

# Infilling the Missing Middle: Leveraging Scripting Tools to Identify Small-Scale Odd Lots

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**Exploring the infill housing capacity of small-scale oddly shaped lots to address cities' demand for the "missing middle," this paper documents the methods and results of a Spring 2023 second-year Master of Architecture studio. The studio leveraged small-scale odd lots to provide innovative housing solutions for downtown urban areas. The investigation frames the development of digital cartographic tools as a way to disrupt the lack of housing options in many cities today. Students in this course developed custom mapping tools that analyzed GIS data and shape metrics to locate a set of parcels for testing and applying architectural strategies at an urban scale.**

## INTRODUCTION

This paper examines the potential for small-scale oddly shaped lots to address cities' need for "missing middle" housing options through infill development. Defined as "a range of multiunit or clustered housing types, compatible in scale with single-family homes," missing middle housing bridges the gap between single-family homes and apartment buildings to "meet the growing demand for walkable urban living, respond to shifting household demographics, and meet the need for more housing choices at different price points."<sup>1</sup> This investigation frames the development of digital cartographic scripting tools as a way to disrupt the lack of housing options in many cities today. By utilizing these software tools to identify small-scale odd lots, architects can engage planners and developers to create diverse housing types currently not being offered through public and private development.

The paper will document the methods and results of a Spring 2023 second-year Master of Architecture studio that utilized small-scale odd lots to provide innovative housing solutions for downtown urban areas. Infill housing development is gaining momentum in many cities as seen recently in Chicago's Come Home: Missing Middle Infill Housing competition and Los Angeles's Low-Rise: Housing Ideas for Los Angeles design challenge.<sup>2</sup> In this course students developed custom mapping tools that analyzed GIS data and shape metrics to locate a set

of parcels for testing and applying architectural strategies at an urban scale.

The studio was situated in Lubbock, Texas—one of the fastest growing cities in the state—and responded to its recently adopted master plan and new form-based zoning code. In the first phase, students worked in teams to conduct case studies on precedent projects to develop rule sets for describing and measuring odd lots. In the second phase students worked collectively to learn and develop computational cartographic tools for identifying and representing downtown small-scale odd lots and their potential buildable massing. In the third phase students worked independently to customize the mapping tool to identify and rank a set of thirty-six parcels that best addressed a housing demographic of their own choosing. In the final phase students developed a design strategy that was applied at an urban scale across all thirty-six sites and at an architectural scale among two select parcels. In parallel to the work in studio, students engaged with city officials from the Tax Increment Financing District and Planning Department to understand local policy plans for future urban growth. Additionally, over spring break students visited New Orleans to study contemporary projects that make use of leftover lots to provide novel housing solutions within the city.

This studio was conducted in collaboration with the City of Lubbock, and final projects were presented by students to a group of city officials that included the City Council, the TIF District Board, and local real-estate professionals. This paper will document the studio's methodology, student outcomes, and discuss the ways the integrated approach developed within the class can serve as a method for leveraging scripting tools to develop missing middle housing solutions in urban areas.

## CONTEXT

The shifting economic and urban landscape in recent years has resulted in both a shortage and lack of diversity in housing options in the United States' downtowns. This paper references two emerging housing trends—the "missing middle" and small-scale infill housing—to identify needed types and how the introduction of digital cartographic tools can serve to identify specific urban sites that can provide novel architectural solutions to address this deficit. By more thoroughly understanding the issues

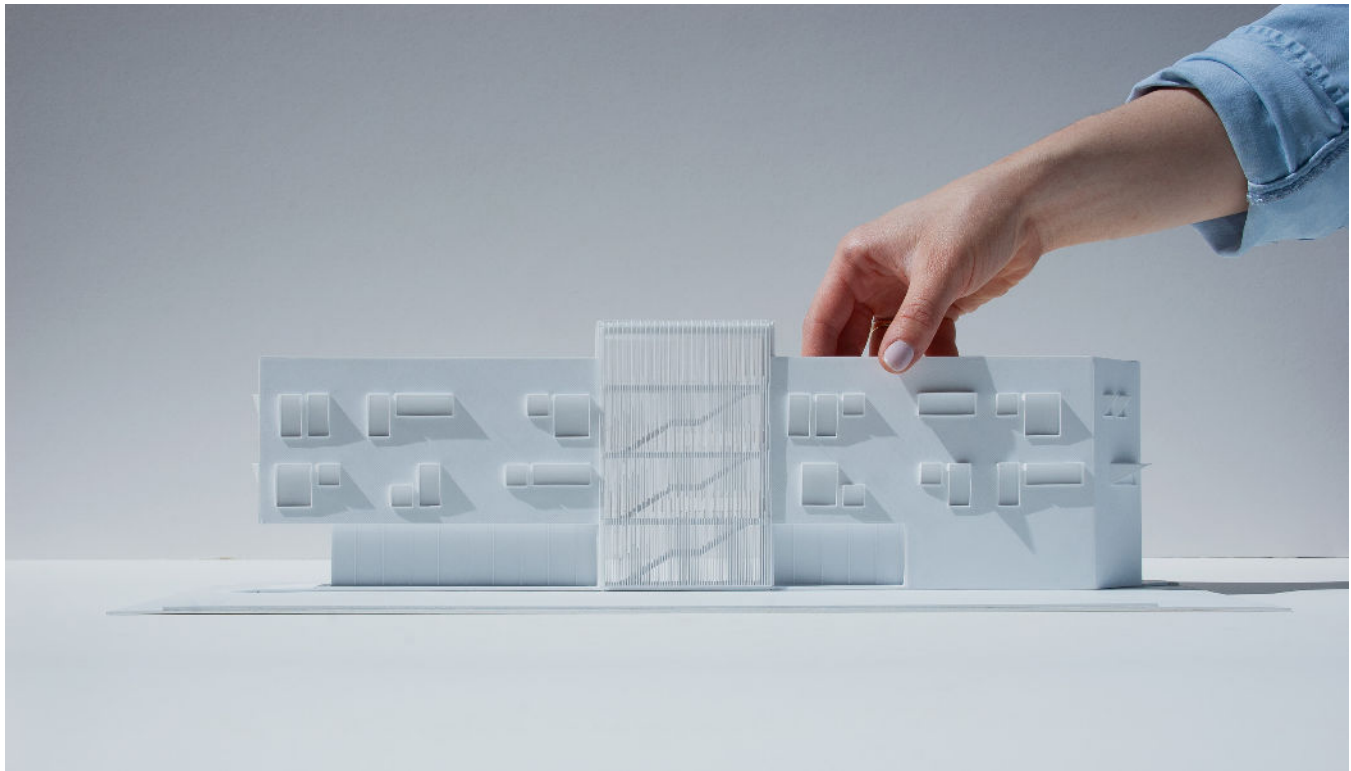


Figure 1. Model photo of a student proposal for “missing middle” housing on a small-scale oddly shaped lot. Student work by Meagan Matthews.

behind the lack of housing options in our cities, architects can be more targeted and responsive in their strategies to address these challenges. This research frames small-scale oddly shaped vacant sites as latent opportunities for the discipline to play a proactive role in the construction of needed housing types. By creating methodologies and tools for identifying parcels that align with emerging housing trends, architects can become empowered to advocate for design considerations earlier in the development process.

Recent attention on the “missing middle” recognizes the lack of diverse housing options available that support a multitude of ways of living in our cities. In the context of this housing approach, the term “middle” means both “the middle scale of buildings between single-family homes and large apartment or condo buildings,” and it also refers to the “affordability or affordability level” of the units.<sup>3</sup> The category encompasses “duplexes, fourplexes, cottage courts, and courtyard buildings,” types that “provide more housing choices and can help people to stay in the neighborhood as their lifestyle needs to change.”<sup>4</sup> Once a common set of housing types throughout the country that provided homeowners a simultaneous place to live and a revenue stream through rentable units, new construction of missing middle residences has been limited by the increased adoption of post-war use-based zoning policies, the growing scarcity of undeveloped parcels (especially in urban areas), and the growing cost of development. While interest in the missing middle reveals blind spots in cities’ current housing options, it simultaneously highlights

challenges from a planning, land scarcity, and economic perspective that must be overcome in order to achieve this need for increased housing diversity.

As a complement to the missing middle, another emerging housing trend is leveraging small-scale infill development to provide novel housing solutions. Already a prevalent phenomenon in Asian Pacific cities as documented by Atelier Bow-Wow’s *Pet Architecture Guidebook*, infill development has increasingly been adopted in the United States as a housing strategy to grow the housing stock in densely developed cities.<sup>5</sup> The work of Office of Jonathan Tate (OJT) is one example of an emerging practice that strategically responds to the scarcity of housing options by focusing on small-scale oddly shaped lots as sites for future starter homes. By identifying the single-family starter home as a foundational cultural and economic component of the United States’ housing market, OJT’s research reveals the misalignments between the needs and lifestyles of today’s populace and cities’ limited housing stock. In its research, OJT identifies two challenges associated with generating new starter homes in urban downtown settings: 1) the “transition from home as consumption good to home as investment commodity” has led to unsustainable large dwellings from both an economic and environmental standpoint, and 2) these oversized homes preclude starter homes from “metropolitan areas” in which they “could most directly benefit first-time homebuyers.”<sup>6</sup> OJT identifies small-scale “non-conforming” odd lots as an opportunity to strategically bring the starter home type in

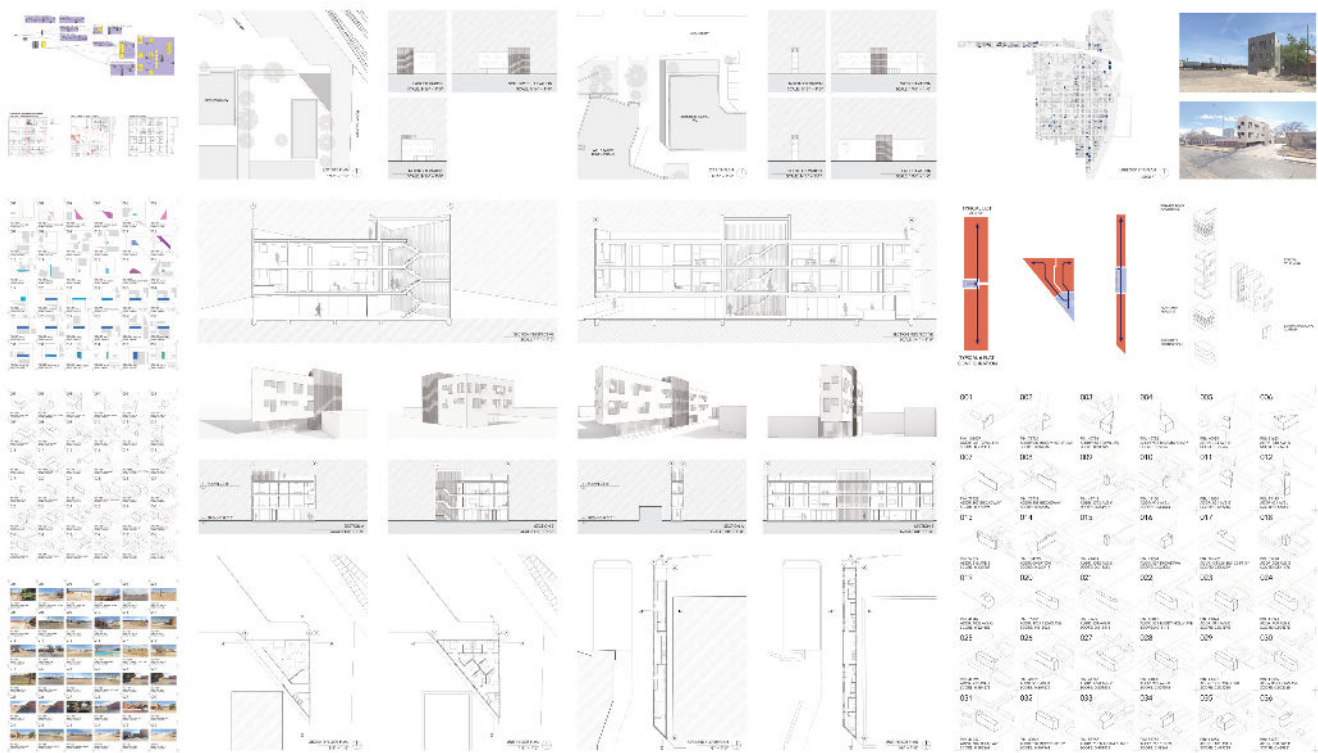


Figure 2. Presentation board of a student housing proposal for two small-scale odd lot sites. Student work by Meagan Matthews.

alignment with urban living by drawing upon the “metro area as an invaluable amenity” and the economic advantages from “transportation, construction, and land costs” associated with these sites.<sup>7</sup> Urbanistic benefits of this method further help to “define the center” of cities by locating dwellings near Central Business Districts and achieving “strength in numbers” through an economy of scale.<sup>8</sup> The studio applies these principles in its practice as best exemplified by its first starter home project, 3106 St. Thomas Street. In this project the office partnered with a local developer to design and develop a 916 square-foot (net) dwelling on a sixteen-foot five-inch wide lot with no variances. While OJT’s starter home approach involves a different housing type than the missing middle, it does provide a strategy to address the challenges facing such multi-unit dwellings by taking advantage of leftover lots as latent development opportunities.

The potential for leftover small-scale odd lots to address the challenges associated with developing missing middle housing is best exemplified by several initiatives in major metropolitan cities. The Chicago Architecture Center’s 2023 Come Home Chicago: Missing Middle Infill Housing competition is one example that sought to “reverse decades of disinvestment and depopulation and transform the urban fabric of Chicago’s South and West Side neighborhoods.”<sup>9</sup> It invited architects to submit proposals for “Chicago’s single family home, two and three-flat, rowhouse and six-flat typologies to better meet 21st century lifestyles.”<sup>10</sup> The forty-two shortlisted participants included OJT, Höweler + Yoon, Kevin Daly Architects, Kwong Von Glinow, Lorcan O’Herlihy

Architects (LOHA), Merge Architects, MOS, NADAAA, and many more that rethought missing middle types within the context of Chicago. Another example was the Low-Rise: Housing Ideas for Los Angeles design challenge held in 2021 by the Office of Los Angeles Mayor Garcetti and Chief Design Officer, Christopher Hawthorne. Focusing on infill housing for low-rise districts, the competition sought to “promote housing affordability, new paths to home ownership, and innovate models of sustainable residential architecture.”<sup>11</sup> Entrants were invited to submit under the categories Corners, Fourplex, (Re)Distribution, and Subdivision and explored architectural strategies for adding density to the city’s low-rise districts that make up “more than three-quarters of the residentially zoned land in Los Angeles.”<sup>12</sup> Both initiatives highlight the opportunities for design innovation afforded by integrating missing middle typologies with infill development and signal a need to identify sites supportive of this approach.

## METHODOLOGY

Architecture Design + Research II is a six-credit hour studio for second-year Master of Architecture students enrolled at Texas Tech University’s Huckabee College of Architecture. This was the second iteration of a multi-year study in which students develop custom digital cartographic tools to identify small-scale odd lots for increasing cities’ density. The bespoke mapping scripts developed in this course analyzed GIS data of a local city to identify and evaluate small-scale odd lots as candidates for testing and applying architectural strategies at an urban scale.

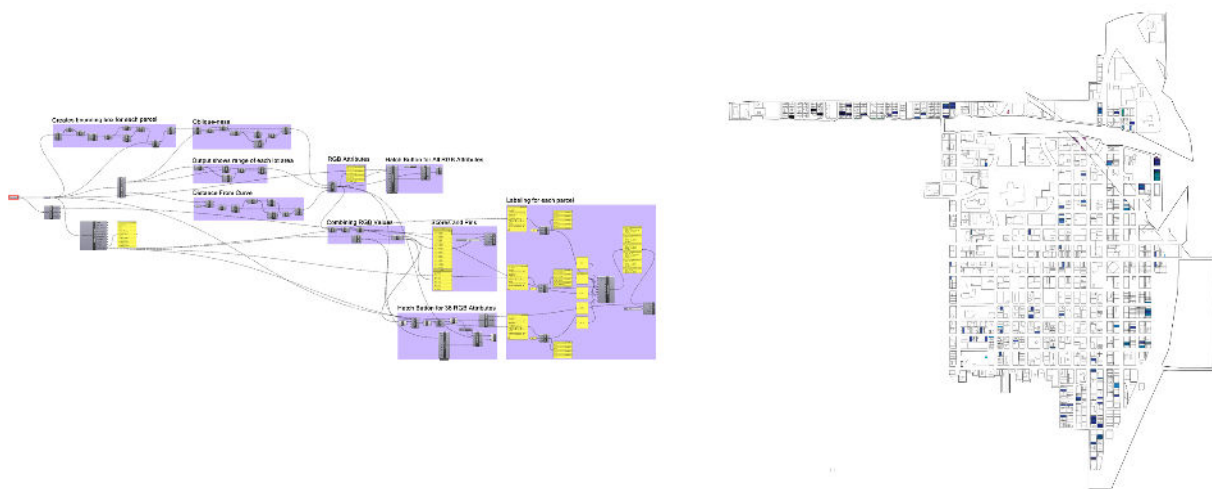


Figure 3. Student developed Grasshopper definition (left) and map of small-scale odd lot parcels (right). Student work by Meagan Matthews.

A new focus for this iteration of the studio was missing middle housing and how the students' digital cartographic mapping scripts could search for small-scale oddly shaped lots that support these housing types. As a methodology, three core components combined to provide students a holistic understanding of the issues associated with developing missing middle housing on these parcels. The first was the learning and application of computational design skills and concepts into the design of mapping scripts to define, identify, and evaluate small-scale odd lots from a top down approach. The second was the studio's consistent engagement with local city officials from the Tax Increment Finance (TIF) District and Planning Department throughout the semester to understand and contextualize students' design strategies with the policies and vision of the City. The third was a studio trip to New Orleans to visit a series of housing precedents that included OJT's small-scale odd lot infill projects that allowed students to develop a bottom-up understanding of the design, development, and construction logics involved in missing middle infill development and experience architectural strategies for designing for such conditions.

#### Course Structure

The studio was designed to build upon foundational computational design skills and conceptual thinking developed earlier in the graduate curriculum and apply them in a design studio setting. In this course Rhino's parametric modeling tool Grasshopper was used to translate design criteria for small-scale odd lots and missing middle housing types into a set of parameters for parsing through GIS shapefile data and creating a set of parcels for exploring innovative housing solutions (Figure 1 and 2). The student learning for the course were: 1) understand how digital cartography can be leveraged to engage the disciplines of landscape architecture, planning, and urban design; 2) apply digital cartography methods to develop tools for mapping architectural and urban relationships across large scales; 3) analyze

geospatial data using a set of design criteria to reveal latent design opportunities for housing at the urban scale; 4) evaluate opportunities for architectural interventions through a well-developed research question focusing on a specific housing type and demographic; and 5) create novel strategies for increasing cities' housing supply through small-scale odd lot developments.

In Assignment 01: Case Study Analysis, students worked in groups to study a set of precedents in order to understand and develop a set of rules for defining small-scale odd lots. The assigned projects for this exercise were Gordon Matta-Clark's *Reality Properties: Fake Estates* (1973), Atelier Bow-Wow's *Pet Architecture Guide Book* (2001), OJT's *The Starter Home\** (2015), and Nicholas de Monchaux's *Local Code: 3,659 Proposals About Data, Design, and the Nature of Cities* (2016). Through their analyses each group sought to answer the following to define attributes of small-scale odd lots: 1) where are the lots located within their urban setting, 2) how are the lots' geometry and form determined by their urban conditions, 3) what are the defining constraints for each lot, and 4) what potential contributions do these lots make to their surrounding urban context.

In Assignment 02: Odd Lot Atlas, students again worked in teams to study the local city context with the aim to develop a method for identifying small-scale odd lots in downtown. The four areas of research the groups focused on were: 1) the creation of a custom script for identifying small-scale odd lots, 2) the city's urban morphology and current housing situation, 3) the City's 2040 Comprehensive Plan and Downtown Master Plan for future development, and 4) the City's current zoning code and proposed form-based Unified Development Code (UDC).

The script developed by the scripting team was used to create an Odd Lot Atlas of vacant parcels in the TIF District that were ranked according to a set of parameters defined by the





Figure 4. Spring 2023 New Orleans studio trip to visit housing precedents by Office of Jonathan Tate.

lot searching tool. The class then collectively applied the research by the zoning team to represent each site's buildable area per the UDC.

In Assignment 03: Thirty-Six Lots, students worked individually to identify small-scale odd lots as potential sites for future sites. Each student developed a research question focusing on how small-scale odd lots can be developed into housing for a specific demographic and housing type of their own choosing. Using their question as a framework and guide for their research, students customized the mapping script generated in Assignment 02 to search for a set of thirty-six sites that best fit a set of criteria responsive to their focused demographic and housing type (Figure 3).

In Assignment 04: Thirty Six Views, students worked individually to develop an innovative architectural strategy to be applied on all thirty-six sites that addressed the issues related to their specific housing type and demographic. Students generated massings for each of their sites that operated at the urban scale. Students then selected two separate sites for two architectural proposals that developed the urban massings in greater depth. One difference that took place in this second iteration of the studio was the emphasis on the missing middle. Students were encouraged to research this housing approach to develop their urban and architectural strategies, and the class followed the emerging proposals from the Chicago Come Home design competition that was taking place concurrently during the semester.

Through these series of assignments, students moved from developing an understanding of what constitutes a small-scale odd lot, to applying that understanding in the scripting and searching for a set of lots supportive of missing middle developments, and then creating an innovative urban and architectural proposal for realizing missing middle housing on downtown infill sites.

### *City Engagement*

In parallel to the studio assignments, students had the opportunity to understand the policies and processes involved in development by engaging with city officials throughout the semester. The City of Lubbock's Business Development Director, Director of Planning, and Neighborhood Planner were a consistent presence, providing feedback to students and answering questions they had. In an initial meeting on campus, the Business Development Director provided an overview of the Downtown Master Plan, the Director of Planning and Neighborhood Planner outlined the intentions of the new form-based UDC zoning code, and all three spoke to the City's vision for future development and housing. These city representatives attended an interim and the final reviews to provide insight and feedback on the research and projects, and the Business Development Director also organized for students to present their work to the City Council, the TIF District Board, and local real-estate professionals following final reviews. This invaluable experience helped students to ground their projects in the context of the city and translate their research into tangible actions.

### *Studio Trip*

As a third component to the course students in this iteration of the studio had the opportunity to travel to New Orleans to see examples of small-scale odd-lot housing and meet with architects working on projects involving these sites and missing middle types. During the trip the class had the chance to visit OJT's 3609-13 S. Saratoga, 3106 St. Thomas, and St. Thomas / Ninth housing projects that exposed the students to the complexities of designing, developing, and constructing on these sites as well as architectural strategies such as embracing tall ceilings in these conditions (Figure 4). The students also met with Jonathan Tate to hear his interest and experience designing for these lots as well as learn about current ongoing projects the

office is working on to provide increased housing options for downtown urban areas.

The studio also had the chance to visit the Lower Ninth Ward to see housing examples that were undertaken with good intentions but lacked proper execution appropriate to the conditions and contexts of the area. The students furthermore visited Tulane University School of Architecture's URBANbuild program and were able to see the construction of a student design-build project on an infill site.

These experiences provided a bottom-up understanding of the issues the students were engaging with through their studio work and gave a holistic perspective of the challenges and opportunities associated with creating missing middle housing on small-scale oddly shaped lots.

## RESULTS

This second iteration of the studio generated successful results that demonstrated an understanding of the opportunities afforded by small-scale odd lots and how the missing middle can provide diverse housing options for local communities. Final projects included housing proposals for student populations, recent graduates, survivors of domestic abuse, and veterans. The framework of the studio provided students the chance to select and research issues and topics they had a personal interest in. It also encouraged them to synthesize their research into strategies for design that blended the needs and interests of their researched demographics with the urban fabric and amenities of the city.

Two students who elected to present their work to the City Council, the TIF District Board, and local real-estate professionals shared projects for graduate student housing and transitional housing for those recovering from substance abuse (Figure 5). Through their research and proposed architectural strategies, these students had the opportunity to present to the City their vision for creating “missing” housing types and advocate for the needs and lifestyles of demographics not addressed by the existing housing stock. This forum furthermore allowed the City Council, the TIF District Board, and local real-estate professionals to visualize the development and design potential of the new form-based UDC zoning code.

## CONCLUSION

This paper proposes a methodology that frames small-scale odd lots as opportunities for introducing missing middle housing options into downtown urban areas. By developing custom scripts that identified and ranked small-scale oddly shaped parcels, students in this studio utilized computational design skills and thinking to reveal opportunities for aligning residents' housing needs with viable sites for development.

This course seeks to empower design students with the technical skills and a holistic mindset to address the growing housing

challenges facing our cities. In framing these lots as opportunities for architectural innovation, students can draw upon their own interests and experiences to formulate novel solutions that close the gap between the needs and lifestyles of today's populace and limited housing supplies. By leveraging scripting tools to identify development opportunities, not only can we begin to address these shortages, but also take a more proactive role as a discipline in shaping our cities' future design.

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Figure 5. Student presentations to the City Council, the TIF District Board, and local real-estate professionals. Student work by Derek Williams.

## ENDNOTES

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