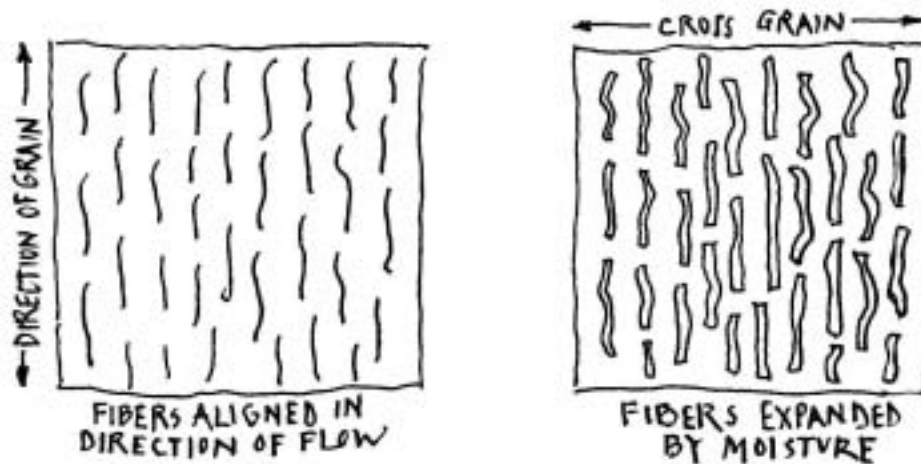


Grain Direction

Paper has a grain direction and this causes it to expand and contract differentially. When paper is made the fibers in the final sheet are aligned more in one direction than another. In handmade paper the fibers are more integrated so that the grain direction is less pronounced. In machine-made paper the fibers flow on the running sieve/mould and will mostly line up in the direction of the flow. People describe this as “grain direction” (with the grain) and “cross-grain direction” (against the grain). Perpendicular to the grain lies the cross grain.

Paper folded “grain direction” will crease sharply and will cause less damage to fibers; paper folded “cross-grain direction” will crack the fibers like sticks. The fibers absorb moisture and swell, more in their width than in their length. Therefore, machine-made paper will expand considerably more in the cross-grain direction (stretch direction) than in the grain direction.



Paper is a hygroscopic material and is affected by moisture, both by direct application of water and adhesives and also by humidity in the air. Its ability to expand and contract is affected by the restraints on it. Other materials such as cardboard, Bristol board, covering materials, etc. all impact this expansion and contraction. Book coverings themselves have a grain direction. Binding cloth, for example, is woven, and the warp and weft form a simple criss-cross pattern. The warp is equivalent to “grain direction” and goes up the roll. The weft is equivalent to “cross-grain direction” and goes from side to side. Cloth expands and contracts more in the weft direction. As a rule all materials used in binding or repair of a book should have their grain running parallel with the spine of the book. A book made with this in mind will hold its shape and not warp, gape, or buckle. The pages will drape easily under their own weight and do not snap shut.

