Symmetric Woodworking Designs

RDU : repeating design unit, section or part of design that is repeated, in a standard laminate it is equal to two ~~x~~ cross sections

$\frac{W_M}{H_M}$: ratio of width RDU (W_M) to height of design (H_M) of the prototype, which is a ratio used for determining the actual width RDU

H_D : height of overall design

$$W_{RDU} = H_D \cdot \frac{W_M}{H_M}$$

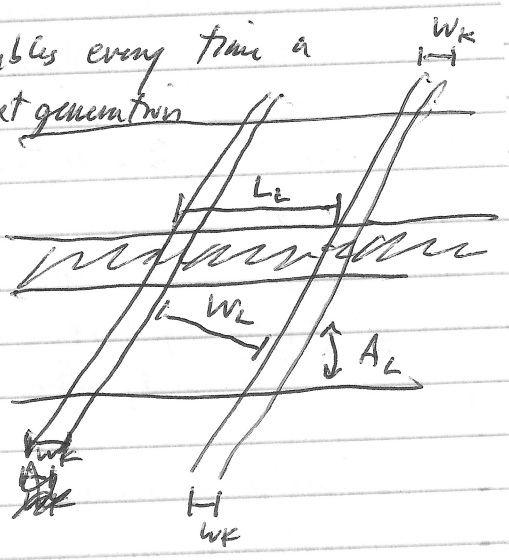
L : length of laminate required for project, reaches from end to end + tip to bottom, ~~measured along longitudinal centerline~~

N_{RDU} : number of repeating design units

$$N_{RDU} = \frac{L}{W_{RDU}}$$

* the number of design units required doubles every time a mitered laminate is converted to the next generation

L_L : length of linear laminate
W_L : width of x section
W_K : width saw blade kerf
A_L : cutting angle of linear laminate



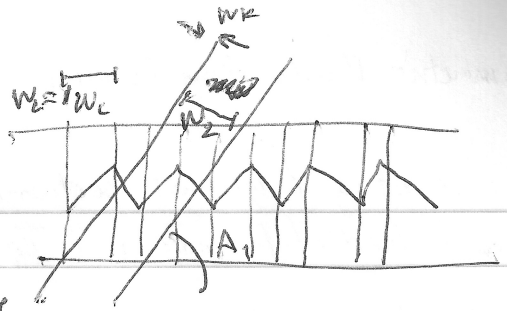
$$W_L + W_K = L_L \sin A_L$$

$$\boxed{L_L = \frac{(W_L + W_K)}{\sin A_L}}$$

total linear length = L_L · # cross sections needed for project

$W_L = {}'W_L$: means that x section cut from linear laminate is same as the width used for making a 1st generation laminate

Converting a 1st generation laminates



W_L: width of xsections from linear laminate
W_2: width of xsection cut for 2nd gen. laminate : width of RDU (repeatable design unit)
W_K: saw blade kerf
A_1: cutting angle for 1st gen. laminate

width of xsections to be cut from linear laminate for each generation

$W_L = {}^1W_L$
or $W_L = {}^2W_L$
or $W_L = {}^3W_L$

$W_2 \cong 2 \cdot W_L \cdot \sin A_1$ approximately from right triangle

~~$W_L = {}^2W_L$ width xsection for 2nd gen. laminate~~

$${}^2W_L \cong \frac{W_2}{2 \cdot \sin A_1}$$ approx

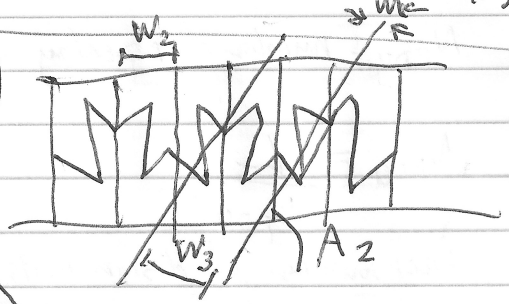
width kerf excluding $\Rightarrow$

$${}^2W_L = \frac{(W_2 + W_K)}{2 \cdot \sin A_1}$$ exact equation

= width of xsections to be cut from the linear laminate to get 2nd gen lamin

Converting a 2nd generation laminate

W_2: width xsections cut from 1st gen. laminate
W_3: width of xsections cut for 3rd gen. laminate
W_K: width saw blade kerf
A_2: cutting angle for 2nd gen. laminate



approx: $W_3 \cong 2 W_2 \sin A_2$

approx $W_2 \cong \frac{W_3}{2 \cdot \sin A_2}$

$${}^3W_L \cong \frac{\frac{W_3}{2 \sin A_2}}{2 \sin A_1} \cong \frac{W_3}{(2 \sin A_1)(2 \sin A_2)}$$

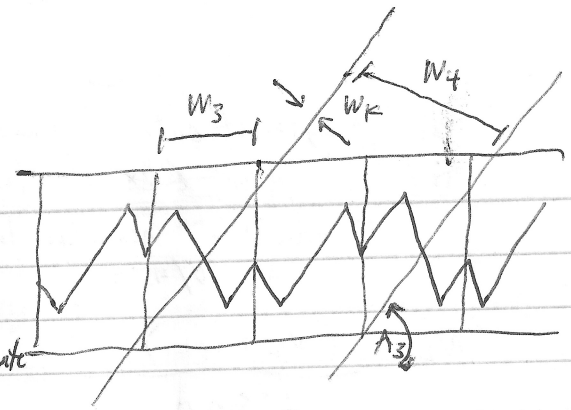
~~not~~ including kerf $\Rightarrow$ exact equation

$$\boxed{{}^3W_L = \frac{W_3 + W_K(1 + 2 \cdot \sin A_2)}{(2 \sin A_1)(2 \sin A_2)}}$$ exact equation

W_L: width of xsections cut from original linear laminate

width of rdu (repeatable design unit) of 3rd gen laminate

Converting a 3rd generation laminate

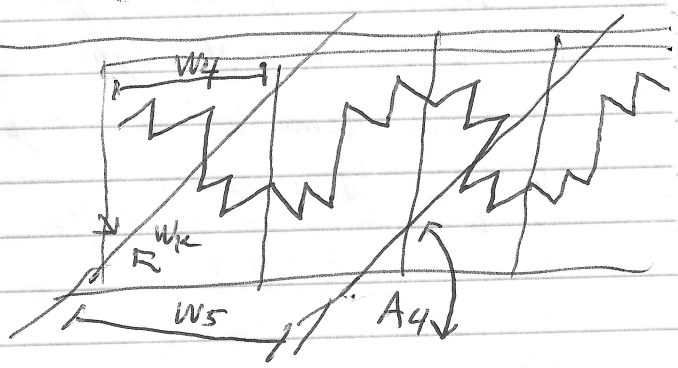


W_3 : width of xsection cut from 2nd gen. laminate
W_4 : width of xsection cut for a 4th gen. laminate
W_K : width saw blade kerf
A_3 : cutting angle of 3rd gen. laminate

approx: $\left[W_4 \approx 2 W_3 \sin A_3 \Rightarrow W_3 \approx \frac{W_4}{2 \sin A_3} \right] \Rightarrow \left[{}^4W_L \approx \frac{W_4}{2\sin A_3 \,(2\sin A_1)(2\sin A_2)} \approx \frac{W_4}{(2\sin A_1)(2\sin A_2)(2\sin A_3)} \right]$

including kerf, exact equation $\Rightarrow$ ${}^4W_L = \dfrac{W_4 + W_K\left[1 + 2\sin A_3 + (2\sin A_2)(2\sin A_3)\right]}{(2\sin A_1)(2\sin A_2)(2\sin A_3)}$

Converting a 4th generation laminate



W_4 : width xsection cut from 3rd gen. laminate
W_5 : width xsections cut for 5th gen. laminate
W_K : width saw blade kerf
A_4 : cutting angle of 4th gen. laminate

approx: $\left[W_5 \approx 2 W_4 \sin A_4 \Rightarrow W_4 \approx \frac{W_5}{2\sin A_4} \right] \Rightarrow {}^5W_L \approx \frac{W_5}{2\sin A_4 \,(2\sin A_1)(2\sin A_2)(2\sin A_3)} \approx \frac{W_5}{2^4 \cdot \sin A_1 \cdot \sin A_2 \cdot \sin A_3 \cdot \sin A_4}$

including kerf, exact equation

$$ {}^5W_L = \frac{W_5 + W_K\left[1 + 2\sin A_4 + (2\sin A_3)(2\sin A_4) + (2\sin A_2)(2\sin A_3)(2\sin A_4)\right]}{2^4 \cdot (\sin A_1)\cdot(\sin A_2)\cdot(\sin A_3)\cdot(\sin A_4)} $$

which gives exact width, ${}^5W_L$ of a linear laminate initial cut sections to make a 5th gen. laminate, having X sections with a width of W_5

Example:

Q: length of cuts of linear laminate
find width of ~~cuts~~ of linear laminate need to make a 1" rdu for 2nd generation laminate at 60°/45°A

$W_2 = 1"$ $A_1 = 45$

$W_K = 1/8" = 1.125$ $A_L = 60°$

$$W_L = \frac{(W_2 + W_K)}{2 \cdot \sin A_1} = \frac{1 + 1/8}{2 \cdot \sin 45} = 0.7955"$$

$$L_L = \frac{(W_L + W_K)}{\sin A_L} = \frac{0.7955 + 0.125}{\sin 60} = 1.0629"$$

~~#2 cuts~~

W_2: width of 2nd gen. repeating design unit (RDU)
W_L: width of cut xsection of laminate
L_L: length of material between cuts for original linear laminate
W_K: blade kerf
A_1: cut angle of 1st gen laminate
A_L: cut angle of original laminate

original laminate from 2nd gen

$$L_L = \frac{\frac{(W_2 + W_K)}{2 \cdot \sin A_1} + W_K}{\sin A_L} \cdot \frac{2 \sin A_1}{2 \sin A_1} = \frac{W_2 + W_K(1 + 2 \sin A_1)}{\sin A_L \cdot 2 \cdot \sin A_1}$$