Springback Calculations for Laminated Work

R i c h a r d J o n e s
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Here are some thoughts and formulae I've collected over the years on bent glue laminations and springback. In my experience they're rather unreliable and intuitive estimations of the requisite 'overbend' seems to work as well for me as any formula. But they are worth knowing about and can be useful. The formulae supplied are for use with solid wood bends that follow the direction of the long grain, not across the grain.

They also have some application where layers of plywood create the bend. Here it must be borne in mind that plywood's construction is odd numbers of alternating layers where the grain of each veneer runs perpendicular to the next one to it. Plywood bends easier in one direction than the other. This is because of the odd number of layers used in the construction already mentioned. It's always easiest to bend plywood perpendicular to the long grain pattern showing on the outer visible layers. To illustrate this try bending a piece of 3 layer birch bending plywood that is 1.5 mm thick.

There's a self explanatory sketch included on the next page and relevant terms plug into the various formulae. Not all woods are good for bending. Maples and cherry for instance are not classical woods for bending being stiff, but they will bend with some difficulty. Steaming and pre-bending your laminations without glue around a former often helps. In my experience ash, European oaks, American white oaks and beech all bend rather well as does American black walnut and chestnut. Where you are planning to bend other species it's always a good idea to check their ability to bend. Also bear in mind that straight grained wood will give less problems than wood where the grain is short and runs out sharply to the surface.

Some Rules of Thumb for Laminate Bending Springback:

- The thinner the laminates, the less pronounced is springback
- More layers means less springback
- Larger radii reduce springback
- Smaller degrees of arc (distance around the circle) reduces springback.
- The more flexible the material, the less springback (e.g. poplar is more flexible than maple).

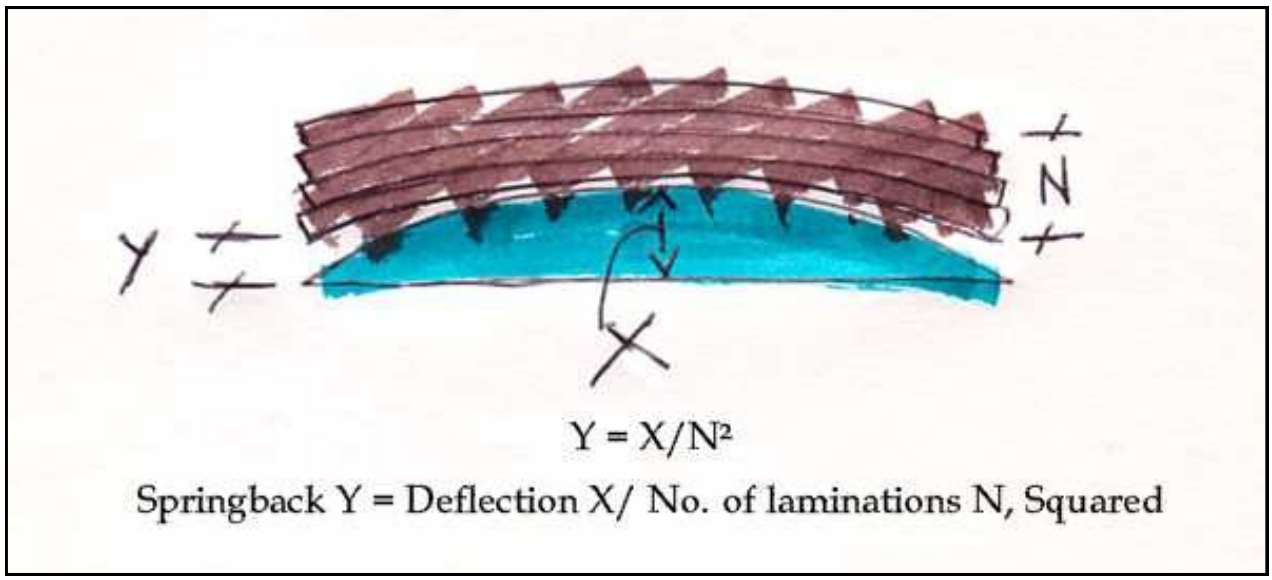
Formula 1

Springback is inversely proportional to the square of the number of strips. You divide the square of the number of strips into the amount of deflection to calculate how much springback will result when the clamps are removed.

Percentage of spring back = 100 X [D ÷ (N^2-1)] where D = the deflection, and N = the number of laminations.

Formula 2

Springback can be predicted with the formula Y = X ÷ N^2 where Y = amount of springback and N = number of laminations, and X = amount of deflection. The ratio of springback to the original deflection depends only on the number of laminations. The ratio does not depend on the properties or thickness of the wood or the geometry of the curved form. Thus, for two plies, the springback is one quarter of the initial deflection, or one ninth for three plies and one sixteenth for four plies—see sketch below.



Formula 3

Springback = R ÷ (N^2 - 1) where R is the form's radius and N is the number of laminations.