THE FOUNDRY
AT 41ST
LAWRENCEVILLE LIVING

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Advisor: Dr. David Riley

Foundry at 41st

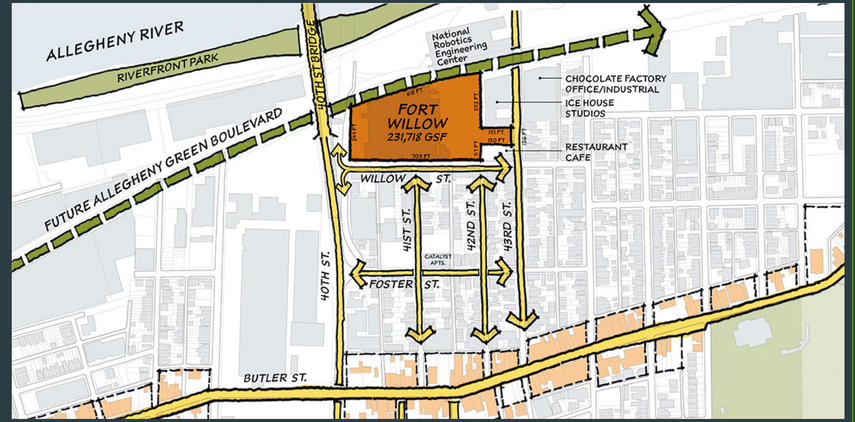
Architecture

Building Facts

Project	The Foundry at 41st
Location	Lawrenceville, PA
Owner	Ft. Willow Developers
Type of Project	Residential
Gross Square Feet	164,997 square feet.
Stories/ Units	6 stories/ 184 units
Project Team	
Owner	Ft. Willow Developers
Construction Manager	PJ Dick
Architect	Rothschild Doyno
MEP	Allan & Shariff
Structural	Atlantic Engineering Services
Schedule	November 2015-May 2017
Budget	$35 million
Delivery Method	Design Bid Build

Foundry at 41st

Introduction:



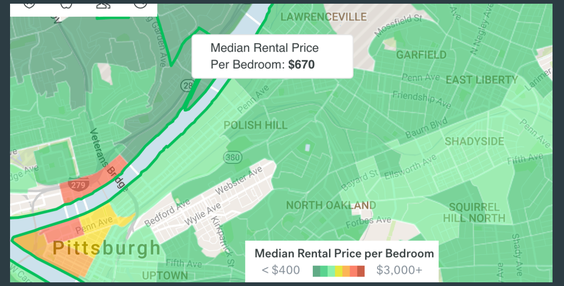
Lawrenceville is one of top Hippest neighborhoods in the world.

25% increase in young professionals in Lawrenceville in last 5 years.

Foundry at 41st

Cost

Total Budget	$35 million
Total Cost	$25 million
Cost/ Square Feet	**$151.52**



Schedule

Total Schedule (years)	2 years
Total Schedule (months)	**24 months**
Dates	November 2015 to May 2017

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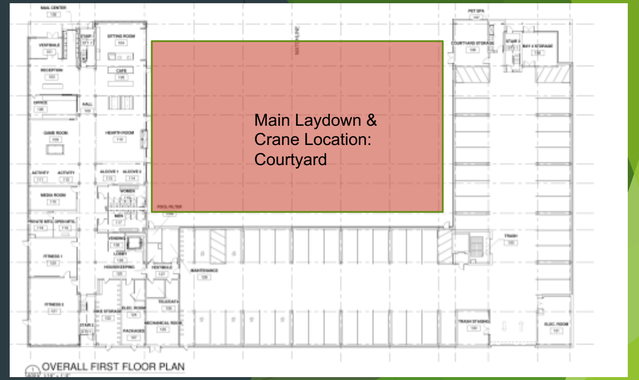
Logistics



Characteristics:
-Tight, Urban Site
-Laydown Area in Courtyard

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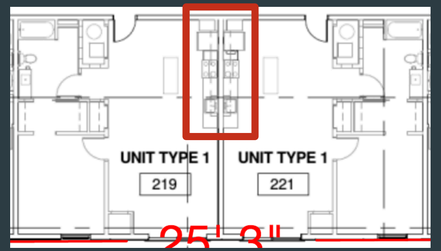
Depth 1: Kitchen Plumbing Manifold

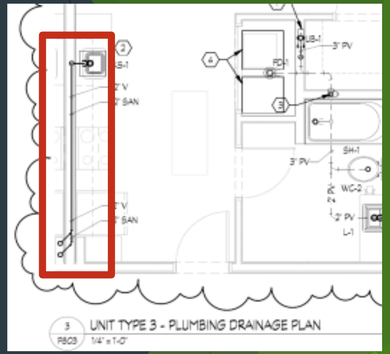
- Problem and Goals
- Background Information
- Execution
- Mechanical Breadth
- Recommendations

Depth 1: Kitchen Plumbing Manifold



Problem:

- Redundancy in plumbing back to back Kitchen and Bathroom Units



Goals:

- Save on waste plumbing
- Save on Schedule
- Reduce Costs

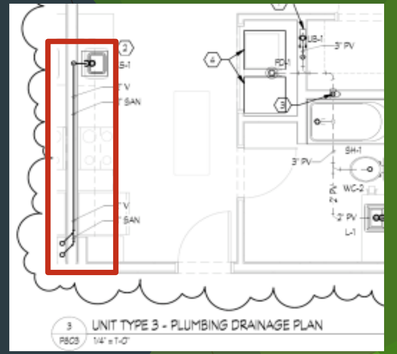
Foundry at 41st

Depth 1: Kitchen Plumbing Manifold
- ✓ Problem and Goals
- ○ **Background Information**
- ○ Execution
- ○ Mechanical Breadth
- ○ Recommendations

Depth 1: Background Information

Key	Unit	Count
Kitchen	3 to 3	43
Bath	3 to 3	28
Bath	3 to 1	10
~~Bath~~	~~3 to 2~~	~~7~~
~~Kitchen~~	~~1 to 1~~	~~5~~
~~Kitchen~~	~~6 to 2~~	~~4~~
~~Kitchen~~	~~2 to 2~~	~~3~~
~~Kitchen~~	~~3 to 1~~	~~3~~
~~Kitchen~~	3 to 2	~~0~~

Identified:
- 43 instances of Unit 3 to Unit 3 Kitchens
- 28 instances of Unit 3 to Unit 3 Bathrooms
- 10 instances of Unit 3 to Unit 1 Bathrooms



Focused on the 43 shared wall instances of Unit 3 to Unit 3 in Wall Kitchens

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Depth 1: Kitchen Plumbing Manifold
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Mechanical Breadth
- ○ Recommendations

Depth 1: Execution

Cost Estimate:

- $33,589.70 Total Cost of 43 Prefabricated Manifolds
- $781 per Prefabricated Manifold
- Cost Savings= $6,000
- 1598 linear feet of piping material
- 37 linear feet of piping per Prefabricated Manifold

Schedule:

- Current System: 18 days on Critical Path
- Alternative System: 10 days on Critical Path

Foundry at 41st

Depth 1: Kitchen Plumbing Manifold
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ✓ Mechanical Breadth
- ○ **Recommendations**

Depth 1: Kitchen Plumbing Manifold

Review of Goals:

✓ Save on waste plumbing

✓ Save 8 days on Schedule

X Reduce Costs

Recommendation:

○ Yes, I would Recommend on basis:

✓ Schedule Savings

✓ Broke even including transportation costs

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Depth 2: Hollow-Core Concrete Plank
- **Problem and Goals**
- Background Information
- Execution
- Structural Breadth
- Recommendations

Depth 2: Hollow-Core Concrete Plank

Problem:
- Schedule Intensive Second Floor Cast in Place Concrete Floor
- Existing System:

LEVEL 2 (SLAB/DECK) SCHEDULE

MARK	TYPE	REINFORCING	TOTAL THICKNESS
S3	5 1/4" N.WT. CONC. SLAB ON 2"-20 GA. COMP. STEEL DECK	REINF. W/ 6X6-W4.0XW4.0 W.W.F.	7 1/4"

Goals:
- Reduce the Schedule of Second Floor Construction
- Reduce Labor Costs
- Meet or Exceed Material Property Requirements

Foundry at 41st

Depth 2: Hollow-Core Concrete Plank
- ✓ Problem and Goals
- ○ **Background Information**
- ○ Execution
- ○ Structural Breadth
- ○ Recommendations

Depth 2: Background Information

	Hollow-core	Double Tee	Post-Tensions Cast in place
Span to Depth Ratio	Excellent	Good	Excellent
Construction Speed	Excellent	Excellent	Poor
STC Ratings	Excellent	Good	Excellent
Shoring Required	No	No	Yes (Significant)
Immediate Safe Working Platform	Yes	Yes	No
Span Lengths	Up to 30 ft	Up to 62 ft	Up to 30 ft
Typical Use	Podium Slabs Residential Floors Hospitality	Parking Garages Office Buildings Warehouse	Podium Slabs Residential Floors Parking Garages Office Buildings
Fire Rating	2 Hour	2 Hour	2 Hour
Contractor Benefits	Reduced Risk Speed of Construction Design Assistance	Reduced Risk Speed of Construction Design Assistance	Self Performance

Hollow Core Concrete Plank:
- Spans up to 35 ft
- Precast
- 2 Hour Fire Rating

Foundry at 41st

Depth 2: Hollow-Core Concrete Plank
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Structural Breadth
- ○ Recommendations

Depth 2: Execution

Cost Estimate:

Current System:
- Composite deck per sq ft= $9.59
- Total cost of the Composite Metal deck = $244, 104

Alternative System:
- Hollow-Core Plank per sq ft=$7.31
- Total cost of the Hollow-Core Plank=$186,068

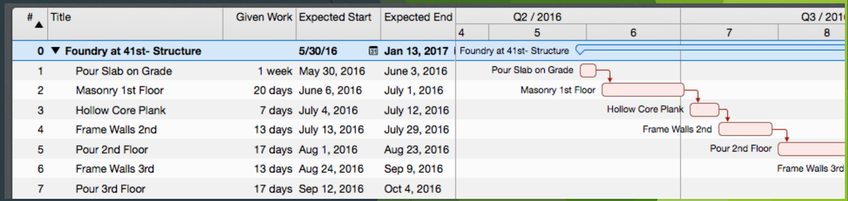
Total Savings= $27,120

Schedule:

Current System:
- Total Days= 28 days on site

Alternative System:
- Hollow-Core Plank per day= 4,500 sq feet
- Total Days= 7 days on site

Total Savings= 10 days



#	Title	Given Work	Expected Start	Expected End
0	**Foundry at 41st- Structure**		**5/30/16**	**Jan 13, 2017**
1	Pour Slab on Grade	1 week	May 30, 2016	June 3, 2016
2	Masonry 1st Floor	20 days	June 6, 2016	July 1, 2016
3	Hollow Core Plank	7 days	July 4, 2016	July 12, 2016
4	Frame Walls 2nd	13 days	July 13, 2016	July 29, 2016
5	Pour 2nd Floor	17 days	Aug 1, 2016	Aug 23, 2016
6	Frame Walls 3rd	13 days	Aug 24, 2016	Sep 9, 2016
7	Pour 3rd Floor	17 days	Sep 12, 2016	Oct 4, 2016

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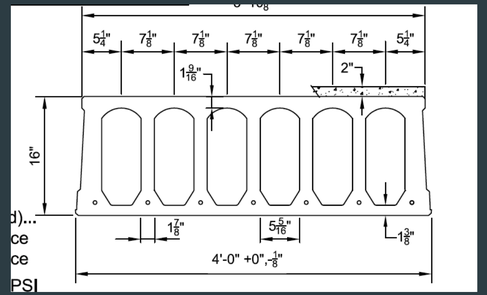
Depth 2: Hollow-Core Concrete Plank
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ○ **Structural Breadth**
- ○ Recommendations

Breadth 2: Structural Connections



Summary of Allowable Stresses

Top Stress=-877-416+935= -368 lb/in^2

Bottom Stress=+1354-416-935= 3 lb/in^2

Prestressed Concrete 16"x4'-0" NiCore Plank

2 Hour Fire Resistance Rating With 2" Topping

PHYSICAL PROPERTIES
Composite Section

A_c = 418 in.^{2}	Precast b_w = 14.25 in.
I_c = 15498 in.^{4}	Precast S_{bcp} = 1653 in.^{3}
Y_{bcp} = 9.38 in.	Topping S_{tct} = 2542 in.^{3}
Y_{tcp} = 6.62 in.	Precast S_{tcp} = 2340 in.^{3}
Y_{tct} = 8.82 in.	Precast Wt. = 367 PLF
	Precast Wt. = 91.75 PSF

Foundry at 41st

Depth 2: Hollow-Core Concrete Plank
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ✓ Structural Breadth
- ○ **Recommendations**

Depth 2: Hollow-Core Concrete Plank

Goals:
- ✓ Reduce the Schedule of Second Floor Construction
- X Reduce Labor Costs
- ✓ Meet or Exceed Material Property Requirements

Recommendation:
- ○ Yes, I would recommend on basis of:
- ✓ Reduced Schedule of 10 days
- ✓ Exceeds the material property

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Depth 3: LEED Implementation and Goals
- **Problem and Goals**
- Background Information
- Execution
- Mechanical Breadth
- Recommendations

Depth 3: LEED Implementation and Goals

Problem:
- Existing building can be LEED certified with Building Size Adjustment
- How can financially justify LEED accreditation

Goals:
- Perform the Size Adjustment
- Financially Justify LEED accreditation
- Objectives to reach Silver or Gold

Foundry at 41st

Depth 3: Background Information

- With the size adjustment, the Foundry is LEED Certified.
- If the Energy and Atmosphere points were pursued it could reach Silver or Goal Status.

Prerequisite/ Credit	Verification Submittals Provided by Project Team		Verification Team	Submittal to GBCI at Certification
EA c Annual Energy Use	Provide architectural plans and basis for calculating size of each home or unit.	AND	Verify building area for each building.	None
		AND	Verify home size adjustment calculation (including ensuring that only appropriate rooms are counted as bedrooms).	
		OR	Perform home size adjustment calculation for each building.	
	LEED Energy Budget report.	AND	Verify energy model output demonstrating energy savings from energy model.	
	OR			
	Calculations demonstrating annual energy use.	AND		

Size Adjustment:

Lowered Standard by 5 pts:
- Certified, 35
- Silver, 45
- Gold, 55
- Platinum 75 points

Threshold Adjustment
(point range: -10 to +10)

Maximum home size (ft²) by number of bedrooms					*Adjustment to award thresholds**
≤ 1 Bedroom	*2 Bedrooms*	*3 Bedrooms*	*4 Bedrooms*	*5 Bedrooms*	
610	950	1290	1770	1940	-10
640	990	1340	1840	2010	-9
660	1030	1400	1910	2090	-8
680	1070	1450	1990	2180	-7
710	1110	1500	2060	2260	-6
740	1160	1570	2140	2350	-5
770	1200	1630	2230	2440	-4
800	1250	1690	2320	2540	-3
830	1300	1760	2400	2640	-2
860	1350	1830	2500	2740	-1
900	**1400**	**1900**	**2600**	**2850**	**0 ("neutral")**
940	1450	1970	2700	2960	+1
970	1510	2050	2810	3080	+2
1010	1570	2130	2920	3200	+3
1050	1630	2220	3030	3320	+4
1090	1700	2300	3150	3460	+5
1130	1760	2390	3280	3590	+6
1180	1830	2490	3400	3730	+7
1220	1910	2590	3540	3880	+8
1270	1980	2690	3680	4030	+-9
1320	2060	2790	3820	4190	+10
For larger homes, or homes with more bedrooms, see below.					

Foundry at 41st

Depth 3: LEED Implementation and Goals
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Mechanical Breadth
- ○ Recommendations

Depth 3: Execution

Summary of Green Roof Cost and Schedule

Item	Estimate
Total Square Feet of Terrace	3,325 sq ft
Total Cost per square feet	$20/ sq ft
Total Investment	$66,500
Payback Period	4 years

Semi-Intensive Green Roof Design

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Depth 3: Execution

According to Research:

- Willing to pay $100 more for Green Apartment.
- The Average Green Apartment can cost up to $560 more per month.

Increase rent by 1%, $100 more a month

- Pay back Green Roof investment in 2-3 months
- Make a profit of $18,400 a month after that

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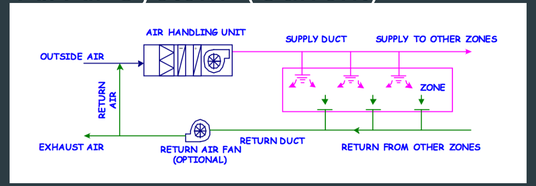
Depth 3: LEED Goals and Green Roof

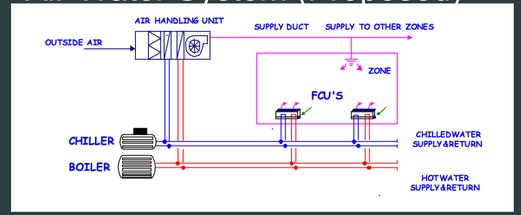
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ○ **Mechanical Breadth**
- ○ Recommendations

Breadth 2: Mechanical Breadth

All Air System (Current)



Air-Water System (Proposed)



Item	Estimate
All Air (current system)	$25/ square ft.
Air-Water System (alternative system)	$34/ square ft. (includes piping)
All Air Percentage of Budget	15%
Air-Water System Percentage of Budget	20%
All Air Total Cost	$5,250,000
Air-Water Total Cost	$6,870,000

Do Not Recommend:

-Expensive First Cost of Air-Water System
-Payback Period is too long
-Requires more to be maintained

Foundry at 41st

Depth 3: LEED Implementation and Goals
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ✓ Mechanical Breadth
- ○ **Recommendations**

Depth 3: LEED Implementation and Goals

Goals:
- ✓ Perform the Size Adjustment
- ✓ Financially Justify LEED accreditation
- ✓ Objectives to reach Silver or Gold

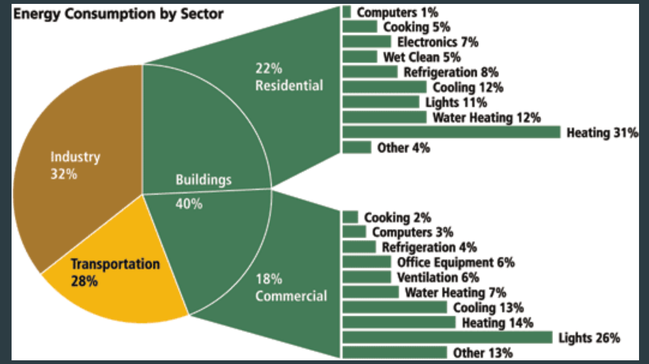
Recommendation:
- ○ Yes, I would Recommend on the basis of:
- ✓ LEED Certified building
- ✓ Work toward Energy and Atmosphere points

Foundry at 41st

Depth 4: Minimal Living Research
- **Problem and Goals**
- Background Information
- Execution
- Recommendations

Depth 4: Minimal Living Research

Problem:
Increased Consumption is damaging our environment.



Goals:
- Sustainable Living
- Simpler lifestyle
- Economic justification

Foundry at 41st

Depth 4: Minimal Living Research
- **Problem and Goals**
- Background Information
- Execution
- Recommendations

Depth 4: Minimal Living Research

Currently there is $2.2 Billion Dollar Storage Industry.

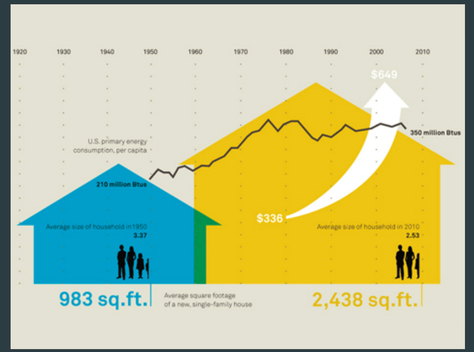
According to the Self Storage Association

"physically possible that every American could stand — all at the same time — under the total canopy of self-storage roofing."

Foundry at 41st

Depth 4: Minimal Living Research
- ✓ Problem and Goals
- ○ **Background Information**
- ○ Execution
- ○ Recommendations

Depth 4: Background Information



3x as much space per person now than in the 1950's

A Family of 4 Uses 40% of Space

The Solution. Microhouse.

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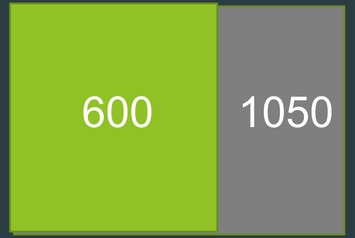
Depth 4: Minimal Living Research
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Recommendations

Depth 4: Execution

Redesign of 6th Floor

Average Sq. Ft. Reduction of 450 sq. ft. or 40%



Redesign 6th Floor Plan

Foundry at 41st

Depth 4: Minimal Living Research
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Recommendations

Depth 4: Execution

675 sq ft- 2 bed

530 sq ft- Micro

Unit Type	Quantity	Area per unit	Total Area
2 bed	10	675	6750
Micro	12	532	6384
			13134
Unit Type	**Quantity**	**Cost per unit**	**Monthly Income**
2 bed	10	1500	15000
Micro	12	1000	15000
			$30000

Broke even on cost:
- before 28,000 monthly income.

Additional 10,000 sq. ft. roof terrace
-tenants can have green roof and terrace

Foundry at 41st

Depth 4: Minimal Living Research
- ✓ Problem and Goals
- ✓ Background Information
- ○ **Execution**
- ○ Recommendations

Depth 4: Execution

Breakdown

New Layout
12, Micros
10, 2 Beds
=24 rooms,
32 people

Foundry at 41st

Depth 4: Minimal Living Research
- ✓ Problem and Goals
- ✓ Background Information
- ✓ Execution
- ○ **Recommendations**

Depth 4: Minimal Living Research

Recommendation: Yes, I would recommend.

Advantages	Disadvantages
Reduction of Utilities	Harder to market specific group of tenants?*
Breakeven on selling units	
Promotes a sustainable residential community	
Research shows people willing to pay more for sustainable spaces	*Lawrenceville, PA has seen an increase in 25% of young professionals to area.

Marketing to young adults: **25%** increase in young professionals in Lawrenceville in last 5 years.

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Conclusion

Depth 1: Kitchen Plumbing Manifold
- ✓ Save on waste plumbing
- ✓ Save 8 days on Schedule
- X Reduce Costs

Depth 3: LEED Goals and Green Roof
Breadth 2: Mechanical
- ✓ Perform the Size Adjustment
- ✓ Financially Justify LEED accreditation
- ✓ Objectives to reach Silver or Gold

Depth 2: Hollow-Core Concrete Plank
Breadth 1: Structural
- ✓ Reduce the Schedule of Second Floor Construction
- X Reduce Labor Costs
- ✓ Meet or Exceed Material Property Requirements

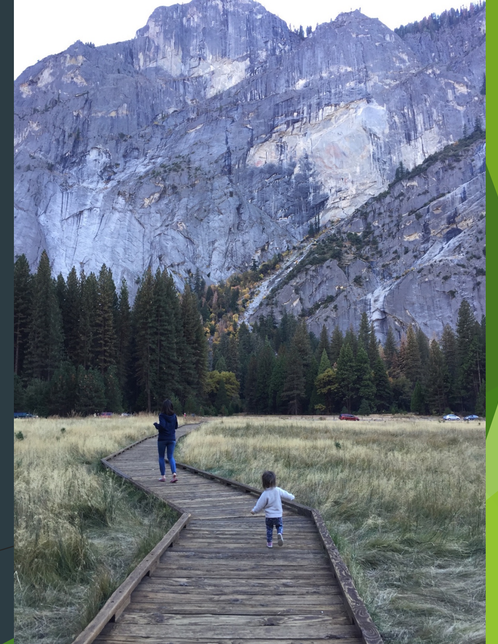
Depth 4: Minimal Living Research
- ✓ Reduction of the overall floorplan
- ✓ Create a design for a sustainable living floor

Foundry at 41st

Thank You!

PJ Dick	Project	Supports	Academic
Bryan Passarella	Walnut Capital	Mom and Dad	Dr. David Riley
Jude Champion	Rothschild Doyno	Diana Malcom	Dr. Robert Leicht
Bruce	AES	Ronda Stern	Dr. Moses Ling
Eric Pascucci	Allen & Shariff	Matt Grimes	Dr. John Messner

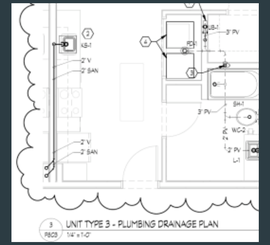
Thanks to all the Partners:



Appendix.

1. Plumbing Manifold

Item	Estimate
Total Plumbing Manifolds Cost	$35,589.7
Single Plumbing Manifold Cost	$781
Total Number of Linear Feet for 43 Manifolds	1,598



Dimensions: 18.7 ft approximately 20 ft long
3.5 ft wide
Dimension of Truck: 48 ft long
8.5 ft wide
Approximately 11 truckloads of 4 manifold each to the site
$1.7/ mile * 7 miles*2 trips*11 truckloads= $275 rental
$67/ hour*8 hour days* 10= $5360
Total Cost of Transportation= $5635

2. Hollow Core Plank

LEVEL 2 (SLAB/DECK) SCHEDULE

MARK	TYPE	REINFORCING	TOTAL THICKNESS
S3	5 1/4" N.WT. CONC. SLAB ON 2"-20 GA. COMP. STEEL DECK	REINF. W/ 6X6-W4.0XW4.0 W.W.F.	7 1/4"

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Span to Depth Ratio	Excellent	Good	Excellent
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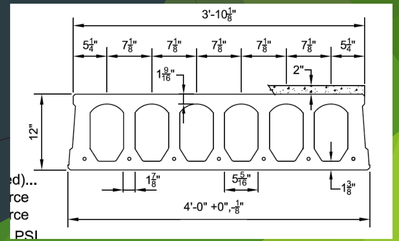
STC Ratings	Excellent	Good	Excellent
Shoring Required	No	No	Yes (Significant)
Immediate Safe Working Platform	Yes	Yes	No
Span Lengths	Up to 30 ft	Up to 62 ft	Up to 30 ft
Typical Use	Podium Slabs Residential Floors Hospitality	Parking Garages Office Buildings Warehouse	Podium Slabs Residential Floors Parking Garages Office Buildings
Fire Rating	2 Hour	2 Hour	2 Hour
Contractor Benefits	Reduced Risk Speed of Construction Design Assistance	Reduced Risk Speed of Construction Design Assistance	Self Performance

Prestressed Concrete 12"x4'-0" NiCore Plank

2 Hour Fire Resistance Rating With 2" Topping

PHYSICAL PROPERTIES
Composite Section

A_c = 361 in.^{2} Precast b_w = 14.25 in.
I_c = 7840 in.^{4} Precast S_{bcp} = 1081 in.^{3}
Y_{bcp} = 7.26 in. Topping S_{tct} = 1644 in.^{3}
Y_{tcp} = 4.74 in. Precast S_{tcp} = 1653 in.^{3}
Y_{tct} = 6.74 in. Precast Wt. = 308 PLF
Precast Wt. = 77.00 PSF



Appendix.

3. LEED Certification

Threshold Adjustment
(point range: -10 to +10)

Maximum home size (ft²) by number of bedrooms					*Adjustment to award thresholds**
≤ 1 Bedroom	*2 Bedrooms*	*3 Bedrooms*	*4 Bedrooms*	*5 Bedrooms*	
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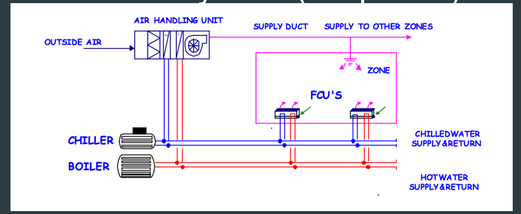
710	1110	1500	2060	2260	-6
740	1160	1570	2140	2350	-5
770	1200	1630	2230	2440	-4
800	1250	1690	2320	2540	-3
830	1300	1760	2400	2640	-2
860	1350	1830	2500	2740	-1
900	**1400**	**1900**	**2600**	**2850**	**0 ("neutral")**
940	1450	1970	2700	2960	+1
970	1510	2050	2810	3080	+2
1010	1570	2130	2920	3200	+3
1050	1630	2220	3030	3320	+4
1090	1700	2300	3150	3460	+5
1130	1760	2390	3280	3590	+6
1180	1830	2490	3400	3730	+7
1220	1910	2590	3540	3880	+8
1270	1980	2690	3680	4030	+9
1320	2060	2790	3820	4190	+10
For larger homes, or homes with more bedrooms, see below.					

Item	Estimate
All Air (current system)	$25/ square ft.
Air-Water System (alternative system)	$34/ square ft. (includes piping)
All Air Percentage of Budget	15%
Air-Water System Percentage of Budget	20%
All Air Total Cost	$5,250,000
Air-Water Total Cost	$6,870,000

Air-Water System (Proposed)



4. Minimal Living Research

Unit Type	Quantity	Area per unit	Total Area
2 bed	10	675	6750
Micro	12	532	6384
			13134
Unit Type	**Quantity**	**Cost per unit**	**Monthly Income**
2 bed	10	1500	15000
Micro	12	1000	15000
			$30000

Advantages	Disadvantages
Reduction of Utilities	Harder to market specific group of tenants?*
Breakeven on selling units	
Promotes a sustainable residential community	
Research shows people willing to pay more for sustainable spaces	*Lawrenceville, PA has seen an increase in 25% of young professionals to area.