

CRETE house

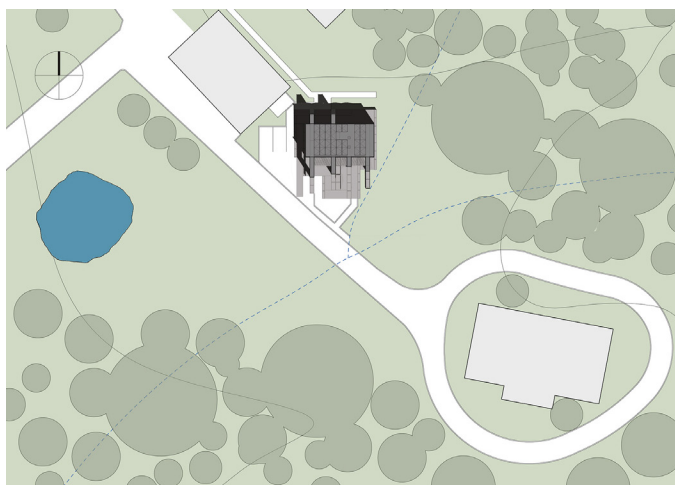
MARKET POTENTIAL

MISSION STATEMENT

CRETE house is a model for advanced building technology, resiliency, safety and livability. The project is designed as a demonstration of integrated innovative precast concrete panelized system used in single-family homes, as a compelling alternative to traditional wood light frame construction.

DEFINED TARGET CLIENT

CRETE house will be permanently located at Tyson Research Center, an internationally renowned biological field station for environmental research and education uniquely sited on 2000 acres of native landscape in Eureka, Missouri. As a part of Washington University in St. Louis, it provides scientific outreach and educational programs as an “outdoor classroom” for students K-12 in addition to university level academics. The goal is to promote interdisciplinary research to confront the challenges that face us in energy and sustainability on a global scale.



CRETE house's FINAL LOCATION AT TYSON RESEARCH CENTER

The house is designed as a short-term residence for research scientists at Tyson Research Center. Most research conducted at Tyson is led by one researcher or a team of two. Accordingly, our house will contain flexible space configurable for two life stages: a single researcher, and a team of two researchers. It contains two rooms that can be used either as a bedroom or as office space. The building's interior core location and configuration allows flexibility of use for both dwellers.

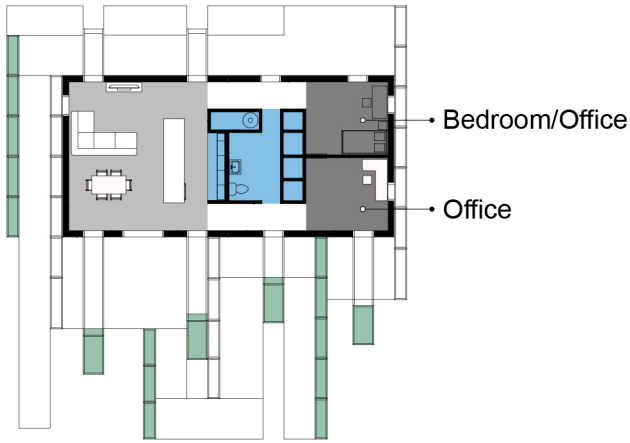
This home will allow researchers to inhabit and study different areas of Tyson, and provide them with the necessary resources to remain there throughout the duration of their research.



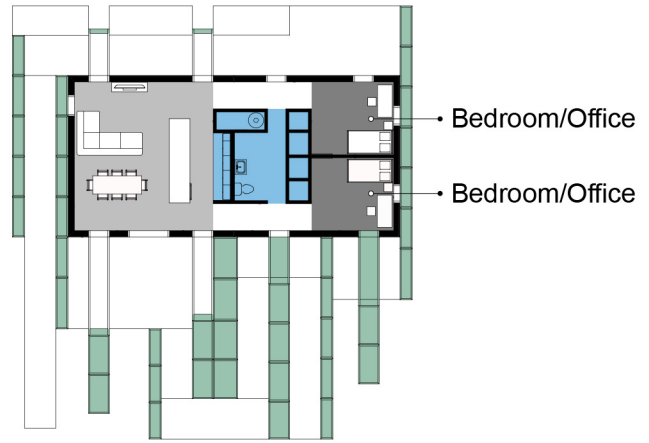
SCIENTISTS CONDUCTING RESEARCH AT TYSON

CRETE house, as a prototype, has the potential to be an affordable option for a variety of homeowners. It is sustainable, has low operating costs and can easily be constructed on any plot.

There is a booming research community



LIVING SCENARIO 1:
SINGLE RESEARCHER / YOUNG PROFESSIONAL
MINIMAL TO MEDIUM PLANTING



LIVING SCENARIO 2:
TWO RESEARCHERS / YOUNG PROFESSIONALS
MEDIUM TO MAXIMUM PLANTING

at Tyson and several strong collegiate campuses in the surrounding area that give an opportunity for several experts and specialists in different fields of work to utilize a home such as CRETE house. Washington University in St. Louis, as well, attracts many students and young professionals that desire to live independently while working on their research.

As the Tyson Research Center positions itself to become a world class biological field station, the addition of a residential community to support the already thriving academic community represents a big step in its 53-year history.

Hellmuth + Bicknese Architects was retained to develop a Master Plan for the field station utilizing the Living Community Challenge as a framework. This capitalizes and builds on the success of the Tyson Living Learning Center, one of the first two certified Living Buildings in the world, to the entire 2,000-acre campus. CRETE house will fit into the new Academic Village, as envisioned in the Master Plan, and be yet another step towards the creation of a Net Positive Energy and Water Biological field station - another first in the country.

THE SITE

The history of the site goes as far back as 12,000 B.C. when Native Americans would use Tyson as a quarry site to obtain the resources necessary to construct their tools. It is believed that Native American families inhabited the area along the side of the Meramec flood plain northwest of Tyson. A Today, Tyson is dense with trees and vegetation, but in the late 1800s/early 1900s the entire area was clear cut.



TYSON RESEARCH CENTER

Due to fire suppression after the clearcutting, the forest grew back very thick. During and after World War II, the Federal government acquired the land and used it to run military strategic operations, such as the building of bunkers and the storing of weapons. However,

within two decades the Tyson property would once again change ownership.

RESEARCH VISION

Washington University acquired Tyson from the government in 1963. Presently, the property spans 1,966.5 acres. The acquiring of the land granted many researchers with the opportunity to utilize its resources for the purposes of ecological research and teaching. During the initial years of obtaining this property, Washington University professors, graduate students, and Tyson staff took on a variety of studies. Some of the projects involved an extensive range of subjects, from forests to amphibians. Over the years, Tyson has also opened its doors to children from grades K-12. Tyson has provided these students with environmental awareness and education through the efforts of professional Biologists, Chemists, Engineers, Entomologists, Botanists, Herpetologists, Mathematicians, Architects, etc. The interdisciplinary cooperation has become so central to Tyson throughout the years that, currently, it is being used more heavily than it ever has been for teaching, research, and outreach. The programs run here continue to involve the faculty and students from Washington University, as well as a visiting or guest researcher from other local and national institutions.

Tyson's primary research focus is on ecosystem degradation, restoration, and sustainability, and they do this as part of Washington University's International Center for Energy, Environment and Sustainability (InCEES). Under the support of InCEES, the sustainability research that is done at Tyson focuses on the conservation and restoration of biodiversity and ecosystem services.

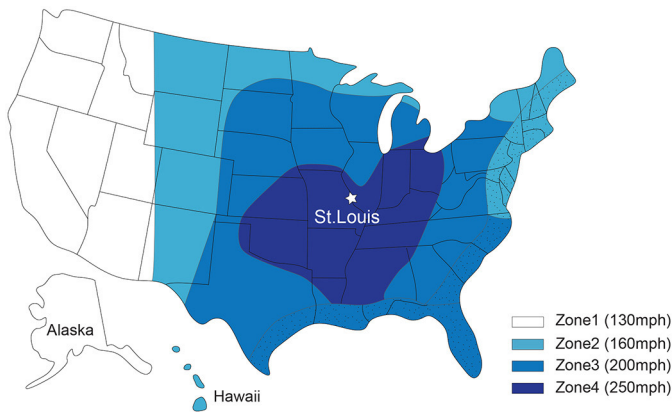


SCIENTIST CONDUCTING RESEARCH AT TYSON

Lastly, other research projects include the studying of environmental biology, sustainable architecture and energy, archaeology, geology, hydrology, crop production, and biotechnology. CRETE house will be constructed at Tyson Research Center, where a new eco-village for research lodging will be a beneficial addition to further aid in the research and education at the site.

RESILIENCY, SAFETY AND DURABILITY

High performance precast concrete structures are inherently resilient. They protect against fire, moisture and mold, insects, seismic events, extreme weather conditions and man-made phenomena such as blasts, force protection and acoustic mitigation. Like many cities in the midwest, St. Louis is in the tornado risk zone, and CRETE house is designed to withstand the force of strong storms while keeping its occupants safe.



TORNADO RISK MAP

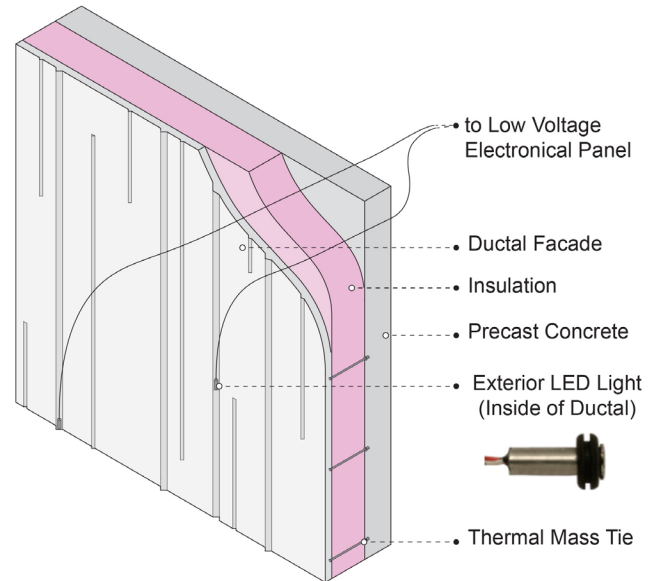
The building enclosure performs different functional roles at different scales by integrating a variety of cultural, social and environmental elements. As a physical interface of spatial, organizational, social, and environmental exchange, a high performance building enclosure design is a particularly critical area of design for CRETE house. The goal for Team WashU is to maximize the performance of the concrete mass in terms of its thermal, structural, resilient and aesthetics properties.

This house uses durable and insulated robust precast concrete panels manufactured in a factory and assembled on-site. Specially designed dry connection methods using bolts rather than traditional field welds make field assembly much easier than traditional methods, significantly reducing field labor and material waste.

The exterior precast concrete walls present a series of strategically placed window and doors. These openings have been carefully dimensioned and located in order to maximize thermal performance and optimal natural light. Additionally, outboard of the windows CRETE house employs an exterior venetian blind system which, when closed, creates an additional layer of protection for the opening in addition to adding privacy and controlling glare and solar gain.

THE UHPC ENVELOPE

Team WashU developed a precast concrete sandwich panel for the exterior walls, which consist of 4" of standard concrete for the interior wythe of the assembly, 5" of insulation and 1-1/4" ultra-high-performance-concrete (UHPC) exterior layer, using Ductal. This is the first time Ductal is used in a sandwich precast panel and in such a thin wythe.



WALL ASSEMBLY DETAIL / INTEGRATED EXTERIOR LIGHTING

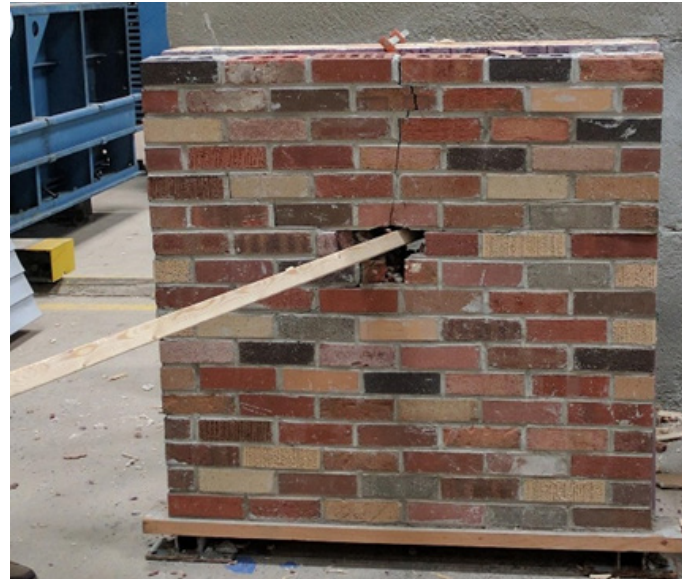
The thin exterior layer significantly reduces the overall thickness and weight of the wall, as compared to traditional precast sandwich panels, which lowers the overall embodied energy. Additionally, it lowers the cost and energy related to shipping the panels to the jobsite. It also provides the possibility of unlimited configurations with geometries and variable thicknesses, which are not possible with traditional concrete panels.

TORNADO CANNON DEMONSTRATION

Last June, Dukane Precast, one of CRETE

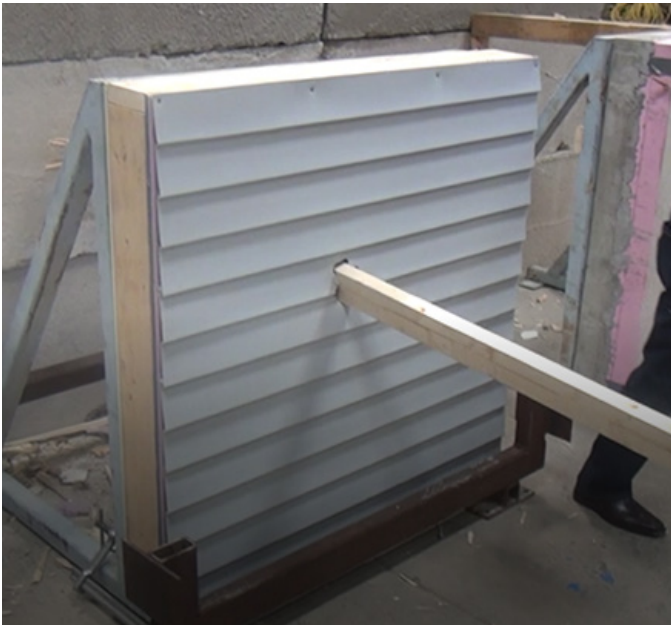
house's industry partners, conducted a tornado cannon test to demonstrate the resiliency of precast concrete against windblown debris generally found in high wind event storms, such as hurricanes and tornadoes. The demonstration emulates flying debris that often become deadly projectiles during extreme storms. It also involved shooting 2x4 wood studs at a high speed at three wall sections.

Wall panel A: typical residential wood-framed wall (vinyl-sided layer, 1/2 " exterior sheathing, R-19 insulation and drywall on the interior). This wall section was shot with a stud at approximately 60 mph (equivalent to only an EF-1 or straight line winds). The stud penetrated the wood framed wall section completely.



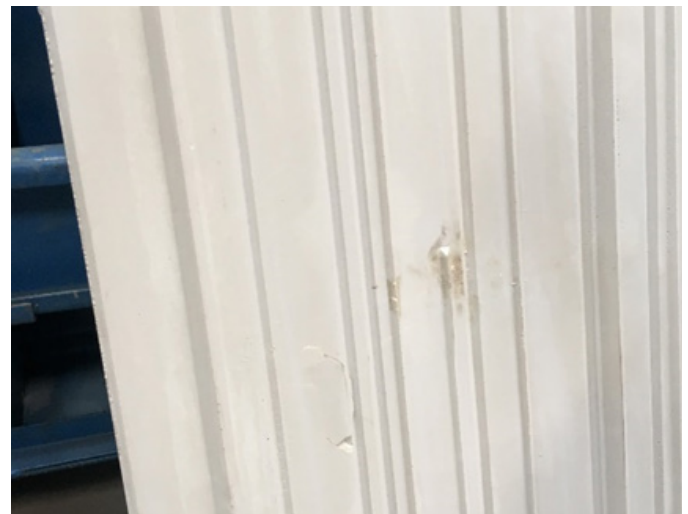
AT 60 MPH, 2X4 PENETRATES THROUGH A BRICK WALL SECTION

Wall panel C: a mockup of CRETE house's precast concrete wall section. The stud shot at the precast concrete wall shattered without penetrating or cracking the wall at all, in fact it barely left a mark. The test was conducted again, this time the stud was shot at 100 mph (a speed that emulates an EF5 tornado with a 260 mph vortex) matching the FEMA 320 live wind test for a tornado shelter, the stud penetrated the UHPC but not the inner pre-cast wythe of the assembly.



AT 60 MPH, A 2X4 PENETRATES THROUGH A WOOD FRAME WALL SECTION

Wall panel B: typical commercial building brick Wall, framed with 2x6 wood studs (exterior layer of full bricks, 1/2" sheathing, R-19 insulation, and 1/2" drywall panels. Once again, the stud completely penetrated the assembly.



AT 60 MPH, A 2X4 LEAVES A SURFACE MARK ON THE EXTERIOR FACADE OF THE CRETE WALL SECTION

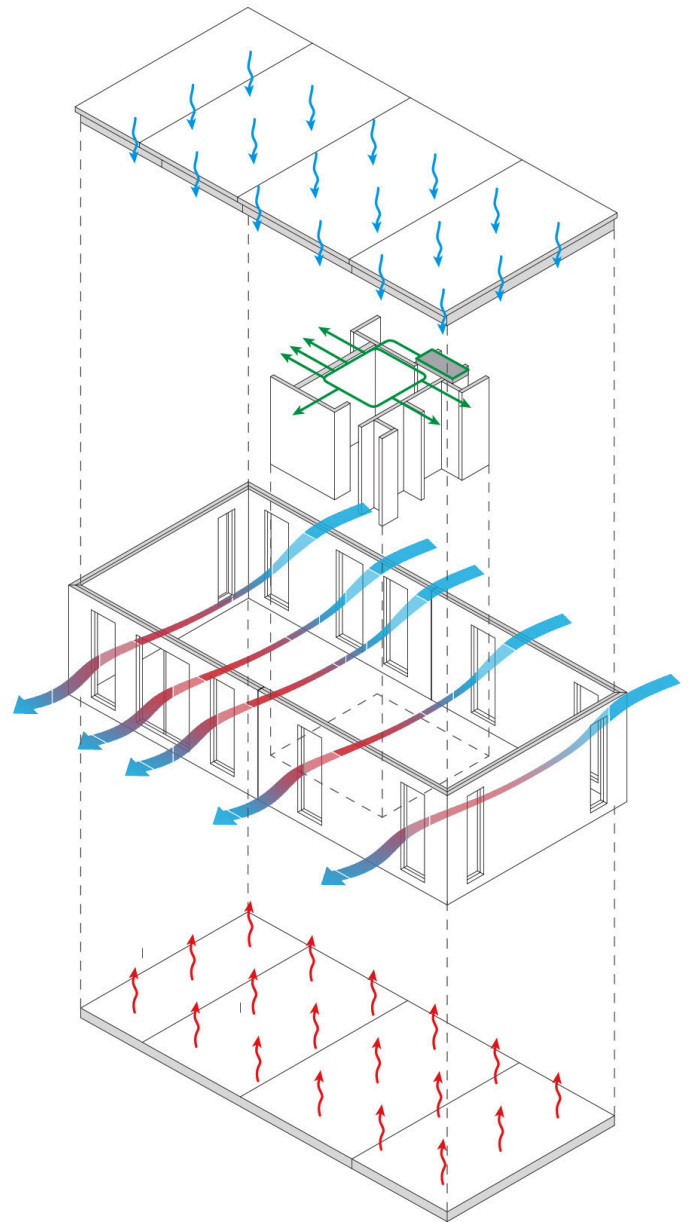
As a result, we can confidently establish that the UHPC wall assembly used in CRETE house is resilient against flying debris due to extreme weather conditions and safe for its occupants in such events. "Due to its optimized gradation of the raw material components, UHPC is 10 percent denser than conventional concrete. Although it weighs the same as conventional concrete, a UHPC panel would use just one quarter of the material required for a panel made with conventional concrete, hence the ability to produce more lightweight components with thinner, longer spans. Along with nanometer sized, non-connected pores throughout the cementitious matrix, this contributes to the material's imperviousness and durability against adverse conditions or aggressive agents. As well, UHPC is highly moldable, replicating texture, form, and shape with precision. Liquid or powder color pigments may be added and use of clear-coat sealants further protect finished surfaces from fading, surface staining, and graffiti.

Overall, UHPC can be an exceptional material choice for innovative, attractive architectural precast elements that are extremely durable and lightweight. UHPC performs well in terms of abrasion and chemical resistance, freeze-thaw, carbonation, and chloride ion penetration. Based on ion transportation predictive modeling, it would take 1000 years for UHPC to have the same level of chloride penetration as high-performance concrete would have in less than 100 years. The potential for building façades with a millennium-long design life (along with little to no maintenance and less environmental impact over time) is a huge paradigm shift from the way sustainable infrastructure is viewed today."¹

¹ G8WAY DC, Ultra-high performance concrete has it covered, by Kelly A. Henry and Bill Henderson.

THERMAL MASS

In precast concrete, the thermal mass acts as a balancing system to moderate diurnal effects from climate, allowing for novel control strategies with smaller mechanical equipment thereby decreasing the upfront cost premium of a concrete structure.



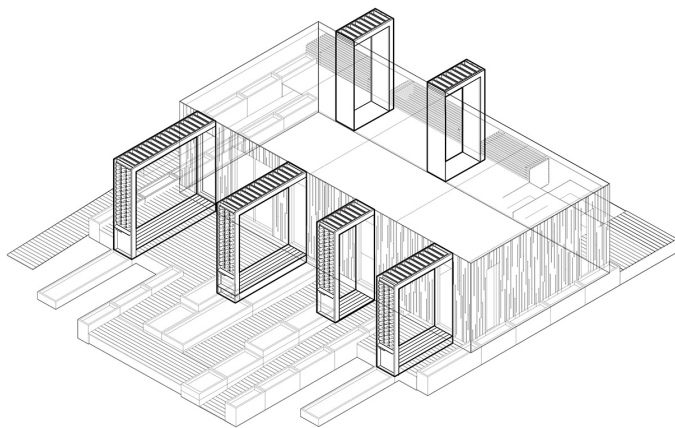
PASSIVE VS. ACTIVE SYSTEMS

In the winter, this mass, coupled with south facing passive solar glazing components, maximizes the passive solar heating potential of the structure as a component of an integrated operating system.

OUTDOOR TRANSITIONAL SPACE

CRETE house consists of a single precast concrete volume treated as an elegant massing, which engages its surrounding landscape. It is a 2:1 rectangular mass, with an east-west orientation. The north and south walls are modulated with concrete “gutters”, and each of them exists as a displacement of the façade’s openings to create a transitional partially covered exterior space. Where the gutters are pulled out from the concrete box, openings are created, forming full height windows and doors allowing natural light and cross-ventilation through the short side of the massing.

This creates a framed outdoor space as a mediator between interior and exterior space. Users can enjoy this transitional space, which extends out the rooms during the enjoyable fall and spring seasons in the St. Louis area. The creation of the outdoor spaces located between the delicate gesture of the “gutters” and the solid stance of the interior concrete box gives users the opportunity to expand their living and working spaces into the natural environment.

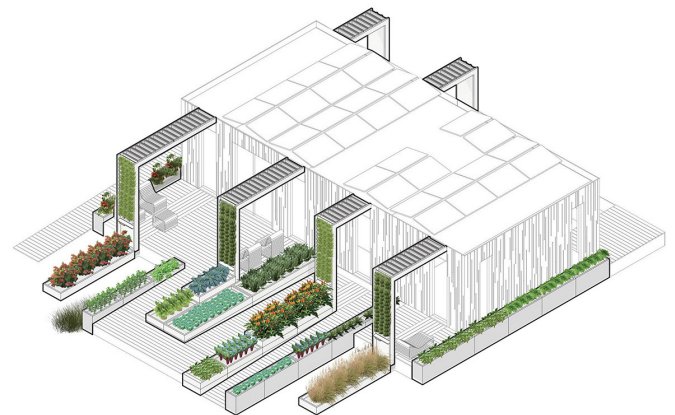


FRAMED OUTDOOR SYSTEM

In addition to creating a framed outdoor space, the gutters perform multiple functions: working as water collector, vertical planting surface supporting a hydroponic system, and sunshade for the corresponding windows behind. The gutters and planters, as a collective unit, will serve as a productive device allowing for the cultivation of vegetables for consumption. It will also serve a formal role as safety and privacy barriers for the inhabitants and their visitors.

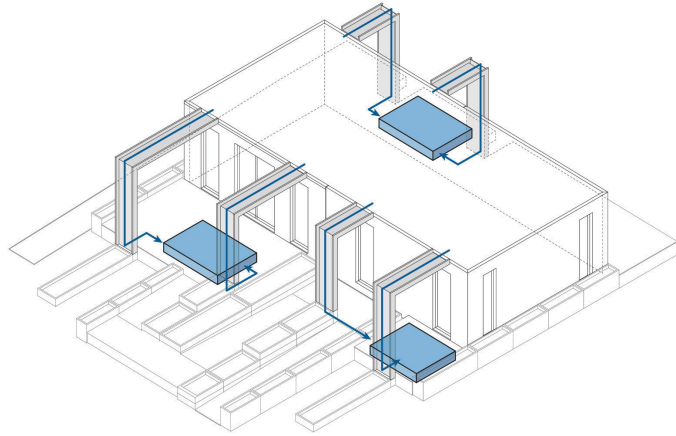
SELF-SUFFICIENCY

CRETE house addresses self-sufficiency in terms of energy, water and food production. It provides an attractive outdoor space integrated with varying capacities of the exterior to grow food sustainably. CRETE house is able to demonstrate a true community collaborative food supply, through a home garden system. As part of a sustainable lifestyle, the house has the ability to provide nearly year-round vegetables, fruits and spices cared and harvested by the residents.



PRODUCTIVE LANDSCAPE

If CRETE house were integrated into neighborhoods within St. Louis, a sustainable edible garden could be a place of community, collaboration and self-sufficiency for food deserts (areas that do not have quick access to produce and grocery stores).



WATER COLLECTION STRATEGY

Implementation and influence of CRETE house within St. Louis neighborhoods is a long-term goal by nature of its prefabrication and modular capabilities. However, the permanent location of this house after the competition, will be at Tyson Research Center right outside the city of St. Louis.

At Tyson, the house will accommodate researchers living and working at the ecological center. The landscaping and edible gardening may remain or adapt to the needs of these residents. For example, the plants may alter to species the researchers are examining or trying to preserve.

LIFE CYCLE

The life cycle of a precast concrete building is more than 100 years. If reinforced with nonferrous materials, such as GFRP (glass-fiber reinforced polymer), concrete lasts much longer. The standard life cycle of a conventional wood structure is about 30 years. The upfront capital cost for a precast concrete house is affordable, considering the long life cycle of the structure. The longer a building's presumed lifecycle, the more sense it makes, in terms of both financial and embodied energy payback, to invest capital up front for energy savings and resiliency.





CRETE house

COST ESTIMATE

August 10, 2017

CRETE House

Washington University in St. Louis

FINAL Estimate

Denver, CO

GFA 996

CONSTRUCTION COST SUMMARY					
SYSTEM DESCRIPTION		SUB-TOTAL	TOTAL	\$/SF	%
A10 FOUNDATIONS					
A1010	Standard Foundations	\$8,850			
A1020	Special Foundations	\$1,050			
A1030	Lowest Floor Construction	\$0	\$9,900	\$9.94	2.3%
A20 BASEMENT					
A2010	Basement Excavation	\$0			
A2020	Basement Walls	\$0	\$0	\$0.00	0.0%
B10 SUPERSTRUCTURE					
B1010	Upper Floor Construction	\$17,660			
B1020	Roof Construction	\$22,075	\$39,735	\$39.89	9.4%
B20 EXTERIOR CLOSURE					
B2010	Exterior Walls	\$51,500			
B2020	Windows	\$21,450			
B2030	Exterior Doors	\$10,209	\$83,159	\$83.49	19.6%
B30 ROOFING					
B3010	Roof Coverings	\$8,220			
B3020	Roof Openings	\$1,400	\$9,620	\$9.66	2.3%
C10 INTERIOR CONSTRUCTION					
C1010	Partitions	\$10,000			
C1020	Interior Doors	\$4,001			
C1030	Specialties/Millwork	\$12,345	\$26,346	\$26.45	6.2%
C20 STAIRCASES					
C2010	Stair Construction	\$0			
C2020	Stair Finishes	\$0	\$0	\$0.00	0.0%
C30 INTERIOR FINISHES					
C3010	Wall Finishes	\$7,517			
C3020	Floor Finishes	\$4,265			
C3030	Ceiling Finishes	\$4,226	\$16,008	\$16.07	3.8%
D10 CONVEYING					
D1010	Elevator	\$0			
D1020	Escalators and Moving Walkways	\$0			
D1090	Other Conveying Systems	\$0	\$0	\$0.00	0.0%
D20 PLUMBING					
D2010	Plumbing Fixtures	\$9,282			
D2020	Domestic Water Distribution	\$5,906			
D2030	Sanitary Waste	\$2,658			
D2040	Rain Water Drainage	\$1,176			
D2090	Other Plumbing Systems	\$0	\$19,022	\$19.10	4.5%
D30 MECHANICAL					
D3010	Energy Supply	\$0			
D3020	Heat Generating Systems	\$11,168			
D3030	Cooling Generating Systems	\$1,168			
D3040	Distribution Systems	\$5,607			

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SYSTEM DESCRIPTION		SUB-TOTAL	TOTAL	\$/SF	%
D3050	Terminal & Package Units	\$0			
D3060	Controls & Instrumentation	\$800			
D3070	Systems Testing & Balancing	\$494	\$19,237	\$19.31	4.5%
D40	FIRE PROTECTION				
D4010	Fire Protection	\$4,673			
D4020	Standpipes	\$0			
D4030	Fire Protection Specialties	\$0	\$4,673	\$4.69	1.1%
D50	ELECTRICAL				
D5010	Electrical Service & Distribution	\$1,059			
D5020	Lighting & Branch Wiring	\$7,352			
D5030	Communications & Security Systems	\$0			
D5090	Other Electrical Systems	\$1,579	\$9,989	\$10.03	2.4%
E10	EQUIPMENT				
E1010	Commercial Equipment	\$11,113			
E1020	Institutional Equipment	\$0			
E1030	Vehicular Equipment	\$0			
E1090	Other Equipment	\$1,272	\$12,385	\$12.44	2.9%
E20	FURNISHINGS				
E2010	Fixed Furnishings	\$5,000			
E2020	Movable Furnishings	\$3,000	\$8,000	\$8.03	1.9%
F10	SPECIAL CONSTRUCTION				
F1010	Special Structures	\$48,771			
F1020	Integrated Construction	\$0			
F1030	Special Construction Systems	\$0			
F1040	Special Facilities	\$0	\$48,771	\$48.97	11.5%
F20	SELECTIVE BUILDING DEMOLITION				
F2010	Building Elements Demolition	\$0			
F2020	Hazardous Components Abatement	\$0	\$0	\$0.00	0.0%
G10	SITE PREPARATION				
G1010	Site Clearing	\$0			
G1020	Site Demolition and Relocations	\$0			
G1030	Site Earthwork	\$10,000			
G1040	Hazardous Waste Remediation	\$0	\$10,000	\$10.04	2.4%
G20	SITE IMPROVEMENT				
G2010	Roadways	\$0			
G2020	Parking Lots	\$0			
G2030	Pedestrian Paving	\$0			
G2040	Site Development	\$0			
G2050	Landscaping	\$1,755	\$1,755	\$1.76	0.4%
G30	SITE MECHANICAL UTILITIES				
G3010	Water Supply	\$0			
G3020	Sanitary Sewer	\$0			
G3030	Storm Sewer	\$0	\$0	\$0.00	0.0%

August 10, 2017

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CONSTRUCTION COST SUMMARY						
SYSTEM DESCRIPTION		SUB-TOTAL	TOTAL	\$/SF	%	
G40 SITE ELECTRICAL UTILITIES						
G4010	Electrical Distribution	\$22,474				
G4020	Site Lighting	\$10,000				
G4030	Site Communications and Security	\$0				
G4090	Other Electrical Utilities	\$0	\$32,474	\$32.60	7.7%	
TOTAL DIRECT COST (Trade Costs)			\$351,073	\$352.48	82.8%	
MARKUPS						
	General Conditions, Overhead & Profit	10.00%	\$35,107	\$35,107	35.24833037	8.3%
SUBTOTAL CONSTRUCTION			\$386,181	\$387.73	91.1%	
CONTINGENCIES/ESCALATION						
	Design and Pricing Contingency	2.50%	\$9,655			
	Trucking	10 trucks	\$20,000			
	Crane time	3 days	\$4,875			
	Lull/Forklift	2 days	\$3,250	\$37,780	\$37.93	8.9%
TOTAL PROJECT COST			\$423,960	\$425.66	100.0%	

Denver, CO

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DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
A10 FOUNDATIONS						
A1010 STANDARD FOUNDATIONS						
Precast Concrete Strip Footings	59	ly	150.00	\$8,850		
SUBTOTAL					\$8,850	
A1020 SPECIAL FOUNDATIONS						
Deck Footings	21	lf	50.00	\$1,050		
SUBTOTAL					\$1,050	
A1030 SLAB ON GRADE						
SUBTOTAL					\$0	
TOTAL - FOUNDATIONS						\$9,900
A20 BASEMENT						
A2010 BASEMENT EXCAVATION						
SUBTOTAL					\$0	
A2020 BASEMENT WALLS						
SUBTOTAL					\$0	
TOTAL - BASEMENT CONSTRUCTION						\$0
B10 SUPERSTRUCTURE						
B1010 FLOOR CONSTRUCTION						

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DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST	
	Precast Concrete Sandwich Floor Panels (3" concrete, 5" insulation, 4" concrete)	883	sf	20.00	\$17,660			
	SUBTOTAL					\$17,660		
B1020	ROOF CONSTRUCTION							
	Precast Concrete Roof Panels (7" concrete)	883	sf	25.00	\$22,075			
	SUBTOTAL					\$22,075		
TOTAL - SUPERSTRUCTURE							\$39,735	
B20	EXTERIOR CLOSURE							
B2010	EXTERIOR WALLS							
	Precast Concrete Sandwich Wall Panels (4" concrete, 5" insulation, 1.5" Ductal)	1,314	sf	39.19	\$51,500			
	SUBTOTAL					\$51,500		
B2020	EXTERIOR WINDOWS							
	Winco, swing window, 35"x107.5", double pane, aluminum	6	ea	1,161.00	\$6,966			
	Winco, swing window, 25"x107.5", double pane, aluminum	3	ea	778.00	\$2,334			
	Hella External Blinds, motorized drive, 863x2705mm	6	ea	1,350.00	\$8,100			
	Hella External Blinds, motorized drive, 609x2705mm	3	ea	1,350.00	\$4,050			
						\$21,450		
B2030	EXTERIOR DOORS							
	Winco, in swing terrace door, 78" x 107.5"	1	ea	1,675.00	\$1,675			
	Winco, in swing terrace door, 35" x 107.5"	2	ea	1,161.00	\$2,322			

Denver, CO

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DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Winco, in swing terrace door, 39" x 107.5"	1	ea	512.00	\$512		
Hella External Blinds, motorized drive, 937x2705mm	1	ea	1,350.00	\$1,350		
Hella External Blinds, motorized drive, 863x2705mm	2	ea	1,350.00	\$2,700		
Hella External Blinds, motorized drive, 1931x2705mm	1	ea	1,650.00	\$1,650		
SUBTOTAL					\$10,209	
TOTAL - EXTERIOR CLOSURE						\$83,159
B30 ROOFING						
B3010 ROOF COVERINGS						
13" of expanded polystyrene	870	sf	6.00	\$5,220		
2" average tapered insulation (EPDM membrane)	1,000	sf	3.00	\$3,000		
SUBTOTAL					\$8,220	
B3020 ROOF OPENINGS						
All penetrations pre cut in precast Flashing	140	lf	10.00	\$1,400		
SUBTOTAL					\$1,400	
TOTAL - ROOFING						\$9,620
C10 INTERIOR CONSTRUCTION						
C1010 PARTITIONS						
Prefabricated light gauge steel core (~13' 6" L x 12' 8" W x 8' 3" H)	1.0	ea	10,000.00	\$10,000		
SUBTOTAL					\$10,000	
C1020 INTERIOR DOORS						

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST	
	(2) plain sliced white maple (3' 7.5" x 9' x 1.75")	2.0	ea	502.00	\$1,004			
	(9) rotary cut natural birch (sizes vary)	9.0	ea	333.00	\$2,997			
	SUBTOTAL					\$4,001		
C1030	FITTINGS							
	Countertops, 2.5" polished concrete	52.4	SF	60.05	\$3,148			
	Lower Cabinet	14.0	LF	397.00	\$5,558			
	Island, Wood Wrap	39.3	SF	15.00	\$590			
	Upper Cabinet	3.5	LF	397.00	\$1,390			
	Bathroom Specialties							
	Countertop	5.0	SF	60.05	\$297			
	Mirror	1.0	ea	200.00	\$200			
	Toilet Tissue Dispenser	1.0	ea	38.85	\$39			
	Grab Bars	2.0	ea	168.00	\$336			
	Glass	31.5	SF	25.00	\$788			
	SUBTOTAL					\$12,345		
TOTAL - INTERIOR CONSTRUCTION							\$26,346	
C20	STAIRCASES							
C2010	STAIR CONSTRUCTION							
	SUBTOTAL					\$0		
C2020	STAIR FINISHES							
	SUBTOTAL					\$0		
TOTAL - STAIRCASES							\$0	
C30	INTERIOR FINISHES							
C3010	WALL FINISHES							
	Tile, Bathroom	83.4	SF	10.64	\$888			
	Accent Tile, Bathroom	38.3	SF	12.75	\$488			
	Backsplash, Kitchen	11.8	SF	53.50	\$631			
	Core, Taktl uhpc	677.2	SF	7.22	\$4,890			
	Core, 1/2" Drywall	108.5	SF	5.72	\$621			

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST	
SUBTOTAL						\$7,517		
C3020	FLOOR FINISHES							
	Bathroom Tile	47.5	SF	10.64	\$505			
	Wood, with vinyl floor stripping on top	250.6	SF	15.00	\$3,760			
SUBTOTAL						\$4,265		
C3030	CEILING FINISHES							
	Perferated metal stripping	250.6	SF	15.00	\$3,760			
	Bathroom, 1/2" Drywall	81.5	SF	5.72	\$466			
SUBTOTAL						\$4,226		
TOTAL - INTERIOR FINISHES							\$16,008	
D10 CONVEYING								
D1010	ELEVATORS & LIFTS							
SUBTOTAL						\$0		
D1020	ESCALATORS & MOVING WALKWAYS							
SUBTOTAL						\$0		
D1090	OTHER CONVEYING SYSTEMS							
SUBTOTAL						\$0		
TOTAL - CONVEYING SYSTEMS							\$0	
D20 PLUMBING								
D2010	PLUMBING FIXTURES							
	Toilet - Kohler 76395-0	1	Each	5,400.00	\$5,400			
	Toilet Tank - Kohler 18647-NA	1	Each	0.00	\$0			
	30" Jute Vanity - Kohler 99540-1WA	1	Each	915.25	\$915			
	Vanity Top - Kohler 5422-S33	1	Each	507.60	\$508			

August 10, 2017

CRETE House

Washington University in St. Louis

FINAL Estimate

NOTE TO ALL TEAM ESTIMATORS
 COLUMNS H, I, AND J CONTAIN FORMULAS
 PLEASE DO NOT EDIT, MOVE, OR DELETE THEM!

Denver, CO

GFA 996

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Jute Bar Pull - Kohler 99688-HF1	2	Each	19.95	\$40		
Lavatory - Kohler 5403-P5-0	1	Each	380.00	\$380		
Lavatory Faucet - Kohler T14415-4-CP	1	Each	550.20	\$550		
Valve - Kohler 410-K-NA	1	Each	209.55	\$210		
Lavatory Drain - Kohler 7124-A-CP	1	Each	82.75	\$83		
TP Holder - Kohler 73147-CP	1	Each	120.00	\$120		
Towel Bar - Kohler 73143-CP	1	Each	170.00	\$170		
Showerhead - Kohler 939-CP	1	Each	97.05	\$97		
Valve Trim - Kohler TS73115-4-CP	1	Each	276.00	\$276		
Valve - Kohler 8304-KS-NA	1	Each	130.45	\$130		
Shower Arm - Kohler 99690-CP	1	Each	163.15	\$163		
Washer Hookup	1	Each	120.00	\$120		
Dishwasher Hookup	1	Each	120.00	\$120		
SUBTOTAL						\$9,282
D2020 DOMESTIC WATER DISTRIBUTION						
Potable Water Storage Tank, 200 gallon	2	Each	250.00	\$500		
Potable Water Storage Pressure Tank	1	Each	300.00	\$300		
Domestic Water Tank, 50 gallon	1	Each	1,467.00	\$1,467		
Domestic Water Distribution Piping	220	LF	15.20	\$3,344		
Domestic Water Pump	1	Each	250.00	\$250		
Expansion Tank	1	Each	45.00	\$45		
SUBTOTAL						\$5,906
D2030 SANITARY WASTE						
Sanitary Sewer Tank, 200 gallon	2	Each	250.00	\$500		
Sanitary Waste Piping, PVC	90	LF	15.20	\$1,368		
Holding Tank	1	Each	400.00	\$400		
Sanitary Waste Pump	1	Each	389.90	\$390		
SUBTOTAL						\$2,658
D2040 RAIN WATER DRAINAGE						
Pumps	3	Each	50.00	\$150		
Rain water storage Tanks, 250 gal	3	Each	300.00	\$900		
Piping	100	LF	1.26	\$126		

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
SUBTOTAL						\$1,176	
D2090	OTHER PLUMBING SYSTEMS						
SUBTOTAL						\$0	
TOTAL - PLUMBING							\$19,022
D30	MECHANICAL						
D3010	ENERGY SUPPLY						
SUBTOTAL						\$0	
D3020	HEAT GENERATING SYSTEMS						
	Radiant Heat, 3/4" tubing	927	lf	1.26	\$1,168		
	Hydro Temp Heat Pump	1	ea	10,000.00	\$10,000		
SUBTOTAL						\$11,168	
D3030	COOLING GENERATING SYSTEMS						
	Radiant Cooling, 3/4" tubing	927	lf	1.26	\$1,168		

Denver, CO

GFA 996

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
SUBTOTAL					\$1,168	
D3040 DISTRIBUTION SYSTEMS						
Zehnder ERV Unit	1	ea	2,000.00	\$2,000		
Air Handler, Unico IS30G080	1	ea	2,643.00	\$2,643		
Supply Grille, Unico, 2.5" outlet, white	10	ea	20.00	\$200		
Exhaust Grille, Titus, 6x6, FS300	3	ea	35.00	\$105		
5" Flexible Ducts	89	lf	7.40	\$659		
SUBTOTAL					\$5,607	
D3050 TERMINAL & PACKAGE UNITS						
SUBTOTAL					\$0	
D3060 CONTROLS & INSTRUMENTATION						
Temperature Control	4	ea	200.00	\$800		
SUBTOTAL					\$800	
D3070 SYSTEMS TESTING & BALANCING						
Test and balance	988	sf	0.50	\$494		

Denver, CO

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DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
SUBTOTAL					\$494	
TOTAL - HVAC						\$19,237
D40 FIRE PROTECTION						
D4010 SPRINKLERS						
Fire Sprinkler Head, ceiling mounted	3	ea	54.25	\$163		
Fire Sprinkler Head, wall mounted	6	ea	54.25	\$326		
Fire Pump, NFPA-13D Home Defender	1	ea	2,100.00	\$2,100		
Fire Suppression Tank, 1100 gal	1	ea	1,500.00	\$1,500		
1" Fire Polyethylene Pipe	48	lf	12.19	\$585		
SUBTOTAL					\$4,673	
D4020 STANDPIPES						
SUBTOTAL					\$0	
D4030 FIRE PROTECTION SPECIALTIES						
SUBTOTAL					\$0	
TOTAL - FIRE PROTECTION						\$4,673
D50 ELECTRICAL						
D5010 ELECTRICAL SERVICE & DISTRIBUTION						
225A 120/240V Electric Panel	1	ea	535.00	\$535		
Heavy gauge service wire	15	lf	34.90	\$524		

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
SUBTOTAL						\$1,059	
D5020	LIGHTING & BRANCH WIRING						
	<i>Lighting</i>						
	Fixture A-recessed light, dimmable	14	ea	171.00	\$2,394		
	Fixture B-recessed light (wet location), dimmable	2	ea	166.00	\$332		
	Fixture C-strip light, dimmable	1	ea	790.00	\$790		
	Fixture D-exterior light, recessed	16	ea	13.00	\$208		
	Fixture E-strip light	12	ea	33.00	\$396		
	<i>Devices</i>						
	20A 120-277V Dup Rec	37	ea	39.75	\$1,471		
	20A 120-277V Dup Rec - GFCI	6	ea	93.00	\$558		
	20A 120-277V Sw - Toggle	18	ea	18.57	\$334		
	<i>Branch</i>						
	#12 THWN conduit	625	lf	1.39	\$869		
SUBTOTAL						\$7,352	
D5030	COMMUNICATIONS & SECURITY						
SUBTOTAL						\$0	
D5090	OTHER ELECTRICAL SYSTEMS						
	Smoke Detector	6	ea	230.00	\$1,380		
	Fire Alarm	1	ea	199.00	\$199		
SUBTOTAL						\$1,579	
TOTAL - ELECTRICAL							\$9,989

Denver, CO

GFA 996

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
E10 EQUIPMENT						
E1010 COMMERCIAL EQUIPMENT						
Induction Cook Top, Beko, CTI30400	1	Each	859.00	\$1,999		
Wall Oven, Beko, BW0S30100	1	Each	2,069.00	\$1,999		
Range hood, Broan 273003	1	Each	544.00	\$544		
Refrigerator, Freezer, Marvel 24" ML24RAP3LP	1	Each	1,700.00	\$1,700		
Refrigerator, Freezer, Marvel 24" ML24FAP2RP	1	Each	1,823.35	\$1,823		
Dishwasher, Beko DWS55100FB	1	Each	649.00	\$649		
Clothes Washer, Beko WM984005X	1	Each	1,099.00	\$1,099		
Clothes Dryer, Beko HPD24412W	1	Each	1,299.98	\$1,300		
SUBTOTAL					\$11,113	
E1020 INSTITUTIONAL EQUIPMENT						
SUBTOTAL					\$0	
E1030 VEHICULAR EQUIPMENT						
SUBTOTAL					\$0	
E1090 OTHER EQUIPMENT						
Car Charger	1	ea	1,272.00	\$1,272		
SUBTOTAL					\$1,272	
TOTAL - EQUIPMENT						\$12,385

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
E20 FURNISHINGS							
E2010 FIXED FURNISHINGS							
	Allowance for living, dining, and bedrooms	1	ea	5,000.00	\$5,000		
	SUBTOTAL					\$5,000	
E2020 MOVABLE FURNISHINGS							
	Exterior concrete/lamboo furniture	1	ea	3,000.00	\$3,000		
	SUBTOTAL					\$3,000	
TOTAL - FURNISHINGS							\$8,000
F10 SPECIAL CONSTRUCTION							
F1010 SPECIAL STRUCTURES							
	Concrete Gutters	472	sf	40.00	\$18,880		
	Simulated Concrete Planters	152	cf	14.00	\$2,128		
	Wood Planter Boxes	714	sf	5.55	\$3,963		
	Deck framing, aluminum	1,300	sf	7.50	\$9,750		
	Composite Decking	1,300	sf	8.50	\$11,050		
	Gutter System, Filtrex System	120.0	SF	25.00	\$3,000		
	SUBTOTAL					\$48,771	
F1020 INTEGRATED CONSTRUCTION							
	SUBTOTAL					\$0	
F1030 SPECIAL CONSTRUCTION SYSTEMS							

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	ESTD COST	SUB TOTAL	TOTAL COST
SUBTOTAL						\$0	
F1040	SPECIAL FACILITIES						
SUBTOTAL						\$0	
TOTAL - SPECIAL CONSTRUCTION							\$48,771
F20 SELECTIVE BUILDING DEMOLITION							
F2010	BUILDING ELEMENTS DEMOLITION						
SUBTOTAL						\$0	
F2020	HAZARDOUS COMPONENTS ABATEMENT						
SUBTOTAL						\$0	
TOTAL - SELECTIVE BUILDING DEMOLITION							\$0
G10 SITE PREPARATION							
G1010	SITE CLEARING						
SUBTOTAL						\$0	
G1020	SITE DEMOLITION AND RELOCATION						
SUBTOTAL						\$0	
G1030	SITE EARTHWORK						
	Excavation of top soil & place compacted gravel (includes labor, gravel material, equip rental)	1.0	ea	10,000.00	\$10,000		
SUBTOTAL						\$10,000	
G1040	HAZARDOUS WASTE REMEDIATION						

Denver, CO

GFA 996

DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
SUBTOTAL						\$0	
TOTAL - SITE PREPARATION							\$10,000
G20	SITE IMPROVEMENT						
G2010	ROADWAYS						
SUBTOTAL						\$0	
G2020	PARKING LOTS						
SUBTOTAL						\$0	
G2030	PEDESTRIAN PAVING						
SUBTOTAL						\$0	
G2040	SITE DEVELOPMENT						
SUBTOTAL						\$0	
G2050	LANDSCAPING						
	Rosemallow	8	Each	7.50	\$60		
	Oueen of the Prairie	2	Each	7.50	\$15		
	Cardinal Flower	6	Each	7.50	\$45		
	Switch Grass	10	Each	7.50	\$75		
	Tomato	2	Each	7.50	\$15		
	Ornamental Peppers	2	Each	7.50	\$15		
	Spinach	3	Each	7.50	\$23		
	Basil	3	Each	7.50	\$23		
	Swiss Chard	2	Each	7.50	\$15		
	Cabbage	3	Each	7.50	\$23		
	Kale	2	Each	7.50	\$15		
	Arugula	2	Each	7.50	\$15		
	Bush Beans	1	Each	7.50	\$8		
	Sage	6	Each	7.50	\$45		
	Mint	6	Each	7.50	\$45		
	Thyme	6	Each	7.50	\$45		
	Rosemary	6	Each	7.50	\$45		
	Parsley	2	Each	7.50	\$15		

Denver, CO

GFA 996

DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
Chives	8	Each	7.50	\$60		
Lavender	4	Each	7.50	\$30		
Golden Chamomile	8	Each	7.50	\$60		
Blue Mistflower	20	Each	7.50	\$150		
Fennel	6	Each	7.50	\$45		
Agave	10	Each	7.50	\$75		
Calamint	20	Each	7.50	\$150		
Blue Waxweed	24	Each	7.50	\$180		
Purple-Headed Sneezeweed	24	Each	7.50	\$180		
Little Hogweed	20	Each	7.50	\$150		
Purslane	18	Each	7.50	\$135		
SUBTOTAL					\$1,755	
TOTAL - SITE IMPROVEMENT						\$1,755
G30 SITE MECHANICAL UTILITIES						
G3010 WATER SUPPLY						
SUBTOTAL						\$0
G3020 SANITARY SEWER						
SUBTOTAL						\$0
G3030 STORM SEWER						
SUBTOTAL						\$0
TOTAL - SITE MECHANICAL UTILITIES						\$0
G40 SITE ELECTRICAL UTILITIES						
G4010 ELECTRICAL DISTRIBUTION						
SolarEdge Electricity Meter SE-MTR240-2-200-S1	1	ea	375.00	\$375		
Solar						
PV Array	30	ea	312.50	\$9,375		
SolarEdge SE7600A-USS 7.6KW StoreEdge Inverter	1	ea	2,944.00	\$2,944		
SolarEdge SE3000A-US-U Inverter	1	ea	1,095.00	\$1,095		

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<i>DESCRIPTION</i>	<i>QTY</i>	<i>UNIT</i>	<i>UNIT COST</i>	<i>EST'D COST</i>	<i>SUB TOTAL</i>	<i>TOTAL COST</i>
SolarEdge P300 Power Optimizer	30	ea	68.00	\$2,040		
Transition Box	3	ea	110.00	\$330		
Disconnect - LA302A Lightning Arrestor	4	ea	30.00	\$120		
#10 Thwn cable	140	lf	1.39	\$195		
Solar Battery	1	ea	6,000.00	\$6,000		
					\$22,474	
G4020						
SITE LIGHTING						
Allowance	1	ea	10,000.00	\$10,000		
					\$10,000	
G4030						
SITE COMMUNICATION AND SECURITY						
						\$0
G4090						
OTHER SITE ELECTRICAL UTILITIES						
						\$0
TOTAL - SITE ELECTRICAL UTILITIES						\$32,474

						\$351,073
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