rejection was the result of lack of materials and not a conscious, possibly religious, decision. Yet another explanation could be the emphasis placed on the binding as a protective element for the bookblock, given the solidness of the structural elements and the

⁴⁰ An illustration of this system is provided by Nascimento & Diogo (1984) in the figures Alc. 145 and Alc. 136, on p. 56

⁴¹ Some Alcobanceses have a brown tanned cover and a decorative element of the cover sewn with a blue

strength and durability of the final work. It seems clear that the thought and effort put into these complex structures indicates how well Alcobaça mastered bookbinding techniques, particularly endband methods. Even after more than seven centuries, most of these endbands are in better condition than others produced with later techniques. Indeed, besides adding two extra sewing steps that ensured the connection between the quires, Alcobaça endbands were designed in such a way, that i) material tensions resulting from the opening of the book were very well-distributed through strong and resistant materials (namely the linings and cover materials); and ii) no element which had a greater potential to fail was exposed to major damaging agents. The multiple connections to the boards, through the strong skin materials used for the cores, linings and covers, as well as the parchment endleaves, ensured redundancy and durability. At the same time, the second sewing step, a critical structural component, was not dependent on the integrity of the core and its attachment to the boards, so even if the joint failed, the sewing could remain intact. Moreover, concealed under at least two layers of thick skin (i.e., the board lining and the cover), there was no way to access this secondary sewing, once the endband folded lining around perimeter edges and the extremely thick covers were added (unless these or nearby elements were damaged). With this design, the weaker thread is well protected, behind the other elements, while the strong skins from the cores, linings and cover ensure a solid and redundant board

thread. Despite having some expression within the surviving codices, none of these elements directly relates to the endband structures hereby described, therefore they were not explored in detail. Within this endband typology, only white skin materials were observed.

attachment. This means that tensions were well and individually distributed through multiple components, creating such a solid structure that if any individual element failed there were always several others to secure the entire book structure in place.

In summary, regardless the correct interpretation, one thing about Alcobaça bookbinding praxis is certain: the effort put into the various steps produced complex elements that primarily provided structural resistance, while at the same time resulted in a careful and rigorous work, somewhat austere but with a strong decorative impact. The decorative impact was achieved by i) the delicate and perfect stitching work (Casanova, 2022) and ii) the different textures/volumes produced by the overlapping of similar materials. The large number of endbands produced in this way—41—clearly indicates an established practice over a considerable period. Nevertheless, some questions remain: Did such practice result from an unintentional local interpretation of travelling traditions reaching the furthest west-end of Europe and the Al-Andalus? Or perhaps, was it a deliberate adaptation and/or fusion of local and ancient practices, which, as in so many other places, emerged as different solutions for the same questions, relating to book production? The fundamental question remains: Why choose such a difficult and complex system? Unfortunately, other types of sources (e.g. working tools, other objects produced using the similar crafting techniques, depictions in varied art forms, written records, etc.) that could provide insight seem to have not survived or remain unknown. Therefore, definitive answers are currently speculative. Nonetheless, Alcobaça endbands exhibit unique, complex endband structures that retain a Spartan beauty materialised in its neat

stitching and overlapping textures and shapes of white materials. In the end, they seem to encapsulate the perfect balance between different aspects of Cistercian devotional life—from the hardworking production process to the austere use of raw white colours and materials—, incorporating centuries-old craftsmanship to create some of the highest-quality, best-protected books of the era, enriched with stunning visual textures.

Conclusions

One of the goals of this paper was to demonstrate that the study of western mediaeval endbands methods can provide new insights into local bookbinding production practices. While the rounded shape of the tab and board linings clearly places the Alcobaça endbands within a western mediaeval production, and the use of a white-tawed skin core laced into wooden boards allowed to classify them as ‘Romanesque’, three distinctive features emerge: the endband core with two-step link-stitch sewing on the top edge, the predominant Alcobaça round lacing system, and the endband folded lining around perimeter edges with saddle and zigzag stitches. These elements are unique to a ‘Romanesque’ production at the Alcobaça scriptorium. The reasoning behind the choice of such a complex structure may remain speculative, but the evidence it left behind is unequivocal: it was a labour-intensive yet sturdy practice, established at a certain point in time, likely influenced by inherited ancient traditions, and used consistently over a significant period. This practice had a notable impact on local production and contributed to the high survival rate of these structures. Furthermore, as demonstrated, the Alcobaça endbands provide a valuable

opportunity to better understand Portuguese endband structures prior to the more commonly found ‘Gothic’ formats, underscoring the relevance of further research in the area.

Glossary

Board attachment system: Means by which boards are attached to bookblocks. In Alcobaça, the most common are different types of lacing.

Boards: Rigid components placed at the left and right side of a bookblock offering it protection and support.

Bookblock: Entirety of the leaves/quires bound together.

Change-over: A stitch formed at the stations where the thread passes from a quire to the following.

Chemise: Secondary covers fitted over a primary cover and often held in place without adhesive by sewn pockets which fit over the fore-edges of the boards. In Alcobaça this format is frequently used as a primary cover, only with board linings under it. (Clarkson, 1993, Figs.1 & 13)

Cover: Material(s) that cover the bound bookblock and (if present) the boards. (Fig.1f)

Endband core: Piece of material that supports an endband sewing. (Fig.1b)

Endband core with two-step link-stitch sewing on the top edge: A particular compound of Alcobaça endbands, in which a skin-based core receives a crowning two-step link-stitch sewing. (Fig.2, step 2)

Endband cross-stitch: Type of endband secondary sewing in which the sewing thread employs a figure 8 sewing, creating a cross-pattern. (Szirmai, 1999, Fig.8.16)

Endband facing lining: Pieces of material, often fabric, facing the side of the tab turned

towards the bookblock. It is often secured to the tab lining and cover through a perimeter sewing, around these three elements, round edge. (Lévêque, 2020, Fig.127)

Endband folded linings around the perimeter edges: Piece of skin-based material used in the Alcobaça bindings. It is folded over the rounded shapes of the tab lining and the horizontal board lining and secured to these elements by either a saddle-stitch (7a) or a saddle, zigzag and whip-stitches (7b). (Fig.2, step 7)

Endband secondary sewing: The endband sewing which wraps around a sewn endband core but which is not tied down into the bookblock. It is mostly decorative and has little to no structural functional. There are different types of endband secondary sewing.

Endleaves: Groups of leaves placed at each side of a bookblock, offering protection to the text leaves of the bookblock.

Fore-edge: Side of a book from where it is opened, opposite to the spine.

Head: Upper side of a book, opposite to the tail.

Herringbone sewing: Sewing in which the sewing thread exits the quire, passes in-between the two parts of a double support, is taken around one of the parts of the support, passing behind the previous quire, and continuing around the other part of the support, forming two stacked rows of diagonal lines that create an arrow pattern. (Szirmai, 1999, Fig.8.5a)

Horizontal board linings: Piece of skin-based material placed on the head/tail of the book. Running on the outside of the boards, at a maximum height that reaches the outermost sewing support, its maximum length extends from the fore-edge of the left board to the fore-edge of the right board. Along the edges of the boards, it is turned in on the inner side of the boards. At the spine, it extends

over the edge of the bookblock, in a round shape. This extended shape is secured to a tab lining with the same form, by an endband folded lining around the perimeter edges and either a saddle-stitch (7a) or a saddle, zigzag and whip-stitches (7b). (Fig.2, step 6)

Integral sewing: Type of sewing in which the endbands are sewn as integral parts of the main sewing (Szirmai, 1999, Figs.8.7 & 9.8)

Knot lacing: Lacing system in which the support/core enters the board through its thickness, heads to a channel on the outer side of the board, then to another channel on the inner side of the board and ends in the middle of the outer side channel, traversing itself. (Nascimento & Diogo, 1984, p. 56, Figs. Alc. 145 and 136)

Left side: All components on the left side of a book open at the centre.

Link-stitch: Stitch in which the sewing thread is taken down and round the thread, forming linked chains. (Fig. 3, model 1; Szirmai, 1999, Figs.2.1a & 3.6a)

Long lacing: Lacing system in which the support/core enters the board through its thickness, heads to a channel on the outer side of the board and then to another channel forward on the inner side of the board, ending with the a securing element on a hole traversing to the outer side of the board (Nascimento & Diogo, 1984, p. 55, Figs. Alc. 425; Szirmai, 1999, Figs.8.10g)

Packed sewing: Type of sewing that uses additional loops to compensate the size of other components. (Szirmai, 1999, Fig.8.5c)

Perimeter sewing: Sewing applied to the rounded edges of the tab lining and and of the cover (or, in case of Alcobaça, horizontal board lining or primary cover) and, in certain cases of the endband lining, securing them together. (Szirmai, 1999, Fig.7.26)

Primary cover: The first, and often only, cover on a binding, and which could serve as the finished external surface of the binding.

Quires: A group of folded or single leaves which can be used either singly or with other gatherings to create a textblock.

Reinforcement sewing: Sewing done on the head and tail of a bookblock (Lévêque, 2020, Figs.83 & 93-96)

Right side: All components on the right side of a book open at the centre.

Round lacing: Lacing system in which the support/core enters the board through its thickness, heads to a channel on the outer side of the board, then to another channel on the inner side of the board and ends in the same place it entered, at the thickness of the board (Nascimento & Diogo, 1984, p. 53, Figs. Alc. 159; Szirmai, 1999, Figs.8.10k)

Saddle-stitch: Stitch in which the sewing thread employs a figure eight sewing in one direction, that returns backwards to the original starting point, forming a continuous line. In Alcobaça it is used in the seventh step of both Romanesque endband variants. (Fig. 10a)

Sewing support: Pieces of material placed across the spine of a bookblock to or through which the quires are sewn.

Short lacing: Lacing system in which the support/core enters the board through its thickness, heads to a channel on the inner side of the board and ends with a securing element on a hole traversing to the outer side of the board (Nascimento & Diogo, 1984, p. 54, Figs. Alc. 1; Szirmai, 1999, Figs.8.10a)

Short lacing entering from the outside of the board: Lacing system in which the support/core enters the board through a channel on its outer side, heads to a channel on the inner side of the board and ends with a securing element on a hole traversing to the outer side

of the board (Nascimento & Diogo, 1984, p. 56; Szirmai, 1999, Figs.9.33b)

Slips (of sewing supports): Part of the sewing supports which are used to ensure the board attachment.

Spine: Side of a book where the leaves are held together, opposite to the fore-edge.

Straight sewing: Bookblock sewing in which the sewing thread employs a figure eight sewing around a double support forming two stacked rows of vertical lines. (Szirmai, 1999, Fig.8.5b & c)

Tab lining: Piece of material, usually skin-based, that helps support an endband sewing. It extends over the edge of the bookblock with a variety of profiles, more often round. It may be connected to the cover behind it and or to an endband facing lining in front, through several means, like a perimeter sewing or an endband folded lining around perimeter edges. (Fig. 2, step 4)

Tail: Lower side of a book, opposite to the head.

Tie-downs: Lengths of thread taken down into the gatherings at head or tail of the spine which provide the structure of the endband, and, where there is a core, secure the core to the bookblock. (Fig. 2, step 5; Lévêque, 2020, Figs.93-96)

Two-step link stitch: Stitch in which the sewing thread is taken down and round the thread 2 steps backward, forming linked chains. In Alcobaça it is used to crown the endband core. (Fig. 3, model 3; Szirmai, 1999, Figs.2.1c & 3.6b)

Whip-stitch: Stitch in which the sewing thread employs a helical sewing, forming, more or less, parallel diagonal lines. (Fig. 10c)

Wound (primary) endbands: Endbands in which the sewing thread winds around a support. May have a secondary sewing on top. (Szirmai, 1999, Fig.816e)

Zigzag-stitch: Stitch in which the sewing thread employs a helical sewing, before returning backwards to the original starting point, forming a zigzag line. (Fig. 10b)

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A Study on the Causes and Types of Endband Deterioration in Byzantine and related Eastern Mediterranean Binding Structures

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ABSTRACT

Endbands are important components of medieval bindings both in structural and decorative terms. This paper provides an overview of the various types and patterns of damage observed in the endbands of Byzantine and related bindings from the eastern Mediterranean. Due to their unique construction, these bindings exhibit specific vulnerabilities related to shelving, handling, and the subsequent effects on the preservation of their endbands. Understanding the causes, mechanisms, and outcomes of endband deterioration is essential for their proper conservation. This study is the first to explore this issue in detail, offering an initial investigation of the topic rather than an exhaustive analysis. The article focuses on endbands found in manuscript books bound between the 10th and 18th centuries, with most of the accompanying photographs featuring books from the St. Catherine's Monastery Library in Sinai, Egypt.

1. Introduction

The term endband designates two bands worked in different ways with threads at the head and tail edges of the spine of a bound book, with the threads usually passing through the gatherings, boards and spine lining.¹ Endbands are one of the most intriguing features of hand-bound books, influencing not only their structure and functionality but also their aesthetic appeal. They have played a particularly significant role in the binding traditions of the Eastern Mediterranean, including Armenian, Byzantine, Coptic, Ethiopic, Georgian, Islamic, Samaritan, and Syriac cultures. These traditions share several key technical characteristics that set them apart from Western European bindings after the 8th century. Notably, they include the sewing of gatherings without sewing supports, smooth spines, endbands that extend and are sewn onto the board edges (except in Islamic bindings), and bookblocks which are cut flush with the boards. This introductory section briefly considers the role of endbands in the structure and function of Eastern Mediterranean bookbindings, along with their classification, terminology, and the relevant prior research.

1.1. Previous research.

Research specifically focused on endbands is relatively limited, particularly regarding the binding traditions of the Eastern Mediterranean.² In 1983, Monica Gast, building on Karl Jäckel's work, *Das Kapital*, described seven types of endbands in Eastern Mediterranean bindings. In 1986, Jane Greenfield and Jenny Hille's book *Headbands and How to*

Work Them discussed five types of endbands found in Armenian, Coptic, Ethiopic, Greek, and Islamic codices. A 1989 publication from the Bibliothèque Nationale de France, *Les Tranchefiles Brodées: Étude Historique et Technique*, described approximately fifteen types of endbands or their components in Eastern Mediterranean bindings. The author of the present paper has contributed to the literature with two articles published in 2007 and 2016, which presented additional examples of endbands in Byzantine and post-Byzantine bindings. In 2019, Karin Scheper published a detailed study on the endbands in Islamic bindings. Most recently, in 2023, the author of the present paper published the most comprehensive account to date, describing more than 50 distinct endbands and variations from Armenian, Byzantine, Coptic, Ethiopic, Georgian, Islamic, Samaritan, and Syriac binding traditions, many of which had not been previously documented.

The growing body of specialised literature and the identification of more endband types indicate rising interest in the field. As more endbands are likely to be discovered in libraries and collections around the world, it is now reasonable and important to explore the mechanisms and causes of their deterioration, which will ultimately aid us approach the issue of their conservation in a more consistent and accurate way.³

1.2. The Role of Endbands.

The original function of endbands was to reinforce and protect the two edges of a book's spine, much like edge-finishing techniques

¹ The term endband was coined by Christopher Clarkson. see <https://www.ligatus.org.uk/lob/concept/2370>

² For a complete bibliography on the subject see Boudalis 2023, pp. 7,8.

³ On the issue of endband repairs in Greek-style Byzantine and post-Byzantine bindings see for example Honey, A., and N. Pickwood. 2010, Marshall, H. 2023, Thompson, S., Duminuco C. & Foley S. 2023, Boudalis, 2024.

work in fabrics.⁴ Subsequently, their role has been extended to include the reinforcement of the connection between the bookblocks and the boards, as well as the decorative enhancement of books. In most Eastern Mediterranean binding traditions endbands were essential structural components, compensating for the lack of sewing supports until as late as the 17th or 18th centuries. In this context, endbands function similarly to sewing supports in Western bindings, reinforcing the connection between the bookblock and the boards. They also help soften the curve of the spine when the book is opened, reducing stress on the sewing and the bookblock-board connection. In some bookbinding traditions, such as the Islamic one where fewer sewing stations are used, endbands provide stability by acting as additional sewing stations at the head and tail of the bookblock.⁵

In all the bookbinding traditions that evolved around the Eastern Mediterranean (with the sole exception of the latter Islamic bindings), endbands extended and were sewn onto the edges of the boards, thus creating characteristic protrusions at the head and tail edges of a book. To our modern eyes, these protrusions seem unpractical, and in fact they are, for shelving books vertically, but at the time these bindings were used, books were stored horizontally. Vertical storage, at least in Greek-Orthodox monastic libraries, likely did not begin before the 18th century.⁶

⁴ *The similarity between fabrics and books is far from accidental. As has been stressed before, the very sewing structure of a codex sewn with unsupported sewing is the structure of a fabric. See Boudalis (2018), p. 59, and Boudalis, Boudalis (2023), pp. 22-24.*

⁵ *For a detailed consideration of the different functions and roles of endbands see Boudalis (2023), pp. 12-15.*

⁶ *Vertical shelving was introduced in the West around the 16th century and certainly much later in the Greek-speaking Orthodox monasteries where most of*

1.3. Structure and Classification.

Endbands can be classified as either simple or compound. Simple endbands are created in a single sewing operation, with the thread passing through both the boards and the bookblock. Compound endbands, on the other hand, involve at least two separate operations. The first (primary component) involves sewing through the boards and bookblock, while the second (secondary component) is worked around the primary component without passing through the bookblock (Figs. 1a, b, c).

Generally speaking, the primary component is perfectly functional and structurally efficient on its own and for these reasons it is generally assigned a structural role to the book structure, as opposed to the secondary component which is often assigned a decorative role. Although this is certainly a useful distinction, in reality it is not always true for two reasons:

1. There are endbands in which the primary component cannot really be, and in fact is never used, without the secondary component, for example as in the typical endbands of Ethiopic and Islamic bookbindings.
2. The working of a secondary component around a primary one, has been shown to clearly enhance the sturdiness and structural efficiency of the whole endband and therefore its role cannot be considered only decorative.⁷

Greek manuscripts are preserved. Specifically for Sinai this change must have probably happened around 1734 when a proper library was built by Archbishop Marthales.

⁷ *See for the example how the working of a secondary twined component in a compound Byzantine endband affects the opening characteristics of the book Boudalis (2023), Figs. 1.4a-c.*

The differences in structure between simple and compound endbands also lead to different patterns of deterioration, underscoring the importance of understanding their construction for effective conservation.

1.4. Terminology.

The terms used in this paper generally conform to the Language of Bindings thesaurus⁸, while the names of the different endbands considered in the text and photograph captions

follow the terminology developed by the author in his book on the endbands in the bookbinding traditions of the Eastern Mediterranean.⁹ This terminology is primarily technical trying to avoid, whenever possible and meaningful, ethnic, and religious terms, like Islamic, Byzantine, Greek etc., in order to stress the common technical ground on which most of the endbands of the different binding traditions of the Eastern Mediterranean, developed.

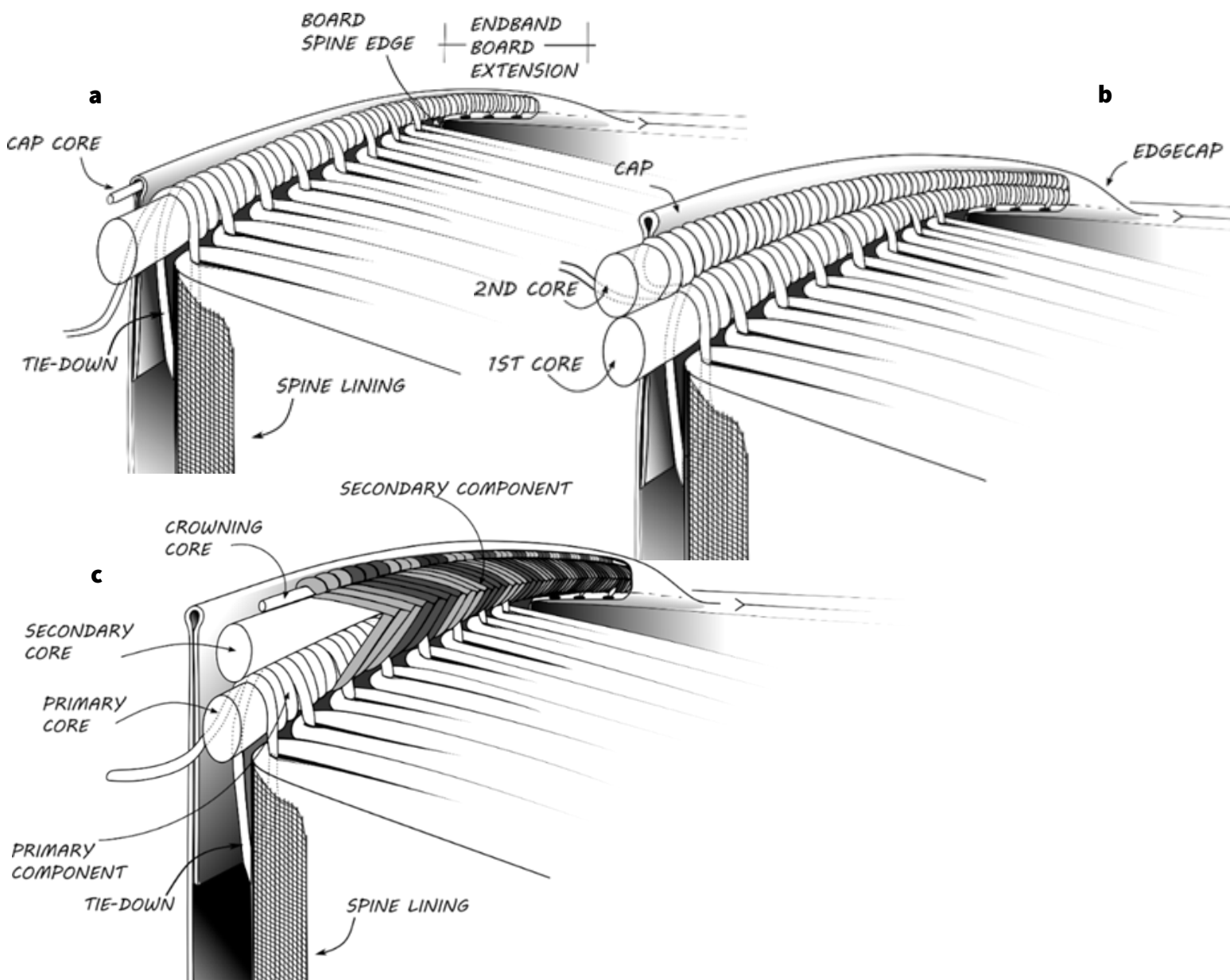


Fig. 1: The anatomy of a simple endband with one core (a), a simple endband with two cores (b) and a compound endband (c) on a typical Byzantine binding.

⁸ See <https://www.ligatus.org.uk/lob/>

⁹ Boudalis 2023, pp. 27-36.

2. The Materials and Techniques Used for the Making of Endband

Most endbands in Byzantine and related bindings consist of one or more cores positioned at the head and tail edges of the bookblock, extending onto the edges of both boards (Fig. 1a, b).¹⁰ In compound endbands, the cores may be part of the primary and/or secondary component (Fig. 1c).¹¹ The most common material used for endband cores is cord, though tanned leather, tawed skin, parchment, rolled textiles or paper, and occasionally a combination of leather and wood shavings are also used, albeit rarely.¹²

The threads used for sewing the part of the endband that passes through the bookblock and boards are typically made of linen or hemp, with cotton being a rare alternative. In Islamic bindings, however, silk threads are commonly used for this purpose. For compound endbands, the secondary component is usually sewn with coloured silk or cotton threads, often in bold, contrasting colour combinations. In more luxurious bindings, metal threads are also used for the secondary component. These consist of a silk thread (often yellow) tightly wrapped with a thin strip of silver or gilt silver.¹³

Several techniques have been identified in the Eastern Mediterranean bookbinding

traditions for creating structural endbands.¹⁴ These include sewing¹⁵, twining¹⁶, weaving¹⁷, soumak¹⁸, interlacing¹⁹ and braiding²⁰, with sewing being by far the most common method. As we will discuss in greater detail below, these techniques vary in the number and type of components used, as well as the stages required to complete them. Both of these factors significantly influence the durability and long-term preservation of the endbands.

3. The Causes of Deterioration

The deterioration of endbands is typically the result of multiple factors, which can be broadly classified as internal and external, though in practice, it is usually a combination of both.

3.1. Internal causes of deterioration

Internal causes of deterioration are primarily related to the materials and techniques used in the construction of the endbands. Some materials are inherently more durable than

¹⁰ There is only one type of endband, and two types of primary components of compound endbands without cores. See Boudalis (2023), pp. 71-75, 179,180, and 185,186.

¹¹ For endbands with cores only in the secondary component see Boudalis (2023), pp. 185-186, 192-195, 256-265.

¹² In a total of 2453 bound codices surveyed for the purpose in the St. Catherine's Monastery library cord was used in 2150, tanned leather in 215, alum-tawed skin in 53 and parchment on 17. See Boudalis (2023), pp 36, 37, fig. 2.7.

¹³ On metal threads see Karatzani (2008), Timár-Balázsy and Eastop. (1998), pp. 128-135

¹⁴ Structural endbands are those that are sewn through the bookblocks and possibly also the boards, as opposed to the non-structural endbands which are connected only through adhesive, as is the case with the stuck-on endbands. On the latter see <https://www.ligatus.org.uk/lob/concept/2540>

¹⁵ Sewing is a technique based on the use of thread/s and needle/s in order to sew endband around and through the gatherings of a bookblock, usually with the incorporation of one or more core/s.

¹⁶ Twining is a fabric-making technique based on the use of warps and wefts, in which at least two wefts interact between them. See Boudalis 2023, pp. 175-177.

¹⁷ Weaving is a fabric-making technique based on warps and wefts in which wefts are used single. See Boudalis 2023, pp. 174-176

¹⁸ Soumak is a type of weaving in which the wefts are used single and are wrapped around the warps. See Boudalis 2023, pp. 277-280.

¹⁹ Interlacing is based on the passing of one element through another one made of the same material. See Boudalis 2023, pp. 287, 296-301.

²⁰ Braiding is based on the oblique interlacing of one set of elements sharing a common starting point and worked with loose ends. See Boudalis 2023 pp. 287-289.

others. For instance, linen and hemp threads are generally more robust than cotton and silk, although thread thickness is also a critical factor—thinner threads are naturally weaker than thicker ones.²¹ Regarding endband cores, cord tends to withstand time and use much better than tanned leather, which can deteriorate severely due to red rot, eventually leading to disintegration and breakage. Alum-tawed skins, on the other hand, are generally more resilient than tanned leather. Parchment, particularly parchment strips used in twined endbands, may become stiff and inflexible over time, making them prone to breaking. A notable example of deterioration involves a still partially unidentified combination of materials—including animal glue, leather, and wood shavings—used as a flat core for certain elaborate and highly decorative twined endbands in luxury Byzantine bindings from the 15th century. Over time, this material stiffens and becomes inflexible, leading to breaks along the bookblock²².

The technique used to create an endband also influences its vulnerability to wear. Certain techniques are more prone to deterioration than others. For example, in twined endbands—the most widespread and varied technique in Eastern Mediterranean book-binding traditions²³—it is common for the warps (usually made of thin threads) to break. In tablet-woven endbands, the threads attaching the endband to the book's edge are similarly prone to damage.²⁴ Twined endbands in Islamic bindings, with their horizon-

tal arrangement at the head and tail of the bookblock, are particularly susceptible to abrasion when books are shelved vertically. In contrast, Byzantine twined endbands are arranged vertically, meaning that when books are shelved vertically, the actual twining does not touch the shelving, though the warps may still wear down over time, subsequently compromising also the twined threads (compare figures 26 and 28).

Secondary components of compound endbands are often more vulnerable to wear because they are more exposed than the primary components. It is also possible for the secondary component to deteriorate without significantly affecting the primary component, though the reverse is usually not true. If the primary component is damaged or worn out, it will eventually compromise the secondary component as well.

Binding imperfections can also contribute to endband deterioration. For example, overly tight board attachments or endband sewing can generate tension over time, especially with repeated opening and closing of the book. This tension can cause breaks, particularly at the joints. A case study involving two volumes bound in the Klimis atelier around 1560–1570 illustrates this point (Figs. 2, 3). Both volumes were bound using the same materials and techniques. The primary endband components in both cases are of the Slanted-on-two-cores type, and the secondary components are Byzantine twined endbands without additional cores, made with light blue and pink silk threads twined around warps of the same pink thread used double.²⁵ Both volumes exhibit the same pattern of end-

21 *On the structure, characteristic and deterioration of different threads see Timár-Balázs and Eastop (1998), pp. 3-36.*

22 *For endbands with this core material see Boudalis 2023, pp. 38, 192-195.*

23 *For twined endbands see Boudalis (2023), pp. 172-254.*

24 *See Boudalis (2023), pp.256-265.*

25 *Unlike all other twined endbands known, the warps in these endbands are not only wrapped around the primary component but are actually sewn through the bookblock.*

band breakage at the head and tail joints between the front board and the bookblock (the right board in the Arabic codex Sinai Arabic 76, which reads right to left, and the left board in the Greek codex Sinai Greek 420, which reads left to right). In both cases, the only remaining connection between the bookblocks and the boards are the silk threads from the secondary, twined endband components. This specific breaking pattern suggests structural problems, likely caused by tensions generated during the attachment of the boards and the frequent opening and closing of the books. The fact that the breakage occurs in the front boards of both volumes is significant, as that board is opened and closed far more frequently than the back. However, there are also cases in Byzantine bindings where the opposite occurs—the right (back) board endbands break at the joints (see [Figs. 9 -11](#)).

One of the most critical factors contributing to endband deterioration is the lack

of a leather cover on the spine, especially around the tie-downs and endbands. Due to the presence of the tie-downs and potentially inadequate stretching of the leather during adhesion to the book's outer face, the leather in these areas often adheres poorly, leading to detachment and splitting. This loss of the covering directly accelerates endband deterioration. ([Figs. 14-24, 26, 29-31](#)). It is common to see endbands damaged along the spine where the cover is missing but still intact on the board edges where the cover remains in place over the tie-downs ([Figs. 20, 21, 29, 31](#)). In some cases, even though the endband itself remains sound, the bookblock may be damaged, leading to the separation of the endband from the bookblock—not due to broken tie-downs, but because of extensive damage to the spinefolds of the bookblock gatherings. This is, for example, the case with the codex Sinai Greek 277 ([Fig. 4](#)).



Fig. 2: *The Byzantine-twined-without-additional-cores headband of codex Sinai Greek 420, written in the 10th – 11th century, rebound in the Klimis atelier around 1560-1570."The breaking is in the left (front) board of the codex*



Fig. 3: The Byzantine-twined-without-additional-cores tailband of codex Sinai Arabic 76, written on paper in the 13th century, rebound in the Klimis atelier around 1560-1570. The breaking is in the right (front) board of the codex.



Fig. 4: The split-chevron-with-crowning-core headband of codex Sinai Greek 277, written on parchment in 1308, possibly rebound at a later date.

3.2. External causes of deterioration.

External causes of deterioration are related to the storage environment and how books are used and handled. Common types of damage include soiling, dust accumulation, colour fading, and superficial wear from abrasion, all of which result from improper shelving, unsuitable storage conditions, and careless

handling. For example, the original horizontal shelving of these books, rather than the vertical storage introduced much later, would have prevented much of the abrasion damage to the endbands. Books bound with endbands extending onto the board edges and protruding beyond them were not made to be stored vertically. Yet, this method became the norm over the centuries and is still common in many libraries today. Storing vertically books bound with unsupported sewing puts extra weight on the tailband and strains the joints between the boards and the bookblock, particularly in heavier volumes. This storage is especially harmful to books and endbands that are already compromised, further accelerating their deterioration (Fig. 5). A bound codex that remains relatively intact, with its leather cover still in place around the boards and endband and with its sewing structure holding firm, can withstand vertical shelving much better than a codex that has already suffered damage and loss, like several of the examples shown in this article. For codices like Sinai Greek 420 and Sinai Arabic 76 (Figs. 2, 3), it is evident that vertical storage would only worsen the condition of their already damaged endbands. However, if stored horizontally and handled minimally, these books could remain stable until repairs are undertaken.

Headbands damaged from pulling a volume off the shelf by the headband is also a possibility when books are shelved vertically, but this type of damage does not appear to have been common. This may be because manuscript books saw much less frequent use after the rise of printed books. Such damage might be more commonly found in bound printed books, whose endbands fall outside the scope of this article.



Fig. 5: Codex Sinai Greek 213, written on parchment in 967 in its original binding. Until recently the codex was shelved in a vertical position, a fact which contributed to the complete loss of its tailband.

4. Types of Endband Deterioration

In line with the distinction between internal and external factors of deterioration, the types of damage to endbands can be categorised as either superficial or structural.

In the simplest cases, an endband may become dusty, soiled, tarnished, or experience colour fading or alteration. These types of damage are superficial and generally do not compromise the endband's structural integrity.

In more severe cases, the deterioration of an endband can compromise its primary or secondary components, affecting the physical integrity of the endband's cores and threads, and thereby its overall structure. Depending on the extent and severity of the damage, deterioration of secondary components often requires minimal intervention. However, when the primary components are affected, more extensive repair is typically necessary.

The most common types of damage are discussed below, with examples primarily drawn from the library of St. Catherine's Monastery in Sinai, Egypt. Most of the accompanying photographs are from bound codices preserved in this collection. To avoid repetitive citations, specific references to binding ateliers or types of endbands mentioned in the captions are not provided. For full details on these, readers are encouraged to consult the author's PhD research and that of Nikolas Sarris' work, while for the latter the author's 2023 book.

4.1. Superficial damages

One striking feature often noted by those who encounter original Byzantine or similar bindings in monastic libraries is the vivid colour of the silk threads used for the secondary

components of compound endbands. This is largely because these books were rarely exposed to daylight, especially as they gradually fell out of use for reading with the rise of printed books. However, there are instances where clear signs of discolouration in the silk threads are visible, even though the threads themselves might still remain structurally sound (Fig. 6).

Endbands can also become soiled, sometimes as a result of the process of decorating the book edges with colours. Over time, dust and dirt may accumulate, especially when books are stored vertically (Figs. 7, 8). While such issues may affect the appearance and aesthetic appreciation of the endbands, they rarely pose serious risks to their functionality or long-term preservation.

Although the wear, fraying, or even loss of silk threads used in the creation of the secondary components in compound endbands may seem like a superficial issue, they are classified here as structural damage. This is because such deterioration affects the material integrity of the threads, which are an essential component of every endband.

4.2. Structural damages

Structural damage to endbands can be categorised into two main types: damage to the cores and damage to the threads. While these two forms of deterioration do not always occur together, they are often interdependent. Damage to one can influence the other, as the integrity of the endband relies on both components functioning together. For instance, weakened threads may fail to hold the core in place, leading to structural instability, while a damaged core can cause undue stress on the threads, accelerating their wear.

4.2.1. Damages to the core/s

Although some endbands exist without cores, either as simple endbands or as primary components of compound endbands, the inclusion of cores significantly enhances their structural strength and durability. As mentioned in the introduction, endbands play a crucial role in reinforcing the connection between the boards. The more cores an endband has, and the thicker they are, the stronger this connection be-

comes. Endband cores serve as the foundation upon which different types of endbands are constructed, making their condition directly linked to the overall integrity of the endband.

The most common form of damage to endband cores is breakage, particularly at the joints between the boards, or complete loss of the cores. This damage often leads to the partial or total loss of the endband itself.



Fig. 6: The Byzantine-twined-without-additional-cores headband of codex Sinai Greek 980, written in 1475 in its original binding. Both the green and reddish threads have faded. The original colours are discernible in the areas less exposed.



Fig. 7a, 7b: The Full-wrapped-on-multiple-additional-cores-rounded-twined tailband (a) and headband (b) of codex Sinai Greek 1293, written on paper in mid-fifteenth century in its original binding. Although both endbands are soiled the top one is much more than the bottom, almost completely covering the bright colours of the silk threads used.



Fig. 8a, 8b: The Split-chevron-and-crowning-bead tailband (a) and the headband (b) of codex Sinai Greek 747, written on paper in the 15th century, rebound in the Giglio atelier around 1622-1655. Due to the vertical shelving of the codex the headband has accumulated dust while the tailband one preserves the original colours in very good condition.

4.2.2.1. Core/s broken at the joint/s with the board/s

A common type of damage to endbands is the breakage of the core/s, typically occurring at the joints between the bookblock and the boards. This damage highlights the tensions present in these critical areas of a bound book, particularly when these tensions are unevenly distributed along the joint. This may explain why such damage often affects only one of the two boards of a volume, as demonstrated in the examples of books bound in the Klimis atelier (Figs. 2, 3). In some cases, the damage may even occur in one of the two endbands on the same board.

Occasionally, the broken endband core(s) coincide with the breaking of the connection between the respective boards and the bookblock (Fig. 9). However, there are instances where these connections may be entirely compromised while the endbands—at least their cores—remain relatively intact, thereby still holding the boards attached to the bookblocks. Conversely, it is also possible for endband cores to be broken at the joints with the boards while the boards themselves are still securely connected to their bookblocks (Fig. 10).



Fig. 9: . The Slanted-stitch-on-two-cores headband of codex Sinai Greek 1222, written on parchment in the 13th century in its original binding. The core is broken both at the headband and the tailband of the right (back) board, which is in fact now completely detached from the book



Fig. 10: The split-chevron-with-crowning-chain-stitch headband of codex Sinai Greek 1106, written on paper in 1478, possibly rebound at a later date. Although the core is broken at the joint the board is still attached to the bookblock through the bridling, spine lining and leather cover.



Fig. 11: The Byzantine-twined-without-additional-cores headband of codex Sinai Greek 968, written on parchment in 1426, in its original binding. The left (front) board of the codex is lost together with the extensions of the endband on its head and tail edge.

4.2.2.2. Core/s broken along the bookblock

The breakage of the core along the bookblock typically results from either a failure in the sewing at that point or from the decay of the core itself. Most cores in the endbands of Byzantine and related bindings are made of cord, which can endure considerable mechanical stress; however, they are still susceptible to occasional breakage. In the case of codex Sinai Greek 968 (Fig. 11), the breakage of the endband cores along the bookblock is due to failures at some of the sewing stations, while in codex Sinai 20 (Fig. 12), although both the headband and tailband are broken at the joint between the bookblock and the left (front) board, only the headband exhibits breakage along the bookblock. This particular breakage corresponds to damage in the sewing of the bookblock toward the head edge, as evidenced by a visible crack in the leather cover and label on the spine.

Cores made of leather and parchment appear to be weaker and more prone to breakage along the bookblock. Parchment strips, which were sometimes employed, particularly in tablet-woven twined endbands, can also break, as shown in the example from Aristotle University (Fig. 13). Tanned leather is especially vulnerable to red rot, which can lead to severe deterioration, breakage, or even disintegration (Fig. 14). Additionally, a loss of flexibility may contribute to the breakage of cores. This is the case with the core in codex Sinai Greek 152 (Fig. 15), which is composed of an unidentified combination of materials—possibly leather and wood shavings mixed with animal glue—that has hardened over time, rendering it inflexible.



Fig. 12: The slanted-stitch-on-two-cores headband of codex Sinai Greek 20, written on paper in the 15th – 16th century, possibly in its original binding. The core is broken in the join between the left (front) board and the bookblock but also along the bookblock.



Fig. 13: The tablet-woven twined headband of codex Aristotle University Library 43, written on paper in the first half of the 16th century in its original binding. A failure of the sewing of the bookblock in a specific opening, combined with the stiffness of the parchment core resulted in the breaking of the endband's parchment core and its tie-downs.



Fig. 14: The front-bead-with-two-threads headband of codex Sinai Greek 1630, written on paper in the 16th century in its original (?) binding made in the context of the Cairo metochion atelier around 1633-1635. A combination of the red rot of the thin leather core and the repeated opening and closing of the book resulted in the breaking of the core in several points and the subsequent loss of the secondary component.



Fig. 15: The full-wrapped-on-multiple-cores-flat-and-vertical-twined headband of codex Sinai Greek 152, written on parchment in 1346, probably in its original binding. The endband is severely damaged as a result of the deterioration and breaking of the endband core.

4.2.2.3. Loss of core/s.

The loss of an endband's cores, even if only partial, often leads to the degradation of all other components of the endband (Figs. 15, 16). However, there are instances where one or more cores may be entirely or partially missing, yet some parts of the endband can still remain intact (Fig. 17). A notable example is codex Dumbarton Oaks MS 3, where, despite the loss of the originally flat core, the intricate twined endband continues to be in place. Nevertheless, the absence of the core means that it no longer serves any structural function (Fig. 18).²⁶

In compound endbands, which feature second and third cores added through

the sewing of the secondary component—referred to as additional cores—the loss of these added cores does not always compromise the primary component. Because these additional cores are sewn only around the primary component and not through the bookblock and boards, the primary component of the endband may remain intact, preserving much of the endband's structural integrity (Fig. 19).

In extreme cases, although the endband may be nearly entirely lost, small remnants can sometimes be found along the edges of the boards. These remnants can provide clues about the original endband, including the technique used in its construction, such as sewing or twining (Figs. 20, 21).

²⁶ The neatness of the surviving endband and the lack of any residues of the lost core and the adhesive used to attach the warps to the spine of this book probably indicate that the preset condition is to some extent the result of some intervention. For this endband see Boudalis 2023, pp. 192-195.



Fig. 16: The split-chevron-with-crowing-chain-stitch headband of codex Sinai Greek 263, written on parchment in the 12th century, rebound at a later date. For unclear reasons almost half of the endband is missing, including all components, that is, the first rolled parchment core, the second cord core, and the thread used.



Fig. 17: The Byzantine-twined-without-additional-cores headband of codex Sinai Georgian N 26 N, written on parchment in the 9th – 10th century. Part of the endband is lost because the right (back) board on which it was sewn and extended is lost.



Fig. 18: The full-wrapped-on-multiple-additional-cores-flat-and-vertical-twined headband of codex Dumbarton Oaks MS 3, written in 1084, rebound in the first half of the 15th century. The original core of the endband is completely lost and the tie-downs/warps which were originally attached to the spine are now detached.



Fig. 19: The split-chevron headband of codex Sinai Arabic 423, written on paper in 1626 in its original binding made in the context of the Giglio atelier around 1622-1655. The endband has lost the second (and possibly a third, crowning) core together with part of the secondary component sewing.



Fig. 20: The head edge of codex Sinai Greek 211, written on parchment in the 9th century, possibly in its original binding. The endband is completely lost, only some of the threads attaching it to the edges of the boards still survive.



Fig. 21: The head edge of codex Sinai Greek 1194, written on paper in 1491 in its original binding. The headband is almost completely lost but the tiny parts surviving on the boards are still enough to establish the type of endband and the materials used, in this case a Byzantine-twined-without-additional-cores endband with the typical materials and colours used in Cretan bindings of the late 15th and 16th centuries.

4.3. Damage of the Threads in Simple Endband

This category of damage pertains to the threads used in the sewing or construction of a simple endband. When the threads are damaged, it typically affects both the functioning of the endband around the cores and the tie-downs, although there are cases where the impact may seem localised to just one or the other. The extent and severity of the damage can range from superficial wear or localised breaks (Figs. 9–12, 14), to significant loss of the threads, potentially compromising the structural integrity of the endband. In more severe cases, the damage can be extensive enough to cause the endband to lose all or part of its structural role (Figs. 16, 22–24).

As mentioned previously, the preservation of the leather cover of a codex plays a crucial role in the condition of the threads. When the leather cover is compromised, especially around the endband areas, the threads become vulnerable to various deterioration factors, including soiling, abrasion, breaking, and eventual loss due to improper han-

dling and shelving. The absence of the leather cover at the caps is particularly problematic; when these books are stored vertically, the endbands—especially the tailband—are left unprotected and are in direct contact with the shelving. This exposure can gradually result in damage from both abrasion and mechanical fatigue of the tie-downs (Fig. 5). Furthermore, simple endbands and the primary component of compound endbands, are always sewn on top of the spine lining, so if this lining detaches from the spine, it can impose additional stress on the tie-downs, especially in areas where the cover is missing or detached altogether (Figs. 5, 22).

The condition of the threads is often indicative of the state of the underlying cores. For instance, damage to the cores, such as a broken core, will eventually lead to the deterioration of the threads surrounding it. Conversely, damage to the threads can also result in harm to the cores, creating a reciprocal relationship between the two.



Fig. 22: The wound-packed-on-core headband of codex Sinai Greek 213, written on parchment in 967. In its original binding. Most of the sewing of the simple endband through the bookblock is broken and lost although the core is still in place.



Fig. 23: The compact-chevron-on-single-core headband of codex Sinai Greek 1231, written in 1236, rebound possibly around the late 15th or first half of the 16th century. More than half of the endband is broken and lost, including the tie-downs.



Fig. 24: The slanted-stitch-on-two-cores headband of codex Veroia Municipal Library 3, written on parchment in the 14th century, probably in its original binding. Affected by the loss of the leather cover around it, the headband is severely damaged.

4.4. Damage of the Threads in Compound Endbands

Compound endbands, due to their intricate structure, present more complex and diverse conservation challenges related to the threads used in their construction. The variety of techniques employed in their creation further complicates these issues. Depending on the specific type of endband, damage may be confined solely to the secondary component, leaving the primary component unaffected, or it may impact both components. In cases where only the secondary component is damaged, the primary component can retain much of its structural integrity. Conversely, if both components are affected, the entire endband's functionality will be compromised, contingent upon the extent and severity of the damage.

The structure of sewn compound endbands, such as those belonging to the Bead and Chevron families, often allows for a clear distinction between primary and secondary components. This separation means that damage to the secondary component may leave the primary component relatively unharmed (Fig. 19). In contrast, the construction of twined, woven, braided, and interlaced endbands typically lacks this structural distinction. In such cases, the primary component—usually the part sewn through the bookblock and boards—derives its structural significance from the secondary component and is rarely functional on its own. This is particularly evident for example in the twined endbands commonly used in Islamic bindings; removing or damaging the secondary component generally impacts the overall structural role of the endband, even if the primary component remains intact (Fig. 26). Consequently, in the context of twined endbands, one can differentiate between damage to the twined threads (the wefts) and damage to the warps.

Warps/tie-downs. In twined endbands, the warps are typically made from thin threads, often silk. Broken warps are a common form of damage in Byzantine and related bindings. In these cases, the warps are usually wrapped around the primary component of the endband, which allows for

the secondary component to be significantly affected while the primary component may still remain intact (Figs. 27, 28, 30). However, in other types of twined endbands, found in Islamic, Byzantine, Georgian, and Syriac bindings, the warps of the twining are also the tie-downs, and when these are broken, the integrity of the entire endband is compromised (Figs. 15, 26, 29, 31).

Wefts/twined threads. Wear and abrasion of the silk threads in the secondary component represent another type of damage that relates to several factors, including the specific technique used, the degree of exposure of the endband (particularly when the leather cover is missing), and vertical storage of bindings originally intended for horizontal storage. When the warps are broken but the wefts remain intact, the wefts may appear as composite threads or cords—depending on the thickness of the threads used—consisting of two, three, or more threads twisted together (Figs. 1, 2, 29, 31).



Fig. 25: The full-wrapped-on-multiple-cores-rounded-twined headband (also known as 'Armenian' endband) of codex Sinai Arabic 134, written on paper in the 17th century, in its original binding. The threads of the twining are lost only locally.



Fig. 26: The twined (Islamic) headband of codex Sinai Arabic 145, written on paper in 972 A.H. (1564 AD.), in its original binding. The core of the endband has slipped towards the spine and most of the twining is now lost although the tie-downs are almost intact. The horizontal arrangement of the endband means that it is more prone to abrasion when the book is shelved vertically.



Fig. 27: The Byzantine-twined-without-additional-cores headband of codex Sinai Arabic 89, written on paper in 1285 and rebound in the context of the 'Antioch' atelier. Both warps and wefts of the secondary, twined component are broken. The primary component underneath is still sound.



Fig. 28: The Byzantine-twined-without-additional-cores headband of codex Sinai Greek 1991, written on paper in the 14th century, rebound around 1475-1482 in Mar Saba (?). Almost all warps are broken and the twining of the secondary component is worn-out, missing or has become loose. The primary component of the endband, visible under to secondary component, is still sound.



Fig. 29: The twined-without-additional-cores headband of codex Sinai Syriac 84, written on paper in the 13th century probably in its original binding. The broken warps along the bookblock and the unbroken twined wefts result in the twisted together three-colour threads, formed in the process, to become loose.



Fig. 30: The full-wrapped-on-multiple-cores-flat-and-vertical-twined headband of codex Sinai Greek 162, written on parchment in the 11th – 12th century, rebound in the 15th century. Although the primary component and the warps are all more or less sound, the twined secondary components are partly broken letting the added cores loose.



Fig. 31: The twined-without-core headband of codex Sinai Georgian 50, written on parchment in the 10th century, probably rebound at a later date. In this peculiar twined endband, so far known exclusively from Georgian bindings, the tie-downs act also as warps, therefore their breaking results to the cord formed in the twining process to become loose along the bookblock but still attached in the edges of the two board.

5. Conclusions

Due to the techniques and materials employed in their construction, as well as their integral role in bookbinding and the ongoing mechanical stress they endure, endbands in Byzantine and related Eastern Mediterranean bookbindings are susceptible to various forms of deterioration. These issues can range from superficial wear and the loss of coloured silk threads in the secondary components of compound endbands—which typically require minimal or no repair action—to extensive material loss that can severely undermine or eliminate the structural function of the endbands altogether. Mapping and understanding the different types of endbands, the techniques used in their creation, and the factors contributing to their deterioration are crucial first steps toward effective conservation, which remains an issue that requires consistent and thorough attention.

Two points warrant particular attention: first, damaged endbands provide valuable insights into their construction. Often, it is the partially worn endbands that reveal the components and techniques used in their creation. Whenever such endbands come to the conservation bench or the scholar's desk, they should receive the extra time and care necessary for thorough documentation. Second, the careful handling of damaged endbands is essential. If appropriately shelved, these endbands can remain stable even without undergoing immediate repair.

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