Politecnico di Torino
Dipartimento di Architettura e Design
Laurea Magistrale in Architettura Costruzione Città
A.A. 2025/2026

Rebuild the Micro Community

Affordable housing project in Los Angeles City
Solutions to tackle Los Angeles' housing crisis

SUPERVISOR
Francesca Frassoldati

CANDIDATE
Yingtong Liu

Affordable housing project in Los Angeles City
Solutions to tackle Los Angeles' housing crisis

Rebuild the Micro Community

CANDIDATE
Yingtong Liu

SUPERVISOR
Francesca Frassoldati

A.A 2025/2026

Abstract

My aim throughout this project has been to provide spaces for a mixed community with a diverse range of dwelling units and forms of tenure for residents with diverse backgrounds and the same difficulties to access decent accommodation. This addresses the current housing crisis in Los Angeles via a design approach.

It focuses on demonstrating how a high-quality housing scheme may benefit from DfMA technology: Design for Manufacture and Assembly, improving construction efficiency through pre-fabricated elements, and providing quality by meeting or exceeding quality and space standards.

I have learned about the features of DfMA and experienced the process of designing it. With DfMA's advantages in rapid-deploying, high potential in economical scale and industrial level stantardization, this approach can be replicated not only in one spot, but in many needed areas in Los Angeles.

LIST of CONTENTS

Abstract i

List of Contents ii

List of Figures iv

Glossary v

1. Housing Crisis in Los Angeles

1.0 General Infomation of Housing Crisis in lA 01

1.1 The Macro-Landscape: Urban Housing Crisis Across the United States 06

1.2 Supply-side Deficits: Historical Pincer Attack from Convulsive & Conservative Urban Acts 09

1.3 Demand-side Capacity: Demographic Profiles of Marginalized Communities 12

1.4 Housing Mismatch Becomes Homelessness and Triggers Urban Repercussions 14

1.5 Institutional Responses: Actionalbe Policy Incentives and Operational Regulations 18

1.6 Architectural Response: What Solution the City Expects? 22

2. Why DfMA Fits Los Angeles

2.1 Defining the Affordable Housing Framework for LA 25

2.1.0 Transition: From Systemic Diagnosis to Product Performance 25

2.1.1 Tectonics and Performance Dimensions 27

2.1.2 Planar Organization and Socio-Spatial Dimensions 28

2.2 Empirical Validation: LA Case Studies 32

2.3 Strategic Recommendations and Synthesis: Implementing DfMA in LA 35

3. Design Research

3.1 Current Status Research 39

3.2 Current Status Evaluation 42

3.3 Similarities of Neighborhoods 44

4. Design Proposal

4.1 Apartments Types 48

4.2 Catalogue of Pre-fabricated Elements 50

4.3 Apartments Axonometrics:

Social - Residential Space 52

Private - Residential Space 54

4.4 List of Elements from Example Apartment 2B4P-Private 56

4.5 Construction Schedule 58

4.6 Plans:

- Ground Floor 60

- First Floor 62

- Second Floor 64

- Third Floor 66

4.7 Sections:

A - A 68

B - B 70

4.8 Panellised Construction System:

- Internal Wall 72

- External Wall 74

- Dividing Wall 76

- Floor & Ceiling 78

4.8 Structural Strategy 80

4.10 Perspective

- view A 82

- view B 84

Conclusion 86

Reference 87

LIST of FIGURES

CHAPTER 1

FIGURE 1
County entitled and opeded affordable housing activity by year
FIGURE 2
Median renter household income vs median rents in Los Angeles county
FIGURE 3
Affordable rental housing shortfall (2024)
FIGURE 4
Change in tenure by age
FIGURE 5
Number of individuals experiencing homelessness in Los Angeles county
FIGURE 6
Homelessness per 1,000 people in select U.S. regions, 2007
FIGURE 7
Homelessness per 1,000 people in select U.S. regions, 2019
FIGURE 8
Rank of indexed rates of homelessness, 2010 vs. 2019
FIGURE 9
Public interest over time for five search terms
FIGURE 10
Marginalized groups are pincer attacked
FIGURE 11
Demand and supply mismatch
FIGURE 12
Share of renter households who are cost burdened by income group (2024)
FIGURE 13
2024 Unhoused deaths in city of Los Angeles
FIGURE 14
Institutional response matrix: Government incentives
FIGURE 15
Institutional response matrix: Government incentives

CHAPTER 2

FIGURE 1
Different four kinds of construction methods features matrix
FIGURE 2
2D panel modular method vs. On-site construction
FIGURE 3
Different four kinds of affordable housing floor plan features matrix A
FIGURE 4
Different four kinds of affordable housing floor plan features matrix B

CHAPTER 3

FIGURE 1
Existing PSH and approved affordable housing distribution
FIGURE 2
Current area analysis and potential selected location analysis

GLOSSARY

CBD
Central Business District
CEQA -
California Environmental Quality Act.
CHP
California Housing Partnership

DfD
Design for Disassembly
DfMA
Design for Manufacture and Assembly
DHS
Department of Health Services
DMH
Department of Mental Health
DRP
Department of Regional Planning

FAR
Floor Area Ratio
FBH
Factory Built Housing

HCD
California Department of Housing & Community Development
HUD
Department of Housing and Urban Development

LACDA
Los Angeles County Development Authority
LAHSA
Los Angeles Homeless Services Authority
LA
Los Angeles
LAO
Legislative Analyst's Office
LAHD
Los Angeles Housing Department

NIMBY
Not in my back yard.
NPV
Net Present Value

RHNA
Regional Housing Needs Assessment

SCAG
Southern California Association of Governments
SFD
Single-Family Dwelling
SLATE-Z
South Los Angeles Transit Empowerment Zone
SRO
Single Room Occupancy
SELA
Southeast Los Angeles

TOC
Transit Oriented Communities

US
United States

WWII
World War II

ZNE
Zero Net Energy

1. Housing Crisis in Los Angeles

1.0 General Infomation of Housing Crisis in lA

1.1 The Macro-Landscape:
Urban Housing Crisis Across the United States

1.2 Supply-side Deficits:
Historical Pincer Attack from Convulsive & Conservative Urban Acts

1.3 Demand-side Capacity:
Demographic Profiles of Marginalized Communities

1.4 Housing Mismatch Becomes Homelessness and Triggers Urban Repercussions

1.5 Institutional Responses:
Actionalbe Policy Incentives and Operational Regulations

1.6 Architectural Response:
What Solution the City Expects?

01

Housing Crisis in Los Angeles

1.0 General Infomation of Housing Crisis in Los Angeles

In this chapter, I will study the basic data of housing crisis in LA, which is also shared issue arcoss the US. Try to understand the mechanism, in market and in legislation, what led to this metropolitan failure. After the pandemic, the housing crisis even causes heavier chain-effect on sanitary public resource.

The LA governers have some attampts on giving instruction in policies, trying to empower the developer to produce affordable housing. In addition to that, Architects should also think of a better way to delivery a better solution about affordable housing.

General Data

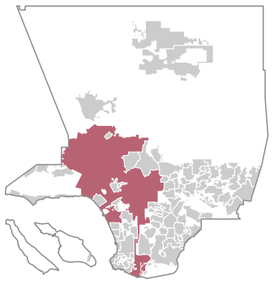
Los Angeles is the second-largest city in the United States and the economic and cultural heart of Southern California. Spanning nearly 470 square miles with a population of nearly 3.8 million residents. However, this massive scale and continuous population growth have also made LA the epicenter of one of the nation's most severe housing crisis.



- California State
- The United States

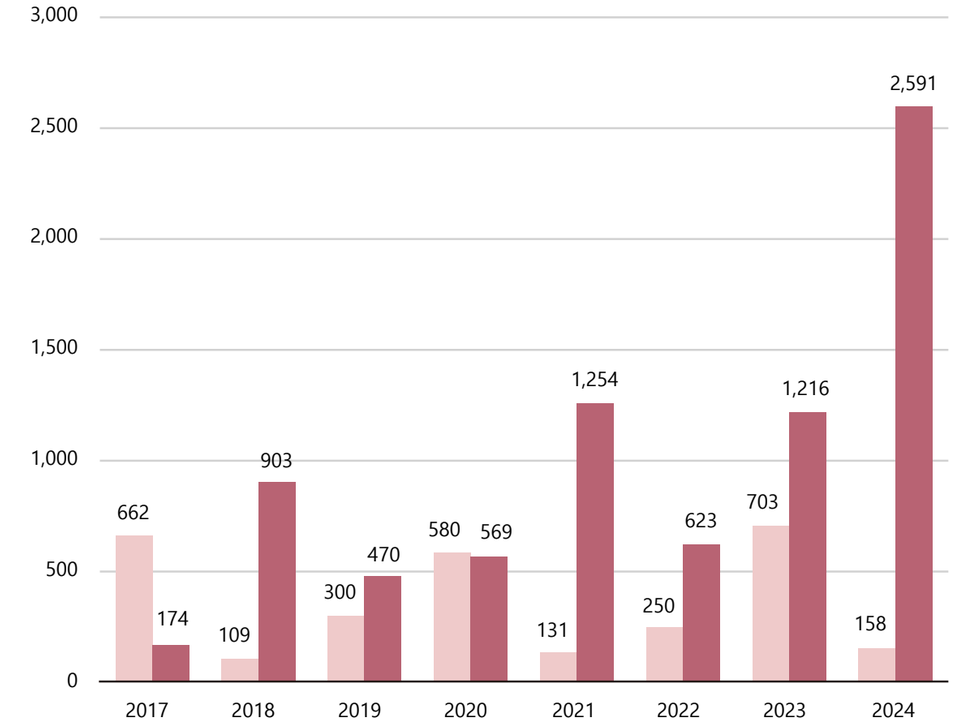


- Los Angeles County
- California State



- Los Angeles City
- Incorporated cities
- Unincorporated areas

FIGURE 1 County entitled and opeded affordable housing activity by year



Source: LACDA, DRP, DMH, DHS, and LAHSA.

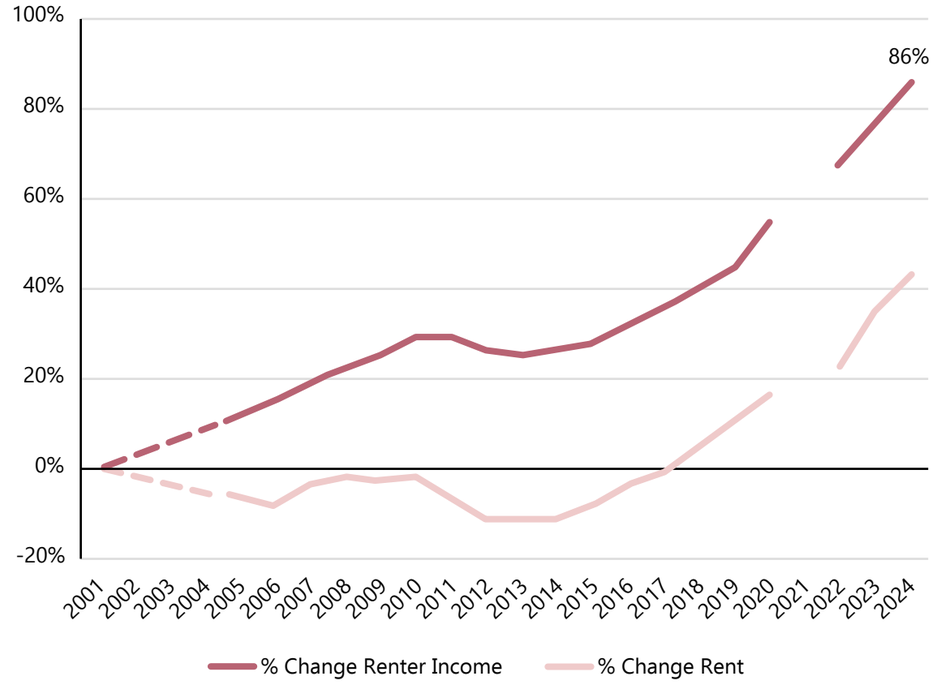
Affordability

The housing market in LA faces a severe rent pressure, having one of the highest rent to income ratios in the country. According to the CHP, 30% of the renters have a "Severe Rent Burden", spending more than 50% of their pre-tax income on rent and utilities. For the lower income group, this percentage rises to 80%. Such a heavy financial burden seriously affects the family's ability to provide necessary funds for food, medical care and social activities, thus destroying the local economic vitality and the neighborhood mutual assistance network. The graphic on top [fig.1] shows the production has nearly trippled in the past 7 years. And in the tendency, mixed income projects have rapidly increased [fig.2], which is a reference for the design.

Supply

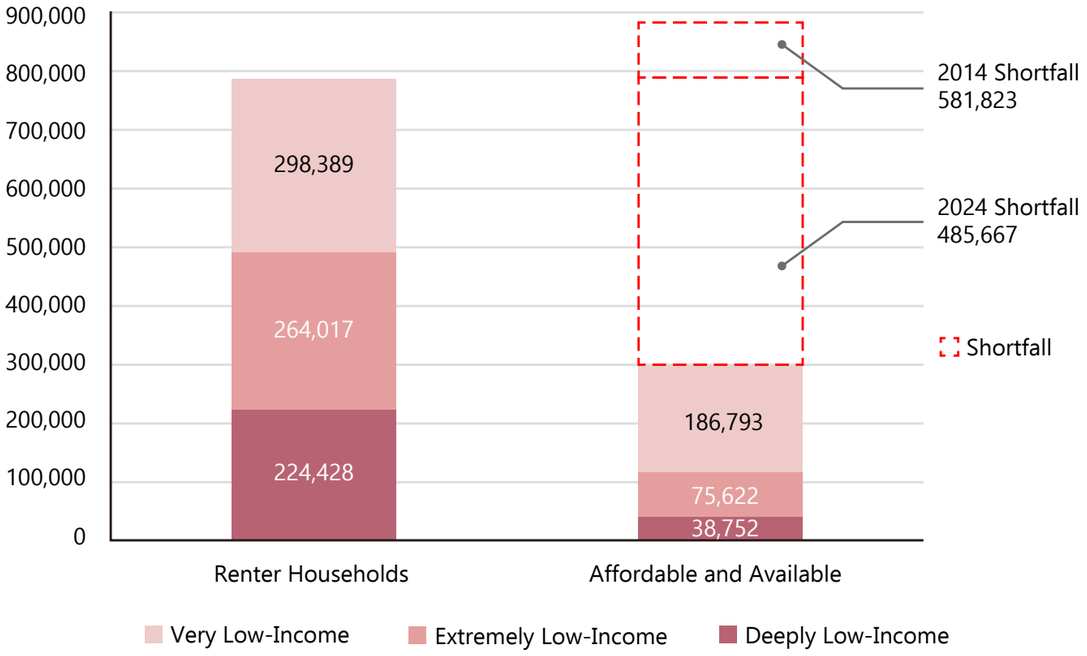
Under the 6th Cycle Regional Housing Needs Assessment (RHNA, 2021-2029) conducted by HCD and SCAG, the City of Los Angeles is required to construct 456,643 new housing units. However, the present zoning regulations cannot meet this need as they only allow for an additional 230,964 units due to the lack of comprehensive changes. This results in a large shortage of 255,415 units. Moreover, over 184,000 units [fig.3] out of the total required must be aimed at low and very-low-income households. The long construction periods and high labor costs in conventional building techniques further increase this difference between supply and demand.

FIGURE 2 Median renter household income vs median rents in Los Angeles county



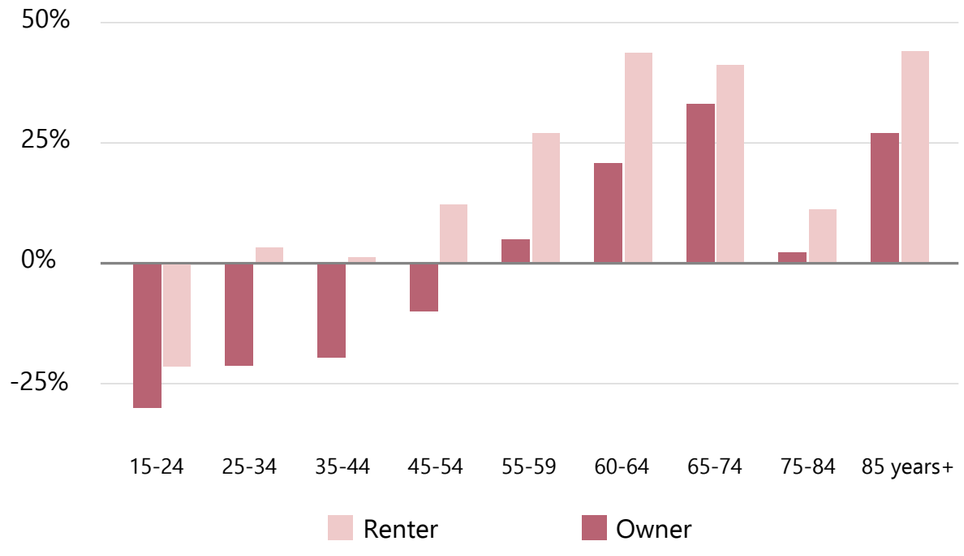
Source: California Housing Partnership analysis of U.S. Census Bureau ACS, 1-year estimates, table ID: S2503, 2001-2024. Due to pandemic-related challenges in data collection, ACS Census data from 2020 were left out of this analysis.

FIGURE 3 Affordable rental housing shortfall (2024)



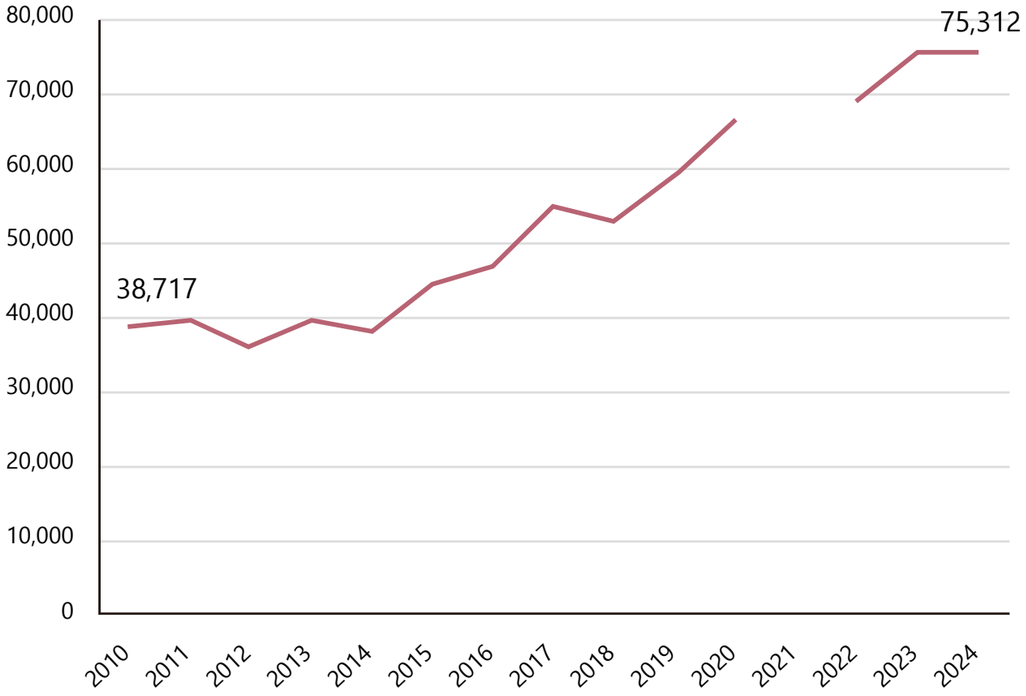
Source: California Housing Partnership analysis of 2023 1-year ACS PUMS data with HUD income levels and added DLI income group subset

FIGURE 4 Change in tenure by age



Sources: US Census Bureau; American Community Survey; 2019 and 2010 ACS 5-Year Estimates, Table DP05.

FIGURE 5 Number of individuals experiencing homelessness in Los Angeles county



Source: LAHSA, 2024. "2024 Greater Los Angeles Homeless Count".
*Note: 2021 is not included in this graphic due to the cancellation of the 2021 LA County PIT Count.

Urban Sprawl

As a prototypical "car city," Los Angeles's multi-centric horizontal sprawl has long sacrificed walkable communities. Residents face an average one-way commute exceeding 30 minutes, locked into a massive freeway infrastructure. This situation removes the feature of Jane Jacobs' 'eyes on the street', turning the sidewalks into inactive areas and preventing spontaneous social contacts. Spatial expansion leads directly to serious urban alienation and social segregation.

Suitability

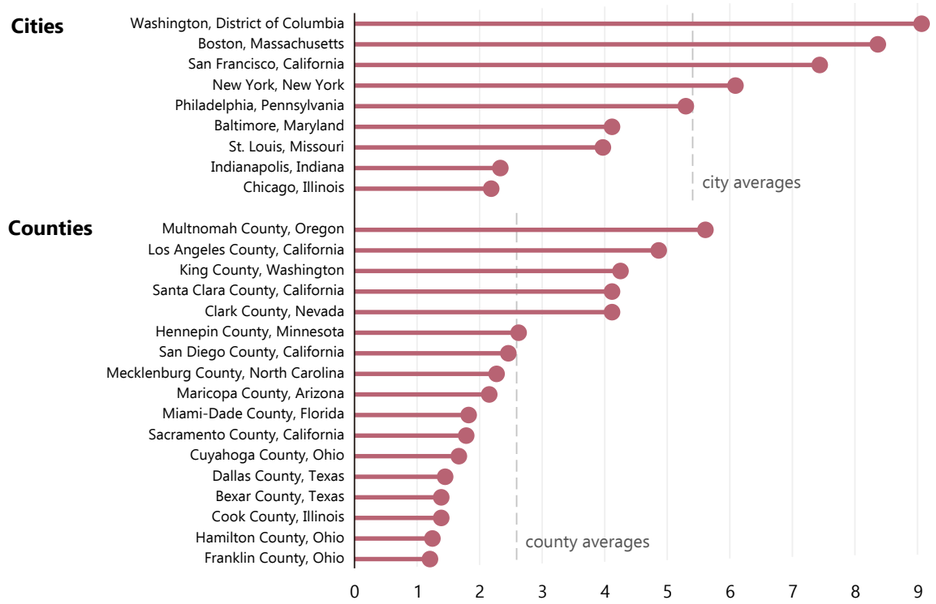
Data from 2010 to 2019 [fig.4] reveals a profound shift in Los Angeles's housing tenure, marked by declining youth ownership and an unprecedented surge exceeding 40% in renters aged 60–74. This trend disrupts traditional housing pathways, trapping a vulnerable aging population in a hyper-inflated rental market. This mismatch triggers a severe suitability crisis: LA's auto-centric urban sprawl and inaccessible multi-story housing lack the physical infrastructure and tenure stability required for seniors, fracturing local support networks and exacerbating social isolation.

Homeless people

Even though the productivity grows, the homelessness keeps deteriorating, as shown in [fig.5] the homeless population has arosen for many years. Skyrocketing housing costs directly accelerate drastic social marginalization. LAHSA's recent Greater Los Angeles Homeless Count registers 75,312 unhoused individuals across the county, with 43,695 concentrated within the city proper. Over 60% remain entirely unsheltered, living on sidewalks, in tents, or in dilapidated RVs. Homelessness is not merely an economic failure, but the absolute collapse of the micro-level community safety net.

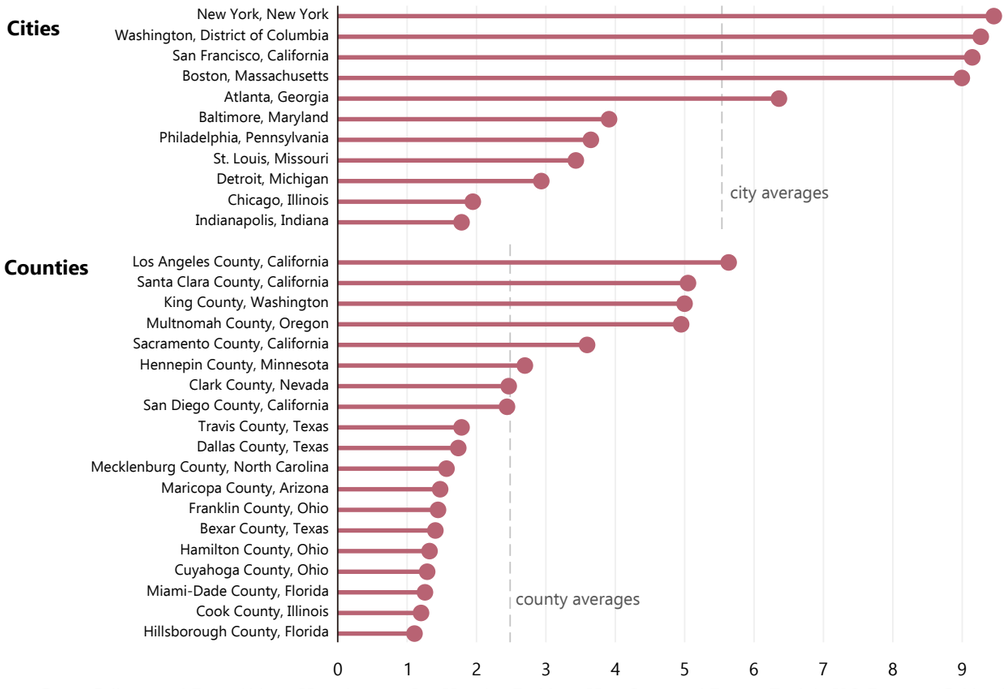
1.1 The Macro-Landscape: Urban Housing Crisis Across the United States

FIGURE 6 Homelessness per 1,000 people in select U.S. regions, 2007



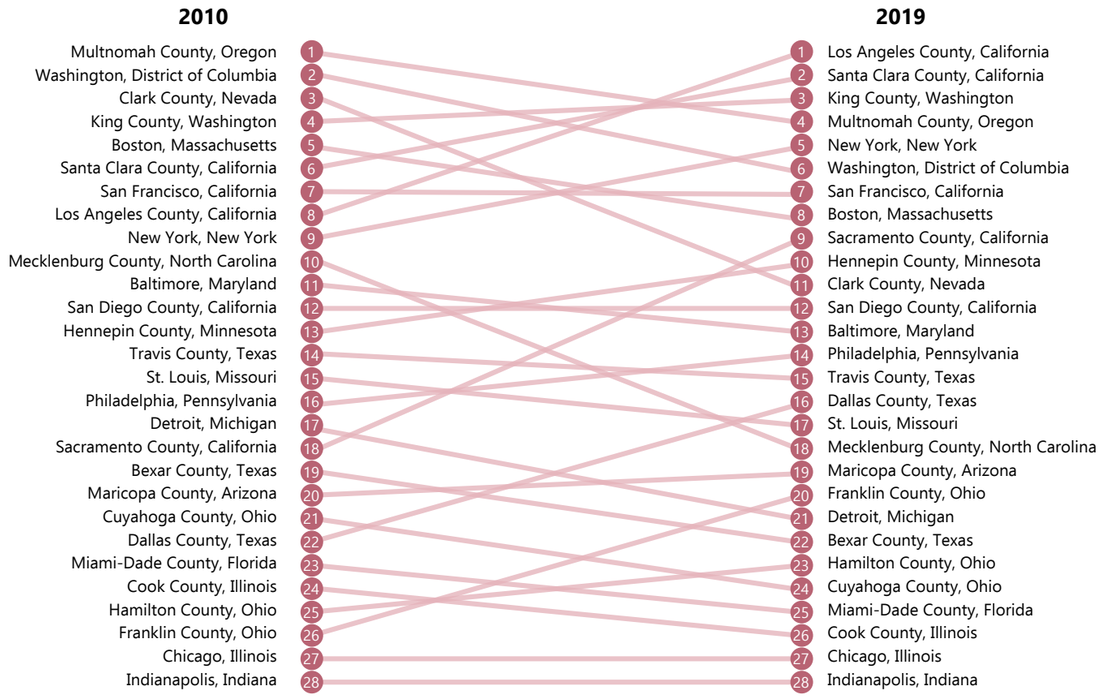
Source: Gregg Colburn and Ryan Aldern, Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns (Oakland: University of California Press, 2022), 35, figure 3.

FIGURE 7 Homelessness per 1,000 people in select U.S. regions, 2019



Source: Gregg Colburn and Ryan Aldern, Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns (Oakland: University of California Press, 2022), 36, figure 4.

FIGURE 8 Rank of indexed rates of homelessness, 2010 vs. 2019

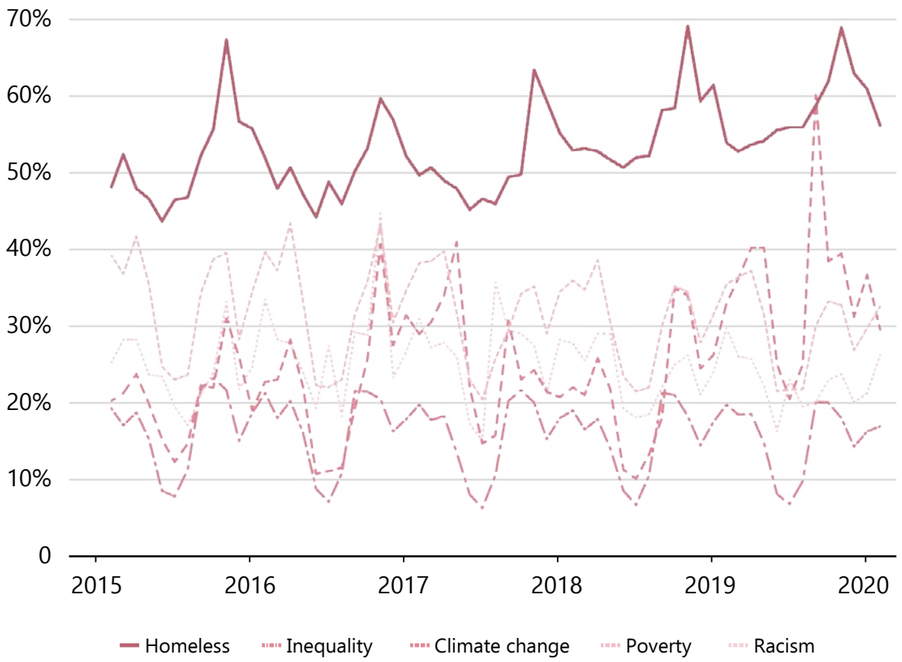


Source: Gregg Colburn and Ryan Aldern, Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns (Oakland: University of California Press, 2022), 37, figure 5.

The contemporary housing crisis in the United States is no longer a localized phenomenon confined to a few coastal metropolitan areas; rather, it has expanded into a pervasive, nationwide structural burden. Macroeconomic data indicates that home price growth has become nearly universal, with 97 of the nation's top 100 metropolitan markets experiencing significant price appreciation [1, p. 2]. This significant rise in cost brings about the limitation of housing affordability throughout the country. At present, more than one third of the American households spend over 30% of their income on house rent. The burden is especially heavy for low-income families and ethnic communities, where the proportion of renter households spending more than 50% on rent has exceeded this figure [1, p. 4]. Thus, the housing shortage is not confined to some regions anymore but has become an important macroeconomic factor affecting the regional development of the whole country.

An examination of the past decade reveals that this crisis is the culmination of a long-term historical trajectory, transitioning from chronic undersupply to an acute market bottleneck. Over the last ten years, the structural mismatch between demand and supply has widened significantly, as the average annual volume of new housing completions fell 27 percent below the historical average of the previous three decades [1, p. 3]. This decade-long stagnation in construction, coupled with record-low inventories exacerbated by the recent "lock-in effect" of rising interest rates, has driven home prices up by 115 percent since 2010, including a staggering 47 percent jump just since 2020

FIGURE 9 Public interest over time for five search terms



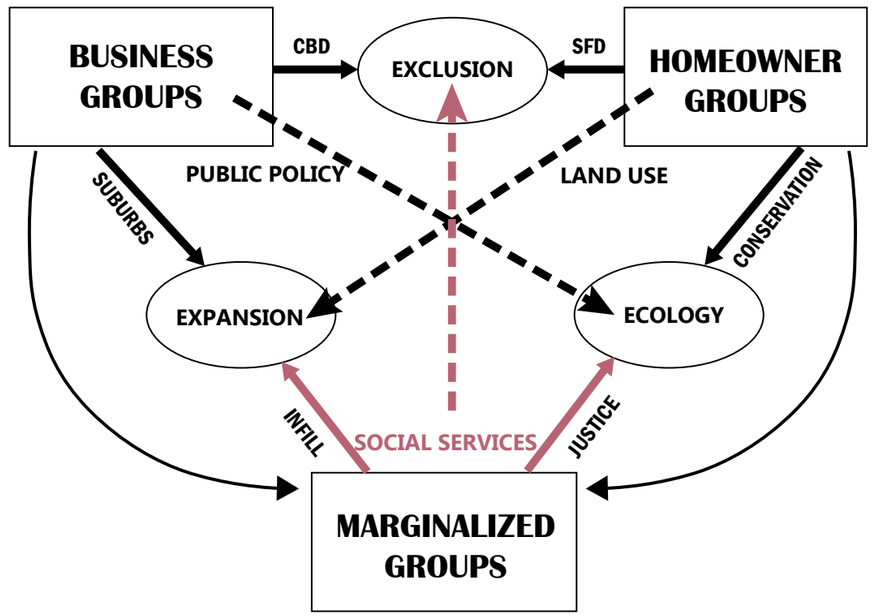
Source: Gregg Colburn and Ryan Aldern, Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns (Oakland: University of California Press, 2022), 19, figure 1.

[1, p. 2]. In stark contrast, the median income of U.S. renters has increased by a mere 2 percent in real terms over the same period [1, p. 4]. This profound historical divergence demonstrates that the market's supply-side mechanisms have systematically failed to align with the actual purchasing power of the population.

At the most vulnerable end of the socio-economic spectrum, the massive deficit in dedicated affordable housing has precipitated a breakdown of the social safety net, resulting in a historic surge in housing deprivation. As low-rent housing stock continues to be eroded by private market forces, the national Point-in-Time count of individuals experiencing homelessness has spiked to an all-time high of over 653,000 people [1, p. 6]. This alarming escalation underscores that private market mechanisms alone are entirely inadequate to resolve the housing needs of extremely low-income populations, rendering expanded government intervention and affordable housing preservation a matter of urgent national significance [1, p. 5]. Therefore, addressing the structural barriers to affordable housing supply is not merely a localized municipal concern, but a critical imperative shared by urban centers across the United States, making the structural analysis of specific hotspots like Los Angeles vital for broader national policy solutions.

1.2 Supply-side Deficits: Historical Pincer Attack from Convulsive & Conservative Urban Acts

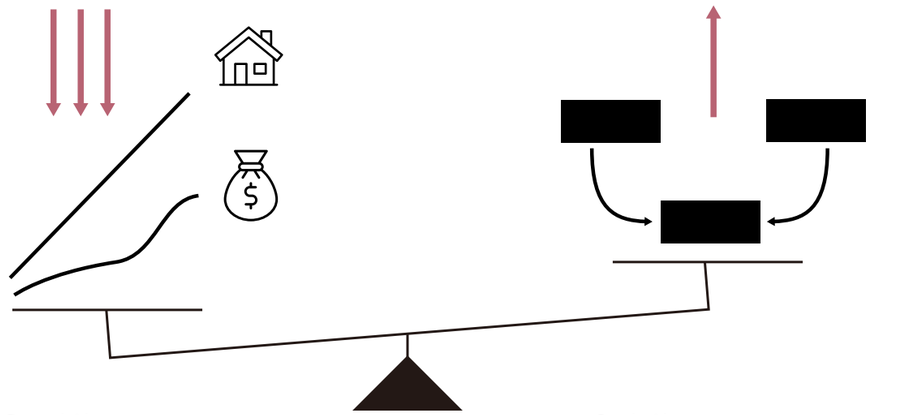
FIGURE 10 Marginalized groups are pincer attacked, inspired by [2, p.13]



Source: Gregory D. Morrow, "The Homeowner Revolution: Democracy, Land Use and the Los Angeles Slow-Growth Movement, 1965–1992" (PhD diss., University of California, Los Angeles, 2013), 29, figure 1-4.

The historical evolution of Los Angeles's built environment is fundamentally characterized by a structural conflict among three primary urban actors: capital-driven business groups, affluent homeowner associations, and vulnerable marginalized/low-income populations. There were 2 forces squezzing the living spaces for the low-income comunities during the rapid urbanizing period 1950-2000, which are the force from the business groups and the force from the homeowner[2]. The influence continues in today. The business groups, i.e. the developers, the oligarchy of the motor manufacturer, they tend to have more representative on public policy, and try to build more commercial centers, CBDs, freeways in the city center. Their momentum to reshape the city always pursuits the profit from the new space in the city, compared with sacrificing the rights of marginalized groups, which is descibed as convulsive urban acts in Dana's book [3]; The homeowner groups are the middle-class residents in city, they acted on direct democracy and limited the land development under the banner of protecting the environment. They wished to prevent the city from changing, freeze the land-use situation, in order to perserve the value of their property. As their thought is to keep the current situation, their acts are called conservative urban acts.

FIGURE 11 Demand and supply mismatch



As Greg Morrow conceptualizes in his model of urban power dynamics, civil rights and low-income communities have historically been trapped in a crushing vice-grip between two opposing yet mutually reinforcing forces [2, p. 13]. Marginalized communities are caught in a pincer movement. From above, municipal alliances between state power and corporate capital drive heavy spatial redevelopment. From below, wealthier homeowners weaponize local zoning laws and anti-growth activism to safeguard property values. Consequently, marginalized residents are subjected to a dual pressure regime: either by physical demolition or by legal exclusion.

The first arm of this structural pressure, which is from top-down "convulsive urban acts", manifested prominently in the post-WWII era through state-sanctioned urban renewal and infrastructure expansion. As Dana Cuff documents, vibrant working-class sanctuaries like "The Flats" in Boyle Heights—defined by dense multi-ethnic networks of Mexican, Russian, and African American families residing in 417 self-built bungalows and auxiliary units—were dismissed as "blight" and subjected to "complete erasure" [3, p. 230]. This space-clearing imperative was further realized through the construction of the interstate freeway system. Edward Soja exposes the stark class asymmetry of this infrastructure: while architectural critics romanticized the freeways as an "Autopia" of "almost erotic excess" connecting the "privatized Foothills for the rich," the actual routes were deliberately carved through politically disenfranchised communities of color [4, p. 15]. By constructing the massive East Los Angeles Interchange directly through Boyle Heights, public policy physically dismembered marginalized neighborhoods, evicting thousands of households under the guise of progress while shielding affluent enclaves from similar infrastructure burdens [3; 4].

Simultaneously, the second arm of pressure, which is from bottom-up, anti-growth politics restricted housing alternatives for these displaced populations.In the 1970s and 1980s, due to increasing environmental and anti-concentration concerns, wealthy homeowners used land-use regulations to control neighborhood changes [2]. Consequently, Proposition U (1986) was approved by the voters, reducing the Floor Area Ratio (FAR) along the Los Angeles commercial corridors from 3:1 to 1.5:1 [2, pp. 242-260]. With the slogan of environmental protection, Proposition U hindered the construction of mixed-use and multi-family houses along the main transit routes - exactly where high-density housing would be most feasible. Thus, while corporate redevelopment violently erased existing low-rent stock in the urban core, homeowner-driven downzoning legally prevented the construction of replacement affordable housing across the broader metropolitan basin.

In Morrow's dissertation, these two forces are two arms of the pincer, pressing the space of the marginalized communities from both sides. They try to expel the low-income community, and keep conflicting on 2 aspects i.e. city expansion and ecology. The convulsive act move the city to re-develop the under-valued area, which is probably the 'slum' area for the marginalized communities; while the conservative act stop the city to develop the area that are in low density. High density 'slums' are removed, and low density residence is forbidden to build, resulting in a city that consists from only high density but high quility space or low density great ecological index space, not such a space for the low-income community.

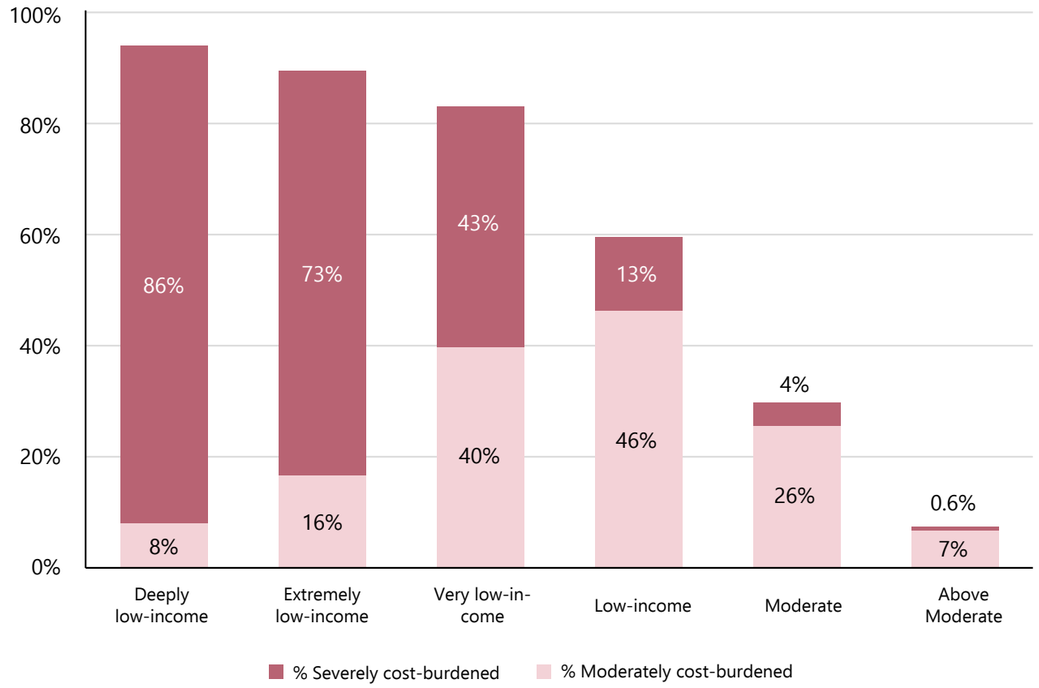
Synthesizing this historical arc illustrates a continuous, generational displacement trajectory for Los Angeles's working-classes who happened to live in the “slum area”. A low-income family displaced from Bunker Hill or Chavez Ravine in the 1950s was forced to relocate to Boyle Heights, only to have their community physically severed by freeway interchanges in the 1960s; seeking refuge in multi-family rentals in the 1980s, they found the regional housing supply structurally paralyzed by Proposition U and suburban downzoning. All these factors caused the failure of market self-adjustment, making the 'invisible hand' unable to solve the housing crisis which exists now. This dual history is still causing the present crisis. On one hand, private capital promotes gentrification near the historic working-class areas with transit orientation, while affluent homeowner groups continue to use Environmental Review Laws (CEQA[16]) and local land-use vetoes to block the affordable developments. This inability to escape historical legacies explains why regional housing deprivation has ultimately escalated into the unprecedented unsheltered homelessness crisis observed in contemporary Los Angeles.

1.3 Demand-side Capacity: Demographic Profiles of Marginalized Communities

In the last section, I discussed the problem on the supply side, i.e. why in the past the 2 major forces were trying to expel the marginalized community. The 2 groups remain today, and their pursuits also continue today, e.g. NIMBYism. In the early 21th century, the city planning has learnt from the past, which isn't enough and I will discuss later. Now though the 2 arms of the pincer being now softened, the consquence of the decades has accumulated to an overwhelming level, as I can see in [1]. It's a nationwide problem, but LA is the worst. In [2] I study the story of urban planning from WWII to 1990, which was a rapid city growing era. And in [1] shows the slow gentrification's effect in 21th century.

As the development was limited on the supply side, on the demand side the low-income population experienced downturns in 2006-2010 and 2020s. Their affordability keeps going weeker. The defining economic paradox of the Los Angeles metropolitan region lies in the acute spatial concentration of low-income households who are structurally incapable of absorbing escalating housing costs. Los Angeles ranks among the most economically unequal metropolitan areas in the United States, underpinned by a severe macroeconomic shift wherein real wages for the lowest-earning decile of regional workers contracted by 25 percent between 1979 and the mid-2010s [5, p. 87].

FIGURE 12 Share of renter households who are cost burdened by income group (2024)



Source: California Housing Partnership analysis of 2024 1-year ACS PUMS data with HUD income levels and added DLI income group subset

This purchasing power deficit at the demand side is tightly linked to persistent labor market disparities across demographic groups. As long-term regional labor data demonstrates, racial and ethnic minorities, consistently face lower labor force participation rates and systematically higher unemployment rates compared to the county average (e.g., Black unemployment historically remaining nearly double that of White residents) [5, p. 31]. These structural employment gaps directly depress household earnings for marginalized communities across the basin.

Consequently, this economic vulnerability is geographically locked into hyper-vulnerable spatial enclaves. Within underinvested geographic corridors like the South Los Angeles Transit Empowerment Zone (SLATE-Z), the poverty rate reaches 41 percent—more than double the Los Angeles County average—while 25 percent of households lack private vehicle access, further isolating them from regional job hubs [5, p. 13]. Similarly, in Southeast Los Angeles (SELA), 26 percent of households experience linguistic isolation (versus 14 percent countywide), creating institutional barriers to higher-wage employment and social safety nets [5, p. 13].

In summary, the demand-side economic capacity of Los Angeles's low-income population is severely constrained by systemic labor market inequities and spatial isolation. Resolving this compounding crisis requires a policy realignment guided by three interrelated imperatives: diversity, equity, and integration [5, pp. 87–88]. Preserving a city's demographic mix is only a starting point; policy must explicitly target public investments and resources toward left-bihind communities, such as South and Southeast Los Angeles. Furthermore, desegregation and economic mobility depend on the removal of the historical spatial barriers and the connection between physical isolates, resulting in segregated coloured communities directly approaching the transit systems, high opportunity jobs and secure affordable housing. Without targeted equity interventions and structural spatial integration, the region's low-income households remain mathematically incapable of absorbing escalating market rent burdens, exacerbating localized housing insecurity across the Los Angeles basin.

1.4 Housing Mismatch Becomes Homelessness and Triggers Urban Repercussions

FIGURE 13 2024 Unhoused deaths in city of Los Angeles



In the last 2 sections, I discussed the 2 arms of the unbalance market libra. On the supply plate, I studied why in the past the 2 major forces were trying to expel the marginalized community. The 2 groups remain today, and their pursuits also continue today, e.g. NIMBYism. In the early 21th century, the city planning has learnt from the past, which isn't enough and I will discuss later in section 1.5. One the demand plate, I analyzed the affordability of the marginalized group becomes weeker. Now though the 2 arms of the pincer being now softened, the consquence of the decades has accumulated to an overwhelming level, and the economical vulnerability of the marginalized groups reaches at peak, resulted in [1]. It's a nationwide problem, but LA is the worst. In [2] I study the story of urban planning from WWII to 1990, which was a rapid city growing era. And in [1] shows the slow gentrification's effect in 21th century.

So in this section, I talk about how this market unbalancy develops into homelessness and also its repercussions. Building upon the macroeconomic supply stagnations and historical zoning exclusions analyzed in preceding sections, homelessness in contemporary Los Angeles represents not an individual deficit, but the ultimate systemic failure of the regional housing market. As Gregg Colburn and Clayton Page Aldern empirically demonstrate, regional rates of homelessness are driven fundamentally by housing market dynamics rather than individual vulnerabilities [6, p. 9]. Their analysis reveals clear 'threshold effects': once median rents exceed 30 to 32 percent of median household income, per capita homelessness spikes non-linearly [6, p.

57]. Federal Point-in-Time (PIT) counts further illustrate this pattern; high-cost metropolitan areas like Los Angeles exhibit per capita homelessness rates that far surpass national benchmarks (see [6, Figure 5]), underscoring how persistent rent burdens dismantle local housing safety nets [6, p. 57].
Leading to homelessness, this market failure operates through 4 mutually reinforcing drivers:

On the demand-side:
Purchasing power contraction and extreme **cost burdens** create a widening financial chasm [1; 5]. As low-tier wages declined while market rents reached historic peaks, Los Angeles emerged as one of the most cost-burdened metropolitan areas in the nation [1, p. 2].

On the supply-side:
Restrictive **land-use governance** and statutory **supply barriers** choked housing production. The California Legislative Analyst's Office (LAO) estimates that preventing California housing prices from outstripping national averages would have required constructing 70,000 to 110,000 additional units annually, shift significantly more construction to high-demand coastal regions, and build far denser housing concentrated in central city cores [7, p. 21]. Instead, Los Angeles experienced the opposite historical trajectory: state-sponsored "convulsive urban acts" destroyed thousands of naturally occurring low-rent units in the urban core, while defensive homeowner governance, e.g. Proposition U's 1986 restriction on commercial FAR, severely restricted multi-family residential density in coastal and transit-adjacent corridors [2; 3; 7]. Combined with lengthy entitlement processes and CEQA[16] reviews, these regulatory barriers pushed the "break-even" cost of new construction far beyond the reach of low- and moderate-income households [7]. **Historical stock destruction** and **private market failure** exacerbated the deficit. State-sponsored urban renewal and redevelopment acts historically destroyed thousands of naturally occurring affordable units in the urban core without one-to-one replacement [2]. Because producing deeply affordable units yields a negative Net Present Value (NPV) for unassisted private capital, the market is economically incapable of supplying housing for the lowest income brackets without direct public subsidy [7]. This dual regime of stock destruction and statutory downzoning resulted in a chronic supply deficit precisely where worker demand was highest.

On the social security side:
The market failure needs **social security** to guarantee to bottom line, otherwise the **unsheltered homelessness crisis** is manifested [1; 6]. Unlike eastern metropolitan areas with legal "Right to Shelter" mandates (e.g., New York City), Los Angeles historically suffered from a severe deficit of emergency shelter beds and transitional housing [1]. Consequently, as market rents pushed low-income households beyond their financial limit, the shortage of both permanent affordable housing and shelter infrastructure forced a disproportionate percentage of the unhoused population onto the streets, cars, and encampments who solidify Los Angeles as the epicenter of unsheltered homelessness in the United States [1; 6].

This structural failure becomes homelessness, which triggers severe, cascading urban repercussions that destabilize public sanity, municipal infrastructure, and social cohesion across Los Angeles. The acute prevalence of unsheltered homelessness—where individuals reside in tents, vehicles, or makeshift encampments—exposes vulnerable populations to extreme environmental hazards, resulting in a lethal public health emergency. Recent mortality tracking among unhoused residents in Los Angeles shows a tragic surge in unhoused deaths, predominantly driven by substance overdoses (fenethylline, etc.) happening within informal encampments. This mortality crisis illustrates how prolonged housing deprivation interacts synergistically with substance vulnerability, turning public right-of-ways into sites of mortality and over- straining local emergency response, healthcare, and social service networks.

Ultimately, the unchecked expansion of unsheltered homelessness generates a destructive feedback loop that further deepens urban divisions. Municipal responses often default to short-term enforcement, such as encampment sweeps and criminalization, which temporarily displace unhoused individuals without resolving their housing needs. These enforcement tactics strain public budgets, degrade shared public spaces, and widen the gap between property owners and unhoused residents. Consequently, homelessness in Los Angeles operates as both a tragic failure of the housing market and an active catalyst for urban degeneration, underscoring the urgent imperative for policy interventions that prioritize affordable housing delivery.

Homelessness is not a simple problem that designer alone can solve, however at least I can consider the associated repercussions during my proposal planning.

1.5 Institutional Responses: Actionalbe Policy Incentives and Operational Regulations

FIGURE 14 Institutional response matrix: Government incentives

Policy	Incentive Mechanism	Targeted Failure	Architectural Response
AB 2011	Authorizes "by-right" ministerial approvals and CEQA[16] exemptions for 100% affordable developments on commercial corridors.	Counteracts historical commercial downzoning (e.g., Prop U) and eliminates lengthy discretionary review holding costs.	• Linear Mid-Rise Massing & Shallow Building Depths • Encourages 4–6 story linear building
Prop. HHH	Allocates $1.2 Billion in general obligation bond debt to directly fund supportive housing construction.	Injects direct public subsidy into negative NPV developments for extremely low-income groups.	• Standardized units • Budget evenly distributed
TOC Guidelines	Grants up to 80% density bonuses, elevated FAR, and parking reductions near major transit stops.	Overcomes local density caps and high production costs by incentivizing market-rate developers to include affordable units.	• Podium-Free / Zero-Parking High-FAR Vertical Stacking. • Eliminates subterranean concrete parking garages.
ED 1	Mandates a 60-day expedited administrative entitlement timeline for 100% affordable housing projects.	Cuts entitlement delays, reducing capital holding interest and mitigating localized NIMBY political vetoes.	• Standardized "Kit-of-Parts" Facade Systems & Simplified Envelopes. • Panel layouts based on rigid 1.5m and 2.59m transport grids.
SB 35/ AB 2234	Statutory ministerial approvals and pre-approved catalog plans for off-site manufactured housing.	Eliminates pre-construction plan-check delays, pre-development engineering fees, and entitlement risks.	• Catalogue Modular Architecture & Rigid Factory Grids. • conform the highway transport limits.
AB 2446 & CALGreen 2024	Mandates a 40% reduction in life-cycle embodied carbon by 2035 and a 65%+ jobsite waste diversion rate.	Mitigates the embodied carbon footprint and severe jobsite waste associated with cast-in-place concrete.	• Low-Carbon Mass Timber Assemblies • Precision Pre-Cut. • Use Cross-Laminated Timber to replace Concrete.
LA Green Deal / pLAn 2019	Promotes circular economy frameworks, material passports, and Design for Disassembly (DfD).	Addresses linear "build-and-demolish" material waste cycles and post-lifecycle demolition loss.	• Demountable Dry-Joint Tectonics & Mechanical Connections

Directly confronting the macroeconomic housing crisis in Los Angeles and across the country (¶Section 1.0 & 1.1), and on the supply-side of the libra where the shortage problem meets its historical root (¶Section 1.2), then on the demand-side of the libra where the purchasing power remains week (Section 1.3), finally considering this severe market failure changing into homelessness and triggering public health repercussions of homelessness (¶Section 1.4), state and municipal authorities have enacted a targeted suite of legislative and executive policy interventions. Instead of depending on the unassisted private market mechanisms which cannot ensure the availability of affordable shelter, these institutional responses deploy public funds, density bonuses and administrative simplification to bridge the regional housing gap. The table below [fig.12] summarizes the core mechanisms, targeted market failures, and persistent operational limitations of these primary state and local initiatives:

According to the matrix, these policy responses work through three aspects. At the capital level, [9] directly invests public bond equity into supportive housing to bridge the negative Net Present Value (NPV) gap existing in low-income developments. At the land-use level, [10] utilizes private capital by providing density bonuses and parking reductions in exchange for dedicated affordable units near public transportation. At the administrative level, [8] and [11] try to decrease the cost of development by setting up ministerial 'by-right' approval and strict 60-day review deadlines, thus avoiding the need for discretionary hearings and environmental lawsuits. Despite their innovative designs, these

institutional interventions remain constrained by persistent operational bottlenecks. Not the investment policy, per se, can bridge the demand gap. Under a Combination of actionable incentives, designers and manufacturers should bring some products with the features that can respond to the incentive mechanism. Direct capital programs like Proposition HHH[9] have struggled with hyper-inflated per-unit development costs ($500,000 to $700,000), resulting in really slow delivery rates relative to the sheer size of the unhoused population. State-level streamlining under AB 2011[8] mandates high-road prevailing wage requirements, creating an elevated labor cost floor that partially offsets the financial savings achieved through faster approvals. Furthermore, administrative accelerators like ED 1[11] apply exclusively to 100 percent affordable projects, leaving the vast majority of mixed-income rental developments subject to traditional entitlements delays. Also in recent years policies [13;14] promote timber work in carbon storage and address the demolition loss in Life Cycle Analysis.

In conclusion, current state and municipal incentives provide valuable tools for targeted affordable housing delivery, and their operational limitations demonstrate the baseline.

On one hand, the incentives (see [fig.13]) point out the way for the future.

On the other hand, summarizing the experience from the past, some institutional demands (see [fig.14]) need to be met.

FIGURE 15 Institutional response matrix: Government incentives

Table 1b – General Development Standards: Multifamily, Commercial, Manufacturing, Parking, and Open Space/Public Facilities/Submerged Lands

Zone	Use	Maximum Height		Required Yards			Minimum Area		Min. Lot Width	Parking Required
		Stories	Feet	Front	Side	Rear	Per Lot	Per Dwelling Unit		
Multiple Residential										
RD1.5	**Restricted Density Multiple Dwelling** One-Family Dwellings, Two-Family Dwellings, Apartment Houses, Multiple Dwellings, Home Occupations		45 ft or (6a), (9)	15 ft	5 ft; or 10% of lot width where lot is less than <50 ft wide; 3 ft min; +1 ft for each story over 2nd, not to exceed 16 ft (6a)	15 ft	5,000 sq0ft	1,500 sq-ft	50 ft	1 space per unit < 3 habitable rooms; 1.5 spaces per unit = 3 habitable rooms; 2 spaces per unit > 3 habitable rooms; uncovered (6a) 1 space each guest room (first 30) Bicycle Parking pursuant to Sec. 12.21 A.16 of the LAMC
RD2								2,000 sq-ft		
RD3					10% of lot width, 10 ft max; 5 ft min (6a)		6,000 sq-ft	3,000 sq-ft	60 ft	
RD4							8,000 sq-ft	4,000 sq-ft		
RD5				20 ft	10 ft (6a)	25 ft	10,000 sq-ft	5,000 sq-ft	70 ft	
RD6							12,000 sq-ft	6,000 sq-ft		
RMP	**Mobile Home Park** Home Occupations		45 or (9)	20% lot depth, 25 ft max	10 ft	25% lot depth, 25 ft max	20,000 sq-ft	20,000 sq-ft	80 ft	2 covered spaces per dwelling unit Bicycle Parking pursuant to Sec. 12.21 A.16 of the LAMC
R3	**Multiple Dwelling** R2 Uses, Apartment Houses, Multiple Dwellings, Child Care (20 max)			15 ft; 10 ft for key lots	5 ft; 10% lot width when lot width is < 50 ft; 3 ft min; +1 ft for each story over 2nd, not to exceed 16 ft	15 ft	5,000 sq-ft	800 sq-ft; 500 sq-ft per guest room	50 ft	Same as RD Zones
RAS3	**Residential/Accessory** R3 uses, Limited ground floor commercial			5 ft, or average of adjoining buildings	Zero ft for ground floor commercial, 5 ft for residential	15 ft adjacent to RD or more restrictive Zone; otherwise 5 ft		800 sq-ft; 200 sq-ft per guest room		
R4	**Multiple Dwelling** R3 Uses, Churches, Schools, Childcare, Homeless Shelter	Unlimited (9)		15 ft; 10 ft for key lots	5ft; 10% lot width when lot width is < 50 ft; 3 ft min; +1 ft for each story over 2nd, not to exceed 16 ft	15 ft; +1 ft for each story over 3rd; 20 ft max		400 sq-ft; 200 sq-ft per guest room		

- **2025 California Residential Code, Title 24, Part 2.5**

This document is suitable for all building types except single-family dwellings, including high-density multi-family housing, co-living accommodation (Category R) and mixed-income communities.

Published by the government to replace existing varying space standards used by local authorities.

- **LAHD Architectural Requirements, 2025**

This design guideline provides additional space standards for affordable housing.

It is to promote and assist in the development of well-designed, quality, affordable housing in a cost-effective manner.

Part 1	The Design Review Criteria	Priority 1	Priority 2
1.0	Site Planning		
Privacy	• Identify neighborhood characteristics: Land use, height, scale, massing of existing structures and relate proposed project to the characteristics found in the neighborhood. • Identify and mitigate adverse impacts from adjacent use. • Design landscaping and place building/s with relationships to adjacent uses and views.	√	
Surroundings	• Consider surrounding traffic with respect to safety, noise, and ease of circulation when locating buildings, landscape, pedestrian walkways, and driveways. • Provide clear separation between pedestrian and vehicle traffic. • Take adequate safety measures to assure child safety.	√	
Noise Levels	• Comply with State's Noise Insulation Standards (Cal Adm Code Title 25, Section 1092), and City of Los Angeles minimum acceptable noise level criteria for residential construction. • Design to minimize impact from noise sources using landscape and architectural features.	√	
2.0	Building Design (exterior)		
Setbacks	• Conform front, rear, side setbacks to prevailing setbacks along street. • Vary yard depths to provide visual interest and usable yard areas.	√	
Height and Scale	• Relate height and scale of new construction to the prevailing height and scale of existing neighborhood buildings. • The building should reflect human scale, integrate with, and enhance the surrounding neighborhood.	√	
Massing	• Break up the mass of the building by using a variety of shapes to express the volume of the building. For example, it may be appropriate to step back the facade of the building to allow for a lower building height at street level, and a taller building height toward the middle or rear of the property.	√	
Neighborhood Compatibility	• Complement the existing neighborhood by taking clues from existing structures to unify the streetscape of the neighborhood. When appropriate, relate facade design, roof shapes, size and rhythm of openings, materials and colors, and architectural style of new buildings to near by buildings.		√

3.0	Building Design (interior)		
Unit Access	• Provide natural light and ventilation in corridor areas and avoid long, double loaded corridors as much as possible. • Consider separate access to public areas such as recreation rooms, and laundry facilities, from the private residential unit area.	√	
Unit Entrance Area	• Unit entries should be prominent, visible, and easy to secure. • Consider privacy, security, and changing hierarchy of space in the transition from public street or parking lot to private unit entries. • Consider expanding side yards to allow access to individual unit entries. • Minimize signage requirements with effective design.	√	
Manager Unit and Office	• Consider a central location for the manager's unit and office, which will provide additional security for the building residents. • Consider providing additional amenities for the manager's unit to attract the best possible manager(s) for the project to assure the long-term success of the project. • Provide offices for property management and social service staff for PSHP projects.		√
Elevators	• All residential buildings with more than three floors of public access (Including garage) must have an elevator. • Residential buildings housing the elderly or handicapped of two stories or more must have an elevator.	√	
4.0	Unit design		
Furniture Layout	• Ensure that all rooms can be reasonably furnished for the use intended. • Consider available wall space, and/or adequate room size for furniture layout. • Ensure that the dining area is sufficient size to accommodate additional chairs and a large table in large family units • For PSHP projects provide fully furnished units including beds, kitchen table, with chairs, light fixtures, dressers and window coverings	√	
Ligh and Ventilation	• Provide operable windows in all bedrooms. • Provide generous natural lighting and "through" ventilation, which creates a bright living environment with fresh air especially in the kitchen area. • Consider using windows that provide greater "depth" in appearance and have greater energy efficiency. • Vent kitchen hoods to building exterior.		√
Finish Materials	• Consider using materials, which facilitate the performance of routine maintenance tasks by the residents. • Provide low maintenance, high durability materials. • Avoid using mill finish, and pressboard cabinets.		√

1.6 Architectural Response: What Solution the City Expects?

In ¶Section 1.5, I summarized the responses to the housing crisis on the legislative level. As well as the governer, I as the designers also learned from the past, data and practical cases. As mentioned before, the designer alone is not capable to solve the housing crisis problem nor the homelessness. However, I should still keep in mind what kind of the targeted current problem is main issue to deal with, and try to bring promotion to the neighborhood via my design in purpose. Next, it's what I will discuss in this section, that's what will be my response as archiets? If I come out of a solution, what features it should be bearing?

• Quick deployability

In section 1.2, one primary factor of the shortage is the limit on supply. In the section 1.5 I can see the governer try to unleash the supply limitation on legislative level. Similar to that my architectural solution should be capable of maximizing the the ability of deploying. That's the fundamental treatment of the supply shortage.

• Affordability

In section 1.3, I leaned that the purchasing power of the marginalized group remains in a low level. So my proposal should be economical.

• Design for Disassembly

In section 1.4, I talked about the unsheltered homelessness outbroke in LA because of the lack of temporary shelter for them. If my design takes the homelessness problem in consideration, then a quick build quick go solution is suitable. In this case I should design for diassembly.

• Flexibility

In section 1.0, I find that demand of elder people incresead and in section 1.3 I knew the marginalized groups are consisted of many enthics. So my solution should have the flexibility to entertain the population of diversity. And it can be easily deployed to many shapes of the sites as an answer to land-use supply.

• Accessiblity

In section 1.0, I find that the majority of the affordable housing residents are living without a car. Also in section 1.5 TOC Guidelines encourages producing car-free residences. So I should find the solution without a big courtyard as parking and easy to evacuate. As the traffic system is simplified, I should use ground floor as activities halls.

• Openness and Harmony

In section 1.4, I realize the homelessness brings negative influence to the city. If my solution can bring harmony to the neighborhood, at least it can ease the problem. That requires my solution helps to build a better safety atmosphere. To do that, I maximize the vision of our dwellers, increasing the eye-contacts. Also I open up many balcony spaces to bring up the chance of communicating.

• Design for the whole Life Cycle

I considered both ends of the building service. Before construction, I study the regulation of the transportation which can be a reference of the material selection. Similarly, I select the products with better energy-consumption performance and timber as the carbon storage to go along with the policy LA Green Deal.

Bibliography

[1]Joint Center for Housing Studies of Harvard University (JCHS), *The State of the Nation's Housing 2024*. Cambridge, MA: Joint Center for Housing Studies of Harvard University, 2024.

[2]Morrow, Gregory D. *The Homeowner Revolution: Democracy, Land Use and the Los Angeles Slow-Growth Movement, 1965-1992*. PhD diss., University of California, Los Angeles, 2013.

[3]Cuff, Dana. *The Provisional City: Los Angeles Stories of Architecture and Urbanism*. Cambridge, MA: MIT Press, 2000.

[4]Soja, Edward W. *My Los Angeles: From Urban Restructuring to Regional Urbanization*. Berkeley: University of California Press, 2014.

[5]Pastor & Scoggins / PolicyLink & PERE (2021), *An Equity Profile of the Los Angeles Region*.

[6]Colburn, Gregg, and Ryan Aldern. *Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns*. Oakland, CA: University of California Press, 2022.

[7]Legislative Analyst's Office. *California's High Housing Costs: Causes and Consequences*. Sacramento: Legislative Analyst's Office, 2015.

Legislative & Policy Documents

Figure 14:

[8] *Assembly Bill 2011* - California State Legislature (2022),
[9] *Proposition HHH* - City of Los Angeles (2016),
[10] *TOC Guidelines* - LADCP (2017),
[11] *Executive Directive 1* - Office of the Mayor of Los Angeles (2022).
[12] *SB 35 / AB 2234 & LADBS Standard Plan* - CA State / City of LA
[13] *Assembly Bill 2446 & CALGreen 2024* CA State Mandates
[14] *LA Green New Deal / pLAn 2019* City of LA Circularity Framework

California Natural Resources Agency. *CEQA Guidelines*. California Code of Regulations, title 14, division 6, chapter 3, sections 15000–15387. Sacramento: California Natural Resources Agency, 2024.
California Public Resources Code. *California Environmental Quality Act (CEQA)*. Division 13, sections 21000–21189. Sacramento: State of California, 2024.

Websites

Figure13:

2023 Unhoused Deaths in City of LA (Completed Cases) la controller - Official Website of the City of Los Angeles
url: https://unhouseddeaths.lacontroller.app/ accessed in July 2026.

Figure15:

https://housing.lacity.gov/ula-program-guidelines
https://planning.lacity.gov/zoning/regulations-summary

2. Why DfMA Fits Los Angeles

2.1 Defining the Affordable Housing Framework for LA

2.1.0 Transition from Systemic Diagnosis to Product Performance

2.1.1 Tectonics and Performance Dimensions

2.1.2 Planar Organization and Socio-Spatial Dimensions

2.2 Empirical Validation: LA Case Studies

2.3 Strategic Recommendations and Synthesis: Implementing DfMA in LA

02

Why DfMA Fits Los Angeles

2.1 Defining the Affordable Housing Framework for LA

This chapter consists of 3 parts:

Firstly, I'll study the advantages of DfMA, by ananlyzing its feature on construction point of view and of floor plan composition, to prove that this building technique is suitable for those features I've just summarized in the section 1.6.

Secondly, I'll study the real cases in LA. The DfMA method is not only a theoretical proposal but also provide practicle cases to study.

Thirdly, I'll summarize the lessons I can learn from these cases. And try to propose some recommendation for my solution.

2.1.0 Transition from Systemic Diagnosis to Product Performance

The multi-dimensional diagnosis established in Chapter 1 demonstrates that the Los Angeles housing crisis is fundamentally a structural failure driven by hyper-inflated land costs, extended capital holding periods, restrictive zoning, and socio-spatial segregation. Rather than treating affordable housing as an isolated, ad-hoc "construction project" subject to traditional market frictions, resolving this crisis mandates re-conceptualizing housing as a standardized, highly scalable "industrial product." To effectively absorb state and municipal policy incentives—such as Mayor Karen Bass's ED 1 [11] 60-day expedited entitlement and AB 2011 [8] commercial corridor rezonings—the spatial and structural performance criteria of next-generation affordable housing must be systematically redefined across two primary dimensions: tectonic performance and planar organization.

FIGURE 1 Different four kinds of construction methods features matrix

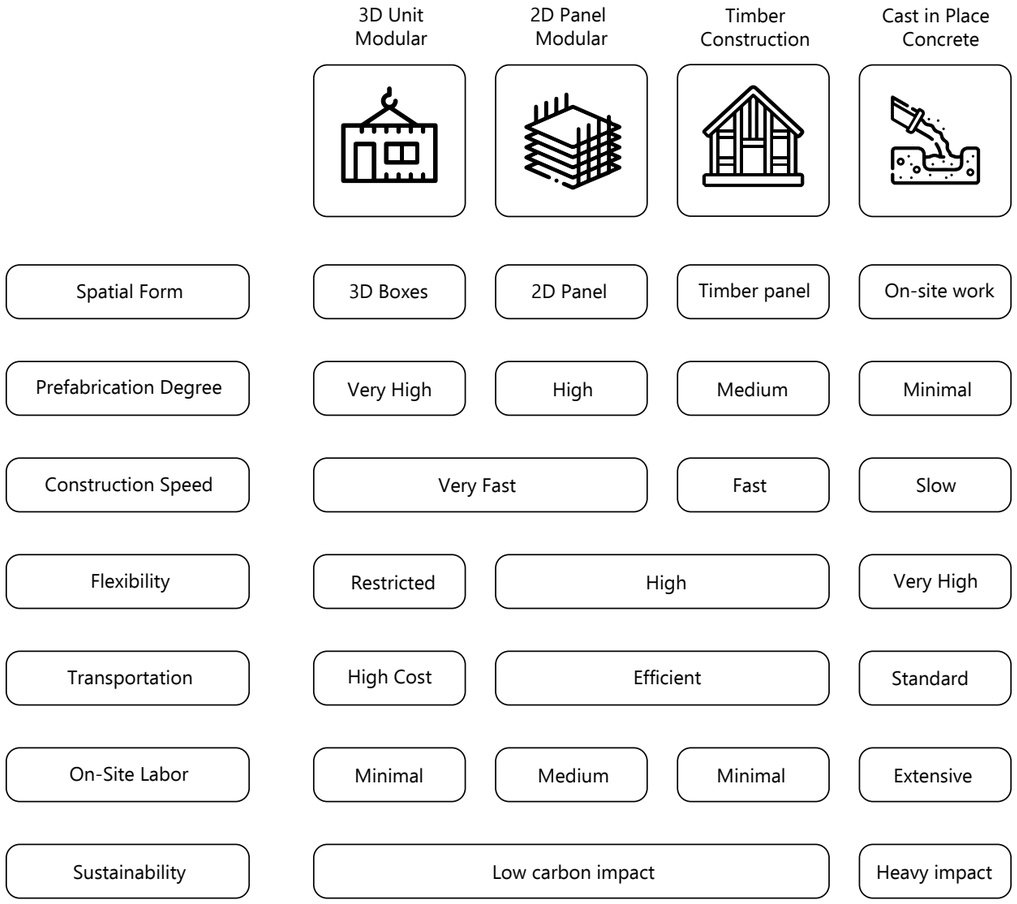
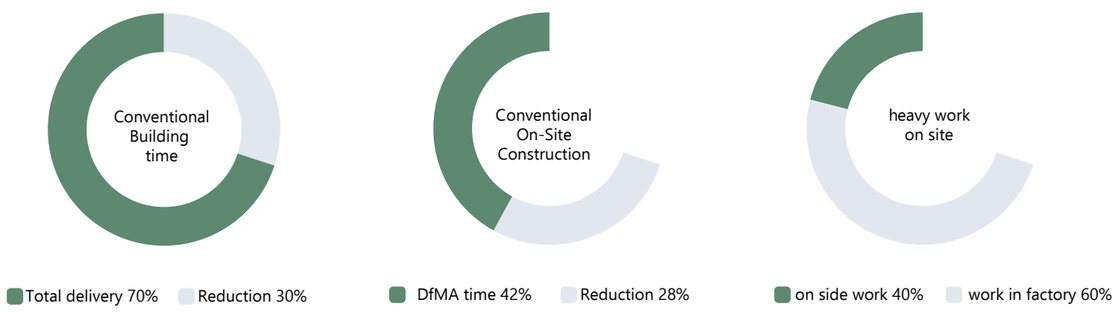


FIGURE 2 2D panel modular method vs. On-site construction [17]



2.1.1 Tectonics and Performance Dimensions

From a structural and production perspective, the technical parameters of the affordable housing product must overcome the cost and time bottlenecks that historically paralyzed project delivery in Los Angeles:

Economic Viability:
By transferring the production process to controlled factory environments, the waste of materials is reduced from the average industry rate of 10-15% to below 2%. Furthermore, the industrial precision can lower the maintenance expenses after occupancy and protect the project budget from the fluctuations in the supply chain.

Sustainability & Environmental Compliance:
Next-generation housing must natively comply with California's Energy Efficiency Standards [15] and low-carbon mandates. Factory-manufactured volumetric modules achieve millimeter-level airtightness, providing an optimal envelope for ZNE performance while minimizing localized dust, noise, and urban disruption during assembly (aligning with CEQA-friendly development priorities), which is vital for neighborhood harmony.

High Scalability & Rapid Delivery:
To maximize the time savings offered by ministerial "by-right" approvals, the structural system must decouple site preparation from building manufacturing. Off-site parallel production allows quick on-site assembly, significantly reducing the risk of construction loan interest rates and holding costs.

Here is an example to demostrate its rapid delivery.

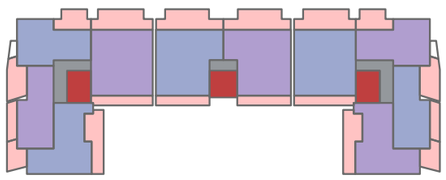
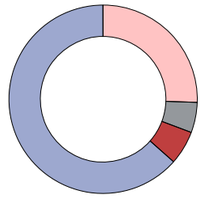
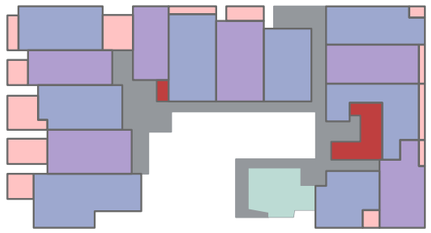
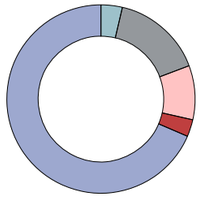
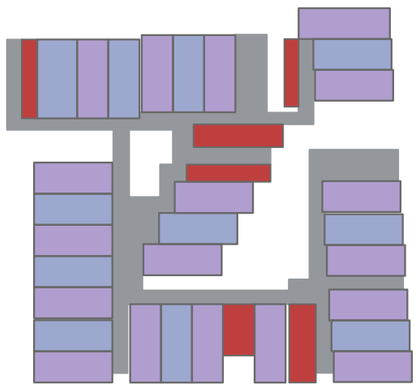
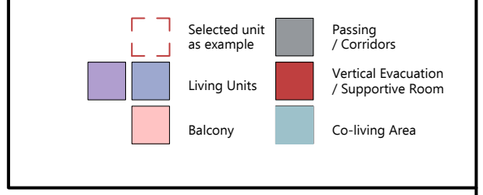
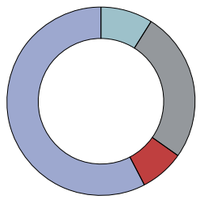
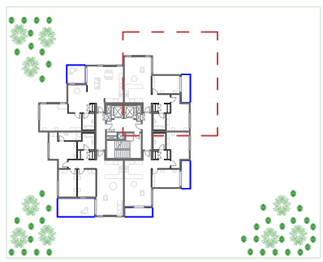
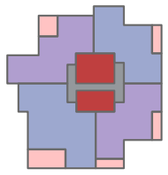
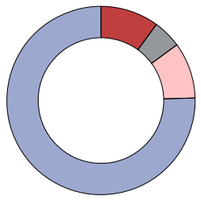
In the practice of modern DfMA, Dagenham Park School (designed by AHMM in collaboration with contractor Laing O'Rourke[17]) demonstrates the exceptional efficacy of 2D panelized systems in industrialized construction.

As a flagship project under the UK BSF (Building Schools for the Future) program,the project has gained high construction efficiency with a budget of £22.6 million by utilizing advanced industrialized structural components and multi-layer sandwich facades.

- **Factory Production:**
An automatic manufacturing plant can manufacture all the necessary components for the whole school in approximately 2 to 3 weeks, while the on-site main structure and facade assembly takes about 6 months.
- **Schedule Reduction:**
his reduces the total construction period from 22 months to 16 months, saving about 27% of time compared with the conventional construction methods.
- **DfMA 70:60:30 Model:**
The project successfully realized Laing O'Rourke's benchmark 70:60:30 DfMA Slogan—shifting 70% of the construction work to a controlled factory environment, i.e. eliminating 70% of high-risk wet work at height and external scaffolding, enhancing on-site productivity by 60%, and shortening overall project delivery by 30%, while achieving over 250,000 work hours without lost-time safety incidents.

This benchmark demonstrates that deeply integrating panellized systems such as, structural load-bearing, thermal insulation, external cladding, and window seals at the factory level (Integrated Panels) is a critical path to balancing high design quality with an expedited schedule.

FIGURE 3 Different four kinds of affordable housing floor plan features matrix A

Example Case	Example Case	Space Layout	Area Porpotion
Viale Giulini Affordable Housing 5380 sqm Barletta (BT), Italy RC Frame, 6 floors			Foot print: 1584 sqm. 3 cores. Italian common enclosed courtyard. Balcony | Area: 342.33 | Ratio: 25.55% Living | Area: 850.04 | Ratio: 63.43% Supportive | Area: 77.97 | Ratio: 5.82% Corridor | Area: 69.68 | Ratio: 5.20% 
11NOHO 110,550 sq. ft. 11311 Camarillo Street, North Hollywood, CA Steel Frame, 5 floors			Foot print: 2264 sqm. 1 core. 2 additional stairs. Rooftop courtyard on ground floor. Living | Area: 1291.26 | Ratio: 68.53% Supportive | Area: 55.17 | Ratio: 2.93% Balcony | Area: 175.05 | Ratio: 9.29% Corridor | Area: 293.65 | Ratio: 15.59% Court | Area: 69.02 | Ratio: 3.66% 
STAR APARTMENTS 95,000 sf Los Angeles, California Lower floors: Mega Structure Upper floors: Self-stacking containers, 4 floors on stacking			 Foot print: 3169 sqm. 1 elevation core. 3 additional stair cases. 2 lightwells. Living | Area: 1812.76 | Ratio: 57.63% Supportive | Area: 238.94 | Ratio: 7.60% Corridor | Area: 812.71 | Ratio: 25.84% Court | Area: 281.09 | Ratio: 8.94% 
My Proposal 2100 sqm. Los Angeles, California Steel Frame + Core 4 floors			Foot print: 671 sqm. 1 core. Compact layout. Living | Area: 376.58 | Ratio: 75.43% Balcony | Area: 48.15 | Ratio: 9.64% Corridor | Area: 24.48 | Ratio: 4.90% Supportive | Area: 50.01 | Ratio: 10.02% 

2.1.2 Planar Organization and Socio-Spatial Dimensions

Beyond structural efficiency, the spatial configuration of affordable units must directly address the demographic vulnerabilities and their initial demands outlined in Section 1.3, 1.4. In section 1.6, I pointed out 7 architectural features I should focus on during deliverying the affordable housing in LA. So I made a matrix here to examine these projects from the aspect of those features.

• **Accessibility:**

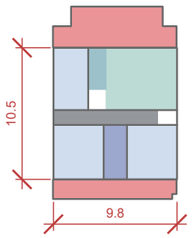
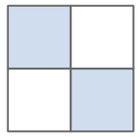
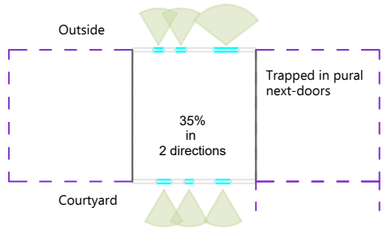
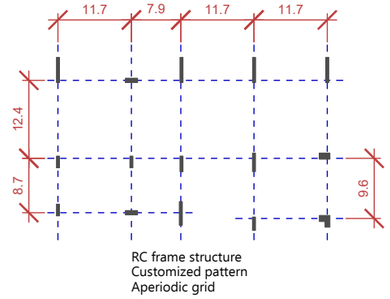
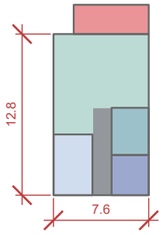
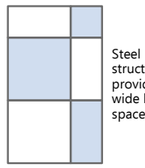
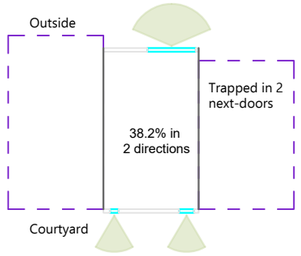
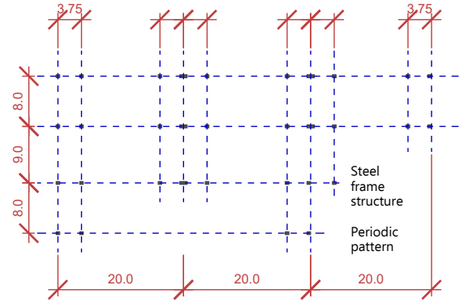
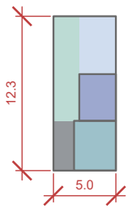
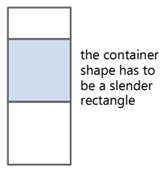
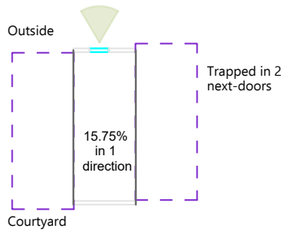
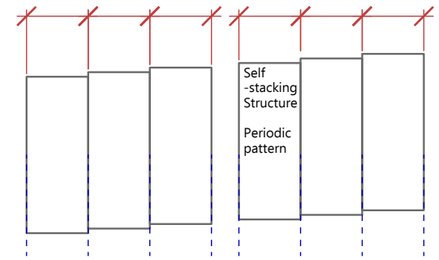
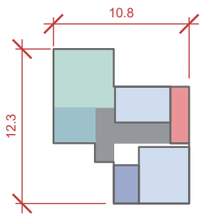
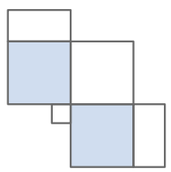
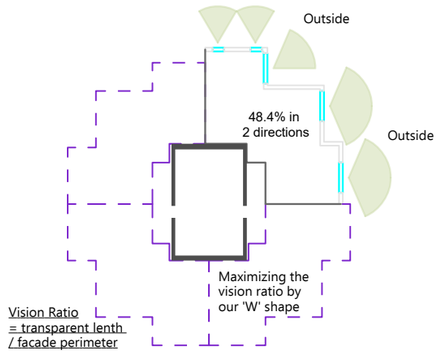
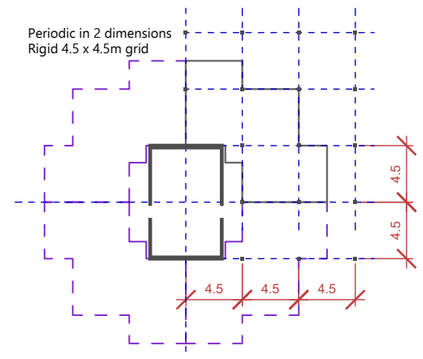
Following the TOC Guidline, I don't place a parking lot on ground floor, which means our dwellers transit via public transportation daily. So I will study my site selection in section 3.3 and try to decrease the distance from door to metro. Minimizing the corridors, I use a compact layout, benefitting in larger space efficiency. Also by placing all the supportive shafts in the core, it makes the fully leverage DfMA's pipe management capabilities, further reducing the construction timeline.

• **Architectural Openness:**

On the left [fig.16], I compare floor plans from different cases, in order to study their openness. By the term openness, I mean both openness outwards, i.e. visibility and contactability to outside which bring security and harmony to the neighborhood; and the openness inwards, i.e. apertures inside the site, e.g. lightwell or wind tunnel, bringing in the daylight and ventilation.

I can see that conventional building method more likely provides the openness inwards, enclosing a inner court for parking; whereas the DfMA products ususally build without parking. But the Star Appartment uses container units whose windows are generally small, so it has

FIGURE 4 Different four kinds of affordable housing floor plan features matrix B

Example Case	Floor Composition	L/W Ratio	Vision Ratio	Structure Pattern
Viale Giulini Affordable Housing 5380 sqm Barletta (BT), Italy RC Frame, 6 floors		1.0 ~ 1.1 		
11NOHO 110,550 sq. ft. 11311 Camarillo Street, North Hollywood, CA Steel Frame, 5 floors		1.6 ~ 1.7  Steel structure provides a wide living space		
STAR APARTMENTS 95,000 sf Los Angeles, California Lower floors: Mega Structure Upper floors: Self-stacking containers, 4 floors on stacking		2.0 ~ 2.5  the container shape has to be a slender rectangle		
My Proposal 2100 sqm. Los Angeles, California Steel Frame + Core 4 floors		1.0 ~ 1.2  The 'W' shape. Steel grid provides flexibility to plan as long as the dimension meets the grid.		

a great potential for openness outwards yet doesn't realize all of them. By utilizing "Core-and-Shell" and modular infill frameworks, units can integrate generous apertures, exterior circulation galleries, and semi-private courtyard transitions that enhance natural light, ventilation, and resident dignity.

• **Structural Flexibility:**

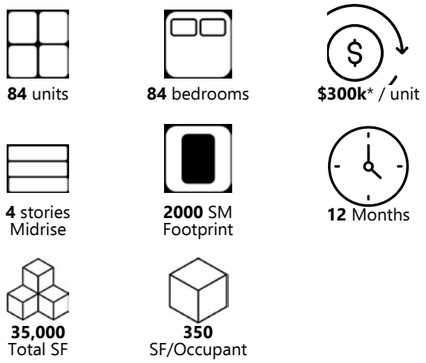
I also compare the structural elements in distribution. DfMA has to follow a spatial rythm in grid. Consindering its shipping convinience, the DfMA living units are in the form of containers which are slender and narrow, limiting the spatial squence in a linear way. To sum up, using Star Appartment as example, the DfMA method bring flexibility on unit distribution but restricts the diversity inside the units. To overcome this weekness, I use a different kind of DfMA method, i.e. using the prefrabricated panels instead of the units. Still keeping the rigid structural pattern, panel system creates wide span, freeing from slenderness(Length/width ration above 2.0). Connecting the kitchen and living room area together directly to the entrance, my indoor living space becomes more versatile. Serving diverse micro-regions like SLATE-Z[*] requires floor plans capable of adapting to shifting household structures—from single unhoused individuals to multi-generational families. Standardized wet cores (kitchens and bathrooms) paired with non-load-bearing flexible partitions allow standardized modular frames to seamlessly reconfigure between SRO, one-bedroom, and family-sized apartments.

2.2 Empirical Validation: LA Case Studies

Hope on Alvarado

Permanent supportive housing built in China, placed in Los Angeles

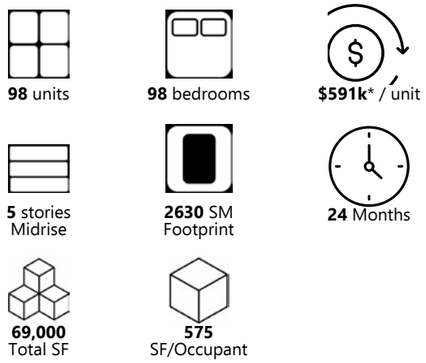
Hope on Alvarado is a 84-unit five-story building located at 166 S. Alvarado St in Los Angeles. KTGY Architecture redesigned shipping containers for a modern and affordable transitional housing on Alvarado street in Los Angeles for homeless population.



McCadden Senior Housing

Conventional affordable housing built on-site in Los Angeles

McCadden Campus Senior Housing is a 98-unit five-story development located at 1119 N. McCadden Pl in Los Angeles. Designed as part of the LA LGBT Center's intergenerational campus, the project provides permanent affordable housing for low-income and formerly unhoused seniors through conventional stick-frame over podium construction.



Project	HOPE on Alvarado [19]	McCadden Campus Senior [20]
Building Method	Modular **DfMA**	LA HHH Baseline (**Conventional**)
Completion	2021	
Total Cost & Scale	Approx. **$27 Million** / **84** Units	Approx. **$55.9M – $57.9M** / **98** Units
Cost / Unit	Approx. $300,000 – $321,000 / Unit	Approx. $570,000 – $600,000+ / Unit
On-Site Construction Duration	Approx. **12 Months** (On-site modular stacking in **23 days**)	24 Months

Time Reduction - 50%

Cost Reduction - 45%



Photo of the construction site of Hope on Alvarado, source: [19]

To validate the real viability of industrialization, the application of Design for Manufacture and Assembly (DfMA) must be examined through concrete projects implemented within Los Angeles County. Among the most prominent precedents is the **Hope On** series [18], a pioneer in deploying volumetric steel-frame modular housing for transitional and permanent supportive housing in density-constrained urban infill sites.

In 2021, there were 2 affordable housing projects completed. By comparing their construction data, I can have a general understand of the benefits gain by adaptin the DfMA method. And I summarized the advantages from it. The operational metrics of the Hope On developments demonstrate the profound time and cost efficiencies attainable through DfMA adopting, which fits my opinion in section 1.6:

• **On-Site Erection Speed:** Utilizing pre-fabricated, fully finished volumetric steel modules, the structural stacking and envelope completion for projects like Hope on Alvarado were achieved in approximately 23 working days[19].

• **Schedule Compression:** The total project schedules are shortened from the regional base of 24 months to 12 months, which means a 50% reduction in the development time.

• **Cost Efficiency & Holding Soft Costs:** By halving the total delivery time, the project effectively reduced the construction loan interest accumulation and the contractor's overhead. The on-site labor requirements can be decreased by up to 60%, thereby protecting the development budget from the regional shortage of union labor and the rising wages due to the state incentives such as [8].



Photo of the completion site of Hope on Alvarado, source: [19]

Furthermore, these case studies benefit directly from California's **Factory-Built Housing (FBH) Program**, administered by the Department of Housing and Community Development (HCD). Under the FBH framework, modular units inspected and approved in certified off-site manufacturing facilities are legally exempt from redundant, time-consuming local building department inspections upon arrival at the Los Angeles site. This state-level regulatory alignment validates that DfMA is not merely a theoretical concept, but an active, legally supported pathway capable of executing rapid housing delivery within Los Angeles.

In addition to the benefits of DfMA, the HOPE ON ALVARADO case also gives us an example of viability of the component shipping in Los Angeles. Keeping all the element within the dimensional limit of a container is rational.

Transport Optimization:
By selecting a panel width of 1.5m, two panels can be loaded vertically onto a custom A-frame trailer within the 2.59m legal width limit or stacked flat.

Elimination of Oversized Load Permits:
Utilizing 1.5m × 4.5m panels avoids Caltrans "Oversized Load" classification, eliminating the demands e.g. expensive escort vehicles, night-only transport restrictions, and route-specific highway permits.

2.3 Strategic Recommendations and Synthesis: Implementing DfMA in LA

Synthetic analysis confirms that DfMA is the definitive technological pathway capable of bridging the gap between Los Angeles's policy incentives and real-world affordable housing delivery. Traditional stick-built wood framing and cast-in-place concrete methods inherently suffer from compounding structural bottlenecks: their labor-intensive, sequential nature leaves projects highly vulnerable to California's prevailing wage cost floors, weather disruptions, and multi-year construction schedules. As a result, when conventional construction methods are applied to policy incentives like ED 1[11], the time savings gained during the 60-day administrative entitlement phase are entirely swallowed by 1.5 to 2 years of on-site schedule, probably followed by construction friction and increasing loan interest.

To successfully scale DfMA across Los Angeles, The Los Angeles Department of City Planning (LADCP) should establish a pre-approved, standardized "Kit-of-Parts" digital catalog for modular housing. The recommendation of Municipal **Kit-of-Parts & Standardization** bring us dual benefits[9;11;12]:

• Firstly, it simplifies the process of design. Standardizing structural connections, corridor dimensions, and wet core layouts will eliminate the need to "re-invent the wheel" for every project.
• Secondly, it points out the precise target for the manufacturer, promoting non-profit developers and modular manufacturers to achieve true economies of scale, also derisking influence from the supply chain and market period, by making the demand end more accountable.

There will be a tendency that municipal authorities partner with regional trade unions to establish retraining programs that transition outdoor, site-based construction labor into indoor, precision factory manufacturing roles.

In addition to that, this chapter also explored a real case which pressents the Los Angeles regulatory, logistical, and legal framework, from where I learned the key takeaways guiding the subsequent design development:

1. Dimensional Discipline Derived from Transportation Limits:
The adoption of a 4.5m × 4.5m structural grid and a 1.5m × 4.5m sub-modular panel width directly resolves the conflict between spatial usability, crane hoisting capacity, and Caltrans non-permit highway limits (2.59m width). With this smaller sub-division of the panel, it also benefitting the usage of cranage on urban site. On tight Los Angeles infill sites, a panel dimension of 1.5m × 4.5m keeps unit weights well within the hoisting capacity of mid-sized mobile or tower cranes (typically 2 to 4 tons at radius), avoiding the cost and street closures required from the heavy-duty hydraulic cranes. It is further introduced in Chapter 5.

2. Multi-Layer Component Integration (The 2D Panel System):
Following the lessons of Dagenham Park School, facade panels integrate structural load-bearing, high-performance thermal insulation, weatherproofing membranes, and factory-sealed glazing in a single precast or mass-timber sandwich unit, eliminating external scaffolding. It is further introduced in Chapter 5.



Photo of the timber panel bundle in the factory, source: [19]



Photo of the timber panel bundle on shipping, source: [19]

3. Parallel Construction Sequences and MEP Core Precedence:

To maximize the efficiency, i.e. achieving the 70:60:30 benchmark, the assembly sequence prioritizes vertical MEP risers and 3D Bathroom Pods. By aligning wet cores 100% vertically and hoisting prefabricated Riser Cassettes and Wet Pods prior to enclosing surrounding 2D floor and wall panels, on-site trade conflicts are eliminated.

4. Alignment with Carbon Regulations and Design for Disassembly (DfD):

By utilizing standardized panel sizes and dry bolted connections rather than wet concrete pours, buildings constructed in Los Angeles can comply with California's aggressive embodied carbon mandates (AB 2446)[13]. Not only it creates simpler maintenance steps within the operating lifecycle but also ensures components can be demounted and reused at the end of the building's lifecycle.

By resolving conventional construction bottlenecks, aligning with state FBH pre-approvals, and offering adaptable planar configurations, DfMA techniques grow from an inefficient craft into a high-performance industrial solution, which sets the precise foundation for the modular prototypes and spatial taxonomies explored in Chapter 3.

Website

[15]California Energy Commission. 2022 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. California Code of Regulations, Title 24, Part 6. Sacramento: California Energy Commission, 2022. https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards.

[16]California Natural Resources Agency. *CEQA Guidelines*. California Code of Regulations, title 14, division 6, chapter 3, sections 15000–15387. Sacramento: California Natural Resources Agency, 2024.
California Public Resources Code. *California Environmental Quality Act (CEQA)*. Division 13, sections 21000–21189. Sacramento: State of California, 2024.

[17]Articles about Dagenham Park School
AHMM Official Project Archive: https://www.ahmm.co.uk/projects/education/dagenham-park-school/
e-architect Project Report: https://www.e-architect.com/england/dagenham-park-school
structural teams: https://www.laingorourke.com/thinking/pbbs/
All sites are accessed in August 2, 2026.

[18] e.g. *Hope on Hyde Park*, *Hope on Alvarado* & *Hope on Lafayette*
Hope on Hyde Park is a modular, permanent supportive housing of the Metro Crenshaw line in 2022, by ktgy.
Hope on Alvarado creatively utilizes purpose-built steel modules into a modern and affordable housing community in 2021 by ktgy.
Hope on Lafayette is an extraordinary modular housing project designed to meet Los Angeles' needs in 2020 by utopia modular.

[19]Articles about Hope On Alvarado.
ArchDaily. *Modular Housing Solutions for the Homeless in LA*. Published October 14, 2019. https://www.archdaily.com/926363/modular-housing-solutions-for-the-homeless-in-la.
Housing Innovation Collaborative. “Hope on Alvarado.” Accessed August 2, 2026. https://housinginnovation.co/design/hope-on-alvarado/.
KTGY, “Hope on Alvarado,” accessed August 2, 2026, https://ktgy.com/Work/hope-on-alvarado/.

[20]Los Angeles Housing Department (LAHD). (2022). *McCadden Campus Senior Housing: Supplemental Tax-Exempt Multifamily Conduit Revenue Bond Request* (Council File No. 16-0345-S5). City of Los Angeles. https://cityclerk.lacity.org/onlinedocs/2016/16-0345-S5_rpt_lahd_727-22.pdf

Cases on Figure 15:

Viale Giulini Affordable Housing by Alvisi Kirimoto - *Paragon of high-quality social housing*
Accessed August 2, 2026. https://www.gooood.cn/en/viale-giulini-affordable-housing-by-alvisi-kirimoto.htm

11NOHO by Brooks + Scarpa *Living around the courtyard*
Accessed August 2, 2026. https://www.gooood.cn/en/11noho-brooks-scarpa.htm

Star Apartments
Accessed August 2, 2026. https://www.architecturalrecord.com/articles/7997-star-apartments-los-angeles
Accessed August 2, 2026. https://www.mmaltzan.com/projects/star-apartments/

Reference for shipping:

[19] Team of bensonwood.
Accessed August 2, 2026. https://bensonwood.com/blog/lumber-to-bundle/

3. Design Research

3.1 Current Status Research

3.2 Current Status Evaluation

3.3 Similarities of Neighborhoods

03

Design Research

3.0 Current Status Research

This chapter consists of 3 parts:

Firstly, I'll study the current status of new coming trend of affordable housing in LA, to understand from the urban planner's view where will be urgent needs for the city.

Secondly, I'll set up 4 rules for selecting the sites for affordable housing.

Thirdly, after some site selected by step I & II, I chose 4 typical ones to present. We'll zoom in into a smaller scale to examine these sites, to see them in detail and if they're really some optional choices, proving that my steps for selection are rational.

Theoretically, all these spots fit in the rules can be an option for the building, which shows the potential of high-scalely solving the city-wide problem from my design strategy.

In order to define where could be the potential DfMA affordable housing locations, I investigated the current situation of PSH and future trends of Los Angeles in this map, which could be an initial reference for the selection.

The locations have formed a number of distinct clusters within Los Angeles city, besides, the current permanent supportive housing also has a separately distribution among the city area.

The approved affordable housing units basically are overlapped with the locations of existing permanent supportive housing, with the Koreatown and Westlake cluster becoming the areas showing the clearest potential for future growth; in addition, they expand into some new areas, such as Vermont Square area, Hyde Park area and Westchester area, etc.

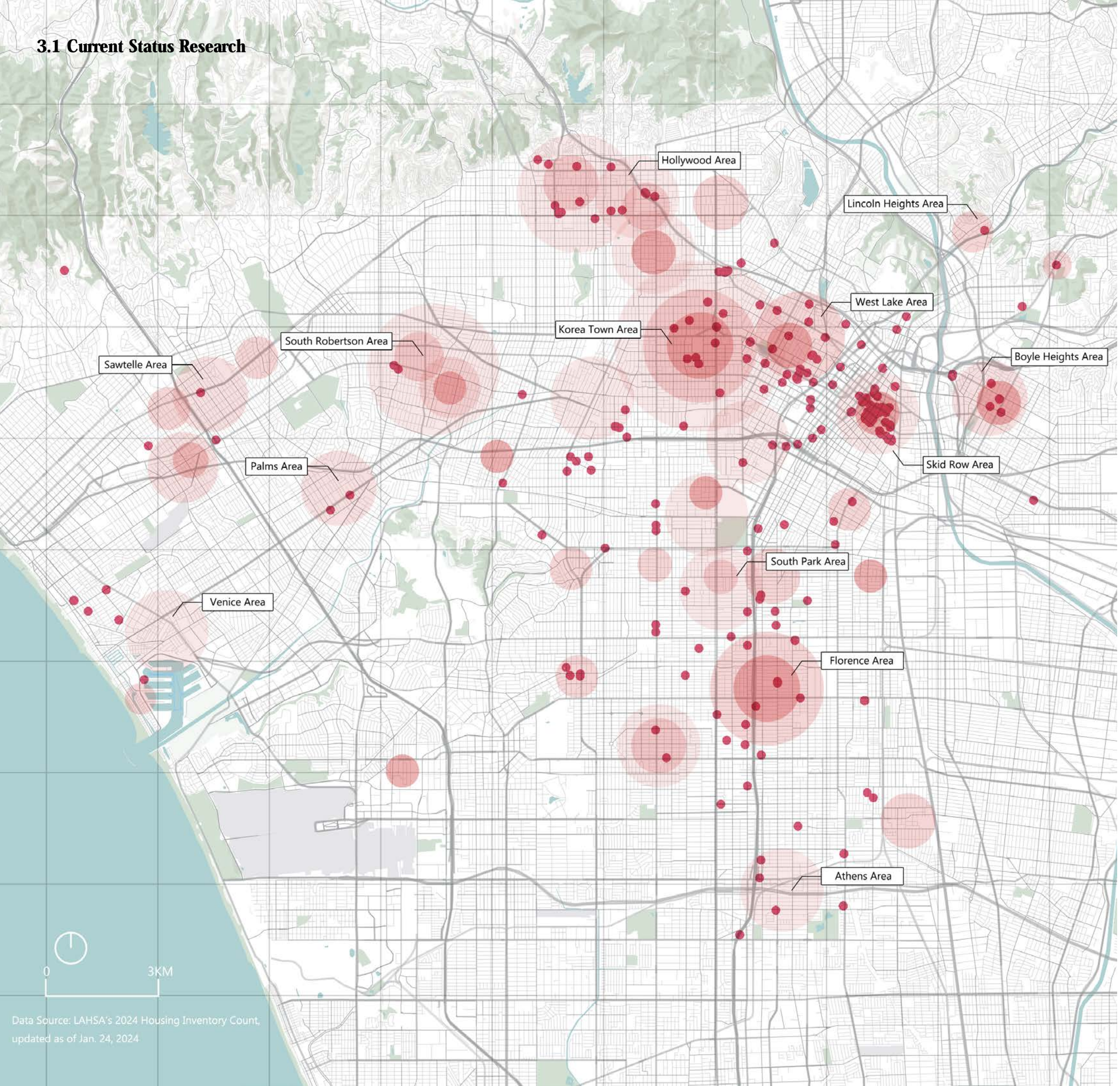


FIGURE 1 Existing PSH and approved affordable housing distribution

Existing Permanent Supportive Housing (PSH)

Heatmap of Approved Affordable Housing Units (2018-2024)

Features of Existing Permanent Supportive Housing Parcels:

Features of existing permanent supporting housing plots:

1. Traffic accessibility:
High accessibility, highly embedded in the TOC zones.

2. Site area:
The scale of the site is usually very small, typically ranging between 0.4 and 1.0 acres.

3. Parcel shape:
rectangles with high-to-width ration between 1:2 or 1:3 are the best choices. Less proper shapes are irregular triangles and sharp corners.

4. Distance from the main road:
buildings are distributed along the property line of the main road.

3.2 Current Status Evaluation

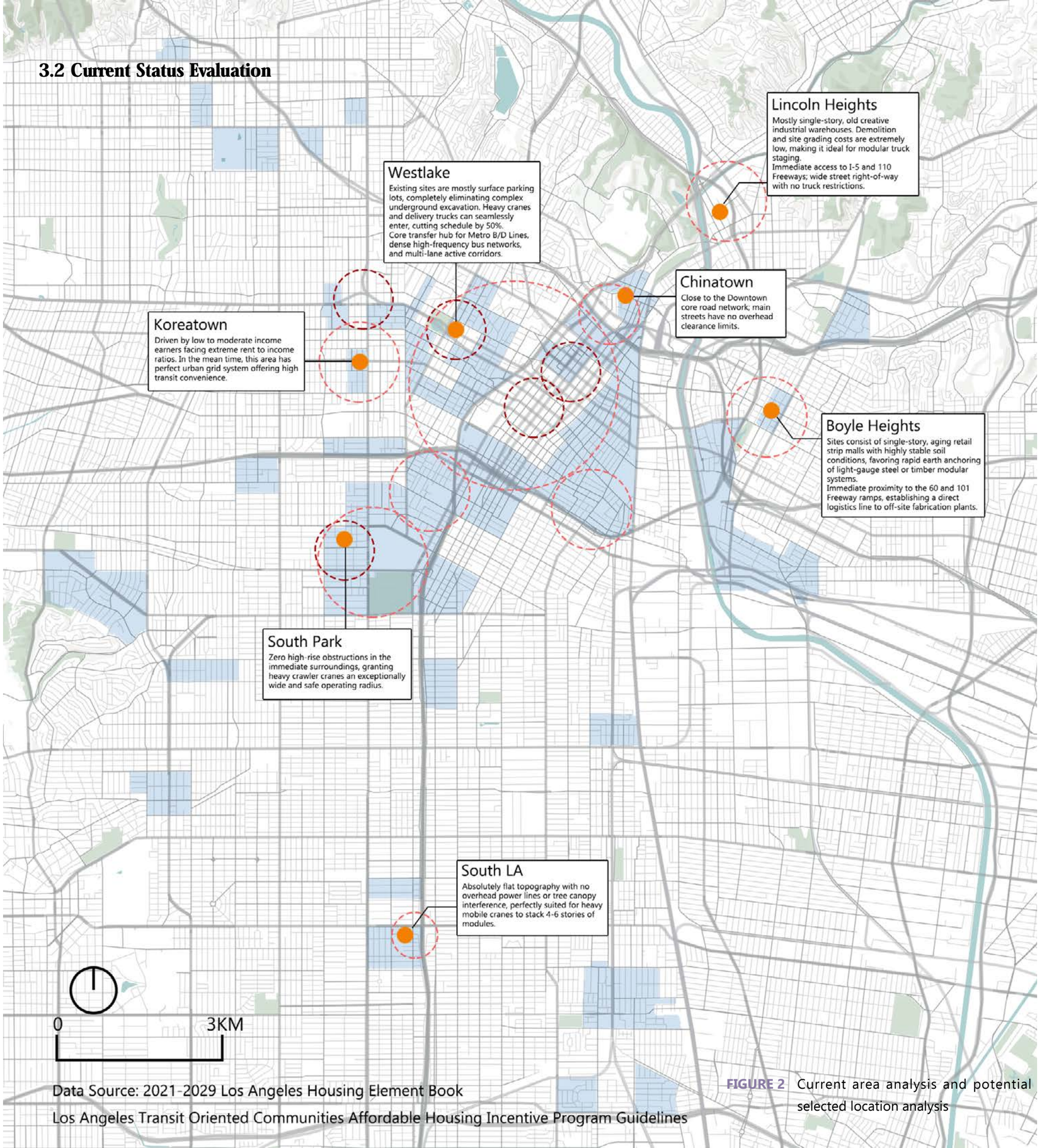


FIGURE 2 Current area analysis and potential selected location analysis

Median annual household income of $30,000 or less

TOC Incentive Area Tier 4

TOC Incentive Area Tier 3

Selected potential DfMA affordable housing locations

TOC incentive area and low income household distribution showed in this map could be an advanced reference and indicated a series of similarities and benefits.
In this map, the low income areas in blue had some overlaps with TOC 3/4 Tiers in red and light red dashed circle, the overlapping areas indicate the capacity in site selection.

I use four principles identified from the existing permanent supportive housing projects to evaluate these selected 7 locations:

Rule 1: TOC Tier 3/4 coverage rule
The selected site have to be located within the highest incentive tiers (Tier 3 or Tier 4) of the Transit-Oriented Communities guidelines.

Rule 2: Street setback width and slope control rule
The setback width of the street adjacent to the site needs to be ≥80 feet (accommodating at least two lanes, plus a roadside parking/loading area), and the natural slope within the site needs to be <3%.

Rule 3: Site Proportion Rule
Priority should be given to rectangular parcels with an aspect ratio between 1:1.5 and 1:3 (such as underutilized single-story car dealers or ground parking lots).

Rule 4: Seamless municipal utility network integration rule
High-capacity municipal water mains, main sewer lines, and primary power grids must already exist underground directly in front of the site's property line.

	Rule 1	Rule 2	Rule 3	Rule 4
Lincoln Heights	√		√	√
China Town	√	√		√
Boyle Heights	√		√	√
West Lake	√	√	√	√
Korea Town	√	√	√	√
South Park	√	√	√	√
South LA	√	√	√	√

3.3 Similarities of Neighborhoods



West Lake



Korea Town



South LA



South Park

These neighborhoods inside Los Angeles City had high range similarities in four aspects, available for duplicating with DfMA construction mode.

Existing buildings

Available voids

1. Zoning & Policy Alignment

TOC Tier 3 or Tier 4: These potential voids among four communities are immediately adjacent to Metro rail stations or major high-frequency transit corridors. This grants them maximum zoning incentives which is up to an 80% density bonus. Also, they are completely fit zero parking minimums.

2. Site Morphology & Logistics

Flatness: The natural slopes of these parcels are practically zero. It's more safe for volumetric modular construction and scheduling of oversized modular flatbeds.

Street Grids: Main roads such as w Jefferson Blvd, w Manchester Ave, and w Olympic Blvd feature exceptionally wide rights-of-way (typically exceeding 80 to 100 feet). This allows full-sized volumetric panels to be transported from off-site factories directly to the property site without being blocked by narrow neighborhood alleys or tight turning constraints.

3. Characteristics of the Existing Built Environment

Underutilized Fabric: The existing buildings across these sites mainly consists of single-story light industrial warehouses, auto repair garages, old retail stores, or sprawling surface parking lots.

Low demolition and clearing costs: These original properties hold zero historic preservation value, feature simple, lightweight structural frames, and can be completely demolished, cleared, and graded within two to three weeks.

Rectangular parcel boundaries: Mid-century urban expansion in Los Angeles left behind highly standardized, deep rectangular lots with highly consistent aspect ratios.

4. Demographics & Socio-Economics

Serious rent burden: The map data on the last page shows that residents in these areas usually spend more than 50% of their family income on rent, and the Area Median Income (AMI) is in. LA County's Low or Very Low brackets (under 50%–80% of AMI).

High Transit Dependency: The proportion of car-free families in these communities is very high. DfMA social housing in such communities will maximize the utilization rate of the surrounding public infrastructure and meet the measures of urban fairness and environmental justice.

4. Design Proposal

4.1 Apartments Types

4.2 Catalogue of Pre-fabricated Elements

4.3 Apartments Axonometrics:

- Social - Residential Space
- Private - Residential Space

4.4 List of Elements from Example Apartment 2B4P-Private

4.5 Construction Schedule

4.6 Plans:

- Ground Floor
- First Floor
- Second Floor
- Third Floor

4.7 Sections:

- A - A
- B - B

4.8 Panellised Construction System:

- Internal Wall
- External Wall
- Dividing Wall
- Floor & Ceiling

4.8 Structural Strategy

4.10 Perspective

- view A
- view B

04

Design Proposal

4.0 Design Strategy

Mixed Community

Attract and retain residents with a wide range of incomes by providing a mixture of housing types, sizes and tenures.
Interlacing social or private tenures throughout the development to prevent social and economic segregation.

Housing Quality

Meeting and exceeding Minimum Space Standards for both social and private tenure.
Both tenures have to be consistent in quality - private apartments will have a higher gross internal area to differentiate the apartment types.
Providing private external spaces to the apartments in addition to common areas.

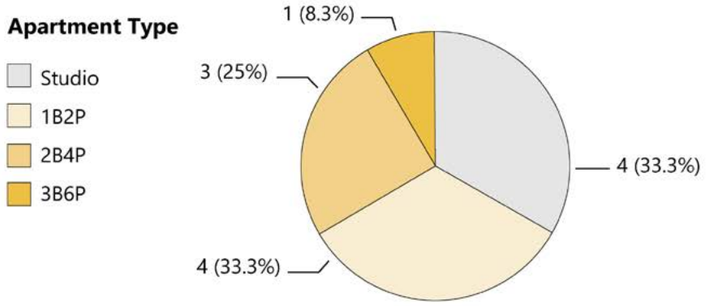
Daylight

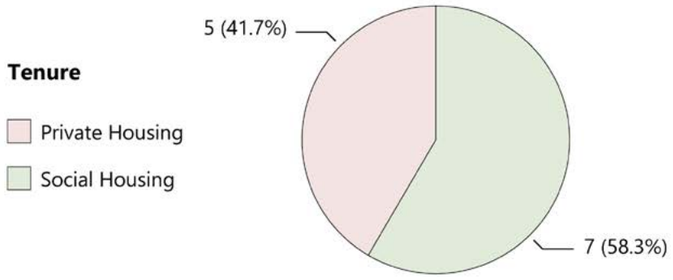
To prioritize natural daylight and make sure all apartments get direct sunlight at some point during the day.
Design the apartments at a depth to confirm adequate daylighting.

DfMA

Utilizing the "Design for Manufacture and Assembly" strategy could efficiently design and construct the development.
Using panelized pre-fabrication construction techniques will help to minimize waste, ensure quality and reduce construction time.
The DfMA techniques will help to reduce construction costs and therefore improve the feasibility of providing quality social housing.

4.1 Apartments Types





Studio Apartment

1 Bedroom 2 People Apartment

2 Bedroom 4 People Apartment

3 Bedroom 6 People Apartment

Wheelchair Apartment (1 Bedroom 2 People)

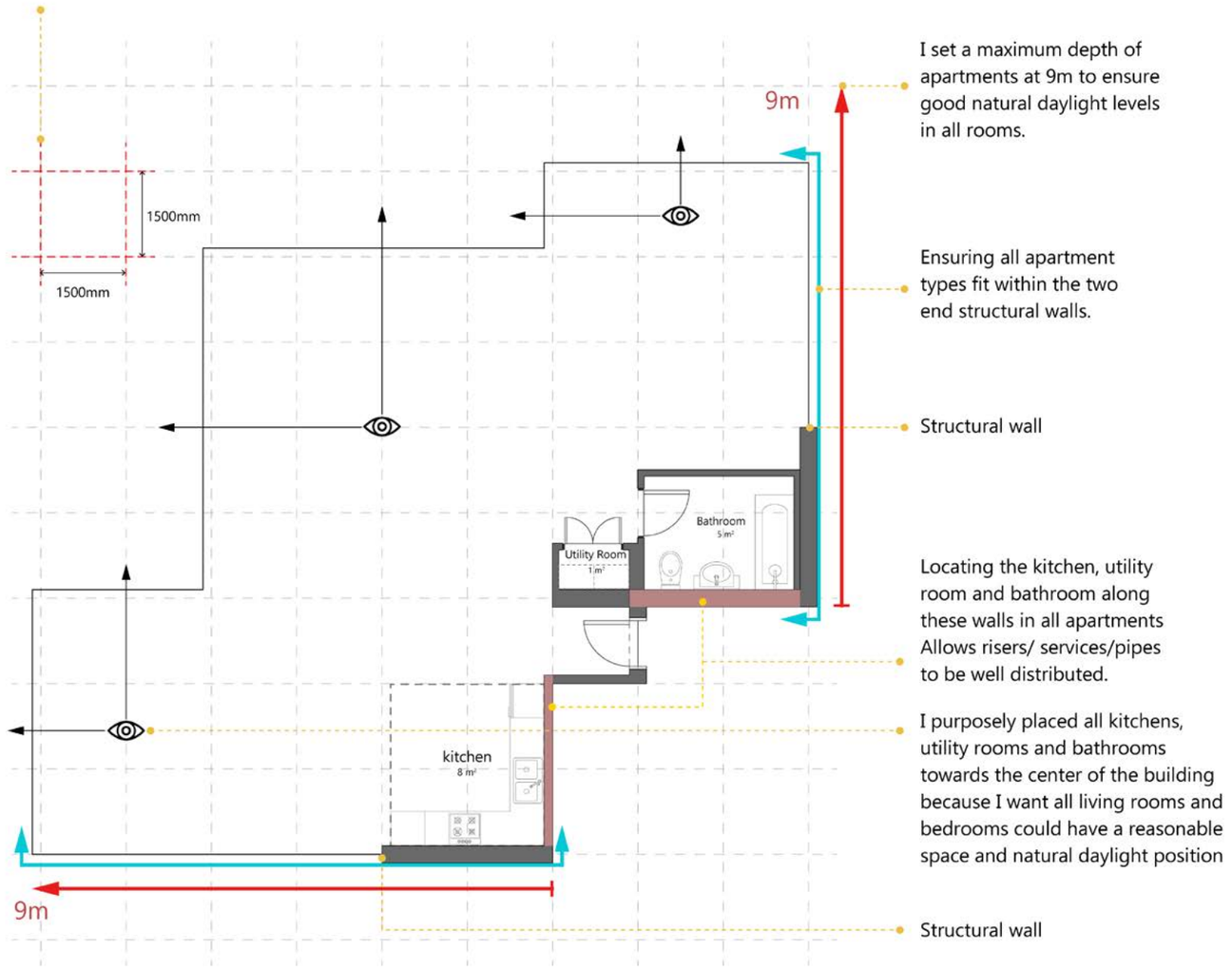


Total No. of People: 30

Total No. of Apartments: 12

Design considerations for all types of apartments

All apartments have to stick to the 1500mm×1500mm grid to allow the layout and modular components.



I set a maximum depth of apartments at 9m to ensure good natural daylight levels in all rooms.

Ensuring all apartment types fit within the two end structural walls.

Structural wall

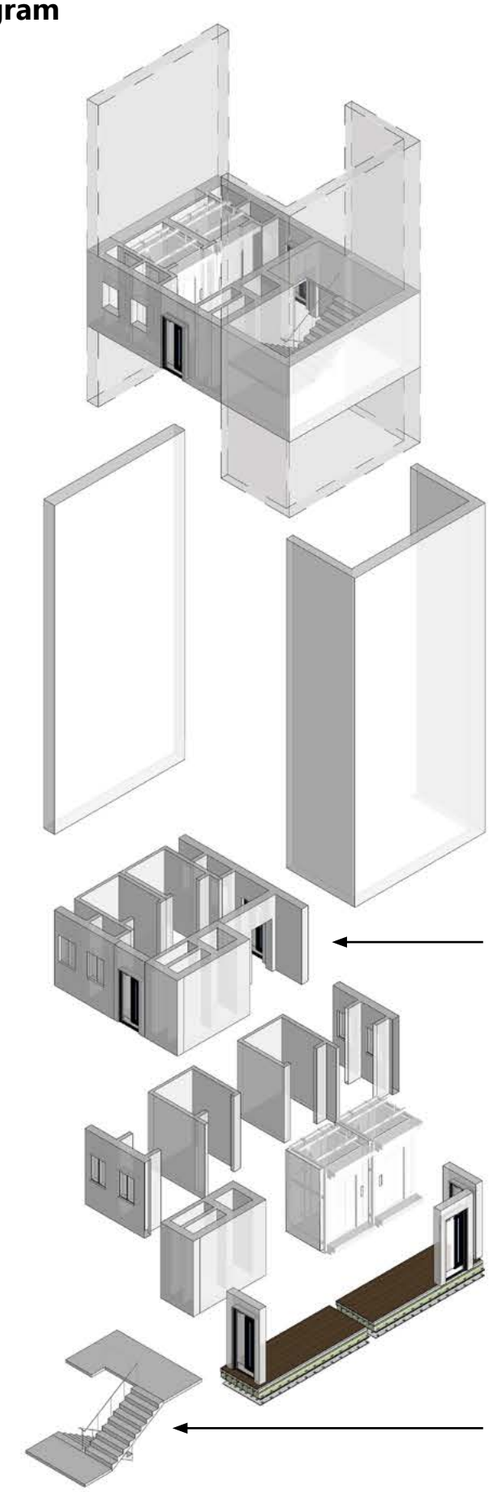
Locating the kitchen, utility room and bathroom along these walls in all apartments Allows risers/ services/pipes to be well distributed.

I purposely placed all kitchens, utility rooms and bathrooms towards the center of the building because I want all living rooms and bedrooms could have a reasonable space and natural daylight position

Structural wall

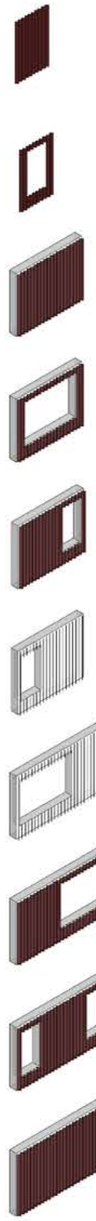
4.2 Catalogue of Pre-fabricated Elements

Core Diagram

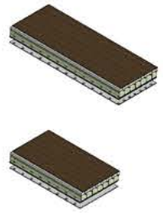


The Core:
- Panel System
- Prefabricate block
- Integrity Shear Wall
- Shafts
- Stairs

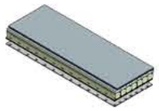
External Panels



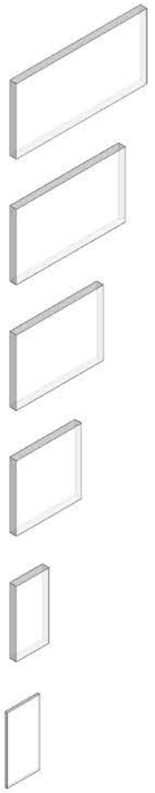
Floor Panels



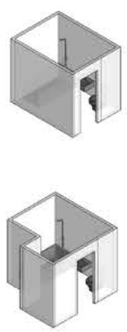
Roof Panels



Internal Panels (Between units)



Bathroom pods

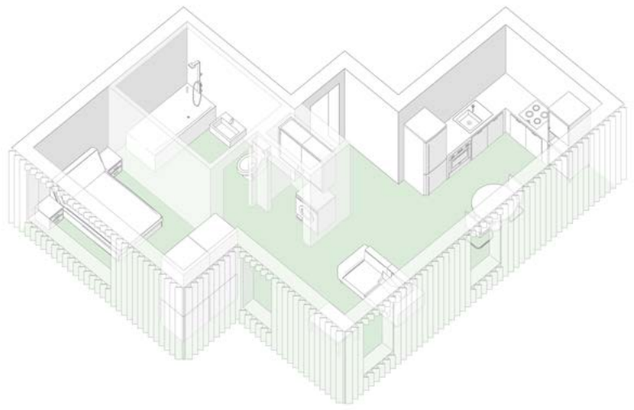


Internal Division Panels

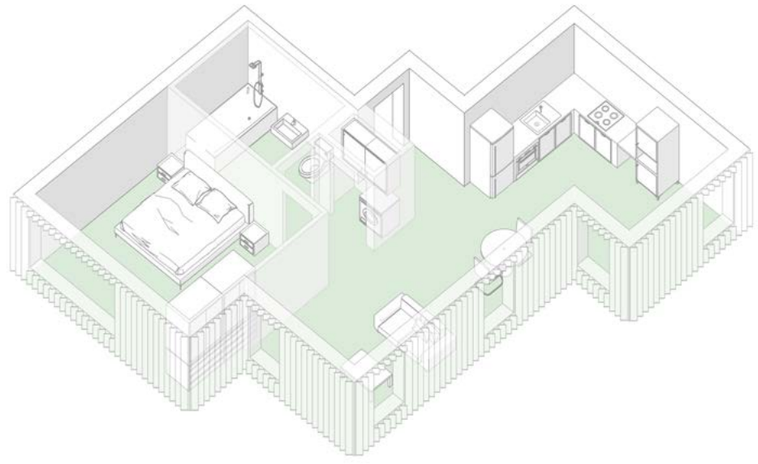


This catalogue shows all of the panels and pods that will be used to construct the building using a panelized DfMA construction strategy.

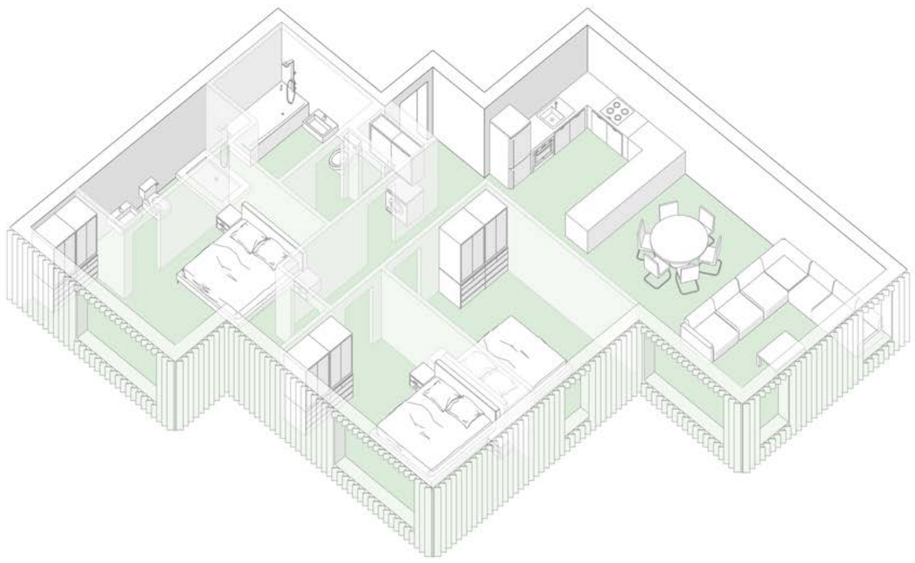
4.3 Apartments Axonometrics-Social: Residential Space



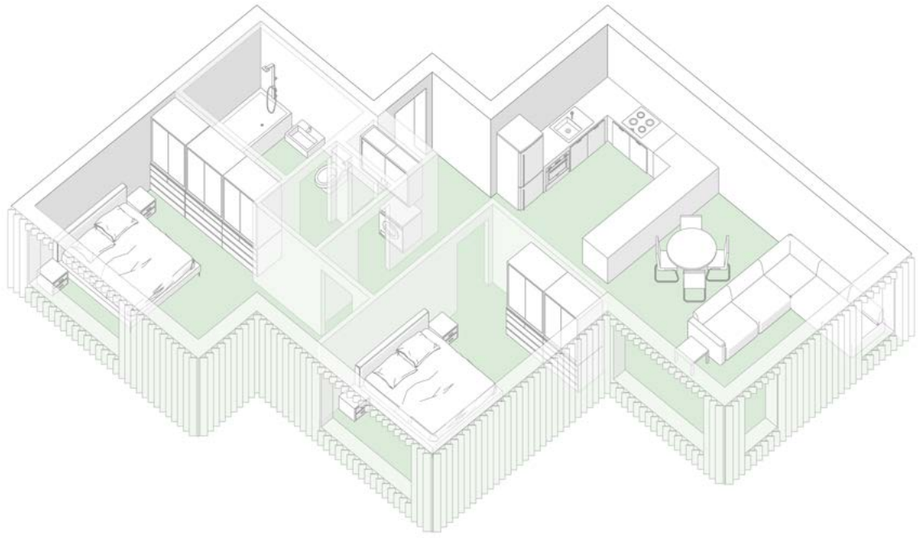
Social Studio Apartment



Social 1b2p Apartment



Social 3b6p Apartment

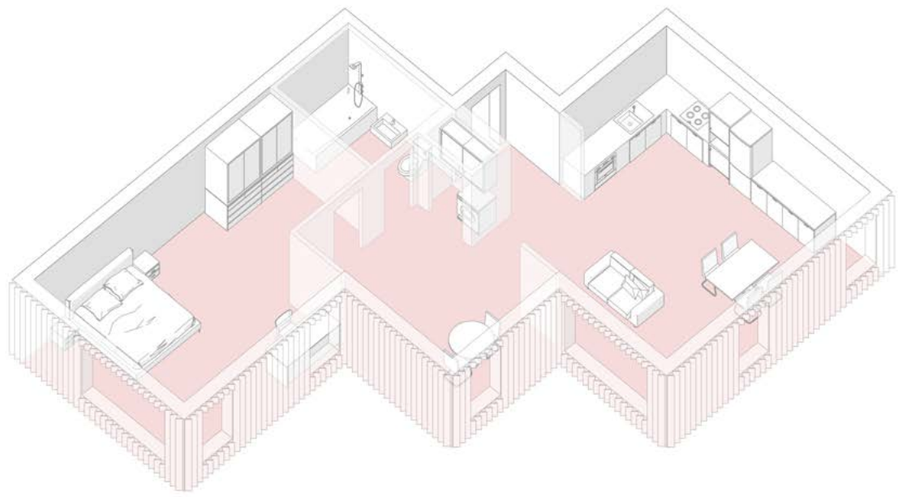


Social 2b4p Apartment

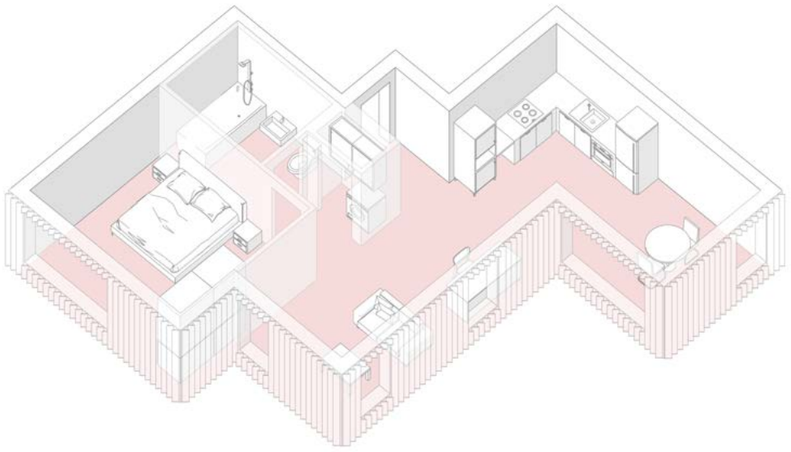
4.3 Apartments Axonometrics-Private: Residential Space



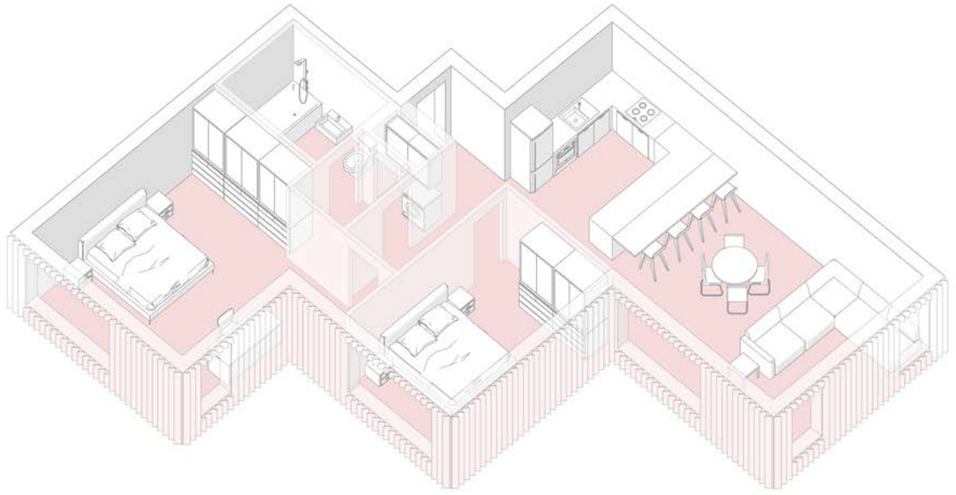
Private Studio Apartment



Private Wheelchair 1b2p Apartment

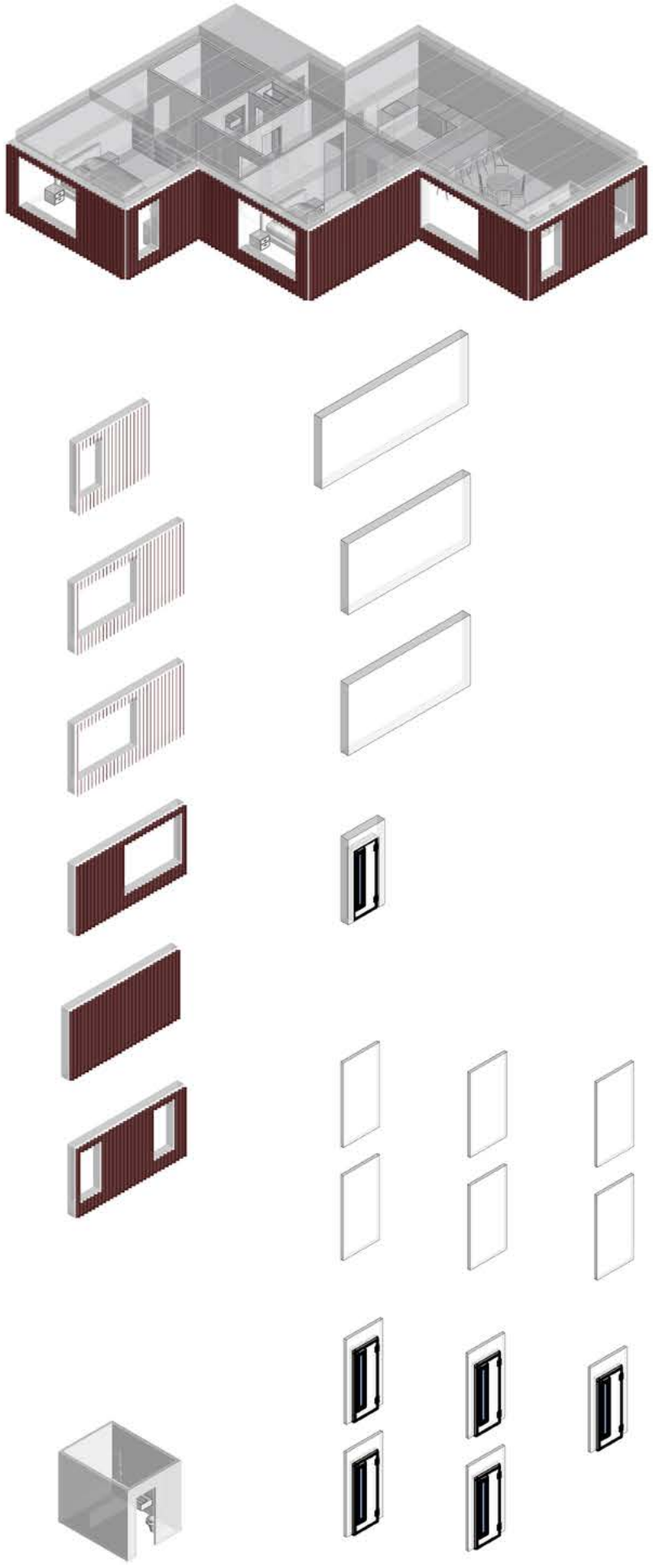


Private 1b2p Apartment



Private 2b4p Apartment

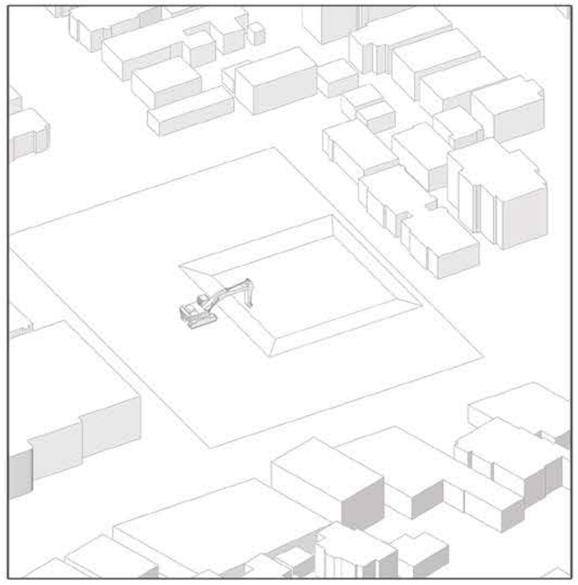
4.4 List of Elements from Example Apartment 2B4P-Private



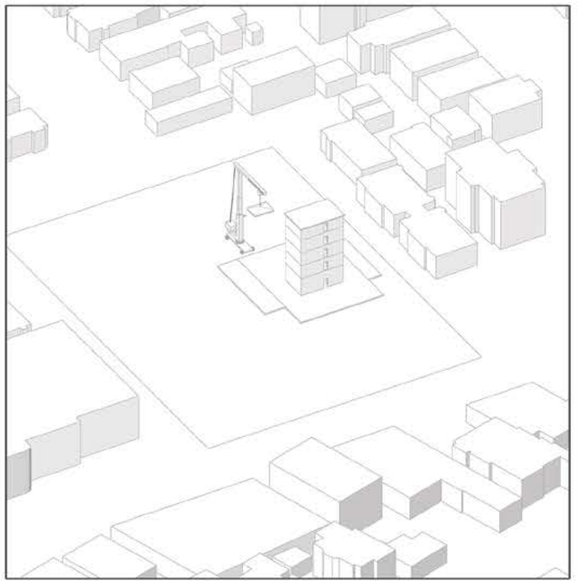


This page shows a panel usage example of one of the panelized apartments.

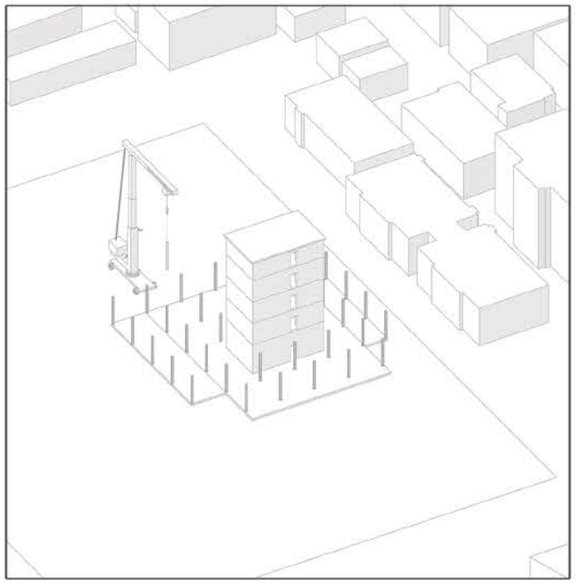
4.5 Construction Schedule



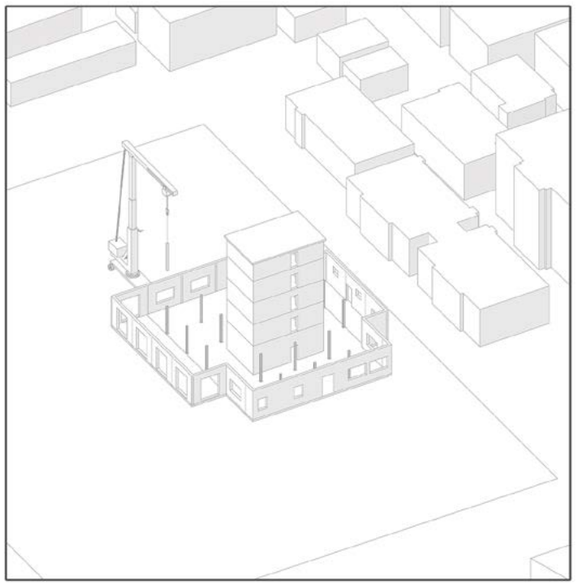
Demolition & Foundation



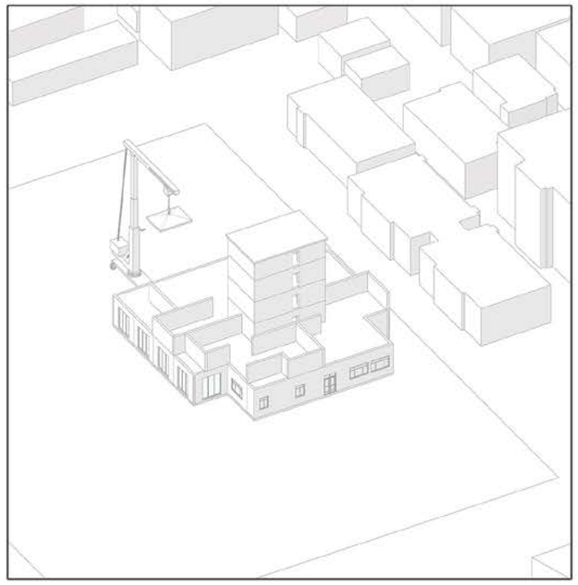
Ground Floor slab and core



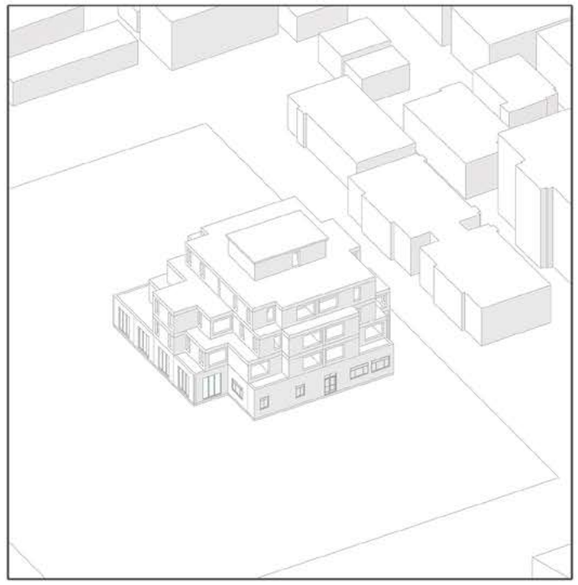
Ground Floor Structure



Ground Floor Construction

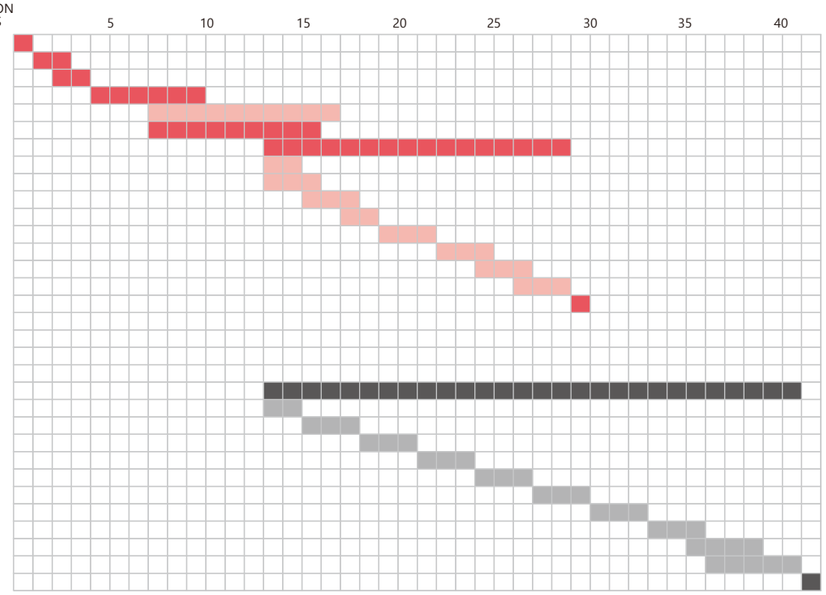


Panel Installation



MEP Fitting & Internal Finishing

STAGE NO.	DfMA STAGE	DURATION WEEKS
0	**Strategic Definition**	1
1	**Preparation & Brief**	2
2	**Concept Design**	2
3	**Developed Design**	6
	Admistrative Approval	9
4	**Technical Design**	8
5	**Construction**	15
	Demolition of Existing Building	2
	Pannel Module Manufacturing	3
	Foundation	3
	Ground Floor Slab and Core	2
	Ground Floor Construction	3
	Pannels Installation	3
	MEP Fitting	3
	Internal Finishes	3
6	**Handover and Close Out**	1
	Conventional STAGE	
5c	**Construction**	28
	Demolition of Existing Building	2
	Foundation	3
	Ground Floor Slab	3
	Ground Floor Construction	3
	First Floor Construction	3
	Second Floor Construction	3
	Third Floor Construction	3
	Facade Scaffolding Removal	3
	MEP Fitting	4
	Internal Finishes	5
6	**Handover and Close Out**	1



Estimated schedule: DfMA vs. Conventional method.

In a ideal situation, the DfMA schedule saves 13 weeks about 29% of construction time.

4.6 Plan: Ground Floor



1. Lobby
2. Reading room
3. Mail room
4. Staff office
5. AA meeting room
6. Private clinic
7. Waiting room
8. Communal area
9. Public clinic
10. Bicycle garage
11. Trash room
12. Toilte
13. Utility room
14. Electrical room
15. Elevator lobby
16. Exit Stairwell
(contains area of refuge)

N

1:150

0 2 10m

4.6 Plan: First Floor



1. Private Wheelchair 1b2p Apartment
2. Social 2b4p Apartment
3. Social 3b6p Apartment
4. Social 3b6p Apartment

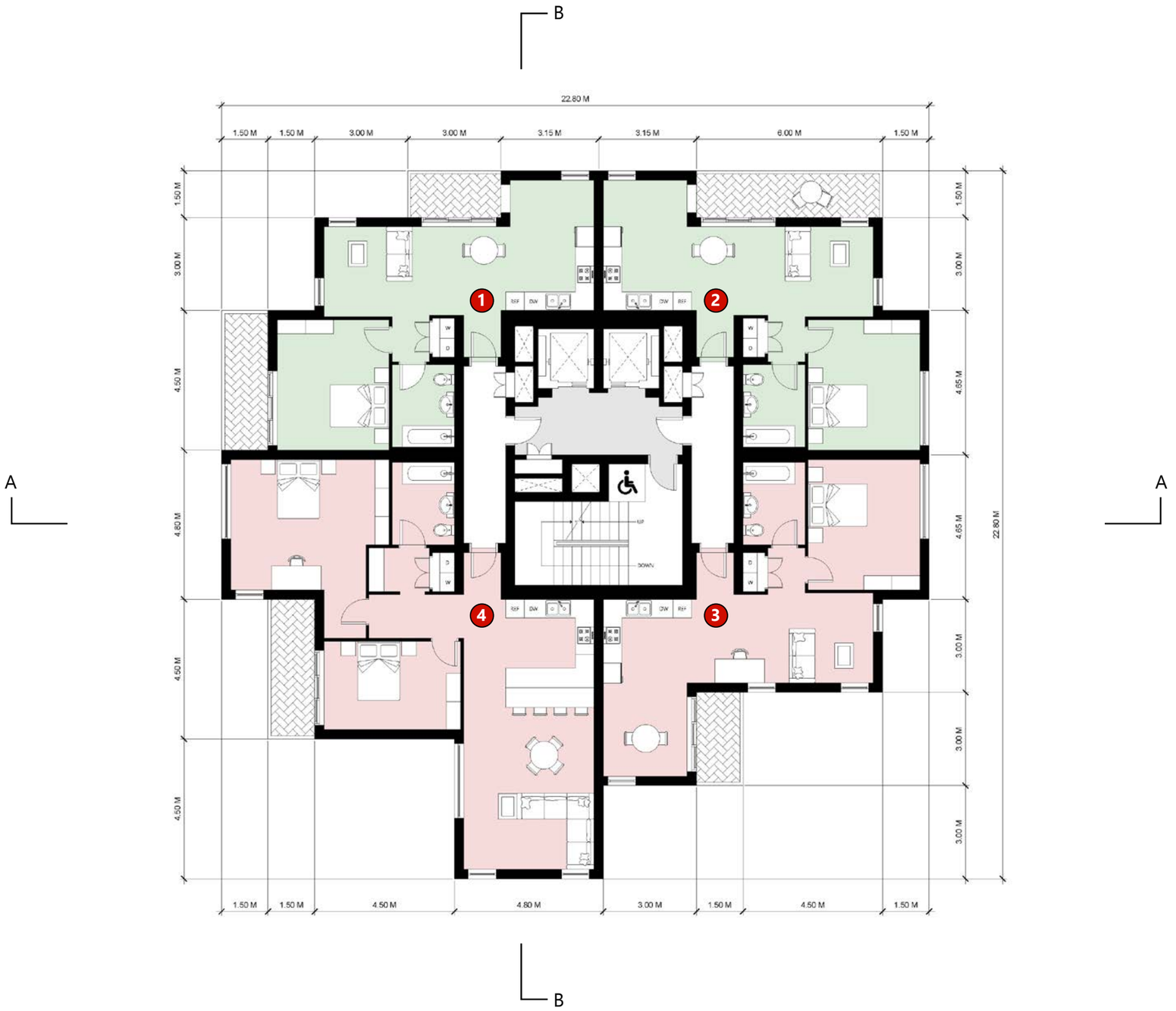
REF=Refrigerator
DW=Dish Washer
W=Washing machine
D=Dryer

N

1:150

0 2 10m

4.6 Plan: Second Floor



1. Social 1b2p Apartment
2. Social 1b2p Apartment
3. Private 1b2p Apartment
4. Private 2b4p Apartment

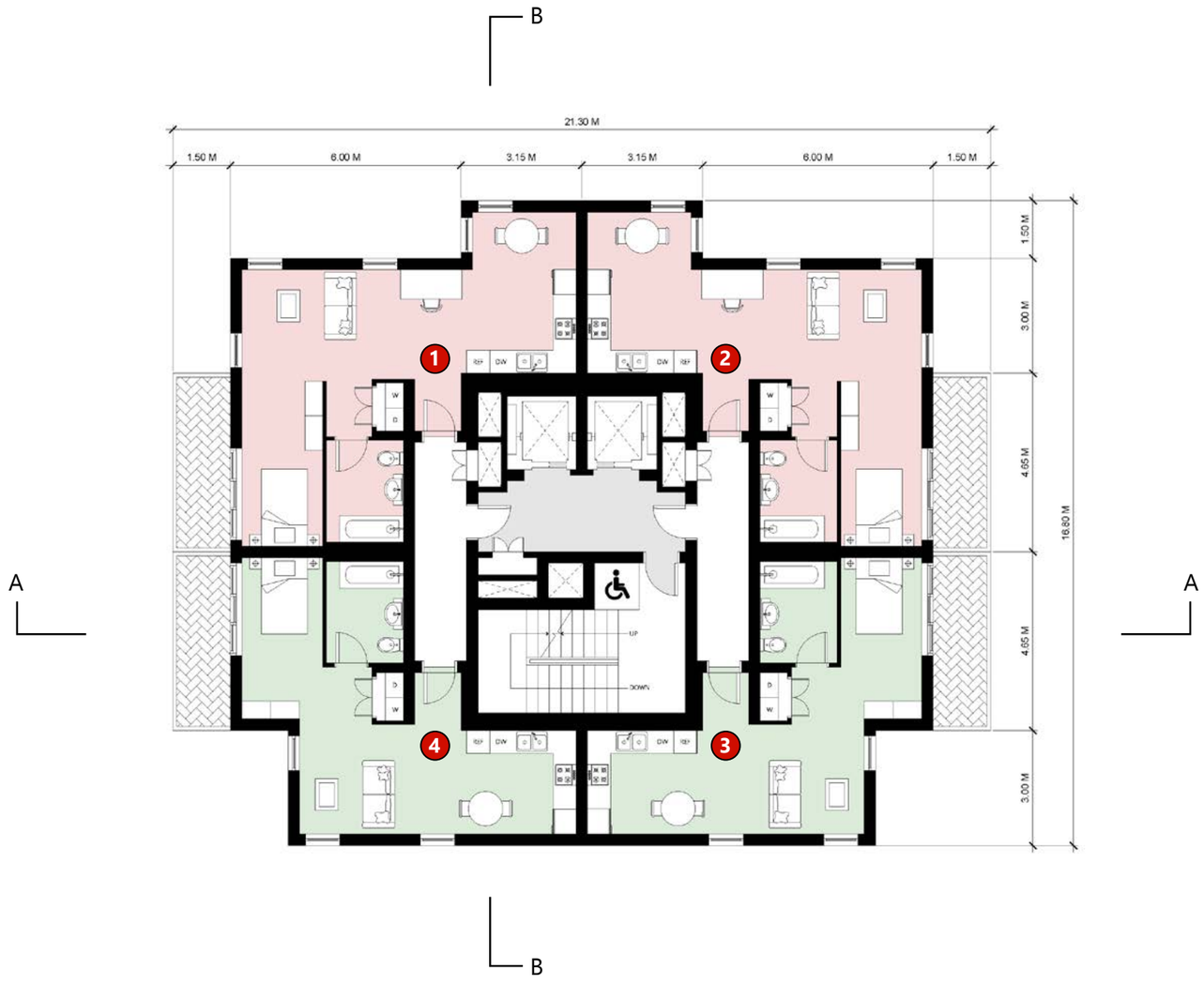
REF=Refrigerator
DW=Dish Washer
W=Washing machine
D=Dryer

N

1:150

0 2 10m

4.6 Plan: Third Floor



1. Social studio Apartment
2. Social studio Apartment
3. Private studio Apartment
4. Private studio Apartment

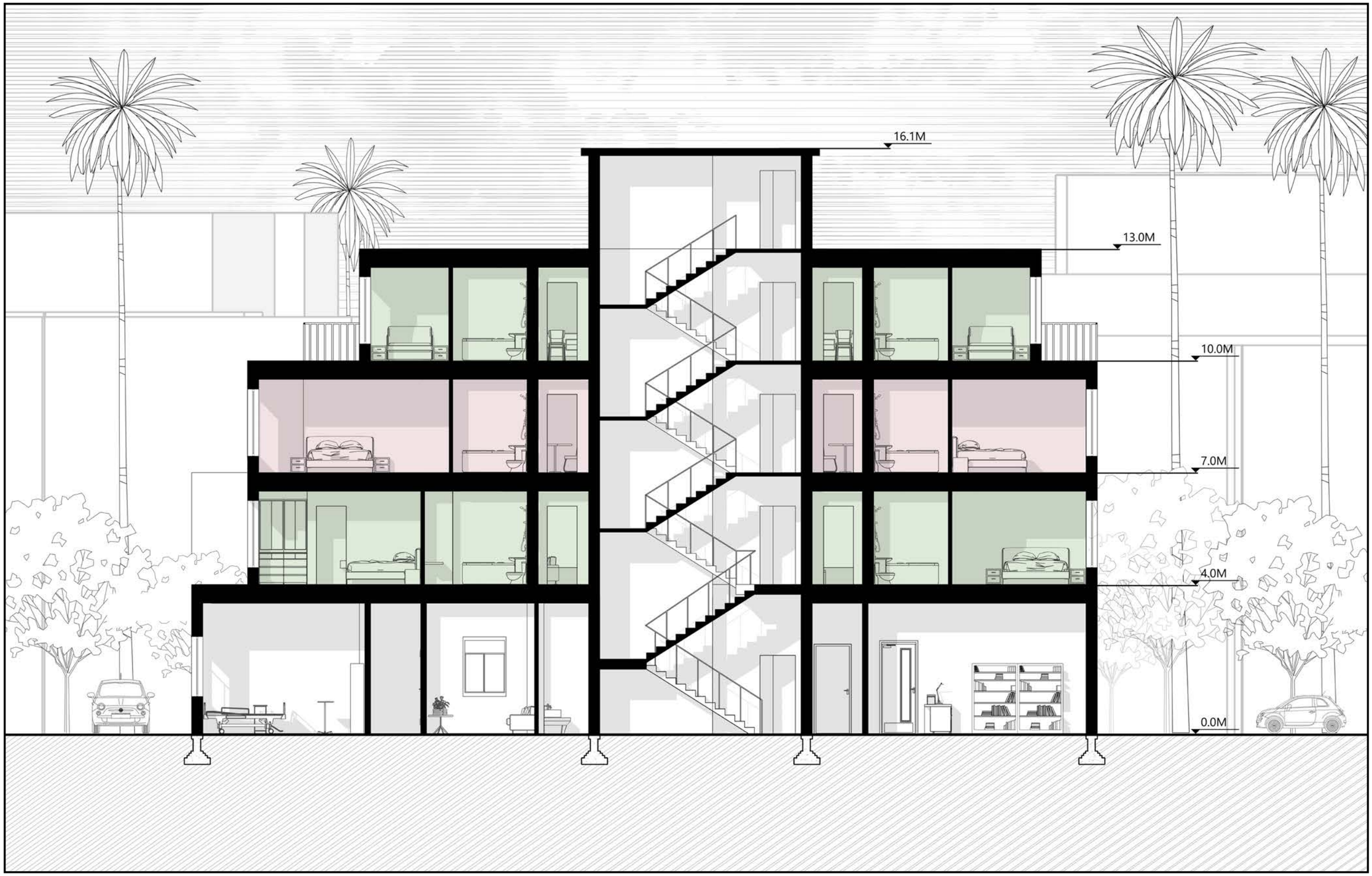
REF=Refrigerator
DW=Dish Washer
W=Washing machine
D=Dryer

N

1:150

0 2 10m

4.7 Section: A-A



1:100

0 2 10m

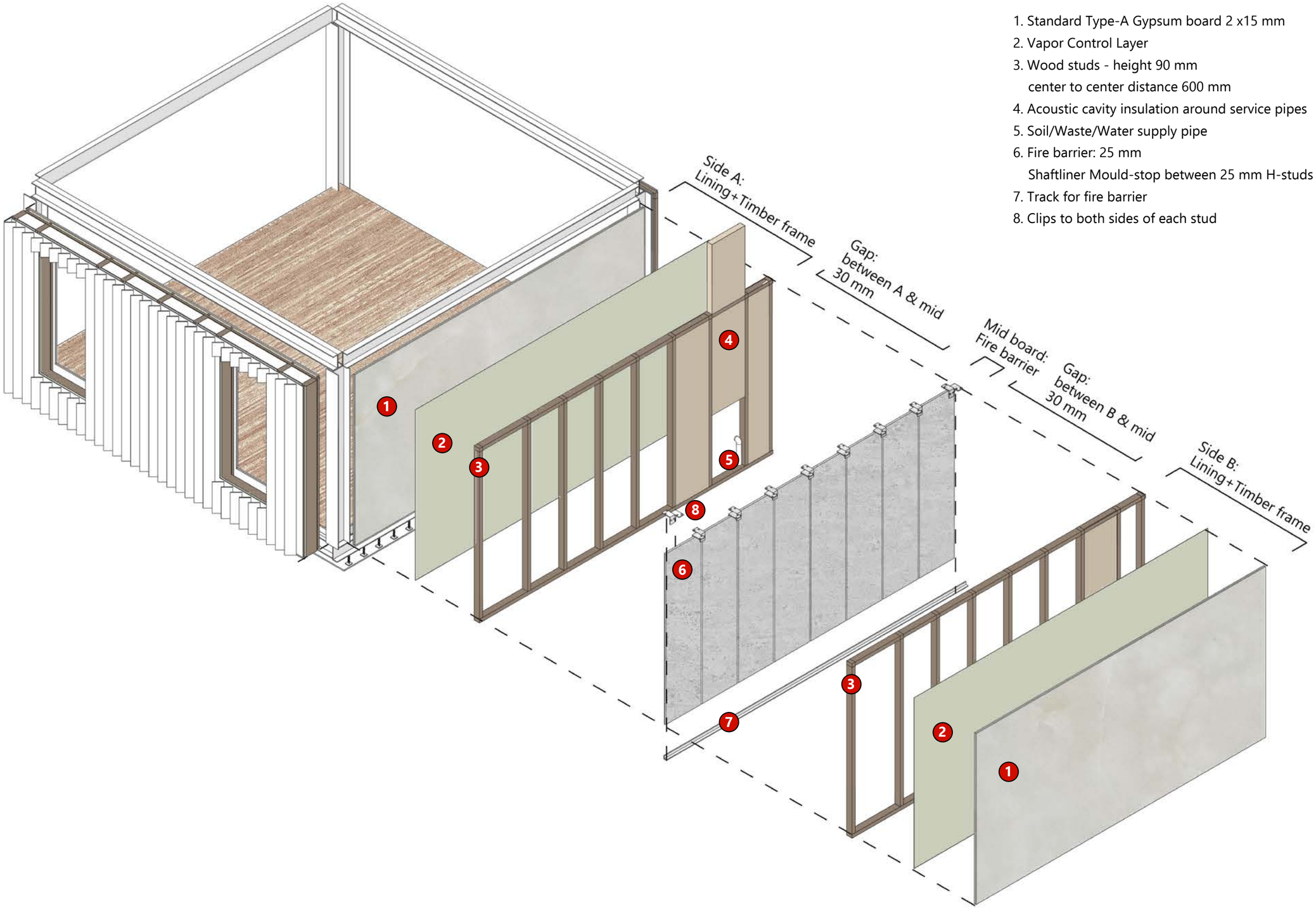
4.7 Section: B-B



1:100

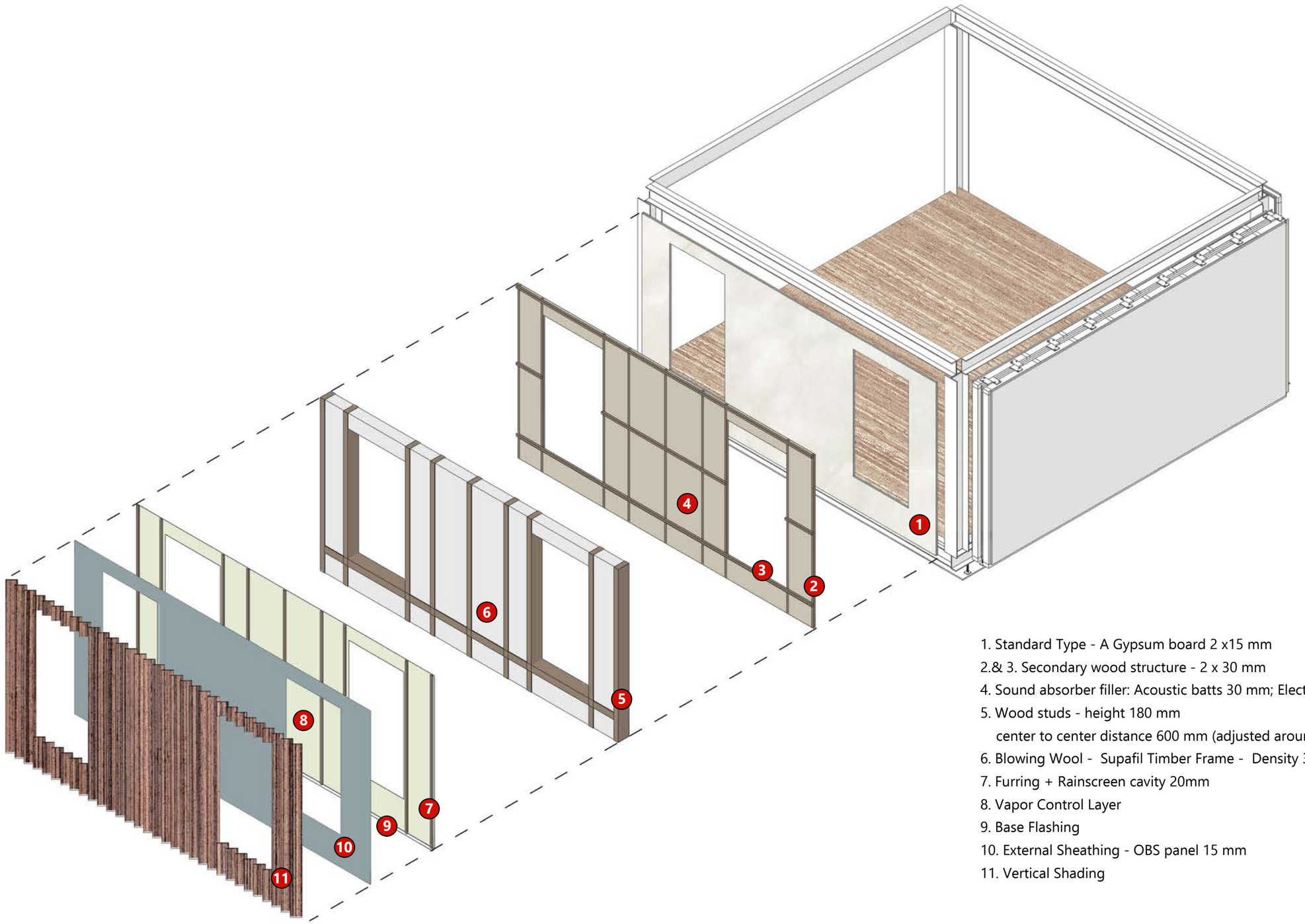
0 2 10m

4.8 Panellised Construction - Internal Wall



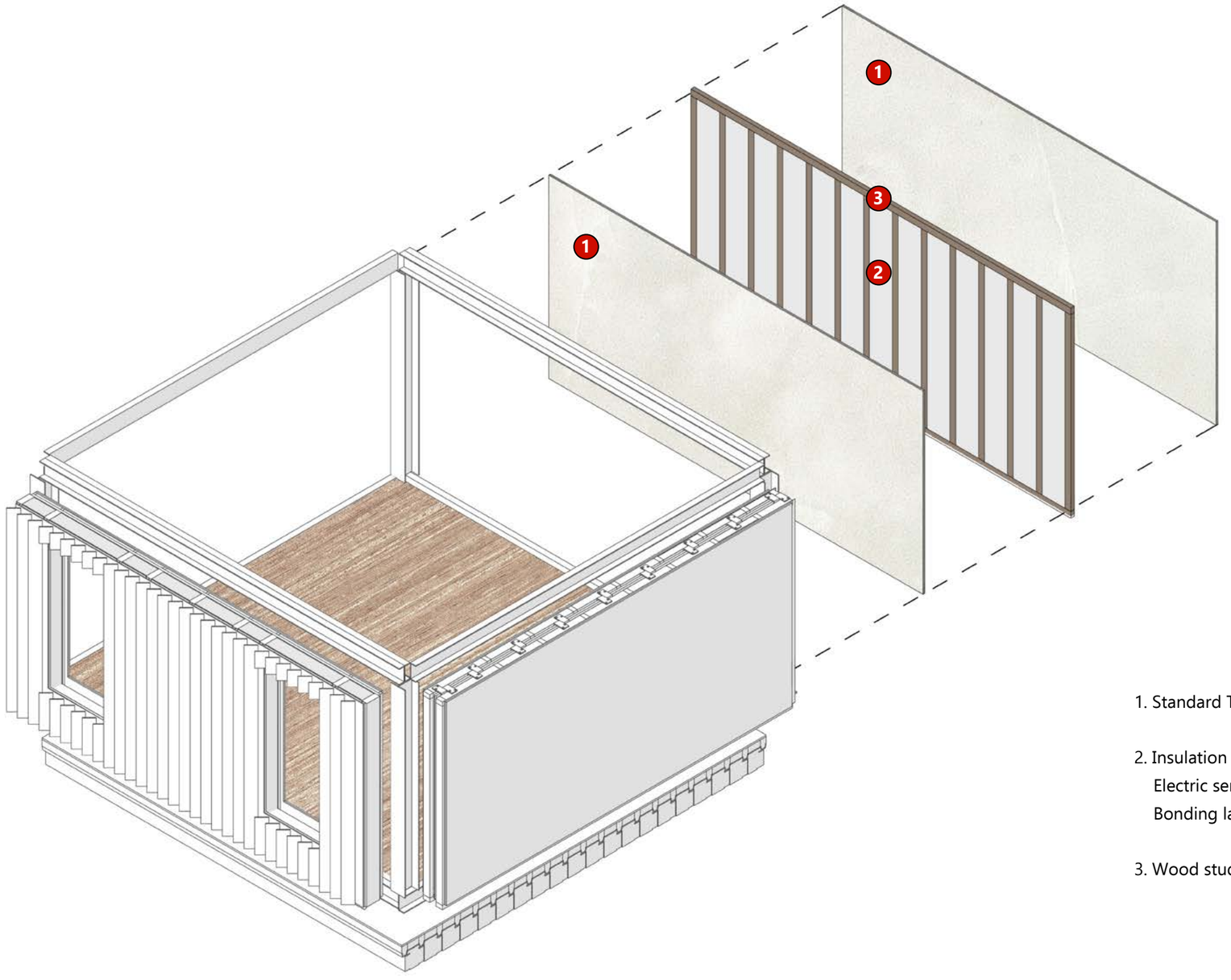
1. Standard Type-A Gypsum board 2 x15 mm
2. Vapor Control Layer
3. Wood studs - height 90 mm
   center to center distance 600 mm
4. Acoustic cavity insulation around service pipes
5. Soil/Waste/Water supply pipe
6. Fire barrier: 25 mm
   Shaftliner Mould-stop between 25 mm H-studs @600 mm ctrs
7. Track for fire barrier
8. Clips to both sides of each stud

4.8 Panellised Construction - External Wall



1. Standard Type - A Gypsum board 2 x15 mm
2.& 3. Secondary wood structure - 2 x 30 mm
4. Sound absorber filler: Acoustic batts 30 mm; Electric service zone 30mm
5. Wood studs - height 180 mm
   center to center distance 600 mm (adjusted around windows)
6. Blowing Wool - Supafil Timber Frame - Density 35 kg/m^3 -180 mm
7. Furring + Rainscreen cavity 20mm
8. Vapor Control Layer
9. Base Flashing
10. External Sheathing - OBS panel 15 mm
11. Vertical Shading

4.8 Panellised Construction - Dividing Wall

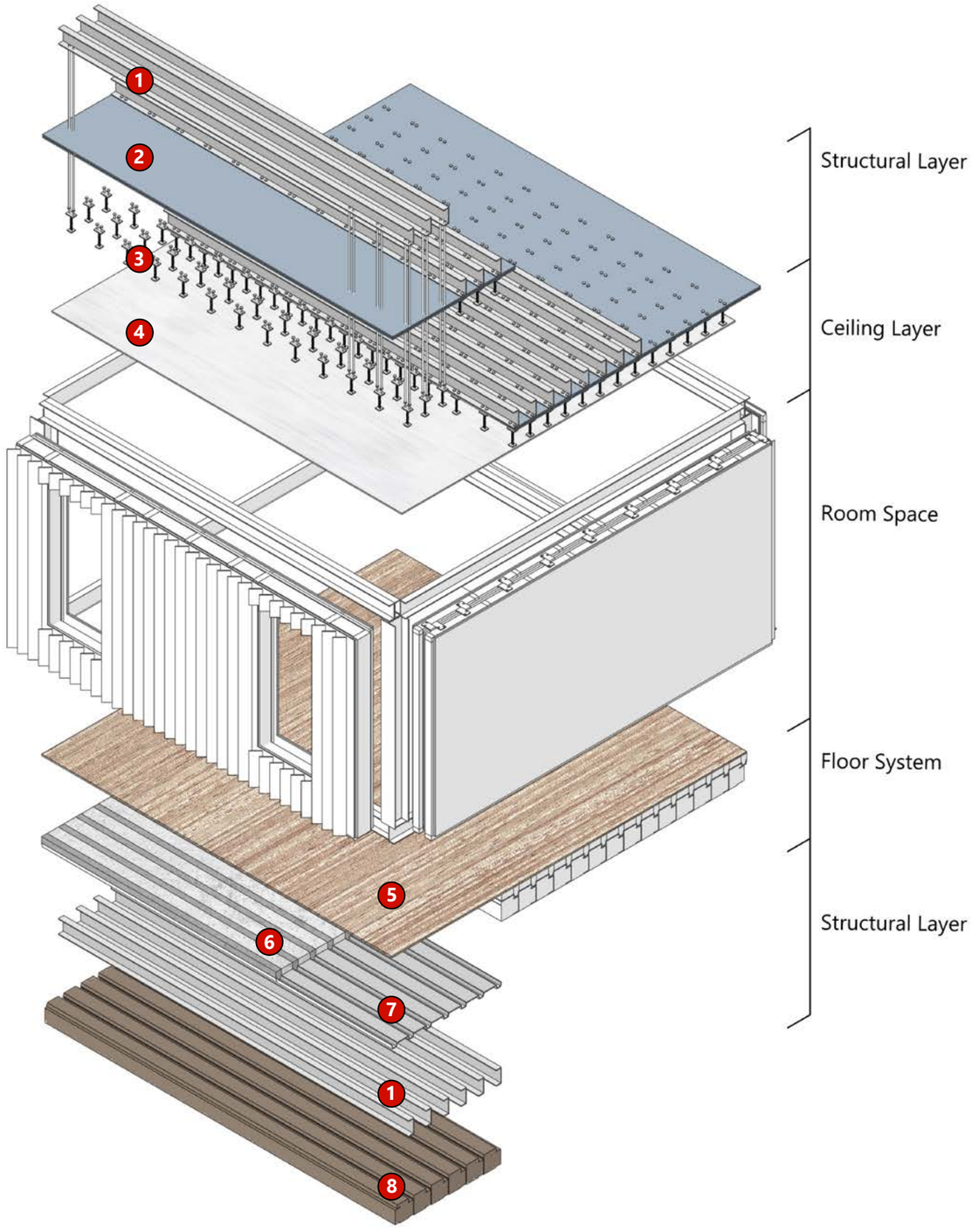


1. Standard Type-A Gypsum board 15 mm

2. Insulation BlowingWool 50 mm
   Electric service layer 10 mm (only on one side)
   Bonding layer each side 2 x 10 mm

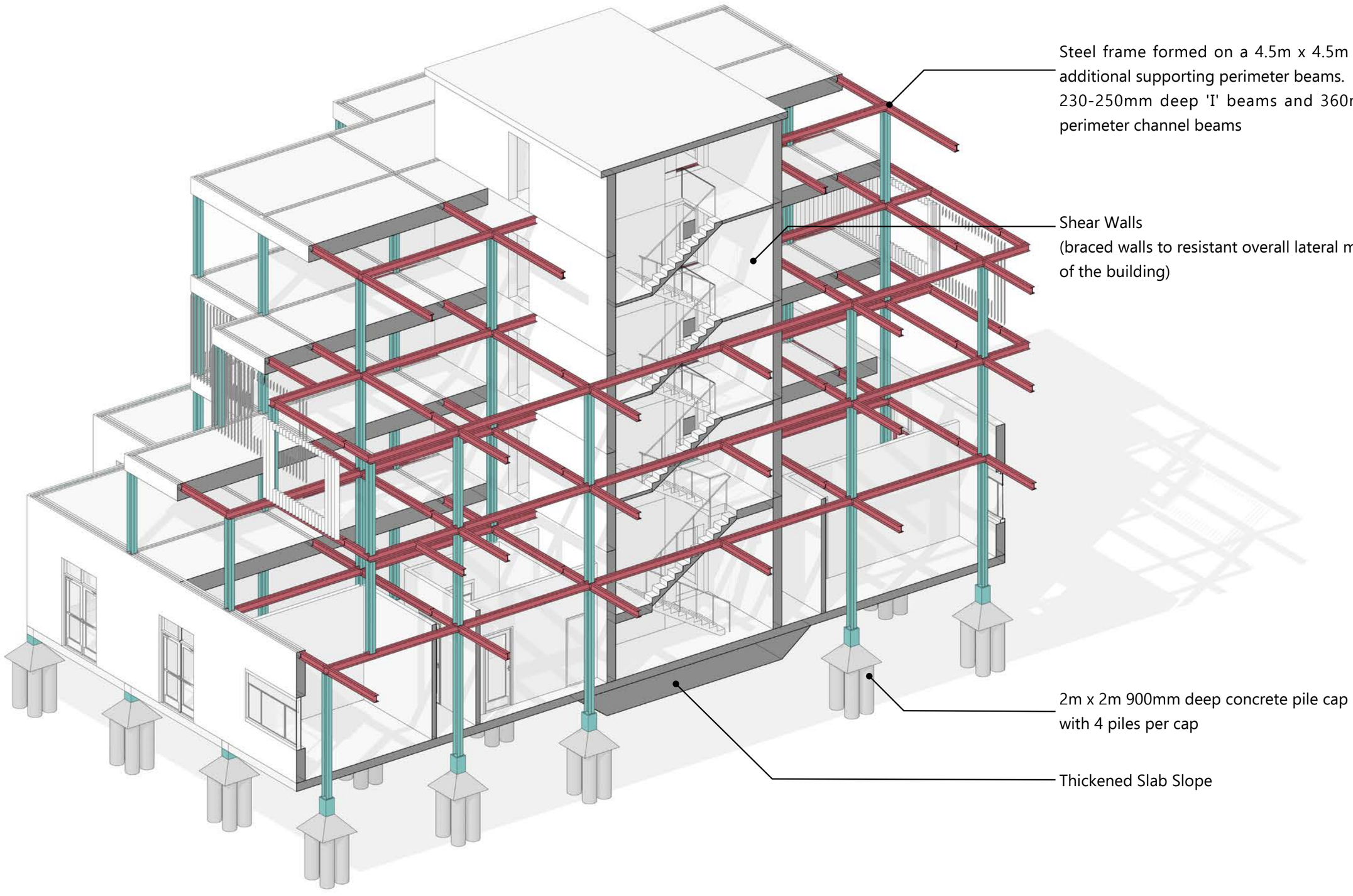
3. Wood studs - height 70 mm

4.8 Panellised Construction - Floor & Ceiling



1. Lightweight Steel 202x20 'C' Support Joists
2. 40mm double layered high performance insulation board
3. 50mm metal hangers
4. 20mm Plasterboard ceiling finish
5. 20mm light oak finish flooring
6. 112mm deep concrete screed
7. 10mm steel metal deck
8. 250mm deep rockwool insulation filler

4.9 Structural Strategy



4.10 Perspective view A



4.10 Perspective view B



Conclusion

In chapter 1, after the research of the cause of housing crisis in LA even the metropolitans across US, I have developed the ideas of what solution fits the current situation.

In chapter 2, I try to find a practical method to ease this problem. By comparing many building techniques and looking up the affordable housing cases in the real world, I define DfMA is the right method that fits LA, in both theoretical and physical way.

In chapter 3, I examine where will be the hot spot for fixing the housing crisis in LA. I firstly studied the policy given by the governers, to know how's the perspective from the urban planners. Then I recall the knowledge from chapter 1, setting up 4 rules to select the spots. Finally, I double checked my selection with the tendency from the planners, carefully zoom in to the intersection areas, discovering them in a smaller preciser scale.

At this point, I have gained the contexts of my designing target, both from historical point of view and the current crisis, from the theory side and the technical side, from the planners and from the users, in the end, the neighborhoods. I think I should make a solution with half social housing and half private appartments which entertains diverse dwellers and also brings harmony to the urban environment. Furthermore, this solution should have the capibility of rapid-deploying, short construction schedule, low-cost in building and operating, and simplacity of Disassembly.

With all those arguments above, I follow a specific method of moduler design. Adapting the concept of DfMA, I changed my deisng process. To select the structure framework at first, and then I go to the detail of construction design, especially for the panel system. Just like playing LEGOs, I defined the pieces at the beginning, then tried to build whole volumn. Then I completed the project step by steps. After that, I tried to simulate some key performance indicators comparing to the conventional building method. To see if my solution finally prevails.

"*To dance in chains, to make things difficult for oneself and then spread over them the illusion of ease and facility—that is the artifice they want to demonstrate to us.*" Friedrich Nietzsche, wrote. If architecture design in a dance in chains, the DfMA is a dance with heavier chains. I have to prepare all the pieces in day one, imagining which panel is needed. And all the pieces must fit in each other. Not many options I can take, only a few dimensions in modus. However, it also benefits my design. E.g. all my structure elements fall in a specific distance, these repeated gaps create a rythm in space. Also I have fewer options in elements, but they all fit in the grid, no exception. It's a mandatory. With this basic rule to follow, my design is limited in a rational space no oddity occurs.

DfMA also gives me a chance to think about the whole life cycle of one of my design. There's a transportation before building and a Disassembly at the end of the service.

Bibliography

[1]Joint Center for Housing Studies of Harvard University (JCHS), *The State of the Nation's Housing 2024*. Cambridge, MA: Joint Center for Housing Studies of Harvard University, 2024.
p. 2: 97 of top 100 metropolitan markets experienced significant home price appreciation; 115% price surge since 2010 (47% jump since 2020).
p. 3: Average annual volume of new housing completions fell 27% below the 30-year historical average.
p. 4: Nearly 1/3 of all U.S. households are housing cost-burdened (>30% income); U.S. renters' median real income grew by 2% since 2010.
pp. 5–6: National Point-in-Time (PIT) homelessness count reached an all-time record of over 653,000 individuals.

[2]Morrow, Gregory D. *The Homeowner Revolution: Democracy, Land Use and the Los Angeles Slow-Growth Movement, 1965-1992*. PhD diss., University of California, Los Angeles, 2013.
p. 13, Fig. 1-4: Theoretical Diagram — Dynamic Between Homeowner, Business, and Civil Rights Groups
pp. 242–260: Proposition U (1986 ballot measure reducing commercial corridor FAR from 3:1 to 1.5:1).

[3]Cuff, Dana. *The Provisional City: Los Angeles Stories of Architecture and Urbanism*. Cambridge, MA: MIT Press, 2000.
p. 230: Urban clearance in "The Flats" / Boyle Heights (erasure of 417 units, 70% Mexican / 30% Russian population).

[4]Soja, Edward W. *My Los Angeles: From Urban Restructuring to Regional Urbanization*. Berkeley: University of California Press, 2014.
p. 10 & p. 15: Regional Freeway System Map & Critique of Banham's "Autopia" vs. wealthy foothill enclaves.

[5]Pastor & Scoggins / PolicyLink & PERE (2021), *An Equity Profile of the Los Angeles Region*.
p. 13: Micro-region indicators — SLATE-Z (41% poverty rate, 25% no vehicle access); Watts & Willowbrook (16% unemployment, Child Opportunity Index -0.86 vs. -0.12 countywide); Southeast LA (26% linguistically isolated vs. 14% countywide).
p. 68: Spatial Segregation Metrics — Entropy Index comparison across LA County and California.
p. 69: Dissimilarity Index — 68% Black residents must move to achieve integration with Whites; rising Latino-White and Latino-API segregation since 1990.
p. 69, fig. 59 *Residential Segregation, 1990 and 2014, Measured by the Dissimilarity Index*
p. 87: Macro Inequality — LA ranks 7th most unequal among top 150 metros; 25% wage drop for 10th percentile workers since 1979; persistent $6/hr racial wage gap among college graduates.

[6]Colburn, Gregg, and Ryan Aldern. *Homelessness Is a Housing Problem: How Structural Factors Explain U.S. Patterns*. Oakland, CA: University of California Press, 2022.
p. 22 Figure 5. *Rank of indexed rates of homelessness, 2010 v. 2019*. Vertical position indicates rank of indexed per capita PIT counts for select U.S. regions.
Data source: HUD

[7]Legislative Analyst's Office. *California's High Housing Costs: Causes and Consequences*. Sacramento: Legislative Analyst's Office, 2015.
p. 21: Empirical Baseline — California required 70,000 to 110,000 additional housing units annually (1980–2010) to prevent prices outstripping national averages; failure to densify central cities and coastal hubs.

Legislative & Policy Documents

Figure 14:

[8] *Assembly Bill 2011* - California State Legislature (2022),
[9] *Proposition HHH* - City of Los Angeles (2016),
[10] *TOC Guidelines* - LADCP (2017),
[11] *Executive Directive 1* - Office of the Mayor of Los Angeles (2022).
[12] *SB 35 / AB 2234 & LADBS Standard Plan* - CA State / City of LA
[13] *Assembly Bill 2446 & CALGreen 2024* CA State Mandates
[14] *LA Green New Deal / pLAn 2019* City of LA Circularity Framework

[15]California Energy Commission. 2022 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. California Code of Regulations, Title 24, Part 6. Sacramento: California Energy Commission, 2022.
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards.

[16]California Natural Resources Agency. *CEQA Guidelines*. California Code of Regulations, title 14, division 6, chapter 3, sections 15000–15387. Sacramento: California Natural Resources Agency, 2024.
California Public Resources Code. *California Environmental Quality Act (CEQA)*. Division 13, sections 21000–21189. Sacramento: State of California, 2024.

Websites

[17]Articles about Dagenham Park School
AHMM Official Project Archive: https://www.ahmm.co.uk/projects/education/dagenham-park-school/
e-architect Project Report: https://www.e-architect.com/england/dagenham-park-school
structural teams: https://www.laingorourke.com/thinking/pbbs/
All sites are accessed in August 2, 2026.

[18] e.g. *Hope on Hyde Park*, *Hope on Alvarado* & *Hope on Lafayette*
Hope on Hyde Park is a modular, permanent supportive housing of the Metro Crenshaw line in 2022, by ktgy.
Hope on Alvarado creatively utilizes purpose-built steel modules into a modern and affordable housing community in 2021 by ktgy.
Hope on Lafayette is an extraordinary modular housing project designed to meet Los Angeles' needs in 2020 by utopia modular.

[19]Articles about Hope On Alvarado.
ArchDaily. *Modular Housing Solutions for the Homeless in LA*. Published October 14, 2019. https://www.archdaily.com/926363/modular-housing-solutions-for-the-homeless-in-la.
Housing Innovation Collaborative. "Hope on Alvarado." Accessed August 2, 2026. https://housinginnovation.co/design/hope-on-alvarado/.
KTGY, "Hope on Alvarado," accessed August 2, 2026, https://ktgy.com/Work/hope-on-alvarado/.

[20]Los Angeles Housing Department (LAHD). (2022). *McCadden Campus Senior Housing: Supplemental Tax-Exempt Multifamily Conduit Revenue Bond Request* (Council File No. 16-0345-S5). City of Los Angeles. https://cityclerk.lacity.org/onlinedocs/2016/16-0345-S5_rpt_lahd_727-22.pdf

Figure13:

2023 Unhoused Deaths in City of LA (Completed Cases) la controller - Official Website of the City of Los Angeles
url: https://unhouseddeaths.lacontroller.app/ accessed in July 2026.

Cases on Figure 16:

Viale Giulini Affordable Housing by Alvisi Kirimoto - *Paragon of high-quality social housing*
Accessed August 2, 2026. https://www.gooood.cn/en/viale-giulini-affordable-housing-by-alvisi-kirimoto.htm

11NOHO by Brooks + Scarpa *Living around the courtyard*
Accessed August 2, 2026. https://www.gooood.cn/en/11noho-brooks-scarpa.htm

Star Apartments
Accessed August 2, 2026. https://www.architecturalrecord.com/articles/7997-star-apartments-los-angeles
Accessed August 2, 2026. https://www.mmaltzan.com/projects/star-apartments/

Reference for shipping:

[21] Team of bensonwood.
Accessed August 2, 2026. https://bensonwood.com/blog/lumber-to-bundle/

Acknowledgment

First and foremost, I would like to express my deepest and most sincere gratitude to my supervisor, Professor Francesca Frassoldati. Her intellectual generosity, meticulous guidance and patience have profoundly shaped both this thesis and my growth as an architecture student.

I am endlessly indebted to my boyfriend and family, whose unconditional love, constant encouragement, and quiet sacrifices have been my anchor throughout this demanding journey. Even across distances and long hours of research, their faith in me never wavered. Their warmth and support provided the emotional resilience I needed to bring this work to fruition. Everything I achieve is a reflection of their devotion.

Finally, I dedicate this work to the broader vision of a more equitable urban future. It is my sincere hope that the scalable paradigms and industrialized architectural frameworks explored in my thesis can contribute, in however small a measure, to improving that high-quality, dignified housing becomes an accessible reality for all who call the city home.