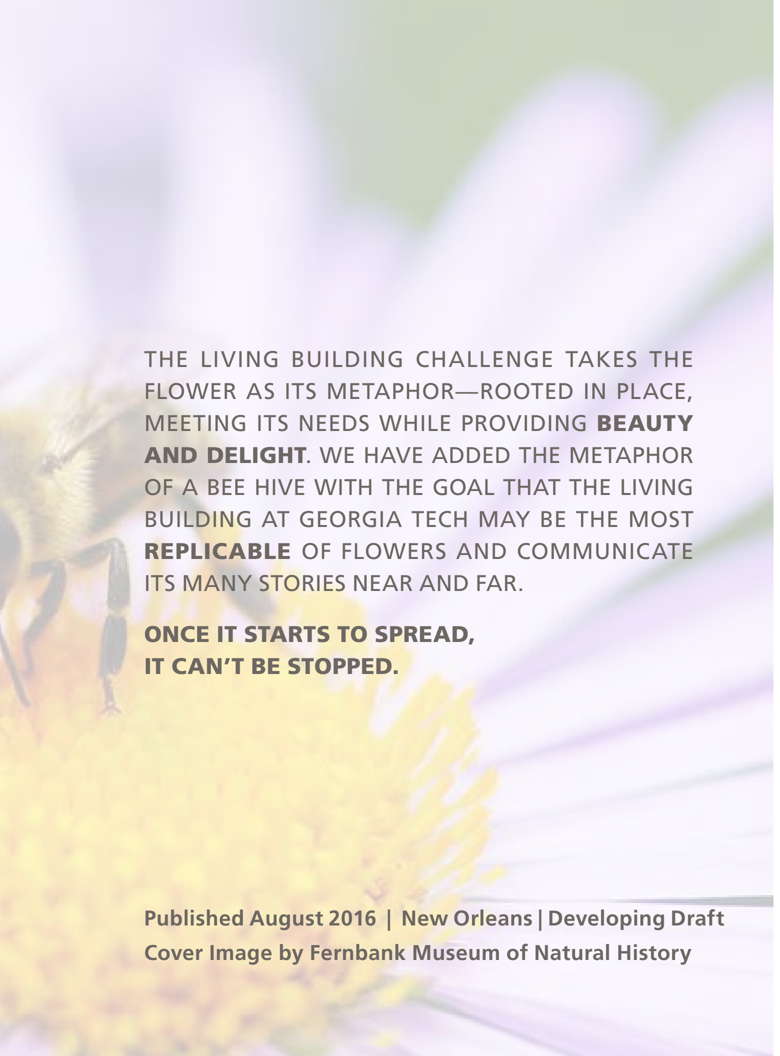
GEORGIA TECH
LIVING BUILDING CHALLENGE
COMPETITION

WHAT WE **LEARNED**

COLLINS COOPER CARUSI
ESKEW+DUMEZ+RIPPLE
HELMUTH + BICKNESE

DECEMBER 2015 - MARCH 2016



THE LIVING BUILDING CHALLENGE TAKES THE FLOWER AS ITS METAPHOR—ROOTED IN PLACE, MEETING ITS NEEDS WHILE PROVIDING **BEAUTY AND DELIGHT**. WE HAVE ADDED THE METAPHOR OF A BEE HIVE WITH THE GOAL THAT THE LIVING BUILDING AT GEORGIA TECH MAY BE THE MOST **REPLICABLE** OF FLOWERS AND COMMUNICATE ITS MANY STORIES NEAR AND FAR.

ONCE IT STARTS TO SPREAD,
IT CAN'T BE STOPPED.

Published August 2016 | New Orleans | Developing Draft
Cover Image by Fernbank Museum of Natural History

The Living Building Challenge (LBC) represents a transformative shift in our approach to how buildings are designed, built, and inhabited. Instead of merely trying to ensure that buildings are safe for occupants, or that we try to reduce the negative environmental consequences of how they are built and operated, LBC asks, "Instead of making buildings 'less bad', how can buildings be 'good'?" How can we make the act of building to be restorative, with net positive impact on the environment and on human health? What would be required for buildings to take nature as their model, living off the sun and rain falling on the site, to incorporate no materials that threaten health, to reject the very notion of 'waste'?

With goals this high, it's perhaps not surprising that only a handful of buildings by 2015 had achieved full LBC certification. These projects have often been small, located in mild climates, with relatively low energy intensity uses, and had the good fortune to be occupied by highly engaged users, committed to adjusting their behavior and even their clothing in alignment with the limitations of the building.

For LBC to become not just an inspirational special case but the new normal, we need to show that it can work in large buildings, in urban settings, in challenging climates, supporting a wide range of energy intensity uses, and be a building that invites occupant engagement but can be occupied by mere mortals, not saints. We need an affordable, replicable template.

In late 2015 early 2016, the Georgia Institute of Technology conducted a remarkable 'Ideas Competition' exploring how to make Living Building Challenge certified buildings affordable and replicable in the hot, humid South. Given an entire precinct of campus as a potential site, three finalist design teams (each with architects, landscape architects, and engineers) were challenged to produce specific design proposals testing how a building providing labs, classrooms, and offices could be integrated into a restored landscape on a modest budget. Georgia Tech's staff, faculty, and students observed throughout, with the School of Architecture's design studios paralleling the competition.

The architecture firm of Eskew+Dumez+Ripple (EDR) was privileged to be part of one of the three finalist teams. For 90 intense days, we collaborated with architects from two other firms (Collins Cooper Carusi and Hellmuth&Bicknese), landscape architects from Andropogon and HGOR, engineers from Newcomb & Boyd, Point Energy Innovations, pattern r+d, Sherwood Design Engineers, Long Engineering and Uzun+Case, and most crucially the cost estimators of the Palacio Collaborative. Given so many players at so many locations, we relied on free-form messaging platforms like Slack for day-to-day communications, and captured what we learned through entries in a shared blog we called The Hive. This document is comprised of selections from these communications streams, curated by the 2015-2016 EDR Research Fellow Marina Michael. This effort has been transformative for our team members. By sharing what we've learned, we hope it can be transformative for you.

Z Smith
Principal | Director of Sustainability
Eskew+Dumez+Ripple

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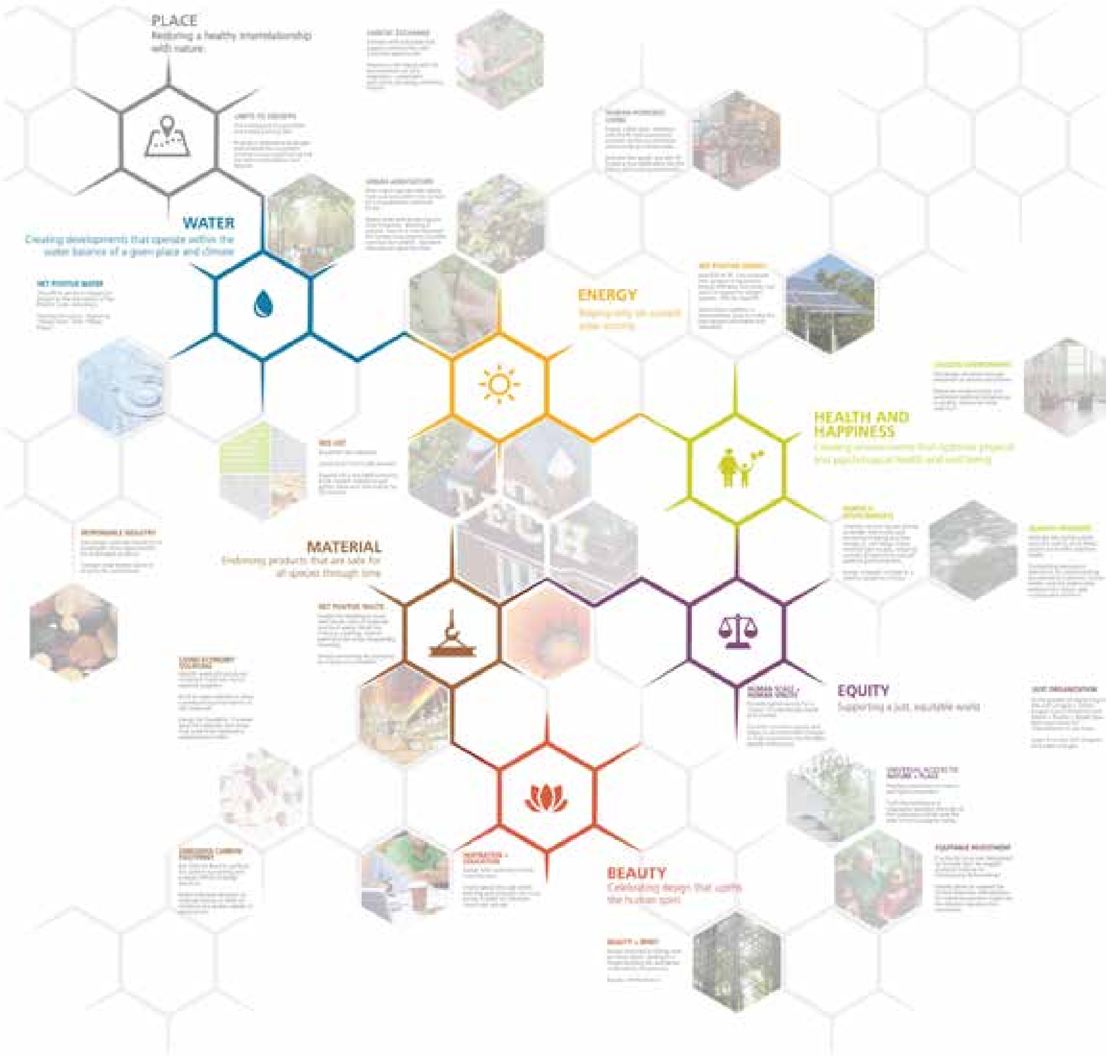

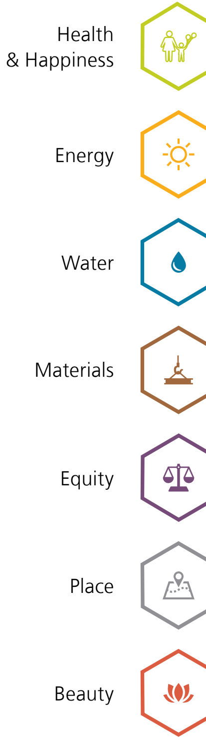

TEAM STRUCTURES + PROCESS

Why the bee as a metaphor? Bees communicate for the betterment of the community. This project challenged us to think differently about our communication. Tasked to make Living Buildings replicable, the team structure and process had to be dutifully considered and the ideas and methodologies recorded.

One of the protocols of Living Building is truth and transparency. Collins Cooper Carusi and Eskew+Dumez+Ripple registered for Just certification to lead by example. Through this self-examination, we can respond and retool to get back on track with our company goals.

The Hive grew from a metaphor to a communication tool– a website where our ideas and exchanges have been deposited. It is a place where all teammates learned about each other's work to benefit from the depth of research taking place. After the competition, we envision the Hive expanding to include the Georgia Tech community, Atlanta, and the global community. The developed ideas will join the collective forces moving towards buildings that not only do no harm, but do good to the environment.

PROJECT TEAM

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Collins Cooper Carusi Architects

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Collins Cooper Carusi Architects

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Eskew+Dumez+Ripple

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Hellmuth + Bicknese

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Hellmuth + Bicknese

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Eskew+Dumez+Ripple

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Eskew+Dumez+Ripple

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Andropogon Associates, Ltd.

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Andropogon Associates, Ltd.

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Eskew+Dumez+Ripple

Kathryn Wu
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Eskew+Dumez+Ripple

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pattern r+d

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Eskew+Dumez+Ripple

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Eskew+Dumez+Ripple

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Sherwood Design Engineers

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Collins Cooper Carusi Architects

Lynda Herrig
Advanced HVAC Design
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Vanessa Smith-Torres, AIA, LEED AP BD+C
Design Team, Architecture
Eskew+Dumez+Ripple

Brenden Gardes
Mechanical Sustainability
Newcombe & Boyd Consultants and Engineers

Michael Street
Mechanical Designer
pattern r+d

THE HIVE

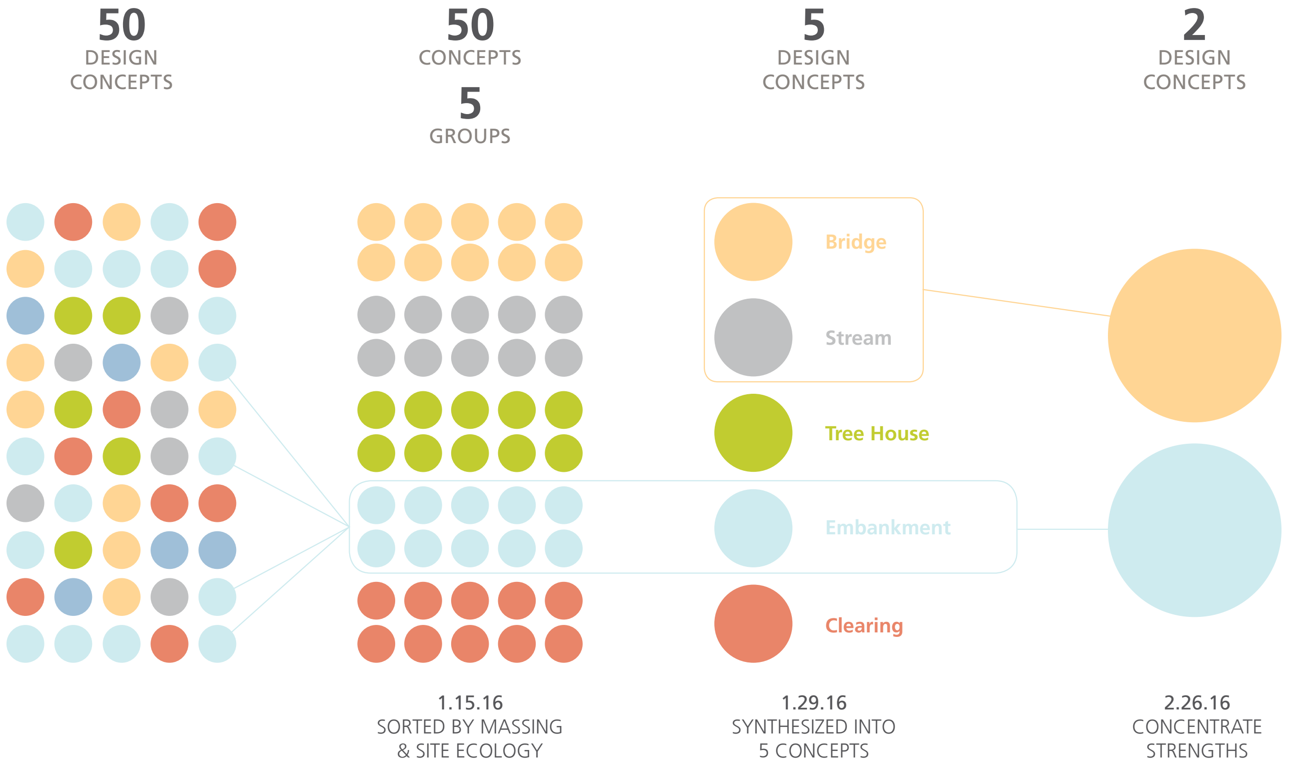
VERNACULAR BUILDING FORMS

lbc-hive.squarespace.com

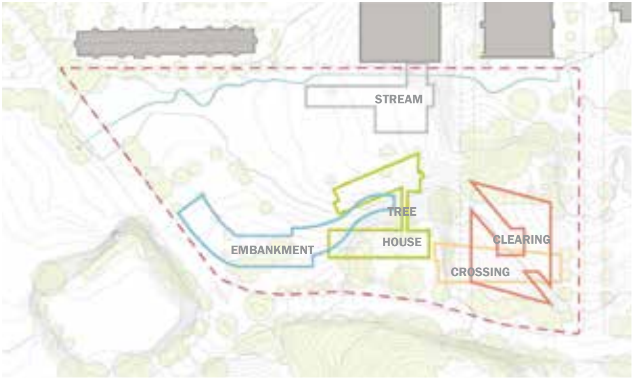
EVALUATING IDEAS
AND ITERATIONS

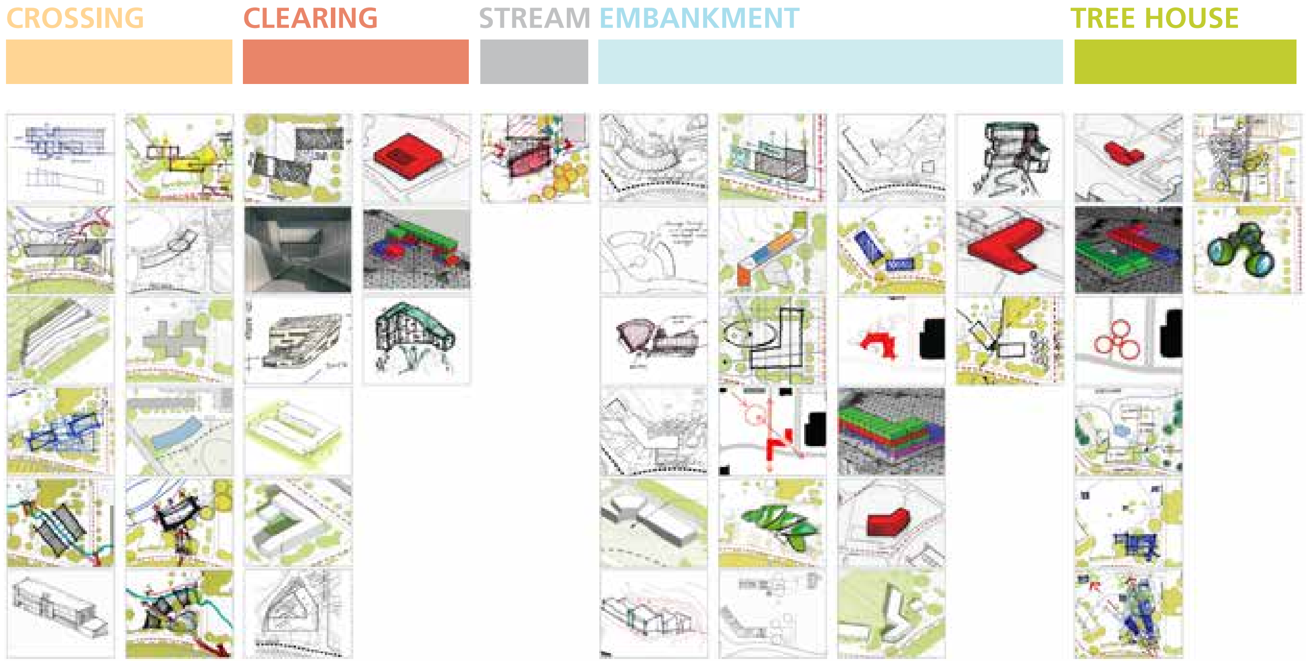
To start, the team collected fifty design concepts, but by sorting them by form, those concepts assembled into five groups.The forms came to be understood not as mere shapes, but as site responses.

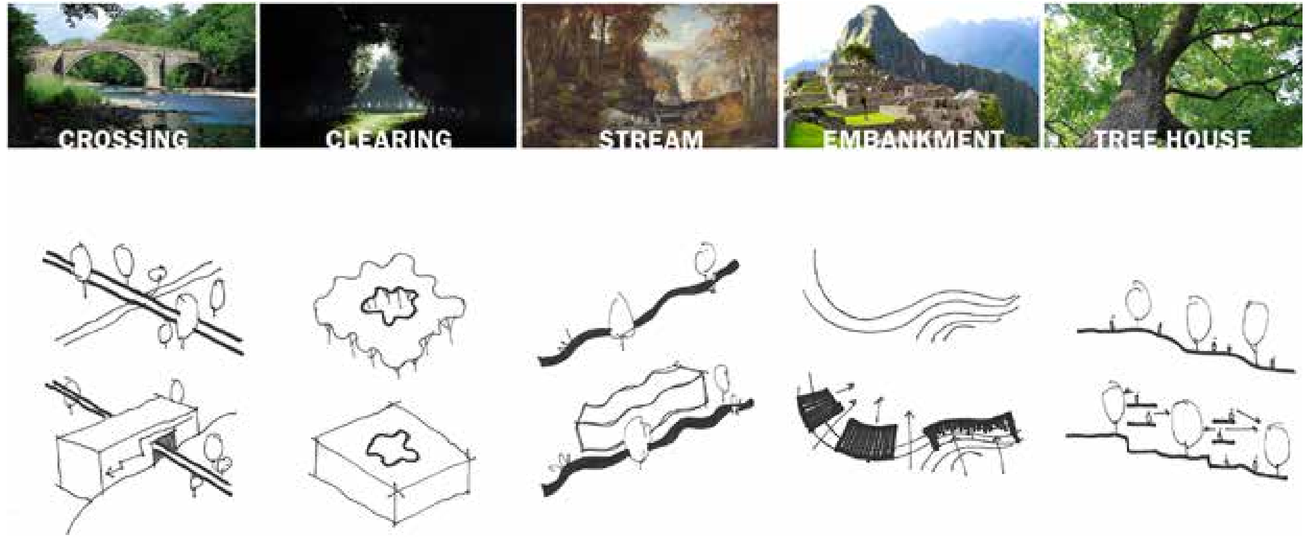
The five best site responses emerged and developed until an evaluation could be made. Following that evalutation, two design concepts remained standing, which became an opportunity for dialogue between several ideas.



The format for parti submissions was left open-ended to encourage contributions in all forms and formats. Site plans were provided at a single scale along with a topographical model. Part of the analysis of the many designs involved comparing how they emerged from and responded to the site as shown on the right.







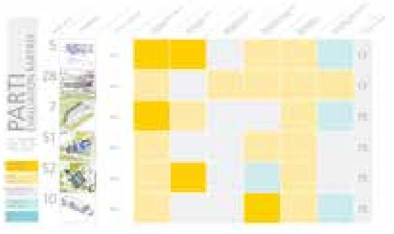
Five schemes form based in a response to the site conditions.

Each designer presents early parti concepts to the group.

1.13.16

EVALUATION CRITERIA

Agree Upon Evaluation Criteria

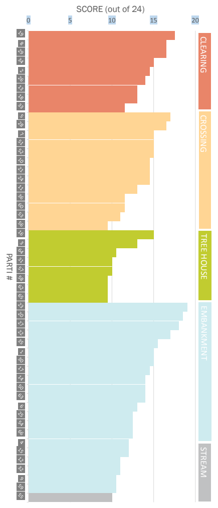


Scores Aggregated and Fed into Data Analysis

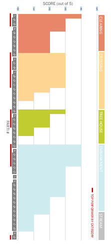
Design Concept
Matrix Evaluations

1.15.16

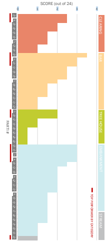
SORTED BY MASSING AND SITE ECOLOGY



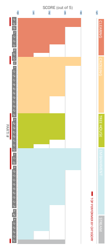
Total Score of Each Concept



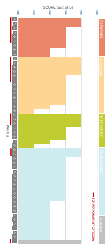
Reinforces Masterplan



Responds to Climate



Integrates Site/Bldg



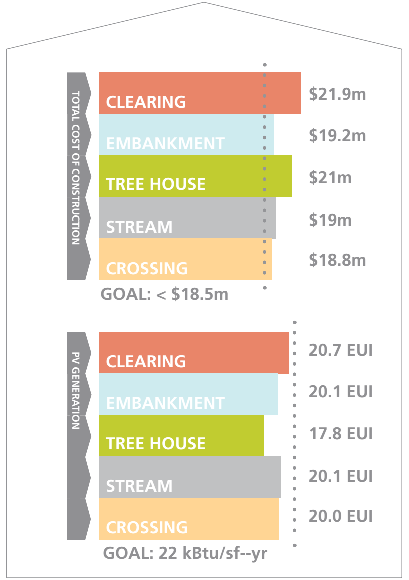
Strength of Parti

Overall Score by
Sorted Concept

Concepts Ranked by
Design Quality

1.29.16

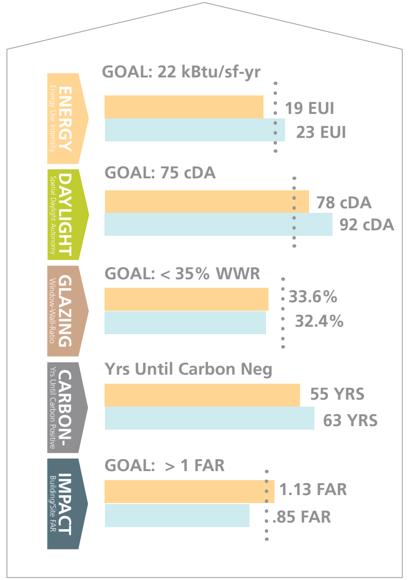
SYNTHESIZED INTO 5 CONCEPTS



Criteria Used to Determine Which 2
Designs to Advance

2.26.16

CONCENTRATE STRENGTHS



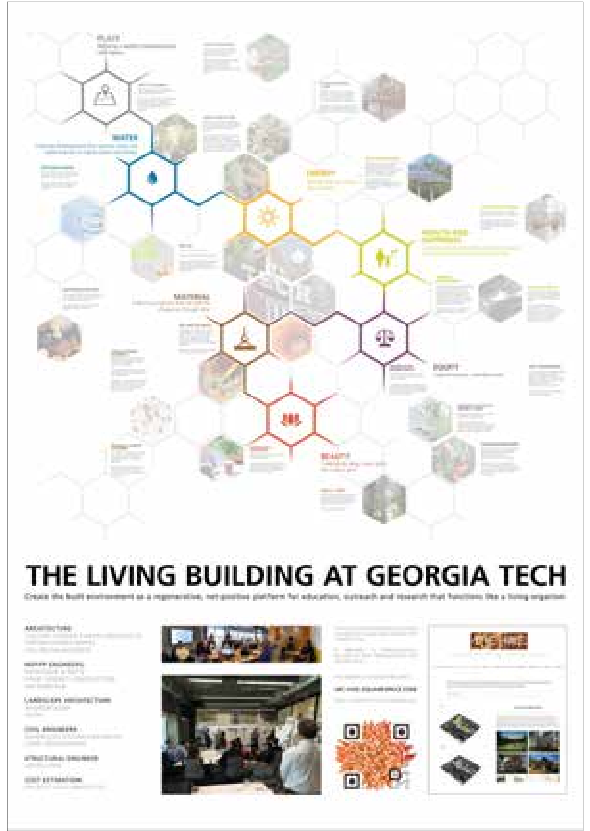
Metrics Used to Understand Performance
Differences Between the 2 Schemes


The design team puts the finishing touches on the model.

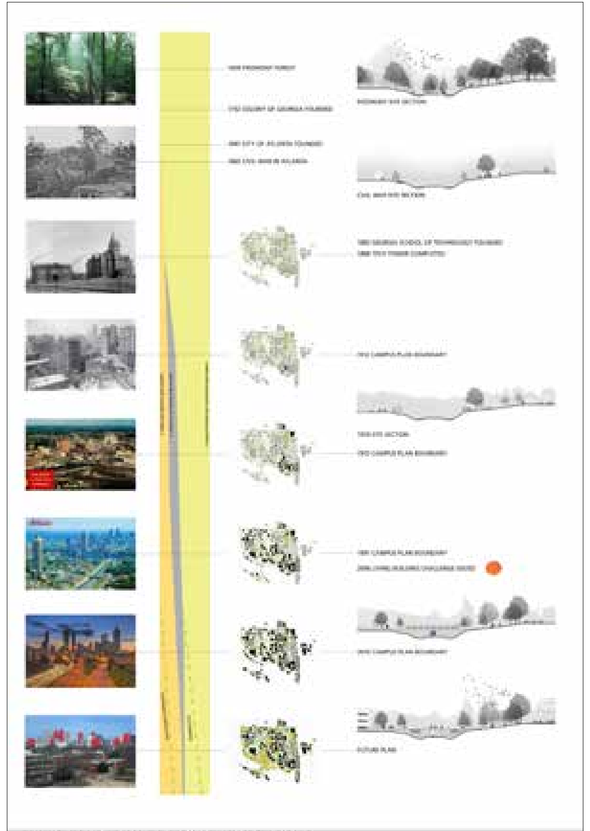
DELIVERABLES

The team presented their work primarily through a slideshow presentation. The room was set up in a theater style lecture hall with the entire jury, the planning commission and some students from the Georgia Tech architecture program. The team’s twelve boards and models were displayed in Clough Hall for students to see the work of all three teams in a unified exhibit following the final decisions.

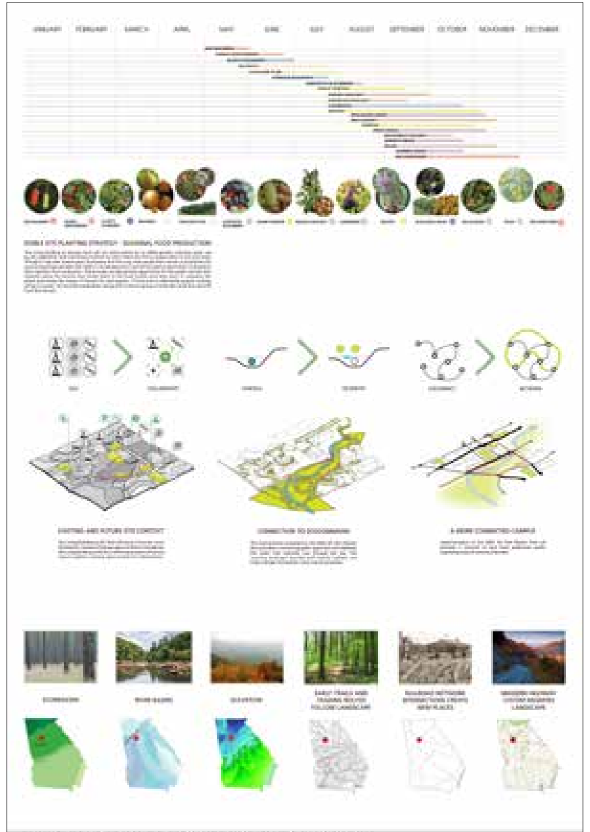
The other submitting teams were Perkins+Will and Miller Hull. Miller Hull received the commision. Later, a symposium at the 2016 International Living Future Institute Conference shared the ideas of all three teams.



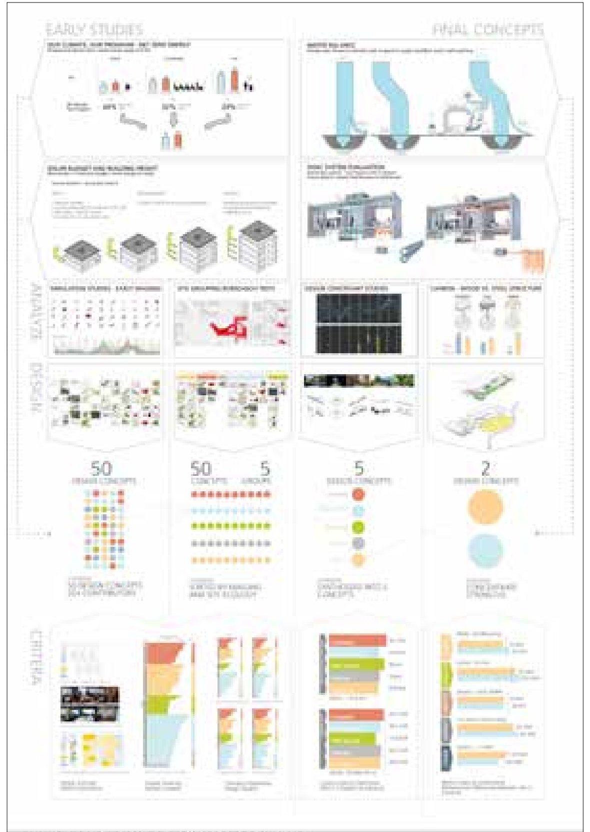
INVESTIGATION PETALS + IMPERATIVES



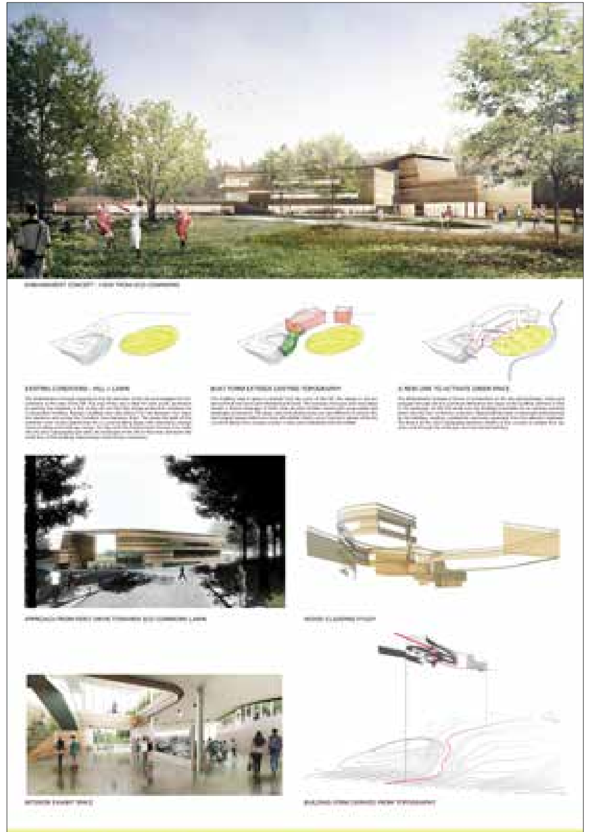
INVESTIGATION TIMELINE



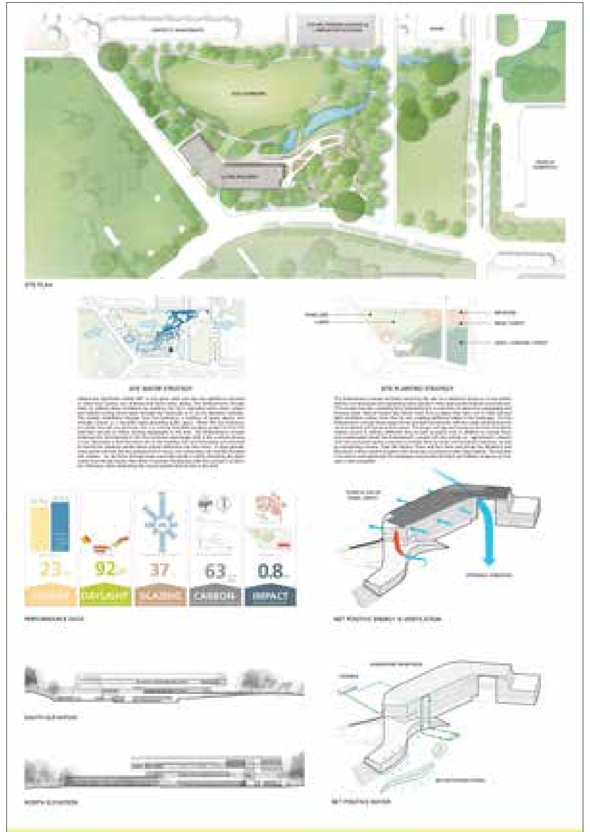
INVESTIGATION OPPORTUNITY



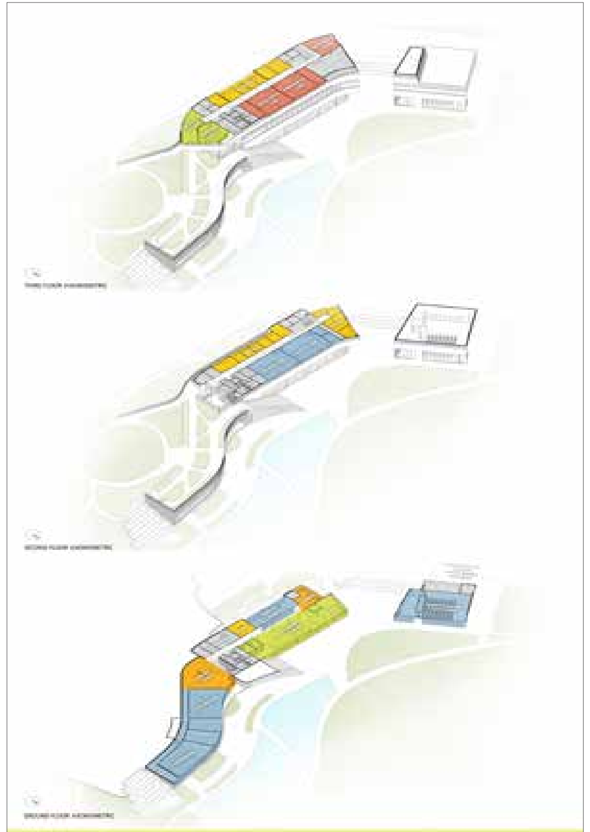
INVESTIGATION PROCESS



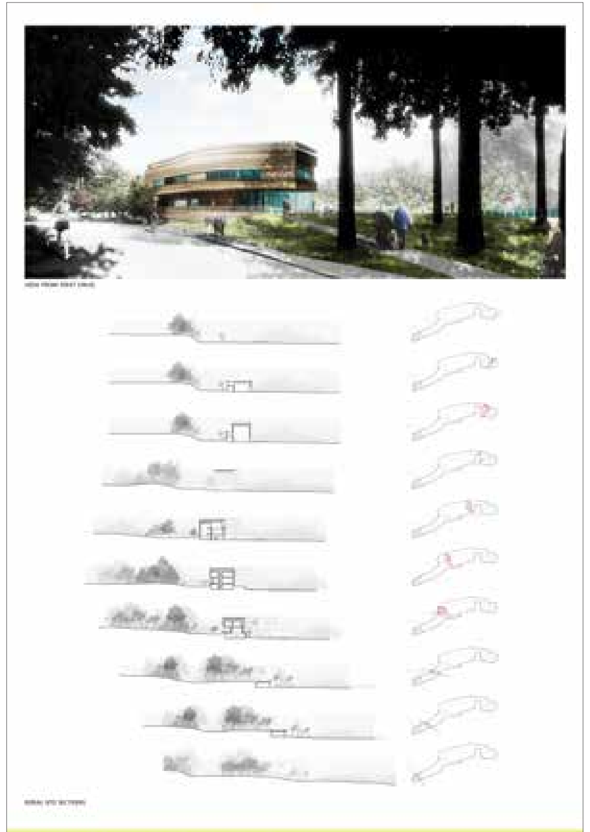
EMBANKMENT CONCEPT



EMBANKMENT ENVIRONMENT

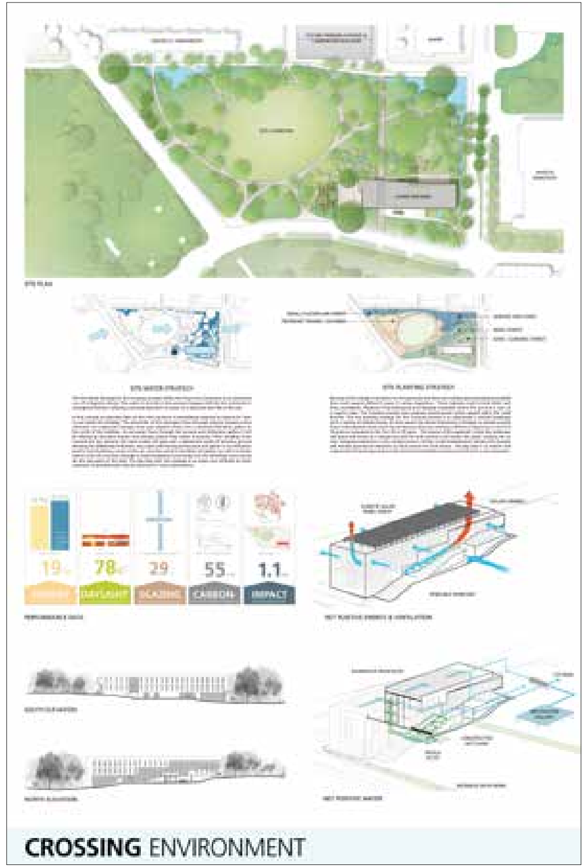


EMBANKMENT PLAN



EMBANKMENT SECTION


CROSSING CONCEPT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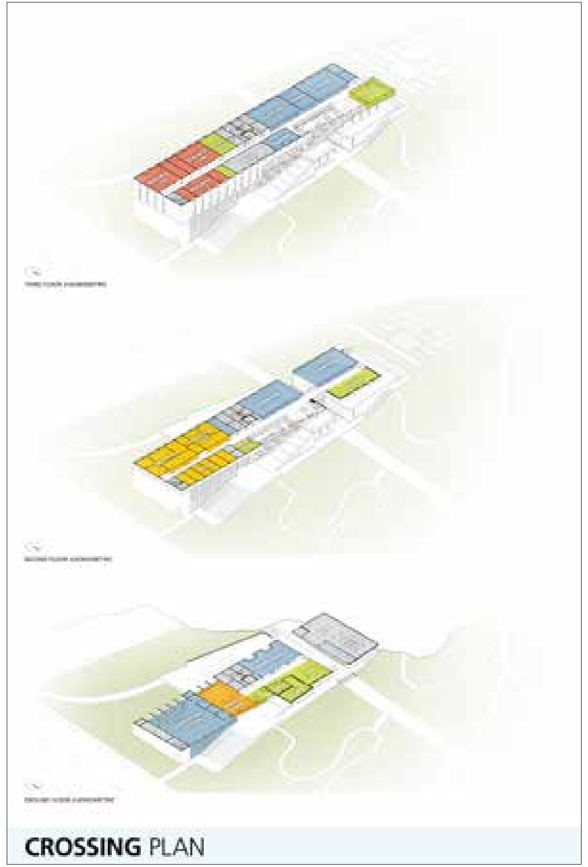
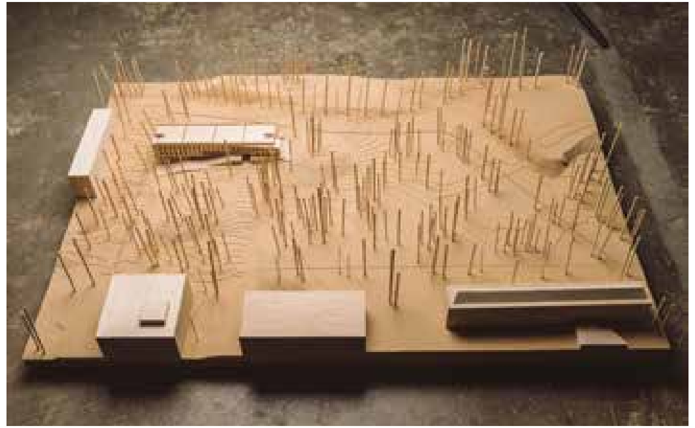
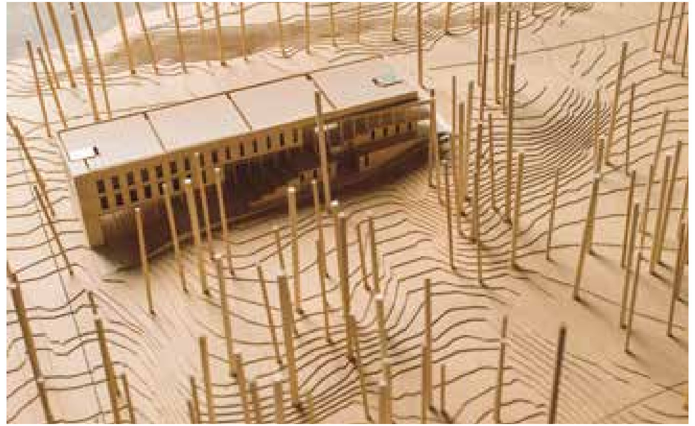
CROSSING ENVIRONMENT

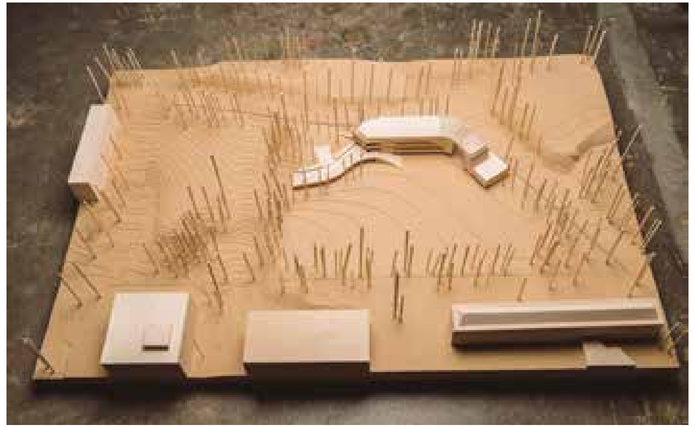

CROSSING PLAN


CROSSING SECTION





CROSSING



EMBANKMENT

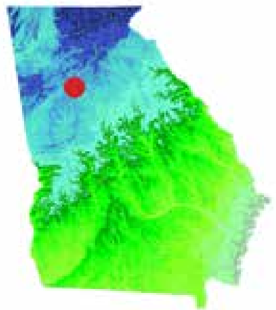

A historical image of Atlanta in the late 1800s

UNDERSTANDING A CAMPUS HISTORY

A replicable solution must respond to the site and context that it joins. The team did not view the project as a creation of a kit of parts isolated from the site. The specific context had to be understood, but the process by which the team came to understand the campus could become a methodology for other future Living Building projects. A Living Building must learn from a site's past, to a time when human occupation did not extort a site's resources, but lived peaceably with it, integrating into the site ecology.

ECOREGIONS

ELEVATION



RIVER BASINS

EARLY TRAILS AND
TRADING ROUTES
FOLLOW LANDSCAPE

RAILROAD NETWORK
INTERSECTIONS CREATE
NEW PLACES

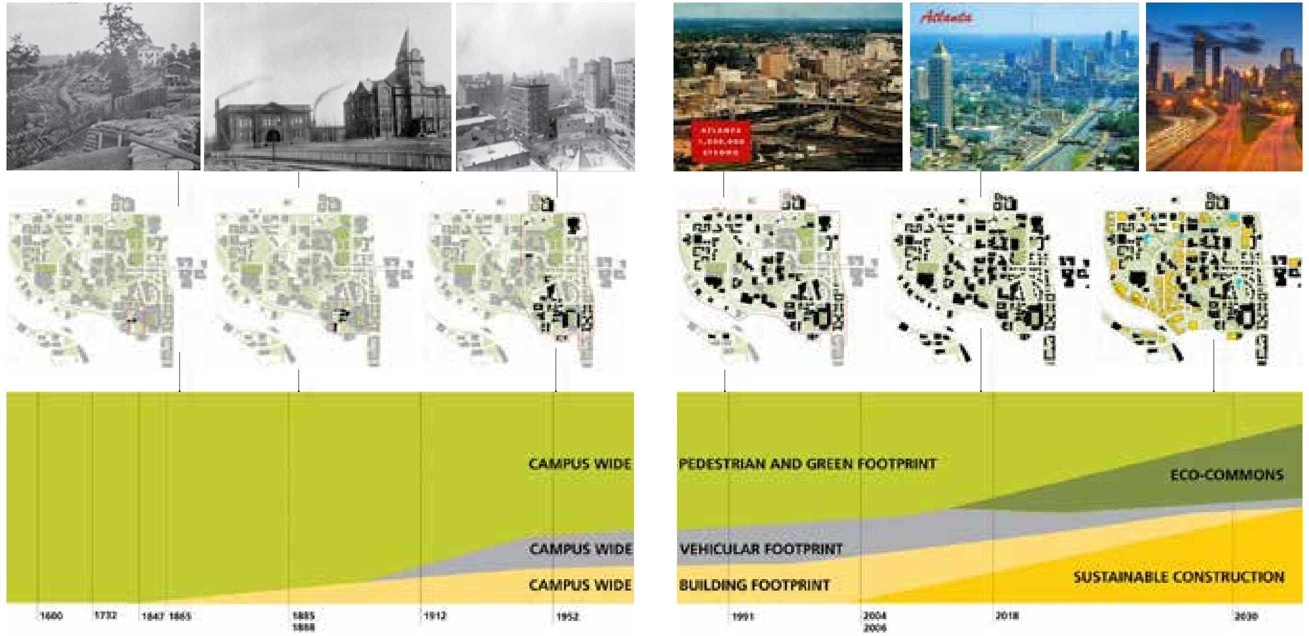
MODERN HIGHWAY SYSTEM
MODIFIES LANDSCAPE

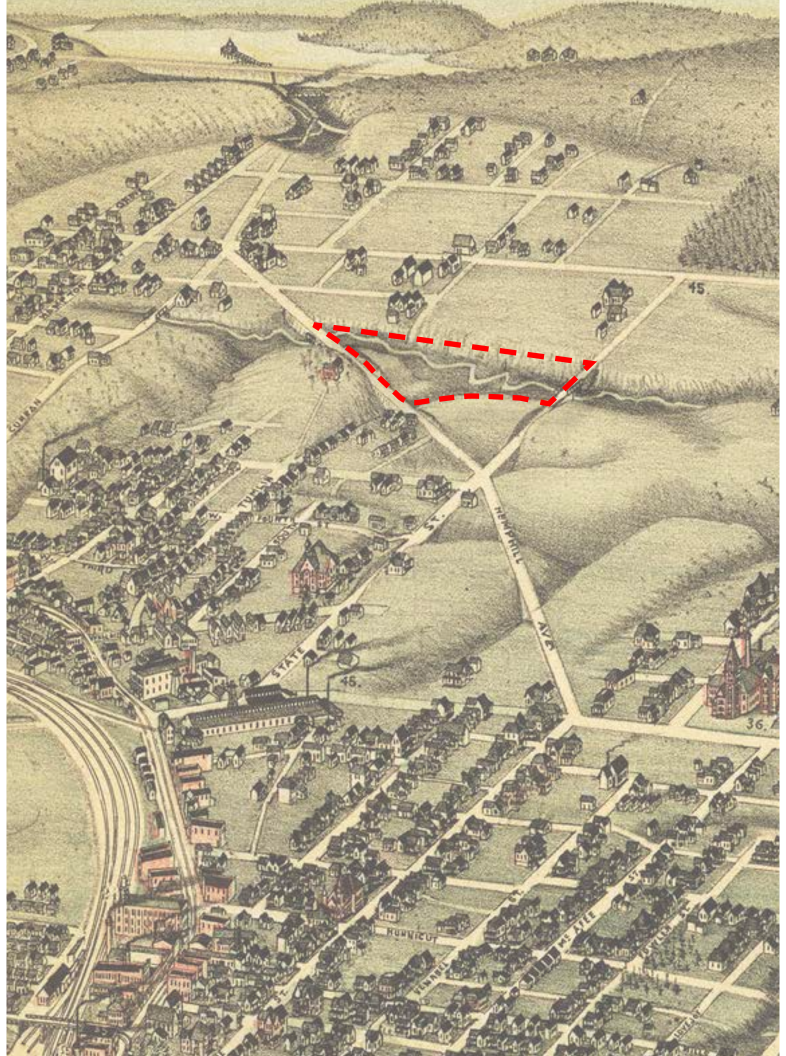
KEY TAKEAWAY

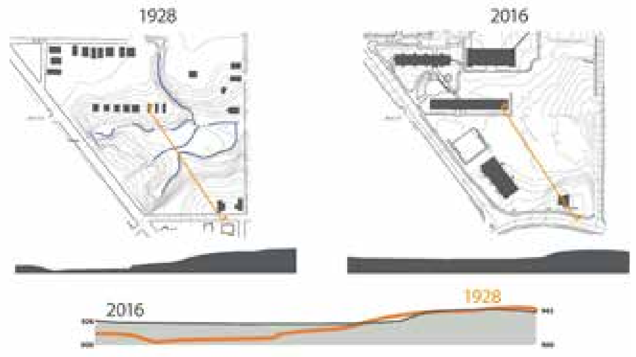
Conditions of the region form the site and that larger context brings clarity about the layers of the site.

A VISION FOR THE FUTURE LEARNS FROM THE PAST

Over time, the Georgia Tech campus footprint grew as structures covered the site. With the introduction of the automobile, the vehicular footprint also expanded, eating away at the green footprint of the campus. The latest Masterplan proposed by Georgia Tech will include an Eco-Commons which will exchange paved areas for green space. Meanwhile, sustainable construction, which is taking precedence in campus plans will add to the building footprint, but without negatively impacting the environment. Eventually, we envision all buildings would become Living Buildings, not only reducing their negative impact, but also generating a positive impact on the environment.



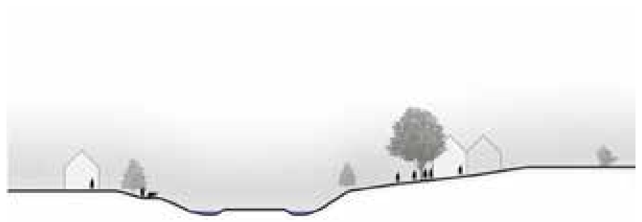




(Left to Right) (1) A simplified representation of rainwater flows on the site. (2) The formations of Union and Confederate troops in Red with the site highlighted as a middle ground. (3) The site highlighted in a historical drawing, showing a set of streams that once flowed through. (4) The accurately represented topographical history of the site showing the transformation that has taken place.

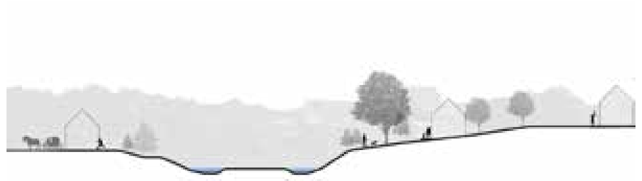
1600

Living Building asks us to think about the site before human habitation or at least before industrial development. We looked back to the site in 1600 before European settlement. The site section above shows the streams that once flowed through the Piedmont forest site.



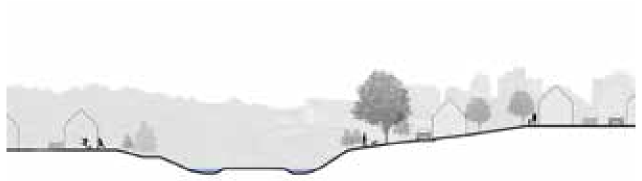
1865

By the time of the Civil War, the site was cleared for logging and agriculture. Armies did not occupy the site during battle because it was low ground, so nature enforced peace on this site. After the Civil War it appears as a ravine on the Sanborn maps.



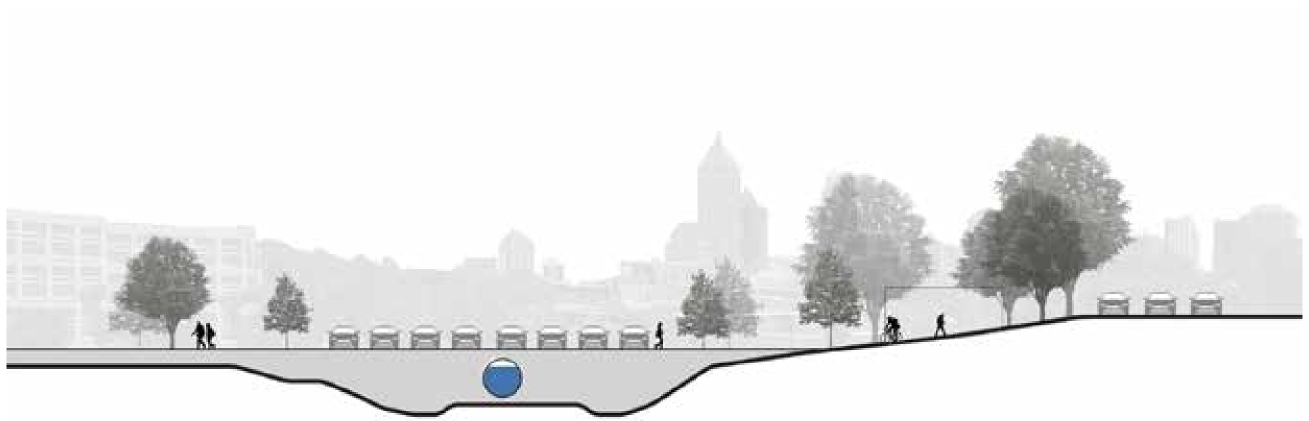
1885

1885 was the start of the Georgia Institute of technology. The first completed structure was the Tech Tower. At this point our site remained residential.



1950

By the 1950s, when Atlanta had reached a population of one million people, the site remained residential with houses on either side of the ravine.

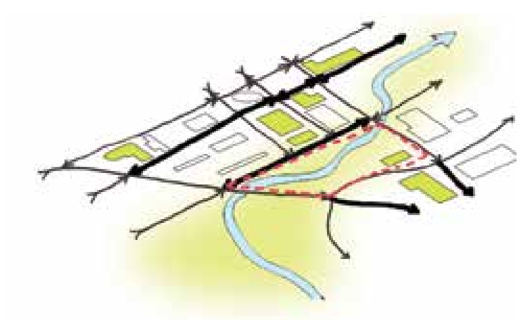


2016

By the 1990s, the site had been acquired by Georgia Tech and we see greater levels of paving. Our site was levelled, which required rerouting the formerly natural flow of water through the site to be concentrated in pipes below ground. Today, the site is a parking lot, but we are seeing Georgia Tech trend towards sustainable buildings —thinking differently about their environmental footprint.

2030

We share Georgia Tech's vision of an Eco-Commons that will gather students and celebrate the water flows that are now so well concealed. Parking will move to a structure on one side of the site, allowing for most of the site to be enjoyed by students who are walking or biking on campus. This regenerative site echoes the environmental cycles of the past while creating a space for students to interact with those cycles.



EXISTING AND FUTURE SITE CONTEXT

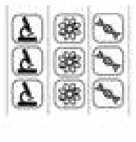
The Living Building at GA Tech will act as a host for cross-fertilization. Instead of being a space of distinct disciplines, the Living Building at GA Tech will bring students of various majors together, creating opportunities for collaboration.

CONNECTION TO ECOCOMMONS

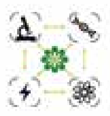
The EcoCommons proposed by the 2004 GA Tech Master Plan provides a connecting green space that will celebrate the water that naturally runs through the site. This 'working landscape' provides both beauty and habitat, while helping manage stormwater through natural processes.

A MORE CONNECTED CAMPUS

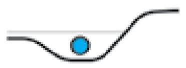
Implementation of the 2004 GA Tech Master Plan will promote a network of tree lined pedestrian paths, expanding beyond existing sidewalks to create a well-connected walking and biking oriented campus.



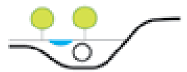
SILO



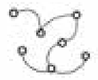
COLLABORATE



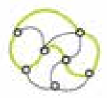
CONCEAL



CELEBRATE



DISCONNECT

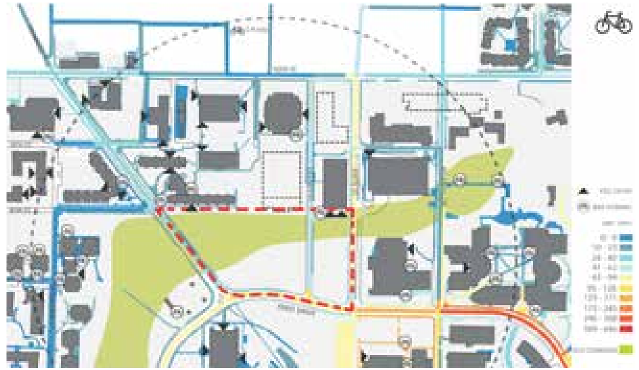


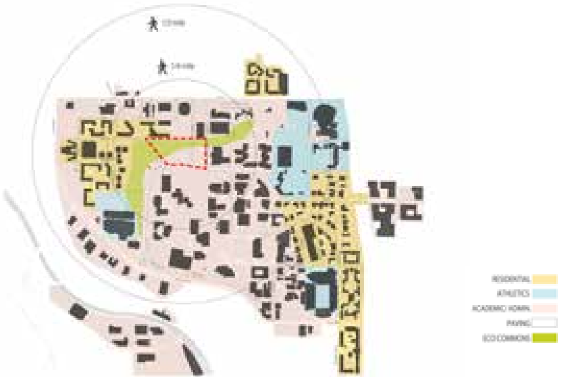
NETWORK

CIRCULATION PATTERNS

ANTICIPATED CHANGE

The following diagrams describe a campus analysis of program divisions, Eco-Commons, bus routes and bike traffic taken from Georgia Tech PDC site. Dashed lines show anticipated new building structures, including the new parking garage on Dalney St.that will act to create better pedestrian and bike access throughout the site while reducing the parking footprint.



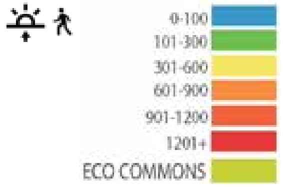


PROGRAM DIVISIONS

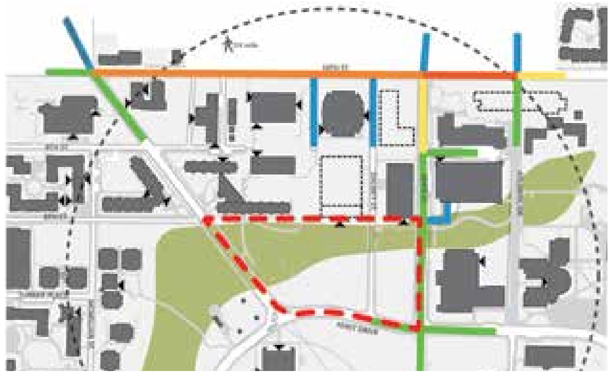
BIKE TRAFFIC HEAT MAP

ECO-COMMONS + ECO CAMPUS

BUS ROUTES

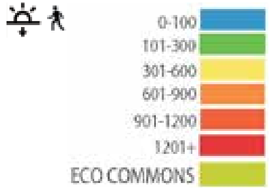


PEDESTRIAN HEAT MAP - MORNING



PEDESTRIAN HEAT MAP - MORNING

The above diagrams show walking data in morning and evening describing levels of foot traffic currently on the site. It is expected that more walking would occur on Dalney after construction of




A breakfast product showcase becomes an opportunity for designers to advocate for LBC Red-list free products and certifications.

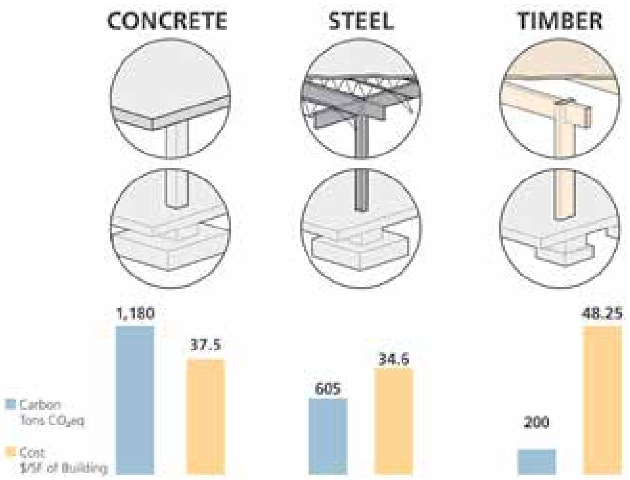
MATERIALS + STRUCTURES

To facilitate decision-making about sustainable materials, new tools were tested and developed. Materials concerns like environmental impact and Red list-free chemistries had to be balanced with the team's limited time and budget.

Advocating with manufacturers builds capacity. The team started conversations with local timber forests to move them toward FSC certification. We also talked to an Atlanta-based LED manufacturer about getting a Declare label. By spreading the buzz about LBC Declare labels and other material goals of the program, the team can prepare the fields of manufacturers' products for Living Building project harvest.

TOOLS FACILITATE MATERIALS DECISIONS

Tally, software developed by the research branch of Kieran Timberlake, accounts for the environmental impact of material compositions through the Revit interface. For the Living Building Challenge, the carbon impact of the project must be offset by purchasing Certified Emission Reductions (CERs), carbon offsets through the Institute's new Living Future Carbon Exchange, or an acceptable, 3rd-party-verified program to offset 100% of the final project's construction-based carbon contribution. The carbon and cost results of three structural material options are compared in the diagram at right.

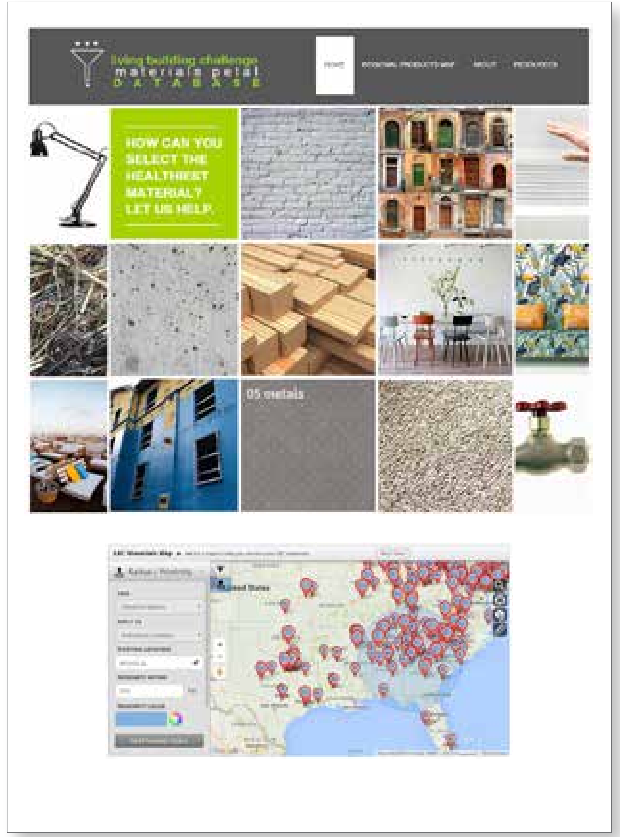


MATERIALS PETAL DATABASE

The team developed a materials website to help designers understand the concerns associated with specific CSI divisions and to find and crowdsource products for each division. A regional materials map helps designers discover product manufacturers in their project region who have previously had their products listed in a Living Building Challenge project. With flags by CSI division and links to manufacturers' sites, it facilitates the start of a conversation.

KEY TAKEAWAY

Technology lowers the barrier for collaboration so everyone can contribute even from great distances.



THE HIVE

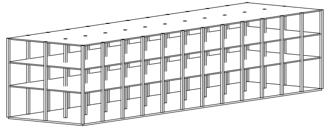
Thinking about Carbon - Structural System Comparison

January 13, 2016 in Materials

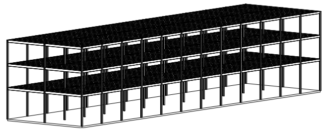
Working with a basic bar building, large enough to house the program of the Living Building at Georgia Tech, we ran a carbon comparison between using flat slab concrete, post tensioned concrete, steel, and heavy timber to see what the carbon impact would be. The structure was sized based on built projects of similar size and use. The analysis excluded the ground floor and the foundations, assuming for the moment that these would be the same across all structural systems.

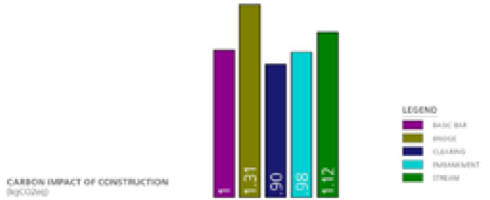
The flat slab concrete frame has the advantage of being able to run large, efficient ducts without having to sit below or bend under beams. It also provides for future flexibility. A 20' x 30' column grid gives plan flexibility and new openings can be made into the floor if the MEP needs of the building change.

Using a post tensioned slab has many of the same advantages of the previous flat slab, and can achieve them with a thinner floor plate. Less concrete means a significant carbon savings, over 395,000 kgCO2eq in savings. A major disadvantage of this system is its lack of adaptability for the future. Creating new openings in the slab would be challenged by the tension cables.



A steel frame system has the ability to span as much as the concrete and allow for a flexible and adjustable plan. Steel allows for a carbon savings of more than 92,000 kgCO2eq over post tensioned concrete construction. Steel construction, however, requires beams that puts the bottom of structure 13" lower than the post tension slab.

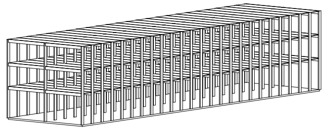




Heavy timber construction using glulam beams and columns has the smallest carbon footprint of the four, over 380,000 kgCO2eq less than steel and over 870,000 kgCO2eq less than the first flat slab concrete option. A drawback is the additional structure - the bay size is reduced to a 10'x30' and the beams are 2' deep under a 4" floor. However, it's adaptable to future configurations.

An additional consideration is the physical weight of the building. Foundations were excluded in this study, but the heavier the building the greater the carbon impact due to foundations. This only amplified the results of the analysis. The 14" thick flat concrete slab was the heaviest, and it's already comparatively large carbon footprint would only get larger. The heavy timber structure was the lightest, and carbon savings would be furthered with a smaller foundation system.

While a heavy timber structure was the clear winner in this study, it does have its limitations. Most notably, it isn't adequate for program spaces that want large, column free areas. Ultimately, a combination of systems may be considered based on program, size, and any special considerations such as cantilevers or curve radius.



The extremes of discomfort often experienced indoors

ENERGY + COMFORT

An energy efficient building must perform to maximize human comfort. Finding the optimum balance between the two is the challenge set to architects and engineers in any project. In a Living Building project, minimizing energy use intensity of the building is key because it allows for reduced energy creation on site, which can have major cost saving implications.

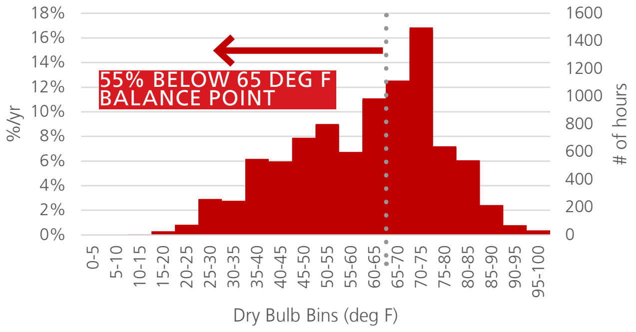
In order to create comfort and energy savings in a replicable form, the team sought solutions that would be familiar to building managers and designers and would be simple to construct. Integrating the building cooling and heating systems into the ways that Georgia Tech and many other campuses already operate would lower the threshold for implementation, operation and maintenance.

EVALUATING THE BALANCE OF COMFORT AND ENERGY USE

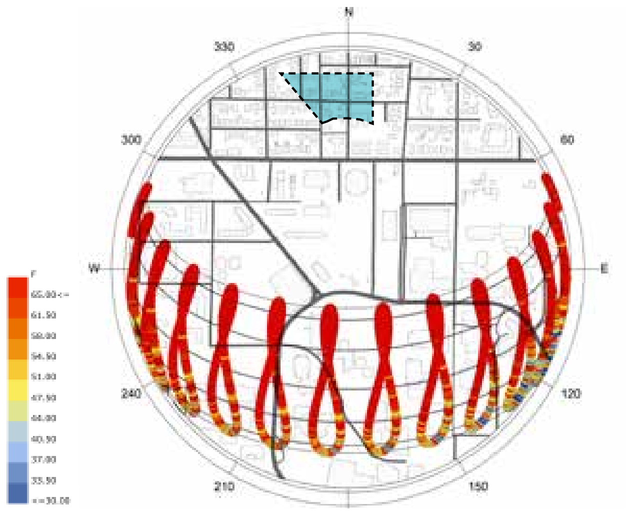
SEATTLE	ATLANTA	NEW ORLEANS	ST. LOUIS
4611 HDD65	2991 HDD65	1513 HDD65	4758 HDD65
474 CDD65	2151 CDD65	3882 CDD65	1616 CDD65

To start, the team used Ladybug, a Grasshopper plugin, to quantify the challenge to meet energy targets in Atlanta compared to other familiar cities. At right, cooling degree days are compared to heating degree days. Cooling and heating degree days are units of measurement in which the difference between 65 degrees and the temperature of the day is added up for every day of the year. It shows us that Atlanta requires similar amounts of heating and cooling.

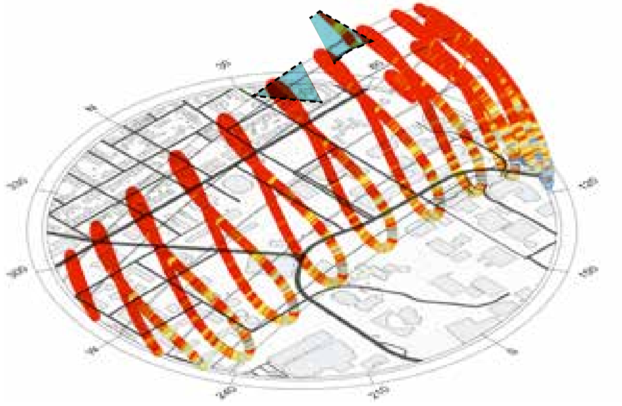
Sun charts at the far right explain what times of the year (shown by the location of the sun) provide what temperature.



SUN PATH DIAGRAM - LATITUDE: 33.77
HOURLY DATA: DRY BULD TEMPERATURE(F)
FULTON CO ARPT BROW, GA, USA



SUN PATH DIAGRAM - LATITUDE: 33.77
HOURLY DATA: DRY BULD TEMPERATURE(F)
FULTON CO ARPT BROW, GA, USA

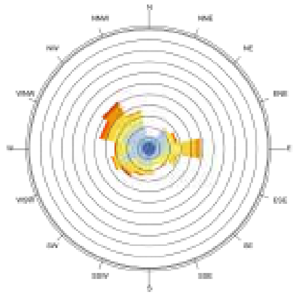


KEY TAKEAWAY

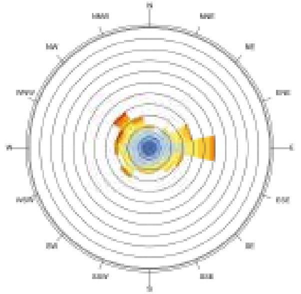
Atlanta is not dominated by cooling as initially thought. However, the solar path diagrams show that shade is needed throughout the year.

WHEN AND WHERE TO CAPTURE BREEZES

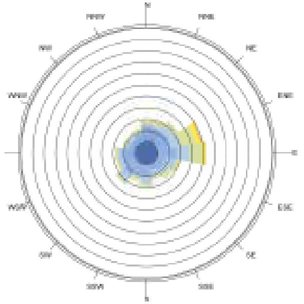
The team found that eastern breezes in the shoulder seasons were the ideal time to open the window. Eastern openings would allow for cross ventilation through the building. The design should protect against northwestern winds during the winter.



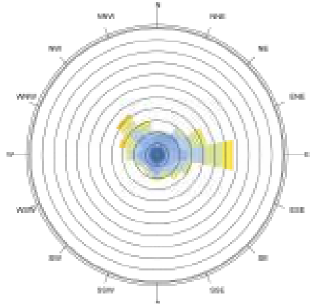
WINTER (JAN-FEB)



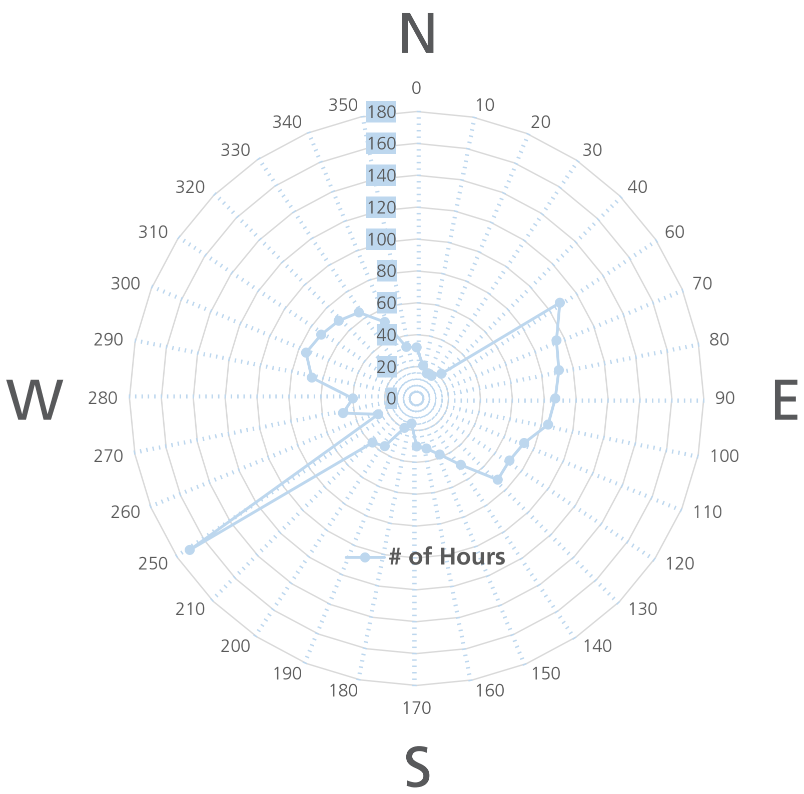
SPRING (MAR-MAY)



SUMMER (JUNE-SEP)



FALL (OCT-NOV)



HOURS WHEN DRYBULB AND DEWPOINT CONDITIONS = NATURAL VENTILATION
(DRY BULB = 55 < X < 78 DEG F ----- DEW POINT = X < 65 DEG F)

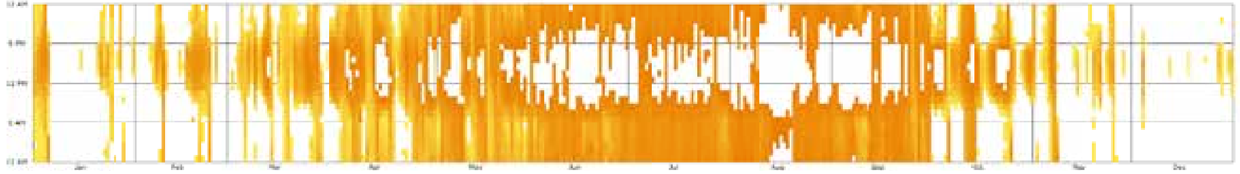
USING NATURAL VENTILATION

By evaluating dry bulb temperatures and dew point simultaneously, the team could understand when windows may be opened to enjoy natural ventilation. The top most graph shows the dry bulb temperatures, the second graph shows humidity levels. The final graph overlaps the two, the remaining colored areas represent times when the window may be opened.

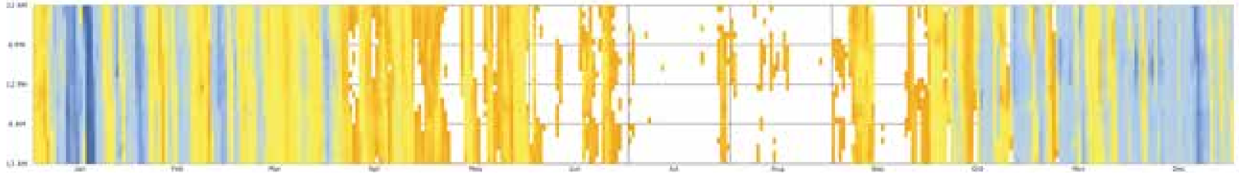
Although operable windows for occupants will be less critical at night, knowledge about ventilation circumstances could give insight about when to night flush the building.

KEY TAKEAWAY

Ventilation will work best in the fall and spring, but better in the spring. Night flushing may be useful in spring, but other analyses found that the low diurnal swing makes night flushing minimally useful.

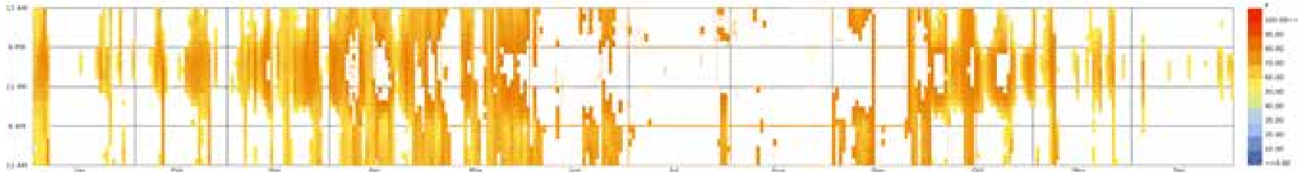


DRY BULB TEMPERATURE

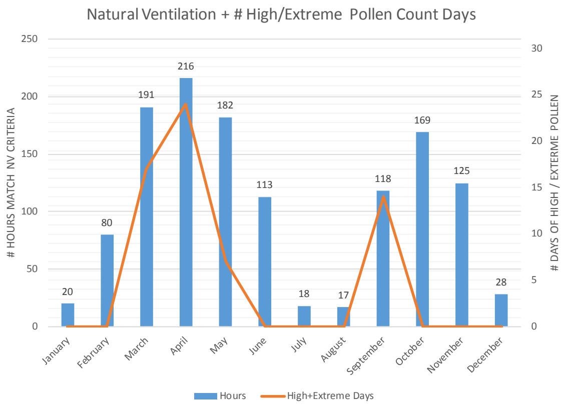


DEW POINT - (X < 65 DEG F)

HOURS IN RANGE (24/7) ANNUALLY **24%**



POLLEN LEVELS RELATIVE TO NATURAL VENTILATION



KEY TAKEAWAY

Since the high pollen days align with the times that natural ventilation is optimal and Atlanta is known to have high levels of pollen, pollen will have to be considered along with the natural ventilation strategy.

THE HIVE

Allergies and the Human Microbiome

February 04, 2016 in Health & Happiness

Research from the Human Microbiome Project shows that people with asthma and certain allergies, as well as more detrimental diseases like cancer, obesity and heart disease have a different microbiome in their gut than their healthier counterparts. This theory comes out of the “hygiene hypothesis” - an idea that getting rid of bacterial infections in Western society has also inadvertently reduced how much helpful bacteria we have. With industrialized nations having increased incidence of asthma and allergies in the last 50 years, the change has been attributed to use of antibiotics, changed microbiota and dietary changes.

What data support the link of the microbiome to asthma and allergies? Two studies looked into the prevalence of asthma for children living on farms compared to those not living on farms-- they found that there are different microflora experienced by the two groups, and (with the exception of IgE-- an antibody that manifests itself in various allergic diseases) that the farm kids who had greater exposure to diverse microbes also had a reduced susceptibility to asthma. Studies have also associated diverse intestinal flora early in life (for example, in the form of mother and infant’s consumption of untreated cow’s milk) as resulting in reduced risk of allergy at age five. Meanwhile, the microflora hypothesis proposes that the gut microbiome interacts with the immune system to maintain immune function. The idea that your microbiome changes as you age and interact in different environments may explain why allergies can develop at any age.

What studies might support that a changed microbiome is a cause of disease rather than an effect? One study found that when microbiome samples taken from obese twins were delivered to mice, the mice ended up gaining weight more than usual. Similarly, overweight mice given a “post-surgery” microbiome lost weight. More support for the theories come from new treatment methods such as ones that infuse patients with the microbiome of healthy people which has been found to help patients with Clostridium difficile infections, for example, resolve their symptoms.

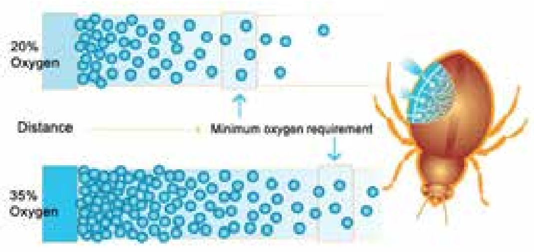
As Washington Post writer Dominic Basulto writes, “At a time when some of us ingest probiotic yogurts to get a mix of “good bacteria” in the morning,” the idea that you may be prescribed a bacterial therapy “is not as far-fetched as it might sound.”

Sources: “The secret to treating your allergies may lie in your stomach” from The Washington Post, “Change Your Microbiome, Change Yourself” from Genome Magazine, “The human microbiome, asthma, and allergy” in Allergy Astma Clin Immunol. 2015, “Finally A Map of All the Microbes in Your body” from NPR.

THE HIVE

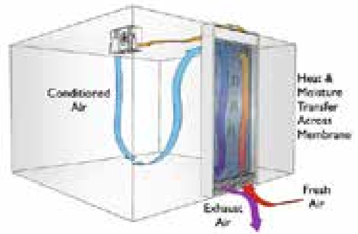
What if a building breathed like an insect

February 04, 2016 in Energy, Health & Happiness

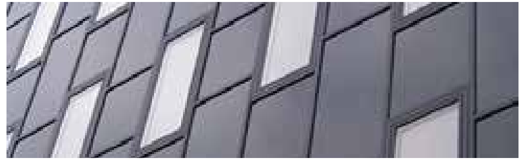


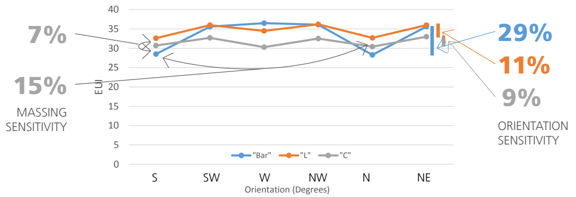
Insects don’t inhale through a centralized duct; instead, their skin / shell contains thousands of small elements that allow it to take in oxygen and expel CO_2. Following the concept of biomimicry, could nature provide an example for a different way to handle this for buildings?

Standard best practice design is to have a centralized air intake where we can take in outdoor air, filter it, then exchange both heat and humidity with the stale air being expelled through an ERV (Energy Recovery Ventilation) system. Recently, there’s a firm that has developed an exterior wall panel that can act as an ERV for the adjacent room: The ‘AirFlow’ product from Architectural Applications can be part of a curtain wall or a rainscreen.



Each unit comes with its own standard-format MERV 11 or 13 filter, which would need to be changed on a schedule similar to what one would handle for distributed fan coil units. Capacity rule-of-thumb: a unit 5’ wide x 3’ tall by 10” thick can exchange 200 cfm of outdoor air for stale indoor air. That is, each one of these units could provide required air for 5 - 10 occupants. The developers state their system has an ERV efficiency of ~85%, while they assert that other wheel-based systems have a lower efficiency. To be verified.





The team conducted energy simulation studies early in the design process, even before any design took place. The goal of these studies was to explore the broad-brush design constraints that might affect energy consumption. Specifically, the impact of orientation and three simple shapes was studied using a simulation package designed for early conceptual simulation. The results provided insight into not only the sensitivity of the shape to different orientations, but also the difference in performance between the shapes. The simulation assumed a simple 4 story volume with 42,500 square feet, equal glazing distribution on each façade, and envelope/HVAC specifications close to the Advanced Energy Design Guide recommendations for Atlanta's 3A climate zone.

Overall, the results showed that the "Bar" used the least energy at 28 EUI, but was also most sensitive to orientation, with a 29% difference in energy from best to worst orientation (~8 EUI). The other two shapes showed less sensitivity, between 9-11%, likely due to the architectural self-shading of their masses. The study also showed that between the best performing scenarios for all three cases, the "L" mass used 15% more energy than the best "Bar" scenario, while the "C" used 7% more energy.

"BAR" "C" "L"

However, an important issue came up as the design progressed and the energy simulation tools used to analyze performance became more sophisticated. It was found that the modeling process over-exaggerated the effect of orientation due to limits in how the glass was input. While the study showed a sensitivity between masses and orientation of ~10-30%, more detailed simulation revealed only

a sensitivity of about 4-6%. Due to the limitations of the tool selected for the analysis, specifications of the glazing inputs weren't available directly in the program or in any online documentation. The specifications were bizarrely available only through the input process in a different simulation program from the same family of tools. Once more information was found on what was modeled, the program's glazing types proved inappropriate for the climate. The lowest SHGC available was .47, while the code requires a .25 due to the large impact of solar gain on buildings in warmer climate zones. The doubling of the sun's effect likely contributed to the over-exaggeration of the results. This is often a problem for early modeling programs that hide input detail or limit flexibility for speed and ease of simulation. This proved to be a good lesson for the team: early conceptual analysis requires the right tool for the right job and quality control on inputs is key.

KEY TAKEAWAY

Because of the latest technological advancements in glass and low-e coatings, orientation makes less of a difference than initially thought.

Early conceptual modeling can be deceptive if you don't use the right tool.

Exploration of Shading Using Trees as Inspiration

February 03, 2016 in Energy, Beauty, Health & Happiness

These sketches illustrate an idea of using winter tree shading as a source of inspiration for shading the sunny sides of the Living Building at Georgia Tech. Even though the sun was very low at the time the photographs at right were taken the glare created by the sun was reasonably low. This provided a clue as to how we might use inspiration from nature and the biophilic connection to these trees to provide daylighting without glare. Early morning and late afternoon direct sun is especially hard to control.

Contrast found in nature from sunlight can be strong. We have the opportunity to select materials with the properties we desire to control color and contrast. The image with leaf pattern below represents what could be a translucent panel in vertical or horizontal louvers and sunshades. The tree trunk like columns could be opaque but lightly colored to diffuse light and soften contrast caused by them. The panel between the tree column and the building should be translucent or micro-perforated. In either case might the pattern be based on leaves in a tree canopy?

One advantage of a large overhang is that it can provide additional roof surface for solar panels. We still need to leave distance between the panels and the roof edge for worker safety issues (and may yet need some sort of worker protection/restraint along the roof edge).

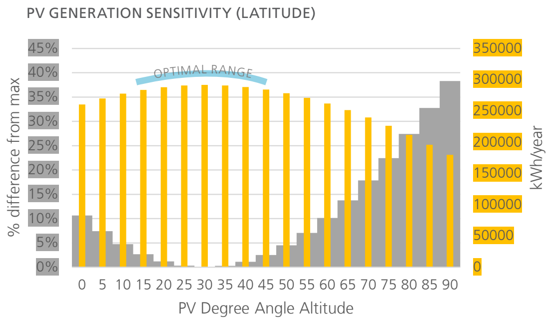
The shading columns and overhang can recall the vernacular precedent of porches with large overhangs and rows of stately columns of many of the local Antebellum and near post-Antebellum houses and civic buildings present in and around the Atlanta area from the late 1850’s to the early 1900’s. However, a more literal ‘porch’ may be needed to make that connection a bit clearer.

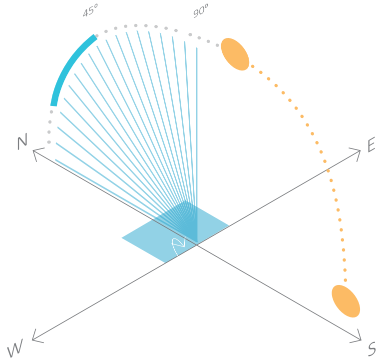
Note that the shadows in this photo fall well across Ferst into the site. These, a future building at the southwest corner of Ferst and State and any plantings we do may impact the south facade of a new building along the north edge of Ferst. Used mindfully (especially the filtered light through winter trees, and summer shade adjacent to our building) these shadows can be used positively (the shading from the future building - not so much).

This is a lot of shade through winter trees. In addition to shading from trees along the north side of Ferst we are also getting shading from trees along the south side of Ferst. These winter morning daylight patterns change rapidly with each successive hour, quickly giving way to more sunlight.

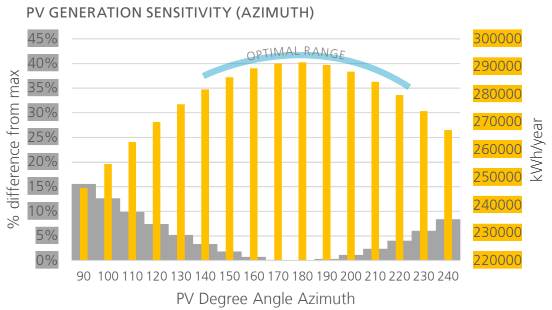
ORIENTING PV CELLS TO MAXIMIZE ENERGY RETRIEVAL

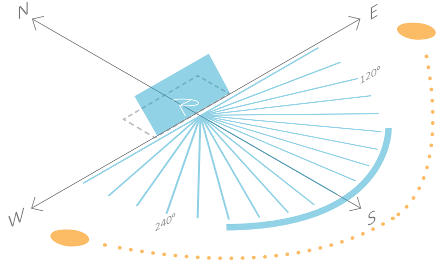
The PV cell study showed us that a wide range of PV azimuths and altitudes are available for the project to use while having minimal generation loss. The difference among the best altitude orientations was less than 5%.





OPTIMUM ALTITUDE:
15-45 DEGREES
(<5% DIFFERENCE)

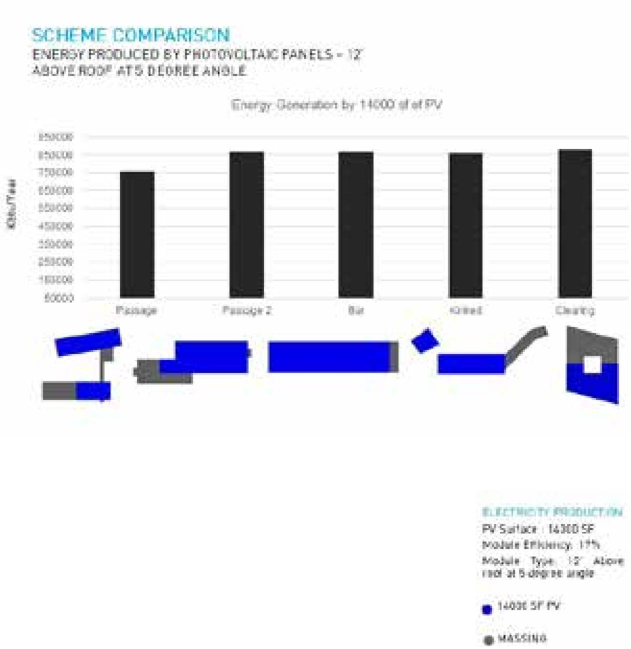


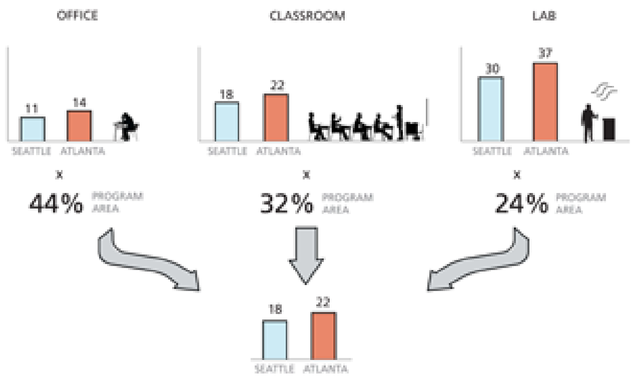


OPTIMUM AZIMUTH:
140-220 DEGREES
(<5% DIFFERENCE)

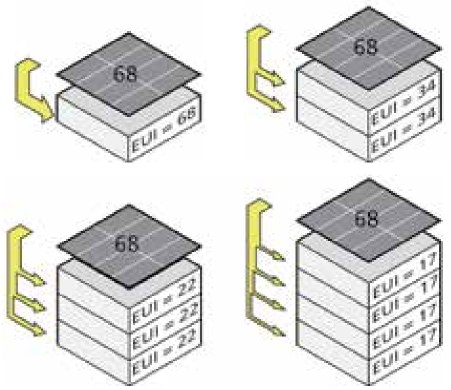
MINIMIZE ENERGY USE, MAXIMIZE SUPPLY, MAINTAIN HIGH COMFORT & STAY ON BUDGET

The team developed a tool to evaluate shading on the roof from adjacent trees. While partis nestled in the trees had the advantage of creating an experience in nature, those trees also shaded the roof and prevented solar cells from capturing energy for the building.





The Bullitt Center was the first building certified under the Living Building Challenge. Located in milder Seattle and with a strictly office program, it became a point of comparison. The team used a spreadsheet calculation to determine the energy use intensity (EUI) for the site and program of the Georgia Tech project as it would be in either location and found that the EUI for the two climates would be only slightly different from one city to another.



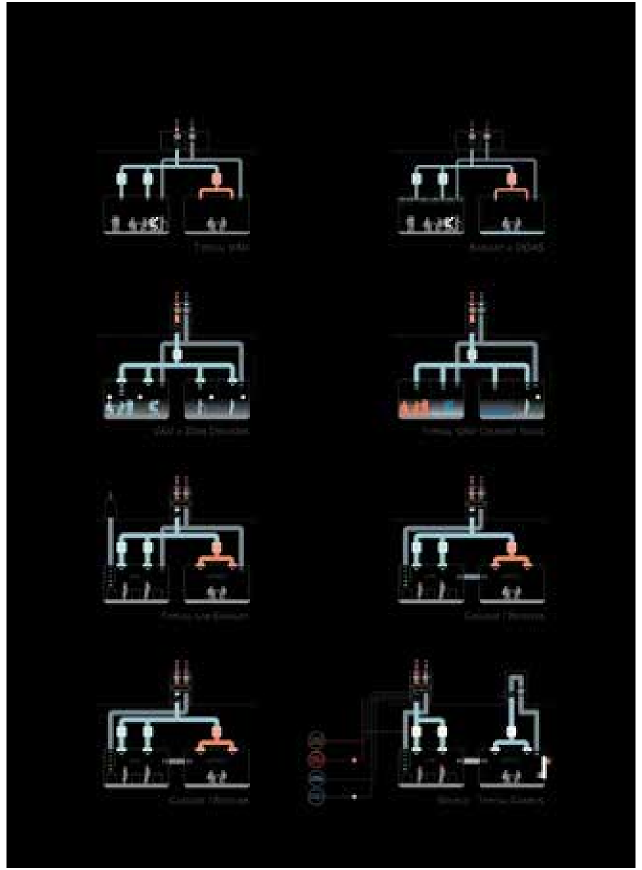
The amount of energy that could be captured per square foot of solar panel was found to be 68 kBTU, using local solar panels and given the climate of Atlanta. For a single story building, all of 68 kBTU could be distributed to a single floor, but this would provide more energy than needed for the floor. A three floor configuration was found to be the perfect number of floors to provide adequate energy to each floor without providing more energy than needed.

KEY TAKEAWAY

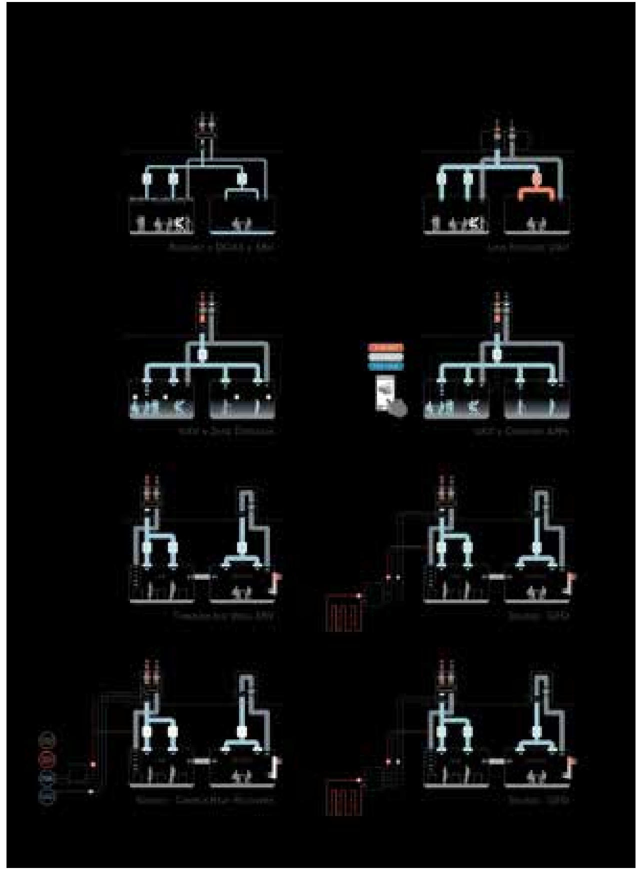
A three story building not only suits the context of Georgia Tech and many other university settings, it also works well for the amount of EUI the solar cell can provide on a per level basis.

A variety of HVAC systems were considered and compared to understand which would make the most sense for a replicable, net positive Living Building.

Individual control became central to the success of the building systems, as they would allow each occupant the ability to control the comfort of their space.



VAV diffusers, smartphone softwares, and technology in objects that come in close contact with the body like conditioned chairs and desk fans were a few of the suggested strategies.

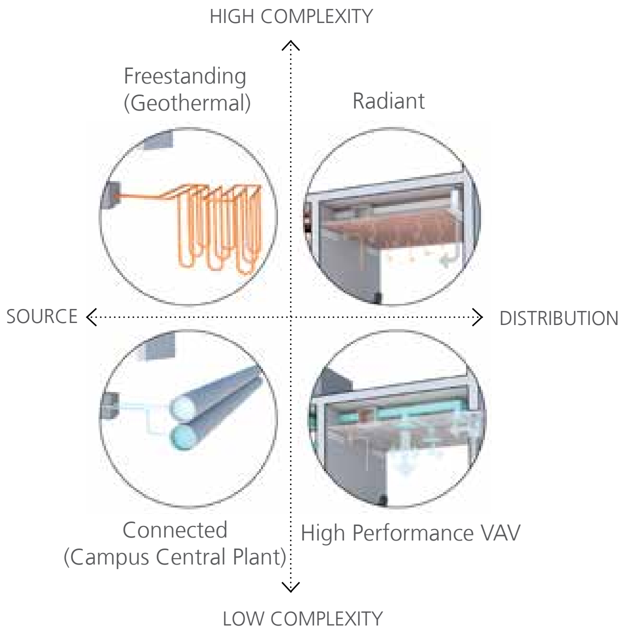


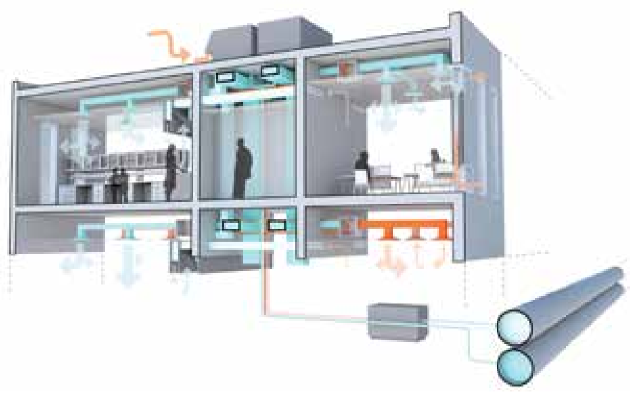
RADIANT + CHILLED BEAMS

GEOTHERMAL

Radiant systems are commonly implemented to maximize energy savings and comfort. However, these systems require a complex construction wherein pipes must be integrated into the floor slab. This makes maintenance difficult and requires the building management team to become familiar with new operations.

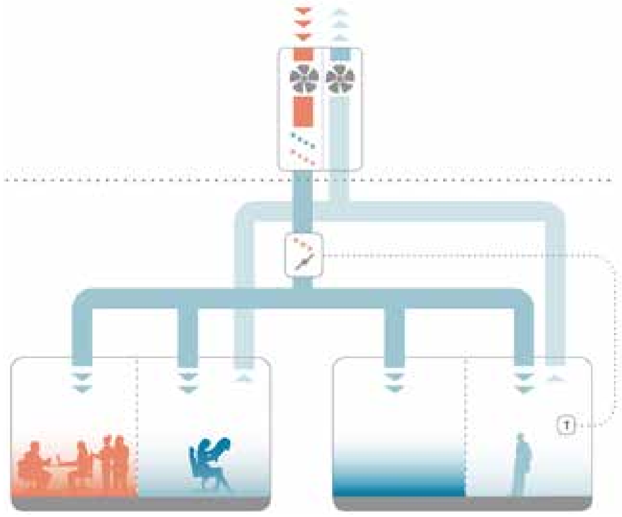
A High Performance VAV on the other hand removes these barriers while performing almost as well at a much lower cost.



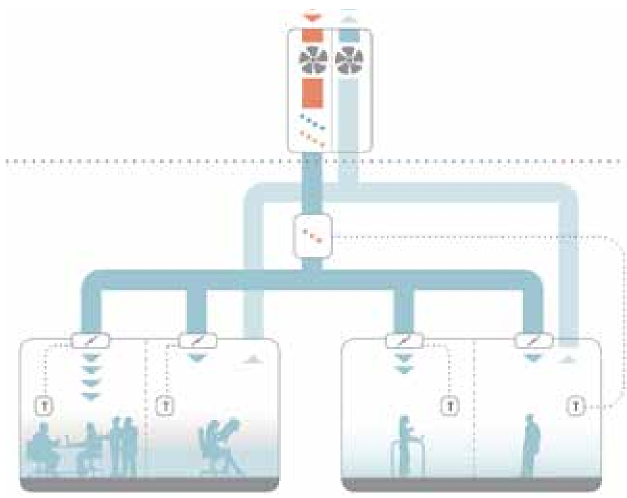


Pros: simple, common, easy to replicate/maintain
Cons: large ductwork, high fan energy

Pros: most efficient distribution and source
Cons: high construction complexity, unfamiliar operations and controls

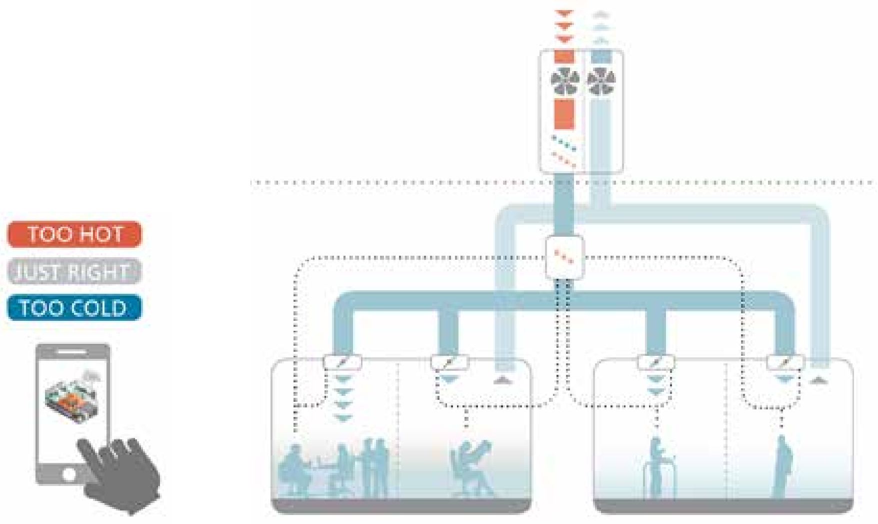


TYPICAL VAV COMFORT ISSUES



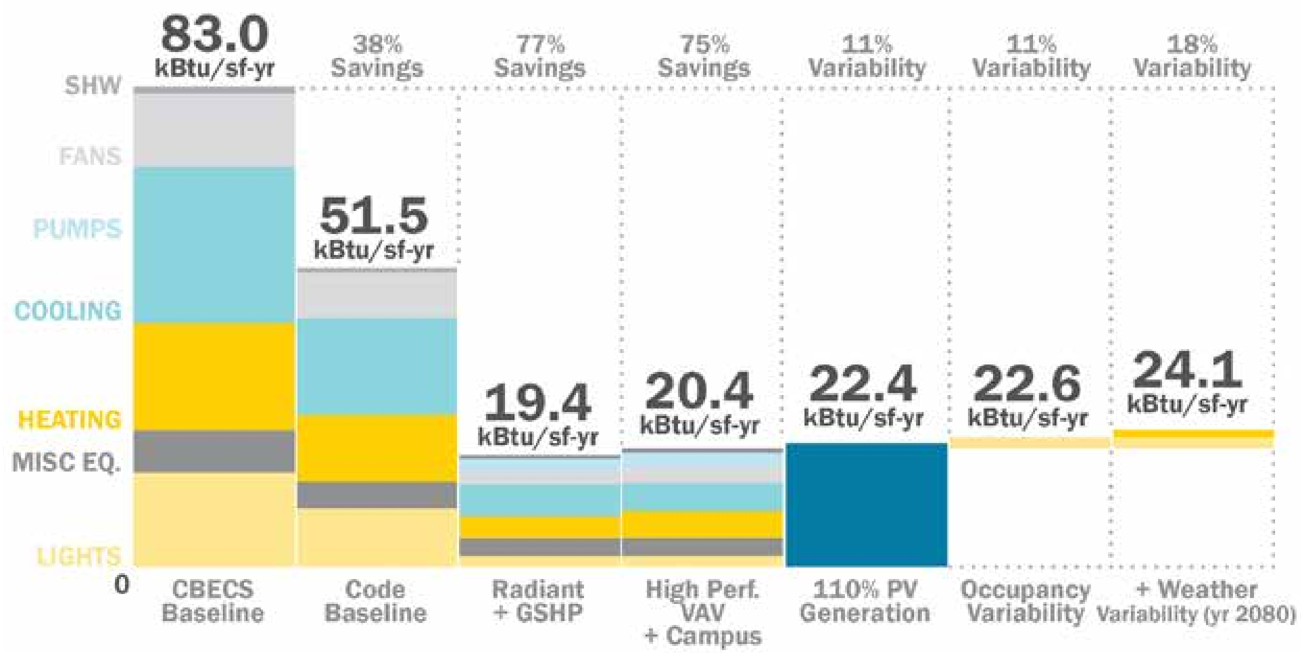
VAV WITH DIFFUSERS

A typical VAV system



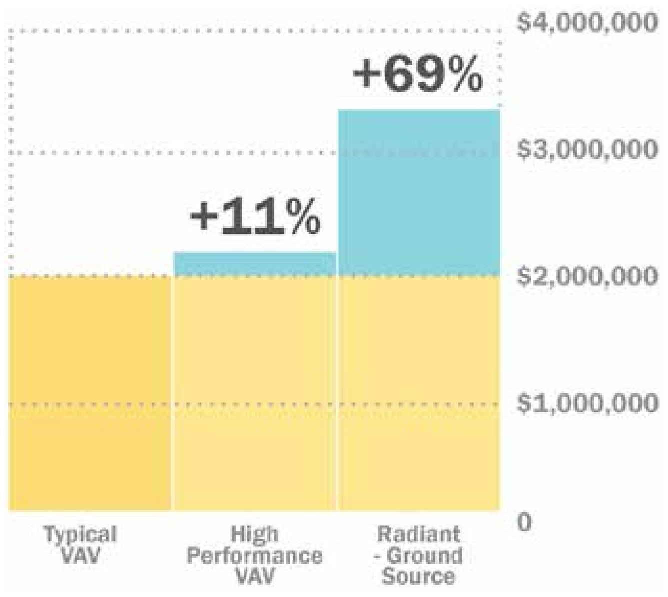
VAV + COMFORT APPs

How can optimal comfort be achieved? A typical VAV system often has comfort problems because the control of temperature and humidity are not at the air delivery points. With diffusers, control of temperature is given on a room by room basis which provides occupant's greater control. New systems use smartphone apps to allow occupants to express how comfortable or not they are in a space which can be communicated to the system.



KEY TAKEAWAY

Occupancy and weather variability play a big role in meeting or not meeting the net positive energy target. With a 2-4 kBtu increase possible with either variable, the team may consider providing additional energy through the PV generation.



A Radiant system will cost 69% more than a typical VAV system.
A High Performance VAV system will cost only 11% more.

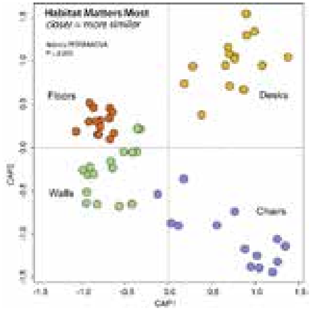
THE HIVE

The Ecosystem of Architecture and the Human Microbiome

January 28, 2016 in Health & Happiness

Is pure air better for your health? Although our bodies only use the oxygen we inhale from the air (78% nitrogen, 21% oxygen with traces of CO2, water vapor, argon and other components), we know that breathing in pure oxygen for long periods of time is detrimental to health and will eventually cause death. As it turns out, the perceived “inefficiency” is actually healthy. Is the same true for other things - for example microorganisms - in the air?

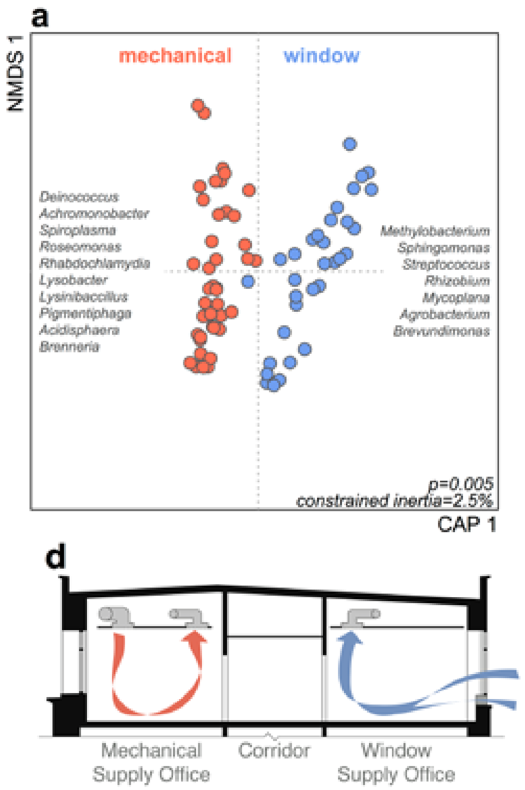
The Biology and the Built Environment Center (BioBE) at the University of Oregon is beginning to investigate just that by understanding the ecosystems produced by architecture. The group is learning about the different micro organisms that exist within the built environment. Their work characterizes the degree of similarity among different spaces- not only bathroom versus office space, but even micro-environments within a space as shown in the diagram below.

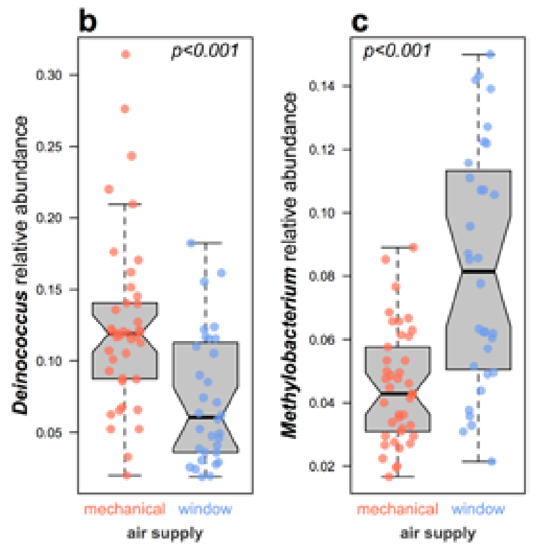


From the University of Oregon’s Energy Studies in Buildings Laboratory

In her TED talk, Jessica Green of BioBE explains that passively ventilated buildings flush out the “resident microbial landscape” that people produce simply by occupying a space. See the diagram below for a glimpse at the different microbial communities in a mechanically ventilated space compared with a passively ventilated space.

Green suggests that we may be able to manipulate our indoor environments to have more “good” bacteria - like bliss, a microbe that wards off pathogens and gives you good breath.

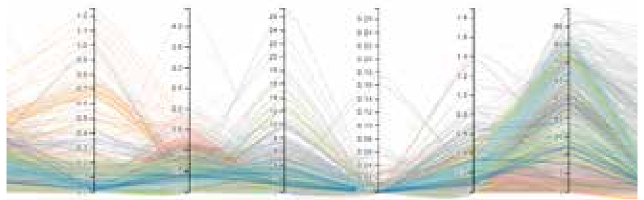


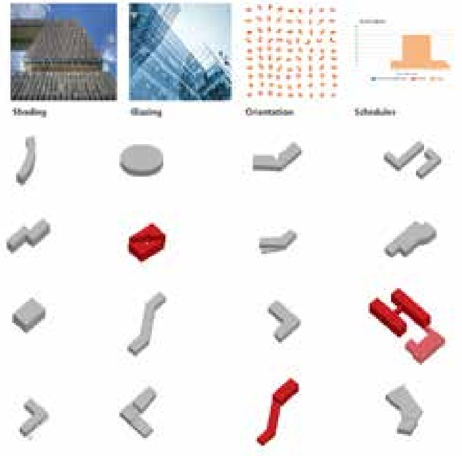


PERFORMANCE METRICS AND DESIGN MASSINGS

STRATEGIES

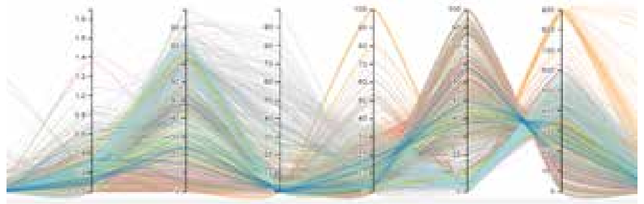
Throughout the design process, different masses were tested for their performance. Design strategies like shading, glazing and orientation were compared for heating and cooling, energy use, daylight, glare, thermal comfort and cost.

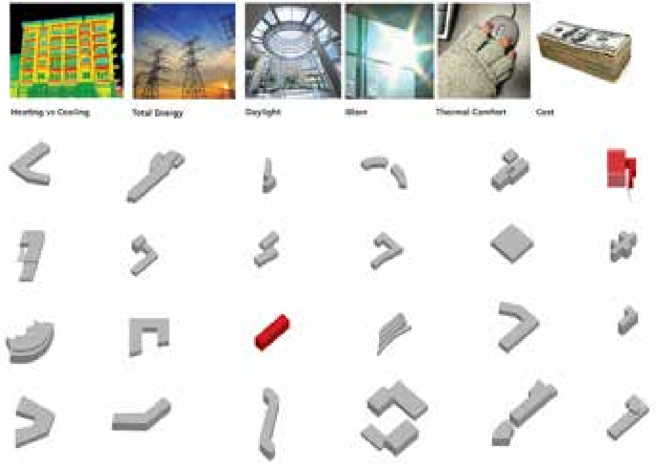




METRICS

The tool shown below was created to visualize large parametric datasets solving for the multiple criteria to narrow down which designs would meet the metrics.





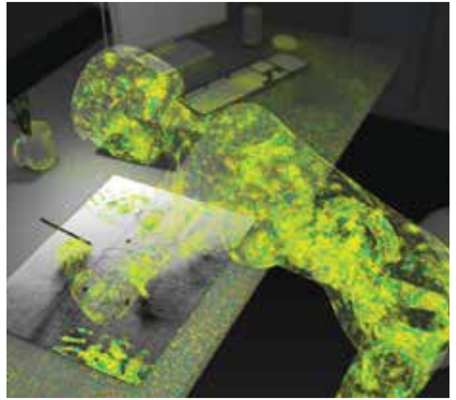
THE HIVE

The Indoor Microbiome

February 04, 2016 in Health & Happiness, Energy

Often times, the best air quality is perceived to be achieved by intensive air filtration (purifying carbon air filters, MERV 8 - 35% pre-filters, MERV 13 - 90% final filters, etc...), and in cities where there is extremely poor outdoor air quality this may in-fact be required. This oftentimes highly energy intensive process is performed in building after building with the intent to create the healthiest environment possible. Research done by the Phylagen group has shown that this may not be the best or only way to create a healthy indoor environment.

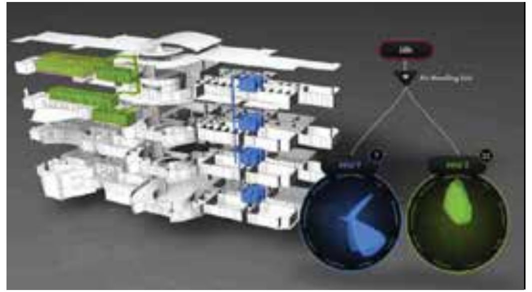
In the words of Jessica Green buildings are full of “invisible ecosystems,” composed of trillions of interacting bacteria, fungi, algae, and viruses that form microbial communities called microbiomes. In buildings that utilize traditional filtration methods, microbiomes have been found to be dominated by the typical microbiomes found on humans. This lack of microbial diversity in our living space has been found less beneficial than the diverse microbiome of the outdoor environment.



By introducing unfiltered outdoor air into our living spaces, particularly at night when negative air particulates (such as pollen and combustion byproducts) are at their lowest, we begin to replenish the indoor microbiome. Such a procedure has the potential to improve individual performance and health.

See below for a great TED talk, given by Jessica Green, on microbiomes as they relate to building design.

https://www.ted.com/talks/jessica_green_good_germs_make_healthy_buildings?language=en

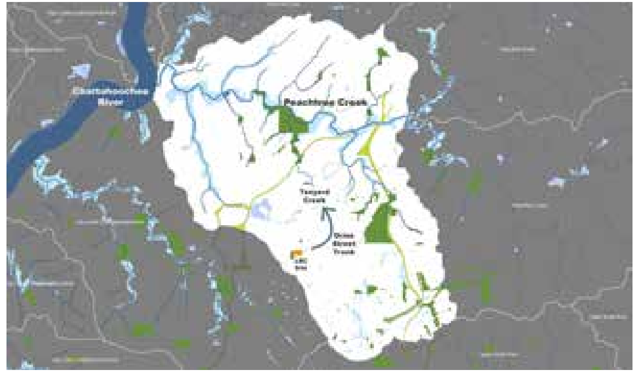


Land that is usually below water is exposed at Lake Lanier Islands near Atlanta, Georgia

WATER SYSTEMS

The Southeastern region has been experiencing a drought for many years, yet even Atlanta's less than usual rainfall will still provide more water on the roof than will be used in the building. We considered the possibilities for using the extra water elsewhere on the site through art that may engage people with the water flows. Extra water also gives us the opportunity to expand beyond the immediate site to use collected water in the campus cooling towers.

How does water flow on the site? The team used GIS analysis of the topography to understand water flows and to see where high concentrations of water would be found on the site during periods of especially heavy rain.



REGIONAL HYDROLOGY

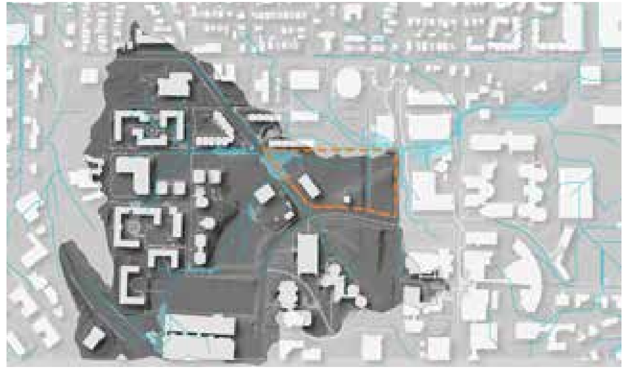
Chattahoochee > Peachtree > Tanyard Creek > Orme Sewer

SITE HYDROLOGY

North Campus Drainage Patterns

SITE PHYSIOGRAPHY

Slope

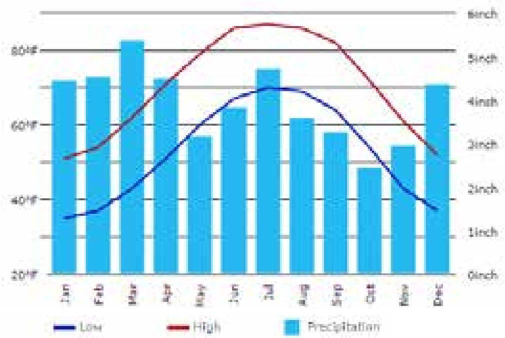


SITE PHYSIOGRAPHY

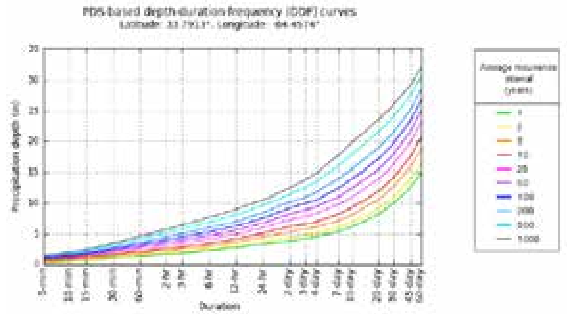
Slope Drainage Area

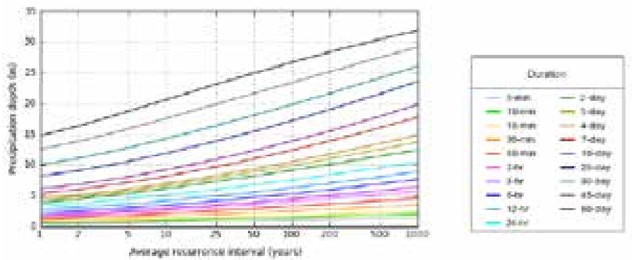
RAINWATER RELATIVE TO WATER NEEDS

Which days get the most precipitation? By understanding this issue, capture of rainwater during the year for human consumption can be properly accounted for. The team sought to understand whether other sources would be needed whether at certain times of year or due to drought in the area.

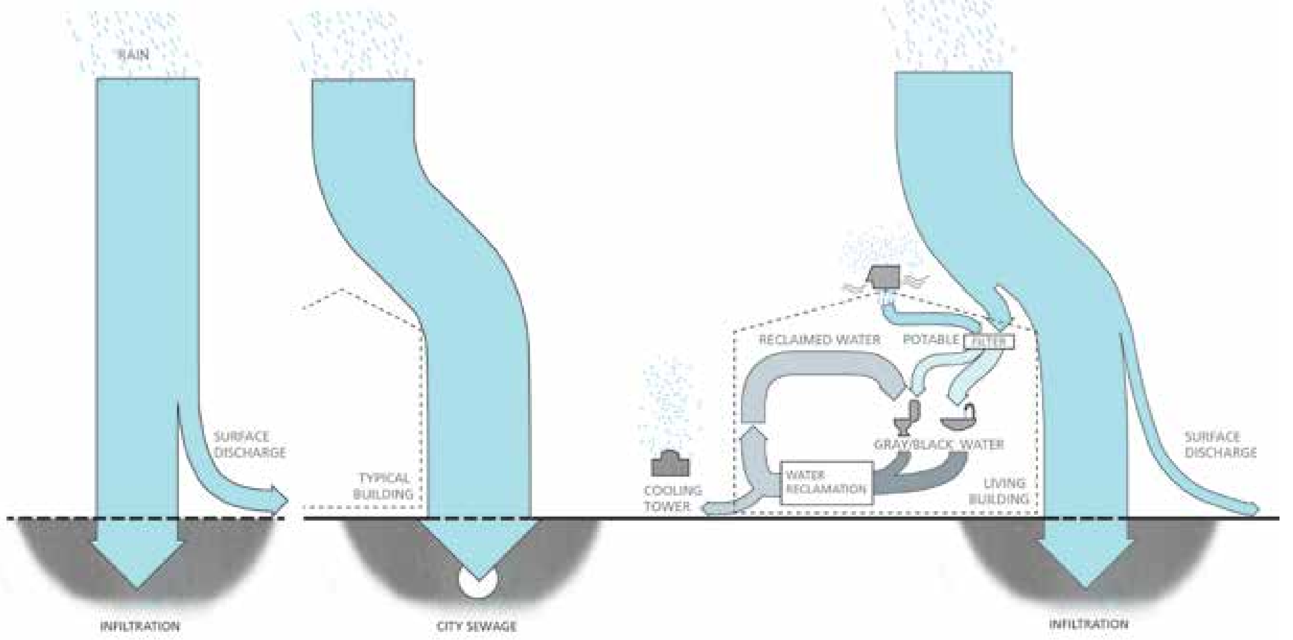


AVERAGE MONTHLY PRECIPITATION AND TEMPERATURE



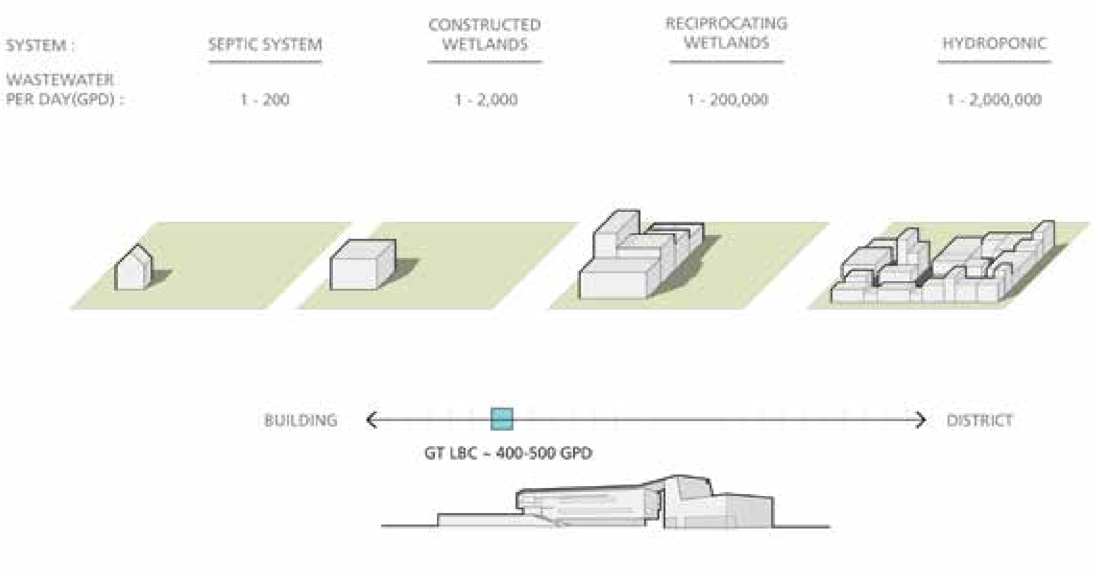


RAINFALL DEPTH-DURATION-FREQUENCY CURVES



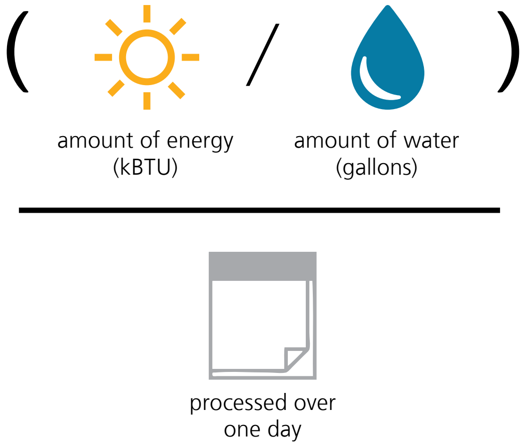
KEY TAKEAWAY

Once we "prime the pump", we will need very little additional rainwater (10% or less), even in times of drought!

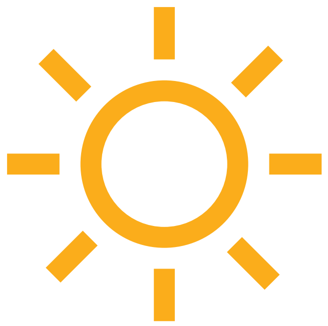


BLACKWATER TREATMENT SYSTEMS

Different densities of human occupation on a site require different scales of blackwater treatment. While a house can use a simple septic system, larger systems are required as more people occupy every square foot.



EMORY WATERHUB
.036 kBtu per gallon per day



ATLANTA HEMPHILL WATER TREATMENT PLANT
7 kBtu per gallon per day

THE HIVE

A Visit to the Emory Water Hub

December 22, 2015 in Water

On Friday, December 11th, Chris Gray and I were given a tour of the Emory WaterHub wastewater treatment & recovery facility by Brent Zern of Emory.

How many buildings it serves

A: It serves 40% of the campus. The campus is divided into 3 sewage-sheds (new term!)

Capacity

400,000 gal/day

How it works

Raw sewage goes into Moving Bed BioReactors (1) anaerobic, then (2) aerobic, which have little plastic widgets with large surface area (for hosting microorganisms) floating around, pumped with bubbles to keep things stirred

Water then passed to 5 hydroponic modules with growing things above and a mesh material below (again, more surface area). 2 of the 5 are inside a greenhouse, 3 outdoors. No significant difference in handling capacity (because the microorganisms that do the work live on the roots even after the outdoor plants die-back above the water). The greenhouse system is just prettier to look at.

The water is then UV processed and they add a small amount of chlorine to meet county regs (I know...)

Water is then stored in a 50,000 gal tank and fed into the campus purple-pipe system, where it is used to fill toilets, and as make-up water for the campus steam plant and campus cooling towers. The state health department would not let them use it to irrigate in ways that it might come into contact with humans (spray irrigation or irrigating food).

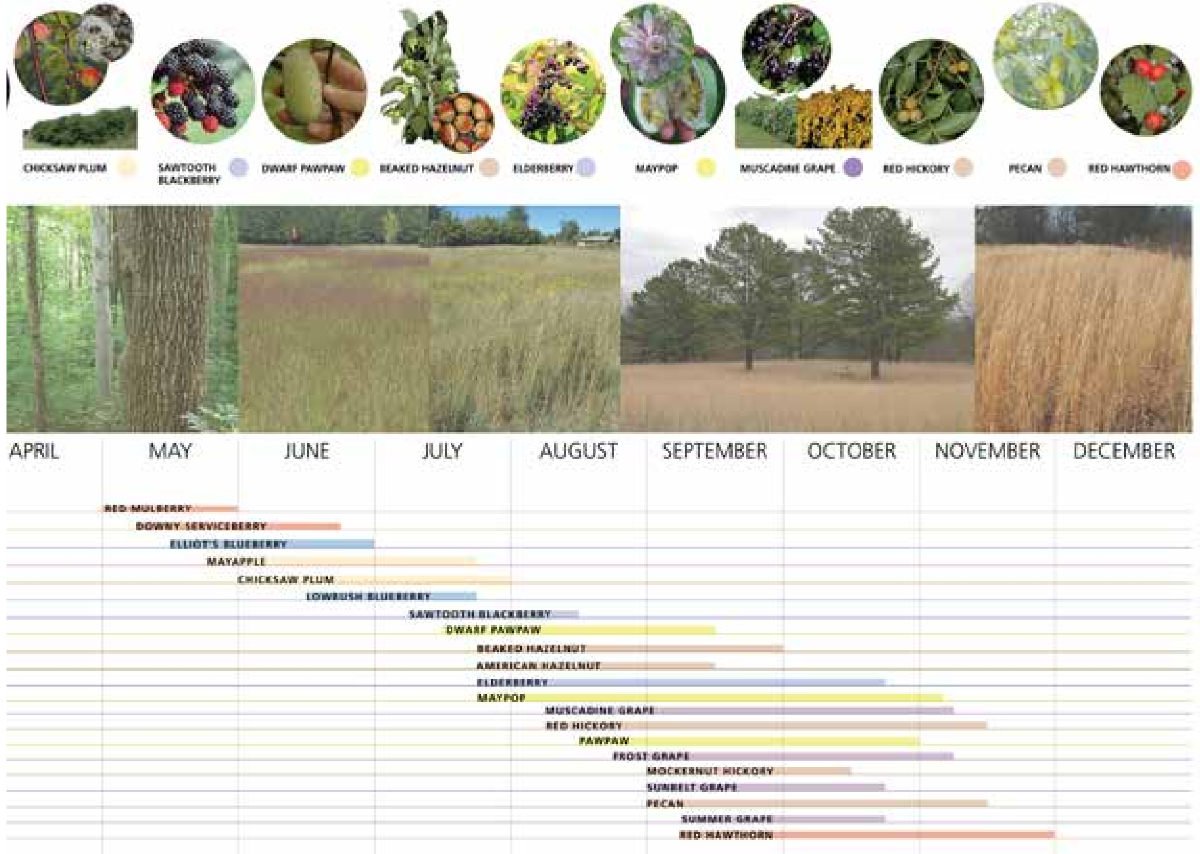

The last remaining Piedmont forest within Atlanta's city limits.

REGENERATIVE LANDSCAPES

There's much to learn from the site itself with its magnificent oak trees and a water regime not much changed from before human influence. Using species from analog sites, we will provide the increased shade that Georgia Tech has proposed in their recent Eco-Commons Master Plan and daylight the streams, bringing the site closer to its former glory as a Piedmont forest. Many of the native plants include species with edible fruits that can reduce the cost and effort required to maintain urban agriculture on the site. The species fruit throughout the year, not only in the summer but also in the fall when the majority of students will be on campus, ready to tend to the garden, connect to nature and learn in the process.

MAKING URBAN AGRICULTURE SUSTAINABLE

The landscape team's research found that plants native to the region provide edible fruit throughout the year. By using native plants, no irrigation would be needed to keep plants alive and with fruition throughout the year, the students would be able to tend to the gardens and learn through the experience.



THE HIVE

Planting Methodologies

January 27, 2016 in Place

Fallow Field - Meadowland

In this methodology we would treat the site as an agricultural field left to fallow. To stabilize the site, the impacted areas will be sown with a mixture of warm season grasses including Virginia Broomsedge, Indian Grass, Little Bluestem and Purpletop. If we engage the lower Ecocommons areas we would add in more wet tolerant grasses such as Bushy Broomsedge, Switch Grass and Eastern Gammagrass. Some early succession legumes such as partridge Pea could be added to the mix to help fix nitrogen in the soil. Willdflowers could also be added to the mix to attract pollinators. Once the meadow is established, it would be allowed to go through natural succession to the point where a mature mesic forest existed on site in about 75-100 years.

The site would have to have the many invasive species that would blow in from the surrounding urban landscapes regularly removed.

Advantages:

- Low cost, Minimal soil prep
- No irrigation required
- Learning laboratory

Disadvantages:

- Management critical and constant vigilance against invasive species.
- Different look than a traditional landscape, may be considered messy, unkempt or unattractive to those used to the traditional landscape look.
- Young Pine Forest

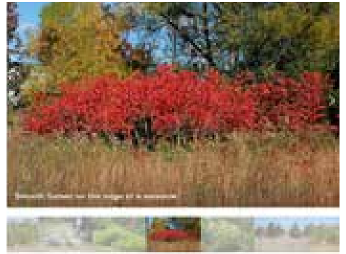
Jump start the property to the first stages of forest development. Plant the ground plain as described in the previous method, but amongst the meadow plant early succession trees such as Sourwood, Sassafras, Sumac, Redbud, Chickasaw Plum, Black Cherry, Black Gum and the ubiquitous pines, Shortleaf and Loblolly. The lower areas would contain more mesic species such as Tulip Poplar, Red Maple, and Sycamore. This planting scheme would progress the design along and introduce the desired early succession species mix whether or not the surrounding landscapes contained the seed bank to draw from. The meadow would eventually be shaded out, but it would perform the critical function in the early years of stabilizing the ground in a mostly sunny condition.

Advantages:

- Low cost
- With small trees, minimal irrigation
- learning tool on succession in a piedmont forest
- More designed/ traditional look with less left to chance.

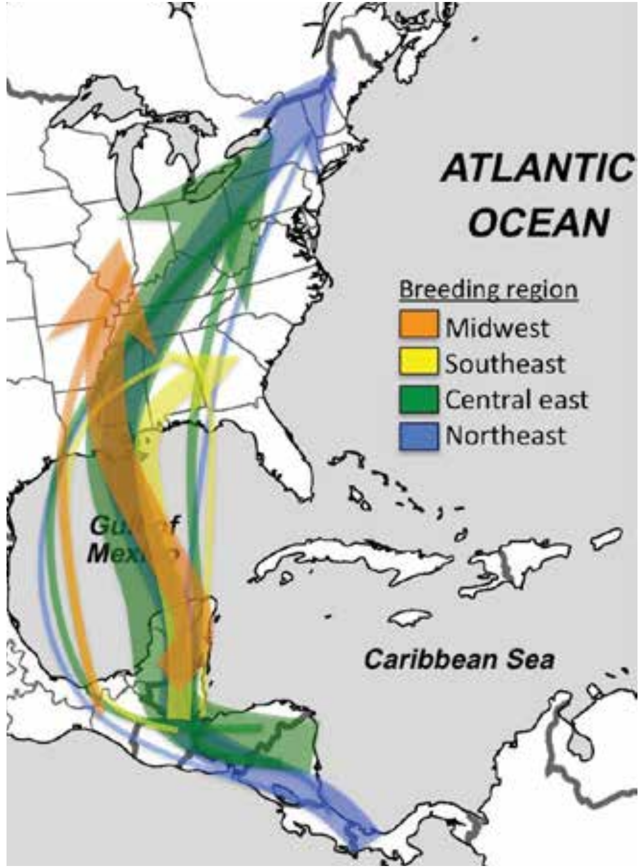
Disadvantages:

- Management critical and constant vigilance against invasive species.
- Young material often grow with poor branching structure that may need some pruning.
- This method has limited control over the final look since it will still depend on the mid and late succession species to seed in from a limited perimeter landscape.



INVESTMENT ABROAD BECOMES LOCAL TOO

In response to the equitable investment and habitat exchange imperative, the team seized on the opportunity to combine the two by donating to an Atlanta-based charity that funds reforestation in Guatemala where birds like the Prothonotary Warbler summer. It's a bird that summers in Guatemala and winters in Atlanta. By helping reforest its summer home, we will be investing in the health of our own ecosystem too.



THE HIVE

Elements and Attributes of Biophilic Design

January 25, 2016 in Beauty, Health & Happiness, Water, Place

Team members have been asking about what incorporating biophilic design means in a building. Is it about plants in a building, or views out windows to nature? Yes, and so much more. Biophilic design is all about using the built environment to connect the occupants with nature and to relate to the human/nature spirit in ways that engage, captivate and inspire - and more specifically with the goals of this building in mind - to be a vehicle that enhances and supports education, research and outreach. This can happen in numerous ways and on multiple levels.

In the book Biophilic Design by Kellert, Heerwagen and Mader, Stephen Kellert identifies 6 design elements and roughly 70 attributes to describe the Elements and Attributes of Biophilic Design - see attached Table 1.1. In the 14 Principles of Biophilic Design Terrapin Bright Green includes similar but slightly different elements aimed at improving health and well-being in the built environment.

The goal is not to use these resources as shopping lists but rather as a source of ideas and inspiration, taking care to read between the lines so we may do what we all do best; discover, synthesize and distill in order to design exceptional buildings that are functional, are beautiful, and connect with the human soul. Success especially in a regenerative building is enhanced when the connections are rooted in an integrated, nature-based, systems approach; where one thing shares relationships with many things which together form mutually supportive systems. (And as an added component found in nature we have recognized the importance of communication - using the honeybee as a metaphor - for the LB at Georgia Tech to be a communication hub. But that is an issue to be discussed in more depth elsewhere.) Natural systems have evolved over billions of years and are made up of groups of of these linked systems to form one huge cluster that is self-supporting, self-regenerative which among other things implies self-replicating and self-healing. The ultimate goal of a regenerative built environment would be to function as nature does. Consider for instance what it could mean for building to be self healing, like a human skin that has been cut. Biophilic building design seeks to use the built environment to make deep human connections to nature but does not necessarily seek to be regenerative. However, biophilic design may help lead to regenerative strategies and ideally would.

As an example consider a rainwater capture system. In most urban buildings water that falls on a roof is directed into a pipe and is sent to a storm water sewer system never to be seen again. What if instead the water is celebrated, reused and eventually provides sustenance for many things. Consider what this might look like and what stories it may tell. What if when the rainwater is collected it might instead of being sent down a pipe, rather be sent down a sculpture, a piece of art that allows the water to visibly cascade down as it flows, splashing, adding oxygen, conveying movement, water-sound and water-smell. Perhaps the water could fall into a sort of surge pool that changes volume hen it rains; and is sometimes dry, sometimes wet and sometimes overflowing. Perhaps that pool is made of shelf rock, much like the rock that might be found in a creek near the site. Perhaps the pool contains plants that provide initial filtration absorbing particulate as well as pollutants that may be in the water. The pool can be used as a funnel, a way to regulate the speed at which water enters a storage tank(s), What happens to the water when the pool overflows, where does it go, what does the observer see and sense? What is visible from outside? What is visible from inside? Does the observer make any connection between this water and something else nearby - perhaps for a living wall in the adjacent lobby or plantings outside near the pool? What about for human consumption?

What happens to the water after it leaves the pool? Since we want to store it and filter it for drinking water how can we make this visible? Could the storage and filtration system be located in an open space directly below the adjacent lobby, accessed

from open and inviting stairs? What then happens to the water after it is used. How might it be food for something else - perhaps a s greywater to flush toilets and/or to infiltrate the ground replenishing the aquifer? What happens to the water used to flush toilets. Rather than sending it to a sewer how can this be food for something else? What about an ecological water treatment system? What might all of this look like and what kind of stories will it tell to those on site as well as off site?

How many of Kellert's Elements and attributes of biophilic design might such a series of systems involve? Many! How many LBC imperatives might such a system engage with? Many! How might we apply this thinking to other building aspects? For instance how might the building function more like a tree? Hmmm, how might this affect a daylighting approach? And how might the built environment function more like a bee, working together and communicating for the betterment of community?

The final models for Crossing and Embankment concepts

TWO DESIGN IDEAS FORM A DIALOGUE

In the absence of discussions with a client, the competition team developed two schemes to create a dialogue of ideas between projects. Instead of providing a “choice” wherein the committee would select which scheme they preferred, this dialogue intended to maximize the ideas available for the project team and the jury to consider.

Both schemes are affordable and replicable - in the ways they use water and energy. Both meet the program requirements, both meet the energy targets.

The differences are also important. Crossing and Embankment are built on two different portions of the site. One has a steel structure with a wood cladding; one has a wood structure with a steel cladding. Both are either on parking lots or already developed sites. Crossing relates more closely to the center of campus and the intersection between Ferst and State, while Embankment pushes closer to the Eco-Commons. It is embraced by the Eco-Commons lawn, and as a result it takes on a completely different configuration and addresses different issues.

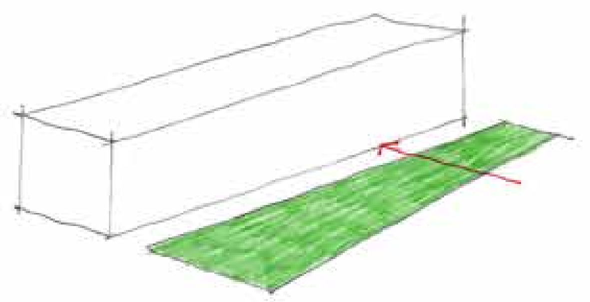
CROSSING

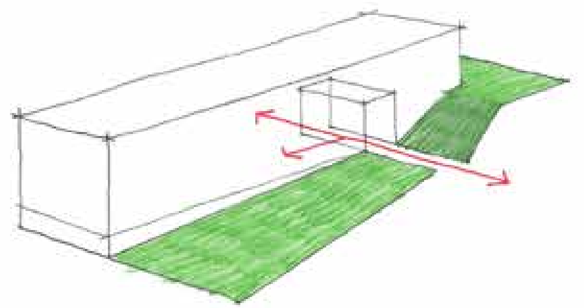
PERFORMANCE

Crossing, with its simple form and small condensed program elements has a lower expected energy use intensity. However, it actually takes up a greater area of land. Crossing holds to the site proposed by Georgia Tech's Master Plan and engages the walking paths that are expected to form and fill with people following construction of the new parking garage.

CROSSING

SITE STRATEGY



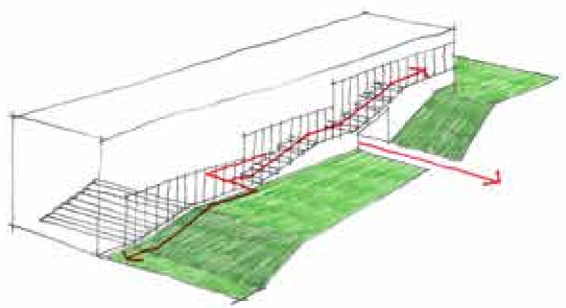


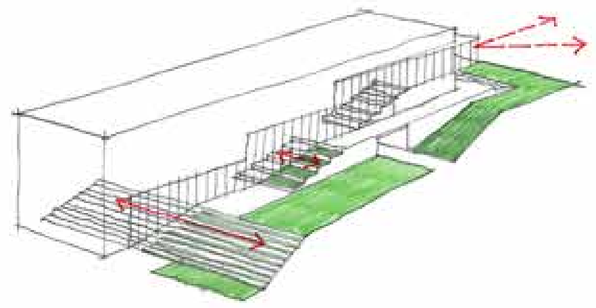
GENERIC BUILDING/ LANDSCAPE RELATIONSHIP

In developing a relationship of landscape to building we sought not a simple adjacency, but a dialogue. Since the building spans across the existing Dalney St., we seek to enhance the circulation with a dogtrot at that juncture. The building moves across the site, stepping across Dalney and onto the hillside on the other side.

SITE ADAPT WITH DOG TROT

It's an opportunity to create an outdoor space of increased comfort that brings air flows through the building, but beyond that it is a social space where people gather and where activity occurs. It's a place that increases opportunities for interaction among people.



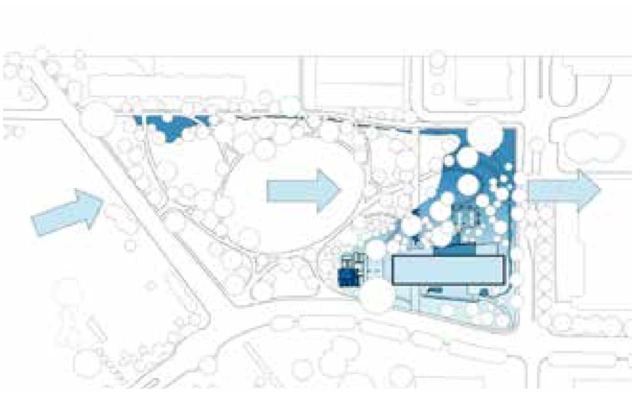


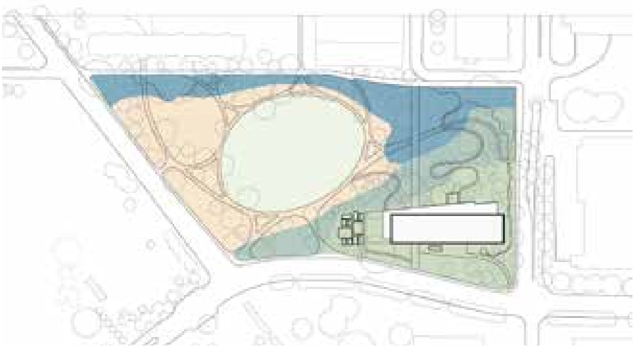
CIRCULATION ALONG BUILDING EDGE

But the relationship between building and landscape had to go further. The building circulation echoes the form of the landscape, allowing people within the building to experience the slope of the site and move up along with it. The break-out spaces along the stair are opportunities for collaboration and the activity is brought to the edge of the building.

CONNECT INSIDE PROGRAM TO OUTDOOR LANDSCAPE

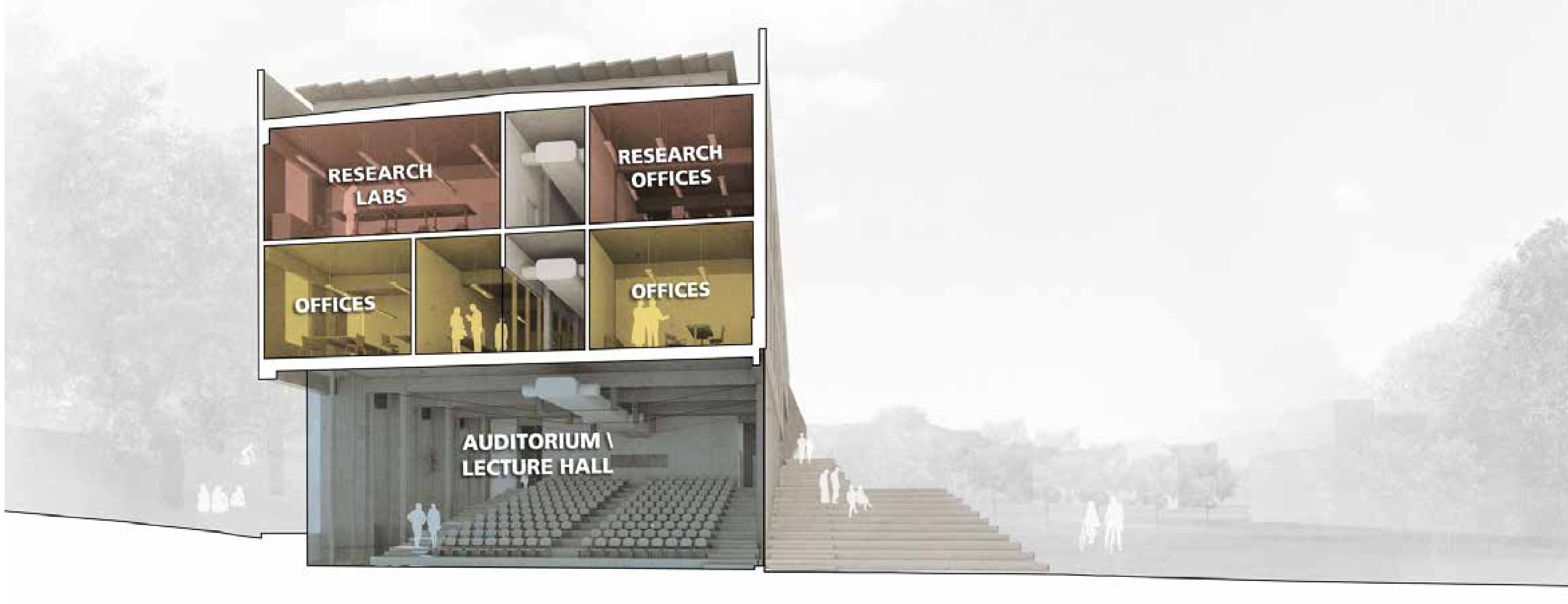
The building and landscape speak to each other not only with views like the one perched at the top level in this collaborative classroom, but with moments for biophilia, bringing nature into the building. The building steps up internally and with cascading landscapes outside the building. The inside and outside are integrated.





The natural flow of water on the site and the flows formed by the building's insertion create conditions for specific landscape types, understood in the context of the region's landscapes.

Microclimates are created that are conducive to different planting communities.

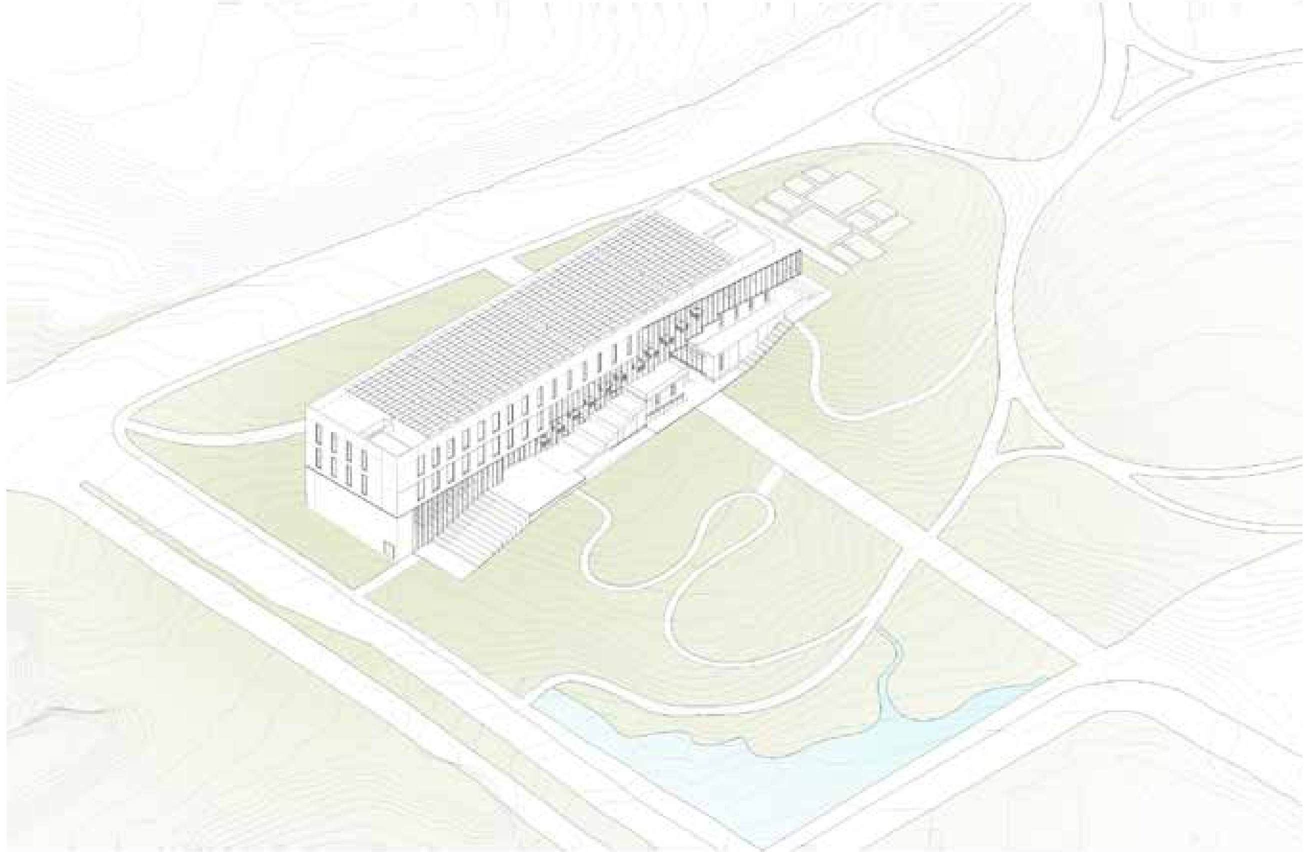


CROSSING

PROGRAMMING

The most public programs are at the lower levels, with programs of increasing privacy levels moving upwards. Research labs have extensive views of their surroundings which may draw others up to the third level.

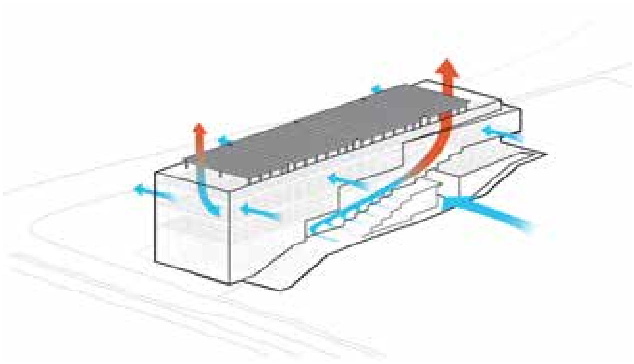
The auditorium on the lower level indoors extends outdoors through the wall. A glass wall allows light in for a lecture that does not require a dark space and creates a visual connection. Operable blinds would allow the interior to be closed off when desired.

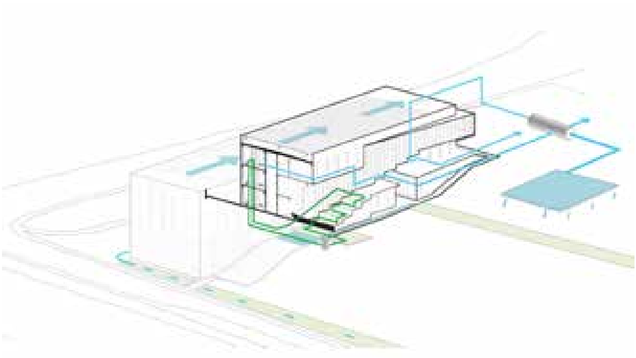


The dog trot shown at left, borrowed from the souther vernacular, creates a social outdoor gathering space. Building visitors and passersby will see the revealed mechanical systems, the maker space where GA Tech's students collaborate and perhaps stop in at the bike repair shop or cafe.

CENTRAL CIRCULATION SPACE

MAKER SPACE

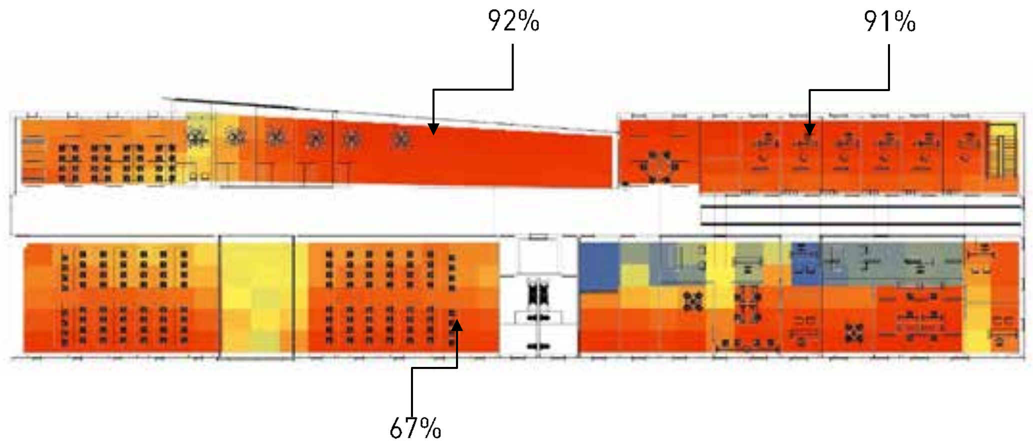




The dogtrot across Dalney Street provides a passage that gives passersby a glimpse of the inner workings of the building, while creating a comfortable exterior common space. Meanwhile two stack vents and operable windows for every occupant increase natural ventilation throughout the building volume.

The water strategy takes advantage of gravity. We collect water across the PVs and any water that cannot be utilized in the building goes into the infiltration gallery or enters Dalney in a new series of infiltration terraces.

78%
CDA

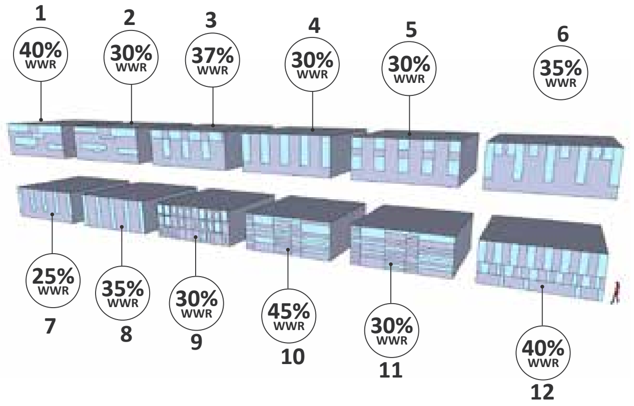


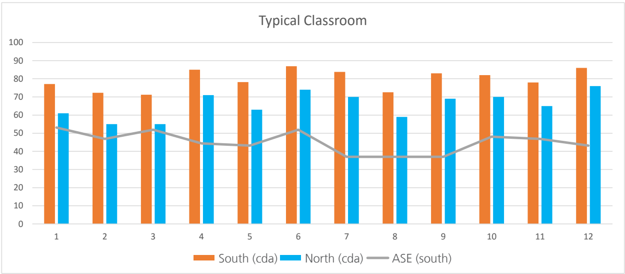
The glazing strategy for Crossing achieves maximum continuous daylight autonomy. Daylight autonomy is the percent of time during use that spaces receive a user-defined lux threshold. Continuous daylight autonomy is similar but awards partial credit for daylight levels below the threshold. The narrow form of Crossing allows for daylight penetration through all occupied spaces.

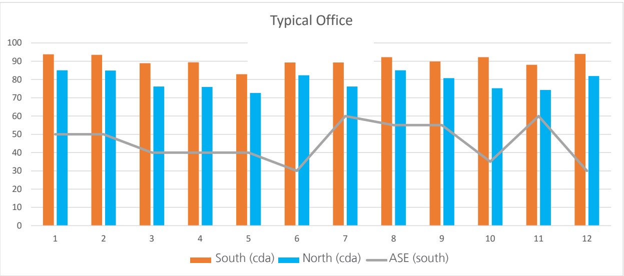
DEVELOPING AND DELIVERING INTEGRATED DESIGN

As part of the preparation for the elevation and facade design, the team did daylight elevation studies. Beginning with a simple “shoebox” with various window configurations equaling somewhere between 40% and 25% Window to Wall Area Ratio (In other words, the amount of area of the window divided by the amount of area of the wall). This helped guide the design team as they went into the program and began forming an aesthetically coherent facade.

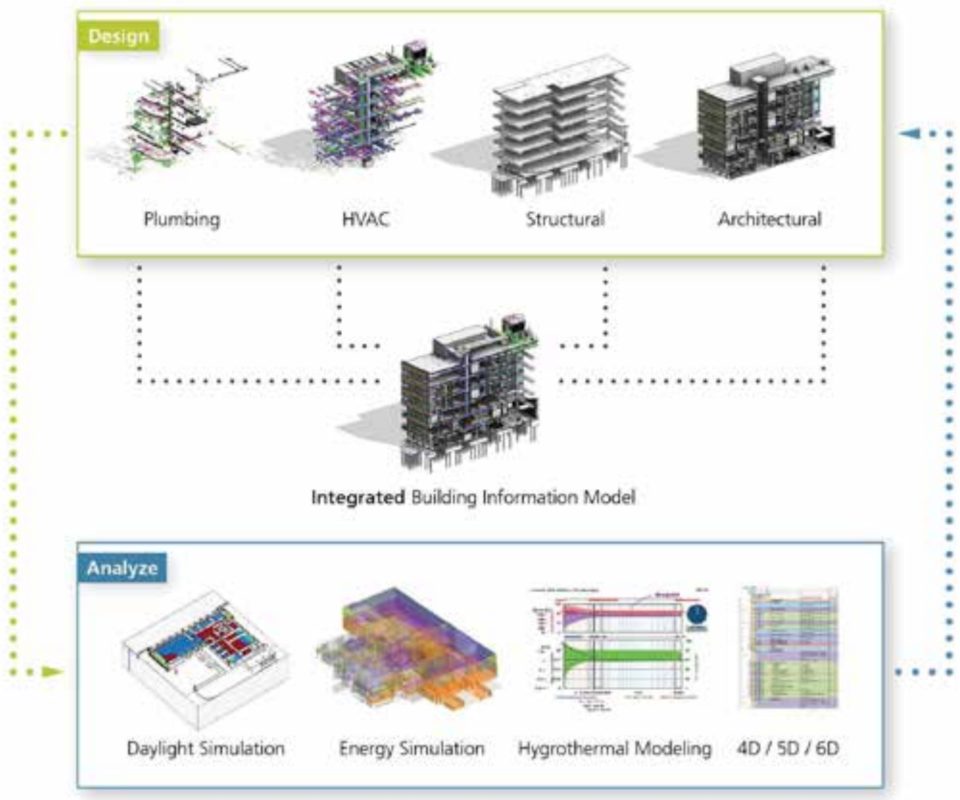
The diagrams on the right hand side describe the percentage of continuous daylight autonomy for both the North and the South facades. With the annual sunlight exposure described by the gray line. Options highlighted with a red square show which options had the best conditions. Tests were completed for both a typical classroom and a typical office module.





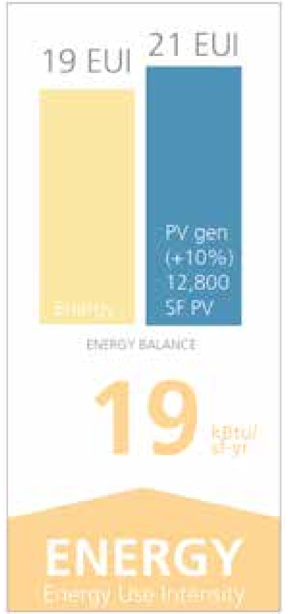


By integrating the model with not only daylight and energy simulations, but also plumbing, HVAC and structural, the team uncovered where collisions occurred and could make adjustments accordingly. The ability to have multiple consultants model within the same program streamlined the coordination process.

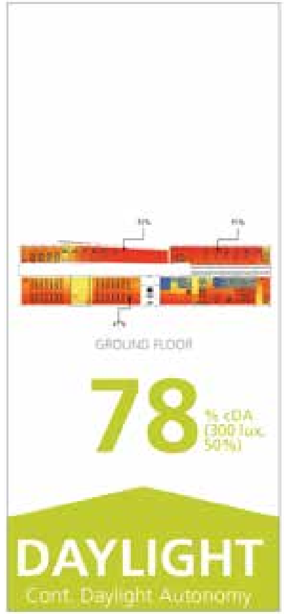


A TOOL FOR COMPARING TWO DESIGNS

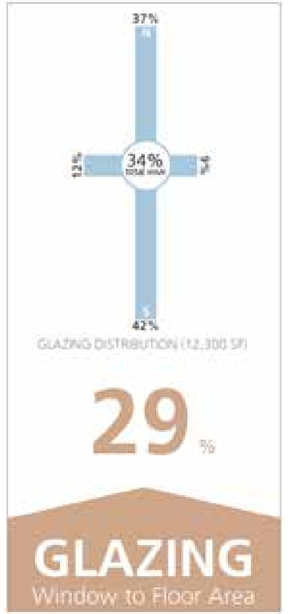
The team designed a “nutrition label” to show quantified measures and make it easier to compare one building design to another. Both schemes were evaluated using metrics like energy, daylight, glazing, carbon impact and site footprint. Each building received a score in each category with informational graphics to explain the meaning of each item. Finding one building design to be “better” than another was not the intent of the “nutrition label”. Instead it is intended to become another piece of the design dialogue.



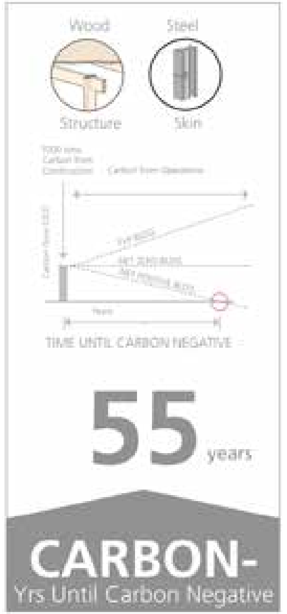
Energy Use Intensity quantifies the amount of energy a building uses per square foot.



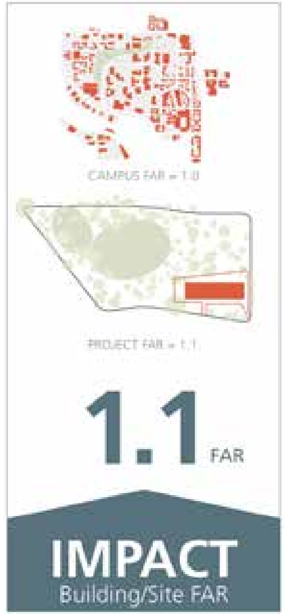
Continuous Daylight Autonomy is the percent of time that a user defined lux threshold is reached using only daylight. It is given here as an annual value.



The window to floor area ratio is the total area of the window divided by the floor area.



This label shows the number of years it would take for the design to be carbon negative.



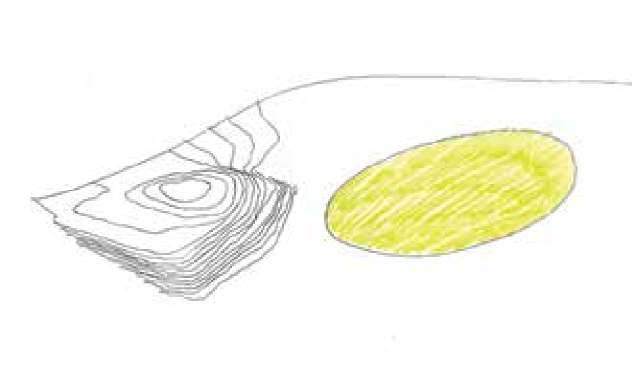
The Floor Area Ratio (or FAR) is the ratio of the building’s total floor area to the size of the land on which it is built. It helps quantify the impact on the land. In the case of our design as is the general rule for the Living Building Challenge, the site is built on a greyfield - a parking lot.

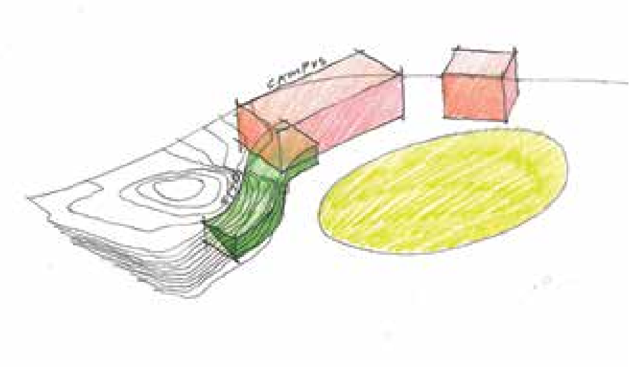
EMBANKMENT

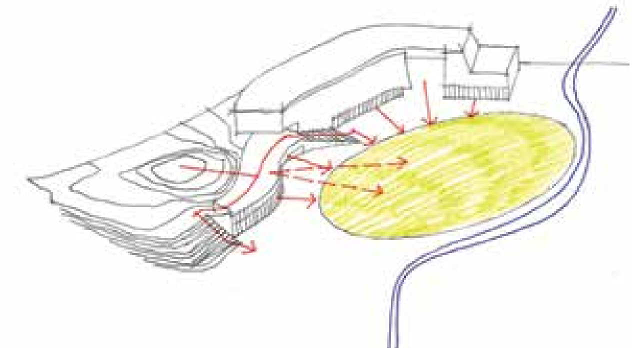
Embankment engages closely to the Eco-Commons, emerging from the hill while forming a passage into the Eco-Commons. Like Crossing, it provides adequate daylight throughout, while maintaining an EUI close to the targeted 22. It has a smaller site footprint, but a greater carbon impact- taking longer to become carbon negative. Its glazing strategy is more complex due to the curves on the facade, but the team achieved about the same budget goal with both designs.

EMBANKMENT

SITE STRATEGY







ECO-COMMONS TOPOGRAPHY - HILL AND LAWN

For Embankment we were interested in a different site engagement. How do we build into a hillside? There is a powerful presence on this site that is not present in the Crossing site. The scheme focused on two site elements: the hill and the Eco-Commons.

PROGRAM ORGANIZATION - SITE AND CAMPUS

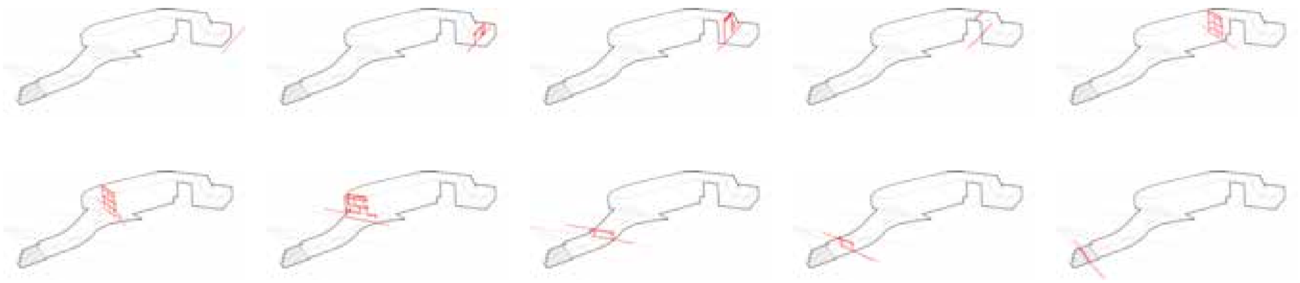
The scheme follows the contour of the land, hugging the hill while embracing the Eco-Commons.

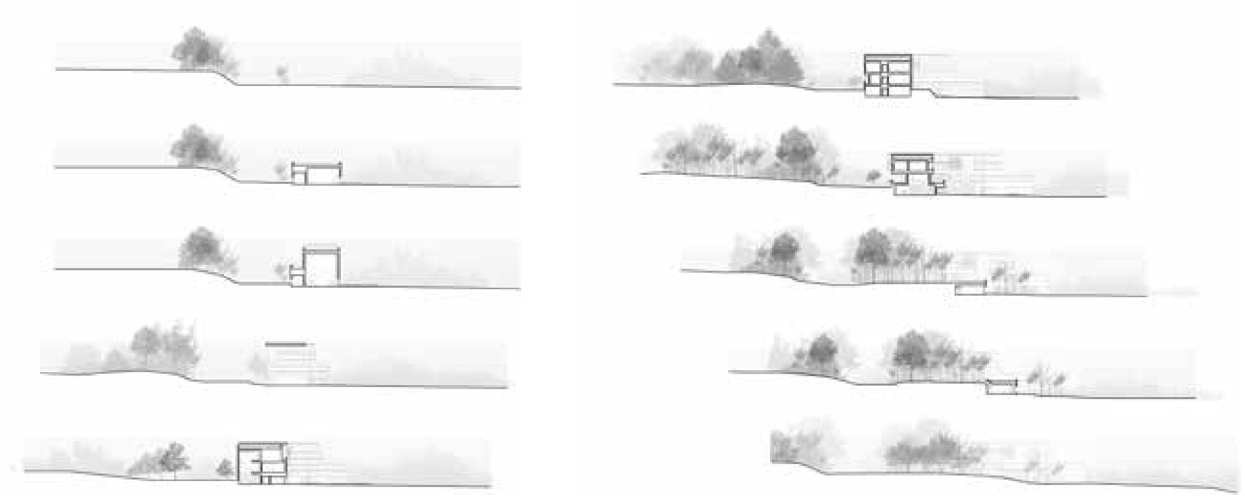
SITE AND PROGRAM INTEGRATION

The result is a design that is more sinuous, more connected to the landscape, and more natural in its feel and organization on the site. At every slice of the building, a relationship between the topography and the Eco-Commons became formative for the experience of the design.

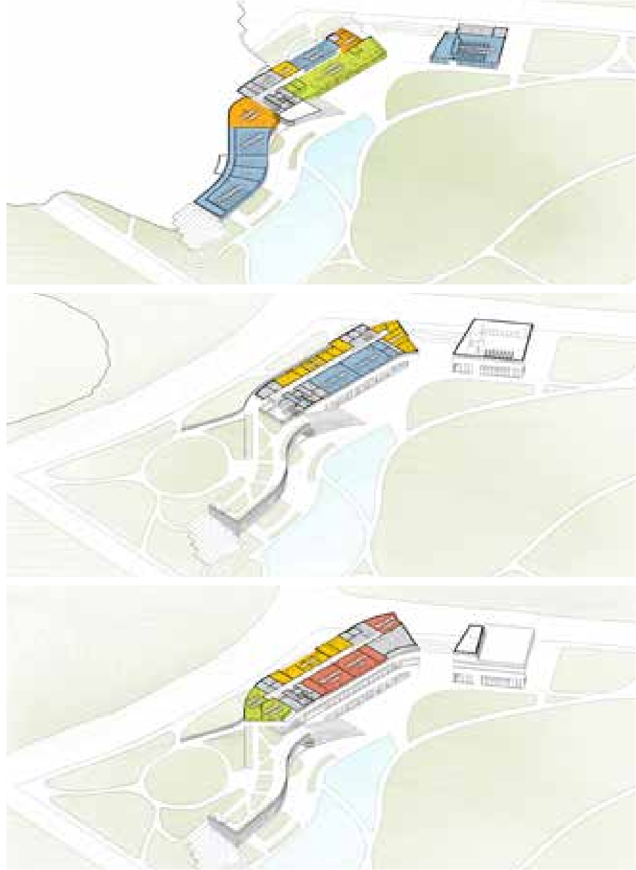
The two schemes deliberately connect the building circulation to the landscape circulation. In this scheme, the site becomes part of the building. There is a large Lawn area for events.

A more hybrid mesic area receives the water coming from the building, with a more mesic woodland and sub-mesic woodland higher up the topography. The species for each area of the site suit the microclimates found there.

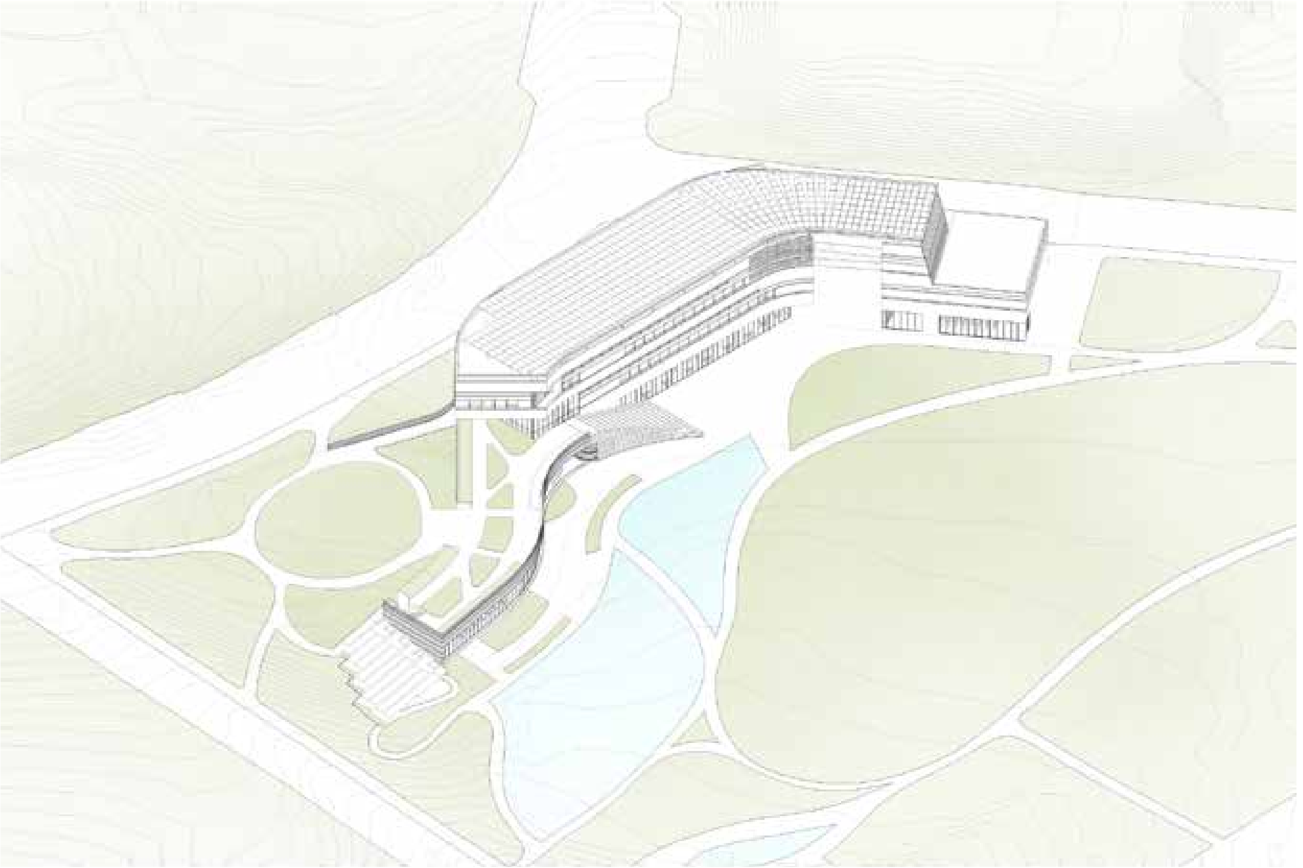


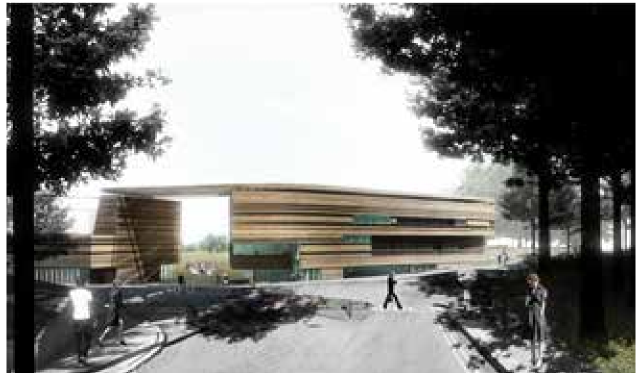


The embankment scheme centers on its connection to the landscape across the building. The "ground" floor engages with the building not only at the first floor, but also at the second on one side of the building where one can walk from the hill onto the rooftop terrace or vice versa.



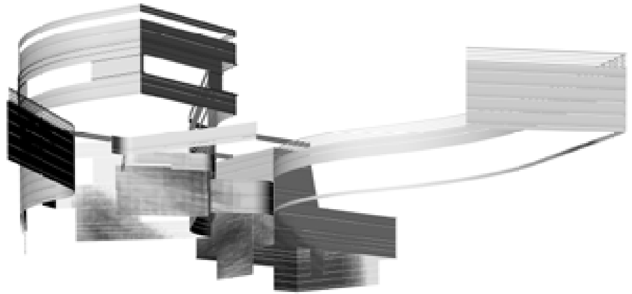
Because of the site topography, the second level occupies the rooftop of the classroom space and builds a connection to the site hilltop. The planted roof provides a view into the Eco-Commons and an opportunity is created to move down on either side for outdoor classroom spaces along the terrace.

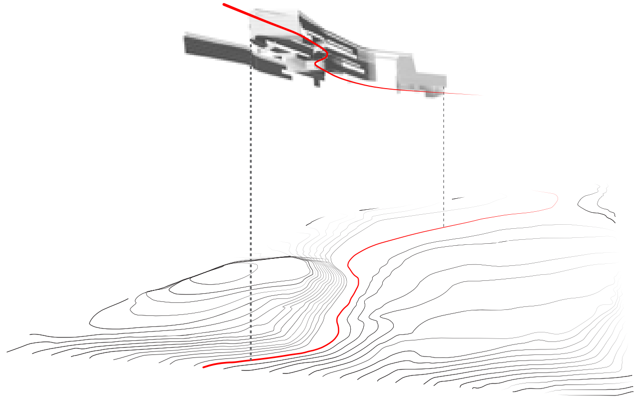




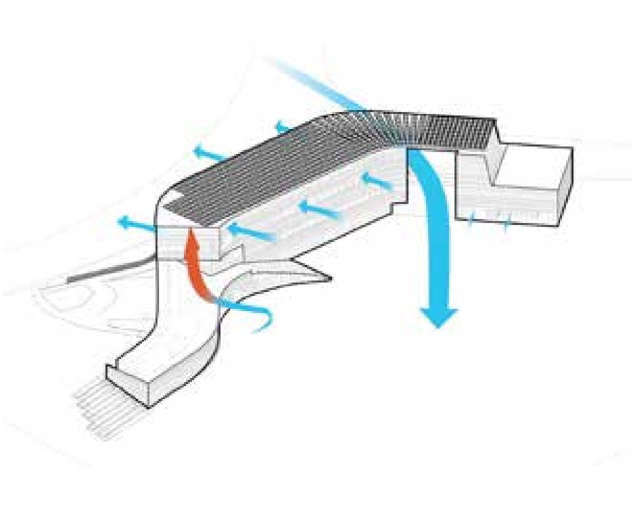
This is a view down Ferst approaching from the south. Pulling the auditorium apart from the building creates a portal into the Eco-Commons as well as the building.

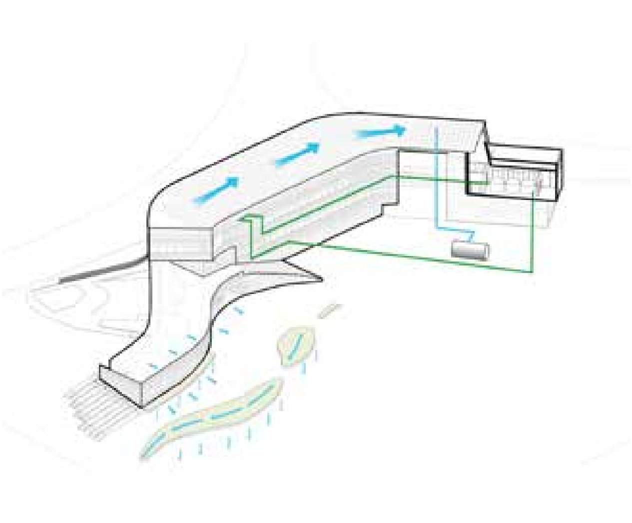
The exhibit space connects to the exterior with views and access, reinforcing the connection to nature. The wood cladding on this steel structure building is brought inside, giving a human scale to the space.





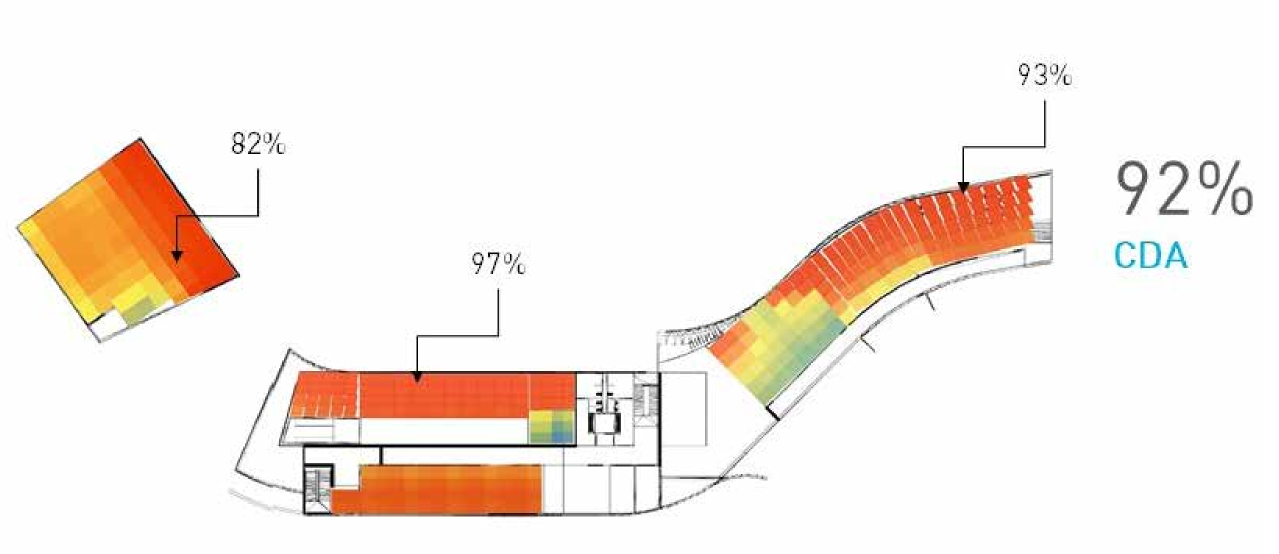
An abstract diagram describing how the topography forms the building form and cladding.





Where the enclosed auditorium pulls apart from the rest of the volume, a portal into the Eco-Commons is formed which also ventilates between the two volumes. Operable windows across the facade allow occupants to control air flow and cross ventilation through the space.

The building and its site systems form a living machine. A system for storage of potable water is required. The interface between the building and the site uses bioretention cells along the north side of the building that slope with the site contours.



The glazing strategy for Embankment achieves maximum continuous daylight autonomy. Its narrow form allows for daylight penetration through all occupied spaces.


The Ise Shrine in Japan

CONCLUSION

The Ise Shrine in Japan is set in a forest that provides the wood from which the temples are built. This building is either 800 years old or twenty years old, depending how its age is defined. Every twenty years it is taken down and its wood distributed to other buildings, then the buildings are rebuilt from scratch and the holy objects returned to it. Wood buildings last more than twenty years so why do this? Because its understood that people need practice to learn and be able to pass on this craft from generation to generation. The process recognizes the integration of building and landscape which at its best is what this Living Building can achieve.

Through this documentation of our process, we hope our knowledge as participants in this inspired project will be passed on to others. Having done deep research and developed an integrated team, we believe that the lessons from this book can provide a toolkit for any team pursuing a Living Building project.

With the right mix of innovation and teamwork, the ambition to have Living Buildings on campuses everywhere can become a reality.

THANK YOU

Eskew+Dumez+Ripple would like to thank everyone involved in the Living Building Challenge Competition at Georgia Tech. In particular, a warm thank you to the Kendeda Fund and the Georgia Institute of Technology who sponsored this incredible opportunity to delve deeper into questions about how we can make buildings that have a positive environmental and social impact.

As one of three finalists, Collins Cooper Carusi, Eskew+Dumez+Ripple, and Hellmuth+Bicknese consulted by engineers, landscape architects and a cost estimator joined forces to engage ideas about what it would take to make a Living Building at Georgia Tech. Having taken the first steps of the path toward developing a replicable Living Building, the team shares what they learned over the course of a three month long charrette in this publication.