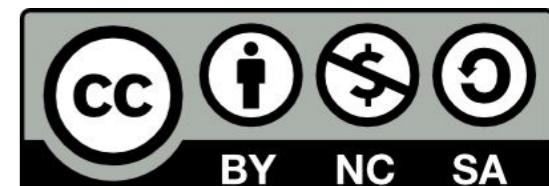


Intro to Laser Cutting and Engraving

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This Clinic

- Introduction to Inkscape (2D CAD) software
- Introduction to XTool S1 Low-cost laser cutter/engraver
- Questions? Please ask!

I don't intend to teach you how to use either the software or the hardware in any detail - that would require multiple clinics - but instead to show you what the potential might be and what the learning curve looks like.



What is Laser Cutting/Engraving?

- 2D fabrication tool
- Think pen plotter, but with a laser! <pew> <pew>
- Way cooler than an X-Acto knife!
- Allows for both cuts and surface texturing.

Why Use Laser Cutting/Engraving?

- Allows for rapid prototyping - test designs in cheap materials and troubleshoot before final design
- Allows for production of ANY prototype. You are no longer dependent on manufacturers
- Greater use of sustainable materials (wood, paper, etc, rather than plastic)
- Especially good for scales other than HO, where commercial kits are more limited.
- Prototype modeling - build things you can't buy.



Getting Started

You need two things:

1. A laser cutter/engraver

Traditionally \$10K and up

New machines \$1K and up

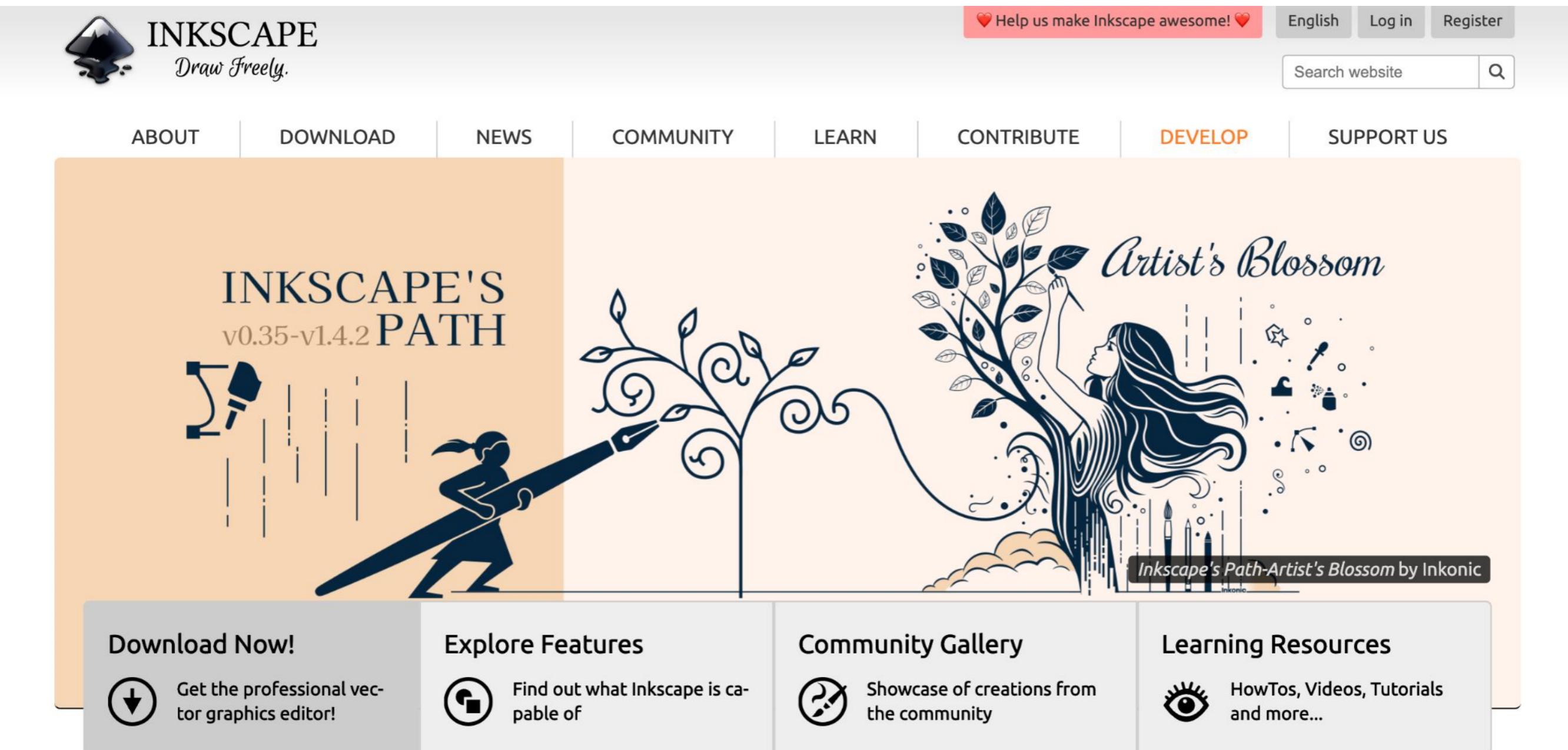
2. Drawing Software (2D CAD)

Anything that can generate vector and raster graphics

I use Inkscape, because it's free and open source



Inkscape



The image shows the homepage of the Inkscape website. At the top, there is a navigation bar with links for "ABOUT", "DOWNLOAD", "NEWS", "COMMUNITY", "LEARN", "CONTRIBUTE", "DEVELOP" (which is highlighted in orange), and "SUPPORT US". There is also a search bar and links for "English", "Log in", and "Register". A red button with the text "Help us make Inkscape awesome!" and two hearts is visible. The main content area features a large illustration of a woman with long hair, holding a paintbrush and drawing a stylized tree. The tree has the text "Artist's Blossom" written in a flowing script. Below the illustration, there is a caption that reads "Inkscape's Path-Artist's Blossom by Inkonic". The main heading on the page is "INKSCAPE'S v0.35-v1.4.2 PATH". Below this heading is a large illustration of a person using a long brush to draw a stylized tree. The bottom of the page is divided into four sections: "Download Now!", "Explore Features", "Community Gallery", and "Learning Resources". Each section has a corresponding icon and a brief description.

INKSCAPE
Draw Freely.

Help us make Inkscape awesome!

English Log in Register

Search website

ABOUT DOWNLOAD NEWS COMMUNITY LEARN CONTRIBUTE **DEVELOP** SUPPORT US

INKSCAPE'S v0.35-v1.4.2 PATH

Artist's Blossom

Inkscape's Path-Artist's Blossom by Inkonic

Download Now!

Get the professional vector graphics editor!

Explore Features

Find out what Inkscape is capable of

Community Gallery

Showcase of creations from the community

Learning Resources

HowTos, Videos, Tutorials and more...

Inkscape is a powerful, free design tool

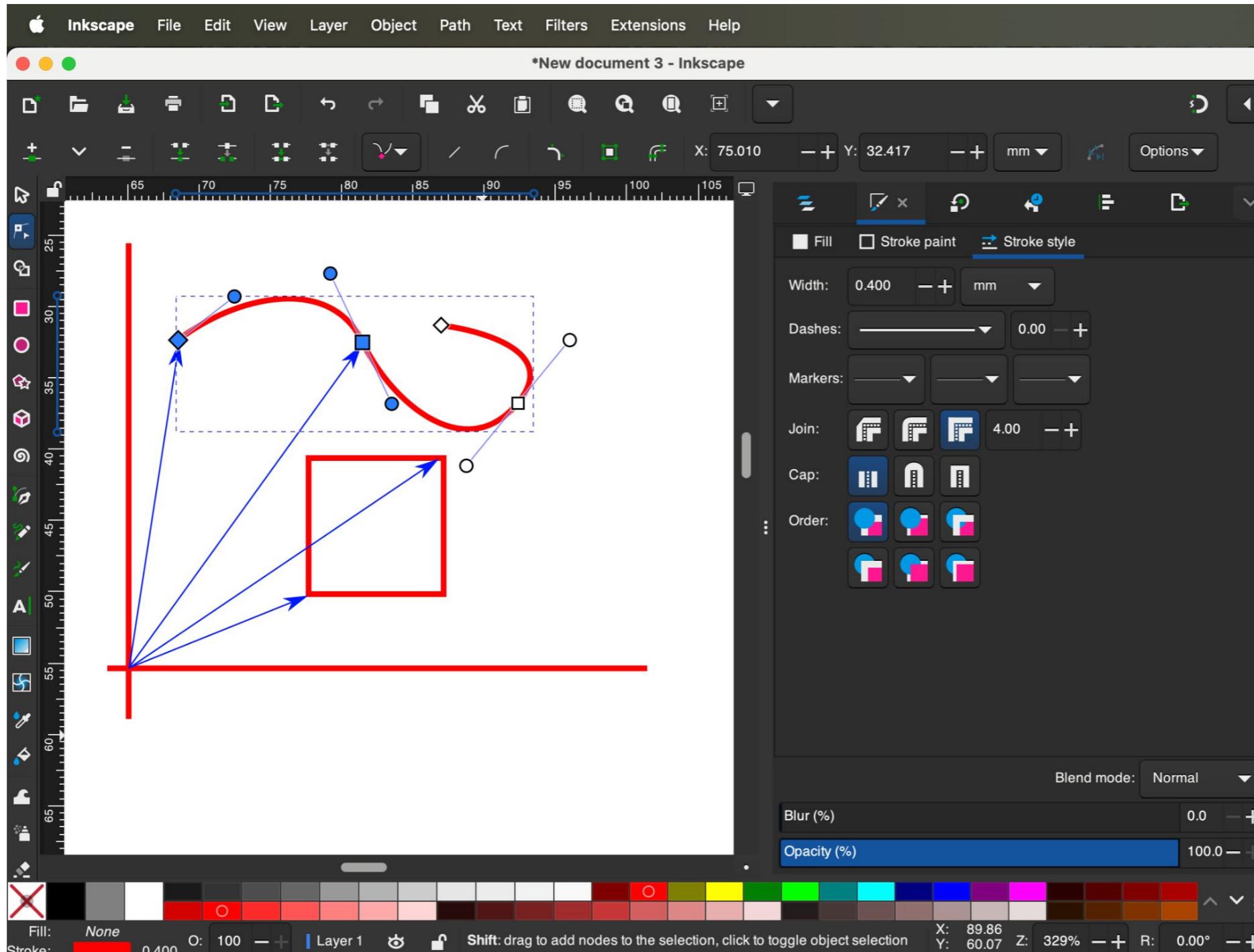
<https://inkscape.org>



Vector Graphics

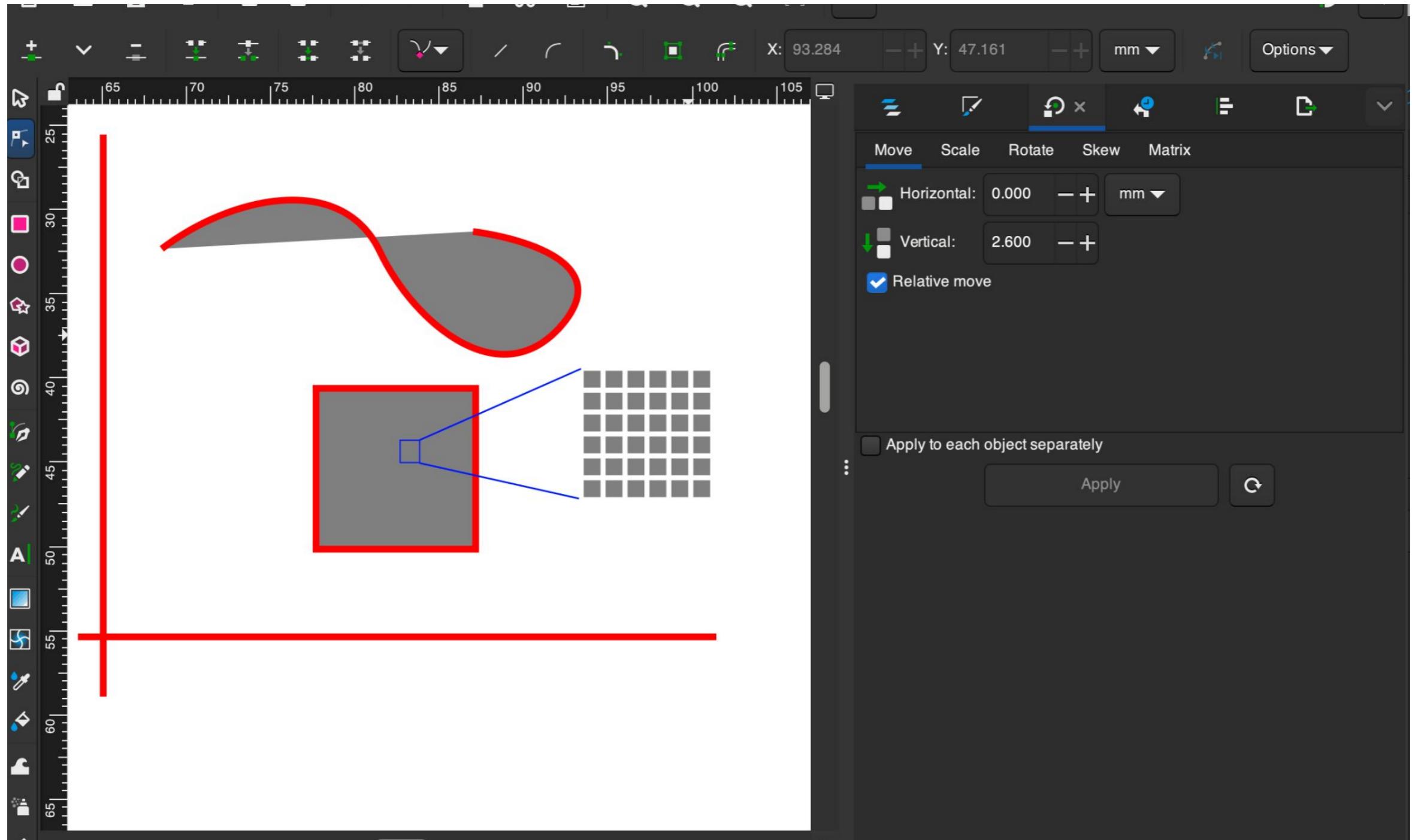
Bezier curves: lines and shapes defined by anchor points and tangent lines - "Path" in Inkscape

Polygons: closed forms defined by corner points - "Object" in Inkscape



Raster Graphics

Anything composed of pixels - “Fill” in Inkscape, also imported “bitmap” files (JPEG, TIFF, PNG, etc.)

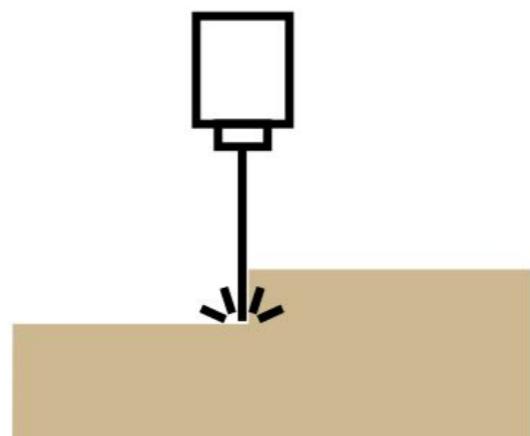


Engraving vs. Cutting

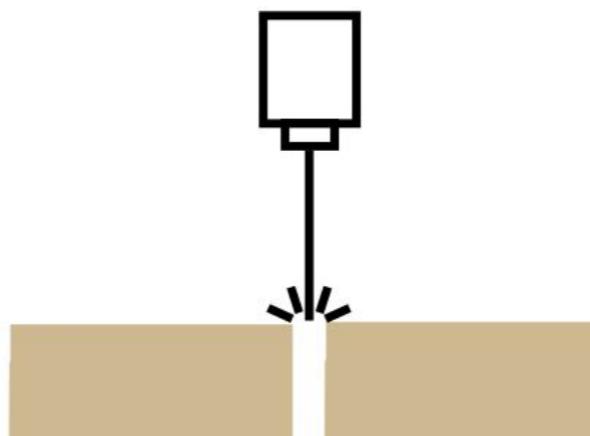
Engraving: Milling away material across an area with one or more passes of the laser

Cutting: carving through the material with one or more passes along a single line

Engraving Cutting

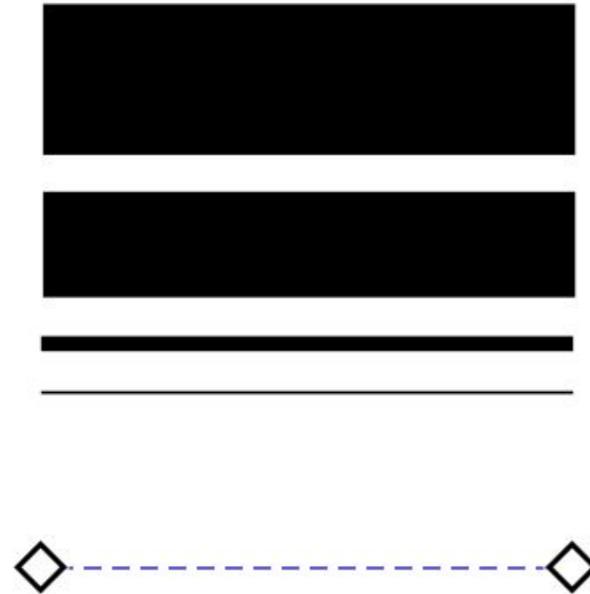


**Raster
Graphics**



**Vector
Graphics**

Vector Graphics and Engraving

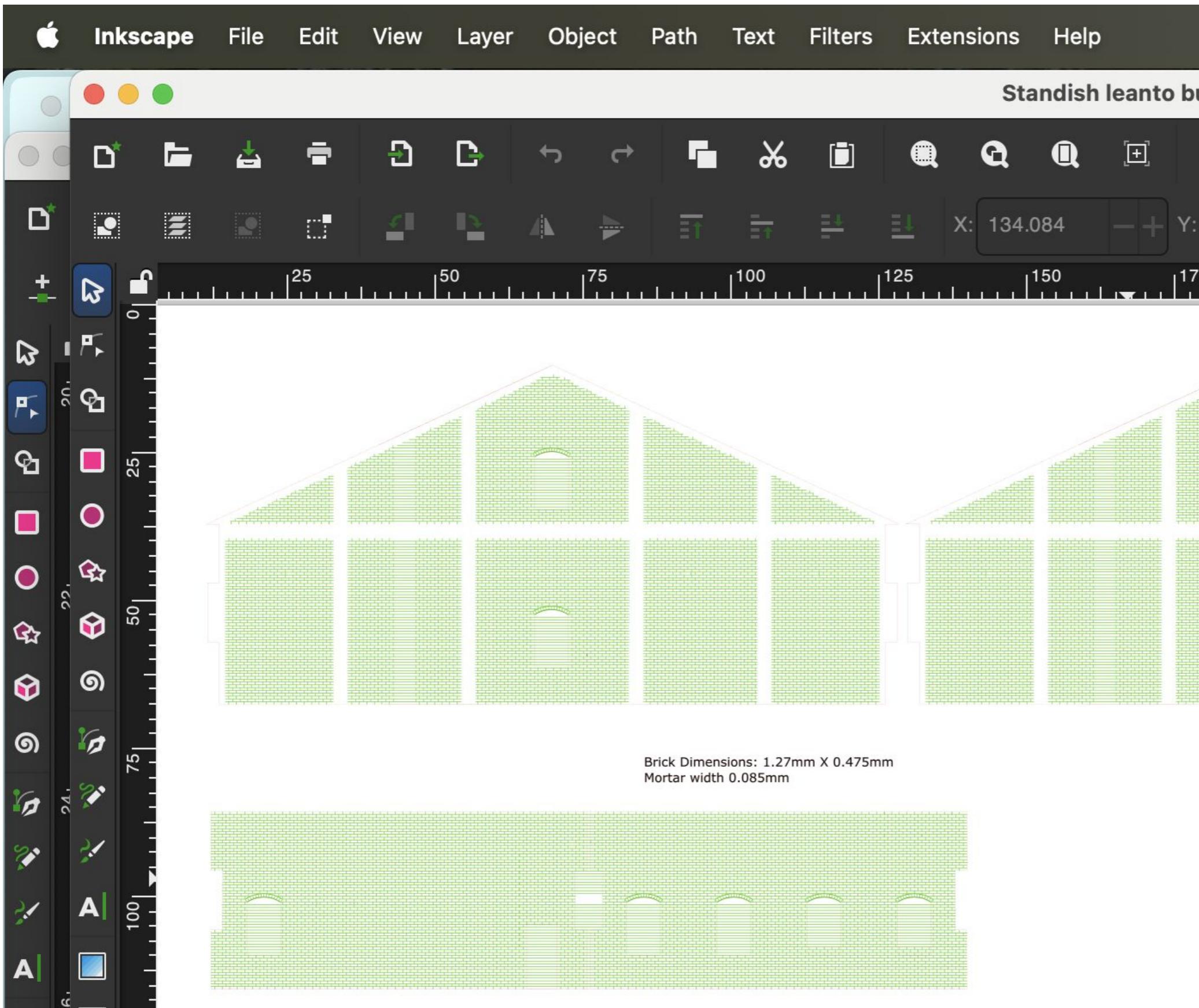


**No matter what
the line weight is,
the software sees this
infinitesimally thin line**

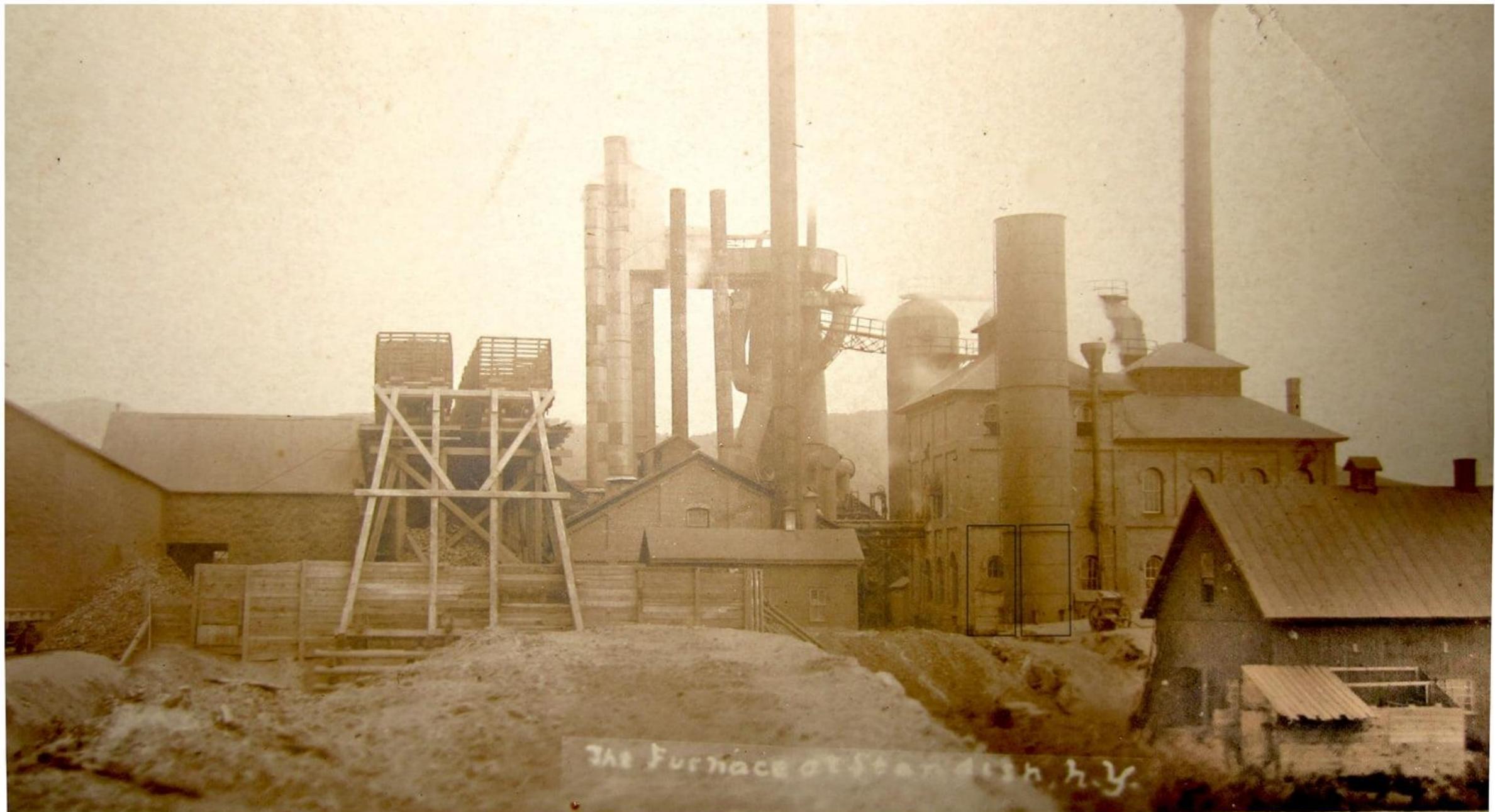
If you are trying to engrave a wide line, and you use a vector line, you will only get a single narrow line, no matter what the line width.

To engrave a wide line, you must use a raster fill or object in your design.

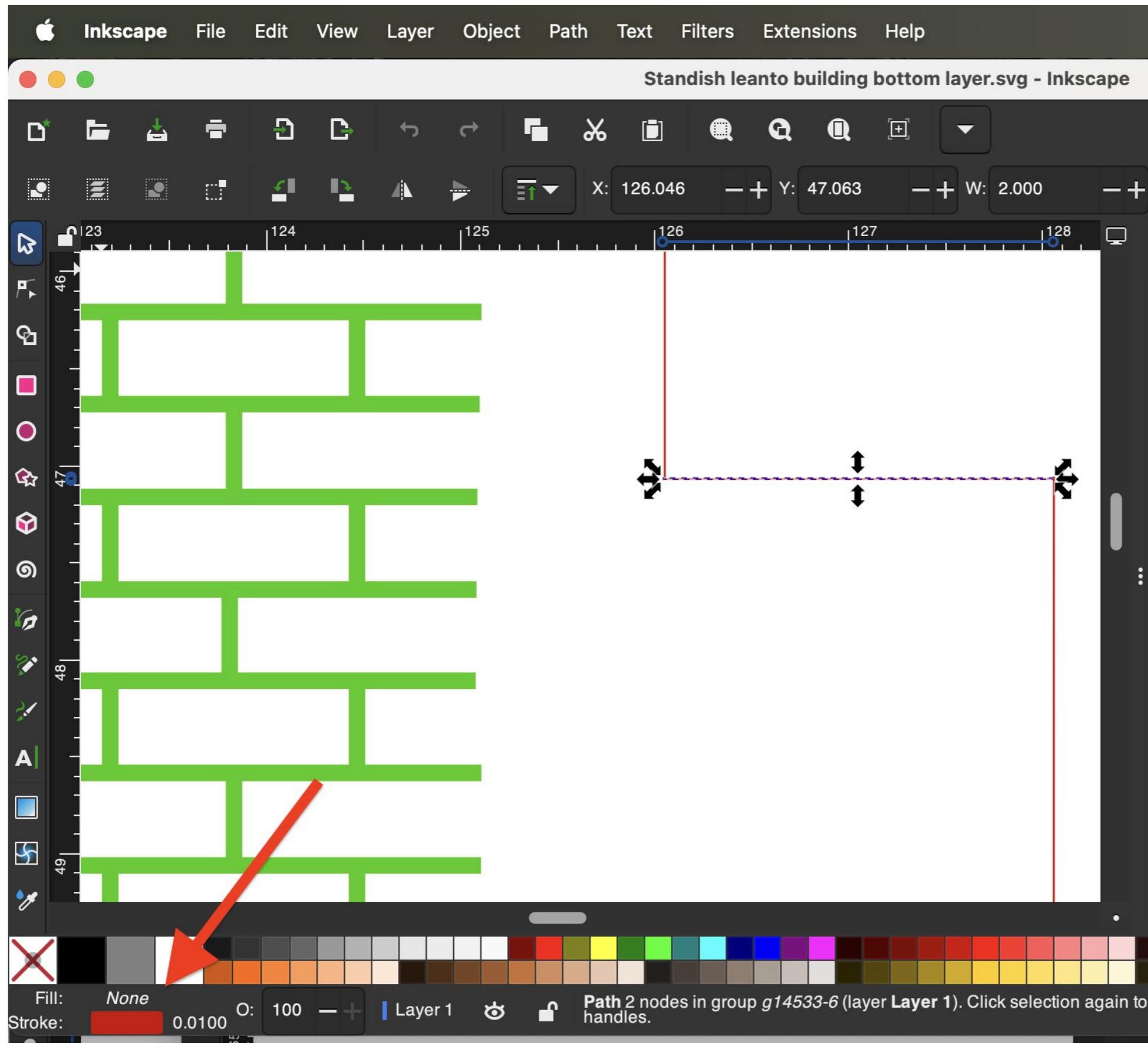
Example: Building for the Standish Blast Furnace



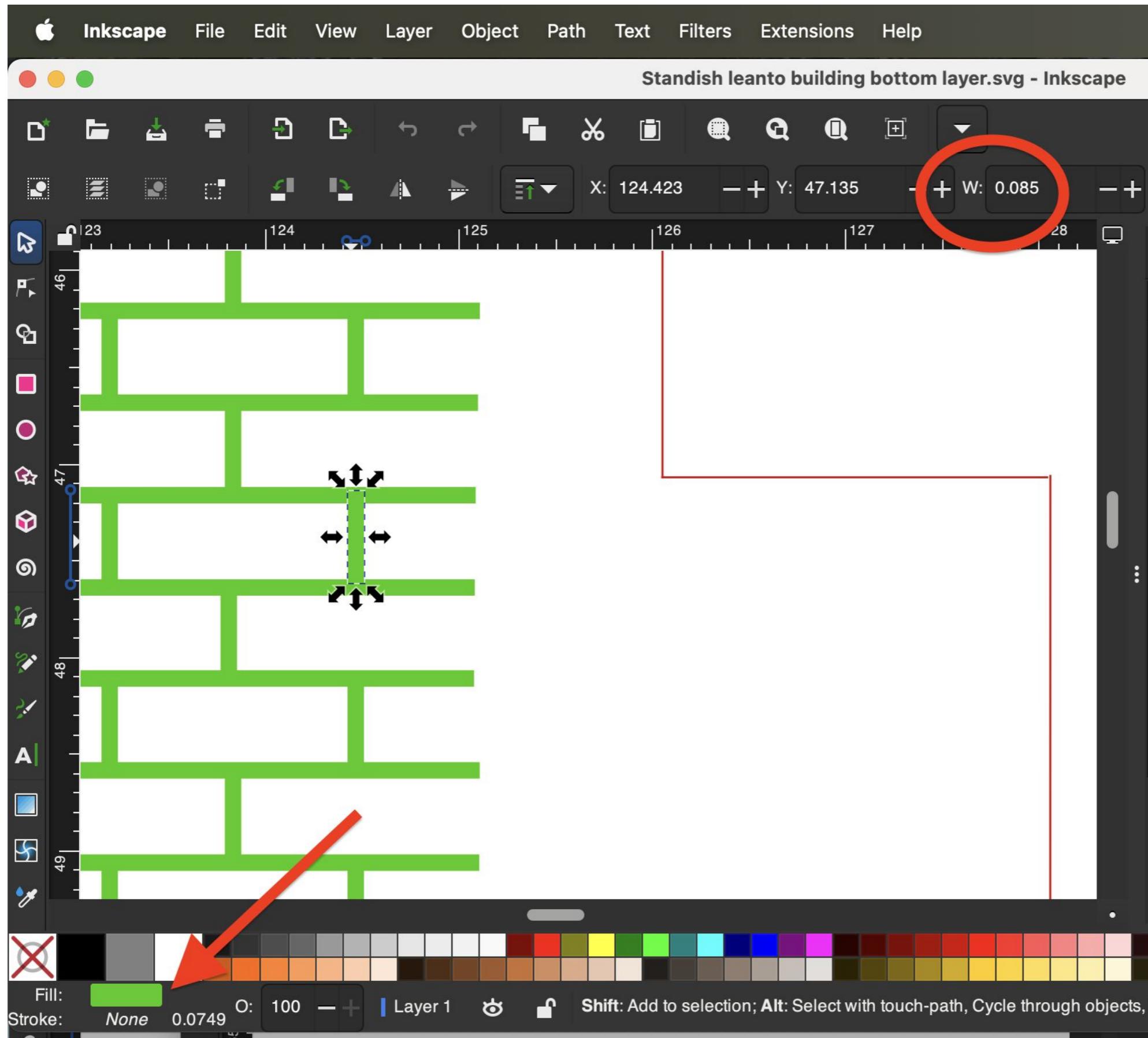
Reference Image



Vector element - cut line on edge of wall



Raster element - mortar lines in brick wall*



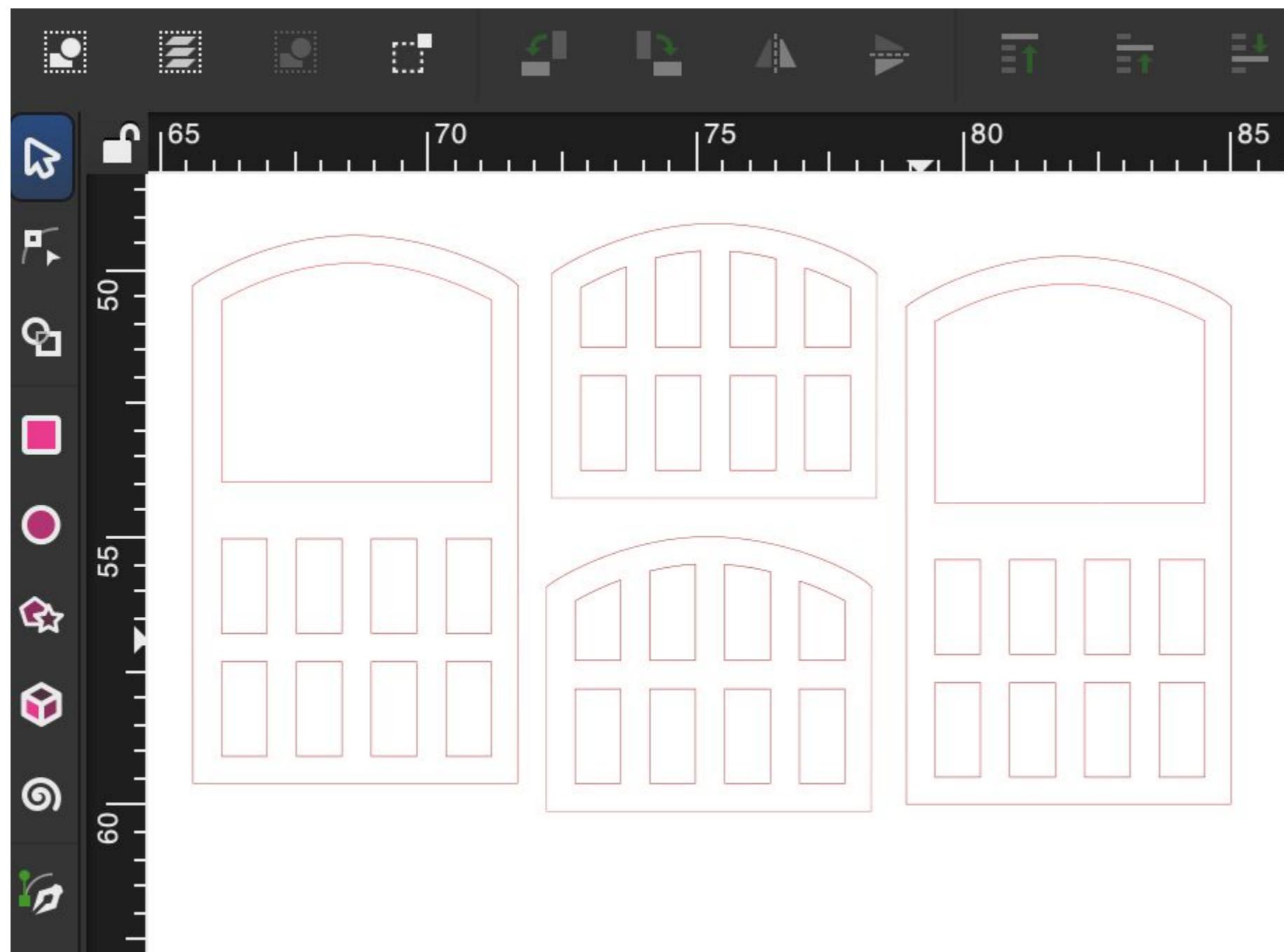
* Note that different colors are assigned here, and will denote different laser operations in the laser cutter software.



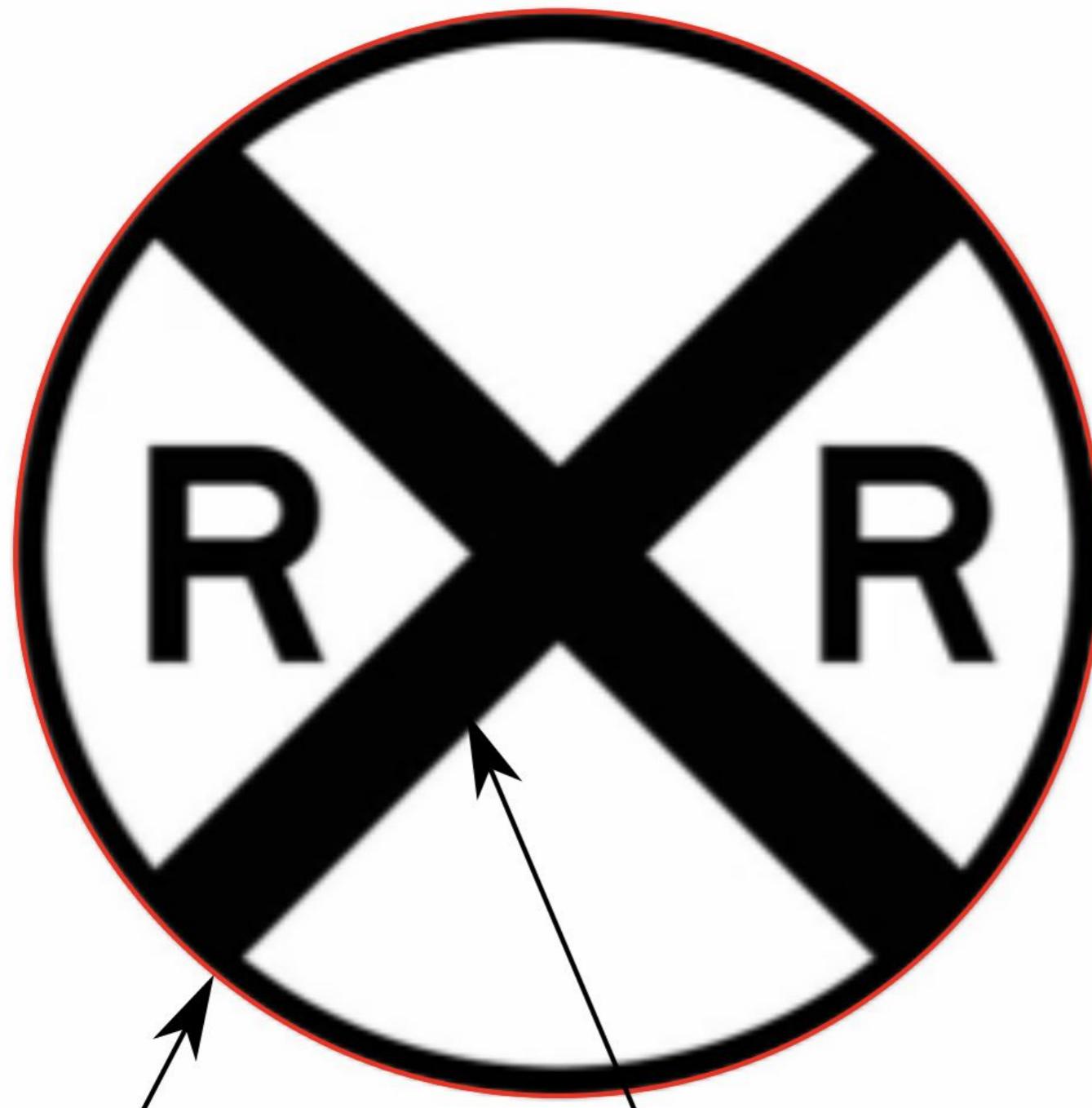
Can cut very thin details from the right material

Minimum line separation for my laser is 0.5 mm (experimentally determined).

Laser cutting kerf is about 0.2-0.3 mm (depends on power, material)
Resulting detail is 0.2-0.3 mm wide (~1 1/2" in N, ~3/4" in HO)



Simpler example



Vector Circle

Raster Crossbuck
Image

Coaster for the train room

Find a crossbuck raster graphic online

Import to Inkscape

Draw a 3" circle

Scale crossbuck to fit circle

Laser Cutter

xTOOL

Products

Anniversary Carnival

New! P3

Materials

xTool Squad

Edu & Retail

Software

Support



Hot

1 / 15



xTool S1 Enclosed Diode Laser Cutter

★★★★★ 699 reviews

- Switchable laser modules satisfy the processing of almost any material.
- Pin-point™ positioning: 10 times more accurate than single-camera systems.
- Larger bed size than others: 23.93" x 15.16" for efficient batch processing.
- AutoPassthrough™ and 3D Curve™ Engraving.
- Class 1 Safety: 5-direction flame detection, emergency stop, lid-open safety stop and laser key lock.

\$999.00 Final Price: \$899.00

\$167/mo. for 0% APR*

Current Plan: shoppay

[Prequalify or view other financing options](#)

This is the system I purchased: low cost, but high quality.

Interchangeable laser modules make more powerful upgrades easy

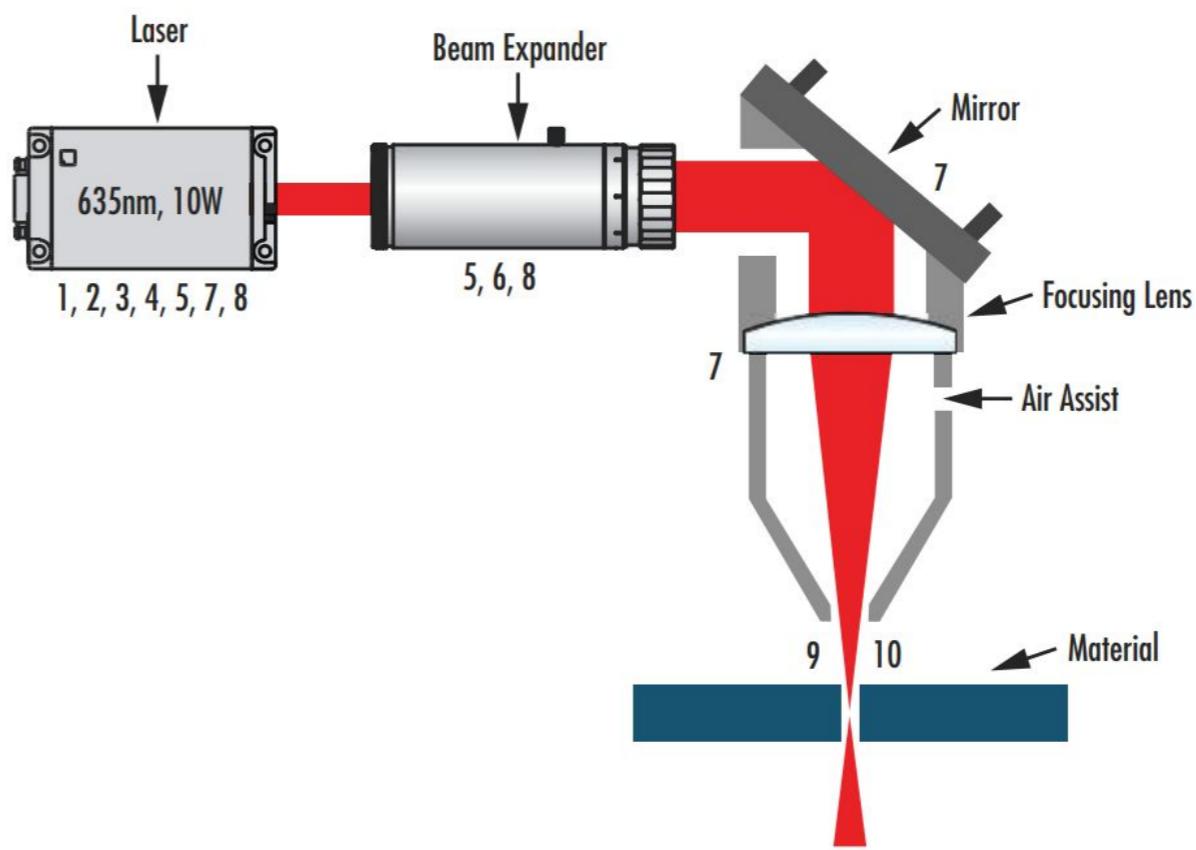
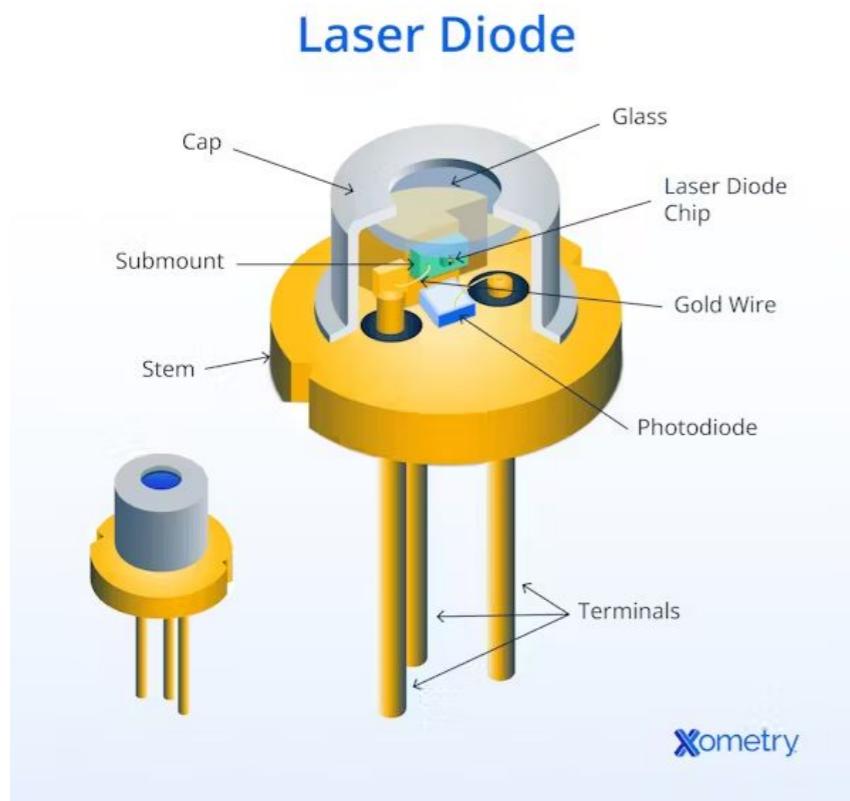


Diode vs CO2

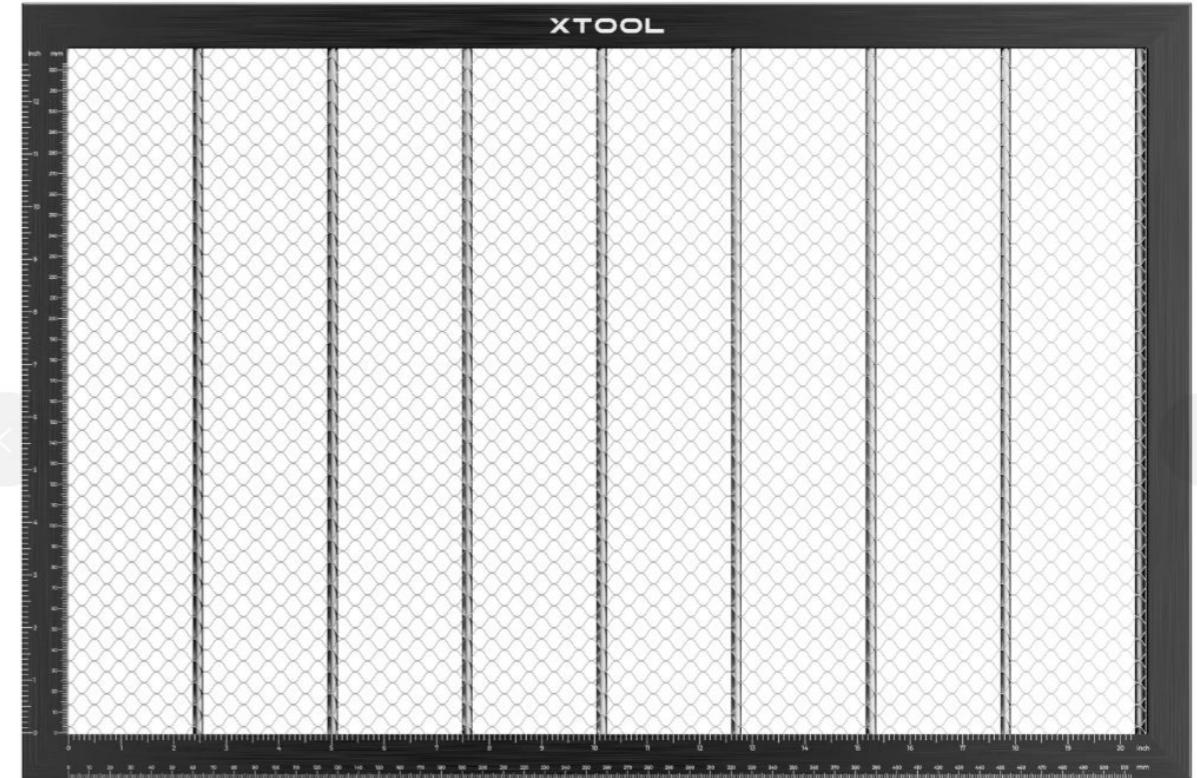
Two different kinds of lasers

CO2 lasers are capable of cutting thicker materials and are more expensive. Overkill for model railroad applications.

Diode lasers are lower power and good for hobby applications



Helpful Accessories



Air Assist - blows smoke away from lens (but can also blow tiny parts around)

Honeycomb panel - allows the use of magnets to secure your material

Safety First!



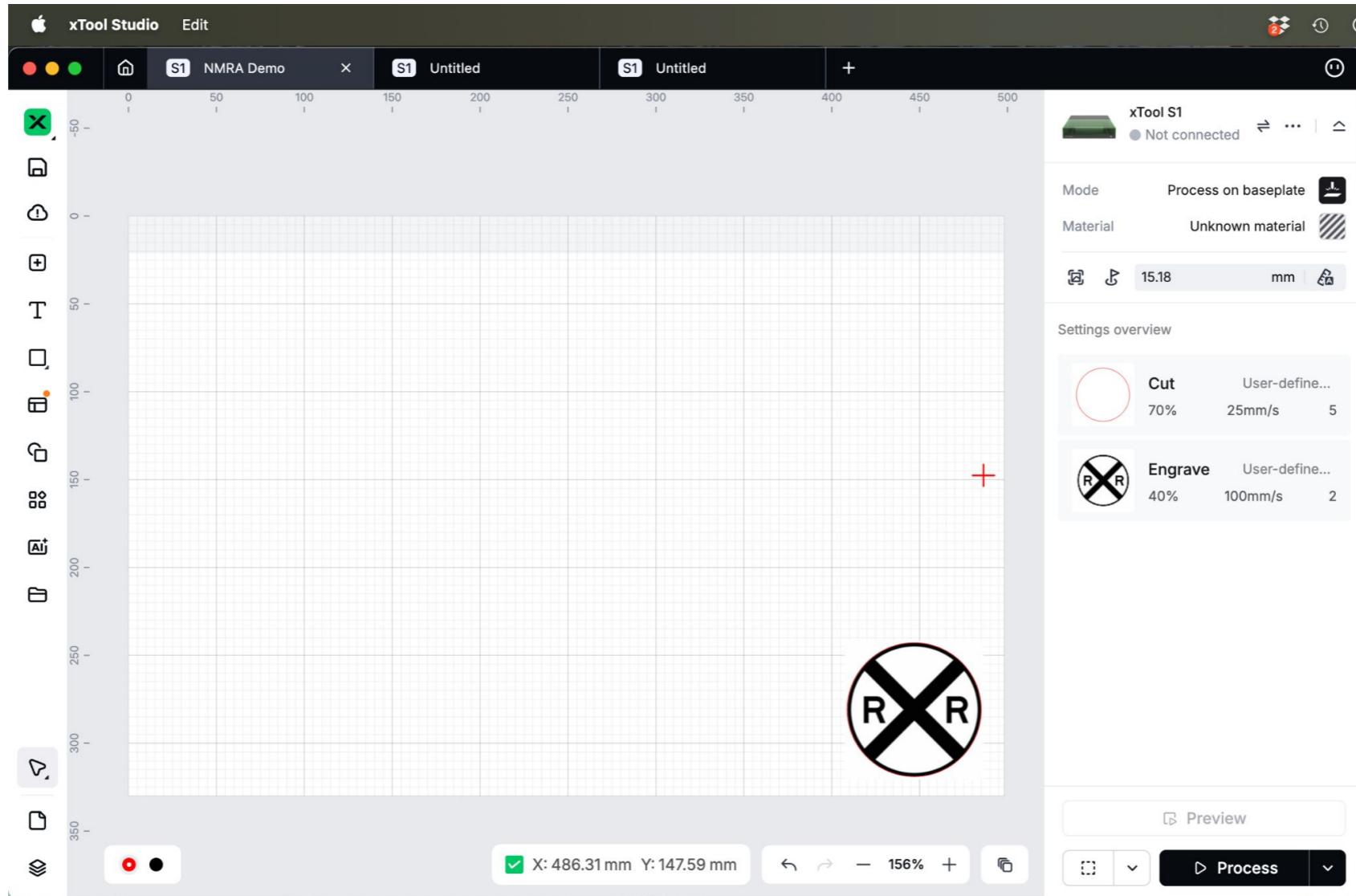
Class 3 laser - it can hurt you!

There are safety interlocks for a reason - USE THEM!

Very real **FIRE** danger - do not leave unattended!



xTool Studio



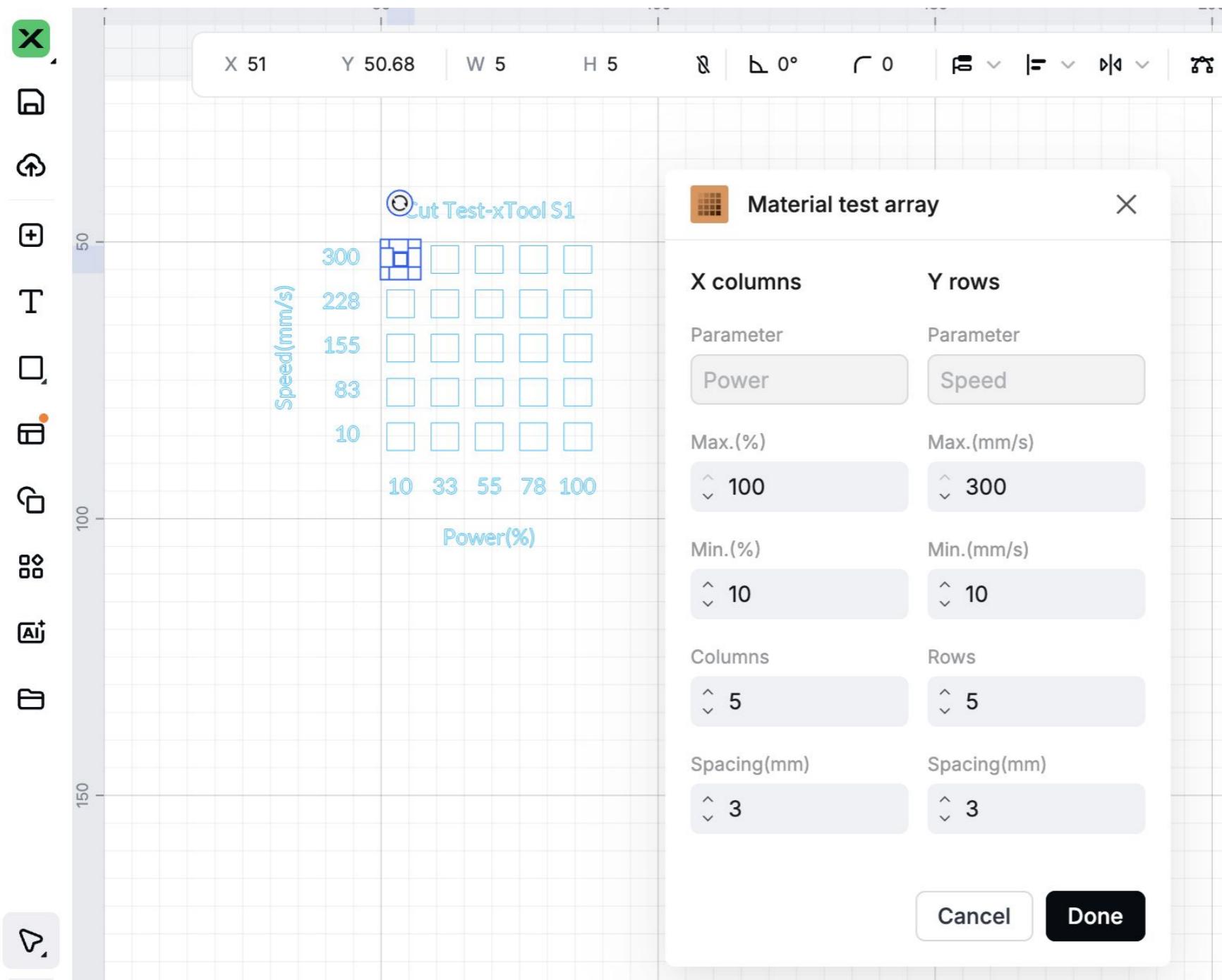
Software driver for the laser

Has basic graphic tools and the ability to manipulate (rotate, duplicate, move, etc) imported graphics

Takes .svg files for vector art, .jpg etc. for raster art

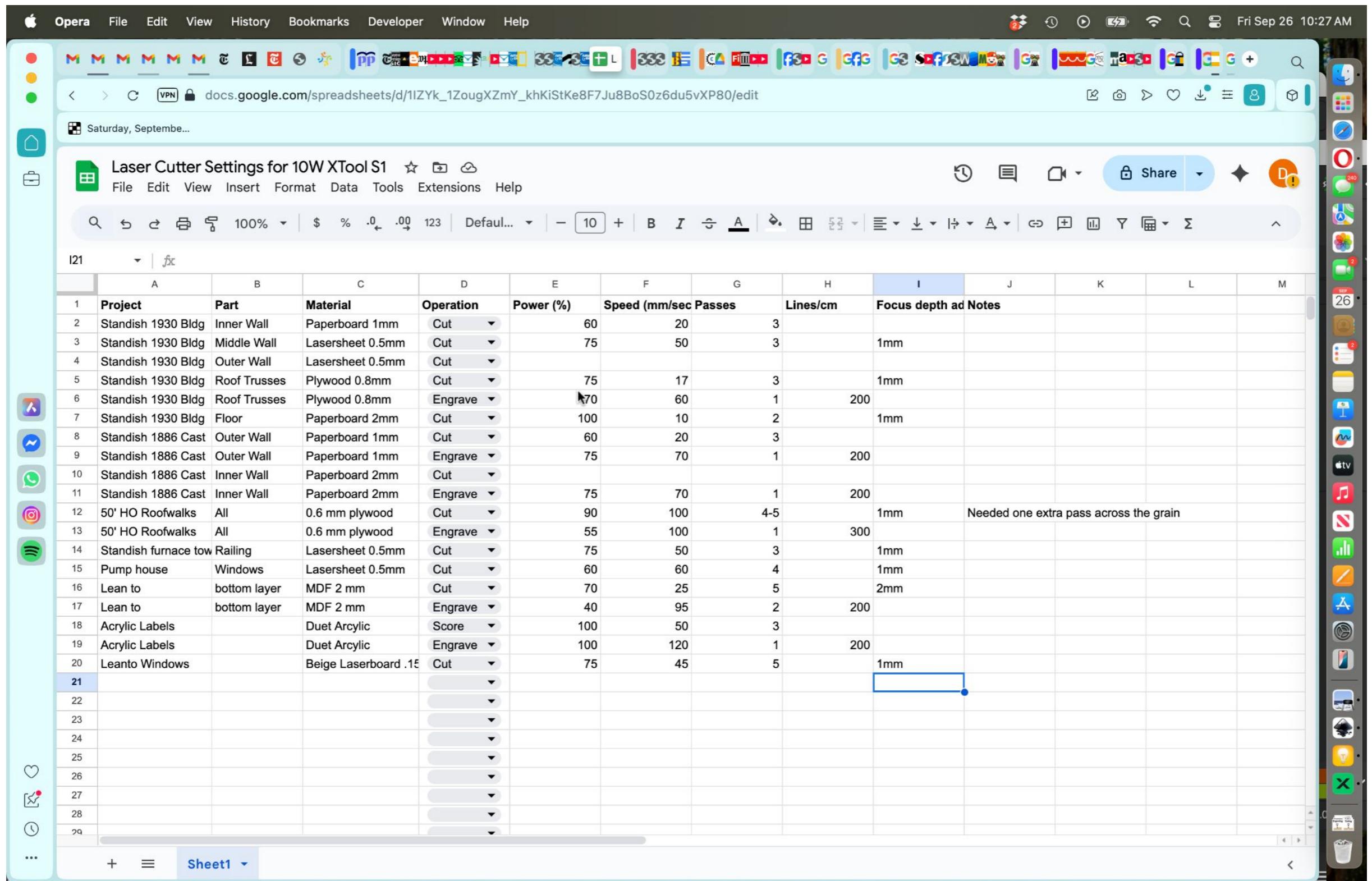


Calibrating Materials



For every material, I do a material test array for cutting and another one for engraving. Then I save those “swatches”.

Record Keeping



Laser Cutter Settings for 10W XTool S1

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Project	Part	Material	Operation	Power (%)	Speed (mm/sec Passes)	Lines/cm	Focus depth ad Notes					
2	Standish 1930 Bldg	Inner Wall	Paperboard 1mm	Cut	60	20	3						
3	Standish 1930 Bldg	Middle Wall	Lasersheet 0.5mm	Cut	75	50	3	1mm					
4	Standish 1930 Bldg	Outer Wall	Lasersheet 0.5mm	Cut									
5	Standish 1930 Bldg	Roof Trusses	Plywood 0.8mm	Cut	75	17	3	1mm					
6	Standish 1930 Bldg	Roof Trusses	Plywood 0.8mm	Engrave	70	60	1	200					
7	Standish 1930 Bldg	Floor	Paperboard 2mm	Cut	100	10	2	1mm					
8	Standish 1886 Cast	Outer Wall	Paperboard 1mm	Cut	60	20	3						
9	Standish 1886 Cast	Outer Wall	Paperboard 1mm	Engrave	75	70	1	200					
10	Standish 1886 Cast	Inner Wall	Paperboard 2mm	Cut									
11	Standish 1886 Cast	Inner Wall	Paperboard 2mm	Engrave	75	70	1	200					
12	50' HO Roofwalks	All	0.6 mm plywood	Cut	90	100	4-5	1mm					
13	50' HO Roofwalks	All	0.6 mm plywood	Engrave	55	100	1	300					
14	Standish furnace tow	Railing	Lasersheet 0.5mm	Cut	75	50	3	1mm					
15	Pump house	Windows	Lasersheet 0.5mm	Cut	60	60	4	1mm					
16	Lean to	bottom layer	MDF 2 mm	Cut	70	25	5	2mm					
17	Lean to	bottom layer	MDF 2 mm	Engrave	40	95	2	200					
18	Acrylic Labels		Duet Arcylic	Score	100	50	3						
19	Acrylic Labels		Duet Arcylic	Engrave	100	120	1	200					
20	Leanto Windows		Beige Laserboard .15	Cut	75	45	5	1mm					
21													
22													
23													
24													
25													
26													
27													
28													
29													

For every project, I track the material and settings I use.



Materials

Laser Board - thin (0.5-0.6 mm/.02-.026") stiff material - essentially resin-impregnated cardboard. Really excellent for fine details.

Paper and Cardstock - very thin, less stiff than laser board

QuickBoard - 1 mm or 2 mm thick recycled paperboard product, inexpensive and excellent for mocking up structures and for testing your graphics

MDF - same stuff as in the hardware store, but as thin as 1.5 mm, stiff, very good for structure walls,

Plywood - as thin as .6 mm, stiff, shows wood grain, may require more power or more passes to cut across the grain of the face sheets.

Basswood or other wood - wood grain

Acrylic - opaque color cuts best, engraveable 2-color sheets for panels and signs

NO STYRENE! It creates toxic smoke and can damage the laser



Sources

MakerStock: <https://makerstock.com>

Laser One: <https://encompass-media.salesvu.com>

LaserSheets: <https://lasersheets.eu> (EU only - I had a friend in Germany reship for me before I found Laser One)

XTool: <https://www.xtool.com/pages/xtool-selected-materials>

Woodworking stores, hobby shops, etc.

