Popular Woodworking Article

At this very moment, artist Reuben Margolin is building a gigantic wooden sculpture that moves. It is titled Yellow Linear Wave, and is only one of his many creations – usually built out of discarded pieces of redwood, bits of leftover metal, and fishing tackle – that he calls "geometrical constructions flavored by art."

Yellow Linear Wave stands on the ground, is sixteen feet long and six feet wide, and has 120 rods that have been topped with blocks made of poplar, and then painted yellow. It is made primarily of wood – mostly poplar and fin ply – but also includes aluminum and UHMW (a slippery kind of plastic). Margolin has created this sculpture to find out what happens when a sine wave with three peaks is added to a sine wave with four peaks, or, in general, to find out what happens when he adds two waves that have different wavelengths. Yellow Linear Wave has two electric motors, and its movement mechanism is controlled by Dacron string, instead of cables.

In general, Margolin – based in Emeryville, CA – uses a lot of redwood in his sculptures: recently, he acquired 14' lengths of clear 2x6 redwood from a salvaged deck. He has also been using salvaged maple from old futon frames, as well as some salvaged old fir and some oak balusters. Otherwise, Margolin buys fin ply, Baltic birch plywood, and poplar, as well as rough lumber and construction-grade plywood. As for his tools, he made the handles of his files from the wood of an acacia tree that had been chopped down near where he grew up in Berkeley. He has also used bamboo for the handles of his rasps.

Margolin likes working with wood for several reasons: he finds it easy to use; he can cut it using inexpensive tools; it's strong for its weight, and it's beautiful. He likes that wood is "linear in nature," but also easily made into planes, like plywood. He further enjoys that wood glues together well, and is abundant. Margolin finds that making mechanical things with wood can be challenging, since wood is not "an abstract material, not homogeneous like aluminum." Instead, it has "grain, life, and can change dimensions with temperature and humidity." These changing dimensions can interfere with sliding parts and pulleys.

I saw one of Margolin's largest sculptures, titled Square Wave, at the Exploratorium, San Francisco's museum of science, art, and human perception. Square Wave stands about twelve feet tall, is about twelve feet wide, and looks like a giant patchwork quilt of connected, hollow wooden squares. Each square is composed of four wooden, dowel-type structures, and at every intersection of two dowels, a metal wire rises to an elaborate web of cams, wooden arms, and metal above the quilt. Like Margolin's other sculptures, Square Wave is powered

by an electric motor, and when the switch is flipped, the cams and arms move, which then pull on the wires. As a result, the patchwork quilt made of dowels and fishing tackle rises and falls as if it were gently floating on an ocean. The effect is hypnotic, soothing, and immensely satisfying: in effect, Margolin has used huge Lincoln Logs and an Erector Set to build an enormous contraption that demonstrates the wave motion that all physics students learn about in class.

Another of Margolin's sculptures, titled Round Wave, is composed of about ten nesting wooden hoops. It is similar to Square Wave, except that instead of being a gently undulating quilt, Round Wave is more like a giant Slinky. Each hoop is suspended by wires from wooden rods attached to the ceiling of Margolin's studio. When the sculpture is turned on, a roller at the top passes under each rod in turn, and in doing so causes the hoops below to alternately rise and fall. The resulting movement looks like a circle turning inside out over and over again.

A third creation is much smaller than the other two, yet in a way more satisfying, since it is powered by human hands. This sculpture is made of redwood, and looks like an open box measuring three feet by three feet. Inside are about twenty wooden bars that have been balanced over two wooden axles. Inserted into the axles are wooden circles, placed in a spiral pattern. The axles connect to two handles placed at the bottom of the box, where a person can turn them. When a person turns the handles, the axles turn, and since the wooden circles are offset, they act as cams, and thus cause the wooden bars to rise and fall in a wave-like motion. Turning the axles together create even more complicated patterns.

Also, one of Margolin's round wave sculptures now hangs in the Chabot Space and Science Center, in Oakland, CA. The sculpture was inspired by ripples in water, but instead of being circular, it is hexagonal. It is about eighteen feet in diameter. Margolin also has a piece on view at the Aquarium of the Pacific, in Long Beach, CA.

Margolin has never taken formal woodworking classes. But, when he was growing up, his father owned woodworking tools, so they were always around the house. In fact, his father was an amateur woodworker, so, among other tools, Reuben got to use his planes, brace and bit, and eggbeater drill. When Reuben was eight years old, he tried – unsuccessfully – to have a business selling wooden duck puppets he cut out of pine with a jigsaw, and then painted orange. When he was sixteen, he made a canoe paddle, and then when he was eighteen, he attempted a canoe. (It remains unfinished to this day.) Additionally, Margolin has gotten a lot of woodworking experience while working at Lodestar Magnetics, a company that builds magnetically shielded laboratories. He has

worked for them for about one month per year since he was eighteen years old, and claims that their crew includes some very skilled craftsmen. While he worked at Lodestar, he learned about framing, finish work, trim, attention to detail, and "simply how to keep working on a large project until it got finished." In general, Margolin has learned how to work with wood by either "messing around," or on carpentry jobs where he can learn from more experienced craftsmen.

Margolin's Emeryville studio is in an old, warehouse-type building that used to house a small ceramics factory; Margolin now shares his space with a specialty soap manufacturer. The difference between Margolin's studio and what used to occupy it is striking: while the building once sheltered kilns, and in fact still houses some of them – white, dormant, and sitting in a corner – now it is filled with large, elaborate, wooden creations that hang like intricate mechanical mobiles from the studio's rafters.

Margolin has long been fascinated by nature, and the physical phenomena found in it. He also told me that he has been "making stuff" for as long as he could remember. He received a wrench when he was eight years old, and remembers taking apart a seat while riding on a ferry. He has always been fascinated by tools, as well as mathematics and geometry, and, in fact, sees geometry as a "practical, hands-on approach to math."

Reuben is also a trained fine artist. After graduating from Harvard College, he attended classical painting schools in Italy and Russia, where he learned how to study nature and create large-scale paintings. But Margolin's skill extends even beyond woodworking and painting: he also has become an expert mechanical engineer.

His engineering exploits began one day while he was observing a caterpillar undulating its way across desert sands. Margolin wondered how he could create a device that would mimic that movement. His first step was to re-learn calculus, which took about three months. Then, he began building. His third attempt at a mechanical caterpillar was five feet long, and was composed of springs, cables, welded pieces of metal, and mechanical linkages, all attached to a turning plexiglass wheel, which resembled the classic steering wheels found on the tall, masted sailing ships of the 18th century.

As a person turned the wheel, a knob would slide in a curved path cut into the plexiglass. As the knob passed particular points in the curve, it would move cables that would then actuate different parts of the caterpillar. The knob's path was the only part of the creation that caused the caterpillar to move in a

caterpillar-like way. The path, in Margolin's words, "uses a really nice integral," which he subsequently named after one of his high school math teachers.

In general, though, Margolin uses the same procedure to create all of his wooden and mechanical marvels. Usually, he is first inspired by nature (for example, water, or grass waving in wind). Sometimes, he is inspired by the mechanical simplicity of bicycles. Then, he sketches the sculpture in a notebook, noting measurements. Next, he moves to his drafting table, where he doesn't use computers, but instead compasses and rulers to make a more accurate drawing of the proposed sculpture. He then builds a quick scale model out of cheap materials, to make sure that the proportions are correct. Finally, he begins building the full-scale sculpture.

Besides working out of his studio in Emeryville, Margolin has also worked at a studio in India. While an artist-in-residence at the Kanoria Center for the Arts, he built mechanical, human-powered butterflies using rickshaws, bamboo, and hand-dyed muslin cloth. The resulting creations, when pedaled, "flapped and fluttered down the streets of Ahmedabad."

When I talked to Reuben Margolin, he told me that his goal, when making sculptures, is simply to "make something beautiful," whether mathematical or not. He certainly has succeeded.