

# MUSIC IN PERSPECTIVE

Zsolt Závodszky

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Hans C. Rott  
Donna W. Dunay  
Kay F. Edge

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## ABSTRACT

This thesis seeks to explore how geometry, music, and architecture can all interweave with each other. Music is based on the harmonic ratios of geometry. These relationships can also be used to inform the geometries of architecture.

As with the aesthetics of music, architecture, too, is not an exact science that must follow rigid geometric rules. A work of music is made more beautiful when it smartly breaks the rules of order and gracefully bends the rules of harmony. Similarly, architecture can bend and break the rules.

This is an academic exploration of creating a building form that starts with the rigid set of rules of harmonic geometry but bends and breaks them by passing them through a filter of perspective to derive a new set of rules.

Many thanks to my family, my friends, and my colleagues both past and present.

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## PROLOGUE

## INSPIRATION

I have been in love with music farther back than I can remember. Growing up, there was always music playing in our house; either the radio was always on, set to the classical music station, or my father's record player was cranking out Beethoven or Liszt or Vivaldi. To this day, my parents still have a little clock radio in the bathroom that is hooked up to the lightswitch to play music when anybody goes in there and turns on the lights.

My formal music education started in second grade when I had wanted to learn the piano, but we could not afford to buy one, so instead we rented a violin and I commenced violin lessons. Within a few years of that, an elderly friend of my parents' was moving away and gave us her piano. I started my piano lessons.

It was probably when I was in fifth grade when I started playing in an orchestra. It was not an orchestra of any kind of merit; it was a beginner group for kids. Since then, I have played in a number of orchestras of varying levels (none professional) in a variety of venues, from high school auditoria, to out door venues, to some of the greatest concert halls of Europe.

Between the ages of fifteen and nineteen, I had the privilege of being a member of the Pittsburgh Youth Symphony Orchestra (PYSO)- one of the premier orchestras for young people in the United States. It is unofficially affiliated with the world renowned Pittsburgh Symphony Orchestra. They rehearse and perform in the same hall, the PYSO coaches are all members of the PSO, and the conductor has always been whoever is the assistant conductor of the PSO.

In my final year with PYSO, we went on a two-week concert tour in Europe. We played five concerts in four countries. The tour started in Budapest, Hungary. It was followed by Vienna, Austria, then Litomysl and Prague, Czech Republic, and finished in Leipzig, Germany. Budapest was extra special for me because I am Hungarian and all my family lives there. Many of my uncles, aunts, and cousins were at the concert- people that had never before heard me perform in an orchestra. We were performing in the auditorium of the famous Franz Liszt Music Academy (Liszt Ferenc Zeneakadémia). In Vienna, we performed in the courtyard of the Rathaus (City Hall). In Litomysl, we were a part of the Smetana Music Festival, an annual event named for the town's native son Bedrich Smetana, a great composer of the nineteenth century. This performance was special because not only were we the first youth orchestra ever to play the festival, also the first American orchestra. Our venue was the central courtyard of Litomysl Castle. From there we were on to Prague to play at the famous Dvorak Hall of the Rudolmium. And finally, in Leipzig, we played in the home of the world renowned Leipzig Gewandhaus Orchestra. The current building is its third incarnation, completed in 1981 after the second one was destroyed in the Second World War. The acoustics of this hall are among the finest in the world.

My desire in this exercise is to create a building form using the rational elements of a passion of mine. I chose to do an orchestra hall because it is a program I have experience with. I hope that now you will understand where my thoughts and ideas originated.



Fig. 1, Franz Liszt Academy interior



Fig. 2, Franz Liszt Academy organ



Fig. 3, Litomysl Castle exterior



Fig. 4, Dvorak Hall of the Rudolfinum exterior



Fig. 5, Gewandhaus exterior



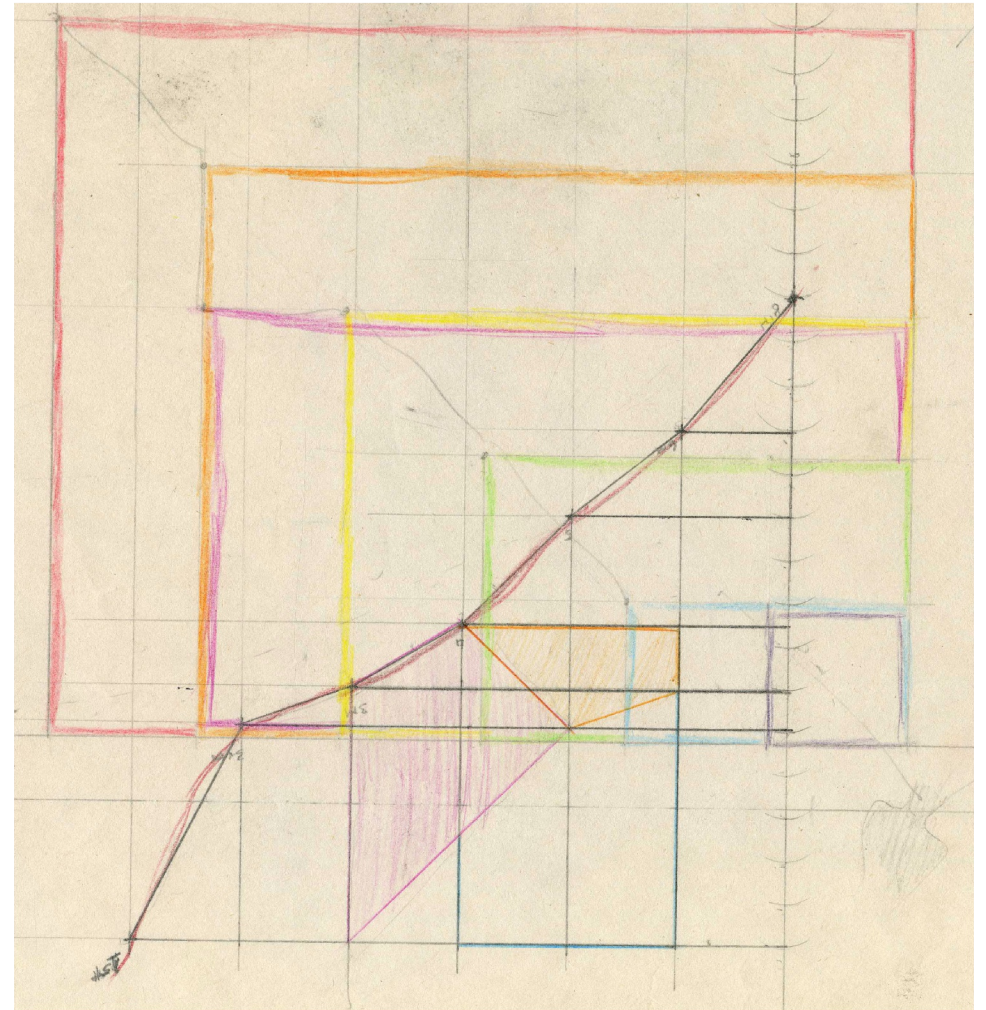
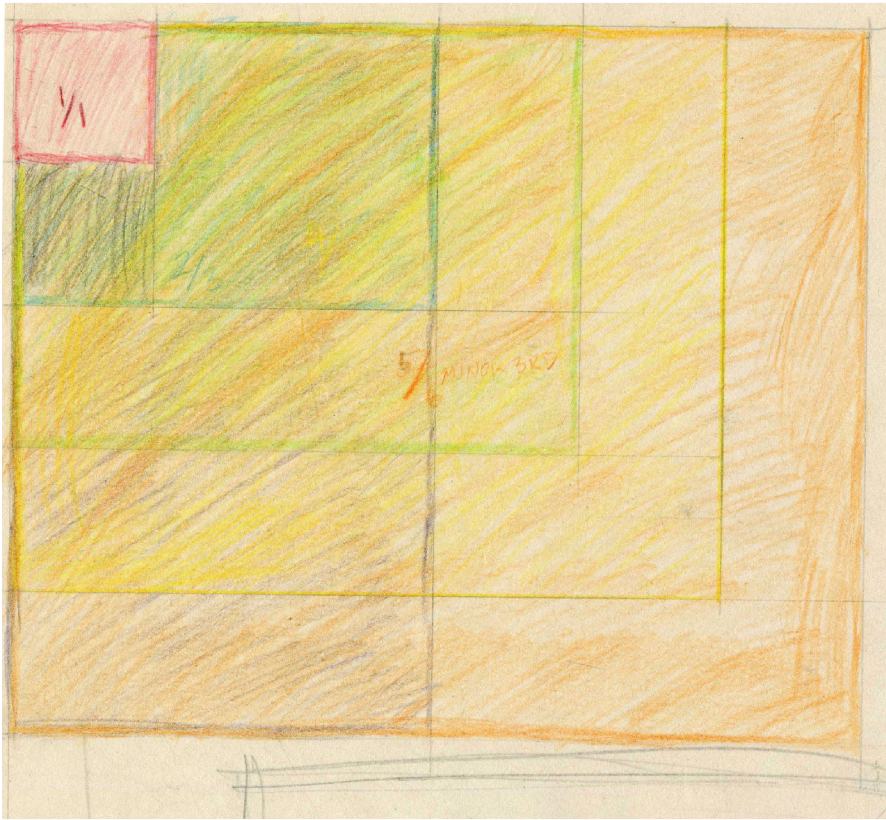
Fig. 6, Gewandhaus organ

## SCHEMA

## THE GENERATION OF FORM FROM MUSIC

It was sometime in high school when I made the connection between music and geometry. I discovered for myself that which Pythagoras had discovered thousands of years ago. A violin does not have frets like a guitar, so muscle memory and aural memory are of utmost importance in learning where to place the fingers on the fingerboard for each desired note. When learning the violin, one soon finds out that the fingers must be placed closer and closer together the farther up on the fingerboard the note is. This is evident on a guitar as the frets are placed increasingly closer together the higher the note. But I asked myself why it is such? I noticed that to play a note that is an octave higher than the open string, I hold the string down at exactly half its length. Thus, half the original length of the string is vibrating. Then to play another octave higher, I hold the string down at half of the remainder of the length: one quarter the length of the original open string. So all the notes in the first octave fit in one half of one string length, but all the notes for the second octave only have one quarter of a string length, and as expected, the third octave only gets one eighth the length. This clearly follows the pattern of a population growth equation. Knowing that the frequency of the A above middle C is 440Hz, we can set the "population"  $P$  of time  $t=0$  at 440. And having discovered the geometric relationship of the octave being 1:2, we set  $P=880$  when  $t=12$ ; 12 because in Western music, the octave is broken into 12 half steps. Each half step has a letter or a letter and sharp or flat associated with it, A through G. With the variables set in the population growth equation, it yields  $P(t)=440*(2^{(t/12)})$ .

| RATIO | NO. OF HALF STEPS | MUSICAL INTERVAL |
|-------|-------------------|------------------|
| 1:1   | 0                 | TONIC            |
| 15:16 | 1                 | diminished 2nd   |
| 8:9   | 2                 | 2nd              |
| 5:6   | 3                 | minor 3rd        |
| 4:5   | 4                 | major 3rd        |
| 3:4   | 5                 | 4th              |
| 32:45 | 6                 | augmented 4th    |
| 2:3   | 7                 | 5th              |
| 5:8   | 8                 | minor 6th        |
| 3:5   | 9                 | major 6th        |
| 5:9   | 10                | diminished 7th   |
| 8:15  | 11                | 7th              |
| 1:2   | 12                | OCTAVE           |



Figs. 7-8, Early diagrams searching for architectural form in the harmonic ratios.

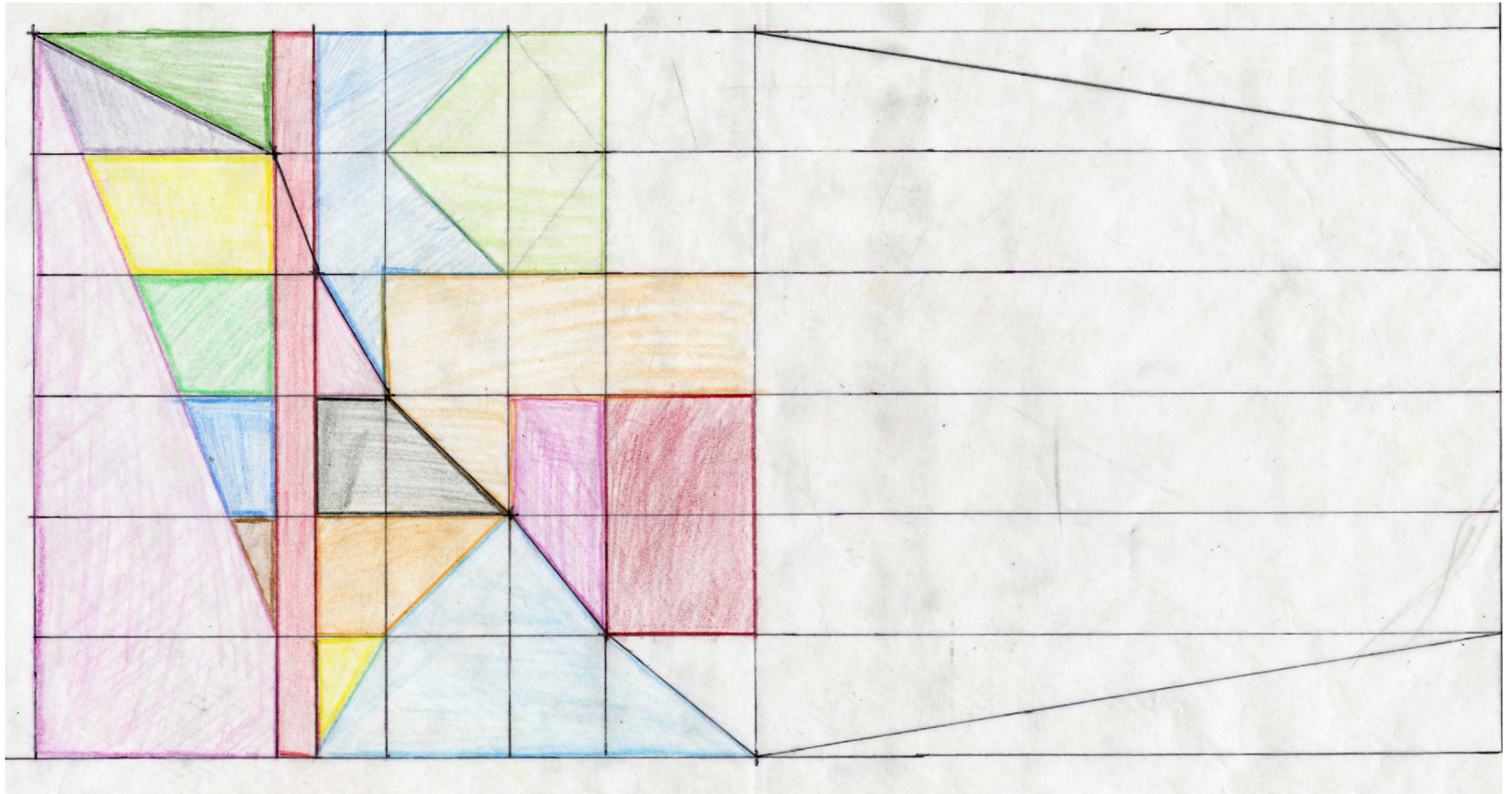


Fig. 9, Early diagram searching for architectural form in the harmonic ratios.

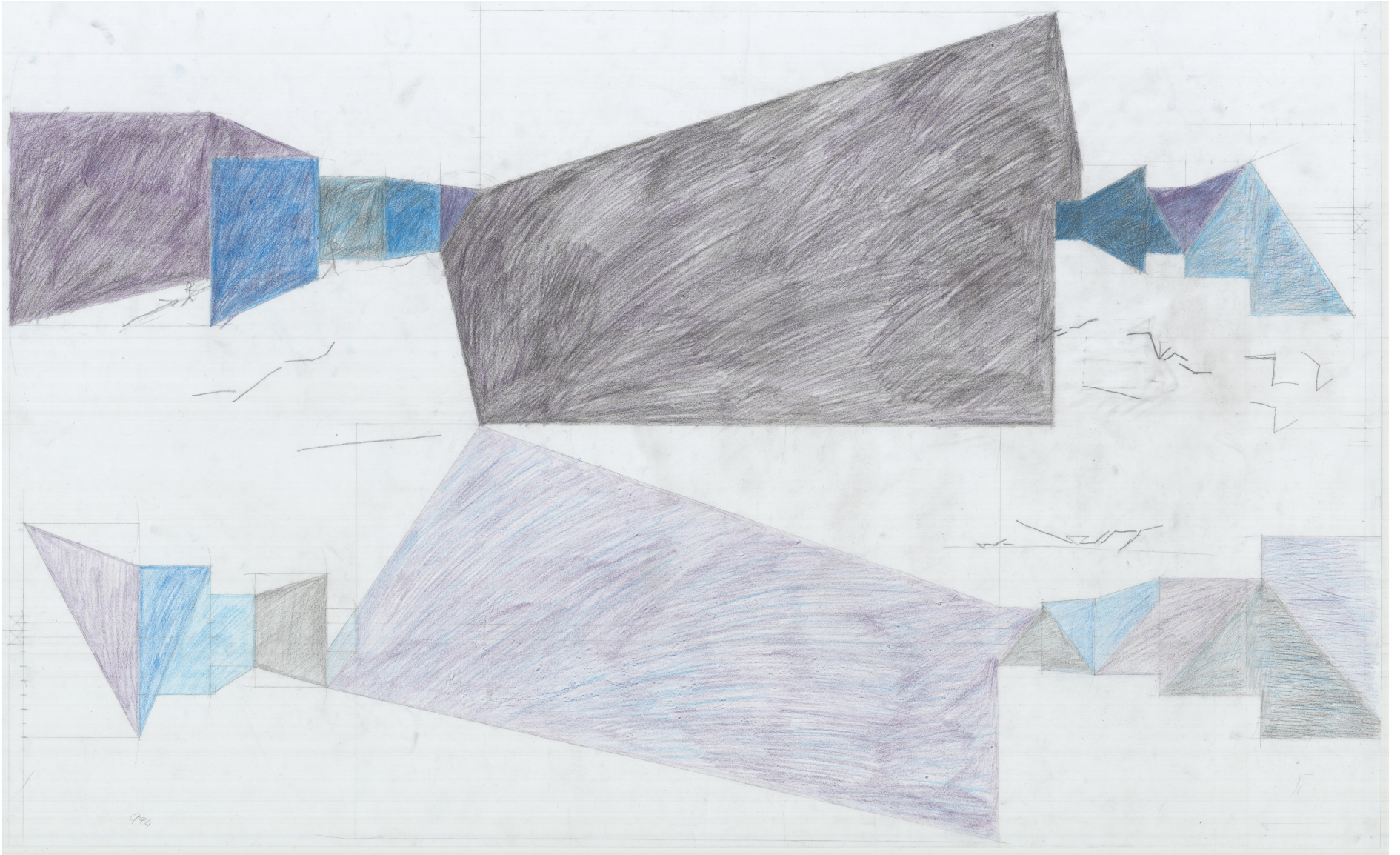


Fig. 10, Diagram on which the building is based.

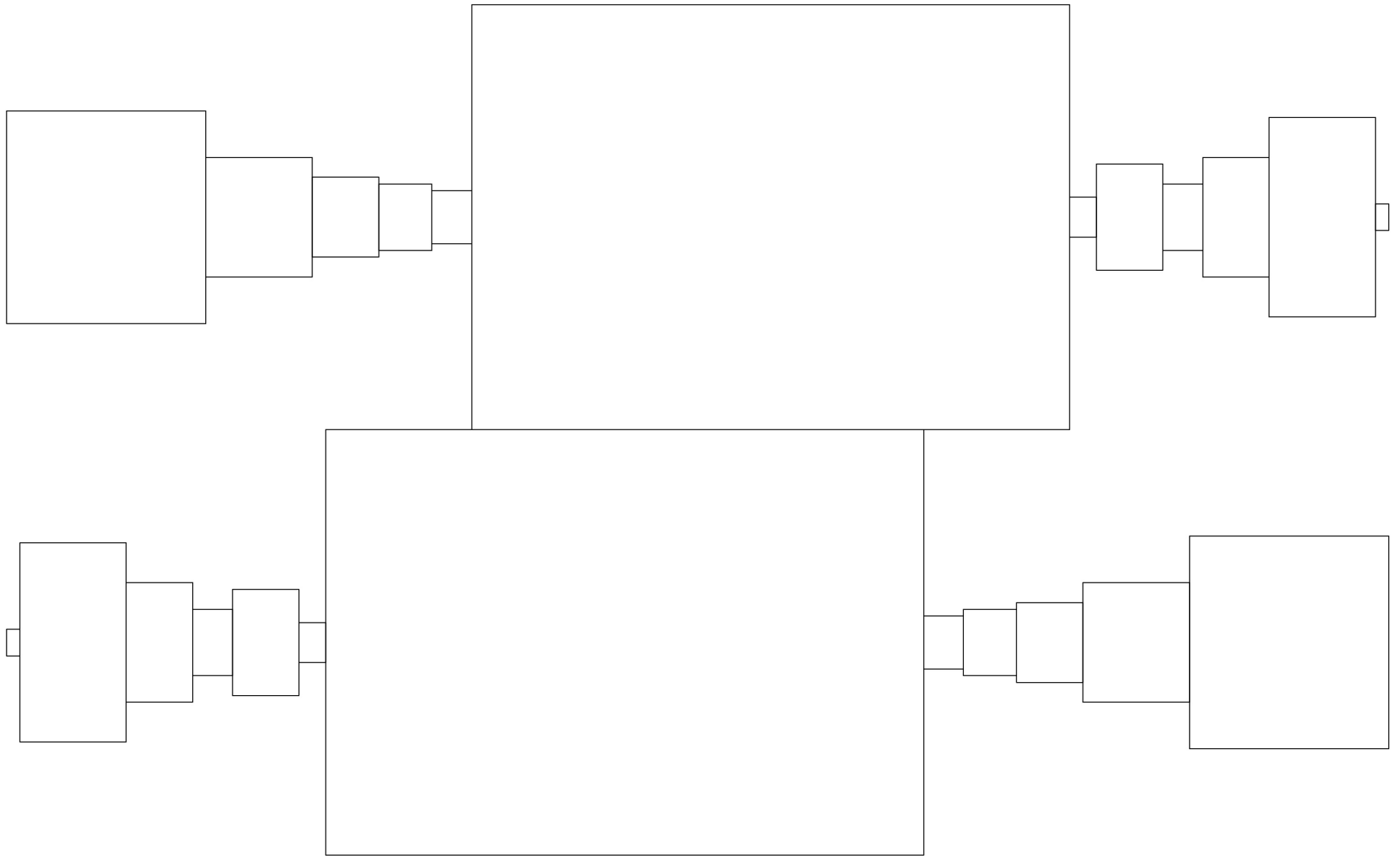


Fig. 11, Two identical series of rectangles from opposite directions as visual description of the harmonic ratios.

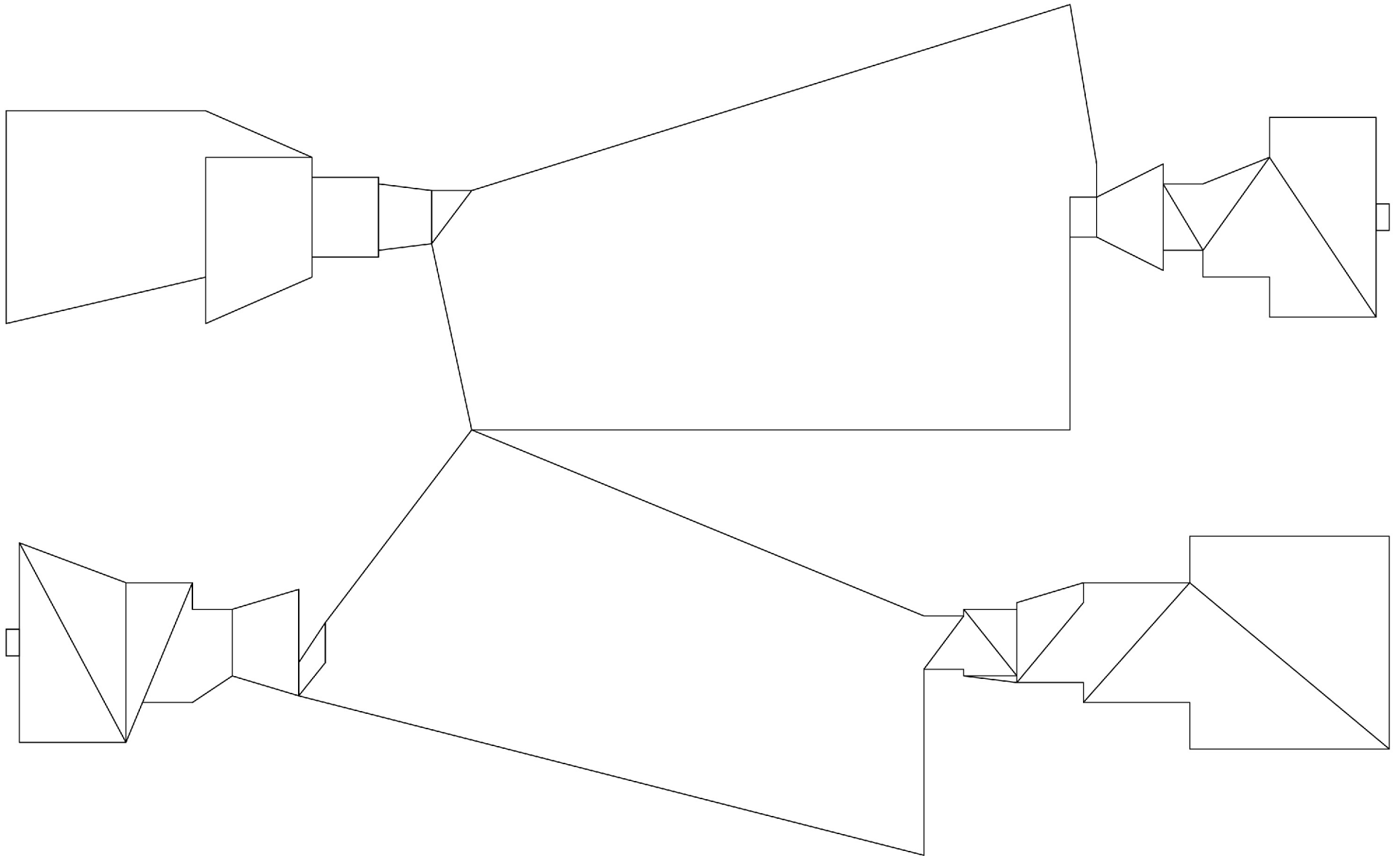


Fig. 12, Diagram derived from the series of harmonic rectangles. The building is based on the top series. It resembles a perspective elevation view of a building.

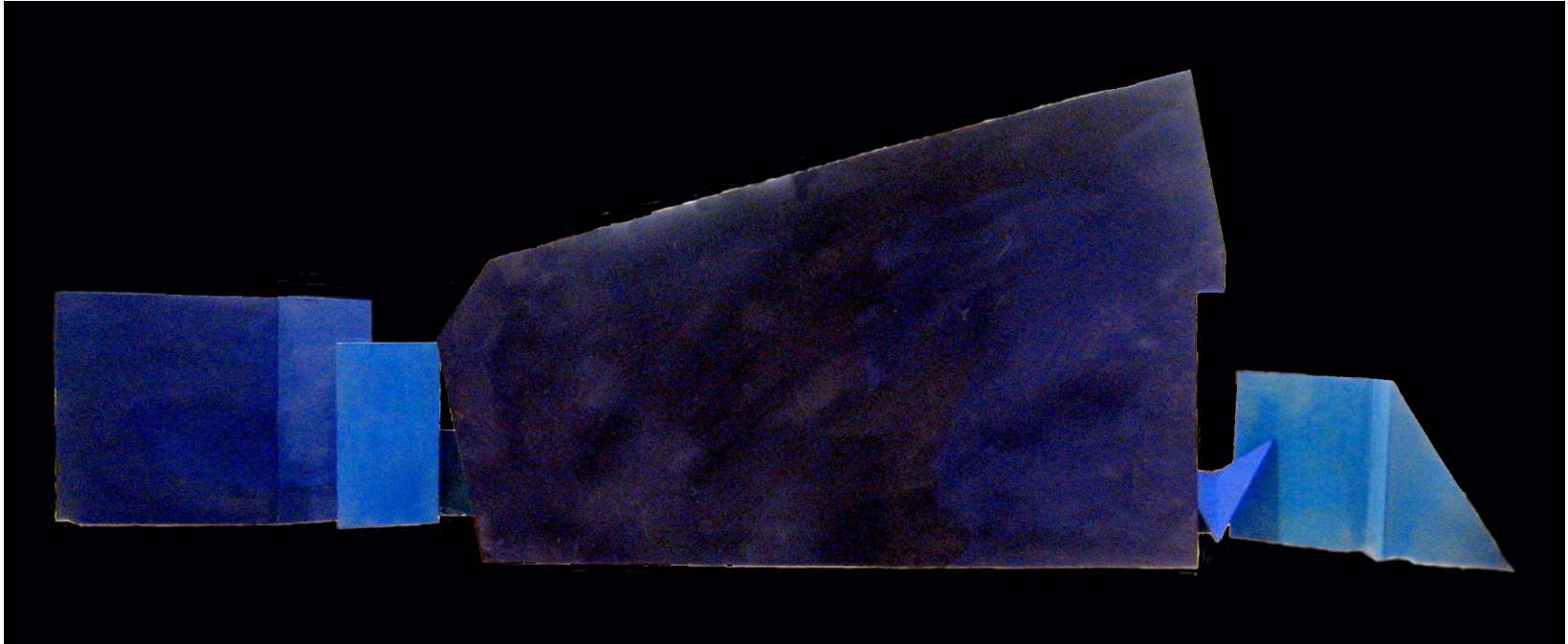


Fig. 13, Sketch model based on the diagram on the previous page.



Fig. 14, Sketch model overhead view.

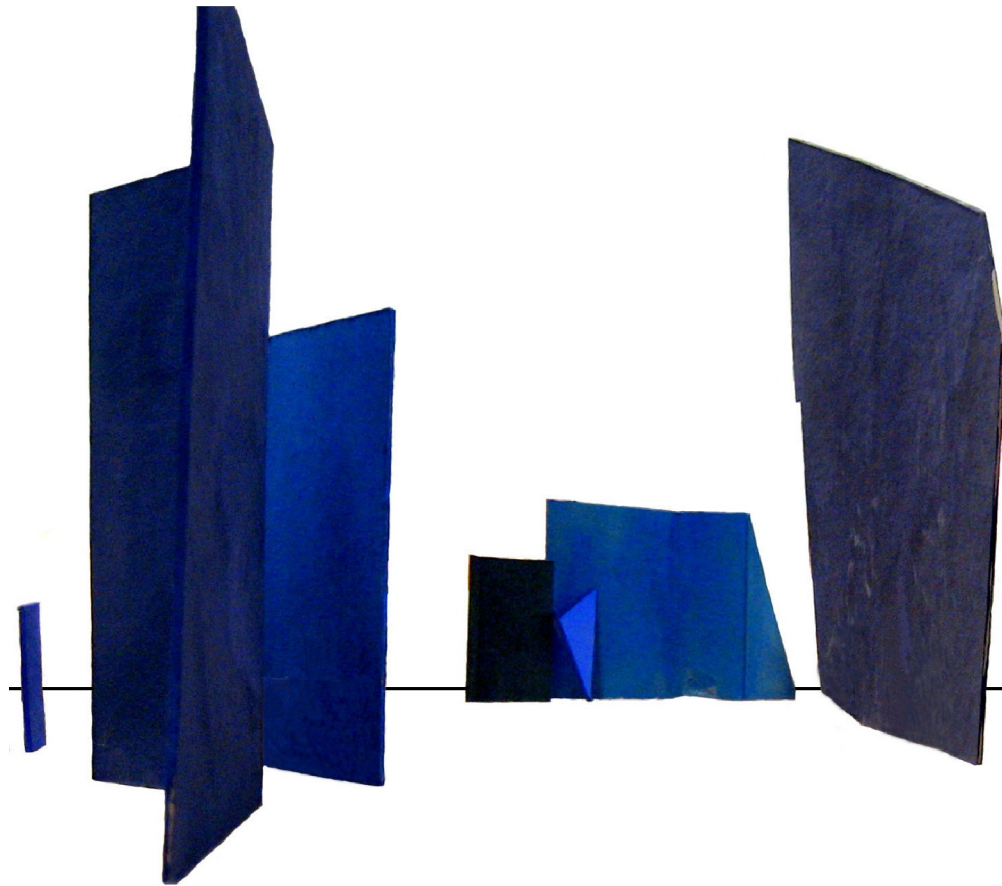


Fig. 15, Sketch model view A.

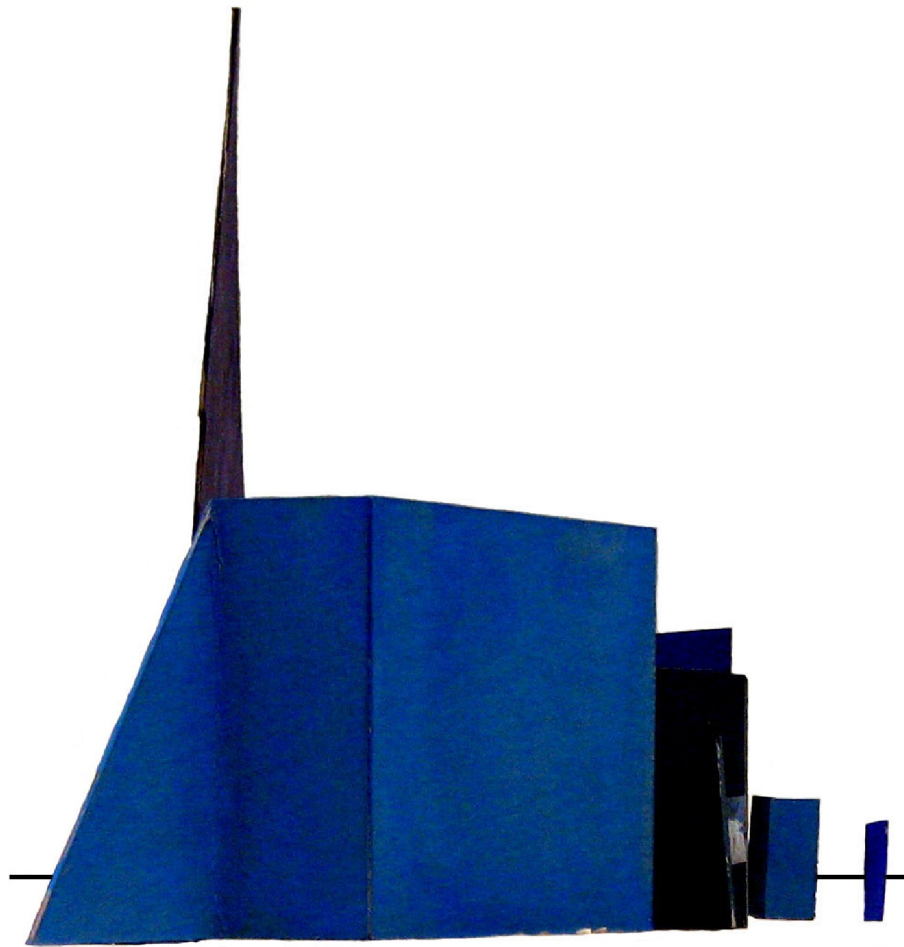
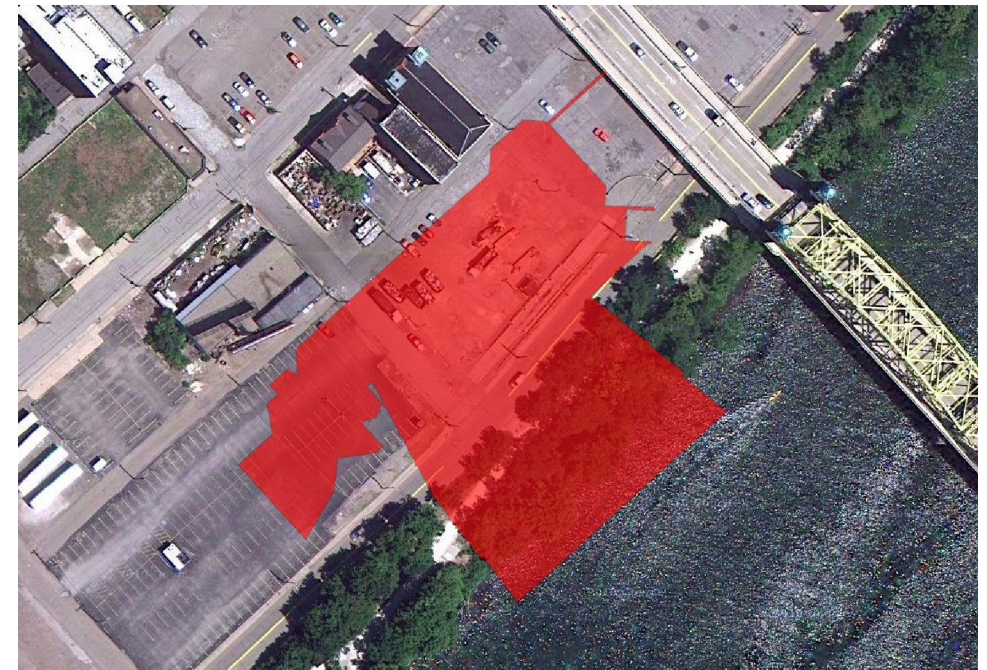


Fig. 16, Sketch model view B.



Fig. 17, Site Location

Fig. 18, Site



The site is located in the city of Pittsburgh, on the North Shore of the Allegheny River. Across the river is the Strip District, which by day is a lively market district and by night is a lively bar and club scene. The site strongly affected the design of the building, taking advantage of its site lines toward downtown Pittsburgh to the southwest, as well as its proximity to the Strip District and its connection to it via the historic 16th Street Bridge, and being on the riverfront. A terrace cantelevers above the existing bike trail and over the river. The intersection of the bike trail and the building's opening to the river make for a pleasant civic space where the line between public and private are blurred. Choosing this site anticipates this dead stretch of four blocks to develop, as it sits between Pittsburgh's sports stadia and the old Heinz Plant, which has been recently refurbished to be the Heinz Lofts. Placing a concert hall here would catalyze such a development.

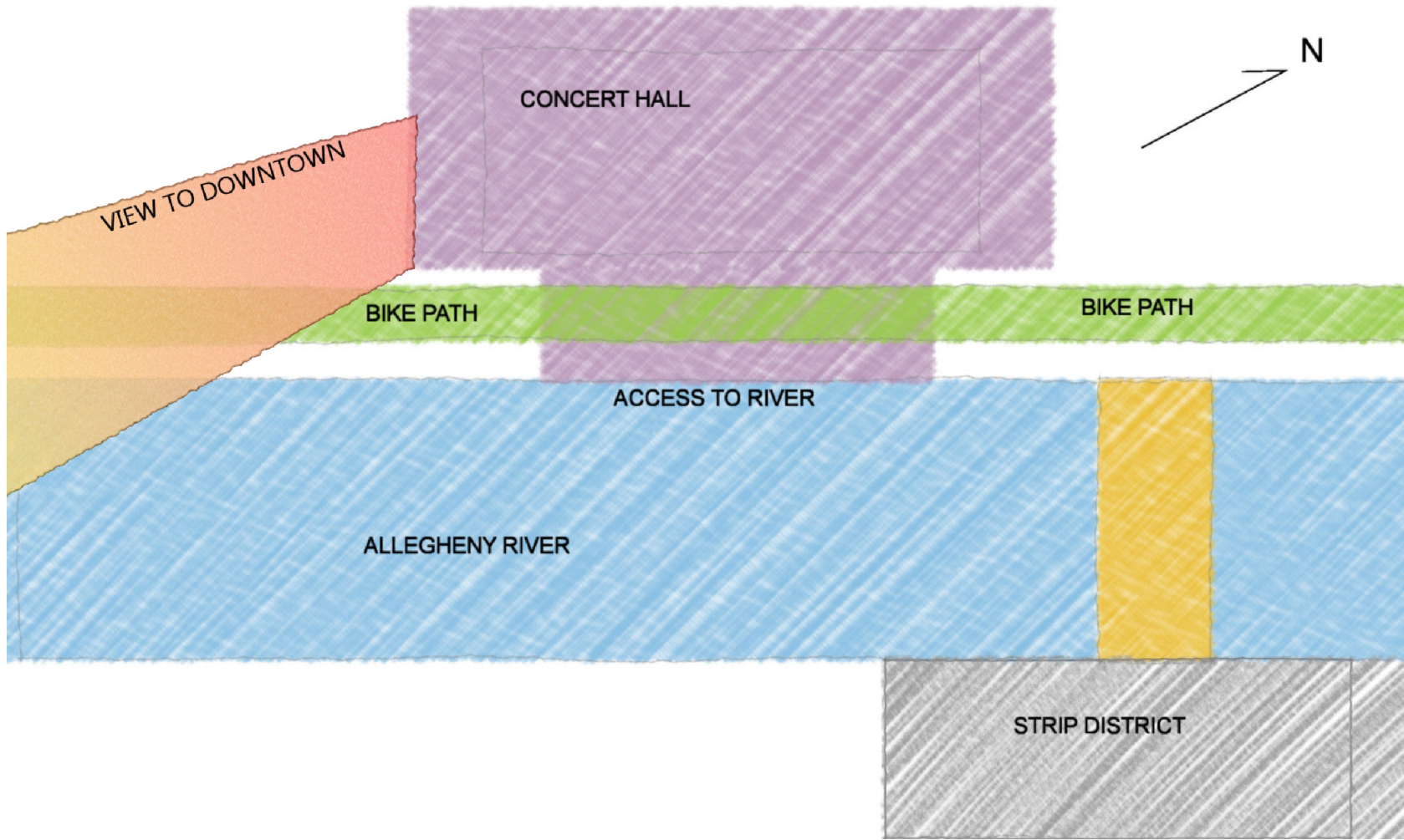


Fig. 19, Site diagram

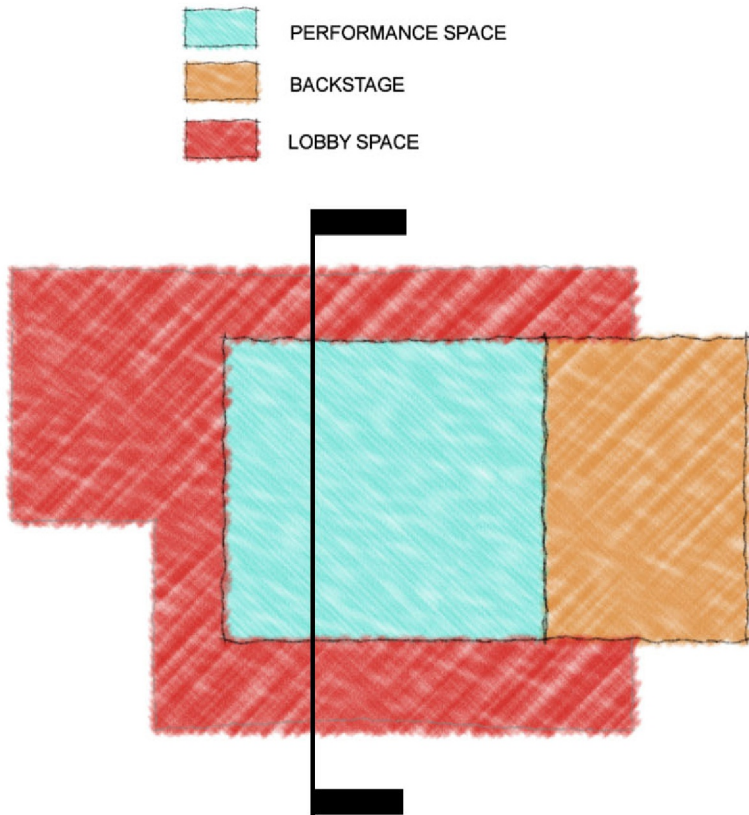


Fig. 20, Program plan diagram.

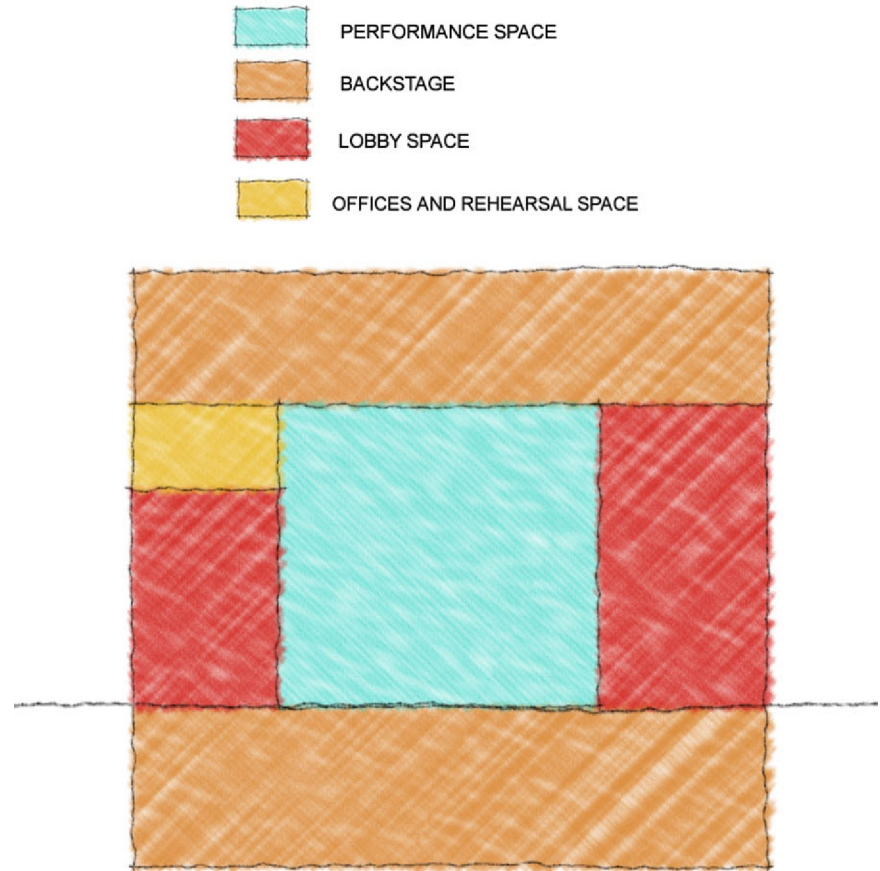


Fig. 21, Program section diagram.

MASSING

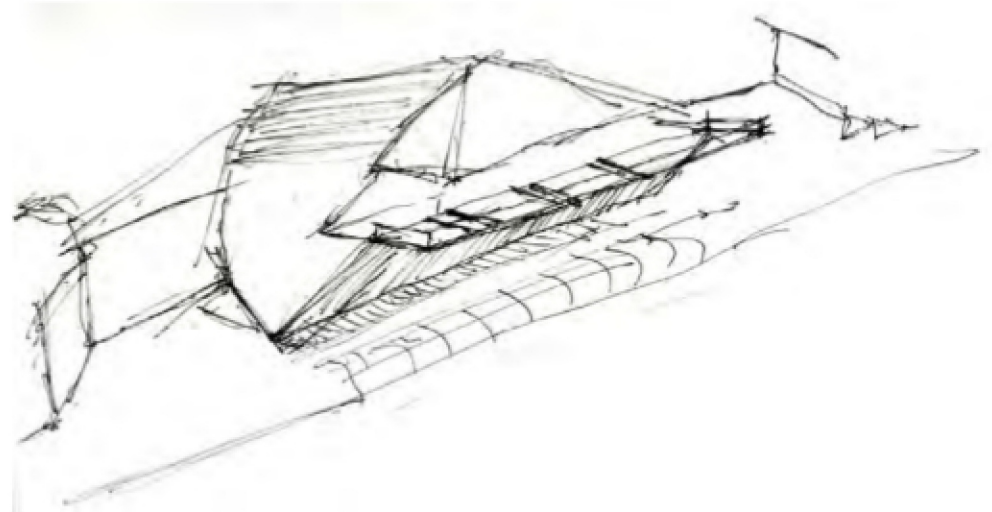


Fig. 22, Concept perspective sketch

With the sketch model suggesting an elevation and the site influences, an image of a building begins to emerge. The large shape in the middle becomes the actual performance space. With the desired site line to the southwest, the left end of the diagram becomes a large lobby space with large windows to let in the view.

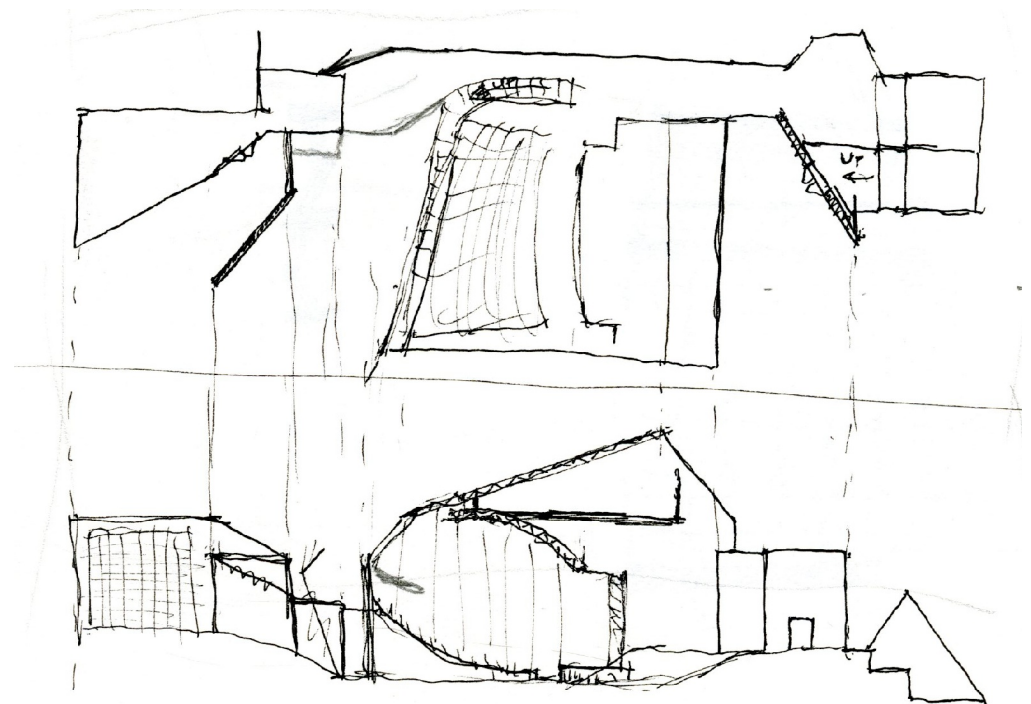


Fig. 23, Concept plan and section sketches

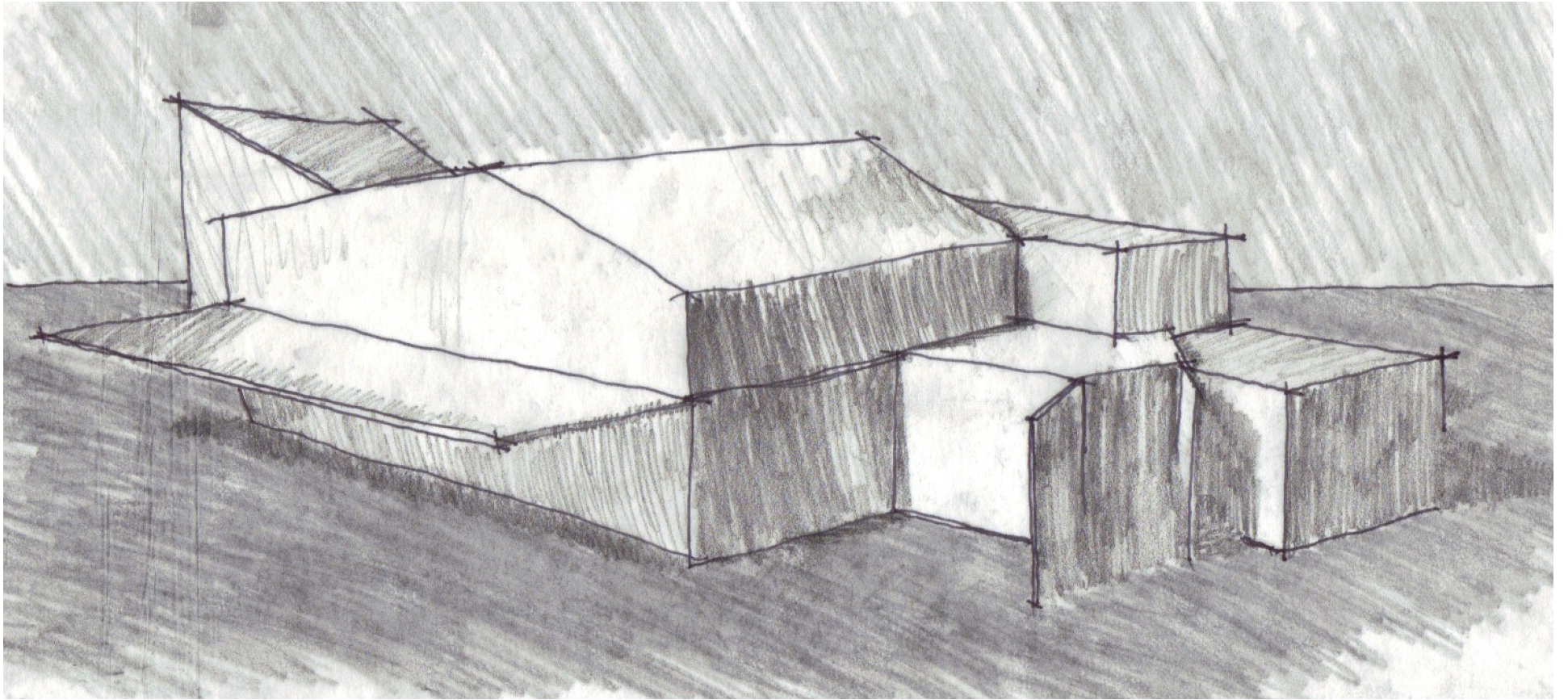


Fig. 24, Form study sketch

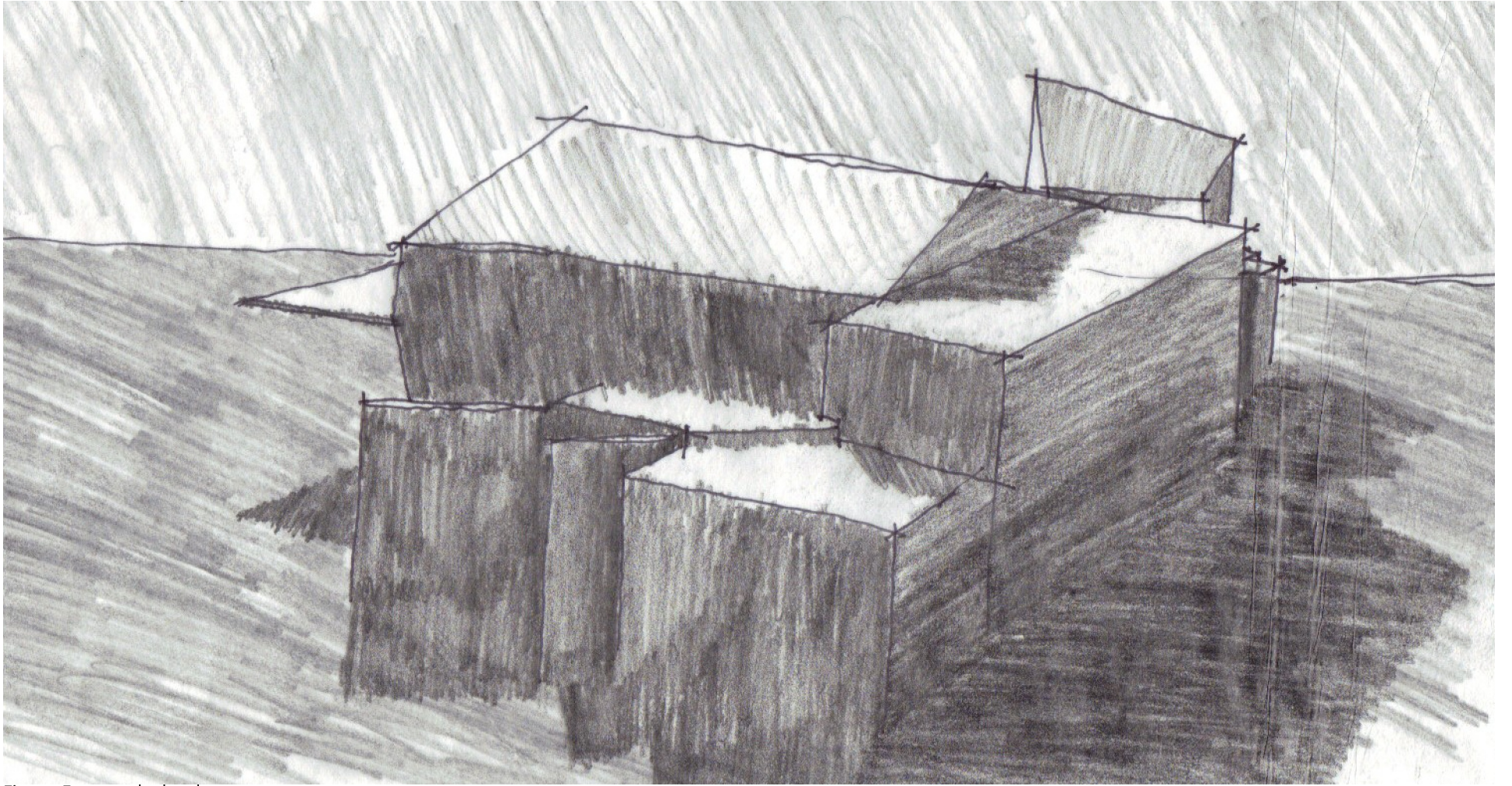


Fig. 25, Form study sketch

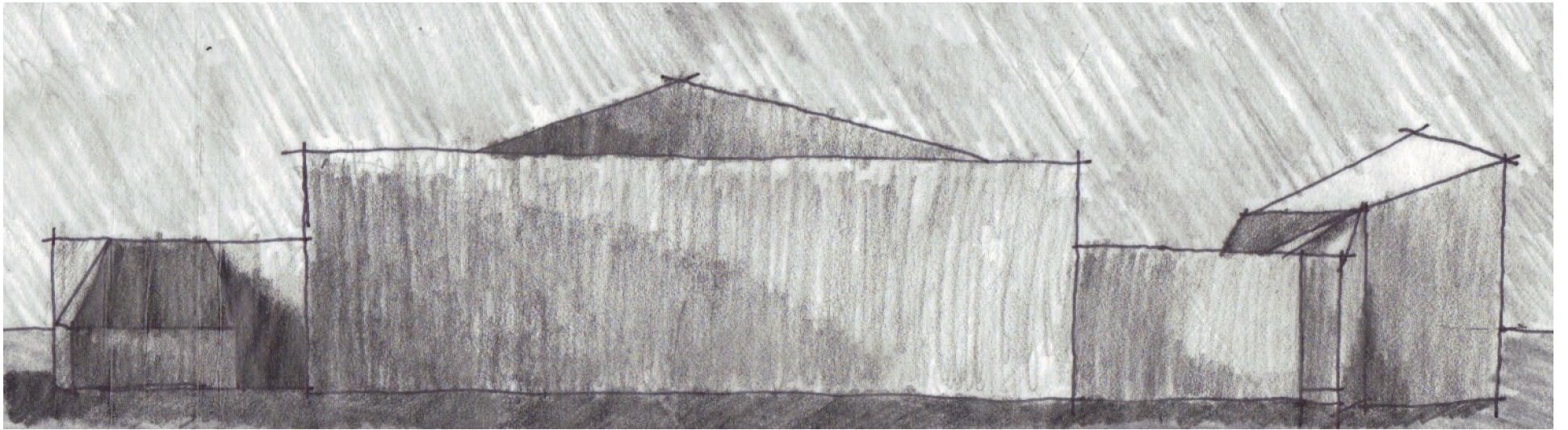


Fig. 26, Form study sketch

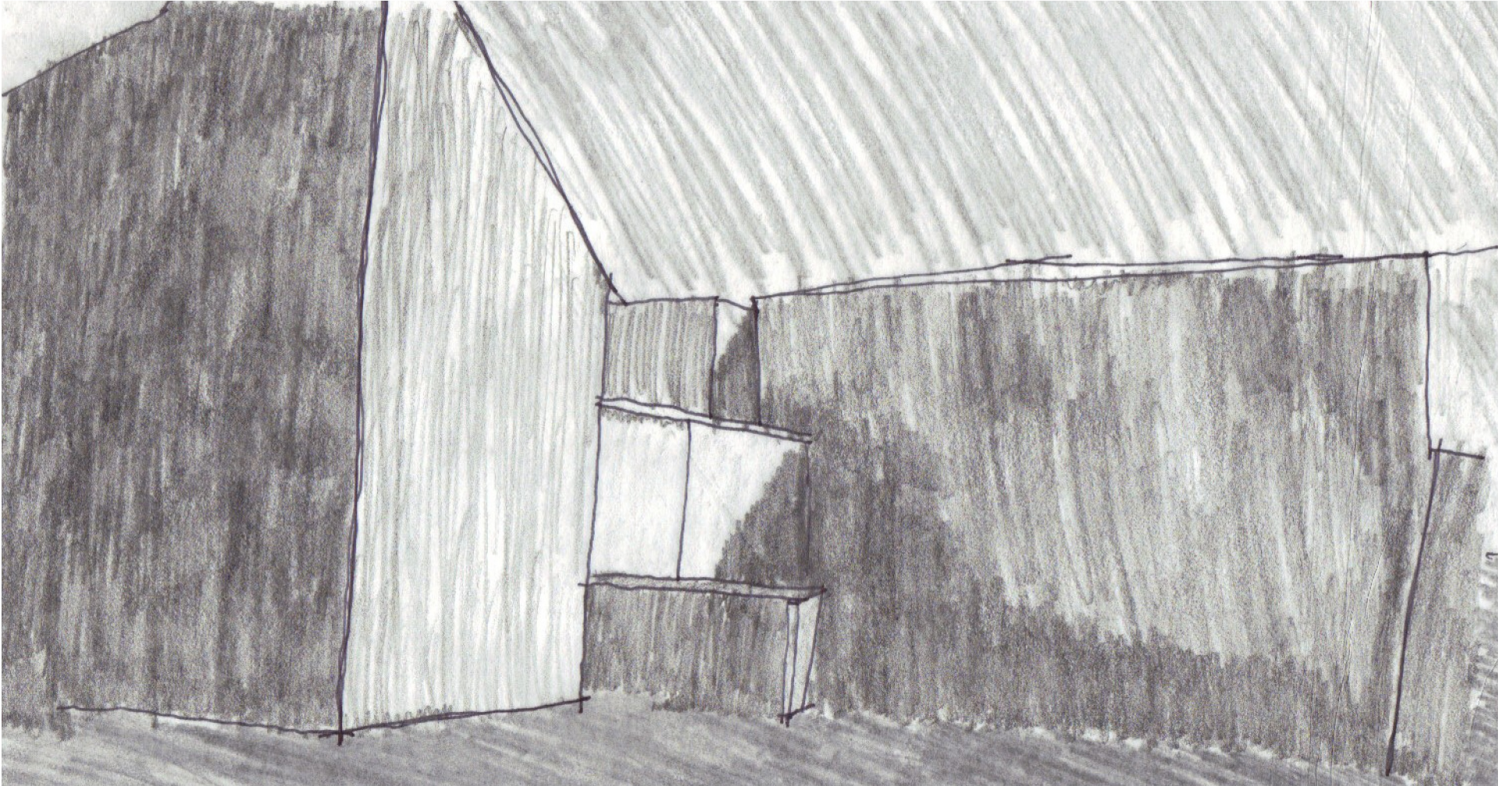


Fig. 27, Form study sketch

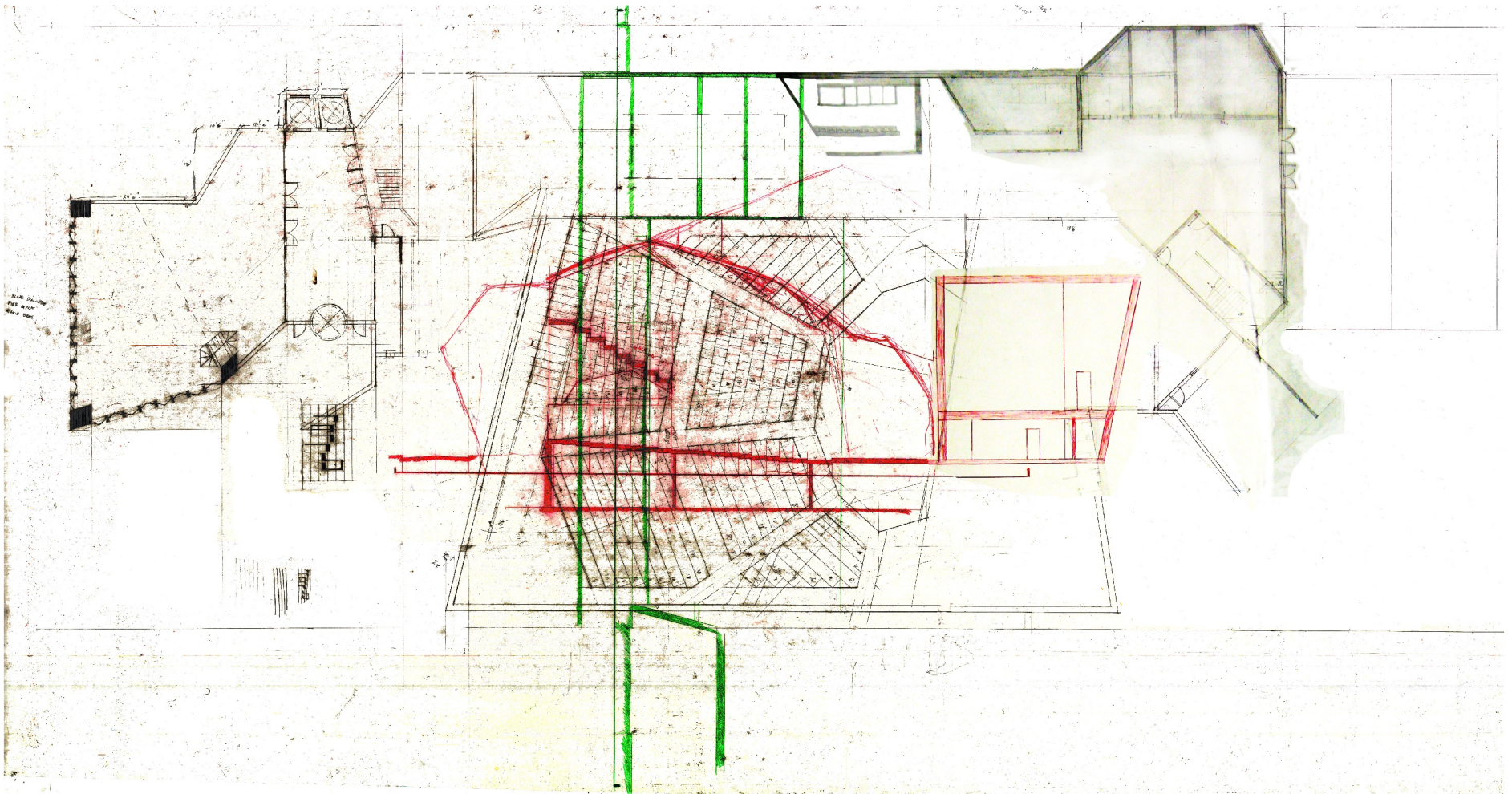


Fig. 28, Developments of plans and sections from the model. Red is long section. Green is short section.

## THE BUILDING

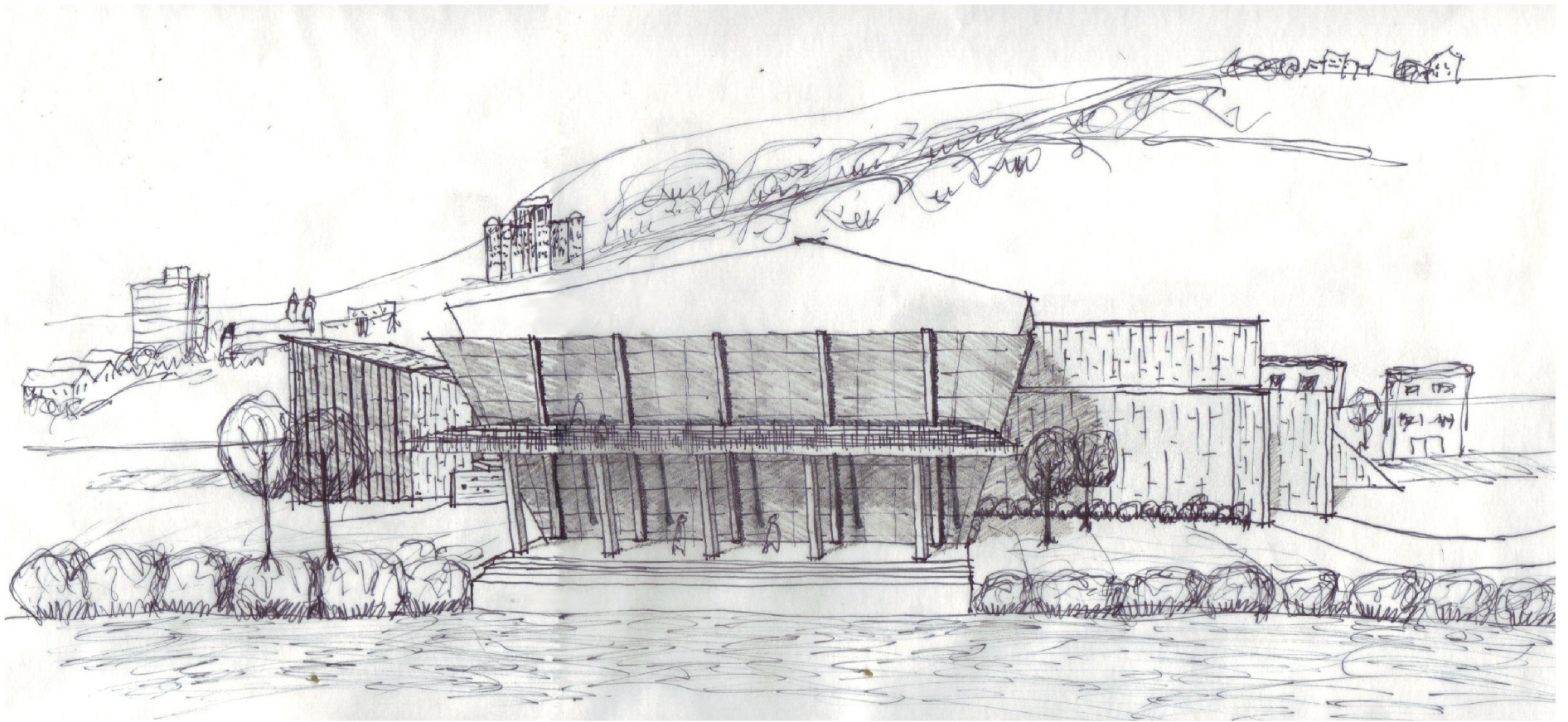


Fig. 29, View of building from across the river

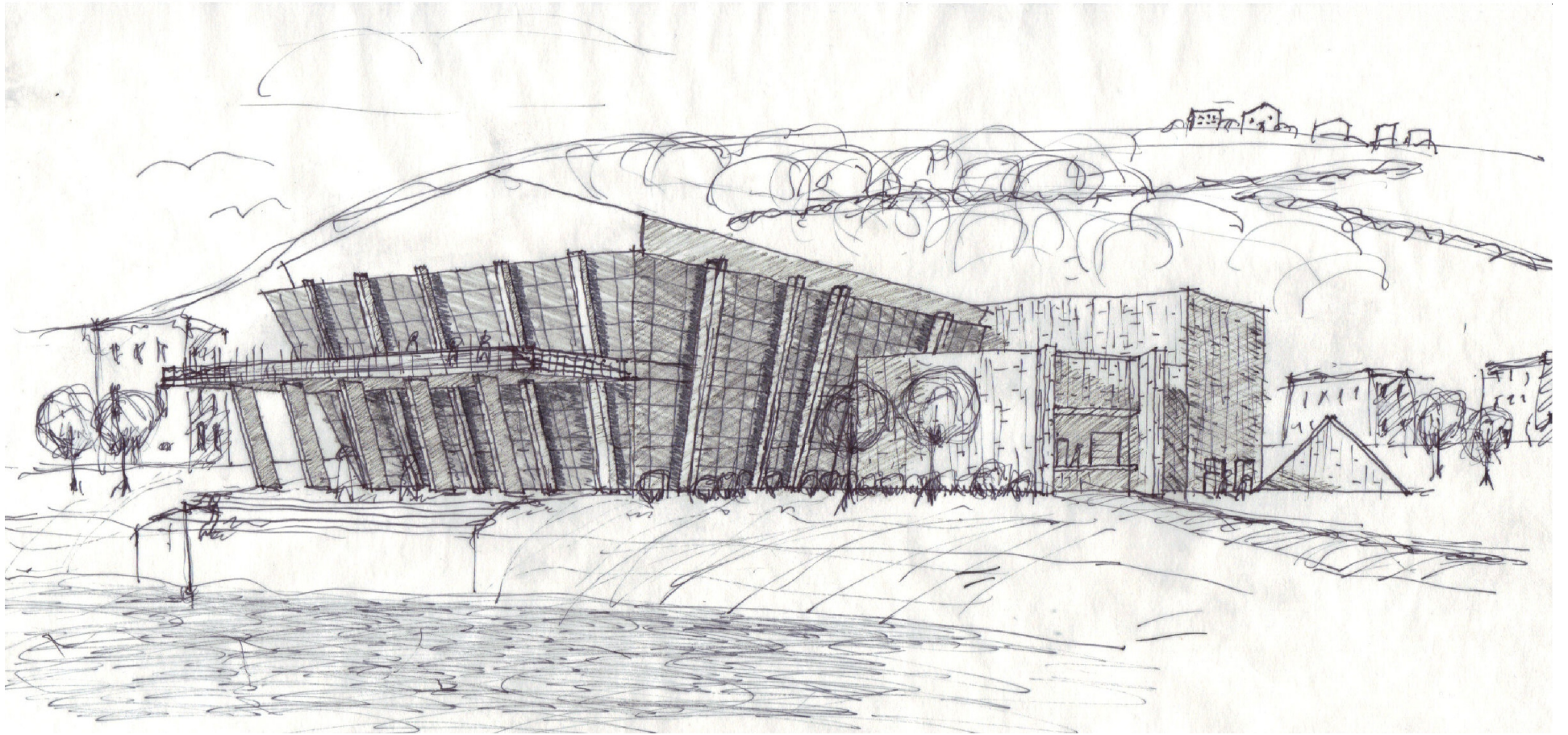


Fig. 30, View of building from the river looking west

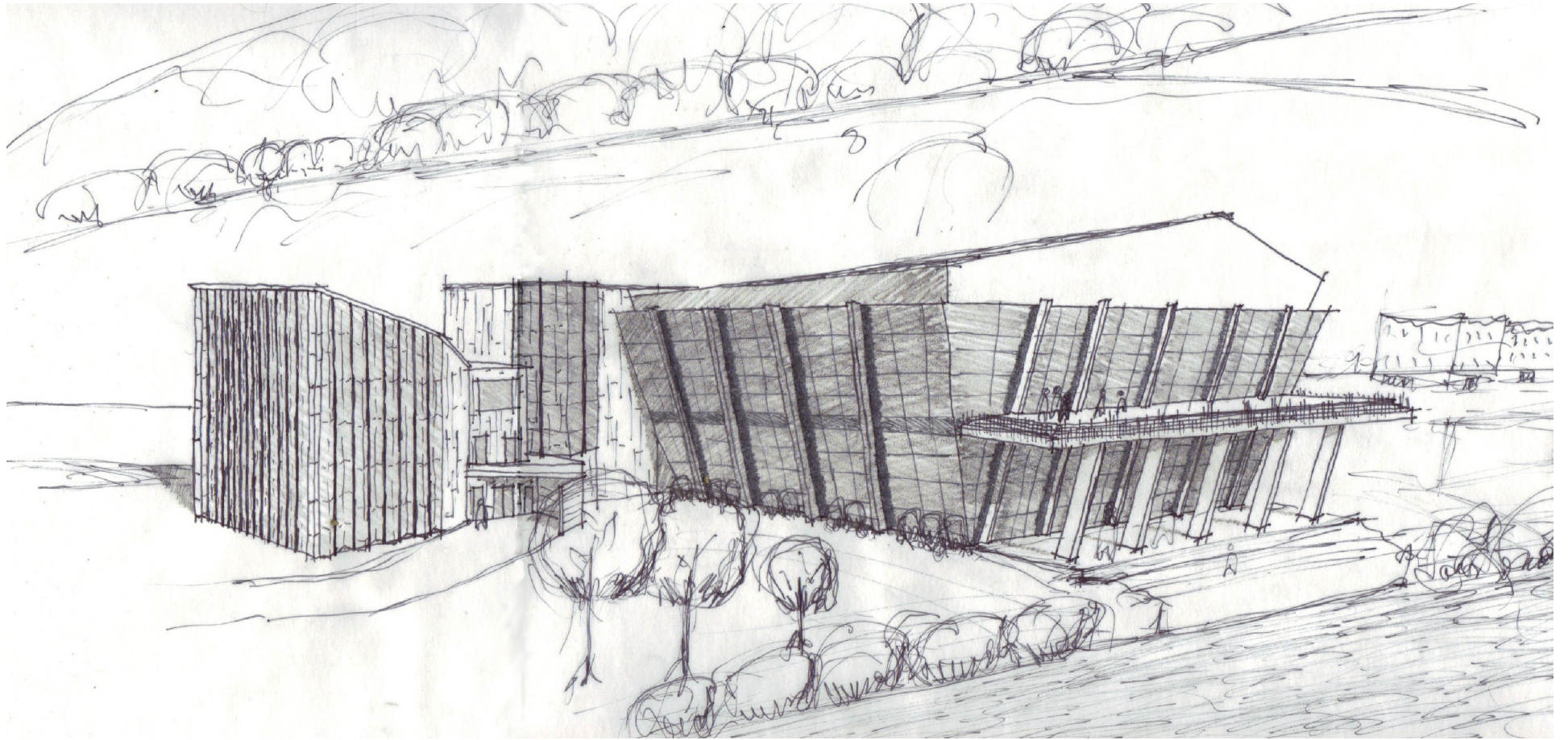


Fig. 31, View of building from the river looking north

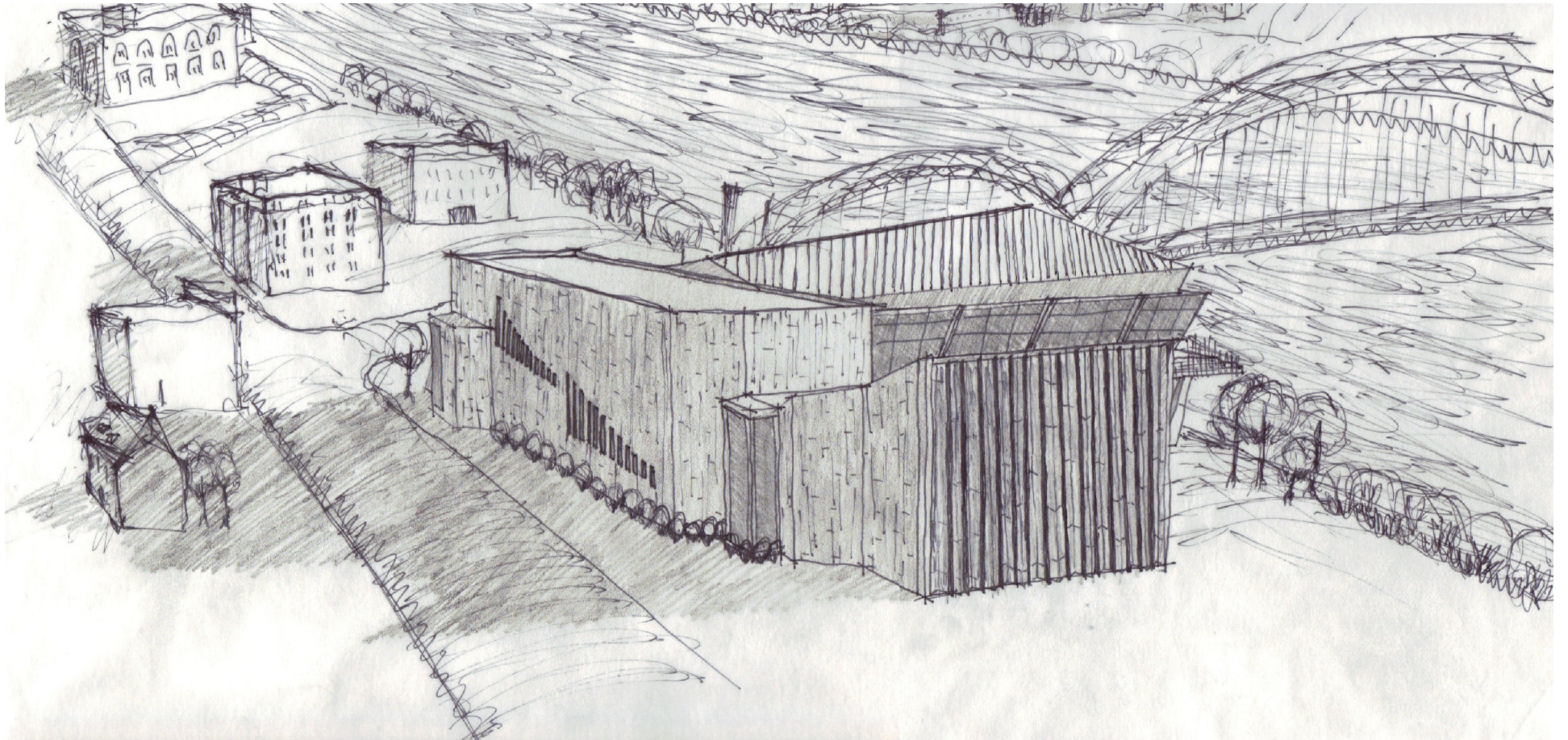


Fig. 32, View of building looking east

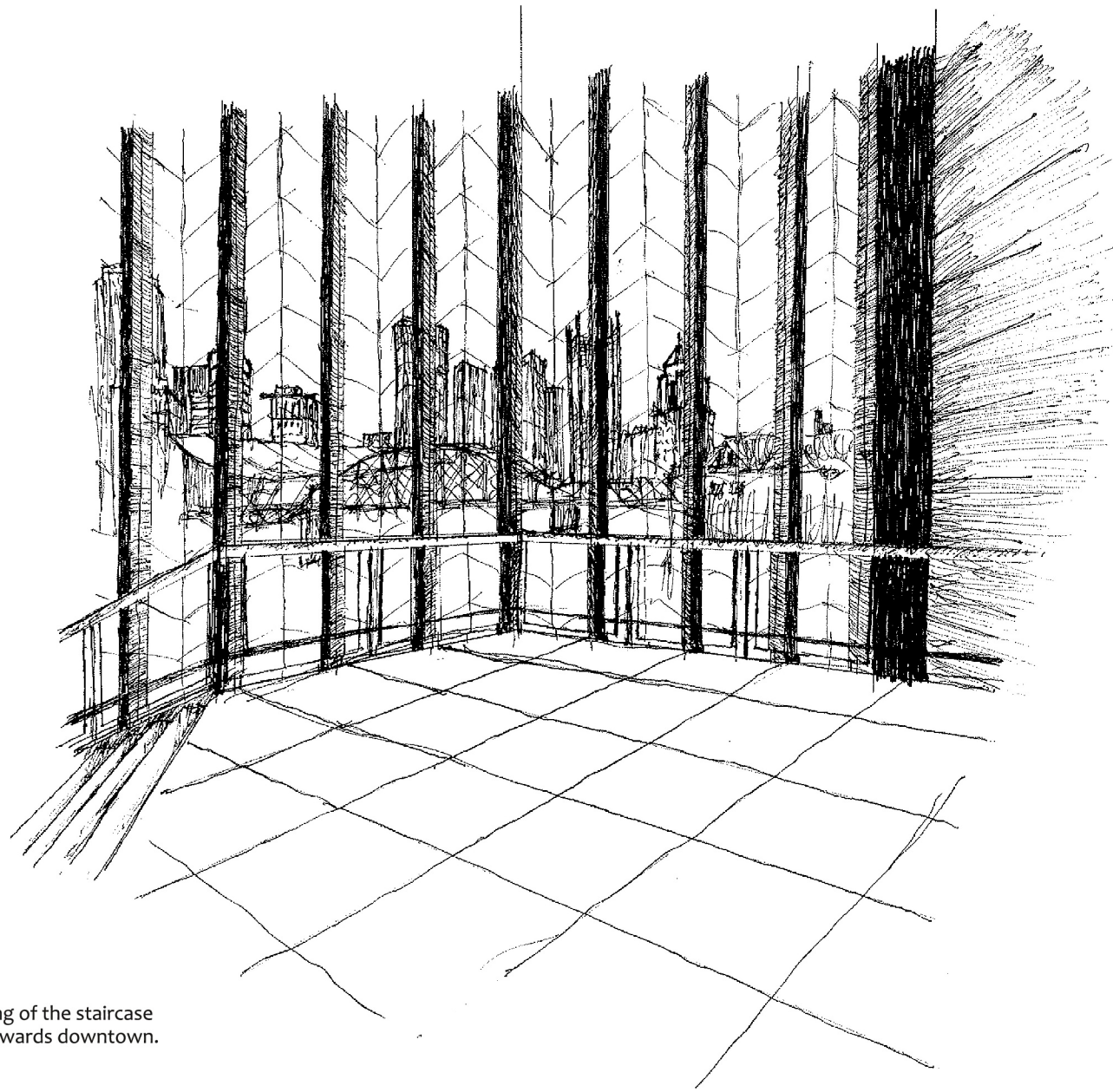


Fig. 33, Standing on the landing of the staircase looking out the curtainwall towards downtown.

## PLANS AND SECTIONS



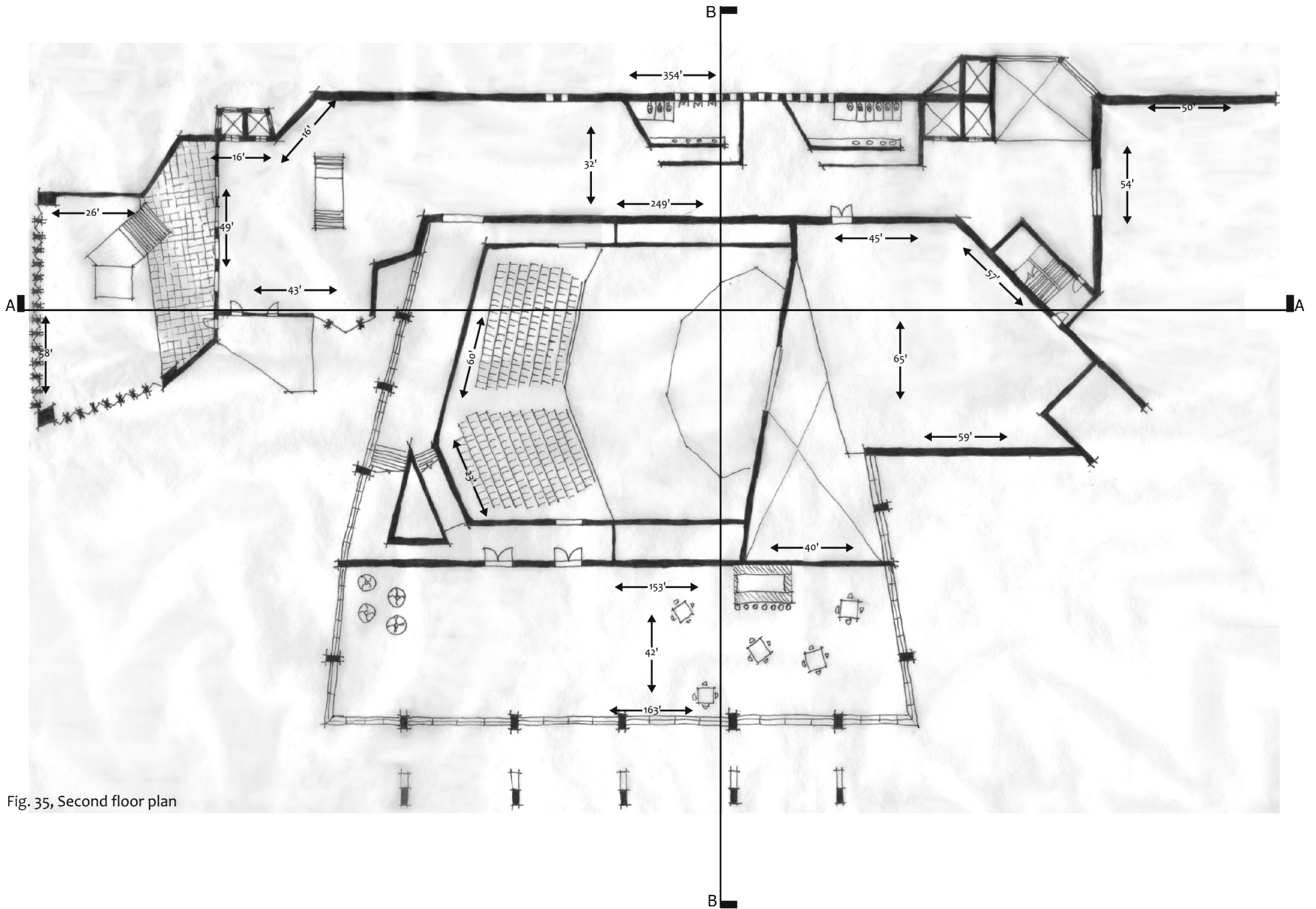


Fig. 35, Second floor plan

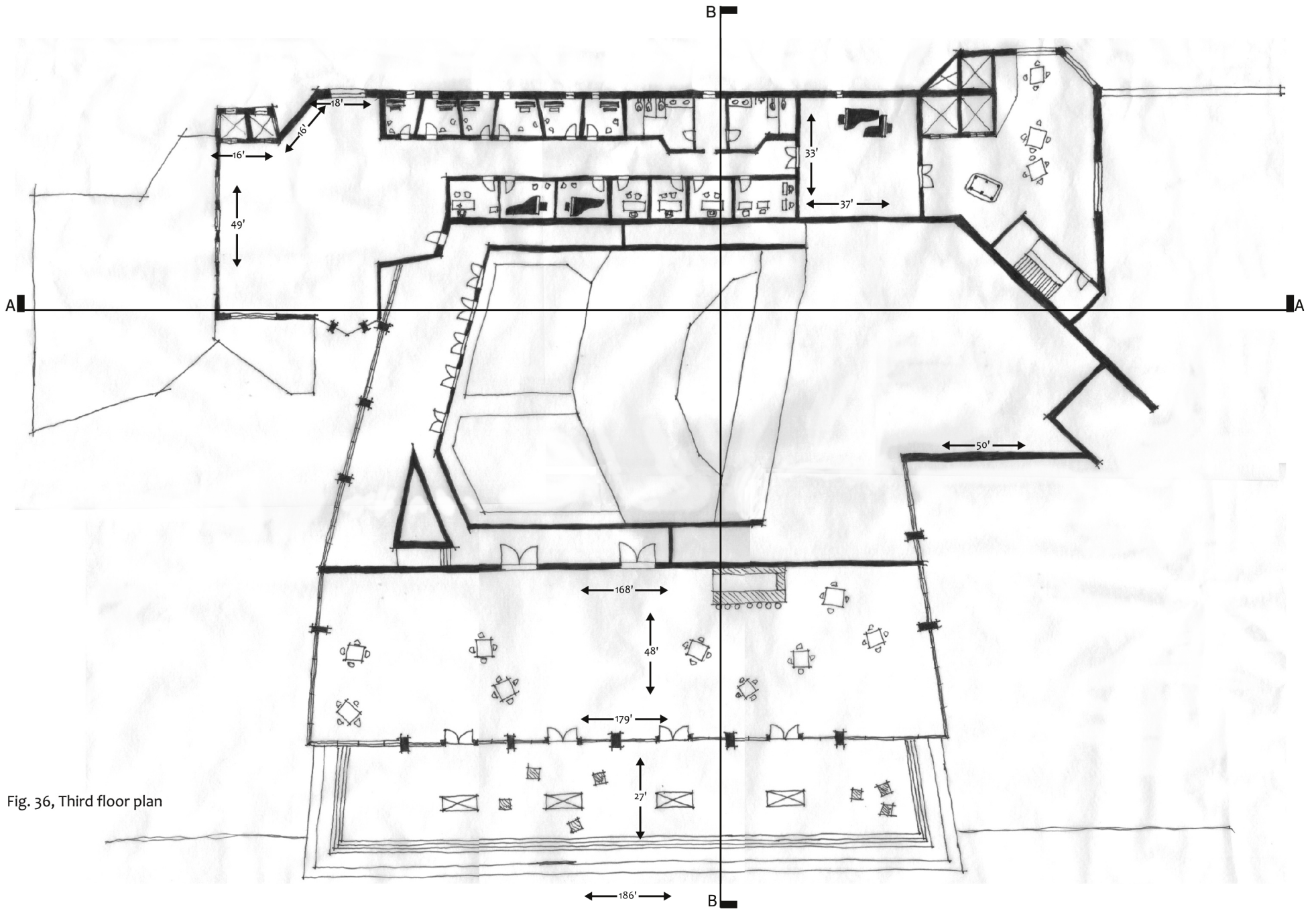


Fig. 36, Third floor plan

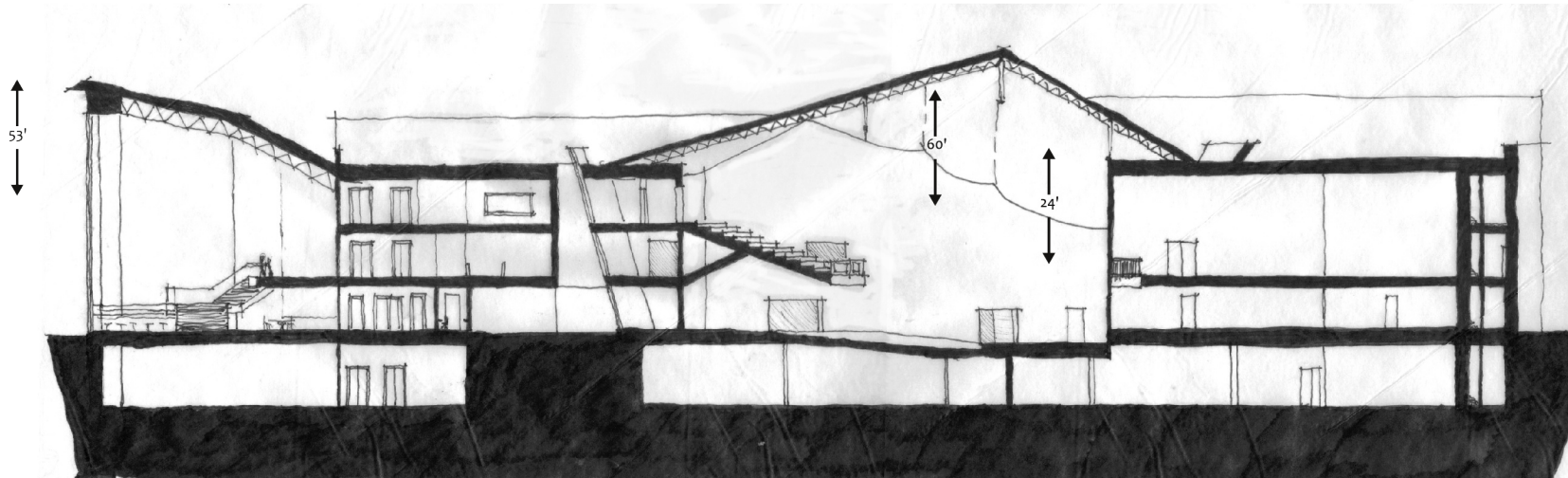
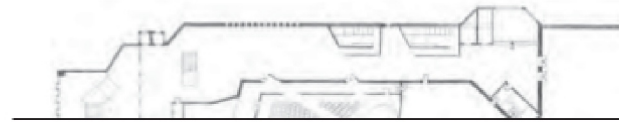


Fig. 37, Section A

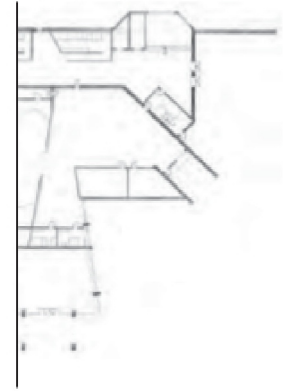
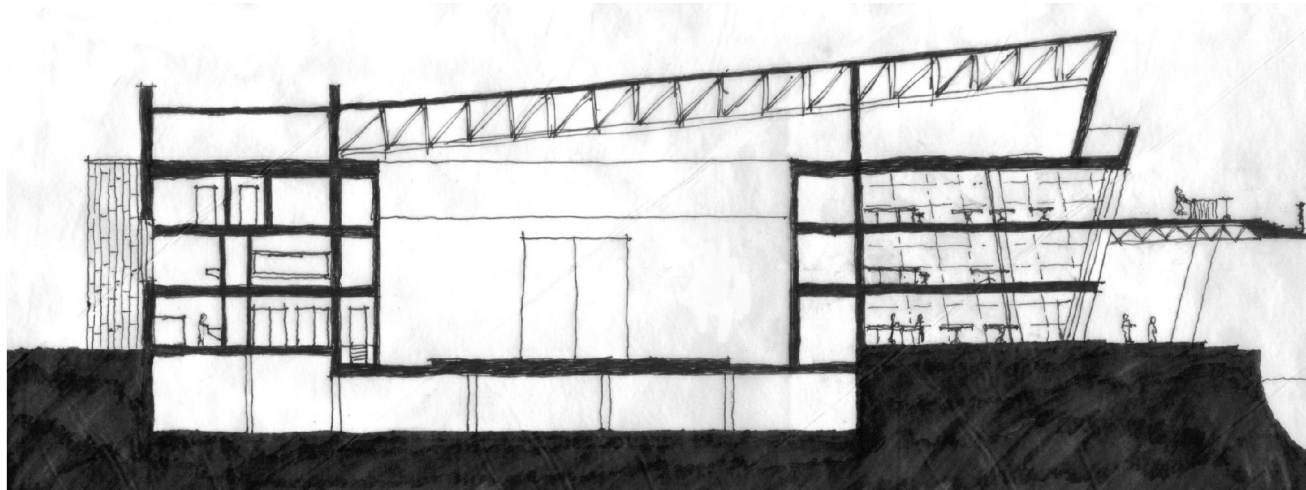


Fig. 38, Section B

## DETAILS

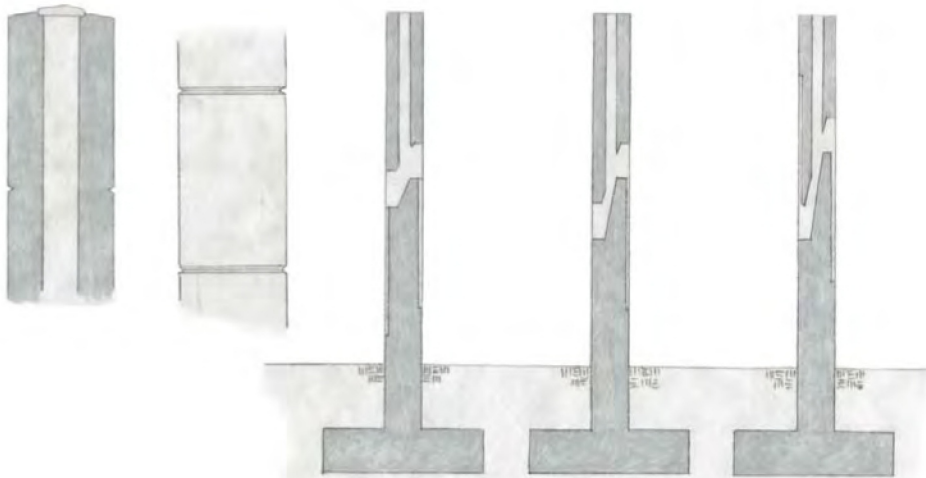


Fig. 39, Entry wall section

The wall next to the main entrance is ten feet tall, concrete, divided horizontally by five recessed lines to create a musical staff. One measure from Johannes Brahms' Academic Festival Overture is relieved into either side of the wall with the notes connected through the middle of the intersection of each note to let light in. This is a literal visual demonstration of music used as ornamentation.

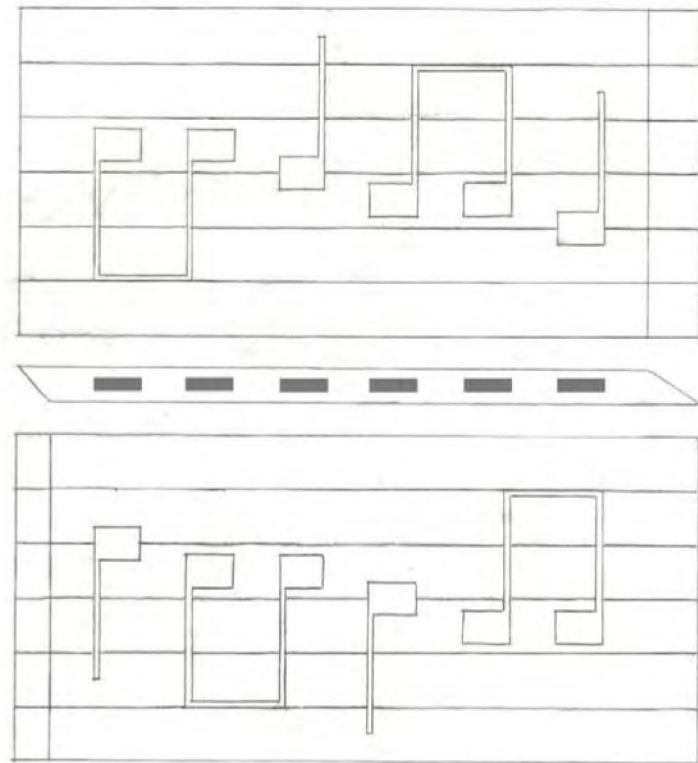
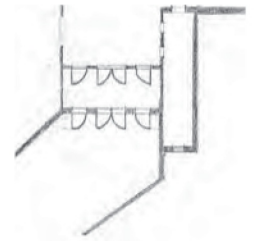


Fig. 40, Entry wall plan and elevations

A conceptual guard rail along the terrace above the Allegheny River based on Brahms' Hungarian Dance no. 1. From across the river, it reads from left to right. If one were to be standing on the terrace and reach out to strike the posts while running along them, the music would play correctly from right to left. This orientation works because music, like Latin lettered languages, reads on the page from left to right, and most people are right-handed, therefore most people would be naturally inclined to "play" it correctly. This is a physical demonstration of music. The longer the post, the deeper the pitch. Thus the varying pitches provide the shape of the line.

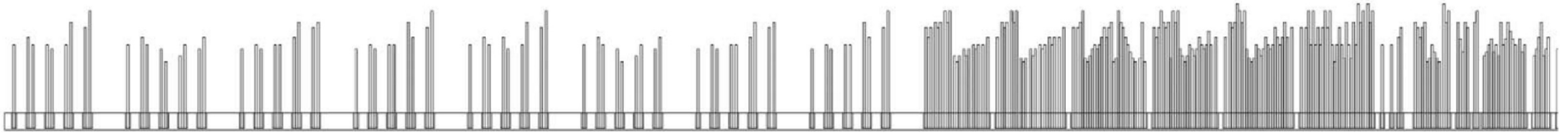
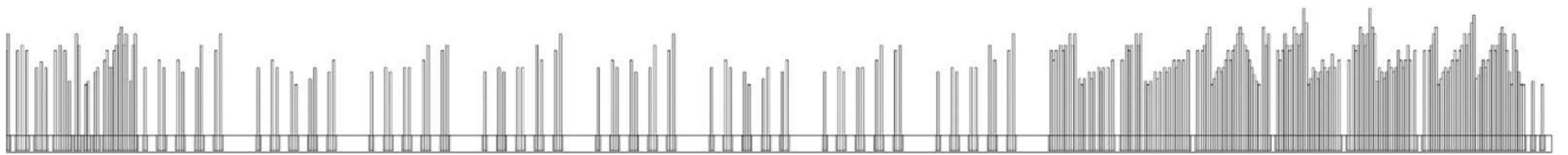


Fig. 41, Musical guard rail elevation



## EPILOGUE: MUSIC AND ARCHITECTURE ANALOGY

In musical composition, a greater level of dynamism can be created with dissonance resolved by consonance. Unresolved dissonance is unpleasant and harsh; it works well as background music for horror flicks where uncertainty builds to disorder. Consonance without any tension is dull and unimaginative. Beethoven, in his first symphony starts boldly by breaking the rules of musical composition at the time. He completely avoids the intended key for the first twelve bars. Each phrase starts with tension and ends in slight resolution, but the big resolution of the larger twelve-bar phrase is in the thirteenth bar when he finally comes down hard with a heavy foot in the key of C major.

With the very first chord of the symphony, he sets up tension with the dissonant Cdim7 chord: a C major chord with the diminished seventh B flat added to create an unsettling sound; that is, unsettling until made beautiful by resolving it with an F major chord, the subdominant key of C major. This F major chord falsely sets the piece in that key. But it is only a decoy key because he creates more tension by moving on to a Gdim7 chord: G major chord (dominant of C major) with an F natural, the diminished seventh of G major, included for dissonance. This is resolved to another false key of A minor. Then it moves onto the dissonant Ddim7, resolved to the harmonious G major. The tune stays in G major for a few more bars, making it sound like that is the intended key until C major is finally established as the true key for the first movement of the symphony.

It is the series of tensions and releases of these first twelve bars that set up the rest of the movement to be so beautiful, complete, and all the more satisfying. To put it simply, a dissonant chord is unpleasant, but when it precedes a consonant chord, it becomes very satisfying to hear and is the beginning of something good in musical composition. Thus this project takes the same idea and improves the stable order of orthagonal, compression-based concrete construction by juxtaposing it against the geometrically unstable non-orthagonal, tension-based curtainwall construction; and vice versa. It is the yin and the yang existing side-by-side for a harmonious existence. Each improving the other's existence just by existing adjacent to one another.

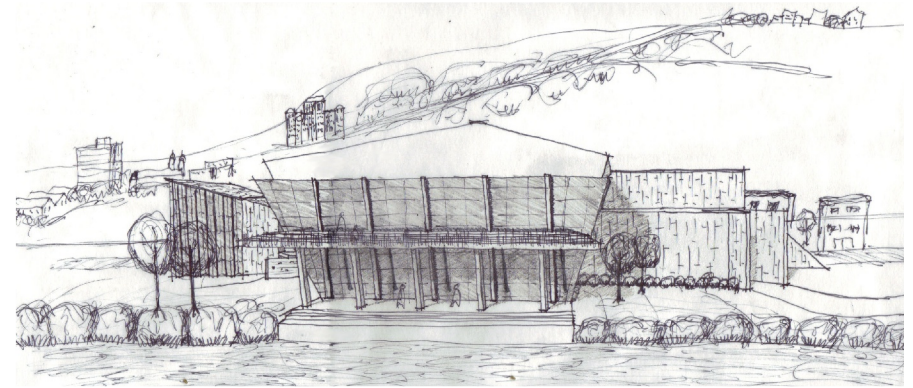


Fig. 42, View of building from across the river, reprise

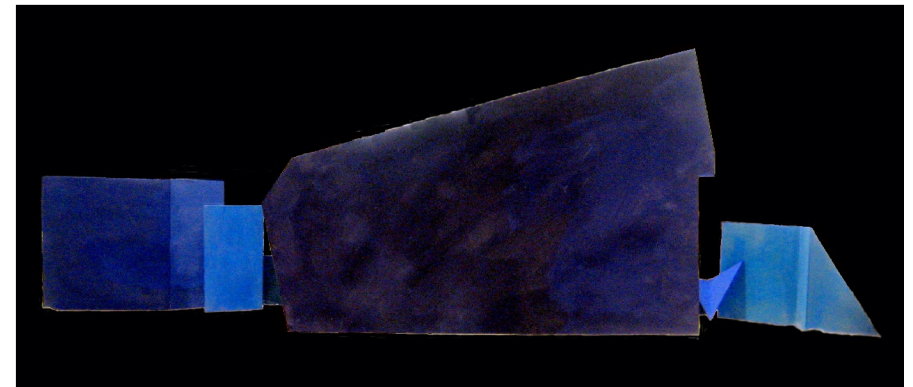


Fig. 43, Sketch model, reprise

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All images are mine except the two Google satellite images on page 20.