Greg Lynn:
Animate Form

Animation is a term that differs from, but is often confused with, motion. Where motion implies movement and action, animation suggests animalism, animism, evolution, growth, actuation, vitality and virtuality. The term virtual has recently been so debased that it often simply refers to the digital space of computer aided design. Virtuality is also a term used to describe the possession of force or power. Design becomes virtual when it begins to model form in association with force. As well as being defined by digital information, animation techniques model form within a virtual space of force and motion.

In the cinema industry there is presently a shift occurring from a paradigm of motion pictures to special effects through animation. The virtual space of cinema is inert where the virtual space of animation is vital. The primary difference between the cinema and animation paradigm is between an ideal virtuality of inertia and a vital virtuality of force. Design is animate, when movement and force are co-present in the beginning rather than being added in order to simulate movement. Before discussing the animation model it is necessary to examine architecture's engagement with the paradigm of the motion picture. Motion pictures as well as cell animation simulate flow and continuity through the addition of motion. Architecture aligns itself with the motion picture model based on its role as the provider of frames through which motion is added.

Architecture's relationship to time is typically posed in terms of the representation of motion. The representation of time and motion in architecture has been a persistent theme throughout its history. It was Siegfried Giedeon's Mechanization Takes Command and Space, Time, and Architecture that established these themes as the primary concern of Twentieth Century architectural theory and design. Yet, despite the experiments of the early Modernists, architecture remains as the last discipline dedicated to statics.

There are two recent models for the modeling of movement in architecture; the first method involves procession and the second involves superimposition.

Both models begin by representing motion pictorially. Architecture has historically modeled time in terms of models of procession. These two approaches are both dependent on the cinema paradigm mentioned previously. Architectural form is typically conceived as a modulating frame through which a mobile eye moves. The nature and complexity of the modulating frame has been the primary factor in discussions of temporal procession. In processional models of time, architecture is the immobile frame through which motion passes. There are two recent alternatives to the processional model of the static frame; both of which formalize time. Where processional time depends on static frames, formal time indexes time through the multiplication and sequencing of static frames.

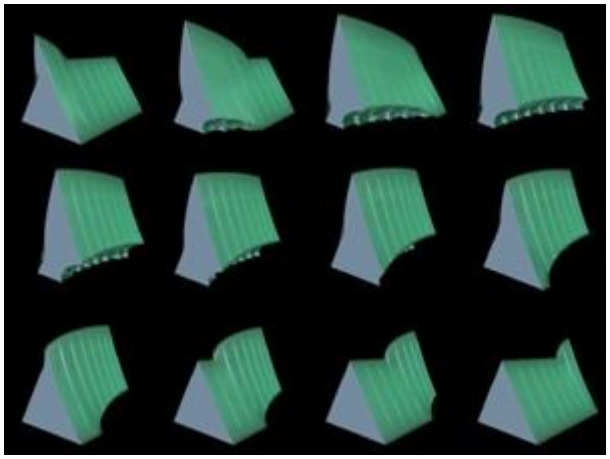
The first is the idea that of Giedeon where time is built into form as memory. The second model of formal time is associated with Colin Rowe and his disciples. In Rowe's text "Transparency: Literal and Phenomenal," that he co-authored with Robert Slutzky, the idea of a formal, or phenomenal, transparency is proposed along with literal transparency. Phenomenal transparency is the tracing or imprinting of a deeper formal space on a surface. Examples of formal or phenomenal time include "shearing," "shifting" and "rotating" operations. Superimposed snap-shots of motion imply time as a phenomenal movement between frames or moments. For instance, Kenneth Frampton's description of Charles Gwathmey's early work as "rotational" is one such example of time being used to describe the movement between superimposed formal moments. These motion picture models of time instance a sequence into frames that are later reanimated with motion. They differ from the processional models of architecture as a static frame because they introduce the idea of architecture as multiply framed and therefore dynamic. The model of multiple frames is similar to the processional model because architecture is a frame to which motion and forces are added.

Rather than understand animation techniques within the paradigm of cinema it is necessary to reconceive motion as force rather than as a sequence of frames. In cinema, force is

added back to give form and shape the simulation of vitality. In computer animation, force is an initial condition. In cinema, the multiplication and sequencing of static snap-shots simulates a linear indexing of time and motion. Animation is based on non-linear, dynamic and kinematic motion techniques. In these systems motion is defined by interacting vectors that unfold in time perpetually and openly. Animation becomes the interaction and inflection of those vectors in a creative field rather than in a regimented linear sequence. Contemporary animation uses interacting forces and vectors within an open temporal sequence rather than a sequences of key frames or cells. With these techniques entities are given vectorial properties and they are released in a space of forces, collisions and boundaries where they move in a continuum.

Many other disciplines have used time and motion structures to redefine themselves. In addition to the special effects and animation industry, any other discipline that models form in a space that is a medium of movement and force uses such an animate approach to modelling forms in a field. These disciplines include aeronautical design, naval design and automobile design.

Animation, in its manifold implications, touches on many of architecture's most deeply embedded assumptions about its structure. What makes animate geometry so exciting and problematic to architecture is that it is perhaps the last discipline to incorporate an ethics of motion into its thinking. Architecture is frequently conceived as the study of the inert because it is dedicated to models of permanence. More than even its cultural role of providing shelter, architecture's expectation is to provide culture with stasis. Statics is important to architecture as a paradigm of literal structure and as an ethic of discretion. Both terms "static" and "discrete" are mutually dependent on the separation of force from form. There is an intimate link between a desire for timelessness, a desire for formal purity and a desire for autonomy. An ethics of motion does not mandate that architecture must be literally moveable nor does it preclude actual motion. The difference between virtual movement and actual movement is critical, as the two imply very different consequences and both conceptual and methodological problems arise when these two concepts of time and force are casually exchanged. Both the processional and the sequential models of movement are instances of virtual rather than literal timing. Both of these examples cast architecture in the role of a static frame that indexes motion and time. The initial elimination of force and motion from form along with the reintroduction of motion to a sequence of static frames is the basis of both the processional and the sequential models.



An alternate model of time and motion would resist the separation of form from the forces that animate it. Form can be conceived in a space of virtual movement and force rather than within an ideal equilibrium space of stasis. For example, discrete fixed point coordinates define an object in ideal static space. The trajectory relative to other objects, forces, motion fields and flows defines an object immersed in an active space of forces. The shift from a passive space of inert coordinates to an active space of interactions implies a move from autonomous purity to contextual specificity. The modeling of architecture in a field populated by forces and motion is dependent on the development from previous paradigms and technologies of stasis. Stasis is a concept which has been intimately linked with architecture in at least five important ways, including; procession, permanence, usefulness, typology and verticality. Many architects have vigorously critiqued static models, such as processional sequencing. Statics does not hold an essential grip on architectural thinking as much as it is a lazy habit or default that architects either choose to reinforce or contradict for lack of a better model. Architectural design has, throughout its history, systematically identified itself with retrograde concepts of motion and time. Each of these assumptions can be transformed once the virtual space in which architecture is conceptualized is mobilized with both time and force. There are several examples of how statics can be rethought through the use of both motion picture technology and dynamical animation systems. For example, the cultural expectation that buildings must be permanent infers that building's physical and symbolic form should persist. Rather than designing for permanence techniques for obsolescence, dismantling, ruination, recycling and abandonment through time can be studied. Another characteristic of static models is that of functional fixity. Buildings are often assumed to have a particular and fixed relationship to their programs, whether they are intersected, combined or even flexibly programmed.

Typological fixity, of the kind promoted by Colin Rowe for instance, depends on a closed static order to underlie a family of continuous variations. The concept of a discrete, ideal and fixed prototype can be subsumed by the model of the numerically controlled multitype Figure 1 that is flexible,

mutable and differential. By modeling the potential of multiple variables as what is often referred to as a "performance envelope" a series of possibilities can be designed from which particular configurations are "instanced". Similarly, multiple independent interacting variables can be linked to influence one another through logical expressions. Expressions are statements that define the size, position, rotation, direction or speed of an object will by looking to other objects for their characteristics.

This concept of an envelope of potential from which instances, or even a sequence or series of instances can be taken is radically different than the idea of the fixed prototype which is varied. In the example of the performance envelope or multitype there is no privileged or fixed type but instead a series of relationships or expressions between a range of potentials. The processional model of the subject as either the animating force or as the occupant of privileged points of view assumes that architecture is a static frame which intersects motion. Architecture provides mobile experience with a series of punctuations or static frames. Architecture can be modelled not as a frame but as a mobile participant in dynamical flows. By defining space as a medium populated by differential forces of attraction and movement one begins to understand the shaping and directional forces that can be built into form that directs space like a current. The idea of privileged points advances to the continuous model of spline paths that hang within differential gradients. Finally, static models underwrite the retrograde understanding of gravity as a simple, uniform, unchanging, vertical force. The example of gravity is a relevant case study for this discussion of the static and animate models for motion. The concept of gravity as a system in equilibrium that can be predicted and modeled as a linear sequence has shifted to a system of relative independent components whose position in time can only be calculated procedurally. In the case of reduction, time and force is eliminated so that positions can be calculated discretely. In the case of complex relative attraction, time and force are constituent to position in space so that positions can only be calculated continuously. The shift from a discrete model of gravity to a continuous model involves the shift from a space of neutral timelessness to a space of temporal change.

Architecture remains as the last refuge for members of the flat earth society. Structure is related to a concept of force and gravity as any architect or structural engineer recognizes. These relationships are by definition multiple and inter-related.

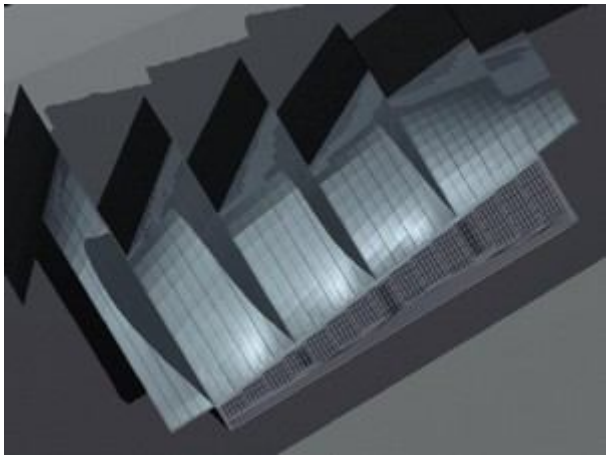
Curiously, architects treat these issues as discrete and reducible to what is still held as a central truth, that buildings stand up vertically. In fact, there are multiple interacting structural pressures exerted on buildings from many directions including: lateral wind loads, uplift, shear, live loads and earthquakes to name a few of the non-vertical conditions, any

one of these "live loads" could easily exceed the relative weight of the building and its vertical "dead loads".

The naive understanding of structure being a primarily vertical problem excludes the fact that lighter buildings have a tendency to uplift and the structural issue is how to tether their roofs. Structures are typically not thought of in purely vertical terms by structural engineers or architects for that matter. The role of vertical structure is an expectation for architecture based on the need for discrete verticality. A reconceptuallization of ground and verticality in light of gravitational orbits and movements might not change the expediency and need for level floors but it would open up possibilities for structure and support that take into account orientations other than the vertical.

Gravity is a concept and not a fact. There is a history of concepts of gravity that is extremely nuanced, fascinating and unresolved at this present time. Gravity has been agreed upon as the mutual relative attraction of masses in space in almost every discipline, except architecture, since the time of Newton. Given a constant mass, stability is achieved through orbits rather than stasis. The distinction between stasis and orbital or dynamic stability is important. In the case of a single simple gravity, stasis is the ordering system through the unchanging constant force of a ground point. In the case of a more complex concept of gravity; mutual attraction generates motion and stability is the ordering of motion into rhythmic phases. In the simple static model of gravity motion is eliminated at the beginning. In the complex stable model of gravity motion is an ordering principle. It is no coincidence that the combinatorial model of gravity without a static equilibrium was put forward by Leibniz in his Ars Combinatoria in opposition to Descartes model of a single point from which gravity originated. Leibniz argued that combination itself would generate a creative movement and development in time that can not be conceived through ideas of reducible organization. In Ars Combinatoria combination generates motion and motion becomes the primary mode of organization, construction, composition and stability. Cartesianism is associated with the isolation and reduction of systems to their constitutive identities in a steady state equation.

Leibniz initiated an alternative epistemology founded on the systematic nature of combinatorial changes in identity that take place with increasing degrees of complexity.



Both the geometry and the mathematics that Leibniz invented to describe an interactive combinatorial and multiplicitous gravity remain as the foundations for topology and calculus upon which contemporary animation technology is based. More than a mere shift in technology, a shift in sensibility from reduction to combination is necessary to compose stability in time based, topological design mediums. Likewise, this sensibility would shift from mechanisms of stasis and equilibrium, such as the compass and the orrery, to abstract machines of differential stability and unfolding structures of movement and temporal flow.

In the 18th century, the orrery came to represent not only the image of the machine but also the conceptual processes of a universe that is harmonically regulated as a closed system of circular orbits around radial center points. The tools used to describe this universe of fixed points as well as the sensibility of reduction to fixed points can be observed in the abstract machine of the orrery. As a technical history, one can see the influence that the compass and dividers has had on architectural design, but it is not enough to situate the influence of a technology in a purely instrumental fashion. Technology establishes both the limits of tools and a broader conceptual sensibility. The compass, like the orrery, has implicit in it a series of conceptual and disciplinary limits that are rehearsed with ever arc that is drawn. Drawing technologies are the necessary intermediary for the actualization of architecture's virtual structures. Because architects produce drawings of buildings and not buildings, the tools for the construction of drawings are as important as the tools for the construction of buildings. The computer has already begun to be thought in terms of construction and fabrication by a few architects. Frank Gehry has been on the forefront of this type of research with his use of the computer as both a complexity manager and as a guidance system for tooling and cutting paths in the realization of heretofore impossible expressionist or sculptural forms. But few architects have attempted to use the computer as a schematizing, organizing and generative medium for design. Computation has already proven to be useful as both a descriptive and a visualizing tool to architects, but its use as a conceptual and organizational tool has been resisted due to

the stigma of releasing control of the design process to software.

Architects are responsible to interrogate drawing technologies, instrumentality as well as their media or visual appeal. The introduction of time and motion techniques into architecture is not simply a visual phenomenon. The visual qualities of computer generated images may be important but it seems misguided to understand technology in terms of style once again. Spurious comparisons of contemporary computer technologies with the technological experiments of the 1960's and 70's based on aesthetic categories reproduce the habits of Modern architects who compared buildings to boats and aircraft based on fenestration and canopies. For instance, although geodesic domes often employ triangulated surfaces and some computer programs use triangular polygon meshes, to align computer aided design practices with Buckminster Fuller because of the stylistic commonality of triangulated surfaces is not an adequate theorization of computation. This might be due to an deficiency in theorists and historians who have training and familiarity with the operation, structure, history and methods of computation.

There are distinct formal and visual consequences to the use of computer animation techniques that can only be elaborated with a technical knowledge of the software. For instance, the most obvious aesthetic consequence is the shift from Cartesian coordinate defined volumes to the definition of topological surfaces with U,V vector coordinates. Another obvious aesthetic fallout of these spatial models is the predominance of deformation and transformation techniques available in a time based system of flexible topological surfaces. These are not aesthetic choices but technical statements of the structure of the topological medium.