California Polytechnic State University, San Luis Obispo

From the SelectedWorks of Thomas Fowler IV, DPACSA, FAIA

2017

Tanzania Collaboratory 2014-2017

Thomas Fowler, IV

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The work in this publication is a summary of ongoing work that started in 2014, when architecture and architectural engineering students started developing the master plan for the proposed Polytechnic University in Samé, Tanzania, Africa, working directly with ARUP’s David Lambert and the MBESESE Initiative. Since this time we have had 60 plus graduate and undergraduate students who have provided research and design input into the development of this project.

This work from 2014 – 2017 provides an update to the master plan and building designs for the Polytechnic University, along with proposed hotel designs have been developed for another location in Karatu, Tanzania the location of Ngorongoro, a World Heritage Site and popular tourist attraction for safari tours.

The Design Collaboratory is an award winning (NCARB Prize, Auto Desk Grant and national student design competition recognition), multi-disciplinary group of undergraduate and graduate students, and faculty (from architecture and architectural engineering, joined occasionally by planning, construction management and civil engineering), that work directly with industry partners in developing building design projects. Professors Dong and Fowler have collaborated on these types of projects, which use interdisciplinary student groups, for more than 10 years. They bring more than 30 years of professional experience which provides avenues for insightful research and innovative design proposals, and leverage approximately 40 years of teaching experience to mentor and enable students to create holistic design solutions.

Sincerely,

Professor Kevin Dong
Professor Thomas Fowler

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Introduction

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Professor Thomas Fowler, DPACSA, NCARB, AIA
The Director of the Graduate Program of Architecture and a Professor of Architecture. Thomas’ teaching responsibilities include third and fourth year design and building technology courses, working with a range of hour and fifth year independent study students and has been co-teaching as part of the Collaboratory Building Design Studio since 2007.

Prior to beginning his teaching career at Cal Poly, Thomas worked with a range of architecture firms in New York City and Washington, DC for over a 13 year period. His work was highly collaborative with a range of disciplines on small to large scaled building types.

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Professor Kevin Dong, PhD, SE
The Associate Dean of Administration of the College of Architecture and Environmental Design and Professor of Architectural Engineering.

Kevin’s teaching responsibilities range from 2nd year technology classes through graduate structural systems and seismic engineering courses, and has been co-teaching the Collaboratory Building Design Studio since 2007.

Prior to beginning his teaching career at Cal Poly, Kevin practiced holistic design with Ove Arup & Partners (ARUP) for 13 years, starting as an Arup Fellow in London and then moving to the San Francisco office. During his tenure with ARUP he worked on numerous projects nationally and internationally that required collaboration and integration of all disciplines from design inception through construction and occupancy.
Contents

2014-15 Karatu Hotel

2014-15 Campus Master Plan

2016-17 Campus Master Plan
The site for the project is located in Karatu, Tanzania
The design process behind the graduate design studio helped me in bridging the gap between Architectural Engineering and Architecture by providing an opportunity to experience first-hand a development approach that challenges more than just technical ability.

Interdisciplinary team work was most definitely a new experience for me and I believe a valuable one. It provided me a chance to get out of the strongly restricted design process I have been following as a working professional during the past few years.

I have valued most the perception that I have gained when working alongside others in separate fields of study. Through interdisciplinary work and collaboration I have gained an insight that has allowed me to consider all aspects of building design. I have found this knowledge to be crucial in the development of an efficient, elegant design.

Gina Kope
Arroyo Grande, CA

Huu Nguyen
Fresno, CA

Augustina Radziunaite
Vilnius, Lithuania

I have valued most the perception that I have gained when working alongside others in separate fields of study. Through interdisciplinary work and collaboration I have gained an insight that has allowed me to consider all aspects of building design. I have found this knowledge to be crucial in the development of an efficient, elegant design.
The team has developed a design proposal for a new Hotel Resort located just outside the town of Karatu in Tanzania, Africa. The project will consist of 30 private hotel bungalows on the south side of the site, providing single and double unit options, in addition to the main hotel space, which includes the hotel entrance area, functioning as the central communal hub for the site. The goal of the project is to provide a destination that will allow guests to engage with the neighboring town and embrace the diverse culture of Tanzania. Utilizing the highly graded landscape, the geometry of the frames mimics a folding motion, forming volumetric geometries for the roofscape. Variable angles and widths provide dynamic interactions throughout the site while capitalizing on the existing surroundings, further enhancing the visitors' experience.
A Hotel Resort proposal focuses on connecting locals and visitors through common activities in large shaded multipurpose areas. The conceptual module of the complex reminds of a striping pattern reflected in local fabrics. Building systems have strongly shaped design decisions and outcomes.

**location:** Tanzania, Arusha Region, Karatu

**concept:** The main intention was to house visitors and cultural activities while providing enough of indoor and outdoor shaded spaces. An initial "folding" design approach was developed into four main external and one internal shapes to create a vibrant exterior shading structure while maintaining unified and functional interior space.

**structure:** The lateral forces are resolved through the frame action. Structural frame encloses a unified interior spaces. The exterior shading frame is patterned by four repetitive shapes and offset from the structural frame with perpendicular truss elements.

Main cladding materials are polycarbonate panels for the walls and corrugated translucent FRP panels for the roof layered with local clay plates and bamboo louvers to control the light (from completely opaque elements to filtered light areas depending on the functional and aesthetic need).

**shading design:** Multiple daylight control strategies included shading within the module itself (functional double layering), isolating light from east and west sides, creating additional shading for gathering on the exterior. Strategic placement of the trees and other greenery accumulates even more coolness crucial throughout the day.

**passive ventilation:** Buildings were strategically placed to catch prevailing south eastern wind and use it for fresh air supply. In addition, natural difference of landscape grading was used to create cold air pocket under the building and move it vertically towards the heated roof. The air enters the building through louvered panels and operable openings.

**water collection:** Rain water collection was addressed through the roof slopes, duct system and landscape grading directed towards multiple water tanks. Moreover, several bio swells were incorporated in garden areas to facilitate agricultural activities.
architectural process

1) [Image]
2) [Image]
3) [Image]
4) [Image]
5) [Image]

Architectural Design Process Summary

Structural Design Process Summary
Material Precedents

Environmental Precedents
Augustina Radziunaite
I learned: 1) Team work 2) Time management 3) Non contextual idea development
Huge work load as well as requirement to work as a team have definitely contributed to this learning. It was the first time in my life developing a totally unrelated idea with a hope that it may turn into something valuable.
The advantages of the interdisciplinary studio are:
I think I have a better understanding about engineer’s work flow. As an architect I can definitely apply that to my structural thinking and incorporate some steps in an initial design.

Huu Nguyen
I learned to create project goals for myself instead of waiting for them to be given: I learned how to stand between two very opinionated minds and find common ground in the interest of forward progress; and I learned how to concisely present convoluted information. I think the open nature of the assignments contributed to my learning, though without proper encouragement (maybe there’s a better word here) this kind of laissez-faire instruction can have the opposite effect. Maybe a focus on getting students to “think for themselves” early in studio would help in the later stages.
Being in an interdisciplinary team configuration helped me in conveying my ideas to someone without a similar background; it forced me to convey my thoughts in a way that anyone could understand.

Gina Kope
The top 3 things I learned from this studio experience: 
(1) The design process is always adapting and changing and that the critique from the instructor and other students is meant to help with growth by addressing what is not working in the project. I have learned to develop a tough skin with criticism and organize the key take-away items from each meeting to further develop each stage of design.
(2) Working in groups takes patience and a strong voice. Communication is key in this setting and although your idea may not be the one that is agreed upon, it is valued as a part of moving forward in the design and is required for discussion on key issues that must be addressed.
(3) The structure of the course is not meant to frustrate you, it is meant to allow for freedom in design and not hinder creativity.

This interdisciplinary experience has exposed me to viewpoints and concerns that I would not be aware of had I been in a class with only engineers. This quarter I was able to work side by side with students that have been exposed to an entire undergraduate education in design and observe how they analyze a building and their concerns. This includes how individuals experience an indoor and outdoor space, how materials are chosen and how a space functions with certain layouts. I am now aware of how to manipulate a site in a way to address circulation, while highlighting important communal areas and distinguishing those for private use.
During my time in the Arch 551 Studio, I learned firsthand experience working with students with a vast amount of knowledge regarding building structure. I learned the importance of developing a structural system alongside an architectural one, in order to create an integrated building system within a harsh environment.

The building design process from this Tanzania Project has given me valuable experience in prioritizing my efforts during the process of developing ideas without any sign of completion on the horizon. The interdisciplinary experience has provided me with insight into aspects of the project deliverables that would have previously gone overlooked and unappreciated.

I got better at making physical models and I learned to use my time more effectively while doing so. Also it was very helpful for realizing that a design process has many aspects to be aware of, such as ventilation, water collection, shading etc.
Beginning as a study regarding the modularity of flattened steel rings, our project has finally culminated into the shape of a truncated icosahedron, as an evacuation shaping made between circular rings and rigid polygonal shapes. With the use of modular materials and structural rigidity, our project has been designed to be an evolutionary stepping stone throughout the site. Attaining our original goal of complete modularity, we have massaged our design to the point where our building's entire structural skeleton can be built utilizing only 15 different individual pieces.

Born of both structural and architectural minds, our building's substructure has been designed both as a means of increasing our building’s rigidity, as well as opening the doors for endless architectural possibilities. Not just cladding as a means of covering the structure, our building exudes both heaviness and grace, as large steel members float above and shade residents of the hotel.
CLADDING AND CONNECTIONS

LOCALIZED WATER COLLECTION AT COLUMN INTERFACE

COMPACT SHipment of MODULAR PIECES

SOlAR PANEL CLADDING CONNECTION

WOOD PANEL CLADDING CONNECTION

Lobby COLUMN ConnectIon Interface

CONNECTIon Gusset PLate

CONNECTION INTERFACE EXPLODED

CONNECTION INTERFACE INTACT

CONNECTION INTERFACE EXPLODED

STANDARD COLUMN CONNECTIon INTERFACE

STANDARD CORNER CONNECTOR EXPLODED

STANDARD CORNER CONNECTOR INTACT

Presentation Board 03

BUILDING PLANS AND SECTIONS

RESIDENTIAL UNIT SITE LOCATION

BACK OF HOUSE SITE LOCATION

MAIN HOUSE / CLOFF SITE LOCATION

RESEARCH

KITCHEN

ENTRANCE / VERANDA

BED / SHELTER

CULTURAL CENTER

OFFICE

FACILITIES

RESIDENTIAL

KITCHEN

ENTRANCE / VERANDA

BED / SHELTER

CULTURAL CENTER

OFFICE

FACILITIES

Presentation Board 04
TRUNCATED ICOSAHEDRON HOTEL

Design Introduction

The truncated Icosahedron Hotel is a hotel and landscape design which has been designed to integrate itself with the landscape. The hotel modules slope along with the landscape in order to preserve the integrity of the site and reduce the amount of infill and excavation. The undulating roofscape helps to organize the space by defining module location, as well as spacing between programs. Its modular design allows the entire site to be built using a kit of 15 parts in total that can be manufactured abroad where material is cheap, and constructed on site, where labor is cheap.

Design Process

Our group’s design process included bringing individual developments to the group for advancement and evolution of each new iteration. Following each critique, the team would separate and try to explore their own personal goals. The team members would then discuss their diverse ideas the next day and choose a direction to proceed.

Influential Precedents

In the beginning, our hotel layout was inspired by the Ecork Hotel. We aimed to replicate the design of a shared centralized public space, with smaller individual private residences. Later, when our project’s design shifted from rings to geodesic domes, we drew from the knowledge of Buckminster Fuller to help determine the ways in which our domes would interact with the ground. Lastly, following the creation of our undulating roof slab, we found inspiration in the design of the Stanstad Airport’s structural columns as a means of elevating members without supporting domes.

Hotel Layout

In our attempt to replicate the style of the Ecork Hotel, we designed our hotel layout to wrap around the central gathering space that is the lobby. The hotel units formed a sort of C shape surrounding the West side of the lobby. This orientation was chosen so that the units would be able to receive the prevailing winds coming from the South-East side of the site. In response to the sloped landscape, the hotels would climb along contour lines, overlapping certain roof tiles as they went. Individual hotel placement was determined by the undulating roof structure, with hierarchy between units being determined by the spacing between the units.

Structure

The structure is made up of modular members that are connected to form a complete panel. These complete panels are linked together to form the undulating structure that serves as both the building, as well as roof structure. The lobby and back of house spaces are unique in that the roof structure is elevated with structural columns. This branching column’s branches contain tubes designed to collect water that collects on the roof. For more details on connections, refer to the structural design poster.
Influence & Precedence

The introduction of the theme is made through the use of images and text, highlighting the importance of the topic. The reader is encouraged to explore the concept of module interaction and the development of a dodecahedron into two floors as a more realistic approach. This study inspired the need to break the rule of adjacent module form, allowing for smooth transitions between different forms. The sharing of the pentagonal form was established that disregarded face-to-face connections.

ITERATION

This iteration incorporated the use of rings as interior space. By bisecting the original form, this iteration closed exterior corners. The incorporation of the previous sphere-like patterns produced a seemingly random translation and rotation of each module adjacent module in all three axes. The sharing of the pentagonal form allowed for exploration of module layout options.

Precipitation and Sunlight

The graph shows the precipitation and sunlit hours for the months of January to December. The data is presented in a bar chart format, with the y-axis indicating the amount of precipitation in millimeters and the x-axis representing the months of the year. The data suggests a higher precipitation during the summer months, with the months of July and August having the highest precipitation. The sunlit hours show a similar pattern, with the months of June, July, and August having the highest sunlit hours.

Structural Design Process Summary

This summary provides an overview of the structural design process, highlighting the key stages and methodologies involved in the development of structural systems. The summary includes examples of structural systems and their applications, such as the column structures of the Passerelle Simon-de-Beauvoir in Paris, France, and the Spaceship Earth in Orlando, Florida. The summary also includes information on the structural and architectural plans and kits provided by the company Steel Dome, which specializes in the construction of geodesic domes.
**CLADDING**

### Choices of Materials

**Concrete**

- **Material:** Concrete
- **Application:** Used for structural elements such as columns, floors, and walls.
- **Advantages:** Durable, strong, and energy-efficient due to its low embodied energy.
- **Disadvantages:** Heavy and requires significant foundational work.

**Steel**

- **Material:** Steel
- **Application:** Used for framing systems, roofing, and as cladding materials.
- **Advantages:** Lightweight, strong, and can be easily shaped and fabricated.
- **Disadvantages:** Requires regular maintenance to prevent rusting and corrosion.

**Glass**

- **Material:** Glass
- **Application:** Used for windows, skylights, and as cladding materials.
- **Advantages:** Translucent, allowing natural light to enter the building.
- **Disadvantages:** Expensive and can be fragile.

**Natural Materials**

- **Material:** Wood, stone, and clay
- **Application:** Used for cladding, roofing, and structural elements.
- **Advantages:** Sustainable, provides thermal regulation, and enhances aesthetic appeal.
- **Disadvantages:** Requires regular maintenance and may have limited availability.

### Natural Ventilation & Lighting

- **Louis Kahn’s Salk Institute in La Jolla, California**
  - **Design Concept:** Integration of natural light and ventilation into the building’s design.
  - **Features:** Large skylights and clerestory windows allow natural light to enter the spaces.
  - **Ventilation:** Cross-ventilation through openable windows and doors.

- **Omar Gandhi’s Sugar House in Toronto**
  - **Design Concept:** Utilization of natural ventilation and lighting to create a comfortable indoor environment.
  - **Features:** Skylights and operable windows allow for natural light and ventilation.
  - **Ventilation:** Cross-ventilation through strategically placed openings.

### Water Collection

- **De Young Museum in San Francisco, CA**
  - **Design Concept:** Integration of rainwater harvesting and storage systems.
  - **Features:** Atriums and fountains capture rainwater, which is then stored and used for landscaping and irrigation.
  - **Advantages:** Reduces water usage and promotes sustainability.

- **Water Cube in Beijing, China**
  - **Design Concept:** Use of ETFE (ethylene tetrafluoroethylene) cushions for membrane structures.
  - **Features:** ETFE cushions cover the building and collect rainwater, which is then stored and reused for maintenance and landscaping.
  - **Advantages:** Efficient water collection, minimal maintenance, and energy-saving.

### Natural Ventilation

- **Bryant University Dome in Smithfield, Rhode Island**
  - **Design Concept:** Use of acrylic skylights for natural light and ventilation.
  - **Features:** Skylights with adjustable shades to control direct sunlight and heat gain.
  - **Advantages:** Reduces energy consumption and provides a comfortable indoor environment.

- **Xan House in Xangrila, Brasil**
  - **Design Concept:** Use of wooden poles as cladding for natural ventilation.
  - **Features:** Wooden poles create a shading effect, allowing for natural ventilation.
  - **Advantages:** Energy-efficient and provides a natural aesthetic.

### Shading Devices

- **Lycée Albert Camus in Frejus, France**
  - **Design Concept:** Integration of shading devices and natural ventilation systems.
  - **Features:** Light metal net attached to the building facade, allowing for adjustable shading and ventilation.
  - **Advantages:** Energy-efficient and enhances the building’s aesthetic appeal.

- **De Young Museum in San Francisco, CA**
  - **Design Concept:** Use of perforated copper as cladding for shading.
  - **Features:** Perforated copper panels allow for sunlight while providing shade to the building.
  - **Advantages:** Sustainable, aesthetically pleasing, and energy-efficient.

### Other

- **Material Precedents**
  - **Solar - Wind - Water**
  - **Environmental Precedents**
  - **Cross Ventilation - Plan**
  - **Sunlight Diagram - Dome (Uncladded)**
  - **Sunlight Diagram - Lobby & Back of House (Uncladded)**
  - **Determining Shading Requirements**
  - **Rainwater Collection Data**
  - **Technical Poster**
  - **Daylighting Analysis**
  - **Choices of Materials**
  - **CLADDING**
  - **Natural Ventilation & Lighting**
  - **Water Collection**
  - **Material Precedents**
Angelo Freeman
(1) Efficiency in site layout in regards to natural ventilation.
(2) How to generate a compelling story to argue your design's integrity.
(3) The ways in which architecture and structure can mesh.

The second point I think will have the most impact in my career as a designer. During our presentation at ARUP we didn’t clearly communicate the specific reasons behind our design choices and this left the reviewers with a lot of questions. Later during our final review we had learned to hone our presentation into something that spoke for itself, rather than requiring us to explain the project in further detail.

During the Fall quarter I felt as though I relied on my group mates to answer any structural questions that may arise. However, by the end of the quarter I felt as though I was as knowledgeable as they were about our design. What I learned from spending two quarters with them was the importance of creating a structurally feasible design early on in the design process rather than having to retroactively generate a structural support system to some out of the box design that may end up ruining the entire project.

Marketa Jelinkova
This quarter in particular taught me how complex building design is, and how much there is to it. Before, I was mostly forced to think about the architectural, structural and managerial side of the design process, but the studio helped me develop a broader view of it and consider other aspects like ventilation, daylighting, and water collection. With time, I also realized more and more how important digital modeling is and how useful and resourceful computer programs are. Presenting our ideas is just as important as coming up with them and it will be helpful in the future to be aware of that and focus on the presentation. The first workshop we had in the studio helped us realize the importance of soft skills and presentation. I also learned that when designing the structural system, I cannot only rely on what I learned in class, books and codes, but it is most of all merely using logic and intuition.

It was a good experience as I realized the importance of being able to use computer programs I haven’t used before and the architect on our team was very good and experienced in utilizing those to receive our digital models.

Charles Weir
1- I was expecting to learn specific design for the architectural requirements of a project. Although we touched on specifics for lighting and ventilation this quarter the majority of the efforts were spent improving the entire presentation each week. The bulk of my education was on the design process and the design requirements seemed to require independent education.

2- I was expecting to perform finalized design, detailing and calculations in support of our project presentation. This class had tasks and assignments that were always evolving which required most of our developing ideas and less of our time finalizing the product. This required many of the details to be easily changeable and the calculations to be rough but accurate. This hectic style was a new experience that will benefit me in life but I still look forward to learning the finalization process.

3- I was expecting to be given an overwhelming amount of criteria at the beginning of the quarter and learn how to incorporate all the needs of a project into a design. Instead we were fed some information here and there and the end product was not always what I wanted it to be. Of course this is the design process but one example is we accommodated our site to a slope as an afterthought as opposed to an initial design decision.

One thing I learned from the interdisciplinary aspect of this group project is that as engineers we need to provide our input to the design process. It is easier to wait for a task, complete it, and move on to the next one but when the structural efficiency is integrated into the design from the beginning it shows in the final product. It is nice to see the form and function integrated.

One of the biggest things I learned from the interdisciplinary aspects of this class is that I want to explore the design aspect of my career more. I have been focused on the technical analysis recently and miss the process of creation. Possibly a career change is required.
I learned through this process that there are many steps to creating a well-designed building. A huge number of variables can affect the final project, and the process never really feels like it has ended. When working in an interdisciplinary environment, listening to others’ ideas was key to moving forward in a positive direction.

Working in this collaborative studio has shown me as an ARCE that there are major advantages to working alongside an architect at every step of the project. I understand the significance of an iterative process and how to progress from form finding to the creation of digital models and renderings, none of which I had experienced before.

Working in this studio, I learned a tremendous amount about the design process. A huge takeaway for me is how to balance the economy of a structural system with the expression of an architectural form. In a collaborative environment, rather than with engineers filling a consultant’s role, engineering and architecture work in harmony rather than in opposition.

The interdisciplinary aspect of the studio taught me to see the ARCE as a multi-faceted discipline, not only because they provided good insight on structural design, but also because they were able to adjust really well into architectural design, contributing great ideas and helping to progress the project.

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The project is a new hotel located in the Karatu District in Tanzania, Africa. It offers a public market and cultural demonstration center that allow for residents to interact with local residents in a very informal manner, and an environment in which cultural values are expressed. The hotel, Tessellate, named after the process of packing together, is a project that challenges the way we think of architecture as an industry. The concept of ambiental space, and together with a series of common cultural assets that encourage a communal atmosphere, is key to the idea of generating living conditions to foster education and values. The hotel, through the integration of living, resting, and entertainment areas, is translated from patterns to structures through the blend of living, resting, and entertainment. The hotel allows for the project to be easily assembled on site as a kit-of-parts, reflecting the construction methods available in the area. Tessellate is unique in its building forms, programmatic relationships, and cladding system. At its core, the hotel design stems from the fundamental concept of interconnected spaces, tied together by a series of common cultural assets that encourage a communal atmosphere. It reflects the idea of grouping together components to form a coherent whole. The blending of culture, comfort, and community is articulated through its modular, triangular patterns. The triangular forms are translated from pattern to structure through the hotel's steel bracing, roofing, and cladding. The steel allows for the project to be easily assembled on site as a kit-of-parts, reflecting the construction methods available in the area.
Window Shading
Woven coconut leaf panels provide shading during harsh daylight hours.

Shading Frames
Outer structural frame holds shading panels in place.

Frame Anchors
Connecting rods secure the frames to the structural members.

Operable Windows
Windows allow for light entry and passive ventilation through the unit.

Wall Assembly
Plywood exterior and gypsum board interior are supported by metal stud framing.

Structural Frame
Triangular frame within the interior supports gravity and lateral loads.

Water Collection System
Roof slopes inward toward central collection point where it is then gathered in an interior storage tank.
Creating pattern with tiled geometric shapes

SITE LOCATION

The site is located in the Karatu District in Tanzania, situated outside the town of Arusha and nearby both Serengeti National Park, Mt. Kilimanjaro National Park, the Ngorongoro Conservation Area.

CONCEPT DESCRIPTION

In an intense arid climate, Tanzania is one of the most bio-diverse and culturally vibrant environments in the World. TESSELLATE’s form references the rhythm of the vibrant patterns and nimble tribal dances that beat the pulse of Tanzania. The pace of the site is articulated by repeating forms and screens manipulated to lend programmatic hierarchy and rationally applied to respond to the environment. This hotel project aims to create a sense of community through a balance of private bungalows, greenery, and public/retail space while speaking of Africa’s intimate connection between people and the environment—blurring the division between elegant hospitality and cultural experience.

PROGRAM CONFIGURATION

Guests experience the area’s beauty and tranquility in an honest and authentic manner. In order to maintain and encourage the interactive flow of pedestrian traffic, the public market and cultural demonstration center trace the existing artery at the site boundary to invite hotel guests to interact with local residents. Tessellate is unique in its building forms, programmatic relationships, and cladding system. At its core, the hotel design stems from the fundamental concept of interconnected spaces, tied together by a series of common courtyard areas that encourage a communal atmosphere—creating a comfortable expression of the traditional East-African value of assembly on a veranda and reflecting the idea of grouping together components to form a coherent whole. The blending of culture, comfort, and community is articulated through its modular, triangular patterns. Tessellate features 24 single units, arranged in pairs, and 6 deluxe units that provide varying levels of seclusion from the more public regions of the site.

SKIN / STRUCTURE

Tessellate echoes the bold geometric patterns found throughout Tanzania by creating a responsible repeatable economic module. As a kit-of-parts, only achieved by implementing steel, the structure elegantly resolves lateral forces with a three dimensional triangulated truss in three equalateral directions. Trusses achieve a strong redundant structure without relying on complex construction methods and appropriate to the availability of materials. Expressed woven panels are rationalized applied as a secondary screen with a simple bolted system to light interior spaces without the associated thermal load.
Material Precedents

Environmental Precedents

Cladding Systems

Al-Bahr Towers
Aedas

Berkamseye Bike Store
Sarah Wigglesworth Architects

Canadian Pavilion
SNC-Lavalin inc.

Esplanade Theatres
DP Architects

Orchard Central
DP Architects

Bermondsey Bike Store
Sarah Wigglesworth Architects

Explorado Theatres
DP Architects

Cladding Systems

Cladding Systems

Cladding Systems

Material Precedents
Karatu is one of six districts in Arusha Region. Its current population is 178,434 with approximately equal proportions of men and women, growing at an annual rate of 3.2%. The average population density in the district is 52 persons/km² with higher density in areas with higher rainfall due to the primarily agrarian economy. The dominant native tribe in Karatu is the Iraqw, though other tribes such as the Bardaigs (pastoralists) and Hadzabe (hunger-gatherers) are also present in the area. Christianity and Islam are the commonly practiced religions in Karatu, though some traditional indigenous religions remain.

Since arriving about 200 years ago, the Maasai have colonized the Ngorongoro Conservation Area (NCA) and remained there in large numbers. They may bring their livestock to the Crater for water and grazing, but they are no longer permitted to settle or cultivate there. The Ngorongoro Conservation Area attracts an average of 500,000 tourists each year, which has played a major role in the development of the Karatu District. Tourists can visit Maasai designated cultural bomas - homesteads containing huts made of sticks, mud, and cow dung - to take photographs and buy souvenirs.

Karatu depends on water supply from natural springs and rivers in the Ngorongoro Conservation Area, Marang Forest, and Northern Highland Forest Reserve. As of February 2013, about 60% of the Karatu District had access to clean tap water. The remaining residents were projected to get clean and safe water by the end of 2014. The number of water users in the Karatu Township tripled from 3,350 in 2013 to 20,920 in April 2014. There are a total of ten water projects targeting the Karatu District for the fiscal year 2013-2014.

The Maasai are known primarily for their beadwork, which may take the form of jewelry, shields, warrior’s spears, and ceremonial headdresses and clothing, though they also sell masks and carvings. Pottery, solely the domain of Iraqw women, is their most common craft. However, they also make tools, reed mats, leather goods, musical instruments, and furniture.

Despite the number of tourists visiting the Ngorongoro Conservation Area every year, the tourism industry is not providing benefits to the local communities. The Maasai population continues to grow while the livestock population has remained about the same as it was in the 1950s. Cultivation in the Crater has been banned for the Maasai multiple times throughout the area’s history. The numerous lodges and other tourist attractions around the Crater rarely employ Maasai; instead, their employees tend to come from distant areas.

The climate in the Karatu district is influenced by nearby Lakes Manyara and Eyasi, especially during the end of the dry season when high winds dry up the landscape. Due to the many rain-fed farming practices, population density is very high in areas higher in rainfall. The climate has allowed for arable farming and pastoralism to be the primary land use, with crop and livestock production being the most important sectors (comprising 90% of the district’s labor force). Unfortunately, agricultural productivity has decreased in recent years due to more erratic rainfall and poor soil fertility, which is forcing Karatu residents to intensify agricultural practices.

Karatu was originally colonized by the Germans in the early 1930s, and the original native tribe in the area was the Barbaig. The Barbaig primarily used the land for livestock grazing, but the arrival of the now dominant Iraqw tribe - who converted much of the space to farms and houses - along with a growing population, caused the Barbaig to move out of the area. The Karatu land was at once threatened by an infestation of the deadly Tse-Tse fly, which was only restored when the Iraqw farmers cut down the bushes that covered Karatu. It became an Administrative District in 1997.

The original inhabitants of the Ngorongoro Crater area were the Datoga tribe, remaining there until the early 19th century. The dominant Maasai tribe eventually forced the Datoga out of the area, but small Datoga communities can still be found nearby. German explorers first discovered the crater in 1892 and built farms in the fertile crater land. In 1959, the Ngorongoro Conservation Area was separated from the Serengeti National Park and made into multi-purpose land for the Maasai tribe.
Derek Avrit
From this studio experience I learned that group collaboration is vital in a design project. Individual work is obvious when compared to a collaborative design, and often lacks the progress of the group piece. I also learned that the correct group configuration could be a refreshing experience compared to other issues that I have had in the past. I also learned that the design process is not about getting the correct answer as much as about constantly moving forward in a positive direction. Producing a large amount of work seemed to be the most useful way to tackle difficult decisions within the process. I do not believe I would have appreciated the design process without an architecture student on our team. There were often times when we would lose sight of the purpose of certain activities, but the architect helped to acknowledge the significance of each stop towards the final product.

Sarah Anderson
I discovered and appreciated the significance of form finding exercises prior to looking at a project in its entirety as this would introduce factors that could restrict the design process. I experienced the challenge of going through a desk critique without taking comments personally. I still need to work on seeing this as criticism of the product and not the people. I learned just how many factors must be analyzed and considered in order to develop a project proposal that is practical yet meaningful. I became increasingly aware during the process that there is an almost endless amount of time that I could put into each step along the way, and that each component of our final submittal could be developed further. This interdisciplinary team configuration taught me that architects and ARCEs can actually approach a problem in much the same way. When placed together in a collaborative environment such as this, I think there is less potential for having conflicting ideas and struggling to agree on a solution. Having an architect on the team rather than all ARCEs is significant because it taught me more about craft and presentation than any number of ARCEs would be able to figure out. The architect on our team brought 5 years of experience in generating similar deliverables to that of our class, so he helped us raise the quality of our models (physical and digital) and drawings/posters.

Brian Murillo
The form finding technique was a new method for me to use when trying to find a design. The several exercises opened my eyes to the potential uses of the technique. Also, I learned that choosing a module helps a lot with restraining the design, or rather, keeping it from straying too far from the main intention/concept of the project. Lastly, I learned a lot about group dynamics. I am much more appreciative of the worth of good team members and how much better a project can be when the group works well. Working in an interdisciplinary studio with the ARCE’s made me more aware of the structural side of design. I don’t think any of my previous projects have considered structure as a tool for design as heavily as this one. I saw that we quickly became equals in terms of designers. Although the aec students looked to me for guidance in terms of architectural design, I did just as much of the same to them for many other things. The sharing of ideas was important for the different perspectives.

Sam Tooley
The overall success and efficiency of a project comes from the successful harmony of form and structure. In other project groups I’ve been involved with, form is one discussion, structure a second, and the modification of each to accommodate the other is a third and lengthy compromise. The entire design process of our project involved both the architecture and structural aspects in the same conversation. Comromises were made on the fly, and the final product was stronger for it. Architectural design is as much about responding to the environment as it is aesthetics. Our design, from the beginning, was an expression of the cultural values we learned about northern Tanzania. The modularized solution was born out of the constructability concerns surrounding the site and lack of skilled labor or heavy equipment. Nearly every other aspect was an application of the design aesthetic in a manner that addressed the environment. The overarching theme of our project, the triangular modules, and the environment were the only constants throughout each iteration. A drawing is an expression of an idea; a model is a test, demanding proof. It’s easy to see how this is directly applicable to my future as a structural engineer. An engineer creates a system that works integrally with the architecture of a space. When an architect and engineer communicate about a project, it is certainly in the project’s best interest to have both parties in a similar understanding of the spatial implications of the structure. A structural engineer who can graphically illustrate choices available or the selection process undergone is certainly more valuable to an architect than the alternative.
I learned about presenting information in an interesting way that perhaps other disciplines should try. This will be the most useful in my career.

Understanding and being open to the iterative design process by always moving forward instead of taking steps back is something Amy took away from the architectural design studio experience. She developed a better foundation for architectural design, which will be utilized in a structural design capacity.

From the Tanzania Project I learned how to pursue a more "naked" form of architecture, where space and structure are tentatively the same thing.

By working on a project for Tanzania, it wasn’t what I learned most, it’s what I realized. I realized that structures reflect a lot on the location of the site.
TENTZANIA

CONCEPT:
Tentzania offers an outdoor living experience. The community is more than a Safari camping ground. The broad tensile surfaces and light vertical framing lend themselves to the environment and local culture. Tentzania’s design of public spaces as well as living units allow for passive ventilation, expansive shaded areas, and minimal wall cladding. The concept of Tentzania is to enhance the visitor’s sense of the African region through a luxurious camping experience.

FORM FINDING:
Investigation of tensile structures started with a woven string system. Undulating the ends of the strings allowed for a more dynamic weaving pattern taking the shape of a hyperbolic paraboloid. A more dense weaving system began to represent an enclosed shape created by tension. Studying the surfaces which created the enclosed tensile structures, also began the development of the structural systems used to support the surfaces. Scaling the size of the surfaces also meant scaling the size of the structural system.

CIRCULATION / PUBLIC AND PRIVATE AREAS
Buildings closest to the road are the visitor reception and spaces to interact with the community, while those that are furthest are private living units. The main buildings include an open air market, water distribution area, cultural center, restaurant, and hotel lobby. The use of larger tensile structures helps differentiate between public and private space. A central axis serves as guest circulation between these two areas. Certain areas of the site were used for agricultural purposes to allow for site sustainability.

SKIN / STRUCTURE:
The tensile enclosures are primarily formed by one of three structural systems. Larger structures incorporate open web steel trusses and steel frames while the individual room modules utilize steel columns and cables to create the same hyperbolic paraboloid. Lateral load transfer along the length of the public buildings is achieved by interconnecting the steel frames and tying them down with cables at the ends of the frame sequences.
The roof system is composed of PTFE tensile sheathing with a separate vertical cladding system beneath. The vertical cladding, both in the main buildings and living units, are composed of light gauge steel frames, insect screen, and shades.

PASSIVE VENTILATION / DAYLIGHTING:
Passive ventilation from prevailing northeast wind proved to be a significant design decision for the orientation of the buildings on the site and development of the cladding system. The shades within the wall systems can be raised and lowered to block sunlight and wind according to the occupants comfort levels. The large overhangs created by the tensile structures also keep out direct sunlight. They are found on both the north and south faces of all buildings, as the site’s proximity to the equator produces a consistent sun path year round.
Site and Context Study

Overview:

- **Ngorongoro Crater**: Over 500,000 people visit the landmark annually. It is the world's largest intact caldera, making it one of the natural wonders of Africa. The crater contains habitats for various African wildlife, vegetation, and ecosystems.

- **Karatu**: One of five districts in the Arusha Region of Tanzania. It features fertile coffee production and arable farms, with the main road leading to the Serengeti National Park and Ngorongoro Conservation Area. The population was recorded at 230,166 people in 2012.

**History**

- **1884-1919**: The area went through a period of colonization, with exploitation for timber, ground nuts, and coffee. Unlike its neighbors Uganda and Kenya, infrastructure was not invested in this region.
- **1961**: Julius Nyerere became the first president of Tanzania, marking the country's independence through legislation rather than revolution.
- **1964**: Zanzibar Islands joined the union.
- **1977**: Single political parties of islands joined TANU.
- **1979-1981**: War with neighboring countries.
- **1992**: Constitutional Amendment allowing multiple political parties.
- **2005**: Jakaya Kikwete became the current president.

**Demographics**

- **Tanzania** population: 47.4 million
- **Kenya** population: 47.4 million
- **Kenya** area: 364,898 sq mi
- **Uganda** population: 47.4 million
- **Uganda** area: 205,652 sq mi
- **Rwanda** population: 12.5 million
- **Rwanda** area: 26,338 sq mi
- **Burundi** population: 10.5 million
- **Burundi** area: 10,580 sq mi
- **Democratic Republic of the Congo** population: 78.5 million
- **Democratic Republic of the Congo** area: 311,000 sq mi
- **Zambia** population: 16.3 million
- **Zambia** area: 290,585 sq mi
- **Malawi** population: 17.1 million
- **Malawi** area: 110,485 sq mi
- **Mozambique** population: 28.9 million
- **Mozambique** area: 240,100 sq mi
- **Lake Tanganyika**: Shared by Tanzania, Rwanda, and Burundi
- **Lake Victoria**: Shared by Tanzania, Kenya, and Uganda
- **Mt. Kilimanjaro**: Shared by Tanzania and Kenya
- **Ngorongoro Crater**: Shared by Tanzania

**Arusha Region Population**

- **Arusha**: 1.7 million
- **Karatu**: 230,166
- **Dodoma**: 227,205
- **Maji Maji Revolution**: 10,000 killed
- **Founding of TANU**: Tanganyika African National Union
- **Julius Nyerere**: First president
- **Zanzibar Islands join union**: 1964
- **CCM Single political parties join TANU**: 1977
- **War with neighboring countries**: 1979-1981
- **Maji Maji Revolution**: 1905
- **Founding of TANU**: 1954
- **Julius Nyerere**: First president
- **Zanzibar Islands join union**: 1964
- **War with neighboring countries**: 1979-1981
- **Constitutional Amendment multiple political parties**: 1992
- **Jakaya Kikwete, current president**: 2005

**Graphs**

- **Urban Population Growth**
- **Tanzania**
- **Kenya**
- **Uganda**
- **Rwanda**
- **Burundi**
- **Democratic Republic of the Congo**
- **Zambia**
- **Malawi**
- **Mozambique**

**Form Finding & Main Goals**

**Private/Public**

- Provide balance to public and private sectors within hotel spaces.

**Sun/Wind**

- Due to the proximity to the equator, there are no dramatic changes in the sun angles. Winds come mainly from the SE.

**Locals/Tourists**

- How to engage the tourists with the locals to allow for cross-cultural experiences for each.

**Camping/Tension**

- Provide an updated camping experience by exploring the possibilities of tension structures.
Amy Burruss
This studio experience put me greatly outside of my comfort zone. The three main things I learned from this studio is to listen and communicate well, understand that the design process is very iterative, and to be open to others ideas. The review sessions in class and form finding iterations helped in developing the understanding of these three ideas.

The interdisciplinary structure of the course forced people to come together and think for one common goal who individually think different from one another. From a structural side, I would focus more on the constructability and stability to a structure whereas from an architectural approach there is more focus on form, sustainability, and layout. The collaboration from each discipline forces each individual to consider the other group member’s focus as well as their own. The entire project and each design step was collaboration between all the group members, which was achieved through bouncing ideas and approaches to the project from one another. If this was an individual effort my final project would look nothing like my group’s final project does. This is not to say that I do not like our final project, but my process individually would have led me to a different end result than combining others ideas at different stages along the way. At each iteration point of our design someone would bring something new.

Joaquin Bermudez
I learned to trust other people when they choose to do only certain tasks for the group. Sometimes it is better to have specialists in the group that only do what they are best at. I learned more about modular design and how to move forward when a shape you are interested in doesn’t really fit in as a module. There are different ways to express the same theme. I learned how to model in Rhino. This was not expected but I am glad I pushed myself to model in this software.

I learned more about presenting material. Our discipline is very technical and information is presented in a dull way. It is more effective to present something that is both useful and interesting.

Sebastiano Beretta
I learned how to deliver a good design with a solid presentation in a short period of time. Having to talk about our project to different people in more than one occasion really helped to come up with a cohesive story, with the good side effect of clearing our heads about where we were heading.

As the only architect in the group I somehow needed to go back to basics in a good way: structure was part of the design process from the very first phase, and my teammates were naturally more aware of that than myself.

Andrew Stephens
The number one thing I learned from this studio is how to model build. I was the main contributor to building the physical models, so there was a large amount of time to practice this. The second would be how to take criticism better. I think this was a direct result of the large amount of critiques we had. I started the quarter off with not being able to do this as well because of the large amount of time that I spent on something and then just having it ripped apart (literally sometimes). The third most learned thing from this class that I learned would have to be how to work in collaboration with other engineers and architects. I know this is usually a challenge in our industry, but with all the interdisciplinary classes we experience here at Cal Poly, I feel it has better prepared me for this.

I learned a great deal about how to work with other engineers and architects, similar to what I expect it to be like in industry.
Karatu Hotel Sandbag Study

The project takes advantage of the size of the site to create opportunities for both public discussion and private retreat. The front of house buildings are organized to create a town square style courtyard, allowing for visitors to sit out and watch dances by the local messai tribe, enjoy a drink at the bar, or peruse through trinkets in an open market shopping area. These buildings take advantage of extreme openness to blur the qualities of the indoors and the outdoors, creating a space that is not quite one or the other.

This open market area creates a primary axis for circulation, guiding tourists to their private bungalows down the gently sloping hill. The bungalows are organized and spread out such that small farming spaces and gardens form between them, taking advantage of heavy rains to allow for multiple stage water use. Passing the gardens becomes a very tranquil experience, relaxing guests after long days of travel.

Primary goals of the project became developing wall and roof systems that would be cheap and efficient to build in the harsh climate of Karatu. The many buildings of the site were equipped with extensive eves to shade the walls as well as a complex double skin roof system. The roof uses buoyant air flow to allow breezes to pass through the two layers, effectively creating a cooled air gap that stops the harsh sun from penetrating the building.

The wall system is equally unique. Sandbags layered with barbed wire create infill panels in between adobe sheer walls. These sandbag walls are tied back to a concrete bond beam, which paired with the barbed wire create connections that will resist out of plane loading on the infill wall.
Reflections

Charlie Crowe

A building in Tanzania seemed like a very interesting challenge to me. It strayed from the normal college architecture project in that understanding the cost of the materials and systems at play in the project was as or more important than the design itself. The project revolved heavily around convincing the professors and outside advisors that the systems being researched were the best way to design a building in a hot humid climate. Understanding that long overhangs and lots of openings was key to the needs of the people inhabiting the project.

The most significant challenge to me was understanding how the connections inside of the project supported the structure. Working with a sandbag system required us to come up with something unique when it came to finding a way to make the wall systems act as a unit. Another serious challenge was understanding the climate. Most of the year is fairly dry, with torrential rainfall in certain significant months. Accommodating that rainfall and designing for rainfall is something that is rarely thought about in architecture school, even though it is heavily discussed.

Jessica Fares

The three things I learned from this experience are how to communicate with architectural terminology, how wind/sun/environment affects a building, and how sandbags and adobe can be used structurally in moderate seismic zones. The type of project given contributed to this learning. I learned about the architectural process and the constant iterations that they have to do.

Jesse Fowler

When I first heard about this class I was immediately intrigued. I hope to be able to help people in impoverished areas around the world with the skills I learn as an Architectural Engineer. I wanted to use this course to learn how we could use materials readily available to a region in the safest way possible. I was also glad to be a part of something that would benefit the local people of Karatu, Tanzania.

I had no idea how architecturally heavy this course would be. I did not understand the point of constantly going over the site plan from the beginning of last quarter to the end of this quarter we were asked to revisit the site plan on a weekly basis. I learned a lot about the architectural process and began to see a beautiful site plan develop from our team over time.

The greatest takeaway this course gave me was the invaluable advice given by the team at ARUP. They would review our projects and give us feedback that only a design professional in the thick of practice could give. There were professionals from all Architectural and Engineering disciplines in the construction process. They were short quick and shot from the hip. They pulled no punches and constantly asked why. There was a practicality to their wisdom, and for that I couldn’t have asked for a better ARCE senior project.

I would have loved to go more into the engineering of the project but we never got to a point that we could fully engineer a wall without it needing to change the very next day. Hopefully, for the future, the classes will be able to use some of the studies we have done to push their engineering further than what we were able to accomplish.

<table>
<thead>
<tr>
<th>Sandbag Wall, No Barbed Wire</th>
<th>Sandbag Wall, With Barbed Wire</th>
</tr>
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<tbody>
<tr>
<td>Steps</td>
<td>Load (lbf)</td>
</tr>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td>10</td>
<td>479.916</td>
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<td>20</td>
<td>615.829</td>
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<td>170</td>
<td>1557.9</td>
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<tr>
<td>190</td>
<td>1463.13</td>
</tr>
</tbody>
</table>

It is easy to see from the data above that the barbed wire reinforcement in the sandbag construction was successful. The maximum load reached before the wall failed in the test without barbed wire was only 600 pounds. The second test proved more interesting. A wooden plate was used in testing, in order to distribute the load throughout multiple sandbags, and it failed at around 1600 pounds of force. The wall continued to hold strong all the way through 1800 pounds of force. What’s equally interesting is that the displacement of the two wall systems were nearly equal at time of failure.
2014/2015 Campus Master Plan

The site for the project is located in Same, Tanzania
ABSTRACT

Communities in East Africa are in need of supplemental and diversified tertiary educational opportunities to enhance human capital and reduce the severe levels of poverty endemic in the region. The Same Polytechnic College in the Republic of Tanzania. The college is the pilot project of a US registered charitable organization whose primary purpose is to improve the quality of life for marginalized communities in rural East Africa. The non-profit has partnered with a multidisciplinary engineering firm and the students and faculty of the university to develop a framework around which the college is designed to be built. The goal is to create a comprehensive educational and infrastructure needed to support a projected enrollment of 1,200 students.

The college is the pilot project of a US registered charitable organization whose primary purpose is to improve the quality of life for marginalized communities in rural East Africa. The non-profit has partnered with a multidisciplinary engineering firm and the students and faculty of the university to develop a framework around which the college is designed to be built. The goal is to create a comprehensive educational and infrastructure needed to support a projected enrollment of 1,200 students.

Collaboration between over 16 students with engineering and architecture backgrounds along with the invaluable input from over 10 licensed architects, engineers and professors specializing in city and regional planning, architectural and engineering design was critical to the success of the master planning team. The student work was highly collaborative and iterative, with each student drawing upon the expertise of their peers in a spirit of academic cooperation.

Non-mandatory two-day workshops were held, in which teams would be provided with a design brief, the student teams would be given an additional week before presenting their project. The students would have access to a panel of professionals throughout the design cycle, including architects, engineers, and other experts in the field. The teams were encouraged to think critically and creatively, and to apply their skills in real-world situations.

Collaboration was fostered among students, faculty, and professionals, and was critical to the success of the master planning team. The student work was highly collaborative and iterative, with each student drawing upon the expertise of their peers in a spirit of academic cooperation.

The students gained knowledge regarding decision-making, project management, design thinking, and problem-solving. They were also able to develop critical thinking, teamwork, and communication skills.

MULTIDISCIPLINARY DESIGN

The team approach also allowed the themes and principles of sustainability and social objectives. This integrated approach allowed the themes and principles of sustainability and social objectives to be simultaneously addressed not only the physical parameters but also the broad range of issues key to successful place making, including transport, buildings and infrastructure while developing a variety of engineering solutions. In collaboration, the students created a master plan that was contextually appropriate and culturally resonant for the region. The team approach also allowed the themes and principles of sustainability and social objectives to be simultaneously addressed not only the physical parameters but also the broad range of issues key to successful place making, including transport, buildings and infrastructure while developing a variety of engineering solutions. In collaboration, the students created a master plan that was contextually appropriate and culturally resonant for the region. The team approach also allowed the themes and principles of sustainability and social objectives to be simultaneously addressed not only the physical parameters but also the broad range of issues key to successful place making, including transport, buildings and infrastructure while developing a variety of engineering solutions. In collaboration, the students created a master plan that was contextually appropriate and culturally resonant for the region. The team approach also allowed the themes and principles of sustainability and social objectives to be simultaneously addressed not only the physical parameters but also the broad range of issues key to successful place making, including transport, buildings and infrastructure while developing a variety of engineering solutions. In collaboration, the students created a master plan that was contextually appropriate and culturally resonant for the region. The team approach also allowed the themes and principles of sustainability and social objectives to be simultaneously addressed not only the physical parameters but also the broad range of issues key to successful place making, including transport, buildings and infrastructure while developing a variety of engineering solutions. In collaboration, the students created a master plan that was contextually appropriate and culturally resonant for the region.
Planning a Campus was something entirely new for me. So I learned how to deal with a large scale project. I also learned how to work in a short time frame, and how to deal with views about a whole compound rather than a single building. The workshop, the presentations and studying the precedents all helped to learn. I didn’t really know what to expect from this quarter, so I cannot say what I was expecting to learn.

Sebastiano Beretta
Desio, Italy

Augustina Radziunaite
Vilnius, Lithuania

Angelo Freeman
Linden, CA

Brian Murillo
Las Vegas, NV

(1) Campus Design – There are so many factors to consider when designing a college campus that I never would have imagined prior to this course.

(2) Laser Cutting – I learned what materials worked well together as well as what materials lent themselves to laser cutting. For example, while our early cardboard buildings worked well for their initial purpose, our switch to mdf board made the buildings sturdier and more visually appealing.

(3) Presentation – The feedback we received from our multiple presentations showed me what elements of our project were most successful in conveying our ideas. For example, the color coding of the program seemed to really aid in the understanding of our audience.

Having not ever worked on a master plan, it really helped that we were presented with research on the big things to consider for campus planning. It also helped we were asked to continue that research in the form of figure-ground drawings/analysis. I would also say that it was a fairly smooth transition from the “typical” architecture design to planning design. We started with core concepts and applied those to all of our decisions. I enjoyed working with other designers because the sharing of ideas went really well, and pushed the design further than if we worked individually. I guess the biggest thing I learned was how to translate my typical design process into a different type of project, one I never dealt with before. The same values apply.

1) Presentation. Again, presentation for ARUP team placed a much heavier responsibility on us and I felt much more pressure to cover all the things as professionally as possible.

2) Urban planning practice. Up till this course my exposure to urban planning was very limited. I feel that this type of projects should be more often incorporated into curriculum.

3) Patience. Every person in a team had a different work style and approach. It took patience and understanding to manage work with three other people.
Master Plan Phasing

Campus Master Plan Zoning Diagrams

- Academic Core
- Public Area
- Faculty Offices and Classrooms
- Labs and Workshops
- Grading Fields and Stables
- Agricultural Fields
- Student and Faculty Housing
- Recreational Stripes
- Public zone
- Administration and Student Facilities
- Classrooms
- School of Automotive Mechanical Technology (SAMI)
- School of Agriculture, Food, And Environmental Sciences (SAFEES)
- School of Building Sciences and Construction Technology (SBSCCT)
- School of Business Management (SBM)
- School of Tourism and Hospitality (STH)
- School of Social Sciences (SSS)
- School of Education (SE)
- Housing
- MISD
- Fields
research: precedents: grid type (linear)

UC Merced  Yale University

research: precedents: radial type

National University of Science and Technology Zimbabwe  Indian Institute of Technology
Campus Shading Strategies

1. Administration and Student Facilities
2. SAFEB
3. BAMP
4. STH
5. S81CT
6. LAYOUTS TYPICAL THROUGHOUT CAMPUS
7. TYPICAL MODULAR SECTIONS

Program Inventory: Plans and Sections
This quarter we worked on the Same Polytechnic College Master Plan near Same in the Kilimajaro region of Tanzania. We started by researching general typologies and principles of university campus master planning, local contexts, and analyzing previous years iterations.

As we started the design process, we laid out some core values. We based the agriculture fields near the water source located on the Northern West corner of the site. We separated grazing fields on the Northern West side to avoid the wind carrying smells across the campus. We focused on the various aspects of project phasing. We emphasized local natural features by developing a visual axis between two neighboring mountains. We subdivided spaces into primary and secondary cores with courtyard spaces, creating cozy enclosures for students and faculty. Lastly, we placed the main entrance to the campus on the Northern East side of the site to have the most direct access from Same to the campus.

The master plans starting as a grid type, with a boulevard to visually connect the mountains: and all the functions were distributed along it. We concurrently designed the radial type where every function would get a different spoke to develop from. As we became more confident with the size of the site, understanding walkability issues and the clustering of similar functions together, we came to the conclusion that the radial scheme was the better choice. It was the more flexible option for further campus development. It was convenient for separating circulation and noise levels, and it was an efficient way to fill the site without compromising functional connections or adding unnecessary infrastructure. The campus structure consists of an academic core, faculty offices and classrooms, then labs and workshops. The area between the academic core and the entrance to the campus is dedicated to the needs of the community, including a daily market, community center, and other administration facilities. On the southern end of the campus we placed the housing units, and the rest of the site is dedicated to the agricultural and grazing fields.

Programmatically, we started by working off of the program that was previously defined. To understand it better we broke it down building by building, and created an inventory. We went into more detail by correlating the buildings to our iteration’s current spatial arrangements, and tweaking them according to the needs we thought the master plan lacked. Eventually we developed new plans for most of the campus buildings with characteristic sections.

Circulation was mainly oriented towards pedestrians and most of the campus paths are solely dedicated for them. Some roads can be accessed by vehicles, but are mainly for site maintenance needs.

The shading strategy was based on the differentiation between big trees, decorative trees and the umbrella structures. Their placement along the roads as well as above social gathering spaces was strategic. To have more shading options, we have incorporated umbrella structures that also can perform as water collection element, artificial outside lighting and power generator if it had the necessary solar battery system.

Geographically we had to be aware of the sun path due its path relative to the equator, as well as high humidity levels. Another big climatic concern for us was the wind, which flows mainly from the South with occasional fluctuations to the west and to the east. The last big concern relates to seismic activity due to the site’s proximity to the East African Rift system. Due to these seismic factors every structural element has to be reinforced. The most common local wall structure is reinforced clay masonry. This was taken into account when choosing how the buildings would be constructed, and with what materials.
2016/2017 Campus Master Plan

The site for the project is located in Same, Tanzania
Planning a Campus was something entirely new for me. So I learned how to deal with a large scale project. I also learned how to work in a short time frame, and how to deal with views about a whole compound rather than a single building. The workshop, the presentations and studying the precedents all helped to learn. I didn’t really know what to expect from this quarter, so I cannot say what I was expecting to learn.

There are so many factors to consider when designing a university campus that I never would have imagined prior to this project.
New Site (103.85 ACRES) is 1/3 rd of the size of Old Site (315 ACRES)

Site Photographs: Views from the Site
**New Master Plan**

**Phase 1**

**ADMINISTRATION AND STUDENT FACILITIES**
- Library, Cafeteria, Admin, Student Services, Auditorium, and Non-Profit Buildings
- SAFES: School of Agriculture, Food, and Environmental Sciences
- SBSC: School of Building Science and Construction Technology
- STH & SE: School of Tourism and Hospitality & School of Education
- SAMT: School of Automotive and Mechanical Technology
- Common Facilities: Classrooms, Faculty Offices, Housing, Restrooms
- Agricultural Fields

**Phase 2**

**Phase 3**

**Color Coding Legend**