

**The Man With The Movie Camera: An Event-Driven
Approach to Architectural Design**

By

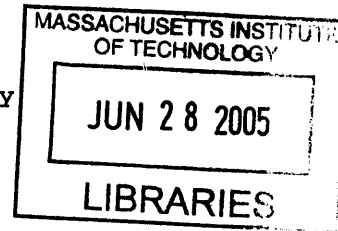
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Submitted to the Department of Architecture in Partial
Fulfillment of the Requirements for the Degree of
Master of Science in Architecture Studies

at the

Massachusetts Institute of Technology
June 2005



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ABSTRACT

Architectural design can be viewed as the manipulation of physical material space in relation to human events that take place inside it. This thesis introduces the notion of event-driven architectural design, and implements an experimental digital tool that automatically constructs a cinematic representation of human characters and events in a synthetic space with little intervention of the designer of the space. Through the application of various filmmaking conventions, this tool intends to enrich currently available modeling software by incorporating algorithmic generations of characters, viewing camera's placements and movements as well as montage of multiple camera shots. Such software gives architectural designers the opportunity to evaluate and iterate their design revisions based not only on the building's form but also on the events and human actions that take place inside it.

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Acknowledgements

I would like to thank Professor Takehiko Nagakura for his insightful guidance and constant support during the development of this project. He was an excellent advisor and without his help this thesis would not have been possible. I would also like to thank Terry Knight and Alexandros Lagopoulos for their valuable comments and feedback.

1. Introduction

The discipline of Architecture has always been thought to evolve around the notion of space or, more specifically, physical space. Architectural designers have constantly been striving to accurately describe space through drawings, capture some of its three-dimensionality through scaled models or illustrate some of its materiality through photo-realistic computer-generated renderings. A brief look into the world of architectural publications will definitely pinpoint that space seems to be the ultimate architectural product. Nevertheless, it is the actual interaction of the designed physical space with its human users that determines the experiential quality and the functional success of the initial design. However, current architectural practice appears to underestimate the importance of the human events that take place in space. This paper examines both theoretical and practical ways of reinforcing the role of this human-space interaction in the realm of architectural design.

This thesis can be roughly divided into two distinct parts. The first part (chapters 2 and 3) attempts to attain a broader theoretical understanding of architectural design. Based on the exploration of the bi-directional relationship between space and its users, the notion of event is adopted as a compact and convenient way of encapsulating the human presence in space. Consequently, the existing notion of design is expanded through the introduction of event-driven design. The various individual characteristics of this human-based theoretical approach are examined in order to detect the potential usefulness of the event-design concept into the architectural design practice. This analysis concludes that the inability of the current architectural visualization techniques to successfully represent events constitutes the most crucial problem of this approach. The second part of the thesis (chapters 4,5 and 6) attempts to propose a digital tool that would facilitate the practical application of the event-design theory by addressing this representational problem. The proposed new software plug-in focuses on the visualization of events through the use of various filmmaking conventions and techniques. The explicit objectives of this tool as well as its functional capabilities are extensively analyzed. Moreover, some concrete examples of how it might be used in a design context are also



discussed. Finally, the potential impact of the tool on the event-design concept and some ideas for further development are examined.

It should be noted that this thesis does not aim at reinventing neither architectural design nor the current established design tools and techniques. Instead, it is trying to efficiently frame and explore ideas that have always been part of the architectural design theory but have been vaguely researched. Similarly, the accompanying new digital tool is targeting the expansion of existing software tools by providing an additional way of manipulating and representing architectural space. Although limited, this research aspires to serve as a first timid attempt of harnessing computation and digital media in order to efficiently explore a new design approach: event-driven design.

2. Expanding the conventional notion of architectural design

The ultimate objective of architectural design is thought to be the purposeful and successful manipulation of physical space. One of the goals of this thesis is to expand this established notion of design by incorporating parameters that are closely related with the actual human users of the space.

2.1 The relationship between space and its human context

In order to explore the relationship between physical space and its inhabitants, it would be quite helpful to briefly examine physical space in its social context. The examination of the underlying principals of this higher spatial level might lead to a better understanding of the individual attributes and characteristics of physical space at the architectural level.

Starting from a broader, social point of view, French philosopher H. Lefebvre (1991) as well as sociologist M. Castells both believe that physical space does not constitute a separated, autonomous entity but forms an integral part of society. More specifically, space is considered to be social product and for this reason is structured and developed according to the social and economical forces. Lefebvre goes even further to suggest that space is not only produced socially but at the same time co-shapes society by being an internal element of the social relationships (Lagopoulos 1994). Thus, current scientific thought believes that every society is connected with its space in an indissoluble and bi-directional way.

According to the above, we can observe that space, as a social product, follows the general socio-economical Marxist model: production - circulation of the product - consumption (Lagopoulos 1993). Elaborating more on the spatial version of this model, Lagopoulos (1985) suggests two levels of production and consumption of space: the semiotic and the non-semiotic or physical level. Therefore, every space is produced semiotically as well as physically and is consumed also semiotically and physically.

2.2 The underlying complexity of architectural space

Going back to the architectural level, the original definition of architectural design can be slightly transformed in order to incorporate the knowledge gained from the social level: The ultimate objective of an architectural designer is to purposefully produce a space both semiotically and physically so as to subsequently give the users the opportunity to successfully

consume the same space in a similar way (semiotically and physically). Through this second definition, it becomes more evident that the bi-directional relationship between space and its users plays a crucial role in the process of architectural design.

The first traces of this relationship were identified and analyzed by C.Alexander (1964). According to him, the designed form and its context constitute an ensemble in which there should exist such order and harmony so as to avoid misfits. In the realm of architecture, the context is compromised by the human users that define the need for new buildings, together with the natural environment. The goal of the designer is not to describe just the form, but to succeed the perfect equilibrium of the system form-context. The form is just the part of the system that he is able to manipulate. Alexander goes on to propose a mathematical model for solving compositional problems. Although his effort proved to be extremely open-minding and influential, the extreme complexity of his model prevented the production of solid and practical results.

From the above it could be inferred that architectural design might be more accurately described as the manipulation of the relationship between human users and physical space rather than just the reorganization of physical form. This statement can potentially lead to a slightly different design approach as it offers a more complex understanding of the focal point of the design process.

This new design approach has to take into account an extra parameter that has a serious impact on the overall complexity: Time. In contrary to the physical form that is usually static over time, the fore-mentioned human-space relationship with all its semiotic and physical extensions is largely quite changeable over time. In other words, the designer is trying to loosely define how the user will interact with the built space from the moment that he approaches the space until the moment he departs from it. Of course, throughout the duration of this interaction, the user will consume the space both physically (his body will occupy part of the space) and semiotically (his eyes absorb the visual image of the space).

Nevertheless, such a design task, although theoretically plausible, appears to be extremely complicated if not unacceptably deterministic. The sheer complexity of the time-based human-space relationship makes almost impossible its full linear manipulation by the designer. At the same time, it appears inappropriate to fully simulate or dictate how a certain designed space will actually be used. In order to design an office building for 50 people based on the approach described above, for example, the designer would have to suggest how all these people would interact

with the space for a time period of around 8 hours, which is the amount of time they will most likely spend inside the building every day. However, there is a way to practically scale down this complexity, while retaining traces of the underlying concept. Instead of dealing with the human-space relationship in its entirety over time, it might be more feasible for the designer to manipulate only small but meaningful temporal parts of this interaction: Events.

2.3 Event-Driven Design

The notion of the event forms the basic spine around which both the theoretical and practical arguments of this thesis are evolved. An event can be defined as a small but important part of time-space continuum in which one or more users are consuming a certain physical space both semiotically and physically in order to reach some specific functional goals. This newly defined theoretical construct can play a crucial role into the process of architectural design by providing the middle ground between the purely spatial, static approach and the overwhelmingly human, time-based approach. On the one hand, treating design as the sheer (re)arrangement of empty physical shells could be inadequate, since architectural space is more complicated than that. On the other hand, conceiving design as the endless time-based human-space relationship is bound to be overcomplicated and unpractical. By incorporating selected characteristics from both of these design approaches, event-driven design attempts to offer a more human oriented yet practical approach to architectural design.

In the case of the design of a residential building, an event may be the small time period in which one user enters the house from the main entrance in order to go to the kitchen while a second user is watching the television in the living room. Similarly, in the case of the design of a restaurant, an event might be the sequence of two customers entering the space and being guided to their table by their host. Instead of designing by just manipulating physical elements like walls and partitions through plans and sections, event-driven design proposes envisioning the space as a "stage" where certain simple but crucial to the success of the building events will eventually take place. Of course, such an approach is not supposed to cancel the existing design techniques but rather offer an additional way of looking into the design problem.

Going deeper into the notion of the event, it is evident that in both examples the ultimate goals that trigger the users to move through or interact with the space are basically socially and not spatially defined. In the first case, the one user goes

to the kitchen because he is hungry while the other watches television because it is a form of entertainment/recreation. In the second example, the users-customers are going into the restaurant in order to have dinner whereas the host-employee is just doing his job. However, the way in which they will (or will not) reach their goals and the quality of their experience depends heavily on the specific space. Therefore, while events are usually initially triggered by society, the fact that the user's physical movement as well as his visual field of view is confined by the space forces the events to be co-shaped, affected or even redefined by the specific space in which they take place.

3. Architectural Representations of Events

Although there is no clear event-design methodology in the realm of architectural theory, it is quite clear that many architects are making design decisions based on the desired relationship between their users and the designed space. Nevertheless, in most of the cases such decisions take place only in the minds of the designers and are rarely documented in the various representational tools and techniques that these architects use. In general, architectural designers rely heavily on intermediate visualizations of their designs so as to further develop their ideas. Sketches, drawings, models and 3D renderings are always assisting architects into their quest of the final design solution. In order for the events to play a major role in the design process, it is absolutely essential for architects to find an appropriate way of representing them. Without that, event-driven design would be limited only to those few gifted architects that can think about and manipulate events and characters into space without having the need to visualize them.

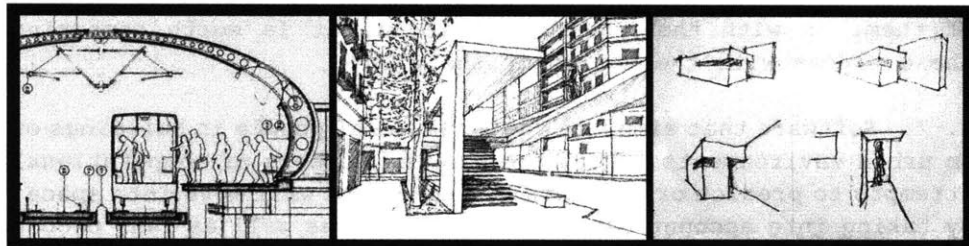
Before attempting to propose new ways of representing events, it is essential to examine if and how the existing representational techniques are related to events or to the human presence in space in general.

3.1 Events in non-digital representational tools

As it was mentioned earlier, a wide variety of media are used not only to communicate the designer's ideas to other people but to also assist him in gaining a better understanding of the strengths and weaknesses of his own design solution. Traces of the event-design ideas can be found in some of these visualization tools and techniques:

a. Human figures appear in drawings and models (Figure 3.1.1). This is quite common and has usually a dual purpose. On the one hand it indicates the human scale in comparison to the represented building while at the same time it attempts to provide some abstract information about the type of user that is

Figure 3.1.1 (left):
Human figures in drawing
Figure 3.1.2 (middle):
Perspective point-of-
view drawing
Figure 3.1.3 (right):
Sequential perspective
sketches



expected to occupy the building. However, the static nature of these representations keeps them far away from the experiential nature of the events.

b. Perspective drawings are simulating the POV of the potential user (Figure 3.1.2). In this case, the user may not be visible in the representation but the designer is seeking to simulate his point of view. Again, the inherent static quality of the pictorial representation makes it event-less. Moreover, because of the fact that sometimes the designer is choosing the user's point of view with the form of his building and not a plausible event in mind, it is possible to have perspective representations that have nothing to do with the actual users.

c. Quick sequential perspective sketches (Figure 3.1.3). In some cases, skillful designers are making quick abstract sketches in order to visualize a certain sequential movement in space. Such an approach appears to be closer to the nature of an event as it is not perfectly static but attempts to attain a temporal quality.

From the above it becomes quite clear that the potential user of the space is abstractly present in some of the representational tools. However, it is evident that most of these tools lack the experiential nature of an event-based visualization.

3.2 Events in digital or computational representational tools

Since the mid-seventies, the introduction of computational media has given designers the potential for a new palette of tools and techniques. A new scientific field was established (CAAD or Computer Aided Architectural design) with two distinct main ambitions (Koutamanis, 2004). The first one was to pursue the automation of design, in other words the replication of cognitive processes, professional knowledge and skills with machine intelligence. Within this approach, the degree of automation ranges from the co-existence of the designer with intelligent computational assistants to the total substitution of the designer by computerized systems. The second objective was to develop computer-based means of representation of architectural designs. Although only the second research objective was sufficiently developed so as to lead to commercially distributed products, the importance of the human-space relationship is traceable in both of them. As with the non-digital tools, it is worth comparing these traces with the notion of the event.

a. Software that simulate the movement of people in buildings or in urban environments. There are growing numbers of computational attempts to predict or simulate how the users will move into space. By taking into account behavioral patterns as well as real people

activity data, software like MouseHaus (Huang C-J et al., 2003) provide a vague indication of how large numbers of people will move through a certain space (Figure 3.2.1). More specifically, the designer is able to define the geometry of the space as well as the points of interest (which are indicated as "cheese"). Consequently, MouseHaus simulates the movement of hundreds of mice based on various behavioral presets and records their paths. In the end, the designer has a visual mapping of the pattern of their movement. However, such approaches are primarily focused on the physical consumption of space and seem to overlook the visual/semiotic aspect of the human-space interaction. Moreover, are usually treating people as anonymous agents without any concrete functional goals and rely on statistical estimations rather than experiential qualities. Therefore, although they are dealing with the movement of people in space, are rarely geared towards events in space.

b. Human figures are digitally inserted in renderings or drawings (Figure 3.2.2). This is the digital analog to the fore-mentioned quite common practice of inserting human figures in hand-drawings. Therefore, it serves the same purposes and has the same shortcomings in relation to event-based representations.

c. Software that deal with modeling and animating human figures (Poser, Character Studio). These are specialized digital tools that are working alongside conventional modeling software in order to insert and animate detailed models of human figures (Figure 3.2.3). They are primarily targeted for character animators and offer quite complex and specialized manipulation of every aspect of the human movement. Whereas typical modeling software are focused on the manipulation of 3D space, these tools are exclusively devoted to the creation of characters. Regarding event-design, their main disadvantages are their relative independence from the spatial model as well as their complexity that makes them unattractive to architects.

It becomes apparent that the existing architectural computing tools, although they are acknowledging the importance of the human presence in architectural design, they are not doing so in an event-based manner. Most of the tools seem to be either too generalized and statistical (case a), or too specialized and character based (case c). In any case, it appears that there are no established visualization techniques for events.

Figure 3.2.1 (left):
Snapshot from the
Mousehaus tool
Figure 3.2.2 (middle):
Human figure in
rendering
Figure 3.2.3 (right):
Snapshot from Poser
software



4. Events in the field of movie-making

Despite its proven theoretical importance for design, the relationship between human actions and physical space is poorly represented in the various digital and non-digital tools and techniques. It appears that events in space encapsulate a certain complexity and flexibility that renders them difficult to be adequately represented within the world of architectural design. More specifically, the fact that events change over time makes them almost impossible to be captured by static media such as still images, drawings or models. The current architectural representational techniques seem to be inadequate.

History shows that whenever Architecture encounters a certain shortcoming, the easiest way out is to borrow a solution from another discipline that has successfully dealt with the same problem. In this case, it appears that there is a certain non-architectural discipline that seems to exclusively evolve around the visual representation of events: Filmmaking.

4.1 Events in Movies

Movies are nothing more than the visual interpretation of stories through the medium of the moving image. Since stories can be seen as succession of certain interrelated events that the author deems important, then it would be quite fair to claim that movies are all about events. Nevertheless, events in movies and architectural events are not completely identical. Movie events are not necessarily linked to a certain space as the main focus is on the character/actor and his emotional goals that are dictated by the story. It is the importance and irregularity of the overall story that makes the movie

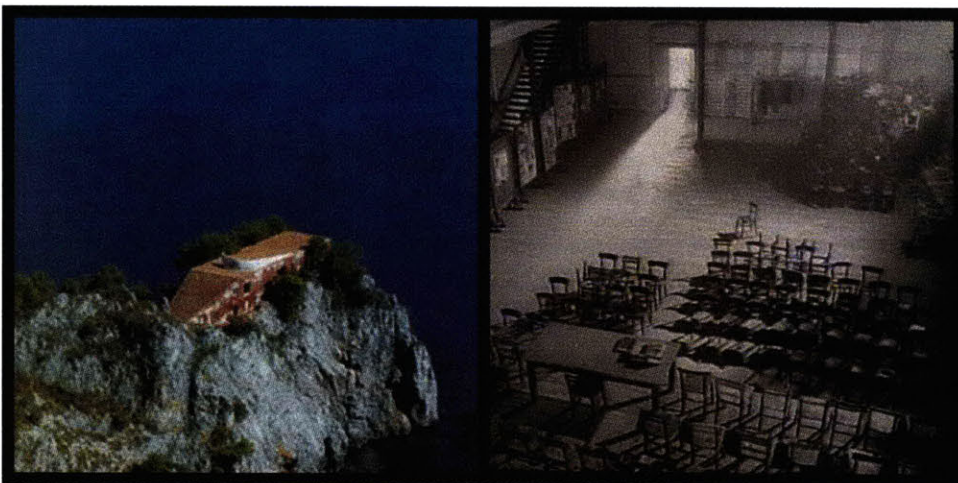


Figure 4.1.1 (left):
Architectural
representation of Casa
Malaparte
Figure 4.1.2 (right):
Architectural
representation of a
fictional courtroom

interesting for the audience. On the contrary, as architects design for the average user, architectural events have to do with the ordinary life of normal users and are always closely related to a specific physical space. Because ordinary events are quite expected, repetitive and sometimes even boring, the cinematic world prefers to limit their presence only to where they are serving the overall "interesting" or extraordinary storyline. Nevertheless, when movie and architectural events overlap, the result is fairly impressive in comparison to the more typical spatial representations. Let us examine two such examples.

The first one involves Casa Malaparte, the famous villa that was built in 1943 by Curzio Malaparte and Adalberto Libera in Punta Massullo in the Italian island of Capri. As this is considered one of the architectural masterpieces of the twentieth century, there are numerous architectural representations of the building in the form of plans, sections and perspective views (Figure 4.1.1). At the same time, French nouvelle vague director Jean-Luc Godard uses casa Malaparte as the setting for part of his movie *Le Mépris* (Contempt, 1963). By comparing the event-driven cinematic representation of the movie (Figure 4.1.3) with the static user-less architectural representations, it becomes quite evident that the event-based one has certain experiential qualities that the architectural ones seem to lack. Undoubtedly, the visualization, through the use of different camera angles, of the movement of the main character on the roof of the building provides a richer understanding of his relationship with the built space.

The second example comes from a fictional courtroom situated in the abandoned train station of Gare d'Orsay in Paris. Seen from a spatial point of view, it is nothing more than a rectangular room with chairs. And this is pretty much what the plans, sections and images (Figure 4.1.2) of that space will reveal. However, the events that take place in that courtroom and are depicted by Orson Welles in his movie *The Trial* (*Le Process*, 1963) show much more. The main character of the movie enters the

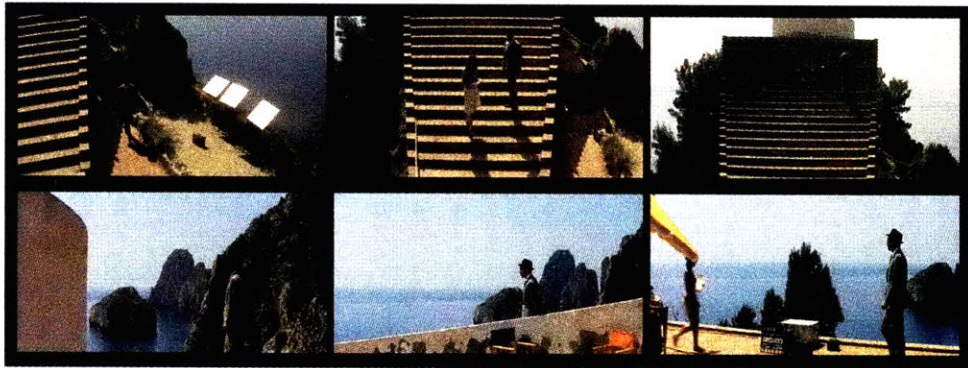


Figure 4.1.3: Cinematic representation of an event in Casa Malaparte

courtroom which is full of people waiting for him (Figure 4.1.4). By alternating subjective and objective points of view, Welles succeeds in describing the experiential dimension of the specific event. The overwhelming number of other people as well as the use of multiple cameras are both parameters that are missing from the architectural representations of the same space. Without them, it is quite clear that the courtroom has hardly the same spatial impact.

Both examples aim at providing visual proof that it is possible to use filmmaking techniques in order to represent architectural events. Moreover, it should also be visually evident that such event-based cinematic representations have certain qualities that are clearly missing from the typical architectural representations. Their advantages can be summarized in two distinct points. The first one is that these visualizations are closely linked with the actual function of the space: They are almost always depicting a character doing something meaningful in space. If a space has no function and there is no reason for someone to use it, then it is most likely that it will not be represented in the movie. On the contrary, architects are frequently carried away into viewing the space from where it looks better and not from where it will actually be seen by the users. The second advantage of event-based representations stems from their ability to unfold over time. Instead of limiting the focus on just one moment in time, the medium of moving images allows the visualization of the event over a small time period. By adding the fourth dimension of time, such representations can capture a better part of both the complexity of the physical space as well as the movements and interactions of the characters in it.

Nevertheless, it should be made clear that the purpose here is not to propose the complete replacement of conventional architectural representations by event-based cinematic ones. Instead, the main objective is to indicate that the distinct characteristics of such representations render them valuable as an additional way of looking into architectural space.

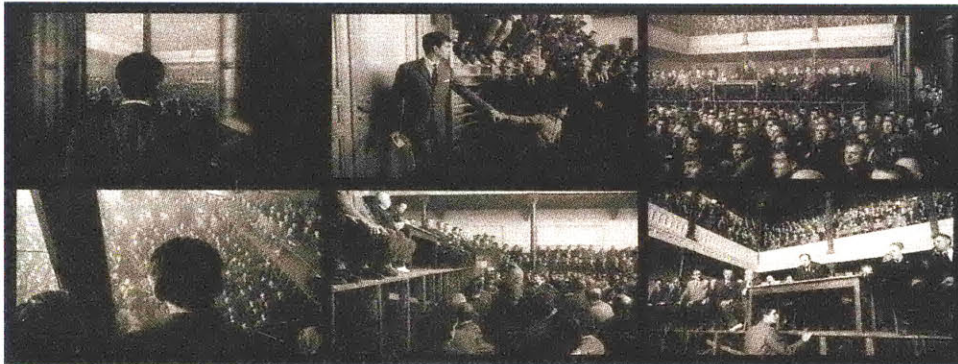


Figure 4.1.4: Cinematic representation of an event in the fictional courtroom

4.2 The current process of creating cinematic representations

Since movie-based representations appear to have certain advantages, designers have to enhance their conventional existing architectural visualizations by using similar techniques. Although the rapid development of various computational applications has made it more feasible than it was in the past, creating cinematic representations remains a complicated task, especially for architects. In order to fully understand the representational tool that this thesis proposes, it is best to examine first the current cinematic representation creation process.

If an architect decides to use filmmaking techniques along with existing computational tools so as to visualize events in space, he has to go through a lengthy process that consists of the following tasks:

- a. Modeling the physical space (Figure 4.2.1). The designer has first to model his space in 3D modeling software like 3DS Max, Maya or Rhino.
- b. Modeling and skeleton and the skin character (Figure 4.2.2). Since events are always character based, the designer has to model the bones and the skin of his character/potential user using either the same software he used for the space or a more specialized one (Character Studio, Poser).
- c. Animating the character (Figure 4.2.3). Consequently, he has to make the character able to move through space by animate his walking pattern.
- d. Has the event (Figure 4.2.4). By inserting the moving character into the space and adjusting its walking path accordingly, the designer has established a virtual event in 3D space.
- e. Creating cameras (Figure 4.2.5). The next step is to create and position the virtual cameras that will record the event. This is usually done in the same modeling software that the space was created.
- f. Animating cameras (Figure 4.2.6). Depending on the type of representation that he is seeking, the designer might need to animate the cameras. This is necessary if he intends to have pan or dolly shots as part of the cinematic sequence.
- g. Rendering all the necessary cameras (Figure 4.2.7). After finishing with the cameras, the designer has to render all the potential shots in order to end up with an array of polished small clips.
- h. Editing the shots (Figure 4.2.8). Consequently, it is crucial to combine the various small clips/shots in a larger meaningful sequence. This task requires the use of video editing software such as Adobe Premiere or Final Cut Pro.

i. Outputting the final sequence (Figure 4.2.9). After editing the sequence, the designer can output the resulting clip as a movie file.

Although the previously described process makes it possible for designers to create event-based representations, it is evident that there are certain disadvantages.

First of all, the whole workflow is quite complicated as it requires knowledge of various software packages. Therefore it can prove sufficiently time-consuming for the designer. Apart from that, the creation of the event appears to be detached from the specific spatial characteristics of the modeled space, much as it happens in the movies. This may prove problematic in the realm of architectural events, as it is essential for the designer to establish relationships and links between the human character and the physical space. The third and maybe most important disadvantage of the described method has to do with the nature of the tasks e, f and h. In these steps the designer has to take decisions that are not directly related with his field of knowledge. The tasks of positioning/animating cameras into space as well as editing small clips into larger movie sequences require

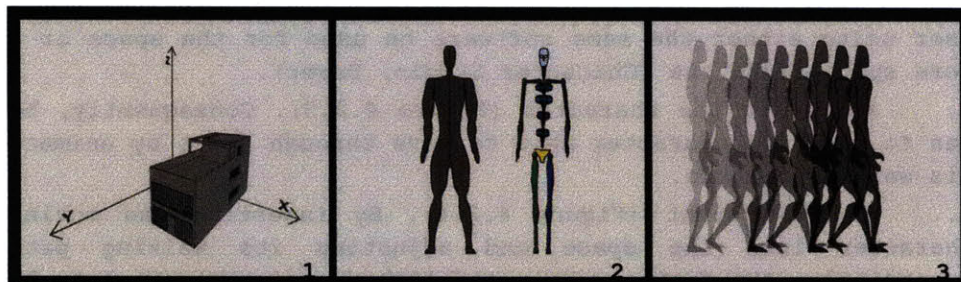


Figure 4.2.1 (1): The typical digital model
 Figure 4.2.2 (2): The skeleton and the skin of a typical character
 Figure 4.2.3 (3): The character is animated in a walking pattern

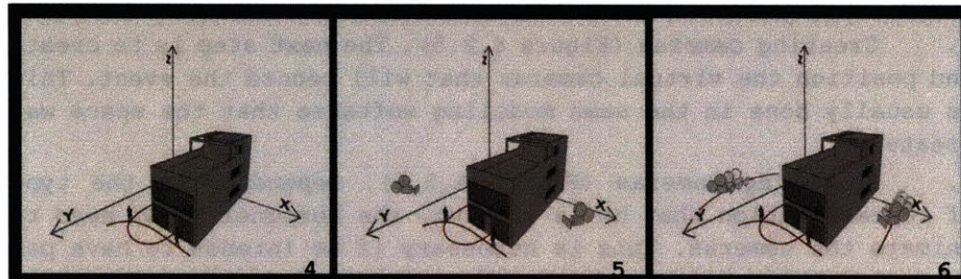


Figure 4.2.4 (4): The character is inserted in the model
 Figure 4.2.5 (5): The user creates cameras
 Figure 4.2.6 (6): The cameras are animated in the 3D space

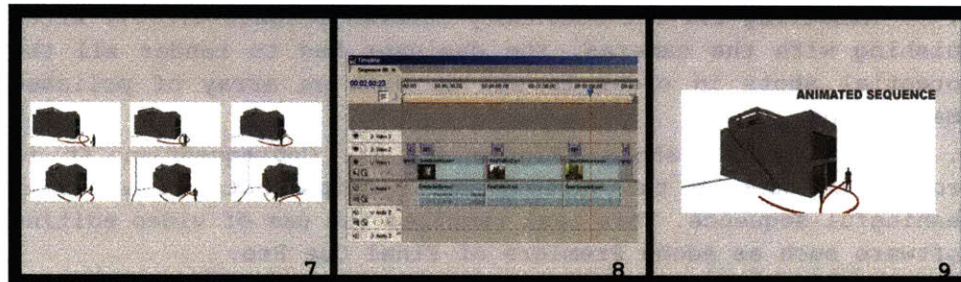


Figure 4.2.7 (7): All the cameras are rendered into small sequences
 Figure 4.2.8 (8): The shots are edited in Adobe Premiere
 Figure 4.2.9 (9): The user ends up with the final sequence

skills that are closer to filmmaking than architecture and are clearly not part of the educational architectural curriculums.

In order to successfully incorporate event-design ideas into the process of architectural design, it is of utmost importance to overcome the fore-mentioned problems. A new digital tool is needed for facilitating the easier and more efficient creation of event-based cinematic representations for architects.

5. The proposed software: EventD²

5.1 The main objectives

This thesis attempts to create a new digital representational tool so as to support the potential validity of the event-design concept. By taking into account the existing techniques and their shortcomings, this new tool attempts to improve their efficiency by focusing on three main objectives.

a. The creation of the cinematic representation should be a fairly straightforward and easy process for the designer. In order for event-design to become feasible, it is crucial that the representation of the events is not a time-consuming task. Architects are usually hesitant to deviate from their usual design approach and try something new. The less effort it requires to come up with a new cinematic representation, the more probable it is that they will actually use this new tool.

b. There should be no filmmaking skills required. Although cinematic representations are based on filmmaking techniques, the user of the tool should not have to make decisions that are based on such knowledge. Instead, any cinematic "wisdom" should be embedded in the software itself. Since filmmaking is a fully established artistic discipline that is comprised from numerous theoretical and technical approaches, it is almost impossible to squeeze its entire knowledge-base into an automated tool. At the same time, it would be inadequate to embed into the tool only one cinematic approach. Depending on the nature of the represented event as well as on the individuality of the designer, a certain filmmaking technique might be more appropriate than another for a specific visualization. Therefore, the architect should have more than one cinematic approach to choose from and experiment with.

Rudolph Arnheim (1957) meticulously analyses the various aspects of filmmaking. For the sake of simplicity, the software



Figure 5.1.1: Typical Rhythmic cinematic sequence from Welles' The Trial

will use only two of Arnheim's cinematic decision categories in order to create a palette of possible filmmaking approaches: Framing and Montage. Framing has to do with the delimitation of the picture and the distance from the object. Essentially, it involves the placing of the cameras in the space. Montage (editing) refers to the way with which the various individual shots are combined into a final meaningful sequence. By using different ways of framing and editing, the tool should be able to provide the designer with various versions of the representation of the same event. More specifically, the tool will use three distinct filmmaking techniques: Rhythmic, Analytical and Monoshot.

The first one of them (Rhythmic) is based on Eisenstein's (1949) theory of montage. According to him, the visual power of the sequence stems from the rhythmical juxtaposition of radically different shots. Every next shot attempts to contract the previous shot through a switch of its framing: a close shot is followed by a long or panoramic shot and vice versa. This technique has been used widely by many directors since its introduction by Eisenstein in the 1920's. A relevant example is illustrated in Figure 5.1.1 and comes from Orson Welles's movie "The Trial". The main character, Joseph K, and his uncle are moving from Joseph's office to the computer room. The director uses consecutive shots of equal length and different framing to capture their movement through the rest of the employees that are going towards a different direction.

The second filmmaking technique (Analytical) proposes the composition of the sequence only from methodically selected detailed shots. The whole panoramic view of the event is either never shown or it is shown just once at the end of the sequence. Here the timing is not rhythmic but dependant on the complexity of each shot. By only revealing parts of the whole, this technique encourages the audience to fill in the gaps by its own expectations. Russian director Timoshenko was a pioneer of this technique in the 1920's. Among the many directors that incorporated analytical sequences in their films, Brian de Palma offers a clear example in his film "Dressed to Kill" (Figure 5.1.2). In one of the most important and suspenseful scenes of the movie, the main character is murdered with a razor in



Figure 5.1.2: Typical Analytical cinematic sequence from De Palma's Dressed to Kill

an elevator. De Palma, partly imitating the Hitchcock's famous shower scene from *Psycho*, uses consecutive extreme close-ups of details (of the razor, of a hand, of blood stains, etc) in order to depict the event.

The last filmmaking technique that will be used by the tool (Monoshot) involves the complete absence of editing. The whole sequence consists of only one shot. As the camera moves through the space, it follows the characters and the story in continuous manner both in space and in time. However, the framing of the sequence may change due to the camera's movement. Directors like Alfred Hitchcock, Orson Welles and Quentin Tarantino have often used this technique in their movies. Figure 5.1.3 shows an example from Tarantino's "*Kill Bill*". In this scene, the main character (the Bride) is moving inside a Japanese club. She walks from the dancefloor to the bathroom of the club where she hides waiting for her enemy. Although the camera follows the character in a continuous shot, the height and the orientation of the camera are constantly changing.

c. There should be a direct link between the event and the space that it takes place in. As it was mentioned earlier, movie events are not closely related with space. Nevertheless, architectural events are co-shaped and redefined by the space that accommodates them. Therefore, this tool should illustrate traces of this interaction. Otherwise the representation of the event would be completely independent from the designed space.

Every designed space has certain spatial elements that the designer considers important to the positive experience of the space. Such elements might be a well-positioned window that frames a nice view, a carefully designed spiral staircase or an unexpected impressive material on the wall. Let us call these "positive" spatial elements. These elements should be initially defined by the designer and would be consequently used by the tool in two ways. First the event itself would be affected by these elements: The visual focus of the characters would be attracted by the "positive" elements (their head will turn towards them). Moreover, the cinematic representation of the event will also be



Figure 5.1.3: Typical Monoshot cinematic sequence from Tarantino's *Kill Bill*

affected: The final sequence will try to have as many "positive" elements as possible depicted in its frame. Since these elements are important, it is crucial to maximize their visualization during the duration of the event.

5.2 The general workflow of the tool

Based on the previous objectives, EventD² was structured as a plug-in (extension) of a sophisticated modeling software package such as 3D Studio Max. It presupposes that the user is already familiar with that modeling environment and is ready to expand his event-based representational techniques. The suggested workflow is as follows:

1. First the designer creates "events" into space. An event involves one or more characters that move into space in order to fulfill a goal. For example, a person enters a room and sits on the couch (to watch TV), while another person goes from his bedroom to the kitchen (to eat something).
2. Then he is able to define various elements of the space that he considers "positive" and that may be noticed by the people that occupy the space. For example, a window with an interesting view, an eye-catching staircase or an unexpected material. As we saw earlier, this part constitutes the linkage between the space and the character.
3. The plug-in generates one Cinematic Sequence as one

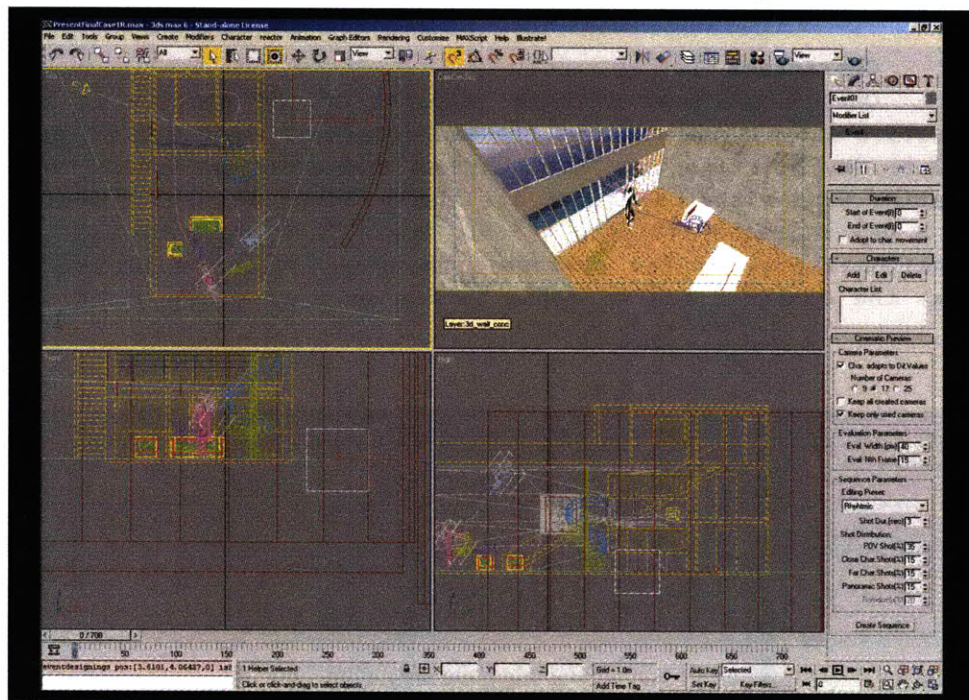


Figure 5.3.1: EventD² in 3DS Max 6

possible visual representation of the event that takes place in the designed space. This is an edited sequence that uses shots from different cameras in the space based on the amount of "positive" elements that each camera sees.

4. The user can then tweak either the "positive" elements of the space or the settings for the sequence generation in order to improve the final result. Once satisfied, he is able to render the sequence into a final animation.

5.3 Detailed description of the software

The plug-in EventD² works with 3D Studio Max 6 and Character Studio 4.2. Apart from the script file that is added to the Max 6 root folder, there is a max file that accompanies the plug-in. This file contains the biped model and the skin of the default character that the plug-in uses.

The user interface of the plug-in is inserted seamlessly into the 3DS Max UI as it is added to the Helpers category (Figure 5.3.1). It consists of 3 distinct rollouts which refer to the three basic functions or settings of the plug-in: Duration, Characters and Cinematic Preview.

a. Duration

The "Duration" rollout involves the settings that are relevant to the temporal aspects of the event. The user has the option to select the starting as well as the ending frame of the whole event (Figure 5.3.2).

b. Characters

One of the most integral aspects of the plug-in is the creation and manipulation of the characters of the event (Figure 5.3.3). By clicking the "Add" button, the user has access to a floating window that includes all the settings for the creation of a new character (Figure 5.3.4). Apart from the name and the functional goal of the character the most important parameter that the designer has to define is the path of movement of the

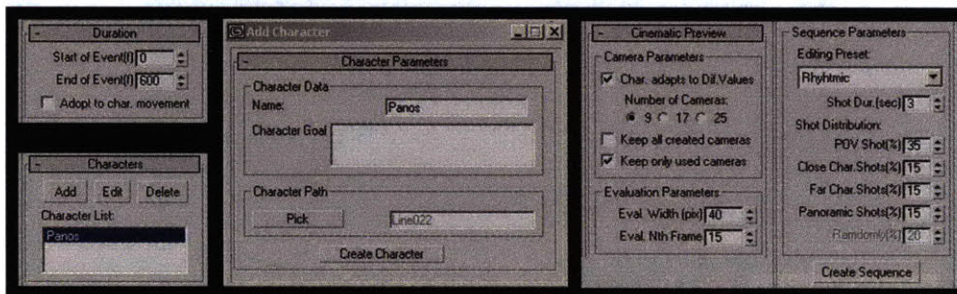


Figure 5.3.2 (top left): The "Duration" rollout
 Figure 5.3.3 (bottom left): The "Characters" rollout
 Figure 5.3.4 (middle): The "Add Character" floating window
 Figure 5.3.5 (right): The "Cinematic Preview" rollout

character. This is usually a spline that the user has already created by using the default spline creation tool of 3DS Max. Once the user clicks the "Create" button, the plug-in first imports the default character biped with his skin mesh and renames them accordingly. Consequently, it uses the defined spline in order to generate footsteps that simulate the walk of the biped along that path. Upon creation, the name of the character appears on the character list in the plug-in UI. By selecting the name and clicking the "Edit" or "Delete" button, the user can either edit the settings of the character or delete it respectively.

After creating the characters, the user is able to define the "positive" elements of the space. This is achieved by selecting objects that he considers interesting or important and changing the Object ID value in their properties. This is the only aspect of the plug-in that is not handled through the EventD² UI but through the default 3ds Max properties window.

c. Cinematic Preview

The creation of the cinematic sequence forms the most important part of the plug-in. There are three groups of settings that are related to the generation of the sequence. Each one of them provides control over each of the three main threads of the plug-in: creation of cameras, evaluation of shots and editing of the sequence (Figure 5.3.5).

Once the "Create Sequence" button is pressed, the plug-in automatically generates a certain amount of cameras in relation to the character. In general, there are four types or classes of cameras (Figure 5.3.6):

- 1) Point Of View Cameras. These are cameras that are located in the head(s) of the character(s) and are originally targeted straight ahead. Their target might consequently move in order to focus on "important" objects in the space.



Figure 5.3.6: Various framing options: Point-of-view (top left), Close Character (top right), Far character (bottom left), Panoramic (bottom right)

- 2) Close Character Cameras. These cameras are situated about half meter away from the character(s) and are framing the upper part of the body of the character. Depending on their rotation in regards to his orientation, they may frame the front, side, back of 45 degree view of the character. Close Char. Cameras are following the character throughout the event.
- 3) Far Character Cameras. These are similar to Close Char. Cameras but are located further away from the character (about 2m.) so as to frame his whole figure. Again, depending on their rotation angle they may offer various view of the characters interaction with the space.
- 4) Panoramic Cameras. In contrast to the other three types of cameras that are exclusively dependant on the character position and orientation, panoramic cameras are also relying on the specific space. These cameras are statically located at a high spot in the model while their target follows the character.

After the creation of the cameras, the plug-in adjusts the POV camera according the designated "positive" objects in the scene. If a Value1 object appears in the frame of the camera, then its target is focused on that object for 3 seconds or until the body of the character turns away from that object, whichever is shorter (Figure 5.3.7). Since the head of the character cannot turn more than 45 degrees in relation to the body, it is not possible to keep the target on the object if the body sufficiently turns into another direction. If a Value2 object appears in the frame, the target follows it for 6 seconds regardless of the

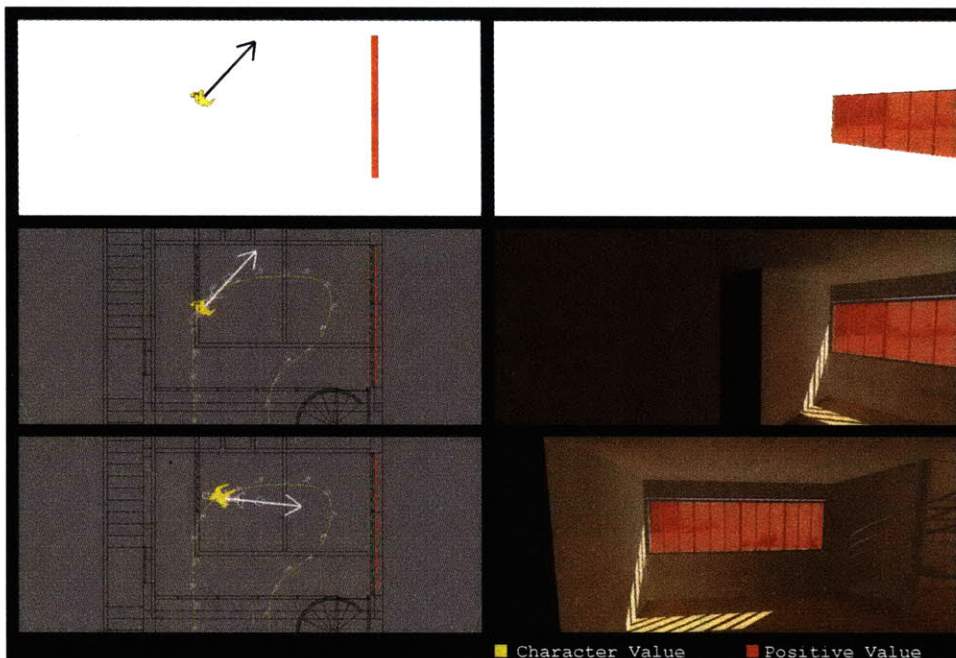


Figure 5.3.7: The character adapts to the "positive" elements. If a "positive" element (a window with a nice view) appears in the frame (middle images), then the plug-in recognises it (top images) and makes the character turn his head straight to that element (bottom images)

body path. In the case the body indeed needs to turn away, the 6 seconds focus is succeeded by slowing the whole movement of the character long enough to allow that time period of focus on the "important" object. If there are more than one "positive" objects then the one with the highest value and with the greater pixel presence on the frame is selected. Moreover, once one object has already been the focus of attention of the character once, it will be ignored if it appears in his POV frame later in the event.

In regard to the camera generation algorithm, the user is able to control the amount of cameras that will be created as well as whether the POV camera will be adjusted to focus on the "positive" objects. More cameras lead to larger computation load but offer more options for the editing part of the sequence. Additionally, the user can select if he prefers to keep all potential cameras after the calculations are over or just the ones that made it to the final sequence.

The second thread of the plug-in involves the evaluation of the potential shots of the sequence. This is where the sequence

Figure 5.3.8: Evaluation of the frame. Top left: High "positive" value and high character value. This shot will probably make it to the final sequence. Top right: no "positive" value and high character value. This shot might be chosen. Bottom left: high "positive" value but low character value. The shot will not be chosen. Bottom right: no "positive" value and no character value. The camera is probably behind a wall

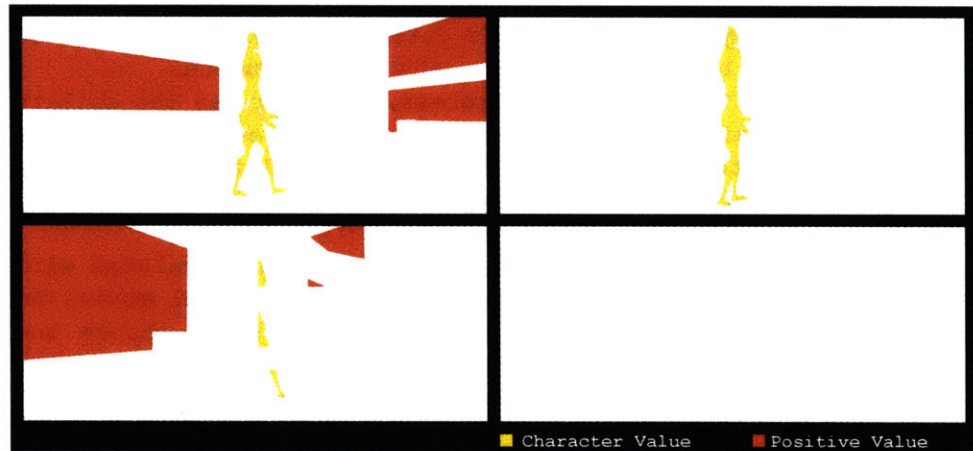
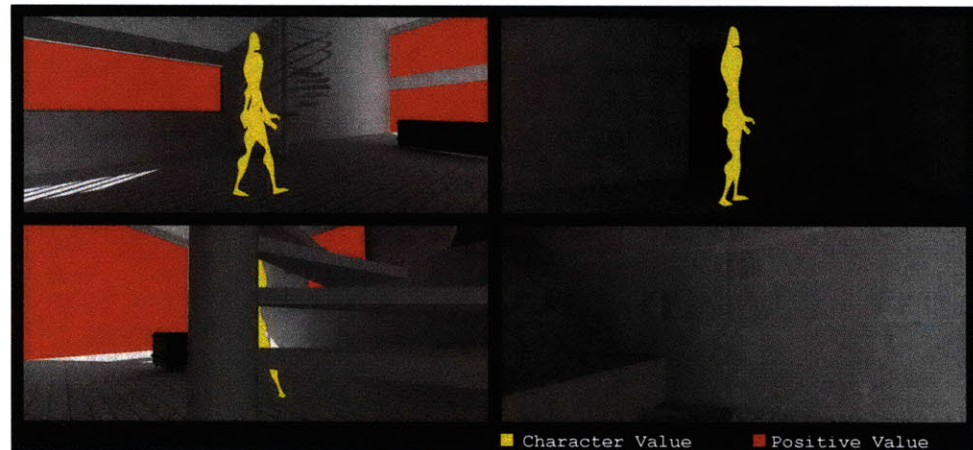


Figure 5.3.9: The actual images that are evaluated in Figure 5.3.8. The yellow areas correspond to the character whereas the red to the "positive" elements (in this case the windows with the view).



generation process is heavily infiltrated with the particularities of the specific designed space. First of all, the overall duration of the event for every existing camera is broken down into smaller time segments depending on the editing settings (which will be discussed later on). These small pieces of animation each representing one camera view for a certain part of the whole duration are called shots. Consequently, each shot is evaluated independently based on two specific factors and is assigned two numbers: Character Value and "positive" Value (Figure 5.3.8). The first one has to do with whether or not the character is visible in the shot. Since most of the cameras are character-based, it is possible that some of them may go through walls or other spatial elements during the event, thus losing visual contact with character. By assigning them a low Character Value, the plug-in prevents these shots from appearing in the final sequence. The second evaluation is related with the amount of interesting objects that appear in the shot. Depending on their individual "positive" value as well as the pixel size of every object in each frame of the shot, the overall "positive" value of the shot is calculated. This number represents the actual spatial value of the shots according, of course, to the designer that defined the "positive objects" and is used during the editing process so as to determine the best shots for the final sequence.

Regarding the evaluation process, the user has the ability to choose the size and the frequency of the evaluations. The size refers to the pixel width of the rendered frame while the frequency indicates every how many frames to evaluate.

The third thread of the sequence creation is related with the editing of the individual shots into a meaningful movie. As it was briefly described above, the user can either choose one of the three available editing presets or input custom editing preferences manually. As these presets represent different

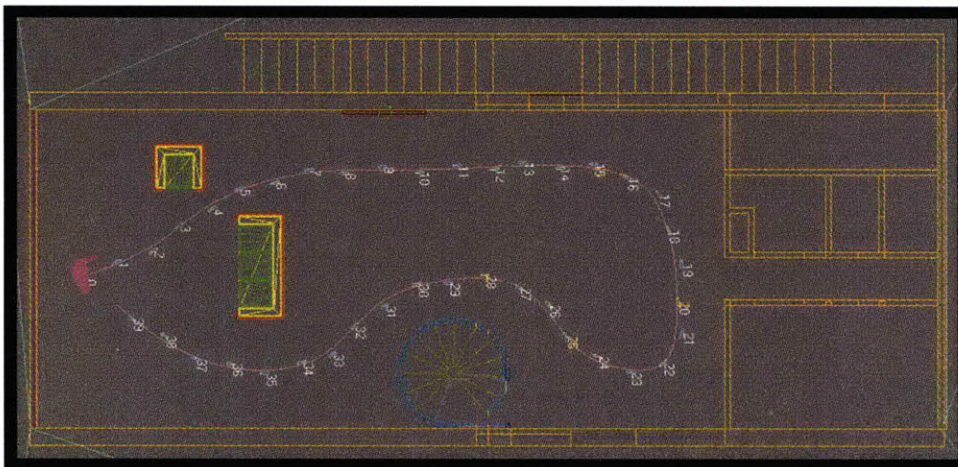


Figure 5.4.1: The character moves from the living room to the kitchen and back

filmmaking techniques, the cinematic quality of the final sequence is heavily dependant on them.

- 1) Rhythmic. In this case, the sequence is composed by shots that have the same length but quite different framing.
- 2) MonoShot. This preset involves no editing at all. During the whole sequence there is only one camera that is interpolated between the various other camera positions. Therefore, it smoothly moves from the one position to the next without any cuts.
- 3) Analytical Montage. In this preset the final sequence consists of various detailed shots of the event without any general shots. The timing is not rhythmic but dependant on the complexity of each shot and goal is to achieve a more abstract or vague representation of the event.

5.4 Examples

In order to attain a better understanding of the functions of the proposed digital tool, it would be helpful to look into an example of how it could be used. Let us suppose that the architect is in the process of designing a residential building and has already modeled a first version of the designed space which is based on Le Corbusier's Citrohan House. The architect is now eager to test his design by inserting events into space and previewing them.

Through the use of EventD², the designer is creating an event that involves one character moving from the living-room of the house to the kitchen and then back to the living-room (Figure 5.4.1). Then he is able to define the "positive" elements of the space which, in this case, are all the windows that frame the view of the sea plus a Mondrian painting that is hanging on one of the living-room walls. He is also setting the total duration of the event to 21 seconds and the number of cameras to 9.

Through the use of the Rhythmic editing preset of the plug-in, the designer is able to generate the sequence of the Figure 5.4.2. In this sequence every shot is 3 seconds long and the selection of the framing clearly favors the "positive" windows of the building. Alternatively, by choosing to use the MonoShot editing preset, the user can create the sequence of the Figure 5.4.3. In this case, there is no cut in the sequence and the camera moves smoothly from the one position to the next. Again, it is evident that the selection of the framing is promoting the relationship of the character with the "positive" elements of the space. By having the option of toggling between different editing presets, the architect has the ability to explore various film-making techniques in order to represent the event. At the same time, he is not required to know anything about these techniques beforehand.

After previewing the generated sequences, the designer may decide to use the visual feedback so as to improve either the model or the event that takes place in it. The architect realizes that the current design is too outwards oriented as there are too many windows. Therefore he decides to make the staircase the center of the design and to reduce the views towards the landscape. The Figures 5.4.4 and 5.4.5 show the two updated sequences of the event after the changes. In this case, the staircase is the designated "positive" element of the space. Consequently, all the cameras are moving around the staircase in order to frame both the character and this central element.

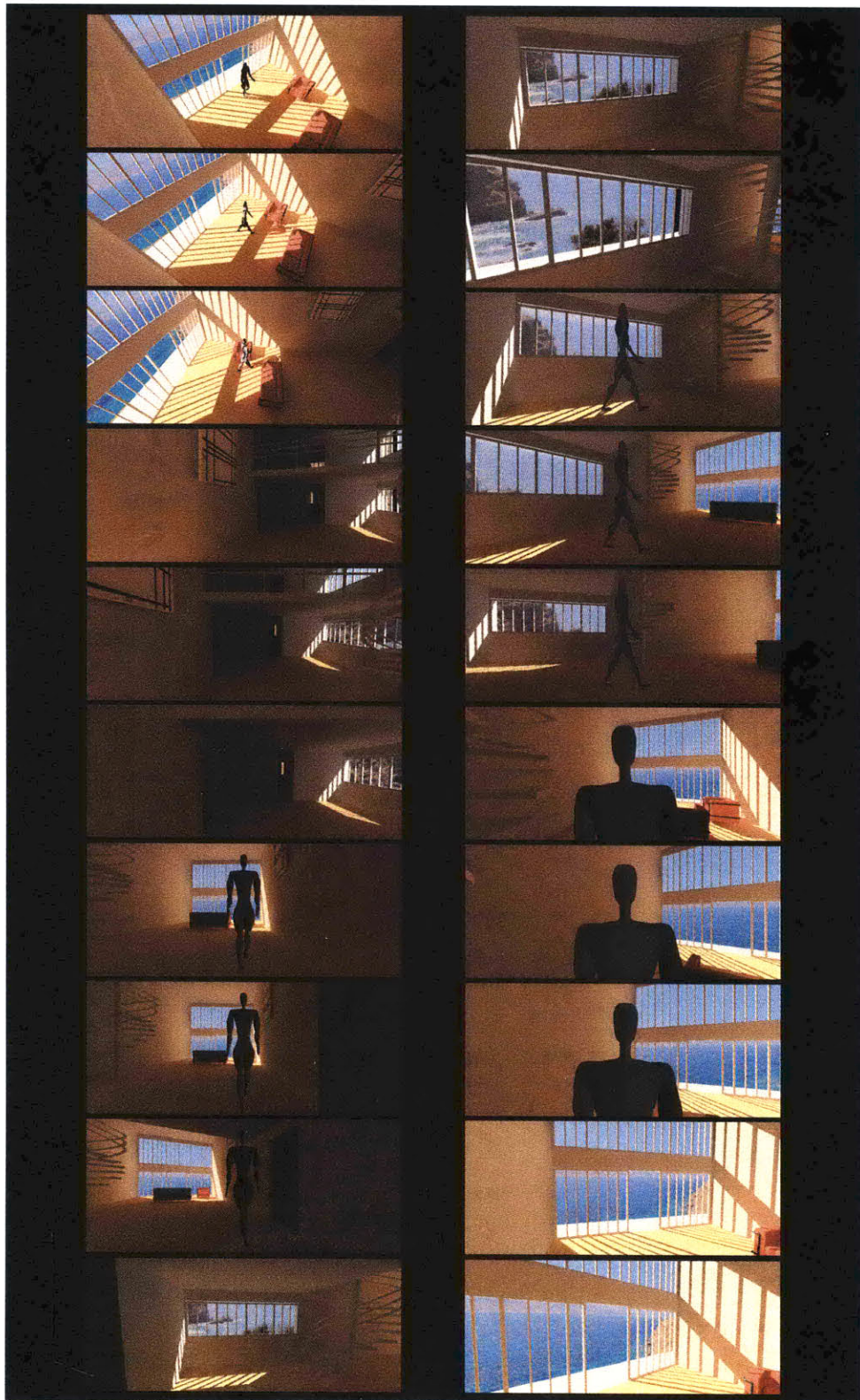


Figure 5.4.2: One potential final sequence, made with the Rhythmic editing preset

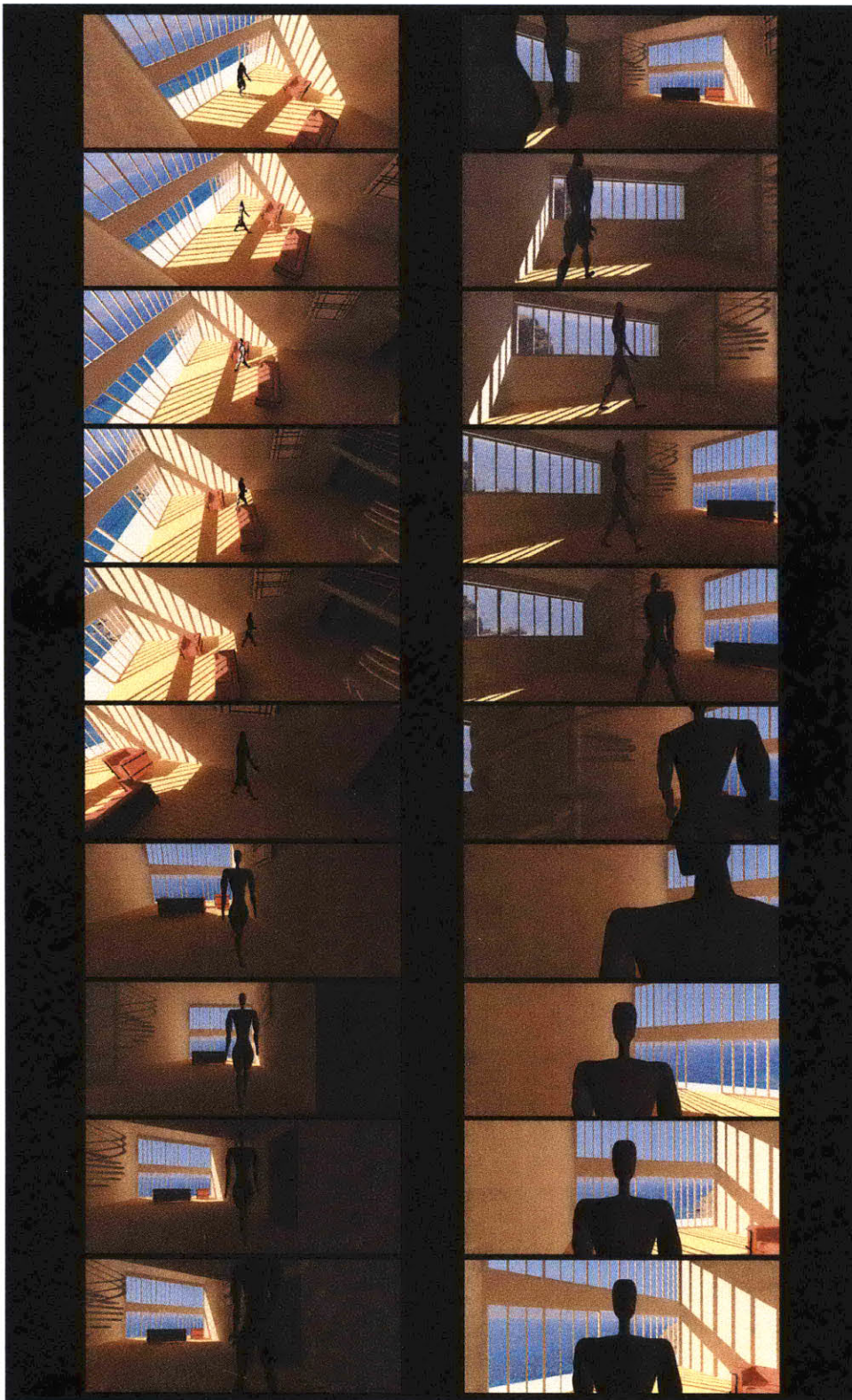


Figure 5.4.3: An alternative final sequence, made with the Monoshot editing preset

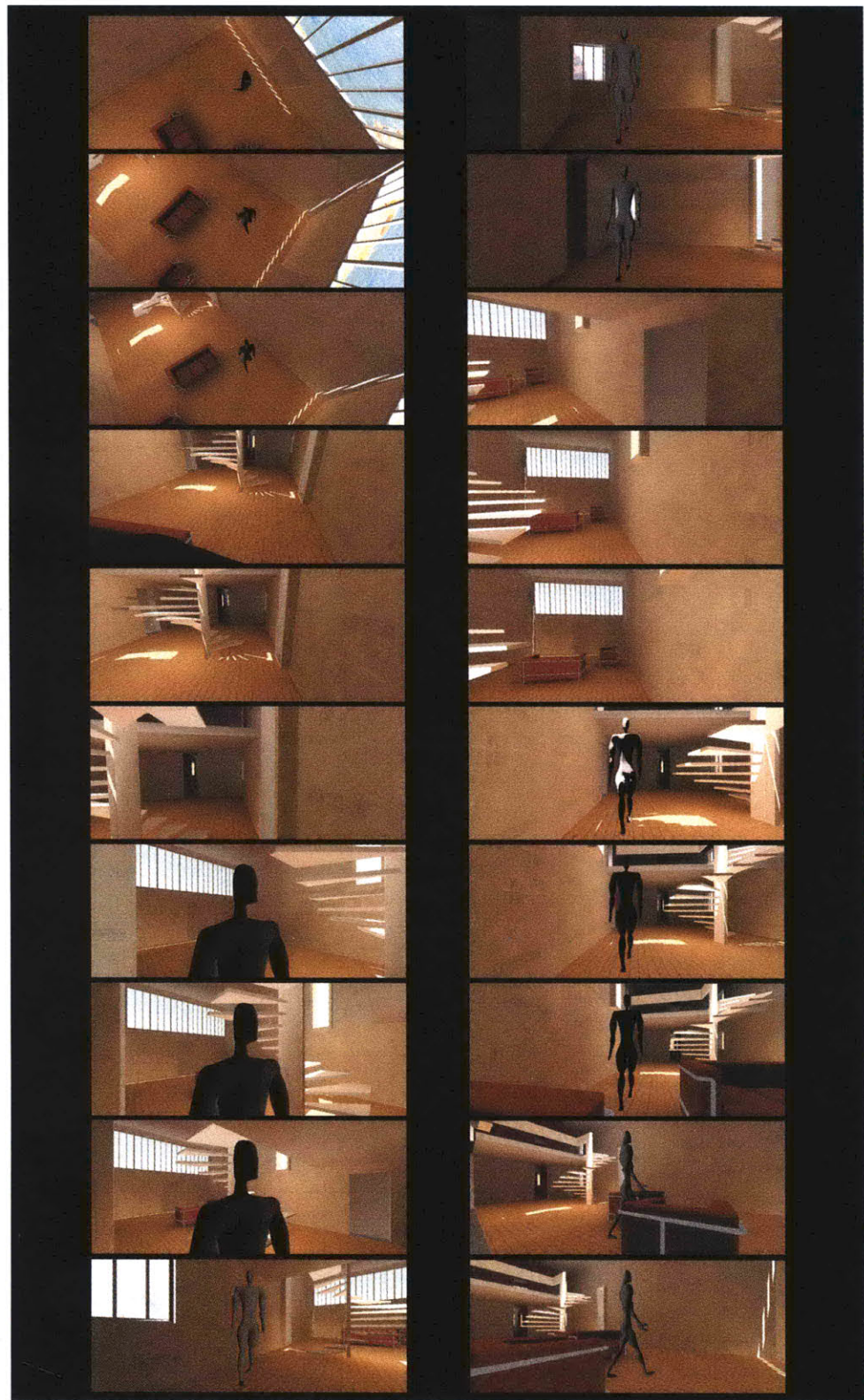


Figure 5.4.4: A new Rhythmic sequence, after the model is changed

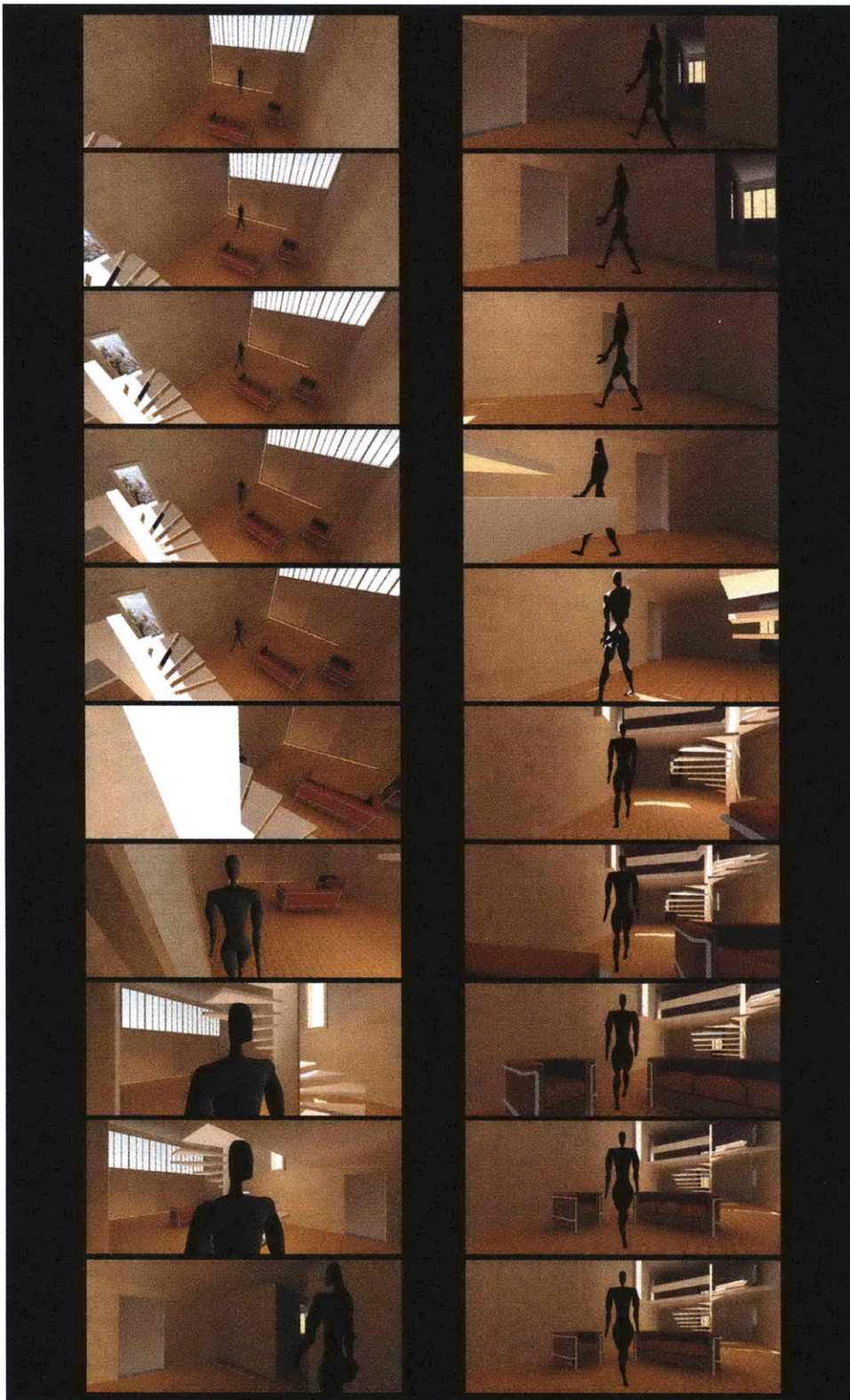


Figure 5.4.5: An alternative Monoshot sequence of the updated model

6. Expectations and future development of EventD²

6.1 Potential Results

Depending on the way architects will interact with it, the proposed digital tool may have different impact on the established architectural design techniques. One possibility is that designers will use the tool in order to create animated sequences of events that take place inside the finished designed space. In this case, the tool is not directly related with the design process but is used as a presentation/visualization tool. Therefore it can be thought to be an animated digital equivalent of the final polished hand-drawn perspective drawings that accompanied many architectural projects in the pre-digital era. Much as it happens with these drawings, the use of the tool comes after the project is finished with the sole purpose of creating a clear and impressive representation of the final design.

However, since it is quite fast and easy to generate sequences through the use of the plug-in, the architect might prefer to improve the first sequence by slightly changing either the model or the plug-in settings and create a second sequence. By creating this feedback loop, the event representations created by the tool are actually informing the design decisions of the architect. Therefore, the digital tool shifts from being a mere presentation tool to being an actual design tool. This is the utmost goal of the proposed plug-in: to not only provide finalized representations of events but to really enable the interactive manipulation and visualization of the character-space relationship. Ideally, the architect could start creating events in parallel with modeling the space and would continue developing both until they reach a meaningful and purposeful equilibrium.

6.2 Further Development

The proposed digital tool in no way intends to cover completely the complexity and the intricacy of the event-design concept. Instead, it attempts to function more like a proof of concept rather than a comprehensive event-representation technique.

Although the fore-mentioned examples showcase that EventD² is capable of generating experiential event-based representations, it is also evident that there is room for further development. The next version of the digital tool could be greatly improved in two distinct ways: by incorporating more sophisticated framing

techniques and by enhancing and multiplying the links between the events and the space.

Most of the current framing options are limited into being totally character based: both the camera and the camera target are following the character as he moves during the event. It would be interesting to create new framing options that are equally interested about the character and the space. In that case, the camera would be cleverly positioned so as to cinematically frame (in a purposeful compositional way) both the character and the important spatial elements.

Apart from the framing, the event-space relationship could be further developed. Instead of just declaring the "positive" elements of the space, the architect could have additional ways of informing the software about his architectural intentions. By breaking down the general term "positive" into the more specific visual, functional or semiotic characteristics of these elements, the digital tool could make more educated predictions of how these elements might interact or interfere with the event. The improvement of the linkage between space and events will most certainly lead to the betterment of the design aspects of the tool.

7. Epilogue

This thesis tried to offer both a theoretical and a practical framework for supporting the idea that architectural design should be focused on the relationship between the human user and the physical space. After providing a general theoretical background, the crucial notion of the event was introduced and a new event-driven approach towards design was analyzed. However, the inability of the current representational techniques to capture the time-based complexity of the events was rendering them invisible and, therefore, event-driven design impossible.

In order to succeed the visual representation of events, a new digital tool was introduced. This tool uses various film-making techniques so as to depict architectural events through the medium of the moving image. By creating event-based cinematic sequences in a fast and easy-to-use way, architects are capable of visualizing how human events unfold, interact or interfere with the space they design. The specific examples that were examined showcase that, despite its limitations, EventD² is a successful first step towards a cinematic event-design path that is worthy to be explored in the future.

It is my belief that architectural space can not be adequately described only by modeling and rendering its material form. Instead, it should be envisioned as a "stage" where events involving humans interacting with the built environment will eventually take place. The ultimate goal of this thesis is to make it possible for architectural designers to evaluate and iterate their designs based not only on the form of the building but rather on the events and human actions that might take place inside it.

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Figure Sources

Figure 1.1: *Mépris, Le* (US title: *Contempt*), 1963, Feature film directed by Jean-Luc Godard and written by Alberto Moravia

Figure 3.1.1: "Renzo Piano 1987-1994" with a contribution by Vittorio Maguago Lampuguanì, Birkhauser Verlag, 1994

Figure 3.2.1: <http://depts.washington.edu/maushaus/obstacles/obstacles.htm>

Figure 3.2.3: <http://www.poserworld.com/DesktopDefault.aspx?tabindex=0&tabid=1&galleryid=24&imageid=27>

Figure 4.1.1 : <http://www.cees-b.nl/w007/w007.htm>

Figure 4.1.2 : *Procès, Le* (US title: *The Trial*), 1962, Feature film directed by Orson Welles and written by Franz Kafka and Orson Welles

Figure 4.1.3 : *Mépris, Le* (US title: *Contempt*), 1963, Feature film directed by Jean-Luc Godard and written by Alberto Moravia

Figure 4.1.4 : *Procès, Le* (US title: *The Trial*), 1962, Feature film directed by Orson Welles and written by Franz Kafka and Orson Welles

Figure 5.1.1 : *Procès, Le* (US title: *The Trial*), 1962, Feature film directed by Orson Welles and written by Franz Kafka and Orson Welles

Figure 5.1.2 : *Dressed to Kill*, 1980, Feature film written and directed by Brian De Palma

Figure 5.1.3 : *Kill Bill*, 2003, Feature film written and directed by Quentin Tarantino

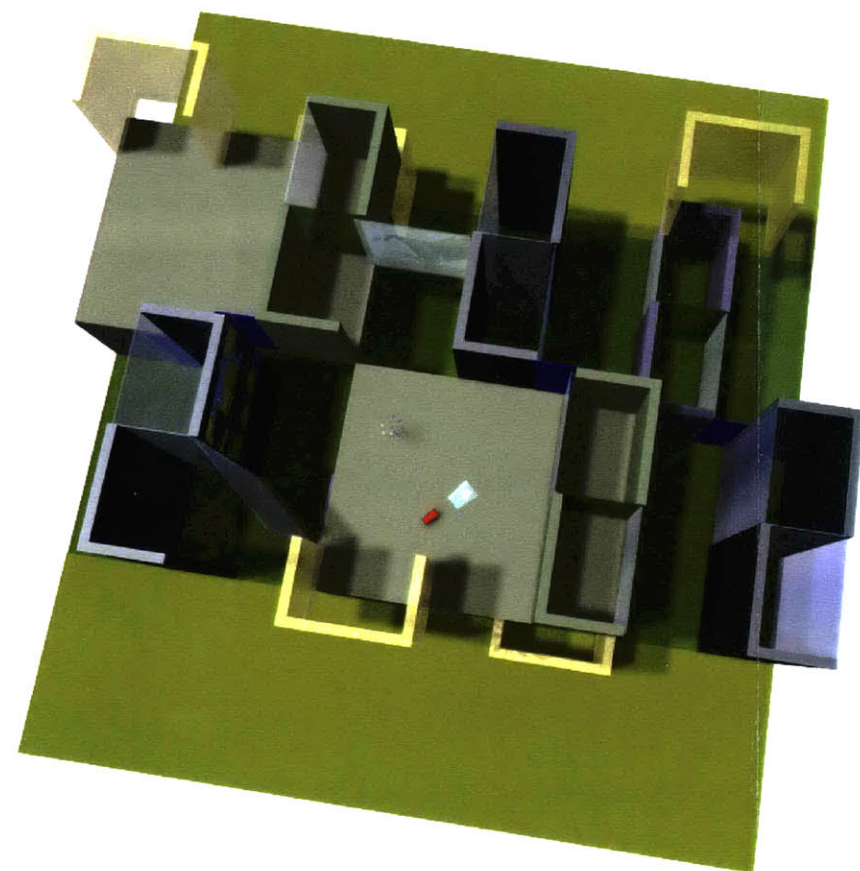
Unless noted, all the figures are by the author.

board 4
unit concept

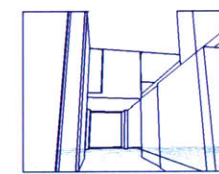
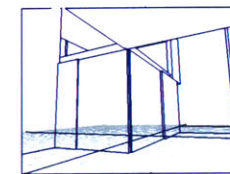
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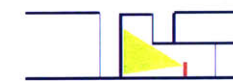
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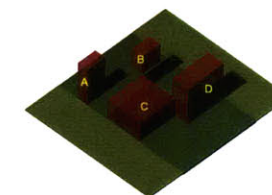
please choose from the menu and make your selection.....



the unit as a scenographic set requires space with various planes of depth

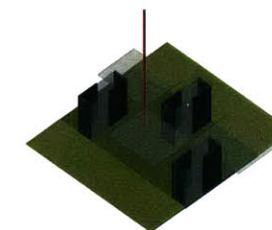


equal allocation of vertical and horizontal surfaces allows maximum scaling of a projected image

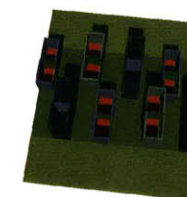


A: 2mX3mX6m
B: 2mX3mX3m
C: 6mX6mX3m
D: 3mX6mX6m

the unit offers a range of scales of spaces for the body to inhabit



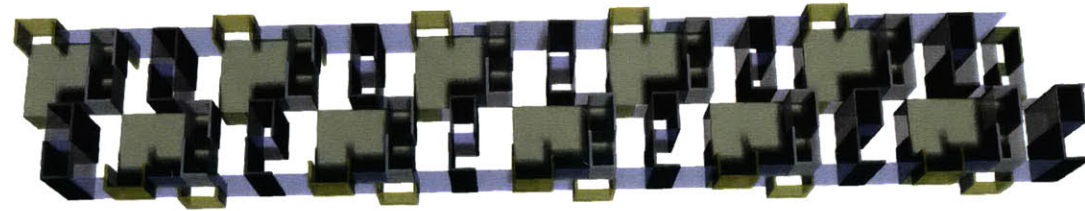
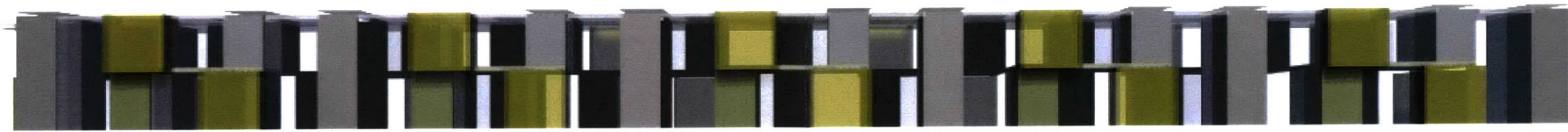
the center of the unit becomes a point around which space continually circulates



the niches contain the utility infrastructure

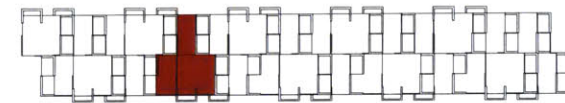
board 5
initial studies of the unit in aggregate form

aggregate

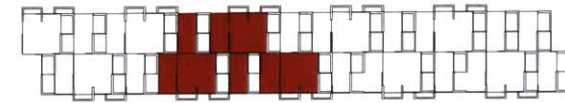


the porous structure allows for the contraction and expansion, and even non-contiguous distribution of living area.

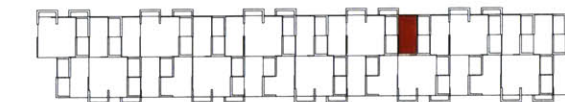
a researcher, 2 years



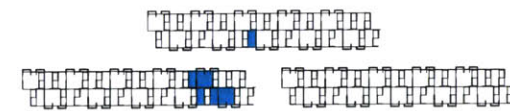
a large family, 4 months



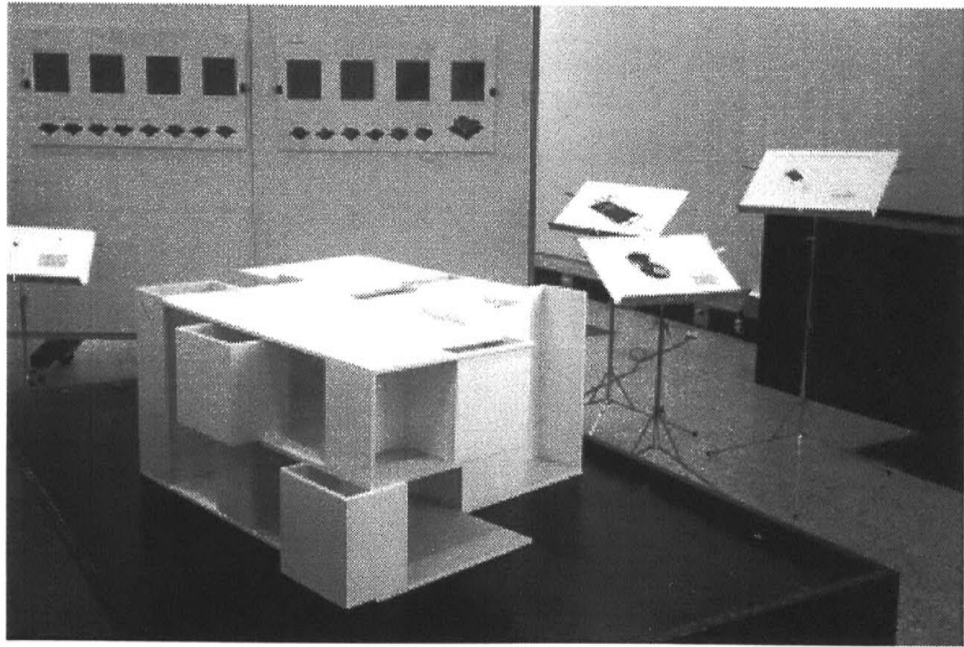
a seminar attendant, 2 weeks



a professor with a separate office space



board 6
an example of a site location

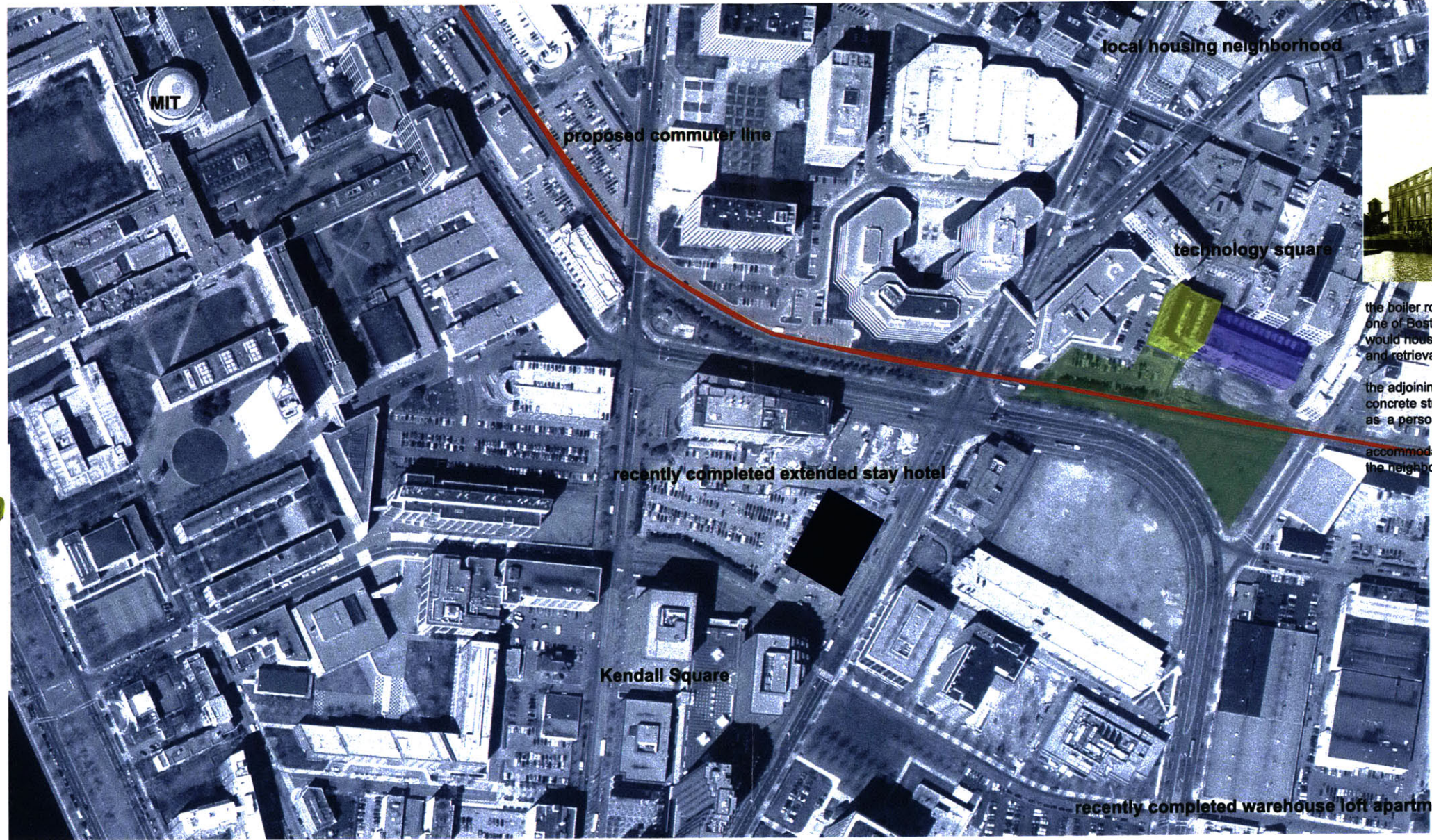


complex



42.37N, 71.11W (Cambridge, MA)

the site chosen for Cambridge is located amidst residential, university, and hi-tech research programs



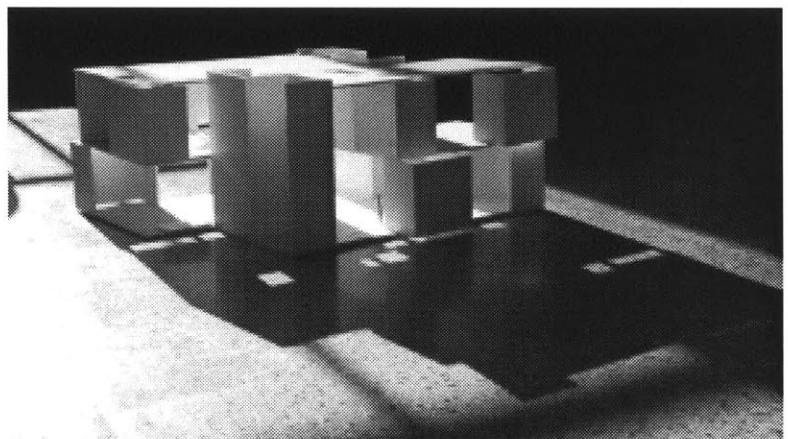
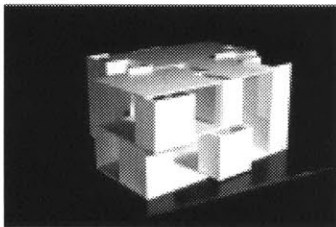
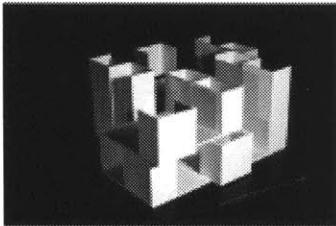
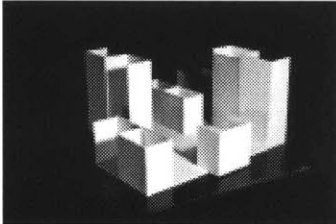
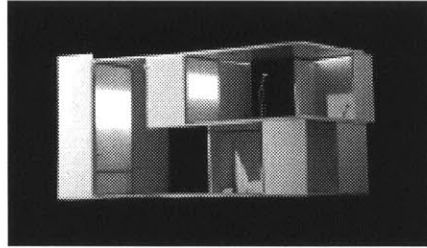
the boiler room of Boston Woven Hose, one of Boston's oldest rubber manufacturers, would house the Cambridge digital archive and retrieval center

the adjoining warehouse, the first reinforced concrete structure in Cambridge, would serve as a personal material bank

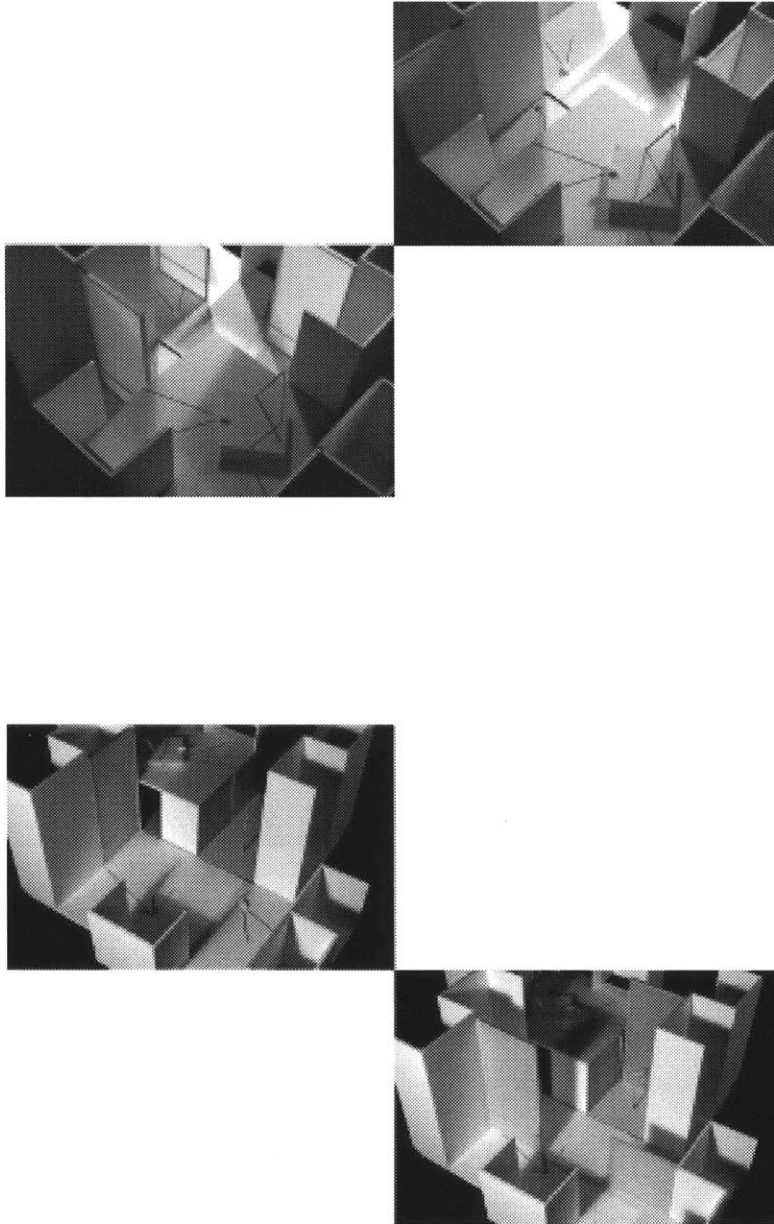
accommodation facilities would be located on the neighboring site



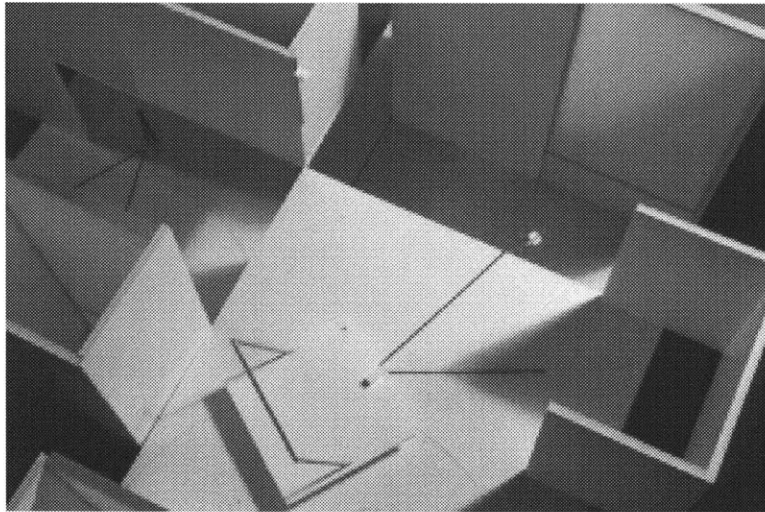
model of the unit
demonstration of the spatial concept



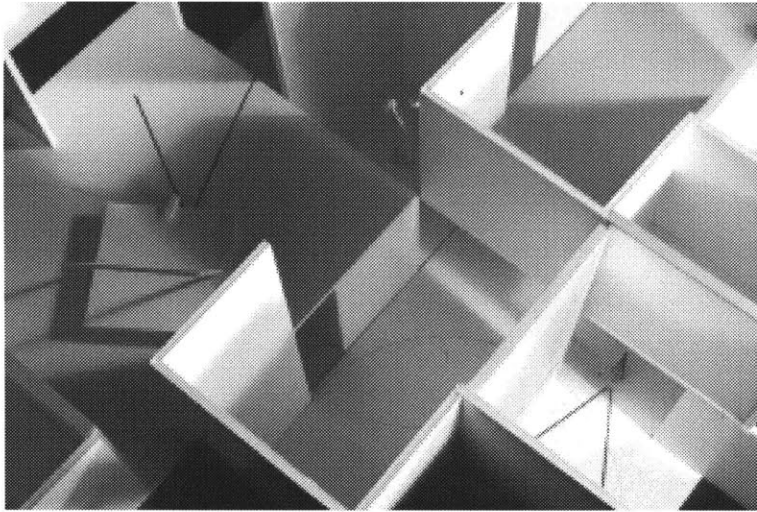
models showing the basic L-shaped spaces forming the units, the allocation of one and two story niches, and the porosity of the resulting structure



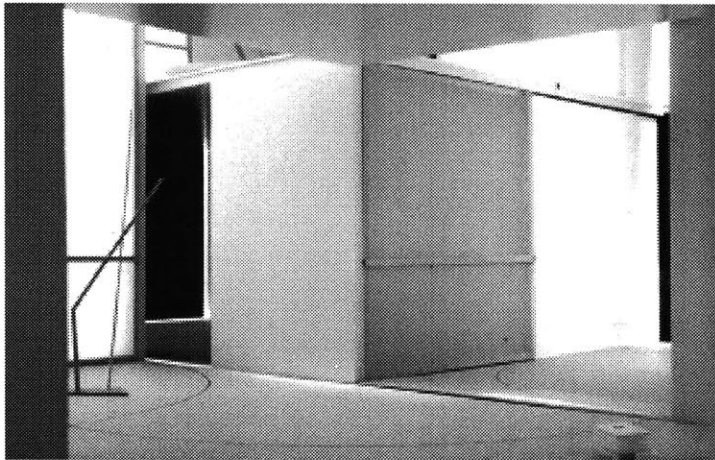
*sequence of photos showing the changed nature of space through the use of large screens, or
deflectors*



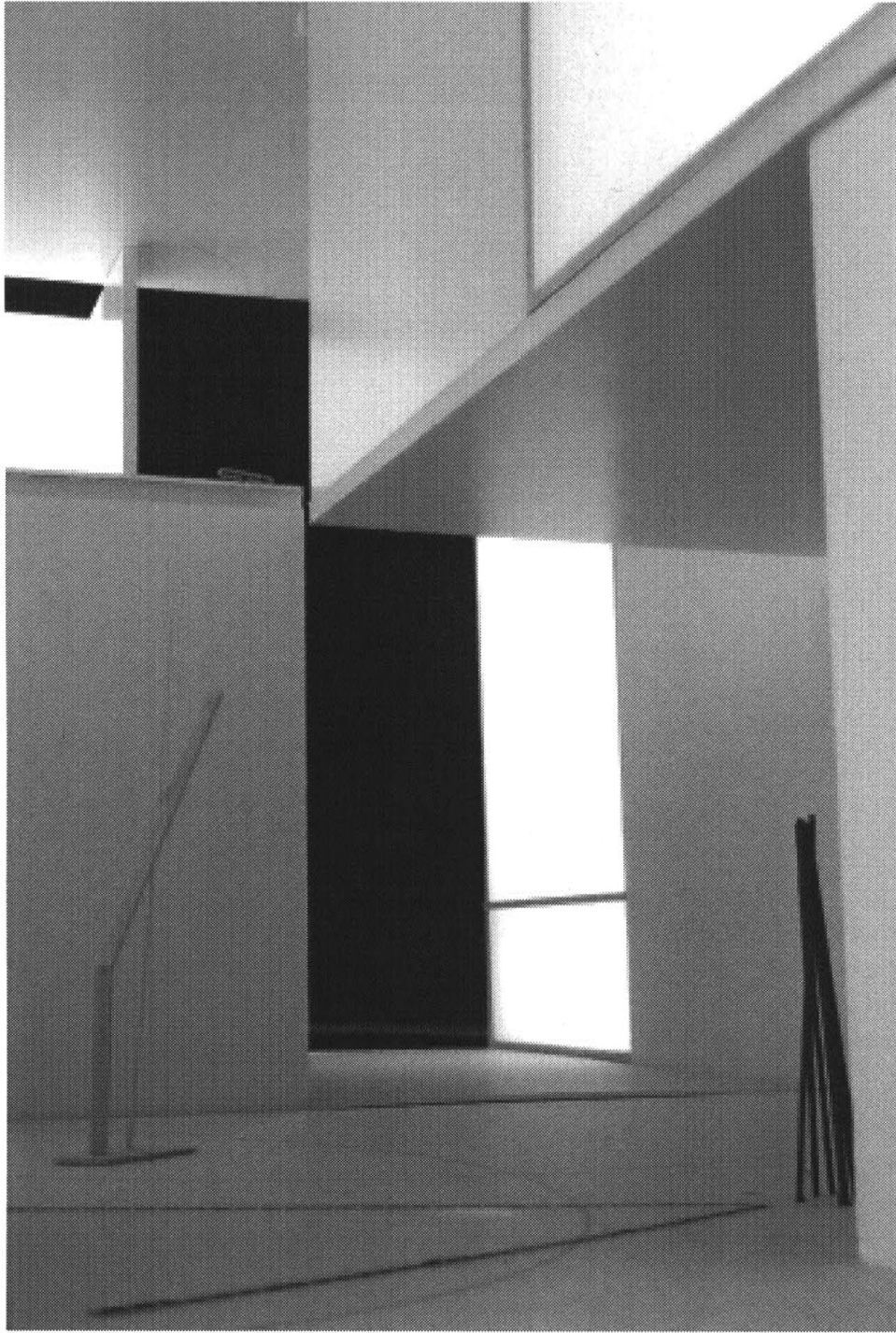
*model showing the bi-leveled space of a unit, which contains both single and double height spaces;
the center of the unit is a point , around which the space of the unit circulates*

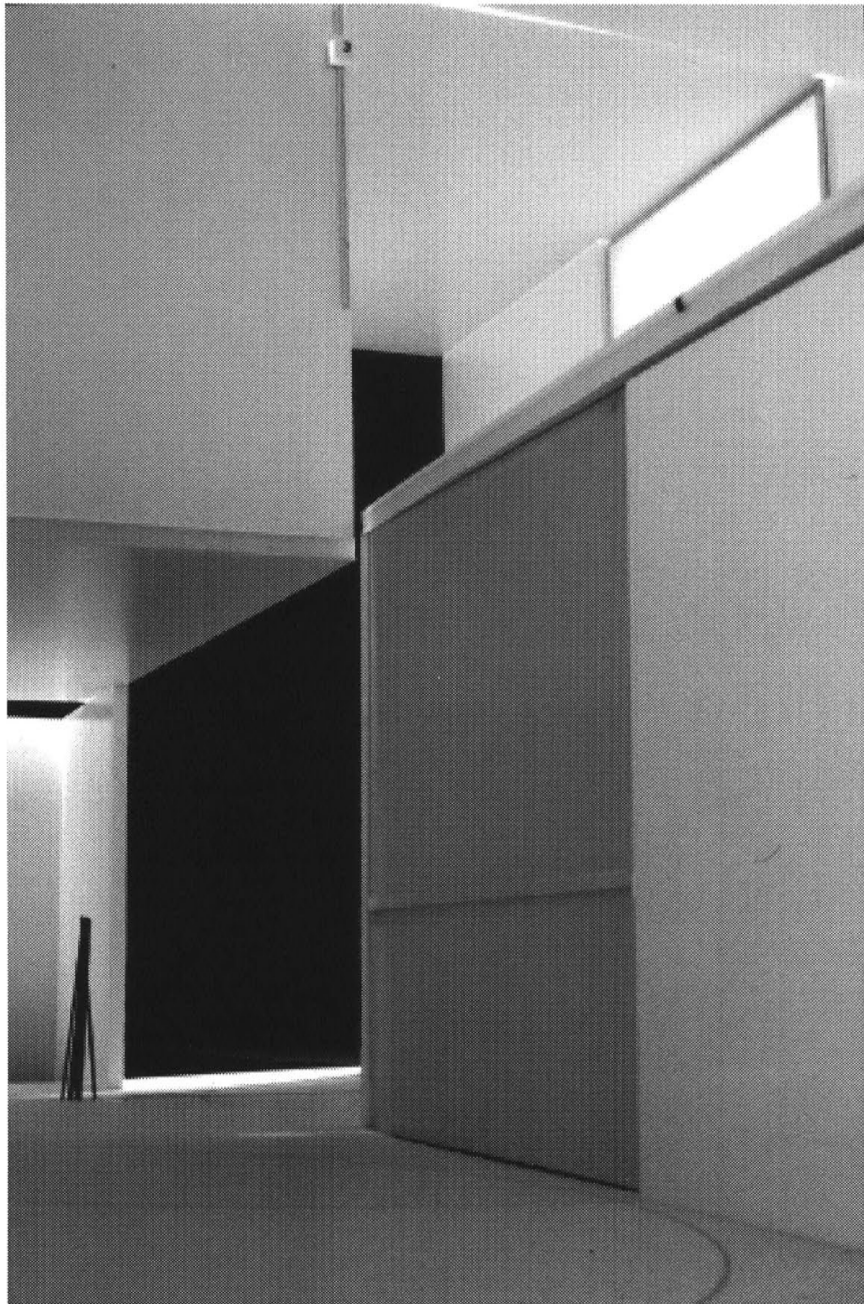


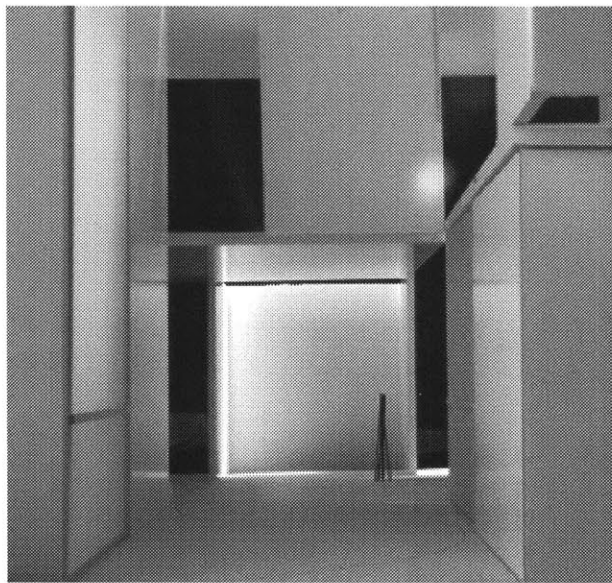
model showing how the use of the large deflectors create a richness of pockets from the rerouting of the flow of space



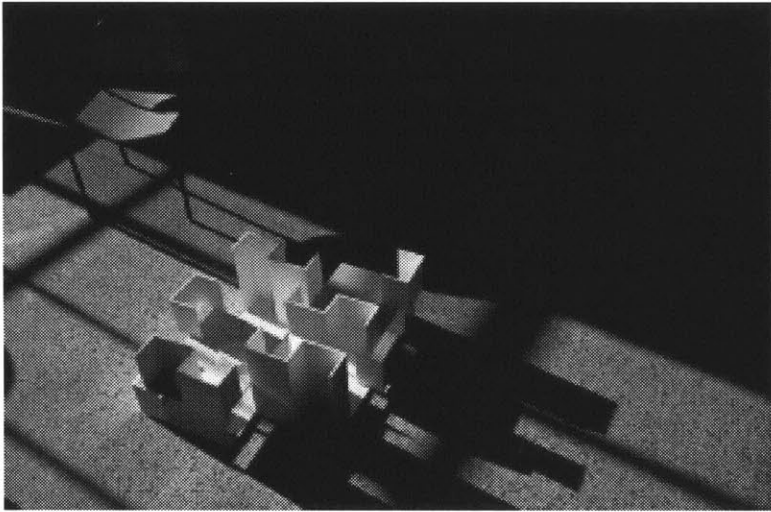
interior views of the unit







interior views of the unit

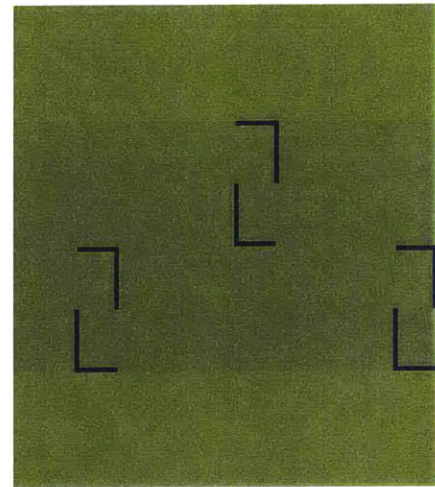


the final model in the dome cafe

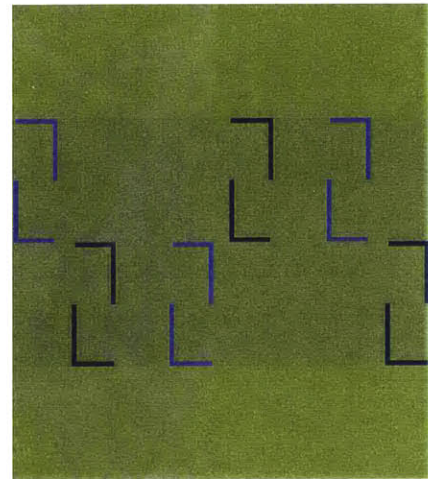
board 7
analysis of the spatial components of the unit

unit components 1

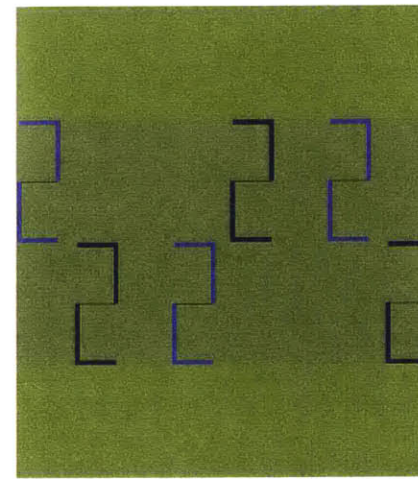
ground floor



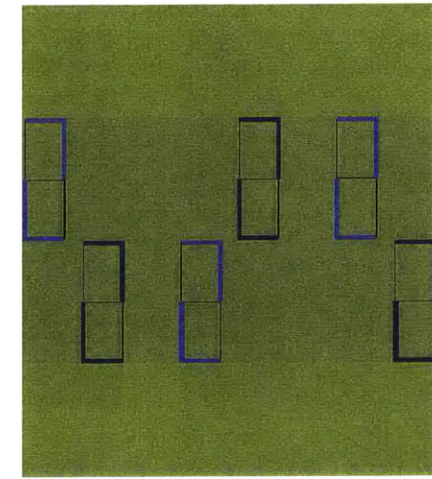
double height primary structure



single story primary structure



locks regulate flow in the X direction



full height deflectors create niches, transform space

double height primary structure



double height locks regulate flow in X direction



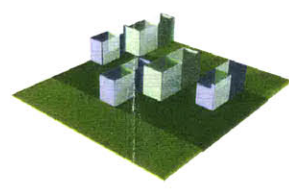
inhabitable niches



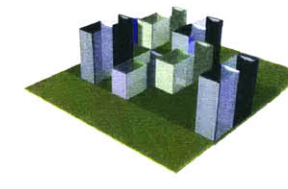
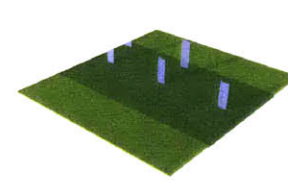
deflectors divert light, transform space



single story locks and niches

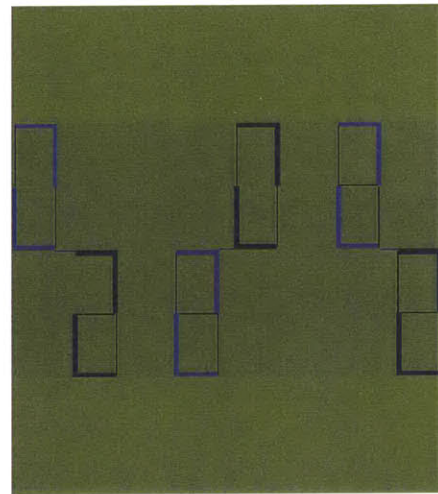


gaps regulate flow in the Y direction

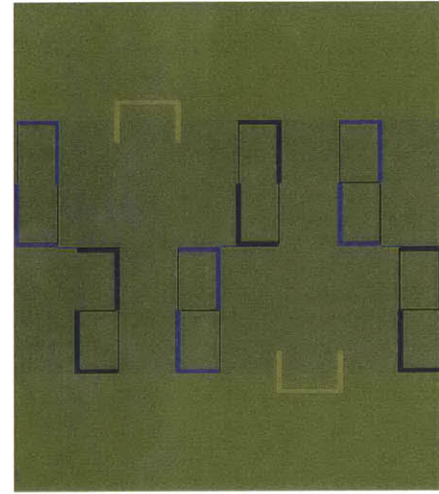


board 8
analysis of the spatial components of the unit

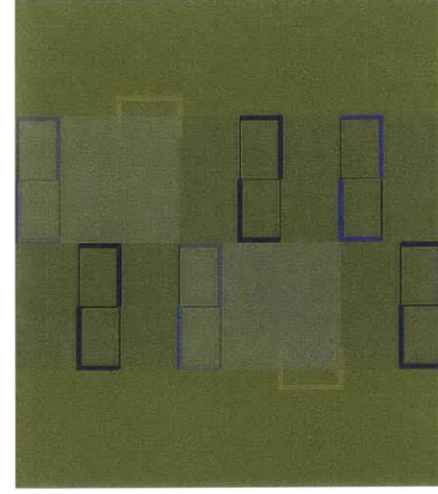
unit components 2



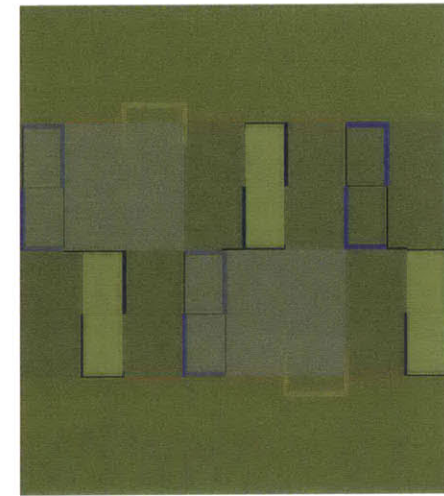
gaps regulate flow in the Y direction



plug in structures act as loading docks for storage

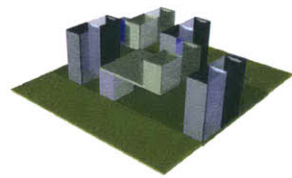


second story floor plates

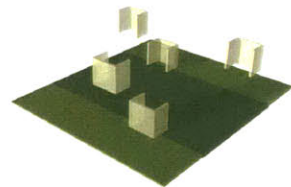


external glazing functions as homepages
light is brought down into the niches

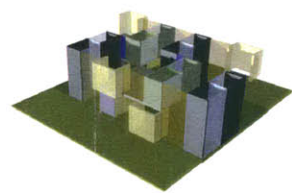
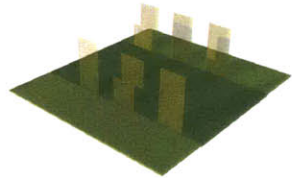
floor plates create L shaped spaces



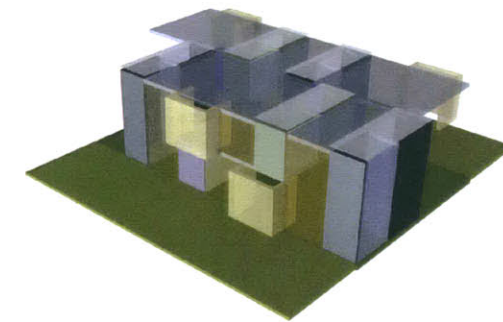
plug in structures



glazing acts as homepages



roof brings in light, collects energy



stands

sphere and chandelier

an alternative definition of individual property, encouraging distributed and/or shared holdings



chandelier



sphere

sphere

IN

the sphere is a collection of video cameras in a piece. It can contract into a ball, or expand into a three dimensional halo or web of cameras. variously chosen lenses take different perspectives on a selected subject. if there is a place which has a certain meaning to you, you select and purchase a view and segment of time. perhaps the time of a lens is shared by many. the real time of a place would be distributed and shared, translated via satellite to the chandelier.

chandelier

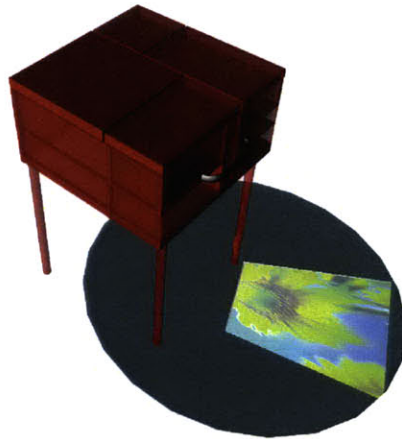
OUT

the chandelier is a mobile, freestanding circular array of projectors, functioning also as a lighting device. the different views one has selected are projected into one's space, onto the ceiling, the floor, or the walls. the circular array can spin on it's axis. depending on where the projectors are directed, and it's distance to a surrounding surface, sometimes some things are in focus while others are in a blur. one turns the projector by taking the cap off the head. one manually decides on the orientation of the stand.

stand 1
chandelier

curiobox

a source of continuity is the steady accumulation through time of memory space



curiobox

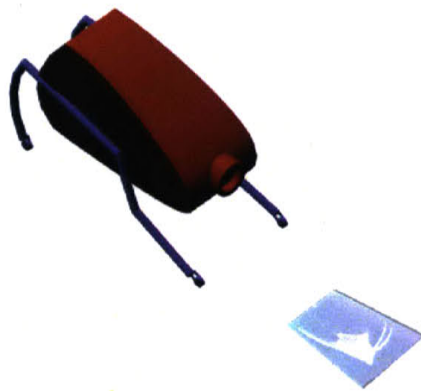
OUT

the curio box is a small trinket box, with hidden drawers of all sorts for different kinds of personal memorabilia. opening one of the drawers reveals and turns on a small projector. the computer retrieves a private file from the network and the projector projects the stored past onto a chosen surface - floor, door, wall. the freestanding curio box can be programmed to project linear or random sequences, with or without sound and can be networked to other furniture in the house. it collapses neatly into a portable case.

stand 2
curio box

pet

a paralel working ensemble of interactive surfaces integrated into daily habitual actions able to accommodate changing body location and position



pet

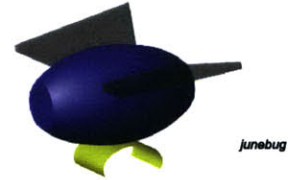
OUT

this is a voice activated moving projector which can follow you as you move. It is networked to the other surfaces so you can continue your thoughts if you stand up or go somewhere else.

stand 3
pet

a junebug and stem

reliance upon telepresence requires multiple and diverse means for self presentation



junebug

IN

the junebug is a voice activated robot that flies around but always with you in view. you are wearing a necklace so it knows where you are. it takes an active view of you, sometimes zooming in, sometimes out. you can tell it to fly around randomly or choreograph it. you can tell it to go fast or to sit down. in any case, this is the view which others are getting of you.

stem

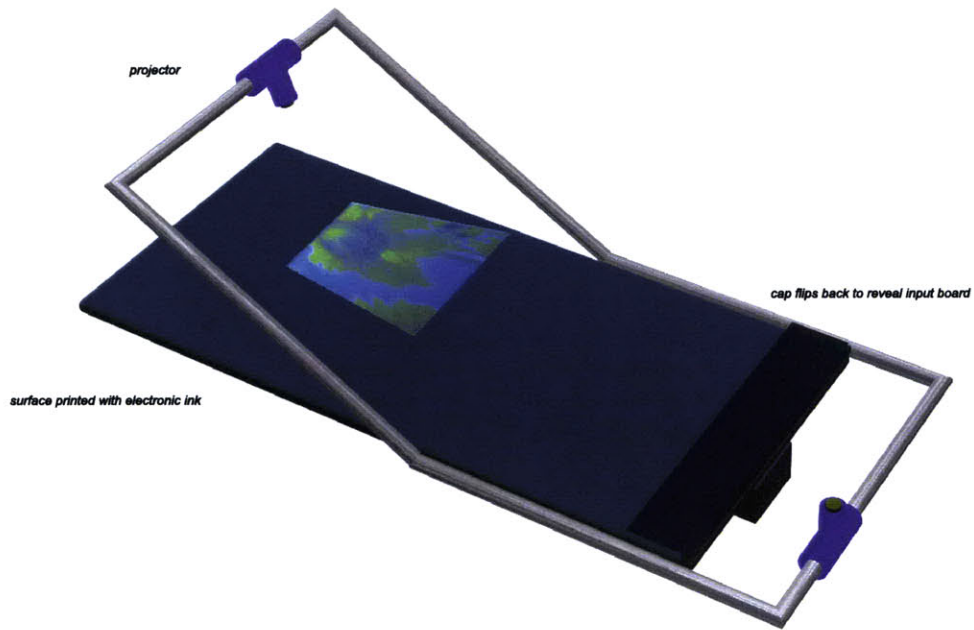
OUT

you can make the junebug land on the stem, an adjustable free standing mobile video camera stand. the stem is a passive camera, non moving, but you can point it where you like. it has a screen, so you can see what the camera is seeing, or who might be watching you.

stand 4
junebug and stem

surfaces

parallel working ensemble of interactive surfaces integrated into daily habitual actions accommodating changing body location and position



surfaces

IN OUT

surfaces at various heights accommodate various body positions. these are computing devices with speaker, projector, key input, and electronic ink display surfaces. the surfaces can be used to work, play, eat, or sleep on. they have sensors imbedded in them, so as you move from one to the next, whatever is engaging you at the moment also moves.

stand 5
surfaces

shakers, quill and ink

multiple new means for personal invention and language creation



shaker

IN

shakers are hand held key devices that allow you to input with your arms in an unconfined position. they are wireless touch sensitive keyboards that are networked to surfaces. they can be taught to recognize you own gestures.

quill and ink

IN

quill and ink recognizes your hand writing through the establishment of a coordinate point, letting you work out your thoughts on a sheet of paper.

stand 6
shakers

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