

what : architects and the digital surface

The adoption of animation software, most notably Maya and 3D Studio Max, by architects over the last decade has resulted in an emphasis on generating surfaces. These software packages, built with character modelers, animators and texture artists in mind, excel at producing and working with curvilinear forms in three dimensional space. The same software has given architects the opportunity to eschew the rigid geometric vocabulary that they have grown accustomed to in favor of the ability to create highly pliable skins. Architects have found that by incorporating these programs into their design process, they can do such things as generate and quickly modulate complex surfaces, smoothly blend between dissimilar surface conditions, infuse surfaces with animate qualities, and interactively design curvilinear geometry through deformation. As this mode of working has become increasingly accessible, many architects have grasped on to it with both hands. Examples range from Greg Lynn, Lars Spuybroek, Kolatan/MacDonald, Reiser+Umemoto, Zaha Hadid, and Ali Rahim to almost every architecture student that has graced a keyboard and mouse. These ubiquitous examples show a clear precedent of architects co-opting the toolset of the animator.

Despite the inclusion of certain animation software in their palette, architects have stopped short of some of the animation industry's most powerful modeling tools: those of digital sculpting. Digital sculptors exist in the film and game industry as an offshoot of character modelers. Their job entails character design from the rough forms for massing to the minute detail that articulates the skin. Their tools are the computer's answer to clay. The design requirements of the job necessitate software that can seamlessly bridge all levels of surface detail and allow for modification at every scale. The synthesis of these multiple scales of detail is essential to the digital sculptor as one level of detail informs the others. The work also requires the ability to work efficiently with extremely heavy computer models. Digital sculptors design highly articulated surface detail that architects have not yet approached with such specificity. Their digital surfaces display highly refined surface articulation and complex flows of topology. This is in no small part due to the software environment that they rely on. Given the same tools, architects can benefit in similar ways.

why : the purpose of surface continuity

For years now, many architects have been chasing a topologically-gearred design methodology. They wish to draw on continuity of surface as a means to reconcile disparate conditions. The belief is that creating heterogeneous surfaces that retain continuity can afford a negotiation of the complex, conflicting and often contradictory forces at play in an urban context or between a building's elements. It is argued that the incorporation of these forces into a design is more appropriate than accentuating their conflict in a Deconstructivist manner. Unlike traditional architectural elements, the continuous transformation of a surface can accept contradiction and articulate it in a smooth, pliant mixture. For instance, continuity can allow the flow of traffic to be registered in surface form while simultaneously transitioning the angle that the building will catch the afternoon sun. On another scale, the careful contortion of a surface could meet the requirements of both a stepping circulatory path and a partition wall punctuated with apertures. When deployed skillfully, surface continuity can negotiate the complexity of both contextual and programmatic requirements.

It is important to note that perfect continuity between unrelated architectural elements is not the goal. The *controlled* modulation of surface heterogeneity is, however, a way to synthesize functional and contextual needs through form. To this end, architects have employed animation software to work with the topological detailing of surfaces. Techniques of deformation, kinematics, hybridization, blending, and dynamics simulations have all been utilized by architects in an attempt to control continuity through surface form. However, a high level of control is needed to bring the appropriate topological transformations to a surface. The aforementioned techniques lack this degree of control, while digital sculpting has proven essential in the animation industry to achieve it. The ability of digitally sculpted surfaces to negotiate dissimilar conditions in building form with a high degree of control will be the measure of success for the software's application to architecture.

how : the challenge of surface continuity

To analyze the criteria set forth, we must accept the link between the workflow promoted by a software environment and the designs produced within that environment. If a form emerges out of the process of transformation that generates it, then it follows that that process should promote results typical to those that the designer aspires to. A quick look at the work of digital sculptors demonstrates the potential of the software to produce a multiplicity of conditions encapsulated within a single surface. One might think that the writings of Greg Lynn were about these digital sculptures and not the topological design work that architects have been producing over the last decade. The software environment employed in generating these forms has a direct impact in the tendencies of the designer and thus the design. Architects have assumed that an animation package such as Maya will promote the creation of desirably heterogeneous surfaces. To an extent, they are right. However, the software of digital sculpting is more conducive to the tendencies architects aspire to in topological detailing. It encourages a modeling workflow that condenses transformations of diverse scales and intensities into a single, but heterogeneous surface.

strategizing the toolset

How can we evaluate the advantages of a software environment to meet particular design goals? One way is careful analysis of the toolset prearranged for the end user. The user-friendly functions within a software package have a tendency to be used more often. For example, architects will often design blob-like surfaces in Maya because the software environment makes it very accessible to do so. That is not to say that one cannot make a highly refined blob after much practice. Maya is indeed a sophisticated program that can yield sophisticated results, but the vast majority of architects that utilize the program will only accomplish what is within a novice's reach. This is not a critique of architects, but a reality of adopting software geared toward a different audience.

The tools found most readily in digital sculpting software, however, are fundamentally different than those of Maya. They are used to actively deform a surface in a painterly fashion. One-to-one modulations of enormous amounts of surface data occur with each stroke of the mouse (or pen with tablet). This direct control allows the user the ability to make precise alterations to a complex surface form. The size and intensity of these deformations is very easily modulated as well, promoting adaptive variation with attention to scale. Transitioning a surface between dissimilar forms becomes easier with digital sculpting as well. As a result merely of convenience, the toolset of digital sculpting promotes the qualities of continuous variation within a heterogeneous surface that topological design strives for. Again, architects may make use of the software on a lower level than most digital sculptors, but the available toolset will shift their work toward surface generation of highly heterogeneous continuity.

controlling specificity

In today's digital design practice, techniques of surface generation place emphasis on smoothly flowing continuity. This is problematic because continuity often negates functionality. Surfaces made with current techniques often fail to acknowledge their architectural responsibilities in any sort of adaptive way. The problem is built into the process that generates these surfaces. Some techniques rely on an aesthetic of gradual transformation that cannot adapt to local specificities. Others rely on dynamics simulation that bears no relation to the use of the respective space. Often, surfaces generated through current digital methods do not align with the functional needs of the spaces they define.

A more controlled process of surface formation is necessary. This is the function of digital sculpting. Local changes are easily performed across any scale. Consequently, the software's tools promote alterations to be made in an extremely adaptive manner. The surface flow can be modulated in any direction at any time at any location on the surface. These modulations can be made at any scale and intensity. There is no blending system that needs to be broken to adapt to a unique condition. There is no simulation that needs to be interrupted. Continuity will not be irreparably broken by addressing a local condition. The environment of digital sculpting enables a freedom of modification that results in a more controlled heterogeneity of surface. Therefore, more intelligence can be built into the surface without restriction. The smooth surface does not need to be a slave to the system that generates it. Continuity can be had without imposing a dictatorial system that does not allow for smart topological modification.

lifting limitations

Another method of quantifying the advantages of a software package to meet certain goals is to consider its limitations. These limitations can guide specific workflows based on paths of least resistance. If a software handles NURBS surfaces in a cumbersome manner, its users are less likely to design with them. Digital sculpting software breaks a key limitation of traditional animation software by allowing massive amounts of polygonal data to be manipulated in real-time. This means that surfaces can be altered in ways that would be prohibitively complex for a surface, whether NURBS or polygon, in a traditional animation package. Due to the limitations of the software that he or she employs, an architect would normally not dream of designing the subtle minutia of surface flow that a digital sculptor will. However, given the right set of tools, with certain limitations lifted, a designer will be happy to delve into the level of surface detail that character artists working with digital sculpting tools do on a regular basis. By suspending limits such as polygon count, digital sculpting software encourages the creation of surfaces complex enough to possess the multiplicity desired by designers interested in creating heterogeneous surfaces.

to what end : the digitally sculpted surface in architecture

Co-opting animation software has given architects the ability to make smooth, pliable surfaces that fulfill the desire for heterogeneity. However, control over these surfaces lacks the precision that digital sculpting software can afford. Between its incorporation of tools that emphasize continuous variation within single surfaces and technical breakthroughs that make the direct manipulation of these surface forms more fluid to work with, digital sculpting software provides an environment that engenders a design workflow that is very effective in the production of topological detail in architectural surfaces.