

## 12. Building a Small World

Fifty or more years ago, a highlight of a trip to the Harvard Geological Museum was a protracted viewing of a large topographical map of the Boston, Massachusetts area. If you lived in an old house in the city - one that existed when the model was made in the early 1900's - you could find it as a tiny cube of faded, cream-white plaster. The advent of airplanes and aerial photography had finally made it possible to make such precise models, but it still must have been a prodigious effort requiring many hours and very skilled hands.

In the last few years, rapid prototyping has removed the construction of such complex topographic models from the realm of extreme skill. And more recently, it's become possible to make models in accurate colors, as well. Like airplanes in the 1900's, this is a new capability in the world, and the consequences of being able to generate such accurate models on an almost trivial basis are as yet unknown.

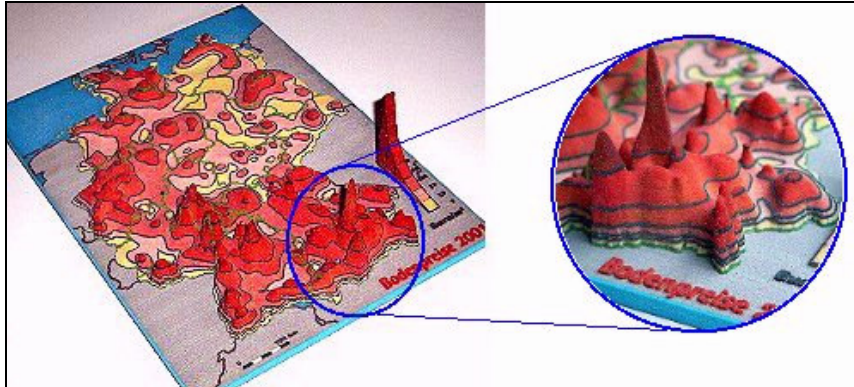


**A full-color urban landscape made with three dimensional printing.**  
(Courtesy of Z Corporation.)

Z Corporation has led the way in the field of geographic information system (GIS) models, first with its Model Z406 and more recently with the Z510 which prints in 24-bit color. The MIT three dimensional printing technology on which these machines are based, can deliver models in hours rather than the days or weeks it takes to make equivalents using CNC or molding techniques. Materials costs are also very low, typically in the few tens to hundreds of dollars. For example the model of the state of Illinois shown below cost only about \$300 in materials. The high fidelity 600 x 540 dpi printing capability also make it possible to print labels on models, making them much more self-explanatory for users and overcoming a previous limitation.

While virtual reality (VR) has some advantages over physical models such as being able to provide walk-throughs, fly-overs and real-time revisions, humans have lifelong training in interpreting 3D objects. Slight changes in point of view remove obstacles in the line of sight and make it easy for people to understand the information. VR is also still very expensive for group viewing and doesn't easily provide feedback from the sense of touch. [1]

Typical applications for topographic models include terrain, urban and sub-surface maps, but the ability to easily generate and replicate them in color expands the possibilities. It makes it easy to combine data with geographic information to make representations of population densities, property values, ocean temperatures, or any other variable.



**Data can be combined with a physical model to create new levels of understanding as in this population density map of Germany.**

(Courtesy of Wolf-Dieter Rase, Federal Office for Building & Spatial Planning, Bonn, Germany.)

Traditional users of topographic models such as universities, military and government and the oil and gas industries are the most obvious beneficiaries of this capability. Urban planners, landscape architects, geologists, are also good candidates and the push to bring the technology to consumers is beginning.



**The state of Illinois made in 8 individual tiles of approximately 8 X 10 in.**

(Photography courtesy of Benjamin Grosser, Beckman Institute for Advance Science and Technology at the University of Illinois.)

Vertical heights were exaggerated 30X and the model weighs about 12 lbs. The model was created by Mr. Kingsley Allan for the Illinois State Water Survey at the University of Illinois.

LandPrint.com is offering 3D physical models of landscapes. Consumers can select their favorite geographic feature, for example a mountain, canyon, forest, river, volcano, waterfall or glacier and submit their order using the web. Users select from a variety of surface features, and will soon be able to apply their own surface imagery. LandPrint.com gets its digital terrain data from NASA and the US Geological Survey and will eventually incorporate street, building and other data making the site a tool for professionals like architects, contractors and civil engineers. Terrain models are available in a range of sizes and start at \$23.95.

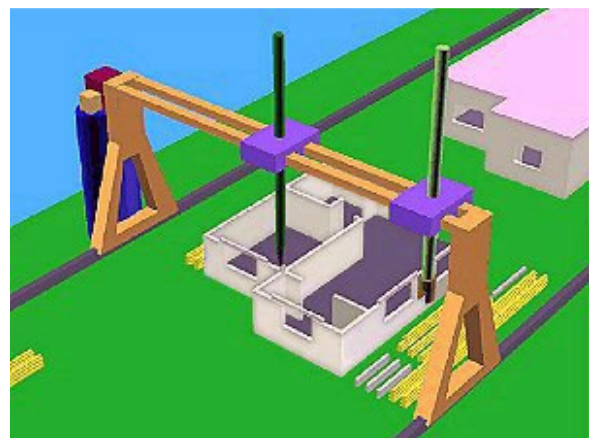


**A topographic model from LandPrint.com. Such models can be ordered over the Internet and delivered in a matter of days.**

(Courtesy, Z Corp.)

### 13. House Beautiful - Martian Style !

Those old enough to remember the shock and exhilaration of Sputnik may find it more astonishing than younger people that there is a serious inquiry underway today to determine the best way to construct buildings for the colonization of the moon and Mars. Rapid prototyping is becoming recognized as one of the few ways of accomplishing that task, and Contour Crafting, under development for several years by Behrokh Khoshnevis' group at the University of Southern California is a leading RP contender.



**Schematic of Contour Crafting used in conjunction with robotic assembly of structural members.**

**The rest of the Chapter is Omitted in this brief sample.**

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