Collective Space in Support of Education

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Submitted to the Department of Architecture
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ABSTRACT

Over the last two hundred years formal education has developed into a major component of modern society. It is seen as the training of individuals to be free-thinking, contributing citizens. Education has also been touted as the best way to solve many social ills. It is related to improving health, employment opportunities, racial tolerance, and general improvements in the quality of life. Despite our hopes for formal education many of our schools are not meeting even our minimal expectations.

The fundamental question this thesis seeks to answer is: How can the architectural experience of a school reinforce the educational experience of the students as well as the school's value in society?

Before we can answer this question we have to ask: What is a good educational experience? While there are a wide variety of opinions in relation to this question, I propose that a good educational experience is one that is based on the natural educative experience of living life in a society. This I would cal l 'informal' education and involves five basic principles: *observation, imitation, instruction, experimentation*, and *discussion.* These five basic principles are best supported in a community. If this is the natural way that one learns in a non institutionalized setting, and if schools are an institutionalized abstraction of the larger society, then it follows that these activities should take place in the school setting so that education is effective in producing active creative citizens.

Based on the premises stated above this thesis seeks to test the following hypotheses:

1) A cohesive community needs to have a genius loci or "spirit of place" to operate. A necessary condition for a genius loci is a collective space. If a school is meant to be a microcosm of this larger society then it needs to operate as its own community. Therefore it needs a genius loci and a collective place for this genius loci to exist. A successful school should thus have the built opportunity for collective gathering.

2) The school cannot be isolated it must have built exchanges with the larger community so that the school's community is sustained.

3) If the school is the institutionalization of 'informal' education then the school must have a variety of spaces that will allow the five basic activities of 'informal' education to take place at a variety of size gatherings as they do in the larger community

4) The school's form should be non hierarchical but reflect democracy.

To test these hypotheses I have designed a small public high school in Cambridge, MA that not only functions as a high school but also provides a genius loci for the community through the built integrating of school and community functions. The site is situated next to Sonnet Park, which is heavily used by the surrounding, ethnically, racially, and economically diverse neighborhood.

The final goal for this thesis is to make an architectural proposal that creates a genius loci for this area and a genius loci within the school, both of which would reinforce educational potential.

Thesis Supervisor: Shun Kanda
Title: Senior Lecturer, Department of Architecture and Planning.

Dedication

This book is dedicated to the memory of David Huston (1968-1991) fellow carpenter and friend, and especially Matthew Scott Mason (1967-1989) My dearest friend and constant inspiration for finding the beauty and joy of this world.

Acknowledgments

I would like to first to thank my professors

Shun Kanda
Maurice Smith

All my comrades in thesis and also Bill, Fred and Pete for helping me finish,
Thanks to my Family for encouraging me.

Above all, I thank Kristen, who allowed me to go through this.
Without her I would only be a shell of my former self.
More than you know.

Finally to God, through Him, all things are possible.

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All photographs and Illustrations are by the author unless otherwise noted.

Introduction

The intension of this thesis is to answer the basic question asked in the abstract.

In chapter one I discuss the need for a change in educational attitudes and my proposed out look based on the philosophy of John Dewey, the writings and exemplary work of Deborah Meier and my own experience and philosophies. In chapter two I present the argument for the need for genius loci and collective form to create a good learning environment. In chapter three I discuss architectural issues that reinforce the ideas of collective form and schools in society. Having presented the need for collective form the next two chapters present how one goes about generating collective form. I propose two principles of form generation and their philosophical foundations. Chapter six then follows with built examples of these behaviors. Having laid out the theoretical background for my approach to designing a good school, I will go through the process which I used to generate my design proposal for the site in Cambridge, MA. This design is the answer to how architecture can reinforce the educational experience of the students and the school's value in society.

CHAPTER ONE: Architecture and Education

1.1 The Need for Change in Educational Attitudes

Over the last two hundred years, formal education has developed into a major component of modern society. It is seen as the training of individuals to be free-thinking, contributing citizens. Education has also been touted as the best way to solve many social ills. It is related to improving health, employment opportunities, racial tolerance, and improving the quality of life. Unfortunately the reality is that many of our schools are not living up to any of these goals. While some schools do provide a reasonable education to prepare students for society, many schools, especially those in the inner city, do not. Poor funding is one major cause of this disparity. Most of the money for schools comes from property tax, and poorer communities tend to be populated by minorities. Thus it could be said that this disparity between "equal" public schools is actually reinforcing racial and class segregation. While funds are a major problem, I believe that money is not the root of the relative problem with education today: it lies in our fundamental philosophy and approach to education.

Education in the broader sense, is the transmission of shared experience and personal experience over time form older to younger members of a society. It is a way of sustaining our societies and cultures over time. Immature members become trustees of the society when they get older. Thus education is a fostering and cultivating process. In short, education is a natural occurrence in any group. It is the by-product of the process of life together and thus needs a community's continued interaction and support to survive.

There are five forms of communication that transmit the shared ideas, practices and beliefs of a culture, namely: observation, imitation, instruction, discussion and experimentation. These processes occur naturally and could be called informal education. Formal education is simply the act of being self-conscious of natural or informal education.

As a society becomes more advanced, more skills and information have to be communicated from old to young. The danger from this exists when formal education drifts away from informal education. When education just becomes the didactic communication of information and instruction of skills, it is separated form the larger community. If this happens it becomes increasingly difficult to foster creativity and participation, expose students to different values, beliefs and ideas or teach problem solving and critical evaluation. Formal education should be based on informal education. If this fails to happen, then education fails to be effective in creating citizens that can operate freely in our complicated society. This is largely our present situation.

In response to this situation my thesis will deal with the architectural embodiment of an educational philosophy that is based on the informal education in a community. While the success of a school will not be determined by its architecture, its form does reflect the atmosphere, values and philosophy of a school and should contribute to those ends.

The relative image and importance of architecture is a fairly good gauge of the values of a particular society. Usually the most prominent buildings embody the values of the community. They form the genius loci or "Spirit of Place", that enable meaning to be associated with a community. The cathedral is a building that reveals this. It also reveals the reality of shifting values in society, by its image now, as a historic building. The school has seemed to take a similar path.

Once viewed as the model as well as the ideal for society, it seems to now be a place to keep some social order. It is seen on the most basic level

as a place to control or to simply train the students. It is no longer an ideal for society. I believe that the school location and form communicate the value of education. The school should be one of the predominant focuses of a community and this should be reflected in its location, orientation and form. This idea of embodied value is not restricted to the image of the whole building but should reveal itself on a continuum to the smallest size within the building.

The form of the school building must start with the educational philosophy that one is trying to embody. As stated above I believe that education should be based on: observation, imitation, instruction, discussion and experimentation. Therefore learning takes place through phenomenological experience and not through the a priori. To this I would add that learning has to take place in a supportive, interactive and free community. Hence the form of a successful school should reflect these values. It should provide spaces for the activities necessary for learning. Its larger form should encourage communication and interaction within the school as well as between the school and society. This implies that the spaces should not be isolated but have spatial and or visual continuity. The values should be apprehended from the larger size down to the person size.

So the question that I am seeking to answer is:

How can the architectural experience of the school reinforce educational experience as well as the school's value in society?

To explore this question I have designed a small public high school. The public high school is usually viewed as one of the most prominent buildings in a community. It is usually a regional center that operates not only as high school but houses many community activities. High schools must accommodate after school programs, adult-ed at night, special events and weekend activities, all through the year. This varied demand also influences the design.

I sought to explore how the built form of the school and the building of connections between the school and the community, could reinforce its educational potential. The size of the school is also important. I have limited the size to 300 students. While this may seem very small for an urban high school, I believe is necessary for a good school. This based on my own experience and the work of Deborah Meier, in New York City. In her book, The Power of Their Ideas, she points out that a school of around 400 is the limit and 300 hundred the idea for maintaining a sense of community within the school. If the school grows larger than 400 students then a new school should be formed, even within the same school building. This is what Deborah Meier has done. She has turned around Central Park East, a once dismal school in Harlem.

The maintenance of a sense of community is essential for a school. If there is a strong sense of belonging to a larger group then the individual will also have a increased sense of responsibility for and accountability to the school. Then the individual will care what goes on and will want to be a part of it. In this case the student will care about becoming educated. This leads me to the discussion of the necessity of genius loci.

CHAPTER TWO: Argument for Collective Form

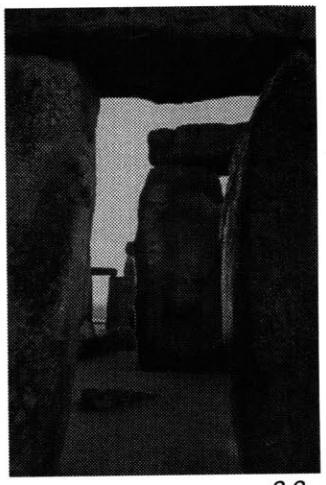
2.1 Genius Loci

As I have stated before education is a formal word for a fundamental function of life, namely the transmission of shared and personal experience over time from older to younger members of a society. The transmission of these experiences must take place in a relatively stable and secure community. One of the most important defining factors for a stable secure community is a positive genius loci in the minds of the members of the community for where they live.

Genius loci means 'spirit of place'. The term, as Norberg-Shultz writes of it, is a way of naming the feelings and thoughts that we associate with the natural and built world. Everything has some sort of genius loci which can either be positive or negative. We experience different genius loci everyday from the seat we choose at the coffee shop to the place we choose to live. We are constantly aware and making judgements as to how we want to relate to the physical world.

For a collective genius loci to exist two fundamental things must be present. One, the genius loci must be define by a group or community, it cannot be defined by individuals independently. Second, there must be a physical place that is the embodiment of the genius loci. The place that is chosen or built, will reflect the spirit and values of the community and the physical phenomena of the place. It is important to point out that the physical phenomena are independent of our will and thus have a life of there own. We can only take these physical facts and work with them to create the type of experience we want to help define our genius loci. Therefore we will never be the sole definers of our built environment. We must work with what is there and can never fully predict what will be the result of our building efforts.

2.1



2.2

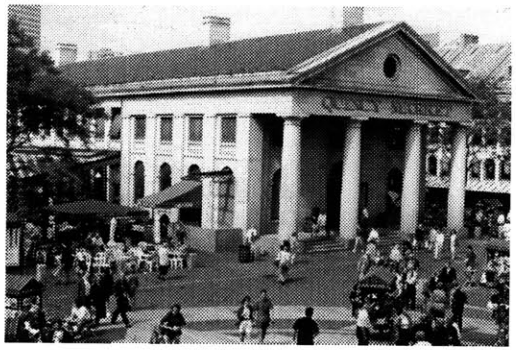
2.1 - Dolmen in northern Scotland
2.2 - Stonehenge

2.2 Collective Space

When we look at cultures around the world one of the most important ingredients for this genius loci is communal collective space. This collective space can take many forms but is usually a market place, park, religious building or political place. Collective space signifies interaction: it reflects our nature as social beings. In these places there is a sense of shared ownership, where we can feel free to inhabit. Most of the time when we remember the genius loci of city or town we think of its public collective places. This is no coincidence, for these collective spaces are essential to their genius loci.

How is this relevant to the form of a school? If we follow from the argument that the school is the institutionalization of informal education which happens in a community, then a school is really the institutionalization of the whole community. In other words the school is an abstraction of the larger community. If this is true then certain things must be true of a school.

First the school must be a community in and of itself. In this case it is the community of learners and instructors. Second, the ingredients that are necessary for a larger community must also be necessary for a school community. One of the most important of these, as mentioned above, is the need for a positive genius loci in the form of a collective place. This collective place should be the area where every member of the community can feel partial ownership. It should be a place in which the whole school can gather together and see each other to be aware who is part of the school. If everyone knows each other then the sense of belonging to and ownership of the school will be reinforced. The lack of awareness of ownership and belonging to a school inhibit the student from understanding their importance as well as the importance of their school as an institution.



2.3

2.3 - Quincy Market Boston. This is a place that has a very strong collective genius loci for Bostonians as well as visiters from around the world.

2.3 Relation to Larger Community

Obviously the description of the school that I have set up is not complete. Not only is the school a microcosm of the larger community, but it is part of the what makes the larger community. In many suburban communities the only two public collective places are the school and the shopping mall. In this case the school plays the dual role of being microcosm of the larger community and a center for that community.

Therefore the school building itself must have two necessary ingredients. One it must have a collective place for the school community defined by the schools privacies (e.g. classrooms, offices, bathrooms, etc.) and second it must have territories that are shared with the larger community so that it is still an integral part of that community. The school becomes a strange breed of building. It is a microcosm of the larger society and at the same time dependent on the larger community to be that microcosm. Obviously students will be apart of both the school's community and the larger societal community. But for the school to be a successful educational institution it must have enough of the behavior of the larger community so that when the students graduate there is a clear connection between the skills and knowledge learned in school and its relevance to situations in the larger world. It seems that if the school just teaches information then the student must find his or her own way in applying that information in an evaluative way. If this is true then the school fails in its most basic mission that of preparing students to be contributing citizens. In fact the school itself might potentiality be a hinderance for this mission because it could take significant time away from the learning outside of the school; which may seem more relevant to a student's survival later in life. This could be an explanation as to why students drop out of school. They do not see the relevance of the education because the education that is

taught is so removed from the larger societal community.

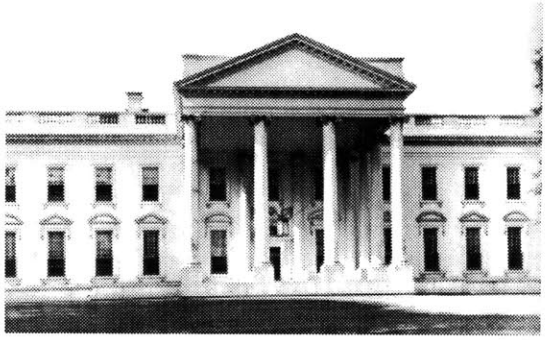
Architecturally there must be a built integration between the school and the larger community. This could be created by the formation of shared spaces and visual accessibility. First there should be territories in the school that are used by both the public as well as the students. These could take the form of a shared theater, library and media center, a cafe, restaurant, retail or even housing. Besides these programmed shared spaces it would be good to build informal spaces where the students and the general public could meet. Second by using a vocabulary of building that allowed for visual accessibility between the inside and the outside the connection between the school and the community would be reinforced.

Creating a school building that had these spaces and functions would allow informal and formal learning to take place between the students and the public. Outside dance and theater companies could teach classes and run shows in which both students and the general public could take part. Meetings between students and the public could happen in the library, media center, cafe and gym. Students could run the media center, library and cafe providing the opportunity for the students to teach and assist the public.

Having explicit integrated functions and visual continuity would cause the school to be valued by the larger community and the students. The larger public would view the school as having a positive genius loci. In this way they would value the school because they would feel partial ownership. The sense of ownership would bring with it a sense of responsibility. The students would be the ones who ultimately benefit from this sense of genius loci. The integration with the community would send a clear message that they and the institution of the school are valued in society.

Therefore the school building itself must have two necessary ingredients. One it must have a collective place for the school community defined by the schools privacies (e.g. classrooms, offices, bathrooms, etc.) and second it

must have build exchanges with the larger community to maintain and support its symbiotic relationship with the larger community.



3.1

3.1 - The White house (Benevolo). This is an example of a building that is referencing classical Greek architecture to validate it as a public building of democratic government.

CHAPTER THREE: Supporting Architectural Issues.

3.1 - Democratic Architecture.

The idea of assigning a political or social label to architecture seems a bit far fetched. But like anything we can evaluate architecture politically even though on the surface it may seem irrelevant. If we do choose to venture into such a realm of thought the first question that comes to mind is, does architecture embody the values of a society? Without getting too far into this question I will simply assert that architecture does embody these values. Architecture in one sense embodies meaning. We just have to look at any culture to see this reality. The great cathedrals of Europe say to us that Medieval Europeans put a great deal of time, money and energy into their religious buildings thus saying to us that they value religion. The form of the impossibly towering arches and radiant stain glass windows speak to us of a people who aspired to create architecture that reflected their love and awe of the devine. The palace as a residence of an King or Queen is another example of embodied value. The form and grandeur of a palace reflect a monarchal system of government where all the money and glory are devoted to the one person or family.

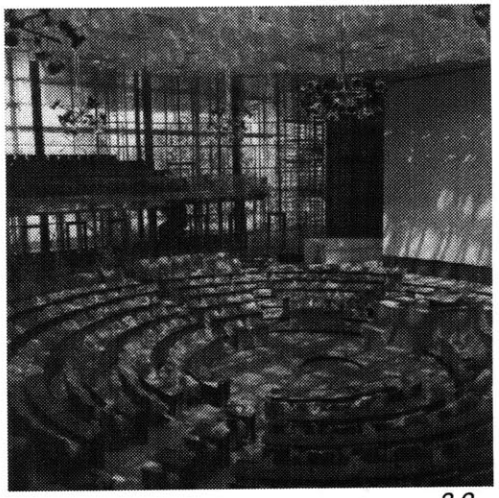
Many examples such as this illustrate embodied values. The question we can now ask is, What kind of architecture reflects democracy? Before we can answer this question we should ask, what is democracy? The values of democracy, at least for the United States, are spelled out very clearly in the

Constitution. We all know that, life, liberty and the pursuit of happiness are inalienable rights. But one of the main values of democracy is an open and free society. One in which citizens are not oppressed in any form. This is the ideal at least. Some of the implications of this are freedom of information, equal access to all public realms, and a government in which each person can have a voice. All of this seems fairly obvious to anyone who lives in a democracy, but what type of architectural form reinforces these ideals?

The traditional 'democratic' civic buildings of the United States borrow heavily from classical Greek and Roman architecture. This was and is done in an attempt to evoke authority and control through historic associations with architectural symbols of power. While we are familiar with the effect of authority these buildings generate, we must ask, does the form of such buildings reflect openness of government, access to information and inclusion in public spaces? I would say not. These buildings in general are closed in form and material, and do not allow easy access either physically or visually.

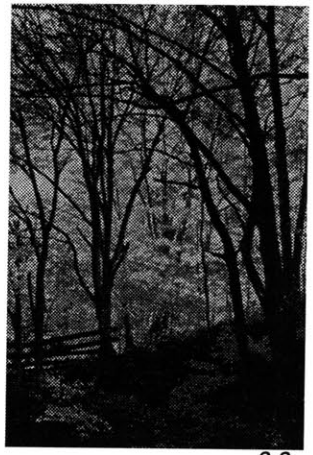
It seems true that a building that embodies democracy should reflect the above mentioned ideals. I posit that the architectural form of a 'democratic' building should have visual as well as physical access. Visual access could take the form of glass and physical would take the form of built exchanges between the landscape and the building. Some examples of this "democratic" architecture are Behnisch's design of the Bunnstag in Bonn, Germany, and Louis Kahn's Parliament buildings in Pakistan.

As I stated above, I believe that an ideal educational system would house a democratic philosophy, breaking away from the didactic and reaching for an integrative system. Thus to honor the integrity of the building, democratic architecture must be employed. Schools should be created as buildings where there is visual and physical exchange creating a positive genius loci and thus a sense of value while embodying the philosophy of the school.



3.2

3.2 - The Bunnstag in Bonn, Germany by G. Behnisch.
The Bunnstag is an example of a building that is attempting to define a new way of embodying democratic ideals, through the use of glass and screen to establish visual accessibility.



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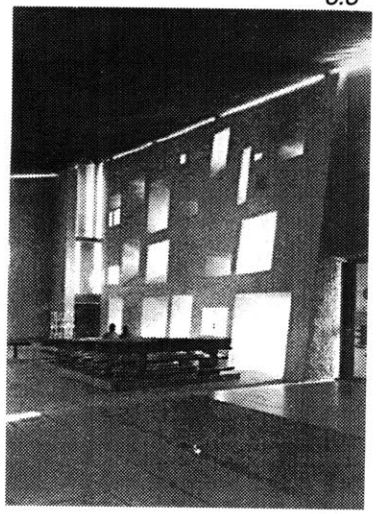


3.4

3.3 - Trees as an example of light and screen.
3.4 - Ronchamp, by le Corbusier (Palazzolo). This is an example of the power of built light.

3.2 - Light

When we start talking about glass as a way to reflect openness and democracy then we are talking about light. Light has always been one of the major defining elements of architecture, but since the advent of new lighter building materials and thus the beginning of the modern movement, the manipulation of light has been of primary focus. Light is now seen as a major component of defining different types of spaces. Larger open public spaces are usually defined by the size of the space and by having ample light. An exception to this would be a place of worship. While the space may be described as being a larger public space, or a space for gathering, it is also a space for ritual, ceremony, and personal contemplation and/or prayer. Many times these activities are defined by a highly refined control of light and not just its availability. We can look to almost any culture in the world to see this. Cathedrals and Mosques both have highly refined uses of light. Modern designers such as Le Corbusier, Alvar Aalto and Levidska put a great deal of energy into the control of light to create solemn but awesome spaces.

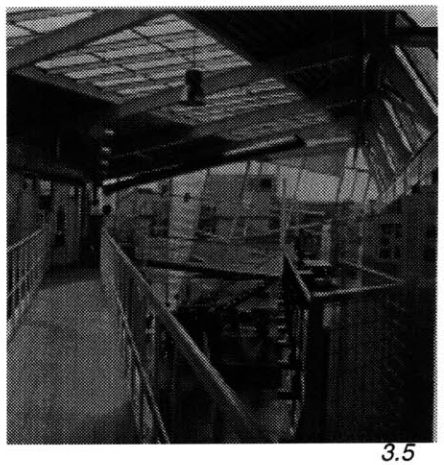
Light also helps to define movement. In general we all desire to be in or in proximity to light. We move with it or toward it, and as stated above it helps define public places.

3.3 - Tectonics and Material

Along with the championing of the use of light the modern movement also took a new approach to the use of materials and tectonics in architecture. The modern movement sought after authenticity. This search was in part a rejection of the enlightenments assertion of certainty in an increasingly uncer-

tain world. This search for authenticity resulted in a dilemma over the use of ornament in architecture. Ornamentation can be described as inauthentic because it is by definition something added on for only the purpose of aesthetics and has no structural or spatial properties. It was thus seen as inauthentic and thus unnecessary if not reprehensible. A new approach was generated to deal with the issue of ornamentation The only accessible ornament was seen as the result of the use of materials and tectonics or structure in an authentic way. Thus the joint of structural materials coming together would be an acceptable 'ornament'. While this goal may seem respectable it is ultimately impossible to satisfy. Because architectural designs are so multivariate with so many possible authentic solutions choices are often based on aesthetics.

In relation to creating a school in which the architectural experience contributes to a good educational experience, I have taken the approach that the school building itself must be as educative tool. This implies that it must be authentic in revealing it's nature. It is a building, and thus has the potential of teaching about how buildings are made. Therefore I believe that the building must reveal its different systems in a way that is discoverable. This does not imply that it must be a simplistic building, on the contrary, a more complex building would have more to teach.



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3.6

3.4 Screen

A subject that relates to both the architectural concept of light and to tectonics and material is that of screens. Screens are basically any element that filters light. Filtering can range from the most minimal like a row of columns, to something as dense as a jungle canopy. The concept of screening in architecture is important because it enables us to perceive light. We can see

3.5 - Interior of Hysolar by G. Behnisch. In this example material and tectonic expression are revealed and used to screen light.
3.6 - Maurice Smith's camp in Maine. An example of built light through the use of structure and screen.

light directly by looking at a light source like a candle. This is not so easy when it comes to the sun. We perceive sunlight through its reflection off of objects. Screens activate light by reflecting and casting shadows to generate contrast. I would call this 'building' light.

Earlier, in talking about democratic architecture I asserted that visual accessibility was necessary. This implies glazing but not just glass. Screening allows for visual access and also builds light. Screening would first be done by the structure of the building and secondly by secondary systems like partition wall, mullions and stairs. Even servicing systems like ducts, heating pipes and lighting equipment could be used as screening devices.

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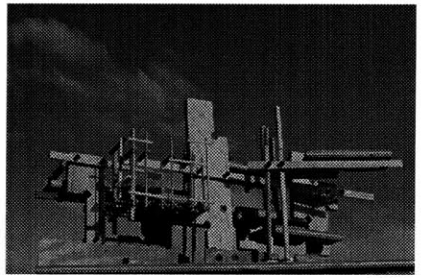


3.8

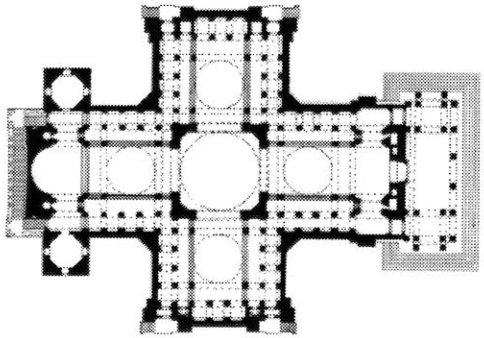
3.7 - Smith camp. The use of screen brings in light and builds a connection with the larger landscape.
3.8 - Collage. This collage was an attempt to build light through the use of structure and screen.

CHAPTER FOUR: Philosophical Foundations of Form Generation

4.1 Form Generation

I have discussed the importance of democratic architecture, light, tectonics and material, and screens, in school design. These give us a general attitude toward design but they do not inform us by what principles we generate the major formal moves of a buildings. How do we decide on the form of buildings? What principles and criteria do we use to create buildings that satisfy our desires and needs. I have stated that collective form is necessary for good education, but how do I define collective form and by what principles do I generate it? By what principles do I satisfy the four hypothesis that I laid out in the abstract namely (1) the need for a genius loci in the form of a collective space. (2) The need for built exchanges between the school and the larger community, (3) The need for a variety of use sizes within the school and (4) that the school's form should be non-hierarchical but reflect democracy? Natural conditions like climate and structural capacity put some limits on the possibilities of design but there is still a great variety of formal options.To satisfy these hypotheses and guide my design I have formulated two formal principles under a paradigm of form generation. I call this paradigm, *a posteriori* form generation. It is one of three that one can use to generate form the other two I have dubbed (1) *A priori* and (2) *Emotive* form generation. Before I go on to describe my principles of form generation it is important to lay out these three paradigms and why I have chosen the a posteriori paradigm to formulate my principles.

4.1



4.2

4.1 - St. Genevieve, Paris (Benevolo)
4.2 - Plan of St. Genevieve (Benevolo)
St. Genevieve was designed by J. G. Souflot and built in 1755. It is an example of how the ideas of the renaissance continued through to the classical period

4.2 A priori

The first paradigm of form generation is what I would call, a priori form generation. This paradigm is based on the premise that form is a priori or relatively independent of nature and is perceived through thought. If a person believed that form is a priori such as Plato[1] believed then they would use deductive reasoning to generate formal ideas and rules that govern them. This would be a basic closed system based on equivalencies such as mathematics. This is what Pythagoris did. He arrived at geometric laws based on tautologous relations between definitions of form. Thus we get a system of mathematics that in its ideal state helps us understand the world. But it is still an idealization of natural phenomena and does not always correspond to reality.

Renaissance thinkers took some of these ideas further. They developed the idea of perspective and perspectival space. It was not that perspective didn't exist before, but by naming and describing it they could manipulate it for certain desired effects. The idea of symmetry as being something that is universally accepted as good form was born out of this type of thinking. The idea of symmetry is not bad in of itself, but if it is always imposed on design solutions then inappropriate spatial relations may be created arbitrarily. The trouble is that in only using a closed system to approach to architecture one is inherently separating one's thinking from observation of the way we live in the natural world. This denies the possibility of arriving at new and better solutions to architectural problems. One way to get around this is by always allowing amendments to the laws. But what is the criteria for amendment? And

1. Plato believed that the realm of ideas is the ultimate reality. Ideas existed in the heavens as perfect and immutable, and took the form of spheres. Plato referred to them as 'forms'.

when does one apply the amendment? In general the trouble with applying a closed determinant system of thought to architecture is that architecture is multivariable and indeterminate

4.3 Emotive

The second paradigm under which architectural form is generated is based on emotive response. Under this paradigm one simply uses one's intuitive emotive response to design. This paradigm can seem compelling at first but soon reveals its denial of fixed criteria. This implies that there is no system but complete relativism. If two people choose the same form then it is because they share similar sentiments not because there is a common language of form. This type of form generation is what creates much of what we would describe as ornamentation. Ornament has nothing to do with the main purpose of a building namely that of providing shelter and territories in which different uses can take place.

In casting a negative shadow on this type of form generation I do not mean to deny the aesthetic aspect of architecture. I believe the every aspect of reality has an aesthetic aspect, from a physical object to the spiritual. This being true it would be a self-deception to deny that architecture is inherently aesthetic. The only problem is that if one uses the aesthetic as the way to generate form then one runs the risk of forgetting the more fundamental aspects of form generation in architecture namely space and light according to use. In short, the fundamental aesthetic of architecture comes from the definition of space through the use of structure, enclosure, and the manipulation of light. If these are forgotten for the manipulation of finish and ornament then one will constantly run the risk of creating buildings that have little to do with how we live but merely reflect our taste.

4.4 A posteriori

The third paradigm of architectural form generation is based on the recognition of existing formal behaviors. The recognition of formal behaviors comes from a posteriori observation of the way we live, the conditions we live in and the physical phenomena of the world around us.

If we look at ourselves and the universe in terms of form we would first say that we are of intermediate size. We are somewhere between sub-atomic particles and cosmic bodies. Cosmic bodies and sub-atomic particles an all that falls between, operate under certain laws and have resulting forms that correspond to those laws. Cosmic bodies in general take the form of spheres at a given density because a sphere is the shape in which all the gravitational force would be constant throughout the volume. This is a very simple example of how form follows the forces of nature.If we look at the natural world around us we can see the result of these forces and conditions. We can see this in the way water flows in a river or in the way rock formations interact with the sea on the coast. We can apply this type of thinking to the way we live and inhabit this world. If we look at the way we live in terms of the physical forms that we choose to build (i.e. architecture) and the way we configure them together in communities (i.e. urban fabric) then we can begin to see certain behaviors arise. Architectural form is firstly determined by availability of materials and the physical limitations of those materials. Any material has a certain form based on its natural state, the way it is produced and the way it is assembled. The form of wood, because of its workability and spanning capability leads to certain frame like forms. On the other hand brick and stone, which can only be used in a compressive manner, result in walls, columns and arches.

Architectural is secondly determined by the physical conditions in which it is built. The form of buildings and configurations of buildings have

much to do with the climate and topography of the land. The last realm that determines the form of architecture is the human condition. Our beliefs, knowledge and traditions have a significant influence of the variety of forms that are created. Despite the variety that the human condition creates we should remember that the expression of our beliefs, knowledge and customs are limited by the physical conditions. Thus in different cultures we can find a range of similar formal responses to the same physical conditions.

Based on the premises stated above we can assume that these behaviors are the result of the natural forces of the world, the conditions we live in and our ability to respond to them.

This way of thinking about form generation is directly based on our interaction with the physical world, there in lies it's strength. This is not true of a priori or emotive form generation. If we are part of the continuum of the physical world it makes sense that we should base ideas of form on behaviors that display themselves naturally.

It would appear to be desirable to find laws of form generation, but this is not the case. To find inductive laws would mean making an exhaustive study of all the variables that go into form generation. This would be like creating a unified law in physics. A difficult task when you add traditions and beliefs of different cultures to the multiplicity of formal expression of physical phenomena.

There is also a danger in trying to do this. Creativity is based on the ability to perceive variations, new alternatives or different paradigms. This would be difficult within strict laws of form generation. Thus the use of the concept of behaviors is more desirable. In this way nominal behaviors can be used while allowing for exceptions based on other criteria like beliefs. Therefore the best way to approach form generation is by creating a formal language that is based on recognized attitudes to design and observed behaviors of natural and man made form.

CHAPTER FIVE: Formal Principles

The two formal principles that I have formulated under the a posteriori paradigm are: slack and exchange. I arrived at these two formal behaviors based on observing physical phenomena and through the analysis of buildings.

5.1 Slack Space

5.1

5.2

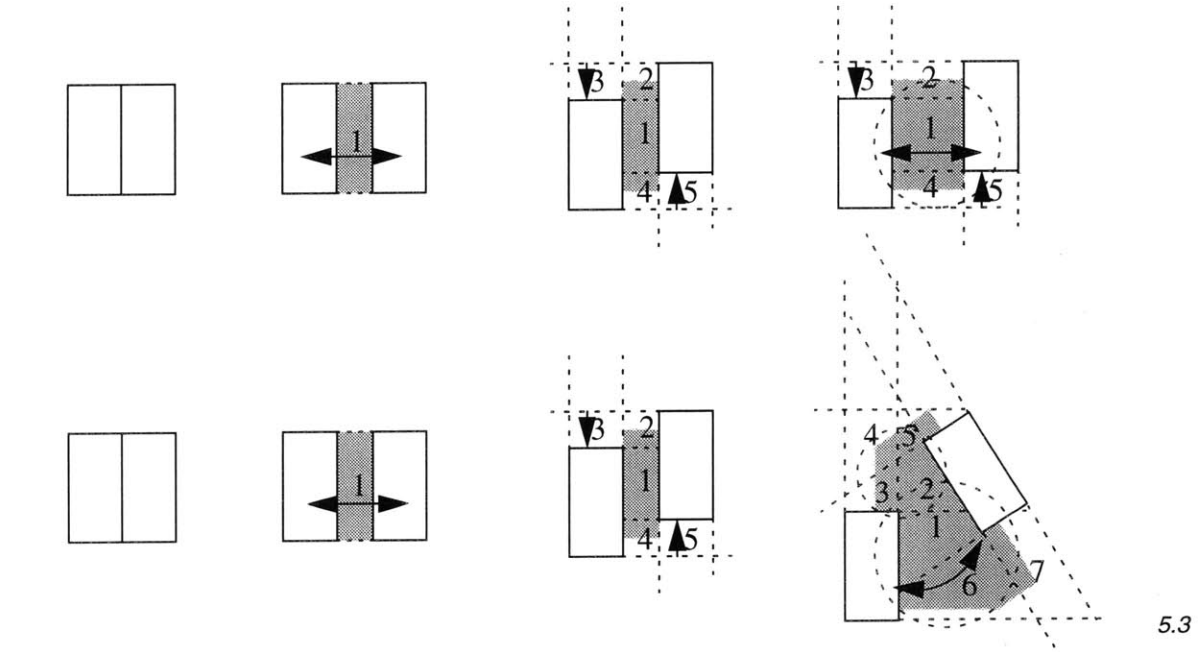
5.1 - Rock formation as an example of slack space
5.2 - Square off of Washington St. Boston. This is an example of slack space in a city which then becomes a public gathering place.
5.3 - Diagrams of slack space in plan.
5.4 - Diagrams of slack space in section.

Through the generation of slack or interstitial space the possibility of collective use is created. Slack space can be generated in many ways. It is the space created by the displacement in a dense packing of objects, edge defined volumes or units of some pattern. When a fracture or displacement of one or more object or units takes place then the space between can be defined as slack space. We can see this phenomena in many natural processes. If we look at a rock formation on a beach the fracturing of the rock creates space which builds a new type of relationship between the rock and the water, the rock and the air, and the rock and the light. The slack space that is created allows for tidal pools in which sea animals can live and inhabit. It also allows for light to penetrate into the rock which was previously closed. This is analogous to architecture. Slack space is the space between, and this space often provides the most natural and appealing atmosphere for habitation. For example, an atrium is created and defined by its surroundings buildings, as a place of both passage and habitation.

Slack space is a tool for creating collective form. Buildings that lack slack space greatly limit the possibilities for interaction with and among the inhabitants. As an extreme example the great pyramids in Egypt allow only one possible relationship between building and person, that of viewer (unless you are a grave robber or entombed). There is no possibility of habitation. There is no exchange.

In fig x slack space is generated through multiple displacements. In the last iteration the larger slack territories could be said to be gaining a collective size because it is larger than the enclosed privacy.

Slack



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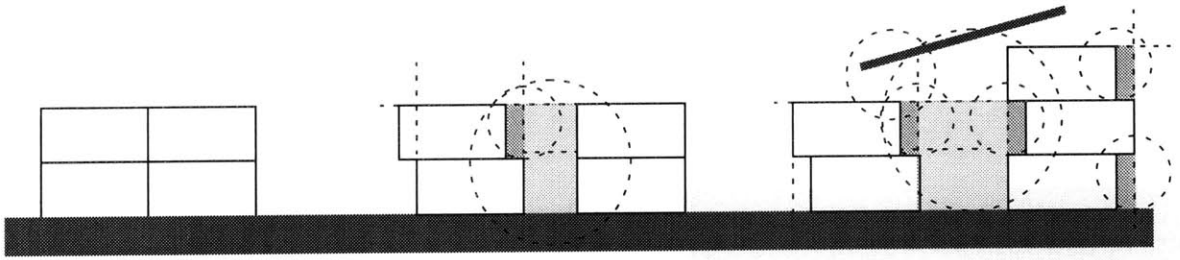


5.4

Slack in Section

5.5

5.6

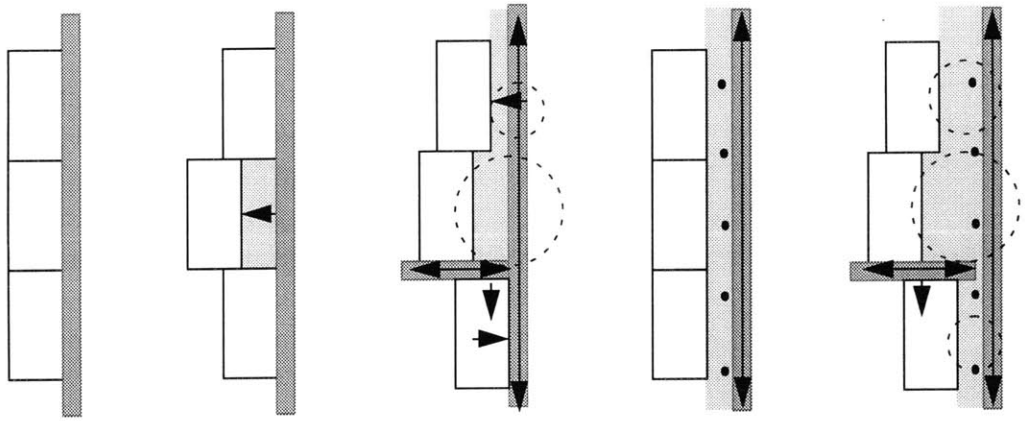
5.5 - Building along Mass Ave., Cambridge, MA.
5.6 - Street in Boston near Quincy Market.
Both of these buildings have zones of exchange with the street in the form of arcades.
5.7 - Diagram of exchange in plan.
5.8 - Diagram of exchange in section.

5.2 Reciprocal Exchange

Exchange is similar to slack. The main difference is that slack is created by the displacement of two objects, privacies or systems and exchange describes the relational behavior between two different territories. The principle of 'exchange' is simply the relationship between two different territories in which the two share a common area over which both have some claim and/or influence to varying degrees.

The principle of exchange is simply the relationship between two different territories in which the two share a common area. This new territory is an area over which both have some claim and/or influence to varying degrees. This behavior can be seen in the relationship of the building edge to the sidewalk. In fig. x the relationship of the building to the sidewalk is minimal or singular. One is either on the side walk or in the building. If we displace the building edge so that it recedes or so that it goes out a new territory is created. Here there is a space that is both shared by the side walk, in that it is continuous, but also out of the flow of movement. It is also claimed by the building to some degree as a space defined by building edges. This type of spatial behavior is prevalent through out the world. We see it in street side cafes. One can also define a shared territory through the use of structure. This is seen with the simple diagram of an arcade. Of course these are simplified versions and can be combined to gain further territorial and spatial definitions.

Exchange



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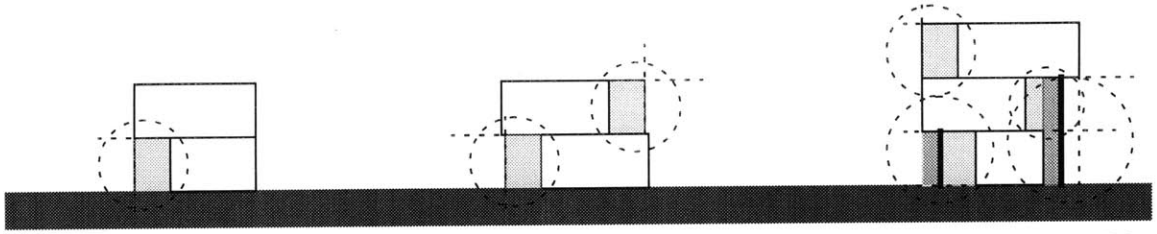
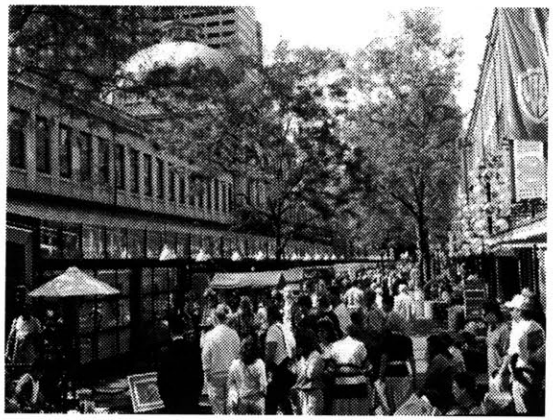


5.8

Exchange in Section

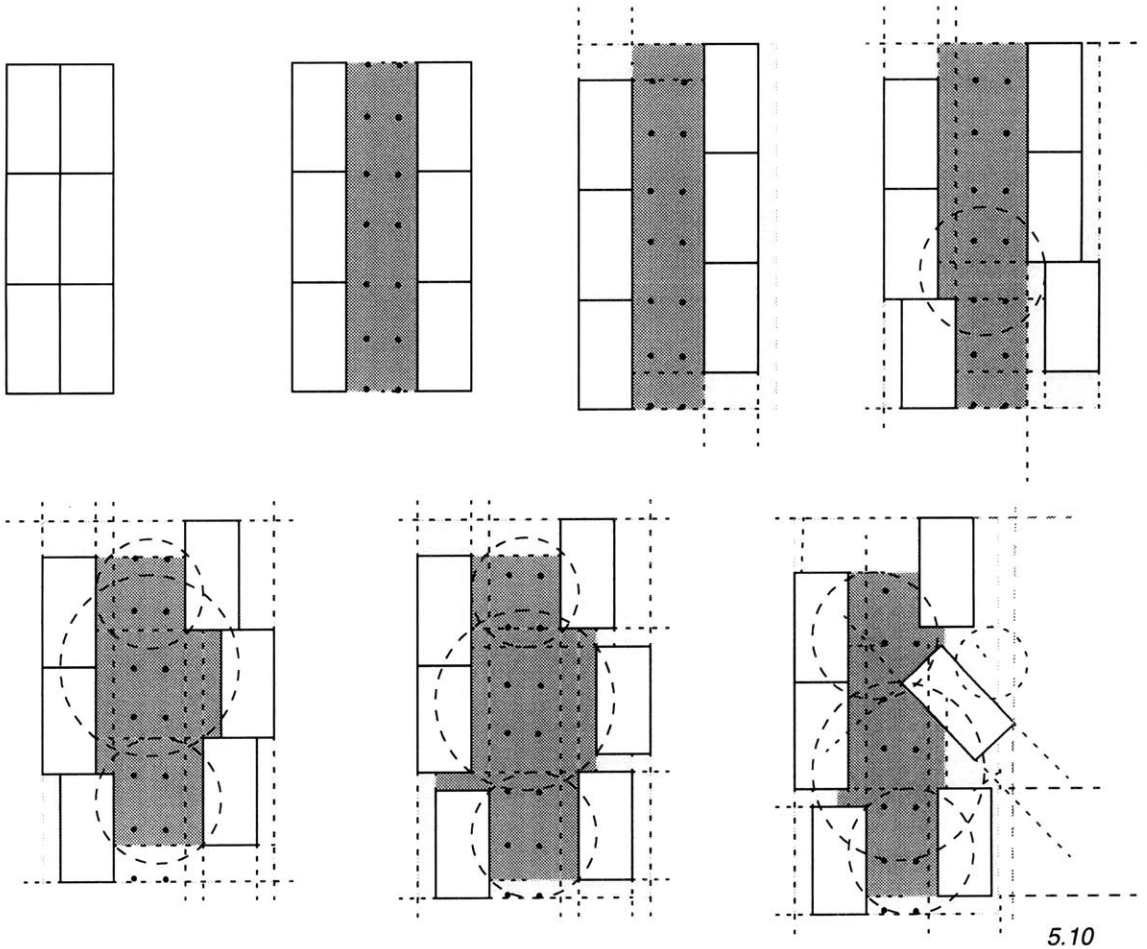
5.3 Built Collective



5.9

Built collective is the combination of the ideas of slack and exchange. If we take a closed form like the one in the diagram and transform it through a series of displacements we begin to not only generate slack space but zones of exchange. The exchange zones occur on the outside of the privacies as well as inside the slack space. As one can see zones of exchange can operate within slack space. This combination results in a multiplicity of territories and use dimensions. The number of territories can also be increased and intensified by the freeing of the structure in the space. The resulting form is that of a collective in the slack space between the privacies. This is a space that all of the privacies have access to and over which can claim some ownership. This space can then operate as a collective genius loci.

5.9 - Quincy Market, Boston. This is an example of built collective.
5.10 - Diagram of built collective in plan.



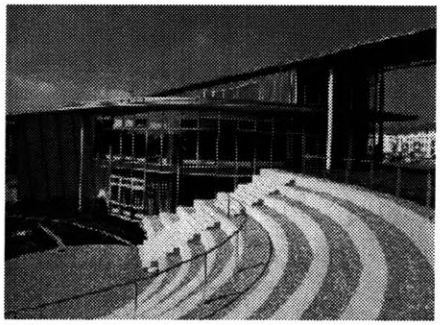
5.10

Chapter Six: Precedents

I have chosen a group of six precedents that display the principles of slack and exchange.

Auer & Weber

6.1



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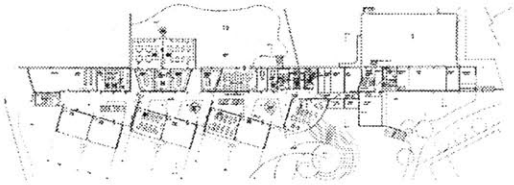

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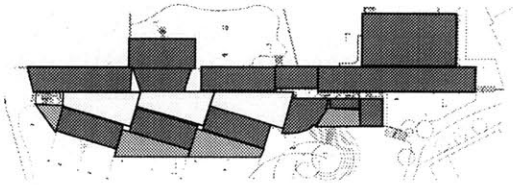
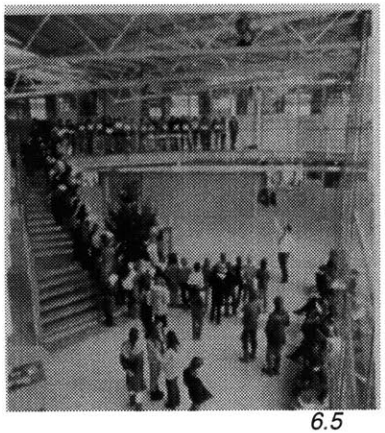


6.4

- Circulation
- Slack
- Exchange
- Privacy

Auer and Weber generate slack and exchange in the same displacement. They started with a basic double loaded corridor condition and by simply using one side as the registration they cranked the classrooms to generate slack. One the outside of the building this generates and exchange with the larger landscape. The fracturing of the corridor allows light to come in and generates a sectional exchange with the lower floors. Auer and Weber rightly placed the vertical circulation in this fracture.

Behnisch



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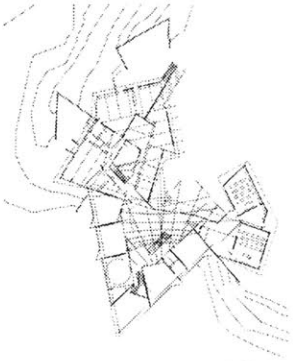

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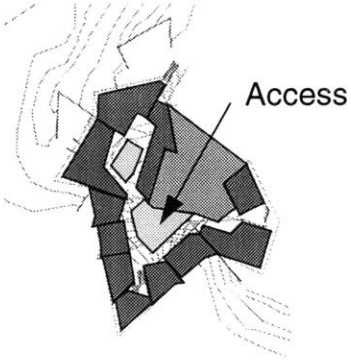
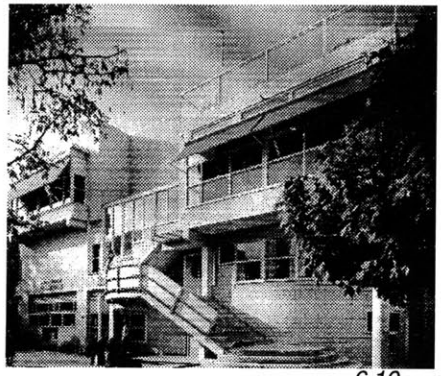


6.9

- Circulation
- Slack
- Exchange
- Privacy

The Lorch Secondary School is a compelling example of a collective space in the slack space of the school. Here we can see clearly that the classrooms or privacies are displaced to create a space that is many times larger than a classroom. This slack space then becomes the collective gathering space for the school. Zones of exchange with the larger landscape are also created. 6.7.

Hertzberger



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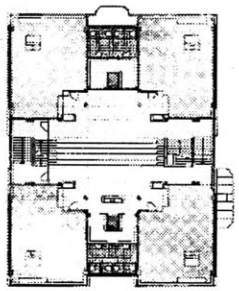

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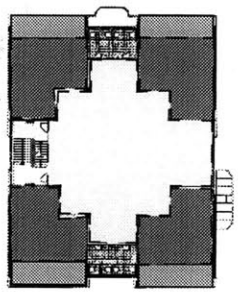

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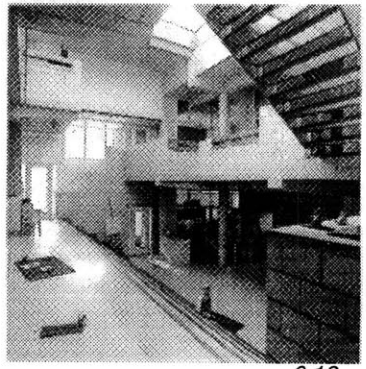

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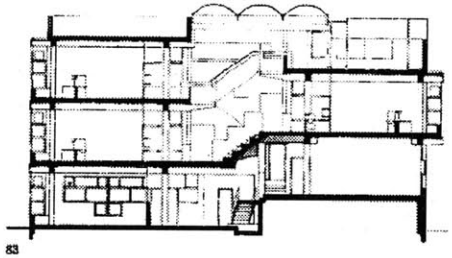

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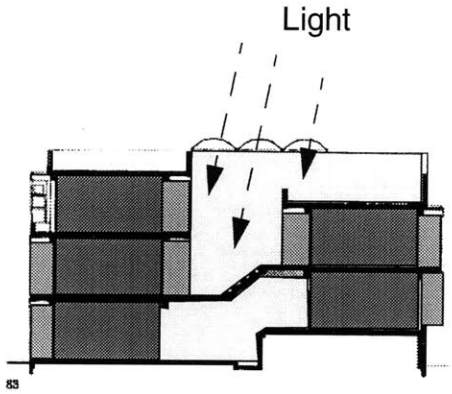
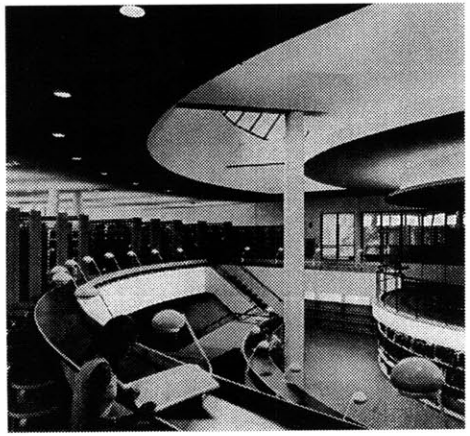


6.15

Circulation
Slack
Exchange
Privacy

In the Apollo Schools Hertzberger is trying to generated areas of slack for collective gathering as well as zones of exchange with the slack and the privacies, and the privacies and the outside. He is starting with a square form which makes his job a little more difficult. He is relatively successful in generating the slack space by a removal of the core of the building and shifting half of it in section. The removal creates the slack and allows in light, both of which help to define this area as a collective. The other positive move he makes is to shift the floor plates half a level in section. By doing this he create a small auditorium like space in the slack collective. The large stairs can then be used as seating for a gathering. I will also note that in plan the slack is also part of the circulation and adjacent to all of the privacies. Hertzberger also makes connections with the outside through the use of balconies.

Aalto



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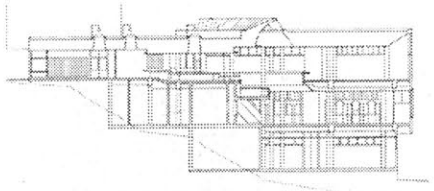

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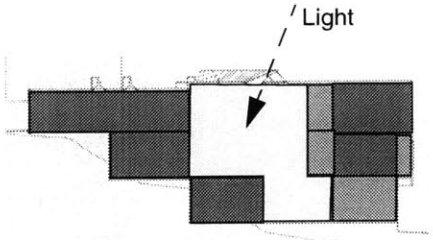

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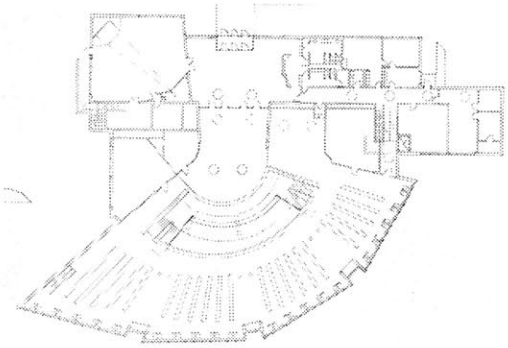

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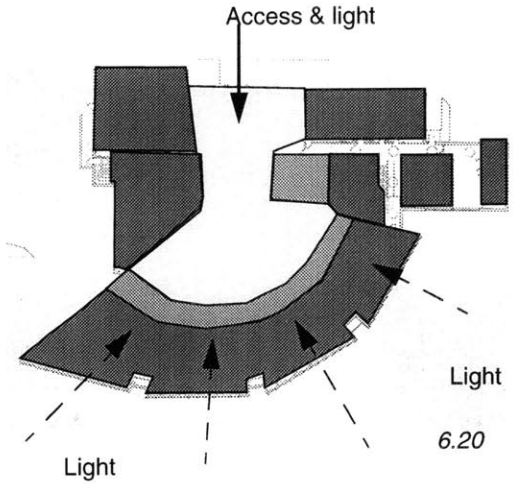

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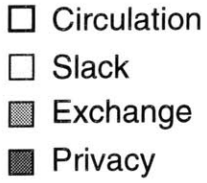
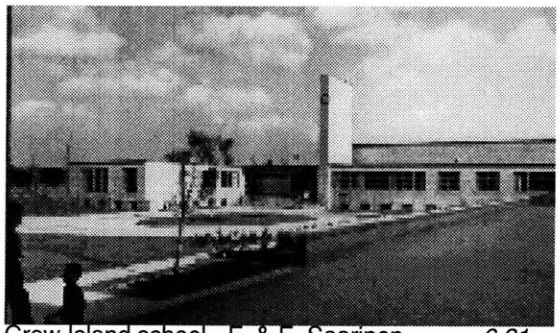
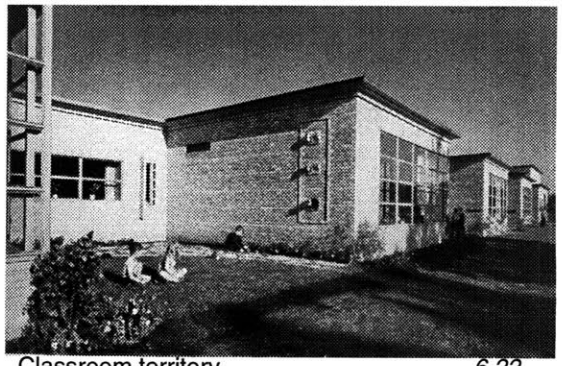


Aalto's Library at the Mount Angel College is an amazing example of the manipulation of light as well as a design that employs the use of slack space to generate a collective space that is used as the reading room. This space is not only present in plan but is built in section. It is the place where there is the most light as well as being a place where one can orient oneself to the rest of the building.

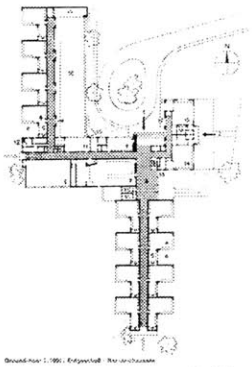
Saarinen



Crow Island school - E. & E. Saarinen *6.21*



Classroom territory *6.22*



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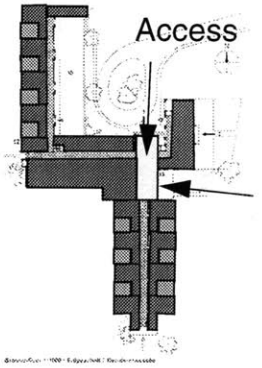
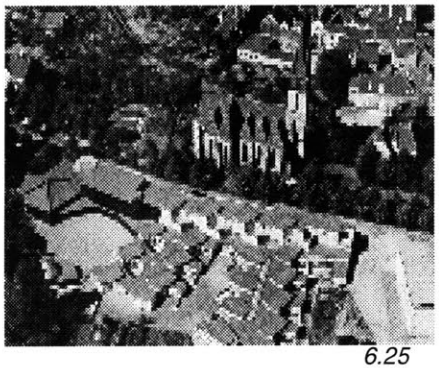


6.24

- Circulation
- Slack
- Exchange
- Privacy

Eriel and his son Eero Saarinen designed the Crow Island school in Illinois as an expression of modernist ideas. This new 'progressive' school was seen to been the new model for suburban schools, which it did become. In the plan we can see the effort to design each classroom with a strong relation with the larger landscape. Each classroom has a territory outside that is partially sheltered by the building form. This outside space is the same size as the classroom thus building the association that it is an outside classroom. The larger form of the school also partially contains a larger area where the driveway comes in. This is a larger area of exchange.The idea of slack space is not explored. There is only minimal area in the entry area.

Sharoun



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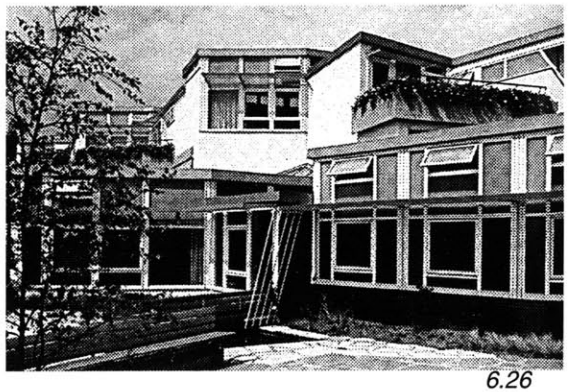

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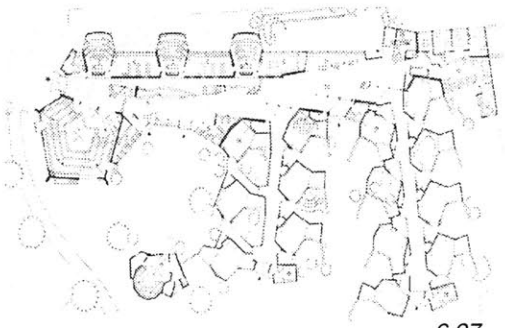


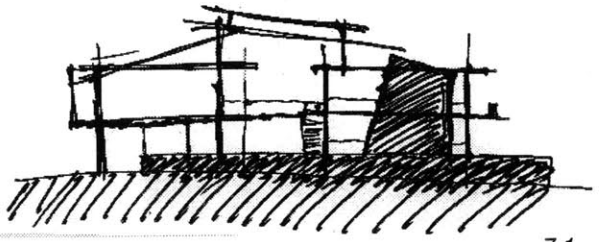
6.27

6.28

- Circulation
- Slack
- Exchange
- Privacy

In Sharoun's school in Germany there is both the use of slack space and exchange with the landscape. Similar to the Crow Island School by Saarinen, each classroom has a territory outside that can act as a sheltered play area or an outdoor classroom. The wings of the school also exchange with the larger site. Next to the auditorium on the left end of the building a large semi-enclosed area is created that could be a gathering place for the whole school.

CHAPTER SEVEN: Design



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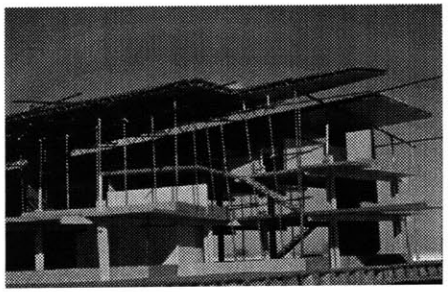
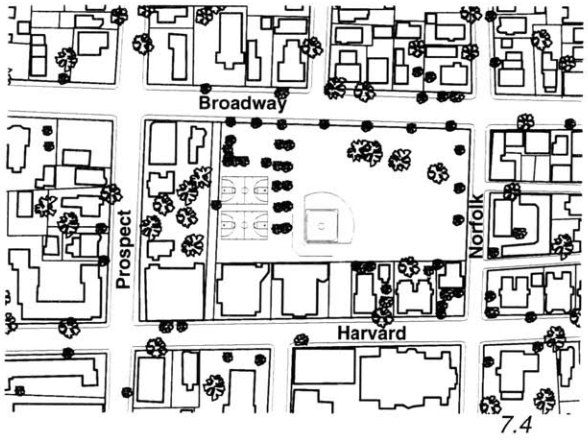


7.2

7.1 - Conceptual sectional sketch

7.2 - View of school, library entrance

7.3



7.4

7.3 - View of Sonnet Park from Broadway St. during winter.

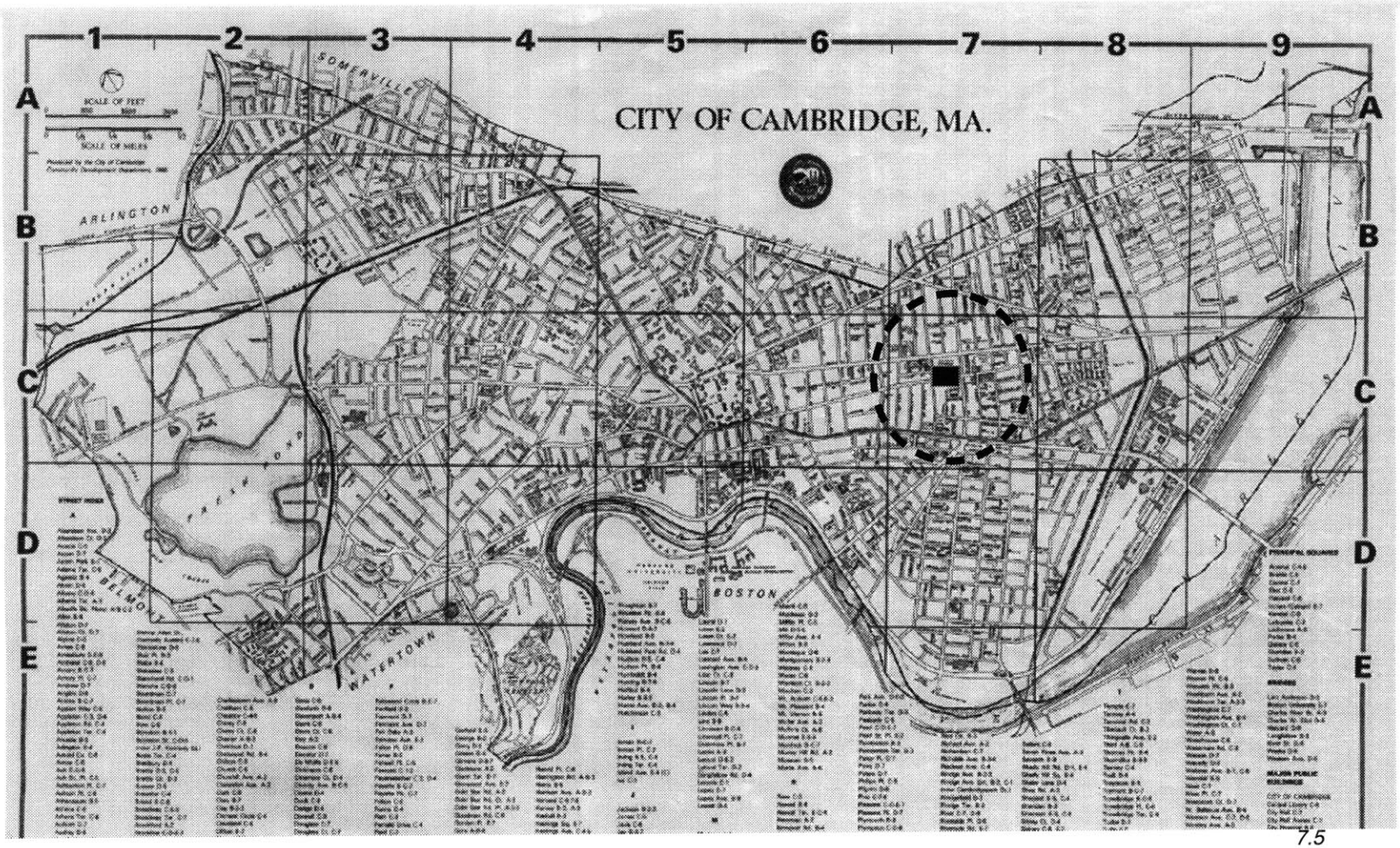
7.4 - Site map showing existing conditions.

7.1 Site

The site that I have choose to test my thesis is located in Cambridge, MA, adjacent to a park named Sonnet Park. This area of Cambridge is racially, ethnically and economically diverse. Sonnet Park is one of the few public areas in which these varied people interact. The park is heavily used through out the year. It is a public place in which every one in the area feels some sense of ownership and belonging. In other words in has a strong positive genius loci.

The streets that boarder the park have significantly different conditions (see Fig. 7.2 and 7.4). Broadway Ave. runs from the Longfellow bridge to Harvard University. It is a street that has many civic buildings along it. From this street one has the most direct visual and physical access. The buildings on the far side of the park from broadway are in prominent view. Unfortunately all of these buildings show us their service side.

Prospect St. lies on the West side of the sight. It is a relatively narrow but busy street. These two intersect at the north west corner creating a busy intersection. Harvard St. and Norfolk St. to the south and East respectively, are very quiet one way streets.

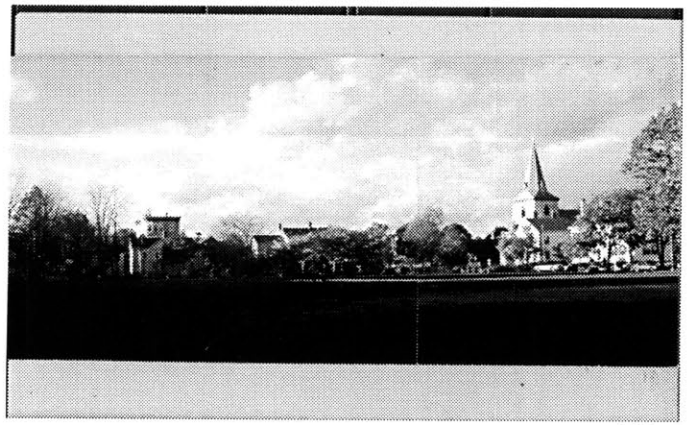


7.5

Harvard street is more heavily used of the two. It also has some very prominent churches and civic buildings near the park.(see Fig. 7.5) This area is an anomaly in the typical housing fabric. The public nature of this park makes it a good siting for a school.

On the site presently is a Youth Center,

7.5 - Map of Cambridge, MA showing site in relation to the rest of the city.



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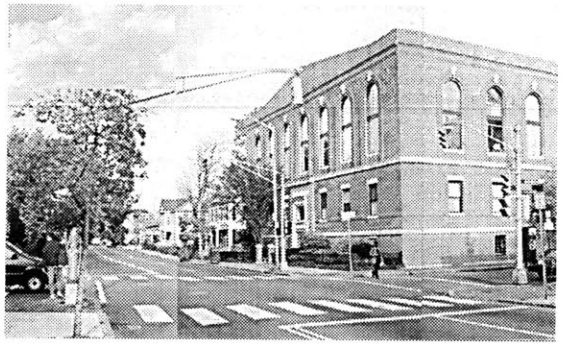


7.7

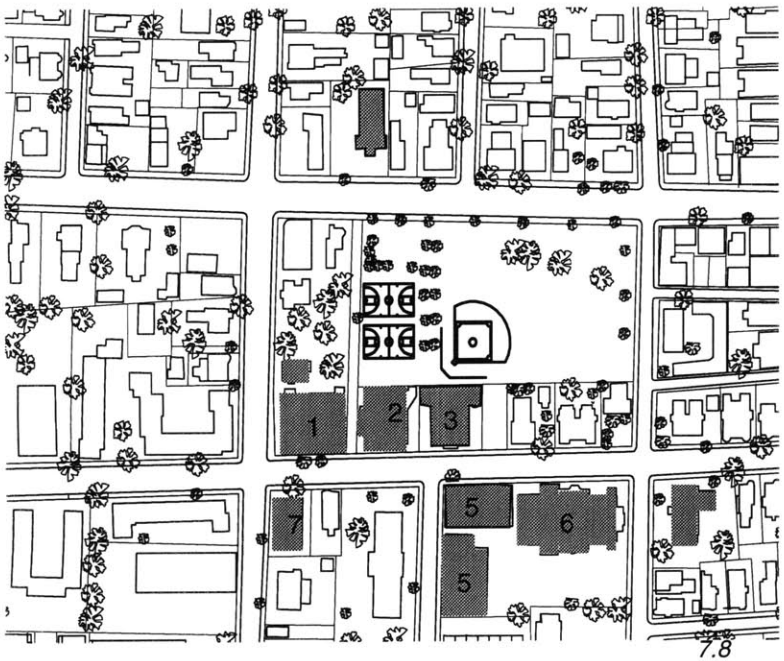
7.6 - Photo of site looking from Norfolk St. across the park.

7.7 - Photo of Existing Building at the corner of Prospect St. and Harvard St.

named Area Four Youth Center, and a renovated brick building. The youth center uses the whole park as an extension of its own facilities. This is one of the major reasons why I chose this site. The relation between the youth center and the park work very well. The site seems to be an idea place for a small school, because it shows evidence of being used well by a diverse variety of people from the surrounding neighborhoods. THe building of a school that has many community functions would only reinforce the whole site as a place of gather; a place that has a strong genius loci.

I am assuming that I am building this school before the youth center was built and before the community building was renovated. I am assuming this because it would be redundant to have a community center as well as a school with community functions. I am keeping the brick building because it has historical presence, and is a positive building on the site. The other buildings are just rundown houses and low commercial buildings.

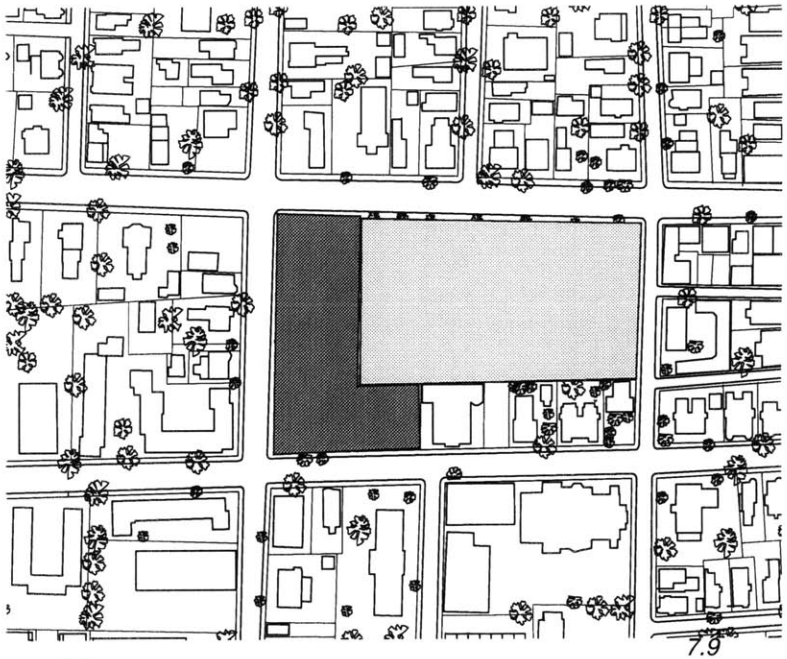
On Harvard there are a collection of community buildings. Most of them are associated with either St. Mary's Catholic Church or St. Bartholomew's Episcopal Church. St. Mary's supports a perocial school adjacent to the church and the community building that I am taking over was once a function hall for the church. obviously this area has had a long history of being a community locus. I am



7.8

Community Buildings

1 - Function Hall
2 - Youth center
3 - St. Bartholomew's
4 - civic building
5 - St. St. Mary's School
6 - St. Mary's Church



7.9

Park

Proposed Site

sitting the building in this area to capitalize on this fact.

7.8 - Site map showing community buildings.

7.9 - Site map of proposed site.

7.2 Program

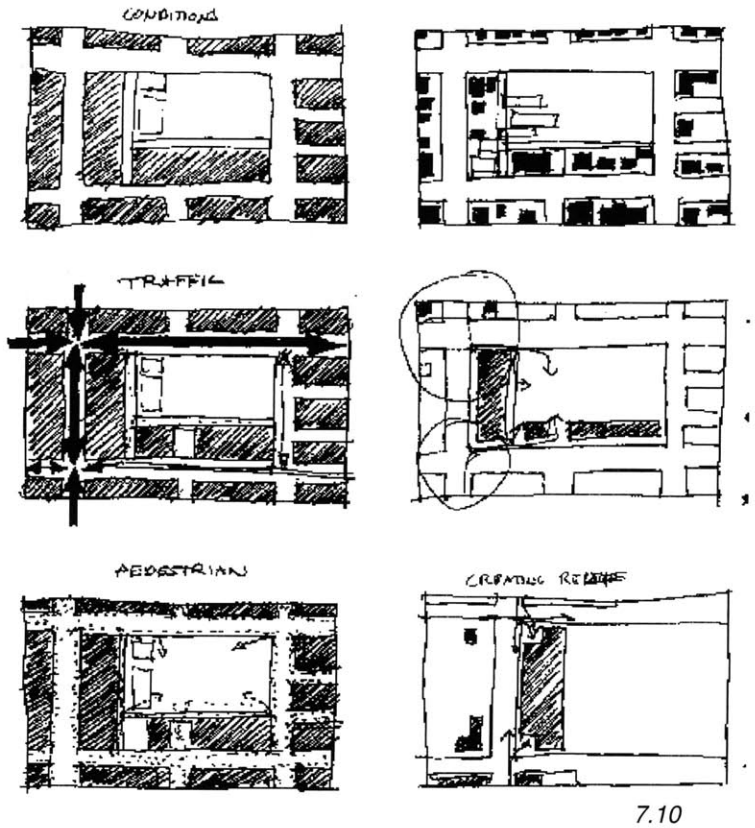
Administration		1000 sq.ft.
Teachers		2000
Classrooms		
	Physics	800
	Workshop	1800
	Art	1800
	Math computer	1800
	Literature/History	4 x 800
	Languages	3 x 800
	Music	
	Rehearsal	1600
	Practice	6 x 150
	Biology	2 x 1000
	Chemistry	2 x 1000
Building facilities		
	Collective Space	3000
	Kitchen	2000
	Bathrooms	6 x 300
Mixed use		
	Cafe/Gallery	1500
	Library	5000
	Theater	5000
	Backstage	1500
	Gym	12000
	Sub total	53,100
Mechanical 10% of 53,100		5310
Storage 3% of 53,100		1593
Circulation 20% of 53,100		10,620
	Total	70,623 sq. ft.

Program Attitudes

To make links to the community some building functions will have mixed use.

Theater - The theater will not only be used by the school it will also function as a community and or professional theater in which students will participate. It could also be used as a movie house.
Cafe/gallery - The cafe/gallery will be open to the public as well as the students. Students could also work and display their art work there.
Library - The library is a branch public library as well as the library for the school. The first floor is primarily for the public and the second floor is more in the realm of the school but they are still connected by an internal stair.
Media center - The media center is next to the library and is configured in the same way with public primarily on the ground floor and students on the upper floor. Again the floors are connected by an internal stair.
Gym - The gym would also be used during off hours for the public and students.

I imagine that these spaces are where most of the informal interaction between the students and the public could take place.



7.10

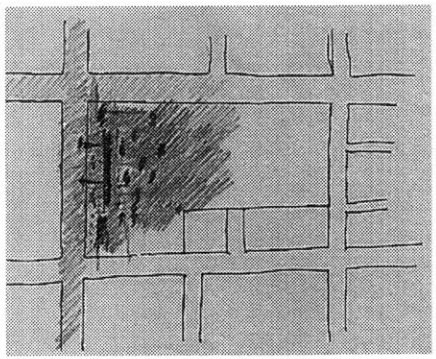
7.10 - Diagrams showing intensity of vehicular traffic and pedestrian movement.

7.3 Initial Design

Site Forces

As I have mentioned earlier, the site has very different surrounding street conditions. The most intense intersections are at Harvard St. and Prospect St., and at Prospect St. and Broadway St. These have a strong public presence. This is true of all of Broadway which runs the length of the park. The pedestrian traffic is also primarily along Prospect St. and Broadway St. but the access to the park is pretty much from every direction. This presents a difficult problem in the fact that it causes the site not to have a back or service side. Every side can be thought of as a primary path of movement. This is something I just had to live with in the design.

I wanted built exchange with the park as well as exchange with Prospect St. to make connection with the larger community. In my first studies I diagramed displacements along the direction of the site that fingered out into the park to achieve this exchange.



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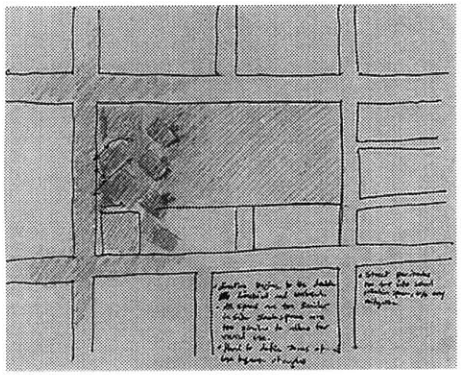

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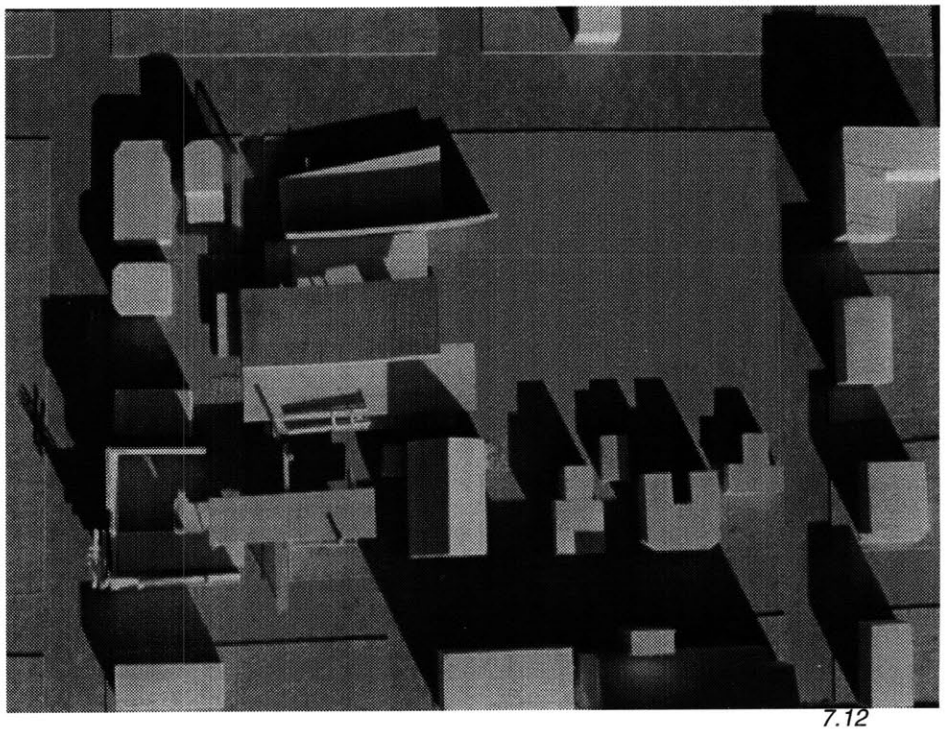
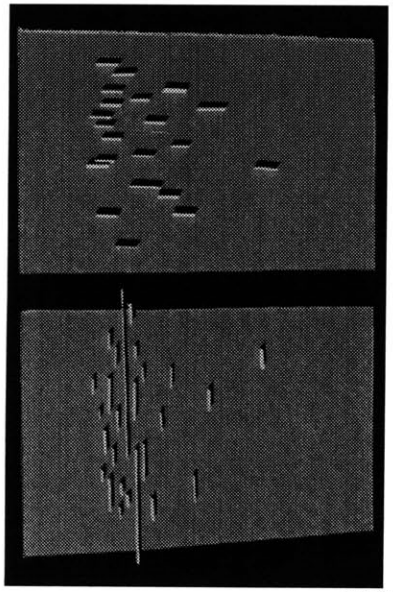


7.12

7.11 - Initial sketch of exchange with the park and with Prospect St. Through displacement.

7.12 - Variation of exchange through displacement and rotation.

7.13 - Early Model trying to build an exchange with the park. In this case the building is too isolated form Prospect St. and too intrusive to the park.



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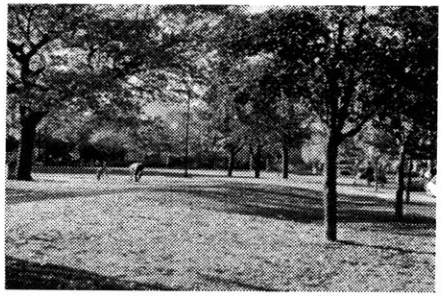

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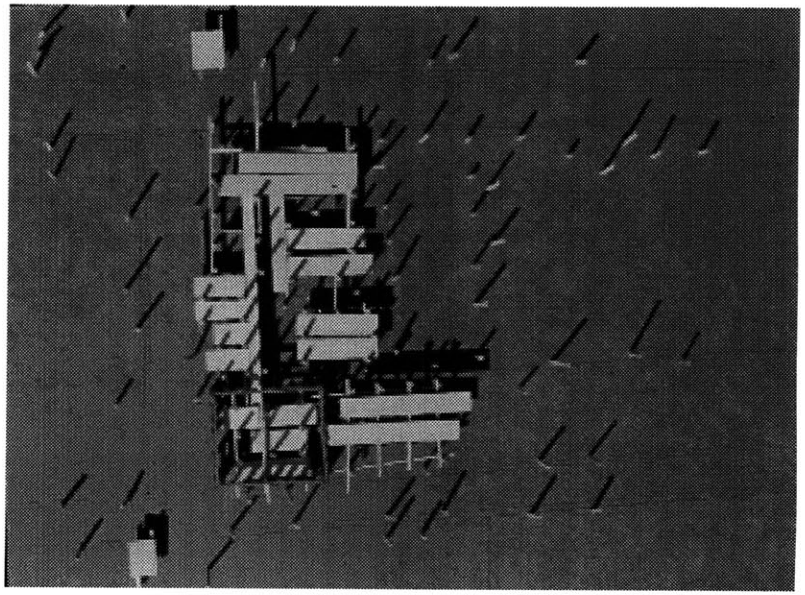


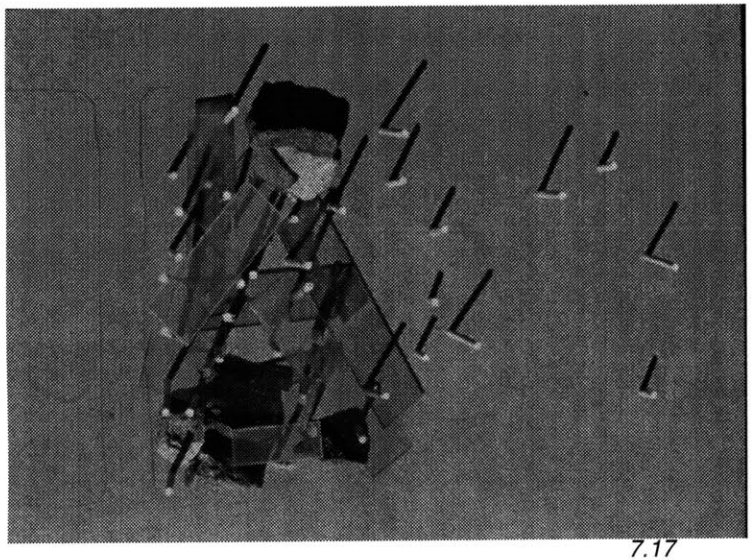
7.16

The natural landscape besides form providing empirical information for the basis of behavioral generalizations, also gives metaphorical inspiration. The trees on the site and in the surrounding area have a pronounced and positive presence. Because of my desire to work with integrating the building with the site in a reciprocal manner I decided to extend the reading of the trees into the structure of the building. The trees provide a good reference in the fact that they are good examples of light structures that support a canopy of screen in the form of branches and leaves. Some of my first gestural explorations of the building was to interpret the brick building as a rock and the rest of the building as built of trees and

7.14 - Conceptual model of directionality on the site.

7.15 - Photo showing the trees in the park from which I took reference.

7.16 - Model 1"=100'. This model is expressing the intension of having the structure of the building appear continuous with the trees.



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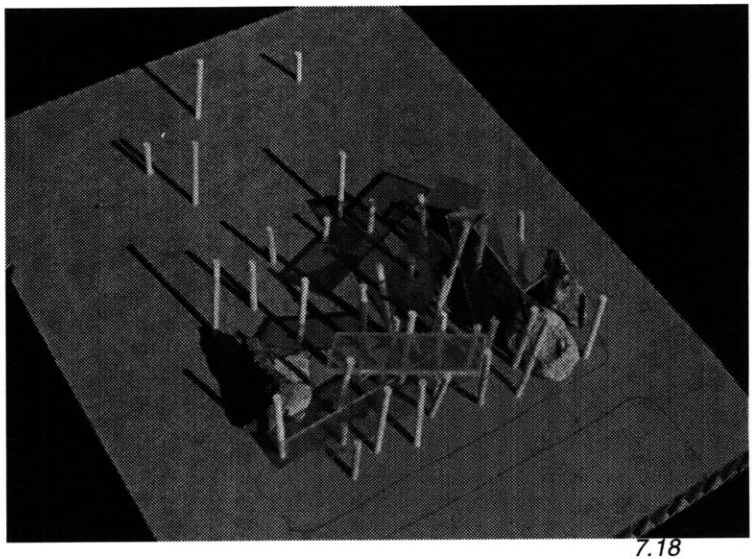
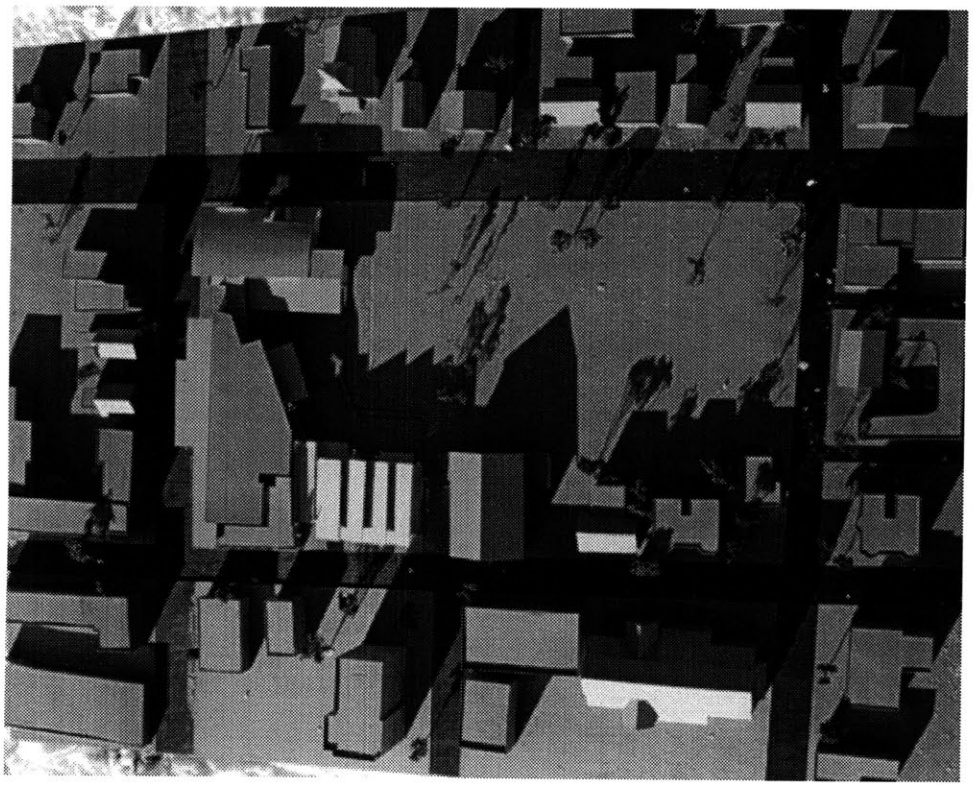


7.18

canopy. In these models I wanted to communicate the attitude of transparency and openness that I wanted in the school. I also fractured the rock of the brick building to show that the new attitude of openness would be dominant despite the need for some protection and privacy for the school.

7.17 - Conceptual model of the building as trees canopy and fractured rocks. Plan view.

7.18 - Same as above angled view.



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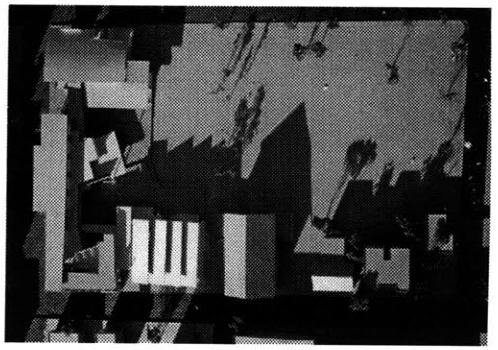

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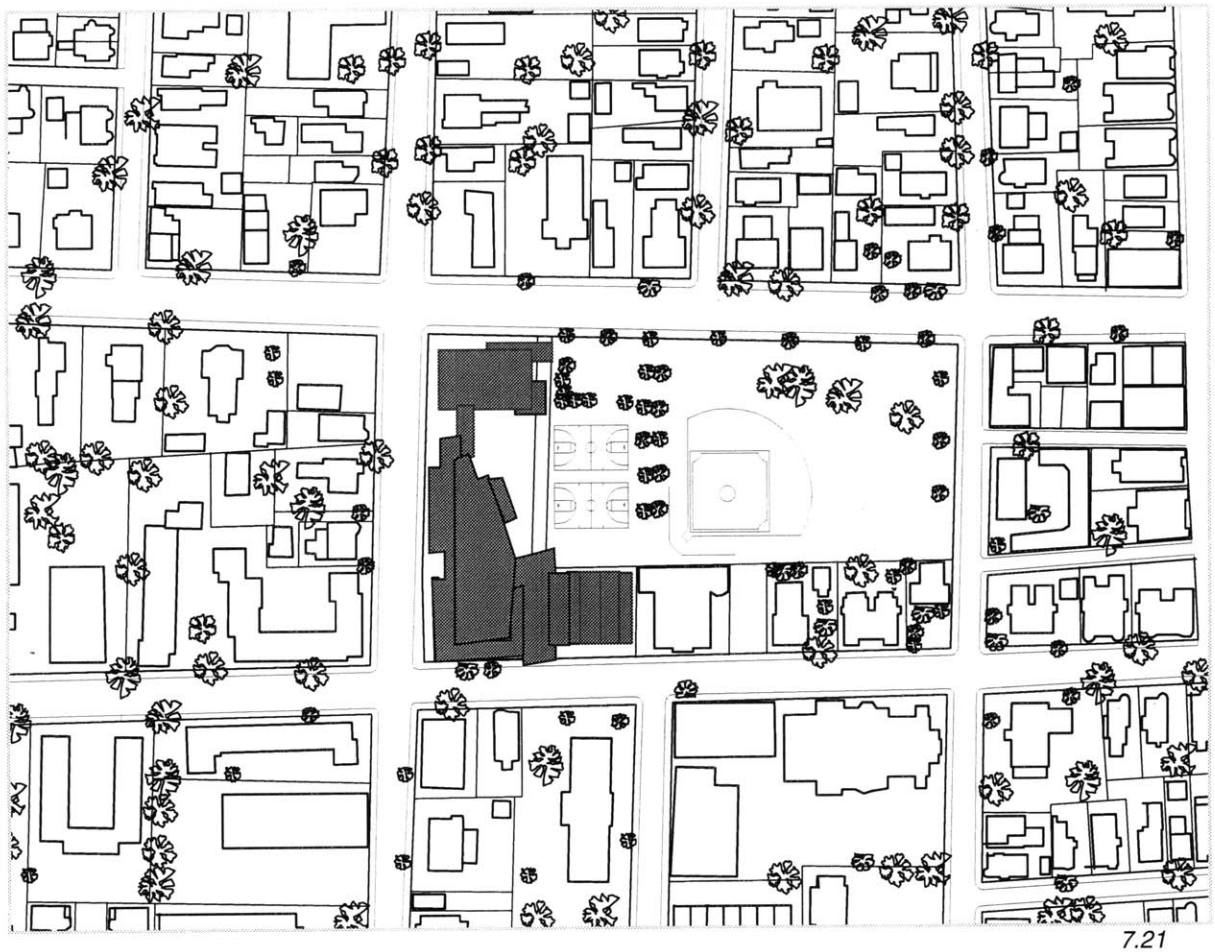
7.19 - Site Model 1/16"=1'.

7.20 - Close up of site model with out main roof to reveal collective space.



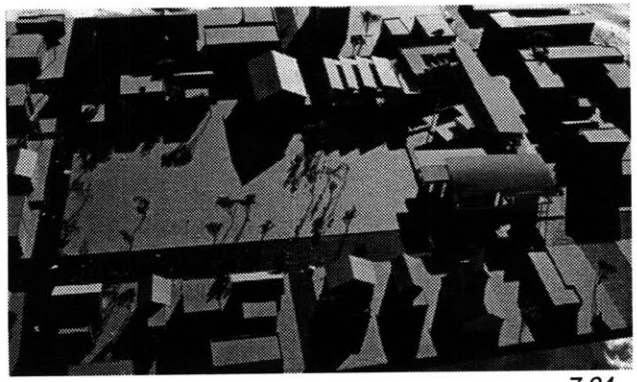
7.21- Site Plan.

7.22

7.23

7.22 - View of site model from Prospect St.: Afternoon light. In this Model one can see the exchange with the street as well as the passage to the park.

7.23 - Same view: morning light.



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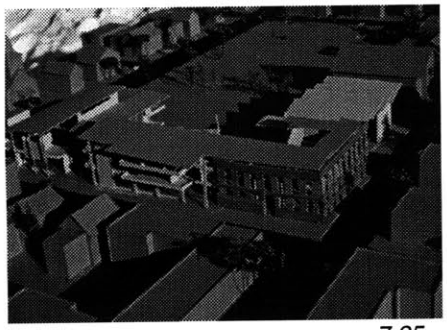

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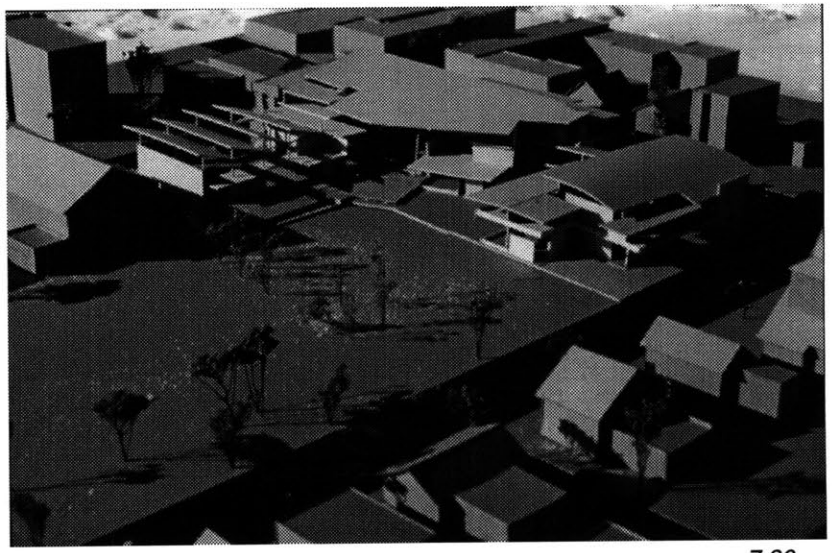
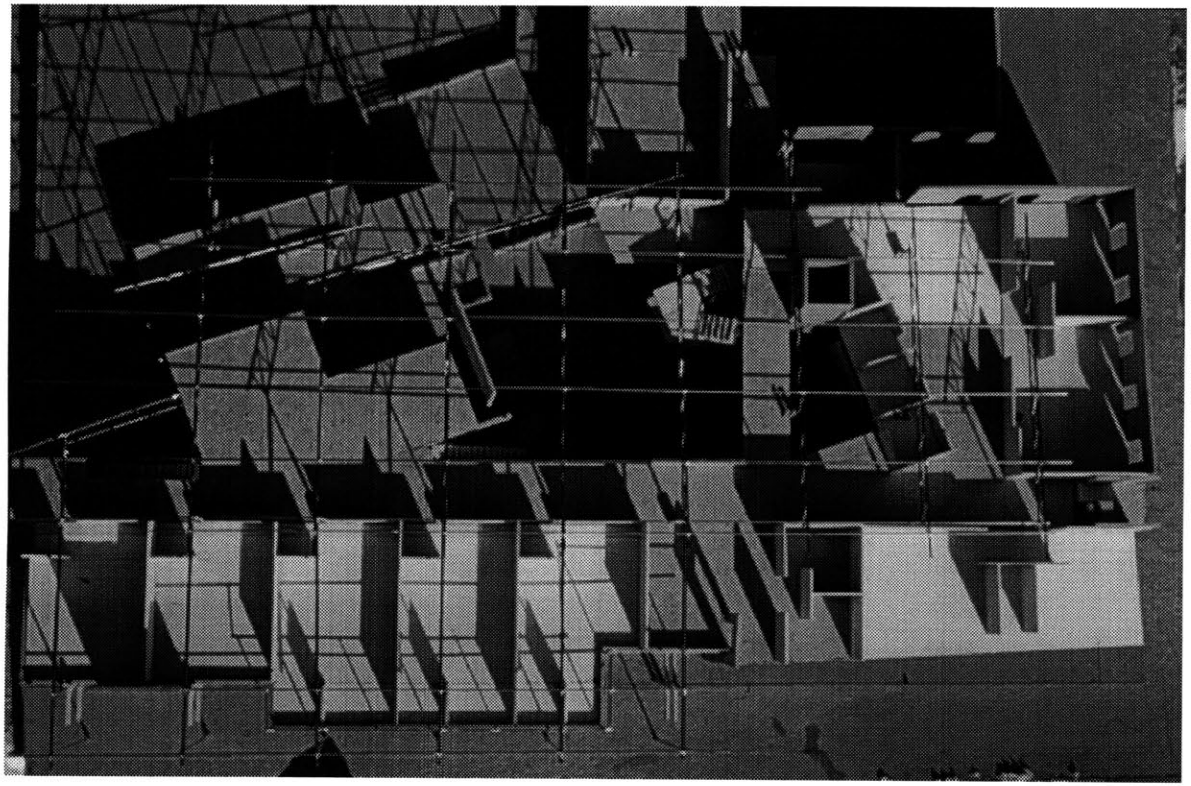


7.26

7.24 - Site model from broadway, without main roof.

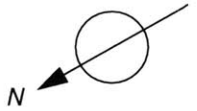
7.25 - Site model from the corner of Prospect St. and Harvard St.without main roof.

7.26 - Site model from Broadway St.



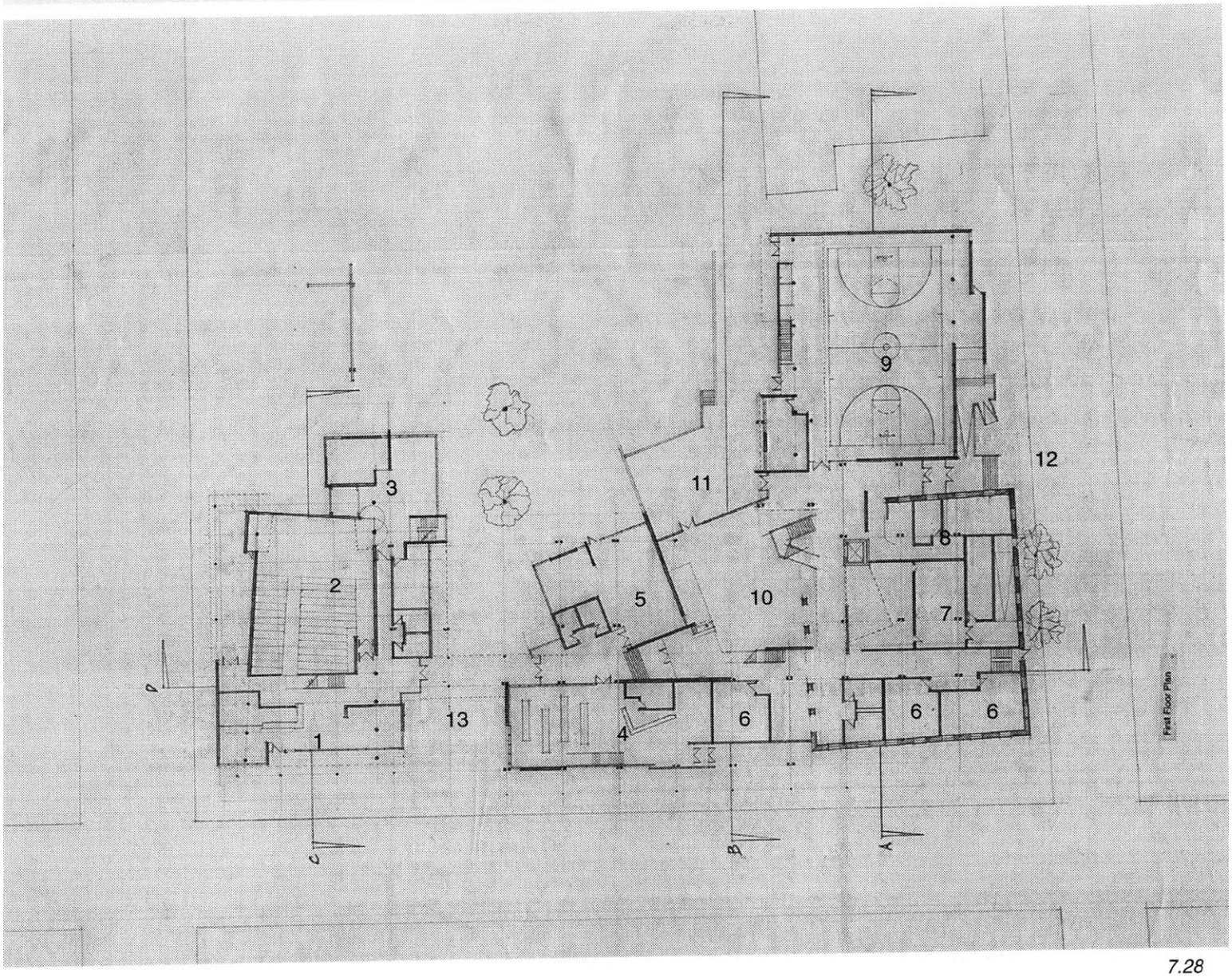
7.27

1 - Café/Gallery
2 - Theater
3 - Back stage workshops
4 - Library
5 - Media center
6 - Classrooms
7 - Kitchen
8 - Administration
9 - Gym
10 - Collective space
11 - Terrace
12 - Main school entrance
13 - Passage to park and public entrances to library, media center and theater.



7.27 - Partial model 1/8"= 1', plan view. This partial model was built to investigate the collective space, exchange with the street and the park and building systems.

7.28 - First floor plan.



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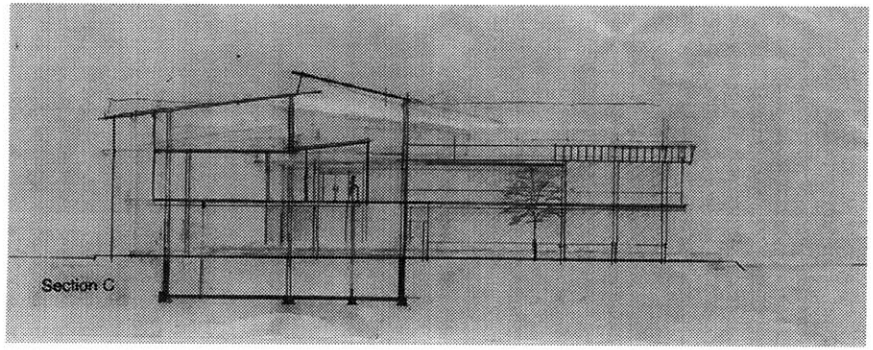

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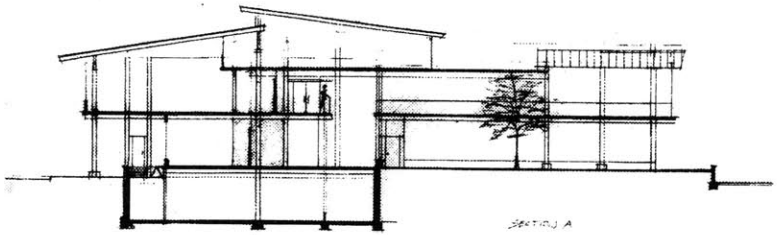

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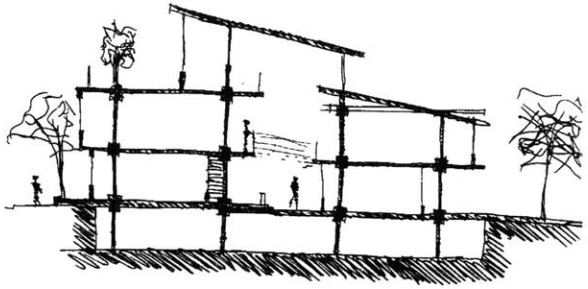


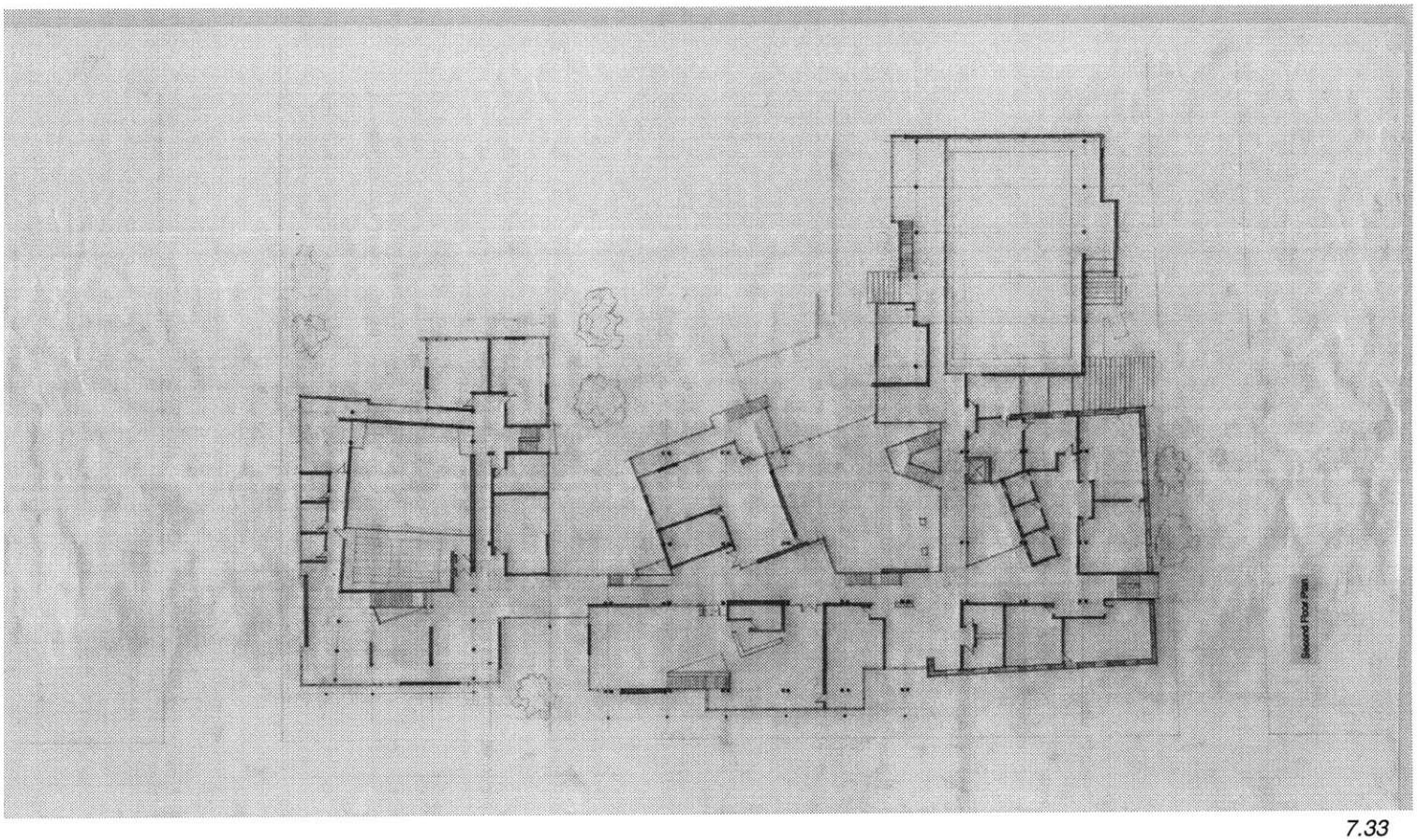
7.32

7.29 - Section through library looking North.

7.30 - Earlier section. This earlier section is only two floors and does not have the external column to the roof.

7.31 - View of library end of the school from the passage through to the park.

7.32 - Early sketch of section.



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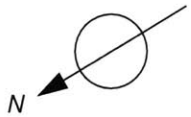
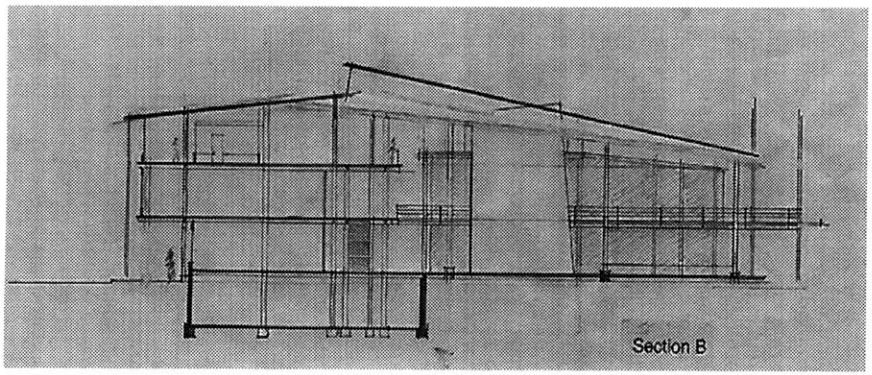


7.33 - Second floor plan.



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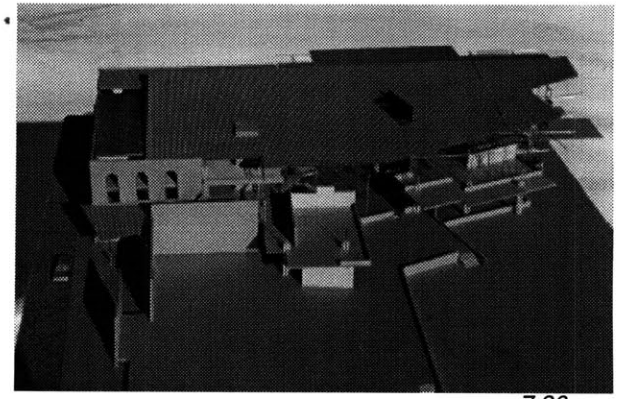

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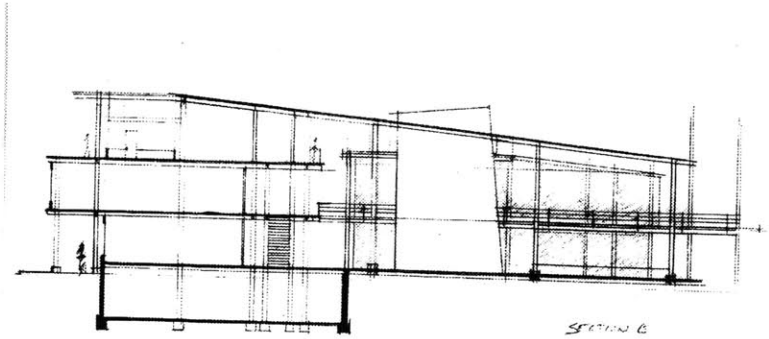

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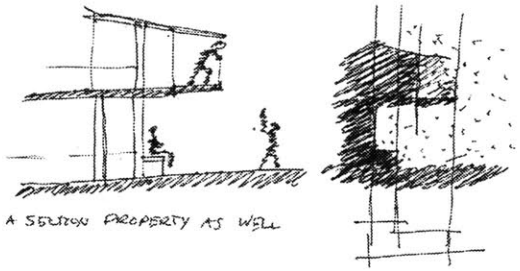


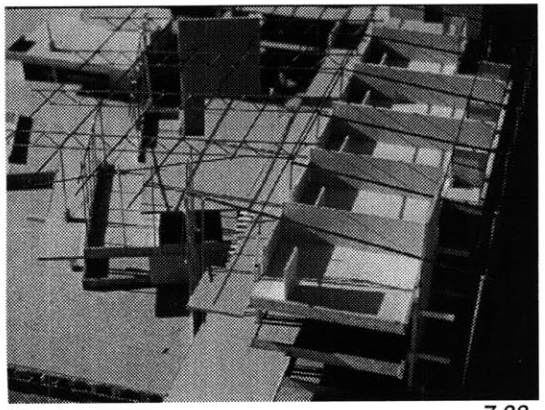
7.37

7.34 - Section cut through the central collective space, looking North.

7.35 - Earlier section with roof terrace and no exterior column.

7.36 - 1/8"=1' model showing full roof.

7.37 - Sketch of zones of exchange in section.



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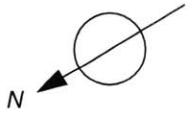
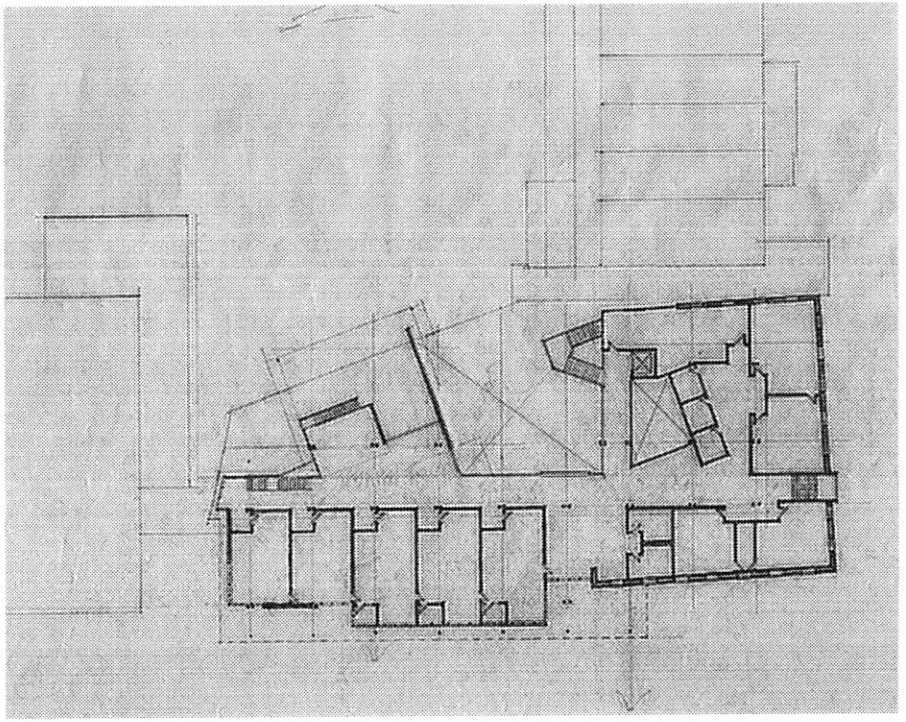
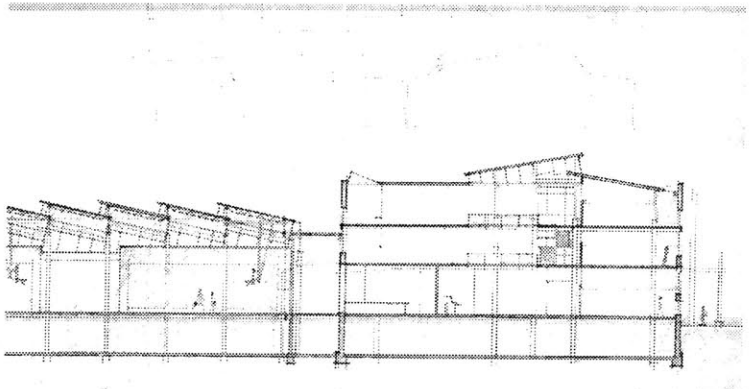




7.39

7.38 - View of partial model from the North with out the roofs.

7.39- Third floor plan.



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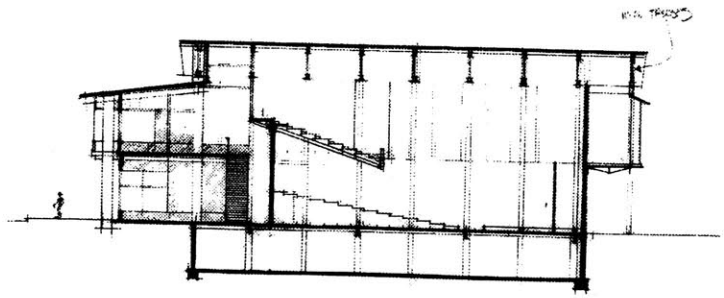
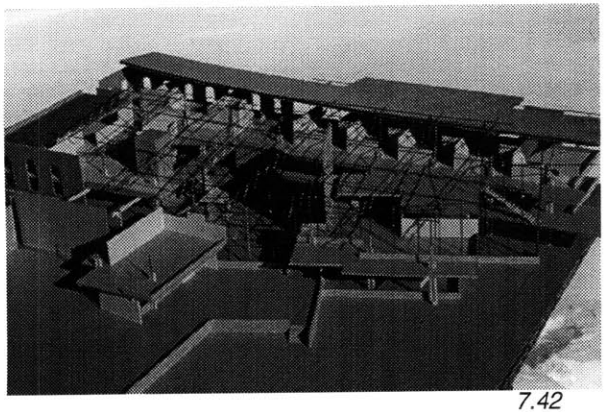


7.41

7.40 - Section through the existing brick building and the gym, looking south.

7.41 - Early section through the theater looking North.



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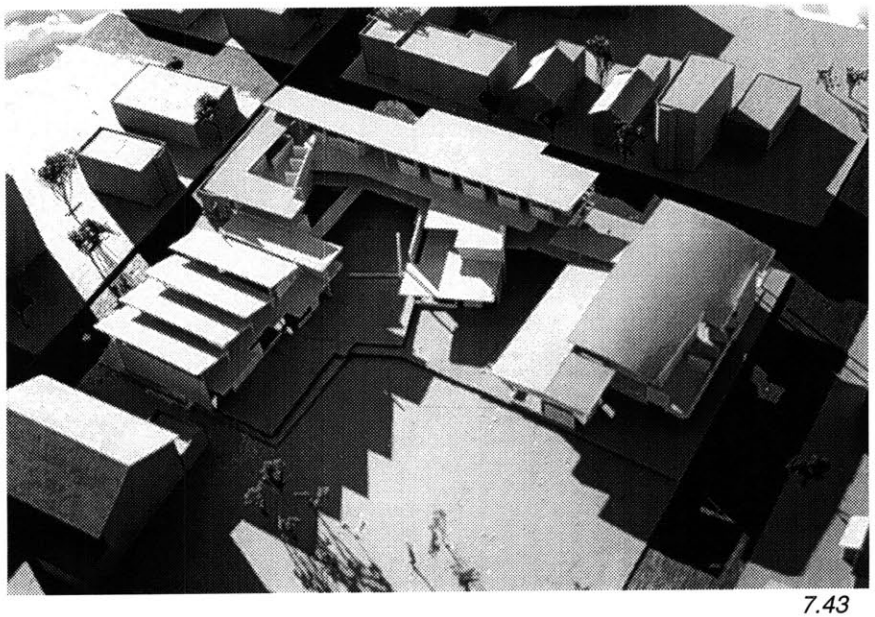
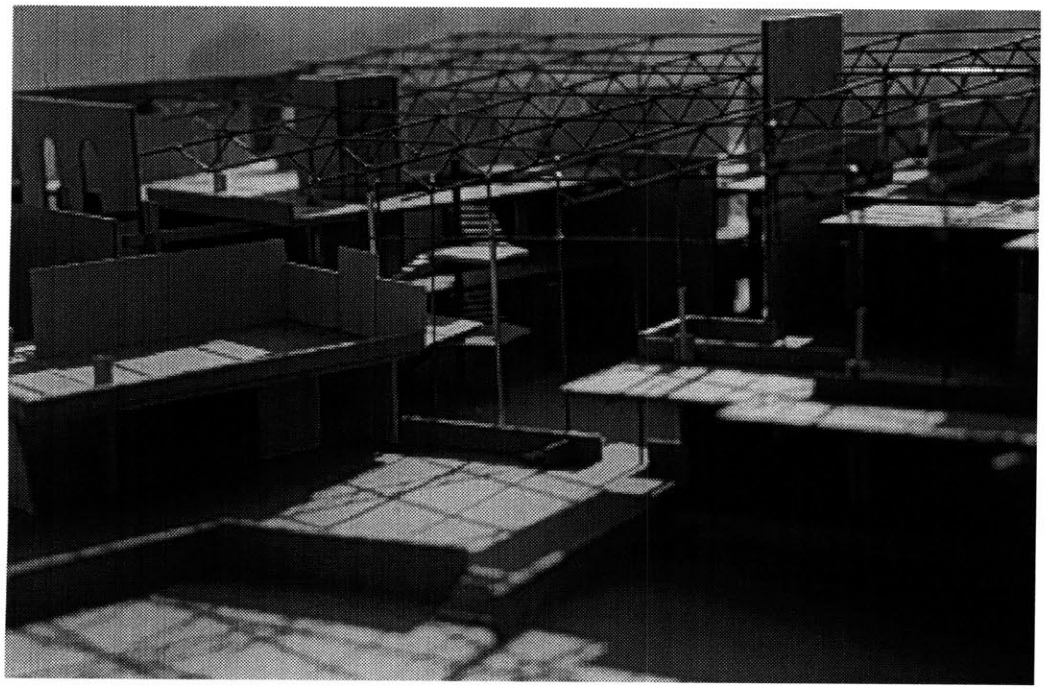


7.43

7.42 - Model without main roof. View of central space in relation to park.
7.43 - Site model without main roof to show central space in relation to the park.



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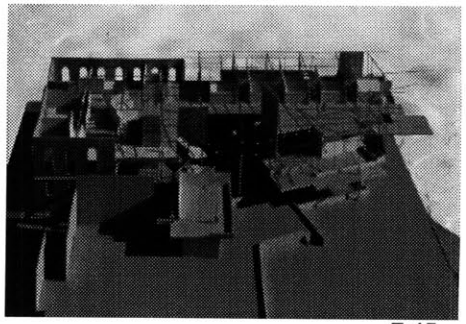
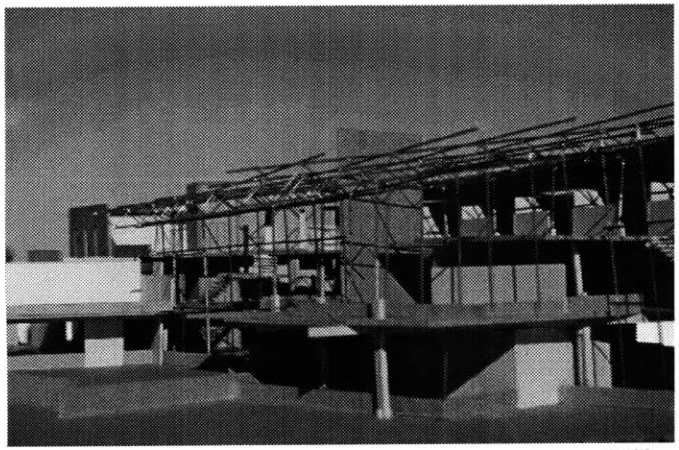


7.45

7.44 - View of collective space from park
7.45 - view of whole 1/8" = 1' model with out roofs.

7.4 Exchange with the park

To built a relationship with the larger community in which one could feel accessibility to the school I needed to develop built exchanges



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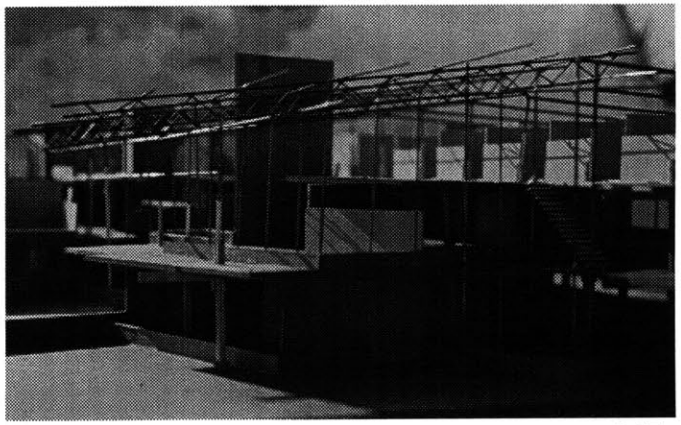
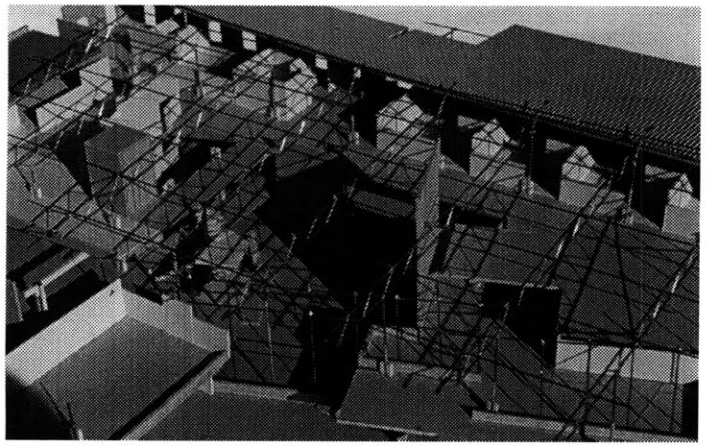


7.47

with the park as well as with Prospect St. and the corner of Prospect St. and Broadway St. To do this I sited the community functions near the Broadway end of the site. I place the auditorium at this corner because it is probably the most public function of the school. By displacing the

7.46 - View looking at the media center from passage to the park.
7.47 - View looking at the library/ media center entrance.



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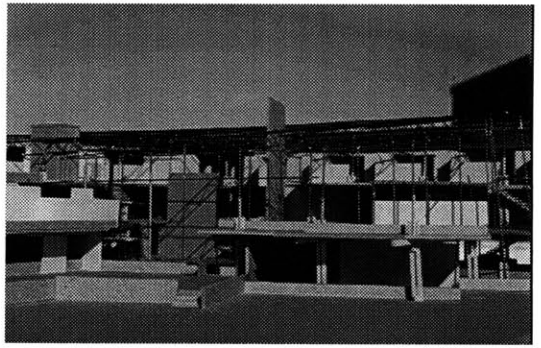
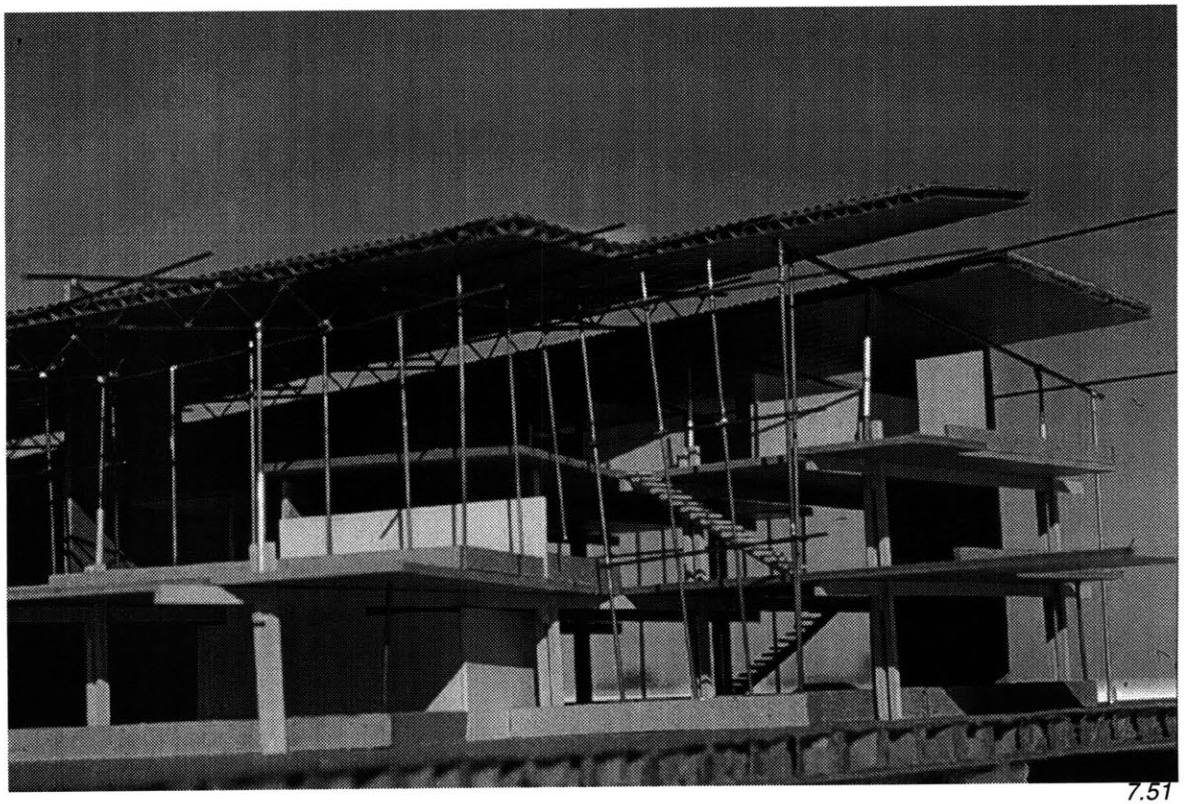


7.49

7.50

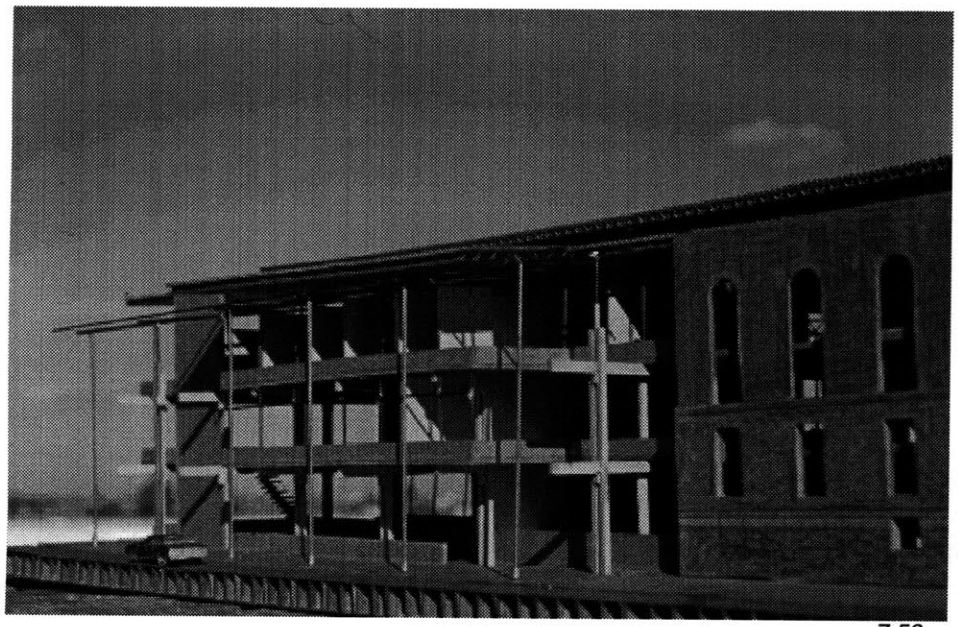
7.48 - Aerial view of the collective space, showing the roof structure.
7.49 - Elevational view of central space from park.
7.50 - View of school from Broadway.

auditorium from the school I created a passage through to the park. I also designed a terrace adjacent to the collective space and the gym that is in the territory of the school but is continuous with the park.

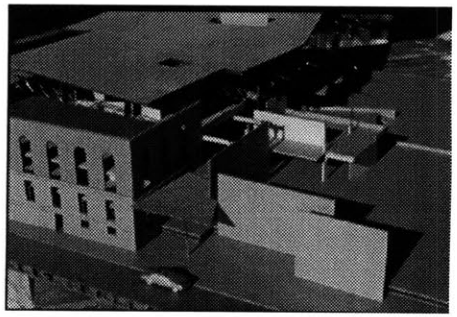


7.51

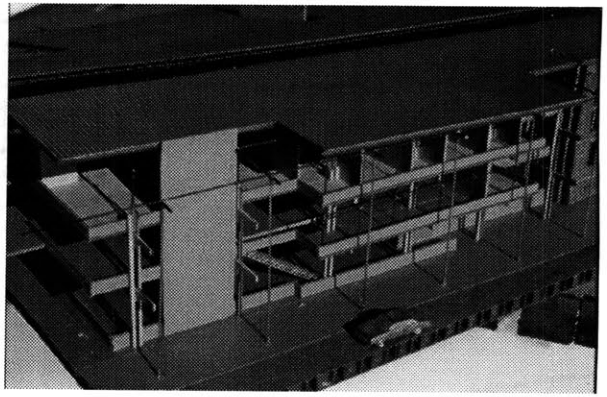
7.51 - View of Library end of school



7.52



7.53



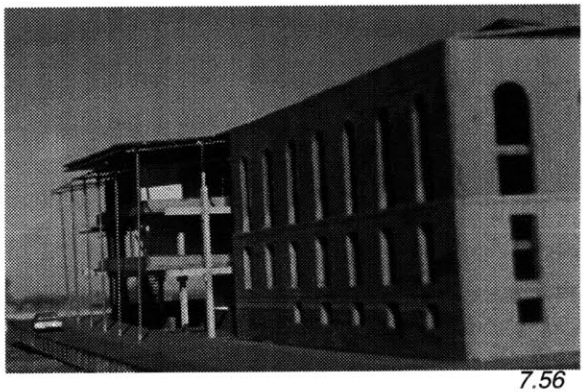
7.54

7.52 - Looking up Prospect St. to the North.
7.53 - View of the entrance to the school off of Harvard St.
7.54 - Aerial View of library end of school. In 7.52 and 7.54 one can see the arcade formed by the over hang and the thin columns that support the roof over hang.

7.5 Exchange with Street

The exchange with Prospect St. happens in the section of the building. I created an arcade where people can walk under and

7.55

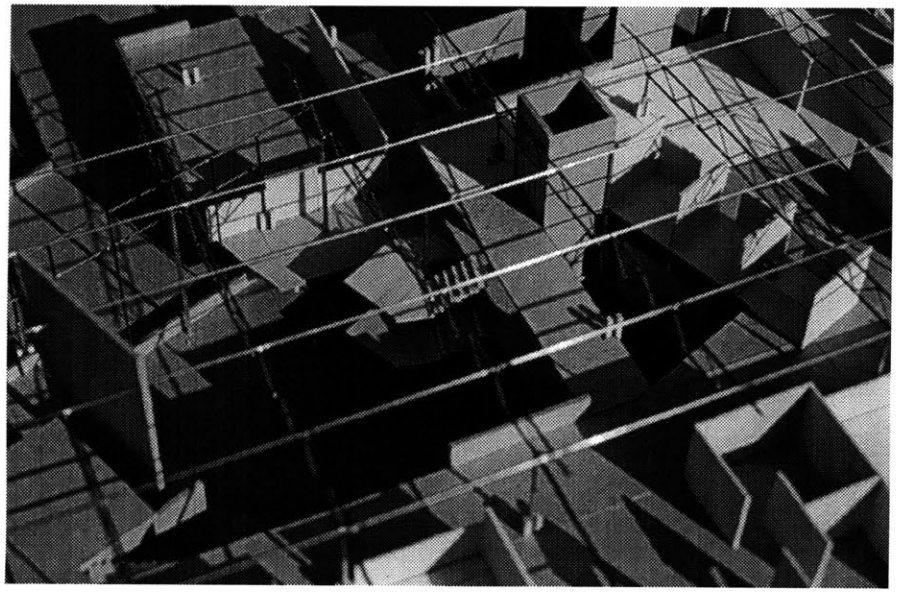


7.56

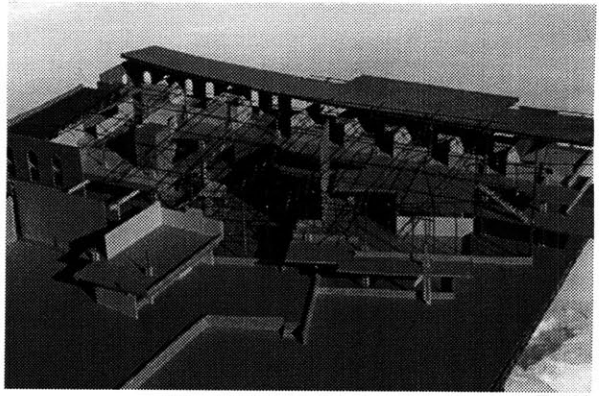
7.57

move through before entering the library or the passage through to the park.

7.55 - Close up of Prospect St. elevation
7.56 - Long view looking up Prospect St. showing arcade.
7.57 - Sketch of Prospect St. elevation.



7.58

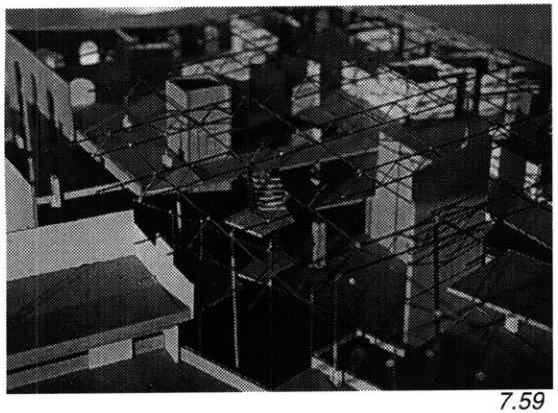


*7.42**

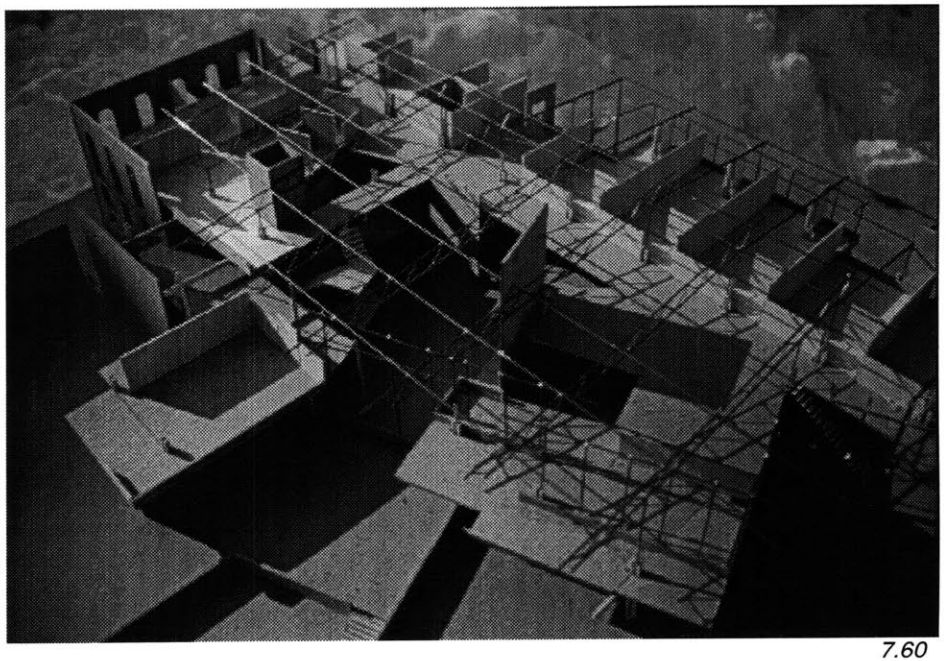
7.58 - Collective space as seen from above from Prospect St. side.
7.42* - (see page 69)

7.6 Built Collective

I created the collective space through the generation of a large slack space. This slack space was generated by the discontinuation of the structural bay system. I further marked this



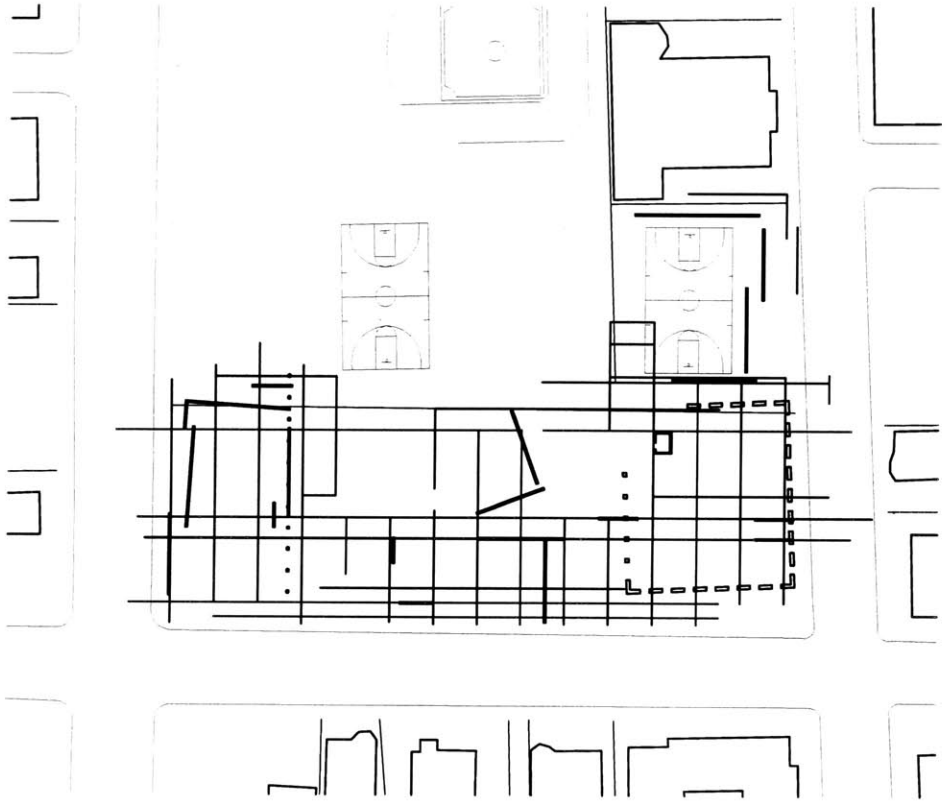
7.59



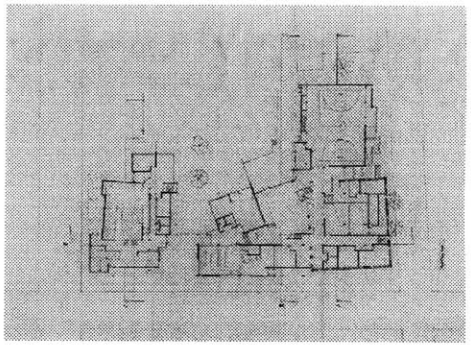
7.60

area by place large vertical concrete shear walls at certain points on the perimeter. Circulation occurs adjacent to this collective and between the collective and the privacies of the class rooms and offices. On the park side of the collective space I put glazing so that the central space has

7.59, 7.60 - Collective space as seen from park (Note the Switch back stair)



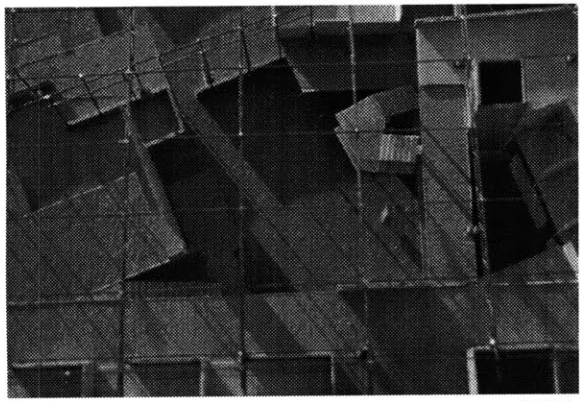
7.61



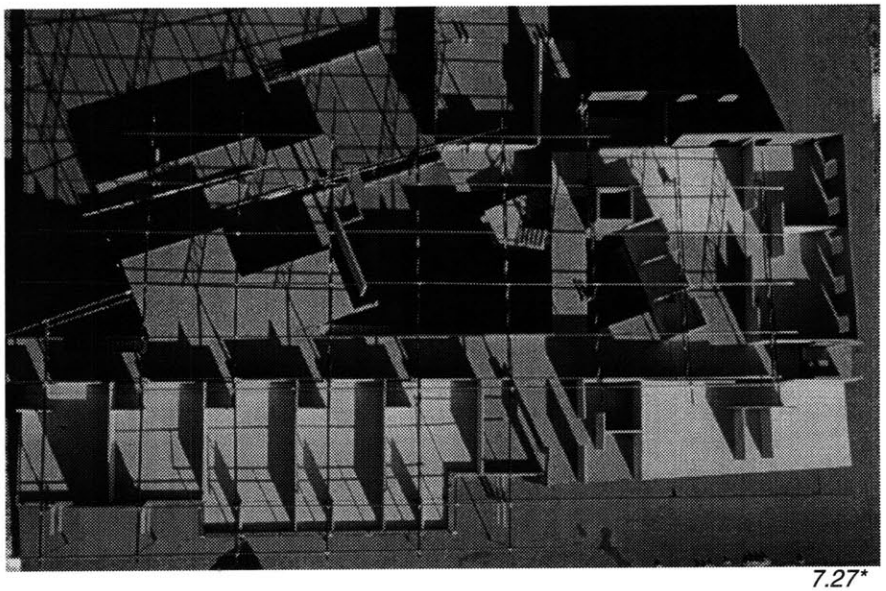
7.28*

7.61 - Drawing of structural grid and shear walls as well as existing structures.
7.28* - (see page 63)

a strong relationship with the park. It is itself an area of visual exchange with the park. The collective space is also open to the full section of the school. This way all three floors of privacies have direct relation to the collective space. Not all the three floors intersect the slack collective



7.62



*7.27**

space in the same way though. The second floor juts into the space to define exchange territories underneath and to engage the space more fully. In this way if there was a large gathering students could be on the second floor and use the walk ways as balconies to be part.

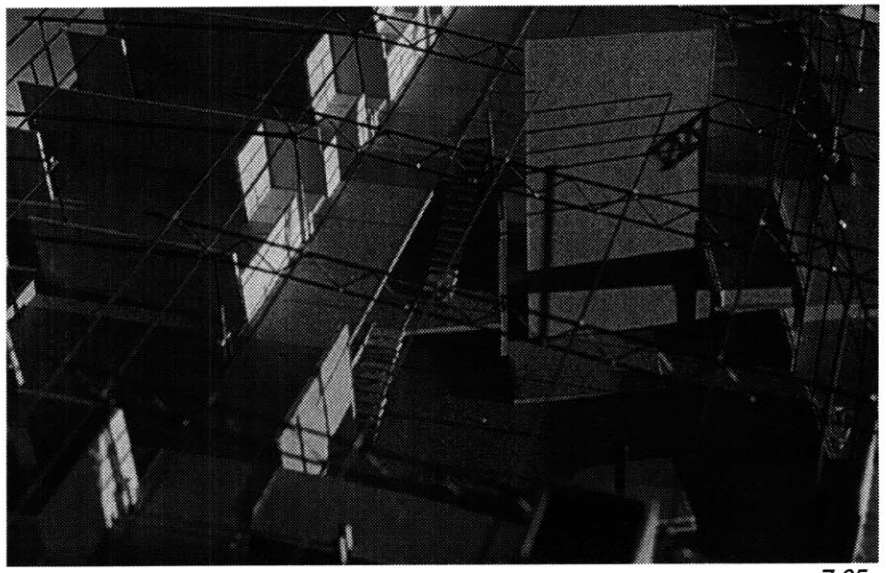
7.62 - Plan view of central space.
7.27* - (see page 62)

7.63

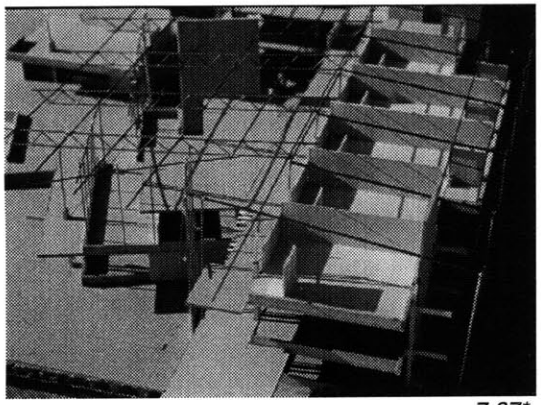
7.64

7.63 - View of stairs adjacent to collective space.
7.64 - View of collective space.

The vertical circulation also happens in the Collective space. The large switch back stairs have landings that can be used like the walk ways as balconies. The treads of the stairs themselves can be used as seating like in Hertzberger's Apollo School, or Behnisch's Lorch Secondary



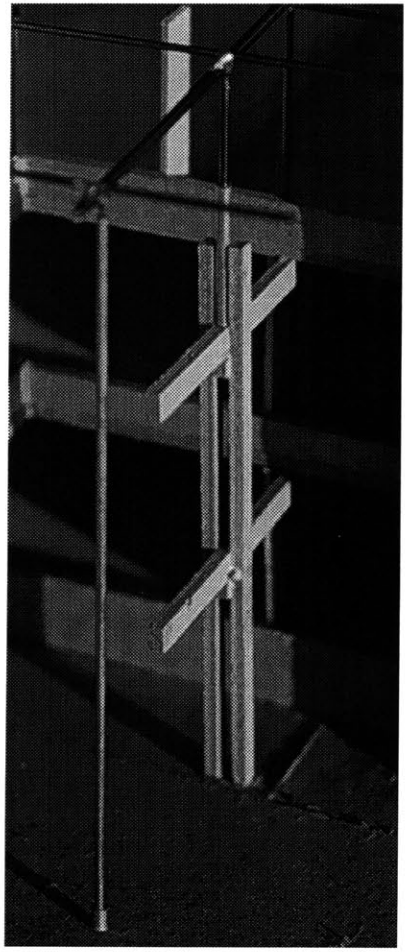
7.65



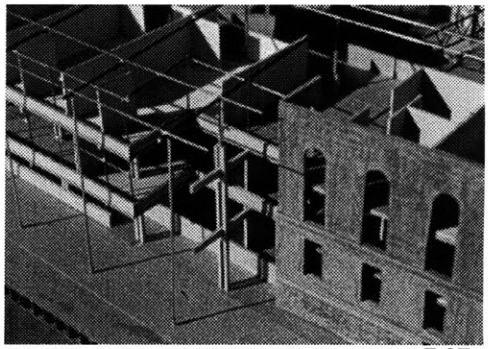
*7.37**

School.

7.37* - (see page 67)
7.65 - View of stairs in relation to collective space.



7.66

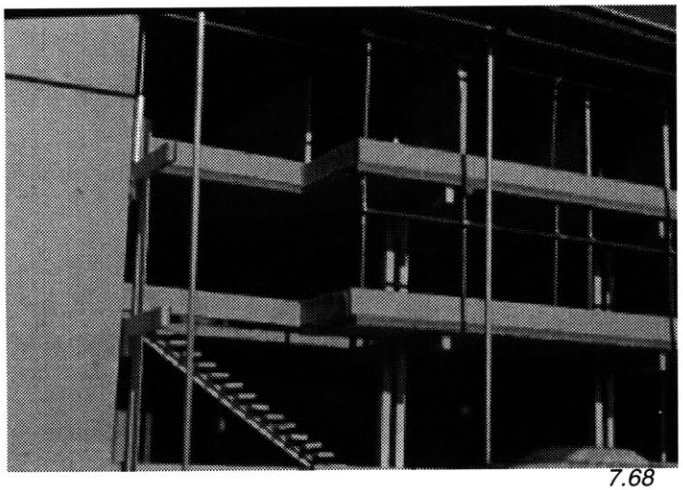


7.67

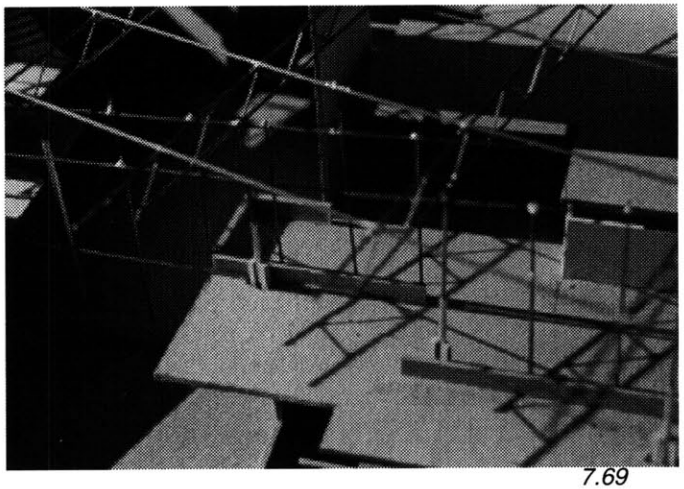
7.66 - Detail of precast concrete structure and steel structure.
7.67 - transition from old building to new. At transition structure is revealed.

7.7 Structural Details

the structural system that I developed is an additive system of precast concrete pieces, in which the column is doubled so that the beam can pass through to cantilever on the other side.On top of the beam are placed hollow core concrete planks running perpendicular. This is not only structurally more efficient for the beam it allows the definition of an additional territory on the other side of the column. At the top floor the doubling of the column also allows for there to be an exchange of material from the precast concrete to



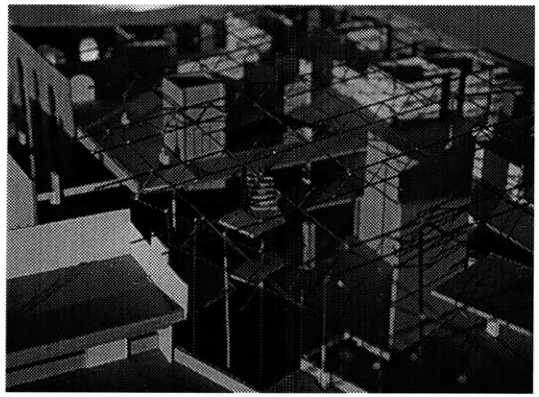
7.68



7.69

steel for the roof structure. The roof is made of medium span trusses with wood roofing system exposed to below on top of which is insulation and metal roofing. This precast concrete system is continuous into the shell of the old brick building.

7.68 - View of stairs internal to the library from the outside.
7.69 - Detail of roof trusses and enclosure at the media lab.



7.70

7.70 - Collective space with roof structure.

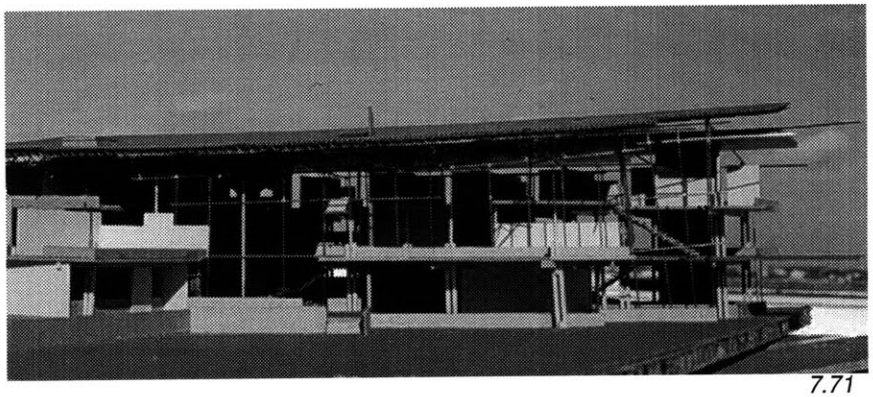
Conclusion

Having made a design proposal I now ask myself Is the design successful? Have I indeed created a successful collective space and built exchanges with the larger community? Ultimately one can only know when the building is built. Only then is there real architectural experience to react to. This aside, I believe that I did make a relatively successful proposal. But it is only one possible solution and most likely is not the best.

In raising the question in the abstract namely, *How can the architectural experience of a school reinforce the educational experience of the students as well as the school's value in society?,* I have come to realize that trying to answer it may be a life long pursuit. Needless to say to develop, a philosophy of education, formal principles that respond to this philosophy and a school that embodies them is a daunting task; larger than a semester of investigation can hold. In the end I believe that I have made a good argument for a certain type of school and the formal principles that generate it.

Although this school is far from complete and architecturally resolved, it does satisfy my initial hypotheses. I did design a

collective space through the use of slack space, in which the whole school can gather. I also created built exchanges with the larger community. In the whole school there are a variety of size spaces to accommodate different uses. It is also a school that reflects some level of democratic openness, through the use of screening to achieve visual accessibility. But as I said earlier this was the first test of my hypotheses. Therefore this thesis is a beginning point. It is an expression of attitudes, phenomenological reasoning to put these attitudes in context, and an initial design to explain them. It is not the end but a tentative beginning from which I hope I will get to truly test by building.



7.71

7.71 - Elevation from the park.

Bibliography

Auer & Weber, "Organic Restraint," *The Architectural Review*, August 1993.

Behnisch, Gunter. *Architecture and Urbanism*. May 1990, 33 -138.

Behnisch and Partners. A Walkthrough the Exhibition. Stuttgart: Verlag Gerd Hatje, 1993.

Behnisch and Partners. On Colour. Stuttgart: Verlag Gerd Hatje, 1993.

Benevolo, Leonardo. History of Modern Architecture, vol. 1, The tradition of Modern Architecture. Cambridge, MA: The M.I.T. Press, 1985.

Blundell Jones, Peter. "Behnisch in Frankfurt". The Architectural Review, April 1995, 23 - 37.

Chastain, Thomas. Explorations in Collective Form: A design Vocabulary Using Directional Village Forms as References. M.Arch Thesis, Cambridge: M.I.T. Department of Architecture, 1982.

Dewey, John. "The Child and the Curriculum." John Dewey: The Middle Works 1899-1924, Vol. 2 1902-1903. ed. Jo Ann Boydson. Southern Illinois University Press, 1976.

_____. Democracy and Education. New York: The Free Press, 1916.

_____. Lectures in the Philosophy of Eduction:1899. ed. Reginald D Archambault. New York: Random House, 1966.

Department for Education: Architects and Building Division. Passive Solar School: A Design Guide. Building Bulletin 79. London, 1994.

Dunster, David. Alvar Aalto. Academy Editions, Architectural Monographs 4. New York: St. Martin's Press, 1978.

Educational Facilities Laboratories, Inc. Community/School: Sharing the Space and the Action. ed. Peter Green. New York: 1973.

_____. Educational Change and Architectural Consequences. New York: 1966.

Harvard Educational Review Architecture and Education. Vol. 39, No. 4 1969.

Geiger, George R. John Dewey in Perspective. Oxford: Oxford University Press, Inc., 1958.

Kennedy, Margrit I., Building Community Schools: An Analysis of Experiences. Paris: UNESCO, 1979.

King, Jonathan. The Physical Environment and the Learning Process. Ann Arbor: Architectural Research Laboratory, University of Michigan, 1979.

Krieg, Richard and Wheelan, Charles. "Separate - But Equal?," Chicago Tribune Magazine, February 12, 1995.

Meier, Deborah. The Power of Their Ideas: Lessons for America form a Small School in Harlem. Boston: Beacon Press, 1995.

Maki, Fumihiko. Investigations in Collective Form. St. Louis: The school of Architecture, 1964.

Norberg-Schulz, Christian. Existence, Space and Architecture. New York: Praeger Publishers, 1971.

Norberg-Schulz, Christian. Intentions in Architecture. Cambridge: The M.I.T. Press, 1965.

Norberg-Schulz, Christian. Genius Loci: Towards a Phenomenology of Architecture. New York: Rizzoli International Publications Inc., 1980.

Palazzolo, Carlos and Vio, Ricardo. In the Footsteps of Le Corbusier. New York: Rizzoli International Publications, Inc., 1991.

Roth, Alfred. The New Schoolhouse. Verlag fur Architektur, Zurich und Stuttgart. 1966.

School Planning Laboratory: Stanford University. British Prefabricated School Construction. New York: Educational Facilities Laboratories, 1976.

List of Figures

Figures reference the bibliography.

All other figures are by the author.

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