BLOCKHEADS

Lego: The ultimate prototyping material. Seriously. By Bob Parks

Adrian Marshall decided that he'd need a very convincing scale model to sell his latest idea. The British designer of factory robots was to meet the board of directors of a large food company, who wanted an industrial robot that could move ten arms independently and burn a picture of the Rugrats cartoon characters on pancakes randomly placed around a moving skillet. It had to be done in under 0.8 seconds in a hot industrial kitchen. Of course, he used the only prototyping material suitable for such a tough job: Lego.

"I always use Lego to present to customers," says Marshall. "If it's simple enough to be made from Lego, then the scaled-up version will be robust enough to survive in the field."

It may be ironic that a toy may be the greatest prototyping medium ever invented, but since the arrival of the primary-colored plastic blocks in 1949, engineers have used them to envision new products. And with the advance of Lego Technic in the late 1970s, inventors could spec out more complicated machines with wheels, gears, and motors.

"Technic is coming from the engineer's mindset," says Hayes Raffle, a researcher using Lego to develop modular robot toys at MIT's Media Lab. "You can replicate the movement you find in motors and other mechanical linkages quickly and cheaply." Now, dozens of university programs across the country supply Lego Technic for students to design everything from unmanned military vehicles to laser-surgery devices.

Part of the Lego prototype popularity may be that everyone seems to have a cache of blocks in a closet somewhere. That's certainly the case with Tim Abbot, an Indiana-based entrepreneur, who used a Dremel tool to cut small holes in his son's blocks and built an innovative backyard sprinkler system. Abbot's Hydro-Edge will be sold nationally this summer. Or how about Kevin Mackie, from Scotland, who used Lego to build a prototype new drum pedal? The design is now used by musicians including Iron Maiden, Chick Corea, and James Brown.

Sooner or later, however, Legos run out. Factory roboticist Marshall says he often finds himself in a crunch for specific pieces, so he orders large batches from educational distributors online. Seekers of rare parts must look to eBay, trade among Lego enthusiasts online, or participate in closed auctions listed in newsgroups and Lego builder's sites like lugnet.com.

Lego has some inherent limitations as well. While some builders pride themselves on using only what's in the catalog — Chicago's Jonathan Brown created a Rubik's Cube solver and Lego juggler using only virgin bricks — even Brown concedes: "[Legos have] lousy strength-to-weight characteristics. They're great for small models, but not so good for large models."

In making factory prototypes, Marshall reinforces his structures with side plates of medium-density fiberboard, aluminum, or steel. "Fine adjustments to geometry aren't easy," he notes.

To make Lego creations more rugged, MIT's Raffle uses hot glue. Meanwhile, professional Lego sculptor Eric Harshbarger swears by Oatey All-Purpose Cement. (He once used seven pounds of the stuff to build a full-size office desk as part of a commission.)

Adjustments to size work best using the carbide cutting wheel on a Dremel; with flat plates, the experts suggest lightly scoring an X-Acto knife along a steel ruler and then making deeper subsequent cuts.

In the end, Marshall's client was blown away by his pancake-stamping machine and ordered a full-sized version in stainless steel to the tune of $200,000. He used a stereolithography machine to make custom parts for a second prototype and recreated the design virtually in 3D Studio, a CAD software program. (Other Lego builders hone their creations using LDraw, a free CAD software made especially for Lego parts.) The toy may not be the best option for going into production, but it's great for delivering a proof of concept.

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Photo illustration by Kirk von Rohr