

Landscapes of Fulfillment:

Re-examining Infrastructures for E-Commerce Distribution in Los Angeles

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Abstract

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The logistical infrastructures supporting the transport and distribution of consumer goods has created a disjuncture in the urban landscape, severing the local space of the city from the space of global product flows. Sprawling agglomerations of mega-warehouses, (such as Amazon “Fulfillment” centers) disregard the local communities that they border, and create environmental concerns due to trucking of freight across increased distances. The rapid growth of e-commerce retail has further separated consumers from the physical realities of distribution, yet has paradoxically created a need for these facilities to be located closer to urban populations. Capitalizing on this trend, this thesis proposes a new model for a consolidated e-commerce fulfillment center, intermodal freight terminal, and retail marketplace on an industrial site near Downtown Los Angeles. By bringing the point-of-exchange back to the site of product distribution in the form of a retail marketplace, this thesis aims to “revive” a classic retail typology in a new urban context - ultimately bringing consumers into direct contact with this infrastructure. Eschewing the current horizontal warehouse typology, a vertical storage typology is proposed, allowing the interweaving of multiple programmatic elements along a new plane of public activity, and the regeneration of land formerly occupied by sprawling railyard operations. Through these design tactics a new synthesis between infrastructure, public activity, and urban space in Los Angeles emerges.

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CHAPTER 1

Introduction

Thesis Statement

The logistical infrastructure for the transport and distribution of consumer goods in Los Angeles has created a disjuncture in the urban landscape, where the “internal” space of the city has been severed from the “external” space defined by networks of global freight flows. The sprawling agglomerations of warehouses that have grown rampantly beyond the urban fringes disregard the local communities that they border, and create environmental concerns for the entire region. Defined by the demands of commerce for the efficient and seamless transfer of cargo, the architecture of the “mega-warehouses” at the heart of these modern networks is typically standardized and mute.

With the rise of e-commerce and the virtualization of exchange in recent decades, a shift in distribution models has taken place, further separating urban consumers from the physical realities of commodity distribution. Through online retailers like Amazon, goods purchased through virtual interfaces are delivered directly to the doors of consumers in a matter of hours, with no indication of the scale or complexity of the infrastructural systems which facilitated the transfer.

This thesis posits that the fractured logistical infrastructure of Los Angeles has the potential to be recalibrated to act as an “interface” or mediator that bridges between the movement of goods and people, and the spaces of commerce and the city. Furthermore this thesis aims to “revive” a classic retail typology, where the point-of-exchange exists at the site of product distribution, ultimately bringing consumers into direct contact with this infrastructure. Capitalizing on a growing need for e-commerce retailers to relocate distribution centers closer to dense urban populations for the rapid delivery of goods, this

Figure 1. (Opposite) Downtown Los Angeles and the “Piggyback Yard” Intermodal Rail Terminal

thesis proposes a new model for a consolidated e-commerce fulfillment center, intermodal freight terminal, and retail marketplace on an industrial site near Downtown Los Angeles. Eschewing the current horizontal warehouse typology, a new vertical storage typology is proposed, allowing the interweaving of multiple programmatic elements along a new plane of urban activity, and the regeneration of land formerly occupied by sprawling railyard operations. Through these design tactics a new synthesis between infrastructure, commerce, and urban space in Los Angeles emerges.

Background

Los Angeles, more than any other city in the U.S., has been shaped by the global flow of consumer goods. The relentless influx of product volume from Asia pours continuously into the Port of Los Angeles, the most active port in the country and fifth most active in the world. After being shuttled from the Port along the Alameda Corridor freight railway (Figure 2), this cargo continues to travel regionally and nationally along various conduits to distribution centers, retailers, and eventually into consumer homes. This flow of consumer goods requires a complex, networked set of infrastructural organs in which to process and filter the objects of American consumer desire. The resulting network of fluid transit corridors and fixed distribution nodes create a distinctly fragmented and disjunctive urban situation. The material residue of the infrastructure of capitalism that is based on pure logistics and economics is expressed in standardized, repetitive, and mute architecture. Tied to this larger global network, these distribution nodes are not dependent on any specific geographic location or topography, despite the fact that they are fixed in a particular place. Furthermore, the sprawl of distribution activity in urban regions has led to the consumption of considerable amounts of land, often for low-intensity logistical uses, creating environmental issues (Figure 3). These arteries of material flow and the vast warehouses and terminals that connect them serve as a paradigm for the character of the city as a whole. In her study of container urbanism, Deborah Richmonds has described Los Angeles as a “magnificently empty city – a collection of container buildings filled with objects in transit”¹.

With the rise of e-commerce retailing models and advanced communications technology, consumers are increasingly separated from the physical realities of the infrastructure of distribution. The e-commerce distribution facility, otherwise known as the “fulfillment” center, has now evolved into the critical point of control in these modern networks of exchange. Paradoxically, the growth of e-commerce retail that is separating



Figure 2. Alameda Corridor

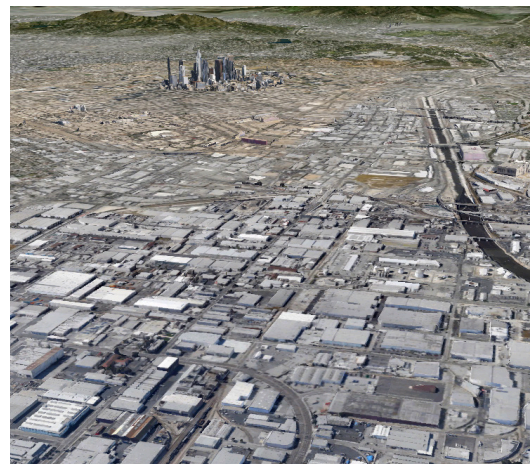


Figure 3. Warehouses in Commerce, south of Downtown L.A.

consumers from this infrastructure is causing retailers to consider relocating fulfillment centers closer to dense urban populations in order to satisfy demand for rapid product delivery. This presents an interesting and unique opportunity to reconnect urban consumers to the actual distribution infrastructure which supports product flow and in doing so, revive a classic retail typology in a new urban context.

This thesis posits that the logistical infrastructure supporting e-commerce distribution in Los Angeles can act as an interface between the space of the city and the flow of commerce. This thesis also argues that the points of interchange within freight distribution networks are heightened moments of kinetic exchange, where new opportunities exist for public engagement. Furthermore, it is argued that intermodal terminals and distribution facilities can better negotiate between the pressures of the exterior network and actual local conditions, permitting the creation of an architecture that responds to variations of place rather than to the generic demands of the network. Finally, this thesis investigates how the architecture of the distribution facility can, like infrastructure, remain open to flows of consumer goods while simultaneously taking on a more visible and stable presence in the urban fabric.

The design proposal serving as a means for testing this thesis is a new model for urban logistics that combines an e-commerce fulfillment center, intermodal freight terminal, and a “brick-and-mortar” retail marketplace. This consolidated facility will act as a flexible “interface” between the flow of goods and urban space, increasing connectivity to surrounding communities and integration with the landscape. Apart from these larger urbanistic goals, other key goals of the proposal are to a) reconnect the point-of-exchange to the physical site of distribution, creating an overlap between spaces of retail and infrastructure, b) allow visibility into dynamic distribution processes that are often hidden, and c) reduce the environmental impact of distribution operations by consolidating infrastructure and relocating it closer to end consumers.

This investigation is conducted in three general stages: First, an analysis of freight distribution networks will be conducted, with a specific focus on cargo movement and logistics activity within the Greater Los Angeles Region. From this analysis, a specific logistical “zone” near Downtown Los Angeles - an existing intermodal freight terminal - is pinpointed as a study site for a design investigation. Finally, based on concepts derived from the overall goals of this thesis, and from research into e-commerce distribution infrastructure, a design for this new urban logistics model will be tested on the study site.



Figure 4. Distribution warehouse along Los Angeles River



Figure 5. Product movement in a regional distribution center



CHAPTER 2

Flows and Nodes: The Infrastructure of Distribution

2.1 Flows: Goods and Mobility

American Consumption and Goods Circulation

The initial point of departure for conducting this study of the physical networks of global supply chains for consumer goods begins with a brief overview of the rampant consumerism present in both the United States, and on a global scale. Globally, personal consumption expenditures (the amount spent on goods and services at the household level) topped \$24 trillion in 2005, up from \$4.8 trillion (in 1995 dollars) in 1960.² In the U.S., shopping has become nearly a sacred rite. After WWII, the national economy shifted away from the production of goods to the distribution and consumption of consumer goods. In his essay “Props: Story of the Eye” Robert Sumrell argues that we have become simply a “background for the objects which we own,” engaging a continuous cycle of procurement in order to formulate our identities. He compares our relationship to objects to that of a “programmer to bits of code:”

“As programmers, we assemble these pieces of code into a context, or language, that builds a program to execute a series of actions. Network systems are the infrastructure on which these programs run and interact. No network is essential, just as no single node is vital - all that matters is movement within the network. What we are left with is a constant circulation of bits, like the elements and molecules in chemistry that create a living ecosystem - it is this constant cycle of change that keeps the system vital.”³

Global Supply Chains and Intermodal Transportation

The fluid global supply chains for the distribution of consumer goods that feed the “needs” of American consumers have shaped the space of modern society. These supply chains stretch horizontally tens of thousands of miles over geographies, nations, and cities.⁴ The supply chains are based on extensive and highly complex logistical networks in order to successfully distribute product across the globe. Aided by innovations in transportation technology and communications, these networks of exchange and distribution operate on a principle of simultaneous connectivity across vast territories in order to maximize the mobilization and flow of goods.

Author Clare Lyster explains that modern transportation methods like the railroad were initially responsible for creating spatial distance between the production and consumption of consumer goods, and “uprooting” them into a continuous flow.⁵ This spatial distance was further increased by other transportation innovations of the 20th century, such as the interstate highway system. The rise of the shipping container in the 1960s, however, allowed for an unprecedented fluidity in global trade through the broad deployment of a prototypical unit that became a highly efficient means of interfacing between different transportation modes. This generic box was the critical component that allowed the modern globalization of commodity supply chains.

In the first “stage” of supply chains, called “composition”, goods from sites of production are assembled into larger loads that can be transported in bulk in order to achieve economies of scale. Moving from this initial point of “composition” along transit conduits of either rail or truck, goods then reach an intermediate location for further transportation to an international node of transport.⁶ This international node is usually either a port or an airport, although the former accounts for 90% of total international freight volumes. From this point, further economies of scale are achieved by condensing loads again, such as through the use of a container ship. Goods proceed to the next international gateway, which is an international port of entry. In the U.S. the dominant points of entry for these consumer goods are at the Port of Los Angeles and Long Beach, which receives more than three times the cargo volume of the next largest American port in New York (Figure 8).⁷ In 2004 the Port of Los Angeles processed more than 120 million tons of containerized merchandise, up 140% from 50 million just a decade before, and the volume has continued to increase (Figure 9).

Following their passage through a port of entry, goods are transshipped again by rail or truck to inland regional distribution hubs commonly located outside of major



Figure 7. Self-Storage Facility. Self-Storage is currently the fastest growing sector of commercial real estate in the U.S.



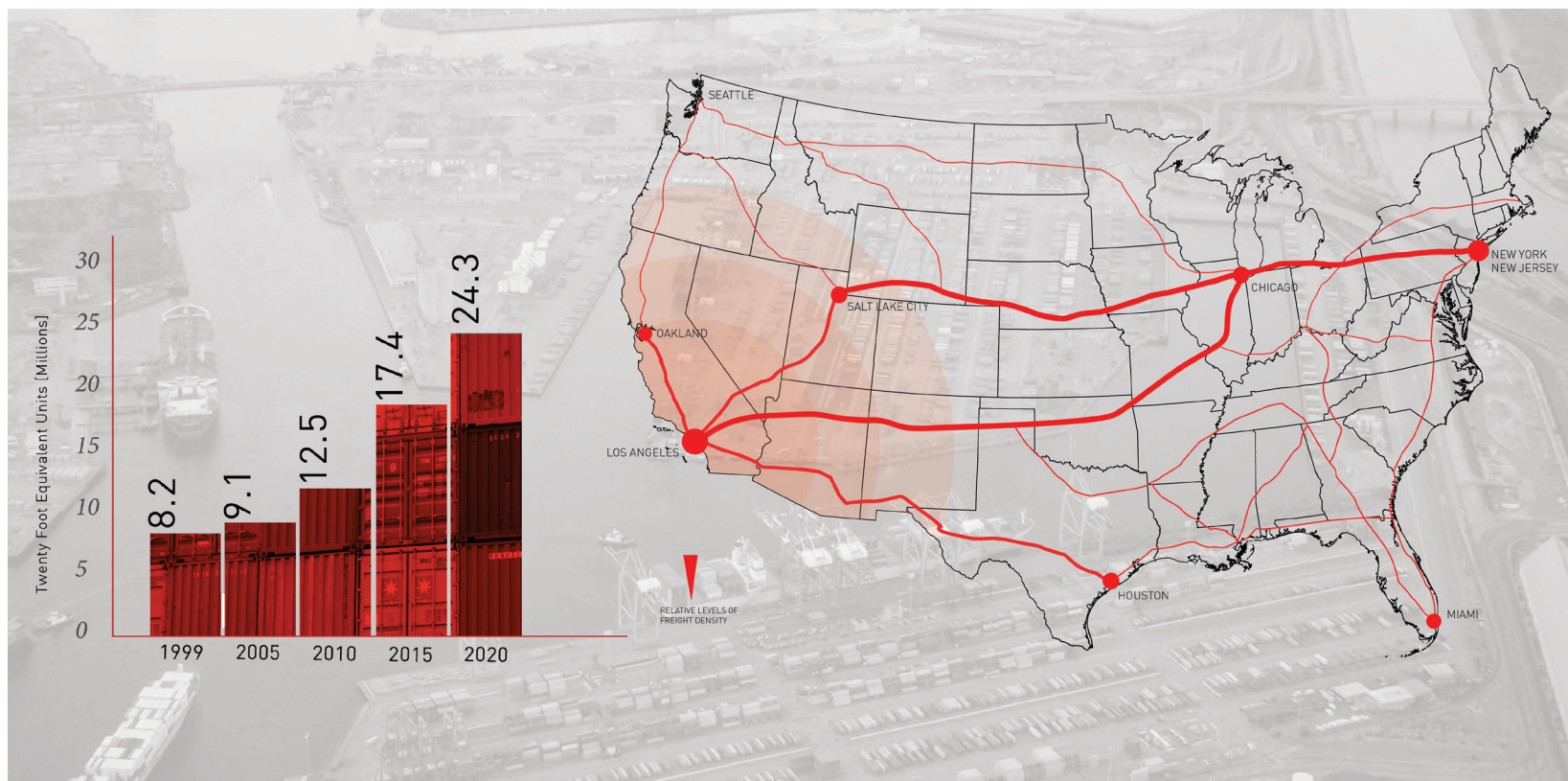
Figure 8. Port of Long Beach

Figure 9. (Opposite) Increase in freight volume through Port of Los Angeles; National trucking routes by volume

urban centers. Trucking along the highway system accounts for 77% of the total weight of freight shipped in the country.⁸ The final stage of the supply chain, called the “Last Mile,” involves the “decomposition” of product loads into smaller parcels that are then trucked to their final points of exchange, such as retail stores (or in the case of e-commerce, directly to consumers). In dense urban areas, this final stage may involve more complex distribution strategies, especially with the trend towards the breaking down of shipment sizes to reach dispersed consumer populations.⁹

E-Commerce Retail and Shifting Distribution Models

Despite the improvements in intermodal coordination and transportation technology, it has been the drastic innovations in information technology that has allowed goods distribution networks to achieve a near instantaneous level of mobility in recent decades. As Clare Lyster points out, the true efficiency of distribution networks comes from



the speed at which information can be communicated, rather than the speed of the various modes of transportation themselves.¹⁰ Virtual flows of information through the internet have now become inextricably linked to the flow of goods through physical distribution networks, combining to form a virtual and geographical phenomenon.¹¹

These developments in information technology have given rise to a highly complex logistics industry that exists solely to control and facilitate the flow of goods. In industry language, Third-Party Logistics providers are outside entities that specialize in optimized supply chain management. These companies handle both physical and virtual aspects of goods distribution, offering integrated warehousing and transportation services as well as virtual tracking interfaces.

The rise of these Information Technology-based logistical entities that digitally track product volume has also coincided with the increasing trend towards a “Just-In-Time” model of global goods distribution. With the use of virtual information, goods are able to be “stored-in-transit,” thereby increasing the amount that is in continual circulation and decreasing the time spent in storage. This also correlates with the shift in “Push” to “Pull” logistics, where product inventory supply is tightly controlled to more closely match actual demand (Figure 12). This increase in goods mobility as a result of Just-In-Time distribution models has had distinctly negative effects on urban areas, as the continual increase in the amount of truck traffic in cities has created widespread congestion and environmental concerns.

The growth of E-commerce as a new retail model in recent decades has also played a key role in this shift that has further separated consumers from the physical realities of the infrastructure of distribution. E-commerce has been the fastest growing segment of the



Figure 10. Warehouse worker using RFID tracking technology



Figure 11. “Amazon Fresh” online food delivery marketplace

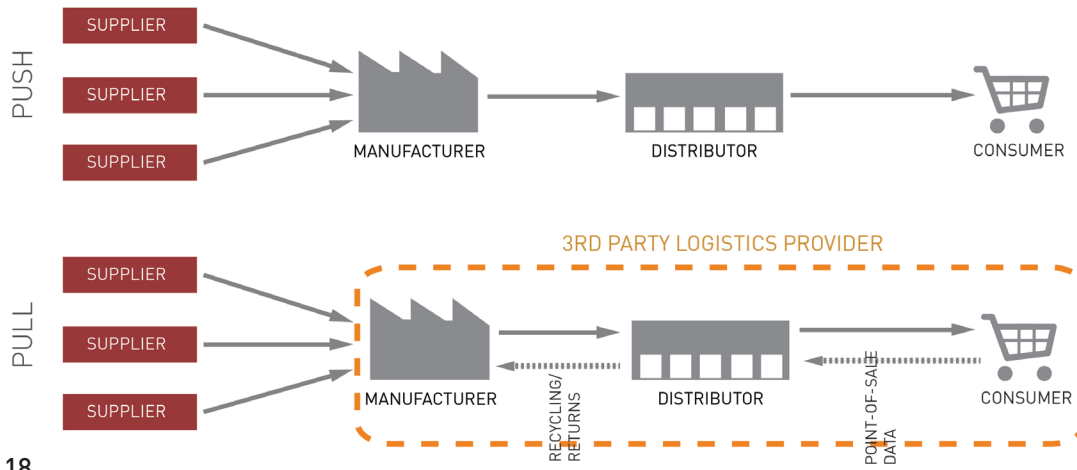
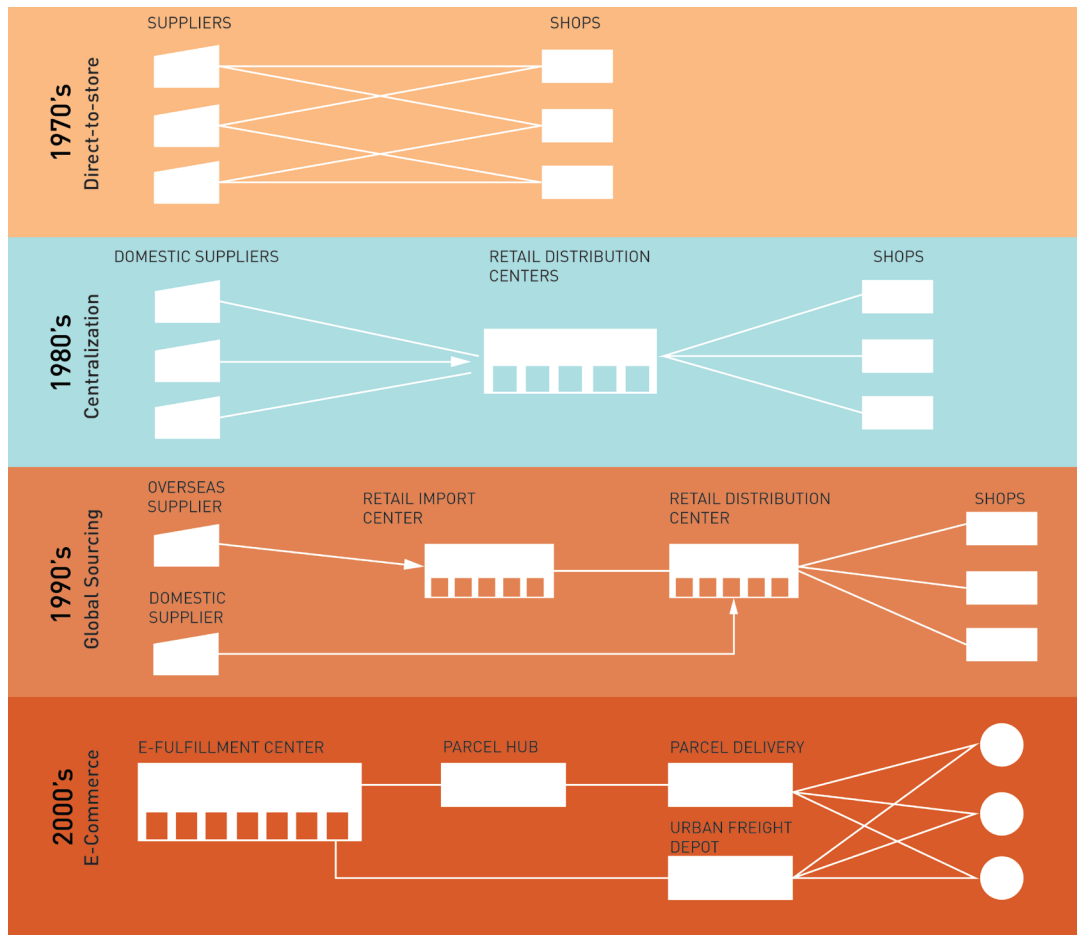
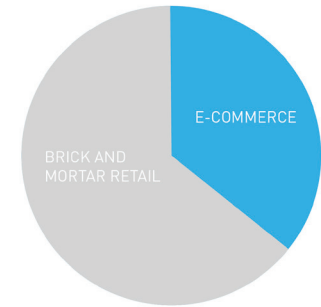


Figure 12. “Push” vs. “Pull” logistics



30% OF RETAIL WILL BE E-COMMERCE BY 2025



40% OF "BIG BOX" WAREHOUSES DEVOTED TO E-COMMERCE ACTIVITY IN LOS ANGELES



Figure 13. E-Commerce and changing distribution models in recent decades

retail market for the last five years, and by 2025 is expected to account for 30% of all retail in the U.S. Currently one-third of big-box warehouse space in the U.S. is tied to e-commerce, with that ratio expected to continue to grow (Figure 13).¹² Many large e-commerce retailers promise rapid delivery of products to consumers, even on the same day of purchase. This challenges retailers to maintain a high level of fluidity in their supply chains, and remain in close proximity to their customer base, which is often difficult in dense urban areas. Furthermore, as the monopoly of brick-and-mortar retail stores begins to fade, the points of consumer exchange in urban areas are pushed into the realm of the virtual. Goods magically appear on the doorsteps of consumers within hours after purchasing them online, with nothing to indicate the complicated organizational and physical infrastructure that enabled their delivery.

Urban Implications of Commodity Flows

The increasing logistical sophistication of these fluid networks of global distribution has had important spatial implications for modern urban regions. Now globally distributed in order to achieve optimal product flow, the infrastructure of distribution is no longer dependent on any one specific geographic location (although it must have a physical presence). As Lyster explains, these networks actually exist “through, between, and over multiple sites.”¹³ The networks’ reliance on connectivity has led to the erosion of the traditional urban core as the center of exchange and distribution, as distribution has moved out to the periphery to sites that are more accessible to transportation and communication conduits. This logistics “sprawl” is also the result of the need for cheaper land and the desire to maintain optimal spatial separation between logistical nodes. The resultant urban form is that of the “Megaregion,” a loose agglomeration of centers connected by flows of goods and information (Figure 14). Peter V. Hall and Markus Hesse argue that this urban form leads to “distintegrating” and “de-territorializing” effects such as loss of local governance and territorial identity of the physical infrastructure, and loss of territorial identity.¹⁴

In addition, the sprawl of distribution activity in urban regions has led to the consumption of considerable amounts of land, often for low-density logistical uses. The grooves created by large tracts of transportation infrastructure that connect these networks have left indelible marks on the terrain of the city, permanently shaping the character of urban areas. In Los Angeles, for example, a 23-mile long trench known as the Alameda Corridor that serves as the primary conduit for freight from the Port of Los Angeles slices through many neighborhoods on its way through downtown (Figure 16).

Another critical implication of the global deployment of distribution infrastructure is the homogenizing effect that it has on urban space. The infrastructure of “distributive space,” states Craig Martin, relies on strategies of “repetition, routinization, and concealment” as a means of maintaining the continuous flow of goods.¹⁵ While repetition of spatial configurations and routinization of flow ensures stability and reliability, this overt “normalization” of the system causes the physical mechanisms to become invisible. The banal sight of loading docks and shipping containers have now become so ubiquitous that the urban areas devoted to this logistics activity recede from everyday awareness. These “forgotten” spaces of distribution become voids in the urban fabric and in the perception of the public.

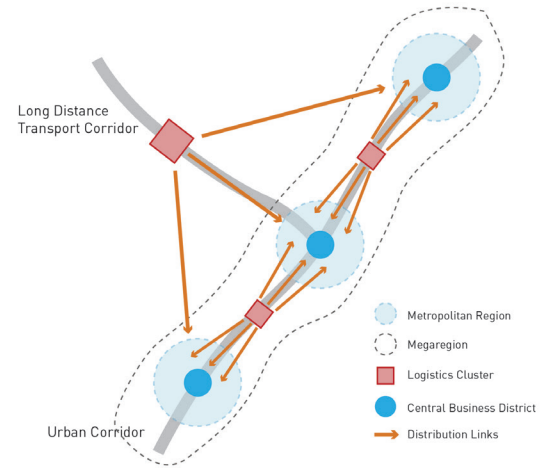


Figure 14. Logistics “Clusters” and growth of urban megaregions

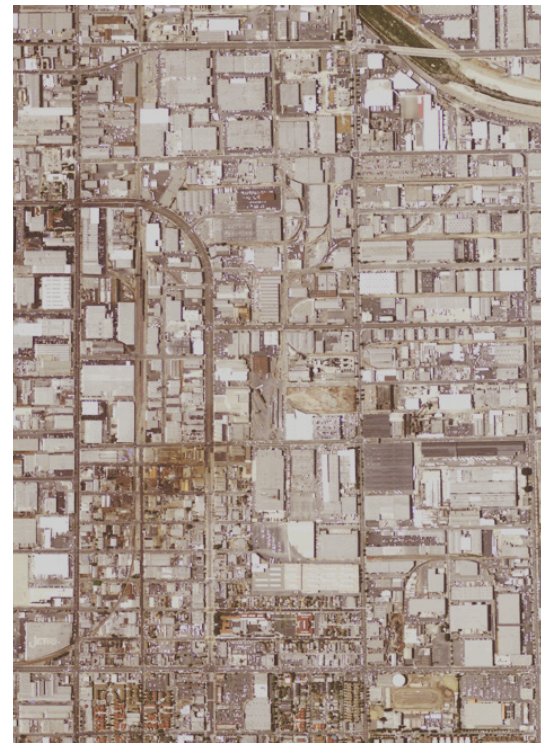


Figure 15. Logistics “sprawl”

Warehouse Sprawl in the Los Angeles “Megaregion”

The Greater Los Angeles Region has been profoundly impacted by global and local flows of goods. In recent decades, due to increasing volumes of freight influx and traffic congestion, logistics activities have been pushed from the downtown industrial core to cheap land far outside the urban fringes. With the rise of e-commerce, however, the geography of distribution is starting to shift to bring logistical activities closer to more dense urban populations.

With the rise of containerized shipping and the growth of the extensive freeway system following WWII, freight infrastructure began to spread across the Los Angeles basin and San Fernando Valley to become the main hub of distribution in the United States. This extensive network now operates at the international, national, and regional/local level, including the nation’s largest container port complex, two major air cargo centers, several major rail hubs, and numerous regional distribution centers. These varying scales of distribution nodes have agglomerated within the region as logistics “clusters.” Prior to the 1990s, these clusters grew primarily around the Ports of Los Angeles and San Pedro in South Los Angeles County, and in Southeast Los Angeles along the eastern portion of the Alameda Corridor. Since the mid 1990s, however, the logistics industry began experiencing rapid growth due to a major spike in freight volume, seeing over a 200% increase in the number of warehouses and distribution centers in L.A. between 1998 to 2009.³² This also shifted the primary site of warehousing activity, which began to increase in industrial areas south of downtown, but more importantly in “inland” zones further to the east in Riverside and San Bernadino counties (Figures 18-19).

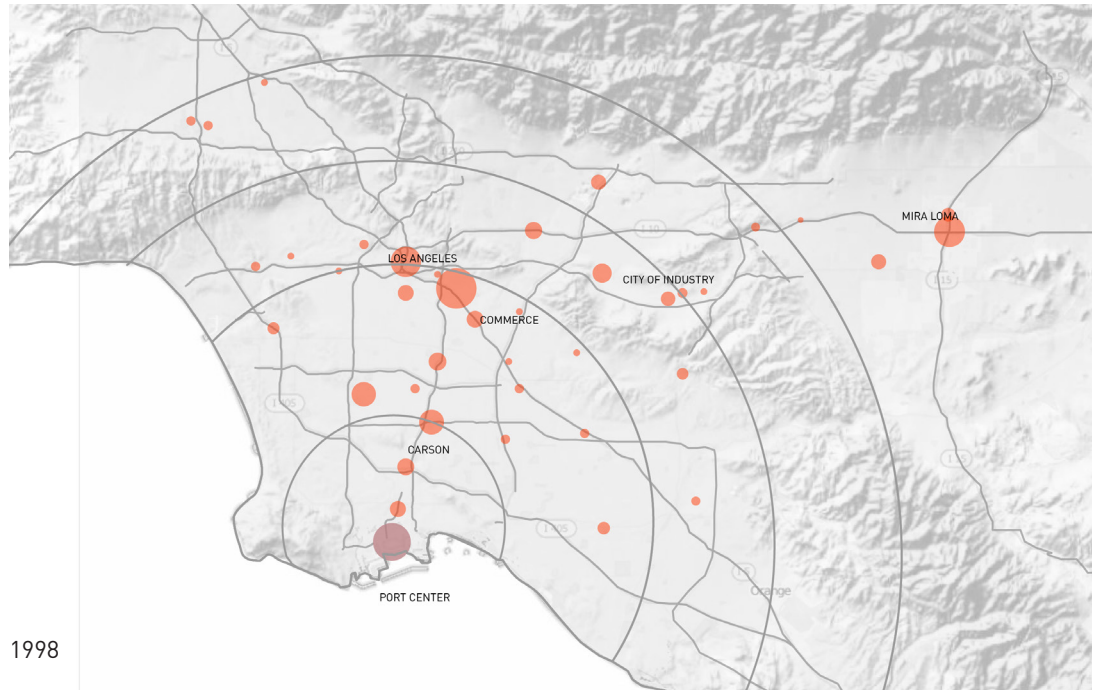
The growth of supply chains serving traditional retail models have driven a high percentage of distribution-related activities to inland areas outside the urban core. However this trend is beginning to change with the rise of e-commerce, leading to a series of changes in the locations of distribution facilities, and the de-aggregation of retail and distribution. As retailers and third-party logistics providers have begun to realize the importance of being closer to major urban markets in order to ensure the rapid delivery of goods, more expensive urban sites in dense areas is being sought. These facilities are typically being located in close proximity to interstate highways and other means of transport such as rail, and often built adjacent to United Parcel Service and Fedex shipping hubs to handle delivery. Given these new requirements for distribution facilities associated with internet retailing, this project will investigate the probable scenario of the introduction of a local distribution facility.³³



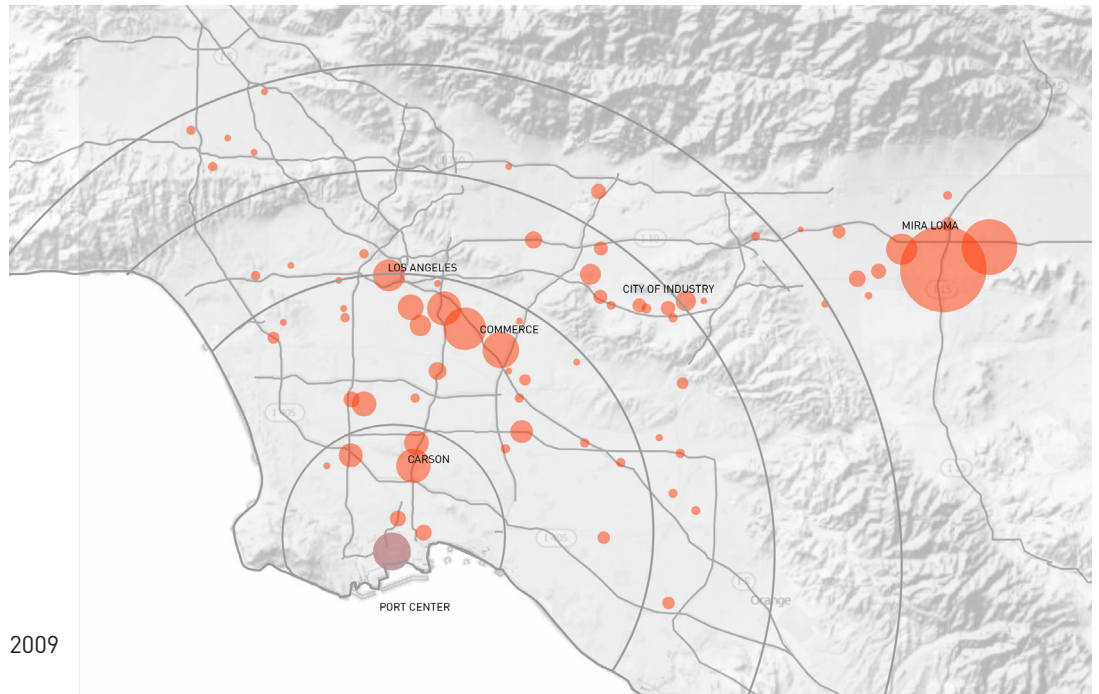
Figure 16. The Alameda Corridor slicing through urban area in south Los Angeles



Figure 17. Trucks hauling containers on an L.A. Freeway



1998



2009

Figure 18. 19. Warehouse sprawl in greater Los Angeles Region - 1998, 2009

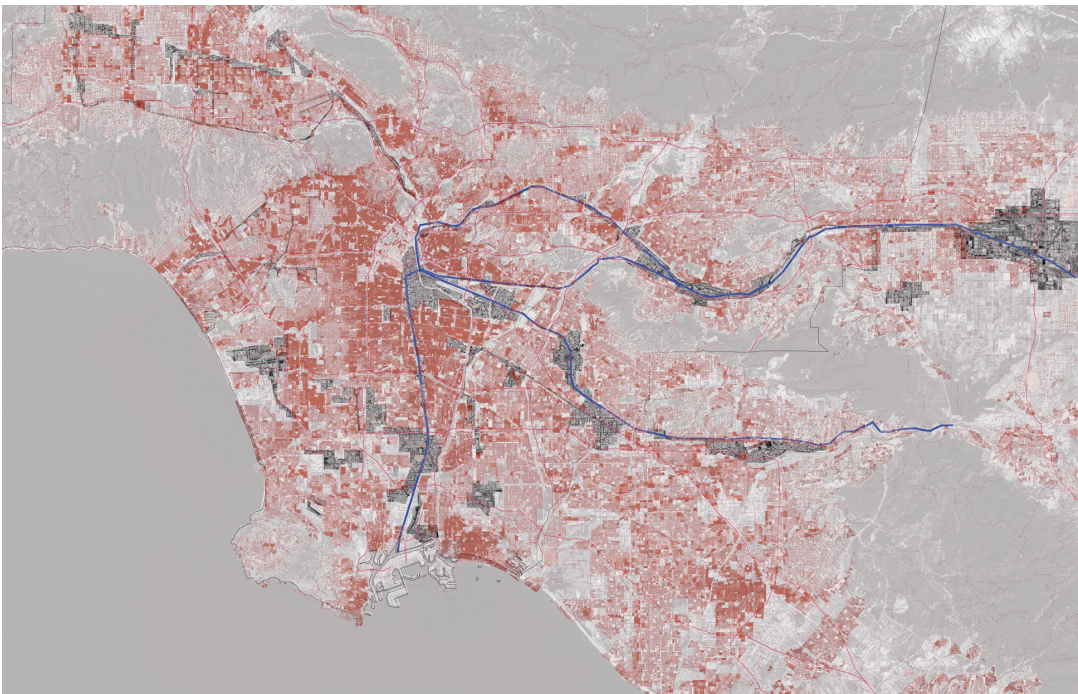


Figure 20. 21. Maps showing key industrial/freight corridors in the Greater Los Angeles Region, and their relationship to transportation routes and population density.

Top: Industrial and Frieight Corridors with Free-way (grey) and Rail (blue) overlay, Greater Los Angeles Region.

Bottom: Industrial and Frieight Corridors with Population densities and Rail (blue) overlay, Greater Los Angeles Region.



2.2 Nodes: Containment Technologies

Logistics Clusters

The flows of consumer commodities that have transformed the space of modern cities rely on a layered system of infrastructural “articulation nodes” that contain and regulate the flows of goods. These nodes operate at a variety of different scales and functions, from vast international maritime ports and airports to local parcel distribution facilities.¹⁶ Such nodes also act as the interfaces or “gateways” between the different spatial systems of global and regional networks.

At the sites of interchange between the networks, these sites gather together the different types of activity related to distribution and logistics, taking advantage of economies of proximity. Intermodal rail terminals located inland from ports, for instance, are usually surrounded by warehouses or third-party logistics facilities. In traditional supply chains, these logistics “clusters” typically form in industrial areas close to urban cores, but with the increase of intermodal activity many of these zones of logistics activity have moved beyond the urban fringes (Figure 22).

As high-intensity sites of interchange within distribution networks, these logistics clusters currently create a multitude of issues for the communities in which they are situated. One recent study of such logistics clusters located in Los Angeles cited the heavy pollution created by concentrations of idling diesel trucks at warehousing sites and on nearby streets, which contributed to health problems for residents and workers. Furthermore, residents in the study felt completely separated from the activity contained within the blank walls of the warehouses, unaware of what was being stored or transported inside. Finally, residents felt that the sprawling warehouses and other logistics spaces located in their community were taking up valuable land that could be instead utilized for more publicly oriented activities.¹⁷

E-Commerce “Fulfillment” Centers

As the speed of freight flow has increased with the advent of new information technology, the distribution warehouse has become the most critical node of interchange within these clusters of heightened logistical activity. With e-commerce, this facility now acts as both retailer and distribution center, as consumers are connected directly to the point of distribution through the virtual interface of the online marketplace.

This modern distribution network has created new spatial demands for built

(Opposite - clockwise, from top)

Figure 22. Warehouses, San Bernadino County

Figure 23. Walmart distribution center

Figure 24. Amazon Fulfillment Center

facilities, leading to the formation of new warehouse typologies that are more dynamic actors in “hub and spoke” networks. Old warehouses serving more long-term storage functions of the traditional supply chains have become inadequate for meeting new technological demands, unable to accommodate newly accelerated processes (such as “cross-docking”, where goods are immediately sorted and reloaded onto awaiting trucks).¹⁸ Current distribution centers now typically occupy a much larger footprint, sometimes more than 1 million square feet, as is the case with Amazon’s “mega-fullfillment” centers (Figure 27). In order to economically accommodate these spatial needs, many of these high-turnover facilities have been pushed to the city periphery, where land is more affordable.

The distribution warehouse, as part of the larger infrastructure that supports this global flow of consumer products, is the product of logistics and economics at nearly every scale. As such, the architectural language of these facilities expresses the mechanized actions of distribution. The architectural typology that serves as the support structure for this network of flow for consumer goods is the “Big Box” warehouse. Like the shipping containers in which consumer goods are transported, the ubiquitous structures are most often standardized and mute, isolated from the urban fabric and surrounded by acres of paved parking. The buildings are typically constructed according to standardized specifications and planning templates, reduced to “pure enclosure”.¹⁹ Angelil and Siress point out that the “big-box” in principle, places a premium on logistical performance. The muteness of the container, they point out, is partly a ploy to hide or shut off these dynamic logistical activities from view.

The indifferent character of the modern distribution facility negatively impacts not only the surrounding urban fabric but also the employees who work there. Despite the automation of product management systems, most warehouses still rely heavily on temporary and seasonal workers to handle order processing. The scale and speed of the distribution operations that take place within these warehouses often create harsh conditions for these employees who must endure them or else risk losing their job. At a mega-warehouse for Amazon located in Allentown, PA, for instance, the “pickers” who are responsible for retrieving product to be combined in outgoing orders have complained of the inhuman pace at which they must perform tasks, and well as the distances they must travel across the vast warehouse floor each day. Furthermore, the basic architecture does little to respond to climatic fluctuations or provide natural daylighting for comfortable working conditions. During summer months, many e-commerce distribution facilities around the U.S., reach unbearable temperatures, forcing some companies such as Amazon to post paramedics outside to treat overheated workers.²⁰

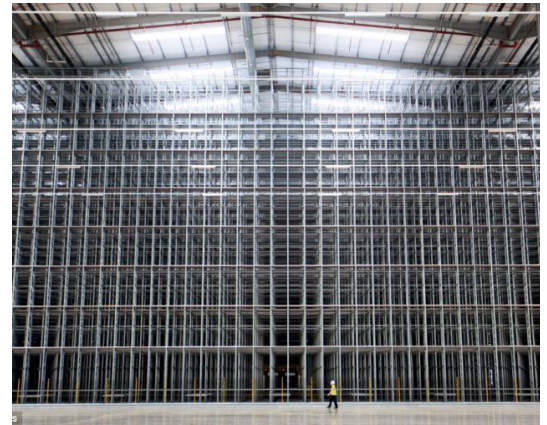


Figure 25. High Bay Mega-Distribution Facility in London (note scale of worker in foreground)



Figure 26. High traffic “picking” area in a distribution warehouse



CHAPTER 3

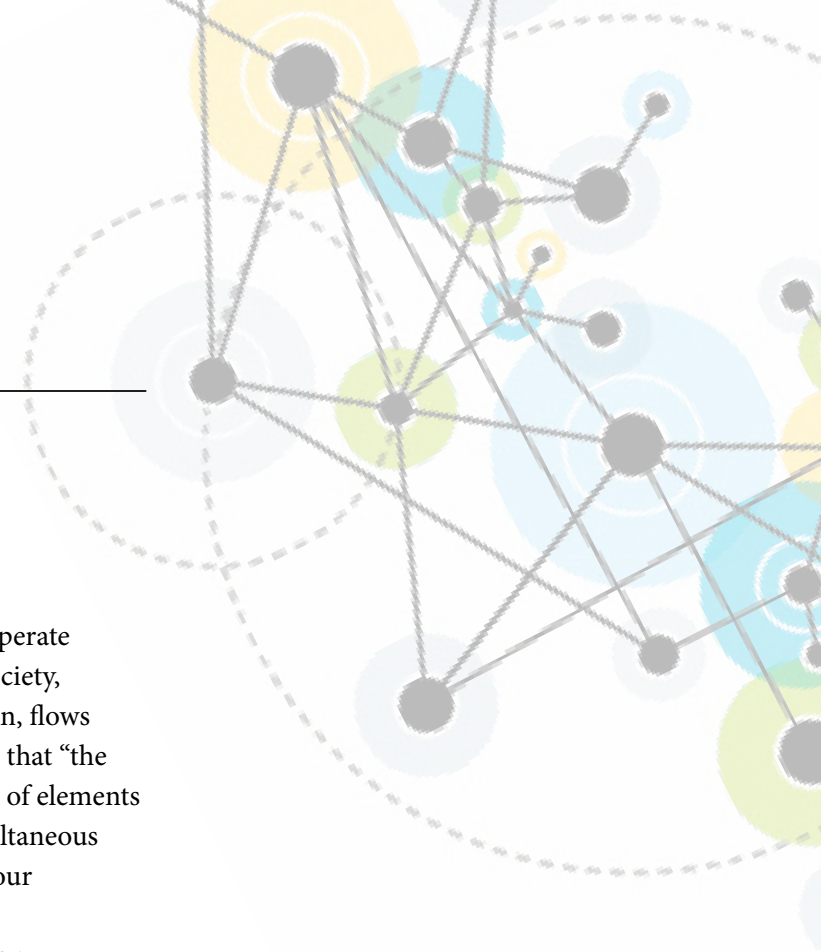
The Space of Flows and Sites of Friction

3.1 The Space of Flows: Infrastructure as Interface

The fluid intermodal networks for the distribution of consumer goods operate in what sociologist Manuel Castells describes as the “space of flows.” Modern society, Castells believes, is constructed around the “flows of capital, flows of information, flows of technology, and flows of organizational interactions.” Furthermore, he argues that “the material support of the dominant processes in our societies will be the ensemble of elements supporting such flows, and making materially possible their articulation in simultaneous time.”²¹ The space of flows, in short, becomes the representative spatial form of our networked society.

Extending Castells theory, Gilles Dalalex argues that the space of flows is a “spatialisation” of the economic, social, and cultural interactions that have penetrated all levels of modern society. These networks operating in the space of flows are based on a simultaneity of relationships and events in space and time, and do not need to be based on physical contiguity. Therefore the infrastructure supporting such networks develops in a manner that disregards any meaning of place or connection to specific geography. Furthermore, he says, the space of flows can be considered a “simultaneous process of concentration and dispersion across urban space.” The spatial implications of this process are the increasing fragmentation of cities, as they are less reliant on physical contiguity for communication, as well as the intensification of economic activity along the lines of communication and distribution movement.²²

The material residue of the space of flows is manifest in the generic infrastructure that exists only as a logistical solution to economic demands, resulting in liminal spaces





in the urban environment. As networks weave between the virtual space of the global economies and the actual space of cities, distinct spaces of tension materialize, taking the form of marginalized areas devoid of any distinct identity. The anthropologist Marc Auge designates such spaces as “Non-Places.” As opposed to the idea of place, Non-place, according to Auge, is “space which cannot be defined as relational, or historical, or concerned with identity.”²³ In discussing Auge’s concept of Non-place, Emer Obeirne explains such places, as a “place to be passed through or consumed, rather than appropriated.”²⁴ The nodes of distribution activity that exist in the urban landscape create this condition of non-place by actively separating the flow of goods and the flow of people in the name of efficiency.

Dalalex recognizes an obvious contradiction in Auge’s distinction between “Place and Non-Place” - that making such a distinction validates the existence of both types of spaces as actual physical places. Non-places like distribution clusters and transportation hubs, Dalalex argues, contain a complexity and tension that is created where the space of flows and “places” in the traditional sense intermingle and overlap. These in-between spaces provide an opportunity to recognize both the global and the local, revealed in juxtaposition and available for comparison. In this way, new meaning is generated allowing the non-places to begin to take on the qualities of a new dynamic sense of place.

In order to create this intersection between the space of flows and urban space, infrastructure must become a connector rather than a divider. Dalalex believes that infrastructure should thus act as an “interface,” taking shape between the “internal” space of cities and the “external” space of flows. The interface exists as a porous frontier that “must not be regarded as a limit to be transgressed, or an impermeable boundary separating the city from the outside, but as a zone of contact and encounter.” Such a space of encounter would not dictate but enable the fluid encounter between the space of flows and the space of the city. In this manner, the introduction of the third element of infrastructure as interface dissolves the boundaries between the space of the city and the space of global flows, uniting them into two faces of the same contorting surface.²⁵

3.2: Sites of Friction: Kinetic Potentiality

Author Craig Martin, in his discussion of the “distributive space” of the global networks of distribution, explains how material infrastructure not only supports the spatial flows have come to characterize modern society but actually works to *facilitate* these flows. In striving for the seamless movement of consumer commodities, a critical factor necessary



Figure 29. (Top) Loading Dock,
Tejon Ranch Industrial Park, CA

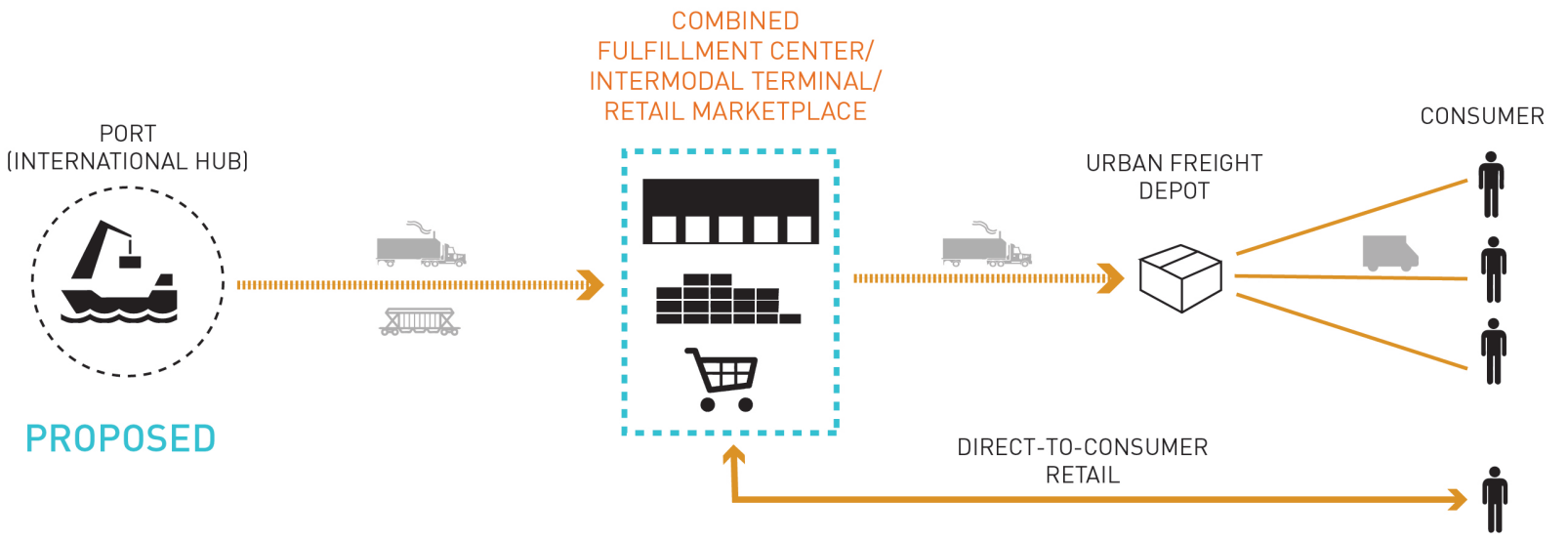
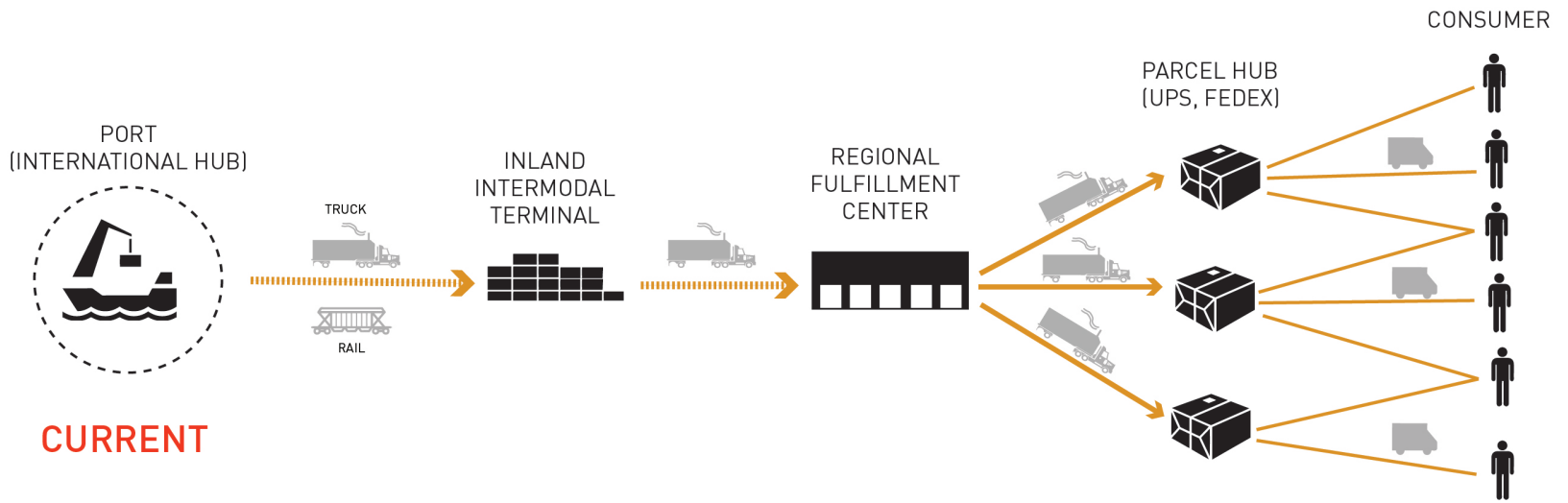
Figure 30. (Bottom) Load Bays,
Tejon Ranch Industrial Park, CA



for the facilitation of flow is the control of outward “disorder” through the “reduction of uncertainty.” Commercial logistics, Martin says, is the infrastructural layer that is dedicated to minimizing such disorder and uncertainty through the strategies of repetition, routinization, and concealment.²⁶

Martin identifies a seemingly contradictory aspect of logistics, which is the tension between the need for free, unimpeded movement of goods and the need to control and routinize such movement in order to maintain stability. These tensions manifest themselves at points of adjustment or switching within the networks, found in hubs of interconnection like ports, intermodal terminals, and e-commerce hubs. These “transfer” facilities can be conceived of as dynamic boundaries or seams that actively control and regulate flow. Material mechanisms deployed throughout these sites of adjustment allow controlled flow through the process of *interlocking*. Martin uses the example of the London Thamesport container terminal to illustrate how various spatial and material devices work to control the compatibility between various modes of transportation: these “devices” include monitored entrance gates, fixed road layouts, automated container stacking mechanisms, and gantry cranes.²⁷

Clare Lyster identifies those points of stoppage, adjustment, and interchange within otherwise fluid networks of exchange and distribution as “opportunistic” moments for the articulation of a new type of urban site.²⁸ In traditional networks of trade, she explains, the point of exchange in commercial operations, or the point of “handover” was concretized both formally and symbolically in urban space by the creation of the marketplace. However in contemporary networks of exchange, little emphasis is placed on the actual point of handover itself, as it is not aggregated in a specific geographic zone. Rather, the emphasis in the transactions of e-commerce is placed on the seamless distribution of goods that allows the exchange to occur unimpeded. As Craig Martin also points out, in such networks where success is gauged by mobility, moments of adjustment or friction along these routes are minimized.²⁹ Lyster believes it is precisely at these “weak” moments where the opportunity exists for design intervention and unique programmatic possibilities. Such moments also act as markers that identify and call attention to the system and that can be exploited to present new spatial opportunities. It is at these heightened moments within networks where multiple points of transfer have accumulated that new programs can be layered onto the existing infrastructure. This new layering of uses along seams of transfer exploits the pre-existing pattern of territorial accumulation already in place, and allows “eccentric and unintended” reactionary spaces to emerge.³⁰



CHAPTER 4

Design Proposal - A New Model for Urban Logistics

The logistical infrastructure of distribution that fractures the urban space of Los Angeles has the potential to be recalibrated to act as an “interface” or mediator that can bridge between the movement of goods and people, and the spaces of commerce and the city. This new infrastructure can continue to facilitate the flow of consumer goods while taking on a more visible and stable presence in the urban fabric. Through the revision of current spatial practices and the integration of new programmatic elements within this infrastructure, a new industrial typology emerges.

The proposal of a hybrid e-commerce fulfillment center, intermodal freight terminal, and “brick and mortar” retail center will serve as the spatial means for revising the current model of logistical infrastructure to become a catalyst for urban activity. The rise of e-commerce retailing as a major form of exchange has posed a significant challenge for retailers and distributors who wish to remain close to dense urban populations for rapid delivery but also need cheap land and access to transportation conduits. By siting a facility at a point of interchange close to the more dense urban areas of Los Angeles, and incorporating new retail functions, the needs of e-commerce networks can be met while also increasing connectivity with the surrounding context. Furthermore, by consolidating and relocating this infrastructure, significant environmental benefits can be realized through a reduction in the amount of shipping needed for product to reach end consumers. As this thesis also seeks to explore how architecture can make visible these normally hidden infrastructural networks, the architectural interface of the facility will be designed in such a way as to expose consumers to the complicated logistical processes that are increasingly virtualized in e-commerce retail networks.

Figure 31. Proposal for consolidated logistics hub

4.1 Goals and Objectives

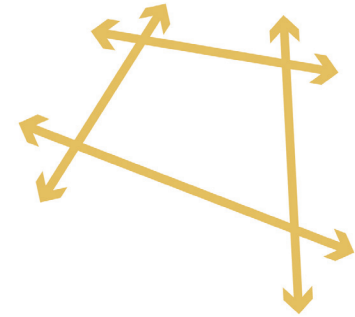
The design proposal for an e-commerce fulfillment center, intermodal freight terminal, and retail marketplace is generated from the overall goals for the thesis, which are to investigate how architecture, as infrastructure, can remain open to global distribution networks while creating new connections to the local space of the city, and to develop strategies for reconnecting urban consumers to the physical realities of product distribution. The specific objectives of the proposal are to increase urban connectivity, bring the point-of-exchange to the site of distribution, increase visibility into distribution processes, and finally to reduce the environmental impact of distribution operations.

A. Increase Urban Connectivity Where Logistics Activity is Based

At the site scale this proposal seeks to create new urban connections to communities in Los Angeles that are currently separated by the presence of logistics infrastructure. It also addresses the issue of how new distribution infrastructure, when located in urban contexts, can become a catalyst for new connections, thus shifting its nature from closed barrier to more porous boundary. A larger site response will involve creating new pedestrian pathways, as well as amplifying existing connections to adjacent communities. Extending public transportation infrastructure, such as light rail, to the site can generate more pedestrian traffic into a neglected part of the city, acting as a bridge between East and West Los Angeles. Furthermore, this thesis will investigate how distribution infrastructure can interact and integrate more wholistically with the landscape. At the building scale, the same principles of porosity and permeability can be employed in order to facilitate finer grain connections and interaction as people move through and across the facility. These principles operating at both the site and building scale will translate into a specific strategy for addressing overall building massing, circulation, and enclosure.

B. Bring Point-of-Exchange to Site of Distribution

With the sprawl of logistics activity to more remote locations outside of urban cores and with the rise of e-commerce as a competitive retail model, consumers are becoming further removed from the physical realities of goods distribution. Yet the need of e-commerce distribution facilities to be located closer to end customers provides a new opportunity to relocate such facilities into the “backyard” of urban consumers, opening the



Increase Urban
Connectivity

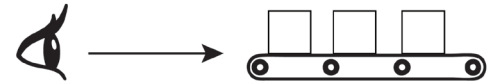


Bring Point-of-Exchange
to Site of Distribution

door to potential increased visibility and contact. By bringing the point-of-exchange to the site of distribution in the form of “brick-and-mortar retail”, a revival of a classic retail model is possible where infrastructure and commerce are fused together in a new articulation of public space.

C. Allow Visibility of Distribution Processes

As a result of the rift between consumers and distribution infrastructure brought about by changing retail models, and because of the inherent muteness in the architecture of modern distribution facilities, consumers are generally unaware of the overwhelming scale and dynamism of the operations that typically happen at these critical sites of transfer. By allowing visibility into these complex industrial systems which enable the flow of goods, a basic awareness of the magnitude of such systems could be instilled in consumers (perhaps causing a reflection on consumption habits in general). The design of the facility should therefore allow transparency into systems normally overlooked or hidden, and create new opportunities for public engagement with the infrastructure.



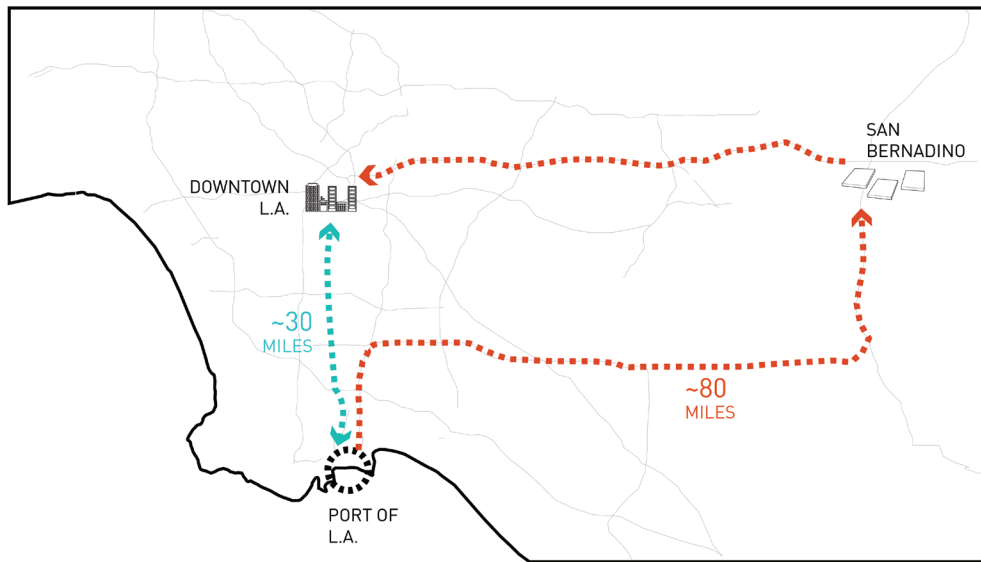
Allow Visibility of Processes

D. Reduce Environmental Impact of Distribution Operations

The current logistical infrastructure in Los Angeles has many negative environmental implications, primarily as a result of the extensive drayage (trucking) needed to convey goods between distribution hubs, retail centers and end customers. Furthermore, the clustering of huge distribution centers in low density configurations beyond the urban fringes wastes land, and increases the distance that regional goods (entering from the Port of L.A.) must be shipped overall to reach consumers in core urban areas of Los Angeles. The proposal seeks to consolidate several nodes of goods transfer into a single facility, thus eliminating unnecessary channels of shipping. Furthermore, the proposal looks to relocate infrastructure that is typically located in distant locations closer to urban populations, thus leading to a significant reduction in truck-related air pollution and strain on congested transportation networks. For instance, if a single Amazon fulfillment center (1,000,000 sf) located in San Bernadino County were relocated to downtown Los Angeles, over the course of a single year the overall amount of CO₂ emissions generated by freight moving to and from the facility could be reduced by approximately 3,000 metric tons, or 64% of current amounts (Figure 32)³¹.



Reduce Environmental Impact



TYPICAL AMAZON FULFILLMENT CENTER
(1,000,000 SF)

=



14,705 TRUCKLOADS/YEAR

CURRENT
REGIONAL MODEL



4,646 TONS/YEAR CO2 EMISSIONS

PROPOSED
REGIONAL MODEL



1,704 TONS/YEAR CO2 EMISSIONS

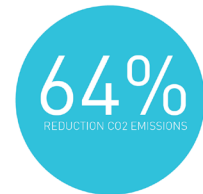


Figure 32. Estimated reduction in CO2 amounts for relocated fulfillment center
*based on data from “Inland Ports of Southern California –Warehouses, Distribution Centers, Intermodal Facilities - Impacts, Costs and Trends”

4.2 Program Development

The program for this new urban logistics proposal is divided into three primary components: A) E-commerce Fulfillment Center B) Intermodal Container Terminal, and C) “Brick-and-Mortar” Retail Marketplace

A. E-Commerce Fulfillment Center

The design of an e-commerce fulfillment center is the primary programmatic component for this proposal. This project proposal is specifically for a “hybrid” distribution facility that is presented as an alternative to sprawling warehouses which currently account for many regional e-commerce fulfillment centers. Given its location closer to dense urban communities and the higher cost of land (compared to outlying areas), the new facility must combine several scales of distribution activities. The proposed facility will consolidate layers of distribution infrastructure by acting as a fulfillment center, parcel hub, and parcel sortation center. Through this consolidation, economies in land usage are achieved, as well as shortening the overall distance that goods must travel along distribution networks. From the facility, goods purchased by online consumers will be shipped by truck to local urban freight depots, from which the final delivery to end customers will take place either by light rail or by electric truck. Smaller goods can be delivered directly from the facility to customers by GPS guided drones. The e-commerce fulfillment center will handle “break-bulk” freight, or freight that is broken down into less than a full container load. The program includes sortation space and storage of break-bulk freight, conveyor circulation, and administrative and office spaces for staff at the facility.

B. Intermodal Container Terminal

In order to achieve economies through the consolidation of shipping infrastructure, the scope of the proposal also calls for the incorporation of an intermodal container terminal as part of the facility. This added functionality will allow the design proposal to consider the mediation of flows of both goods and people at a larger scale, particularly important for examining the relationship between infrastructure and the landscape. The terminal will handle the transloading of standard 40’ containers between rail and truck modes, as well as the temporary storage of containers waiting to be loaded. Program for the

PROGRAM OVERVIEW



E-COMMERCE FULFILLMENT CENTER

PRODUCT

“Break-Bulk” Storage
Automated Sortation
Conveyor Movement Space
Shipping/Receiving



WORKERS

Office/Admin
Staff Facilities



INTERMODAL FREIGHT TERMINAL

Intermodal transloading
(Rail and Truck)
Container Storage
Control Office



RETAIL MARKETPLACE

BUY

Wholesale Market
Product Gallery
Consumer Interface



SOCIALIZE

Restaurant
Cafe
Courtyard



terminal will also include control offices for staff monitoring operations.

C. “Brick-and-Mortar” Retail

The third main programmatic component to be introduced in the design of the facility is a “brick-and-mortar” retail marketplace. One overall goal for this program is to bring more outside urban activity to a site normally reserved for distribution functions. The facility will serve as a means of “reconnecting” consumers to the points of physical exchange, which have been virtualized with the growth of e-commerce, as well as connecting them to the physical infrastructure of goods circulation. By interacting with the physical point of goods exchange, the opportunity for interpersonal interaction is also presented, as well as the potential for a new type of public space centered around commercial activity. Physical showrooms and marketplaces for e-commerce retailers are becoming increasingly common, as these retailers realize the desire of consumers to have a “tangible” shopping experience. For instance Bonobos, an online clothing brand, has opened physical storefronts at various sites in New York City, where customers can view and try the clothing items before purchasing online (Figure 34). Mega e-retailers, such as Amazon, have recently begun to experiment with “brick-and-mortar storefronts as well.³²

Two separate retail “environments” will be incorporated in this proposal that relate to the different types of distribution infrastructure in the facility. The first is a wholesale marketplace, where consumers can purchase bulk goods at cost directly from shipping containers that are temporarily stored at the facility and rotated on a daily basis. The second retail environment is a specialty “boutique” retail marketplace associated with the e-commerce fulfillment center. The spaces within this boutique marketplace will include virtual interfaces for product browsing and purchase, and a physical “gallery” for the display of goods. In-stock product purchased on-site can be picked up immediately at facility. Finally, as a way of increasing local connections while maintaining openness to global distribution networks, the facility will also handle the distribution of goods from a variety of retailers, including goods from local manufacturers in the L.A. area. This will help promote local manufacturing and heighten the visibility of local businesses.



Figure 34. Bonobos (online retailer) brick and mortar retail store

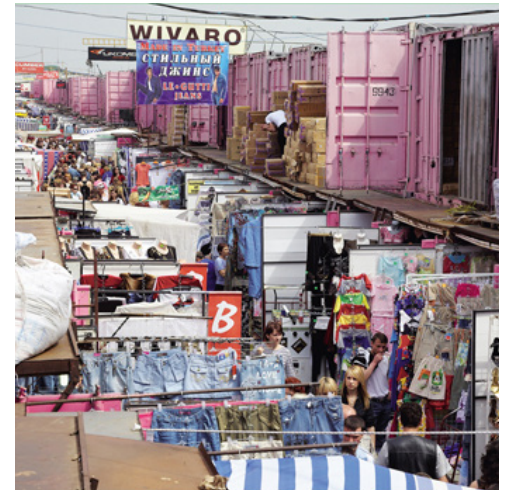


Figure 35. 7km wholesale container market, Odessa, Ukraine

DETAILED PROGRAM OF SPACES

A. E-Commerce Fulfillment Center **1,183,500 SF TOTAL**



GOODS	Storage	High Bay Storage (Break-Bulk)	850,000 SF	
		Sorting	Automated Sortation	220,000 SF
	Conveyor Movement Space		20,000 SF	
	Shipping/Receiving	Loading Bays (Incoming/Outgoing)	30,000 SF (30 x 1000 SF)	
		Pallet Storage	15,000 SF	
		Circulation (20%)	6,000 SF	
		Truck/Trailer Parking	17,000 SF	
				<hr/>
				1,158,000 SF TOTAL
	STAFF	Control	Control Offices/Admin	9,000 SF
Front Office/Entrance			2,000 SF	
Restrooms			1,000 SF (500 SF x 2)	
Rest		Kitchen/Canteen	2,000 SF	
		Restrooms	1,000 SF (500 SF x 2)	
		Locker Rooms	2,000 SF	
Move		Employee Parking	8,000 SF	
			<hr/>	
			25,500 SF TOTAL	

B. Intermodal Container Terminal **276,000 SF TOTAL**



CONTAINERS	Intermodal Transloading (Rail/Truck)	14,000 SF
	Container Storage	260,000 SF
STAFF	Intermodal Control Office	2,000 SF
		<hr/>
		276,000 SF TOTAL

C. Retail Marketplace

118,000 SF TOTAL



CONSUMERS	Buy	Wholesale Container Marketplace	30,000 SF
		On-Demand Purchase Interfaces	7,000 SF
		Boutique Product Gallery	17,000 SF
		Automated Product Pickup	5,000 SF
		Circulation (20%)	11,000 SF
		70,000 SF TOTAL	
	Socialize	Cafe	4,000 SF
		Restaurant	3,000 SF
		Restrooms	2,000 SF (500 SF x 4)
		Courtyard	6,000 SF
		Roof Terraces	25,000 SF
		<hr/>	
		40,000 SF TOTAL	
	Move	Customer Parking	8,000 SF TOTAL

4.3 Site Selection

Study Area Criteria

The site for this proposed design investigation is thus determined as a connective element between the larger distribution networks and the local urban fabric. The project will be located in an existing node of distribution that is currently in close proximity to the urban core, based on the need for e-commerce retailers to be located closer to more dense urban populations for faster delivery of product. In order to address issues of urban connectivity, this site should be visibly disconnected from the surrounding urban fabric. To address issues related to the control of freight flow in urban environments, the project will be located adjacent to major transportation conduits that convey cargo.

Study Site – The “Piggyback Yard”

Located northeast of downtown Los Angeles, the “Piggyback Yard” is an important hub for freight distribution for region (Figure 36). The 130-acre study site contains an active intermodal rail hub owned by Union Pacific railroad, which currently handles both regional and domestic freight. Its current character is that of an infrastructural island, severed from the adjacent communities and downtown by major highways, and rail lines, all which form impenetrable borders (Figure 37). This “through-put” site is highly representative of an urban “non-place” as described by Auge and Dalalex, representing an in-between condition created by the flows of cargo and existing apart from the space of the city.

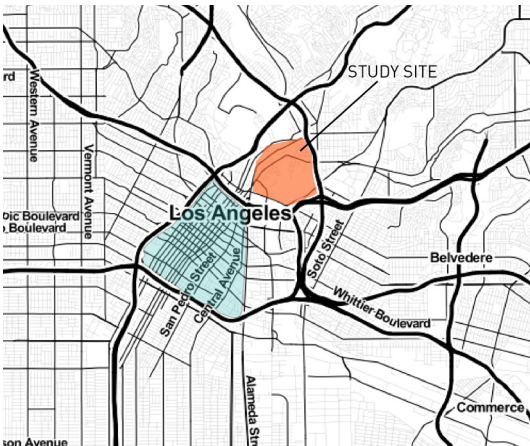


Figure 36. Location of study area in Greater Los Angeles Region

Figure 37. (Opposite) The study site - an infrastructural island

10 FREEWAY

PIGGYBACK YARD
(STUDY AREA)

L.A RIVER

UPS FACILITY

I-5 FREEWAY

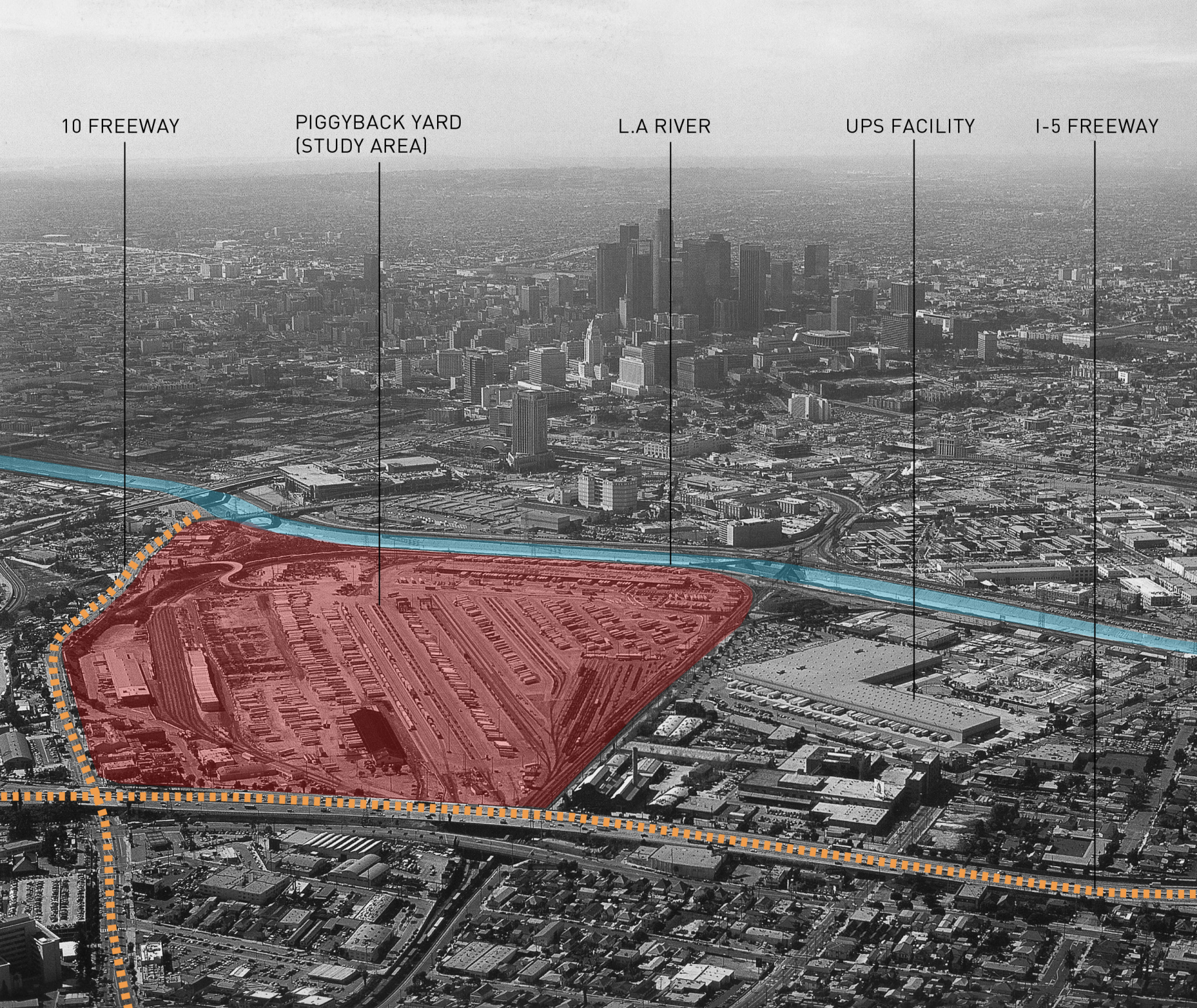
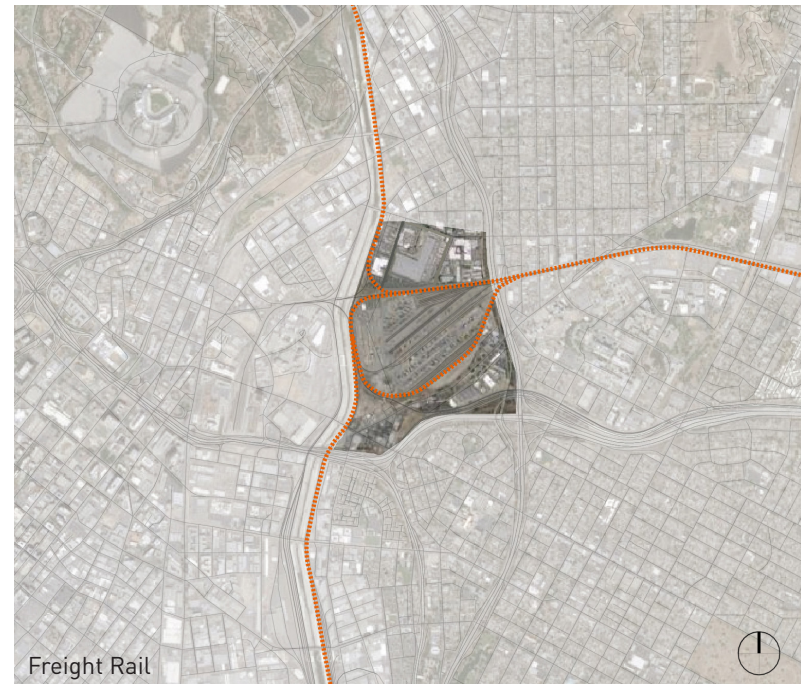






Figure 38. The Piggyback Yard, aerial view from south



Site Analysis - Flows

The Piggyback Yard is a complex site of interchange in the city that intersects with regional, local and global flows of goods. Bounded by the L.A. River to the west and the I-5 freeway to the east, the site is distinctly shaped by the numerous conduits of movement for freight, people, and water. This web of flows that converges on the urban space in the form of rail lines, freeways, and river, demarcates the boundaries of the site and simultaneously fractures the continuity of the urban fabric (Figure 39, opposite).

Historically, the site has maintained a connection to rail lines that provide national and regional freight connections. Originally owned by the Southern Pacific railroad, the site in the early 20th century was the location of a “shop” for the repair and construction of railway cars. As railroad machinery switched from steam engine to diesel in the 1930s, these shops became obsolete. With the subsequent rise of the freeway system and drayage (trucking) as a new mode of freight transport, the yard became a freight-forwarding, or “piggyback” site. Currently the yard interfaces with two active freight rail lines. Those on the north side belong to Union Pacific’s “Yuma Route,” which is both a major freight line that connects westbound train traffic to the Ports of Los Angeles and San Pedro, as well as the Union Pacific’s East L.A. intermodal terminal. The tracks on the western edge of the site, also owned by UP, are called the “east bank” tracks and form a connection between the ports and cities to the north such as Bakersfield, Sacramento, and San Jose. Rail lines serving passengers are also present at the site, creating a complex overlap of both passenger and freight traffic – the tracks at the north end, for example, handle freight but also Amtrak trains. The rail tracks at the south end of the site, owned by Metrolink, are devoted nearly completely to passenger traffic. Recent developments in passenger rail transit in L.A. could potentially increase flows of passenger traffic across the Piggyback Yard. Another major passenger rail development is a proposed high-speed rail network originating at Union Station (just west of the Los Angeles River).

Highway and road infrastructure also significantly impact the Piggyback Yard, with I-5 bordering on the east side and Highway 101 on the south. Several primary arterial streets also pass near the site, connecting to points beyond: Mission Road at the south edge connects to the adjacent urban communities of Lincoln Heights and Boyle Heights, on the east side of I-5, and connects to Caesar Chavez Ave at the southeast end.

Finally, the Los Angeles River is another key conduit that borders the Piggyback Yard (Figures 40, 41). The river has played a critical role in the industrial growth of Los Angeles, as transportation lines have typically followed the low-lying tract of land that it

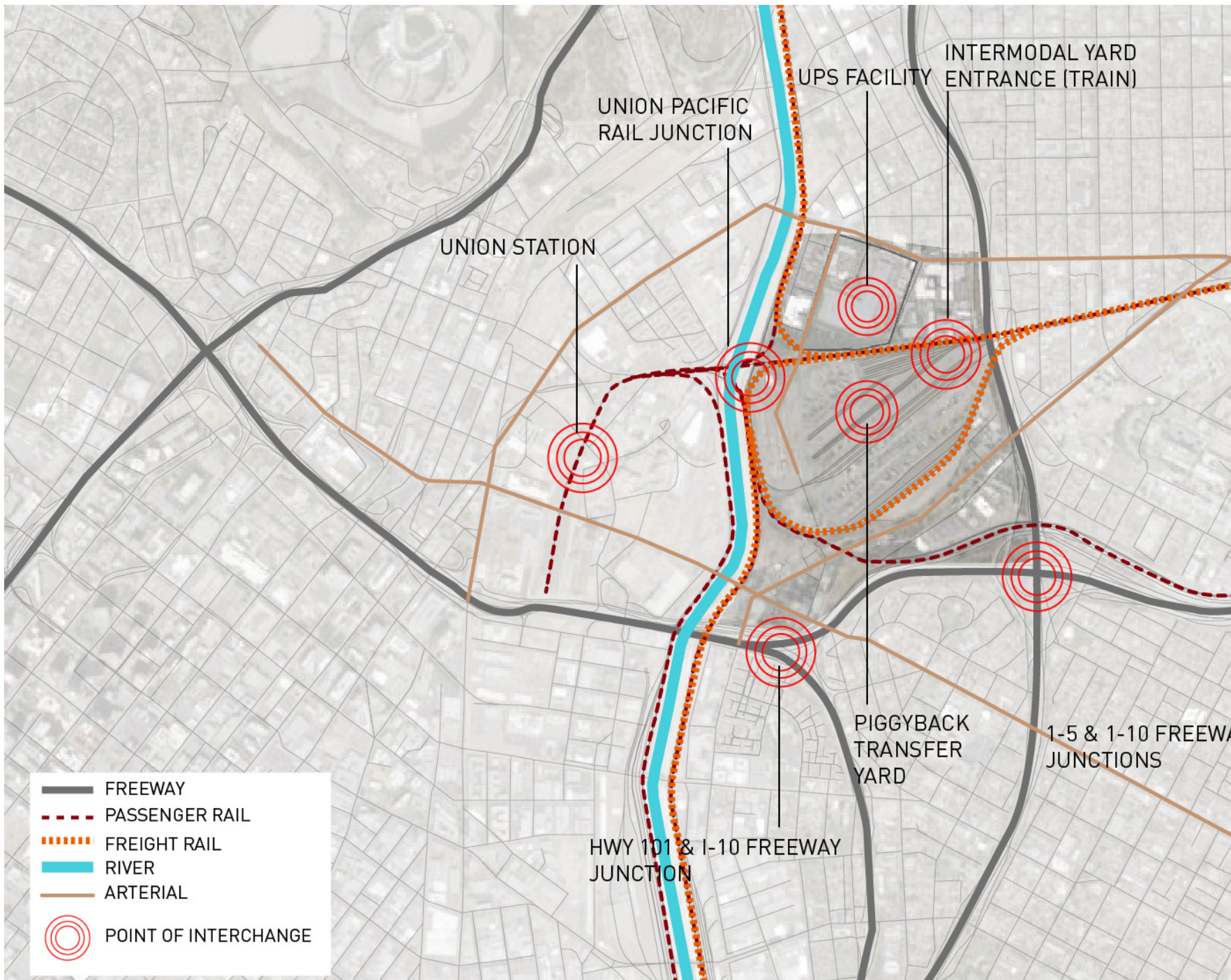


Figure 40. View of L.A. River



Figure 41. Aerial view of the L.A. River running through industrial area south of downtown

Figure 39. (Opposite) The study area contains multiple layers of infrastructural flow which demarcate the site and separate it from the surrounding context





carves through the city. However the mute concrete channel that currently funnels the river through the city is similar in nature to the conduits for cargo transit, in that it becomes a physical barrier to larger urban connections.³⁴ This suggests possibilities for a site response to engage with the river as a means of re-stitching the urban fabric at these points of interchange.

Site Analysis - Nodes

Mediating the infrastructural flows of goods and people across the study site and in the nearby vicinity are several key points of interchange, or nodes (Figure 42). In some cases, these nodes are completely contained within a single mode of transit, but in others, they facilitate multi-modal switching. Important nodes include the regional UPS distribution center to the north, which handles regional parcel distribution. Within the vast intermodal freight terminal, there are several “sub-nodes” which dictate the flow of freight through the site. These are: the primary truck gateway (located at the northwest corner off Lamar St., which handles all inbound and outbound road traffic; the main train entrance to the yard, just west of the I-5 bridge; and the actual transfer yard which handles multimodal switching between truck and rail, located in the center. An important node located nearby for passenger transit is Union Station (where many trains passing through the piggyback yard originate), located on the west side of the river. Finally, there are several key highway and interstate junctions bordering the site, which are critical interchanges for traffic flow in the region.

Conceptual Master Plan for the Piggyback Yard

In 2010, four architecture and landscape architecture firms - Michael Maltzan, Mia Lehrer + Associates, Perkins + Will, and Chee Salette Architecture Office - were commissioned by the non-profit group Friends of the Los Angeles River (F.O.L.A.R.) to create a conceptual master plan for the Piggyback Yard site, as part of a larger project of revitalizing and restoring major portions of the Los Angeles River corridor. This master plan, which assumes the removal of the rail lines currently owned by Union Pacific, outlines a comprehensive vision for the site by proposing major changes to the river basin along with new urban development (Figure 44).

Figure 42. Major nodes and sites of interchange in and around study area

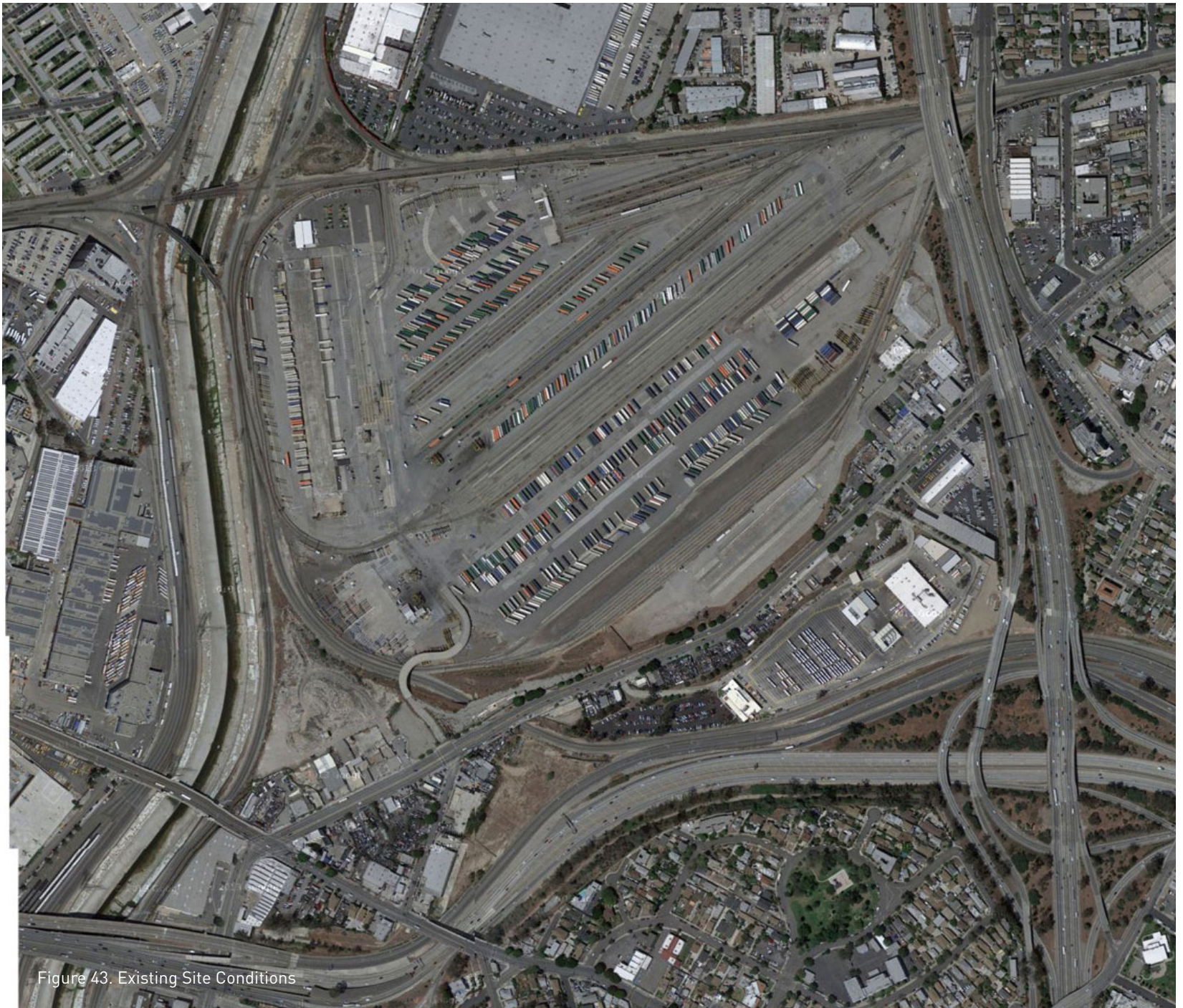


Figure 43. Existing Site Conditions

1. TRANSIT DISTRICT
2. BROADENED L.A. RIVER
3. ARTS CAMPUS
4. MIXED USE CORRIDOR
5. "CLEANTECH" INDUSTRIAL
6. URBAN PARK

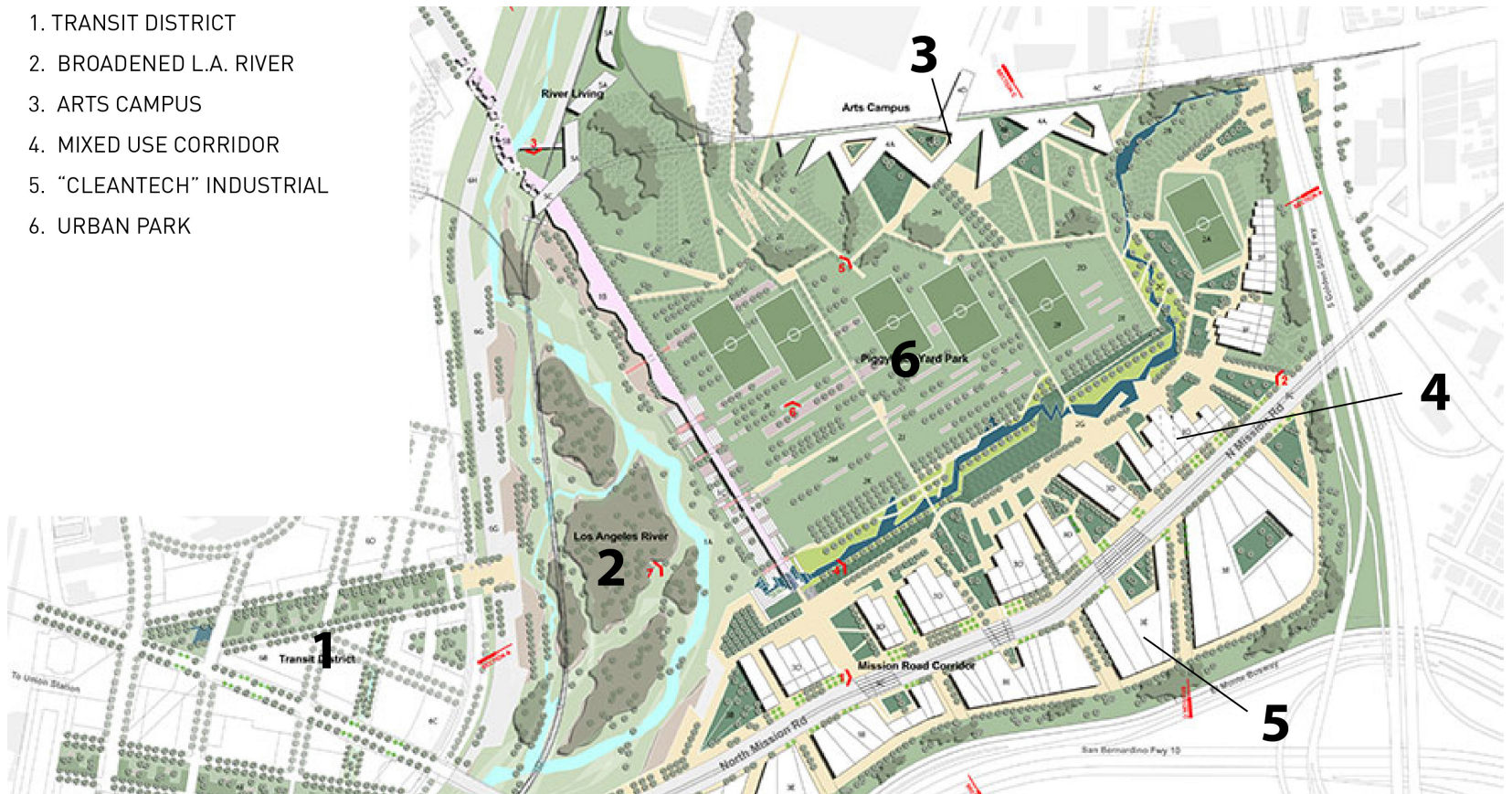


Figure 44. 2010 Master Plan Proposal for Piggyback Yard Site (Michael Maltzan, Mia Lehrer + Associates, Perkins + Will, and Chee Salette Architecture Office)

A critical component of this proposal is the broadening of the L.A. river, replacing the narrow concrete channel that currently exists with a widened riverbed, allowing the restoration of a riparian habitat. New opportunities for storage of floodwater during times of peak flow are also included in this strategy. In this master plan, the restored river habitat is the centerpiece of a larger, 130-acre urban park rising from the level of the river at the west to connect to new development on the eastern edge of the site. Replacing the existing intermodal rail infrastructure, the park proposed by the architects includes various sports amenities, walking and biking paths, and a large botanical garden³⁷.

The conceptual master plan by the architects also addresses future urban development and densification in several ways. By proposing a new mixed-use corridor along Mission Road at the south edge of the site, and an extension of the Metro Gold Line Light Rail along this corridor, a critical urban connection could be made linking communities in East L.A. to a revitalized Downtown “transit district” (focused around



ALHAMBRA AVE

I-5

MISSION RD.

SAN BERNADINO FWY

CAESAR CHAVEZ AVE

SITE PLAN



- BREWERY ARTS DISTRICT
- ARTS CAMPUS
- DISTRIBUTION INFRASTRUCTURE
- "CLEANTECH" INDUSTRIAL INCUBATORS
- MISSION ROAD MIXED USE CORRIDOR
- GOLD LINE LIGHT RAIL EXTENSION



Union Station). This mixed-use corridor includes housing which borders the new riverfront park, as well as “cleantech” industrial facilities (incubator spaces and light manufacturing) along the southern edge of Mission Road, as part of a larger initiative in Los Angeles to bring new industrial activity to the downtown core. Finally, the conceptual plan includes the addition of new cultural and educational facilities around the site, in particular an arts campus connecting across rail lines to the existing Brewery arts district at the north.

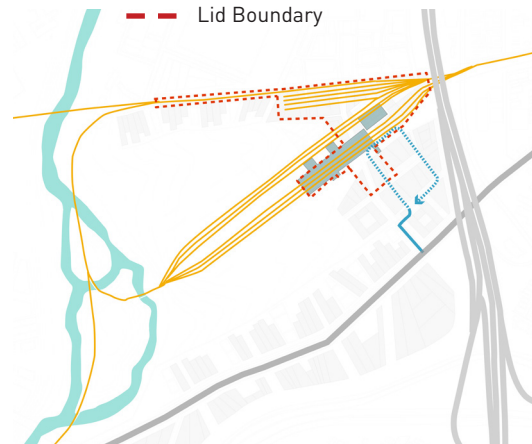
4.4 Site Response

The project proposal outlined in this thesis for a consolidated e-commerce fulfillment center, intermodal freight terminal, and retail marketplace builds upon many components of the 2010 conceptual master plan, yet departs from this plan in several key ways to develop a unique site response. As this thesis argues for a new synthesis between freight infrastructure, landscape, and urban space, a critique is put forth of the decision in the original master plan to remove (or relocate) nearly all rail lines devoted to freight activity that currently exist on the site. Instead, by retaining the majority of this infrastructure and expanding the scope of urban development originally proposed, an alternative site response is generated for this project which works to fuse the elements mentioned above in a more cohesive manner.

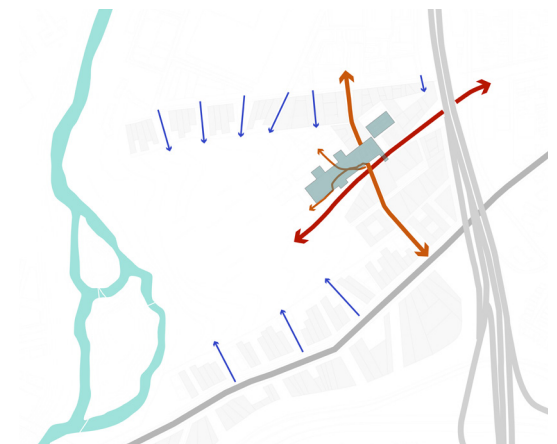
In their original 2010 proposal for the site, the architects assumed a scenario where the entire intermodal yard- currently owned by U.P. - would be sold to the city, and freight operations transferred to facilities elsewhere in the region. Recognizing the importance



Stormwater



Freight Infrastructure



Pedestrian Connectivity

of this yard to regional freight operations, and the problems associated with moving this intermodal activity to another community, a alternative solution is offered. In the proposal for this project, nearly all rail lines devoted to intermodal activity are kept on the site, which include several lines used for intermodal switching, and several more to the north used for temporary storage of rail cars. This new proposal follows the original plan in keeping the majority of passenger rail lines that border the site intact.

Aside from this major difference in site strategies concerning freight rail, the site proposal for this thesis follows many core ideas of the 2010 master plan, such as the broadening of the L.A. River, the addition of a mixed-use corridor with “cleantech” industrial facilities along Mission Road, and the establishment of an arts campus to the north. However, these components of the original plan are expanded in this new proposal to create more dense urban growth on the site. Mixed-use development, for instance, is expanded along the northern edge of the site. Likewise, the arts campus in the original plan is revised and expanded to included other institutional uses and occupy more of the site. Finally, more “cleantech” industrial facilities are added to the interior of the site, and along I-5. This alternative site response generates a more dense urban context which the new distribution infrastructure (that is the primary focus of the design investigation) can respond to. This infrastructure is situated in between the expanded arts campus to the north and industrial incubator spaces to the south.

Although the new site proposal retains the rail infrastructure, this does not preclude the creation of a new urban park space on the site. Instead, a unique type of park space considered, where a temporal overlap of both rail activity and community activity is possible. The basis for this unconventional urban landscape is grounded in data that details the movement of trains in and out of the intermodal yard at present. A closer look at these timetables show that cargo trains passing through the yard to and from various locations in the U.S. only stop in the yard for several hours at a time, almost always at night or in the early morning (when container transloading takes place). During the remaining hours of the day, no trains stop in the yard; it is reserved for truck traffic and static container storage. Assuming a solution is proposed for truck movement and container storage (which this design offers), it is therefore possible to envision other public activities occurring at the rail grade during daytime hours.

The park landscape that extends upland from the expanded riverbed is graded along the north and south sides of the site to allow a gradual slope down to the broadened riverbed from the height of the new lid level covering the rail tracks. This landscape would remain flat at rail grade (+25') in the center of the site. The gradual slope establishes a larger



- ILBOA (FROM PORT OF L.A. TO CITY OF INDUSTRY)
- MWCCI (WEST COLTON TO CITY OF INDUSTRY)
- ZLAMN (L.A. TO MARION, AZ.)
- ZLAMQ (SAN BERNADINO TO DALLAS, TX.)
- ZLCAI (L.A. TO ATLANTA, GA)
- ZLCAT (L.A. TO NEW ORLEANS, L.A.)
- ZLCBR (L.A. TO SEATTLE, WA)
- ZLCLT (L.A. TO LATHROP, CA)
- ZTLA (L.A. TO ATLANTA, GA)

FREIGHT LINES AND DESTINATIONS

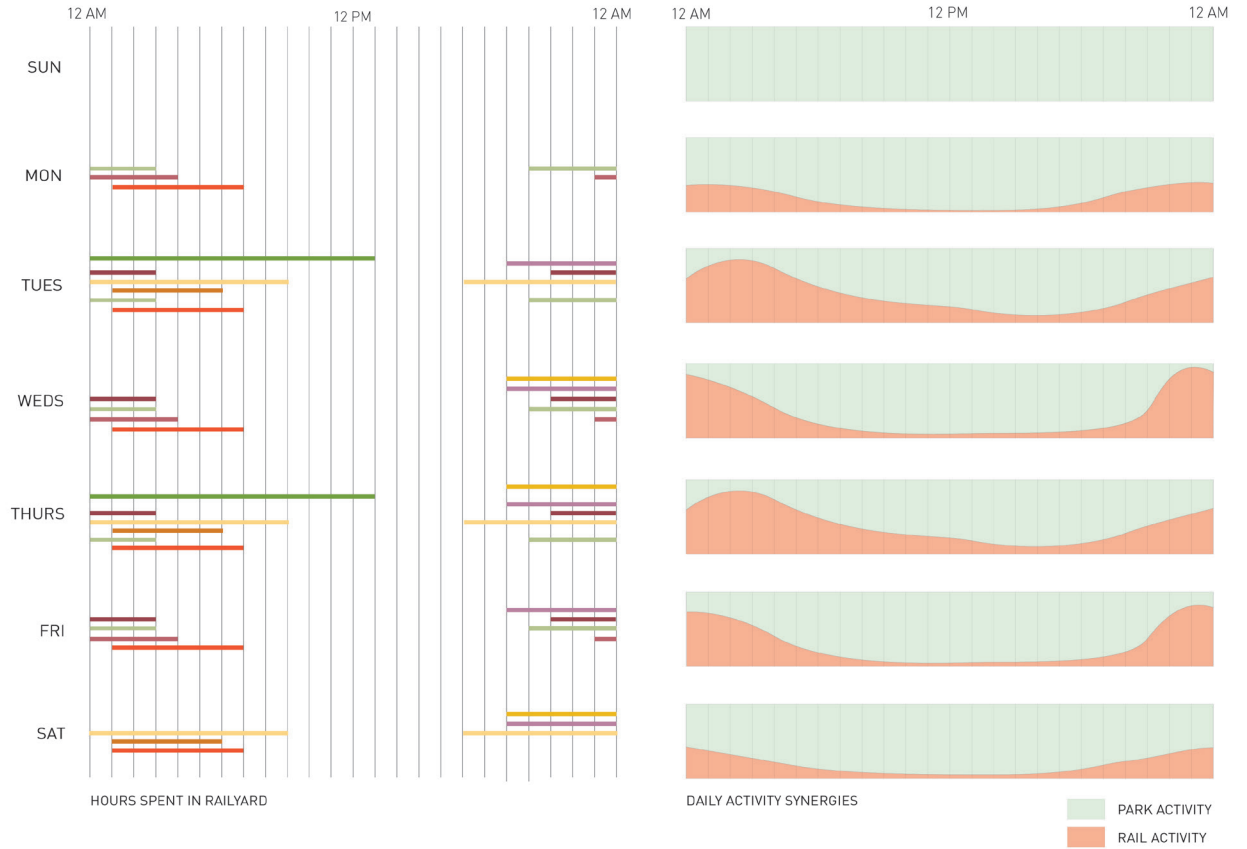


Figure 47. Rail timetables for current intermodal activity on the site. This data indicates a potential flexibility between intermodal rail activity and public activity in the landscape. *Data gathered from information posted on <http://www.westcoastrailforums.com>

strategy for stormwater management on the site. Water is collected separately from the development along the north and south edges, and filtered along two streams to eventually drain into the broadened river. Stormwater could also be retained in underground basins along these streams.

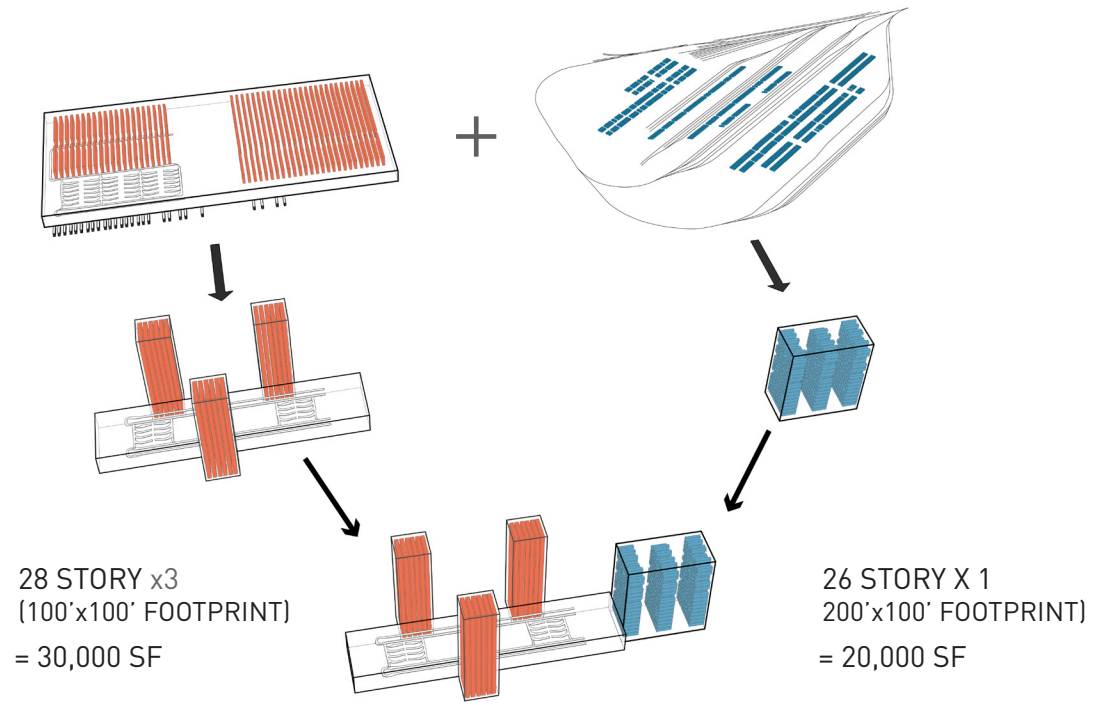
The site response for this project develops two important pedestrian connections across the Piggyback Yard site. The first connection runs north-south between the arts district at the north and the mixed use corridor along mission road, creating an urban pathway situated at the new lid level above the rail lines. A second pedestrian pathway forms an axial connection running roughly perpendicular to the first, from Alhambra Street at the northeast down through the constructed park landscape to the broadened river. Both of these new pedestrian paths will intersect at the new distribution infrastructure. Finally,



1,400,000 SF AMAZON
FULFILLMENT CENTER =
850,000 SF STORAGE



EXISTING INTERMODAL
CONTAINER TERMINAL =
~800 CONTAINER CAPACITY
(256,000 SF)



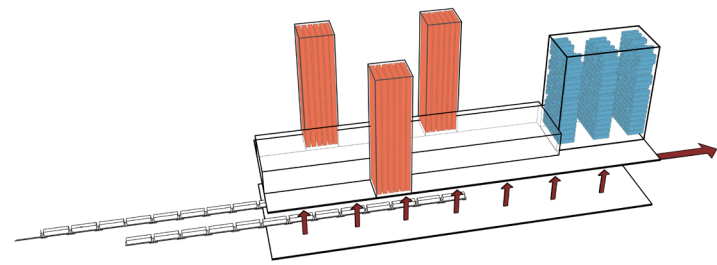
1. VERTICAL CONSOLIDATION

the site response allows for porous connections into the park through voids in the mixed use development along the perimeter.

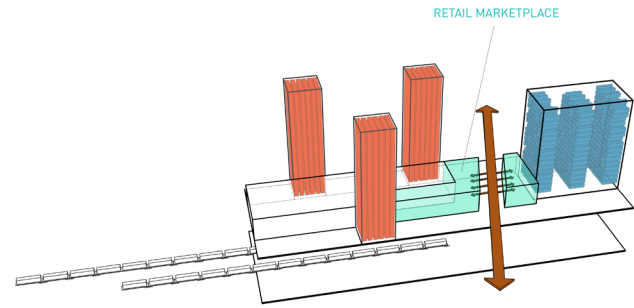
Figure 48. Diagrams of Design concepts

4.5 Building Design Concepts

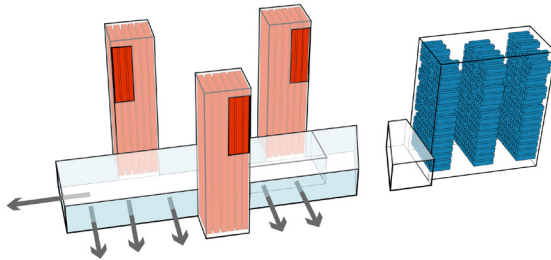
The design response for the new distribution infrastructure is based on several core concepts generated from the larger goals of this thesis. The first of these primary design concepts is the vertical consolidation of storage volumes found in both the e-commerce fulfillment center and intermodal container terminal. Taking a closer look at modern examples of both of these types of facilities reveals drastic spatial inefficiencies in storage practices. In the case of e-commerce fulfillment centers, the sprawling buildings often cover a footprint of over 1,000,000 sf, and rarely rise above a height of 40'. In a 1,400,000 sf Amazon warehouse, for instance, roughly 850,000 sf would be devoted solely to low-slung storage of consumer goods, with the remainder allocated to product movement space and administrative spaces.



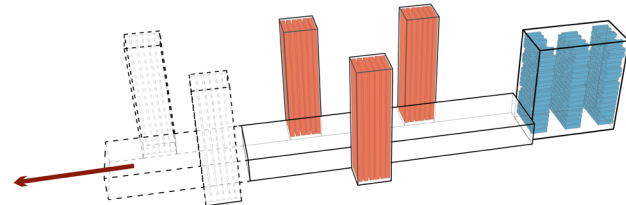
2. VERTICAL SEPARATION



3. PERMEABILITY



4. TRANSPARENCY/VISIBILITY

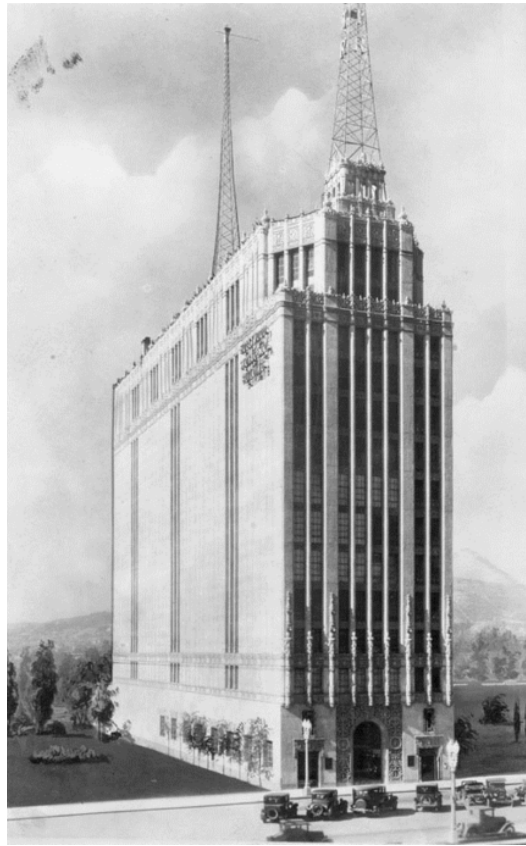


5. FLEXIBILITY/EXPANSION

As e-commerce fulfillment centers have begun to employ more complex automated equipment for handling product, however, much taller “high bay” shelving systems are able to be utilized, allowing the vertical consolidation of product storage. By stacking the total amount of storage found in a 1.4 million sf Amazon warehouse into three 28 story towers at 100' x 100', the storage footprint is reduced by approximately 95%, to 30,000 sf in this design proposal.

Inefficient storage practices are similarly evident within intermodal freight terminals, where the majority of space is utilized for temporary storage of containers awaiting transloading to either rail or truck. In the Piggyback Yard, which has a daily capacity of approximately 800 containers, stored containers are loosely organized, sprawling haphazardly over the paved 130-acre site. A new vertical storage system for this cargo, proposed in this design, reduces the 256,000 sf currently utilized for container storage to a single 26 story volume with a 20,000 sf footprint.

This vertical consolidation of storage is a return to an earlier warehouse typology,



which has an historic precedent in Los Angeles. During the 1920's and 30's, as L.A. was experiencing a massive influx of new residents from other parts of the country, the Bekins moving company built several large concrete warehouses around the city for storage of personal goods. At 11 stories, some of these muscular concrete warehouses were the tallest built structures in the city at the time. Many are still in use today, serving as enduring landmarks in the urban environment (Figures 49-52)³⁸.

Several other key concepts inform the overall design of the infrastructure. First, a vertical separation of intermodal distribution program and public program is achieved by utilizing a lid strategy, allowing a new plane of public activity to emerge. Second, as permeability is critical to achieving the overall goal of increased urban connectivity, the infrastructure is "pierced" at this lid level by retail program, allowing pedestrian movement to penetrate through the distribution program. Third, the possibility of future expansion of e-commerce distribution operations is considered in the overall design by allowing sortation and storage components to grow horizontally along the existing rail lines. Fourth, as a major

(Clockwise, from left)

Figure 49. Hollywood Storage Warehouse, 1929

Figure 50. Hollywood Storage Warehouse, 1930

Figure 51. American Storage Warehouse, Beverly and Wilshire 1928

Figure 52. Bekins Storage Warehouse, 1930

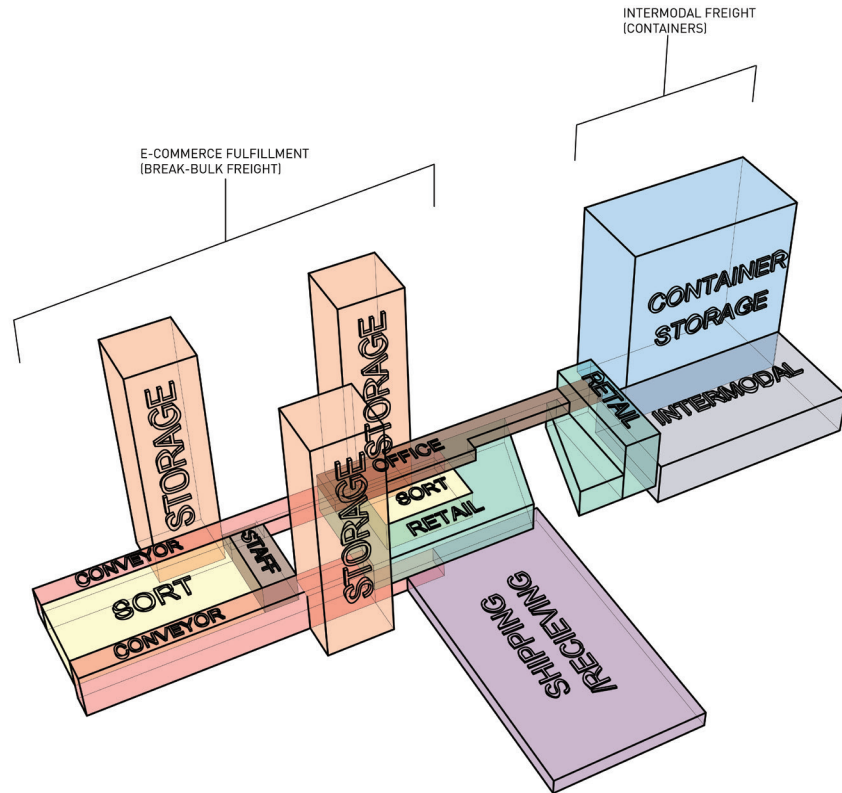


Figure 53. Program Relationships

goal of this thesis is to allow increased visibility into dynamic distribution activity, building enclosures (particularly in high-activity sortation spaces) will have a high degree of visual transparency. Finally, the relative speed of product flows through this new infrastructure is expressed through the massing of the facility, with goods moving faster through horizontal volumes (conveyor spaces), and more slowly through staggered vertical volumes (high-bay storage towers).

4.6 Building Organization and Flows

The programmatic organization of the building follows logically from these initial design concepts, with the general building massing responding to flows of goods and people across the site (Figure 53). Intermodal program (including transloading and container storage) is combined on the east side of the facility. Program related to e-commerce fulfillment (“break-bulk” freight storage, automated sortation, and conveyor movement space) is



Figure 54. Aerial view of site, looking north

combined on the west side of the facility. Both container freight and “break-bulk” freight enters the facility at ground level. Above, at the lid level, these two general categories of freight program are separated by the retail program, which responds to the new pedestrian pathway running from north to south. Office and administrative space related to both the e-commerce fulfillment center and intermodal container terminal is located at the roof level.

As this project seeks to generate a dynamic overlap between flows of people and flows of product within this new infrastructure, careful consideration was given to how these flows intersect at both the site and the building scale. The conceptual diagrams below map the flows of break-bulk freight and container freight as they move through the infrastructure, as well as pedestrian movement through retail spaces and exterior public spaces. Overlaying these two diagrams identifies these key points of intersection and overlap.

The overall massing of the building reflects an architectural language that is derived from these underlying flows of freight and people. This language is expressed through an interplay between longer, horizontal surfaces (spaces of movement and transfer) and stacked vertical mass (spaces for storage and collection).

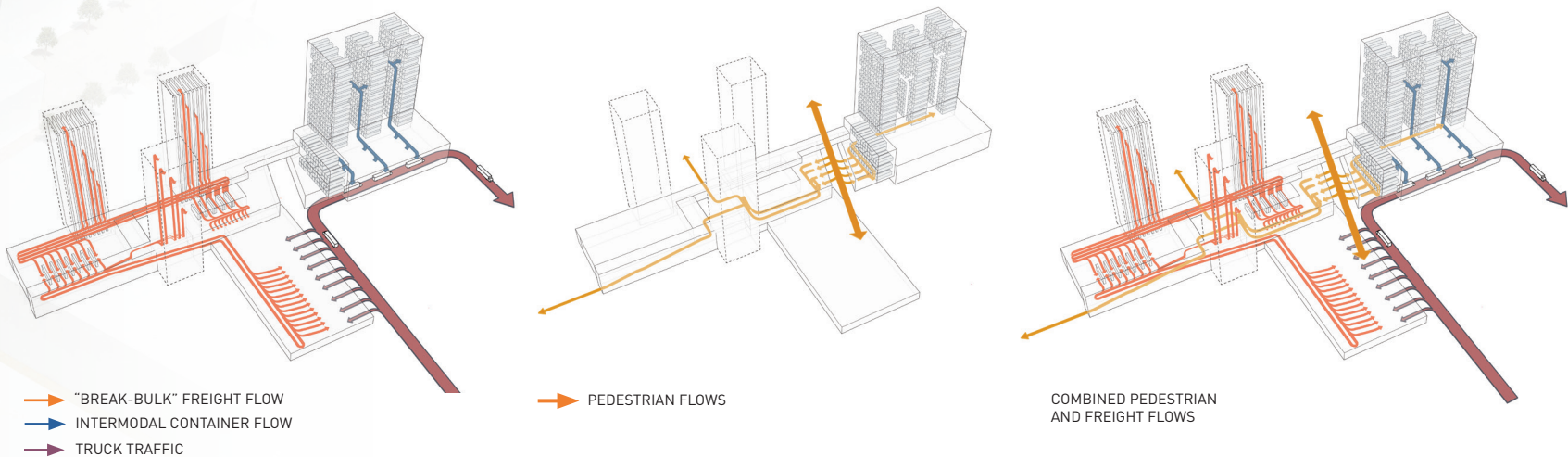




Figure 56. Aerial view of site (looking south)

BROADENED L.A. RIVER

RESTORED RIPARIAN HABITAT

ELEVATED RAIL TRACKS

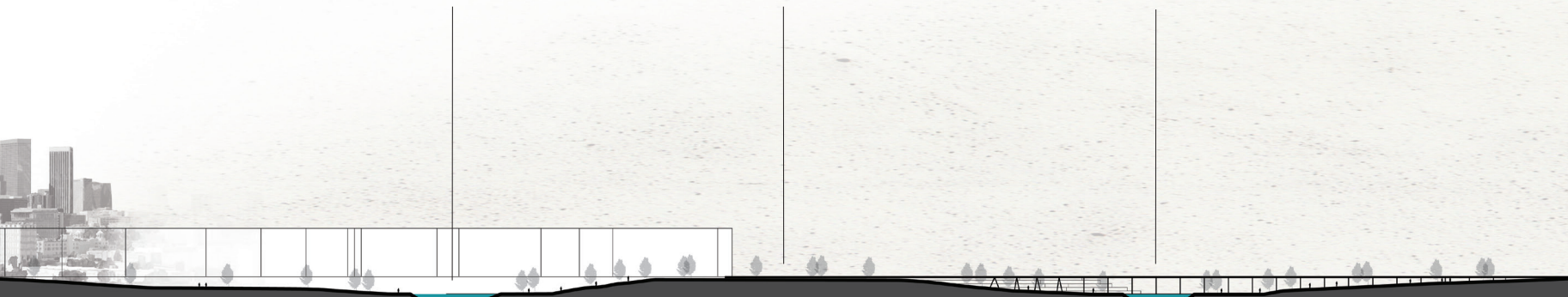




Figure 57. View of pedestrian pathway connection the arts district to the Mission Rd. mixed-use corridor (looking south). The Arts campus buildings flank this pedestrian path, with the office level of the distribution facility bridging overhead. Mixed-use towers are visible beyond, to the south.



Figure 58. View of park pathway, looking west. This pedestrian path, connecting the broadened river landscape to the communities east of the site, passes along industrial incubator buildings and compresses at the intersection of the distribution facility. High-bay storage towers act as waypoints along this path.



PARK AT ACTIVE RAIL GRADE

DISTRIBUTION INFRASTRUCTURE

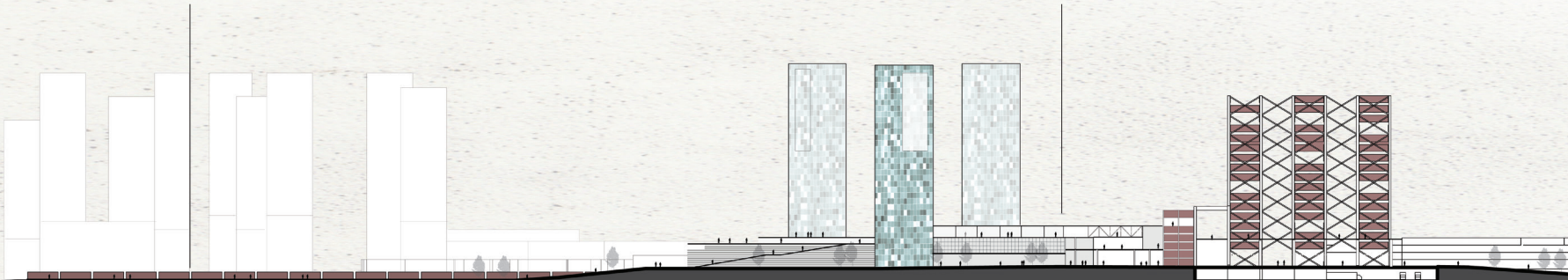
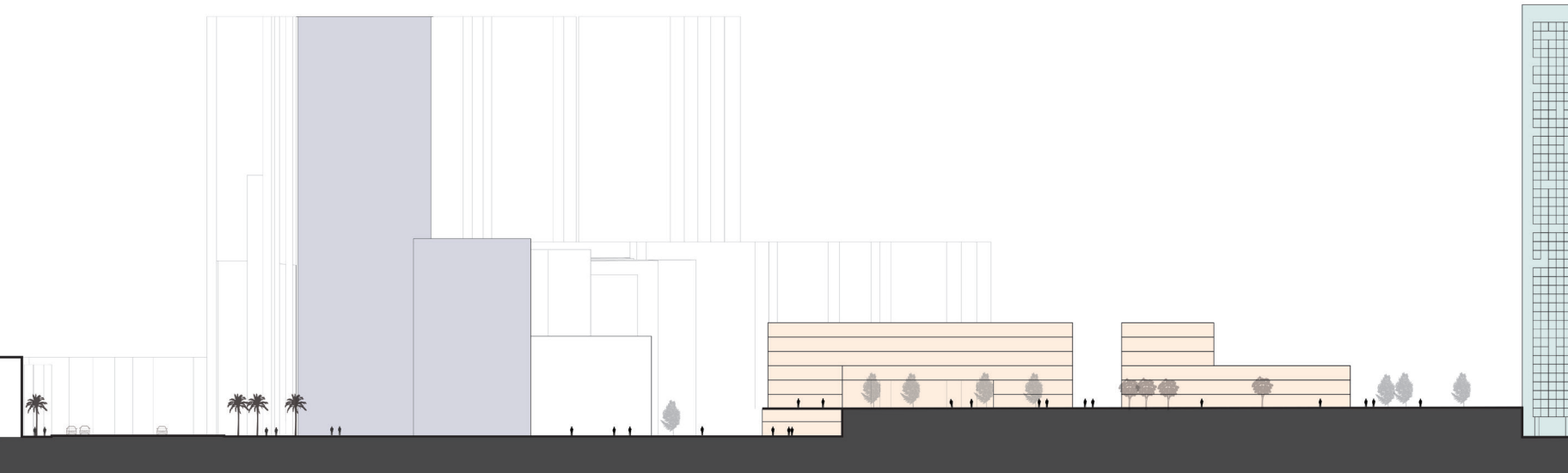
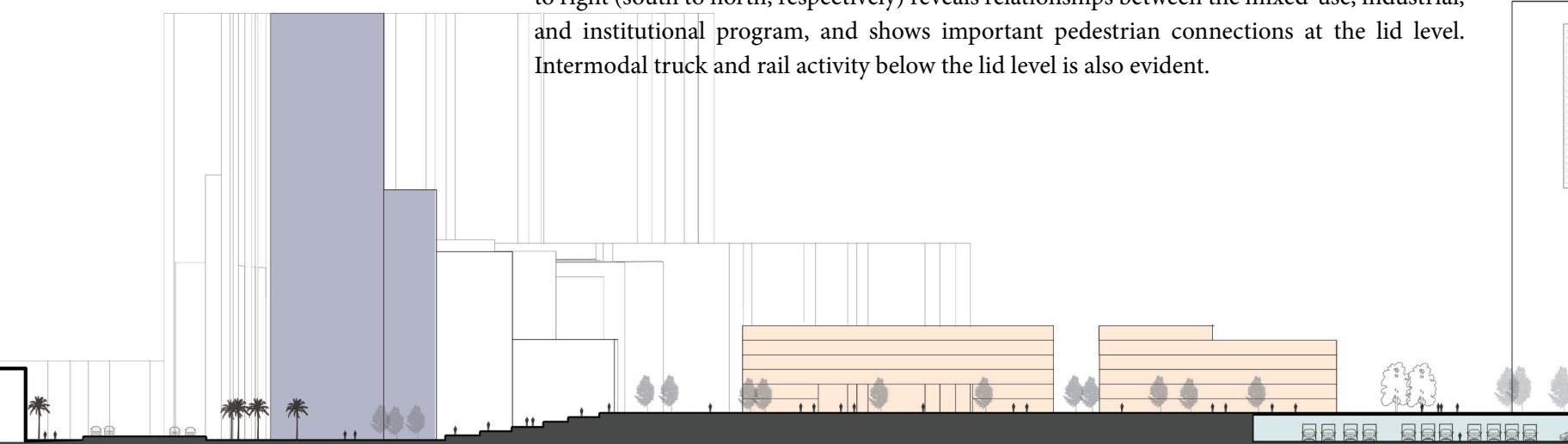


Figure 59. Site Section (Facing North)

Two transverse sections through the site (facing west) explain the proposed development strategy for the Piggyback Yard, and the integration of the new distribution infrastructure into this overall site response (Figures 60, 61). Reading the sections from left to right (south to north, respectively) reveals relationships between the mixed-use, industrial, and institutional program, and shows important pedestrian connections at the lid level. Intermodal truck and rail activity below the lid level is also evident.

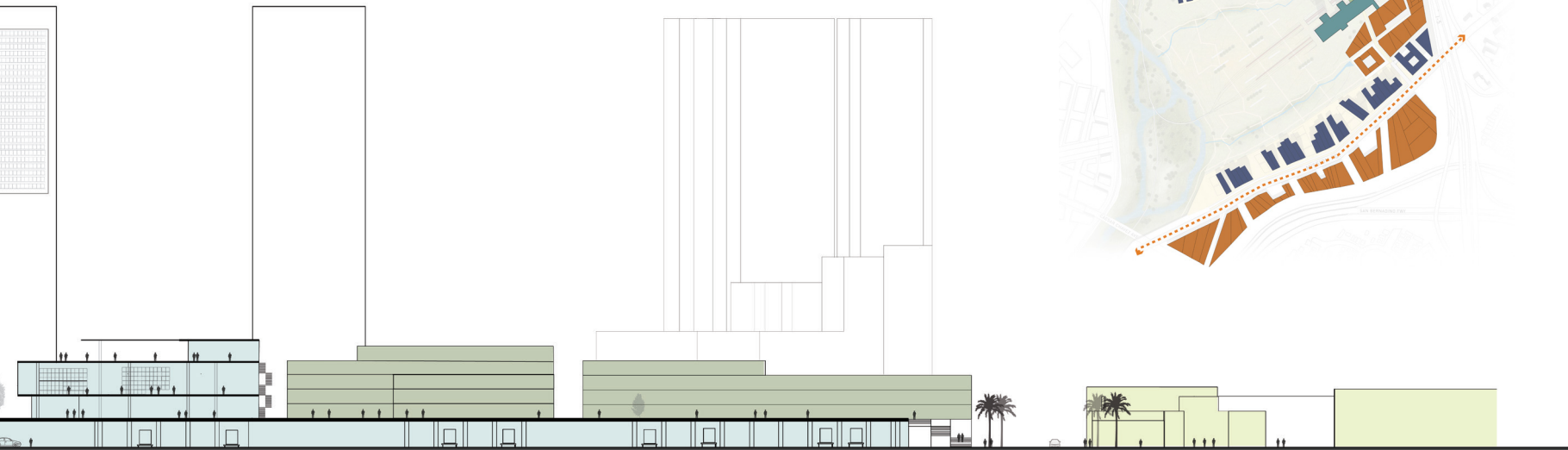


MISSION ROAD

MIXED USE

INDUSTRIAL INCUBATORS

DIS



TRIBUTION INFRASTRUCTURE

ARTS CAMPUS





Figure 62. (Left) Section perspective through container storage tower

Figure 63. (Right) View from I-5 Freeway, facing west

As visibility of infrastructure is a key goal for this proposal, the design and orientation of the facility takes advantage of unobstructed views along I-5 in order to broadcast the dynamic freight movement occurring within. The 26 story container storage tower is designed as an open frame that showcases the vertical movement of containers being transloaded onto trucks during the day and to cargo trains at night. A section perspective through the tower reveals the complex layering of this distribution infrastructure with urban space. Pedestrians moving along the “park” path towards the L.A. river are given glimpses directly into these container transloading systems, where the lid is cut away at critical moments. The architecture of this new urban context is essentially an extension of the infrastructure, with the same structural systems used in distribution also creating new routes of pedestrian circulation at several levels.



The three high-bay storage towers of break-bulk freight within the e-commerce fulfillment center also serve as iconic landmarks on the site. The enclosure of the conditioned towers is comprised of individual metal panels of varying textures, creating a “pixelated” effect that expresses the variegated configuration of product stored within. Transparent voids cut from the facade reveal the actual high-bay shelving behind. This panelized skin is also equipped with LED lights, and used for rotating media installations created by students at the adjacent arts campus.

At the lid level, a bridge over the intermodal rail tracks (seen here in both the section perspective at right and eye-level perspective above) establishes an important landscape connection between the arts campus and a courtyard located at the base of the towers. Here, art exhibitions and other types of social gatherings are held.

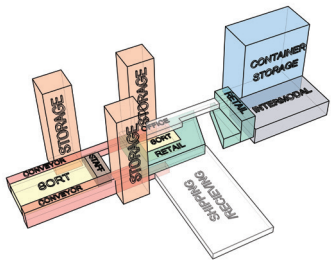
Figure 64. (Left) View of courtyard from arts Campus

Figure 65. (Right) Section Perspective through break-bulk tower, facing SW



L0 - Ground Level

The plan of the facility at ground level is primarily infrastructural in nature. It shows how existing intermodal rail lines on site are integrated directly into the facility, and also shows, in closer detail, how the two different types of cargo (containers and break-bulk freight) enter and exit the facility from a new access road connecting to Mission Road underneath the lid level. Parking for both staff and retail customers, as well as intermodal truck parking, is located at this ground level.



EXHIBITION COURTYARD/
SCULPTURE PARK

ARTS CAMPUS/
MIXED USE

INTERMODAL

CONTAINER
STORAGE

INTERMODAL

CONTAINER
WHOLESALE MARKET

RETAIL

SORTATION

"CLEANTECH"
INDUSTRIAL INCUBATORS

CAFE

COURTYARD

SORTATION

AUTOMATED
BREAK-BULK
STORAGE

L1 - LID LEVEL PLAN

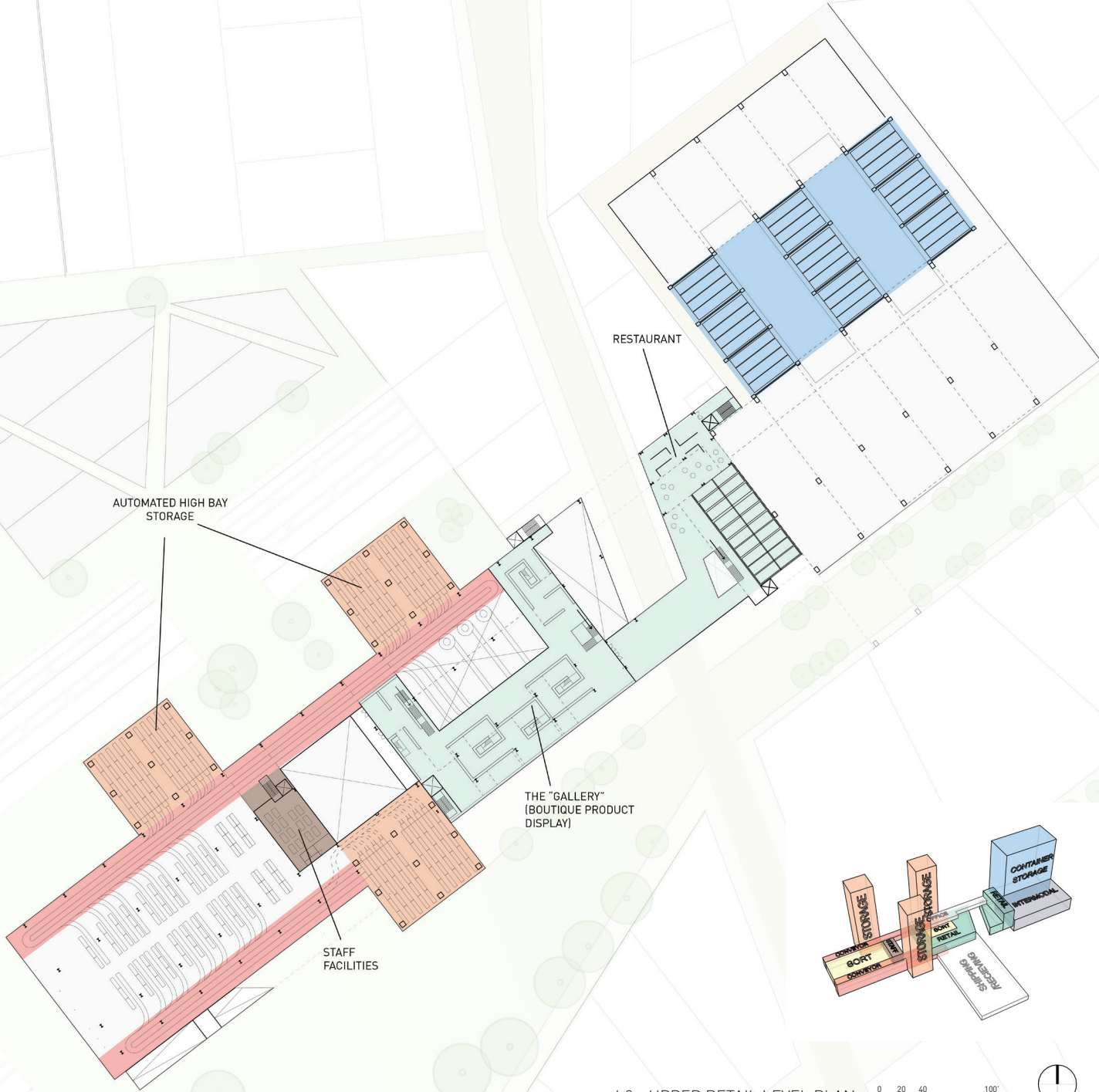




Figure 68. (Above) View of facility from pedestrian intersection. Wholesale container marketplace and e-commerce “boutique” retail are visible from this point.

L1 - Lid Level

The lid level, where retail program begins, is established as a new, primary plane of public activity on the site. This lid level is also where the core distribution activities related to e-commerce are located, such as automated sortation and conveyor movement space. The plan shows how retail is located at the intersection of the two new site connections and wraps through the e-commerce fulfillment program, connecting back to the landscape at the north. The lid is cut away at several key points, creating voids that expose the heavier rail operations below.

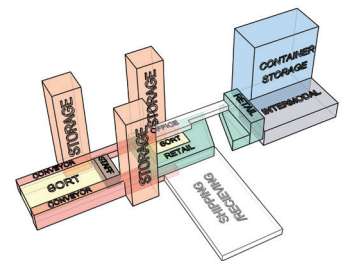


AUTOMATED HIGH BAY STORAGE

RESTAURANT

THE "GALLERY"
(BOUTIQUE PRODUCT DISPLAY)

STAFF FACILITIES



L2 - UPPER RETAIL LEVEL PLAN



L2 + L3 - Upper Retail and Roof Terrace Levels

Both of the main retail components continue up to another level, and are connected by a bridge that spans over the pedestrian path. Retail on this level continues to wrap around the sortation spaces of the e-commerce fulfillment center. Facilities for staff, including a canteen and locker rooms, are located on this second level. Above the upper retail level of the facility are office and control spaces for the distribution operations, as well as several roof terraces accessible to the public from the retail levels below. A ramp at the west edge of the facility connects these roof terraces back down to the park landscape.



L3 - ROOF TERRACE LEVEL PLAN

0 20 40 100



4.7 - Retail Program

The various retail components integrated into the facility form an important “seam” between urban space and distribution infrastructure. It is these points of programmatic overlap in the design that reflect a major goal of this thesis, which is to reconnect the point of consumer exchange back to the physical site of product distribution. The retail program beginning at the lid level is comprised of two separate retail “environments” which relate to the two different types of distribution programs. Extending from the intermodal container storage tower at the east is a wholesale marketplace for containerized cargo (the “Stack”). The “boutique” brick-and-mortar retail spaces to west of the pedestrian pathway are associated with the e-commerce fulfillment center, and include an on-demand virtual browsing space (the “Interface”), an automated product pick-up zone (the “Carousel”), and a product display “gallery” on the second level. The section below highlights the relationship between retail program, distribution program, and voids that allowing pedestrian movement through the facility.

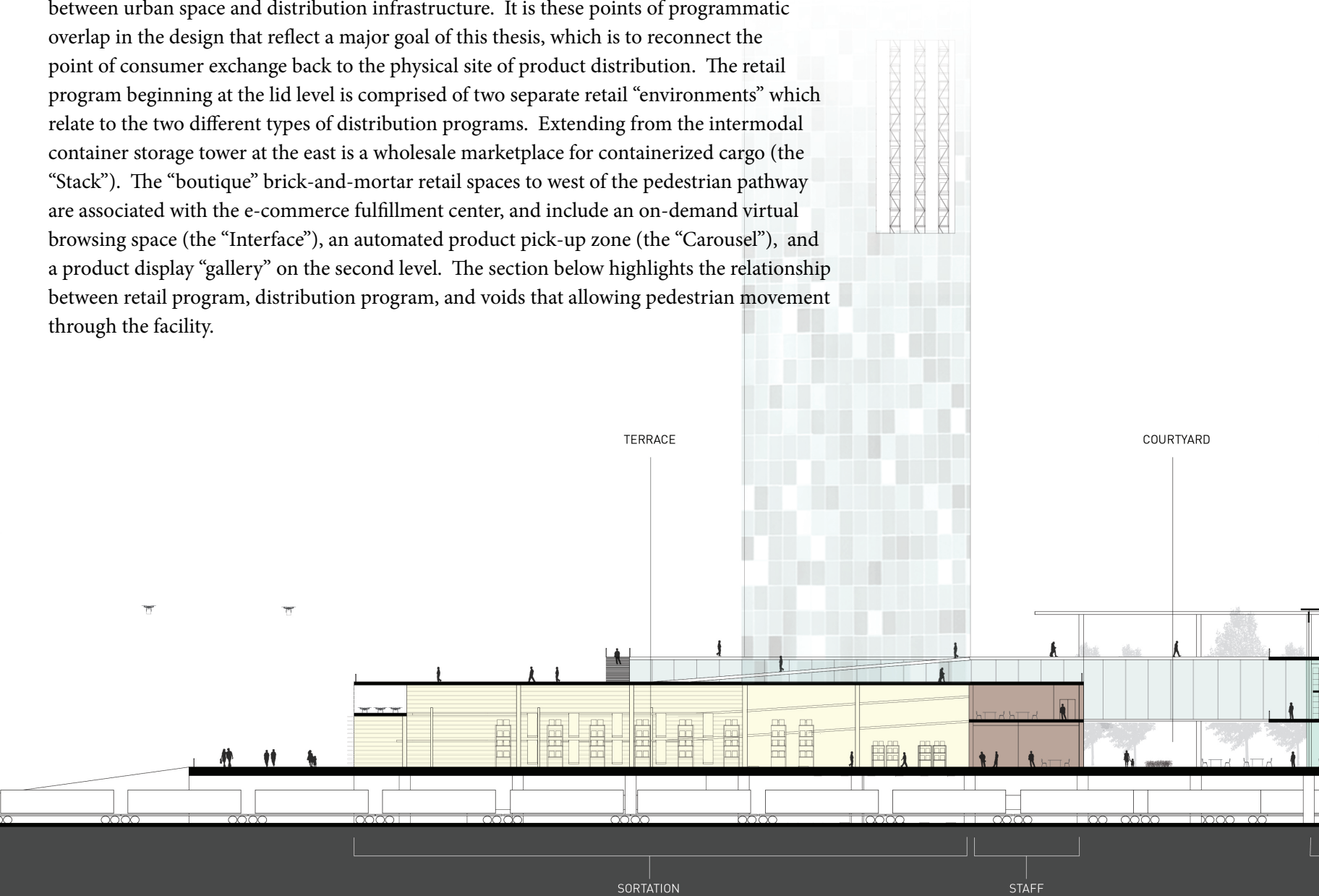
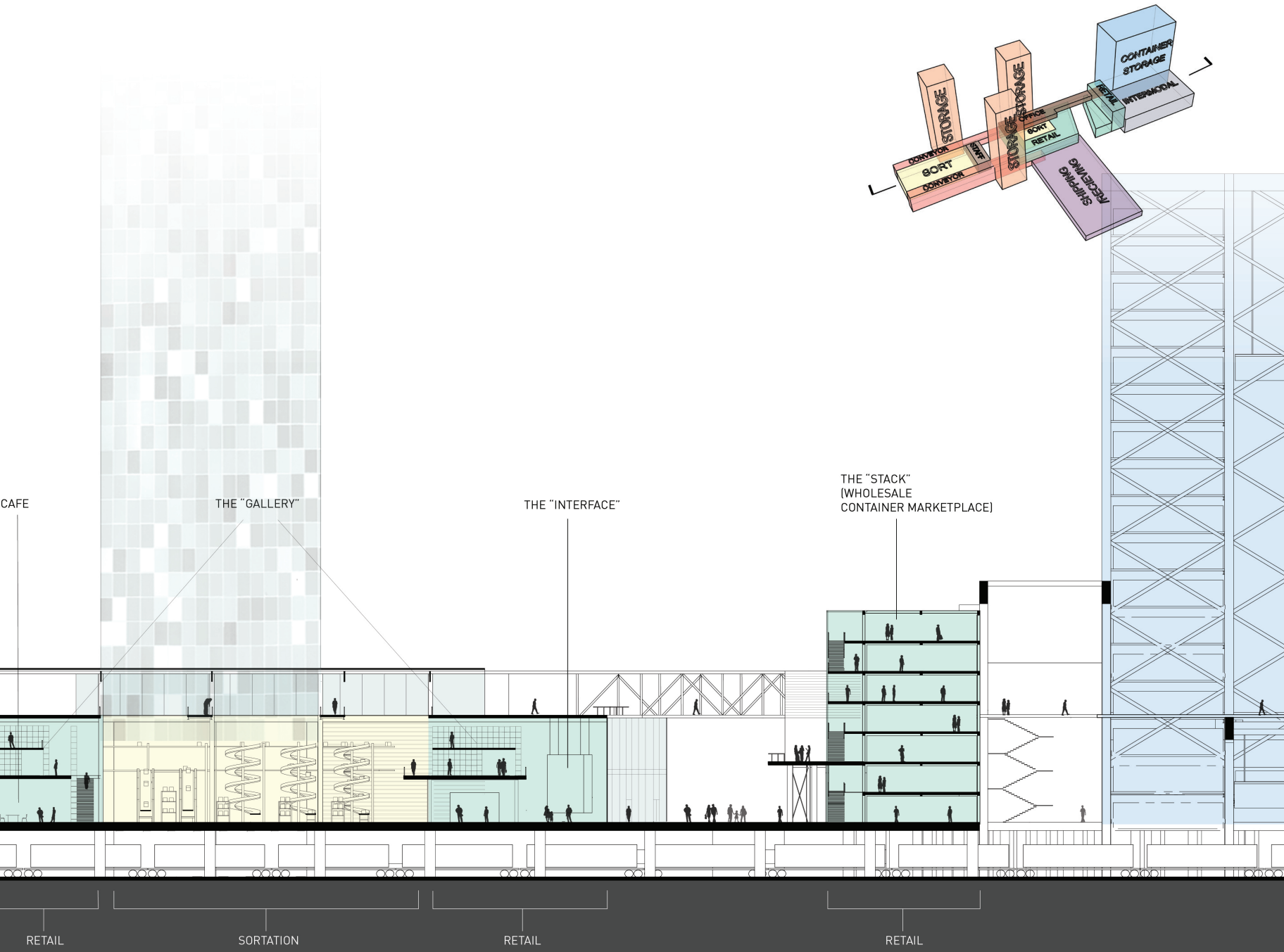


Figure 71. Longitudinal building section (facing north)



Architectural section drawing illustrating the layout of a building, showing various functional zones and their relationship to the ground level. The zones are labeled as follows:

- CAFE
- THE "GALLERY"
- THE "INTERFACE"
- THE "STACK" (WHOLESALE CONTAINER MARKETPLACE)
- RETAIL
- SORTATION
- RETAIL
- RETAIL
- RETAIL



THE "INTERFACE"

BREAK-BULK
STORAGE

SORTATION

CAFE

COURTYARD

THE "CAROUSEL"

THE "STACK"
(WHOLESALE CONTAINER
MARKET)





Figure 73. (Above) View of the “Stack” wholesale marketplace, during open market hours

Wholesale Container Marketplace (The “Stack”)

The “Stack” is an informal retail marketplace where bulk goods are sold directly to consumers from containers shipped to the facility from various retailers. The container “shops” within this marketplace are rotated on a daily basis, offering a frequent influx of fresh consumer product. Schedules of these freight shipments are posted online daily for shoppers to view. The atmosphere at the “Stack” market is imagined to be extremely vibrant, drawing a wide range of people from around the city to create a unique and exciting space of commerce.

The architecture of this retail marketplace is utilitarian and flexible. As a simple steel scaffolding that functions both as an occupiable marketplace and infrastructure, the expression is that of a stacked mass with intermittent voids, where other programs and social activities can be inserted. The configuration of solid/void within this frame changes on a daily basis depending on container shipments. The experience of wholesale shopping at the “Stack” is akin to stepping inside the intermodal infrastructure itself.



Figure 74. (Top) View of the "Interface" (On Demand product browsing)



Figure 75. (Bottom) View of the "Carousel" (Automated Product Pickup)

On-Demand Product Browsing (the “Interface”)

The “Interface” is part of the boutique retail marketplace associated with the e-commerce fulfillment center. It is an on-demand product browsing environment where virtual consumer interfaces and physical distribution infrastructure come together. It is intended as a quick, immediate space of exchange, where shoppers passing by the facility can stop to view current product inventory and special deals on large, interactive screens. Here they can also place orders for immediate pickup at the facility, or track existing orders. Behind the interactive screens are glazed walls which offer direct views into the high-speed sortation spaces beyond.

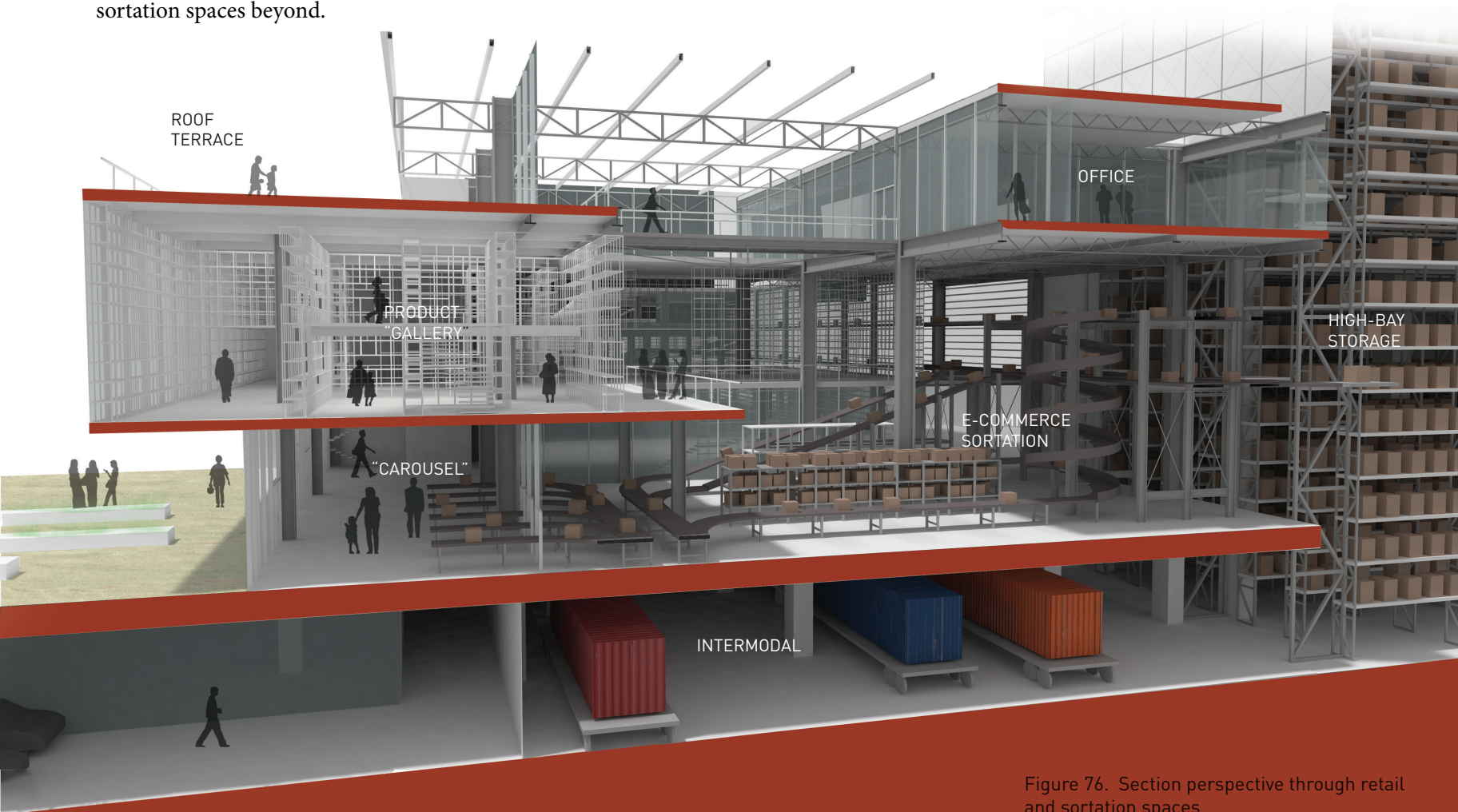


Figure 76. Section perspective through retail and sortation spaces



Beats
DY • NAM • IC
ENERGETIC AND HIGHPOWERED.
by dr. dre

Heillo
Samsung GALAXY S
Android

I AM SHARING MY VIEW
I AM SHARING MY VIEW
I AM SHARING MY VIEW
I AM SHARING MY VIEW
I AM SHARING MY VIEW

Stacks of cardboard boxes on shelves and a spiral ramp structure.

Apple iPhone 5



Automated Product Pick-up (The “Carousel”)

The “Carousel” is an automated product pick-up zone in the fulfillment center, where customers who have ordered product either online or at the on-demand browsing interface can retrieve it immediately after purchase. After inputting an RFID tag code, customers watch through a glazed wall as their purchased items are retrieved automatically from storage in the main sortation space, then sent along conveyors to the specified pick-up area. Seeing these dynamic systems for moving and sorting product up close could instill consumers with a renewed sense of excitement and anticipation accompanying the physical act of exchange.

Boutique Product Display (The “Gallery”)

The boutique product gallery component is imagined as an “archive” of physical product that consumers are able to interact with. To differentiate this space where the items of consumer desire can actually be handled from the other retail spaces that are geared more towards facilitating transaction, the gallery space is elevated above these lower levels of retail and distribution activity. The design of the “archival” goods display is conceived of as a porous frame (echoing the language of the container storage tower) which holds individual product but also allows shoppers continuous visibility into the sortation spaces beyond. The gallery display spaces have two levels, and are intended to create a feeling of being continually being surrounded by product while one moves through them.

The overlap of the primary sortation volume with this upper level product gallery sets up an interesting spatial dynamic and juxtaposition of scales by forcing consumers to simultaneously confront both the large scale distribution operations and the finer grain interaction with physical product. Establishing this critical point where the varying scales of infrastructure and commerce can ultimately be perceived by consumers is one of the major measures of success for this proposal.

Figure 77. View of the “Gallery” and e-commerce sortation spaces below



CHAPTER 5

Conclusion

This thesis contends that the logistical infrastructure of Los Angeles can be recalibrated to provide an “interface” or mediator connecting the movement of goods and people, and the contemporary spaces of commerce and the city. E-commerce retail has increasingly severed consumers from the physical realities of distribution. In response, this project seeks to revive (and revise) the traditional retail typology in which the point of commercial exchange exists at the geographic site of product distribution. Recognizing the inevitable need of e-commerce retailers to relocate fulfillment centers closer to dense urban populations, this thesis proposes a new model for urban logistics that consolidates and integrates critical parts of supply chain infrastructure. The design response provides an alternative to the currently inefficient spatial practices and mute architecture of fulfillment centers and intermodal freight terminals through vertical consolidation of the logistics infrastructure and its visibility, accessibility, and permeability to the general public. In addition, the proposal expands these connections through the integration of “brick-and-mortar” retail spaces and urban public space.

While this investigation has focused specifically on freight distribution in the Greater Los Angeles Region, the issues it addresses are ubiquitous and apply to virtually any urban area. Cities worldwide are facing similar struggles with logistics sprawl and its related environmental problems while searching for better ways to manage these infrastructural changes. When logistical infrastructure encroaches on urban space, tensions often arise between the demands of commerce and industry and the demands of urban populations. In response, this thesis proposes a synthesis between logistical infrastructure, urban space, and commerce. In doing so, it suggests a prototypical model that could potentially be applied to other cities facing this same dilemma.

Looking ahead to further tests of the proposal, it would be interesting to choose

Figure 78. (Opposite) View of distribution infrastructure from restored river landscape

a study site in a more dense city than Los Angeles, where space for such large scale infrastructure is even more limited, presenting a different set of challenges and opportunities. The proposal might also be expanded to include the design of an entire network of distribution facilities, and the development of new prototypes within this network that responds to different scales of product distribution, from the size of the port down to small urban freight “depots”.

In conclusion, the core function of architecture is to give prevailing social attitudes and trends physical form and meaning, and in doing so, invite a public dialogue about them. The ambiguities and tensions inherent with the design proposal (civic vs. “corporate” space, industry vs. landscape, physical vs. virtual, etc.) are a reflection of today’s urban consumer who actively participates in e-commerce retail, yet may or may not recognize the issues that it creates for cities and regions. This project neither condemns nor celebrates current consumer practices. Rather, it strives for a more thorough understanding of the complex contemporary issues. The proposal is put forth, not as a solution per se, but with the intention of initiating a critical discussion of a topic generally overlooked in design and social discourse today.

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