A Ball State University Center for the Environment

An Honors Thesis (ARCH 401)

by

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A Ball State University Center for the Environment
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Abstract

The Ball State University campus currently has an interior street leading from the Robert Bell building to the Arts and Journalism building. There is a vacant lot adjacent to the Arts and Journalism building with Teacher's College on the opposite side. This project provides an urban and environmental response to the vacant lot, creating the last link for the contiguous interior street between the Robert Bell building and the Teacher's College.
Acknowledgements

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Finally, I would like to thank my colleagues Joseph Bohn, Luke Christen, Erin Carpenter, Tayler Mikosz, and Madeline LaPlante for assisting with my preliminary research and precedent analysis.
Purposes and Intents

- Design centered around living machine- making use of its output
- Living Walls- 2-fold design elements
  - Enhances learning environment by utilizing output from living machine
  - Creates another tool to be monitored
  - Environmental aspects
    - Carbon filter-takes on toxins
    - Adds moisture to air
    - Reduces urban heat island effect
- Distributing Water to use for irrigation on McKinley
- Taking technology to a level people can see and understand- see all steps of the process
  - Tiered living machine- gravity
  - Views from outside
  - Views from 2\textsuperscript{nd} floor path
I. INTRODUCTION

For this, your last scheduled design experience in your undergraduate course of study at Ball State, you will be presented with a trifurcated set of challenges/ opportunities. These are:

- The opportunity to design a building that has urban design response and environmental response as key aspects of the design problem. The urban design response relates to the necessity to interpret the design vocabularies of the contiguous buildings as well as those of the campus as a whole and creation of a vocabulary for the building in response to that interpretation. The environmental response requires the design consideration of those many aspects that live under the rubric of “sustainability”: e.g., water harvesting, storm water management (green roof, retention pond, detention pond, cistern, treatment), on-site black water treatment, solar thermal management (useful collection and avoided overheating), cross ventilation, stack ventilation, PV electrical production, energy flow balances and mechanical system(s) type(s).

- The challenge of a Cripe Architects + Engineers design competition that provides you with another opportunity to present your design solution for judgment in the absence of your presence and elucidation.

- The opportunity, probably your first opportunity, to comprehensively explore the technical infrastructure of your design. The elements of this “Comprehensive Project” as defined by the National Architectural Accrediting Board are listed in an attachment to the course syllabus.

Adding to the complexity of the above set of challenges is that presented by the configuration of the site and of the Teachers College building to the south of the site. The site is elongated in the north-south direction, not an orientation normally considered ideal for solar access, but it can become ideal with inventive solutions. And, the ten story Teachers College building casts a solar shadow over the site for the middle part of the day.

The result is a design problem replete with opportunities for inventive and interesting solutions.
II. THE CONTEXT

The building will be a linkage between the Art and Journalism building and the Teachers College building, thus providing the opportunity for the continuation of the internal “street” that begins at the Bell Building and now terminates with the Art and Journalism building.

It will house programs and facilities focused on environmental education, research and monitoring. In December of 2006, President Gora joined with eleven other members of the Leadership Circle of presidents and chancellors of colleges and universities as a signatory to the American College & University Presidents Climate Commitment (ACUPCC). A goal of the ACUPCC is to, “exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality”. This building will be a visible manifestation of that commitment. As such, it will provide facilities for:

- Environmental education programs such as the university’s Clustered Minors in Environmentally Sustainable Practices as well as other environmentally focused education offered by units across the university.
- Environmentally-focused research and symposia
- Offices for the Center Director, the University Sustainability Coordinator and other persons involved in campus environmental quality initiatives

The overarching goal of center is to encourage education and research and to provide campus leadership in the issues subsumed under the rubric of “environment quality” and the many interrelations of these issues within human society. The Center will draw its strength from faculty members and students across the University who make up an intellectual community of teachers and scholars in diverse fields including architecture, biology, business, earth and planetary sciences, economics, government, landscape architecture, natural resources, public health and urban planning as well as visiting scholars with expertise in areas focused on the quality of the environment. The most pressing problems facing our natural environment are complex, often requiring collaborative investigation by scholars versed in different disciplines. By connecting scholars and practitioners from different disciplines, the Center for the Environment seeks to raise the quality of environmental research and education at Ball State University and beyond.

III. TABLE OF ACCOMMODATION

The building will accommodate the following uses and spaces:

1.0 Multi-Use Suite
   These spaces will be used during the day for lectures for large classes, for evening banquets, for evening lectures by prominent “environmentalists” and for plenary sessions for symposia.
   1.1 Auditorium (Seating for 150 in chairs or for 64 at tables of eight for dining) 1200 sq. ft.
   1.2 Stage Area 640 sq. ft.
   1.3 Stage Activity Prep Area (Quasi-Green Room) 240 sq. ft.
   1.4 Meals Serving Area (For catered meals brought by truck) 320 sq. ft.
   4,000 sq. ft.
1.5 Storage for Tables and Chairs 320 sq. ft.
1.6 A-V Room (For “state of the art” A-V) 360 sq. ft.
1.7 Coat Room (For 150 coats) 120 sq. ft.
1.8 Reception Area 800 sq. ft.
    (Outside of the auditorium: can be combined with an atrium or other common space)

2.0 Exhibit Suite 1,440 sq. ft.
2.1 Exhibit space 1200 sq. ft.
2.2 Exhibit storage 240 sq. ft.

3.0 Library 1,200 sq. ft.

4.0 Classrooms 2,880 sq. ft.
4.1 Four classrooms @ 240 sq. ft. (Capacity: 24 ea.) 960 sq. ft.
4.2 Four classrooms @ 480 sq. ft. (Capacity: 48 students ea.) 1,920 sq. ft.
These classrooms will be used as break-out rooms during symposia

5.0 Laboratories 1,920 sq. ft.
Four laboratories @ 480 sq. ft. (Capacity: 24 students ea)

6.0 Model Fabrication Suite 600 sq. ft.
6.1 Fabrication area 480 sq. ft.
    One routing machine and two laser cutting machines
6.2 Technician’s Office 120 sq. ft.

7.0 Computer Lab 960 sq. ft.
24 Stations

8.0 Director’s Office Suite 480 sq. ft.
8.1 Director’s Secretary plus waiting area 240 sq. ft.
8.2 Director’s Office 240 sq. ft.

8.0 General Office Suite 2,000 sq. ft.
9.1 General Office (One secretarial position, plus areas for copying and storage and waiting seating) 360 sq. ft.
9.2 Office for Campus Sustainability Coordinator 180 sq. ft.
9.3 Two person office for Coordinator of Clustered Minors in Environmentally Sustainable Practices and Coordinator of “Green” Initiatives 180 sq. ft.
9.4 Technician’s Offices
    7.41 “Living Machine” Technician 120 sq. ft.
    7.42 Computer Technician 120 sq. ft.
    7.43 General Laboratories Technician 120 sq. ft.
9.4 Four person office for graduate assistants 360 sq. ft.
9.5 Conference Room for eight w/ Kitchenette 360 sq. ft.
9.6 General Storage 120 sq. ft.
9.7 Unisex disabled-accessible toilet 80 sq. ft.

10.0 Visiting Scholars Office Suite 2,000 sq. ft.
9.1 Four Offices for Four Visiting Scholars (4 @ 360 sq. ft.) 1,440 sq. ft.
9.2 Four person office for graduate assistants 360 sq. ft.
9.3 Secretary for the Visiting Scholars 200 sq. ft.

11.0 Lounge
Seating at tables for 24 and a concession area with hot and cold drink machines and a microwave station (No food machines) 600 sq.ft.

12.0 “Living Machine” Suite
(“Living Machine” is more accurately titled, a “Solar Aquatic System”)
11.1 “Living Machine” 1,200 sq. ft.
11.2 “Living Machine” controls and monitoring 360 sq. ft.

13.0 Toilets (Disabled Accessible)
These toilets are intended to serve the entire facility, but if the organization of the facility makes one set of toilets impractical, an additional set should be provided. Also, a drinking fountain is often located in the area of the toilets.
12.1 Men’s toilet 200 sq. ft.
12.2 Women’s toilet 240 sq. ft.

14.0 Janitors’ Closet
This facility is often located in proximity to toilets. It contains a janitor’s sink and cleaning equipment and supplies. 120 sq. ft.

15.0 General Storage Area 240 sq. ft.

16.0 Total of Above Spaces 20,440 sq. ft.

17.0 Grossage at 50% of the subtotal (This is not a programmed space, but an area allowance for corridors, stairs, elevators, wall thicknesses, etc.) 10,220 sq ft.

18.0 Total Occupied Area 30,660 sq. ft.

19.0 Mechanical Room at 5% of the Total 1,533 sq. ft.

20.0 TOTAL BUILDING AREA 32,193 sq. ft.

21.0 Service Dock and Entrance
It is assumed that—as was the case with the Letterman Building—because the linked-to buildings on either side have docks, received materials will come into, and discarded materials will go out of, the building through one of these two docks.
Due to the nature of this building, it would seem appropriate for a number of the spaces to have contiguous outdoor—or quasi-outdoor—areas. Most likely of these are the multi-purpose room, the classrooms and the offices. But these outdoor spaces, if included, must be provided within the boundaries of the site.

However, because the site abuts the existing parking lot on its west edge, an area 35' in width for 125' of the northern half of north-south length of the site has been allocated to this building to be designed as a landscaped buffer between it and the parking lot. The remaining 125' must be kept clear of planting to allow access to the Teachers College building loading dock, but the paving material may be replaced. The design of that area will be the responsibility of the building designer.

Moreover, the area between the east edge of the site and the McKinley Avenue sidewalk can be repaved and/or re-landscaped, but the current sidewalk pavement and configuration must remain unchanged.

IV. THE SITE

1.0 Site Location and Dimensions
The site for the building will be an 85' x 250' area between the Art and Journalism building and the Teachers College building. The 85' east-west dimension has as its east edge the extension of the line of the east face of the southeast block of AJ and as its west edge the extension of the west face of the main block of TC. (An outline plan showing site dimensions will be distributed)

2.0 Parking
There will be no automobile parking requirement for this building. However, bicycle racks will be provided.

3.0 Utilities Access
For the purpose of this design exercise, the assumption can be made that all utilities with the exception of potable water—data, chilled water, natural gas, power, steam and telephone—will come from a utility tunnel along McKinley Avenue. Potable water will come underground from the west.

4.0 Subgrade Use
Subgrade water conditions preclude placing any parts of the building, except a utility tunnel, or utility tunnels, below grade.
Architectural Philosophy

"The Roman Auditorium, however, is not simply an Auditorium, but a complete City of Music: with three halls, an open air amphitheatre, large rehearsal and recording rooms. The Roman adventure, therefore, has been enriched by an important urban dimension; The Auditorium is not simply a musical establishment; there is also a square, Santa Cecilia, people who work there, there are shops, bars and restaurants. All these activities add an additional dimension to the project: to give an urban sense to an area that needs urban participation."

-Renzo Piano
Morphological & Volumetric Organization

Circulation

Renzo Piano
Parco Della Musica Auditorium
Radial Axis
The yellow lines represent the axis of the three main halls as they converge into the central outdoor stage. The red lines represent the secondary functions of the Auditorium following this same radial axis pattern.

Proportion
The red boxes represent the capacity of each hall in hundreds of people. The yellow boxes show the proportion of each hall in comparison to the given capacities.
Geometry

Structural Forms

Primary Structure

Renz0 Piano  Parco Della Musica Auditorium
Materials

Although the Auditorium's form is not typical of Roman architectural styles, the materials are closely linked to the vernacular language.

Renzo Piano  Parco Della Musica Auditorium
Response to environmental factors

Ventilation

Interior Illumination
The Auditorium uses all artificial illumination to create a controlled atmosphere for the performances.

Acoustics
Ideal Conception and its Transformation

Sources: http://www.moleskincity.com/jo/index.php?option=com_content&task=view&id=116&Itemid=33
Architectural Record  v.191 no.9-12 2003
GA Document v.73-75 2003

R enzo P iano  P arco D ella M usica A uditorium
Chemistry labs have all the standard Mechanical, Electrical, and Plumbing needs that other classrooms have. However, there are several special requirements in this area due to the specific needs of the lab work being performed in these spaces.

STANDARD MEP
Several electrical outlets at each lab station
Central Air

SPECIAL MEP
Distilled Water
Vacuum Adapter
Gas Source
Compressed Air Source
Fume Hood (ADA Accessible)
Security Lights
Outside Air Source (maintain negative air pressure)
Dimensions

A. Lab: 48'x24'
B. Counter: 6'x15'
C. Sink: 1'6"x2'6"
D. Fume Hood: 2'6"x3'
E. Individual Cabinets: 36"x18"
F. Individual Drawers: 24"x18"
G. Coat Rack: 20'x8"
H. Outside Air Vent: 4'x4'
I. White Board: 2"x10'
J. Eye Wash/Safety Shower: 2'6"x10'
K. Drying Oven: 3'x3'
L. Fire Blanket: 2'x2'
M. Printers: 1'x2'
N. Security Lights: 6"x2'

ERIN CARPENTER
LUKE CHRISTEN
JOE BOHN
ASHLEY VANMETER
A SOLAR AQUATIC SYSTEM, OR LIVING MACHINE, IS A WATER TREATMENT SYSTEM THAT USES NATURAL PLANTINGS INSTEAD OF CHEMICALS. THE SYSTEM IS A SERIES OF TANKS THAT HAVE DIFFERENT CLEANSING FUNCTIONS. EACH SYSTEM IS SPECIFICALLY DESIGNED TO TREAT A CERTAIN AMOUNT OF WATER PER DAY AND TO REMOVE CERTAIN TYPES OF CONTAMINANTS. DIVERSITY IN THE SPECIES OF PLANTS PROVIDES FOR A FASTER AND MORE REGULATED CLEANING SYSTEM. IN THIS BUILDING THE AMOUNT OF SPACE NEEDED FOR THE LIVING MACHINE IS APPROXIMATELY 1,000 CUBIC FEET. EACH TANK CAN BE APPROXIMATELY 3-4 FEET DEEP, THUS THE SQUARE FOOTAGE WOULD BE AROUND 300 FEET, SO THE SPACE WE'VE BEEN GIVEN CAN ALSO CLEAN WATER FROM TC.
The maximum distance from any point to the exit depends if the building has a fire protection system. If the building has a fire protection system the maximum distance is 250', otherwise it 200'.

Maximum distance for a dead end corridor is 20'. The minimum clear corridor width is 72" for educational facility with over 100 occupants.

The organization of the lab space may create an inopportune dead end spaces that would create fire hazards. The peninsula lab tables typically creates the best opportunity to avoid these spaces.
STANDARD CHEM LAB

This is a standard general chemistry lab. It accommodates a maximum of twenty-four students at any given time. Labs for advanced chemistry students will be similar, but may contain even more specialized equipment.

STANDARD EQUIPMENT
Printers
Dry Erase Board
Clock
Stools

SPECIAL EQUIPMENT
Chemical Resistant Counter Tops
Balances
Centrifuge
Eye wash station
Safety shower
Fire Extinguisher
Drying Oven
Fire Blanket
Door Buzzer (alert prof. of emergency or request additional supplies)

STORAGE
Glassware
Private drawer with lock for each student
General equipment drawers
Coat Racks (aprons and lab coats)
Separate chemical room (security reasons)
Stock Room (with various shelving units)

ERIN CARPENTER
LUKE CHRISTEN
JOE BOHN
ASHLEY VANMETER
Programming Place Types

Davis Museum
José Moneo
Wellesley University - Boston, MA

Auditorium Parco Della Musica
Renzo Piano
Rome, Italy

Nelson Fine Arts Center
Antoine Predock
Arizona State University campus
Outdoor Space

Each of these three buildings creates an important outdoor space. The outdoor spaces act as circulation and gathering space. The outdoor space is utilized successfully at various points around the buildings. In one case, the space leads to the entrance, in another it is the center of a complex of auditoriums, and in the final case the spaces are courtyards surrounding the building. While each space is placed differently, they create similar place types for gathering and movement. This space must be involved in initial design plans because the buildings themselves shape these spaces and connect with and through the spaces.

Taylor Mikosz | Ashley VanMeter | Madeline LaPlante
These three buildings contain auditorium and museum spaces. Lighting needs to be limited and indirect to keep from disturbing the activities which are taking place in these spaces. Day lighting during a stage performance can destroy the stage lighting and can be distracting. Direct lighting on paintings and other art forms could destroy them. Methods of lighting must be considered in the initial design phases to achieve the desired relationship between day lighting needs and opportunities for exterior views from the building.

Taylor Mikosz  |  Ashley VanMeter  |  Madeline LaPlante
Circulation patterns are always an essential part of successful building design because wayfinding is difficult for users in spaces with unclear circulation patterns. Each of the three precedents took a different approach to circulation due to the general nature of the buildings. The Fine Arts Center has the most flexible circulation space while the auditorium seems to have the most rigid. The circulation strategies are an obvious result of the intended flow and function of each respective space. The Auditorium wants users to quickly find their destination. The Davis Museum and Nelson Fine Arts Center both allow for more fluidity in their circulation paths.

Tayler Mikosz | Ashley VanMeter | Madeline LaPlante
Schematic Plans
Ashley's Design
This model should show more materials. Site design is an important aspect to this design, so the next model should incorporate more of those ideas.

**Study Model**  
Ashley's Design

This model is a good start, but the next iteration should begin to show the materials. The outdoor spaces need to be more defined and developed.

**Study Model**  
Tayler's Design
1 Library
2 Mechanical
3 Restroom
4 Solar Aquatic Machine
5 Stage Prep
6 Meal Serving Area
7 Storage
8 Audio Visual Room
9 Coat Room
10 Reception
11 Exhibit
12 Lab
13 Computer Lab
14 Small Classroom
15 Office
16 Model Fabrication
17 Large Classroom

First Floor Plan 1/32"=1'-0"
1 Library
2 Mechanical
3 Restroom
4 Solar Aquatic Machine
5 Stage Prep
6 Meal Serving Area
7 Storage
8 Audio Visual Room
9 Coat Room
10 Reception
11 Exhibit
12 Lab
13 Computer Lab
14 Small Classroom
15 Office
16 Model Fabrication
17 Large Classroom

Third Floor Plan 1/32"=1'-0"
1 Library
2 Mechanical
3 Restroom
4 Solar Aquatic Machine
5 Stage Prep
6 Meal Serving Area
7 Storage
8 Audio Visual Room
9 Coat Room
10 Reception
11 Exhibit
12 Lab
13 Computer Lab
14 Small Classroom
15 Office
16 Model Fabrication
17 Large Classroom

Fourth Floor Plan 1/32"=1'-0"
1. Waste Water Holding Tank
2. Grinder Pump
3. Distribution Tank
4. Small Algae, Sludge
5. Small Plants-start to remove ammonia
6. Radial Flow Settler-solids out of water
7. Lagoon Plants- plants in and on the water and additional aquatic life present
8. Wet Prairie Plants w/ big roots
9. Marsh- oxygen free zone- most ammonia is gone

Solar Aquatic Machine Process Diagram
Perspective McKinley looking northward
Perspective McKinley looking southward
Solar Aquatic Machine Perspective
Facade Swatch & Wall Section 1/8"=1'-0"
Section B 3/64"=1'-0"
Bibliography


