At MIT

The Technology Institute Supports the Arts

WITH SEVEN PROFESSORS WHO ARE NOBEL PRIZE LAUREATES IN THE SCIENCES AND TECHNOLOGY, the Massachusetts Institute of Technology has a well-deserved reputation as the premier university for science and technology. It is also a place where the arts are taken seriously. Its Performance Series brings distinguished artists to perform on the campus. Faculty projects include Tod Machover’s Opera of the Future at the Media Lab. Featuring robots and hyperinstruments, the main character in the current opera downloads himself to live entirely in the digital realm. In 2010, the Department of Architecture inaugurated the Program in Art, Culture and Technology. The campus boasts several remarkable buildings designed by renowned architects including I.M. Pei, Alvar Aalto, Eero Saarinen, Frank Gehry and Fumihiko Maki. Artworks on campus by famous artists include Eduardo Catalano, Alexander Calder, Henry Moore, and Louise Nevelson. During her residency at MIT, the African American artist Betye Saar created Mojo Tech, a mixed media (including circuit boards) installation.

Hampton University faculty members are collaborating with the MIT-based Robert R. Taylor Network (RRTN) on a digital archive that documents the work of black architects. Named for the first African American graduate of MIT, the RRTN is led by MIT alumnus Darian Henricks. The organization links MIT’s African American alumni, conducts research and provides resources such as ADIAS, an interactive, web-hosted, multi-media timeline. ADIAS documents black contributions to science, technology, engineering, architecture and mathematics. An early build of the timeline can be viewed at www.adias.org. – A.K.

Digital Craft, Design and the Work of Lawrence Sass

MIT ASSOCIATE PROFESSOR AND ARCHITECTURAL DESIGNER LAWRENCE SASS came into architecture and computing from a background in painting and drawing. During a conversation in December 2010, he said the impetus for this transition came suddenly. One day he realized design computing would open doors to areas and resources he wanted to explore — areas that went beyond his art work. Today, he is among the most renowned digital designers and fabricators and the only African American who has received such a high level of visibility.

Currently, Sass directs MIT’s Digital Design and Fabrication Group. For years, the MIT center has supported the establishment of fabrication labs — “fab labs” — in the United States and globally. Under Sass’ direction, it continues to present local workshops with schoolchildren and at other institutions of higher learning. The fab labs combine design with digital representation (hands-off) and computer-controlled fabrication (hands-on). The art of making is at the heart of craft, where making is engaged with imagining. In his book, The Craftsman, Richard Sennett argues that craft is founded on highly skilled practice where “technique is no longer a mechanical activity.” With the increasing development of rapid prototyping processes and computer-controlled manufacturing tools, two questions must be raised as artists and designers use such technological practices in their design work: What skills are developed when a machine makes the object? What art is left in machine work?

As part of his doctoral dissertation, Sass was involved in creating accurate models of the unbuilt villas of 16th century Italian architect Andrea Palladio. Since the 1970s, Palladio’s villa designs have been used in studies to understand the forms that result from applying transformation rules to basic shapes — an area of study called “shape grammar.” The plans of Palladio’s villas appear to have followed a clear set of proportional and shape rules. Sass said he was intent on adding construction rules to the established shape grammar set. He tested those new rules using rapid-prototyping, or solid deposit 3D printers, to build precise, scaled models.
Larry Sass is inspired by the work of his friend, Kehinde Wiley. The embellishments of the Digitally Fabricated House are similar to some of the decorative elements of Wiley's style of painting.
The process Sass proposed was complex. It required interpreting the rules Palladio recorded in his *Four Books of Architecture*. Sass then analyzed Palladio's built work to verify the rules. Finally, Sass generated new rules that allowed construction in three dimensions from two-dimensional information. At its root, this process required well-defined geometric forms, possible topological relationships and transformation procedures. Sass expressed the three-dimensional model of a villa in four ways: a spreadsheet containing the objects' variables and rule equations, the printed 3D model, detailed 2D drawings and renderings. Any modification to a rule resulted in a slightly different model, or version. The practice is called versioning; Sass called it a creative generative design process.

From the development of the process, Sass realized that design creativity is embedded in the development of rules for construction, and not in the rules' application. Sass also concluded that masons would incorporate their own ideas into the system of rules established by Palladio, thereby making Palladio's designs their own. For Sass, this notion became a guiding principle in his subsequent projects: the Instant House and the widely reviewed Digitally Fabricated House for New Orleans created for the 2008 Museum of Modern Art exhibition, *Home Delivery*. Both were designed to be shared as digital building kits facilitating mass-customization. Sass describes it as an “IKEA-style” kit made of interlocking numbered parts.

When Hurricane Katrina hit New Orleans in 2005, Sass already had been working for several years on the Instant House concept, a do-it-yourself shelter kit comprised of parts put together without nails or screws. The Instant House appeared as a viable alternative to a tent or a trailer. Its parts would be cut from available materials, such as standard, 4-by-8' plywood panels. These panels would integrate snap-on friction (or friction-fit) joints and would be assembled manually using few tools. The builder-homeowner could customize the house following his or her own sensibilities. But the idea had not been tested in a full-size mock-up. The structural stability needed to be verified. The commission of the house installation for the MOMA exhibit allowed investigating the potential of the snap-on joints parts system. For Sass, it became version one of a working house model.

The New Orleans House was a temporary art installation, more sculpture than house. It lacked some of the basic characteristics of an actual shelter. Its shell was not waterproof. It didn’t have electricity or plumbing. Future versions will. Everything from the structure to the cladding to the ornamentation is pre-fabricated for assembly.

The house consists of a room with a porch. The porch is to be the more customizable of the spaces. This is the first full implementation of the concept, testing parts and joints to deliver a viable self-supporting structure. While individually the parts are simply flat pieces of plywood, their assembly into walls makes them structurally sound. Designing joints, explained Sass, is more art than science because there are many possibilities. Here
Sass made an analogy with HTML, explaining that shaping parts and joints is like writing code to put together a website. Anyone, then, can make their own.

Sass is very interested in opening design to all. He said the application of DIY (Do-It-Yourself) concepts in design is akin to the development of new computer programs from open domain software and scripts. Each house becomes a personal expression, each different from the next. In the future, Sass speculated, design will be a more common activity, less exclusive. Ordinary people will be able to design their own version of the house.

The digital or materialized building kit that is at the heart of Sass' design depends on a “layered manufacturing software” that translates a three-dimensional model into layers fabricated one at a time. Implementing the layered system requires more than design skills. Sass used the phrase design-for-assembly (DFA) to sum up all that is needed. It involves knowledge of the materialization process, the digital fabrication tools and process, and material properties and assembly process. Fabrication of the parts is conditioned by the process of materialization and the construction rules. Materialization refers to the translation of a design from three-dimensional model into two-dimensional planes, and ultimately into the shapes of the parts arranged to fit the flat material from which they are to be cut. The construction rules are applied to the materialization process to ensure that the parts’ final geometry conforms to the material used, as well as to their fabrication and assembly. Modifications in the construction rules generate a different house version.

The New Orleans House is a three-door, shotgun type. Sass considers buildings to be an expression of people, and the shotgun house, in particular, he says, is the “only true African American architectural symbol.” The porch of the New Orleans House installation is highly decorated with pierce-work brackets, spindle band friezes, pediment and elaborate railings and columns drawn from similar elements found in New Orleans’ traditional shotgun houses reminiscent of the Eastlake style. It must be noted that, originally, many of the decorative elements used by masons and carpenters were factory-produced. Yet, building a house was a community affair, allowing apprentices to learn their trade. Interestingly, the Digitally Fabricated New Orleans House does not look like a high-tech, highly industrialized object. Sass and members of his team travelled to the city seeking local models on which to base their design. The team selected a few styles as test models and then developed their design until they found one that worked best with the design production system. They could have generated new forms and never-before-seen ornamentation. Instead, they chose the traditional because it is part of the collective imagination and ordinary people would identify with it.

During our conversation, Sass said he has been inspired by the work of New York artist Kehinde Wiley, who makes portraits of ordinary men in regal positions with dense ornamental backgrounds such as fleur-de-lis. The men’s poses are masculine, but the setting surprisingly softens them. Sass wanted to achieve a similar effect with his New Orleans House, by contrasting the ostensibly cold industrial precision of the computer work with a more feminine, delicate image.

The shotgun typology and the decoration of the Digitally Fabricated New Orleans House connect directly to the vernacular architectural traditions of the area. New Orleans was built by skilled masons, carpenters, ironworkers, latherers, masons and plasterers. Building traditions evolved through generations. The flooding after Hurricane Katrina destroyed and damaged the legacy of the artisans. Now, New Orleans is struggling to educate a new generation of craftspeople who can restore, but also create anew, while maintaining the crafts unique to the city. Sass’ proposal of design for assembly may evolve into a tradition of new forms, different yet derived from those that historically have been associated with New Orleans. To make this happen, however, Sass’ new craftspeople must be fully conversant with digital fabrication. Only then will their art of making become the heart of New Orleans craft and move from technique into the art of the people.

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