The H.I.L.: South Broad Street Mixed-Use Co-Housing Community

A Senior Project

presented to

the Faculty of the Architectural Engineering and Architecture Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Architectural Engineering, Bachelor of Science and

Architecture, Bachelor of Architecture

by

Kaele Snapp & Ashley Simoniak

June, 2016

© 2016 Kaele Snapp Ashley Simoniak
THE H.I.L. HEALTHY. INTERACTIVE. LIVING.

SOUTH BROAD STREET MIXED-USE CO-HOUSING COMMUNITY

Ashley Simoniak | Kaele Snapp | ARCH 453
# TABLE OF CONTENTS

1.0 Preface  
1.1 Letter to Client ........................................................................................................................... 4  
1.2 Executive Summary ..................................................................................................................... 5  

2.0 Statement of Project Intent  
2.1 Project Intent ........................................................................................................................... 6  
2.2 Living Building Challenge ......................................................................................................... 7  
2.3 Mental Health in Architecture ................................................................................................. 8  

3.0 Project Background  
3.1 Site History .............................................................................................................................. 9  
3.2 Project Goals ............................................................................................................................ 10  
3.3 Program List ............................................................................................................................ 11  

4.0 Project Proposal ......................................................................................................................... 12-32
Letter to the Client

June 3, 2016

Proposal for Broad Street Mixed-Use Co-Housing

Dear Stacey,

A|K Designs is an interdisciplinary student team that consists of an architecture student and an architectural engineer student from California Polytechnic State University, San Luis Obispo. We are proud to present to you our design of the Broad Street Mixed-Use Co-Housing Project.

We have collaborated to create an enjoyable interactive hub consisting of cohousing and commercial uses. Included in this design are an indoor farmers market style restaurant/market area, professional offices with a shared economy office, and cohousing residential units consisting of shared communal spaces (ie: shared kitchen and rooftop garden).

A|K Designs would like to thank you for this opportunity to help solve and design the Broad/Branch St block and bring in the important aspects of the community to bring diversity together into one happy, healthy place.

Thank You.
Sincerely,

Ashley Simoniak
Kaele Snapp
Executive Summary

As an integrated studio of architecture and architectural engineering students at California Polytechnic University San Luis Obispo, we have collaborated to design a mixed-use space called the Broad Street Mixed-Use Co-Housing Project to integrate commercial, residential, and community needs. As a team, we are working to design a space that incorporates a “community within a community” feel that also blends with the Railroad District of San Luis Obispo. Our goal is to enhance the mixed-use space by making it a co-housing and commercially shared project suitable to fit a living and working environment.

The current site features commercial parcels that do not connect with each other. With a large parking lot dividing a restaurant, a small residential space, and a bar, there are limited options as how to make that corner lot an iconic place for people to stop and want to spend more than a few hours maximum there.

In addition, this lot is positioned in an area with substantial ethnic and economic diversity. Thus, we would like the area to be inviting to those who not only live and work in the space, but also for pedestrians who are strolling and biking past. The current corner intersection of Branch Street and Broad Street can be very intimidating when driving or while trying to cross the street. Therefore, the site will be bike friendly with many suitable stations. Vehicle parking will be mechanized and stored underground to increase density, to leave room for more building, and to provide a more sustainable atmosphere. In addition the street noise will be controlled by installing more residencies away from Broad Street and more commercial areas towards Broad Street. This lot also contains a gradual slope that builds from Branch Street and continues north down Broad Street. This incline will need to be addressed by our team to ensure that it is engineered appropriately to draw civilians into the space.

Outside visitors can use the indoor farmer market style restaurant/market and private and shared economy offices. Tenants will be able to access those features plus many other communal spaces, such as a shared garden and rooftop kitchen, making the co-housing desire come alive. The tenants will have different kinds of housing to choose from depending on the number of rooms desired. There will be studio and one-bedroom apartments to cater to a singular residents and two and three-bedroom units for roommate residents and small families.

We are proposing this project in hopes to mesh this lively neighborhood. The property will serve to ease the on-the-go atmosphere of its district by providing all of the essential amenities all in one place.
It is one thing to come home to an empty house, and another to live in a happy and healthy environment that makes us want to come home and enjoy our friends and family. In San Luis Obispo, there is a great need for housing for individuals and some small families, especially in the workforce environment of South Broad Street. Density is key to this project to bring more people together, but happy and healthy interaction is also key to for people to be mentally healthy and just to really be excited to come home to a friendly and lively environment. This project explores a mix of co-housing environments, live/work spaces, and a commercial marketplace style atmosphere to create an ultimately natural and healthy interactive hub in the town for anyone and everyone to enjoy.
STRATEGIES:

• Healthy interior environment
  - Bringing the Outdoors in, Happy Daylighting, Ventilation, Landscape
  - Providing Physical Activity Rooms and Walkable Circulation and Movement throughout the Site
  - Providing Interactive Opportunities within the Co Housing and Public Community

• Net Positive Energy
  - Solar Panels on Slanted Roofs

• Net Positive Water

• Urban agriculture
  - Rooftop Garden and Farm

• Human Powered Living
  - Indoor Bike Parking and Storage
  - Promoting Stairs
  - Push Bike and Pedestrian Culture

• Human Scaled
  - Highly Walkable throughout the site
  - No cars in the site other than deeply hidden mechanized parking
  - Gathering Spaces Indoor and Outdoor

• Universal Access to Ammenities
Part of having a happy and healthy mind and mindset involves what you experience within and with what is around you. For a place to become happy and healthy, aspects to be considered is interaction and activity. This project includes a physically active environment for people to move throughout the site and perform activities throughtout moments in the site. As people move through they can start to cross paths and interact with each other and bond to create a fun community environment that will get rid of lonliness and toxic mindsets. The environment in the project strives to bring a natural feel (includes nature outdoors and in) with emphasizing lighting and landscape and views to nature. The program of the project then brings places of interaction and activity to bring people together. Spaces include: co-housing shared spaces (roof garden, kitchen and lounges), live/work connect spaces, outdoor plaza for gathering and a fun indoor farmers market style commercial corner. Even though San Luis Obispo may be the happiest city in America, people still go through different stresses of life. Instead of coming to a home that make people feel alone and sink in their problems, they can come home to a lively environment where there is always someone such as a neighbor who can support them or come to a place where they can face their stresses of life and become a healthier human.
- Inviting Commercial towards Broad St to Bring a Connection of Diversity
- Bring in important ideals of South Broad Street and the Railroad District
- Co Housing Residential Spaces with High Density
- Landscape and Outdoor/Indoor Common Spaces that Optimize Natural Light
- Encourage Pedestrian/Bike/Public Transit
- Encourage Interaction (Community within a Community)
- Create a Positive and Healthy Environment for All to Enjoy

Inviting Community Hub to Encourage Diverse Interaction

Interaction Between Community and Residents (Indoor and Outdoor), Interaction Within Residents (Indoor and Outdoor).
Residential
- Studios (3) - 400sf
- 1 Bedroom (8) - 650sf
- 2 Bedroom (4) - 800sf
- 3 Bedroom (2) - 1100sf
- Shared Areas (Community Kitchen, Lounges, Physical Activity Rooms, Roof Garden/Farm)

Commercial
- Farmers Market Style Restaurants (2) - 3000sf
- Offices (6 Professional with Shared Amenities) - 1000sf
- Market - 3000sf

Other Public Spaces
- Interactive Child Center - 1200sf
- Mechanized Parking, Outdoor/Indoor Bike Parking
- Interactive Plaza/Paseo with Picnic Areas, Event Spaces (Art/Food)
RESIDENTIAL SECTION
MASONRY & WOOD
- Masonry and wood on first level, wood on all levels above
- OSB sheathing (3/4” floor, 1/2” roof) bearing on TJI I-joists bearing on LSL or PSL beams
- 1 1/2” LW concrete between floors
- Masonry bearing walls will be solid grout filled 12 x 8 x 16 blocks
- Wood bearing walls on the levels above will be stick framed (2x4s interior, 2x6s exterior) at 16” o.c.
- Wide flange and PSL columns

STEEL & WOOD
- Steel and wood on the first level and wood on all of the levels above
- OSB sheathing (3/4” floor, 1/2” roof) bearing on TJI I-joists
- At second floor, wood framing will bear upon wide flange beams and columns
- Wood bearing walls will be stick framed (2x4s interior, 2x6s exterior) at 16” o.c.

CIRCULATION
- Elevators will be masonry constructed.
- Staircases and ramps will be wood constructed.

wood I-joists bearing on steel beams
http://inspectapedia.com/structure/Site%2083%20App9-06dfs.jpg

wood construction bearing on masonry construction
http://inspectapedia.com/structure/Site%2083%20App9-06dfs.jpg

wood I-joists bearing on CMU walls
https://www.cuug.ab.ca/bramwell/NSLand/blog_gallery/stairs.jpg

wood staircase
https://hardings4pitt.files.wordpress.com/2012/11/stairs-going-up.jpg

masonry elevator shaft
http://www.cuug.ab.ca/bramwell/NSLand/blog_gallery/stairs.jpg
WOOD
- Used in residential buildings where span lengths are 15’-25’
- Lighter than steel and masonry (materials wood will bear on)
- Includes sprinkler systems
- Engineered lumber will come from recycled wood and can be reused as wood chips
- Typically least expensive assembly compared to other materials by 10%-15%.

STEEL
- Used in spaces where span lengths are greater than 25’
- Used in places of heavy loading to keep members at reasonable sizes
- 80% of steel can be recycled and made into structural shapes
- Sprayed with fireproofing
- Used to architecturally expose structure

MASONRY
- Higher STC (Sound Transmission Control) rating (of 50-60 for solid grout filled) to block noise from street
- Used to architecturally expose texture of blocks
- Acts as a thermal mass to control temperature swings and heating/cooling loads
- Less expensive than concrete
**STEEL**
- moment frames
- wide flanges
- optimal space for entrances, windows, and displays

**MASONRY**
- Shear walls
- Reinforced solid grout filled 12 x 8 x 16 blocks

**WOOD**
- Shear walls
  - 2x4s at 16" o.c. for interior walls
  - 2x6s at 16" o.c. for exterior walls
  - straps and holdowns to resist shear
  - 15/32" OSB sheathing

**LATERAL SYSTEM**
- Moment frames
- Shear walls
- Reinforced solid grout filled 12 x 8 x 16 blocks
- 15/32" OSB sheathing
- Straps and holdowns to resist shear

**Masonry shear walls**

**Wood shear walls**
http://www.apawood.org/Data/Sites/1/media/images/apa_designbuild_shearwallsdiaphrams1.jpg

**moment frame**

**CMU bond beam**
https://s-media-cache-ak0.pinimg.com/736x/56/b7/53/56b75367f2181149d2494f9a07669e45.jpg

**hold down**
http://www.contractortalk.com/attachments/f14/73501d1340071255-need-shear-wall-gazebo-img_2219-1-.jpg
WOOD
- Inexpensive and less labor involved to laterally secure with straps and holdowns
- Light-frame wood walls with wood structural panels permitted for SDC D
- Used in residential spaces where many walls are needed

STEEL
- Used where openness and daylight is desired for commercial storefront
- Steel special moment frames permitted for SDC D if building is under 160’ tall (> 42’ tall project)
- Frames are prefabricated

MASONRY
- Used in spaces where masonry bearing walls exist
- Special reinforced masonry walls are permitted for SDC D if building is under 160’ tall (> 42’ tall project)
(c) Flat slab raft thickened under column

- Part of corner building has elevated mat slab
- Part of north building has elevated mat slab
RAFT MAT SLAB THICKENED UNDER COLUMN

- Thickening slab under the column reduces the moment at the slab to column connection (reduces punching effect)
- Post-tensioning of steel in the slab will make the slab stiffer and able to move as a whole
PALLET SYSTEM

plan view of pallet system

MECHANIZED PARKING SYSTEM

turntable
- Vehicles are mechanically lowered to a below grade garage composed of two sublevels.
- Vehicles will move on a pallet system that rotates horizontally in plan view.
- Entire lot is a 72’ x 180’ space.
- Each parking space is 8’ x 18’.
- Total of 144 parking spaces (satisfies requirement of 92 parking spaces).
column grid

southern slant for solar energy
+ water management

wood + steel framing members

metal roof cladding

steel vertical members
for open floor plan

water storage + distribution

branch street

branch street

wood + steel framing
with wood finish cladding

wood + steel framing
with gfrc wall cladding
It is one thing to come home to an empty house, and another to live in a happy and healthy environment that makes us want to come home and enjoy our friends and family. In San Luis Obispo, there is a great need for housing for individuals and some small families, especially in the workforce environment of South Broad Street. Density is key to this project to bring more people together, but happy and healthy interaction is also key to for people to be mentally healthy and just to really be excited to come home to a friendly and lively environment. This project explores a mix of co-housing environments, live/work spaces, and a commercial marketplace style atmosphere to create an ultimately natural and healthy interactive place for anyone and everyone to enjoy.

THE H.I.L. HEATHY. INTERACTIVE. LIVING.

SOUTH BROAD STREET MIXED-USE CO-HOUSING COMMUNITY

Inviting Community Hub to Encourage Diverse Interaction

Interaction Between Community and Residents (Indoor and Outdoor), Interaction Within Residents (Indoor and Outdoor)

live+work-housing+office
co-housing
with shared spaces
commercial marketplace

RESIDENTIAL SECTION
PROJECT GOALS
- Inviting Commercial towards Broad St to Bring a Connection of Diversity
- Bring in important ideals of South Broad Street and the Railroad District
- Co Housing Residential Spaces with High Density
- Landscape and Outdoor/Indoor Common Spaces that Optimize Natural Light
- Encourage Pedestrian/Bike/Public Transit
- Encourage Interaction (Community within a Community)
- Create a Positive and Healthy Environment for All to Enjoy
Masonry construction exists on the first level of the North and West buildings. Masonry walls are used for bearing and resisting lateral forces. The walls consist of 12 x 8 x 16 solid grout filled blocks.

Wood construction exists on every building above the first level. All floors are composed of OSB sheathing (3/4” floor, 1/2” roof) bearing on TJI I-joists bearing on LSL or PSL beams. There is 1 1/2” LW concrete between floors. Wood walls have 2x4s (interior) and 2x6s (exterior) at 16” o.c.

Steel construction exists on the first level of the Corner building. Wide flange beams and columns support wood framing. Wide flange moment frames function to resist shear forces and to allow maximum openness and daylight.
A mat slab foundation is thickened under columns to reduce the moment (and punching effect) at the slab to column connection. Post-tensioning of steel in the slab will make the slab stiffer and able to move as a whole.

Incoming vehicles are mechanically lowered to a below grade garage composed of two sublevels. Vehicles will move on a pallet system that rotates horizontally in plan view. Each parking space is 8' x 18', allowing a total of 144.
GRAVITY DESCRIPTION

MASONRY & WOOD
- Masonry and wood on first level, wood on all levels above
- OSB sheathing (3/4" floor, 1/2" roof) bearing on TJI I-joists bearing on LSL or PSL beams
- 1 1/2" LW concrete between floors
- Masonry bearing walls will be solid grout filled 12 x 8 x 16 blocks
- Wood bearing walls on the levels above will be stick framed (2x4s interior, 2x6s exterior) at 16" o.c.
- Wide flange and PSL columns

STEEL & WOOD
- Steel and wood on the first level and wood on all of the levels above
- OSB sheathing (3/4" floor, 1/2" roof) bearing on TJI I-joists
- At second floor, wood framing will bear upon wide flange beams and columns
- Wood bearing walls will be stick framed (2x4s interior, 2x6s exterior) at 16" o.c.

CIRCULATION
- Steel and wood on the first level and wood on all of the levels above
- OSB sheathing (3/4" floor, 1/2" roof) bearing on TJI I-joists
- At second floor, wood framing will bear upon wide flange beams and columns
- Wood bearing walls will be stick framed (2x4s interior, 2x6s exterior) at 16" o.c.

Staircases and ramps are wood constructed.

Elevators are masonry constructed.
<table>
<thead>
<tr>
<th></th>
<th>WOOD</th>
<th>STEEL</th>
<th>MASONRY</th>
</tr>
</thead>
</table>
| **PROGRAM**   | - Used for residential buildings where the framing span lengths are 15'–25' to coordinate with rooms.  
- Four story typical height limit. Matches project intent.  
- Higher STC (Sound Transmission Control) rating (of 46-47 for staggered studs). | - Used in spaces where span lengths are greater than 25'.  
- Used in places of heavy loading to keep members at reasonable sizes. | - Higher STC (Sound Transmission Control) rating (of 50-60 for solid grout filled) to block noise from street. |
| **AESTHETICS**| - Provides warmth and will be covered with gypsum board.  
- Matches surrounding architecture. | - Used to architecturally expose structure. | - Added texture creates an aesthetic appearance. |
| **FIRE RESISTANCE** | - Includes sprinkler systems. | - Sprayed with fireproofing. | - Multiple wythes to increase fire blockage. |
| **SUSTAINABILITY** | - Engineered lumber will come from recycled wood and can be reused as wood chips. Can get LEED points for using engineered lumber without urea-formaldehyde resins.  
- Allows for solar panel and green roof installation. | - 80% of steel can be recycled and made into structural shapes. | - Will be recycled.  
- Acts as a thermal mass to control temperature swings and heating/cooling loads.  
- Can get LEED points for stormwater management. |
| **CONSTRUCTABILITY** | - Lighter than steel and masonry (material that it will bear upon).  
- Straightforward assembly during construction. (No formwork, no major field welding.) | - Members can be prefabricated. | - Do not have to size down pieces to transport to site.  
- Can use specialty masons. |
| **COST**      | - Typically least expensive assembly compared to other materials by 10%-15%. | - Costs less to maintain over time because it is usually not exposed to outdoor conditions. | - Cheaper alternative compared to concrete because of constructibility. |
| **SUMMARY**   | **USED IN RESIDENTIAL CONSTRUCTION IN SURROUNDING AREA, LIGHTER TO BE ABLE TO BEAR UPON MASONRY OR STEEL, LESS EXPENSIVE** | **USED IN OPEN AREAS FOR COMMERCIAL SPACES AND WHERE THERE IS HEAVY LOADING, HIGHLY RECYCLABLE TO COORDINATE WITH LIVING BUILDING CHALLENGE, LESS EXPENSIVE TO MAINTAIN** | **CONTROLS SOUND TRANSMISSION FROM NOISY STREET, THERMAL MASS TO FLUCTUATE WITH DAY TO NIGHT TEMP SWING, LESS EXPENSIVE THAN CONCRETE** |
BEARING WALLS are placed according to building programming (use and partitioning). All bearing walls are meant to support gravity loads and resist lateral forces. All walls are vertically continuous if they continue above the first floor.

COLUMNS are placed according to the appropriate span length and the building programming (use and partitioning). Almost all columns are continuous except at points where loading is extreme or where a wall cannot be placed.
Refer to previous page for key plan.

(By engineering judgement, shear and deflection does not govern for the design of joists and beams.)

(For simplifications, only axial loads are used to design columns.)

(Texts/Codes/Catalogs used: 2015 NDS, 2012 IBC, Weyerhaeuser Trus Joist, Weyerhaeuser)
**Lateral Description**

**Steel**
- Moment frames
- Wide flanges
- Optimal space for entrances, windows, and displays

**Masonry**
- Shear walls
- Reinforced solid grout filled 12 x 8 x 16 blocks

**Wood**
- Shear walls
  - 2x4s at 16" o.c. for interior walls
  - 2x6s at 16" o.c. for exterior walls
- Straps and holdowns to resist shear
- 15/32" OSB sheathing

**Images**
- Steel moment frame: [image](http://blog.buildllc.com/wp-content/uploads/2014/05/braced-frame-moment-frame.jpg)
- CMU bond beam: [image](https://s-media-cache-ak0.pinimg.com/736x/56/b7/53/56b75367f2181149d2494f9a07669e45.jpg)
- Wood shear walls: [image](http://www.apawood.org/Data/Sites/1/media/images/apa_designbuild_shearwallsdiaphragms1.jpg)
- Shear straps: [image](http://www.contractortalk.com/attachments/f14/73501d1340071255-need-shear-wall-gazebo-img_2219-1-.jpg)
<table>
<thead>
<tr>
<th></th>
<th><strong>WOOD SHEAR WALLS</strong></th>
<th><strong>STEEL MOMENT FRAMES</strong></th>
<th><strong>MASONRY SHEAR WALLS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROGRAM</strong></td>
<td>- Used for residential buildings where there are many walls that can be used for shear forces</td>
<td>- Moment frames can be used to keep openings clear for entrance and daylight.</td>
<td>- Textured shear walls can be used to break up architectural glass along perimeter.</td>
</tr>
<tr>
<td><strong>SEISMIC PERFORMANCE</strong></td>
<td>- Light-frame (wood) walls with wood structural panels rated for shear resistance are permitted. (SDC: D)</td>
<td>- Steel special moment frames are permitted for 160’ tall buildings. (SDC: D) This project requires 42’.</td>
<td>- Special reinforced masonry walls are permitted for 160’ tall buildings. (SDC: D) This project requires 42’.</td>
</tr>
<tr>
<td><strong>COMPATIBILITY W/ GRAVITY SYSTEM</strong></td>
<td>- Works with wood framing.</td>
<td>- Works with steel framing and wood framing/walls.</td>
<td>- Works with masonry bearing walls and wood framing/walls that stack on top.</td>
</tr>
<tr>
<td><strong>STRUCTURAL COST</strong></td>
<td>$</td>
<td>$$$</td>
<td>$</td>
</tr>
<tr>
<td><strong>SUMMARY</strong></td>
<td>- PERMITTED FOR SDC D, INEXPENSIVE AND LESS LABOR INVOLVED TO LATERALLY SECURE, WALLS NEEDED TO PROVIDE PRIVACY BETWEEN RESIDENCES</td>
<td>- PERMITTED FOR SDC D, ALLOWS MAXIMUM SPACE FOR ENTRANCES, DAYLIGHT, AND DISPLAYS CRUCIAL TO COMMERCIAL STOREFRONT</td>
<td>- PERMITTED FOR SDC D, INEXPENSIVE TO LATERALLY SECURE, ADDS TEXTURE TO ARCHITECTURAL FACADE</td>
</tr>
</tbody>
</table>
LATERAL SYSTEMS (MOMENT FRAMES and SHEAR WALLS) are configured with limited horizontal or vertical irregularities. Any vertically discontinuous shear walls are supported by columns; therefore, the columns would need to be designed with overstrength and overturning in mind. All shear walls are meant to resist lateral forces and support gravity loads. The shear walls and frames are placed to keep the center of mass and center of rigidity within reason of each other.
LATERAL SIZING

[Diagrams and text excerpts related to lateral systems, wood shear walls, masonry shear walls, and moment frames.]
Thickening the slab under the column reduces the moment at the slab-to-column connection and therefore reduces the effect of two-way (punching) shear.

Part of corner building has elevated mat slab
Part of north building has elevated mat slab
# Foundation Selection

## Program
- Flat slab works well under parking garage
- Individual slabs selected because of dramatic changes among the building's base elevations

## Aesthetics
- Clean looking
- Works well in warmer climates where freezing and thawing is not a concern and floor heating is not needed

## Seismic Performance
- Post-tensioning of steel in the slab will make the slab stiffer and able to move as a whole
- Approved option to combat liquefaction and expansive soils

## Gravity System
- Thickening slab under the column reduces the moment at the slab-to-column connection (reduces punching effect)
- Distributes heavy column loads uniformly

## Structural Cost
- Less expensive than caissons

## Summary
- Separate slabs per building’s base elevation, post-tensioning of steel makes the slab stiffer and able to move as a whole, approved option to combat liquefaction and expansive soils, thickening slab under columns reduces punching effect, less expensive than caissons

---

**Fig 2. Flat Plate Thickened Under Column**
MAT SLAB FOUNDATION

Punching (two-way shear) controls for mat slab thickness.

UNDER PARKING GARAGE

\[ \text{Column load} = (4 \times 10\,000 \times 10 \times 16 \times 1\text{.2} \times 1\text{.2}) \]

\[ = 3,438 \text{ kips} \]

\[ d = \frac{3,438}{22} = 15.6\text{"} \]  

- Use 15" slab

UNDER NORTH BLDG.

\[ \text{Column load} = (3 \times 6\,000 \times 10 \times 16 \times 1\text{.2} \times 1\text{.2}) \]

\[ = 343.8 \text{ kips} \]

\[ d = \frac{343.8}{22} = 15.6\text{"} \]  

- Use 15" slab

UNDER CORNER BLDG.

\[ \text{Column load} = (4 \times 10\,000 \times 10 \times 16 \times 1\text{.2} \times 1\text{.2}) \]

\[ = 3,438 \text{ kips} \]

\[ d = \frac{3,438}{22} = 15.6\text{"} \]  

- Use 15" slab
The pallet system allows passengers and their vehicles to access an above grade holding garage. Once the passengers have exited the garage, the vehicle is slid onto a pallet, rotated appropriately on a turntable, and dropped down below grade on a lift to either the first or second sublevel. At a sublevel, the vehicle is translated in a horizontal plan view until an empty space is available for parking. When claiming a vehicle, the sublevel will rotate in the same fashion until the vehicle requested is in front of the lift.
The parking configuration has two garages. The main garage (72 parking spaces) has an entering and exiting holding garage. The overflow garage (80 parking spaces) is used in case the main garage becomes full. Its holding garage is used for entering and exiting.

The entire parking structure is 72’ x 180’ lot below grade. Each parking space is 8’x18’. There is a total of 152 parking spaces, which satisfies the requirement of 92 parking spaces based upon parking reduction codes.