Restitching Post-industrial Sugar Heritage: Developing Advocacy Attitudes as a Strategic Plan

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Sugar production exerted a substantial influence on land use and settlements throughout the Americas. Departing from sugarcane areas of Aguirre-Puerto Rico, and connecting other important sugar heritage sites, such as of Sao Paulo-Brazil and Texas-United States, this paper examines a pedagogical approach for advocates of preserving industrial heritage as an indispensable component of livable, sustainable communities. Through research analysis developed in three experimental design exercises for a senior architectural studio, students were able to explore the significance of historical resources and proposed different program narratives. These design activities consider students as storytellers and explore virtual data as a way to expose others' viewpoints, build shared ideals and explore narratives based on a collective memory that may be revealed by community interaction. These visual story products promote diversity and the exchange of information, allowing students to define and communicate their interests, viewpoints and experiences. Students and community stakeholders can understand the critical role historical structures play in the environment to spur advocacy.

SUGAR HERITAGE

From the early plantations through the mid-twentieth century company towns, sugar production exerted a substantial influence on land use and settlements. Sugar production was the first and most significant economic activity established in Brazil. Sugarcane played a critical role in the socio-economic development of Puerto Rico and was the reason for the urbanization of south Texas, in the area of Sugar Land. Therefore, one of the earliest forms of architectural expression and urbanization in colonial Brazil, Puerto Rico and Texas emerged on the sugar plantations. Sugar towns symbolized the industrial landscape, while retaining some characteristics of traditional rural life. The grandiosity of the plant, the smokestacks and strong odor, the cranes loaded with cane, the juice running from the crushers, and the "Chaplinesque" gears in the factory contrasted sharply to low scale rows of houses and barracks-like structures, the church on the hilltop, the green cane-shaped walls following the dirt roads, and some distinctive community buildings. These agro-industrial communities, which built up around the processing plant, expanded considerably in the Americas throughout the late nineteenth to the mid-twentieth century. [1]

Adaptive reuse has emerged as an important strategy in the preservation of post-industrial buildings and landscapes. [2] Departing from sugarcane areas of Aguirre-Puerto Rico, and connecting other important sugar heritage sites, such as of Sao Paulo-Brazil and Texas-United States, this paper examines a pedagogical approach for advocates of preserving industrial heritage as an indispensable component of livable, sustainable communities. Through research analysis developed in three experimental design exercises for a senior architectural studio, students were able to explore the significance of historical resources and proposed different program narratives. These design activities consider students as storytellers and explore virtual data as a way to expose others' viewpoints, build shared ideals and explore narratives based on a collective memory that may be revealed by community interaction. These visual story products promote diversity and the exchange of information, allowing students to define and communicate their interests, viewpoints and experiences. Students and community stakeholders can understand the critical role historical structures play in the environment to spur advocacy. A comparative study attempts to reveal common models and to distinguish specific characteristics of each location, looking at issues related to sustainable regeneration in post-pandemic, climate change times, and using this as a way to empower students to develop common narratives that build common understanding of architecture and place.

Sugar company towns, which flourished in Brazil from 1910 to1945, are a small-scale urban-rural hybrid with agricultural, industrial, and residential features. Sugar plantations based on slavery were often the starting point for the development of many company towns, which grew out of the modernization of sugar production in rural areas. These settlements juxtaposed industrial (urban) and rural (country) aspects. According to Mário de Melo, the sugarcane agro-industry generated a "sugar civilization," which imprinted particular characteristics on the area where it was implanted in an almost irreversible way. [3]

Figure 1. The Imperial Sugar Company, Sugar Land, Texas, USA
Credits: Gabriela Campagnol

These post industrial sites are prime examples in the rehabilitation process of the industrial heritage. The history of the Engenho Central de Piracicaba, a former sugar factory and refinery that operated from 1881 to 1974, provides an instructive example of the complex issues involved in adaptive reuse. Since the 1980s the site and its fate have been the subject of political controversies and stewardship debates, resulting in several rehabilitation plans by renowned Brazilian architects. Among the most recent developments have been a theater, which opened in 2012, and a project for a Museum of Sugar, currently in progress.[4] Through an examination of the professional design approaches proposed for the rehabilitation of the sugar heritage, this study addresses the consequences of the disappearance of industrial buildings in general and examines the role played by architects and planners in defining the contribution of industrial heritage to contemporary (and future) urban identity.

Sugar Land flourished as a model company town for the Imperial Sugar Company, the first sugar refinery in Texas and the oldest extant business in the state (Figure 1). But before it became in the 1920s one of the "best planned and equipped communities" in Texas for its size, Sugar Land had been called the "hell-hole of the Brazos," defined by its dependence on convict labor and its identity as a segregated community. Under the impact of Houston's expansion in the 1950s, it changed status. In 2002, activities in the refinery ended, so that its original identity and history, connected to the sugar industry, has been weakened. The area has been on the verge of redevelopment and included in the National Register of Historic Places in 2017. The plan for Sugar Land's district forms an important case study of a defiant industrial structure on the bend of Oyster Creek, subject to flooding, as well as of urban rehabilitation strategies. In its heyday, Sugar Land demonstrated industrial features and residential characteristics like other sugar towns in South America, the Caribbean, and the United States. Now considered "one of the fastest growing cities in America," Sugar Land has lost its historic

identity and is easily mistaken as one of Houston's suburbs. Sugar production and changing attitudes towards the workforce were central to the generation of housing and urban form for white, African American, and Hispanic workers in Texas. [5]

Puerto Rico built several sugar mills around the start of the 20th century as part of American-led economic efforts, leaving a stock of post-industrial buildings when the industry faded. One example is Salinas' La Centrál Aguirre. Hacienda Aguirre's makeover and development in 1899 created this sugar mill and company town. These abandoned post-industrial buildings shaped this city's culture and represent the US's political and economic ties with one of its most significant Caribbean colonies. A relationship with advantages and challenges. The major industrial buildings and numerous adjacent structures, such as administrators' residences, workers' housing, hospital, theater, and hotel, continue to decline due to a lack of preservation measures, governmental failures, the economic crisis, and natural factors. Hurricane Maria (2017) and the 2020 earthquakes exacerbated this neglected landscape.

Architecture educators must create effective design learning experiences to help students develop attitudes and create strategies that match them. Architects face many ethical dilemmas when deciding whether to demolish a building to make room for a new one. Unprotected historical buildings, which aren't safeguarded by historical preservation ordinances, may contribute to the urban fabric in ways that are hard to monetize. There are towns such as the company town of Central Aguirre where losing its main iconic structure may substantially affect the urban character of the town, both physically and emotionally. How do students carry these messages? Through targeted research exercises, students could realize how to promote cultural heritage as an indispensable component of livable, sustainable communities and the significance of these historic resources in order to propose different program narratives that could bring them back to life. In addition, students must also identify community leaders in order to facilitate community contacts to capture stories that are not necessarily found in academic history books, but bring knowledge that enriches the histories of the structures and help in the narratives and creative process for various design strategies. Moreover, these design exercises, mapping of buildings "at risk,'' producing analytical visual material, identifying potential partners, media channels, and allies to support their proposal, may yield the best potential to communicate these historical structures' critical role in society.

Before the structures of post-industrial abandoned buildings continue to degrade to the point where they are rendered utterly unusable and become an eyesore in the environment, architects play a vital role in the process of developing ideas and advocating for the preservation and repurposing of the post-industrial heritage that many cities across the world have inherited. Architects shall contribute to the spatial narratives that make up the city's fabric; they should conceive designs

Figure 2. Central Aguirre after Hurricane Maria.
Credits: Awilda Rodriguez Carrion

that honor old narratives while creating new ones. Aldo Rossi, the first Italian architect to win the Pritzker Award, argued that a building should be capable of accommodating a variety of functions independent of its original form throughout its existence. The form is precisely what the observer sees and experiences. However, knowing and highlighting the original stories behind these spatial experiences deepens the meaning of these structures beyond tangibility. French sociologist Maurice Halbwachs, known for developing the concept of "collective memory" considered memories to persist only in the longue durée if they are encoded into architectural spaces and mapped into urban and historical topographies. As Halbwachs states, "while the collective memory endures and draws strength from its base in a coherent body of people, it is individuals as group members who remember." [6] Therefore, individual citizens know and maintain urban narratives. Moreover, Rossi believed that for a structure to obtain a meaningful identity within a city, it must develop in both the spatial and temporal dimensions; this is how the structure imprints itself on the collective memory of the city. Conservationists raised awareness and respect for spaces' uniqueness and history, which helped shape the modern urban design concept, emphasizing "continuity with" rather than "break from" the past. [7] Visual, physical evidence of the past is valued for its sense of place and lasting character and identity in a constantly evolving environment. [8] The architect must access this community-wide information base in various ways. Thus, community involvement is necessary for post-industrial heritage adaptive reuse. Architecture students (arch. students) must be prepared to become citizen-architects who can cultivate clients' and stakeholders' appreciation for post-industrial legacy and cultural heritage and create space to express the diversity of voices that were integral to spatial creation. These industrial building complexes or company towns sometimes founded and organized the city, that is the case of Central Aguirre Sugar Mill.

SUGAR CANE INDUSTRY IN PUERTO RICO AND

CLIMATE CHANGE

Puerto Rico has been cultivating sugarcane since the 16th century. In early 1899, Ford & Company founded La Centrál Aguirre Sugar Mills on the Island, which prospered under Spanish authority. The corporate town featured telegraph, stores, hotel, movie theater, post office, social clubs, school, churches, golf course, hospital, and administrative personnel housing. Aguirre became a self-contained town within a town. [9] La Centrál Aguirre was included on the US National Register of Historic Places in 2002 (Figure 2); but the mill faces several challenges today and in the future, including the country's economic crisis, climate change, and coastal zone gentrification. Climate change threatens cultural heritage sites especially when governments have a fiscal crisis and need to prioritized spending needs.

In 2017, Hurricanes Maria and Irma caused significant disruptions and damage to the Island, already suffering from an economic emergency. It created a humanitarian crisis that directly affected many Puerto Ricans, including the citizens from the La Centrál Aguirre company town. Reconstruction of historic structures and recovery efforts has been riddled with U.S. corporate and local Puerto Rican government corruption.[10] Three years later, a series of powerful earthquakes struck the Island's southwestern side, including one measuring 6.4 on the Richter scale. These last natural disasters further damaged La Centrál Aguirre Company town. Today, many buildings remain vulnerable to future earthquakes. The road to recovery became more difficult and expensive with each catastrophic stroke. Addressing the impacts of climate change on cultural heritage sites requires a combination of mitigation and adaptation strategies. International collaborations and the involvement of local communities are crucial in safeguarding and protecting these valuable cultural assets for future generations.

CULTIVATING A RHETORIC TOWARDS ADVOCACY AND ACTIVISTS THROUGH STUDIO COLLABORATION FRAMEWORK

The spatial practice of architecture is political. Sites and buildings provide narratives with which architects can either concur and enhance or dispute and provide alternative narratives. Educators' role is to facilitate understanding how constructed environments and architecture carry political overtones that sometimes are outside the designer's control but could be influenced by other stakeholders. Architects occupy a unique place as interpreters of complex and bureaucratic procedures. Architects explain their position concerning various domains of knowledge that govern and exist in the spatial realm.

Consequently, it is the architect's responsibility to ensure that the processes of design and the concepts behind a particular building project are successfully integrated. [11] Buildings become actors capable of forming and constructing democratic societies that unite people, yet they may also separate and facilitate the surveillance of individuals. Architects are at the center of the power structure. The ties between the architecture

profession and society shall be examined through the power struggles of achieving the many goals and demands not only of the immediate users, building codes, and materials but also of the ethical responsibility of how we build impacts the world. Therefore, one may argue that politics and ethics need a more prominent place in architectural education. As citizens first and architects second, we must advocate for the "right doing" and expose any wrongdoing, including governmental failures or corruption. The process of architectural research and analysis exposes the political and power structures that govern space, and through more careful analysis, it uncovers the historical or current injustices.

This section discusses the initial pilot exercises for a cross-cultural collaborative learning research framework—a research project for a conceptual pedagogical model to cultivate rhetoric toward advocacy and resilient design. The dynamics of architectural practice inform academic collaboration, which entails discussing, negotiating, [12] and acquiring a clear understanding of the end-user perspectives that lead to the design of real-world challenges. Collaboration is a personal and synergistic process of building a relationship. [13] These interactions can help arch. students depart from merely questioning technical inquiries by creating a dialogue space to uncover the context "sites of memory." Who are the keepers of "the memory of place"? Architects need to translate the urban memory to maintain the authentic identity and legacy of the place. Public memory and spaces have the scars of political oppression and resistance. Recent experience has shown that reckless designs for architectural restoration to "reconstruct history" or the "Disneyfication" of history may damage societal memory by imposing a design "amnesia." Memories are socially generated, disparate, and intimately related to architecture, urban environments, and people. [14] Therefore, when designing interventions, how do students understand all the "collective memory" that sometimes carries traumas they have not experienced? Students make deeper connections through the types of collaborations and frameworks curated by faculty that could facilitate arch design.

Over the past decade, new design trends have highlighted design's ethical obligation and promoted social fairness. Community engagement, programming, and post-occupancy reviews have democratized design. Participatory design lets users, customers, and community members shape the architecture. This approach is crucial when engaging with disadvantaged subcultures. The unforeseen cost of restoring National Register of Historic Places buildings is high. Many rules slow the process, making it hard for common residents to participate, and require lengthy and expensive bureaucratic procedures. Students used infographics (IG) and photovoice (PV) to create design concepts in this undergraduate studio for nine years.

METHODS AND FRAMEWORK OF THE LONGITUDINAL

RESEARCH

As mentioned, the design of several collaborations dealing with diverse cultural and social challenges has allowed the faculty to develop products that facilitate the narratives' flows. This later collaboration, "Laboratorio Impacto (LABI), is tied to a larger research project that involves the local Puerto Rico government, HS students, and arch. students. The LABI research partnership and its one-year curriculum engage with Puerto Rican high school-age students on a six-unit learning workshop, activities, and a practicum where learners will work in the community to design-build small constructions while learning resilient methods.

The collaborative pedagogy is the focus of Unit One of a larger three-year cycle of a smart device STEM-based curriculum. The pedagogy framework engages High School (HS) students and architecture with the faculty as mediators in participatory action research, utilizing "Deep mapping" and spatial storytelling to understand better the lived experiences of people from this underrepresented and underserved population. Beyond capturing these stories, the research seeks to measure the empowerment of participants and their involvement and commitment toward social change through deep mapping (Figure 3). The H.S. students have empirical knowledge of the climate and context. They can assist the arch. students with a design where they will map hazards, damage, and exposure of the existing structures through a GIS map linked with qualitative information. Deep mapping is a participatory action research strategy that can contribute to youth mobilization for community change. [15] This strategy can enable youth to storytelling their community's strengths and concerns while promoting critical dialogue and knowledge about community issues.

Figure 3. Design Studio & HL Framework. Credits: Awilda Rodriguez Carrion

The theoretical background for this research proposal focused on horizontal learning (HL); HL pedagogy aligns with constructivist and socio-cultural theories of learning, emphasizing the social.

ECONOMIC STATUS + DEMOGRAPHICS

PRE-HURRICANE MARIA

In the years leading up to 2017, Puerto Rico profitted heavily from pharmaceuticals & tourism. Pharmaceuticals represented 72% of Puerto Rico's 2016 exports, valued at 14.5 billion. Tourism contributed nearly $4 billion to Puerto Rico's economy.

Number of People Working in Different Industries Pre-Hurricane Maria

12,327 Retail Trade
13,490 Educational Services
14,954 Health Care & Social Assistance
38 K Pharmaceuticals
80 k Tourism

Population 3.337 Million
Median Household Income $22,729
Number of Households 143 K
Median Property Value $152,400

Pharmaceuticals represented 25% of total U.S. pharmaceutical exports
Tourism made roughly 10% of Puerto Rico's economy
11 new airlines in the past 3 years
Number one home port confirmed for cruise ships

Poverty Rates in Puerto Rico Over Time

Numerous employees living near Abbvie's site in Jayuya went without power 11 months after the Hurricane

Puerto Rico's Major Pharmaceutical Locations

Barceloneta
Vega Baja
San Juan
Guaynabo
Carolina
Jayuya
Juncos
Las Piedras
El Yunque rain forest

Peak wind in kph
154 167 178 209 246

Path of Hurricane Maria

POST-HURRICANE MARIA

Puerto Rico's economic recession & the impact of Hurricane Maria led to depopulation and job loss. This resulted in a decline equity values and foreclosures. The housing stock took a tremendous loss due to Hurricane Maria, which devastated the island on September 20, 2017.

Population Change In Puerto Rico
2000 to 2010   2000 to current
Net natural change   Net migration

Population 3.195 Million
Median Household Income $20,078
Number of Households 135k
Median Property Value $116,750

Pharmaceutical industry took over a $60 billion dollar hit
Tourism lost over $1 billion in revenue
Six of the largest airlines in the country lost more than $550 million in 2017
Cruise ship passengers declined by over 59%

Pharmaceutical Industry Loss
Pfizer   Amgen   Patheon   Sartorius

Merck & Co was forced to ship over a 1,500-kW generator from its West Point site to support its operations in Las Piedras

Tourism Statistics
$3,800,000,000
$3,600,000,000
$3,400,000,000
$3,200,000,000
$3,000,000,000
2012 2013 2014 2015 2016 2017 2018

82% of powerlines were destroyed
1/3 of Hotels were forced to close
El Yunque National Forest experienced massive defoliation & landslides
Many restaurants remained closed

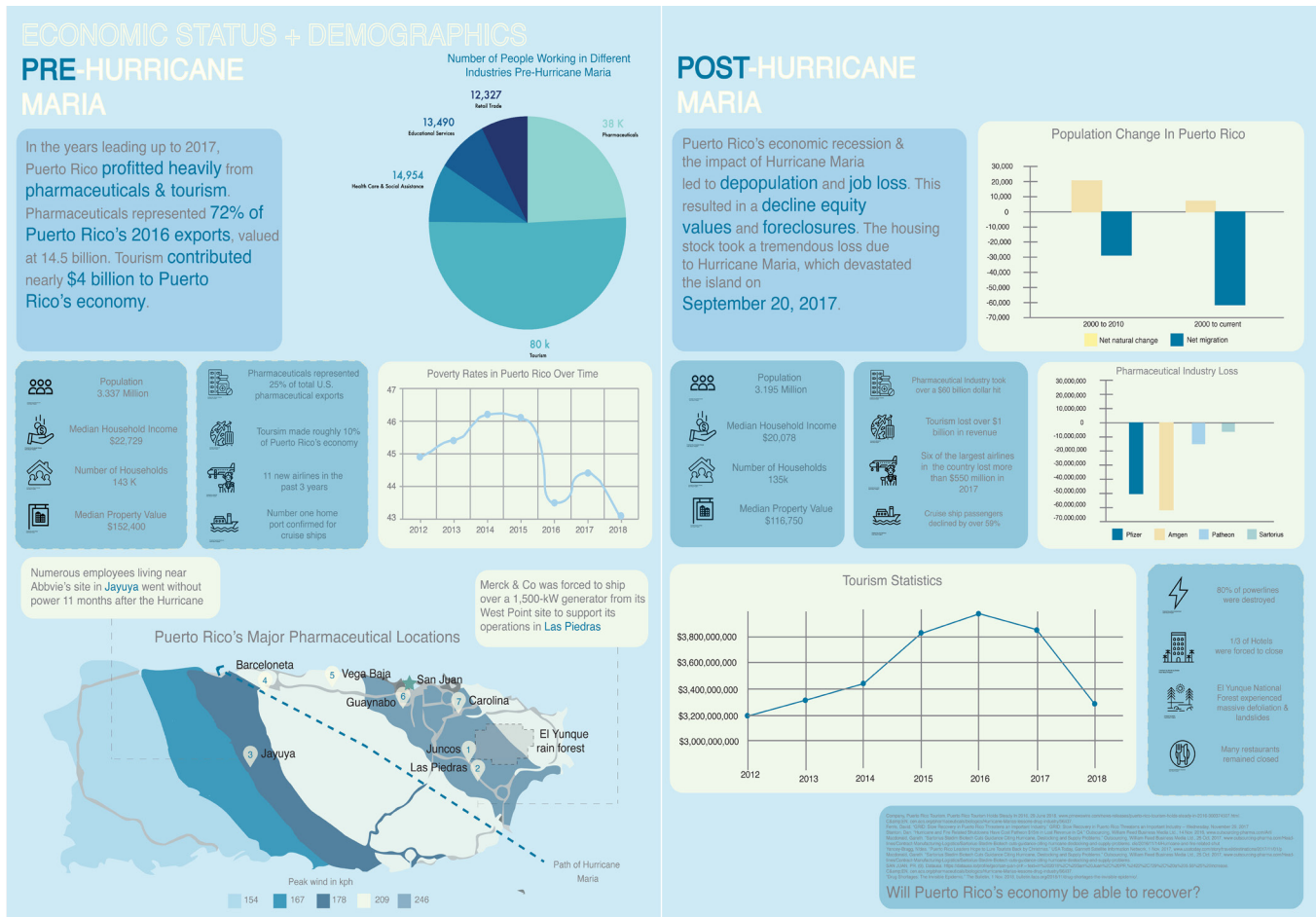Will Puerto Rico's economy be able to recover?

Figure 4. Architecture students advocacy infographics. Credits: Awilda Rodriguez Carrion

and contextual nature of knowledge construction. It promotes learner autonomy, collaboration, and the development of critical thinking and problem-solving skills. HL encourages a more democratic and inclusive approach to education. Therefore, effectively communicating with the local citizens and educating them in the specialized terminology used in architecture and planning is an essential step to enable them to participate and give them the ability to take action. In today's world, connecting and gaining knowledge are rapidly becoming integral to our digital society. The rise of social media and other digital technologies impacts the transmission of information and the way we communicate. To place students in authentic learning environments, it is essential to construct learning experiences that combine actual and virtual learning environments. Seamless learning, which overlaps with mobile learning and ubiquitous learning, is a model that allows learners to learn across time and locations and switch between formal and informal, individual and social learning scenarios using a smart personal device. [16] Mobile phones and other smart devices, such as tablets, have been augmented with augmented reality (AR) capabilities and applications. These are being utilized in various fields to teach and

connect with individuals. The use of AR to communicate the value of cultural heritage sites has also gained a following, particularly among the entities that make up museums. The application of AR provides opportunities to engage with others and inform them in novel ways, potentially increasing both economic value and epistemic significance. In the following sections, we will briefly present three exercises, IG, PV, and AR, that narrate different contextual information. Investigate how AR encourages mobile users to develop an appreciation for cultural heritage and communicate heritage sites' historical and cultural breadth.

Exercise Study 1: Infographic

IG is an efficient visual representation of information that uses visual relationships to make an argument. It provides one way to accomplish this goal that engages the learners in research and writing as creating, not just reporting. Indeed, we can argue that infographics can teach students "design thinking," an invention strategy that asks writers to explore multiple composing possibilities and to see design as a critical strategy connecting multimodal and alphabetic essay assignments. [17] The infographic exercise allowed students to learn design thinking, engaging in questions regarding information literacy and the ethics and possibilities of composing for a public audience. After examining research papers and public documents facilitated by the faculty, students identified the topics they wished to analyze and explained how these topics may affect community stakeholders. Students identified media platforms like Instagram and other social media as public discussion forums. They developed content to engage individuals in social media and advocated for a public forum to raise awareness about issues that are important to them. Previous Figure 4, illustrates a case study of architecture students interacting with locals to produce infographics that delved into social, cultural, or economic aspects of the local context.

Exercise Study 2: Photovoice

Photovoice, a form of participatory action research, has been used by researchers to better understand the lived experiences of people from underrepresented and underserved populations. Beyond capturing these experiences, Photovoice seeks to empower participants and help facilitate positive social change. With a cohort of 13 arch students, this exercise asked them to identify a problem in their environment and document it only using photographs. Once the students identified various challenges in their environment, they ranked which one affected them the most in their daily lives. As Hergenrather originally established we use the same questions: What do you See here? 2. What is really Happening here? 3. How does this relate to Our lives? 4. Why does this concern, situation, strength exist? 5. How can we become Empowered through our new understanding? 6. What can we Do? [18] Photovoice allowed the students to develop their personal and social identities, comment on their experiences and insights, and develop a social morality that could stimulate them to become positive agents in their environment. Through open discussion of the challenge or the problem they identified students brought different opinions and discussed them. The exercise forced them to take a position on the issue, and within that position make recommendations on how to overcome the challenge. Faculty referred to a non-judgmental approach to the different perspectives being discussed.

Exercise Study 3: Augmented Reality Test

By creating immersive and interactive digital experiences that can bring artifacts and historic sites to life, augmented reality is increasingly used to improve cultural heritage experiences. AR can be used to enrich cultural heritage in a variety of ways, including immersive and interactive learning experiences that engage students and facilitate their comprehension of complex topics, which could transform education. When students cannot visit the project site, obtaining an understanding of the immediate context is one of the most challenging tasks. The significance of spatial movement and in-situ awareness when using an augmented reality application was evident in our preliminary design research. Even though the exercise's primary focus was a technical narrative, it enhanced the learner's comprehension of how a proposed design feels on site and how the surrounding environment influences it. HS students using the AR application can wander through the real world and observe and capture virtual design proposals. The exercise was conducted with graduate students using a prototype augmented reality (AR) application, allowing the students to construct a wall assembly in the actual environment and guiding the correct relationship between the primary components of a hurricane-resistant wall design (Figure 5). AR collaborations, on a practical level cannot completely supplant face-to-face collaboration and offers only limited experience, but it does provide essential mechanisms and opportunities that were not previously available. [19]

The experiential augmented environment can allow for the emotional, sensual, and immaterial to form a non-reductionist, dimensionally multifaceted setting. Thus, it is possible to explore the material, intangible, and symbolic aspects of a site and create spatial stories embedded within those geographies that encompass emotions and site-specific qualities far beyond the representational dimensionality of a two-dimensional map. [20]

CONCLUSION

Cross-cultural collaborative environments supported by emerging technology such as AR for design teaching may reduce the cognitive burden and help students make sense of cross-cultural context from afar and build advocacy attitudes. Deep mapping could extend students' learning experiences and could help them develop emotionally and cognitively through the process of visually storyboarding ephemeral knowledge collected from the collective intelligence interactions. A deep map is not merely a digital map; it is a multilayered construction of meaning and process. [21] Design narratives in their various formats, as illustrated previously, allowed students to work together and learn flexibly, fostering personal and collective intelligence. Creating a framework to raise student expectations where they can understand the value that industrial heritage has to the community and tap into those narratives to inform design decisions as well as advocate for their preservation. The three exercises engaged students as storytellers using the design data exploration process as a way to expose the perspectives of others, construct shared ideals, and examine narratives based on a collective memory that could be better informed

Figure 5. AR pilot construction assembly test.
 Credits: Awilda Rodriguez Carrion.

with community participation. Consequently, the results of the exercises directly informed the design for the Unit One-Deep Mapping , that involves qualitative data that can be transformed into visual narratives, and will be the methodology used for the longitudinal research. These visual storytelling products supported the exchange of knowledge by embracing diverse interests, perspectives, and experiences, thereby promoting diversity and advocacy towards preservation of the sugar industrial heritage.

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