When Cover Boards Start to Warp – Causes and Solutions

By Werner Rebsamen – Winter is approaching, causing many inquiries at this bookbinding expert's desk about why hardcover boards are warping. Cold weather generates low, relative humidity. All materials made from cellulose fibers are affected by atmospheric changes, such as high and low humidity. These fibers react accordingly. Books printed on paper and paper boards are no exception. Paper must adjust to any given environment. During these conditions, it is simply amazing what bound books are expected to absorb. During winter, books may be left in a car and freeze. How high is the temperature inside a car during a hot summer day? "Cooking" books is an expression not related to library books left in a car but you get the idea. No matter what the weather condition or environmental fluctuations, in general, hardcover bound books perform extremely well under extreme circumstances. Occasionally, book manufacturers are at fault when critical items - paper grain direction and many other items are ignored. Initially, hardcover bound products may perform well, but once they are subjected to extreme variables in storage environments, problems with board warping may occur. As more and more books are printed and bound abroad, such warping problems are unfortunately on the rise. On several occasions, this writer had consulting assignments on board warping problems in Asia; a part of the world where humidity is usually very high, especially in the summer. The bound products are then shipped via containers, spend several weeks at sea and thereafter are, in the winter, displayed in a book store to be sold during the holidays. The minute these books are no longer in a stack and pressed, mother nature's fibers will react. The cellulose fibers begin to shrink and pull on the cover boards. Warped or distorted cover boards are often the results.

No matter what the weather condition or environmental fluctuations, in general, hardcover bound books perform extremely well under extreme circumstances.

The complex make-up of a book cover

Hardcover bindings are not so easily controlled. You may ask, "What is the problem when a book case consists only of a cover material glued over paper boards?" As easy as it sounds, this is where the problems start. Paperboards are made from recycled paper fibers. Now just imagine how many different papers are found in a common waste pile–newspapers, magazines, card boards, and packaging materials. The selected waste paper stock is put into a pulping device and mixed with water. It is then broken down by centrifugal and mechanical actions. Thereafter, the mills start the manufacturing processes. The mills have different ideas of what constitutes high quality paper board. Mills have variable ratios to mix the various types of fibers, including natural kraft, bleached kraft, sulfite, bleached sulfite, and ground-wood. The results are many different kinds of paper boards available for bookbinding. You may be familiar with names like binders boards, multi-cylinder, and laminated boards. Each manufacturer and their suppliers market their own specialties who all offer different boards for various purposes. Just think of the many multiple calipers or given thickness paper boards are marketed. For example, small, thin books require thinner board. Large, heavy books require thicker boards. The paperboard industry is large. Boards for binding books are simply a small part of their business. Just look at a supermarket, particularly the cereal aisle and what is packaged into paperboards and you get the idea.

Now let's take covering materials. There are many different varieties and qualities of cloth, finishes, natural or starch-filled; some are made from cotton, polyester, rayon or a mixture. Then there are printed and laminated materials over various substrates,

non-woven cover-stocks in all kinds of finishes and extruded plastic-like materials. In short, there are many difficult to control factors, which all react differently to adhesives and the gluing process over paper boards.

Adhesives mounts play a major role to control cover warp. Edition book covers are made using animal glues and lately with hot-melts. Library binders and other binders use water-based PVA cold emulsion adhesives. In this category, many different kinds of adhesive formulas all play an important role. We must also consider the machinery used to make a book cover. Some edition binders utilize high-speed case-making equipment which produces up to 120 covers every single minute! Others may produce 8 to 60 covers a minute or less. Some book covers are made by hand, a relatively slow process. These differences in speed affect the forces being built into a cover structure.

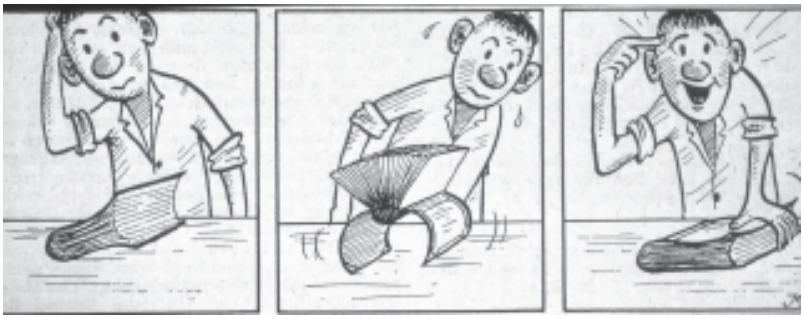
And finally, we must consider covers are being wrapped around book blocks. Before the endpapers are glued to the cover boards, a coat of a water-based PVA adhesive is applied. For the casing-in tasks, bookbinders employ various type of machinery, which vary in speed. These speeds and the various formulas of water-based PVA casing-in adhesives do affect a potential cover warp problem.

Why book covers warp

These different factors should lead to a better understanding of the fundamental relationships in the reactions of paper, boards, cloth and endpapers. When cellulose fibers are processed, they expand and shrink while adjusting to any given environment. As they absorb water, either in the case-making or in the casing-in processes, these fibers will absorb water by capillary action and grow in their diameter. In simple terms, fibers expand, four to five times their width, very little in their length. In a fast manufacturing process, the materials have virtually no time to grow or when drying, to shrink. Some materials expand and shrink more than others. A heavy coating of adhesives may also contribute to these important factors. An interesting factor may also be short paper fibers (all recycled papers have short fibers) which tend to saturate more rapidly and therefore expand and contract relative quickly. Long-fiber cover-stocks are more stable and allow better control to balance the forces. What about cloth? Book-cloth fabrics react in much the same way as paper fibers. The warp threads, which travel the length of the roll, correspond to the grain direction in the paper and paper boards. They swell and shrink when exposed to a water-based adhesive.

An experiment to understand an imbalance of forces

Now let us take a piece of paper board and mount any given cover-stock onto one side. When you apply the adhesive, the cover-stock will grow in its width. Let it dry under a weight over night. If you expose this little test item to open air, the cover-stock being on top. It soon will start to bend, that is the board will warp upwards. Now repeat the same test and mount identical pieces to both sides of the board. Watch your timing and the amount of adhesives used. After drying overnight and exposure to open air, that sample piece of a cover board should stay perfectly flat. Now alternate those experiments with different grain directions! What do we learn from such an experiment? The main reason book covers warp is, most of the time, due to an imbalance of forces. Moisture is being taken on or given off at different rates by the various materials that make up a book. A good



"Dummkopf was a Bookbinding apprentice featured every month in a German Bookbinding magazine in the 1950. This cartoon shows a warp problem. Ach sooooo - "Just hold them tight and the book will stay closed!"

Perhaps the most important factor in keeping book covers flat is the environment.

example to evaluate a problematic book cover is perhaps on some publisher's books which use the text-paper as a so-called self-contained endpaper. Many children's books are made this way. These types of papers may grow and shrink in an uncontrolled manner. What's worse, if the paper grain direction is perpendicular to the binding edge, you have a recipe for disaster.

Warp-free boards?

There are suppliers who advertise the use of "warp-free binder boards!" There is no such thing. All paperboards are subject to warping. Granted, some boards may be more resistant than others. Warping is not caused by the board itself. It is due to the unequal forces mounted to the board which subsequently cause warping.

Why control of a storage environment is so important

Would you believe we experience a warp problem with books over 500 years old? Over two decades ago, during one summer, our university's administrators decided to turn off the air conditioning system for the entire building to "save" money. After all, there were only a few summer courses being taught. It did not bother my classes too much as our labs were located in the basement. However, it did not take long before the curator of our rare book library, located in the same building, contacted this bookbinding expert and expressed his concerns, that some books bound in parchment– including those from the Middle Ages– started to "move." The covers started to warp outwards, in some cases, these forces were breaking the slip cases. What was going on?

Parchments are animal skins. Interestingly, such skins are still "alive" when it comes to adjusting to a different environment. As a fact, we bookbinders still have a lot of respect when controlling parchment covers. To keep them flat, some bookbinders use aluminum or Plexiglas as cover "boards." We solved the rare book libraries problem by inserting moist sheets between the covers and text blocks. Needless to say, we of course protect the text blocks with a sheet of Mylar.

Perhaps the most important factor in keeping book covers flat is the environment. The Library of Congress (LC), in a preservation leaflet, recommends an "ideal" temperature range of 55 to 70 degrees (wear a sweater!) and a relative humidity of 40 to 50 percent. However, LC admits that the upper temperature range is more realistic because no person wants to be in a library with a temperature of 55F degrees!

Digital, on demand printing and cover warping

A new trend is to sell a book first then print and bind it virtually overnight. Recently, this writer had the pleasure of being invited to such a sophisticated facility where every day, 7 days a week, 35,000 to 44,000 individual books are printed and bound on demand. Granted, the majority are soft-cover bound. However, in general, there are adherent problems with such new publishing endeavors. Digital printing is done with toners. In order to create conductivity, all the water must be taken out of the paper. That is a very harsh treatment for a natural cellulose fiber. After printing, the paper must recover and absorb water from the air. The text blocks then begin to get wavy. Worse, if the text blocks are hardcover bound, the lack of moisture may cause covers to warp. Why? The dry text blocks are "thirsty" and soak up the moisture needed to balance the cover structure. The wavy text also lifts the covers. Binders need to implement various "tricks" to control such factors. Libraries and individual buyers of books will need to adjust to such new, booming publishing endeavors.

Why library bound books virtually never warp

Perhaps the most respected standard for binding hardcover books in the trade is the new NASTA/ANSI/LBI specifications. Superior materials and controlled processes when binding library books assure simply the best quality of a certified binding. After a long career in bookbinding, this writer is not aware of any warping problems with library bound books. If so, these books most likely were improperly stored. For example, a cross-grained text block is exposed to excessive moisture. The content starts to become "wavy" and lifts the covers. Thus, it has nothing to do with the quality of the binding.

Finally, some solutions to control problems with warping boards.

If you find yourself with warped covers, here are some "hints" which may be of help:

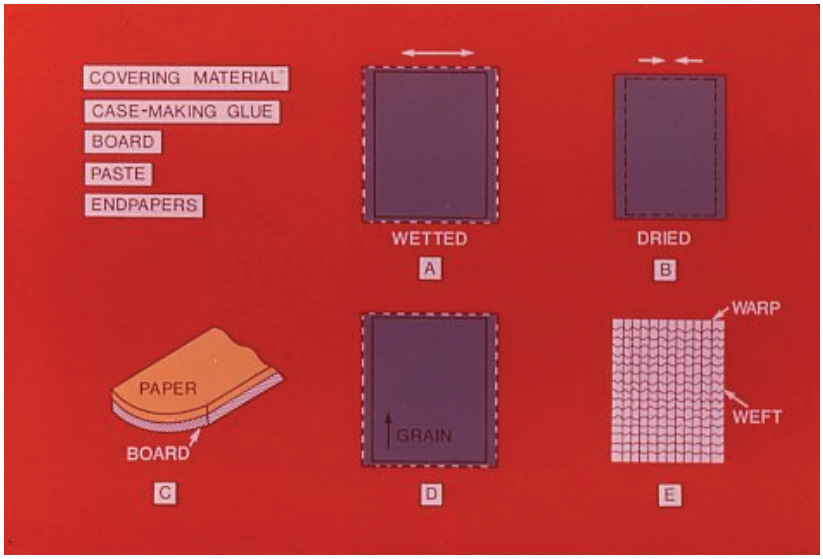
Problem: If books dry out in the winter due to low humidity, the covers may warp.

Solution: Take clean tap water. With a sponge, apply a thin coat of water into the inside of the covers. Be careful if the text blocks consist of coated paper stocks. If this is the case, insert a moisture barrier such as a sheet of Mylar between the cover and the text block. Overnight, leave a heavy weight covering the entire book. Do the same with digital printed and hardcover bound text blocks.

Problem: The book was on display for weeks. After being opened and fanned out for so long, it will no longer close. Or, during the summer, increased humidity and/or cross-grained text blocks get "wavy" and covers move upwards.

Solution: Insert books into a press or place heavy books on top of it, as long as possible, but at least overnight.

This writer has served as a "judge" or expert witness on many paper board warping disputes. Needless to say, as always, one party blamed the other. Some pointed their fingers at the boards, others at the covering materials or the methods used in book manufacture. This article should have explained why book covers warp. As long as quality paper boards are being used, warping has very little to do with the paperboard itself. As one well-known paper board expert once stated, board warping is a bookbinders problem but as we now know, many other factors such as a dry text block, waviness, and storage conditions all may contribute to the problem. Increasingly knowledgeable publishing production managers, book manufacturers, binders and best of all, dedicated suppliers are all aware of what must be done to avoid such potential problems. Such good communication in this regard, at least on the North



"40,000 books bound in Asia arrived in this condition in the USA!"

American continent, has paid dividends. This is why we are able to enjoy the exceptional performances of quality bound hardcover books in all kinds of environments, no matter if it is cold, hot, dry or wet. This itself is a great achievement.

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