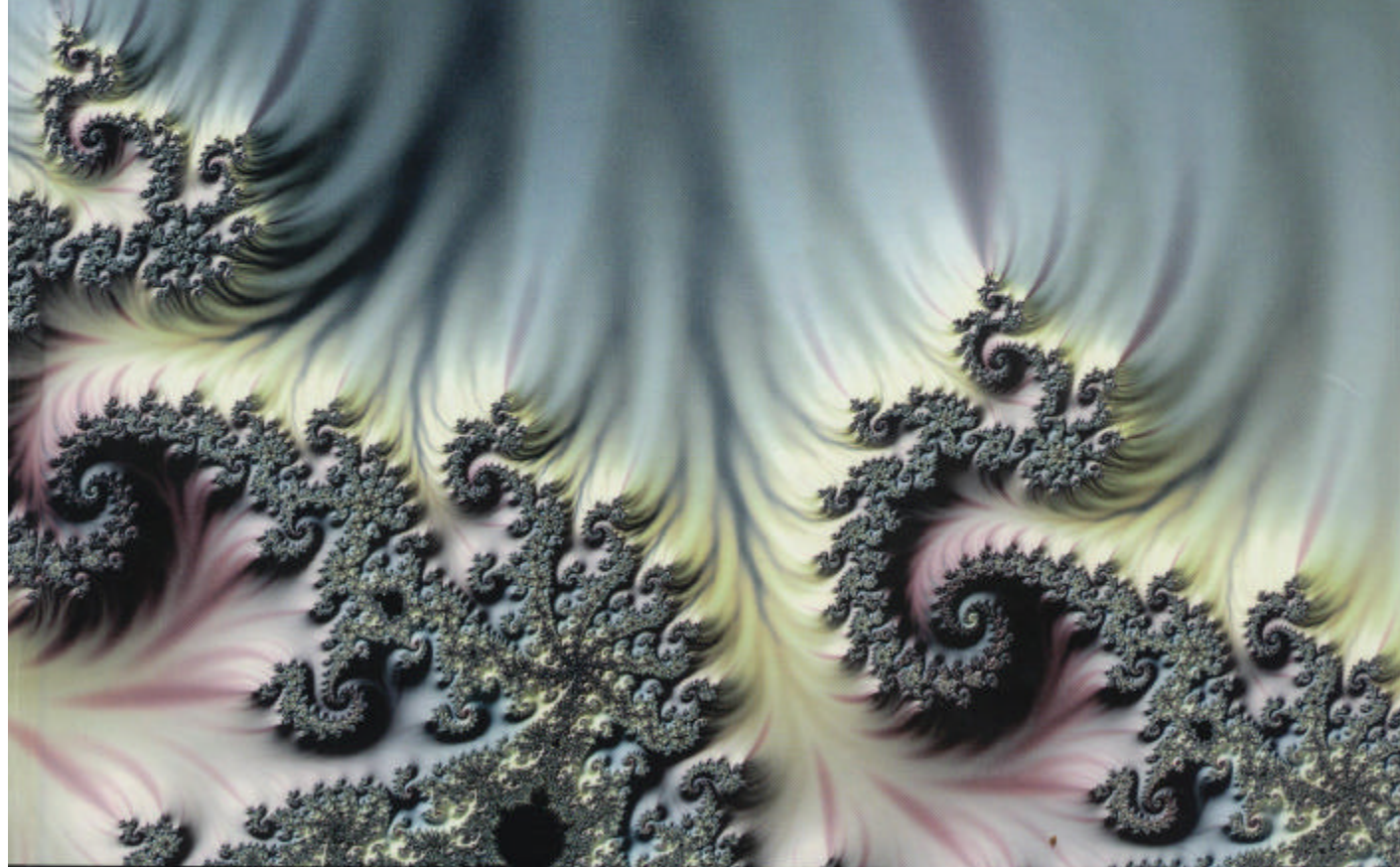


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# BEYOND PAPER ARCHITECTURE: THE USE OF CADD AS AN ARTISTIC MEDIUM

*Michael Mahan*

P.O. Box 913  
Valley Center, CA 92082 U.S.A.  
mmahan@4dcomm.com

*Abstract. CADD programs, developed for the architect and designer, can serve as an important tool in the production or instruction of art. Allowing the artist to go far beyond the “design” of a project, CADD offers capabilities for representation of conceptual projects as well as the actual production and reproduction of drawings as “flat” art. This paper will follow a project, from its initialization as a conceptual piece, through expression as a three dimensional sculpture, finally a return to as-built drawings as abstract art. The final phase of this project will be an animated version of the original piece. In the spring of 1997 I completed a project titled, “Generations of a House.” The project was conceptual and whimsical. It was created in a CADD format by manipulating an elementary drawing of a house according to precise mathematical formulas to create geometric solids of ever-increasing complexity. At each stage a graphic was generated and saved, but the CADD drawing was “undone” and no record was kept of the three dimensional form or of the formulas used in its creation. The record consisted of 26 captioned images, each representing the concept of a solid with no mass. When I planned to include these representations in an exhibition, it was suggested that I build one of these forms as a sculpture. I executed one of the simpler ones in three real (as opposed to virtual) dimensions, and in the course of doing this created as-built drawings of the model. I included extreme details of these drawings in the exhibition as computer art of even greater conceptual abstraction. Although none of the original CADD drawings were recoverable, they will be reconstructed for an animated video.*

## Introduction

This paper is a case study of a project, titled *Generations of a House*, created using a 3D modeling program, as it evolved from purely conceptual representations, to sculpture, to as-built CADD drawings that became “flat art”, and finally to video. The deliberately unwieldy subtitle, *A Visual Essay on the Nature of Generative Rules of Geometry using the Theme of the House Symbol as a Starting Point: Together with Some Verbal Musings and Ruminations, Not Altogether Serious, Containing a Large Number of Puns, Some Not Entirely Unintentional, but nevertheless, not without some Intended Comments, both Epistemological and Ontological in Nature on the Structures of Language and Space*, was intended to evoke imagery of an archaic tome and at the same time suggest that under the whimsical surface the text of the work is double coded. The original *Generations of a House* was never intended to be more than a conceptual piece, so the transformation was truly evolutionary. This

paper will evaluate that transformation from the point of view of the artist working with various media, and from the point of view of the art educator in teaching media, technique, artistic and spatial concepts.

### Generations of a House

It has been my contention that the built environment owes its meaning as well as a good part of its physical form to chaotic forces rather than deliberate design decisions. This occurs at the level of an individual building as soon as the users take over from the designer in adapting its use and meaning to their own needs. It certainly occurs on the level of urban space when multiple design elements come together in ways beyond the control of any individual designer. The structure of the built environment is what N. Katherine Hayles calls *Orderly Disorder*. In the spring of 1997 I completed a project titled *Generations of a House*. The purpose was multifold: I wanted to visually express the idea of chaos in the built environment, to explore the inherent possibilities of 3D computer modeling, to create three dimensional objects, not through deliberate design, but by design of generative geometries, and to deconstruct the relationship between language and space.

I began with a simple iconic representation of a house (Figure 1). In virtual space it was a 2 dimensional entity. It had surface but no volume. I chose this as a starting place, not because it has any physical relationship to a house, but rather because of its simplicity of form and complexity of symbolism.

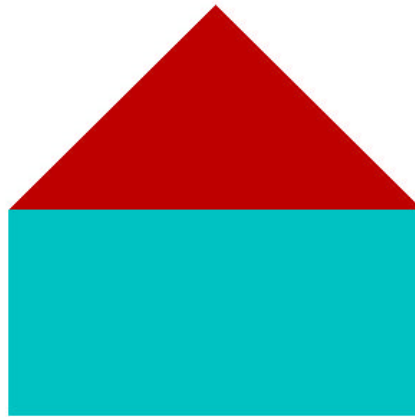


Figure 1. The basic house icon in 2 dimensions was used to create all the “generations”.

The “generations” were created by geometric manipulation of this two dimensional object in virtual three-space to create virtual three dimensional objects. Most of the generations are produced by extruding the house in a spiral, the only variables being the axis of rotation, the offset along this axis, the number of degrees of rotation, and the relative size at the end. The process was not truly chaotic, but small changes in the initial state could produce large changes in the final result. Most of the generations represent virtual solids, although in one case the result was a three dimensional surface. In every case virtual object was created, a point of view was established, and a bit map snapshot was produced and saved. The manipulation was then undone and no record was kept of the actual formula involved.

Relatively simple manipulations produced simple objects, that had a kind of potential relationship to the built environment (Figure 2). Much more complicated objects, rooted less and less in reality, were created simply by changing the basic parameters (Figures 3 & 4).

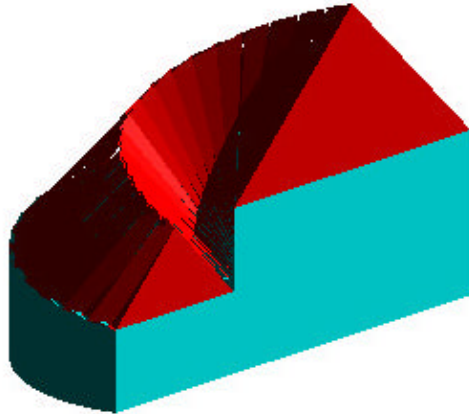
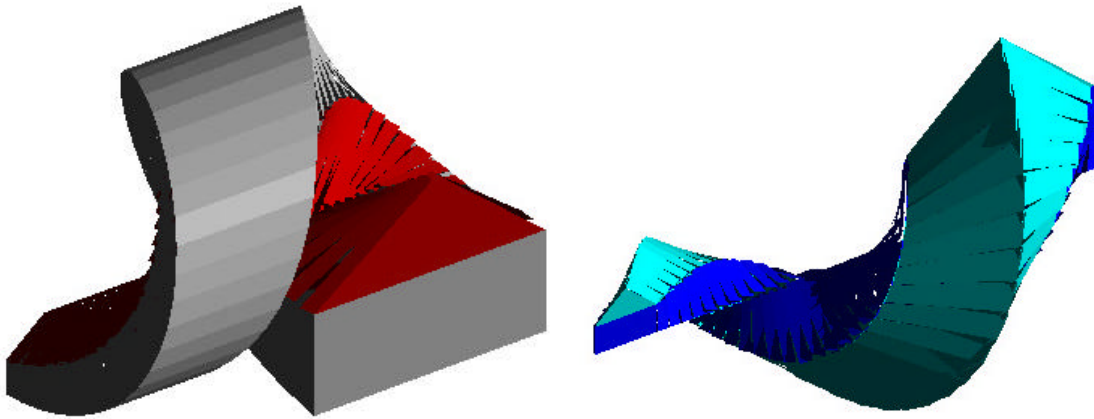


Figure 2. This is the house rotated 180° around a vertical axis with the offset held fixed. The relative size is 2 to 1.



Figures 3 and 4. Simple changes in the generative parameters can result in complex differences in form.

### The Conceptual is Made Real

*Generations*, although conceptual in nature, did produce a documentary record. The 26 bit map images were captioned in simple language that was intended to create a flavor of childrens literature, but with words double coded to introduce some serious questions. It was formatted as a book and published in hard copy as several artist's proofs and in electronic media. In its limited form *Generations* was well received but it had never had public presentation. When I was designing my MFA thesis show in the fall of 1998 I thought it would be good to include it. The subject of my thesis was theoretical, so my thesis chair, Professor Kotaro Nakamura, suggested that a sculptural piece based on *Generations* would provide a strong visual counterpoint . I was intrigued by this idea since it seemed metaconceptual to execute a physical realization of a design that had originally been created as deliberately unbuildable.

The execution of this piece was immediately clear to me, so I attempted to draft some working drawings using CADD and discovered that, as clear as the reality was in my mind, I could not do design drawings. So, instead, I built the thing. I wanted the piece to occupy a fairly large physical volume, be easy to build, and I wanted it to be light weight and fairly transportable. The result was an iconographic house diagram repeated 36 times in a 180°

rotation. The largest of these was 4' wide and 6' high. The smallest was 1' wide and 1.5' high. The finished piece was 6' wide, 6' high and about 3' deep. All the pieces were cut from 4 sheets of ultra light MDF, a total weight that could be lifted by one person. All of the pieces nested into a 2" high stack that could be assembled and disassembled in a few minutes. I was tempted to title this piece *Generation X*, with the X being read as a Roman numeral ten. This pun would have continued the double coding of the project. Instead I choose to maintain the conceptual framework by not using that title but to still use it as a point of reference. (Figure 5)

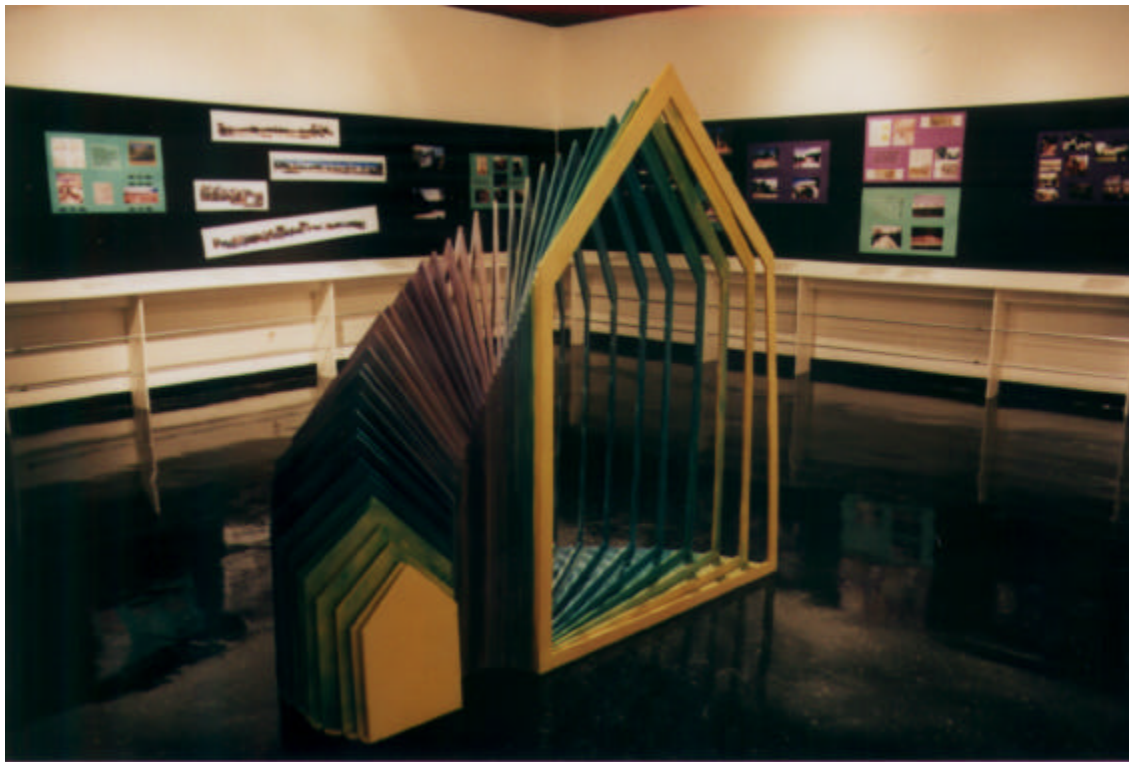


Figure 5. The sculptural manifestation of Generations that was not titled Generation X.

### As-built drawings and abstract art

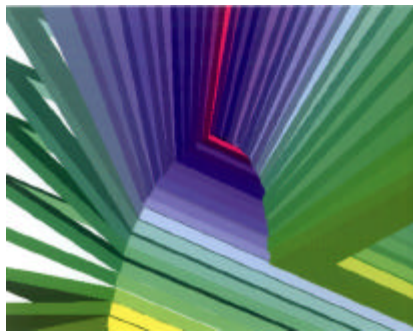
I was troubled that I was able to so easily conceive of and build this, yet I hadn't been able to pre-create it as a three dimensional CADD drawing. Determined to find out why, I set about doing as-built drawings. What I came to realize was that the problems I encountered were ones of methodology. I had tried to make drawings that could be used to build the piece. I originally attempted to create the drawings by repeating variations of the original icon. The problem with this was that variables that were held fixed in the built piece, were difficult to hold fixed in the CADD process. My next attempt was to draw all the individual components at the corresponding place in the drawing that they would occupy in the final piece. This method failed because the concept was so complicated that it would have been extremely time consuming.

In doing the as-built drawings I adopted the same methodology that I used in construction. I drew all the individual components flat and nested, just as they were cut out of sheet material in the construction phase. Then I simply assembled them as I had done in constructing the piece. Using this method I was able to produce accurate as-built drawings quickly and easily (Figure 6). This method just wasn't obvious until after the construction.



*Figure 6. CADD rendering of the as-built drawing.*

CADD objects exist in three virtual dimensions. Unlike real objects they are not limited to particular points of view, and views of a virtual object have an infinite depth of field. Once I had completed the as-built drawings, I experimented with rendering points of view that would not have been possible with the real object. Normally, CADD renderings are intended to be as realistic as possible, but my intent was to produce a high degree of abstraction (Figures 7 – 10).



*Figures 7, 8, 9 and 10.*

*Generations* was presented with in the exhibit with the abstractions first without reference to the other parts. The text was presented in its entirety as individual matted prints. The sculpture was displayed with the text and the as-built drawings. I do not regard any of these as individual entities, but as different representations of an entire concept. It is a work in progress, the next stage of which will be an animated video based on the text. At the time the original text was done it was conceptually important to me not to retain any of the 3-D models, but only the images. I saw the text as the end product. As this project has evolved toward animation I have come to regret that decision.

### **Beyond paper architecture**

Paper architecture consists to two distinct classes. The first is what I will call “objectified paper architecture”. This is architectural representations that have come to be regarded as autonomous aesthetic objects, either because the creator was someone of great reputation or because the drawings themselves are seen as beautiful or unique. The second class is what I will call “conceptual paper architecture”. It is here that I would place projects that remain unbuilt for various reasons: projects by established architects, such as runners up in competitions; projects that were not designed to be built but were rather aesthetic exercises; the vast majority of student work, that is not built because no client exists. This is not to say that objectified paper architecture does not present important concepts, nor that conceptual paper architecture be represented beautifully.

As a side note I must mention what I consider a built piece of paper architecture – Mies’ Barcelona Pavilion. It originally existed as one of the greatest expressions of the modernist aesthetic. It was subsequently destroyed and existed only in the documentary evidence. It has now been rebuilt only because of its value as an architectural object. It has no primary function other than as pure architecture.

My project, *Generations*, goes beyond these two classes of paper architecture to suggest a new class that I will call “CADD art”. With the use of 3-D modeling, fundamental restrictions to the imagination no longer need exist. In virtual space there is no gravity; up and down are simply arbitrary concepts. Virtual objects have no mass. Two or more virtual objects can occupy the same space at the same time. They can be used, as I have, to open questions of ontology and epistemology. With the introduction of animation the fourth dimension of time can be included. CADD art’s relationship to paper architecture is that it can only be expressed physically in documentation and conceptually with representation.

### **Mathematics, art, architecture and education**

Students of the arts often have little exposure to, or even a negative predisposition toward, mathematics; students of the mathematical sciences often see little personal need for art. Yet, within a postmodern episteme there is an inherent interdependence. The implied potential of CADD art should be of interest to the practicing artist who is seeking expanded possibilities of spatial exploration and to the educator concerned with breaking down the barriers between disciplines. To the latter it should suggest curricula that can be tailored to the beginning student to teach CADD fundamentals as well as spatial and mathematical concepts, and to expose the advanced student to interdisciplinary research, especially in mathematics or the computer sciences and the visual arts. Conceptual and abstract art are easily misunderstood; CADD offers the possibility of teaching the ontological potential of the former and the visual strength of the latter.