

Place-based Design Curriculum for Environmental and Spatial Justice Education

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The desert region of El Paso and Ciudad Juarez continues to urbanize, and as pressures of climate change, human migration, and resource scarcity continue to impact livability, the architectural discipline must recognize its role at this historical and environmental planetary crossroads. Designing an architectural education curriculum in this increasingly contested region must be informed by hyper-localized issues with global consequences.

CURRICULAR OBJECTIVITY AND CORPOREAL SUBJECTIVITY

The US-Mexico borderland provides a rich context for faculty research and focused experiments in design pedagogy in a unique—and uniquely successful—undergraduate architecture program serving minoritized students and the border community. The Texas Tech University Huckabee College of Architecture at El Paso engages a binational, bicultural, and bilingual student body, through cumulative curricular sequencing that supports critical thinking and design research¹.

The desert region of El Paso and Ciudad Juarez continues to urbanize, and as pressures of climate change, human migration, and resource scarcity continue to impact livability, the architectural discipline must recognize its role at this historical and environmental planetary crossroads. Designing an architectural education curriculum in this increasingly contested region must be informed by hyper-localized issues with global consequences. Issues of scarcity and abundance permeate each design studio course, working on design strategies that address architectural elements and methods, while critically probing disciplinary assumptions. Scarcity of resources, heightened by desert conditions and binational systems of control, coupled with unique contextual material, such as geological content, infrastructural and logistical systems, form the intellectual framing of the architectural project. Students are encouraged to explore the ways in which urban and architectural design can have positive impact within this dynamic context using design and representation tools to give image to their contested region

and to record their diverse regional heritage. The pedagogical framing considers both disciplinary knowledge and the subjectively lived experiences of the students, some of whom cross the border daily to attend classes. Ability to articulate in disciplinary terms their binational, bicultural, and bilingual perspectives is nurtured in design studio, using architecture as a vector through which students take ownership and authorship of the region's narrative.

While the required curriculum remains disciplinary, the pedagogical methodology expands upon its content by probing questions that highlight the relevance of lived experiences. The question of who the designer is, plays an important role in pedagogical goals and should inform design decisions as much as architectural historical precedent. The combination of the personal and the inherited knowledge of architecture is the conduit for forging relationships outside the academic context. When the disciplinary becomes personal, students relate to the institutions that practice design at various scales outside the university. Making space within the required curriculum, and hybridizing traditional teaching methods with inter-institutional workshops, internships, and collaborations offers a broadened understanding of pedagogy while streamlining transition to practice. This approach reduces the assumed education-to-practice distance and re-establishes the importance of rigorous architectural education in the professional community².

The design studio sequence is coordinated to help students think of pressing ecological and spatial justice issues through scalar increments, from airborne particulate matter to the impact of climate change at the scale of the human body, to waste streams and their infrastructural systems.

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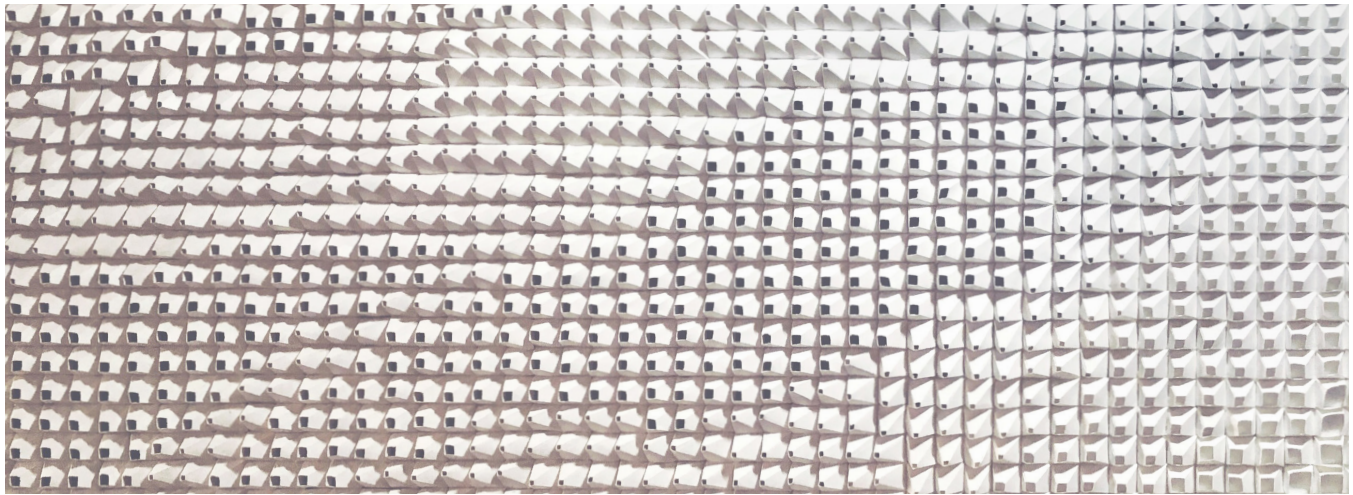


Figure 1. Border Bubble: Infrastructural Sanatorium. Physical model of geological and ecological site conditions as an active context for design. Student work by Lauren Carmona in Kripa's studio.

DUST INSTITUTE: DESIGN RESEARCH FOR ARID URBAN FUTURES

Urban populations living in the arid US-Mexico borderland face significant environmental and public health challenges from atmospheric pollution. The region's desert geology contributes to dangerously high levels of fine particles, threatening the estimated 25 million borderland inhabitants with adverse health impacts from airborne sand and dust. This environmental and public health crisis is exacerbated by the combined impacts of climate change, climate migration, desertification, and rapid urbanization, intensifying conditions of spatial, social, and environmental injustice. (Heyman, 2007, Eades, 2018). The built environment of the borderland has yet to adapt significantly to these airborne threats. While other urbanized desert regions have adopted advanced building technologies to manage the adverse impacts of extreme particulate exposure (Bishop, 2011; Grassi, 2019), the borderland has yet to develop an expertise to address these changing threats specific to its unique environmental conditions.

The design research in this studio seeks to develop advanced building construction systems capable of managing and mitigating the flows of airborne particulate on an urban site near the US-Mexico border. Privileging dust flow as a primary driver for envelope design, disciplinary building envelope design principles were interrogated and subverted in the studio, with student designs imagining new assemblies capable of accelerating and amplifying the behaviors of airborne dust within and through architectural assemblies. Designs explored scouring, infiltration, creep, and suspension, among other dust-specific phenomena. Through their designs, students identified architectural strategies that could leverage these new construction systems to promote the public awareness and scientific study of changing dust conditions.

To begin the iterative design process, students worked in small teams, selecting an architectural precedent to draw, model and analyze. Understanding the precedent as an aggregated volume, students identified volumetric and spatial aggregates, and drew and modeled the aggregates in detail, developing a formal language related to the spatial qualities of dust flow and territorial assemblage.

In a parallel introductory assignment, students chose a precedent building enclosure to draw, model, and analyze. Understanding the precedent as an aggregated skin, students developed representational skills unique to the studio, drawing unfolded elevations, technical wall sections, and aggregate assembly drawings describing the precedent's environmental performance and construction logic in detail.

Students worked iteratively throughout the studio to produce scaled models—or prototypes—of building components and enclosure systems. Students worked through multiple prototypes to consistently improve the performance and resolution of their designs. These prototypes were considered as be the primary means of design exploration and development, and the primary evidence of a working solution.

Using computational fluid dynamics simulations to study and test assemblies for airflow and dustflow characteristics, students were able to develop and test experimental, innovative, and detailed architectural designs using dust as a driver for innovation. By simulating air and particulate flow both in their 'real-world' physical prototypes, and in these computer simulation environments, students were able to refine their approach with findings from the feedback. Students gained insight into design research informed by critical material practice, and developed their ability to design synthetic relationships between environmental conditions, sites, building forms, and the public realm.

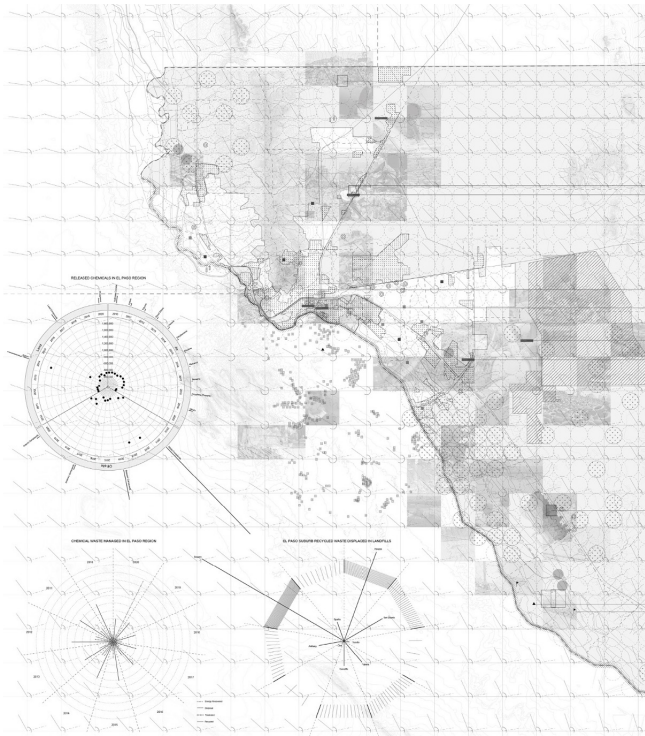


Figure 2. Waste Streams, Hydrological Patterns, and landfill conditions. Student work in Gandara studio by Collin Whitener, Dominique Valenzuela, Jessica Marquez, Beiry Duran, and Daisy Porras.

The studio operated at the invisible intersections of environmental performance, material systems, building technology, and architectural program, viewing transnational dust flow as an abstract machine, indexing, organizing, and transforming the changing urban and territorial landscape of the US–Mexico borderland.

Students focused their work on extrapolating the constructive logics of airborne particulate to develop architectural and programmatic assemblages unique to the binational territory of the Chihuahuan Desert and the transformative potential of dust. The studio worked with additive methods of digital production and fabrication to develop their designs.

Students developed architectural solutions that engage transnational dust flows as unique regional climatological phenomena and potential cultural experiences, culminating in the design of the Dust Institute, a research facility for the study of binational air quality issues, and local dust phenomena on an urban site.

Students then worked individually to analyze the windflow of their precedent and propose, model and test new designs that addressed the Dust Institute program and helped them to distinguish their emerging interests in aggregative strategies

for building organization and building performance strategies capable of manipulating dustflow.

In their final assignment, working individually, students developed a detailed architectural design for the Dust Institute on an urban site in El Paso. Each student identified and investigated a unique vector of particulate transmission (e.g., allergens, pathogens, fine particles, geologic and biologic signatures, radioactivity, magnetism, etc.) related to their site. Designing their enclosures and aggregated spatial volumes to engage this vector, each student designed spatial membranes including areas for the study, observation, and dissemination of knowledge related to the transnational dust flows. Designs integrated volumetric and spatial components with the articulation of a performative building envelope that develops the student’s individualized approach to the management and observation of dust, and address the public realm of the urban site.

Through their work for the Dust Institute studio, students were able to imagine and design new territorial imaginaries through the advance of design technologies at the scale of technical enclosure details, the design of responsive and adaptive envelopes and architectural assemblies, and the articulation of new public programs advancing the lives and livelihoods of border inhabitants through increased awareness, scientific study, and public health impacts.

BORDERLAND WASTE STREAMS

This studio engages issues of ecological and social justice through the analysis of waste stream management along the U.S.–Mexico border, with a focus in El Paso, where all waste from cities along the Rio Grande from Anthony to Tornillo is collected. Ranging in scale from buildings to infrastructure systems, to restoration projects, and land remediation strategies, the design proposals engage environmental and spatial justice through design. The studio’s pedagogical structure is organized as a research and design studio, asking students to construct robust and thorough regional mappings that record waste streams, recycling practices, highlighting the overlapping geography of waste dumping and landfill sites with wealth distribution disparities, while also uncovering water and soil pollution throughout the fragile Rio Grande ecosystem of the channelized border.

The course teaches students research methods, ways in which to use their research findings to construct complex mappings, and how to develop infrastructural ideas. Students use databases maintained by the state of Texas to gather information about the site at a macro-scale and city databases for local infrastructure. In addition, students learn to synthesize the gathered information towards the design of a building which accommodates domestic space, communal space, and waste management. Students are encouraged to pursue higher levels of thinking, producing, and representing sets of information to empower local communities and develop sustainable methods of waste reuse, reduction, and disposal.

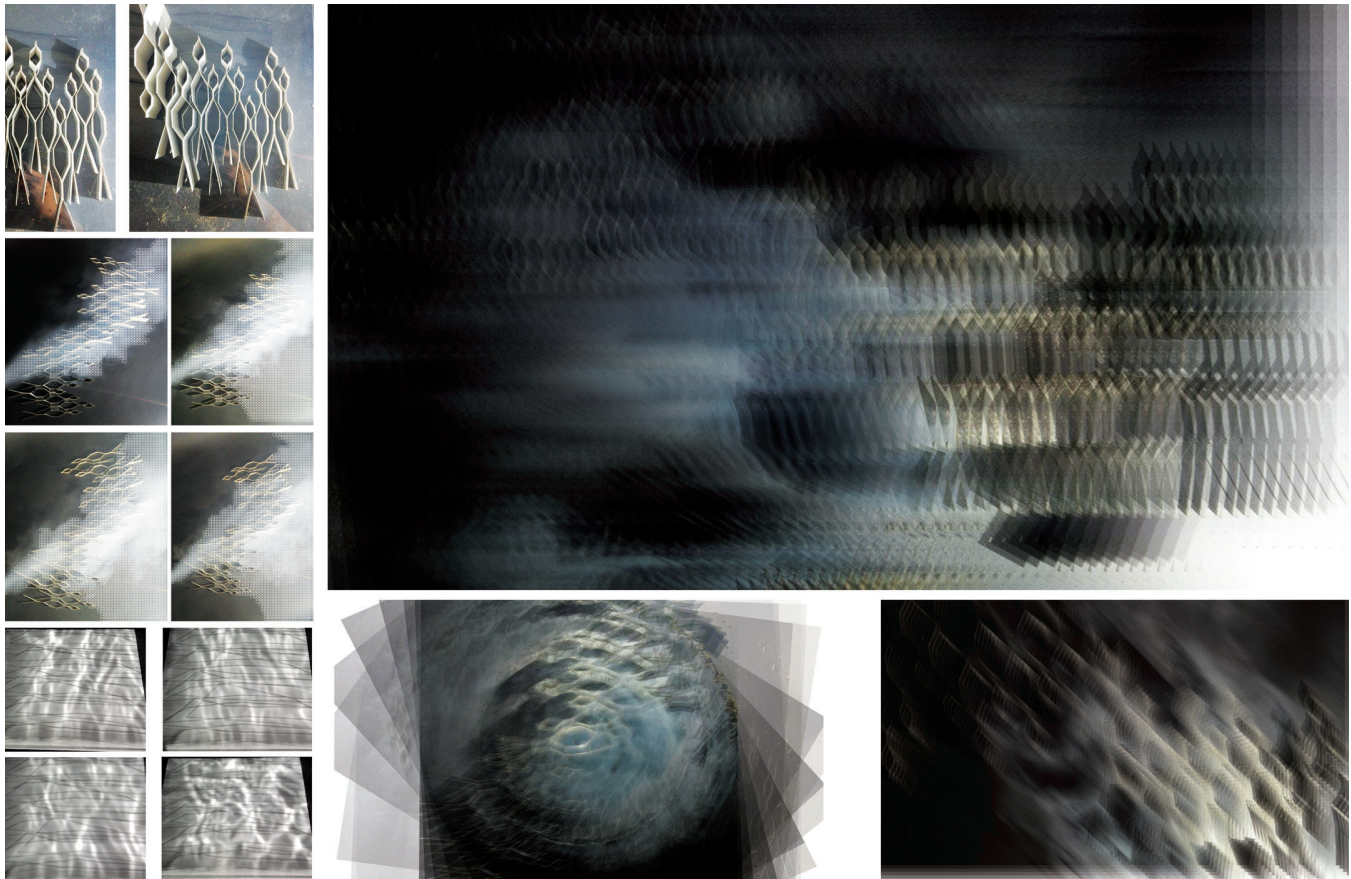


Figure 3. Border Bubble: Infrastructural Sanitorium. Form-finding exercise of physical and digital model testing of aerodynamic properties. Student work by Victor Carrillo in Kripa's studio.

The oldest city recorded in history had a waste problem. By constructing walls from the combination of human waste, food, fly ash, and alluvial clay, the city of Çatalhöyük created an unexpected byproduct: a unique social life. As the city grew, the construction of dwellings on top of one another created an urban density that relied solely on waste, which became the most important asset for construction. Since then, cities in geographically and financially varying conditions, continue to grapple with the tenuous and costly task of managing their waste, either by displacing or burying it in landfills.

In El Paso, waste is disposed of in two ways: it either becomes compost or it is disposed of in a landfill. The city of El Paso is responsible for collecting all solid waste produced by cities along the Rio Grande from Anthony to Tornillo. Most collection points, if not all, are not part of a recycling program, which is also poorly maintained and lacking at best, ranking as the least efficient in Texas. El Paso's recycling program was established as late as 2006 and has not been functioning thoroughly since. A third of the content placed in recycling bins ends up in landfills due to misinformation and lack of end-user education, and due to the continued practice by municipal workers of dumping recyclable content in the El Paso County landfill. The city pays over a quarter of a million dollars each year to manage these contaminants.

The county landfill has had significant spills that have affected residents downstream during heavy rain, however, there hasn't been substantial efforts made by the local government to ameliorate this issue. The leachate—a by-product of contaminants mixing with water in a landfill—is polluting the potable water sources of the region, including the Hueco and Mesilla Bolsons. However, considerable resources have been invested in burying, covering, and building domestic spaces above the landfills, rather than in truly addressing the growing waste levels. Landfills have been repurposed in the city as parks, golf courses, and low-rise building construction such as Washington Park and the far East of El Paso residential area. This does not offer a long-term solution to a problem that is continuous and with alarming growth – capping the landfills will soon not be enough.

To begin addressing this wicked problem, students are asked to analyze the waste streams of El Paso County as they intersect with geological, hydrological, and socioeconomic data, and to construct diagrams that highlight specific issues of environmental injustice at these intersections. By mapping hydrology, soil toxicity, and air pollution, students aggregate the timelines and projected changes that impact ecological equilibrium in the arid desert conditions of the region. The complex mapping exercise asks students to aggregate multiple types of information

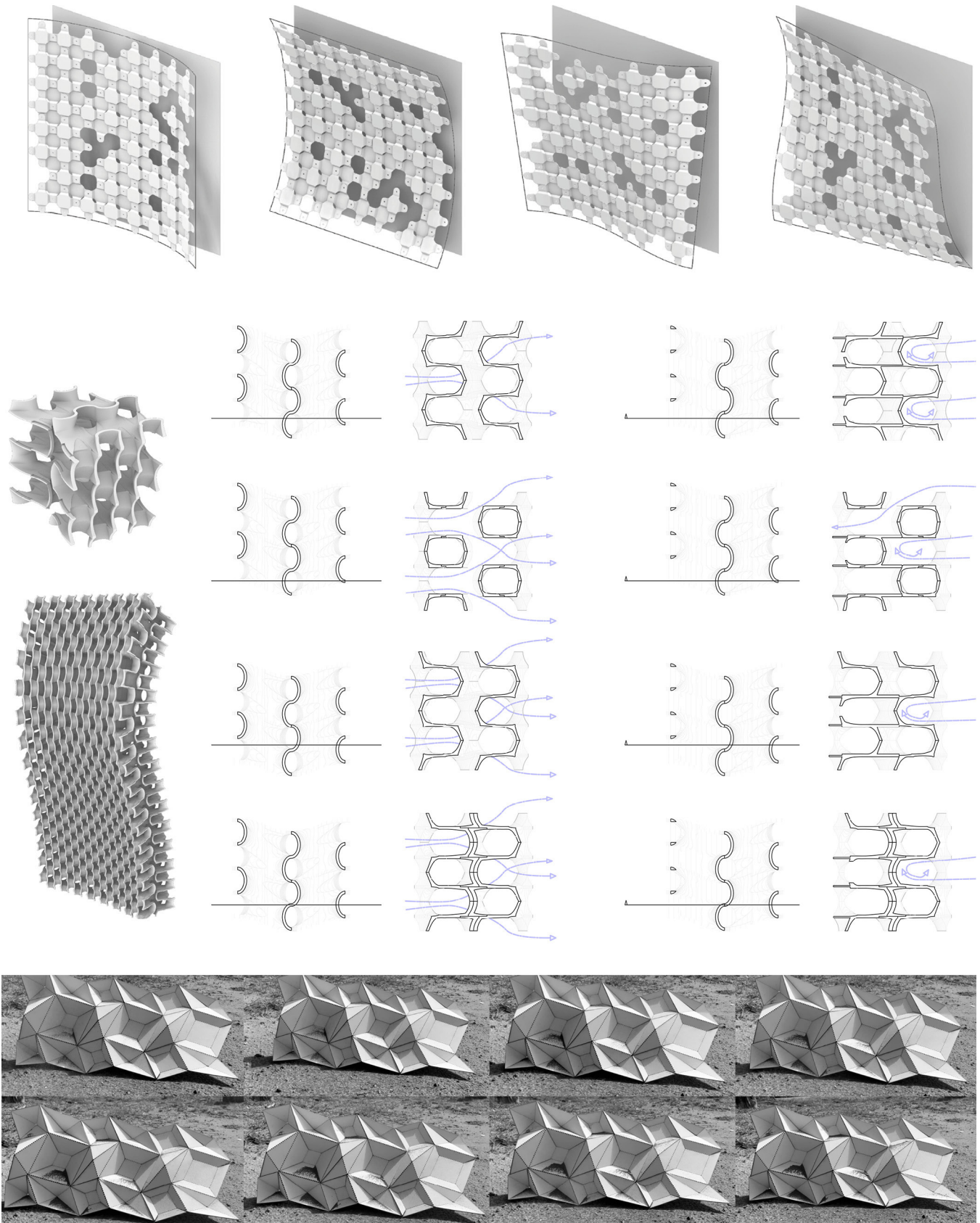


Figure 4. Dust Institute: Design Research for Arid Urban Futures. Student work in Mueller studio by Melissa Lexa (top) and Emmanuel Urena (middle). Student work in Cortez-Lagos studio by Dagmar Dena (bottom).

including city boundaries, relevant infrastructure such as solid waste disposal routes, rivers and canals used for irrigation, gray water ponding, runoff water ponding, landfill sites, solid waste collection sites, abandoned landfills, construction debris landfills, water wells, water treatment plants, affected landfill spill areas, superfund sites, remediated sites, and old landfill sites.

Students are invited to respond to the brief by developing a program that is relevant to the waste management issues of El Paso as they become apparent in the mapping exercise. Each student selects a site of their own interest, which affects the program specificity, while adhering to the studio's requirement that the waste processing system reduce waste volume by 60%. In addition, students develop systems of community outreach to ground their project within specific contexts and engage the public through site and program development. The projects merge infrastructural systems, building construction, and design in pursuit of a new architectural typology, which remediates, retrofits, or repurposes a site that is affected by improper solid waste management by the county government.

Specifically, the design project asks students to rethink waste and its processing systems as both material resource and infrastructure in the design of low-carbon waste processing centers that take on unique characteristics due to their specific context. Students are asked to design passive and active solutions that streamline municipal waste management. These can range from the scale of a factory to landfill reconfiguration systems around El Paso county. Inventive systems are to be deployed around the city as catalysts for better solid waste management. These systems can be materialized as buildings, infrastructure systems, restoration projects, land remediation, or a combination of any. Students develop organizational methods and designs that accommodate human relations at a macro scale, and merge this to a typical program for a facility that collects, sorts, and repurposes solid waste. In addition to the architecture-as-infrastructure work, the studio's high-level goal is to develop viable material repurposing processes that can broaden the discussion about conscious discarding and environmental preservation.

BORDER BUBBLE: INFRASTRUCTURAL SANITARIUM

Unpredictable and extreme climate fluctuations have triggered an unprecedented global climate migration. Droughts and floods in highly populated areas are forcing large populations to relocate to more suitable, but perhaps unfamiliar, weather conditions. Housing this population will require designing for climate and designing for change. To this end, architecture must borrow from infrastructure's performative logics to truly support humans while co-existing with environmental variabilities.

On the U.S. – Mexico border, climate migration can be understood as both human movement as well as weather; water, air and the pollutants they carry. Each nation regulates its climate differently, and while national climate indexes vary, weather movement transcends borders. The studio looks at the

natural border as a channel that perhaps can regulate micro while affecting macroclimates in the region. The Rio Grande, in its current man-made form, inscribes not only the 'natural' boundary between two nations, but it also indexes the precisely controlled water distribution politics of the Chihuahuan Desert, where increased desertification enacts a growing impact on respiratory ailments, due in part to climate change and environmental neglect at the regional scale. Students are invited to map these conditions and to understand them at the scale of the region and the implications on the body. The regulation, treatment, and containment of elusive pollutants is paired with updating the 20th century sanatorium as a medicalized architectural typology. The sanatorium invites complex questions of healthcare within the border region, where access to medical treatment depends upon multiple types of documentation.

Students are invited to design a sanatorium supporting respiratory healthcare with an infrastructural function that responds to the unique environmental and political setting. Students explore hybridization of functions of healthcare and climate mitigation and design a climatological bubble that treats environmental pollution and respiratory disease of climate refugees, where environmental justice is intrinsically linked to universalized healthcare. Historically, the architectural typologies employed to regulate a body's relationship to its environment have been the bubble and the sanatorium. The bubble, with its ability to isolate an environment, is able to contain a designed microclimate condition, while the sanatorium, with its ability to maximize natural ventilation, connects bodies to remote locations infusing them with fresh air away from pollution. The course begins by studying these two typologies, imagined and built, and develops them as one complex hybrid. While the bubble promotes containment to remedy health concerns, the sanatorium orchestrates exposure. The design process inhabits the space between these two paradigms.

The architectural project is a performative bubble in a unique environmental and political setting. The geologic, hydrologic, and meteorological conditions of the context are engaged as protagonists in shaping the bubble. While the bubble responds to climatological matter, it is also meant to treat humans fleeing extreme environmental pollution who need medical attention. The design process is grounded in the tension between highly controlled interior containments and fluctuating climatic conditions, resulting in architectural systems that create their own microclimatic conditions. The successful student project creates and maintains its own climate that can support a human body suffering from respiratory disease. The final project is a studied result of typological and technological precedents, where connectivity of interior and exterior, machine and human, air and lungs, informs transitional spaces that become the tributaries of a well-connected system of mechanics and materiality. At the scale of the site and region, climatic, geologic, and hydrologic analysis is layered with the historical evolution of the

cross-border security screening apparatus in order to uncover the site's latent conditions that can support a sanitorium.

CONCLUSION

The curriculum and extended community outreach in the Huckabee College of Architecture offers a framework for critical thinking through design research that focuses on environmental, spatial, and social justice, equipping students with the critical tools to formulate their own design practice in a contested context. The combination of curricular requirements—considered somewhat 'universal'—with the tangible lived experiences of students and faculty—considered 'personal'—offers a unique methodology for training designers to cultivate their individual agency in relationship to a complex and powerful geopolitical context.

ENDNOTES

1. Students enter the university's Bachelor of Science program after completing their first two years of architectural education at the El Paso Community

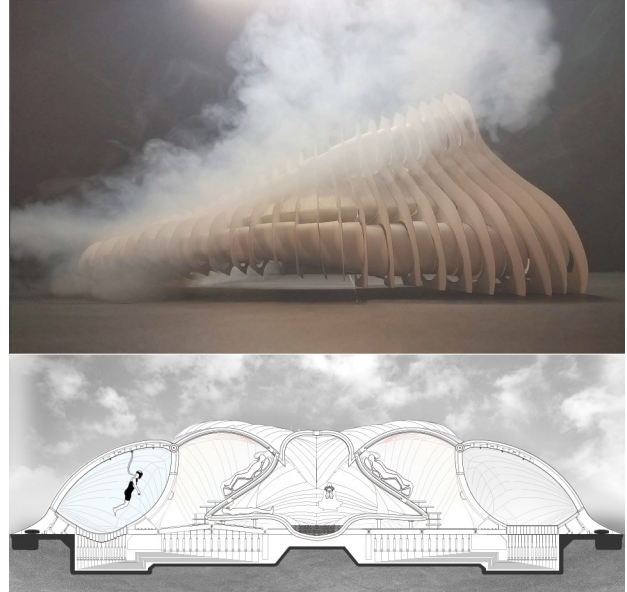


Figure 5. Border Bubble: Infrastructural Sanitorium. Physical model tests inform spatial performance in relationship to the body. Student work by Javier Breceda (top) and Daniel Rios (bottom) in Ersela Kripa's studio.

College. A robust articulation agreement between the two institutions makes education more affordable for our students, without which they would not be able to attend.

2. In order to ensure our students success in their professional endeavors after graduation, we facilitate access to local organizations and government leadership via collaborations in both El Paso and . In El Paso, we facilitate internships with the City's various departments, as well as at a local Community Foundation. In Ciudad Juárez, we have been organizing a collaborative series of workshops with colleagues from Tecnológico de Monterrey, with NGOs that support migrants and other underserved communities with language skills, job training and computer skills through the design of community centers.