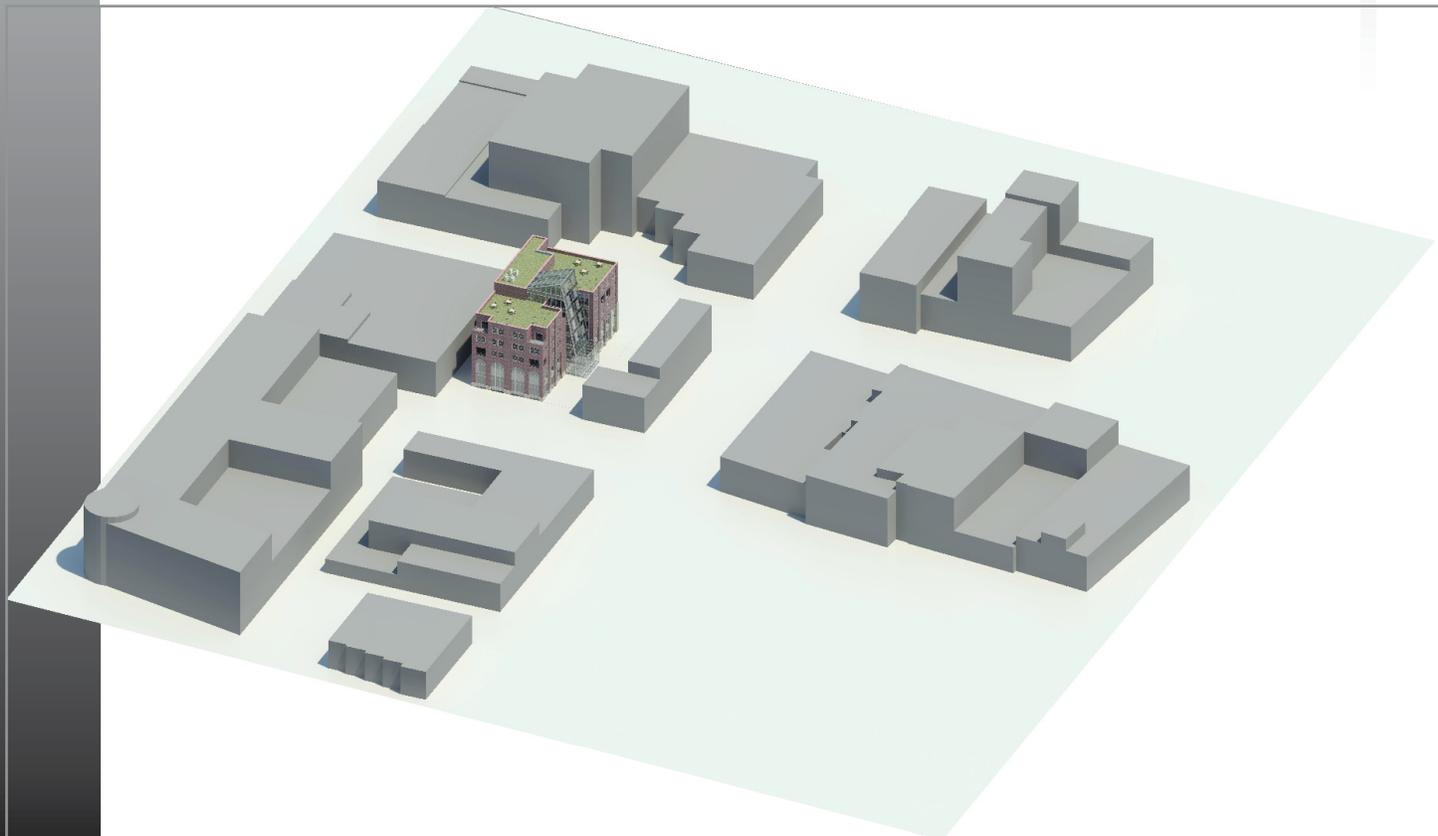


Building Within Our Bounds

Drew Olson



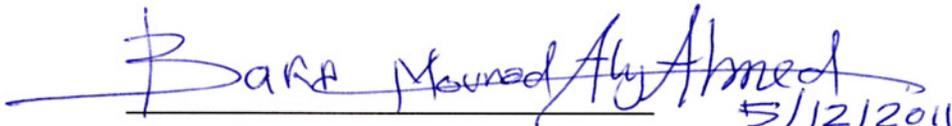
BUILDING WITHIN OUR BOUNDS

A Design Thesis submitted to the
Department of Architecture and Landscape Architecture
of North Dakota State University

By

Drew R. Olson

In Partial Fulfillment of the Requirements
for the Degree of
Master of Architecture


Primary Thesis Advisor 5/12/2011


Thesis Committee Chair 05/12/11

May 2011
Fargo, North Dakota

NON-EXCLUSIVE DISTRIBUTION LICENSE

By signing and submitting this license, I Drew R. Olson grant to North Dakota State University (NDSU) the non-exclusive right to reproduce, translate (as defined below), and/or distribute my submission (including the abstract) worldwide in print and electronic format and in any medium, including but not limited to audio or video.

I agree that NDSU may, without changing the content, translate the submission to any medium or format for the purpose of preservation.

I also agree that NDSU may keep more than one copy of this submission for purposes of security, back-up and preservation.

I represent that the submission is my original work, and that you have the right to grant the rights contained in this license. I also represent that my submission does not, to the best of my knowledge, infringe upon anyone's copyright.

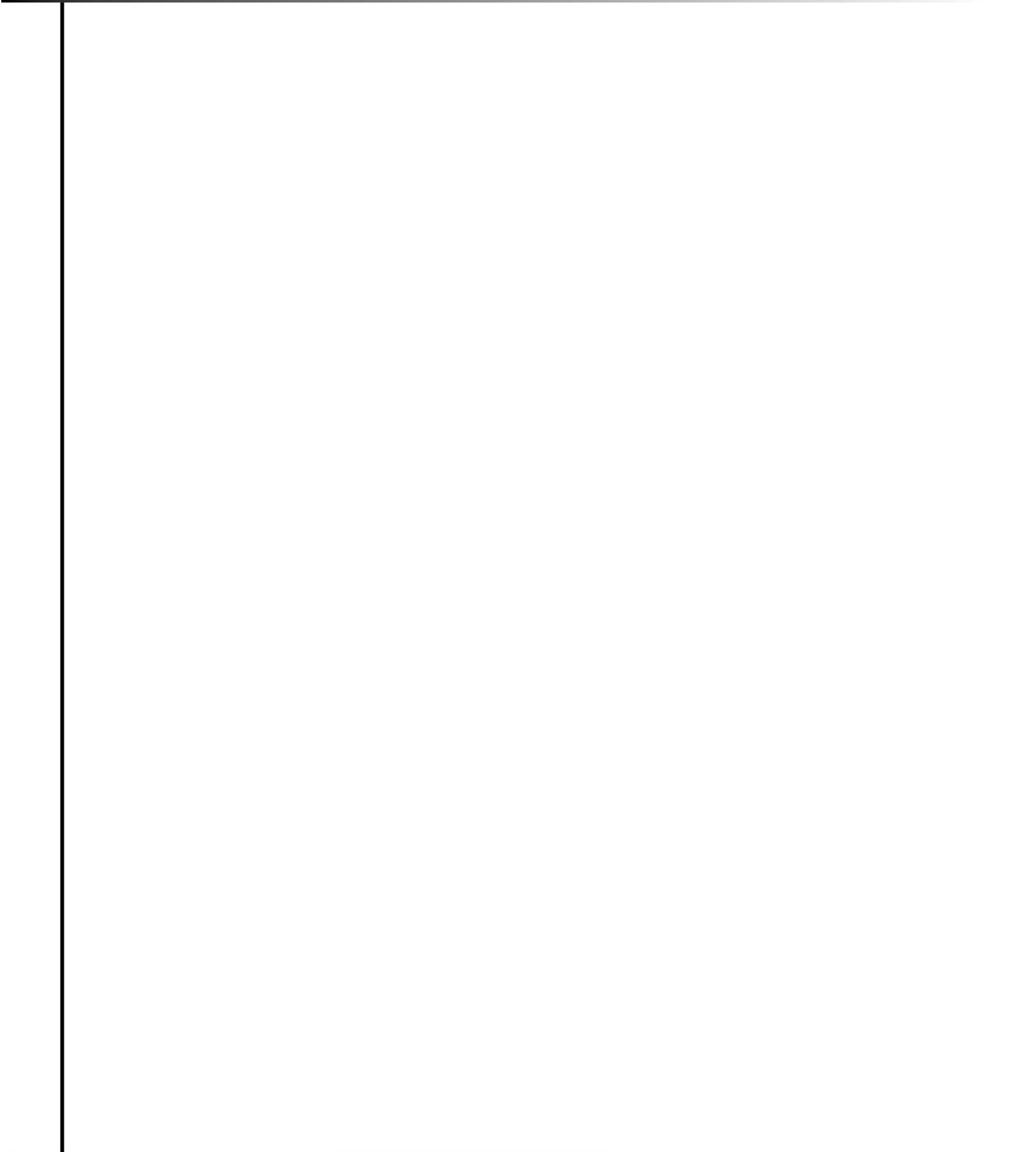
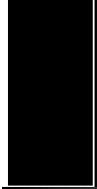
If the submission contains material for which I do not hold copyright, I represent that I have obtained the unrestricted permission of the copyright owner to grant NDSU the rights required by this license, and that such third-party owned material is clearly identified and acknowledged within the text or content of the submission.

IF THE SUBMISSION IS BASED UPON WORK THAT HAS BEEN SPONSORED OR SUPPORTED BY AN AGENCY OR ORGANIZATION OTHER THAN NDSU, YOU REPRESENT THAT YOU HAVE FULFILLED ANY RIGHT OF REVIEW OR OTHER OBLIGATIONS REQUIRED BY SUCH CONTRACT OR AGREEMENT.

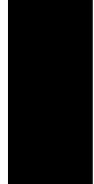
NDSU will clearly identify my name as the author or owner of the submission, and will not make any alteration, other than as allowed by this license, to my submission.


(Student Name)


(Date)



01	Cover
03	Project Title
05	Non-exclusive Distribution License
07	Contents
09	Abstract
10	Problem Statement
11	Statement of Intent
13	The Proposal
14	The Narrative
15	The User/Client Description
16	The Major Project Elements
17	Site Information
19	Project Emphasis
20	A Plan for Proceeding
21	Previous Studio Experience
23	The Program
24	Theoretical Premise/Unifying Idea Research
39	Summary of Theoretical Premise
43	Case Study One
46	Case Study Two
49	Case Study Three
52	Summary of Typological Research
54	Historical Context
57	Goals for the Thesis Project
59	Site Analysis
68	Reference List
69	Personal Identification



This graduate thesis explores where waste (or unutilized material) is being produced in the design methodology of a mixed-use building in Fargo, ND. There is waste produced in the construction process that is inevitable, but the majority of waste can be attributed to the decision making process of the architect's methodology for generating a building's form and space.

By analyzing the different approaches taken toward design decision making, one can determine at what point(s) the designer is intentionally or unintentionally creating a building that produces unutilized material, whether through the means of drawing floor plans, assigning dimensions, modular design, creating a form then working inward on space allocation, BIM computer programs and so forth.

The interpretation of this information will be gathered at multiple levels: through the deduction and analysis of a building's spaces and form, algorithmic computations that analyze and calculate a building's waste production, as well as analyzing an "economical" formation of space to the aesthetical success of space.

Key Words:

Design methodology, utilizing material usage, sustainable building, mixed-use

Problem Statement

What is it in the method of the architect's design process that produces waste?

Statement of Intent

Typology:	Mixed-use Building
Claim:	It isn't the construction process that creates waste, but the methodology that the architect uses through the process of design that produces unutilized material.
Premise:	<p>It is the approach that the architect takes through the design process and decision making along the way that determines whether the building is going to be sustainable or not.</p> <p>An understanding of the methodology that the architect uses through the entire design process is crucial in calculating how much unutilized material will be produced.</p> <p>There is a finite amount of resources available within our environment and as stewards of the built environment it is our duty to reuse and preserve our scarce supply of building materials.</p>
Conclusion:	In conclusion, we have a finite amount of resources that we can use to construct our built environment and, with the knowledge of the unutilized materials from an architect's methodology of design, we can raise awareness and build more sustainably.
Project Justification:	By determining and analyzing the steps to an architect's design methodology, we can bring a better understanding of when and where the waste/unutilized material is gathering and being produced throughout a building design process. Through these findings of the research, I hope to be able to make strong recommendations to future designers that would help in the reduction of waste produced from a form of design.

The Proposal

The Proposal

The Narrative:

The optimization of our resources is a necessity for maintaining a sustainable existence. The fact that we have a finite amount of resources legitimizes the awareness of the impact the design community has on our natural environment. I wish to bring to life a conscious understanding of how the design decisions impact our resources supply more than any other part of the building process.

My personal experience in light construction has brought me to many construction sites during different levels of the building process. Based on my experiences I have accrued through travels abroad and years of schooling at North Dakota State University, my attention has been drawn to the materials that are being discarded in the dumpsters. This so called waste that is brought to a landfill, I see merely as processed unutilized material that wasn't capitalized by a design to its fullest potential.

Watching the development of the Fargo area over the years made this city a viable site location. In an effort to bring a more sustainable building and needed amenities for the area, I chose a site in downtown Fargo. This project brings about a need for a typology that can address multiple building styles, but remain at a scale that maintains a high level of attention to the analysis of the building's design process. The designing of a sort of residence came to my attention, by the idea that an inherent lower cost of building could potentially serve a lower living cost for a member of the community. Also a grocery center in the downtown area will not only be more convenient for its urban dwellers, but reduce the vehicular necessity for acquiring one's necessities and reduce our daily carbon footprint.

The User/Client Description:

Downtown Fargo has a very diverse collection of people. The site and building typology suggests the primary users being a wide range of individuals.

With the site currently a parking lot, the need for parking is essential for the existing users of this space, residents of the apartment complex, and employees of the grocery center and the office spaces.

The usage of the building will vary throughout the course of the day. The peak hours of usage will be during the early morning and evening. The morning is when the residents of the building will be leaving their homes and partaking in their daily routine, as other members of the community will be arriving to utilize the parking space available. The evening is when residents will be returning, possibly stopping in at the lower level grocery center to pick up their evening meal, and then proceeding to their home. At this time the other members of the community may be following a similar routine before they return to their home, which is why a substantial parking structure is important.

The Proposal

Major Project Elements:

Grocery Center

This component will serve the residents as well as the community with a means for gathering their favorite foods within a reasonable walking distance.

Parking

This component serves the residents and working community.

Apartments

The apartments will attempt to provide a reasonably priced place to live with a great location within downtown Fargo.

Office Space

These spaces allow for more local business interaction within the downtown setting.

Site Informations:



Macro

My site location will take place in the upper Midwest of America, Fargo, ND being the focus of the location.

Site Information:



Micro

The site is located in downtown Fargo, ND. It is currently a gravel parking space located on N. Broadway Dr.

Streets

The site is located on North Broadway Drive and is just north of NP Avenue.

Transportation Links

The site offers accessibility by car, bike, and walking, and is located one block east of the MAT Area Transit Center in Fargo, ND.

Site Area

The site occupies a lot that is 112' by 125'.

Major Landmarks

The site is located on the historical Broadway Drive in Fargo's downtown district.

Views

The site offers great views of the downtown city life.

Project Emphasis:

Studying the methodology of an architect's project design process can become very complicated. This process may take many different possible directions depending upon the typology of a project. The emphasis of this project is the variations that are available in the designing of a building which will reduce the amount of material that is placed into the construction process. The idea is that with the manipulation of small levels of a building's layout and taking into consideration the available dimensions of the material selected, the amount of unutilized material being produced through the construction process can be significantly reduced.

The Proposal

A Plan for Proceeding:

Research Direction

The research conducted for this thesis will be directed toward obtaining data that will further examine the methodology of an architect's design process and how it can aid in reducing the amount of unutilized materials in the constructing of our built environment. The data collected will also further the understanding of the project typology, historical context, site analysis, and determining the program requirements.

Design Methodology

A mixed method approach will be conducted while collecting the research for this design. This will be an effective approach because it combines the collection of quantitative and qualitative data, following a Concurrent Transformative Strategy. This strategy will be guided by the three points defined in the theoretical premise. The implementation of this strategy combines the qualitative and quantitative data to be gathered concurrently throughout the research and design process.

Documentation of the Design Proocess

Through the process of research and design, the work produced and gathered will be physically and digitally recorded each week. The physical work will be placed into a binder that will be added to as the process develops. The work will be composed of sketches, inspirations, case studies, drawings, images collected, and other forms of data. In the end the work will become available to future scholars by the means of the digital collections through the North Dakota State University library database.

Previous Studio Experience

FALL 2006: Joan Vorderbruggen
Tea House - Fargo, ND
Rowing Club House - Minneapolis, MN
Mountain Dwelling - Bear Lake, CO

SPRING 2007: Bakr Aly Ahmed
Dance Studio - Fargo, ND
Montessori School - Moorhead, MN

FALL 2007: Ron Ramsay
Fictional Town Development - Agincourt, IA
Shaker Barn Renovation - New Lebanon, NY

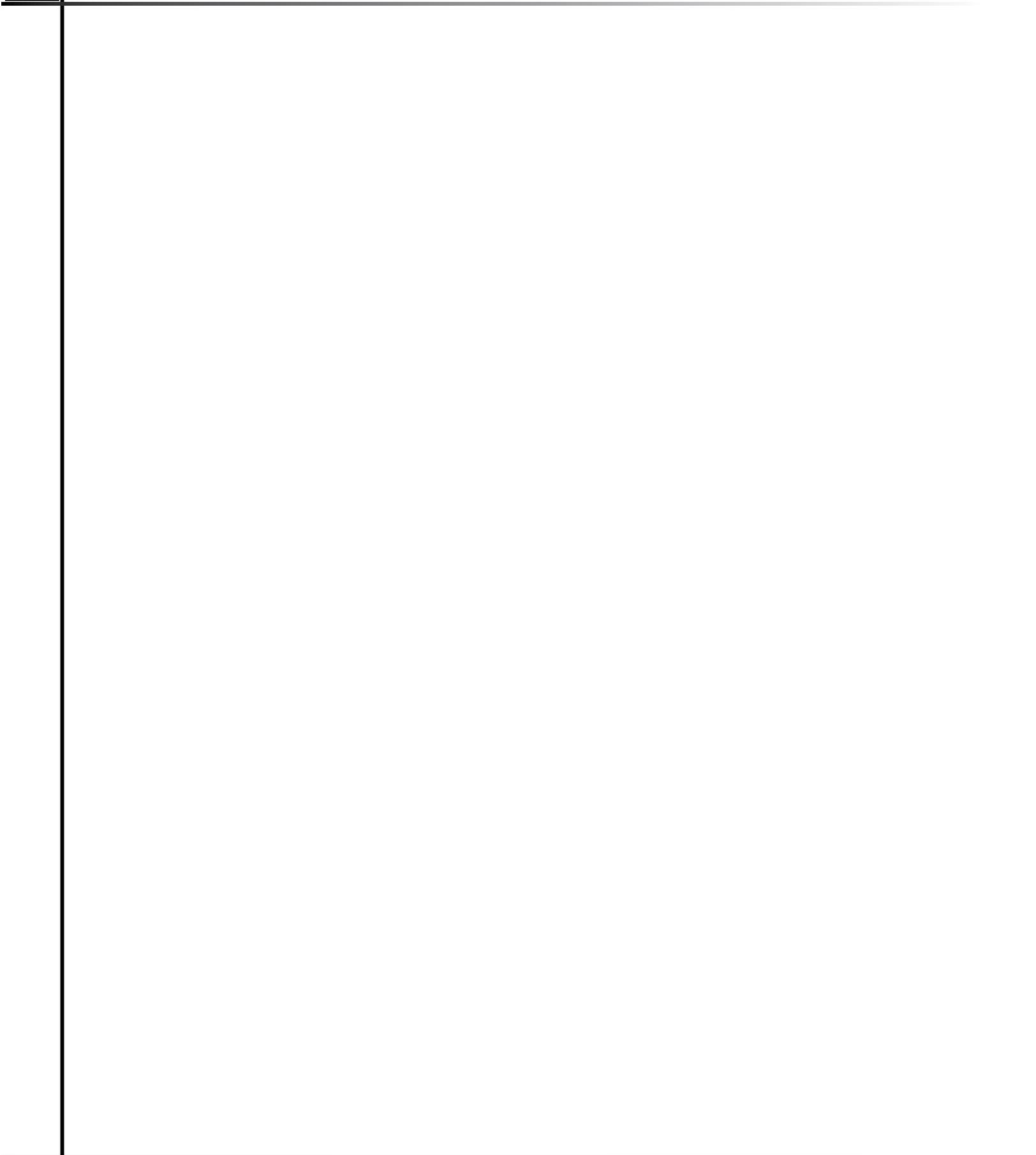
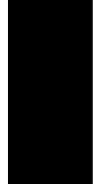
SPRING 2008: Steve Martens
Children's Museum - Fargo, ND
Mixed-use Downtown Structure - Fargo, ND

FALL 2008: Darryl Booker
High-rise - San Francisco, CA

SPRING 2009: Steven Wischer
AVE Train Station - Barcelona, Spain

SPRING 2010: Darryl Booker, Don Faulkner, and Frank Kratky
Creating Viable Communities - Santo Domingo, DR
Housing and Market for Santo Domingo, Santo Domingo, DR

FALL 2010: Ganapathy Mahalingam
Research Studio



The Program

Research Results:

Theoretical Premise

The theoretical premise is a search for a way of calculating a building's wastage prior to construction. There is a finite amount of resources available within our environment and as stewards of the built environment it is our duty, as the architectural profession, to reduce and preserve our scarce supply of building materials. Through an analytical review of my personal design approaches, I wish to determine when and where waste is being created and find a way of quantifying the amount of waste being produced based on a particular design.

In this investigation the term "waste" needs to be further defined. The meaning of the term waste that I am referring to is any material that has been utilized to its maximum potential, i.e., scraps of material that are no longer intended to be used in the construction process and are then being discarded into a landfill.

Design Approaches

Through my years of experience at North Dakota State University I have approached design problems in different ways and techniques. The design process can be handled in a multitude of approaches: drawing, conceptual diagrams, physical models, computer modeling, and BIM, but these are the approaches I intend on addressing with respect to how they are able to inform the designer of the amount of material waste. When approaching a design problem the process begins with data collection. Once that has been established with a strong understanding of the subject or typology of the project, then the design process begins. My routine has begun with a conceptual diagram of the spaces that were desired in the program. After the spatial layout the next step is form. For the development of the form I have usually begun with sketches and played with the different configurations and layouts that are most logical. From the sketching comes the modeling, which I have handled by creating physical models as well as computer generated models.

Conceptual Diagrams

The conceptual diagrams take place in the early stages of the design process. In order to reduce the materials used and minimize the waste, the conceptual diagrams or spatial diagrams serve an important role. Through this process, similar spaces begin to be grouped together or near each other, for example: the stacking of the spaces that require plumbing, which begins to reduce the required material. Another material reducing strategy at this stage is trying to have spaces with shared walls. Although there is an understanding at this stage of material reducing techniques, the calculation of waste is not present. The approximate sizes of rooms have been determined, but generally material selection has not been fully explored.

Drawing

Drawing, more importantly drawing at a scale, informs the designer of the special sizes and the surface area that needs to be designated as a particular material. As with any phase of the design process, a strong knowledge of the materials being used and their manufactured dimensions are crucial in calculating the material waste. The major problem for figuring out the amount of unutilized material at this stage is that you can only get a raw number through some basic mathematical functions without putting forth a substantial amount of time. When the material is known or predetermined, then materials' dimension can serve as a basis for the order in the design. Using the predominate building's material in the dimensioning of the spaces will most likely reduce a lot of waste, but it brings about the topic of quality and how that gets addressed. The pencil is a very strong weapon in a designer's arsenal, but it doesn't help in the calculation of the waste that is going to be produced from a construction site in a timely fashion.

Modeling

There are increasingly more ways to model a building and get results that inform the decision making of the design process. Why do we model? The models are the representation of the drawings in a three-dimensional form. The better question is how do we model? I have produced physical and computer generated models. Physical models serve a great example of material usage. It took a couple years of model building to understand the amount of materials going into them, also the high value of reusing model materials. When working on a physical model with your hands, the more irregular the building's form becomes the more difficult it is to build a representational form, also the more waste is generally being created. The waste can be seen as the by-product of the material left over. Another modeling technique for creating models of a design would be a computer generated model. There are many different programs that allow for computer modeling. A few examples that I have used in the past are Google Sketch-Up, Autodesk Revit, and Autodesk 3D Max. Each program has its inherent advantages and disadvantages, the main determining factor being time: the amount of time it takes to create the model and to learn and understand the capabilities of each. When asserting the question of how is waste being created through this designing process, this is not very evident at all. The computer models are able to give you a more precise dimensioning and scaling of the form, but currently these programs do not have a material waste calculator built within them. The computers are a great aid for taking lengths and square footages of the building, which are essential to the current calculation of waste that is based off percentages.

The current waste being produced from a construction site is based off a general percentage that is more or less just a rule of thumb than a true measure of the waste actually being produced. If the true percentage of waste could be determined, then the next step is to determine how this is produced. Designers and engineers have been able to analyze and test the performance of a building with the aid of programs that serve as plug-ins or add-ons to Building Information Models, or BIM. These programs can calculate energy efficiency of a building, the solar gains and thermal

loss through the windows, structural analysis, and code compliancy. With programs currently out there taking on these complex operations, then there has to be a way for a waste calculation to be addressed. For furthering my investigation, my process needed to be altered. The design problem now is how to create such a program and find out how the others were produced.

It was not until my fifth year's fall research studio when I began to seek an understanding of this approach to design. Can the total material wasted be calculated from an algorithm, a step by step recipe that could maximize the material used to produce minimal waste? The ramifications of such an algorithm would in turn reduce the quantity of materials in a building, allowing more money to be put toward a higher quality of materials. The result of this investigation would be the creation of an algorithm that could calculate the most efficient procedure and layout of material based off a particular design.

The following is work that I have done for covering a floor plan with carpet, maintaining a simpler two-dimensional approach for a solid foundation to this method.

The process worked in a linear fashion: beginning with the hand drawn experiments on graph paper and then constructing the algorithm structured by the Pseudocode Standard. From the Pseudocode the algorithm was refined and developed into a flow chart which introduced more variables and processes in a more detailed order. Once a flow chart was constructed, the decision of repeating this process for another building component or carrying this component into a computer language was addressed. Development and understanding of this algorithm were brought into Visual Basic to construct a program that could operate the simple function of outputting a square footage of material declared as waste and producing a graphical representation of the floor plan (polygon) inputted into the program.

Start:

Origin = (0,0)

OptimalMatUsage = $\frac{\text{Tot. Sq. Ft. of Floor Plan}}{12' \text{ (width of defined carpet)}}$

Efficiency Check = $\frac{\{ ((\text{Tot. Ft. Run of Mat used}) - \text{OptimalMatUsage}) \}}{\{ \text{OptimalMatUsage} \}} * 100$

Defined Material = 12' x R (roll length)

Aesthetic Check = Sum Ft Run of segments

1. Input Floor plan (data defined by as DXF or .dwg) Any data system based on coordinate positioning
 - a. Find furthest point on x-axis
 - i. Store in memory
 - b. Find furthest point on y-axis
 - i. Store in memory
2. Define Bounding Box
 - a. Create a bounding box using the origin, furthest points on x and y axis, and their intersecting point
3. Define Segment Box
 - a. Origin is defined as point 1
 - b. From origin move greatest width of defined material on y axis
 - i. Store as point 2
 - c. Move to greatest value of bounding box in x value, remaining with y = 12
 - i. Store as point 3
 - d. Move, on same valued x-axis, down 12 on y axis
 - i. Store as point 4 and return to origin
 - e. Store rectangle formed as Wn
4. Continue process of segment box until the Bounding Box is fully divided
 - a. Use point 2 from previous segment box as new location of origin
 - b. Store as W(n+1)
5. Intersect Wn with floor plan
 - a. Take the closest and furthest x value of newly formed shape
 - i. Store that in memory as ft. run of material used
 - b. Can material be placed without any obstructions?
 - i. If yes then;

1. End function
 - ii. If no then;
 1. Check database for stored material that can be used
 - a. If yes then;
 - i. Use it
 - b. If no then;
 - i. Store dimension of material in database.
 - c. Do the edge segments of the new shape share the same segments of the floor plan?
 - i. If yes then;
 1. End function;
 - ii. If no then;
 1. Store the length of that segment in memory.
6. Repeat Process 5 with $W(n+1)$ until all segments complete
7. Run Efficiency Check
 - a. Store value in memory as Testn_1
8. Run Aesthetic Check
 - a. Store value in memory as Testn_1
9. Repeat steps 5-8 changing order of all segments as a permutation
 - a. Store value in memory as Test(n+1)
10. Change point of origin of $W1$ by bumping the y value by 1
 - a. Repeat steps 3-8
 - b. Store value in memory as Test(n+1)
11. Repeat steps 1-10 with the values for x and y interchanged
 - a. Store value in memory as Test(n+1)
12. Compare all Efficiency Check Tests to find the lowest valued Testn
13. Compare all Aesthetic Check Tests to find the lowest valued Testn
14. Print Testn with lowest valued Efficiency Check and layout procedure
15. Print Testn with lowest valued Aesthetic Check and layout procedure

End

Start

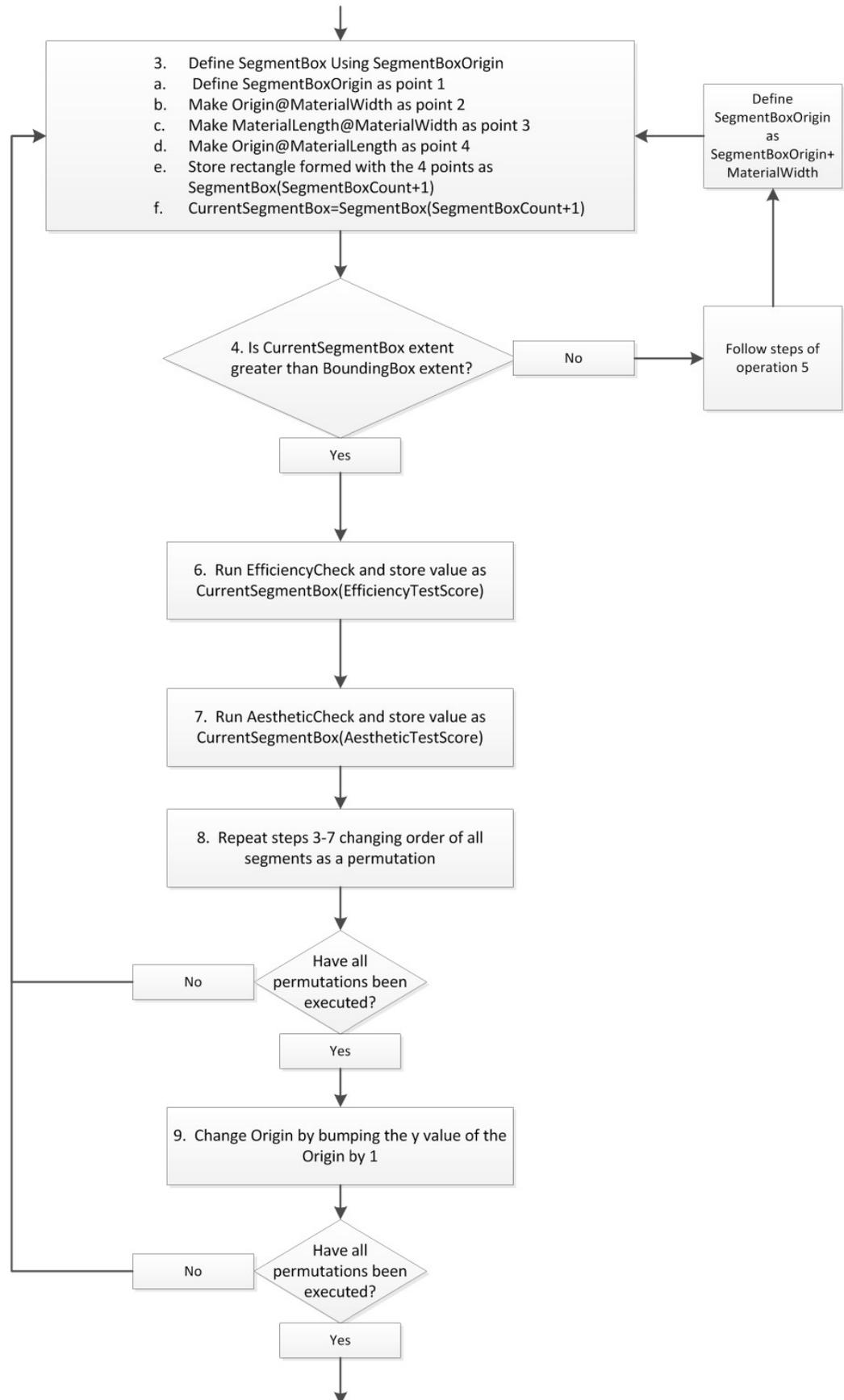
Define Variables
BoundingBoxLength
BoundingBoxHeight
BoundingBox
CurrentSegmentBox
EfficiencyTestScore
AestheticTestScore
MaterialWidth
MaterialLength
OptimalMaterialUsage
Origin
FloorPlan
SegmentBoxCount
SegmentBoxOrigin
MaterialUsed
PartialMaterial
SeamLength
CurrentIntersectionBox
SubForm
SubFormCount
CurrentSubForm
SubDivision
SubDivisionCount
CurrentSubDivision
EfficiencyCheck
AestheticCheck

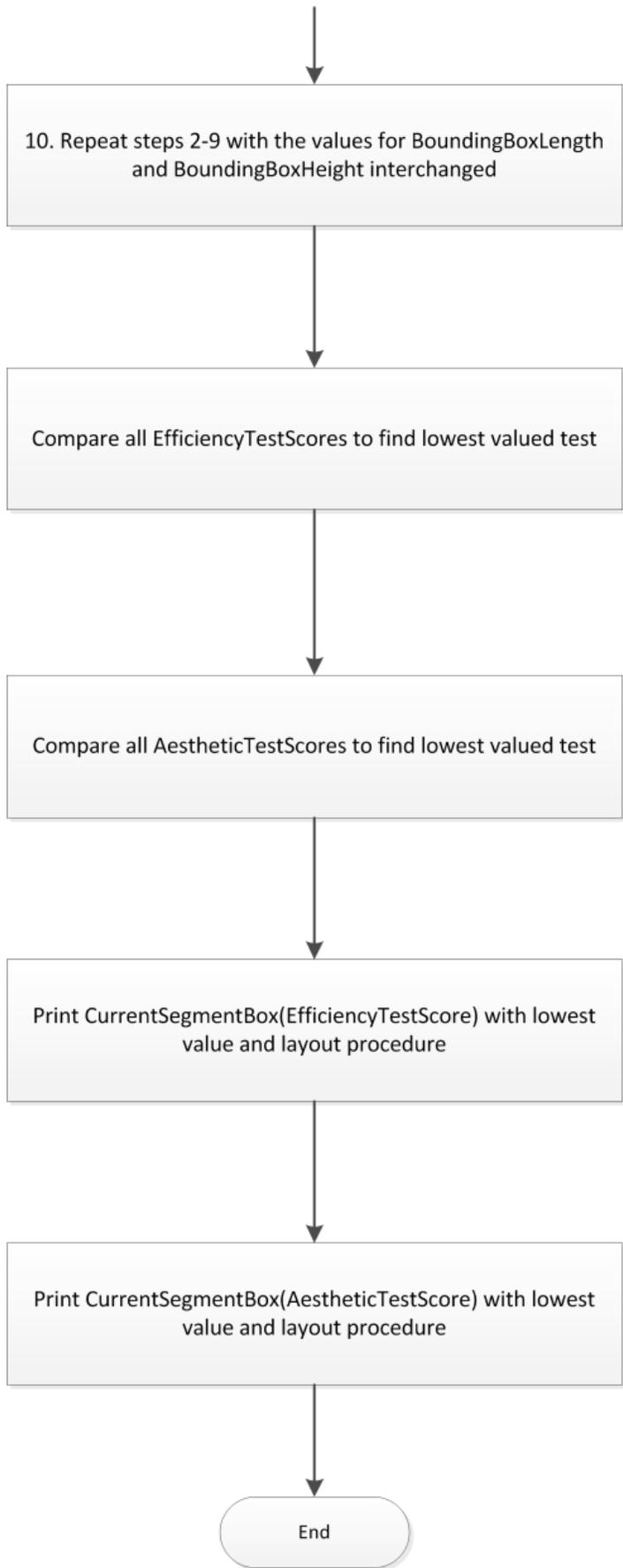
1. Input Floor plan (data defined as DXF or .dwg)
Any data system based of coordinate positioning

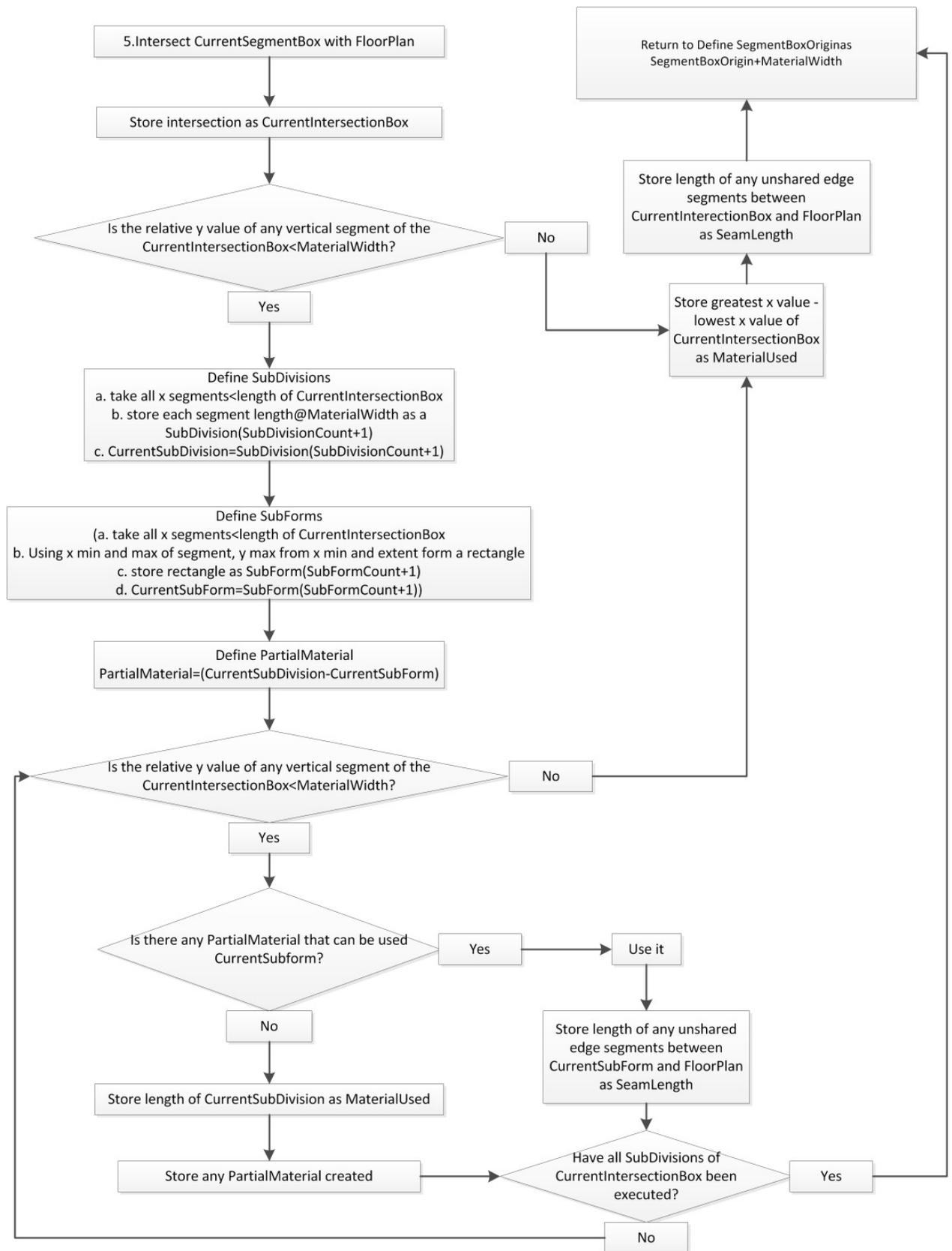
a. Find furthest point on x-axis. Define BoundingBoxLength

a. Find furthest point on y-axis. Define BoundingBoxHeight

2. Define BoundingBox
(Create a bounding box using the Origin, furthest points on x and y axis)

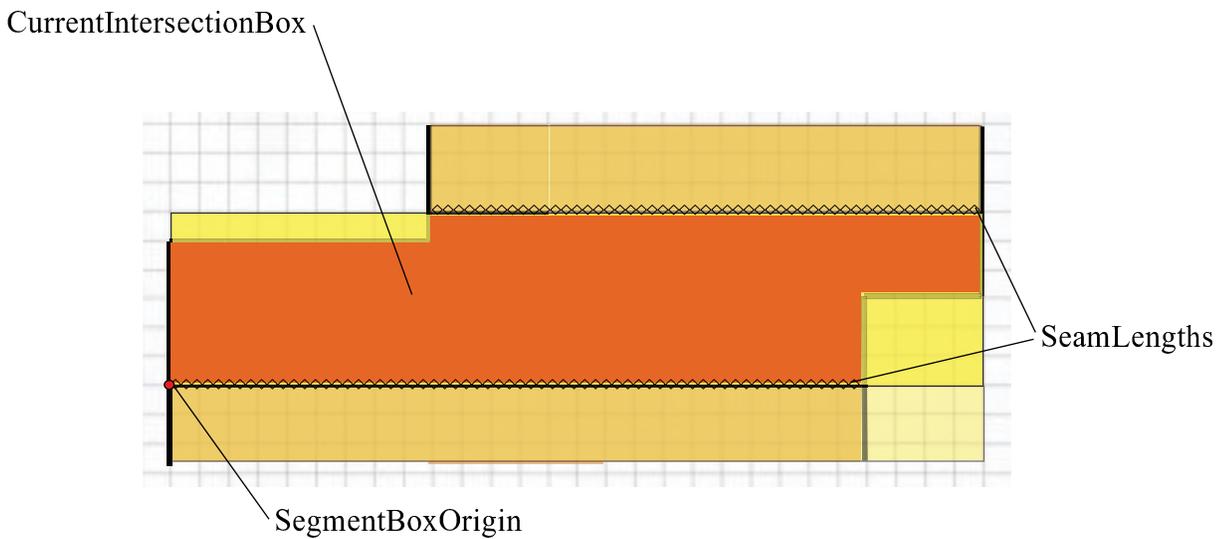
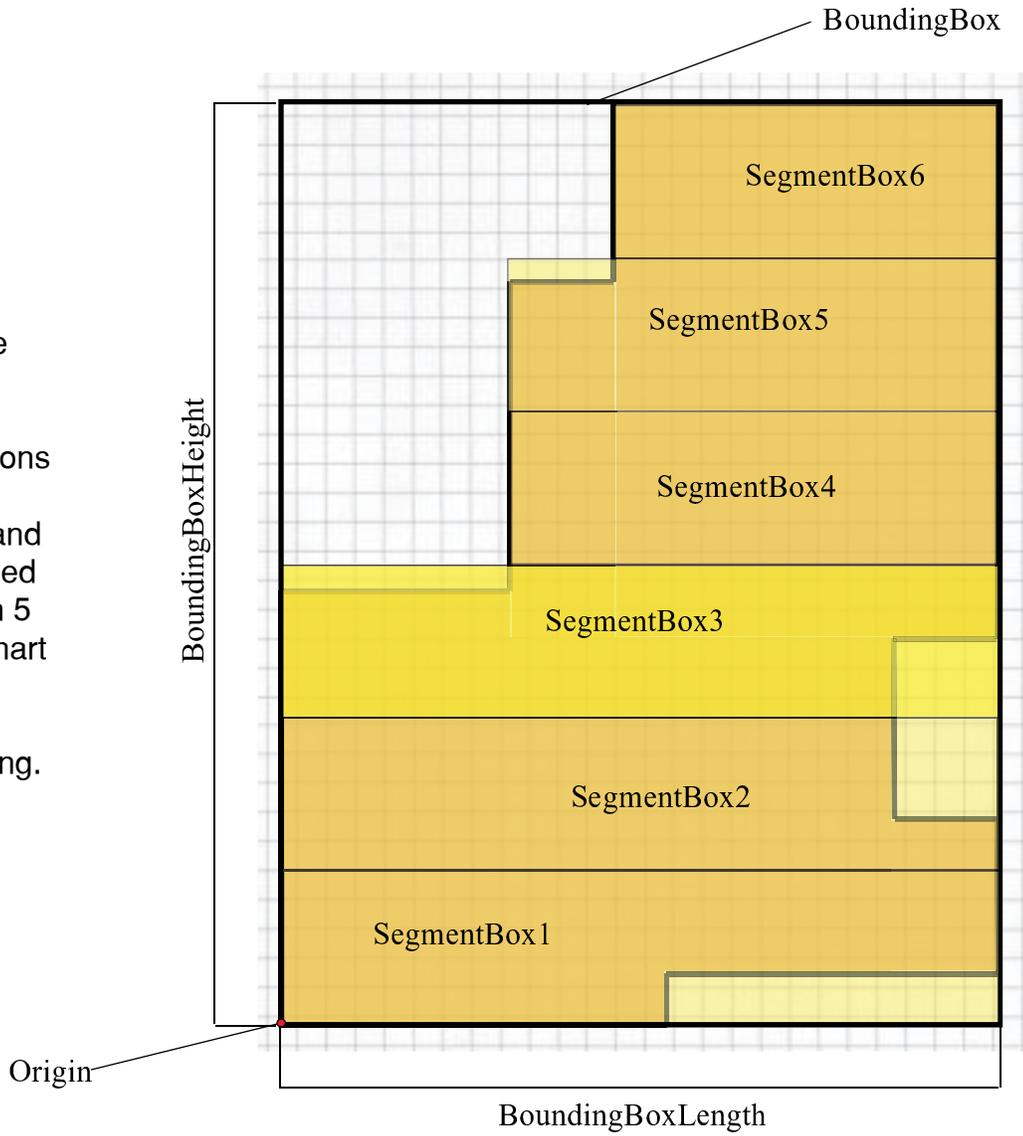


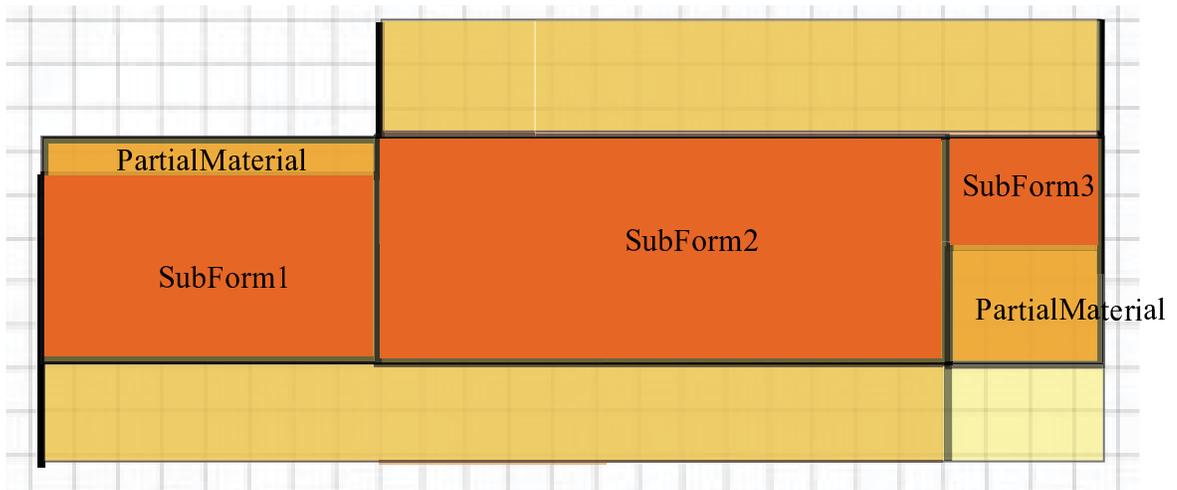
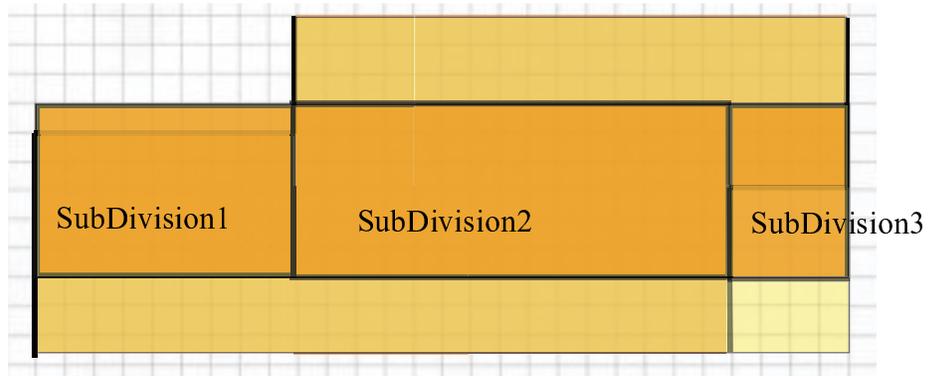




Expanded View of Operation 5

These descriptive images following the flowcharts are visual representations of the operations and variables used in Operation 5 of the flowchart for better clarity and understanding.

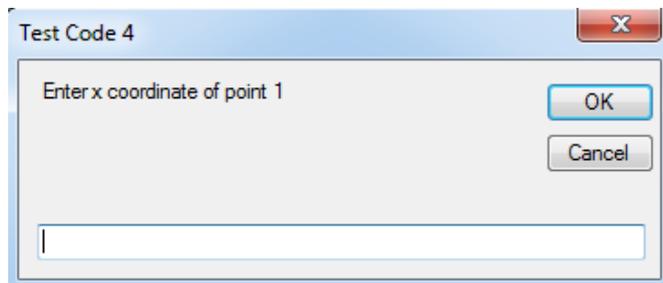
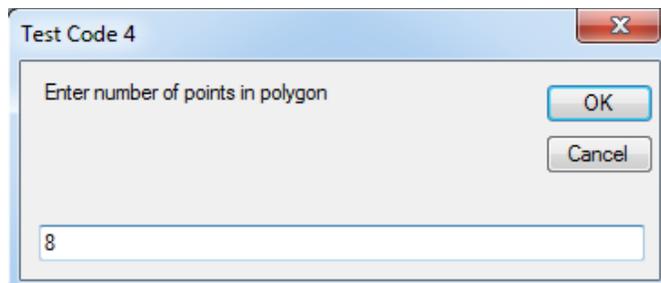




As of now this process will allow a user to analyze a floor plan and determine the most efficient layout of material and also a more aesthetic layout. The aesthetic value is based off the idea of having fewer seam lines (the joining of two pieces of material) and holds a potential higher level visual quality.

After completing the Pseudocode and flowcharts, I continued the process to the next level by writing a very basic computer program, using Visual Basic, that would exemplify the capabilities of a waste calculation program.

The resulting program sends you through a series of prompt windows which ask for the data input for the design at hand. It will start by asking the total number of points for the floor plan, or polygon parameters, then the specific x and y values of each point. After processing the form the program begins asking about the material's width, length, and the starting coordinates. This program then returns the square footage of material that is declared waste. The following figures present the program's input inquiry and data output.



Test Code 4

Enter y coordinate of point 1

OK

Cancel

Test Code 4

Enter width of carpet roll

OK

Cancel

Test Code 4

Enter length of carpet roll

OK

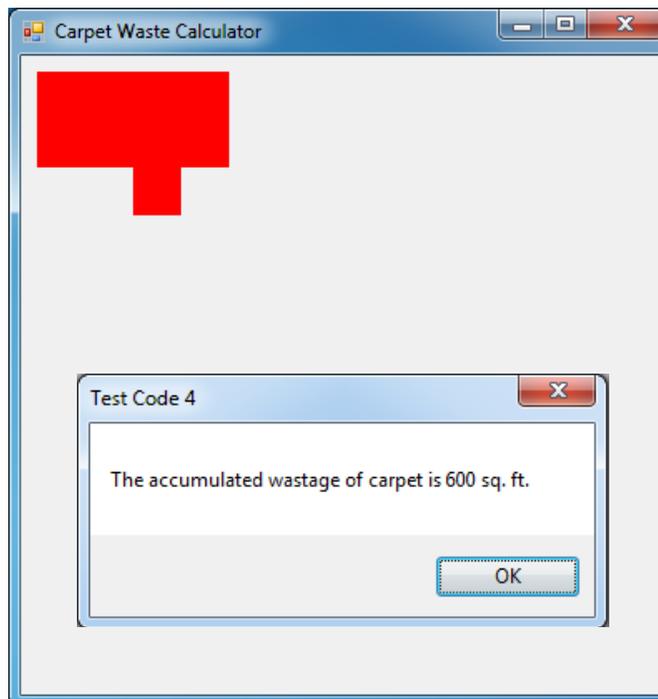
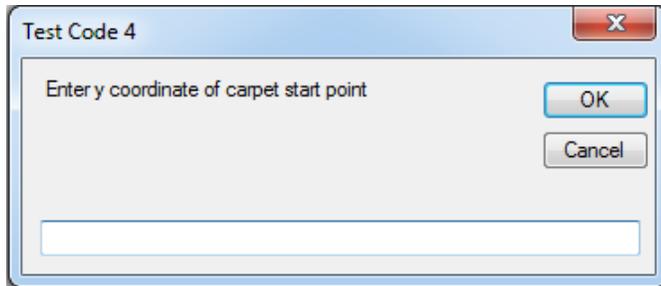
Cancel

Test Code 4

Enter x coordinate of carpet start point

OK

Cancel



In this program waste is not calculated as accurately as it is presented in the flow chart. At this point in the program's evolution, the partial material is not directed into any reusable material data bank, thus any partial material is being declared as waste.

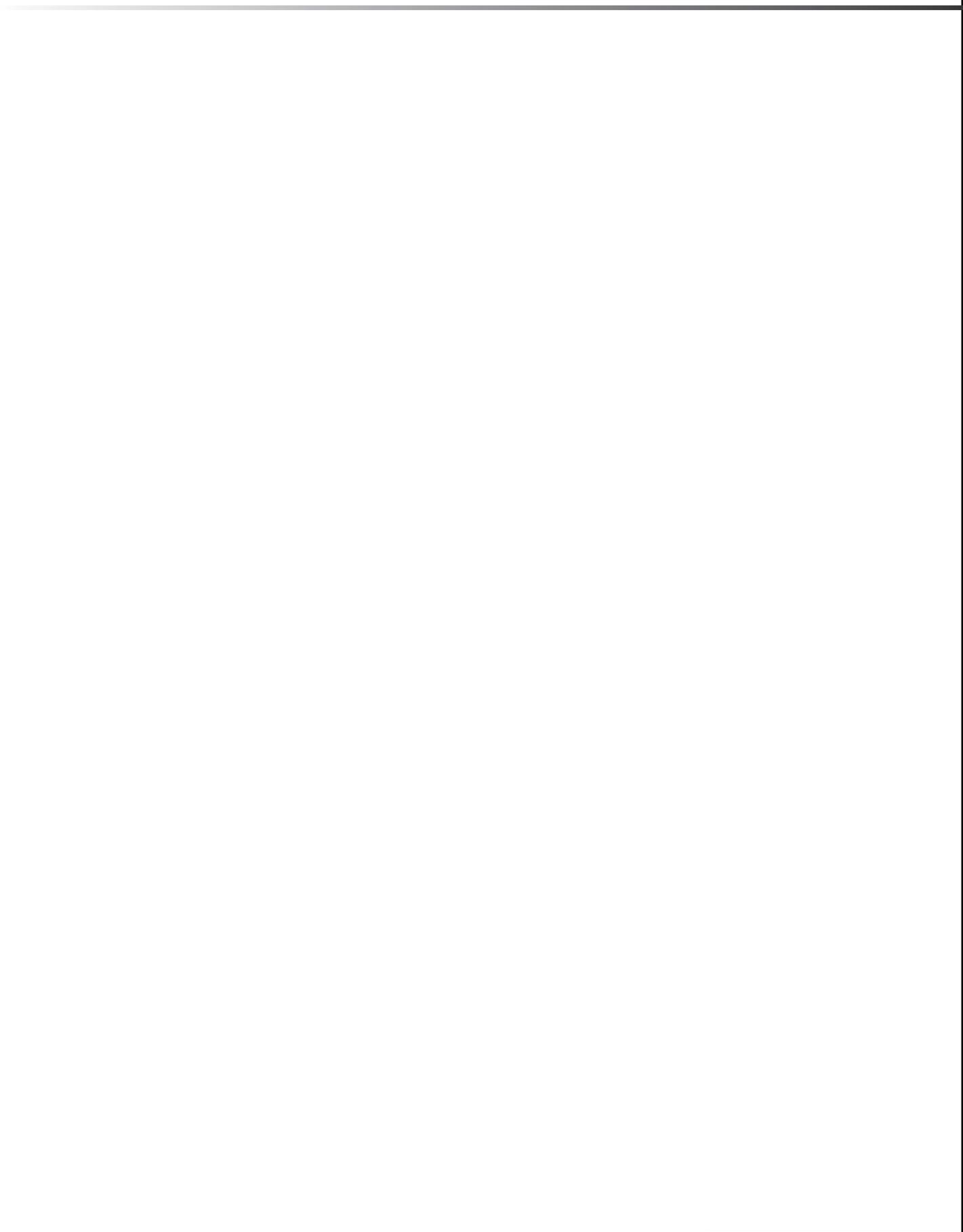
Summary of Theoretical Premise/ Unifying Idea Research:

The process of design can be approached in many different ways, but they all have similar underlying concepts. Each design requires a problem to solve, a start, a process of decision making, and an end result. There are structured processes or checklists available, but each designer seems to have their own approach. In this investigation I have been able to analytically break down the previous processes I have taken toward design to see if in fact I could determine when and where a particular design is producing wasted material. The results have concluded that it is an obtainable feat, but it requires the use of new age technology and a new approach to the design process in order to achieve an accurate outcome in a timely fashion. The graphic and three-dimensional representations are proven to be great techniques at the beginning phase of the design process for understanding how to break a building component composed of potentially numerous materials down to create a way to minimize the amount of material wasted and maximize the resources applied.

This new approach to analyzing a design's material wastage through the development and application of an algorithm that can calculate the waste is a great foundation for further investigation. The carpet wastage is a relatively simple component in regards to the other components that make up an entire building system. The question of whether such a program needed to be addressed and proven, and with the allotted time of research, this building component seemed to be viable solution.

The knowledge gained on the technology and process required to get the wasted material of a building component will serve in the furthering of the investigation. The ideal goal by the end of this thesis is to design and analyze a building's wasted material that was produced during construction for a floor, wall, and roof component. The development of a program could then become a plug-in or add-on to a BIM program that uses a .dxf or .dwg format that is based on a Cartesian coordinate system of points.

Such a tool will enable the design community and building industry to preserve our planet's resources and to maximize the utilization of processed and manufactured materials. The value in saving and reducing these processed materials will be a great step toward minimizing our impact on the natural environment, because these materials have an embodied energy. Resources were used in the process of extracting them, processing them, refining them, and delivering them to the construction site. The program developed would not be a design tool, but a tool to analyze a specific aspect of a particular design that aspect being the design's production of wasted material. The concepts of a quantitative analysis cannot exist without quantifying the qualitative aspects of a design.



Results from the Typological Research:



Project Name: Agnes Lofts

Location: Seattle, Washington

Gross square footage: Gross/40,000-sf;
Unit Sizes/685-992-sq.ft.

Completion Date: October 2007

Total construction cost: \$6,100,000

Owner: Urban Shelter LLC / Liz Dunn

Architect:
Weinstein A|U Architects + Urban
Designers LLC



Located in Seattle's Pike-Pine District, the lofts explore a dwelling typology inspired by the industrial scale of nearby buildings. The twenty-four loft-style apartments occupy three double-height stories above a street-level restaurant space, which is double height ("Agnes lofts, n.d.").

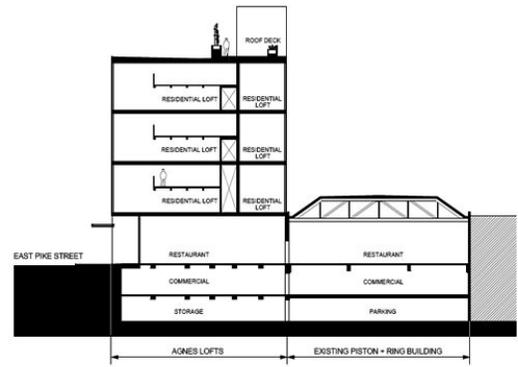
There are two levels below grade that house a toy store, a theater, and additional storage. The building uses economic materials such as polycarbonate panels for the interior guardrails, salvaged bar grating for exterior guardrails, and Ikea cabinetry for kitchens and bathrooms ("Agnes lofts, n.d.").

The loft typology allows for skinnier units, which are efficient in plan and dynamic in section. Double-height volumes at the living room level allow for the space above and below the sleeping lofts to be compressed ("Agnes lofts, n.d.").

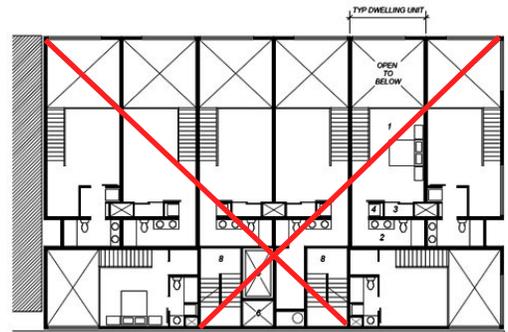
The design embraces the street life, with double-height window walls and sliding-glass-doors reconnect apartment dwellers to their context. Transparency is maximized at the street-level commercial space and glazed overhead doors allow interior space to open up to sidewalk activity ("Agnes lofts, n.d.").

Two Squares

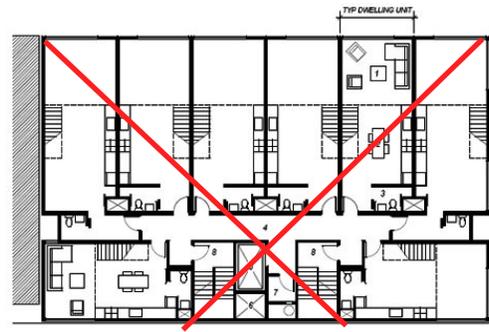
The floor plans are composed of 6 units and using the two squares to break down the plan. The shared part of the two squares denotes the two center units.



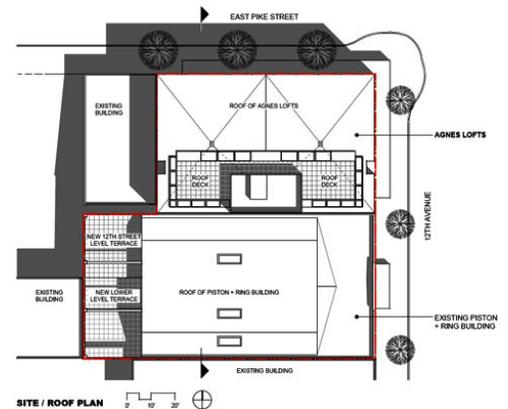
BUILDING SECTION



FLOOR PLAN: TYPICAL RESIDENTIAL LOFT LEVEL



FLOOR PLAN: TYPICAL RESIDENTIAL LIVING LEVEL



SITE / ROOF PLAN

Case Study 2

Project Name: Plaza Apartments

Location: San Francisco, CA

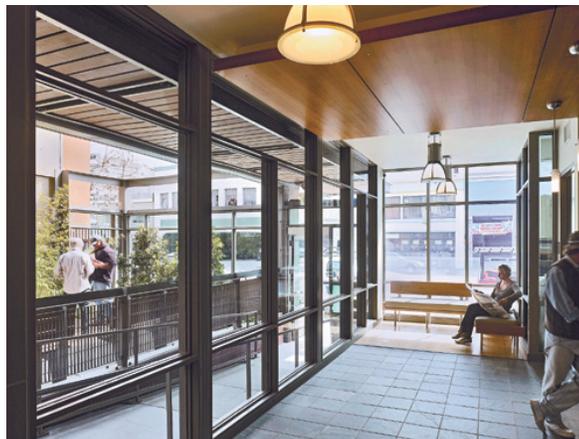
Gross square footage: 56,800 sq. ft. (5,277 sq. m)

Completion Date: January 2006

Total construction cost: \$22 million

Owner: Public Initiatives Development Corporation

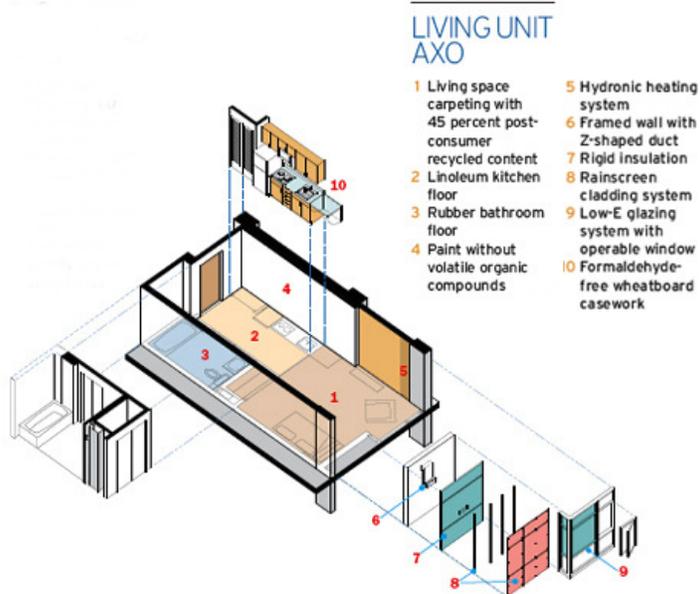
Architect/Interior Designer: Leddy Maytum Stacy Architects and Paulett Taggart Architects



Plaza Apartments is one of the city's first green affordable housing projects. It incorporates sustainable materials, on-site power generation, and strategies to ensure good indoor air quality. It is designed to achieve a 25 percent energy savings over a building that complies with California's energy standard (Gonchar, 2007).

A typical residential floor contains 14 apartments, each a very compact 280 square feet, including a kitchenette and bath. The units are arranged in pinwheel fashion around the building's central core. This organization allows for windows and ventilation louvers at the end of each common corridor, providing daylight, views, and fresh air (Gonchar, 2007).

Given San Francisco's temperate climate, mechanical cooling is used only in the retail area and the theater. Those spaces are served by water-cooled heat pumps that receive condenser water from a roof-mounted cooling tower. A radiant hot-water system provides heating for most of the remainder of the building. Two natural-gas-fired boilers with thermal efficiencies of 85 percent generate the hot water, and pumps with variable-speed drives circulate it throughout the building. On the roof is a 28-kilowatt photovoltaic array that generates about 5 percent of the Plaza's power needs (Gonchar, 2007).



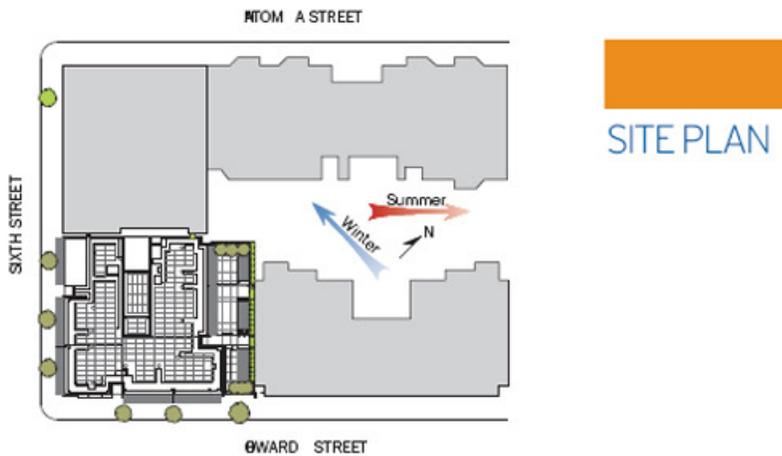
NINTH FLOOR

- 1 Apartments
- 2 Laundry
- 3 Deck
- 4 Lounge



Unique Added to Repetitive

The layouts of the room clusters spiral around the core and this concept is carried out by the site place as well. They are not exactly the same and that is how they are unique.





Project Name: Thin Flats

Location: Philadelphia, PA

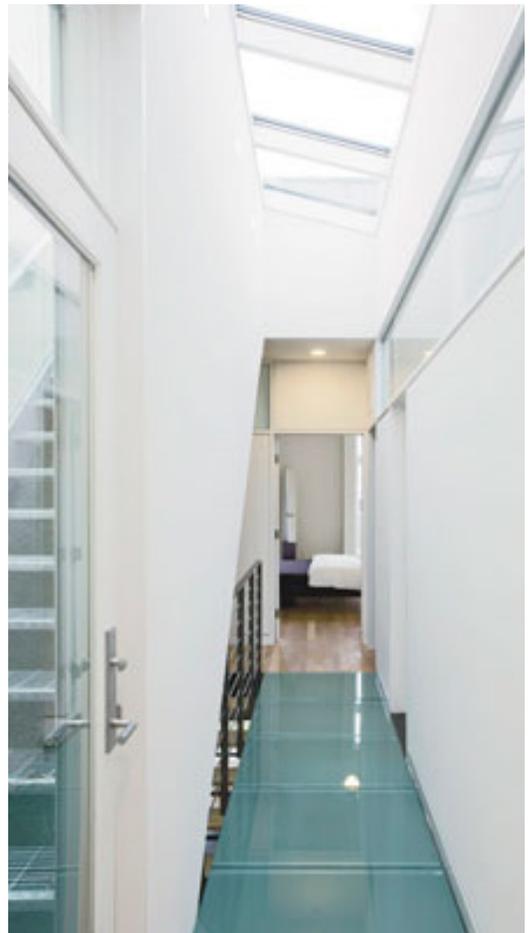
Gross square footage: 20,000 sq. ft. (1,858 sq. m)

Completion Date: November 2008

Total construction cost: \$3.4 million

Owner: Onion Flats LLC

Architect: Plumbob LLC



Thin Flats comprises a four-story block divided into four 18-foot-wide townhouses. Each building contains a two-story upper and lower duplex apartment. The street wall facade is a "crazy quilt, featuring planes of glass and metal, airy openings, and gold- and apricot-colored wood-composite panels" (Sokol, 2009). These panels serve as an added protection and also as a double skin for the south-facing front elevation of the duplex buildings, which is in reality two layers separated by a three-foot-deep air space. The gap provides a transitional space for entry, and creates a thermal chimney where warm air courses upward and out of openings in the outermost facade. Each skin is constructed as a rain screen, and the low-e-coated windows are double-glazed, argon-filled, and thermally broken.

Thin Flats funnels rainwater from the intensive green roof to two 6,000-gallon cisterns that are beneath the parking area on the north side of the buildings, which feeds the backyard gardens. Two 4-by-8-foot flat-plate solar-thermal panels generate all of the domestic hot water for both duplex units (Sokol, 2009).

The green roofs are planned around off-center skylights. While the southern elevation's outer skin shades occupants from intense, direct sun, each skylight maximizes ambient daylight for residents of the upper duplexes. To increase light penetration, the stairwells of these apartments are composed of translucent laminated glass (Sokol, 2009).

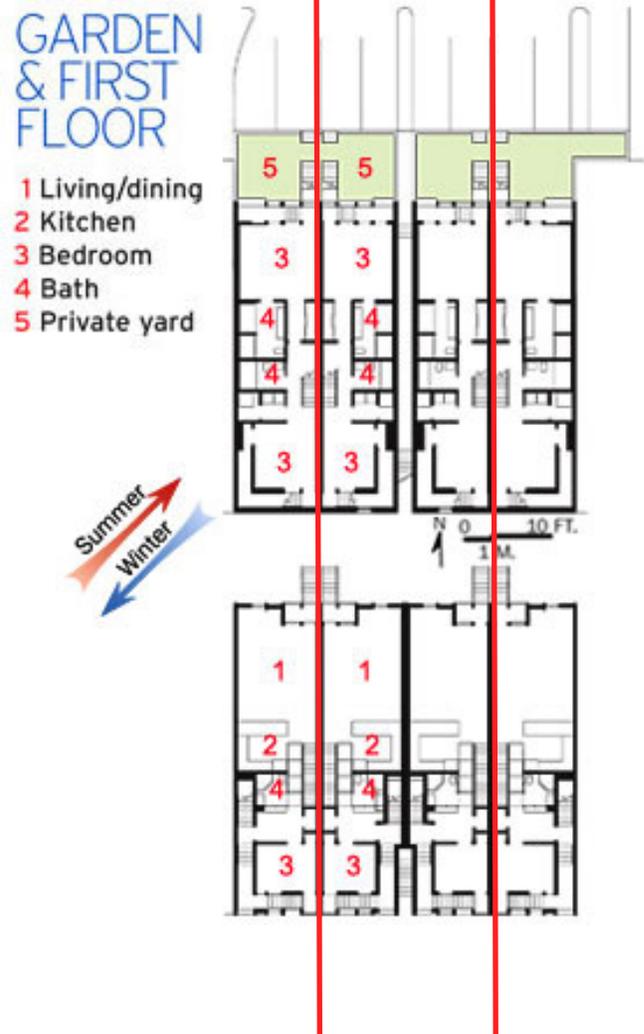


Symmetry

The floor plan of Thin Flats uses symmetry to connect and share utilities between adjoining units.

Repetition

This is shown through the floor plan. As each of the townhomes are reflective of the space joining them, the units are repeated in an array.



Summary of Typological Research:

All three case studies researched aim to support and provide an enjoyable environment to live. Each take on a mixed use typology and share the use of sustainable technologies. The series of case studies provided interesting and different sustainable strategies. With my theoretical premise based on my own method of analyzing a particular design, the designation of space and its use is still up in the air as far as keying in on a particular use within the thesis project. The underlying characteristics that unify this series of selected buildings are: they are all multi-use spaces providing many different arrangements of uses within the building, they all contain residential spaces, and they each tackle sustainable design with different technologies.

The focus in this investigation was on the different styles of residential type and use. For my thesis the residential element is a key role. Unlike an office building where the spaces are typically an array of offices, residential units present a small and controlled volume of space with diverse layout styles.

Agnes Lofts presents double level units with a large volume of living space, which I can see as an interesting and viable design quality for my thesis project, and the way it is able to bring this modern appearance and still hold

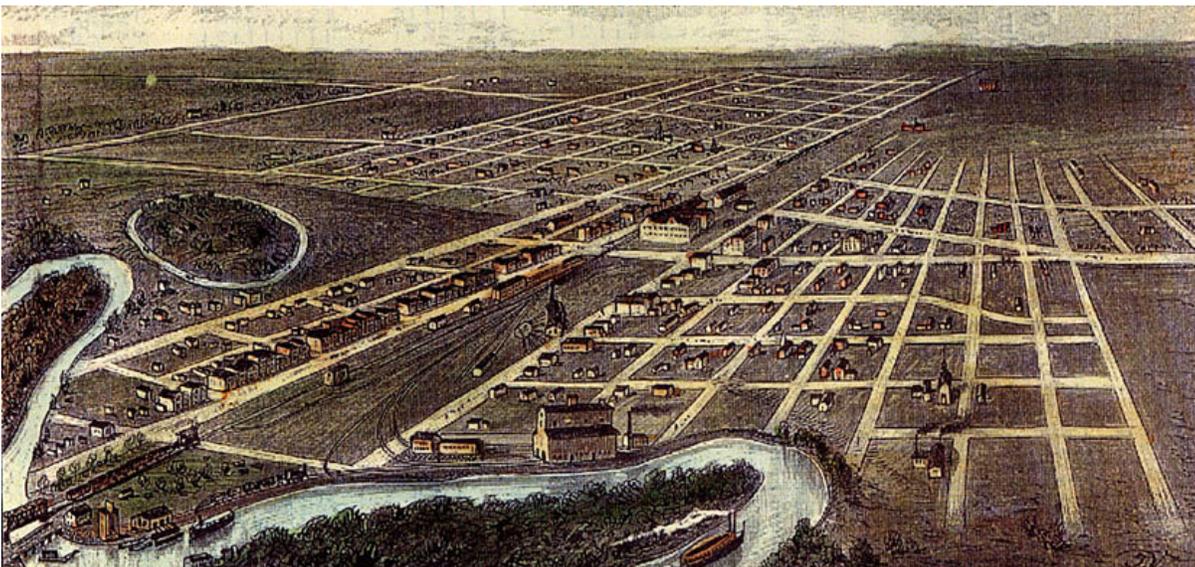
harmony with the surrounding neighborhood. Plaza Apartments is a very impressive low-income housing project. The spaces are small, but seem to meet the needs of the individuals within the space. Its entrance is something that really drew my attention. I see the entry way into the building to be a very desirable place to just relax with some friends or get to know the neighbors.

The sleek design of the townhomes of Thin Flats reiterates my urge to create slim tall space that was brought forth by Agnes Lofts. The other characteristic of this building that I would like to implement is the design placed into the roofs. This building does a fantastic job of accomplishing water collection, sky lights, and a green roof.

Historical Context:

History of the Site Location

The area that embodies the present-day Fargo was an early stopping point for steamboats moving up and down the Red River during the 1870s and 1880s. The original name for the city was Centralia, a name that was given by first postmaster, Gordon J. Keeney, on October 6, 1871. The name did not last long due to the disapproval of William G. Fargo who was a director and financial backer of the railroad and a partner in the Wells-Fargo Express Company, and was changed to Fargo a few months later on February 14, 1872. The city began to grow rapidly after the arrival of the Northern Pacific Railroad, which completed the bridging across the Red River in 1872. After Fargo the Northern Pacific Railroad continued westward reaching Bismarck in 1873. With a passage in and out of the city by train, Fargo became known as the gateway to the west.





In 1890 the North Dakota State Agricultural College was founded as North Dakota's Land-Grant University. North Dakota State Agricultural College became the first to be accredited by the North Central Association in 1915. The NDSAC changed its name in the 1960s to North Dakota State University.

On June 7, 1893 Fargo was stricken with a terrible fire that devastated the downtown area. The fire was caused when a proprietor of a grocery store was emptying ashes behind her store on a windy day. The flames flourished and the fire destroyed 31 blocks of downtown Fargo, including the city hall, the business district and the homes of most of Fargo's 6,000 residents. The city was quickly rebuilt with buildings made of brick, new streets, and a water system. After the fire a building boom began, with over 246 new buildings built within one year.



The beginning of the twentieth century brought about the introduction of the automobile. This industry flourished nationwide and in the city of Fargo as well. In 1905, Fargo became the home of the Pence Automobile Company. Fargo continued to boom after World War II and grew rapidly despite being struck by a violent tornado in 1957. The tornado destroyed a big portion of the north end of the city. The city also endured 500 year flood levels in 1997 and 2009. The coming of two interstates (I-29 and I-94) really revolutionized traveling into the region and pushed Fargo's growth to the south and west of the city limits. In 1972, West Acres Shopping Center was constructed, holding the spot as the largest shopping mall in North Dakota, near the intersecting two Interstates. The mall started the retail boom in the area and also the decline of Fargo's downtown area.

More recently due to Fargo's low crime rate and decent amount of affordable housing, Fargo's population has been on the incline. The city government has offered tax incentives, for public and private entities to renovate the downtown area and its buildings. This has shown a significant improvement even over the last half decade that I have been here to experience the city.

Goals for the Thesis Project:

The thesis takes place in three different contexts, the academic, the professional and the personal. For each of these contexts the thesis takes on a different meaning, and so each context must present its own goals.

My goal academically is to produce a professional level thesis manual as a preparatory step toward my professional career. The thesis is a requirement and a capstone for the Masters of Architecture at North Dakota State University. I want to exemplify my years of education within this institution with a strong finish toward the real world. I acknowledge and recognize that after my time and effort put forth, this thesis will be posted electronically for all to view. Not only do I wish to represent myself in a professional manner, but to honor NDSU in the educational community.

I intend to create a clear, precise, and well thought out thesis project that encompasses all of my years of education. I wish to prepare and give a final presentation that is captivating and inspirational.

Professionally, I want my thesis to bring awareness toward the design community of a program that could calculate and inform a designer of the waste their particular design is producing. I wish to continue into the design profession upon graduation and become a licensed architect within three to five years.

Personally I strive to be the best designer I can. I aim to discipline myself and stay focused on graduating this coming spring. In order to achieve this I know that a strong, clear, and academically influential thesis is going to be required.

Site Analysis:

I came on upon my site selection as I was considering a city and place I wish to propose my thesis project. After living and going to school at North Dakota State University in Fargo for the last half decade, the city and its community has really grown on me. The city presents an urban environment and safe, small town feeling. This is an aspect of a city that I did not have as much growing up in a suburb of the Twin Cities. A lot of the homes in my town don't possess the characteristics and charm of the homes located just north and south of Fargo's downtown area. The homes are mostly composed of some poor development schemes, where if you didn't double check the address on the door you may be walking into your neighbor's home uninvited. The urban layout, like most suburbs, requires a vehicle or some mode of transportation other than walking. Living just outside of Fargo's downtown district puts me only 12 blocks from my school which I find to be an enjoyable walk in the spring, summer, and fall and a tolerable walk during the winter. The only time my vehicle really gets any use is when I am coming or going from the town, or going out and purchasing groceries.

I selected my site for my thesis in the booming downtown district of Fargo. The site is located off the historic North Broadway Drive and just north of Northern Pacific Avenue. To the north of the site is an alleyway that has utility poles running east and west, followed by the outdoor space of the broadcasting center for AM 1100 the Flag. To the south is the outdoor patio for the Fort Knox



bar and tavern. The easement of the alleyway and patio space provides an open feeling that is extenuated by another parking lot to the west and N. Broadway Dr. to the east. For a site that is in the heart of the downtown district, the density is fairly light. These open areas to the east and west allow a great level of sun to enter. The only times the site is not filled with sunlight are the early mornings and late evenings. The openings also allow for the wind to carry through very easily. Most of the wind channels through the alleyways from the northwest corner in the winter time and breezes from the southern east and west sides during the warmer days.

During my site visits, the lot was mostly vacant with the exception of about 10 to 15 vehicles during the workday hours. I observed less vehicular traffic during the weekend and more pedestrian traffic. Upon the visits there weren't ever really any people using the site other than a short cut through the city's blocks. During my summer visits I noticed the space to be more utilized than in the cooler seasons. During the warmer dry conditions the lot becomes very dusty and is puddle ridden during the wetter conditions. The site seems to retain a lot of the water that enters the site until it is absorbed into the ground.

Qualitative Aspects:

Soil

Beneath the city of Fargo and immediate surrounding area are two main layers of sediment, the Brenna/Agusville Formations and the Sherack Formation. The Brenna/Agusville Formations are based at approximately 85 ft., composed of gray, slickensided, fat clays and are overlaid by 20 ft. Sherack's tan-buff, laminated silty-clays.

Typical soil engineering values for the Sherack Fm (depth: 1 - 6 m) are:

PL (plastic limit) = 30

LL (liquid limit) = 85

N (number of blows for Standard Penetration Test) = 12

Qu (unconfined compressive strength in lbs/ft²) = 3000.

For the uppermost Brenna Fm (depth: 8 m), typical values are:

PL = 31

LL = 113

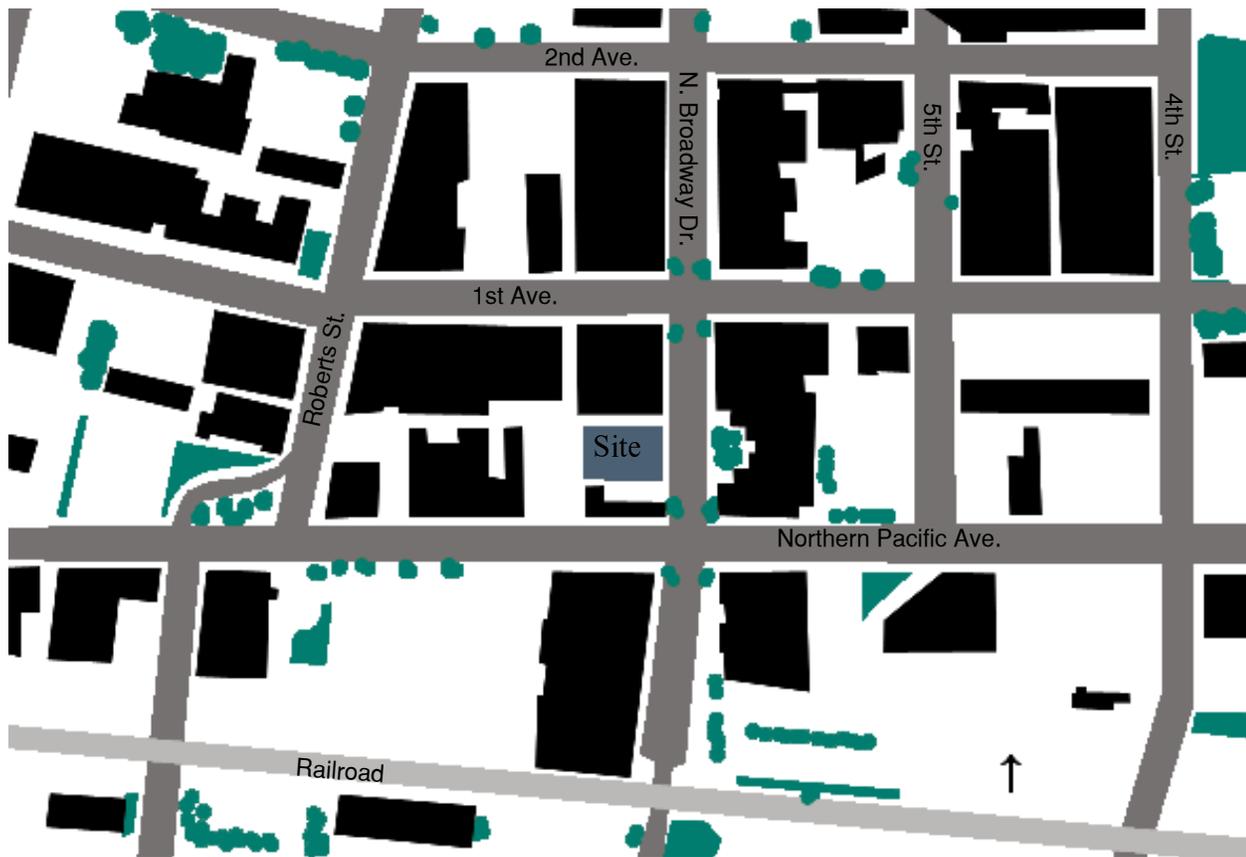
N = 6

Qu = 1370



Slope

The slope on the site is less than 1%, which accounts for the water accumulation during the wet warmer months.



Utilities

The utilities on and around the site consist of the power lines that run through the alleyway at the northwest corner to the west.

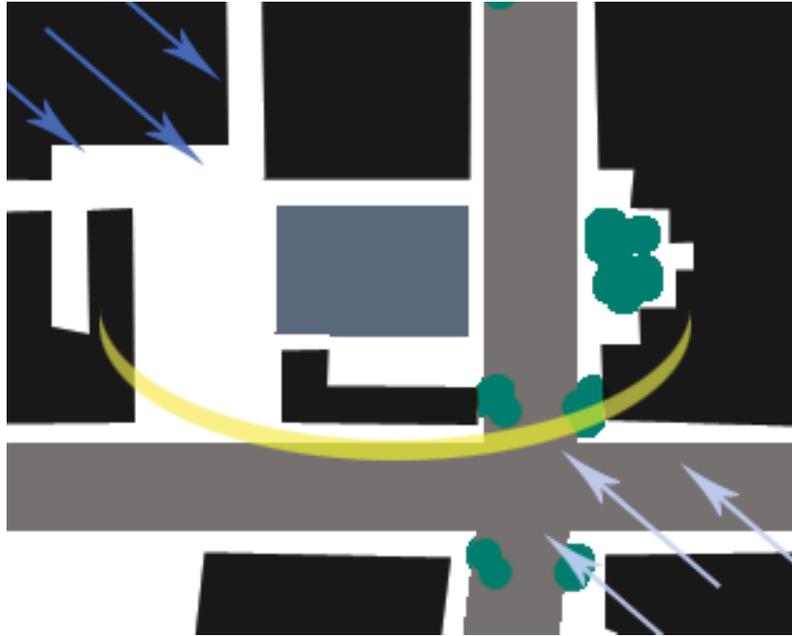
Vehicular Traffic

The site doesn't seem to be overused by vehicles, based on the observation that the site is never at full capacity. The vehicles only have access to the site on the east side of N. Broadway Drive. There is a lot of traffic that takes place on N. Broadway Drive at all times of the day.

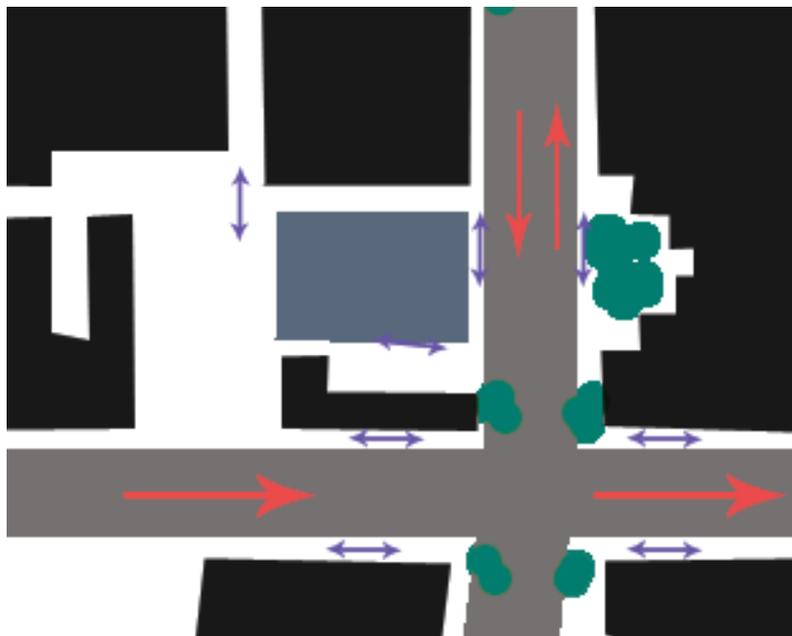
Pedestrian Traffic

Pedestrian traffic can be observed as the main sort of traffic that takes place on this lot with people cutting through the city block. The site is accessible by foot from either the east or west side. People are always walking up and down N. Broadway, posing heavy foot traffic on the east side.

Wind and Solar Study



Pedestrian and Vehicular Traffic





South



West

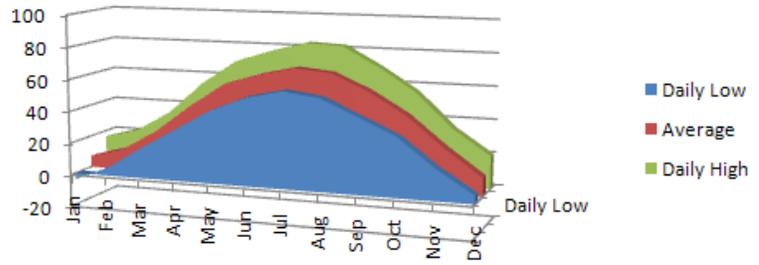


East

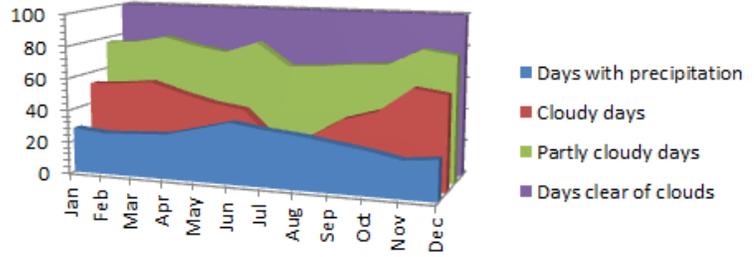
North



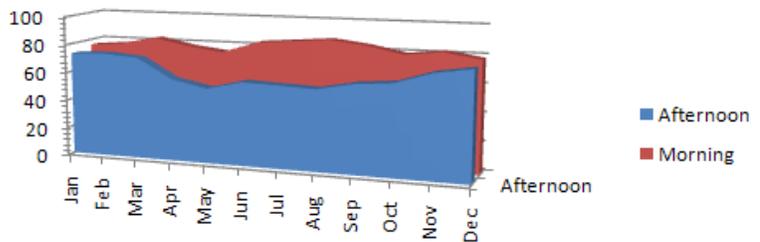
Average Temperature



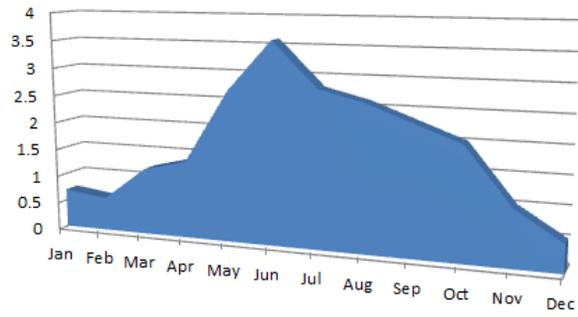
Cloudy Days (%)



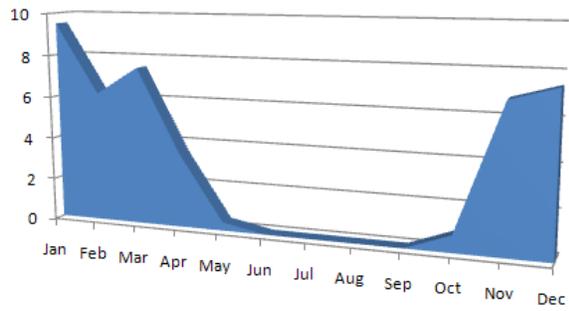
Humidity (%)



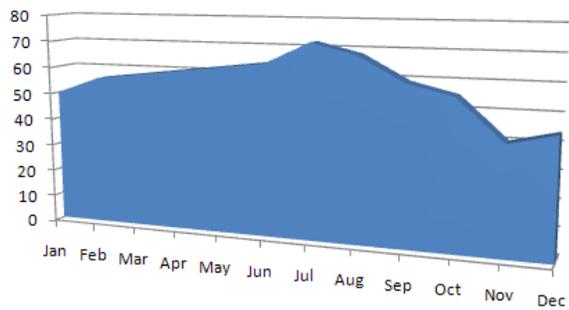
Precipitation (Inches)



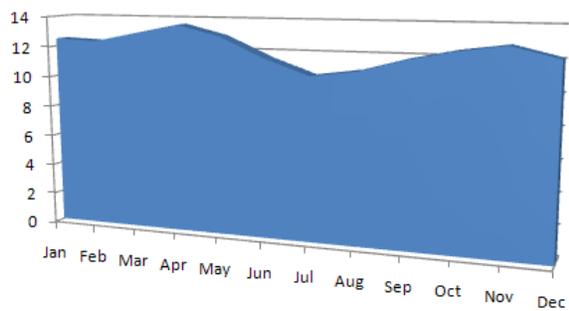
Snowfall (Inches)



Sunshine (%)



Wind Speed (mph)



Allocation of Space:

Grocery Center

Floor Space	8,640 sq. ft.
Storage	1,500 sq. ft.

Residential Units

The need for 9 apartment units, ranging from efficiency to 2 bedroom designs with an average of 700 sq. ft. per unit	6,275 sq. ft.
--	---------------

Office Space

Three offices spaces including kitchen, conference, and executive space.	7,060 sq. ft.
--	---------------

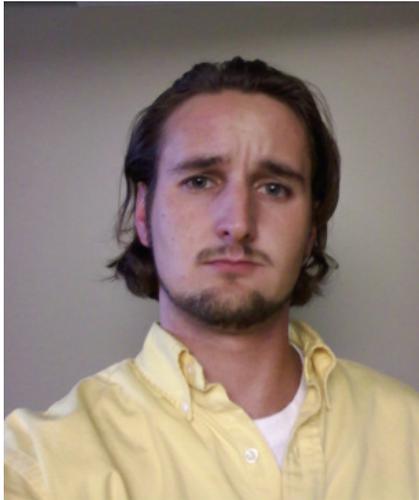
Parking

Underground parking	30 parking spaces
---------------------	-------------------

Reference List

- Agnes lofts. (n.d.). Architectural Record, Retrieved from http://archrecord.construction.com/projects/bts/archives/multifamhousing/08_AgnesLofts/default.asp
- Gonchar, J. (2007, July). Plaza apartments. GreenSource Magazine, Retrieved from http://greensource.construction.com/projects/0707_PlazaApts.asp
- <http://www.fargo-history.com/early/fargo-fire.htm>
- <http://www.cityoffargo.com/CityInfo/FargoHistory/>
- <http://www.city-data.com/city/Fargo-North-Dakota.html>
- J, D. (2003, February 21). Pseudocode standard. Retrieved from http://users.csc.calpoly.edu/~jdalbey/SWE/pdl_std.html
- Kalay, Yehuda E. (1989). Modeling Objects and Environments. New York: John Wiley & Sons.
- Knuth, Donald E. (1968). Fundamental Algorithms: The Art of Computer Programming. Reading, MA: Addison-Wesley Publishing Company.
- Sokol, D. (2009, January). Thin flats. GreenSource Magazine, Retrieved from http://greensource.construction.com/projects/2009/01_ThinFlats.asp

Drew Olson



4860 Lodge Ln.
Greenwood, MN 55331

612-702-3837

drew.olson@ndsu.edu

"My experience at NDSU has guided me in the direction of a bright and prosperous future."