Advanced Studio VI, Columbia University, GSAPP, Spring 2016
Benjamin Aranda, Principal Instructor, Daniel Bosia, Co-Teacher
Teaching Assistants: Joaquin Bonifaz, Stephanie Lin

Desert site for a $5 billion Tesla Battery Plant

THE DESERT FACTORY

The focus of this studio is the design of the next generation of factories in the American desert. The desert has long been the site of architectural imagination. Its dry air, clear skies, and unique geological formations inform and inspire the way humans inhabit it. From ancient cliff dwellings to utopian structures and movie sets, architectural experiment within the desert comes in many forms and varying degrees of permanence. In some cases, these experiments have proven to fail, such as the gold rush era ghost towns and utopian experiments. In other cases the natural conditions have created military and civilian infrastructure projects of epic proportions.

Between Tucson, Arizona and Las Vegas, Nevada is a swatch of desert that epitomizes the American west in its natural splendor, settlement history and technological promise. Within this swatch national monuments like Montezuma Castle, infrastructural feats like the Hoover Dam, utopian experiments like Biosphere and Arcosanti, and new forms of power generation like solar arrays and wind farms all highlight the persistent hold the desert has on American ingenuity. The cloudless skies have made the aviation industry and observatories a permanent fixture around Tucson and the Hoover Dam stands in its final days as America's greatest engineering triumph. The studio will consider these sites and explore how the desert can be captured as not only a site for new kinds of architecture, but as a process that defines it.

Within this very hot and dry context, students will design the next generation of factories. Currently many high profile factories are in development or being constructed including a $5 billion Tesla Battery Plant in Reno, a $2 billion Apple Data Center in Mesa, as well as a recently completed Intel microchip factory outside of Phoenix. The reason desert locations are selected for critical technology production is deceptively simple; the desert is cheap open land with solar energy as a guaranteed power source. These examples mark the beginning of autonomous factories built to extend industries from high-tech to renewable energy to automotive and aerospace. Students will look at how industry is being affected by new modes of manufacturing with advances in artificial intelligence, printing, robotics, biological and distributed production as well as human-robot collaboration.

This new generation of factories are some of the largest and most technically advanced buildings in the world, their complexity often belying their traditional boxy shell. As they are judged by their capacity to produce and their sophistication remains internal, they frustrate the traditional domain of design for the architect. Within they are radically transformed by new manufacturing methods, materials, and information technologies, sometimes without even the presence of humans. This is the domain of organization and procedure for architects interested in being part of this conversation. To initiate the process, students will invent their own factory, its methods and its products, to be built on the outskirts of Tucson, Arizona.

PROCESS

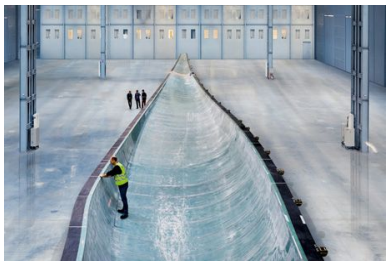
The process of the studio is divided into five parts in order to develop an open-ended program into a fully resolute architectural proposal:

1. **Factory Definition**
2. **Tooling & Prototype**
3. **Factory Sketch**
4. **Travel**
5. **Building Development & Fabrication**

Each part is composed of assignments and corresponding workshops that lead to a pin-up. This studio is Workshop intensive. Emphasis is placed on developing the student's voice and position through project-specific workshops leading towards the production of deliverables. There is a dynamic between Desk Crits, Workshops and Pin-Ups that asks the student to learn new tools through critical thinking and concept development. At the students disposal is a team of instructors that together offer a depth of expertise and experience. Benjamin Aranda, principal at Aranda\Lasch, is the lead instructor and will be present most of the classes. Daniel Bosia, director at AKT II, is a designer with a unique combination of architecture and engineering talents. Daniel will be present for a number of desk crits and reviews throughout the semester. Workshops will be led by Joaquin Bonifaz and Stephanie Lin.

PART 1: FACTORY DEFINITION

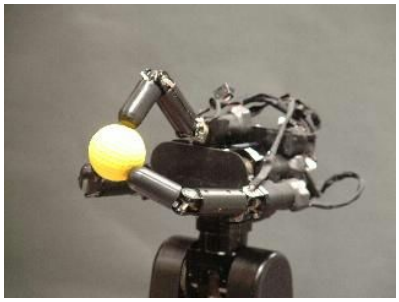




Students will research current trends in manufacturing and their effect on industries in order to propose their own factory program. The aim of this first part is to guide research towards the question, what to build? The future will be manufactured in a way that looks nothing like what we currently understand as a factory. Considering how distributed manufacturing, robotics, biological production, autonomous vehicles, printing, and human-robot teamwork will upend all markets, students are given wide range to explore new futures for the factory as a building type. What is important is that they define the production process as a procedure with a series of coherent steps.

Workshop: Rhino Advanced Modeling and Grasshopper
Assignments: 1) White Paper: a shared Google Doc format, with their own writing, narrative, links and found videos.
2) Production Process: Their factory procedure modeled as a diagram with scale.

PART 2: FACTORY TOOLING & PROTOTYPE



After defining the factory procedure, students begin the process of tooling, or preparing a product for manufacture. This is imagined in the abstract, without a site per se, but rather conceptualized in the mode of spatial constraints and the organization of tools for manufacture. *Tooling* is imagined as a spatial procedure, a syntax that considers the dimensional constraints of machine fabrication. This leads to the development of a prototype, a physical construction that validates the factory production process. Open to interpretation, the prototype can be imagined as a part of a building, or the organizational substrate of a building, or the even the product being made by the building itself. The prototype is finally mocked up as a physical object, the guiding conceptual artifact of the studio.

"Manufacturing is building the machine that makes the machine." — Elon Musk

Workshop: Advanced Grasshopper
Assignments: Factory Prototype & Tooling Presentation
Prototype Physical Mock-up

PART 3: FACTORY SKETCH

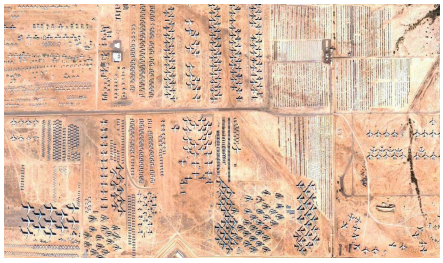


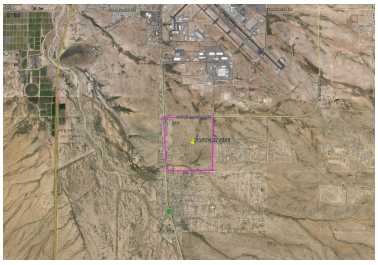
Consider the Tooling Prototype in the desert. In this part, students sketch their factory in situ, positioning their tooling logic within the extreme climate of Arizona's Sonoran desert. If the prototype is a spatial procedure then the sketch is a release of that procedure on its territory. Influenced by its own internal modulation and repetition across the site as well as external issues such as material, weather and urban contexts, the sketch demonstrates not so much a building as a prototype in performance. Students will be introduced to advanced modeling techniques to modulate variation and build physical models all the while accessing context-driven information such as weather and geography.

Workshops: Context/Site/Performance Modeling in Grasshopper
Fabrication

Assignments: Context Research
Context/Site/Performance Modeling
Factory Sketch & Physical Model

PART 4: TRAVEL





At the core of this studio is a journey through the American desert. The desert in this part of the country is a filled with spectacular and moving scenery, our culture's story is written in it and students are challenged to take it all in. Each student will be a guide to the desert, picking a place along the trip and giving a the rest of the class a tour. The site itself is a desert plot just beyond Tucson city limits, next to the airport and strategically located by regional transportation infrastructure. It is chosen for its relative anonymity in the sand. Untouched but not blank, it lies close enough to the city to provide urban programming opportunities.

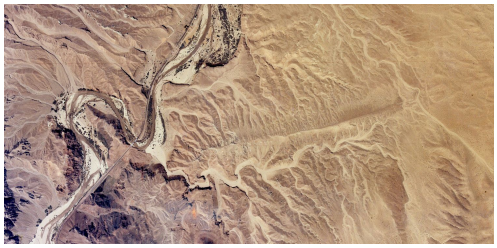
Tentative Itinerary:

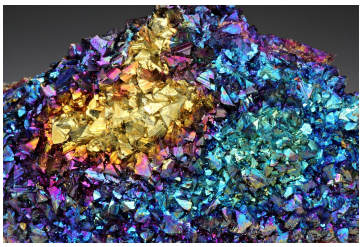
Aircraft Boneyard
Kitt Peak National Observatory
Desert Museum
Heard Museum
Arcosanti
Additional factory visits to be included

Asarco Mineral Discovery Center
Tohono O'odham Nation
Biosphere 2
Taliesin West
Montezuma Castle National Monument

Assignments: Trip Planning, Guide Preparation
Site Reconciliation Report

PART 5: FACTORY DEVELOPMENT





Across the remaining six weeks after travel, students will develop their concepts through their own procedures, models and images. Emphasis is placed on developing the student's voice and position through project-specific workshops leading towards the production of final deliverables. This studio is workshop intensive. The workshops essentially provide the student with their own teaching assistants whose role is to help clarify the project and accelerate its production. But this is not a cookie-cutter studio, a variety of approaches are demanded. With their experience in software, fabrication and building technologies, the instructors will push the students to test their proposals through a variety of scales, drawings, physical models and renderings in order to support their thesis.

Workshop:	Project Specific, tailored to student investigations
Final Requirements:	1) Site Model 2) Revised Concept Model/Prototype 3) Section Model 4) Plans & Sections at varying scales 5) Diagrams 6) Renderings

TEAM
Students can work individually or in groups.

Principal Instructor: Benjamin Aranda (BA), principal Aranda\Lasch
Co-Teacher: Daniel Bosia (DB), director at AKT II
Teaching Assistant: Joaquin Bonifaz (JB), architect Aranda\Lasch
Teaching Assistant: Stephanie Lin (SL), architect NY

SCHEDULE
Classes meet Monday & Thursday 1:30PM - 6:30PM (Friday 3PM-5PM 113 Avery)
Benjamin Aranda (BA), Joaquin Bonifaz (JB), Daniel Bosia (DB), Stephanie Lin (SL)

Week 1	**PART 1: FACTORY DEFINITION**	
January 20 Wed	PRESENTATION: Lottery Presentation	BA
January 22 Fri	PRESENTATION 1: The Desert Factory ASSIGNMENT 1: Program Research	BA, JB, SL
Week 2		
January 25 Mon	Desk Crit: Program Research (2.5 hrs) WORKSHOP 1: Rhino Advanced Modeling and Grasshopper (2.5 hrs)	BA, JB, SL
January 28 Thur	PIN-UP 1: Assignment 1 & 2, Program Research, Tooling	BA, JB, DB, SL
January 29 Fri	PRESENTATION 2: Modularity, Ruins, & the Desert (1.5 hr) ASSIGNMENT 2: Factory Tooling Prototype	BA, DB
Week 3	**PART 2: FACTORY TOOLING & PROTOTYPE**	
February 1 Mon	Desk Crit WORKSHOP 2: Advanced Grasshopper (2 hrs)	BA, JB, SL
February 4 Thur	Desk Crit	BA, DB
Week 4		
February 8 Mon	PIN-UP 2: Factory Tooling Prototype ASSIGNMENT 3: Physical Model	BA, JB, SL
February 11 Thur	WORKSHOP 3: Fabrication with GrassHopper (2 hrs)	JB, SL
Week 5	**PART 3: FACTORY SKETCH**	
February 15 Mon	WORKSHOP 4: Context/Site/Performance Modeling in Grasshopper Desk Crit	BA, JB, SL
February 18 Thur	Desk Crit PIN-UP 3: Program Research, Factory Tooling Prototype, Physical Model	BA, JB, SL
Week 6		
February 22	Desk Crit	BA, JB, SL
February 26	MID-REVIEW: Program Research, Factory Tooling & Prototype, Physical Model of Factory Sketch	BA, DB, JB, SL invited guests
Week 7		
February 29 Mon	Desk Crit, post review	BA
March 3 Thur	WORKSHOP 5: Project Specific (5 hrs)	JB, SL

Week 8	**PART 4: TRAVEL**	
March 7 - 11	Kinne Week: Desert Factory Trip ASSIGNMENT 5: Site Reconciliation Report	BA
Week 9		
March 14 - 20	Spring Break	
Week 10	**PART 5: FACTORY DEVELOPMENT**	
March 21 Mon	PIN-UP 4: Site Reconciliation Report Presentation ASSIGNMENT 6: Factory Development 1	BA
March 23 Thur	WORKSHOP 6: Project Specific	JB, SL
Week 11		
March 28 Mon	GUEST SPEAKER ROUNDTABLE: (2 hrs) Desk Crit (half class, 3 hrs)	BA, JB, DB, SL
March 31 Thur	Desk Crit (remaining half class)	BA
Week 12		
April 4 Mon	PIN-UP 5 (Individual): Assignment 6 Review	BA, JB, SL
April 7 Thur	WORKSHOP 7: Project Specific ASSIGNMENT 7: Factory Development 2	JB, SL
Week 13		
April 11 Mon	Desk Crit (half class)	BA, DB
April 14 Thur	Desk Crit (half class)	BA, DB
Week 14		
April 18 Mon	Desk Crit: Assignment 7 Review	BA, JB, SL
April 21 Thur	WORKSHOP 8: Project Specific	JB, SL
Week 15		
April 25 Mon	Final Review Rehearsal 1	BA, JB, SL
April 28 Thur	Final Review Rehearsal 2	BA, JB, SL
Week 16		
May 2 Mon	Final Review	BA, DB, JB, SL