Four Family Houses in a College Town

Travis Steed
Virginia Polytechnic institute and State University
Master of Architecture
M.Arch 3
College of Architecture and Urban Studies
Hans Rott
William Galloway
Joseph Wheeler
November 7, 2006
Blacksburg, Virginia

Keywords: cubic house, insulating concrete forms, family house
Four Family Houses in a College Town

Travis Steed

Abstract

This thesis began as a study in creating good family houses in a town built for students. It evolved into a study of the form of the houses themselves. The nature and qualities of the site generated the form the buildings ultimately would take.

The site is a south facing slope with distant mountain views that improve as the viewer ascends. The orientation allows for a line of buildings along the east-west axis where each can enjoy the benefits of unobstructed southern glazing. The slope offers the opportunity to create a proper base upon which to place the houses. This base provides a level, more usable site and creates a new horizon which edits the view below.

The houses are four subdivided cubes elevated above the shared semicircular base. One half of each cube is divided into three floors, the other half is open from floor to roof and contains the large open staircase winding up to the upper floors. One has an opportunity to experience the full scale of the cube, both from the bottom looking up and as one ascends through it. The southern glass wall allows for passive solar heating in the winter and takes maximum advantage of the mountain views. The remaining three walls are punctured only where necessary to bring light to the more private rooms. This focuses attention to the southern view and lessens the awareness of the houses on either side. The result is efficient use of the land with perceived seclusion.
To my dearest Angela.
Acknowledgments

I would like to thank my committee Hans, Bill, and Joe for all of their guidance and support throughout this project.

I would additionally like to thank Frank Weiner, Kay Edge, Jim Jones, Heiner Schnoedt, and Steve Thompson for their time and attention in the studio.

I would like to thank my Mom and Dad for their unwavering support and their encouragement for me to always chase my dreams.

I must thank my wife Angela for her unending love and patience. I could never have done this without her.
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title Page</td>
<td>i</td>
</tr>
<tr>
<td>Abstract</td>
<td>ii</td>
</tr>
<tr>
<td>Dedication</td>
<td>iii</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>iv</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>v</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Site</td>
<td>2</td>
</tr>
<tr>
<td>The Base</td>
<td>3</td>
</tr>
<tr>
<td>Program</td>
<td>4</td>
</tr>
<tr>
<td>Plans</td>
<td>6</td>
</tr>
<tr>
<td>Sections</td>
<td>11</td>
</tr>
<tr>
<td>Precedents</td>
<td>16</td>
</tr>
<tr>
<td>Façades</td>
<td>17</td>
</tr>
<tr>
<td>Interior Space</td>
<td>22</td>
</tr>
<tr>
<td>Conclusion</td>
<td>26</td>
</tr>
<tr>
<td>References</td>
<td>27</td>
</tr>
</tbody>
</table>
Introduction

This project began with a goal of designing good family housing in a town primarily known for student housing. From the beginning the idea focused on the form of the cube. Cube as house. There were various iterations of ways to adapt the cube. Converting a geometric ideal to an inhabitable structure offers many challenges. Ultimately, it requires one to abandon the perfect shape in favor of the idea of the cube.

Difficulties arose when I attempted to bring materials to the cube. There were experiments with everything from timber frame to steel frame. Through several cardboard models it became evident that the form required a solid, unifying material: concrete.

After focusing on concrete construction, the form of the building began to appear. The cube was subdivided into usable spaces. The cube was elevated above the ground. The south wall became glass to take advantage of the view and the sun.

The site had requirements of its own. First, the slope of the hill required intervention in order to prepare the site to receive the cube. Secondly, both the size of the site and the nature of the neighborhood called for greater density than one cube could offer. The result is the composition of four cubes resting on a semicircular base.

Isometrics from various stages in the development process.
Blacksburg, Virginia is the home of Virginia Polytechnic Institute and State University. The town population of 40,000 includes more than 25,000 college students. The site is less than a mile from downtown and the adjacent campus. It is a south-sloping meadow with some deciduous trees around the perimeter. The southern view includes the distant Blue Ridge Mountains.
Any given site must be shaped in order to receive a building. This sloped site provided an opportunity to create a level base upon which to place the houses. The semicircular base accomplished several things.

First, it provided a level, usable yard around the houses. It separated this site from its surroundings. The lot is shared creating a sense of community in contrast to the secluded nature of the houses themselves.

This grassy plane is surrounded and supported by a semicircular concrete retaining wall. From below, this element unifies the four dwellings into an architectural whole.

Three staircases cut through the solid base. These concrete stairs are reminders of the natural slope of the land and permit movement through the site.

Finally, the base also creates an artificial horizon for the inhabitants of the houses. Each has a glass wall facing south looking out over the curved base and the valley below. This view is framed by the walls of each house and ultimately by the base itself. The clutter of neighboring houses and apartments disappears behind the base and all that is left are tree tops, distant mountains, and sky.
Program

Blacksburg, Virginia is a college town. Much of the habitable square footage in the town is therefore dedicated to housing students. It is more difficult to find a good family house. This is the need I intended to fill with this project. The Program is therefore dictated by the needs of a family.

First, there are the shared spaces of the house. These include the living room, dining room, and kitchen. These rooms are open and flow into one another.

Upstairs are the more private spaces. There is the main bedroom and bathroom as well as two secondary bedrooms and a secondary bathroom.

Completing the program are the necessary storage and service areas. The largest of these is on the ground floor and includes the laundry area.

Finally, this program is then multiplied by four. This project is intended to house a small community of four families, connected yet independent.
Each house contains 1570 square feet of usable interior space.

The breakdown per room is as follows:

<table>
<thead>
<tr>
<th>Room</th>
<th>Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>entry</td>
<td>67</td>
</tr>
<tr>
<td>living room</td>
<td>357</td>
</tr>
<tr>
<td>kitchen</td>
<td>138</td>
</tr>
<tr>
<td>dining room</td>
<td>131</td>
</tr>
<tr>
<td>storage/laundry room</td>
<td>149</td>
</tr>
<tr>
<td>main bedroom</td>
<td>240</td>
</tr>
<tr>
<td>main bathroom</td>
<td>68</td>
</tr>
<tr>
<td>main closet</td>
<td>48</td>
</tr>
<tr>
<td>second bedroom</td>
<td>154</td>
</tr>
<tr>
<td>third bedroom</td>
<td>137</td>
</tr>
<tr>
<td>bedroom closets</td>
<td>28</td>
</tr>
<tr>
<td>second bathroom</td>
<td>53</td>
</tr>
</tbody>
</table>

**total** | **1570 ft²**
How does one examine a building? …or a group of buildings?

In order to examine the entire project, we must first break it down into its component parts. First, we will take one house: the house on the eastern end of the base.

Then we break it down further into a series of plans. The following plans are four horizontal slices through the house. In plan, we can see the vertical structure as well as the grouping of spaces inside the house and how movement occurs between the spaces.
The ground floor serves both physically and programmatically as the base that supports the cube of the house and elevates it above the base. This level contains a carport as well as the main entrance into the house and a storage and laundry area. After passing through the door, one is at the bottom of a shaft of vertical space that leads up to the skylight three floors above. This shaft is surrounded by the staircase that winds upward into the rest of the house.

The south side of the first floor contains two outdoor rooms sheltered from above by the house itself.
The second floor contains the shared living spaces of the house. This is the bottom level of the geometric cube that makes up the form of the house. This cube is divided about the north/south axis by a concrete block wall.

One half of the cube, (the west half of this house), is open from floor to roof. This space contains the main living room and the staircase. Standing in the living room one is able to experience the full scale of the cube.

The other side of the central wall contains the more confined spaces of first a sitting area, then a dining area and kitchen. The floor is raised in the latter two rooms and in the dining room the ceiling is lowered. The result is progressively compressed space that is scaled to the human figure.

The south wall of the house is made of glass panels. This is to take full advantage of the elevated site and views of the mountains as well as to allow for passive solar heating of the house in winter. The floor of the living room is polished concrete and is able to store the sun’s heat and slowly release it in order to reduce the need for electric heating.
The third floor is contained within the enclosed box that juts out above the open living spaces below. This is the more private area of the house. This level contains the two smaller bedrooms as well as a bathroom.

These rooms are secluded from the day lit public spaces. Therefore access to light and fresh air is gained through square openings punched into the outside wall. Within the bedrooms this is a four foot square opening that is sized to maximise both the amount of light admitted and the connection to the outdoor landscape.
The top floor of the house contains the master bedroom. This is the most secluded space in the house. It is two floors above the open living area and is reached via a bridge from the staircase.

The bedroom is accompanied by a bathroom and large closet. The south wall is made of glass doors connecting the room with the balcony and the view beyond. These doors can slide out of the way to completely remove the line between inside and outside.
To truly understand how a building goes together and how the spaces inside interact, one must look at the building in section. This cut reveals attributes of the materials and structure as well as the character of the space itself.

On the following pages we will see a vertical slice through the building from each of the four directions. Each section is taken three feet in from the outer edge of the façade looking inward. By looking from just inside each wall we can see the unique characteristics behind each face of the cube.
The north section reveals how the cube is divided and how movement through the cube is achieved.

The left side of this section is floor after floor of functional rooms. It houses space for the bed and bathrooms, the kitchen, and even the car.

The right side of the section shows the open nature of this half of the cube. It also illustrates the main architectural element inside the house, the large concrete staircase.

The section also reveals the materials. The supporting structure is concrete. Both the walls and floors are constructed with an insulating concrete form system.
The west section reveals the largest open space in the house. This is one half of the cube open from floor to roof. The stairs to the upper floors permit vertical movement through space that allows a person to experience the scale of the cube from all elevations. The southern wall of this space is made of glass panels with minimal metal framework blurring the line between inside and outside.

This section also reveals the insulating concrete floor system. The expanded polystyrene panels begin as the form work for the wet concrete then become the insulating material under the floor. The thick portions of the panels create cavities for ducts, lighten the weight of the floor, and form the adjacent beams in the floor.

Polished concrete provides the finished floor material in the living room to allow for passive heating. On the stairs the concrete is clad in hardwood on the treads and handrails in order to provide a warmer material where man makes direct contact with the building.
The south section reveals the separation between the shared public space of the house and the more secluded private rooms.

The shared area is open and easily accessible. The south wall is glass, (the wall has been removed in this drawing,) and open to the outside view. Then the space becomes more compressed as you make your way back into the kitchen.

The bed and bath rooms on the other hand are elevated above and to the side of this public area. They are accessible only by returning to the staircase and continuing upward.
The east section is a slice through the functional side of the cube. From this vantage point nearly every part of the program is visible. Only the stairs and living room are hidden. This is a result of the physical bisection of the cube that occurs in plan.

This is also the best view of the dynamic floor and ceiling levels as one moves into the dining room and kitchen. These are the more intimate rooms on the public level. Therefore the space in these rooms is more compressed. In the dining room the ceiling is lowered to create a space specifically scaled to a group of people seated at a table. The low ceiling also focuses attention out to the view beyond the glass wall.
Several aspects of this thesis relate to the work of Adolph Loos. His affinity toward the cube as a form in architecture and the unadorned faces of his buildings had an influence on this project. Here we are looking at his treatment of the façade of the Steiner House in Vienna and how it relates to the façades of this thesis project.

Loos treated each face of this house differently. The street face was the result of strict building regulations. It was the public face of the building and was therefore tightly controlled. The rear garden façade was free from such rules. So, Loos imposed his own rules of strict symmetry in the massing and openings. The side façade is treated differently from either of the others. It has no symmetry. It is instead a collection of openings placed wherever they were needed based on the activities taking place inside the house.

In the following pages you will see it is this side façade that most closely relates to this project. Three sides of this house are governed by the same idea of puncturing the façade only where necessary to admit light. The fourth façade, the south face, is the symmetrical public face of the house visible from the road below.
The façade is the face the building shows to the world. In the case of this building it is a stucco surface punctured by rectangular openings with no recognizable pattern.

By overlaying the section drawings with the façade we can understand the building better by seeing what is happening just under the skin. In other words, how does the façade interact with the section?
The north façade can be both the front and back of the house. The entire project is facing south with the public face looking out over the road below. However, entry to the house would nearly always come from the north side driveway. Therefore this face is important. It offers the clearest view of the cube. It is the only face that has no visible additions to or subtractions from the cube. It only has five square and rectangular openings.

The underlying section drawing reveals the activities that would occur behind these windows. Throughout three sides of the house windows are only placed where it is necessary to admit light for specific tasks. On the north side this includes the bathrooms, kitchen, and stair landings.
West Façade

The west façade is deceiving. It is the most private face with only three small openings. However behind it is the most public area in the house.

The nearly unbroken face is a response to the shared site. This face is merely fifteen feet from the east facade of the neighboring house. The solid wall helps maintain privacy and direct attention back to the south wall of windows. Small squares of glass admit light only at the stair landings.
The south façade is the public face of the house. This is the most visible face from the road below.

This façade is the most revealing face of the building. The public spaces are visible through the glass wall. The more private rooms are hidden behind the solid concrete square.

The glass wall allows the low winter sunlight to pour into the house and onto the concrete floor. The direct rays of the high summer sun are mostly blocked by the overhanging roof above.
East Façade

The east façade conceals the majority of the functional rooms in the house.

The size and shape of the various windows on this façade are a result of the functions each serves. At the top, the master bedroom already features floor to ceiling glass on the south side. Therefore the east wall only needs a horizontal opening to admit morning sun.

The third floor houses the other two bedrooms. This wall is the only connection from these rooms to the outdoors. The openings are therefore sized to provide maximum light and views.

The second floor has only three small openings to admit light into the workspace of the kitchen.
The place where the human directly experiences the architecture is in the interior. The exterior elements and internal structures we have discussed serve to support and enclose this protected living space. Man comes in direct contact with materials. Man becomes aware of the scale of space in reference to his own scale. Man must physically navigate from one space to another within the whole of the building.
As we have seen in earlier drawings, the cube has been divided in order to provide spaces for the various functions of a house. These divisions were also made with the intention of maximizing the occupants' ability to experience the cube.

This isometric section drawing gives some sense of those different spaces and how they interact.
The largest space in the house is the living room and the adjacent staircase. This is where one has the rare ability to truly experience the full scale of the building from the inside.

The ceiling is thirty feet high and the entire south wall is glass. The result is a keen awareness of the vastness of the space in relation to one’s own body.

The stairs allow both this spatial awareness and the view outside to be experienced from any level from floor to ceiling.
From the expansive living room one moves into the more compressed space of the dining room and kitchen. The raised wood floor creates a different quality of space that is more intimate and more sympathetic to man.

The ceiling in the dining room is lowered. This space is specifically scaled to a group of people seated at a table. These rooms are still open to the other areas of the house. The dining room is only separated from the sitting area by a low wall punctured with square openings for books or artwork.

Left: Looking north into sitting, dining, and living rooms.
Above: Section through east side of the second floor.
Conclusion

This project has been an experiment in form and material. The challenge was adapting the geometric ideal of the cube for use as a fully functional house. The cube lends itself well to subdivision in a variety of different ways. By alternating between large open spaces and low, layered spaces, the house becomes an experiment in scale and the awareness of scale.

The nature of the form dictated a material that would be monolithic and integral with the structure. When cast-in-place concrete was deemed too exotic for this project, the insulating concrete form system was studied. This material had many advantages such as a decrease in labor costs and increased insulating properties. There were also several problems with this system such as potential moisture issues as well as difficulty adapting it to some of the nonstandard aspects of the design.

Ultimately it was a very worthwhile experiment for a young architecture student. I was forced to deal with real world construction issues as well as age-old questions of form and scale. It was these latter issues that proved to be the most fun and hopefully had the greatest influence on the finished building.
References

Loos References:


Insulating Concrete Forms References:


Other Material References:
http://www.quadlock.com
http://nanawall.com