INTERPRETING TAKEFUMI AIDA'S TOY BLOCK HOUSES

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ABSTRACT

Three-dimensional modeling projects interpreting Takefumi Aida's Toy block Houses form the basis of a first course in architectural computer graphics described in this paper. Takefumi Aida's houses were chosen for two recent offerings of the course because they form a consistent body of architectural work which is very sculptural, geometrically structured and based on a single vocabulary of shapes. Shaded images produced in the course show the importance of human skill and judgement in computer modeling and rendering. The paper demonstrates the subjective nature of computer interpretations.

INTRODUCTION

This paper demonstrates that computer renderings of architectural models are not objective and that therefore any set of renderings will not convey the same understanding of a particular model as another set.

The paper is about a first course in architectural computer graphics, in particular, three-dimensional modeling and rendering treated as a medium for representation. The aim of the course is to prepare students for the use of this medium in the design studio so that they can model buildings and context to the appropriate degree of abstraction in a way that will express an intended interpretation (possibly one of many). A related aim is to discover the strengths of the computer graphics medium. Throughout, the computer is treated as an aid to design to be used alongside tracing paper, rather than an interactive design tool. For such a tool the appropriate software has not been written, in this writer's opinion. From the beginning, this course has been taught separately from the studio for several reasons: first, so as not to compromise the design by taking up valuable studio time of which there never seems to be enough; second, because the capabilities of the computer graphics medium should be understood fully in order to exploit these capabilities from the earliest phase of design; and third, because a broad introduction to computer graphics is required which will go beyond the immediate needs of the studio and will outline current hardware and software.

Although the idea of a separate course is, on the one hand, not to compromise studio design; on the other hand, the idea is not to compromise the computer graphics course by spending a great deal of time designing. It is for this reason that students in the course interpret distinctive architecture from the recent or distant past rather than design it. By placing the emphasis on interpretation, not in Mitchell's sense that a design can be interpreted to give an objective predicate for the truth value "beautiful" (Mitchell, 1986) but a subjective one, it is hoped to counter the common assumption that renderings of computer models are objective. The situation we find ourselves in with regard to rendering by computer is somewhat reminiscent of a point in time in the
second half of the nineteenth century when photography was being introduced. Some artists at that time felt that there was really no further point to painting scenes because the camera could capture realistic scenes truthfully and objectively.

In time, in the work of Ansel Adams or Alfred Stieglitz, it was realized that there was art in photography. The photographer has in fact control over many aspects such as the quality and orientation of the light, the season and weather, the framing of the picture, and the focusing and depth of field with which to control the way a photograph interprets a scene. With a computer graphics system the situation is similar: there is an objective reality corresponding to nature in the form of the geometry of a building and its context (wire frame model stored in the database) while the commands at the disposal of the modeller give him similar control to that of the photographer without having to wait for the right time of day, season or weather. In addition, computer graphics allows direct intervention in the scene in terms of color, transparency and the disposition of the objects themselves. There is, therefore, much room for interpretation. Indeed, computer representations are not different from conventional representations which, as John Brown stated, "are in fact highly subjective instruments of the designer's intentions." (Brown, 1987).

Rather than having the students randomly select architectural works to interpret, for the past two terms the course has focused on the work of a single architect, Takefumi Aida, in particular on his Toy Block House series. By concentrating on a consistent body of architectural work, a by-product of teaching architectural computer graphics is that one can teach something about architecture which cannot be taught in the studio or in architectural history classes. Such a study allows a much more careful analysis of a body of architectural work than a cursory examination of plans and photographs will allow because in modeling and rendering buildings students must grapple with the geometric forms and vocabulary, as well as with the role of light in revealing exterior and interior form.

TAKEFUMI AIDA'S TOY BLOCK HOUSES:
Languages of Design in a Consistent Vocabulary

Takefumi Aida's Toy Block House series represents a phase of Aida's work in which every building is based on the same vocabulary of simple shapes. These shapes are the toy blocks which are primarily cubes of various sizes and a few triangular prisms, cylinders both filled and hollow, cuboids, and a few isolated shapes such as spheres, pyramids and stepped ramps. These shapes are the primitive building blocks of most three-dimensional modeling systems making the Toy Block Houses obvious candidates for modeling.

Only some of the houses have been built and photographed (Sasaki, 1983; Unknown, 1983). The entire set of houses is well documented with drawings in two books published by Aida (Aida, 1984; Aida, 1986). All of the built houses (#1-4, 7, 10) were designed for the dense, low-rise urban fabric of Tokyo, Yokohama and Hiroshima. The houses, including the prism roofs, are built of reinforced concrete (presumably because of earthquake requirements). The houses are obviously expensive and often are commissioned by dentists and other well-to-do professionals.

Traditionally, architecture with a clear vocabulary has usually had associated with it rules for the assembly of the parts in the vocabulary. The architectural designs resulting from the use of this vocabulary and rules for assembly can be thought of as forming a language of designs. Thus, in classical architecture there are definite rules for the ordering of elements of the vocabulary in plan and elevation (Tzonis, 1986). One would not think for example, of using a capital for a base or vice versa nor would one think of reversing the order of abacus, echinus and necking in a capital. Similarly, in the Prairie Houses of Frank Lloyd Wright, shape grammars have been
found which describe the language of these designs (Koning, 1981). The vocabulary of these designs bears obvious affinities to the arrangements of the Froebel Blocks with which Frank Lloyd Wright played as a child (MacCormac, 1981). Styne (Styne, 1980) has written about shape relations and shape grammars using the Froebel Block vocabulary and illustrated some languages of designs possible using this vocabulary. The Froebel Blocks bear a close resemblance to the Aida Blocks. Indeed, Aida has produced a set of toy blocks (Toy Block House O) which comes in a box similar to a set of Froebel Blocks. All of this emphasis on formal vocabulary and language is not to devalue, of course, the poetic and symbolic meanings associated with the shapes in the vocabulary as Hershey (Hershey, 1988) has written recently to complement the view offered by Tzonis and Lefaivre (Tzonis, 1986).

The rules which Aida uses to assemble the shapes in the basic vocabulary of toy blocks are the games he plays with the toy blocks. Of these games, Takefumi Aida has written the following in his book *Toy Block House* (Aida, 1984):

> One enjoys a game because of developments that occur unexpectedly despite one’s finest calculations. In this sense a game is very similar to the process of architectural design in which the architect overcomes restrictions imposed by reality. The creative activity of an architect vis-à-vis society is a type of intellectual game. Playing with toy blocks is a sophisticated game compared to playing with mud or sand. One of the challenges it offers is to create forms given the imposed conditions. In other words, it is a question of combining a limited number of pieces in order to create forms analogous to other forms.

Except for two of the houses, #5 and #6, these games, or rules of composition, differ from house to house. In some cases, blocks are piled up; in others they are pulled down or subtracted and displaced. Takefumi Aida’s houses are therefore, except for the two houses noted, examples of designs in different languages using the same vocabulary of shapes. Only the physical dimension of the the shapes in the vocabulary differs from one house to another. Since we are given, with the exception of houses 5 and 6, only one example of a house for each game, there is not enough information to infer completely what the rules of each game are.

Thus, although it is probably not possible to infer shape grammars for the Aida Toy Block houses in the sense of Styne (Styne, 1980), there are some commonly-occurring relationships between the toy blocks. For example, the cubes are usually aligned so that as many faces as possible touch or are aligned both vertically and horizontally; they are not laid in overlapping brick fashion. The benefit of modeling an architecture with obvious rules of composition (even if not completely understood) and some common shape relationships is that such buildings are both easier to model and provide a clearer understanding of the formal nature of the architecture involved. Ultimately, of course, one would envisage three dimensional computer aided design systems, which, given a language of designs, can function like a text editor to create and edit designs in the language. (Mitchell, 1986)

**TYPES OF MODELS AND IMAGES**

Two kinds of models and three kinds of images are produced in the course. The first kind of model is a simple massing model whose purpose is to focus on the essence of an Aida Toy Block house. Students begin with this kind of model, creating the model on personal computers (IBM PC/XT or AT) with software which limits the models to 1500 edges and 400 polygons. For simple and very abstract designs (house #2, for example) such a model can be very effective. For the more complex models the simple massing model tends to be too abstract (house #8 for exam-
Renderings of the simple massing model are limited to a single light source and sixteen colors, dithered with black for shading. This is the first kind of image. A second type of image is created with the same massing model by merging renderings of the massing model into video-captured scenes captured directly from slides. The colors are again limited to sixteen and the resolution to 640 x 480 as in the first type of image.

The second type of model is a much more detailed, didactic model. This model may consist of an entire building or it may focus on a portion of the interior or exterior. The model may be realistic or it may be an abstraction of, say, the circulation scheme. As in the case of the simple massing models, the geometry for the didactic model is assembled on personal computers but the rendering is accomplished on a mini computer. The didactic model may contain up to 10,000 polygons. Renderings of these models, at a resolution of 1024 by 1024, comprise the third type of image which may include shadows, transparency, smooth surfaces, highlighting, multiple light sources and practically unlimited colors.

COMPUTER INTERPRETATIONS

The computer images of Takefumi Aida's Toy Block houses speak largely for themselves. In keeping with the philosophy of treating computer graphics as any other medium, such as watercolor, the images should be expected to stand on their own and to be judged as works in any other medium. In the course, the critics for the final review have generally been architects not conversant with computers and all have been delighted by the results. The most striking aspect of many of the computer interpretations has to do with the viewpoint taken. Often this is a perspective view at ground level. Takefumi Aida's drawings, in contrast, are all axonometrics reinforcing the impression that the houses are toys. The perspective views make architecture of Aida's houses, providing a distinct change of scale to human scale, although the duality between toy block scale and human scale is always evident as Aida intended. He likes the tension between the two scales, between serious and not serious, between construction and destruction, between stability and instability, between life and death (Aida 1984, see house #3).

Following is a brief description of some of the houses and a discussion of the computer images presented in the paper. (Unfortunately the quality of these interpretive images can only be fully appreciated in the form of the color slides which are to accompany the presentation of this paper or in the original black and white photos).

HOUSE #2

This is the first of the toy block series of houses which clearly looks as though it were assembled out of giant blocks. Particularly toy-like is the manner in which the two columns at the entrance support the single block entablature. The almost cartoon-like simplicity of this building lends itself to representation by a simple massing model as seen in Figure 1. There is an obvious affinity to the work of Aldo Rossi. This is a mixed-use building with, two levels of retail at the street and three levels of residential above.
Figure 1: House #2: Perspective view of simple massing model and partial reflected image

HOUSE #4

Underlying the form of this house is a game whereby a box is emptied of the blocks it contains and these are then replaced in an attempt to reconcile, in Aida's view, the demands of circulation, building code and structure. These conflicting requirements resulted in some cubes protruding from the box and the sides of the box itself being ripped down in a couple of places. This is the first house in the series in which the blocks, in many cases, are the size of rooms. Thus the design vocabulary consists of boxes, having sides the thickness of a wall and tops the thickness of ceilings. The ambiguity between scales is very apparent and clarified only when one perceives details such as window mullions and railings. This ambiguity of scale prompted one team of students to create a set of three images of a simple massing model merged with video-captured scenes. In the first, the house is a toy and three children, much larger than the house, play with the house. In the second, the house is set into a modified painting by di Chirico where the figure seems to be somewhat taller than the house. The scale here is ambiguous; is the figure a large sculpture or is the house very small? The third image is reproduced in Figure 2 showing the house to be clearly at human scale in relation to the figures from Laugier's Primitive Hut illustration. Figure 3 is a view of part of a detailed, didactic model which shows the circulation scheme in the house and how circular elements signal changes in direction. The cubes being sliced at the left represent the fact that, in the house, the smaller cubes with the more public spaces are on one end of the house while the larger, more private spaces are on the other.
Figure 2: House 4: Perspective view of simple massing model with video-captured figures

Figure 3: House 4: Partial view of a detailed, didactic model showing circulation, massing and proportions
As noted earlier, these are the two houses in the toy block series which follow the same rules for assembly and differ only because of programmatic differences. They are both unbuilt projects and hence the program is somewhat idealistic. House #5 appears to be an art collector’s house with much gallery space and a large hall for receptions. House #6 also has much gallery space but in addition it has an atelier and Tatami room. Perhaps this is an ideal artist’s house. The game for the conceptual assembly of these two houses consists of taking a set of blocks in the Aida Box (Toy Block House #0) and with the same pieces, for each house to lay out a design. The blocks become, for the most part, rooms (as in House #4) while the large hall in each house forms the space between cubes. In House #5 the hall is totally enclosed while in House #6 the hall is open to the outside. Both houses also show a transition from public spaces, around the gallery and entrance hall, to private space at the opposite end of the house. Guest bedrooms are on the second floor. Figure 4 shows a view of a partial section through the hall (with second floor removed) of House #5. Most remarkable about this image is the play of light and shadow due to the large, mullioned windows and the tectonic nature of the wall on the right where light and shadow emphasize reveals and joints which Aida uses to reinforce the toy block theme.
HOUSE #8

With this house we return to the mixed-use buildings characterizing the earlier houses of the series. On the ground floor there is an office for at least eleven people and on each of the two floors above, an apartment. In other ways, however, this house is quite different from the others. Here the game is not a building up of blocks but a decomposition by removing blocks from one very large, initial cube. It is not a random decomposition, however, but one in which collections of blocks move in different axial directions. This gives the composition a very dynamic appearance, an appearance of energetic destruction. On the exterior of the building, the site, which is unusually large for Japanese urban locations, is animated by some cylindrical shapes including a well in a pavilion. The well and the plane of the site, into which some of the cubes seem to be submerging or from which some cubes seem to be emerging, could be seen as an ocean of water, as one student observed, adding, together with the well, the theme of regeneration to the theme of decay symbolized by this house. This is clearly the most complex house in the series as it is made of numerous cubes which, as in house #3, are often also expressed on the interior. Figures 5 and 6 show views of the house from ground level looking toward the entrance. Note how different these two interpretations of the same building are. (Some cubes representing hedges are taller in Figure 6 than Figure 3 but otherwise the geometry is the same.)

These two images, more than any other, emphasize the subjective nature of computer modeling and rendering. Note also, especially in Figure 5, how this building, which in axonometric does indeed look like a pile of toy blocks, now takes on the appearance of a medieval castle. Part of the power of these images comes from the structures and landscaping which animate the foreground, thereby generally increasing the sense of three-dimensional depth (the figures in Figure 2 have a similar effect). Figure 7 shows a birds eye view of the site clearly demonstrating the axiality of the composition and the structures and paths which animate the site.
Figure 5: House 8: Ground-level perspective view towards the entrance. Detailed model

Figure 6: House 8: Ground-level perspective view towards the entrance. Detailed model
CONCLUSIONS

By leaving out design from a course on architectural computer graphics and by instead concentrating on modeling and rendering distinctive architecture designed by someone else, all the students' creative effort is applied to the interpretation of a body of architecture. These interpretations are highly subjective creations independent of the objective modeling data stored in the computers. Computer aided design (CAD) imagery is therefore art, the quality of which depends primarily on the user rather than on system software and hardware.

While some impressive work has been done, a common problem has been that students begin work on a detailed computer model too early in the design process, before many issues have been settled. Too much energy and time is then absorbed by the computer model leaving insufficient time for design. It is best to do only very simple massing models in the early stages of design work and to use plenty of tracing paper. Computer modeling and rendering of the detailed type demonstrated in this paper is most appropriate for final presentations, when it is important to render a design to convey an interested interpretation.
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