July 2015

Sustainable Design of Student Centers Retrofitting and Adaptive Reuse of UMass Student Union

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Sustainable Design of Student Centers

Retrofitting and Adaptive Reuse of UMass Student Union

A Thesis Presented

by

TIANYE SONG

Submitted to the graduate school of the

University of MassachusettsAmherstin partial fulfillment

of the requirements for the degree of

MASTER OF ARCHITECTURE

MAY 2015

Department of Architecture

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ACKNOWLEDGMENTS

I wish to express my sincere thanks to Professor Kathleen Lugosch, Professor Ajla Aksamija, for the continuous encouragement and guidance. Thanks to Youngduk and Fahim who inspired me with their experience.

ABSTRACT

SUSTAINABLE DESIGN OF STUDENT CENTERS
RETROFITTING AND ADAPTIVE REUSE OF UMASS STUDENT UNION
MAY 2015

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Directed by: Professor Kathleen Lugosch

Based on the research of university Student centers and students' daily activities within a campus, this Thesis focuses on how to strengthen the relationship between the student and the Student Center, by developing a methodology for a successful architecture that towards making the daily life of a student better. This approach will help overcome current disconnect between students' daily activities and an environmentally integrated experience. The Thesis project focus will be the UMass Amherst's Student Union. The existing Student Union has long been unable to meet the needs of today's students, and its shortcomings have been felt throughout the campus, from a sense of alienation to the absence of places for activities and for actively connecting the campus with the environment.

Methods: Studying two student centers through visiting and investigating. Studying campus life through observing and recording; Using Questionnaire to collect data; studying the interaction between campus and facilities. Using Ecotect and concerned software to build and analyze solar radiation, shading and wind.

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CHAPTER 1

INTRODUCTION

1.1 Definition

There are many different types of building found on university campuses. The student activity center is one of them and it is called student union in the United States. It is devoted to student recreation and socialization and it is also the community center of the university. A student union offers different kinds of programs, activities, services and it is often the center of student affairs and activities within the campus.

1.2 The Specific Characteristic

The student union has its own specific characteristic in the campus. Compared with other buildings in campus, for example, learning center, campus center or library, Student union plays a more and more important role in students' daily life. Currently, with the increasing importance of student union, a lot of student unions have been built or renovated.

> In the United States, a lot of universities and colleges are in the midst of a building boom as they are investing tens and hundreds of millions of dollars to revitalize their student unions.[1]

[1] The 25 Most Amazing Campus Student Unions
at: http://www.bestcollegereviews.org/features/most-amazing-campus-student-unions/

How to revitalize student unions is a question I want to answer in this paper.

CHAPTER 2

RESEARCH OBJECTIVES

2.1 University of Massachusetts Amherst

Being a public and land-grant University in Amherst, Massachusetts, United States, and the flagship of the University of Massachusetts system, the UMass Amherst has 1,174 faculty members and more than 27.000 students. It is the largest public university in New England. There are eight schools and colleges in this university and they offer bachelor's degrees, master's degrees, and doctoral degrees. The main campus is located in the north of the downtown Amherst.

2.1.1UMass Campus Guidelines

There are five Official Guiding Principles about UMass campus future development:

1. Understand the Long-Term Growth Potential

2. Build a series of systems as the framework for growth Build an open space framework: Create a clear vehicular and pedestrian circulation system/ Develop an active mixed-use campus core/ Create growth opportunities and flexibility for the future

3. Respect planning and building heritage

4. Sustainability – Live it, Learn it, Lead it

5. Embrace Community Connectivity

According to University of Massachusetts Amherst Design Guidelines, new buildings should have the long-term growth potential. The vehicular and pedestrian circulation system within the campus core which concludes student union should be clear and developed. Based on the principle 3, the existing buildings which were built decades ago in campus should be respected. Sustainability is an important element in campus planning.

2.2 The Existing Student Union of UMass Amherst

2.2.1 Background

The Student Union of UMass Amherst is located within the central campus and it was the first facility to student activities and organizations. The area of this building is 106,000 square foot. It was the largest building on campus. The two-story building is multi-purposed and has rectangular plan. The main entrance is at the west facade at grade. The basement level is exposed at the building's east rear elevation.

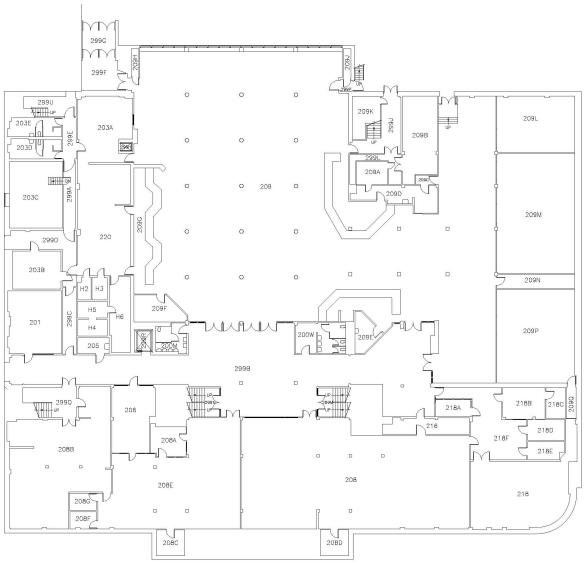

Figure 1- Basement floor plan of existing building

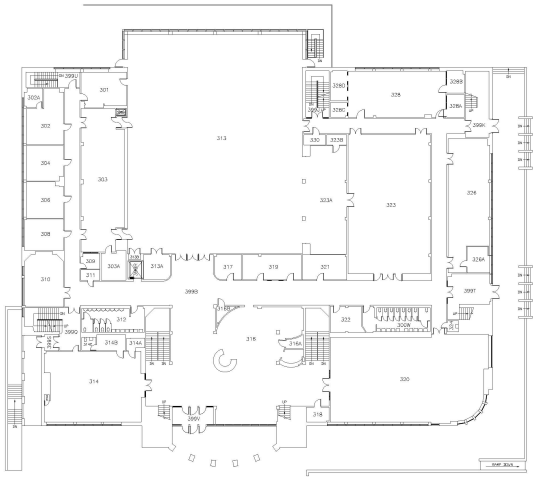

Figure 2- First floor plan of existing building

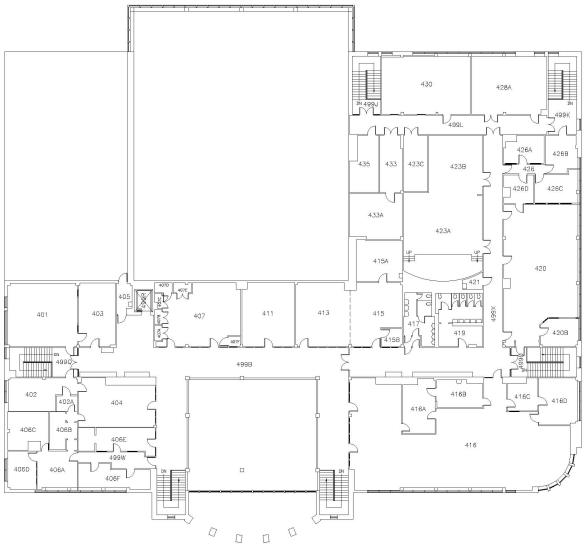

Figure 3- Second floor plan of existing building

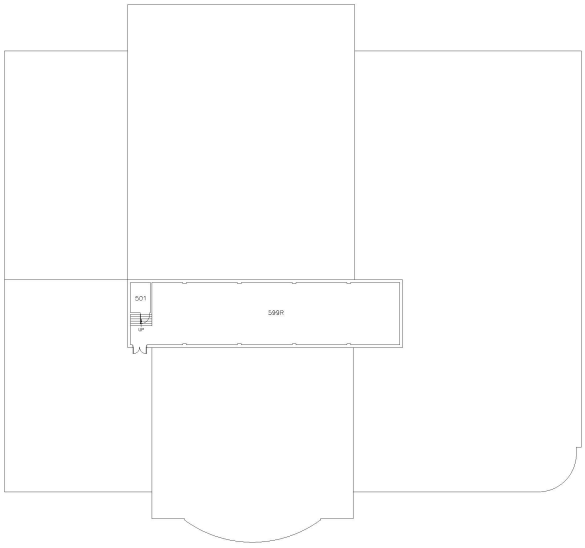

Figure 4- Roof plan of existing building

The structure is steel and concrete frame. This building has a flat roof, limestone coping, and brick veneer. At both west and east elevations, we could find two-story glazed curtain walls. The main entrance which is at the west facade is defined by a two-story portico. Through this glass panels, we could see the atrium lobby. Adjacent to the lobby is a 2-story ballroom, with a glazed curtain wall to provide views of the pond landscape. There were many different function rooms in this student union: offices, bowling alley, the Hatch cafeteria, a barber shop, and multiple student lounges. The following paragraphs show the development of UMass Amherst Student Union in the last 70 years:

> In 1948, strains to the campus facilities were publicized, particularly the 3,220 student body dining in Draper Commons, designed to accommodate 300. Such conditions supported the $7 million Van Meter Building Program initiated in 1948 aimed to double student capacity on the 700-acre campus within three years. All dormitory construction was alumni financed.
> Following WWII in 1946, a proposal had emerged to create a student union as a dedicated war memorial. The project was initially proposed as an addition to Memorial Hall. The initiative continued in fits and spurts until October 1953 when the campus planning council commissioned a study to determine a suitable location for a free-standing union. Four sites were proposed, including the previously considered addition to Memorial Hall, the intersection of North Pleasant and Clark Hill Roads, on North Pleasant across from pond, and a location within the central oval. The final site choice was based on a calculation of walking distances to the men's and women's housing districts planned and under construction. The building was the first dedicated facility to accommodate student extra-curricular activities and organizations, which became a significant component of the post- WWII academic experience. The project was also financed through the institution's self-liquidating alumni corporation.
> The location also influenced the construction of Machmer Hall, also constructed in 1957, directly across Olmsted Drive. Although designed by separate architects, both Machmer Hall and the Student Union employed

similar architectural details and contributed towards defining the central campus academic complex. Following the completion of Hasbrouck Hall in 1950, the University adopted a modern approach to the design of all new academic buildings.

The Student Union was the last of two non-residential structures Ross designed for the institution, and uniquely was conceived in a contemporary modern style. Although there were virtually no distinctions in the building's construction technology from his other projects of the period (concrete and steel frame) the exterior form was a clear departure from the Georgian Revival style influencing the dormitory construction. Such a distinction was not uncommon to this period of post-WWII campus architecture, when academic facilities often embraced the symbolic connotations of modern design, while residential construction adopted the historic.

New construction in 1970, including the Lincoln Campus Center to the northeast and the Parking Garage to the northwest, has impacted views to and from the building. As part of the current construction of the new Academic Classroom Building, the green space to the east of the Student Union is being renovated.[2]

[2] Student Union, YouMass

at: http://scua.library.umass.edu/youmass/doku.php?id=s:student_union

2.2.2Current situation analysis

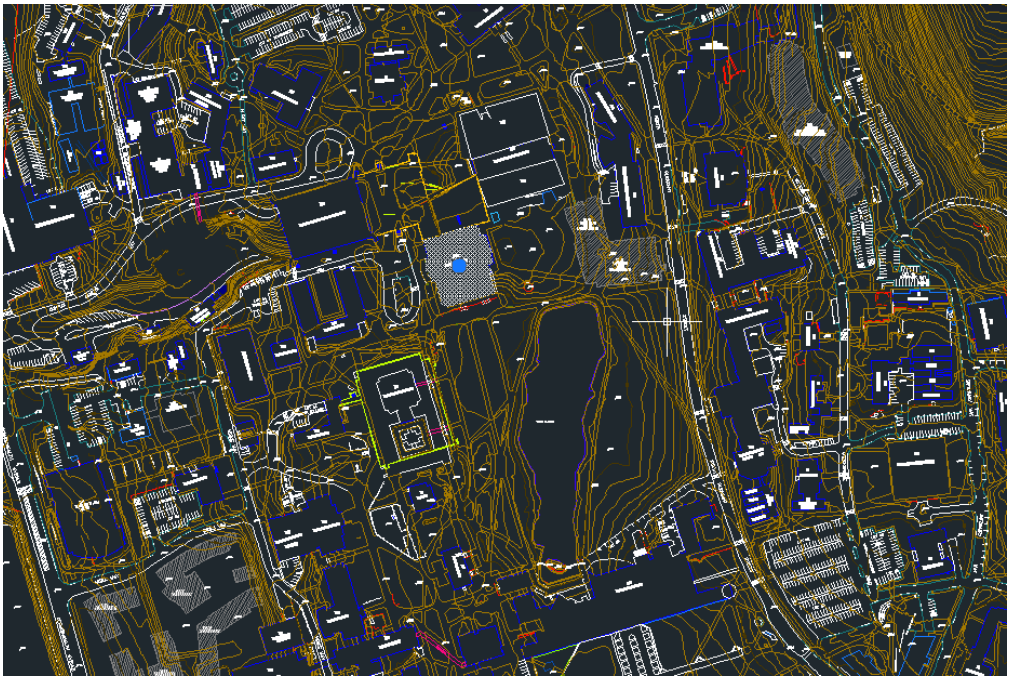

Figure 5- The Contour of UMass Amherst Campus

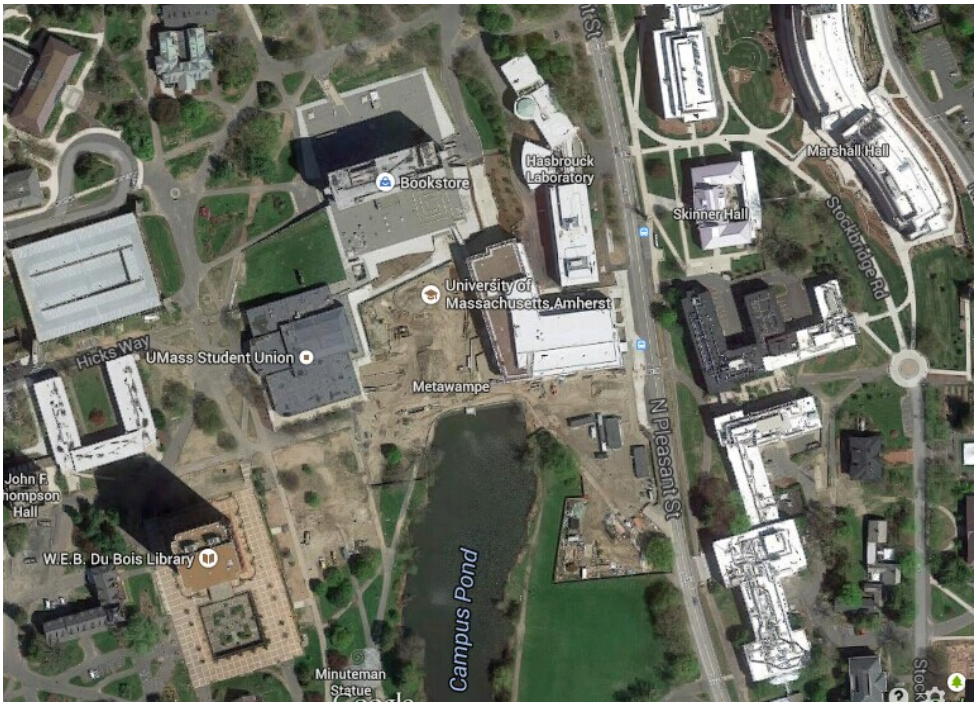

Figure 6- UMass Amherst Campus Google map

Figure 7- Courtyard

Figure 8- Existing Student Union Lounge

Figure 9- Existing Student Union Basement

Located in the central part of campus, Student Union is surrounded by the Campus Center and Library. There is 10feet height difference within the site. After the Integrative Learning Center's completion in 2013, Campus Center, Student Union and ILC form a courtyard in the center of campus but the connection between courtyard and Student Union is very weak. The number of UMass students is much biggerthan before and some space in the Student Union seems very crowded now, especially when an event is held. The basement space of Student Union is dark and it is no longer in use. The working space is not sufficient. Over the past sixty years, the social life and community engagement requirements of students has changed considerably. The Student Union has long been unable to meet the needs of today's students and it is really in need of space modernization and the ability to provide contemporary technology and assembly facilities for the diversity of hundreds of student organizations on campus.

CHAPTER 3

PRECEDENT STUDY AND LITERATURE REVIEW

3.1 Precedent

3.1.1 Student Center, Colorado State University

This project includes renovation of 160,000 gross square feet of the existing student centerwhich was built in 1962and adds approximately 69,600 gross square feet of new space.

The substantial change in energy performance and efficiency is provided by the updates to the existing exterior and mechanical systems. The growth of new space will be focused on the ballroom, dining and food venues, meeting rooms. student lounge spaces and building infrastructure.

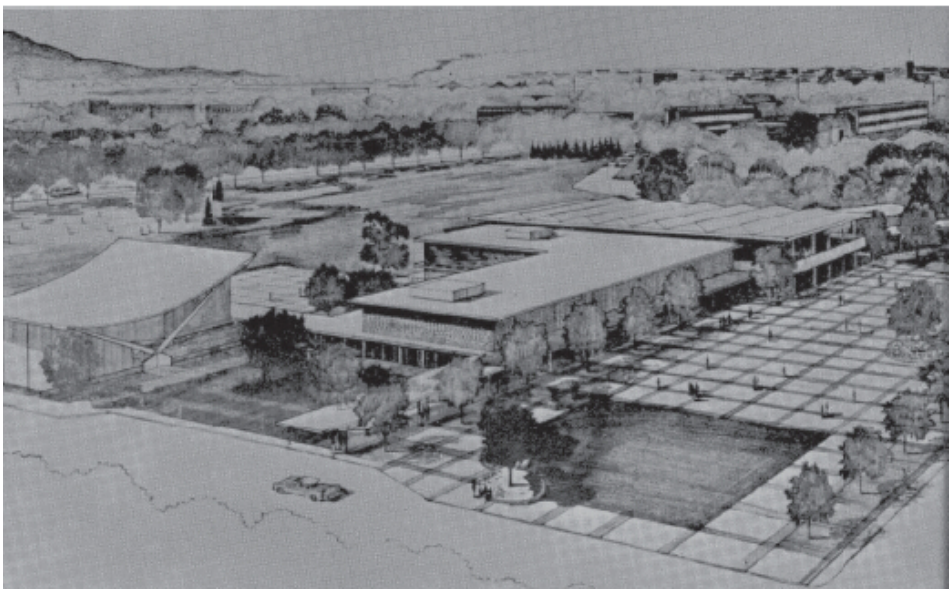

Figure 10- Design Concept Rendering, James Hunter 1962

Existing, Demolition, and New Construction Scope:the project scope includes approximately 203,116 gross square feet (gsf), blended through a mix of renovationand new construction. Of the 203,116 gsf, 143,050 gsf is existing space, 60,066 gsfis new construction, and 10,808 gsf will be demolished. Much of the area that will bedemolished has outlived its useful life; and includes areas that were either added afterthe LSC original design, or original space that is in the direct path of major expansion.[3]

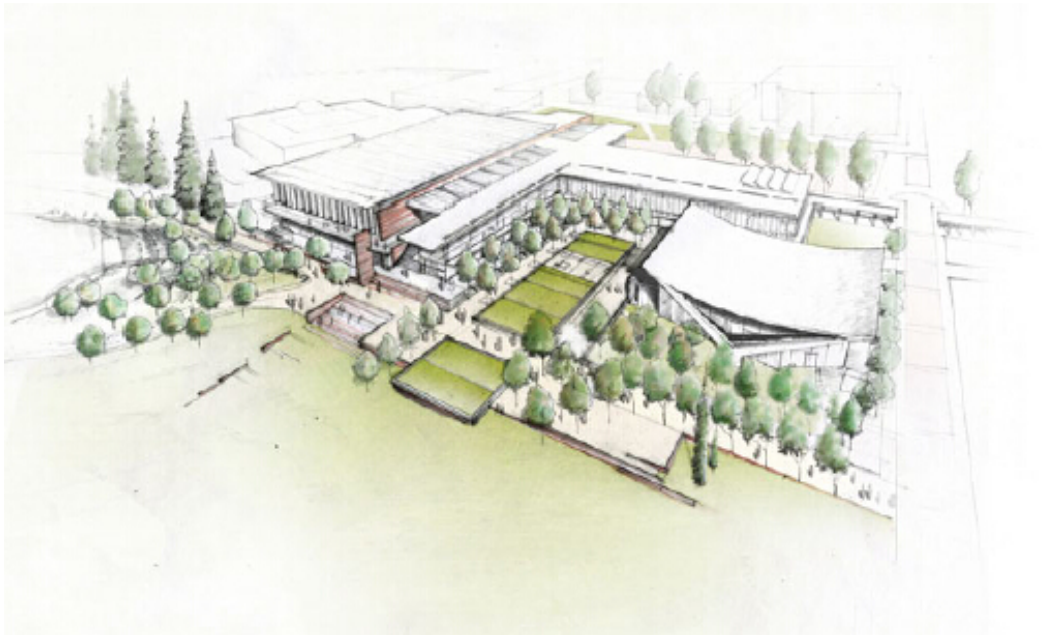

Figure 11- New Design Concept Rendering, Perkins + will, 2011

[3] Concept Design Report, October 28, 2011, Perkins + will

3.1.2 Student Center, Boston University

Figure 12- Student Center of BU, Images ©Richard Mandelkorn

BU's new Student Center will be a hub of student activity including dining, studying and seeking counseling. The first two floors, almost 46,000 square feet, will be dedicated to the Marciano Commons, cafeterias and cafes. Different types of student organizations will be housed on the top four floors. Based on the city's context and history, the building is respectful by utilizing traditional masonry material and continuing the rhythm and geometry of the familiar neighborhood façade. But it also shows the new materiality through a glass tower extending beyond the facade to reveal the modern flare of this new building.

3.2Literature review

3.2.1 **Net Zero Energy Design** by Thomas Hootman

This is an important book and the author believes that it could "play a meaningful role in moving our industry toward a new way of designing and delivering buildings - towards net zero energy architecture."[4]

In this book, there are twelve chapters. Within these chapters, there are overall guidance for net zero energy, design guidance and process guidance for net zero energy commercial buildings.

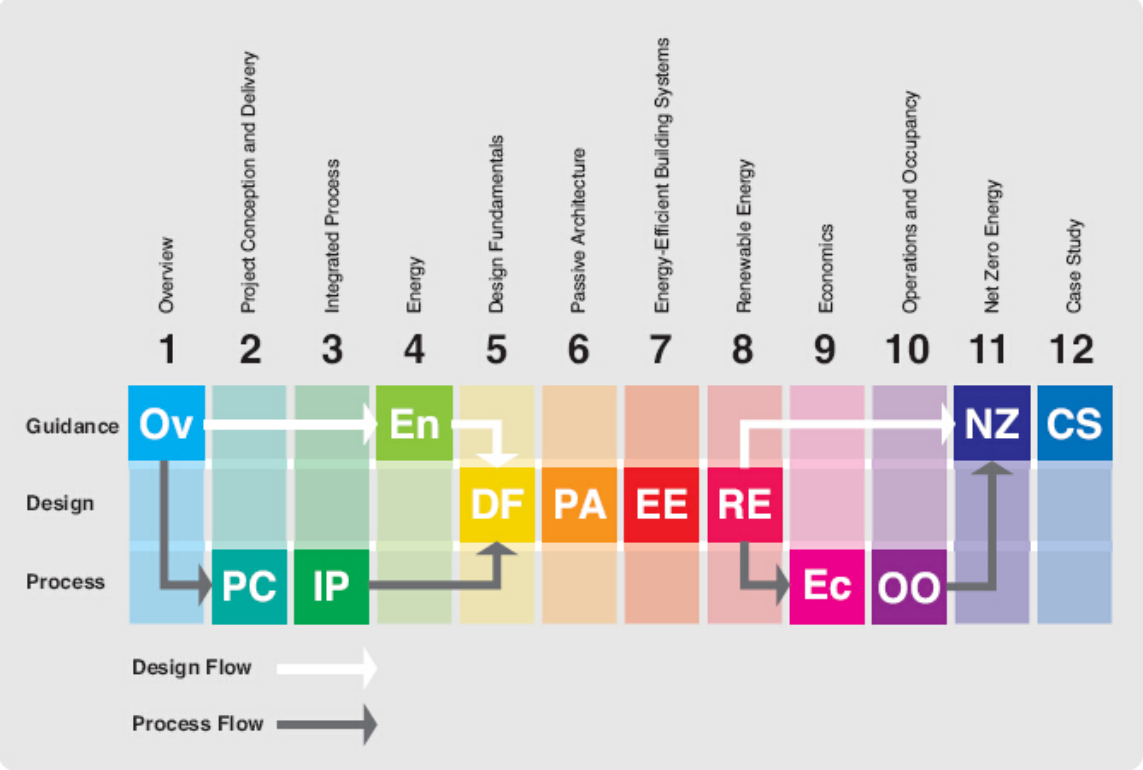

Figure 13- Chapters (retrieved from Net Zero Energy Design)

For example, in the chapter 5 (design guidance), the author suggest the designers to establish the fundamental energy design conditions for the project before

[4] Net Zero Energy Design: A Guide for Commercial Architecture, Thomas Hootman, October 2012

beginning the design phase in earnest.

There are four major parts in energy design conditions: climate, site, massing, and program.

Climate: Based on the koppen climate classification system, the overall climate information will be understood easily which will guarantee the beginning of our design is on the right track. After finding the correct one from five main climate classifications, we could also find the relevant typical passive and low-energy design responses. The passive strategies could be informed and evaluated through the analysis climate data. Climate Data Sets include Temperature, Humidity, Wind rose, Ground Temperature, Solar Radiation, Solar Geometry, Sky Cover, Illumination, and Psychrometric Chart.

Site: Climate information, which is a large picture, is important but it need to be analyzed in more detail within our specific site. Combined with site, the information will be more accurate. Using the site plan, site inventory, and climate data, the site can be analyzed, and opportunities and constraints regarding energy flows evaluated. "This process makes the climate analysis project-specific and establishes the evaluation of climate parameters at a site and building level."[5]It concludes solar and Daylight, Wind and Microclimate.

Building massing and geometry: the next step is to decide how the building can be

[5] Net Zero Energy Design: A Guide for Commercial Architecture, Thomas Hootman, October 2012

designed to optimize the indentified passive strategies. The orientation, Solar, Ventilation and building shape will be developed.

This climate-site-massing-program method will be used in the following design.

CHAPTER 4

SURVEY

How to satisfy the users of the building is the most important thing. Because my design focuses on the Student Union of UMass Amherst, it is vital to investigate what the students need or desire.

Therefore, a questionnaire was conducted focusing on existing UMass Union and students. The results were useful to develop design guidelines for the new Student Union.

4.1 Data collection

4.1.1 Questionnaire and Results

This Questionnaire includes 10 questions in total. The survey was sent to 100 students and 100% responded to it.

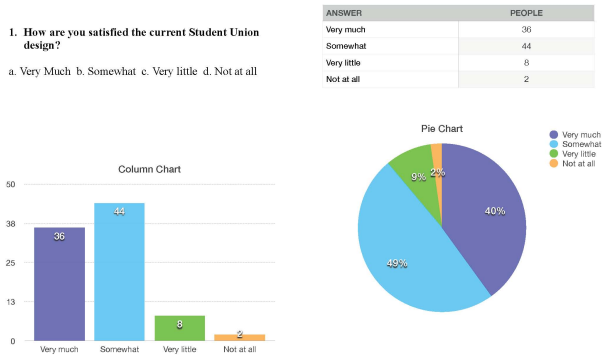

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Figure 14- Questionnaire Question 1 and Results

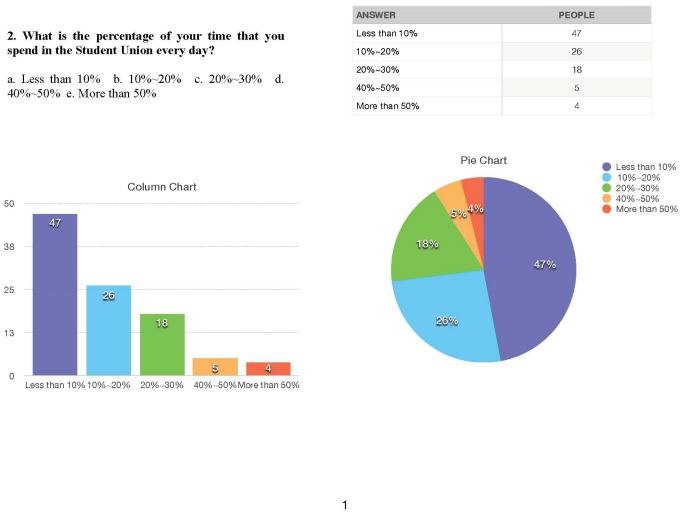


Figure 15- Questionnaire Question 2 and Results

From Question 1&2, we can find that less than half students are satisfied with the existing Student Union and 47% students spend only 10% of their time there every day. It should play an important role in students daily life but the time they spend there is too little.

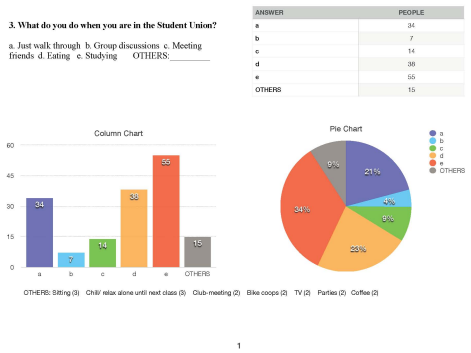


Figure 16- Questionnaire Question 3 and Results

From this question, we can see Studying and Eating are two major activities when they are in Student Union and then Walking through. So studying space and dining space should be emphasized and then movement space.

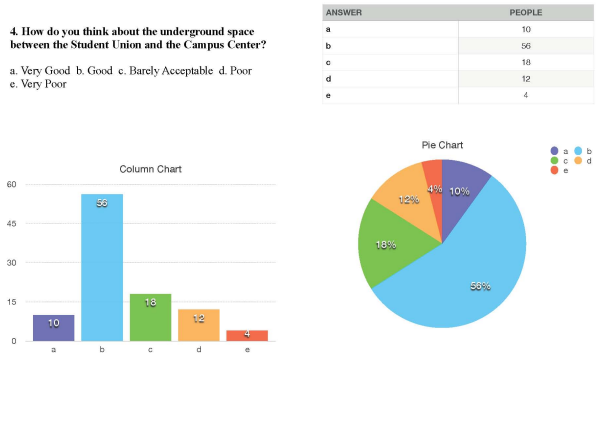


Figure 17- Questionnaire Question 4 and Results

From this question, more than half students are unsatisfied with the underground space between the Student Union and the Campus Center.

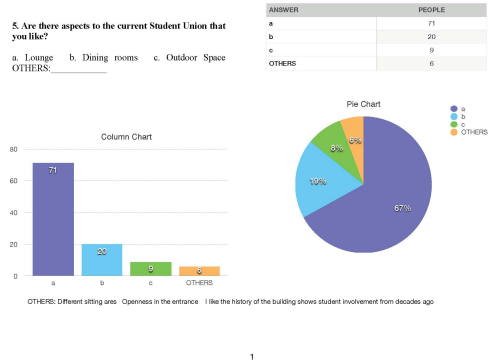


Figure 18- Questionnaire Question 5 and Results

Almost 70% students like the existing lounge. In the future design, this kind of space should be kept.

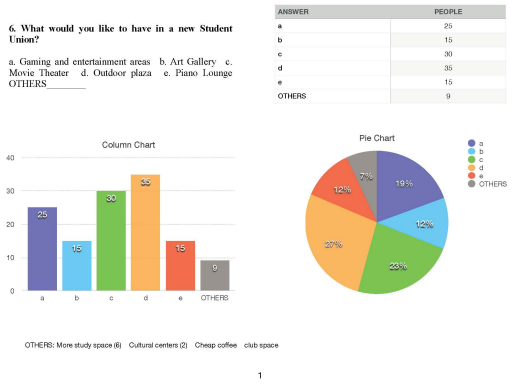


Figure 19- Questionnaire Question 6 and Results

Half students want to have more outdoor space, movie theater and entertainment space. The lack of such space could be a reason why the students spend so little time here.

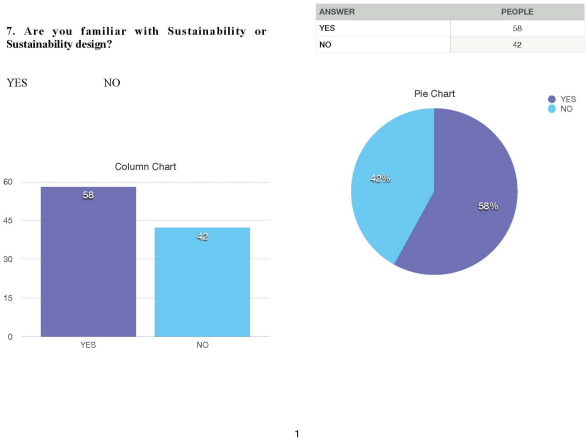


Figure 20- Questionnaire Question 7 and Results

More than half students are not familiar with sustainability. Changing the new building into a place to show and teach sustainability will be a good solution.

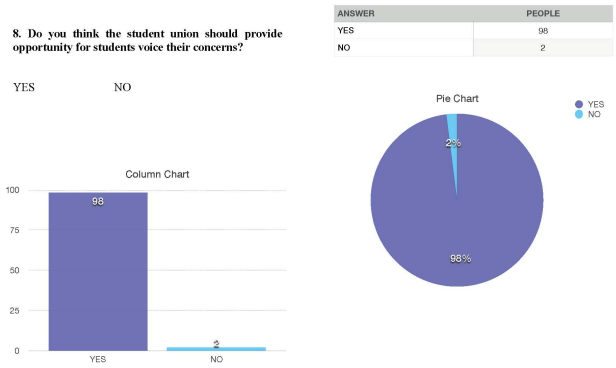


Figure 21- Questionnaire Question 8 and Result

98% students think the student union should provide opportunity for them voice their concerns.

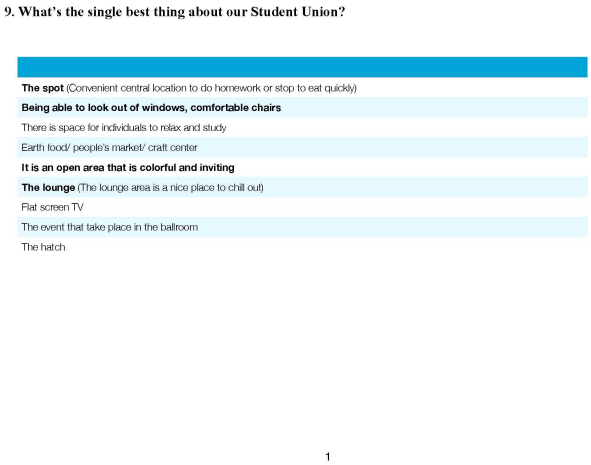
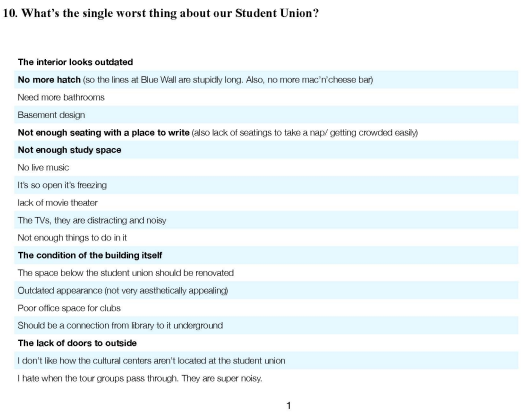


Figure 22- Questionnaire Question 9 and Results

Students like the lounge, comfortable chairs and big window which they can look out of and the colorful and inviting open area.



10. What's the single worst thing about our Student Union?

The interior looks outdated
No more hatch (so the lines at Blue Wall are stupidly long. Also, no more mac'n'cheese bar)
Need more bathrooms
Basement design
Not enough seating with a place to write (also lack of seatings to take a nap/ getting crowded easily)
Not enough study space
No live music
It's so open it's freezing
lack of movie theater
The TVs, they are distracting and noisy
Not enough things to do in it
The condition of the building itself
The space below the student union should be renovated
Outdated appearance (not very aesthetically appealing)
Poor office space for clubs
Should be a connection from library to it underground
The lack of doors to outside
I don't like how the cultural centers aren't located at the student union
I hate when the tour groups pass through. They are super noisy.

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Figure 23- Questionnaire Question 10 and Results

The interior looks outdated and the seating space and study space are not sufficient. The condition of the building itself is also a problem. For example, there is a lack of doors to outside and the restrooms are insufficient. Such issues will be resolved in the following student union design.

CHAPTER 5

DESIGN

5.1 Location

The project is located in the central part of UMass Amherst, Amherst town, MA. The project scope includes approximately 126,237 gross square feet (gsf), blended through a mix of renovation and new construction. Of the 126,237 gsf, 106,000 is existing space, 20237 is new construction, and 12,110 gsf will be demolished. The most of the demolished space is ballroom.

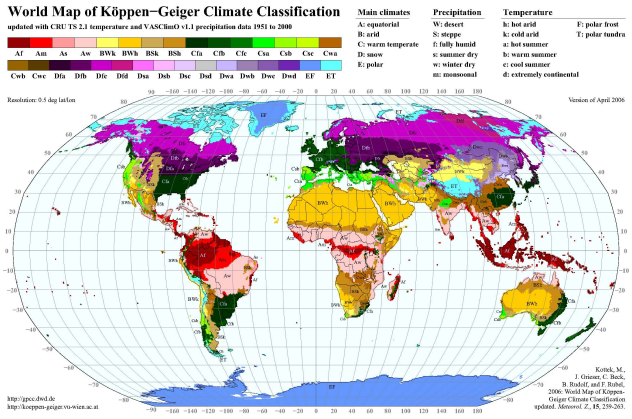

Figure 24- Climate Classification Map

In the climate Classification Map, the climate of Amherst is Cold-Warm Summer without Dry Season. Cold Climates characteristics is "... a wide range of seasonal temperatures but are characterized by cold winters with snow. Locations in cold climates are often interior to continental landmasses..."[6]

[6] Net Zero Energy Design: A Guide for Commercial Architecture, Thomas Hootman, October 2012

Climate analysis for this project:

Temperature:

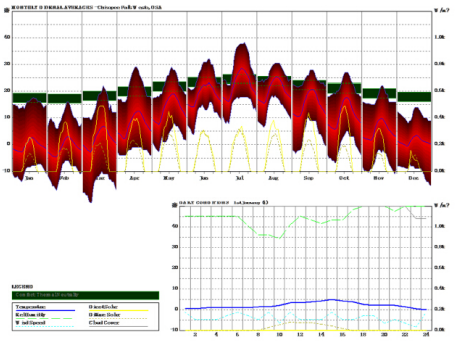

Figure 25- Amherst Weather information (retrieved from Ecotect)

Wind Rose:

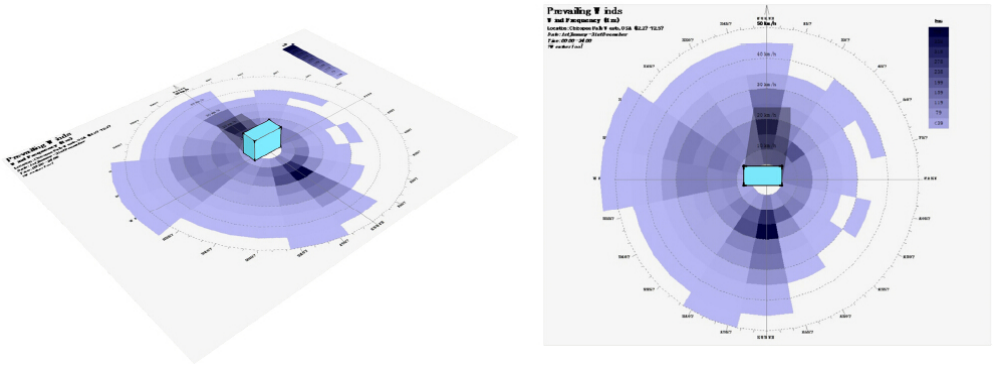

Figure 26- Wind Analysis (retrieved from Ecotect)

The prevailing wind is north-south wind. Considering the building mass, I allow the narrow section of the building to be cross ventilated by orienting the long face of the building to the wind.

Solar Position:

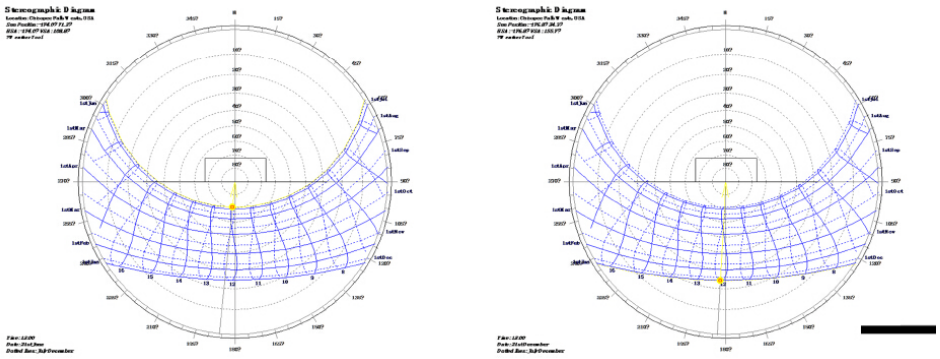

Figure 27- Sun Position Analysis (retrieved from Ecotect)

On 21st June, the solar angle is 71 degree and on 21st December, the solar angle is 24 degree. These angles will be used to shape the building.

5.2 Passive strategies

Shading:

Shading is one of the most basic and time-tested passive cooling strategies. Because glazing is the largest contributor to solar radiation gain, shading is always designed with the glazing systems. In this project, the vertical shading devices are used on the east and west facades of existing and additional building.

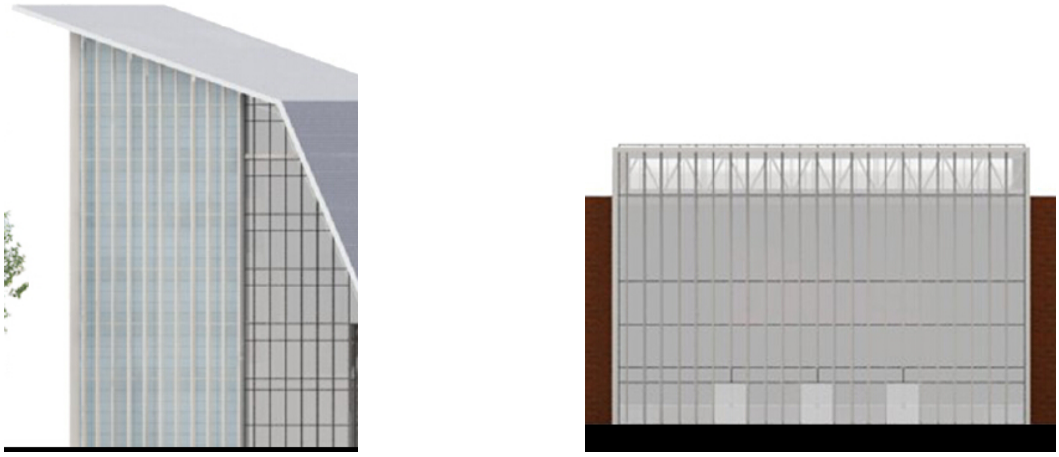

Figure 28- Vertical Shading System

Passive Solar: We could use the sun to power and light or heat the building. In this project, the solar is used to power the building and the ray of sun light will be used to shape the building.

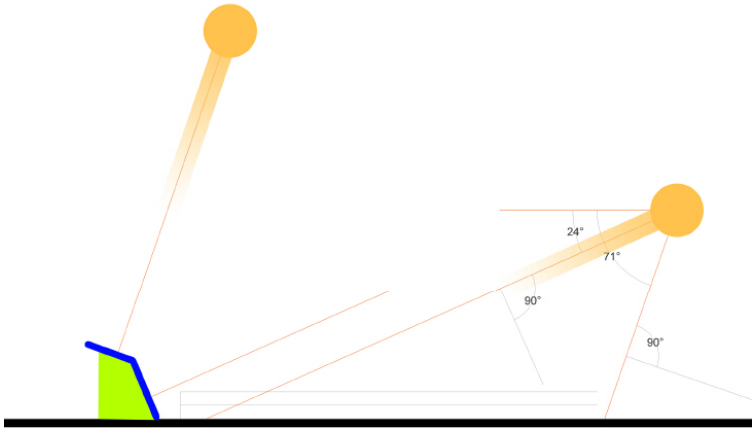

Figure 29- Sun Position and Angel Analysis

Side Lighting:

Side Lighting can be brought through apertures in an exterior wall. In this project, the side lighting is used in the ballroom space. The daylight is reflected the ceiling to prevent glare and direct west sunbeam penetration.

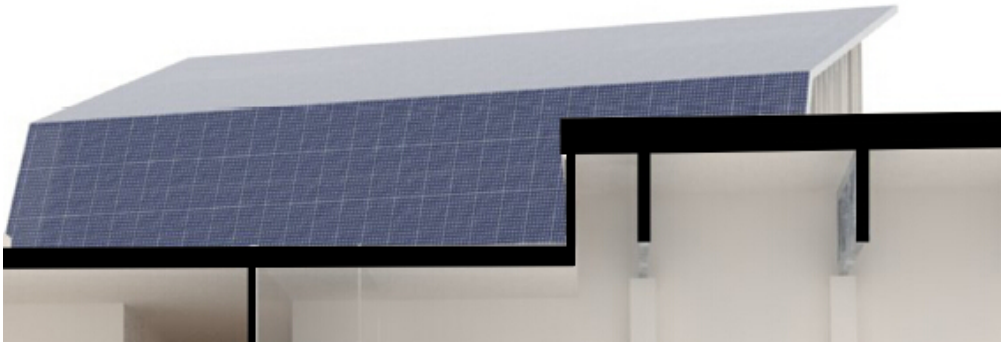

Figure 30 - Side Lighting

Natural Ventilation:

Natural ventilation is a simple and effective way of providing cooling and fresh outside air to building occupants. The facade system of the new student union is double skin facade. There is opening on the elevation for supplying air. The fresh air will get interior through the outside opening and the cavity between double skin facades.

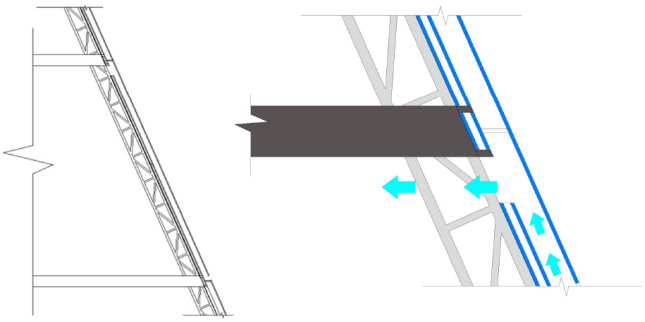

Figure 31- Natural Ventilation

Two kinds of ventilation systems in additional and existing buildings: Cross ventilation and Stack ventilation

Figure 32- Two kinds of Ventilation systems

5.3 Renewable energy

Solar Power:

In this design, photovoltaic materials are used as parts of the building envelope such as the roof and facades.

> The advantage of integrated photovoltaics over more common non-integrated systems is that the initial cost can be offset by reducing the amount spent on building materials and labor that would normally be used to construct the part of the building that the BIPV modules replace. These advantages make BIPV one of the fastest growing segments of the photovoltaic industry.[7]

The facade will use semitransparent PV glass which will provide a good field of vision and the roof will use opaque PV glass which is more efficient. Through the image of Radiation, we can see there is huge potential to generate electricity by roof and south facade.

[7] Net Zero Energy Design: A Guide for Commercial Architecture, Thomas Hootman, October 2012

Figure 33- BIPV System

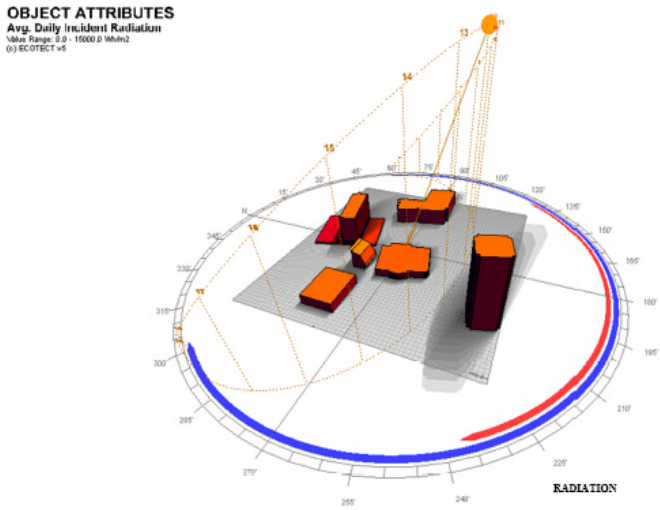

Figure 34- Solar Radiation (retrieved from Ecotect)

5.4 Program

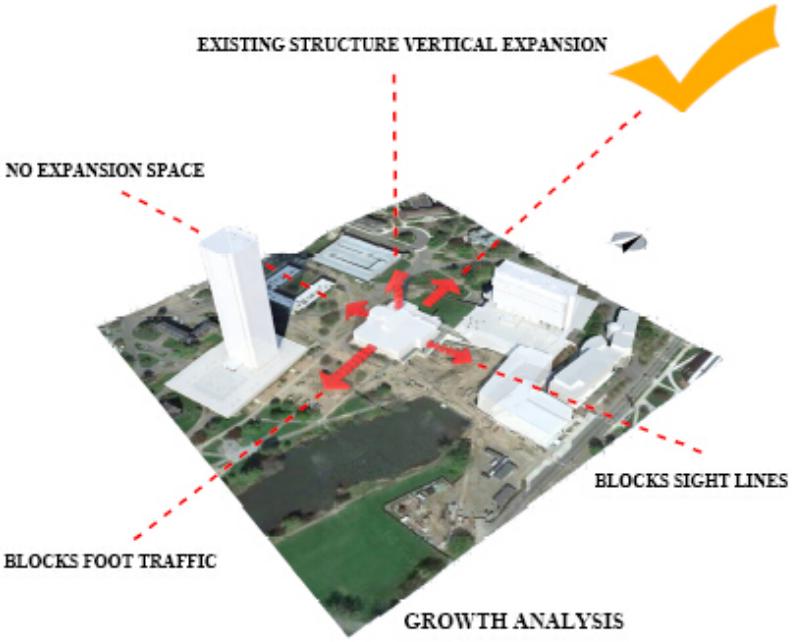

Figure 35- Growth Analysis

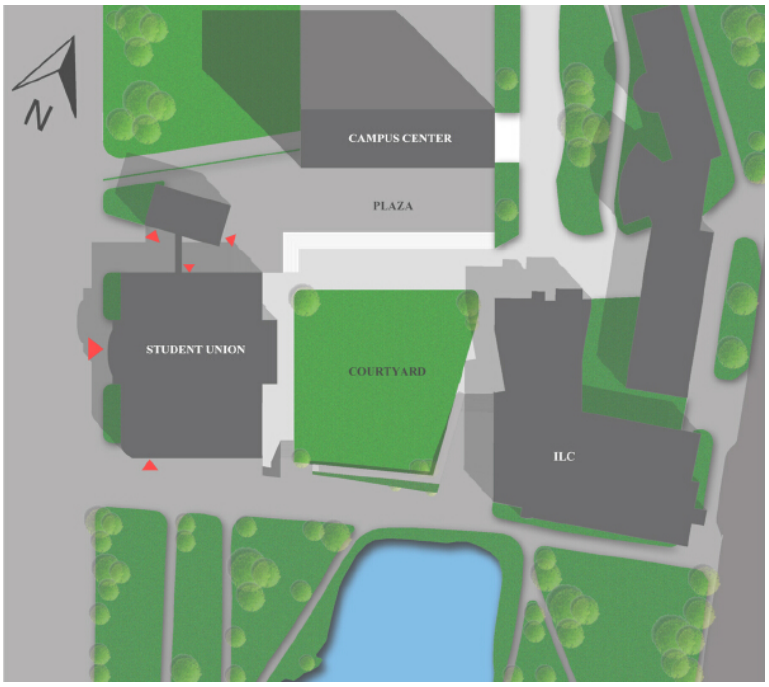

Figure 36- Site Plan

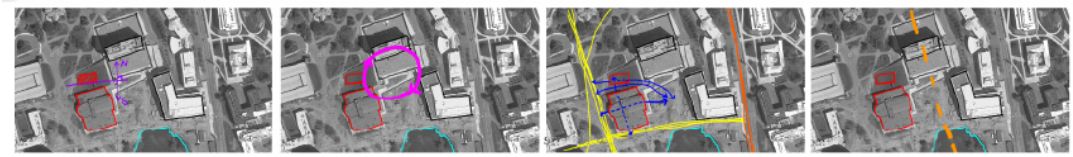

Figure 37- Location/ Internal Connection/ Foot Traffic/ Sight Line

After analysis, the new Student Union could be divided into two parts: an existing part and an additional part which is located in the north of the existing building. The design is organized around clear circulation that connects all three levels to the North, South, East, and West entries. The East and West entries are strengthened by existing outside columns and big glazing window. The four entries in existing part connect front plaza, courtyard, additional building, and the South. The two entries in additional part connect Campus Center and existing part.

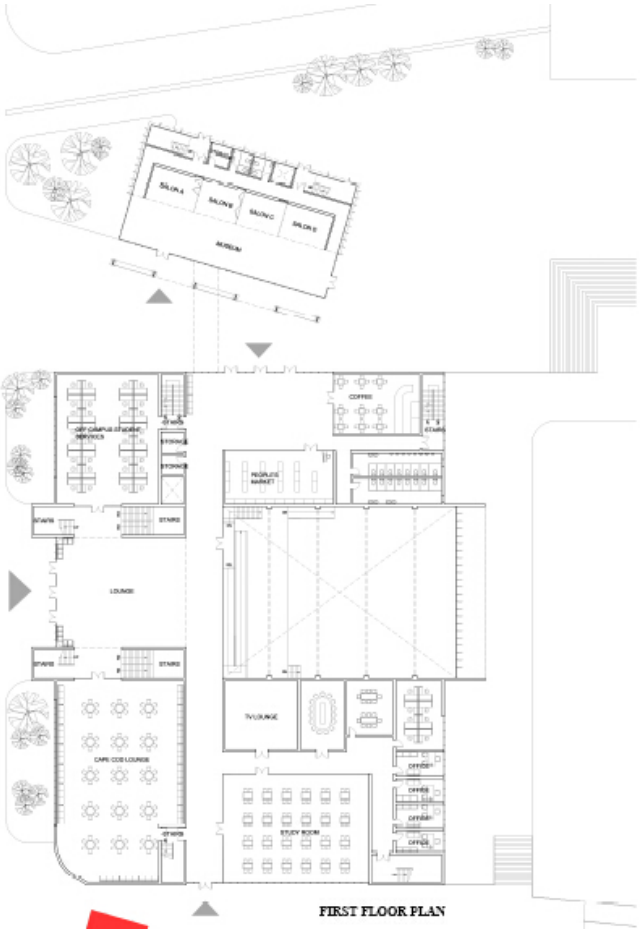

Figure 38- First Floor Plan

Figure 39- Section

5.5 New space for Students

Figure 40- New Ballroom in the Existing Building

The existing ballroom was an empty and useless space when there is no event and it was also an obstacle between the west(main entrance of existing building) and the east (courtyard). After renovation, a new multi-function ballroom is designed. This ballroom' capacity is bigger than before with new structure and it is transformed toan important connection when there is no event. People can enter this ballroom through the west main entry or the east courtyard entry. There is a stage in this ballroom and there is a ramp which is designed for improving the visual experience of the handicapped connects the stage and the upper floor.

Figure 41- Event Space in the Additional Building

From the questionnaire, many students complain that the option in the existing Student Union is so few. In order to improve the students' activities after class, this event space has been designed. There are my options in this event room: Climbing, Badminton, Frisbee, Ping-Pong and basketball.

Figure 42- Top-floor Ballroom in the Addition Building

This is a small ballroom for students' gathering on holidays. There are also many options here. It will be a perfect place for different kinds of parties. The location of this ballroom is on the top of the additional Student Union with wonderful scenery. The roof and facade of this room is covered by PV panels and this roof could be a place to make students be familiar with sustainability and the use of renewable energy.

5.6 Forms and Materials

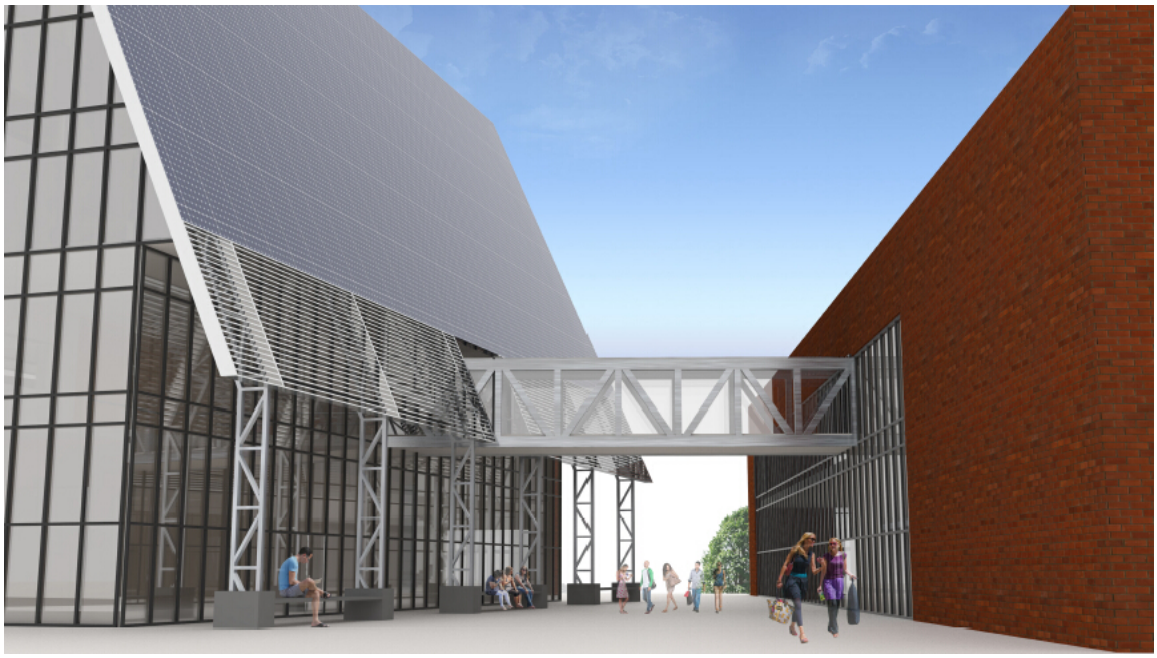

Figure 43- Connection between the Buildings

The shape of the additional part of Student Union is combination of lines which are perpendicular to the beam of sunlight. The semitransparent PV glass is used as roof and south facade. There PV panels have the perfect angle which will increase the efficiency of generating electricity and, because of their property, they will allow light to pass through.

The north, west and east facades of additional Student Union is kalwall.

> Kalwall reduces heating and cooling loads by controlling solar heat gain to deliver significant energy savings while creating more balanced and comfortable spaces. During the manufacturing process, panels are fitted with translucent insulation (TI) including the revolutionary Kalwall+ Lumira® aerogel's .05 U-value (R-20). Optional thermally broken panel grid-cores yield the ultimate in energy performance and condensation resistance. U-factors range from our standard .29 with options from .53

to .05. Unlike gas-filled technology, which eventually leaks out, Kalwall's highly insulating properties remain constant.[8]

Concrete will be used as vertical shading fins. The structure of additional Student Union is steel structure.

The existing part of Student Union keeps the structure and exterior material. The concrete fins are added on the east facade. The existing glazing is replaced by high performance glazing.

[8] Kalwall: Home http://www.kalwall.com/

CHAPTER 6

CONCLUSION

The original intention of my thesis is to explore a methodology for a successful architecture that towards making the daily life of a student better. Student Union is such an important building found on campus for student's daily life and in many universities in United States, most of the student unions were built decades ago. Currently, in the midst of the building boom nationwide, what kind of attitude should universities and colleges have when they are prepared to revitalize their own student unions is a question I want to answer in a specific way.

The design process starts from the decision of saving or demolishing the existing building. Respecting building heritage, I try to revitalize UMass Amherst Student Union through the minimum demolishment. After some kinds of analysis (site analysis, growth analysis, students foot traffic analysis, internal and external connection analysis etc.), I demolished some parts of the existing building and add a small building in the north. After updating the conditions of the existing building, I use sustainable methods to shape the additional building and make it work well. The sustainable methods start from climate, site, massing, and program. With these useful data, we could change them into passive strategies: shading, lighting, ventilation, etc. After using passive strategies to develop the additional building, I also take advantage of renewable energy which will power

the building and be helpful for students to learn the sustainability. In order to diversity and improve student's daily life, I also create some different types of interesting space in the both existing and additional buildings.

In conclusion, the existing student center's revitalization should be treated seriously when universities begin to develop their campuses. Based on the history and heritage, combined with the current situations and survey, using the sustainable design methods that starts from climate, site, massing, and program to passive strategies, building systems, and the using of renewable energy, in my opinion, this way could be used and developed in the sustainable design of student centers in the future.

APPENDIX

CONTENT OF QUESTIONNAIRE

1. How are you satisfied the current Student Union design?
a. Very Much b. Somewhat c. Very little d. Not at all

2. What is the percentage of your time that you spend in the Student Union every day?
a. Less than 10% b. 10%~20% c. 20%~30% d. 40%~50% e. More than 50%

1. What do you do when you are in the Student Union?
a. Just Walk through b. Group Discussions c. Meeting friends d. Eating or Drinking e. studying OTHERS:_____

2. How do you think about the underground space between the Student Union and the Campus Center?
a. Very Good b. Good c. Barely Acceptable d. Poor e. Very Poor

3. Are there aspects to the current Student Union that you like?
a. Lounge b. Dining rooms c. Outdoor Space OTHERS:_____

4. What would you like to have in a new Student Union?
a. Gaming and and entertainment areas b. Art Gallery c. Movie Theater d. Union Square e. Piano Lounge OTHERS:_____

7. Are you familiar with Sustainability or Sustainability design?
YES NO

8. Do you think the student union should be a place where students can voice their concerns?
YES NO

9. What's the single best thing about our Student Union?

10. What's the single worst thing about our Student Union?

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