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Designing Affordable and Sustainable Apartments

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2023 McNair Summer Research Project

DESIGNING AFFORDABLE AND SUSTAINABLE APARTMENTS

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Abstract

Studies have shown that the unaffordable prices of housing in the United States are mainly caused by inadequate zoning policies that restrict higher density housing, and lower the supply of homes, which means that more units must be built to lower prices. However, construction is one of the main sources of pollution and climate change, which is why it is essential to design new buildings to minimize damage to the environment and people. Fortunately, in recent years more apartment buildings have been built around the world to address the problems of aesthetics, sustainability, affordability, community, health, and flexibility. I analyze the design methods of successful sustainable housing projects for low income people as well as the plans of old apartment complexes that have been built in the area of El Cajon, California to understand what works in their design and what can be improved. I apply the lessons learned from my research to design an apartment building with a greater emphasis on affordability and using natural materials on an empty land lot for sale in El Cajon. My research indicates that implementing affordable housing programs funded by the government can help real estate developers pay the costs of building sustainable apartments for extremely low income people without sacrificing beauty, a sense of community, and people's health in semi arid environments with limiting zoning policies such as in El Cajon.

Introduction

Studies have shown that the unaffordable prices of housing rising faster than wages every year in the United States are mainly caused by inadequate zoning policies that restrict higher density housing in favor of building big single family houses. This zoning restriction lowers the supply of homes, so it is necessary to change zoning policies to incentivize the construction of more and smaller units in order to lower prices. However, construction is one of the main sources of pollution and climate change, which are problems that have been getting worse as the overconsumption of

resources increases. Housing prices can also increase due to climate change since certain regions are becoming more desirable to live in due to their more pleasant weather and more abundant resources, meanwhile other regions become less habitable as more extreme natural disasters destroy people's homes, which causes refugees to relocate for shorter or longer periods of time. Climate change can also increase migration as coastal areas become uninhabitable with rising sea levels while at the same time rising temperatures and droughts decrease agricultural production and access to clean water, which leads to competition over natural resources that instigate wars and more migration. The cities that are already dealing with housing unaffordability will have an even greater problem if their population increases more from immigration. With these problems from climate change and pollution in mind, it is essential to design places that minimize damage to the environment and people.

I'm conducting this research project because it is rare to find a building designed to address the combined problems of aesthetics, sustainability, affordability, community, health, and future use. Most buildings for a long time have focused on aesthetics and affordability while sustainable design has become a big topic recently. However, designs that help build community and keep people healthy are barely starting to get recognized as important. No one seems to ever consider the future use of the land that buildings occupy, which is why it is essential to design flexible buildings that can be easily adapted to the needs of future users. This flexibility includes designing the building to be recyclable once it is too old to continue using, which is why natural materials are also necessary so that they do not pollute the environment when their only purpose left is to be used as compost. Artificial materials used in construction should also be assembled in a way that will be easy to remove and even recycle once the building is disassembled. Our health problems are made worse by the artificial environments we live in that slowly kill us due to the toxic chemicals we absorb released from common construction materials. Therefore, I explored using natural construction materials such as wood, metal, rammed earth, clay, or straw bale in order to keep the apartment residents safe from pollutants.

Literature Review

My research topic is inspired by the success of a housing organization founded in 2007 in Melbourne, Australia called Nightingale that has already built many apartment buildings, which serve as a model for me to use since they follow the same principles I used to design the apartment building in El Cajon. This organization was founded by a group of architects who address the exact problems I mentioned before of designing affordable and sustainable housing without sacrificing beauty, a sense of community, and people's health. However, one problem with the apartments built by the Nightingale organization is that they are only for sale instead of rent, and their prices are still high since people who buy an apartment are still paying for what it cost to build. What makes them relatively affordable is that buyers do not pay any extra money to provide profit for the developers. So for this project I focused more on designing housing for people with the lowest incomes in the United States who cannot buy a house, which is why I researched about apartments for rent rather than for sale since that makes them more affordable and provides people with more flexibility to move. I also learned that there are other ways to make apartments more affordable in the United States by implementing government programs that help with affordable housing.

In her article from 2020, "To improve housing affordability, we need better alignment of zoning, taxes, and subsidies," Jenny Schuetz clearly provides the three main solutions necessary to make housing in the United States more affordable. She explains that in order to build enough affordable housing, it is essential to align zoning, taxes, and subsidies to incentivize real estate developers to invest in sustainable and affordable apartment construction. Zoning must be reformed to favor the construction of apartment buildings over single family houses by decreasing parking minimums and increasing height limits as well as density. In order to further encourage construction of more affordable housing, taxes need to be raised for underused land in the most desirable parts of cities. Another way the government can help low income people afford housing is by providing more housing subsidies such as vouchers. I expand on this knowledge provided by Schuetz by learning how architects can contribute to this

problem as progress is made in fixing these political issues. Developers will be incentivized to build more affordable and sustainable housing if the government improves their policies, which means that architects and urban planners will be needed to create better places for people and the environment instead of cars.

The article written in 2014, “Design and Affordable American Housing,” by Gwendolyn Wright provides a great guide for architects by exploring the history, mistakes, and good practices of designing affordable housing. For more than two centuries, private companies, nonprofit organizations, and government agencies have experimented in the United States with new ways to develop affordable housing. Wright explains that architects have also been crucial in great designs for housing, which is not subjective because three design methods are necessary to create the best spaces for people. These methods include the direct involvement of residents who state their needs and preferences, researching technologies and strategies that lower costs, and good site planning. It is essential that the local area surrounding a site provides everything people need such as jobs, shopping, transportation, childcare, schools, parks, cultural activities, health facilities, and other supportive services. Some mistakes regarding affordable housing include too much extravagant ornamentation, the resentment against poor people, and focusing on homeownership as an affordable housing strategy because it is more risky to own a home than to rent one. Wright also states how the misconceptions that design “is simply a matter of aesthetic preferences”, and that “the benefits of good design should be reserved for those who can afford them,” result in low quality affordable housing that can be depressing and ugly. However, there are some architects who have designed outstanding and high quality low-income housing that are even superior to those of market-rate housing. I expand on the lessons from this article by giving equal importance to sustainability in the design of the apartment building for this project.

Elihu Rubin provides a great analysis of old Californian apartment buildings in his article, “New in Town: The California Garden Apartment in the 1960s.” Rubin explains how the garden apartment typology was developed when investment in rental apartment buildings increased during the 1960s. The California garden apartments had

a car centric design that can be distinguished by their abundant car parking and minimal landscaping that stood out. Other features include their low-rise construction, exterior circulation, and individual unit entrances that opened directly to the outdoors. This typology addressed the desire of residents to live in apartments with the privacy of a separate house with plenty of storage. A great method used to decrease construction costs for these buildings was to make balconies work as outside corridors that save floor space and reduce extra costs for fireproof construction and maintenance. Rubin provides examples of plans and pictures of these garden apartments, which is useful to compare and contrast to modern buildings and see what works well in their designs. This typology of multi-family housing can also be found in El Cajon, and I implement similar methods such as outdoor corridors around a courtyard with gardens in the low rise apartment building I designed for this project. I also improved on the design of these apartment buildings by hiding the parking and giving priority to people and nature, while also researching how to implement more sustainable construction methods.

A great example of a sustainable residential building made without toxic materials can be found in Rebecca Tasker's article from 2016, "Net Zero, Naturally." She uses Brian and Sue Fallgrens' home located 60 miles east of San Diego, as an example to explain the benefits of natural sustainable construction. The house generates more energy than it uses by using passive ventilation, appropriate placement of windows, and by being well insulated through its natural materials: straw bale, wood, and clay. These materials are from local sources, which means less pollution from transporting them to the construction site. This house also addresses the problem of the future use of the building site by using wood recycled from old buildings at the job site. Since the materials are natural, they can decompose once they cannot be recycled anymore, which solves the problem of buildings polluting the environment with toxic materials. For this project, I researched using the same sustainable construction methods of this small home, but applied on a bigger scale for a 3 story apartment building.

Research Question

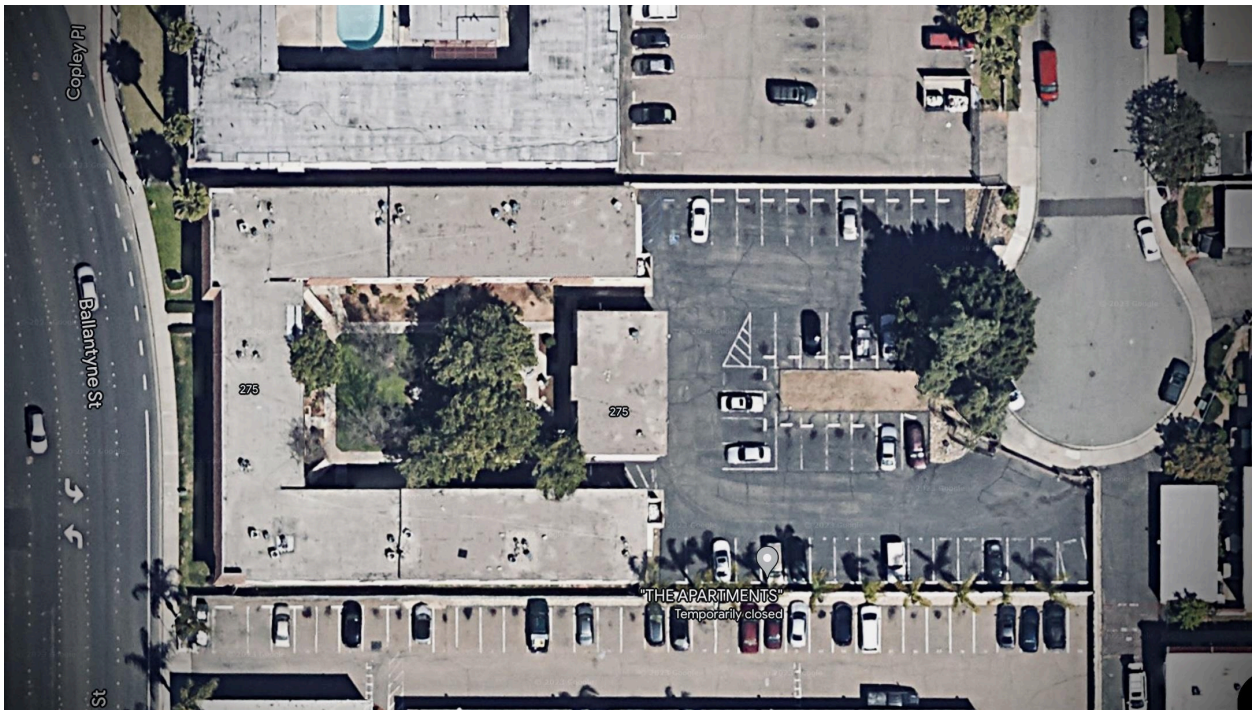
Is it possible to design extremely low-income, sustainable housing without sacrificing beauty, a sense of community, and people's health in semiarid environments with limiting zoning policies such as in the city of El Cajon, California?

Research Methods

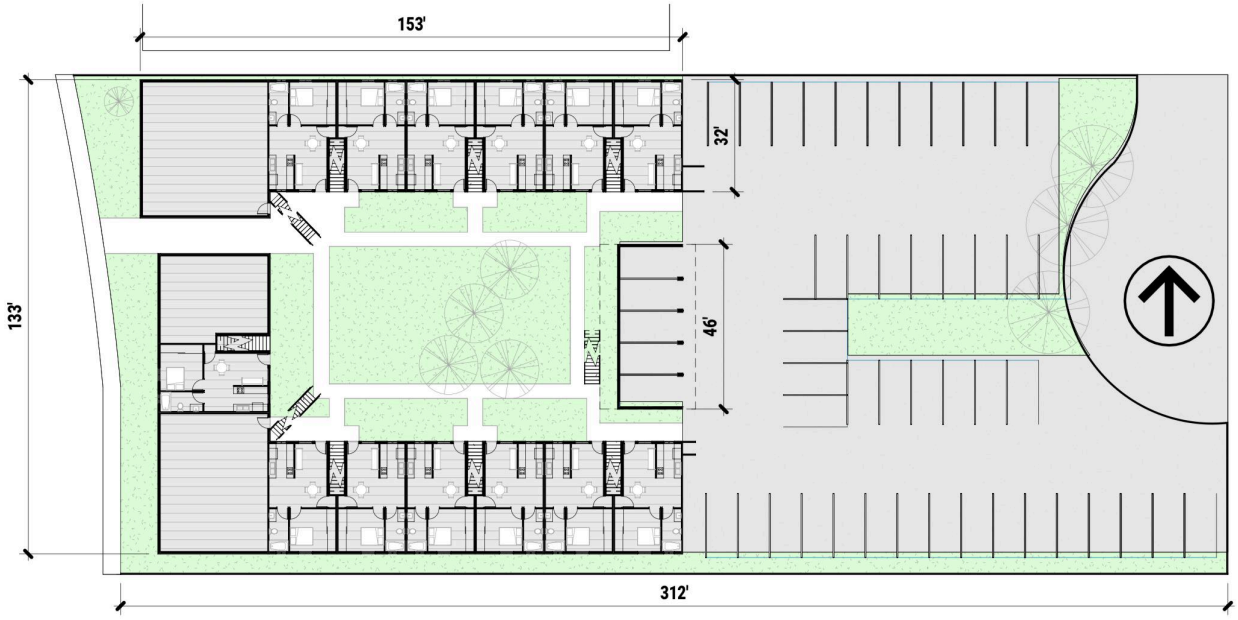
My main research methods consisted of analyzing literature and existing buildings. I read and took notes on the relevant resources I found through the internet and academic literature about my topic in order to apply this knowledge for my design of the apartment building. I visited four existing apartment complexes with my mentor in El Cajon and walked around them to understand how they are organized on the exterior and interior. For the building analysis, also known as a case study, I surveyed and reconstructed the floor plans with the BIM software, Revit, for two of these apartment buildings in El Cajon to compare the layout of two courtyard style buildings built in different decades. Reconstructing the floor plans allowed me to better understand what works in their designs and what needs to be improved. I provide the information for the two case studies I reconstructed digitally in the tables and diagrams below showing the first floor plans of the apartment buildings. Moreover, for the property site research I used real estate websites and digital maps to find a land lot for sale that was as close as possible to public transport, a school, a park, and stores. After choosing a land lot in the center of El Cajon, I visited the site with my mentor to take notes on information I could not get from the internet, such as noise pollution and the views from the park and the buildings next to the property, which are important to consider for the design of the apartment building.

Ballantyne 275

Apartments Information



Unit Size	Square Footage	Monthly Rent	# of units	Total Rent Income
1 BR	625	$1618	24	$38,832
2 BR	800	$1586	10	$15,860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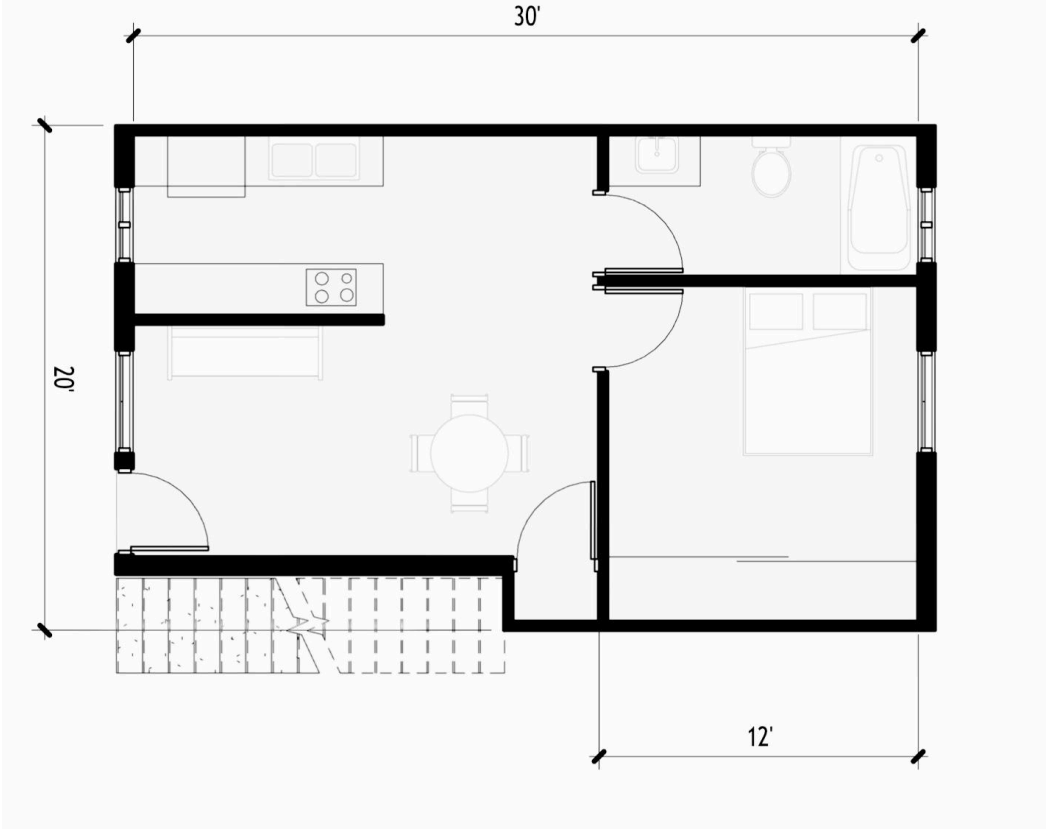
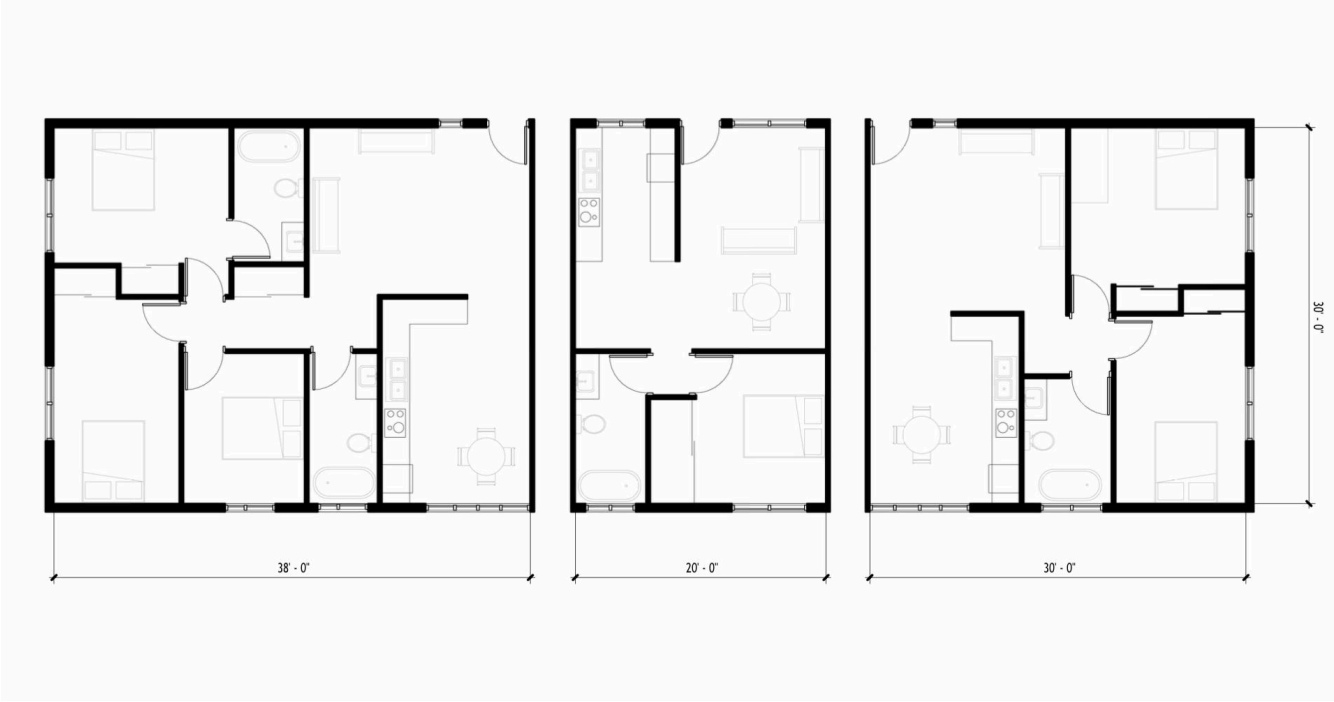
32'
133'
46'
312'

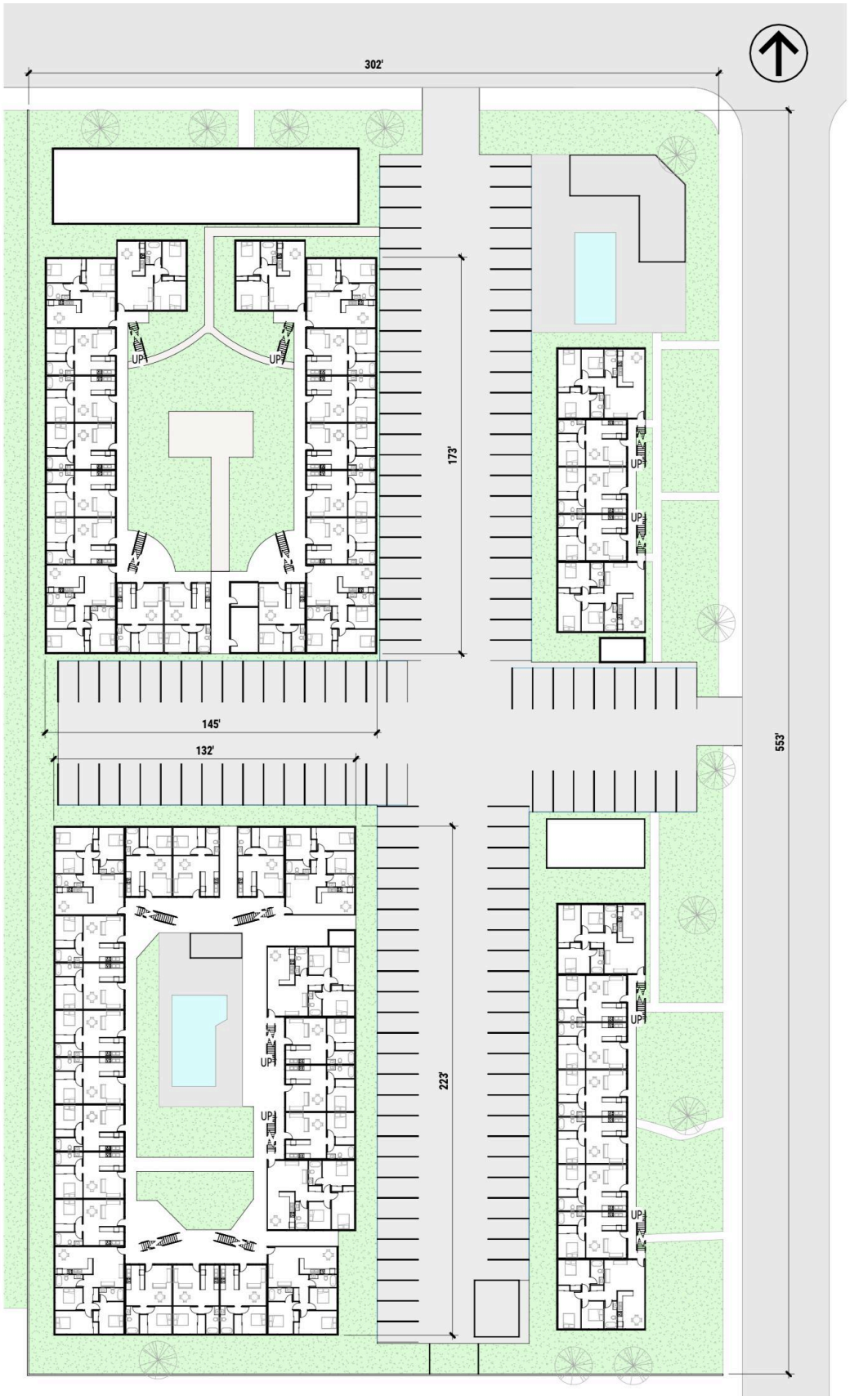

30'
20'
12'

1249 E Madison Ave

Apartments Information

Unit Size	Square Footage	Monthly Rent	# of units	Total Rent Income
1 BR	600	$1618	77	$124,586
2 BR	900	$1586	24	$38,064
3 BR	1200	$2645	8	$21,160




302'
173'
145'
132'
223'
553'
UP
UP
UP
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UP

Findings

After reconstructing the plans of the two apartment buildings in El Cajon, I realized how courtyards provide many benefits for people and the environment. Organizing units around a courtyard with vegetation provides a communal space that can be used for gatherings or simply as a place where residents can bump into each other and socialize. The courtyard also allows for outdoor corridors instead of indoor corridors that prevent units from having windows on 2 sides, restricting cross ventilation, and increasing the need for air conditioning. More sunlight can enter the apartments and reduce the need for artificial lighting as the courtyard requires more space that can be reserved for nature between the buildings. The apartment units in the buildings I analyzed are designed as modules that are repeated by mirroring the layouts in a way that allows the plumbing to be installed in the same wall for 2 apartments, which reduces complexity and construction costs. The living spaces in the units face the courtyard while the private spaces such as the bathrooms and bedrooms have windows facing away from the courtyard. It is also common for these apartment buildings to be securely gated to prevent anyone from walking in. By having shared amenities such as a laundry room and BBQ grills with outdoor dining areas the sizes and costs of the apartment units can be reduced by not having to provide space for these amenities in every single unit. Other ways to maximize living space inside the apartments is by getting rid of hallways, providing enough storage space that reduces clutter, and by having only one bathroom for apartments with less than 3 bedrooms. A big problem I had to fix for buildings with big open parking spaces, is that they waste too much space that could be used for people instead of cars. Parking also contributes to the urban heat island effect by absorbing sunlight and releasing it back as heat into the environment, making the hot weather of El Cajon worse. This is why it is better to provide shaded parking spaces with trees, solar canopies, or by placing the parking under the building.

In order to build sustainable housing for extremely low income people, it is important to understand how to make it financially feasible. The Low Income Housing

Tax Credit program is the most important resource for creating affordable housing in the United States by giving “State and local agencies the equivalent of approximately $9 billion in annual budget authority to issue tax credits”, which are tax reductions to incentivize the acquisition, rehabilitation, or new construction of low income rental housing. The California Tax Credit Allocation Committee (CTCAC) “administers the federal and state Low-Income Housing Tax Credit Programs”. Both programs were created to promote private investment in affordable rental housing for low-income Californians.

California also created the Density Bonus Law to incentivize the construction of affordable housing by allowing more units to be built, which generates more income for the real estate developers. The higher the percentage of affordable units in a proposed building is, the more units are allowed to be built, which is why it can be more beneficial to make 100 percent of the units affordable. Affordable rental units built with the density bonus must be restricted by an agreement which sets maximum incomes and rents for those units that must remain in place for a 55 year term for very low or lower income units.

For this project, the original zoning for the site I found in El Cajon allowed only 8 units to be built, but by making 100% of units affordable for very low income families, the government provides an 80 percent density bonus, which means 7 more units can be built for a total of 15 apartments. Moreover, building 100% affordable units provides four concessions and incentives to modify zoning code and architectural design requirements, allowing for the construction of commercial spaces mixed with housing. Other incentives include the reduction of site development standards, setbacks, minimum square footage requirements, or any other concession that can reduce costs and provide benefits. The site for this project is located within half a mile of two major bus routes with a frequency of service of 15 minutes or less during the morning and afternoon peak commute periods, which classifies them as major transit stops. Since the project is 100% affordable and within half a mile of major transit stops the density bonus also reduces the original parking minimum from 22 to 0 required parking spaces, allowing for a design that can focus more on serving people.

People are considered extremely low income when they earn less than 40% of their city area median income. For example, in San Diego the area median income in 2023 is $116,800 for a family of four. For this project, I chose to design an apartment building for the extremely low income people earning 30% of the San Diego area median income. I used the information provided by the San Diego housing commission to create the table below showing how much rent these people can pay based on their income and family size.

Rent Information for Proposed Building in El Cajon
for Extremely Low Income Families

Family Size	Unit Size	Proposed Square Footage	Annual Income	Maximum Monthly Rent	# of Proposed Units	Total Potential Rent Income
1-2	Studio	450	< $28,950	$724	2	$1,448
1-2	1 BR	600	< $33,100	$828	7	$5,796
3-4	2 BR	900	< $37,250	$931	2	$1,862
4-6	3 BR	1150	< $41,350	$1,034	4	$4,136

The LIHTC and density bonus law are government programs that help with the construction of affordable housing but there are other programs that directly help low income people afford existing housing. The Section 8 Housing Choice Voucher Program is available in all 50 states and is administered by the U.S. Department of Housing and Urban Development (HUD), which provides money to help low-income families and individuals pay rent. There is also a similar program known as the Low-Income Home Energy Assistance Program (LIHEAP), which helps low-income households pay their

home energy bills. It is also available in all 50 states and is administered by the U.S. Department of Health and Human Services (HHS). Other programs are targeted to help more specific groups such as low income seniors, rural low income families, and veterans.

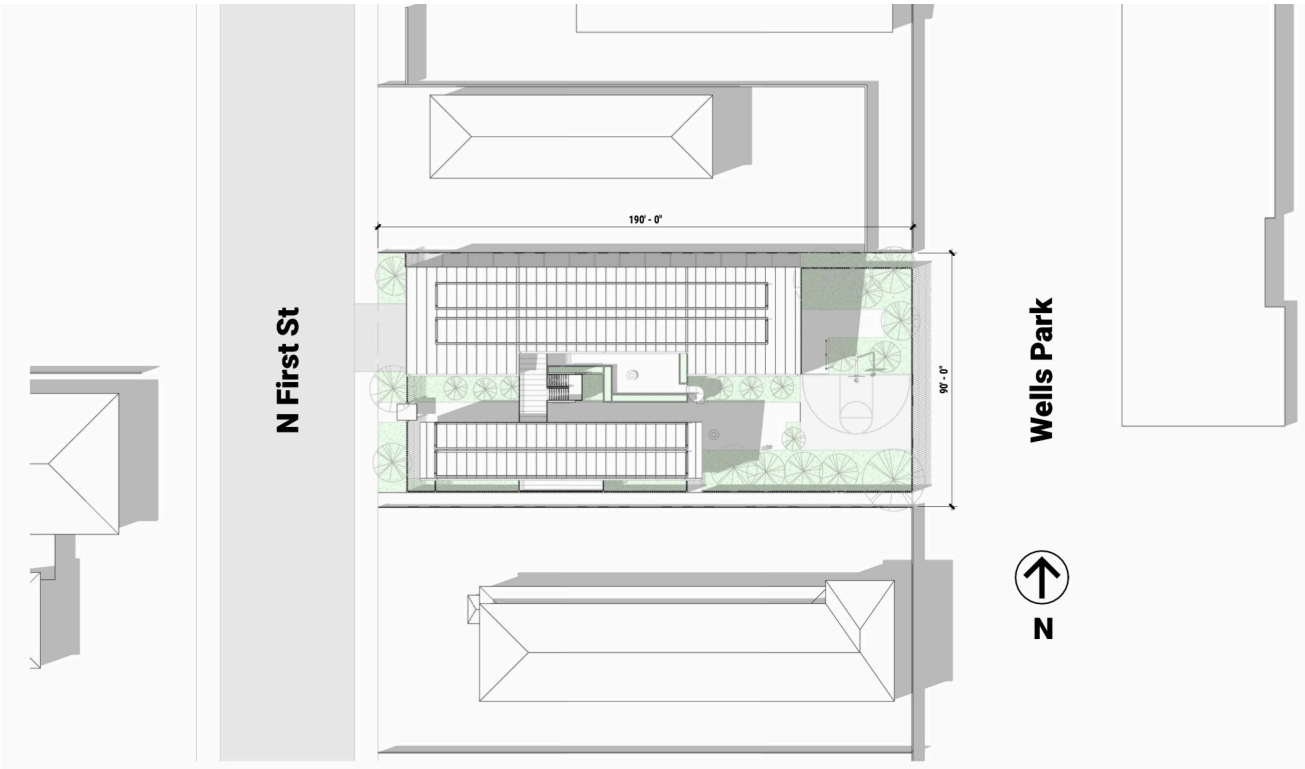
Each city has a housing commission that administers the Section 8 Housing Choice Voucher rental assistance program. For example, in San Diego, “more than 16,000 households receive help to pay their rent with vouchers administered by the San Diego Housing Commission.” As a housing developer, investor and lender, “SDHC also has helped produce more than 26,000 affordable rental housing units since the agency’s inception in 1979 through partnership developments and acquisitions. This includes more than 3,700 affordable rental housing units owned or managed by SDHC, including its nonprofit affiliate, Housing Development Partners.”

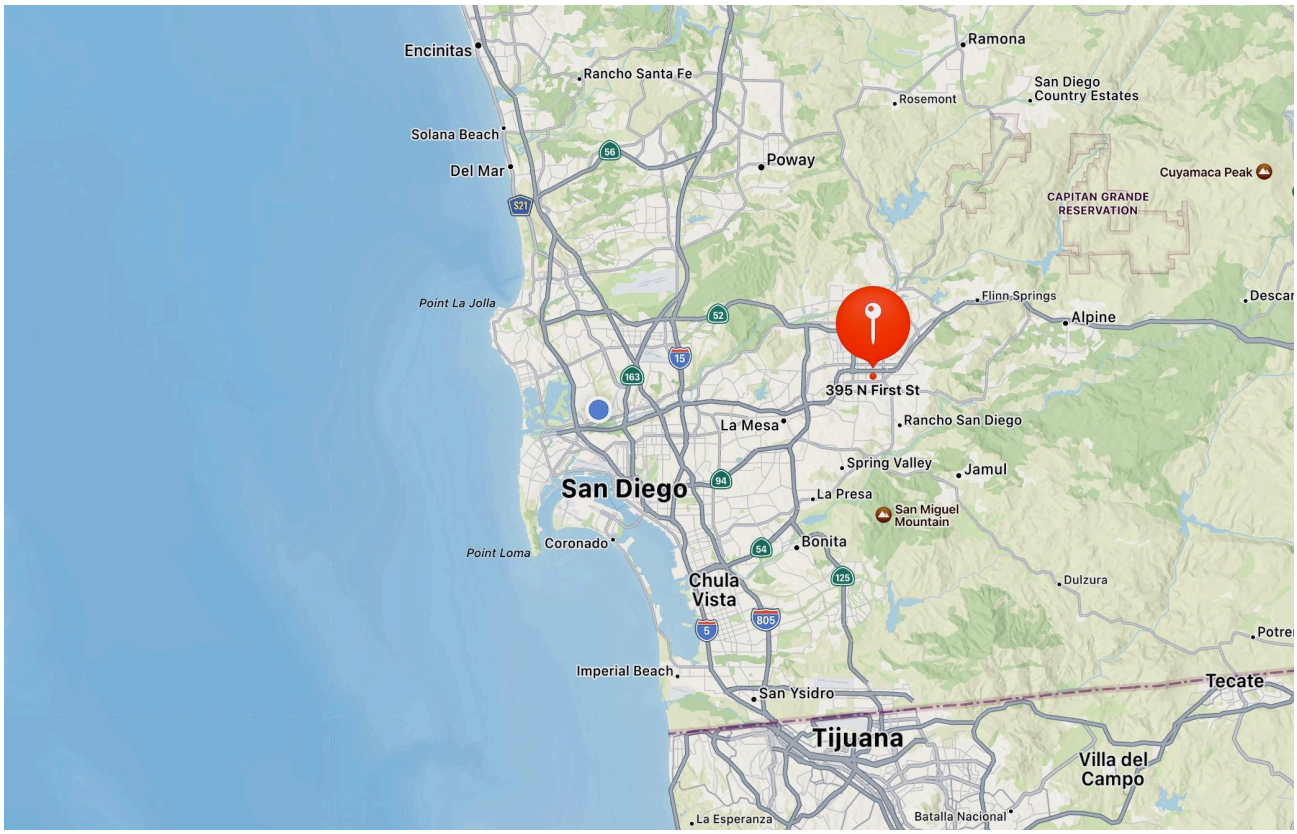
Design Constraints

The main design constraints specific to this project include designing for a maximum of 15 apartments units with 15 parking spaces to have one for every unit. These 15 units have to be divided into 4 sizes to have a variety of housing types for four different sizes of families ranging from single people to families of up to six people. The reason for providing a variety of unit sizes is that El Cajon is home to one of the largest populations in the country of a persecuted religious and ethnic minority from Iraq known as Chaldeans. They are part of a larger Middle Eastern community consisting of refugees and immigrants from Iraq, Syria, and Afghanistan who live together in El Cajon. Many of these middle eastern families have children that bring the average household size of El Cajon up to 3.5 people per home according to government census data. The median age is about 35 years old with about half of the population being single, which is why I made 9 out of the 15 units with only 1 bedroom. Moreover, the narrow site made it more challenging to design a courtyard, which is why it was necessary to make the buildings longer and more narrow to provide open space in the middle that also allows the apartments on the north to receive plenty of sunlight throughout the year. The

mostly hot and dry weather of El Cajon was a big factor for focusing more on a design that passively cools the building by providing plenty of shade, ventilation, and insulation. The 45ft height limit was not a big limitation since it is more expensive to build taller buildings, and for this project it was important to keep the costs down by building up to only 3 stories.

Site Context


N First St
190' - 0"
90' - 0"
Wells Park
N


Encinitas
Rancho Santa Fe
Ramona
San Diego Country Estates
Rosemont
Solana Beach
Del Mar
Poway
Cuyamaca Peak
CAPITAN GRANDE RESERVATION
Point La Jolla
Flinn Springs
Alpine
395 N First St
La Mesa
Rancho San Diego
Spring Valley
Jamul
San Diego
La Presa
San Miguel Mountain
Coronado
Point Loma
Bonita
Chula Vista
Dulzura
Imperial Beach
San Ysidro
Tecate
Tijuana
Villa del Campo
La Esperanza
Batalla Nacional

Apartment Building Design Proposal

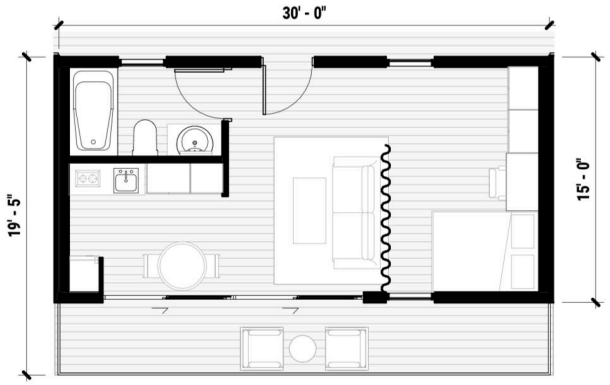
Southwest Axonometric

Level 1

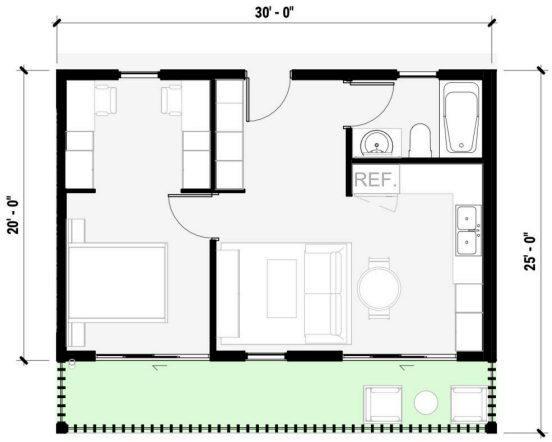
Level 2

Level 3

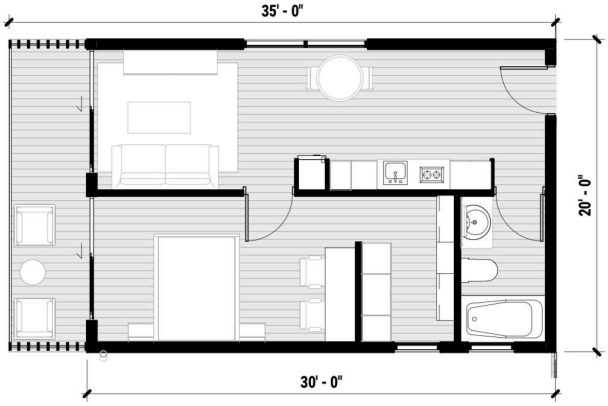
Studio Unit Floor Plan



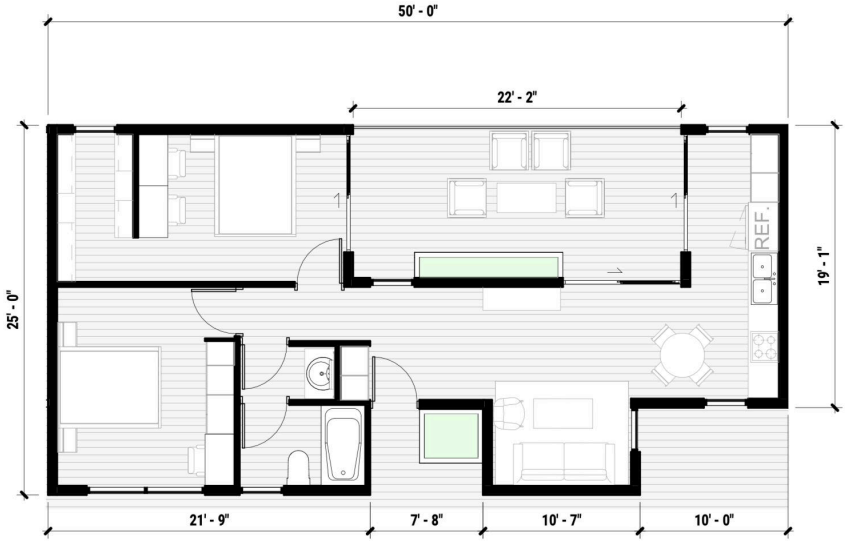
L1 1 Bedroom Unit Floor Plan



L2 1 Bedroom Unit Floor Plan

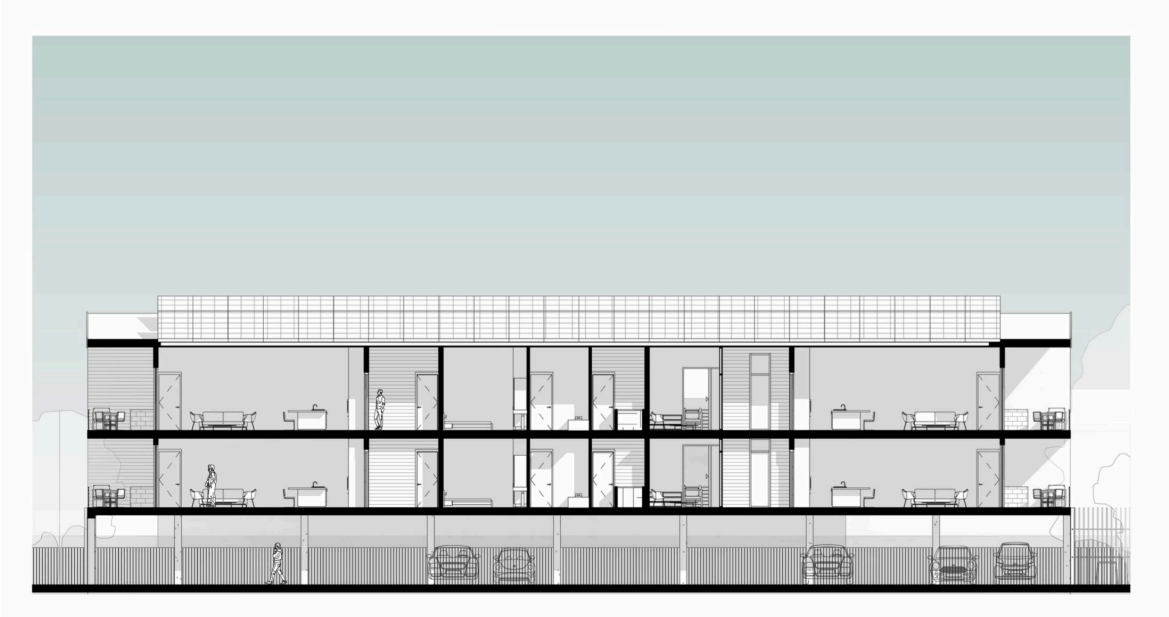


2 Bedroom Unit Floor Plan

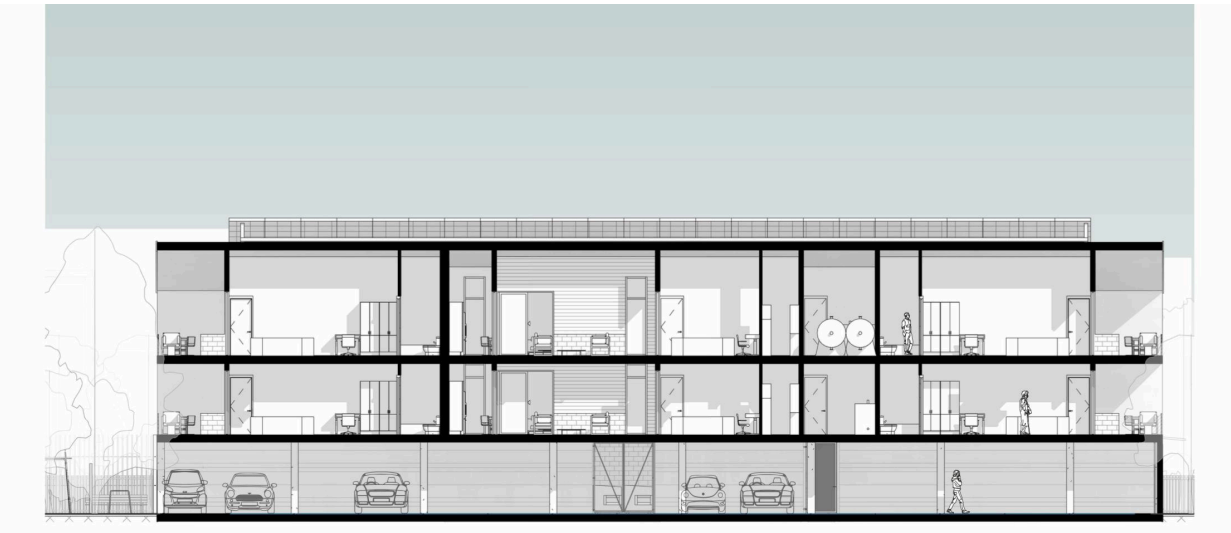


3 Bedroom Unit Floor Plan

North Facing Section Drawings



South Facing Section Drawings



West Facing Section Drawings

East Facing Section Drawings

West Facade

East Facade

North Facade

South Facade

Northeastern Axonometric

Building Comparison

Building Address	# of Units	# of Parking Spaces	Parking to Unit Ratio	Total Monthly Rent Income	Property Cost	Amenities
275 Ballantyne St, El Cajon, CA	34	51	1.5:1	$54,692	$9,099,000	• Outdoor BBQ area • Gated Community • Shared laundry room • Courtyard with trees • Gated Community • Bike racks
1249 E Madison Ave, El Cajon, CA	112	141	1.26:1	$183,810	$27,509,500	• Outdoor BBQ area • Gated Community • Shared laundry room • Grass Courtyard • 2 Pools • Clubhouse
395 N 1st St, El Cajon, CA	15	15	1:1	$13,242	$1,150,000 (Land Value) + $4,000,000 (Estimated construction cost based on average of $300/sqft) = $5,150,000	• Outdoor BBQ area • Gated Community • Shared laundry room • Courtyard with trees • Bike racks • Rainwater storage tanks • Solar panels • Private Balconies • Outdoor Workout area • Access to park • Basketball/soccer court • Shaded Parking • 2 bonfire sitting areas

Conclusion

Architecture can only go so far in creating affordable and sustainable housing because policies and laws determine what can actually be built. In order to build enough affordable housing, it is essential to align zoning, taxes, and subsidies to incentivize real estate developers to invest in sustainable and affordable apartment construction. Zoning must be reformed to favor the construction of apartment buildings over single family houses by decreasing parking minimums and increasing height limits as well as density. In order to further encourage construction of more affordable housing, taxes need to be raised for underused land in the most desirable parts of cities. Another way the government can help low income people afford housing is by providing more housing subsidies such as vouchers. The good news is that California has made some progress in their zoning policies and subsidies by introducing the density bonus law and section 8 vouchers, which can still be further improved. Therefore, implementing affordable housing programs funded by the government can help real estate developers pay the costs of building sustainable apartments for extremely low income people in environments such as in El Cajon with limiting zoning policies without sacrificing beauty, a sense of community, and people's health. However, it is important to accept that it can be more expensive and not as profitable in the beginning to build good sustainable housing, but in the long term, high quality construction with natural materials, passive design, and solar panels will save money by reducing maintenance and energy costs.

Future Research Possibilities

There are 2 ways in which I can continue to expand on this research. One possibility is to learn how a real estate investor would finance this type of project because I was only able to learn some of the basic procedures such as the density bonus law and special loans with lower interest rates for affordable housing projects. It was difficult to understand how exactly I could get a loan for this type of affordable housing project so it would be helpful to get advice from a real estate agent with experience in affordable housing. Moreover, I can focus even more on sustainability by learning about the process of remodeling existing buildings into apartments in order to further reduce construction costs and waste. As I continue working on designing sustainable and affordable housing, it is important that I interview extremely low income residents to understand what they actually need and provide the best experience possible for them.

Acknowledgments

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