PROJECT INFORMATION

Project Name: Meltwater-UWM Carbon Neutral House
Project Number: 2009-001

City, ST: Milwaukee, WI

Date Created: 16 December 2008
Date Revised: 27 May 2009

Owner/Tenant: University of Wisconsin – Milwaukee

Estimated Construction Cost: $650 000

Summary: A collaborative project of the School of Architecture and Urban Planning and the School of Engineering at the University of Wisconsin – Milwaukee.

Firm Name: University of Wisconsin – Milwaukee School of Architecture and Urban Planning

Project Principal: Team Meltwater
Project Architect: Team Meltwater
Project Designer: Team Meltwater

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01. Introduction

The University of Wisconsin Milwaukee has been selected by the U.S. Department of Energy as one of 20 student teams from an international pool of universities to participate in the 2009 Solar Decathlon. The Solar Decathlon is a global contest in which university students compete to design, build and operate a solar-powered house more efficiently than other competitors. When the UWM House is completed in the fall 2009, it will travel to Washington, D.C., where it will be erected on the National Mall. At that time the project will be judged with the 19 other teams from around the world, and will be viewed by over 150,000 visitors, including officials from the U.S. Department of Energy and members of Congress.

The University of Wisconsin Milwaukee Team

To design and construct the Solar Decathlon house, UWM has brought together a diverse team of faculty, students, and professional collaborators. These participants, from across the campus and city, represent architecture, engineering, business, and contractors to name a few. The interdisciplinary and collaborative nature of the process requires that each of the students and faculty contributing to the project must balance the goals of their profession with the goals of the rest of the team. Through their efforts to design, build, and eventually operate the house, team members will pioneer new uses for existing technologies and develop new standards for integrated practice. This will result in a design for the UWM Carbon Neutral House that is successful for all team members. Our work will balance innovative architecture and engineering processes, with elegant design aesthetics and practical market viability.

The Challenge

Project goals for the UWM Carbon Neutral House will emphasize three specific areas:

1.) Interdisciplinary teams of architecture, engineering, business and other fields;

2.) Design practices integrating leading edge digital simulation and BIM software, and

3.) Development of new processes for grid-connected solar photovoltaics.

The goals of this project are intended to bridge the gap between education and practice, and to create a model of sustainable design and construction methods for Wisconsin. Simply be participating in the competition our project will provide life-changing opportunities for our students. But to reach a bigger audience and to provide opportunities for invaluable connections between students and professionals we seek committed sponsors in this important project – sponsors

who would in turn be recognized on our Web site, and on the National Mall in Washington, D.C.

Support Areas

While small in scale, the project will have many complex building systems used in its construction and operation. Below is a list of a few of the primary areas where we will need support.

Materials: lumber for building, roofing membrane, doors and windows, interior finishes

Equipment: domestic (kitchen / bath / laundry), HVAC, photovoltaics, BMS

Services: delivery on building to and from Washington, D.C., assembly and disassembly, electrical installation, HVAC installation and commissioning,

Expertise: integrated project delivery, building systems coordination, project oversight and steering (document review, design review, etc.)

Why Industry Participation Is Important

Between 2008 and 2030 the practice of designing, documenting, delivering, and operating buildings will be changing at a pace not seen in the industry for a generation. This change will bring with it exponential growth in the demand for high performance buildings, and, as a result, increasing numbers of jobs tied to green technologies and practices. Students involved in the UWM Solar Decathlon project will be positioned to step into these jobs in a variety of industries with the knowledge and skill to make an immediate impact on increasing production and profitability. These students, with their experience in a multi-disciplinary project, will be future leaders of local and regional Architecture/Engineering firms, with whom industry members will be working to apply leading edge research to the practice of building high performance buildings.

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02. Systems Narratives

02.01. Structural Systems

02.01.01. Structural System Description

The structural system consists of foundation system using twenty-two structural steel footing pads supporting treated heavy timber grade-beams. The primary structure of the building consists of 3-1/2” x 11-7/8” engineered plywood I-joists with solid blocking spaced 16” on center. This floor system has treated plywood attached to the underside of the system, and a structural plywood deck on the top side. The outside ring of the floor system is 5-1/2” x 11-7/8” Parallel Strand Lumber (PSL). The PSL edge beams provide the primary horizontal support for the load-bearing walls of the building. The plywood I-joists are connected to the PSL with steel joist hangers. The floor (and the building itself) are divided into four primary divisions (modules) for transportation, and are connected with 3/4” threaded rod at the floor, the top plate, and the module beams. Load bearing wood frame walls rest on top of this framing system and support an inverted roof structure. The load-bearing walls are composed of offset nominal 2 x 4 stud construction attached to nominal 2 x 8 bottom and top plates. The studs are spaced 12” on center, and alternate across the horizontal plates in order to provide greater wall width for greater insulation amd to prevent thermal bridging from occuring at the stud locations. The primary roof structure is made of engineered lumber. The roof structure is composed of a primary valley beam made of two 3-1/2” x 11-7/8” Laminated Veneer Lumber (LVL), with secondary rafters made of paired 1-3/4” x 9-1/4” LVL members spaced 4’-0” on center. The vertical loads are carried from the roof to the walls by paired, vertical 1-3/4” x 9-1/4” LVL members at each of the rafter ends. The rafters are connected to the valley beam and the vertical members by 3/8” structural steel connectors and 1/2” structural steel bolts. The roof is covered with a structural insulated panel (SIP) system, which spans between the structural rafters. The SIP panels are carrying vertical loads to the rafters, but are not the primary roof structural system.

02.01.02. Structural Calculations

See attached documents.

02.01.03. Building Assembly Process

See attached documents.

02.02. Electrical Systems

02.02.01. Photovoltaic Systems

A photovoltaic (PV) system will be setup to run the systems of the home. This PV system will consist of a number of strings, a group of PV cells put together, and inverters as is required to meet and/or exceed the homes power needs.

Not only will the PV system power the home but it will also have to relay information about itself to the controls system. This information will consist of current power production, voltage and current readings, and a system diagnostic that will indicate if a string, or inverter, is not working properly.

Included with the PV system will be a zone draw recognition component, which will keep track of the zones in the home that use the most power and at what times of the day that power is being used. An option to turn off a specific zone(s) will be available through this recognition component. This component is separate from the required breaker and master power cut controls. All information collected by the recognition component will be available to the user via the control system.

02.02.02. Monitoring Systems

A precise monitoring system will be designed for this home. This system will consist of a collection network of sensors to determine conditions inside and out side the home. These sensors will be capable of delivering, to the control/display system, information pertaining to the interior air temperature, interior humidity, hot water temperature, and exterior climate conditions.

The network of sensors will be large enough for accurate data collection to be achieved, and if one sensor ceases to operate the system would not be crippled. Also, the network will allow for the use of interchangeable components, so that, in the event of a sensor failure, it could be replaced without having to remove large sections of structure.

Lastly, this system must be functional but not pointedly visible. The network is meant to help run the systems of the home, not to be aesthetically dominant.

02.02.03. Control/Display Systems

The system for controlling building systems, and displaying building performance, consists of the acceptance of the inputs from the monitoring equipment. Working in conjunction with the monitoring designer the controls designer must setup the PLC units to read the data being collected. Using the collected data the system will be designed with the capacity to keep the house within the range of conditions set by the user, and determined to be acceptable in terms of human environmental comfort. Settings coordinated for the competition will allow the control system to relay that information to the proper location in the home, e.g. to valves that control/display the heating or cooling, so that control strategies can be carried out.

The building control and performance display system will offer an interface for the user, which will provide information on current comfort level settings for the home, if the user needs to, or has taken, any actions affecting the settings, e.g. if the heat is turned on when comfort levels are conditions are still being met. The system will also allow for user input to adjust the comfort level settings based on seasonal or diurnal changes, times when the house is not occupied for extended periods, and other circumstances that may deviate from the normal control settings. Display of other systems performances will also included, including data pertaining to the operation of the solar electric and solar thermal systems. A display of power production, current and total, will be available as well as power usage, which will be divided by branch.

The building control and performance display system will be able to receive data from the monitoring system that indicates what the conditions are on the outside of the home. With this data the control system will be capable of performing a comparison between external conditions and internal comfort level settings. If these conditions are within the specified tolerances, the system will notify the user that using operable windows (and other passive cooling, ventilation, or heating measures) will allow comfort to be maintained with little to no use of energy.

02.03. HVAC Systems

A heat pump was chosen for heating and cooling the home due to its dual function. This saves on space, as well as system complexity. The *Solcool* system has a capacity of 18,000 Btu/hr of cooling during the cooling season, and 22,000 Btu/hr for heating during heating season. Two air handlers, located in the living room and bedroom, will be connected to a packaged unit located outside he house. The unit containing the compressor, condenser, and circulation pump will supply the air handlers with refrigerant, which will create the desired conditions inside the living

space. Each air handler has a thermostat and a wireless controller, which helps the building occupant to control the system. This particular system also has motion sensors, to sense occupants, and a dry function, which dehumidifies the air without cooling, when necessary or if so preferred.

02.03.01. HVAC Calculations

See attached tables.

02.04. Plumbing Systems

02.04.01. Water Supply

The domestic water system has two facets to it, a cold water supply system, and a hot water system. The hot water system is split between hot water storage and water heating through solar thermal panels. Both systems provide either hot or cold water to various points of use: hot water to the kitchen (sink and dishwasher), bathroom (sink, and shower), and the laundry room (clothes washer); and, cold water to the kitchen (sink and dishwasher), bathroom (sink, toilet, and shower), and laundry room (clothes washer).

The cold water supply system is a simulated well system, instead of a well during the competition, the project will use water storage tanks. Water is stored outside the house, in tanks totaling 600 gallons. The water stored in these tanks will be pumped to a 20 gallon pressure tank to provide the necessary water pressure. From the pressure tank the water is distributed either to the cold water side of the various points of use or to the hot water tank.

02.04.02. Waste Removal

There will be a drain system in place where wastewater from the sinks, shower, washers etc. will go. This system is a standard domestic drain system where water flows from its source (a sink), down and out of the house. During the competition this system will flow to a wastewater storage tank system. The system will be outside the footprint of the house, and will be downhill from the supply tank system.

02.04.03. Domestic Hot Water

The domestic hot water in the hot water tank is heated through solar energy by use of a heat exchanger. A separate closed loop of water is pumped up to solar panels on the roof where energy in the form of heat from the sun is collected and transferred to the water. The water then flows back down into a coil of pipes inside the hot water tank where it transfers its heat to the domestic water, heating it up. After running for 1 day the system should gain enough energy from the sun to heat the 80 gallons of water in the hot water tank to above 110 ^{o}F.

In the event of long periods of cloud cover, or extensive hot water use in the house, an electric hot water back up system will be in place. This system consists of two electric on-demand hot water heaters, one will

provide hot water to the kitchen and clothes washer, and the other will provide hot water to the bathroom.

Two solar thermal panels placed on the northwest side of the roof will provide majority of the hot water consumed in the house. A water/glycol mix will be circulated by a small pump located in the mechanical room to the panels and back. Upon return, the hot solution will flow through a small spiral heat exchanger placed inside the water storage tank. Here, the heat extracted from the sun's rays will be passed on to the relatively cold water. The process will continue till the domestic hot water set temperature has been reached and then the pump will stop unless it senses that the water inside the panels is getting too hot and then it will keep circulating the fluid to prevent system damage. An expansion tank will also be placed in the solar thermal loop, again to avoid personal and equipment damage. On overcast days, when sunlight might not be sufficient, electric tankless water heaters will ensure that hot water can be supplied for everyday use.

Energy required to heat 80 gallons of water from 55^0F to 110^oF = Volume of water x 8.33 x Temp diff.

80 gallons (8.33) x (110^oF-55^oF) = 36652 Btu/day

Incidence angle modifier = $1 - b_0 (1/\cos(\theta) - 1)$

□ = Angle of incidence – Angle of panel

□ = $41.59^o - 18^o = 30.41^o$

$1 - 0.3381(1/\cos(30.41^o) - 1) = .946$

Energy gained from 1 solar panel = Solar Insolation x Efficiency of Panel x Area of Panel x Incidence angle modifier x Efficiency of heat exchanger

1065.46 Btu/ft^2/day (.70)(40ft^2)(.946)(.85) = 28,222 Btu/day

03. Energy Analysis

03.01. Energy Strategies and Concepts

Energy conservation does not exist in a vacuum. Each part of the design is linked to the others and in a well developed design, each of the parts work to enhance the others. In the Carbon Neutral House, energy conservation, maximizing the use of renewables, and human delight and comfort are balanced.

The first and one of the most basic strategies in any energy efficient design is controlling the heat and light that passes through the walls, roof, and windows. The Carbon Neutral House is designed with 7" of closed cell rigid insulation in the walls and roof to minimize the heat loss during cold Wisconsin winters and excessive heat gain in the summer months. The roof material encompasses a reflective coating to help protect it from hot summer radiation. A rain screen protects the walls from direct sun.

The windows are a gas filled triple glazed high R construction with louvers on the long south face that allow warming direct sunlight through in the cold winter months but block it in the hot summer months. The louvers also serve to reflect the cooler rays of the sun up and deep into the building, eliminating glare as they do so. Elimination of glare together with ample light makes the interior friendly. Together with the natural wood interior this gives a feeling of warmth and cheer. These lighting strategies also eliminate the need for artificial lighting during most of the day, thereby lowering electric consumption and summer heat gains. Windows that are operable allow the occupants to have control over their environment and provide cross ventilation on days air movement or cooler outside air is adequate to provide needed cooling.

Windows on the cold north face are smaller but high R clerestory windows on the north contribute an even glare-free indirect light. These north windows do not receive direct rays at any time of the year and therefore do not require shading. The western windows on the other hand are shaded by screens that can be opened when the sun is not too hot. Windows are small on the eastern face of the building.

Much of the material in the house is renewable or recycled. Interior walls are made out of recycled paper and the framing and rain screen use wood from a sustainably harvested forest, the Aldo Leopold woodland.

Conserving energy with an efficient shell and natural lighting are only the necessary start of a good design. The roof is pitched to accomplish two things concurrently. Care was taken to assure an appropriate angle for the

photovoltaics placed on it. In spite of the v-shape, no shadow falls across the PV array on the roof. This is important even a small shadow falling on the pvs can cut out a major portion of the cell as it has the effect of creating an open circuit. In order for the pvs to be adequate for meeting the electric demand of the house appliances is all highly energy efficient. LED lighting is used in much of the house.

The second special function of the roof is water collection. Rainwater flows from the north and south sections to the central v and then off a spout on the east side. The collected water will be used for toilet flushing.

A very cost effective means of using the sun's energy is to use it to heat water for domestic use. Flat plat panels are used for heating of water in the Carbon Neutral House. On the energy use side, low water use appliances and fixtures were chosen for this house. For active heating and cooling when necessary, air to air heat exchangers will be used to supplement the passive solar gains in the winter and provide cooling in the summer.

03.02. Energy Simulation Assumptions and Criteria

The Target Market for the 'UW-Milwaukee Carbon Neutral House' is defined as a "boomerang parent", a baby boom retired couple. Cases were run for the following five types of days:

A **typical Saturday** in which the couple spends the day at home by themselves. They both take a six minute warm shower and brush their teeth, running ¼ gallon of water, when they get up. The husband shaves with a straight edge razor. They then make and eat a full breakfast. At noon and evening they also prepare and eat full meals. Dishes, totaling six sets, from the three meals for the day are washed in a single drawer of the two drawer dishwasher at the end of the day. At meal times some small amount of water is used from the kitchen faucet for clean up and meal prep. No laundry is washed on this day. The couple remains at home the entire day with no visitors. It is assumed they will flush the toilet four times each during the day and wash their hands five times, running the water for 15 seconds each time. They will brush their teeth again at the end of the day. Whenever warm water is used it is assumed that it is comprised of a mix of half hot and half cold water. The dishwasher is assumed to use only hot water and the toilet only cold. The washing machine is also assumed to have half hot and half cold, weighting somewhat conservatively toward hot.

A **high use Saturday** in which the couple has six guests over from 1:00 PM to 10:00 PM. The will serve them one warm meal at supper time. There will be an additional 16 flushes of the toilet and an additional 16 hand washings

throughout the afternoon. The extra dishes will require that both drawers of the dishwasher be used to wash dishes that day. All other functions and water use are the same as for case one.

A **typical light load weekday** in which the couple are home together for the morning and evening but go out between 1:00 PM and return between 5:00 and 10:00 PM in the afternoon. They will do their morning routine of showers, shaving, brushing teeth, and eating breakfast. They will do a load of wash, eat a lunch, and start the dishwasher before leaving for the afternoon. They will eat supper out on days they come home after 5:00PM.

A **heavy load weekday** in which the couple remains home alone the entire day and does two loads of wash. In all other ways the water usage is the same as in case number one, a typical Saturday.

A **childcare weekday** in which the couple care for a toddler and infant between 8:00AM and 5:00PM. The children will eat lunch and supper with them, generating some extra dishes, some of which will be done by hand. The infant will be given a sponge bath in the afternoon requiring one gallon of warm water. The older child will use the toilet and his/her their hands several times while there. The infant uses cloth diapers which need to be rinsed but not washed as the parents have diaper service. The couple will wash one extra load of wash during weeks they babysit. One load of wash and one load of dishes will be done on this day. The couple's personal routine will otherwise be the same as for a typical Saturday.

	Assumptions:
1	One 6 min. shower/resident/day
2	4 toilet flushes/person/24 hr
3	5 hand washes/person/24 hr (15 sec per wash)
4	One drawer load dishes/2 people/day (6 place sets)
5	3 loads laundry/week on typical week w/o children
6	4 loads laundry/week on typical week w children
7	2 tooth brushings/resident/day (1/4 gal ea)
8	Shaving once per day (1/2 gal per shave)
	Sponge bath for children - 1 gal

The University. of Kentucky Guidelines for 40

gal/day/person water use was used as the baseline for determining water usage for the various activities.

03.03. Energy Simulation

See attached tables.

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02.01. Structural Systems

02.01.01. Structural System Description

The structural system consists of foundation system using twenty-two structural steel footing pads supporting treated heavy timber grade-beams. The primary structure of the building consists of 3-1/2” x 11-7/8” engineered plywood I-joists with solid blocking spaced 16” on center. This floor system has treated plywood attached to the underside of the system, and a structural plywood deck on the top side. The outside ring of the floor system is 5-1/2” x 11-7/8” Parallel Strand Lumber (PSL). The PSL edge beams provide the primary horizontal support for the load-bearing walls of the building. The plywood I-joists are connected to the PSL with steel joist hangers. The floor (and the building itself) are divided into four primary divisions (modules) for transportation, and are connected with 3/4” threaded rod at the floor, the top plate, and the module beams. Load bearing wood frame walls rest on top of this framing system and support an inverted roof structure. The load-bearing walls are composed of offset nominal 2 x 4 stud construction attached to nominal 2 x 8 bottom and top plates. The studs are spaced 12” on center, and alternate across the horizontal plates in order to provide greater wall width for greater insulation amd to prevent thermal bridging from occuring at the stud locations. The primary roof structure is made of engineered lumber. The roof structure is composed of a primary valley beam made of two 3-1/2” x 11-7/8” Laminated Veneer Lumber (LVL), with secondary rafters made of paired 1-3/4” x 9-1/4” LVL members spaced 4’-0” on center. The vertical loads are carried from the roof to the walls by paired, vertical 1-3/4” x 9-1/4” LVL members at each of the rafter ends. The rafters are connected to the valley beam and the vertical members by 3/8” structural steel connectors and 1/2” structural steel bolts. The roof is covered with a structural insulated panel (SIP) system, which spans between the structural rafters. The SIP panels are carrying vertical loads to the rafters, but are not the primary roof structural system.

02.01.02. Structural Calculations

See attached documents.

Ps=λ*I*Ps30

Velocity	90mph	
Importance Factor	1	
Exposure	C	
Mean roof Height	18 FT	
λ18	1.258	(1.29-1.21)/(20-15)=(λ18-1.21)/(18-15)

Ps30			Simplified Wind Pressure Ps (Psf)
	Zone	If Θ=0*	
Horizontal Pressure	A	12.8	16.1
	B	-6.7	-8.43
	C	8.5	10.69
	D	-4	-5.03
Vertical Pressure	E	-15.4	-19.37
	F	-8.8	-11.07
	G	-10.7	-13.46
	H	-6.8	-8.55

Assumptions

[01] 50 PSF building deadload [calculated]
[02] 20 PSF wind uplift
[03] 16.1 PSF wind lateral force [calculated from simplified wind pressure ASCE-07]
[04] Center of Mass at center of buildig
[05] Most severe wind loading from north to south
[06] Assume building 18'-0" tall (from grade to horizontal project of highest point of PV array
[07] Plywood 125 PSI Shear capacity

Vertical Force of Building	Dead Load	Uplift	Vertical Force
Dead load-Uplift = Vertical Force	40,337.61 Lb-F	-13,896.00 Lb-F	26,441.61 Lb-F

Lateral Wind Load

Worst Case - North Wall	Width	Height	Area	PSF*	Force
	38.60 ft	18.00 ft	694.80 ft^2	16.1 lb/ft^2	**11,186.28 Lb-F**

* Simplified wind pressure calculated from ASCE-07

Sum Moments about North wall ground With wind from So

Force		Moment Arm	Moment
M Resistance	26,441.61 Lb-F	9.00 ft	237,974.50 Ft-LbF
M Overturn	11,186.28 Lb-F	9.00 ft	100,676.52 Ft-LbF
		Possibility for Overturn	42.31%

Shear Forces	**Location Applied**	Force	Shear Capacity	Required Length o	Provided Length of Wall
	Lateral Wind Load - North Wall	11,186.28 Lb-F	240.00 PLF	46.61 ft	
	Roof (50% of North Wall)	5,593.14 Lb-F	240.00 PLF	23.30 ft	32.00 ft
	East Wall (50% of Roof)	735.94 Lb-F	240.00 PLF	3.07 ft	12.00 ft
	West Wall (50% of Roof)	588.75 Lb-F	240.00 PLF	2.45 ft	6.00 ft
	Module AB	1,471.88 Lb-F	240.00 PLF	6.13 ft	4.00 ft
	Module BC	1,471.88 Lb-F	240.00 PLF	6.13 ft	6.00 ft
	Module CD	1,324.69 Lb-F	240.00 PLF	5.52 ft	4.00 ft
	Floor (50% of North Wall)	5,593.14 Lb-F	240.00 PLF	23.30 ft	
	Footings		# Footings	Horizontal Load / Footing	
	(1/2 from walls, 1/2 directly)	11,186.28 Lb-F	10	1,118.63 Lb-F	

Vertical Forces in Footings	**Location Applied**	Force	Assumption
	Dead Load-Building	50 PSF	calculated
	Live Load-Floors	50 PSF	given
	Roof Live Load - Snow	35 PSF	given
	Wind Load	-20 PSF	calculated
	Live Load-Egress	100 PSF	given
	Soil Bearing	1,500 PSF	given

Assumptions

[01] 50 PSF building deadload [calculated]
[02] 20 PSF wind uplift
[03] 16.1 PSF wind lateral force [calculated from simplified wind pressure ASCE-07]
[04] Center of Mass at center of buildig
[05] Most severe wind loading from north to south
[06] Assume building 18'-0" tall (from grade to horizontal project of highest point of PV array
[07] Plywood 125 PSI Shear capacity

Calculations

Dead Load

		Volumes / Areas	Masses		Force
Materials	Dimension Lumber	174.01 ft^3	45.0 lb/ft^3		7,830.27 Lb-F
	Plywood	196.67 ft^3	35.0 lb/ft^3		6,883.33 Lb-F
	EPS	1,540.00 ft^3	2.0 lb/ft^3		3,080.00 Lb-F
	ccSPF	1,515.00 ft^3	4.0 lb/ft^3		6,060.00 Lb-F
	Roofing	800.00 ft^2	2.9 lb/ft^2		2,359.48 Lb-F
	PV Array	37.84 lbs/panel	28 panel[s]		1,059.52 Lb-F
	DSHW	124.00 lbs/panel	2 panel[s]		248.00 Lb-F
	Appliances				1,029.00 Lb-F
	Casework/Furnishings	700.00 ft^2	8.0 lb/ft^2		5,600.00 Lb-F
	HW Floor	700.00 ft^2	4.0 lb/ft^2		2,800.00 Lb-F
	5/8 GWB	960.00 ft^2	2.8 lb/ft^2		2,688.00 Lb-F
	Lighting	700.00 ft^2	1.0 lb/ft^2		700.00 Lb-F
				Total Dead Load	**40,337.61 Lb-F**

Up Lift		Area	Assumed Uplift	**Total Uplift**
Wind Uplift		694.80 ft^2	-20.0 lb/ft^2	**-13,896.00 Lb-F**

Vertical Force of Building	Dead Load	Uplift	**Vertical Force**
Dead load-Uplift = Vertical Force	40,337.61 Lb-F	-13,896.00 Lb-F	**26,441.61 Lb-F**

Lateral Wind Load

Worst Case - North Wall	Width	Height	Area	PSF*	**Force**
	38.60 ft	18.00 ft	694.80 ft^2	16.1 lb/ft^2	**11,186.28 Lb-F**

* Simplified wind pressure calculated from ASCE-07

Sum Moments about North wall ground With wind from South

Force		Moment Arm	Moment
M Resistance*ƒ*	26,441.61 Lb-F	9.00 ft	237,974.50 Ft-LbF
M Overturn*∂*	11,186.28 Lb-F	9.00 ft	100,676.52 Ft-LbF

ƒ measurement taken from center of gravity, assumed to be midpoint of building

Possibility for Overturn **42.31%**

Assumptions

Building vertical Loads

	Location Applied	Force	Assumption
[01]	Dead Load-Building	50 PSF	calculated
[02]	Live Load-Floors	50 PSF	given
[03]	Roof Live Load - Snow	35 PSF	given
[04]	Wind Load	-20 PSF	calculated
[05]	Live Load-Egress	100 PSF	given
[06]	Soil Bearing	1,500 PSF	given
[07]	Dead Load-Deck	10 PSF	calculated

Load Totals

Load Type	Applied	Area	Total Load
Dead Load-Building	building footprint	800.0 ft^2	40,000.0 lb
Roof Live Load - Snow	building footprint	800.0 ft^2	28,000.0 lb
Dead Load - Deck	deck area	1850.0 ft^2	18,500.0 lb
Live Load-Egress	building footprint	800.0 ft^2	80,000.0 lb
	Building Total Vertical Load		**148,000.0 lb**
	Deck Total Vertical Load		**18,500.0 lb**

Main Building Foot Design Tables

ALTERNATE [01a] 10 footings	house assumed total load	148,000.0 lb
	number of footings	10
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	14,800.0 lb
	min area of footings	98.7 ft^2
	footing length [square]	2.50 ft
	area/footing	6.3 ft^2
	soil load / footing	2,368.0 lb/ft^2
	Meets Allowable Pressure	NO
ALTERNATE [01b] 15 footings	house assumed total load	148,000.0 lb
	number of footings	15
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	9,866.7 lb
	min area of footings	98.7 ft^2
	footing length [square]	2.50 ft
	area/footing	6.3 ft^2
	soil load / footing	1,578.7 lb/ft^2
	Meets Allowable Pressure	NO
ALTERNATE [01c] 20 footings	house assumed total load	148,000.0 lb
	number of footings	20
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	7,400.0 lb
	min area of footings	98.7 ft^2
	footing length [square]	2.50 ft
	area/footing	6.3 ft^2
	soil load / footing	1,184.0 lb/ft^2
	Meets Allowable Pressure	YES

Deck Foot Design Tables

ALTERNATE [01a] 10 footings	deck total load	18,500.0 lb
	number of footings	10
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	1,850.0 lb
	min area of footings	12.3 ft^2
	footing length [square]	1.00 ft
	area/footing	1.0 ft^2
	soil load / footing	1,850.0 lb/ft^2
	Meets Allowable Pressure	NO
ALTERNATE [01b] 15 footings	deck total load	18,500.0 lb
	number of footings	15
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	1,233.3 lb
	min area of footings	12.3 ft^2
	footing length [square]	1.00 ft
	area/footing	1.0 ft^2
	soil load / footing	1,233.3 lb/ft^2
	Meets Allowable Pressure	YES
ALTERNATE [01c] 20 footings	deck total load	18,500.0 lb
	number of footings	20
	allowable soil pressure	1,500.0 lb/ft^2
	weight / footing	925.0 lb
	min area of footings	12.3 ft^2
	footing length [square]	1.00 ft
	area/footing	1.0 ft^2
	soil load / footing	925.0 lb/ft^2
	Meets Allowable Pressure	YES

input paramaters
calculated from input parameters
maximum allowable soil pressure

Volume of ccSPF

	cavity width	cavity length	cavity height	
volume of walls	0.71 ft	120.00 ft	9.00 ft	765 ft^3
volume of floor	20.00 ft	40.00 ft	0.94 ft	750 ft^3
			total volume	1,515 ft^3

ccSPF Weight

120.00 grams	0.26 lb	1 m^2	2.9 lb/ft^2
1 m^2	1.00 grams	11 ft^2	

Appliance Weights

Wolff DDV	75.00 lb	Refrigerator	230.00 lb
Wolff 15	30.00 lb	Dishwasher	100.00 lb
Wolff Range	273.00 lb	Washer	167.00 lb
Wolff Microwave	68.00 lb	Dryer	86.00 lb

Building Dead Load	Volumes / Areas	Masses	Total Weight
Dimension Lumber	174.0061 ft^3	45.0 lb/ft^3	7830.27 lb
Plywood	196.6667 ft^3	35.0 lb/ft^3	6883.33 lb
EPS	1540.0000 ft^3	2.0 lb/ft^3	3080.00 lb
ccSPF	1,515 ft^3	4.0 lb/ft^3	6060.00 lb
Roofing	800 ft^2	2.9 lb/ft^2	2359.48 lb
PV Array	37.84 lbs/panel	28 panel[s]	1059.52 lb
DSHW	124.00 lbs/panel	2 panel[s]	248.00 lb
Appliances			1029.00 lb
Casework/Furnishings	700.0 ft^2	8.0 lb/ft^2	5600.00 lb
HW Floor	700.0 ft^2	4.0 lb/ft^2	2800.00 lb
5/8 GWB	960.0 ft^2	2.8 lb/ft^2	2688.00 lb
Lighting	700.0 ft^2	1.0 lb/ft^2	700.00 lb
		total building weight	40337.61 lb
		weight / ft^2	50.4 ft^2

Loading Parameters	SI	
Dead Load-Building	50.0 lb/ft^2	accounted for in calculations above
Live Load-Floors	50.0 lb/ft^2	
Roof Live Load - Snow	35.0 lb/ft^2	
Wind Load	60.0 lb/ft^2	
Live Load-Egress	100.0 lb/ft^2	
Soil Bearing	1500.0 lb/ft^2	
Dead Load-Deck	10.0 lb/ft^2	assumed

Assumptions

[01] 15 PSF roof deadload
[02] 5 PSF solar thermal + solar electric
[03] 35 PSF snow load [Wisconsin]
[03] 20 PSF wind uplift on north roof plane [calculated from simplified wind pressure ASCE-07]
[04] 10 PSF wind uplift on south roof plane [calculated from simplified wind pressure ASCE-07]
[05] Rafters spaced 4'-0" o.c.

Vertical Forces on Roof	Roof DL	Solar DL	Snow	Wind [North]	Wind [South]
Area	15.00 PSF	5.00 PSF	35.00 PSF	-20.00 PSF	-10.00 PSF
Linear	135.00 PLF	45.00 PLF	315.00 PLF	-180.00 PLF	-90.00 PLF

Load Case 01	Unsupported	Supported		
Section 01	Length	Length	Unsupported	Supported
	29.00 ft	12.00 ft	Projeced Length	Projeced Length
Roof DL	3,915.0 lb	1,620.0 lb	29.00 ft	12.00 ft
Solar DL	1,305.0 lb	540.0 lb	Length	Length
Snow Load	9,135.0 lb	3,780.0 lb	29.00 ft	12.00 ft
Wind	-2,610.0 lb	-1,080.0 lb		
TOTAL LOAD [with wind]	**11,745.0 lb**	**4,860.0 lb**		
TOTAL LOAD w/o wind]	**14,355.0 lb**	**5,940.0 lb**		

Sum Forces-29'-0" Length			Moment Arms	Inches	Feet
∑Forces Vertical	Force P01 [West Wall]	7177.50 lb	R01 - P01	40.78 in	3.40 ft
	Reaction R01 [West Wall]	-7177.50 lb	R01 - R02	81.55 in	6.80 ft
	Reaction R03 [Mod Line C-C]	-7177.50 lb	R01 - R03	235.31 in	19.60 ft
	Force P02 [Mod Line C-C]	7177.50 lb			
	∑ Forces	0.00			

∑Forces Vertical = 0 = Force P01 - Reaction R01 - Reaction R02 + Force P02
∑Forces Horizonal = 0

∑Moments R01 = 0 = (R01*0 ft)+(P01*3.40 ft)+(R02*6.80 ft)+(P02*13.18 ft)
∑Moments R01 = 0 = #REF!

Sum Forces-12'-0" Length			Moment Arms	Inches	Feet
∑Forces Vertical	Force P01 [South Roof]	0.00 lb	R01 - P01	40.78 in	3.40 ft
	Reaction R01 [South Wall]	0.00 lb	R01 - R02	81.55 in	6.80 ft
	Reaction R02 [Valley Beam]	0.00 lb	R01 - P02	158.43 in	13.20 ft
	Reaction R03 [North Wall]	0.00 lb	R01 - R03	235.31 in	19.60 ft
	Force P02 [North Roof]	0.00 lb			
	∑ Forces	0.00			

∑Forces Vertical = 0 = Force P01 - Reaction R01 - Reaction R02 - Reaction R03 + Force P02

∑Forces Horizonal = 0

∑Moments R01 = 0 = (R01*0 ft)+(P01*3.40 ft)+(R02*6.80 ft)+(P02*13.18 ft)+(R03*19.61 ft)
∑Moments R01 = 0 = 0

Valley Beam

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	2,991 Lbf
Density	r	31 PCF	Shear Stress	54 psi
Allowable Stresses			% Stressed	19%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	9034.2 Lbf*Ft
			Section Modulus	164.52 in^3
Beam Size			Bending Stress	659 psi
Thickness		11.88 in	% Stressed	23%
Width		7.00 in	Meets Bending Reqs	YES

Dead Load	20.00 PSF	Deflection	TL = L/180
Live Load	35.00 PSF	Allowable Deflection	0.81 in
Total Load	55.00 PSF	Moment of Inertia	976.827 in^4
		Deflection	0.12 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Beam Span	145.00 in	Beam Schedule	
Support Spacing	108.00 in	Valley Beam Segments	
		VaBe 01	8'-0"
Beam Load	495.00 PLF	VaBe 02	12'-1"
		VaBe 03	8'-1"
		VaBe 04	9'-10"

Density of MicroLLam	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Assumptions

[01] 15 PSF roof deadload
[02] 5 PSF solar thermal + solar electric
[03] 35 PSF snow load [Wisconsin]
[03] 20 PSF wind uplift on north roof plane [calculated from simplified wind pressure ASCE-07]
[04] 20 PSF wind uplift on south roof plane [calculated from simplified wind pressure ASCE-07]
[05] Rafters spaced 4'-0" o.c.

Vertical Forces on Roof		Roof DL	Solar LL	Snow	Wind [North]	Wind [South]
	Area	15.00 PSF	5.00 PSF	35.00 PSF	-20.00 PSF	-20.00 PSF
	Linear	60.00 PLF	20.00 PLF	140.00 PLF	-80.00 PLF	-80.00 PLF

Load Case 01		South Roof Plane	North Roof Plane		
Section 01		Length	Length	South Roof Plane	North Roof Plane
		7.00 ft	13.17 ft	Projeced Length	Projeced Length
	Roof DL	420.0 lb	790.0 lb	7.00 ft	13.17 ft
	Solar DL	140.0 lb	263.3 lb	Length	Length
	Snow Load	933.3 lb	1,773.3 lb	6.67 ft	12.67 ft
	Wind	-560.0 lb	-1,053.3 lb		
	TOTAL LOAD [with wind]	**933.3 lb**	**1,773.3 lb**		
	TOTAL LOAD w/o wind]	**1,493.3 lb**	**2,826.7 lb**		

Sum Forces			Moment Arms	Inches	Feet
∑Forces Vertical	Force P01 [South Roof]	1493.33 lb	R01 - P01	40.78 in	3.40 ft
	Reaction R01 [South Wall]	-746.67 lb	R01 - R02	81.55 in	6.80 ft
	Reaction R02 [Valley Beam]	-2160.00 lb	R01 - P02	158.43 in	13.20 ft
	Reaction R03 [North Wall]	-1413.33 lb	R01 - R03	235.31 in	19.60 ft
	Force P02 [North Roof]	2826.67 lb			
	∑ Forces	0.00			

∑Forces Vertical = 0 = Force P01 - Reaction R01 - Reaction R02 - Reaction R03 + Force P02

∑Forces Horizonal = 0

∑Moments R01 = 0 = (R01*0 ft)+(P01*3.40 ft)+(R02*6.80 ft)+(P02*13.18 ft)+(R03*19.61 ft)
∑Moments R01 = 0 = 0

Rafter Schedule

North Rafters	IMP Dim	Inches	Dec. Dim	South Rafters		Inches	Dec. Dim
NoRa 01	13'-1 3/4"	157.75	13. ft 15 in	SoRa 01	3'-10 7/8"	46.875	3. ft 91 in
NoRa 02	12'-3 5/8"	147.625	12. ft 30 in	SoRa 02	4'-5 1/4"	53.25	4. ft 44 in
NoRa 03	11'-9"	141	11. ft 75 in	SoRa 03	4'-11 7/8"	59.875	4. ft 99 in
NoRa 04	10'-4 1/2"	124.5	10. ft 38 in	SoRa 04	5'-6 1/2"	66.5	5. ft 54 in
NoRa 05	9'-10"	118	9. ft 83 in	SoRa 05	6'-1"	73	6. ft 08 in
NoRa 06	9'-3 1/2"	111.5	9. ft 29 in	SoRa 06	6'-7 5/8"	79.625	6. ft 64 in
NoRa 07	9'-6 3/4"	114.75	9. ft 56 in	SoRa 07	7'-2 1/8"	86.125	7. ft 18 in
NoRa 08	9'-0 1/8"	108.125	9. ft 01 in	SoRa 08	7'-8 3/4"	92.75	7. ft 73 in
NoRa 09	8'-5 1/2"	101.5	8. ft 46 in	SoRa 09	8'-3 3/8"	99.375	8. ft 28 in
NoRa 10	7'-11"	95	7. ft 92 in	SoRa 10	8'-9 7/8"	105.875	8. ft 82 in
NoRa 11	7'-8"	92	7. ft 67 in	SoRa 11	9'-0 5/8"	108.125	9. ft 01 in

Rafter Material

Microllam Grade 1.9 E			Max. Shear	1,446 Lbf
Density	r	31 PCF	Shear Stress	67 psi
Allowable Stresses			% Stressed	24%
Shear	Fv	285 psi	Meets Shear Reqs	YES
Bending	Fb	2,600 psi		
Elasticity	E	1,900,000 psi	Max. Moment	4752.4 Lbf*Ft
			Section Modulus	49.91 in^3
Rafter Size			Bending Stress	1,143 psi
Thickness		9.25 in	% Stressed	44%
Width		3.50 in	Meets Bending Reqs	YES

Dead Load	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.44 in
Total Load	55.00 PSF	Moment of Inertia	230.840 in^4
		Deflection	0.34 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Rafter Span	157.75 in
Rafter Spacing	48.00 in
Rafter Load	220.00 PLF

Density of MicroLLam	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Valley Rafter - NoRa 01

Rafter Material

Microllam Grade 1.9 E			Max. Shear	1,446 Lbf
Density	r	31 PCF	Shear Stress	134 psi
Allowable Stresses			% Stressed	47%
Shear	Fv	285 psi	Meets Shear Reqs	YES
Bending	Fb	2,600 psi		
Elasticity	E	1,900,000 psi	Max. Moment	4752.4 Lbf*Ft
			Section Modulus	24.96 in^3
Rafter Size			Bending Stress	2,285 psi
Thickness		9.25 in	% Stressed	88%
Width		1.75 in	Meets Bending Reqs	YES

Dead Load	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.44 in
Total Load	55.00 PSF	Moment of Inertia	115.420 in^4
		Deflection	0.67 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	NO

Rafter Span	157.75 in
Rafter Spacing	48.00 in
Rafter Load	220.00 PLF

Density of MicroLLam	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Module Header Schedule - Supported

Header Schedule	IMP Dim	Inches	Dec. Dim
MoBe 01 aW	13'-6"	162	13.50 ft
MoBBHd 01	12'-0"	144	12.00 ft
MoBBHd 02	6'-0"	72	6.00 ft
MoDDHd 03	8'-0"	96	8.00 ft
MoDDHd 04	3'-6"	42	3.50 ft
MoDDHd 05	3'-6"	42	3.50 ft

Mod Header - MoBe 01 aW

Header Material

Parallel Strand Header Grade 2.0 E			Max. Shear	1,485 Lbf
Density	r	31 PCF	Shear Stress	34 psi
Allowable Stresses			% Stressed	12%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	10023.8 Lbf*Ft
			Section Modulus	99.82 in^3
Header Size			Bending Stress	1,205 psi
Thickness		9.25 in	% Stressed	42%
Width		7.00 in	Meets Bending Reqs	YES

Dead Load (Roof DL + PV)	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.45 in
Total Load	55.00 PSF	Moment of Inertia	461.681 in^4
		Deflection	0.28 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Header Span	162.00 in
Header Tributary Length	13.50 ft
Header Tributary Width	4.00 ft
Mod Header Load	2,970.0 lb

Density of PSL	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Mod Header - MoBBHd01

Header Material

Parallel Strand Header Grade 2.0 E			Max. Shear	660 Lbf
Density	r	31 PCF	Shear Stress	20 psi
Allowable Stresses			% Stressed	7%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	3960.0 Lbf*Ft
			Section Modulus	74.87 in^3
Header Size			Bending Stress	635 psi
Thickness		9.25 in	% Stressed	22%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Roof DL + PV)	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.40 in

Total Load	55.00 PSF	Moment of Inertia	346.261 in^4
		Deflection	0.12 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Header Span	144.00 in
Header Tributary Length	8.00 ft
Header Tributary Width	3.00 ft
Mod Header Load	1,320.0 lb

Density of PSL	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Mod Header - MoDDHd 03

Header Material

Parallel Strand Header Grade 2.0 E			Max. Shear	660 Lbf
Density	r	31 PCF	Shear Stress	20 psi
Allowable Stresses			% Stressed	7%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	2640.0 Lbf*Ft
			Section Modulus	74.87 in^3
Header Size			Bending Stress	423 psi
Thickness		9.25 in	% Stressed	15%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Roof DL + PV)	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.27 in
Total Load	55.00 PSF	Moment of Inertia	346.261 in^4
		Deflection	0.04 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Header Span	96.00 in
Header Tributary Length	8.00 ft
Header Tributary Width	3.00 ft
Mod Header Load	1,320.0 lb

Density of PSL	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Mod Header - MoDDHd 03

Header Material

Parallel Strand Header Grade 2.0 E			Max. Shear	440 Lbf
Density	r	31 PCF	Shear Stress	20 psi
Allowable Stresses			% Stressed	7%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	1760.0 Lbf*Ft
			Section Modulus	49.91 in^3
Header Size			Bending Stress	423 psi
Thickness		9.25 in	% Stressed	15%
Width		3.50 in	Meets Bending Reqs	YES

Dead Load (Roof DL + PV)	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.27 in
Total Load	55.00 PSF	Moment of Inertia	230.840 in^4
		Deflection	0.04 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Header Span	96.00 in
Header Tributary Length	4.00 ft
Header Tributary Width	4.00 ft
Mod Header Load	880.0 lb

Density of MicroLLam	
psubstance = SG x pH20	
p H2O	62.43
SG - Microl	0.5
p =	31.215

Mod Header - MoBe 02 ab

Header Material

Parallel Strand Header Grade 2.0 E			Max. Shear	193 Lbf
Density	r	31 PCF	Shear Stress	4 psi
Allowable Stresses			% Stressed	1%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	336.9 Lbf*Ft
			Section Modulus	147.66 in^3
Header Size			Bending Stress	27 psi
Thickness		11.25 in	% Stressed	1%
Width		7.00 in	Meets Bending Reqs	YES

Dead Load (Roof DL + PV)	20.00 PSF	Deflection	TL = L/360
Live Load	35.00 PSF	Allowable Deflection	0.12 in

Total Load	55.00 PSF	Moment of Inertia	830.566 in^4
		Deflection	0.00 in
Load for One foot Wide Strip	55.00 PLF	Meets Bending Reqs	YES

Header Span	42.00 in
Header Tributary Length	3.50 ft
Header Tributary Width	2.00 ft
Mod Header Load	385.0 lb

Density of MicroLLam
psubstance = SG x pH20

p H2O	62.43
SG - Microl	0.5
p =	31.215

Ring Beam Schedule

North Ring Beam	IMP Dim	Inches	Dec. Dim	South Ring Beam		Inches	Dec. Dim
NoRB 01	8'-0"	96	8. ft 00 in	SoRB 01	8'-0"	96	8. ft 00 in
NoRB 02	12-'0"	144	12. ft 00 in	SoRB 02	12-'0"	144	12. ft 00 in
NoRB 03	8'-0"	96	8. ft 00 in	SoRB 03	8'-0"	96	8. ft 00 in
NoRB 04	9'-9"	117	9. ft 75 in	SoRB 04	9'-9"	117	9. ft 75 in

Ring Beam - NoRB 01

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	4,200 Lbf
Density	r	31 PCF	Shear Stress	101 psi
Allowable Stresses			% Stressed	35%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	8400.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	817 psi
Thickness		11.88 in	% Stressed	28%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load	(Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load	(Given)	100.00 PSF	Allowable Deflection	0.53 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.07 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	96.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL	
psubstance = SG x pH20	
p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - NoRB 02

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	6,300 Lbf
Density	r	31 PCF	Shear Stress	152 psi
Allowable Stresses			% Stressed	52%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	18900.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	1,838 psi
Thickness		11.88 in	% Stressed	63%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Calculated)		50.00 PSF	Deflection	TL = L/180
Live Load (Given)		100.00 PSF	Allowable Deflection	0.80 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.33 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	144.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL
psubstance = SG x pH20

p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - NoRB 03

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	4,200 Lbf
Density	r	31 PCF	Shear Stress	101 psi
Allowable Stresses			% Stressed	35%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	8400.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	817 psi
Thickness		11.88 in	% Stressed	28%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Calculated)		50.00 PSF	Deflection	TL = L/180
Live Load (Given)		100.00 PSF	Allowable Deflection	0.53 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.07 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	96.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL

psubstance = SG x pH20

p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - NoRB 04

Beam Material

Parallel Strand Beam Grade 2.0 E				Max. Shear	5,119 Lbf
	Density	r	31 PCF	Shear Stress	123 psi
Allowable Stresses				% Stressed	42%
	Shear	Fv	290 psi	Meets Shear Reqs	YES
	Bending	Fb	2,900 psi		
	Elasticity	E	2,000,000 psi	Max. Moment	12477.0 Lbf*Ft
				Section Modulus	123.39 in^3
Beam Size				Bending Stress	1,213 psi
	Thickness		11.88 in	% Stressed	42%
	Width		5.25 in	Meets Bending Reqs	YES

Dead Load	(Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load	(Given)	100.00 PSF	Allowable Deflection	0.65 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.15 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	117.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL

psubstance = SG x pH20

pH2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - SoRB 01

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	4,200 Lbf
Density	r	31 PCF	Shear Stress	101 psi
Allowable Stresses			% Stressed	35%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	8400.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	817 psi
Thickness		11.88 in	% Stressed	28%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load	(Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load	(Given)	100.00 PSF	Allowable Deflection	0.53 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.07 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	96.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL	
psubstance = SG x pH20	
p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - SoRB 02

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	6,300 Lbf
Density	r	31 PCF	Shear Stress	152 psi
Allowable Stresses			% Stressed	52%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	18900.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	1,838 psi
Thickness		11.88 in	% Stressed	63%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load (Given)	100.00 PSF	Allowable Deflection	0.80 in
Total Load	150.00 PSF	Moment of Inertia	732.620 in^4
		Deflection	0.33 in
Load for One foot Wide Strip	150.00 PLF	Meets Bending Reqs	YES

Beam Span	144.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL
psubstance = SG x pH20

p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - SoRB 03

Beam Material

Parallel Strand Beam Grade 2.0 E			Max. Shear	4,200 Lbf
Density	r	31 PCF	Shear Stress	101 psi
Allowable Stresses			% Stressed	35%
Shear	Fv	290 psi	Meets Shear Reqs	YES
Bending	Fb	2,900 psi		
Elasticity	E	2,000,000 psi	Max. Moment	8400.0 Lbf*Ft
			Section Modulus	123.39 in^3
Beam Size			Bending Stress	817 psi
Thickness		11.88 in	% Stressed	28%
Width		5.25 in	Meets Bending Reqs	YES

Dead Load (Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load (Given)	100.00 PSF	Allowable Deflection	0.53 in
Total Load	150.00 PSF	Moment of Inertia	732.620 in^4
		Deflection	0.07 in
Load for One foot Wide Strip	150.00 PLF	Meets Bending Reqs	YES

Beam Span	96.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL

psubstance = SG x pH20

p H2O	62.43
SG - PSL	0.5
p =	31.215

Ring Beam - SoRB 04

Beam Material

Parallel Strand Beam Grade 2.0 E				Max. Shear	5,119 Lbf
	Density	r	31 PCF	Shear Stress	123 psi
Allowable Stresses				% Stressed	42%
	Shear	Fv	290 psi	Meets Shear Reqs	YES
	Bending	Fb	2,900 psi		
	Elasticity	E	2,000,000 psi	Max. Moment	12477.0 Lbf*Ft
				Section Modulus	123.39 in^3
Beam Size				Bending Stress	1,213 psi
	Thickness		11.88 in	% Stressed	42%
	Width		5.25 in	Meets Bending Reqs	YES

Dead Load	(Calculated)	50.00 PSF	Deflection	TL = L/180
Live Load	(Given)	100.00 PSF	Allowable Deflection	0.65 in
Total Load		150.00 PSF	Moment of Inertia	732.620 in^4
			Deflection	0.15 in
Load for One foot Wide Strip		150.00 PLF	Meets Bending Reqs	YES

Beam Span	117.00 in
Beam Spacing	84.00 in
Beam Load	1050.00 PLF

Density of PSL

psubstance = SG x pH20

pH2O	62.43
SG - PSL	0.5
p =	31.215

Assumptions

[01] 15 PSF roof deadload
[02] 5 PSF solar thermal + solar electric
[03] 35 PSF snow load [Wisconsin]
[03] 20 PSF wind uplift on north roof plane [calculated from simplified wind pressure ASCE-07]
[04] 20 PSF wind uplift on south roof plane [calculated from simplified wind pressure ASCE-07]
[05] Rafters spaced 4'-0" o.c.

Rafter Loading

Vertical Forces on Roof	Roof DL	Solar DL	Snow LL	Wind [North]	Wind [South]
Area	15.00 PSF	5.00 PSF	35.00 PSF	-20.00 PSF	-20.00 PSF
Linear	60.00 PLF	20.00 PLF	140.00 PLF	-80.00 PLF	-80.00 PLF

RafterLoading for Bolted Connections

total load at rafter DL+LL	220.00 PLF
total load at rafter end connection - DL+LL (P/2)	1,446.0 lb
total load at rafter end (DL+WL)	0.00 PLF
total load at rafter end connection DL+WL (P/2)	0.0 lb

Rafter Schedule

North Rafters	IMP Dim	Inches	Dec. Dim	total load at rafter connection
NoRa 01	13'-1 3/4"	157.75	13.15 ft	1,446.0 lb
NoRa 02	12'-3 5/8"	147.625	12.30 ft	1,353.2 lb
NoRa 03	11'-9"	141	11.75 ft	1,292.5 lb
NoRa 04	10'-4 1/2"	124.5	10.38 ft	1,141.3 lb
NoRa 05	9'-10"	118	9.83 ft	1,081.7 lb
NoRa 06	9'-3 1/2"	111.5	9.29 ft	1,022.1 lb
NoRa 07	9'-6 3/4"	114.75	9.56 ft	1,051.9 lb
NoRa 08	9'-0 1/8"	108.125	9.01 ft	991.1 lb
NoRa 09	8'-5 1/2"	101.5	8.46 ft	930.4 lb
NoRa 10	7'-11"	95	7.92 ft	870.8 lb
NoRa 11	7'-8"	92	7.67 ft	843.3 lb
South Rafters		Inches	Dec. Dim	
SoRa 01	3'-10 7/8"	46.875	3.91 ft	429.7 lb
SoRa 02	4'-5 1/4"	53.25	4.44 ft	488.1 lb
SoRa 03	4'-11 7/8"	59.875	4.99 ft	548.9 lb
SoRa 04	5'-6 1/2"	66.5	5.54 ft	609.6 lb
SoRa 05	6'-1"	73	6.08 ft	669.2 lb
SoRa 06	6'-7 5/8"	79.625	6.64 ft	729.9 lb
SoRa 07	7'-2 1/8"	86.125	7.18 ft	789.5 lb
SoRa 08	7'-8 3/4"	92.75	7.73 ft	850.2 lb
SoRa 09	8'-3 3/8"	99.375	8.28 ft	910.9 lb
SoRa 10	8'-9 7/8"	105.875	8.82 ft	970.5 lb
SoRa 11	9'-0 5/8"	108.125	9.01 ft	991.1 lb

Rafter Material

Microllam Grade 1.9 E		
Density	r	31 PCF
Allowable Stresses		
Shear	Fv	285 psi
Bending	Fb	2,600 psi
Elasticity	E	1,900,000 psi
Compression Perpendicular to Grain	Fc	750 psi
Tension Stress	Ft	1,555 psi

Rafter Size (main member)	
thickness (t_m)	1.75 in
depth	9.25 in
(Minimum Bearing length 3-1/4") - Bearing Area	127.12 in
dowel bearing strength - parallel (F_{em})	1,555 psi
dowel bearing strength - perpendicular (F_{em})	
dowel bearing strength - angle (F_{em})	
angle of load to main member ($ø_m$)	0.00 °
specific gravity (SG_m)	0.50
Steel Size (side member)	
thickness (t_s)	0.38 in
depth	8.25 in
dowel bearing strength - parallel (F_{es})	58,000 psi
dowel bearing strength - perpendicular (F_{es})	
dowel bearing strength - angle (F_{es})	58,000 psi
Bolts	
Number	3
Spacing	1.00 in
Rows	1.00 in
bending yield strength of bolt (F_{yb})	45,000 psi
Diameter (D)	0.50 in

Bolt Adjustment Factors		DL	SL	WL	
Load Duration	C_D	0.9	1.15	1.6	
Wet Service	C_M	1			
Temperature	C_t	1			
Geometry	C_Δ	1	q_{zx}		
Group Action	C_g	1.88			
Number of Bolts in row		n	1		
E_mA_m/E_sA_s E_sA_s/E_mA_m		R_{ea}	0.28	0.28	3.62

Elastic Modulus Main Member	E_m	1,900,000 psi	Main PSI	
Elastic Modulus Side Member	E_s	36,000,000 psi	Side PSI	
Cross Sectional Area Main Member	A_m	16.1875	Main X-Section Area [in]	
Cross Sectional Area Side Member	A_s	3.09375	Side X-Section Area [in]	
	m	0.68		
	m^2	0.456624261		
	m^{2n}	0.456624261		
	u	1.08	1.16	0.40
cntr-to-cntr spacing between fasteners in a row	s	1		
load/slip modulus	γ	95459.42	270000	0.35
Bolt Diameter	D	0.50 in		
base end distance for bolts		4		
actual end distance for bolts		4		

Bolted Connection Design

Bolt Allowable Stress - Nominal (Z)	Z	340 psi
Bolt Adjusted Allowable Stress - (Z')	Z'	735 psi
Bolt Adjustment Factors		
Load Duration	C_D	1.15
Wet Service	C_M	1
Temperature	C_t	1
Geometry	C_Δ	1
Group Action	C_g	1.88
Allowable Stress - Connection	N = P/Z'	2 Bolt(s)

Rafter Bearing Design

Bearing Length	3.25 in
Bearing Width	1.75 in
Required Bearing Area	0.52 in^2
Actual Bearing Area	5.69 in^2
Check	Yes
Allowable Bearing Stress	750 psi
Actual Bearing Stress	254 psi
Check	Yes

Bolt Nominal Design Values

Coeffcients for Yield Limit Equations - single shear

wood/wood - single shear

$R_e=F_{em}/F_{es}$	0.02681	
$(1+R_e)$	1.027	
$(2+R_e)$	2.027	
$(1+2R_e)$	1.054	
R_t	4.67	
$(1+R_t)$	5.667	
$(1+R_t+R^2_t)$	27.444	
ø	0.00 ˚	
Kø	1.00	
k_1	0.1035	
k_2	0.9269	
k_3	11.0877	
Mode I_m	340.2 lb	
Mode I_s	2,718.8 lb	
Mode II	312.8 lb	
Mode III_m	374.1 lb	
Mode III_s	498.4 lb	
Mode IV	526.6 lb	
	312.8 lb	Nominal Design Value (Z)

wood/steel - single shear

$R_e=F_{em}/F_{es}$	0.02681	
$(1+R_e)$	1.027	
$(2+R_e)$	2.027	
$(1+2R_e)$	1.054	
R_t	4.67	
$(1+R_t)$	5.667	
$(1+R_t+R^2_t)$	27.444	
ø	0.00 ˚	
Kø	1.00	
k_1	0.1035	
k_2	0.9269	
k_3	11.0877	
Mode I_m	340.2 lb	
Mode I_s		
Mode II	312.8 lb	
Mode III_m	374.1 lb	
Mode III_s	498.4 lb	
Mode IV	526.6 lb	
	312.8 lb	Nominal Design Value (Z)

Bolt Yield Limit Equations for single shear

Wood/Wood

Mode I_m	$Z=Dt_mF_{em}/4K\text{ø}$
Mode I_s	$Z=Dt_sF_{es}/4K\text{ø}$
Mode II	$Z=k_1Dt_sF_{es}/3.6K\text{ø}$
Mode III_m	$Z=k_2Dt_mF_{em}/3.2(1+2R_e)K\text{ø}$
Mode III_s	$Z=k_3Dt_sF_{em}/3.2(2+R_e)K\text{ø}$
Mode IV	$Z=D^2/3.2K\text{ø}\sqrt{2F_{em}F_{yb}/3(1+R_e)}$

Wood/Steel

Mode I_m	$Z=Dt_mF_{em}/4K\text{ø}$
Mode I_s	~~$Z=Dt_sF_{es}/2K\text{ø}$~~
Mode II	$Z=k_1Dt_sF_{es}/3.6K\text{ø}$
Mode III_m	$Z=k_2Dt_mF_{em}/3.2(1+2R_e)K\text{ø}$
Mode III_s	$Z=k_3Dt_sF_{em}/3.2(2+R_e)K\text{ø}$
Mode IV	$Z=D^2/3.2K\text{ø}\sqrt{2F_{em}F_{yb}/3(1+R_e)}$

Placement of Bolts

Distance from Edge - Parallel to Grain Loading

∫/D Ratio	Minimum Edge Distance
when ∫/D ≤ 6	1.5D
when ∫/D > 6	greater of 1.5D or 1/2 the spacing between rows of bolts

∫/D ratio to be used is lesser of

[a]	$\int_m/D$	4.00 in		
[b]	$\int_s/D$	0.75 in		Minimum Edge Distance
	∫/D Ratio	0.75 in	∫/D≤6	0.75 in

Distance from Edge - Perpendicular to Grain Loading

Loaded Edge	4D	2.00 in
Unloaded Edge	1.5D	0.75 in

Distance from End

Direction of Loading	Minimum End Distances for Reduced Design Value	for Full Design Value
Perpendicular to Grain	2D	4D
	1.00 in	2.00 in
Parallel to Grain , Compression	2D	4D
	1.00 in	2.00 in
Parallel to Grain , Tension	2.5D	5D
	1.25 in	1.25 in

Spacing Between Bolts in a Row

Direction of Loading	Minimum End Distances for Reduced Design Value	for Full Design Value
Parallel to Grain	3D	4D
	1.50 in	2.00 in
Perpendicular to Grain	3D	As required for attached members
	1.50 in	

Bolt Nominal Design Values

Coeffcients for Yield Limit Equations - double shear

wood/wood - double shear

$R_e=F_{em}/F_{es}$	0.02681
$(1+R_e)$	1.027
$(2+R_e)$	2.027
$(1+2R_e)$	1.054
R_t	4.67
$(1+R_t)$	5.667
$(1+R_t+R^2_t)$	27.444
ø	0.00 ˚
Kø	1.00
k_1	0.1035
k_2	0.9269
k_3	11.0877
Mode I_m	340.2 lb
Mode I_s	2,718.8 lb
Mode II	
Mode III_m	
Mode III_s	498.4 lb
Mode IV	1,053.2 lb
	340.2 lb

Nominal Design Value (Z)

wood/steel - double shear

$R_e=F_{em}/F_{es}$	0.02681
$(1+R_e)$	1.027
$(2+R_e)$	2.027
$(1+2R_e)$	1.054
R_t	4.67
$(1+R_t)$	5.667
$(1+R_t+R^2_t)$	27.444
ø	0.00 ˚
Kø	1.00
k_1	0.1035
k_2	0.9269
k_3	11.0877
Mode I_m	340.2 lb
Mode I_s	
Mode II	
Mode III_m	
Mode III_s	498.4 lb
Mode IV	1,053.2 lb
	340.2 lb

Nominal Desig

Bolt Yield Limit Equations for double shear

Wood/Wood		Wood/Steel	
Mode I_m	$Z=Dt_mF_{em}/4K\text{ø}$	Mode I_m	$Z=Dt_mF_{em}/4K\text{ø}$
Mode I_s	$Z=Dt_sF_{es}/2K\text{ø}$	Mode I_s	~~$Z=Dt_sF_{es}/2K\text{ø}$~~
Mode II	~~$Z=k_1Dt_sF_{es}/3.6K\text{ø}$~~	Mode II	~~$Z=k_1Dt_sF_{es}/3.6K\text{ø}$~~
Mode III_m	~~$Z=k_2Dt_mF_{em}/3.2(1+2R_e)K\text{ø}$~~	Mode III_m	~~$Z=k_2Dt_mF_{em}/3.2(1+2R_e)K\text{ø}$~~
Mode III_s	$Z=k_3Dt_sF_{em}/1.6(2+R_e)K\text{ø}$	Mode III_s	$Z=k_3Dt_sF_{em}/1.6(2+R_e)K\text{ø}$
Mode IV	$Z=D^2/1.6K\text{ø}\sqrt{2F_{em}F_{yb}/3(1+R_e)}$	Mode IV	$Z=D^2/1.6K\text{ø}\sqrt{2F_{em}F_{yb}/3(1+R_e)}$

Terms + Definitions + Equations

$k_3=-1+\sqrt{(2(1+R_e)/R_e)+(2F_{yb}(2+R_e)D^2)/3F_{em}t^2_s}$

$R_e=F_{em}/F_{es}$

$K_ø=1+ø/360$

D = bolt diameter, inches

t_m=thickness of main (center) member, inches

t_s=thickness of side members, inches

F_{em}=dowel bearing strength of main (center) member, psi

F_{eII} - for load parallel to grain

F_{eperp} - for load perpendicular to grain

$F_{eø}$ - for load at angle to grain ø (Hankinson's formula)

F_{es}=dowel bearing strength of side member, psi

F_{eII} - for load parallel to grain

F_{eperp} - for load perpendicular to grain

$F_{eø}$ - for load at angle to grain ø (Hankinson's formula)

F_{yb}=bending yield strength of bolt, psi

ø= maximum angle of load to grain (0≤ø≤90 degrees) for an member in connection

$\int_m$ length of bolt in main member

$\int_s$ length of bolt in side member

Deck Design Template

Project	Meltwater
Designer	
Date	

Deck Material

Black Walnut			
	Density	ρ	35 PCF
Allowable Stresses			
	Shear	Fv	210 psi
	Bending	Fb	1,050 psi
	Elasticity	E	1,420,000 psi

Dead Load	0.85 PSF
Live Load	100.00 PSF
Total Load	100.85 PSF
Load for One foot Wide Strip	100.85 PLF
Joist Spacing (Deck Span)	16.00 in

One Inch Nominal Deck	
Thickness	1.00 in
Width	3.50 in
Section Modulus	0.58 in^3
Moment of Inertia	0.292 in^4
Max. Shear	67 Lbf
Shear Stress	29 psi
% Stressed	14%
Max. Moment	22.4 Lbf*Ft
Bending Stress	461 psi
% Stressed	44%
Deflection	0.02 in

Module 1, Module 1a, Module 2, Module 3

Joist Material

Spruce-Pine-Fir - Construction Grade			
	Density	ρ	27 PCF
Allowable Stresses			
	Shear	Fv	135 psi
	Bending	Fb	1,000 psi
	Elasticity	E	1,300,000 psi
Width	1.50 in		
Depth	9.25 in		
Section Modulus			21.39 in^3
Moment of Inertia			98.932 in^4
Joist Weight			2.60 PLF
Total Joist Loading			137.07 PLF

Joist Span 1	8.0 Ft		Module 1, Module 1a, Module 2
Max. Shear	548 Lbf		
Shear Stress	59 psi		
% Stressed	44%		
Max. Moment	1,097 Lbf*Ft		
Bending Stress	615 psi		
% Stressed	62%		
Deflection	0.10 in		

Joist Span 2	4.0 Ft		Module 1, Module 1a, Module 2
Max. Shear	274 Lbf		
Shear Stress	30 psi		
% Stressed	22%		
Max. Moment	274 Lbf*Ft		
Bending Stress	154 psi		
% Stressed	15%		
Deflection	0.01 in		

Joist Material

Spruce-Pine-Fir - Construction Grade			
	Density	ρ	27 PCF
Allowable Stresses			
	Shear	Fv	135 psi
	Bending	Fb	1,000 psi
	Elasticity	E	1,300,000 psi
Width	1.50 in		
Depth	5.50 in		

Section Modulus	7.56 in^3
Moment of Inertia	20.797 in^4
Joist Weight	1.55 PLF
Total Joist Loading	136.01 PLF

Joist Span 1		4.0 Ft	Module 1, Module 1a, Module 2
	Max. Shear	272 Lbf	
	Shear Stress	49 psi	
	% Stressed	37%	
	Max. Moment	272 Lbf*Ft	
	Bending Stress	432 psi	
	% Stressed	43%	
Deflection		0.03 in	
Joist Span 2		2.0 Ft	Module 1a, Module 3
	Max. Shear	136 Lbf	
	Shear Stress	25 psi	
	% Stressed	18%	
	Max. Moment	68 Lbf*Ft	
	Bending Stress	108 psi	
	% Stressed	11%	
Deflection		0.00 in	

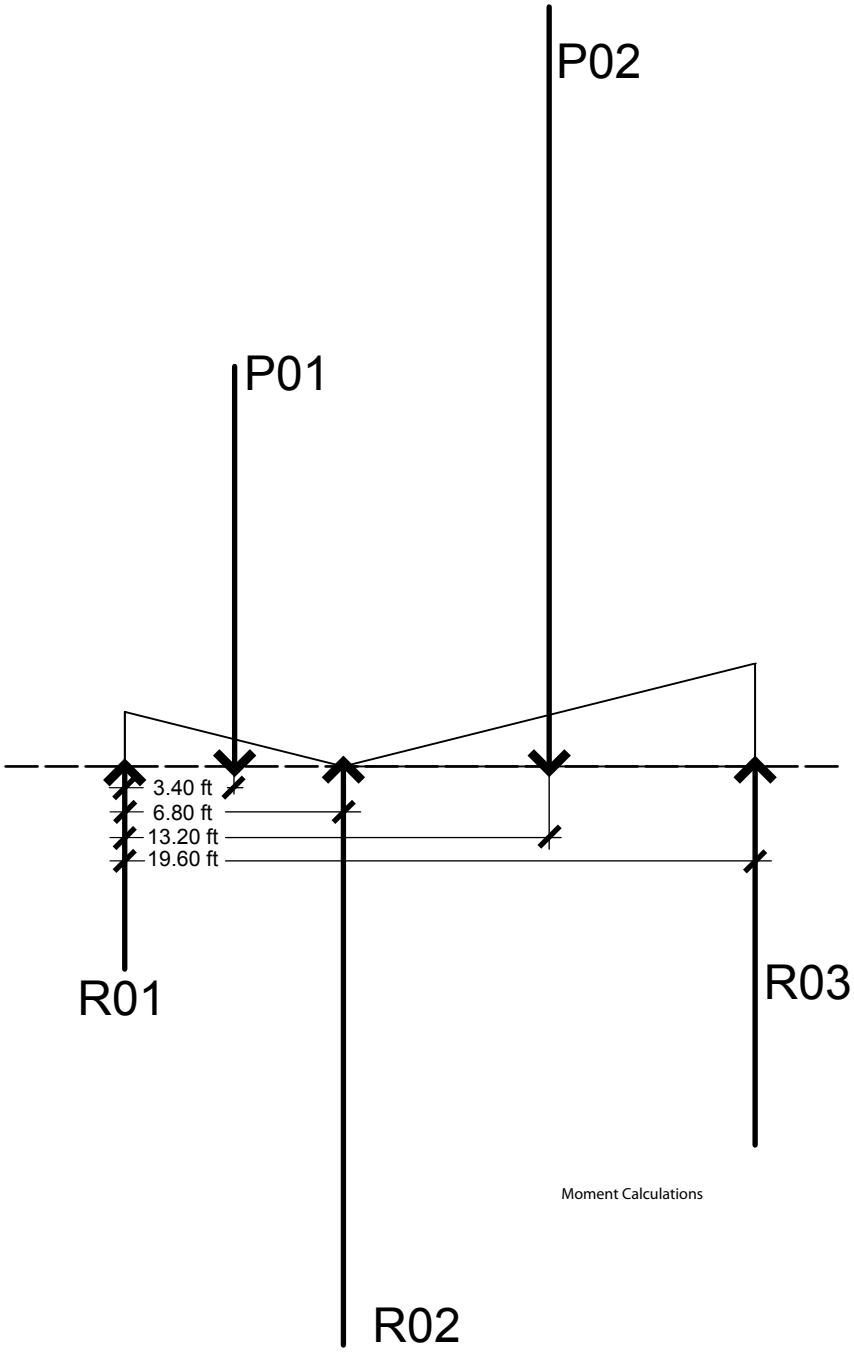
Beam Material

Spruce-Pine-Fir - Construction Grade			
	Density	ρ	27 PCF
Allowable Stresses			
	Shear	Fv	135 psi
	Bending	Fb	1,000 psi
	Elasticity	E	1,300,000 psi
Width	1.50 in		
Depth	11.25 in		
Section Modulus			73.83 in^3
Moment of Inertia			250.068 in^4
Beam Weight			3.16 PLF
Total Beam Loading			139.93 PLF

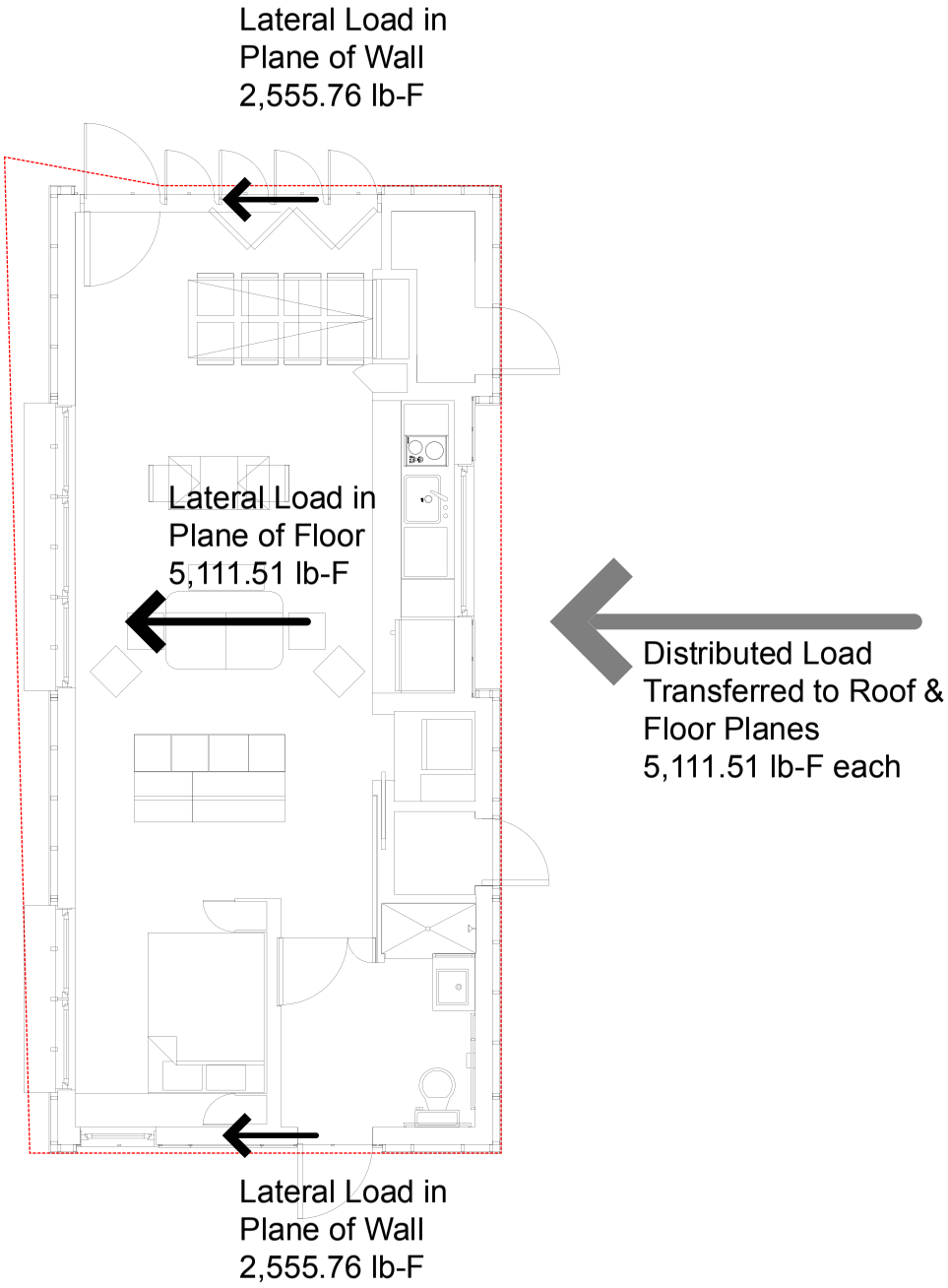
Beam Span 1	10.0 Ft	Module 2, Module 3
Max. Shear	700 Lbf	
Shear Stress	62 psi	
% Stressed	46%	
Max. Moment	1,749 Lbf*Ft	
Bending Stress	284 psi	
% Stressed	28%	
Deflection	0.10 in	

Beam Span 2	12.0 Ft	Module 2, Module 3
Max. Shear	840 Lbf	
Shear Stress	75 psi	
% Stressed	55%	
Max. Moment	2,519 Lbf*Ft	
Bending Stress	409 psi	
% Stressed	41%	
Deflection	0.20 in	

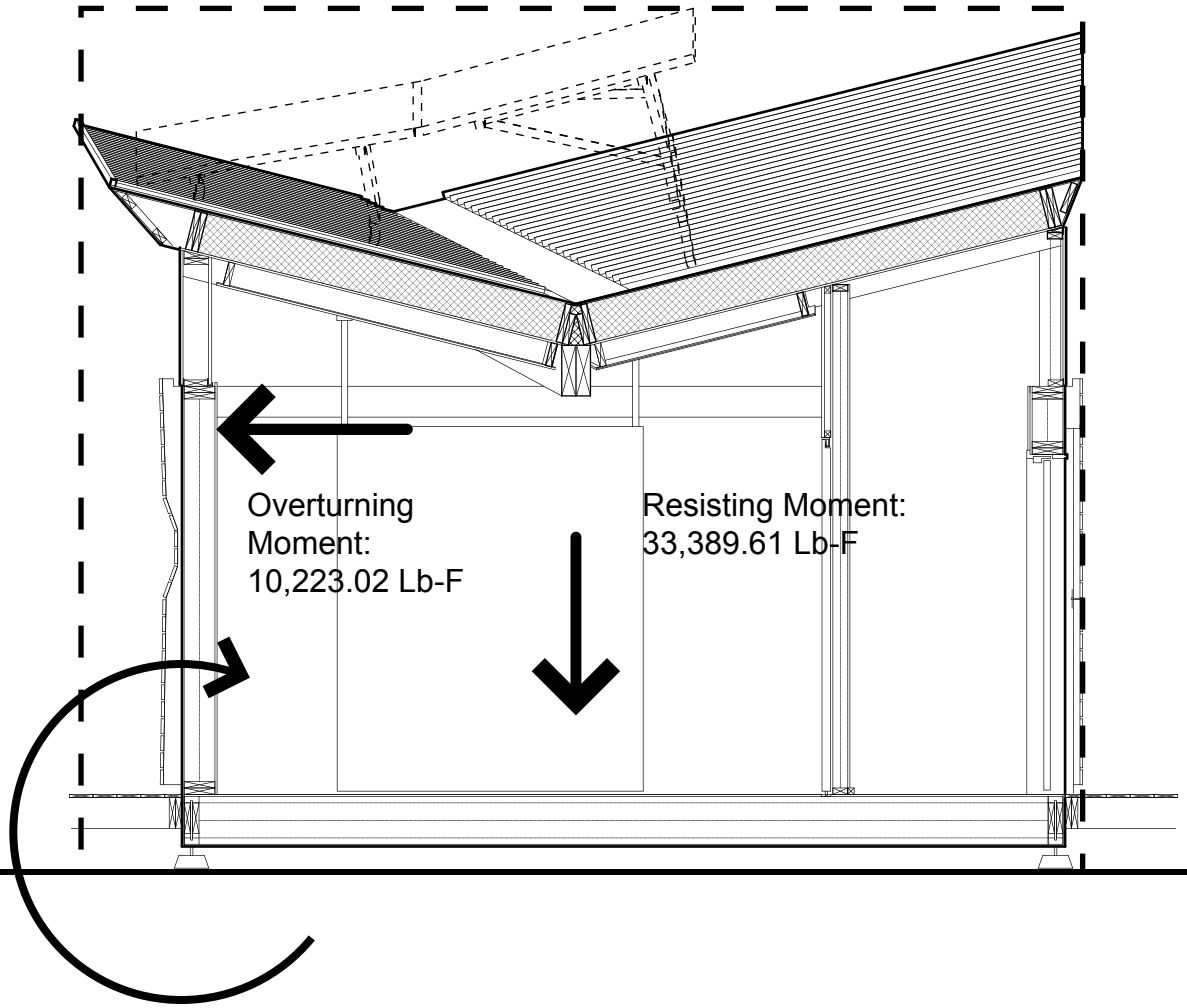
Beam Span 3	16.0 Ft
Max. Shear	1,119 Lbf
Shear Stress	100 psi
% Stressed	47%
Max. Moment	4,478 Lbf*Ft
Bending Stress	728 psi
% Stressed	73%
Deflection	0.63 in

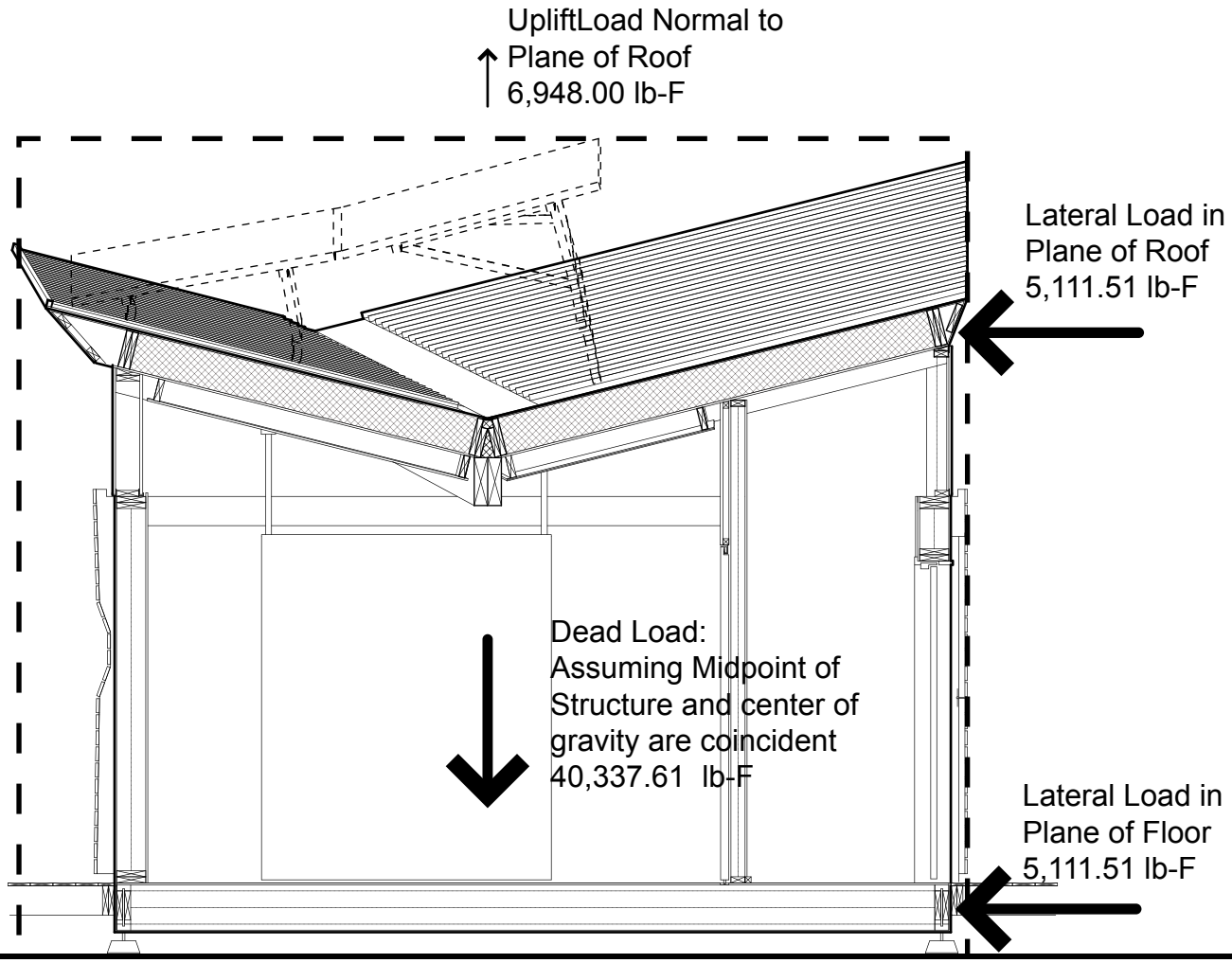


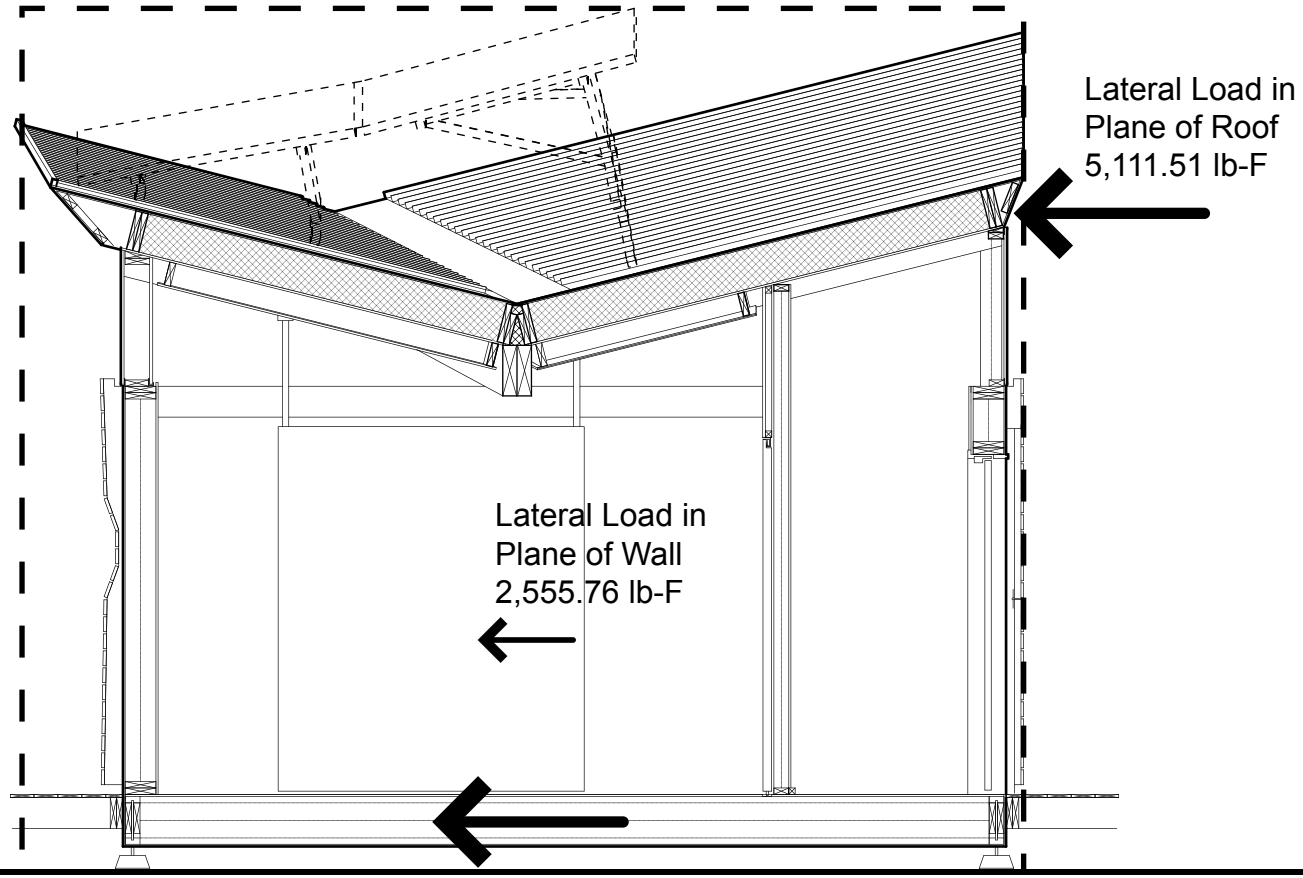
Moment Calculations

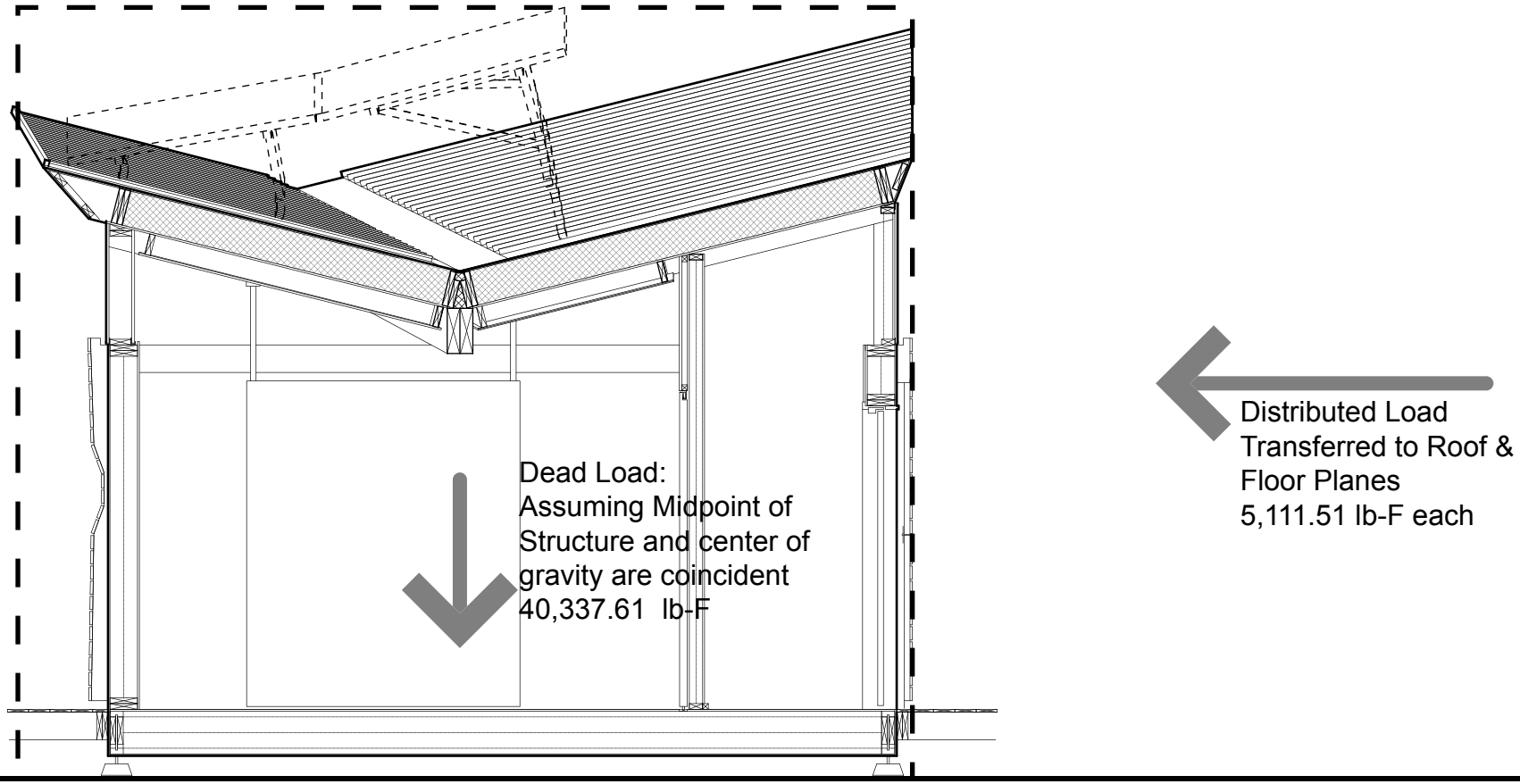

Lateral Load in
Plane of Wall
2,555.76 lb-F
Lateral Load in
Plane of Floor
5,111.51 lb-F
Distributed Load
Transferred to Roof &
Floor Planes
5,111.51 lb-F each
Lateral Load in
Plane of Wall
2,555.76 lb-F

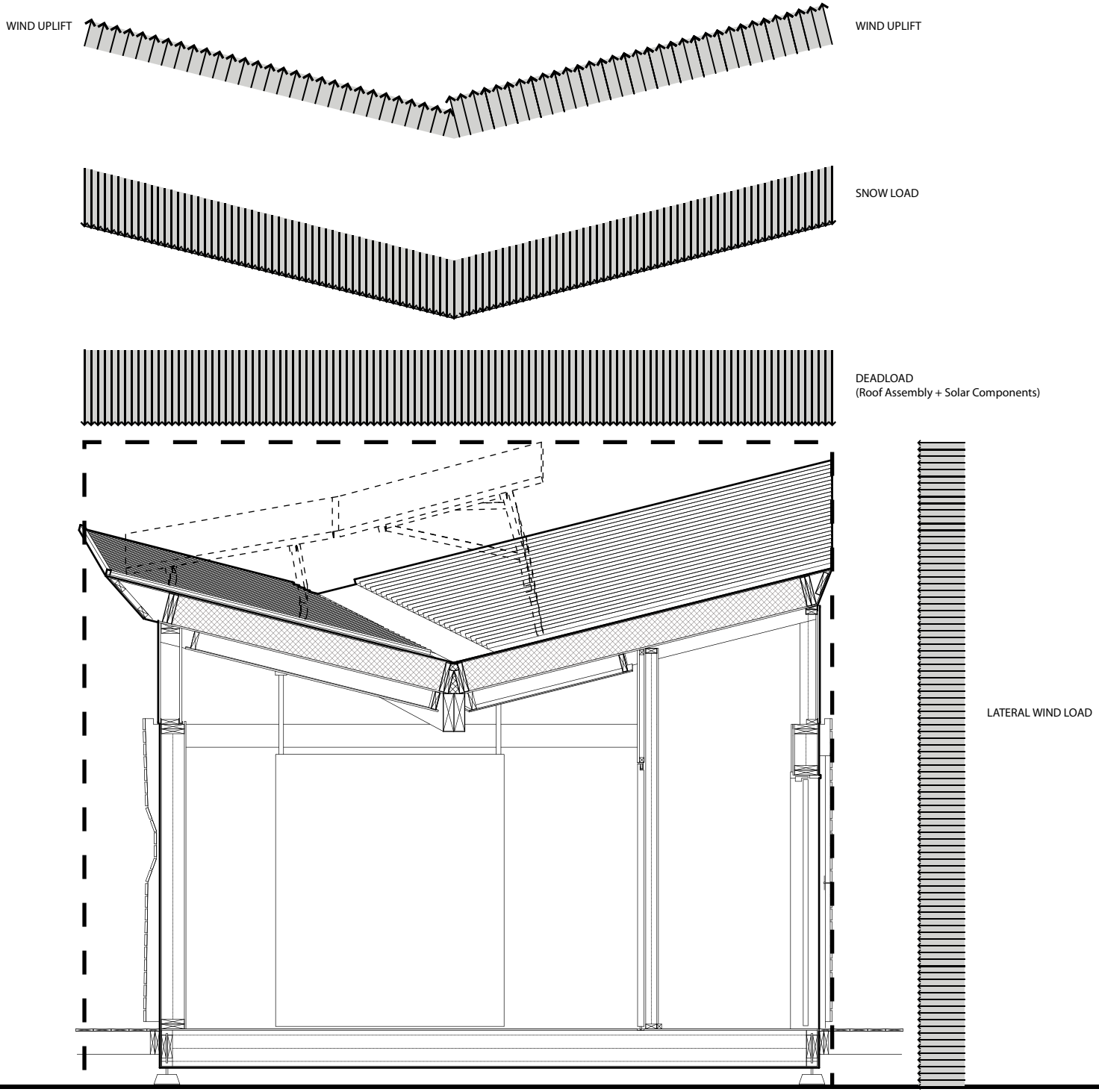
Lateral Load From Wind
Distributed on North Wall
10,223.02 lb-F
Lateral Load in
Plane of Wall
2,555.76 lb-F
Lateral Load in
Plane of Wall
2,555.76 lb-F

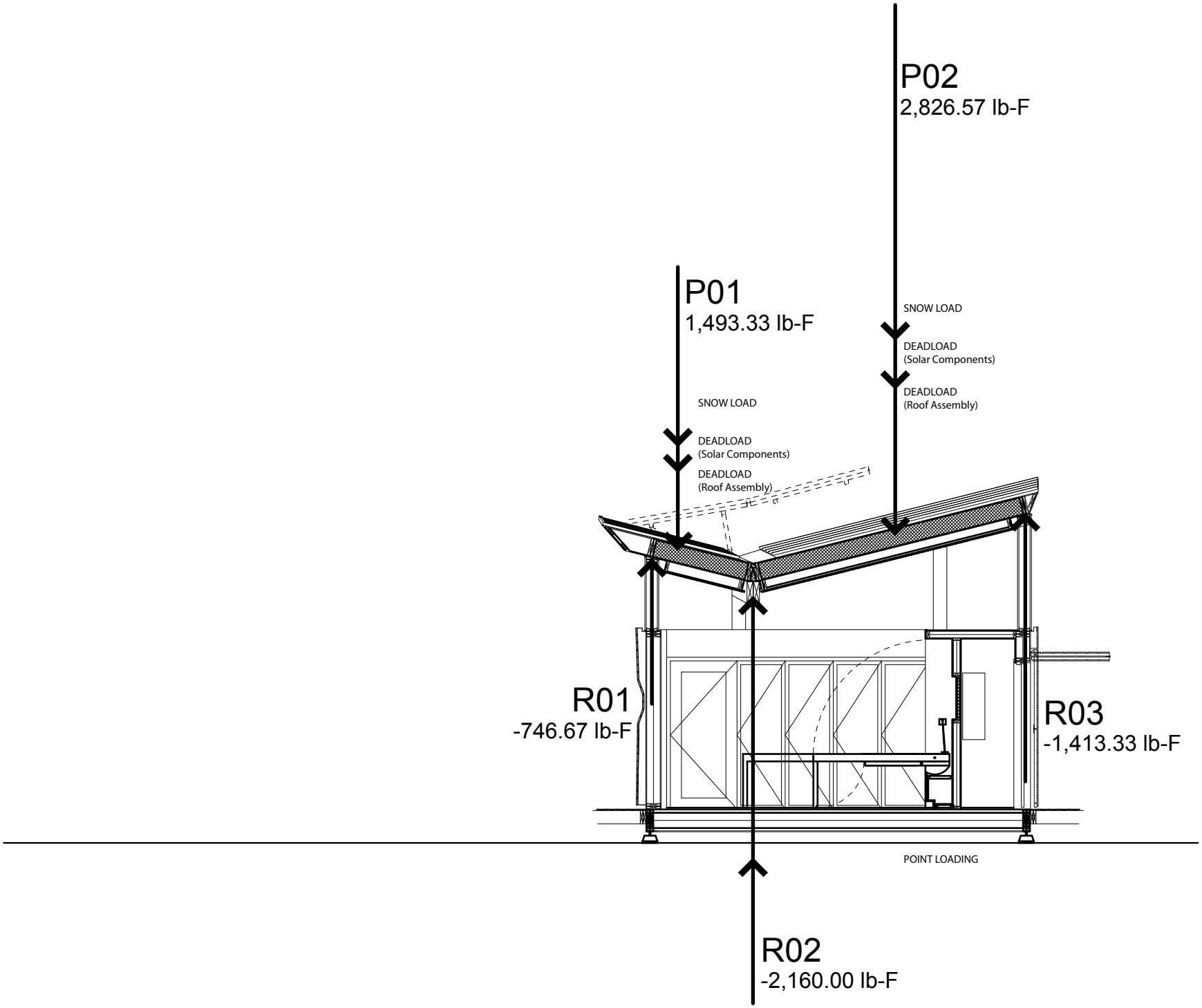

Overturning
Moment:
10,223.02 Lb-F
Resisting Moment:
33,389.61 Lb-F

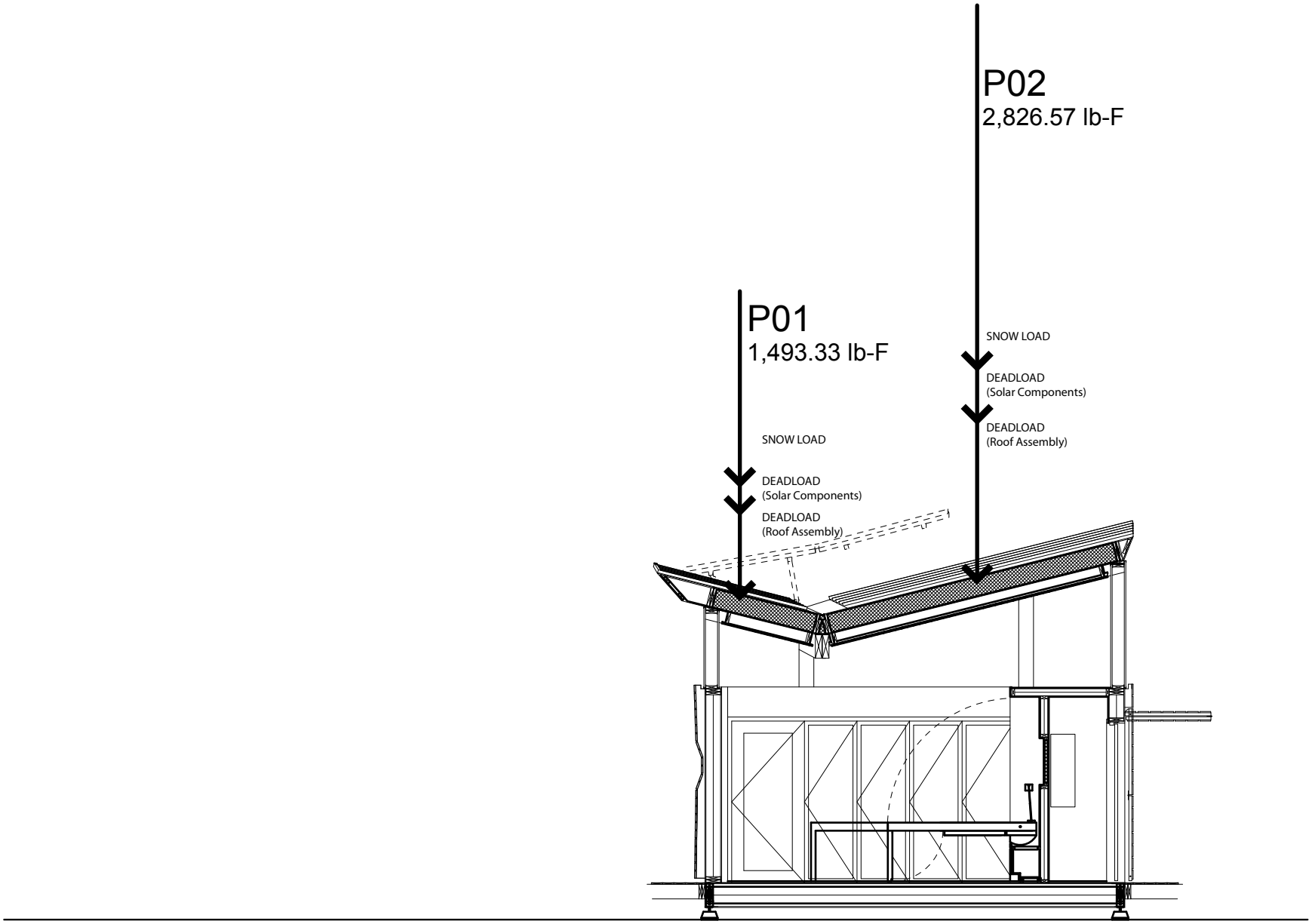

UpliftLoad Normal to
Plane of Roof
6,948.00 lb-F
Lateral Load in
Plane of Roof
5,111.51 lb-F
Dead Load:
Assuming Midpoint of
Structure and center of
gravity are coincident
40,337.61 lb-F
Lateral Load in
Plane of Floor
5,111.51 lb-F


Lateral Load in
Plane of Roof
5,111.51 lb-F
Lateral Load in
Plane of Wall
2,555.76 lb-F
Lateral Load in
Plane of Floor
5,111.51 lb-F

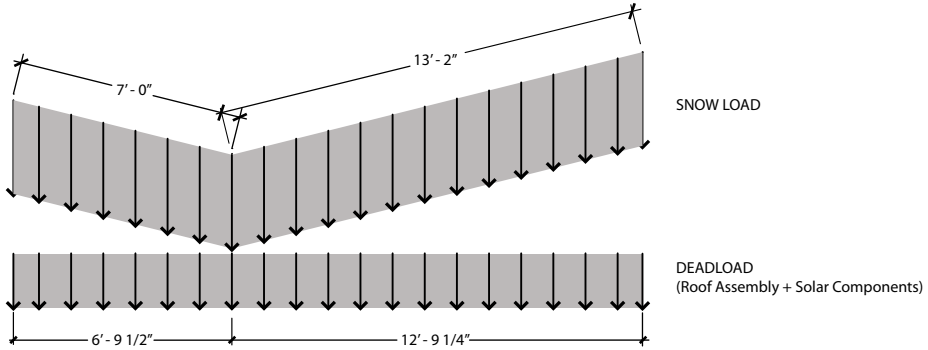

Dead Load:
Assuming Midpoint of
Structure and center of
gravity are coincident
40,337.61 lb-F
Distributed Load
Transferred to Roof &
Floor Planes
5,111.51 lb-F each

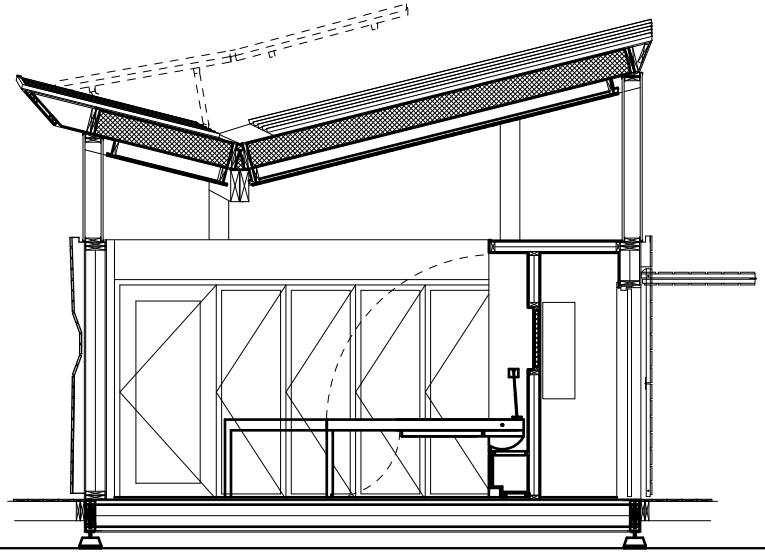

WIND UPLIFT
WIND UPLIFT
SNOW LOAD
DEADLOAD
(Roof Assembly + Solar Components)
LATERAL WIND LOAD


P02
2,826.57 lb-F
P01
1,493.33 lb-F
SNOW LOAD
DEADLOAD
(Solar Components)
DEADLOAD
(Roof Assembly)
SNOW LOAD
DEADLOAD
(Solar Components)
DEADLOAD
(Roof Assembly)
R01
-746.67 lb-F
R03
-1,413.33 lb-F
POINT LOADING
R02
-2,160.00 lb-F

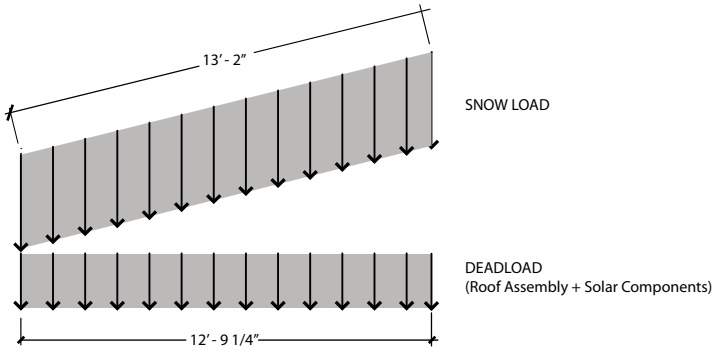


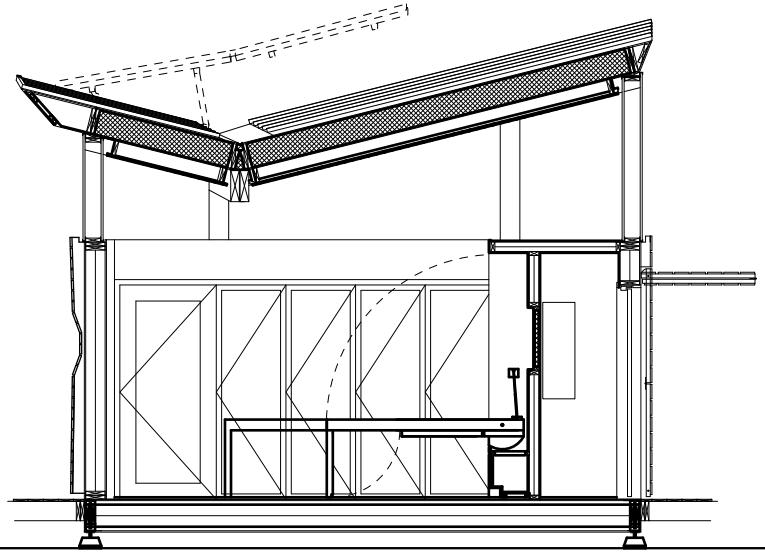
POINT LOADING

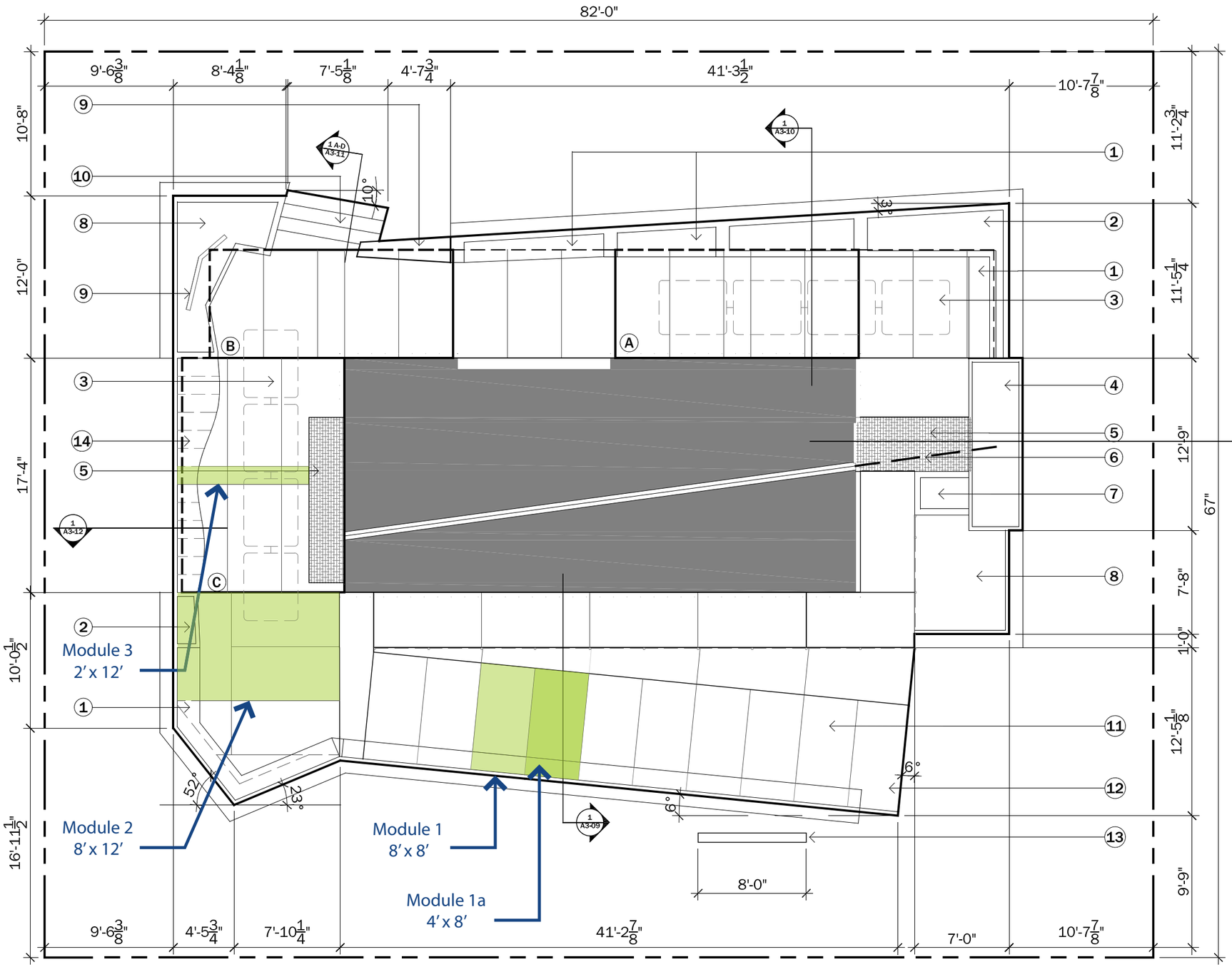




DISTRIBUTED LOADING


13′ - 2″
SNOW LOAD
DEADLOAD
(Roof Assembly + Solar Components)
12′ - 9 1/4″





1. BENCH
2. PLANTER
3. WATER BLADDER SYS.
4. REFLECTING POOL
5. ALUMINUM GRATE
6. EXTENDED DOWNSPOUT
7. WATER GARDEN
8. "LARGE PLANT" GARDEN
9. DISPLAY BOARD
10. EXIT STAIR
11. ENTRY RAMP FROM MALL
12. SEE A1-05 FOR TYPICAL DECK MODULE
13. UNIVERSITY SIGN
14. ESKER BENCH SEE A3-12

2 / A3-10

15. MODULE A
16. MODULE B
17. MODULE C

DECK SECTIONS: A,B,C USED FOR BRACING DURING SHIPPING, SEE A1-05

1 / A1-04 **DECK PLAN**

SCALE: 1/8" = 1'-0"

meltwater

UNIVERSITY of WISCONSIN UWMILWAUKEE

CLIENT NAME: DOE/NREL
PROJECT: SOLAR DECATHLON
PROJECT NO.: SD 2009

REVISION HISTORY

ISSUE DATE: 2009.2.18
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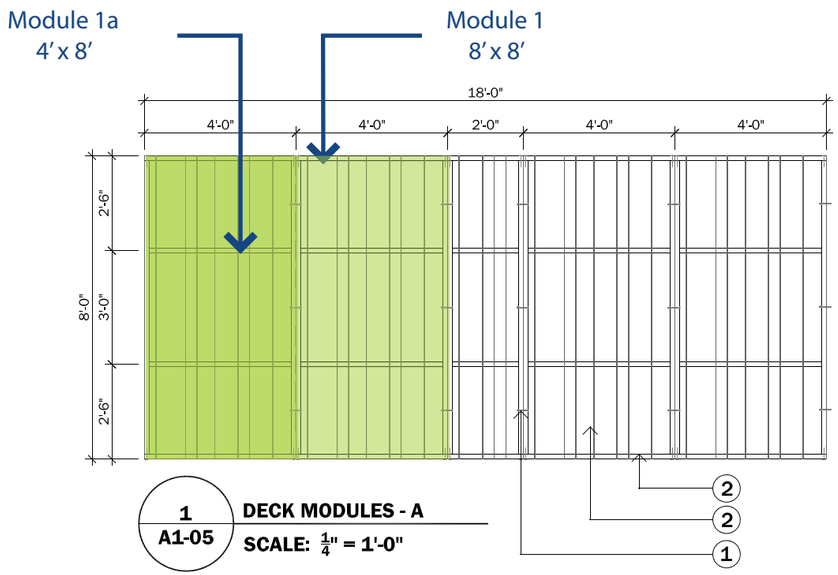
DRAWN BY: JPR

PROJECT STATUS: CD
SHEET NAME:

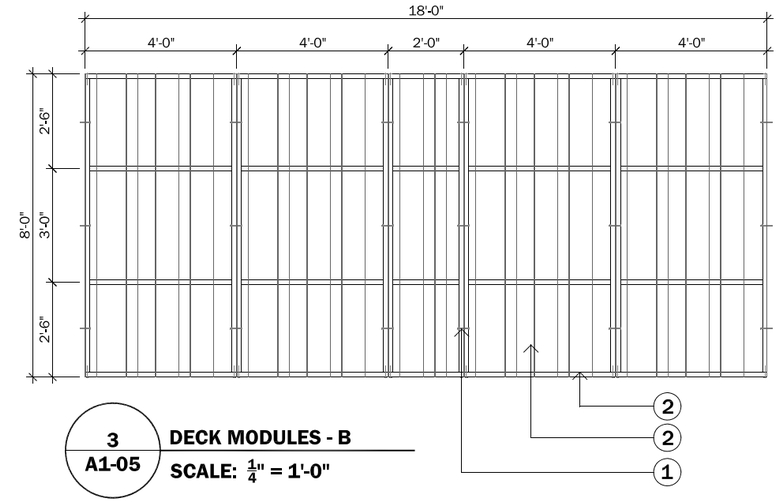
DECK PLAN

A1-04

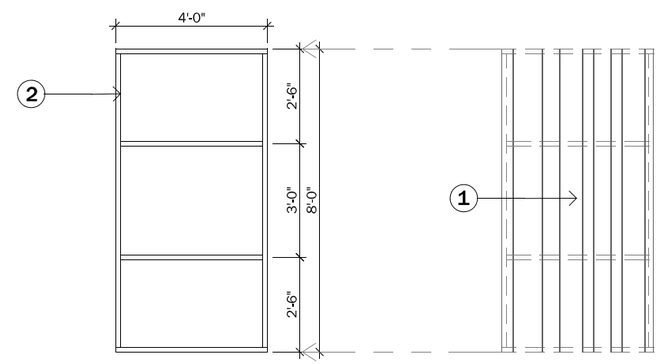
SCALE: 1/8" = 1'-0"



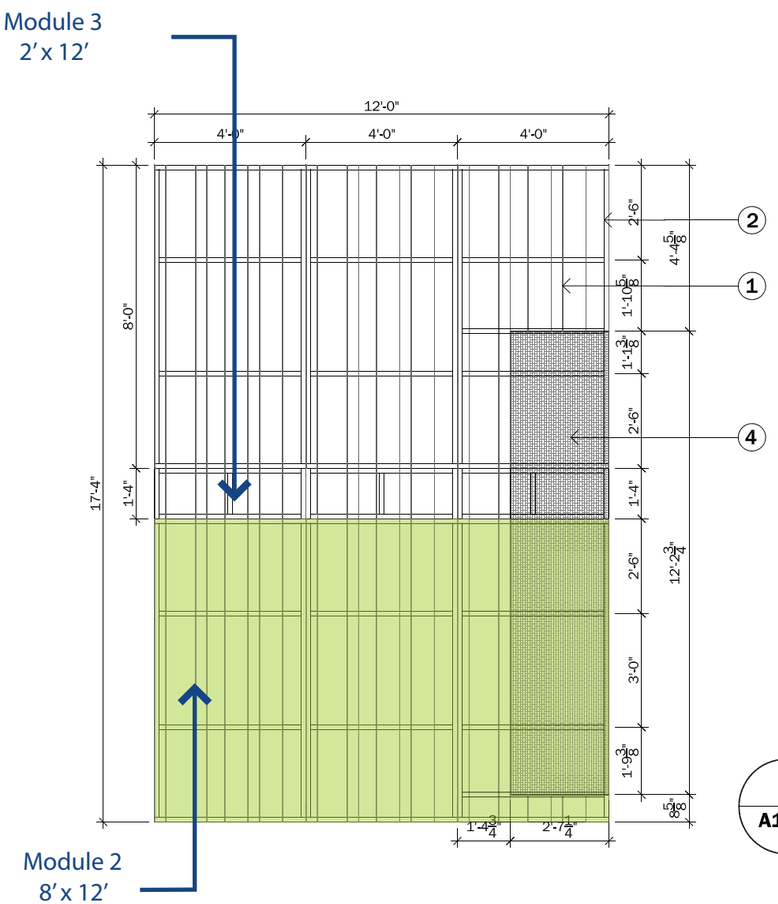
1 / A1-05 **DECK MODULES - A**
SCALE: $\frac{1}{4}$" = 1'-0"



3 / A1-05 **DECK MODULES - B**
SCALE: $\frac{1}{4}$" = 1'-0"



4 / A1-05 **DECK MODULES - TYPICAL**
SCALE: $\frac{1}{4}$" = 1'-0"



2 / A1-05 **DECK MODULES - C**
SCALE: $\frac{1}{4}$" = 1'-0"

1. DECK BOARDS VARIES BETWEEN:
   2" X 4"
   2" X 6"
   2" X 8"
   2" X 10"
2. MODULE FRAME MEMBERS:
   2" X 8" PINE
3. $\frac{3}{4}$" THREADED BOLT
4. 1" THICK ALUMINUM GRATE

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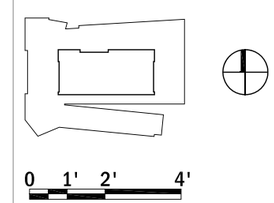


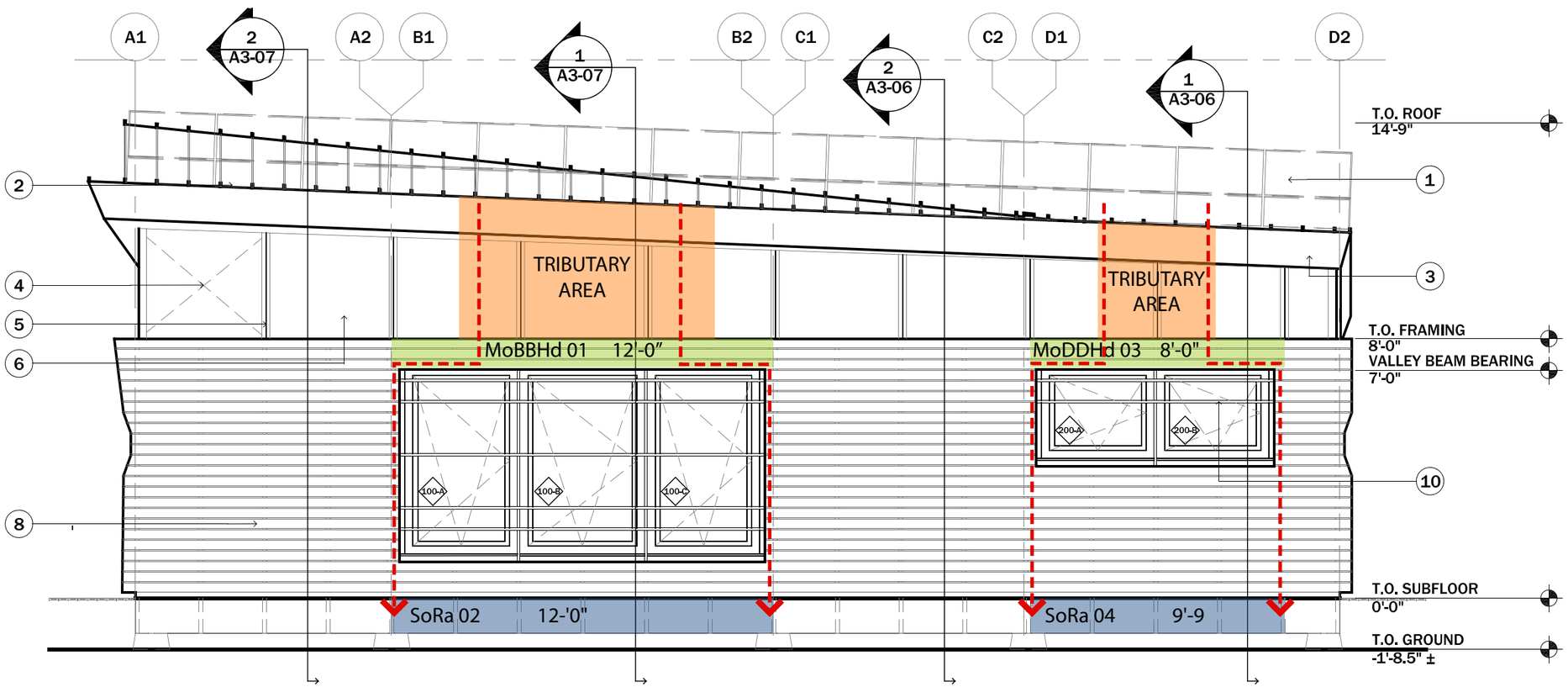
PROJECT STATUS: CD
SHEET NAME:

DECK MODULES

A1-05

SCALE: 1/4" = 1'-0"

1. P.V. ARRAY (SEE ELEC. DWGS.)
2. GALVALUME STANDING SEAM METAL ROOF SEAMS @12" O.C.
3. GALVALUME FASCIA
4. TENSION RODS
5. 1.5" X 5.5" COLUMN
6. TRANSLUCENT POLYCARBONATE CLERESTORY WINDOWS
8. 1" X 4" NOMINAL PINE RAINSCREEN
10. PERFORATED METAL LOUVRES



Header Schedule	IMP Dim
MoBe 01 aW	13'-6"
MoBBHd 01	12'-0"
MoBBHd 02	6'-0"
MoDDHd 03	8'-0"
MoDDHd 04	3'-6"
MoDDHd 05	3'-6"

Ring Beam Schedule			
North Ring Beam	IMP Dim	South Ring Beam	IMP Dim
NoRB 01	8'-0"	SoRa 01	8'-0"
NoRB 02	12-'0"	SoRa 02	12-'0"
NoRB 03	8'-0"	SoRa 03	8'-0"
NoRB 04	9'-9"	SoRa 04	9'-9"

1 / A2-02 **SOUTH ELEVATION**
Scale: $\frac{1}{4}$" = 1'-0"

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DRAWN BY: AWM/JPR

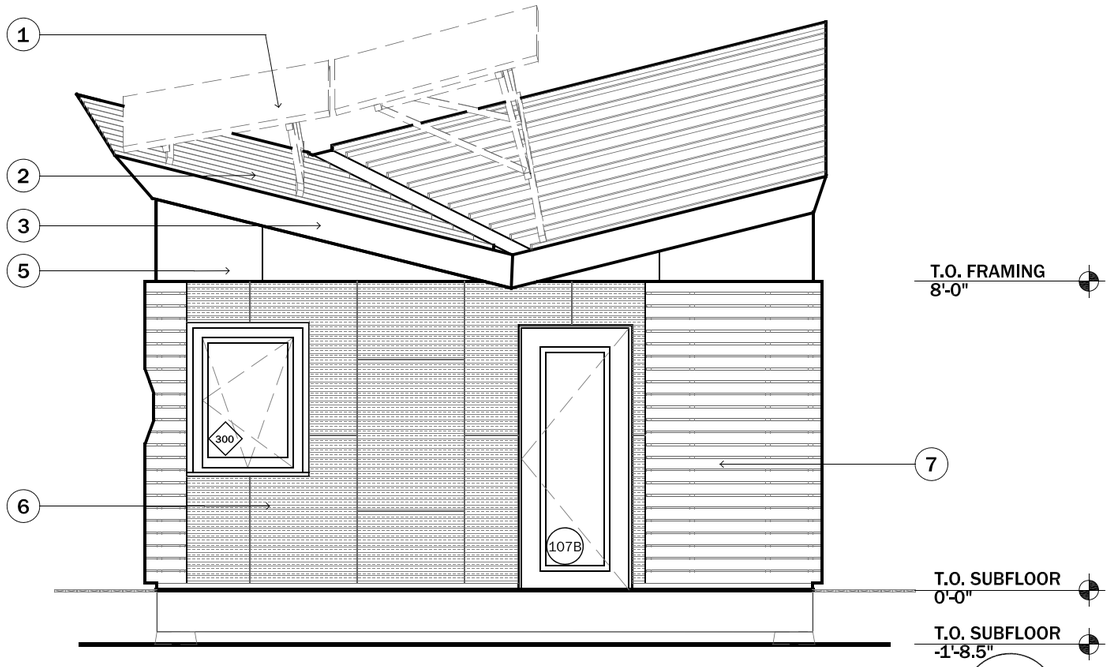
0 1' 2' 4'

PROJECT STATUS: CD
SHEET NAME:

EXTERIOR SOUTH ELEVATION

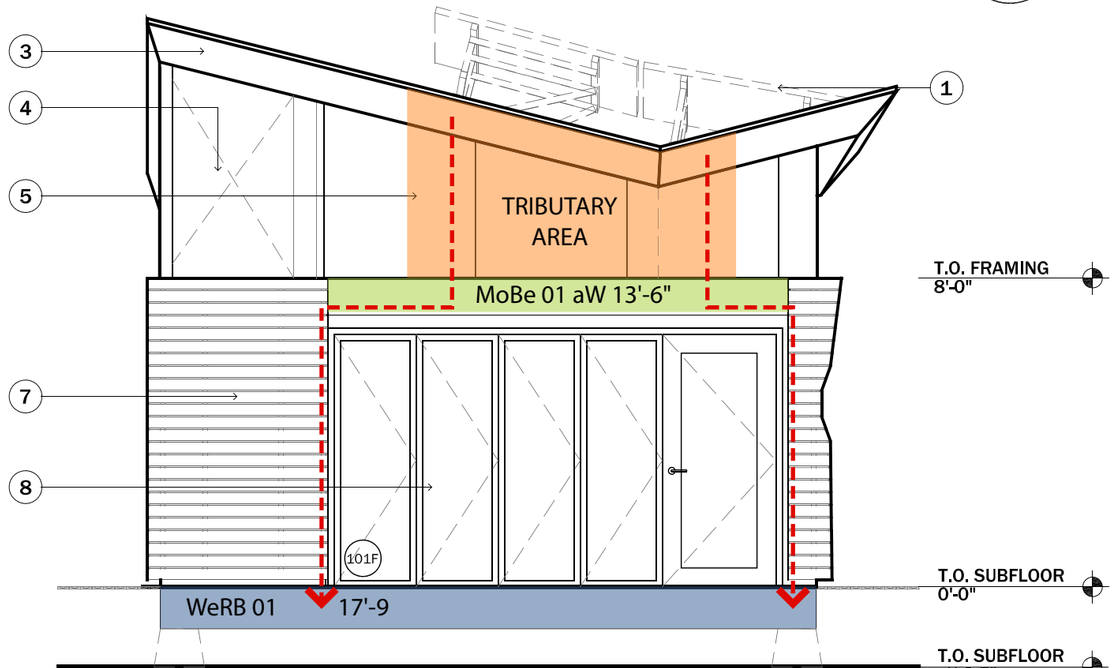
A2-02

SCALE: 1/4" = 1'-0"



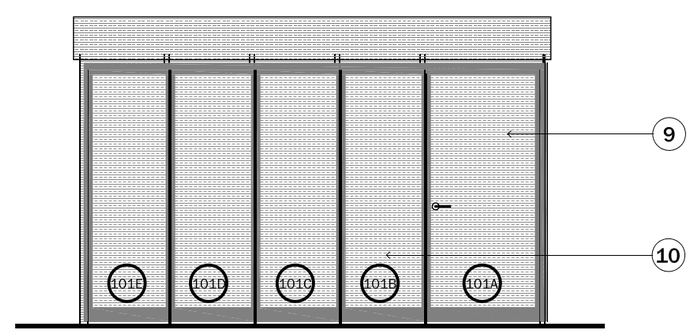
1 A2-03 **EAST ELEVATION**
Scale: $\frac{1}{4}$" = 1'-0"

1. P.V. ARRAY (SEE ELEC. DWGS.)
2. GALVALUME STANDING SEAM METAL ROOF SEAMS @12" O.C.
3. GALVALUME FASCIA
4. TENSION RODS
5. TRANSLUCENT POLYCARBONATE CLERESTORY WINDOWS
6. PERFORATED METAL SIDING
7. 1" X 4" NOMINAL PINE RAINSCREEN
8. FOLDING DOOR SYSTEM
9. PERFORATED METAL DOOR
10. PERFORATED METAL EXTERIOR SUNSHADE DOORS



Header Schedule IMP Dim
MoBe 01 aW 13'-6"

2 A2-03 **WEST ELEVATION**
Scale: $\frac{1}{4}$" = 1'-0"



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UNIVERSITY of WISCONSIN UWMILWAUKEE

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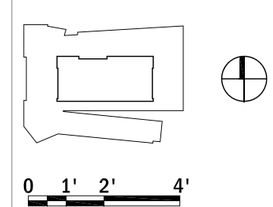
DRAWN BY: AWM/JPR

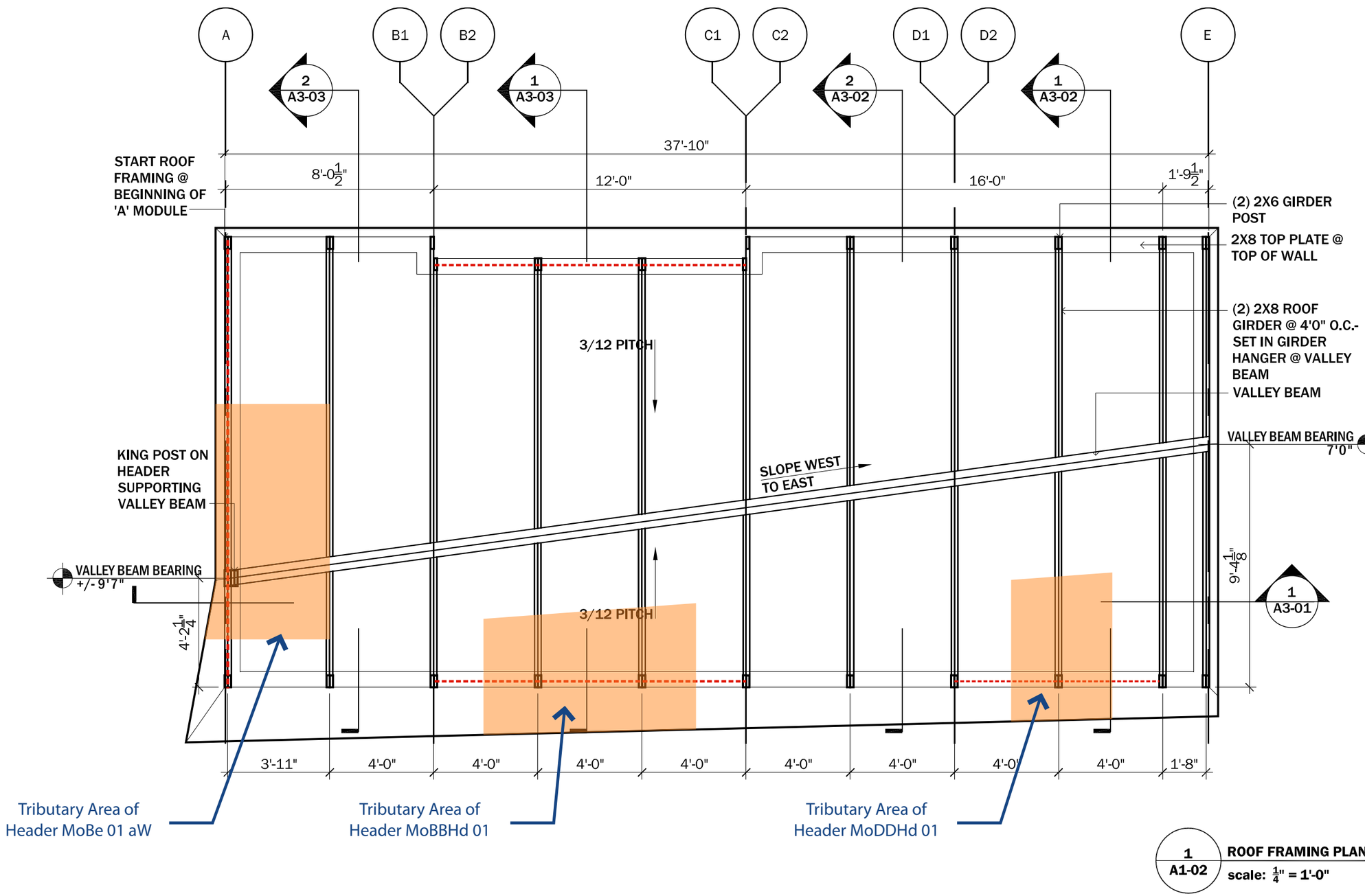


PROJECT STATUS: CD
SHEET NAME:

EXTERIOR EAST/WEST ELEVATIONS

A2-03

SCALE: 1/4" = 1'-0"



1
A1-02
ROOF FRAMING PLAN
scale: ¼" = 1'-0"

meltwater

UNIVERSITY of WISCONSIN UWMILWAUKEE

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PROJECT: SOLAR DECATHLON
PROJECT NO.: SD 2009

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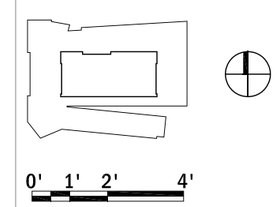
CHECKED BY: GDT/CTC
DRAWN BY: ERH

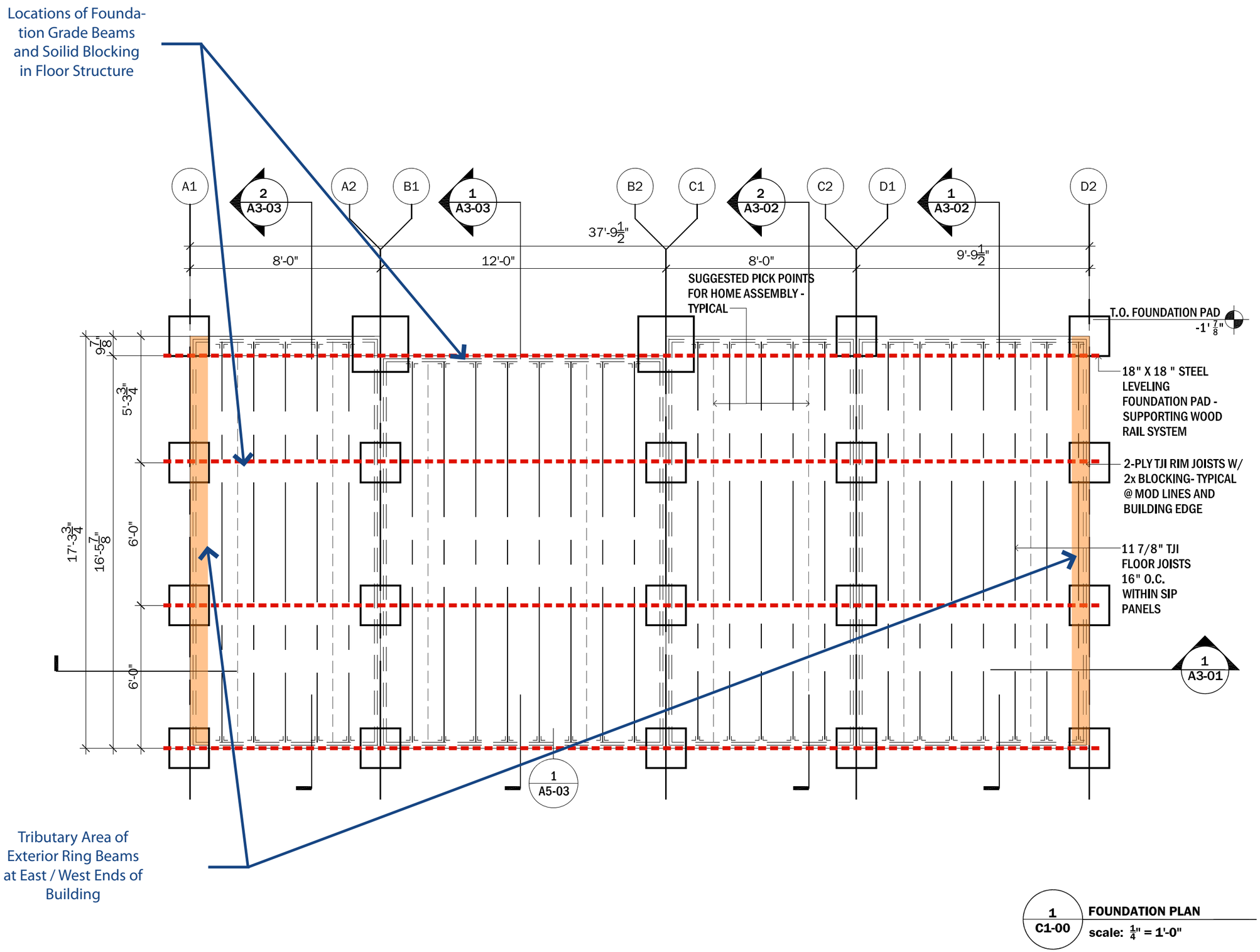


PROJECT STATUS: CD
SHEET NAME:

ROOF FRAMING PLAN

A1-02

SCALE: 1/4" = 1'-0"



1 C1-00 **FOUNDATION PLAN**
scale: 1/4" = 1'-0"

meltwater

UNIVERSITY of WISCONSIN UWMILWAUKEE

CLIENT NAME: DOE/NREL
PROJECT: SOLAR DECATHLON
PROJECT NO.: SD 2009

REVISION HISTORY

ISSUE DATE: 2009.2.18
APPROVED BY: GDT/CTC
CHECKED BY: GDT/CTC
DRAWN BY: ERH

0' 1' 2' 4'

PROJECT STATUS: CD
SHEET NAME:

FOUNDATION PLAN

C1-00

SCALE: 1/4" = 1'-0"

02.01.03. Building Assembly Process

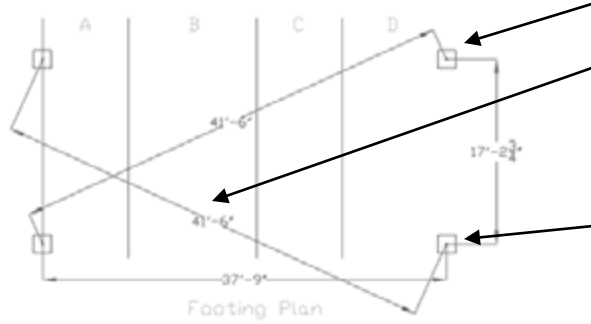
See attached documents.

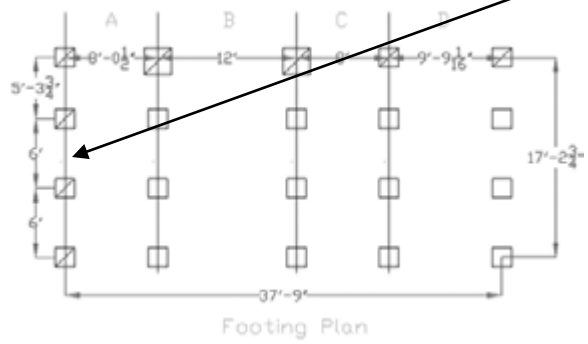
Project Assembly

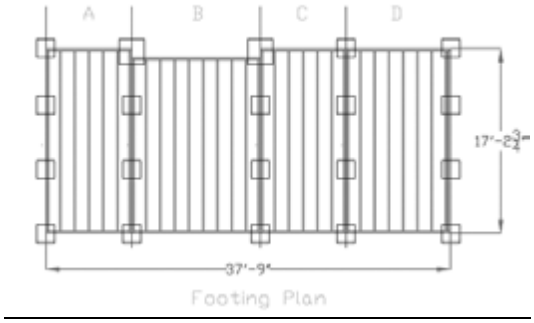
- The primary intention of the following instructions is to establish seven or eight main pieces that will assemble, disassemble, and then ship and reassemble in a manner that works.
- In order to efficiently make the roof, it is the theory of this document that the beam has to be set in place first. Then, an angle iron has to be securely bolted into place on the beam, and a string line stretched from the west to south walls, to establish the rafter locations, and angles from the beam to the wall.
- It's recommended to tig weld simple rafter holding steel plates against the angle iron, using the string line as a guide.
- When all rafters are very securely bolted into place, the roof section will be removable, able to be shipped, and will reassemble exactly into the same position it was built to fit in.
- Any other veering off this path will lead to a different outcome and could alter drastically, the success of this paper.
- The beam and rafters are designed to be installed without any plywood in-between for aesthetic reasons.

Footing, Floor System and Walls Assembly Instructions

1. Install footing system

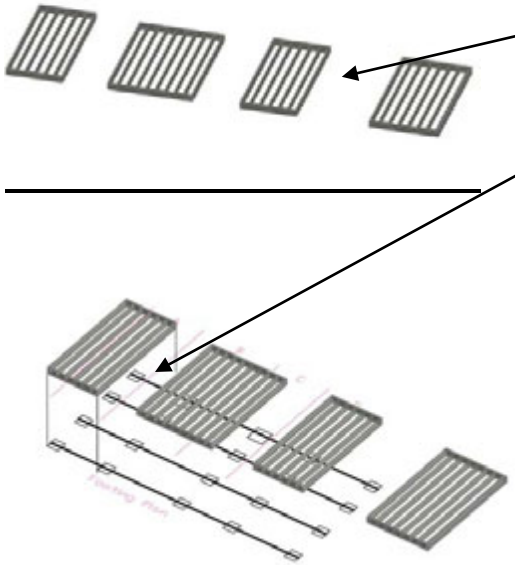






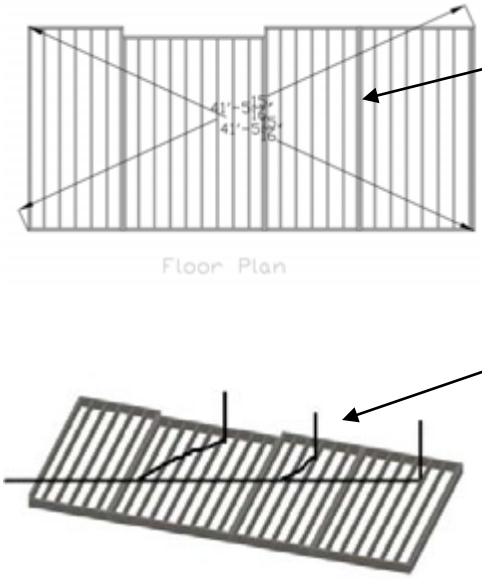
1. Set 4 corner stakes
2. Use a tape measure to check that diagonal corner measurement is the same, to ensure footing is in square.
3. Use a transit to set all 4 corner footings level.
4. Stretch a string line between the corners to establish the height of the rest of the footings.
5. Set all footings and check level with transit and string line.
6. Set all 8 x 8 Rails in place in footing pockets and check for exact level.

2. Set 4 floor modules on top of footing



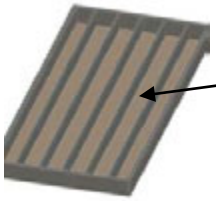
1. Use a crane to lift floor module pieces directly from the Wick Homes delivery truck and set them on the footing system.

3. Put 4 floor modules together.



1. Install 4 – floor mods in permanent position.
2. Square and level floor system and bolt together at mod connections.
3. Check diagonal dimensions to assure its square.
4. Rough-in plumbing drains per plan.
5. Install all cables, systems connection, HVAC items, etc., that will be run in the floor joists
6. Do inspections needed per building codes.

4. Insulate Floor

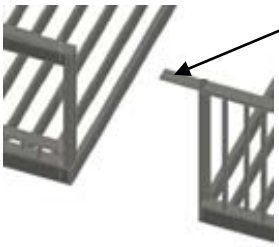


1. After installing all drains, call for Honeywell to spray foam insulation in floor system.

5. Install subfloor.

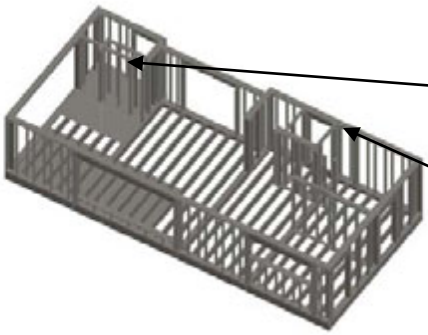
1. Glue and screw ¾” OSB subfloor on all modules.
2. Be sure to have all OSB panel cut lines aligned correctly for disassembly of the 4 modules latter.

6. Exterior walls panels on.



1. Place all preassembled and sheathed exterior wall panels in place, level and square them, and fasten securely.
2. Make all bolt connections to secure 2” x 6” x 6’ top plate connections at mod connections in a manner so they can be disassembled again. Note: The mods are fastened with bolts only with the removable 2 x 6 top plate and a few bolt and nut connections within the floor joists. Mods D and C do not use a removable 2 x 6 top plate connection because the roof doesn’t come off above Mod D. Connect there using the rafters and collar ties.

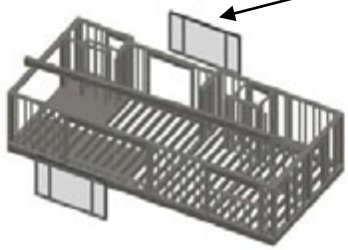
7. Interior wall panels on



1. Level, square, plumb and permanently fasten interior walls into position.
2. Pay special attention to how the interior walls connect at the Mod connections. (see plans)

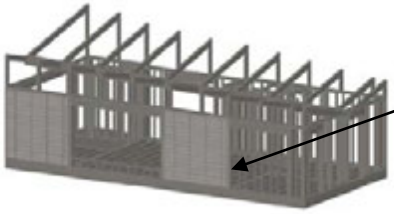
8. Start roof assembly. See roof assembly instructions starting on page 8. More than one crew can work on more than one job area from here.

9. Set windows and door frames.



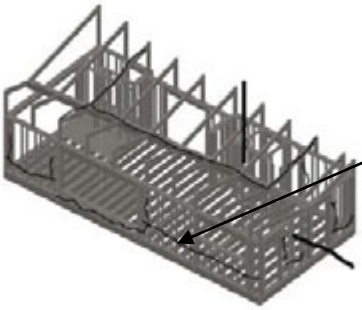
1. Permanently fasten all windows and door frames in place.
2. Square windows by measuring diagonally from corner to corner until dimension is the same. (see the method of squaring the footings on page 1)
3. Note: see set beam instructions under the roof assembly section.

10. Apply rainscreen.



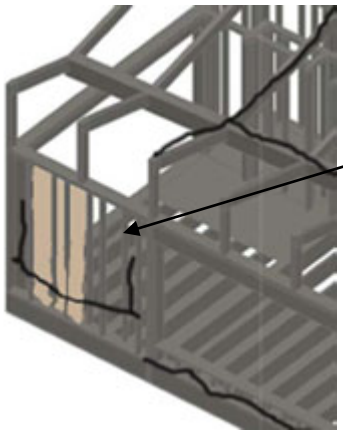
1. Rainscreen can start to be applied while a different crew works on the roof rafters now.

11. Rough plumbing, electric and heating, venting and air conditions, etc.



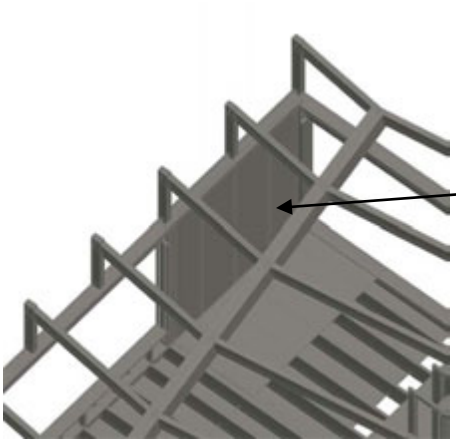
1. While rainscreen crew is installing rainscreen and rafter roofing crew is working in another area of the building, another crew can start roughing in plumbing, electric and HVAC.

12. Insulation



1. As soon as rain screen is underway and roof system is weatherproofed, and plumbing, rough carpentry and electric roughs have passed inspections, install insulation and plastic vapor barrier on all interior walls.

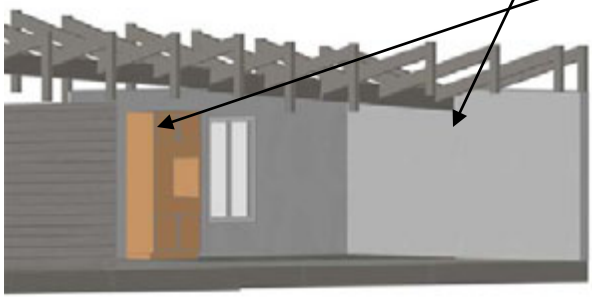
13. Drywall



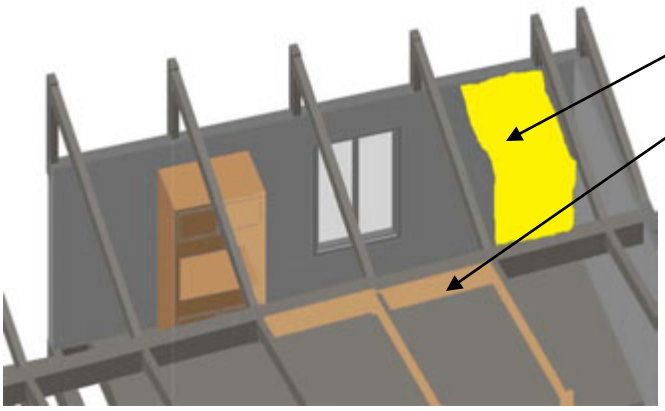
1. After insulation and plastic interior vapor barrier have passed inspection.
2. Install drywall on all interior areas.
3. Tape and finish coat all drywall areas.

14. Finish carpentry, trim and cabinetry.

1. Install all doors, window trims, cabinets, etc.



15. Finish Painting

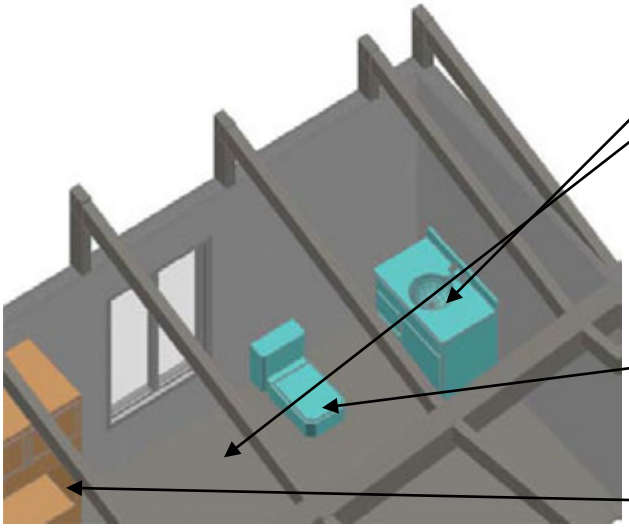


1. Complete all interior painting of walls and finishing of all woodwork.

16. Install countertops and tile.

17. Have a separate work crew start installing the finish flooring in the main living space.

18. Install all finish plumbing and finish electric

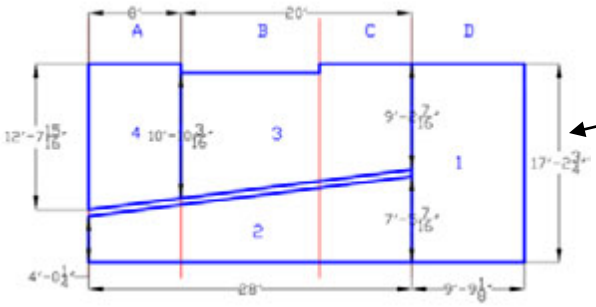


1. Install all countertops and tile

2. Install all finish plumbing fixtures
3. Install all finish electric fixtures
4. Install all finish hardware and misc.

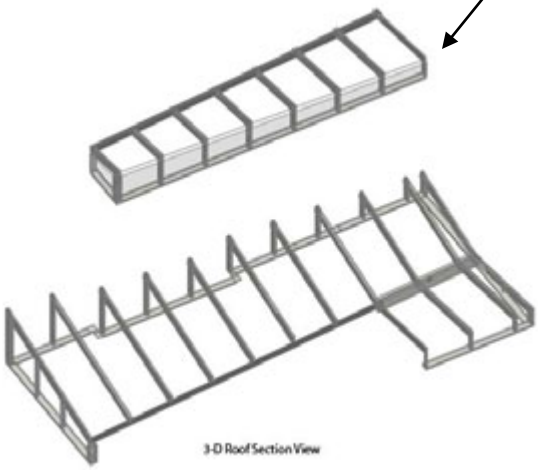
Roof Assembly Instructions

The roof will consist of 4 sections, as seen in the diagram below.
Note: Job measure to check sizes for all cuts.



Roof Sections Plan View

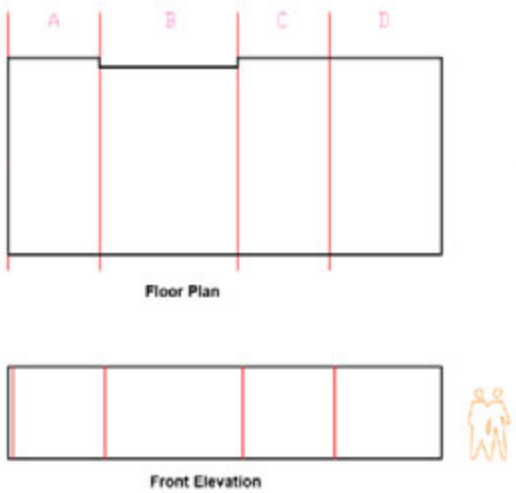
Note: The roof will be lifted off, trucked and craned back onto place in 4 whole pieces. Section one is permanently installed on Mod D. The 4 pieces are numbered and dimensioned as shown here. See also the dimensions in the 3-D diagrams in the shipping instructions pages.



Note: The 3-D roof view is shown here for general informational understanding only.

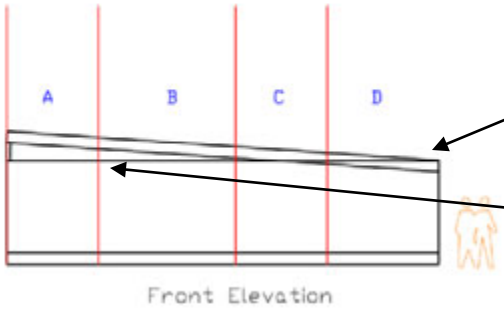
Roof 3-D View

1. Assemble all 4 modules.



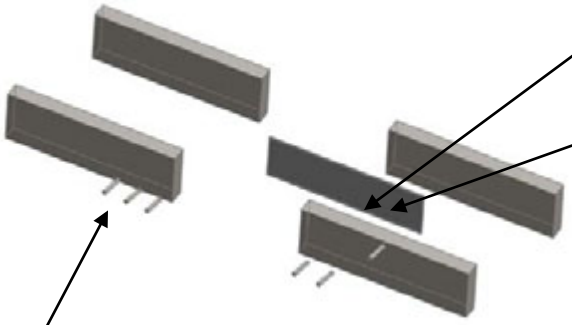
1. Assemble all 4 modules in permanent positions, as they will be at the completion stage, in terms of level, plumb, square, etc.

2. Set beam.

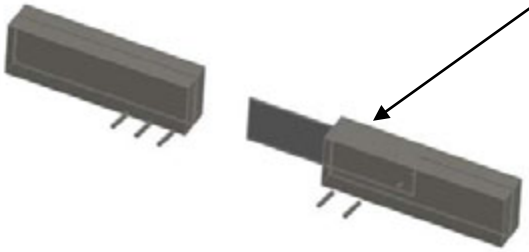


1. Make all attachments between modules D & C. (see page 11), secure the beam in the wall pockets in final positions @ east and west building ends.
2. Set all beam prop supports in final positions under beam at collar tie positions.
3. See instruction #3 for how to attach beam at connection between mod D and C.

3. Attach beam between modules C and D.

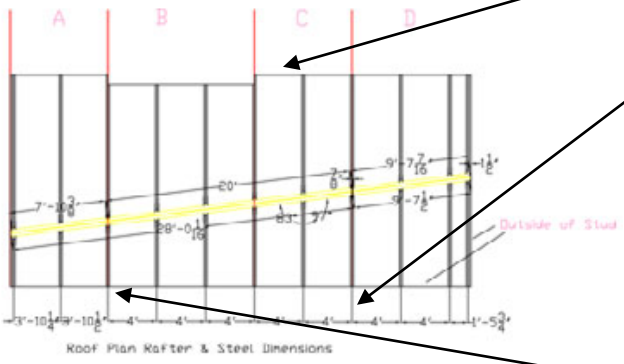


½” x 20 carriage bolts with washers on each side. Secure with ½ x 20 nuts.



1. Route a pocket groove in the middle-side face of each south half of the beam, ½” x 10” x 1-1/2’.
2. Set 2- beam front pieces in final position and insert one 1/2” temporary bolt into each beam through the steel/or middle side of the beam to temporarily fasten. Be sure to drill hole all the way through. Clearance rear beam for temp bolt head.
3. Set all beam pieces in place and clamp together for temporary support. Drill all other bolt holes through both sides of beams.
4. Set all six 1/2” bolts in place to secure beam in proper alignment.

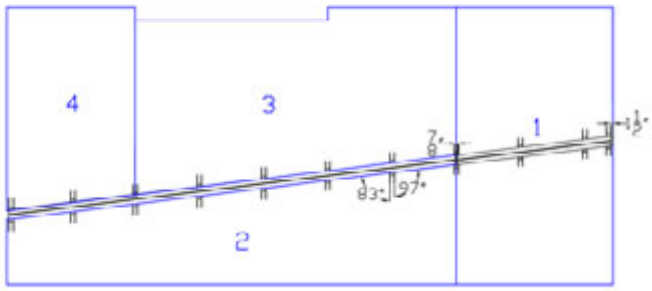
4. Lay out rafters



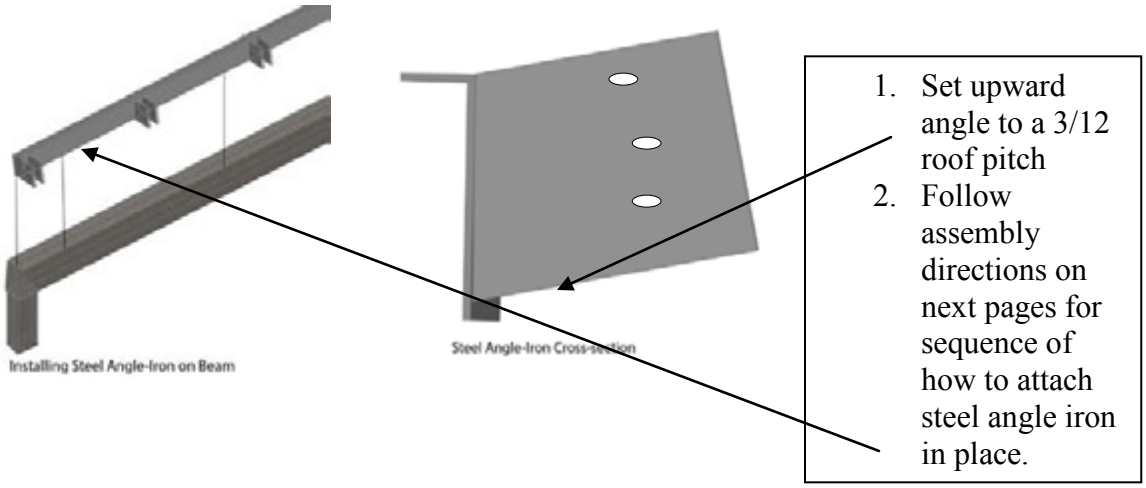
1. After beam is set, mark off the rafter spacing on the top plates of the south and north sides.
2. Hold a string line at each side in an elevated position, so the beam height is cleared.
3. Snap a chalk line at each rafter location, marking the points on top of the beam.
4. The rafters are not exactly 4’ O.C. for purposes of splitting the rafters at Mod connections.

Note: Assembly of roof rafters in roof section #2 will be described here. Each section of the roof will be assembled using the same procedure.

Note on steel fabrication: Concerning the ¼" x 8" x 3" steel angle. The fabricator needs to attach the bracket pieces in a manner that keeps the angle iron from bowing. Either use a Tig Weld method, or fabricate bracket pieces and bolt them together. Drill holes after both brackets are installed so holes line up. Job measure to check all cuts.

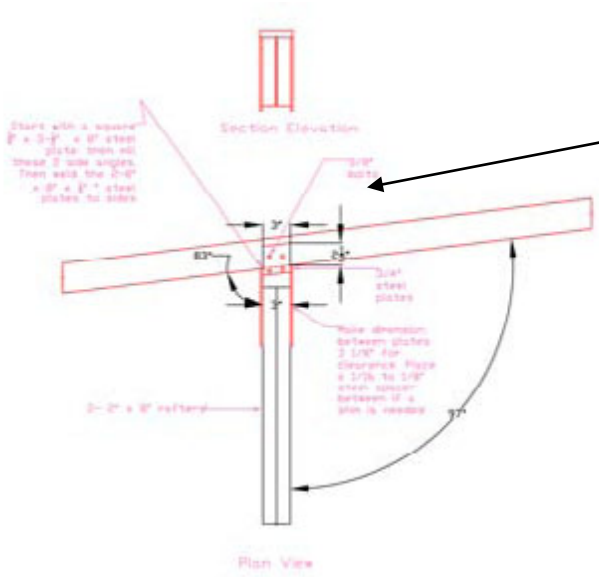


Note: The design intent is: Lay ¼" x 3" x 8" angle iron on top of beam in roof section #2.

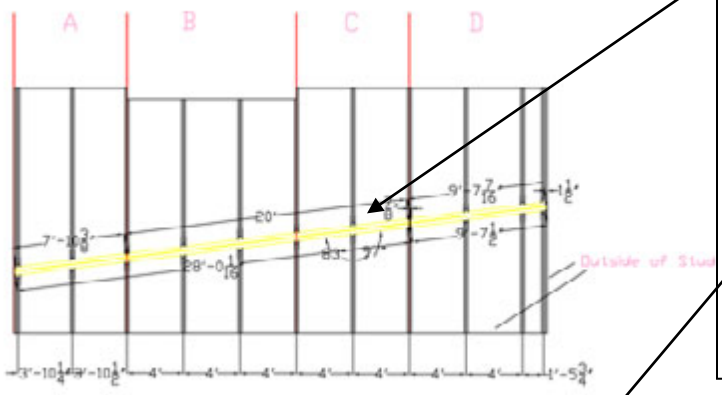


Note: There are two choices described below. One is to make pieces that hold the rafters and bolt them to the beam. The other is to Tig weld the rafter holders to the angle iron.

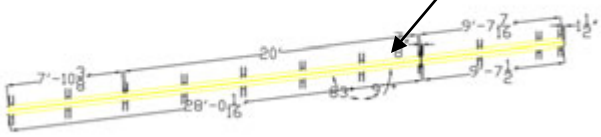
5. To use bolted-on rafter holders, make 22 angled rafter holders.



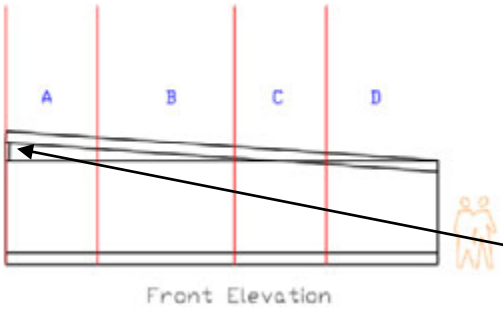
1. Fabricate 22 pieces as shown. Make pieces from ¾" plate steel. Cut angles on each side. Leave a 1/8" of extra interior space. A shim can be placed in fitting if necessary.
2. At mod connections, the rafter holder needs to be split into 2 parts.



1. Set angle iron pieces on top of beam.
2. At the chalk line rafter marks on top of the beam, place a steel rafter holder piece.
3. Attach all rafter holder pieces to the angle iron by drilling and bolting.
   Or
   Tig weld ¼" steel plates directly to angle iron.

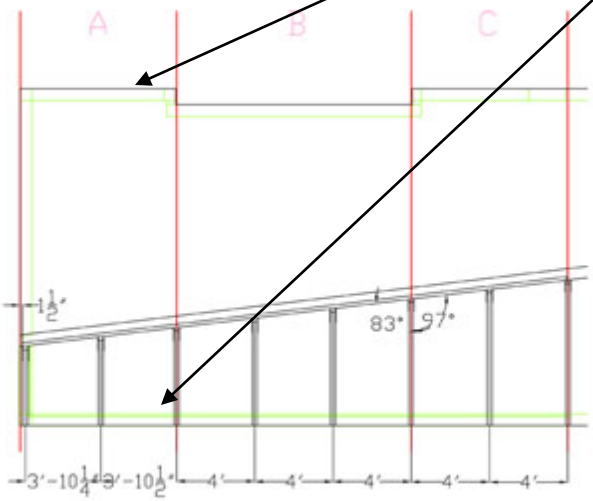


6. Install the southwest most building rafter. Job measure for all cuts.



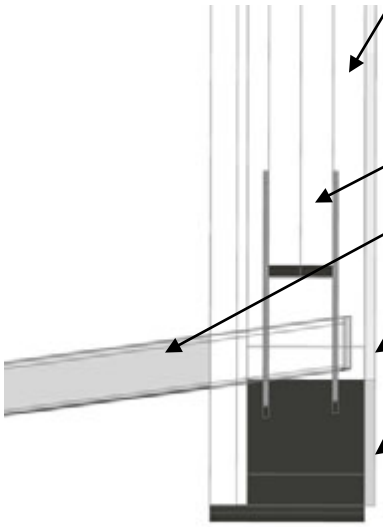
1. Install southwest most rafter and 2 x 6 corner as described in how to install a rafter below.
2. Establish 3/12 roof pitch with first rafter. See how to install a rafter instructions on page 16.

1. Establish rafter spacing and angle on beam
2. Mark these dimensions on top plate of west and east building sides
3. Pull a string taught from each top plate in a manner that it hangs freely over the beam top.
4. This is the location of the rafter on the beam and the angle from the beam to the walls
5. If welding rafter holders onto angle iron, hold the steel plates along the angle of the string and Tig weld in place.
6. Be sure to bolt the angle iron securely to the beam before any welding
7. Securely bolt all rafters into position before attempting to remove the roof section, in order that the angle iron does not bow, due to the welding process.



Roof Plan Section 2
Rafter Dimensions

Note: Hold rafters at end walls 1-1/2" from wall edge for clearance. Steel angle should be about the same distance from wall edge for clearance. This is to serve as clearance when craning the roof sections on and off.



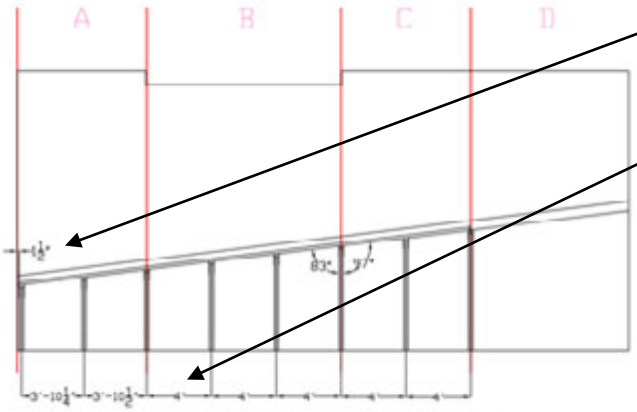
Plan View West Wall at Beam End and Rafter Connection

Rafters/farthest south-west point

Beam

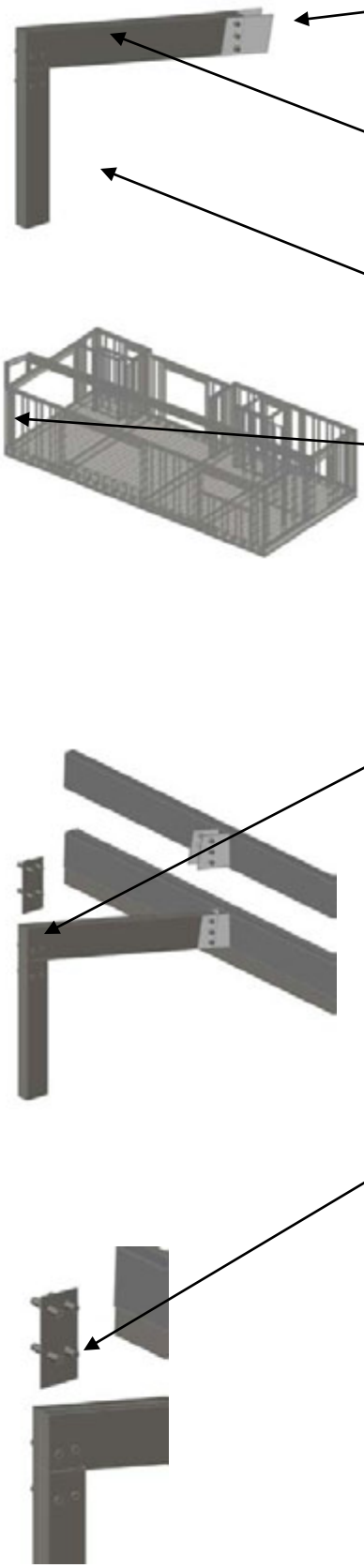
Exterior wall glass on west wall

Create flashing to go under glass



Roof Plan Section 2
Rafter Dimensions

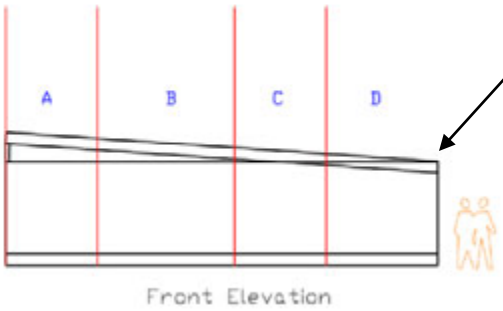
1. Set rafters so there is a 1 ½" clearance at end walls
2. Set rafters using these dimensions, so rafters split at mod connections.

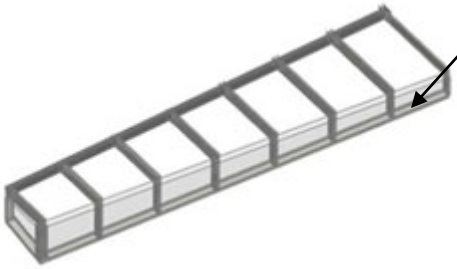


How to Install a Rafter

1. Hold square-cut rafter end approx. 2” from beam between 2 steel fastening plates.
2. Drill one of the ½” bolts holes and insert a bolt but don’t tighten it.
3. Rock rafter to a 3/12 pitch and temporarily brace it there at that pitch.
4. Set 2 x 6 corner post, but leave it a bit long for a coming top cut.
5. Plumb corner post to both south and west walls.
6. Draw pencil mark by using the underside of the rafter along the top of the 2 x 6 corner post and cut it of to get correct pitch angle.
7. Set rafter on top of corner post and check that corner post is plum with the south and west walls.
8. Place a 1/8” x 5 ½” x 12” steel plate between the 2 x 6 stud wall so 4” is above the top of the studs.
9. Clamp, then drill 2-1/2” bolt holes through the rafter and the stud to hold the steel tie plate in place.
10. Finish fastening rafter end to beam by drilling the other 2-1/2” bolts.

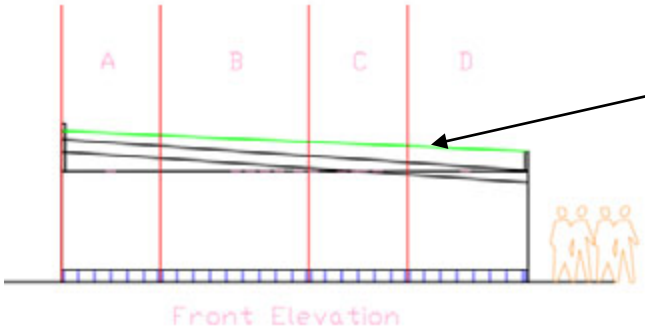
7. Install the southeast most building rafter. Job measure for all cuts.





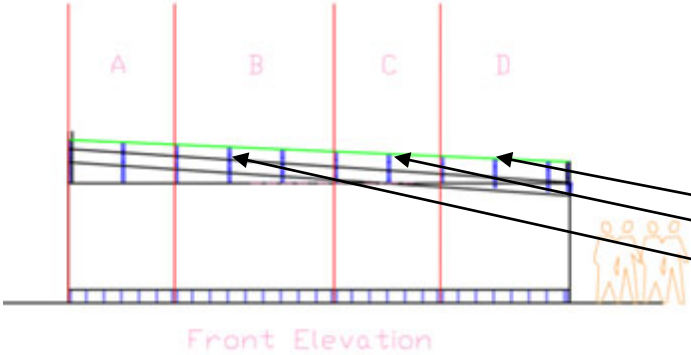
1. Install the rafter and 2 x 6 partial stud wall that is on the SE most corner. Be sure to establish the correct 3/12 roof pitch.
2. Important note: Use a double 2 x 6 plate on top of the top plate of the wall mod that's already in place. This 2 x 6 double plate will be removed and trucked as a part of the roof section. Its purpose is to hold the roof section together while shipping and craning.

8. Establish a guide for all other rafter heights.

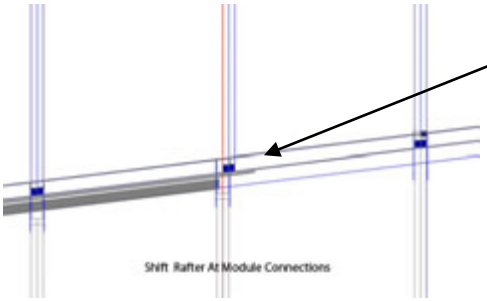


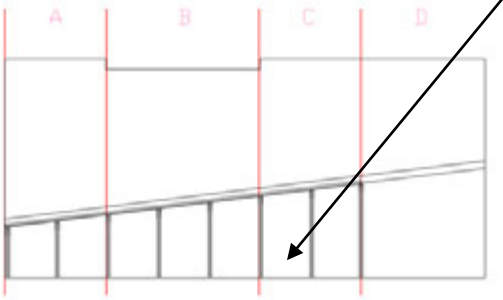
1. Stretch a string line taught from the center top of the 2 corner stud walls.
2. This will be the top of all stud wall marker, you use to set the rest of the rafters.

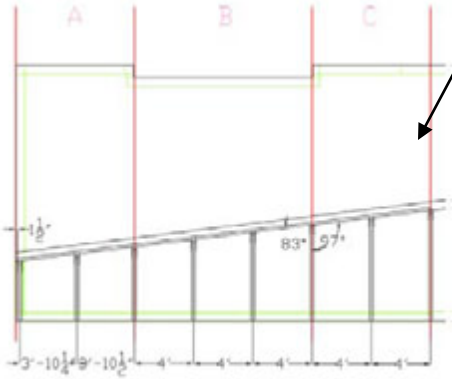
9. Fill in all rafters between the east and west corners.



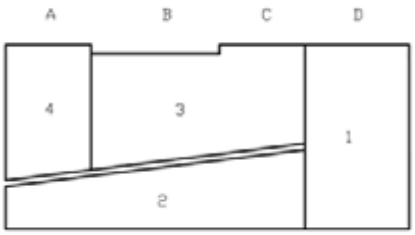
1. Follow how to install rafter instructions for each rafter.
2. Important note: at mod connection points, between A to B, B to C and C to D, the rafter dimension needs to work out a little different than 4” OC. The rafter shift is meant to have one rafter go with each side of the roof section when it is craned off. Follow the dimensions seen below.
3. See rafter dimensions diagram





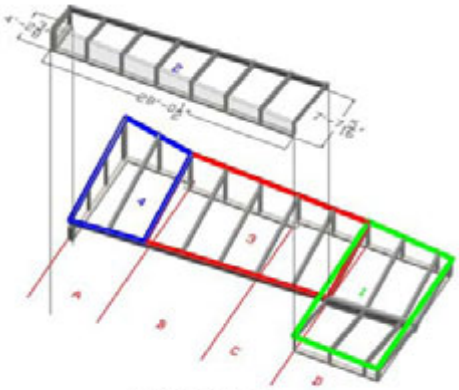


10. Complete all 4 sections of roof.



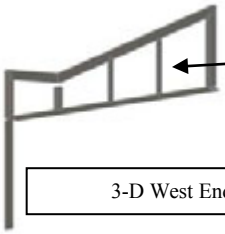
The 4 Roof Sections

1. Use same method for rear elevation rafters as listed above for front elevation rafters (i.e. do the 2 end corners first and then string a guideline, etc.).



The 4 Roof Sections

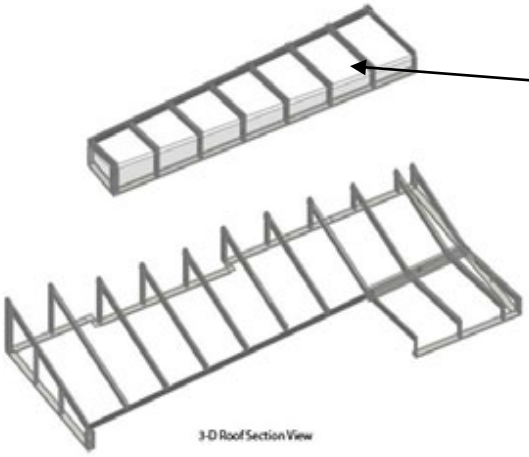
11. Fill in the stud supports for glass at the 2 end walls.



3-D West End Wall

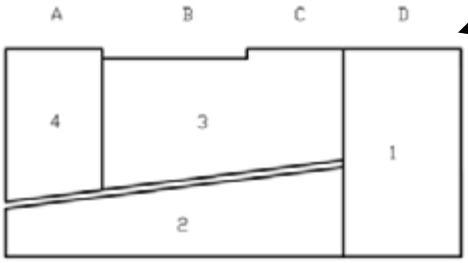
1. Install 2 x 6 partial stud wall above top plate to carry glass panes and insulation.

12. Have SIP panel company job measure for roof panel.

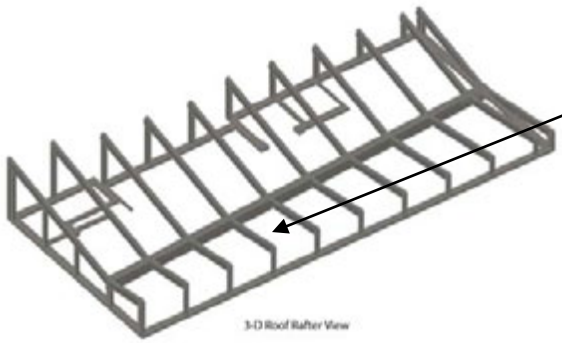


1. Cut each SIP panel to fit the 4 roof sections.
2. The SIP panel must be drywalled before permanently fastening them to the rafters.

13. Delivery of SIP panel and then install them.



1. There should be four SIP panel areas, numbered 1-4.
2. Each one will split at the four roof section lines.
3. Roof sections 2, 3 and 4 will be craned off, shipped and reassembled as three whole units.
4. Metal roofing will be pre-installed, except for weather-proofing connections at the mod lines, as part of the assembly process.

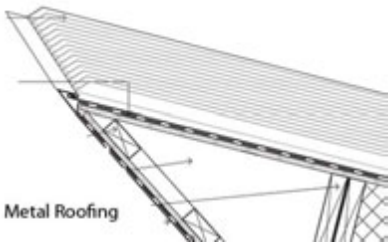


1. Drywall the interior of each SIP panel. Use glue and screws to fasten drywall.
2. Finish drywall (i.e. tape and finish joints and cover screw holes).
3. Permanently fasten each SIP panel to each of the 4 roof sections.

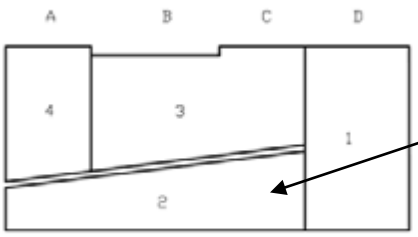
14. Install soffits and fascia.

1. Install soffit and fascia per plans.
2. Attach permanently to SIP panels so that the 4 roof sections can each be lifted off in one piece, trucked and lifted back into place in one piece.

15. Install metal roofing.



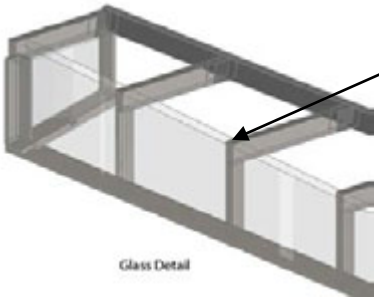
1. Install metal roofing permanently, but only to each of the 4 roof sections separately.
2. Each roof section is to be trucked with the metal roofing in place.
3. Design a method of weatherproofing between the 4 roof sections after assembly.



The 4 Roof Sections

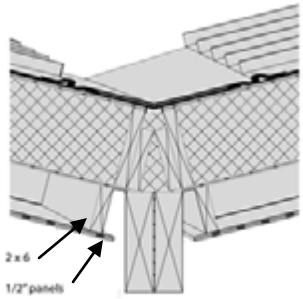
1. Each roof section is meant to be so solidly bolted together at completion that you would have to drop it to shift it out of shape.

16. Install glass wall panels and insulation.



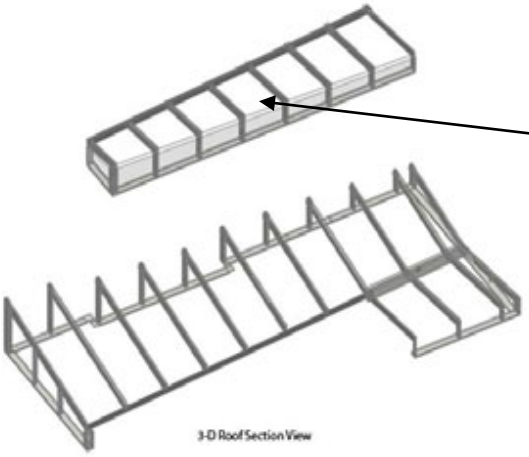
1. Run glass panels to topside of rafters inside and outside.
2. Glass is to bump up to the underside of the soffit on the exterior.
3. Glass is to be trimmed around the rafters on the interior.

17. Attach straw panels to interior ceiling areas per plan.

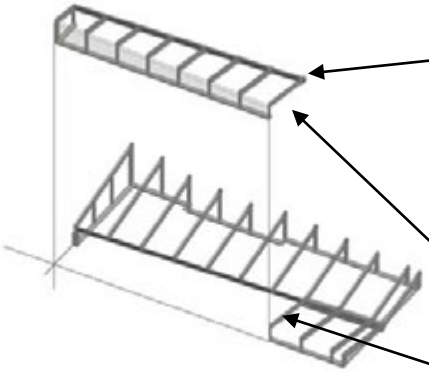


Straw Panel Detail

18. Disassembly.



1. Attach crane to roof section-2 and lift up with a crane.
2. Package it for trucking

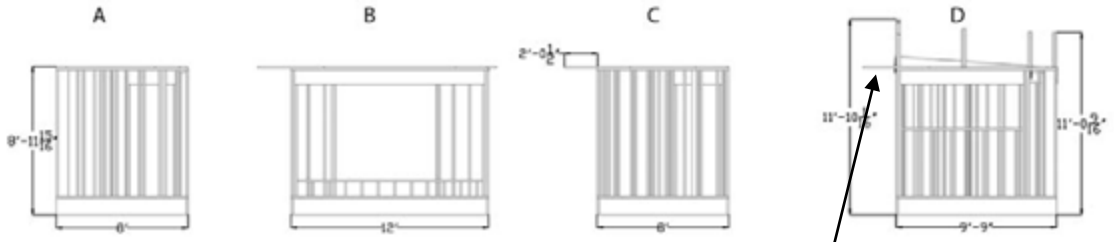


3-D view of the Roof Sections

1. **Each roof section is meant to be so solidly bolted together at completion that you would have to drop it to shift it out of shape.**
2. **The basic thesis of this document is to be able to crane it into place easily again.**
3. **When setting with a crane, the angle iron on the roof rafters is placed on the beam and top walls plates, then slide against the rafter in the adjoining Mod section, and fastened.**
4. **This is only possible because the entire assembly was originally built to fit as a unified whole.**

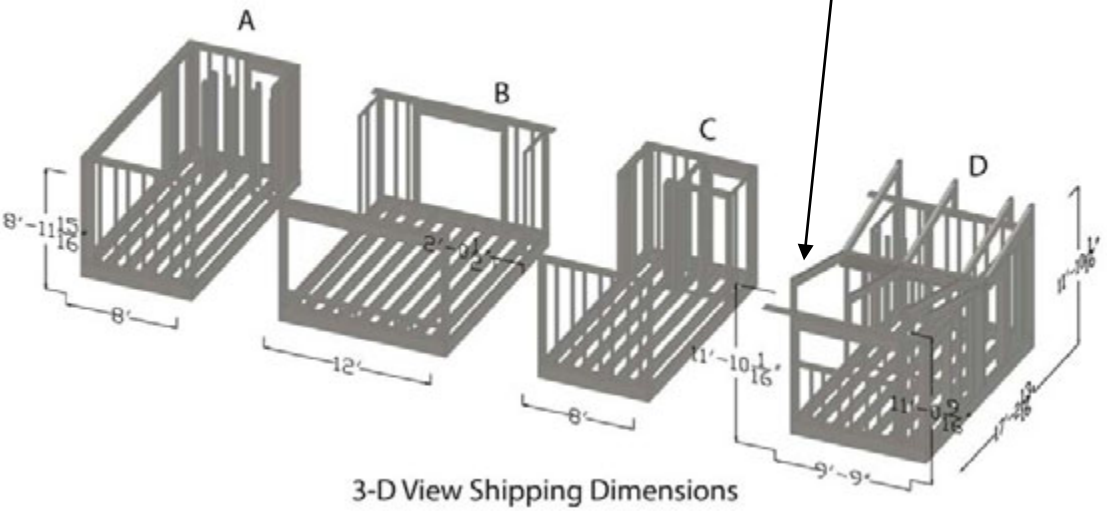
The Shipping Parts

The building to meant to be disassembled into the seven large pieces shown. There are four floor and wall mod pieces, one of which, Mod D, has the roof attached permanently, and three roof pieces.

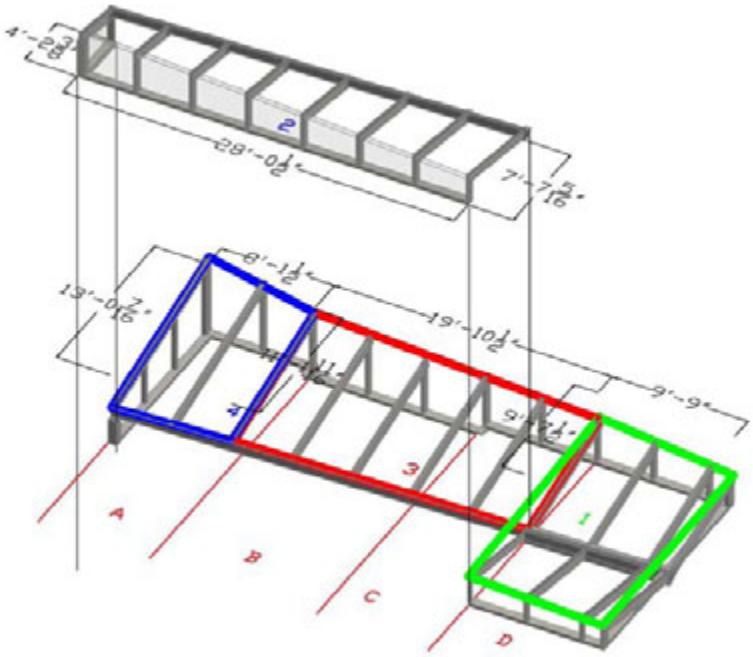


Front Elevation Shipping Dimensions

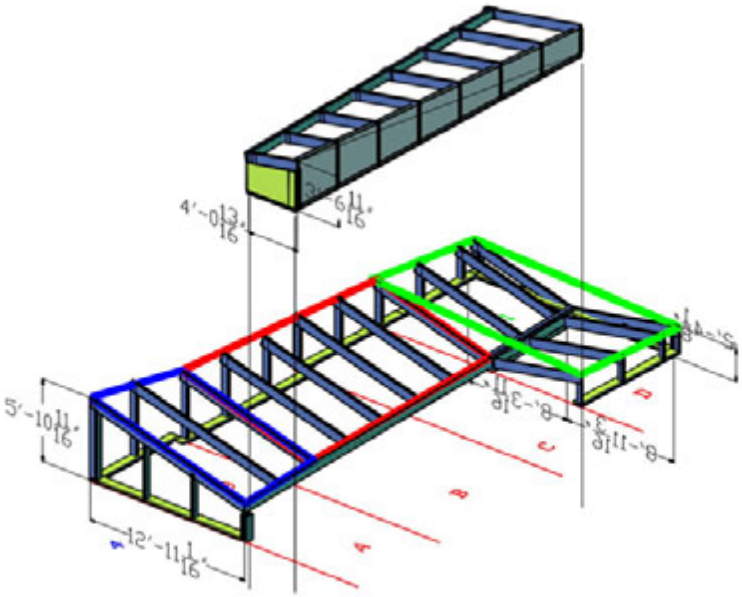
1. Due to Mod D being shipped with the roof on it, Mod C and D will not connect by using a removable 2 x 6 top plate as shown.
2. Connect Mods D and C by bolting the rafters together when installing the roof sections



3-D View Shipping Dimensions



The 4 Roof Sections



The 4 Roof Sections

02.02. Electrical Systems

02.02.01. Photovoltaic Systems

A photovoltaic (PV) system will be setup to run the systems of the home. This PV system will consist of a number of strings, a group of PV cells put together, and inverters as is required to meet and/or exceed the homes power needs.

Not only will the PV system power the home but it will also have to relay information about itself to the controls system. This information will consist of current power production, voltage and current readings, and a system diagnostic that will indicate if a string, or inverter, is not working properly.

Included with the PV system will be a zone draw recognition component, which will keep track of the zones in the home that use the most power and at what times of the day that power is being used. An option to turn off a specific zone(s) will be available through this recognition component. This component is separate from the required breaker and master power cut controls. All information collected by the recognition component will be available to the user via the control system.

02.02.02. Monitoring Systems

A precise monitoring system will be designed for this home. This system will consist of a collection network of sensors to determine conditions inside and out side the home. These sensors will be capable of delivering, to the control/display system, information pertaining to the interior air temperature, interior humidity, hot water temperature, and exterior climate conditions.

The network of sensors will be large enough for accurate data collection to be achieved, and if one sensor ceases to operate the system would not be crippled. Also, the network will allow for the use of interchangeable components, so that, in the event of a sensor failure, it could be replaced without having to remove large sections of structure.

Lastly, this system must be functional but not pointedly visible. The network is meant to help run the systems of the home, not to be aesthetically dominant.

02.02.03. Control/Display Systems

The system for controlling building systems, and displaying building performance, consists of the acceptance of the inputs from the monitoring equipment. Working in conjunction with the monitoring designer the controls designer must setup the PLC units to read the data being collected. Using the collected data the system will be designed with the capacity to keep the house within the range of conditions set by the user, and determined to be acceptable in terms of human environmental comfort. Settings coordinated for the competition will allow the control system to relay that information to the proper location in the home, e.g. to valves that control/display the heating or cooling, so that control strategies can be carried out.

The building control and performance display system will offer an interface for the user, which will provide information on current comfort level settings for the home, if the user needs to, or has taken, any actions affecting the settings, e.g. if the heat is turned on when comfort levels are conditions are still being met. The system will also allow for user input to adjust the comfort level settings based on seasonal or diurnal changes, times when the house is not occupied for extended periods, and other circumstances that may deviate from the normal control settings. Display of other systems performances will also included, including data pertaining to the operation of the solar electric and solar thermal systems. A display of power production, current and total, will be available as well as power usage, which will be divided by branch.

The building control and performance display system will be able to receive data from the monitoring system that indicates what the conditions are on the outside of the home. With this data the control system will be capable of performing a comparison between external conditions and internal comfort level settings. If these conditions are within the specified tolerances, the system will notify the user that using operable windows (and other passive cooling, ventilation, or heating measures) will allow comfort to be maintained with little to no use of energy.

02.03. HVAC Systems

A heat pump was chosen for heating and cooling the home due to its dual function. This saves on space, as well as system complexity. The *Solcool* system has a capacity of 18,000 Btu/hr of cooling during the cooling season, and 22,000 Btu/hr for heating during heating season. Two air handlers, located in the living room and bedroom, will be connected to a packaged unit located outside he house. The unit containing the compressor, condenser, and circulation pump will supply the air handlers with refrigerant, which will create the desired conditions inside the living

space. Each air handler has a thermostat and a wireless controller, which helps the building occupant to control the system. This particular system also has motion sensors, to sense occupants, and a dry function, which dehumidifies the air without cooling, when necessary or if so preferred.

02.03.01. HVAC Calculations

See attached tables.

Hourly Heat Gain - Day 8

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3356	4292	5832	6547	6700	7193	8030	9962	10487	10690	10651	10129	6812	5438	4400	3676	3071	2582

Hourly Heat Gain - Day 9

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4225	5165	5913	7980	8473	9310	9962	9207	9410	9371	8849	6812	5438	4400	3676	3071	2582

Hourly Heat Gain - Day 10

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4225	5165	7193	7980	8473	9310	9962	10487	10690	9371	8883	7178	6104	4733	3676	3071	2582

Hourly Heat Gain - Day 11

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4225	5165	7193	7980	8473	9310	9962	10487	10690	9371	8849	7292	5918	4400	3676	3071	2582

Hourly Heat Gain - Day 12

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4825	5765	5913	7980	8473	9310	9962	9784	9988	10549	10027	7389	6016	4462	3676	3071	2582

Hourly Heat Gain - Day 13

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4803	5743	6491	7980	8473	9310	9962	9273	9477	10038	9449	6812	5438	4400	3676	3071	2582

Hourly Heat Gain - Day 14

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4225	5165	6491	8925	9718	10255	10539	11064	9410	9371	8849	6812	5438	4400	3676	3071	2582

Hourly Heat Gain - Day 15

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
BTU Gained	2106	1815	1590	1382	1213	2330	3323	4225	5165	5913	7980	8473	9310	9962	9207	9410	9371	8883	6878	5504	4433	3676	3071	2582

Washington DC Outdoor Temperature

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Temperature	56	56	57	58	59	60	61	61	62	62	63	63	63	63	63	62	62	61	61	60	59	58	57	56

CLTD

	Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Direction of wall	N	15	14	14	13	12	11	11	10	9	9	9	8	9	9	9	10	11	12	13	14	14	15	15	15
	E	23	22	21	20	18	17	16	15	15	15	17	19	21	22	24	25	26	26	27	27	26	26	25	24
	S	21	20	19	18	17	15	14	13	12	11	11	11	11	12	14	15	17	19	20	21	22	22	22	21
	W	29	28	27	26	24	23	21	19	18	17	16	15	14	14	14	15	17	19	22	25	27	29	29	30

Corrected CLTD

	Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Direction of wall	N	-12	-12	-12	-13	-13	-14	-14	-15	-15	-15	-15	-16	-15	-15	-15	-15	-14	-13	-13	-12	-12	-12	-12	-12
	E	-7	-8	-8	-9	-10	-11	-12	-12	-12	-12	-11	-10	-8	-8	-6	-6	-5	-5	-4	-4	-5	-5	-6	-6
	S	3	3	2	2	1	0	-1	-2	-2	-3	-3	-3	-3	-2	-1	0	1	2	3	3	4	4	4	3
	W	-3	-4	-4	-5	-6	-7	-8	-10	-10	-11	-12	-12	-13	-13	-13	-12	-11	-10	-8	-6	-4	-3	-3	-2

$$CLTD_{corr} = (CLTD + LM)K + (78 - t_r) + (t_o - 85)$$

LM = Latitude-month correction October at 38.85N latitude.
- LM North Wall = -5
- LM East Wall = -6
- LM South Wall = 12
- LM West Wall = -6

K = .65 for lightly colored house
tr = Indoor desired temperature = 74
to = Outdoor design temperature = 63 **Average for the days of the competition**

House Parameters

		U-Value	Area
Direction of wall	N	0.025	252
	E	0.025	119
	S	0.025	232
	W	0.025	68

South		East		West		North	
66	14	12	21	84	21	21	18

Heat Gain

	Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Direction of wall	N	-72	-77	-77	-81	-85	-89	-89	-93	-97	-97	-97	-101	-97	-97	-97	-93	-89	-85	-81	-77	-77	-72	-72	-72
	E	-21	-23	-25	-26	-30	-32	-34	-36	-36	-36	-32	-28	-25	-23	-19	-17	-15	-15	-13	-13	-15	-15	-17	-19
	S	20	16	12	8.7	4.9	-2.6	-6.4	-10	-14	-18	-18	-18	-18	-14	-6.4	-2.6	4.93	12.5	16.2	20	23.8	23.8	23.8	20
	W	-5	-6	-7	-8.5	-11	-12	-14	-16	-17	-18	-20	-21	-22	-22	-22	-21	-18	-16	-13	-9.6	-7.4	-5.2	-5.2	-4.1
	Total	-78	-89	-96	-107	-121	-136	-143	-155	-164	-169	-167	-168	-161	-155	-144	-133	-117	-103	-90	-79	-75	-69	-71	-75

CLTD Roof

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Roof	35	33	30	28	26	24	22	20	18	18	18	20	22	25	28	32	35	38	40	41	41	40	39	37

Corrected CLTD Roof

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Roof	1.5	0.2	-2	-3	-4	-6	-6.95	-8.25	-9.55	-9.6	-9.6	-8.3	-7	-5	-3.1	-0.4	1.5	3.45	4.75	5.4	5.4	4.75	4.1	2.8

Same procedure as calculating CLTD for walls.
The f=1 because there is no positive ventilation.

Roof Parameters

	U-Value	Area
Roof	0.025	655

Heat Gain

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Roof	25	3	-29	-50	-71	-93	-114	-135	-156	-156	-156	-135	-114	-82	-50	-7	25	56	78	88	88	78	67	46

CLTD Window

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Window	1	0	-1	-2	-2	-2	-2	0	2	4	7	9	12	13	14	14	13	12	10	8	6	4	3	2

Window Parameters

	U-Value	Area
Window	0.08333	257
Clearstory	0.264	229.625

Heat Gain

Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Window	82	0	-82	-164	-164	-164	-164	0	164	328	574	738	984	1066	1149	1149	1066	984	820	656	492	328	246	164

Max Heat Gain @ 38.5N latitude

		Heat Gain	Area
Direction of Window	N	25	92
	E	180	22
	S	234	112
	W	180	44

Cooling Load Factor for Glass with Interior Shading

	Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200
Direction of Window	N	0.25	0.23	0.21	0.2	0.19	0.38	0.45	0.49	0.55	0.6	0.65	0.69
	E	0.09	0.09	0.08	0.08	0.07	0.2	0.34	0.45	0.49	0.49	0.43	0.36
	S	0.13	0.12	0.12	0.11	0.10	0.11	0.14	0.17	0.24	0.33	0.43	0.51
	W	0.14	0.13	0.12	0.11	0.10	0.11	0.12	0.13	0.14	0.14	0.15	0.16

	Hours	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Direction of Window	N	0.72	0.72	0.72	0.7	0.7	0.75	0.57	0.46	0.39	0.34	0.31	0.28
	E	0.32	0.29	0.26	0.24	0.22	0.19	0.17	0.15	0.13	0.12	0.11	0.1
	S	0.56	0.55	0.5	0.43	0.37	0.32	0.26	0.22	0.2	0.18	0.16	0.15
	W	0.21	0.3	0.4	0.49	0.54	0.52	0.38	0.3	0.24	0.21	0.18	0.16

Heat Gain

	Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200
Direction of wall	N	576	530	484	461	437	875	1036	1128	1266	1382	1497	1589
	E	363	363	323	323	282	806	1371	1814	1976	1976	1734	1452
	S	684	631	631	579	526	579	737	894	1263	1736	2262	2683
	W	1097	1019	940	862	784	862	940	1019	1097	1097	1176	1254
	Total	2720	2543	2378	2224	2030	3122	4084	4856	5602	6191	6668	6977

	Hours	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Direction of wall	N	####	####	####	####	#REF!	####	####	####	####	####	0	0
	E	####	####	####	####	#REF!	####	####	####	####	####	####	0
	S	####	####	####	####	#REF!	####	####	####	####	####	0	#VALUE!
	W	####	####	####	####	#REF!	####	####	####	####	####	####	#VALUE!
	Total	####	####	####	####	#REF!	####	####	####	####	####	####	#VALUE!

Heat Gain from 10 Adult Males who are Standing, Walking =	**5500**

The adult males are assumed to be the judges

Air Infiltration	
Assumed Air Change Rate	0.35
Volume of House	9702

Sensible Heat Gain												
Hours	100	200	300	400	500	600	700	800	900	1000	1100	1200
Temperature	-1086	-1086	-1025	-965	-905	-844	-784	-784	-724	-724	-663	-663
Hours	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Temperature	-663.4	-663	-663	-724	-724	-784	-784	-844	-905	-965	-1025	-1086

DAY 08

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																	0.3	0.3	0.3	0.3				
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																								
TV	240																								
Dishwasher	100														0.3	0.3	0.3	0.3	0.3	0.3					

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0												
TV	240			1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0												
Dishwasher	100																								

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	255.3	255.3	255.3	555.3	555.3	555.3	522.0	222.0	222.0	222.0	222.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	0.0	0.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 09

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																					1.0	1.0	1.0	1.0
TV	240																					1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400	1.0	1.0	1.0	1.0																				
TV	240	1.0	1.0	1.0	1.0																				
Dishwasher	100																								

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 10

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																			1.0	1.0	1.0	1.0	1.0	1.0
TV	240																			1.0	1.0	1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200														0.3	0.3	0.3	0.3							
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0																
TV	240	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0																
Dishwasher	100												0.3	0.3	0.3	0.3	0.3	0.3							

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	862.0	862.0	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	222.0	222.0	222.0	255.3	255.3	555.3	555.3	555.3	555.3	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 11

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																			1.0	1.0	1.0	1.0	1.0	1.0
TV	240																			1.0	1.0	1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0																
TV	240	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0					1.0	1.0	1.0	1.0								
Dishwasher	100																								

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	862.0	862.0	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	862.0	862.0	862.0	862.0	222.0	222.0	222.0	222.0	462.0	462.0	462.0	462.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 12

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200															0.3	0.3	0.3	0.3						
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																					1.0	1.0	1.0	1.0
TV	240																					1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200									0.3	0.3	0.3	0.3												
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454					0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5								
Dryer	371					0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2							
Computer	400	1.0	1.0	1.0	1.0																				
TV	240	1.0	1.0	1.0	1.0																				
Dishwasher	100																								

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	522.0	522.0	522.0	522.0	222.0	222.0	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	227.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	510.9	510.9	510.9	510.9	810.9	810.9	810.9	810.9	510.9	510.9	510.9	510.9	283.8	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 13

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454															0.5	0.5	0.5	0.5	0.5	0.5				
Dryer	371															0.2	0.2	0.2	0.2	0.2	0.2				
Computer	400																					1.0	1.0	1.0	1.0
TV	240																					1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200									0.3	0.3	0.3	0.3												
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400	1.0	1.0	1.0	1.0																				
TV	240	1.0	1.0	1.0	1.0																				
Dishwasher	100					0.3	0.3	0.3	0.3	0.3	0.3														

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	227.1	227.1	227.1	227.1	227.1	227.1	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.8	61.8	61.8	61.8	61.8	61.8	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	510.9	510.9	510.9	510.9	510.9	510.9	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	255.3	255.3	255.3	255.3	555.3	555.3	522.0	522.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 14

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																						0.3	0.3	0.3
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																			0.5	0.5	0.5	0.5	0.5	0.5
Dryer	371																			0.2	0.2	0.2	0.2	0.2	0.2
Computer	400																					1.0	1.0	1.0	1.0
TV	240																					1.0	1.0	1.0	1.0
Dishwasher	100																					0.3	0.3	0.3	0.3

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.3																							
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454	0.5	0.5	0.5	0.5	0.5	0.5																		
Dryer	371	0.2	0.2	0.2	0.2	0.2	0.2																		
Computer	400	1.0	1.0	1.0	1.0	1.0	1.0																		
TV	240	1.0	1.0	1.0	1.0	1.0	1.0																		
Dishwasher	100	0.3	0.3																						

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	300.0	300.0	300.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	227.1	227.1	227.1	227.1	227.1	227.1
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.8	61.8	61.8	61.8	61.8	61.8
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	33.3	33.3	33.3
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	510.9	510.9	1184.2	1484.2	1484.2	1484.2

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	227.1	227.1	227.1	227.1	227.1	227.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	61.8	61.8	61.8	61.8	61.8	61.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	1484.2	1184.2	1150.9	1150.9	1150.9	1150.9	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0

DAY 15

Schedule of Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400																					1.0	1.0	1.0	1.0
TV	240																					1.0	1.0	1.0	1.0
Dishwasher	100																								

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200																								
Refrigerator	667	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Washer	454																								
Dryer	371																								
Computer	400	1.0	1.0	1.0	1.0																				
TV	240	1.0	1.0	1.0	1.0																				
Dishwasher	100												0.3	0.3	0.3	0.3	0.3	0.3							

Heat Gain by Appliances

Appliance	lax Heat Gain	100.0		200.0		300.0		400.0		500.0		600.0		700.0		800.0		900.0		1000.0		1100.0		1200.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0
TV	240	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	240.0	240.0	240.0	240.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	862.0	862.0	862.0	862.0

Appliance	lax Heat Gain	1300.0		1400.0		1500.0		1600.0		1700.0		1800.0		1900.0		2000.0		2100.0		2200.0		2300.0		2400.0	
Exhaust Hood	1,200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigerator	667	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	220.0
Washer	454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dryer	371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Computer	400	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TV	240	240.0	240.0	240.0	240.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dishwasher	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	33.3	33.3	33.3	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL	862.0	862.0	862.0	862.0	222.0	222.0	222.0	222.0	222.0	222.0	222.0	255.3	255.3	255.3	255.3	255.3	255.3	222.0	222.0	222.0	222.0	222.0	222.0	220.0

Thursday (Day 8)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																		2.4																																
Clothes Washer																			18																															51
Cooking																				0.6																														
Hot Water Draw																					15				15																									

Friday (Day 9)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																																																	
Clothes Washer																																36																	81
Cooking																																																	
Hot Water Draw																						15														15							15						

Saturday (Day 10)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																																						2.4											
Clothes Washer																																																	33
Cooking																																									0.6									
Hot Water Draw																																				15	15													

Sunday (Day 11)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																																																	
Clothes Washer																																																	45
Cooking																																																	
Hot Water Draw																				15																15	15													

Monday (Day 12)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																																																	
Clothes Washer																																36																	66.6
Cooking																		0.6																																
Hot Water Draw																		15																				15												

Tuesday (Day 13)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher								2.4																																										
Clothes Washer																		18																															65.4
Cooking																																																	
Hot Water Draw																		15														15	15																

Wednesday (Day 14)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																								2.4																										
Clothes Washer																						36																											69
Cooking																									0.6																									
Hot Water Draw																							15								15																			

Thursday (Day 15)	12:00 AM	12:30 AM	1:00 AM	1:30 AM	2:00 AM	2:30 AM	3:00 AM	3:30 AM	4:00 AM	4:30 AM	5:00 AM	5:30 AM	6:00 AM	6:30 AM	7:00 AM	7:30 AM	8:00 AM	8:30 AM	9:00 AM	9:30 AM	10:00 AM	10:30 AM	11:00 AM	11:30 AM	12:00 PM	12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM	7:00 PM	7:30 PM	8:00 PM	8:30 PM	9:00 PM	9:30 PM	10:00 PM	10:30 PM	11:00 PM	11:30 PM	Daily Total Water Use (Gal)
Dishwasher																																						2.4											
Clothes Washer																																36																	83.4
Cooking																																																	
Hot Water Draw																				15	15												15																	

Total Dishwasher	12
Total Clotheswasher	180
Total Cooking	2.4
Total Hot Water Draw	300
Net Water Use	494.4

02.04. Plumbing Systems

02.04.01. Water Supply

The domestic water system has two facets to it, a cold water supply system, and a hot water system. The hot water system is split between hot water storage and water heating through solar thermal panels. Both systems provide either hot or cold water to various points of use: hot water to the kitchen (sink and dishwasher), bathroom (sink, and shower), and the laundry room (clothes washer); and, cold water to the kitchen (sink and dishwasher), bathroom (sink, toilet, and shower), and laundry room (clothes washer).

The cold water supply system is a simulated well system, instead of a well during the competition, the project will use water storage tanks. Water is stored outside the house, in tanks totaling 600 gallons. The water stored in these tanks will be pumped to a 20 gallon pressure tank to provide the necessary water pressure. From the pressure tank the water is distributed either to the cold water side of the various points of use or to the hot water tank.

02.04.02. Waste Removal

There will be a drain system in place where wastewater from the sinks, shower, washers etc. will go. This system is a standard domestic drain system where water flows from its source (a sink), down and out of the house. During the competition this system will flow to a wastewater storage tank system. The system will be outside the footprint of the house, and will be downhill from the supply tank system.

02.04.03. Domestic Hot Water

The domestic hot water in the hot water tank is heated through solar energy by use of a heat exchanger. A separate closed loop of water is pumped up to solar panels on the roof where energy in the form of heat from the sun is collected and transferred to the water. The water then flows back down into a coil of pipes inside the hot water tank where it transfers its heat to the domestic water, heating it up. After running for 1 day the system should gain enough energy from the sun to heat the 80 gallons of water in the hot water tank to above 110 ^{o}F.

In the event of long periods of cloud cover, or extensive hot water use in the house, an electric hot water back up system will be in place. This system consists of two electric on-demand hot water heaters, one will

provide hot water to the kitchen and clothes washer, and the other will provide hot water to the bathroom.

Two solar thermal panels placed on the northwest side of the roof will provide majority of the hot water consumed in the house. A water/glycol mix will be circulated by a small pump located in the mechanical room to the panels and back. Upon return, the hot solution will flow through a small spiral heat exchanger placed inside the water storage tank. Here, the heat extracted from the sun's rays will be passed on to the relatively cold water. The process will continue till the domestic hot water set temperature has been reached and then the pump will stop unless it senses that the water inside the panels is getting too hot and then it will keep circulating the fluid to prevent system damage. An expansion tank will also be placed in the solar thermal loop, again to avoid personal and equipment damage. On overcast days, when sunlight might not be sufficient, electric tankless water heaters will ensure that hot water can be supplied for everyday use.

Energy required to heat 80 gallons of water from 55^0F to 110^oF = Volume of water x 8.33 x Temp diff.

80 gallons (8.33) x (110^oF-55^oF) = 36652 Btu/day

Incidence angle modifier = $1 - b_0 (1/\cos(\Theta) - 1)$

Θ = Angle of incidence – Angle of panel

$\Theta = 41.59^o - 18^o = 30.41^o$

$1 - 0.3381(1/\cos(30.41^o) - 1) = .946$

Energy gained from 1 solar panel = Solar Insolation x Efficiency of Panel x Area of Panel x Incidence angle modifier x Efficiency of heat exchanger

1065.46 Btu/ft^2/day (.70)(40ft^2)(.946)(.85) = 28,222 Btu/day

03. Energy Analysis

03.01. Energy Strategies and Concepts

Energy conservation does not exist in a vacuum. Each part of the design is linked to the others and in a well developed design, each of the parts work to enhance the others. In the Carbon Neutral House, energy conservation, maximizing the use of renewables, and human delight and comfort are balanced.

The first and one of the most basic strategies in any energy efficient design is controlling the heat and light that passes through the walls, roof, and windows. The Carbon Neutral House is designed with 7" of closed cell rigid insulation in the walls and roof to minimize the heat loss during cold Wisconsin winters and excessive heat gain in the summer months. The roof material encompasses a reflective coating to help protect it from hot summer radiation. A rain screen protects the walls from direct sun.

The windows are a gas filled triple glazed high R construction with louvers on the long south face that allow warming direct sunlight through in the cold winter months but block it in the hot summer months. The louvers also serve to reflect the cooler rays of the sun up and deep into the building, eliminating glare as they do so. Elimination of glare together with ample light makes the interior friendly. Together with the natural wood interior this gives a feeling of warmth and cheer. These lighting strategies also eliminate the need for artificial lighting during most of the day, thereby lowering electric consumption and summer heat gains. Windows that are operable allow the occupants to have control over their environment and provide cross ventilation on days air movement or cooler outside air is adequate to provide needed cooling.

Windows on the cold north face are smaller but high R clerestory windows on the north contribute an even glare-free indirect light. These north windows do not receive direct rays at any time of the year and therefore do not require shading. The western windows on the other hand are shaded by screens that can be opened when the sun is not too hot. Windows are small on the eastern face of the building.

Much of the material in the house is renewable or recycled. Interior walls are made out of recycled paper and the framing and rain screen use wood from a sustainably harvested forest, the Aldo Leopold woodland.

Conserving energy with an efficient shell and natural lighting are only the necessary start of a good design. The roof is pitched to accomplish two things concurrently. Care was taken to assure an appropriate angle for the

photovoltaics placed on it. In spite of the v-shape, no shadow falls across the PV array on the roof. This is important even a small shadow falling on the pvs can cut out a major portion of the cell as it has the effect of creating an open circuit. In order for the pvs to be adequate for meeting the electric demand of the house appliances is all highly energy efficient. LED lighting is used in much of the house.

The second special function of the roof is water collection. Rainwater flows from the north and south sections to the central v and then off a spout on the east side. The collected water will be used for toilet flushing.

A very cost effective means of using the sun's energy is to use it to heat water for domestic use. Flat plat panels are used for heating of water in the Carbon Neutral House. On the energy use side, low water use appliances and fixtures were chosen for this house. For active heating and cooling when necessary, air to air heat exchangers will be used to supplement the passive solar gains in the winter and provide cooling in the summer.

03.02. Energy Simulation Assumptions and Criteria

The Target Market for the 'UW-Milwaukee Carbon Neutral House' is defined as a "boomerang parent", a baby boom retired couple. Cases were run for the following five types of days:

A **typical Saturday** in which the couple spends the day at home by themselves. They both take a six minute warm shower and brush their teeth, running ¼ gallon of water, when they get up. The husband shaves with a straight edge razor. They then make and eat a full breakfast. At noon and evening they also prepare and eat full meals. Dishes, totaling six sets, from the three meals for the day are washed in a single drawer of the two drawer dishwasher at the end of the day. At meal times some small amount of water is used from the kitchen faucet for clean up and meal prep. No laundry is washed on this day. The couple remains at home the entire day with no visitors. It is assumed they will flush the toilet four times each during the day and wash their hands five times, running the water for 15 seconds each time. They will brush their teeth again at the end of the day. Whenever warm water is used it is assumed that it is comprised of a mix of half hot and half cold water. The dishwasher is assumed to use only hot water and the toilet only cold. The washing machine is also assumed to have half hot and half cold, weighting somewhat conservatively toward hot.

A **high use Saturday** in which the couple has six guests over from 1:00 PM to 10:00 PM. The will serve them one warm meal at supper time. There will be an additional 16 flushes of the toilet and an additional 16 hand washings

throughout the afternoon. The extra dishes will require that both drawers of the dishwasher be used to wash dishes that day. All other functions and water use are the same as for case one.

A **typical light load weekday** in which the couple are home together for the morning and evening but go out between 1:00 PM and return between 5:00 and 10:00 PM in the afternoon. They will do their morning routine of showers, shaving, brushing teeth, and eating breakfast. They will do a load of wash, eat a lunch, and start the dishwasher before leaving for the afternoon. They will eat supper out on days they come home after 5:00PM.

A **heavy load weekday** in which the couple remains home alone the entire day and does two loads of wash. In all other ways the water usage is the same as in case number one, a typical Saturday.

A **childcare weekday** in which the couple care for a toddler and infant between 8:00AM and 5:00PM. The children will eat lunch and supper with them, generating some extra dishes, some of which will be done by hand. The infant will be given a sponge bath in the afternoon requiring one gallon of warm water. The older child will use the toilet and his/her their hands several times while there. The infant uses cloth diapers which need to be rinsed but not washed as the parents have diaper service. The couple will wash one extra load of wash during weeks they babysit. One load of wash and one load of dishes will be done on this day. The couple's personal routine will otherwise be the same as for a typical Saturday.

	Assumptions:
1	One 6 min. shower/resident/day
2	4 toilet flushes/person/24 hr
3	5 hand washes/person/24 hr (15 sec per wash)
4	One drawer load dishes/2 people/day (6 place sets)
5	3 loads laundry/week on typical week w/o children
6	4 loads laundry/week on typical week w children
7	2 tooth brushings/resident/day (1/4 gal ea)
8	Shaving once per day (1/2 gal per shave)
	Sponge bath for children - 1 gal

The University. of Kentucky Guidelines for 40

gal/day/person water use was used as the baseline for determining water usage for the various activities.

03.03. Energy Simulation

See attached tables.

Occupancy

HOUR

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ
1	Saturday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Saturday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	2	2
3	Weekday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	2
4	Weekday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	Weekday (with child care for 2 children)	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2

Target Market- Retired Couple [typical saturday]

HOUR

	Hot and Cold Water Use Combined					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		2.4							2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7																									0
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2							0.25	0.25					0.25					0.25							1
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.25	0.75				0.55	0.55				0.55	0.55				0.8	0.8		4.8
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							10.5	10.5																	21
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1							1	1				1	1				1	1				1	1		8
						0	0	0	0	0	0	12	12.5	0	0	0	1.55	1.8	0	0	0	1.55	4.2	0	0	0	1.8	1.8	0	37.2

	Hot water only					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drw	2.4																		2.4							2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7																									0
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2																									0
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.13	0.38				0.28	0.28				0.28	0.28				0.4	0.4		2.4
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							5.25	5.25																	10.5
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1																									0
						0	0	0	0	0	0	5.38	5.63	0	0	0	0.28	0.28	0	0	0	0.28	2.68	0	0	0	0.4	0.4	0	15.3

Assumptions:

1 One 6 min. shower/resident/day
2 4 toilet flushes/person/24 hr
3 5 handwashes/person/24 hr (15 sec per wash)
4 One drawer load dishes/2 people/day (6 place sets)
5 3 loads laundry/week on typ week w/o children
6 4 loads laundry/week on typ week w children
7 2 toothbrushings/resident/day (1/4 gal ea)
8 Shaving once per day (1/2 gal per shave)
9 Sponge bath for infant - 1 gal

Use Univ. of Kentucky Guidelines for 40 gal/day/person

Occupancy

HOUR

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ
1	Saturday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Saturday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	2	2
3	Weekday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	2
4	Weekday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	Weekday (with child care for 2 children)	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2

Target Market- Retired Couple [high use saturday]

HOUR

	Hot and Cold Water Use Combined					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		4.8							4.8
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7																									0
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2							0.25	0.25					0.25				0.25	0.25							1.25
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.25	0.75				0.55	2.2	1.65			2.2	2.2				3.3	1.6		14.7
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							10.5	10.5																	21
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1							1	1				1	4	3			4	4				6	2		26
						0	0	0	0	0	0	12	12.5	0	0	0	1.55	6.45	4.65	0	0	6.45	11.3	0	0	0	9.3	3.6	0	67.8

	Hot water only					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		4.8							4.8
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7																									0
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2													0.13				0.13	0.13							0.38
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.13	0.38				0.28	1.1	0.83			1.1	1.1				1.65	0.8		7.35
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							5.25	5.25																	10.5
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1																									0
						0	0	0	0	0	0	5.38	5.63	0	0	0	0.28	1.23	0.83	0	0	1.23	6.03	0	0	0	1.65	0.8	0	23

Assumptions:

1 One 6 min. shower/resident/day
2 4 toilet flushes/person/24 hr
3 5 handwashes/person/24 hr (15 sec per wash)
4 One drawer load dishes/2 people/day (6 place sets)
5 3 loads laundry/week on typ week w/o children
6 4 loads laundry/week on typ week w children
7 2 toothbrushings/resident/day (1/4 gal ea)
8 Shaving once per day (1/2 gal per shave)
9 Sponge bath for children - 1 gal

Use Univ. of Kentucky Guidelines for 40 gal/day/person

Occupancy

HOUR

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ
1	Saturday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Saturday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	2	2
3	Weekday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	2
4	Weekday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	Weekday (with child care for 2 children)	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2

Target Market- Retired Couple [typical weekday]

HOUR

	Hot and Cold Water Use Combined					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4												2.4													2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7										5.7															5.7
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2							0.25	0.25				0.25													0.75
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.25	0.75				1.1											1.6		3.7
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							10.5	10.5																	21
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1							1	1				2											2		6
						0	0	0	0	0	0	12	12.5	0	5.7	0	5.75	0	0	0	0	0	0	0	0	0	0	3.6	0	39.6

	Hot water only					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4												2.4													2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7										2.85															2.85
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2												0.13													0.13
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.13	0.38				0.55											0.8		1.85
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							5.25	5.25																	10.5
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1																									0
						0	0	0	0	0	0	5.38	5.63	0	2.85	0	3.08	0	0	0	0	0	0	0	0	0	0	0.8	0	17.7

Assumptions:

1 One 6 min. shower/resident/day
2 4 toilet flushes/person/24 hr
3 5 handwashes/person/24 hr (15 sec per wash)
4 One drawer load dishes/2 people/day (6 place sets)
5 3 loads laundry/week on typ week w/o children
6 4 loads laundry/week on typ week w children
7 2 toothbrushings/resident/day (1/4 gal ea)
8 Shaving once per day (1/2 gal per shave)
9 Sponge bath for children - 1 gal

Use Univ. of Kentucky Guidelines for 40 gal/day/person

Occupancy

HOUR

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ
1	Saturday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Saturday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	2	2
3	Weekday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	2
4	Weekday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	Weekday (with child care for 2 children)	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2

Target Market- Retired Couple [high use weekday]

HOUR

Hot and Cold Water Use Combined					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1 DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		2.4							2.4
2 W6222 (Asko)	Washer	1	5.7 gal/load	5.7								5.7		5.7															11.4
3 K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2							0.25	0.25					0.25					0.25							1
4 K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.25	0.75				0.55	0.55				0.55	0.55				0.8	0.8		4.8
5 K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							10.5	10.5																	21
6 **San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1							1	1				1	1				1	1				1	1		8
					0	0	0	0	0	0	12	18.2	0	5.7	0	1.55	1.8	0	0	0	1.55	4.2	0	0	0	1.8	1.8	0	48.6

Hot water only					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1 DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		2.4							2.4
2 W6222 (Asko)	Washer	1	5.7 gal/load	5.7								2.85		2.85															5.7
3 K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2													0.25					0.2							0.45
4 K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.13	0.38				0.28	0.28				0.28	0.28				0.4	0.4		2.4
5 K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							5.25	5.25																	10.5
6 **San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1																									0
					0	0	0	0	0	0	5.38	8.48	0	2.85	0	0.28	0.53	0	0	0	0.28	2.88	0	0	0	0.4	0.4	0	21.5

Assumptions:

1 One 6 min. shower/resident/day
2 4 toilet flushes/person/24 hr
3 5 handwashes/person/24 hr (15 sec per wash)
4 One drawer load dishes/2 people/day (6 place sets)
5 3 loads laundry/week on typ week w/o children
6 4 loads laundry/week on typ week w children
7 2 toothbrushings/resident/day (1/4 gal ea)
8 Shaving once per day (1/2 gal per shave)
9 Sponge bath for children - 1 gal

Use Univ. of Kentucky Guidelines for 40 gal/day/person

Occupancy

HOUR

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ	Occ
1	Saturday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2	Saturday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	8	8	8	8	8	8	8	8	8	8	2	2
3	Weekday (typical)	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	2
4	Weekday (high use)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	Weekday (with child care for 2 children)	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2

Target Market- Retired Couple [wkdy w/2 child]

HOUR

	Hot and Cold Water Use Combined					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		2.4							2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7										5.7															5.7
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2						0.25	0.25					0.25	0.25				0.25	0.25							1.5
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2						1.25	1.25	1.3	0.55			1.55	1.1	0.55			1.1	1.1				0.8	0.8		11.4
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75						10.5	10.5																		21
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1						1	1	1	1	1			1	1	1	1	1	1				1	1		13
				Total gal		0	0	0	0	0	13	13	2.3	1.55	6.7	0	1.8	2.35	1.55	1	1	2.35	4.75	0	0	0	1.8	1.8	0	55

	Hot water only					01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	Model	Appliance	Qty	Spec		gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
1	DD224-P5 (DCS)	Dishwasher	1	2.4 gal/drawer	2.4																		2.4							2.4
2	W6222 (Asko)	Washer	1	5.7 gal/load	5.7										2.85															2.85
3	K-6227 (Kohler)	Kitchen faucet	1	2.2 gal/min	2.2												0.13	0.13				0.13	0.13							0.5
4	K-2443-4 (Kohler)	Bathrm faucet	1	2.2 gal/min	2.2							0.63	0.38				0.78	0.55	0.28			0.55	0.55				0.4	0.4		4.5
5	K-997 (Kohler)	Shower head	1	1.75 gal/min	1.75							5.25	5.25																	10.5
6	**San Raphael™ - K-3597 (Kohler)**	Toilet	1	1.0 gpf	1																									0
						0	0	0	0	0	0	5.88	5.63	0	2.85	0	0.9	0.68	0.28	0	0	0.68	3.08	0	0	0	0.4	0.4	0	20.8

Assumptions:

1 One 6 min. shower/resident/day
2 4 toilet flushes/person/24 hr
3 5 handwashes/person/24 hr (15 sec per wash)
4 One drawer load dishes/2 people/day (6 place sets)
5 3 loads laundry/week on typ week w/o children
6 4 loads laundry/week on typ week w children
7 2 toothbrushings/resident/day (1/4 gal ea)
8 Shaving once per day (1/2 gal per shave)
9 Sponge bath for children - 1 gal

Use Univ. of Kentucky Guidelines for 40 gal/day/person

1. System Overview

Simulation Comparison (against previous assessment)

	Total	Comparison (with previous)
Net energy consumption (MMBtu)	315.967	**No previous**
Carbon emissions (lbCO2)	144089.2	**No previous**

Note: The results in this report are generated by the IES ApacheSim module. ApacheSim is a rigorous building thermal simulation approach that conforms to ANSI/ASHRAE Standard 140. If you wish to know more about ApacheSim and obtain a copy of the ANSI/ASHRAE 140 standard report select the following link (will open new window) www.iesve.com/apachesim

Simulation History (MMBtu)

Run	Total	Heating	Cooling	Fans/Pumps	Lights	Equip
run1	316.0	119.5	57.0	17.1	34.4	87.9

2. Building systems energy summary

Comment

Maximum values highlighted in red

MMBtu

Month	Heating (boilers etc.)	Cooling (chillers etc.)	Fans, pumps and controls	Lights	Equip.
Jan	20.2	0.0	0.0	2.9	7.5
Feb	19.0	0.0	0.0	2.6	6.7
Mar	16.7	0.0	0.0	2.9	7.5
Apr	10.8	0.3	0.1	2.8	7.2
May	5.8	4.3	1.3	2.9	7.5
Jun	1.7	10.0	3.0	2.8	7.2
Jul	0.2	15.6	4.7	2.9	7.5
Aug	0.3	18.4	5.5	2.9	7.5
Sep	1.2	7.5	2.3	2.8	7.2
Oct	7.7	0.9	0.3	2.9	7.5
Nov	15.0	0.0	0.0	2.8	7.2
Dec	21.0	0.0	0.0	2.9	7.5
Total	**119.5**	**57.0**	**17.1**	**34.4**	**87.9**

The maximum value in each column is highlighted in red. More than one value may be highlighted

Total Yearly Energy Consumption = 316.0 MMBtu

Total Yearly Energy Consumption = 514.5 kBTU/ft^2

3. Carbon Dioxide

Comment

Maximum values highlighted in red

lbCO2

Month	System (boilers, chillers, fans,pumps)	Lights	Equip.
Jan	9,216.8	1,333.0	3,404.1
Feb	8,653.8	1,204.0	3,074.7
Mar	7,606.3	1,333.0	3,404.1
Apr	5,102.6	1,290.0	3,294.3
May	5,209.5	1,333.0	3,404.1
Jun	6,686.9	1,290.0	3,294.3
Jul	9,374.5	1,333.0	3,404.1
Aug	11,032.7	1,333.0	3,404.1
Sep	5,002.6	1,290.0	3,294.3
Oct	4,055.0	1,333.0	3,404.1
Nov	6,818.7	1,290.0	3,294.3
Dec	9,555.0	1,333.0	3,404.1
Total	**88,314.4**	**15,694.5**	**40,080.4**

The maximum value in each column is highlighted in red. More than one value may be highlighted

Total carbon dioxide emissions = 144,089.2 lbCO2

4. Comfort - Occupied

Total no. rooms exceeding PPD max limit (highlighted red): 15

	Temp		Relative Humidity		PPD	
Room Name	Max°F	Min°F	Max%	Min%	Max%	Min%
Mech Rm 1	78.1	33.1	64.7	13.0	96.6	5.0
Kitchen/Dining	89.7	37.9	62.3	11.0	100.0	5.0
Mech Rm 2	76.3	32.4	65.2	13.5	100.0	5.0

5. Comfort - Full Day

Total no. rooms exceeding PPD max limit (highlighted red): 50

Room Name	Temp		Relative Humidity		PPD	
	Max°F	Min°F	Max%	Min%	Max%	Min%
Mech Rm 1	78.1	33.1	64.7	13.0	96.6	5.0
Kitchen/Dining	89.7	37.9	62.3	11.0	100.0	5.0
Mech Rm 2	76.3	32.4	65.2	13.5	100.0	5.0

6. Peak Hourly Room Loads

>30 Btu/h.ft^2

	Peak Room Conditioning Loads (Btu/h)				Internal Gains	*Cooling Checks	
Room Name	Sensible Heating	Sensible Cooling	Humidi-fication	Dehumid-ification	(Btu/h)	(Btu/h•ft^2)	(cfm/ft^2)
Mech Rm 1	20000	17925	7919	28623	6174	1013.38	65.23
Kitchen/Dining	20000	18327	11067	30190	9795	31.40	2.02
Mech Rm 2	20000	17941	7904	28583	6143	1397.21	89.93

04. Program Assignment Plans
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    06.02. Door Schedule
    06.03. Window Schedule
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        06.04.01. Luminaire Schedule
        06.04.02. Luminaire Cut Sheets
    06.05. Plumbing
        06.05.01. Fixture Schedule
        06.05.02. Fixture Cut Sheets

Meltwater

Solar Decathlon 2009

Milwaukee, Wisconsin

University of Wisconsin-Milwaukee School of Architecture and Urban Planning

May 25, 2009

PROJECT INFORMATION

Project Name:	Meltwater
Project Number	2008-001
City, ST:	Milwaukee, Wisconsin
Date Created:	December 1, 2008
Date Revised:	May 27, 2009

Owner/Tenant: University of Wisconsin-Milwaukee School of Architecture and Urban Planning

Estimated Construction Cost: $650000

Summary: Solar Decathlon Competition Entry 2009

Firm Name: Team Meltwater

Project Principal: Team Meltwater

Project Architect: Team Meltwater

Project Designer: Team Meltwater

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SECTION 01100 SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Project Identification: Meltwater (Milwaukee, WI).

B. Project Summary: ((To construct a solar-powered residential home of approximately 800 square feet)).

C. Particular Project Requirements: None

D. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company backcharges required to perform the work. Submit copies to Architect.

E. Codes: Comply with applicable codes and regulations of authorities having jurisdiction. Submit copies of inspection reports, notices and similar communications to Architect.

F. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.

G. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval.

H. Coordination:
1. Coordinate the work of all trades.
2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.
3. Verify location of utilities and existing conditions.

I. Installation Requirements, General:
1. Inspect substrates and report unsatisfactory conditions in writing.
2. Do not proceed until unsatisfactory conditions have been corrected.
3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
4. Install materials in exact accordance with manufacturer's instructions and approved submittals.
5. Install materials in proper relation with adjacent construction and with proper appearance.
6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.
7. Refer to additional installation requirements and tolerances specified under individual specification sections.
J. Limit of Use: Limit use of work as indicated. Keep driveways and entrances clear

01100-2

K. Existing Construction: Maintain existing building in a weathertight condition. Repair damage caused by construction operations. Protect building and its occupants.

L. Definitions:

1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.

2. Approved: Acceptance of item submitted for approval. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Approved' in General and Supplementary Conditions.

3. Match Existing: Match existing as acceptable to the Owner.

M. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.

N. Writing Style: Specifications are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

PART 2 EXECUTION - Not Applicable To This Section

END OF SECTION

SECTION 01111 – SUSTAINABLE DESIGN REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Environmental Goals:
a. Requirements for participation in a green building rating program.

b. **[Checklist of green building features.]**

B. Related Sections:
1. 01 10 00 (01100) – Summary: Environmental Goals for project.

1.2 DEFINITIONS
A. Definitions pertaining to sustainable development: As defined in ASTM E2114.

1.3 ENVIRONMENTAL GOALS

A. Environmental Goals: As specified in Section 01 10 00 (01100) – Summary.
1. Participation in a green building rating program: As specified in Section 01 10 00 (01100) – Summary.

2. **[Checklist of green building features:**
a. xxxx
b. xxxx
x. xxxx]

PART 2 - PRODUCTS

PART 3 EXECUTION

END OF SECTION

SECTION 01351– CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Special requirements for waste management during construction operations.
a. Protect the environment, both on-site and off-site, during **deconstruction,** and construction operations.
b. Prevent environmental pollution and damage.
c. Maximize source reduction, reuse and recycling of solid waste.

B. Related Sections:
1. 01 30 00 (01300) - Administrative Requirements: Environmental Manager and Contractor training requirements.
2. 01 40 00 (01400) – Quality Requirements: Meetings and project coordination.
3. 01 78 53 (01780) – Sustainable Design Close-Out Documentation.

1.2 DEFINITIONS
A. Definitions pertaining to sustainable development: As defined in ASTM E2114.

1.3 QUALITY ASSURANCE

A. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.
B. Diversion Goals: A minimum **75**percent by weight of total project solid waste to be diverted from landfill.

1.4 PRECONSTRUCTION MEETING

A. After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner and Architect to discuss the proposed Waste Management Plan and to develop mutual understanding relative to details of environmental protection.

1.5 SUBMITTALS

A. Solid Waste Management Plan: Not less than 10 days before the Pre-construction meeting, prepare and submit a Solid Waste Management Plan including, but not limited to, the following:
1. List of the recycling facilities, reuse facilities, municipal solid waste landfills and other disposal area(s) to be used. Include:
a. Name, location, and phone number.
b. Copy of permit or license for each facility.
2. Identify materials that cannot be recycled or reused. Provide explanation or justification.
3. Revise and resubmit Plan as required by Owner.
a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.
B. Progress Documentation: Document solid waste disposal and diversion. Include the quantity by weight of waste generated; waste diverted through sale, reuse, or recycling; and waste disposed by landfill or incineration. Identify landfills, recycling centers, waste processors, and other organizations that process or receive the solid waste.
1. Document on form in Appendix A of this Section, or similar form as approved by Owner.

2. With each Application for Payment, submit updated Documentation for solid waste disposal and diversion.
3. With each Application for Payment, submit manifests, weight tickets, receipts, and invoices specifically identifying the Project and waste material.

C. Record Submittals: With Record Submittals as specified in Section 01 78 53 (01780), submit the following:
1. Summary of solid waste disposal and diversion. Submit on form in Appendix A of this Section, or similar form as approved by Owner.

PART 2 - PRODUCTS

PART 3 EXECUTION

3.1 SOLID WASTE MANAGEMENT

A. Develop and implement a waste management program in accordance with ASTM E1609 and as specified herein.

B. Collection: Implement a recycling/reuse program that includes separate collection of waste materials of the following types as appropriate to the project waste and to the available recycling and reuse programs in the project area:
1. Land clearing debris.
2. Asphalt.
3. Concrete and Masonry.
4. Metal.
   a. Ferrous.
   b. Non-ferrous.
5. Wood, nails and staples allowed.
6. Debris.
7. Glass, colored glass allowed.
8. Paper.
   a. Bond.
   b. Newsprint.
   c. Cardboard and paper packaging materials.
9. Plastic.
   a. Type 1: Polyethylene Terephthalate (PET, PETE).
   b. Type 2: High Density Polyethylene (HDPE).
   c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
   d. Type 4: Low Density Polyethylene (LDPE).
   e. Type 5: Polypropylene (PP).
   f. Type 6: Polystyrene (PS).
   g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.
10. Gypsum.
11. Non-hazardous paint and paint cans.
12. Carpet.
13. Insulation.
14. Others as appropriate.

C. Recycling/Reuse: Maximize recycling and reuse of materials.
1. Recycling/Reuse on project site: **[Coordinate with Architect.] [As indicated on Drawings.] [Items to be reused include: xxxx.]**
2. Recycling/Reuse off project site: The following is a partial list for Contractor's information only. For more information, contact the State Department of Environmental Quality and the local Integrated Solid Waste Management Office.

a. Habitat for Humanity, a non-profit housing organization that rehabilitates and builds housing for low-income families. Sites requiring donated materials vary. Contact the national hotline (800) HABITAT.
b. Materials For The Arts (MFA) sponsored by the Department of Cultural Affairs. MFA is a materials exchange that accepts waste and excess materials from private donors and distributes them to various non-profit art organizations throughout the City. **Contact xxxxxxxxxxxxxxx.**
c. Michigan Department of Environmental Quality; 517-373-1322.
d. Michigan Recycling Coalition (MRC). The MRC is an organization whose members consist of recycling coordinators and professionals in Michigan; 517-485-WRIN (9746) or 517-371-7073.
e. California Materials Exchange (CAL-MAX) Program sponsored by the California Integrated Waste Management Board; (916) 255-2369.

D. Handling:
1. Clean materials that are contaminated prior to placing in collection containers. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process).
2. Arrange for collection by or delivery to the appropriate recycling or reuse facility.
3. Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations. Coordinate with Section 01 41 00 (01411).

E. Composting: In accordance with State Extension Service recommendations and as follows:
1. Moisture content: Maintain between 35 percent and 60 percent.
2. Carbon to nitrogen (C/N) ratio: Maintain at approximately 30 to 1 by weight.
3. Do not compost meat or dairy products on site.
4. Where the proposed Waste Management Plan incorporates composting of plastics, assess the potential effect of each type of plastic to be included on the composting process in accordance with ASTM D5509 and ASTM D6002.

END OF SECTION

SPECIFIER NOTE:
The summary below identifies those material categories represented in the federal Construction Waste Management Database. The Database contains information on companies that haul, collect and process recyclable debris from construction projects. Created in 2002 by GSA's Environmental Strategies and Safety Division to promote responsible waste disposal, the Database is a free online service for those seeking companies that recycle construction debris in their area. Recyclers of construction and demolition waste may list their services in the Database at no charge. Refer to: www.wbdg.org/tools/cwm.php

Appendix A

SUMMARY OF SOLID WASTE DISPOSAL AND DIVERSION

Project Name: _____ Project Number: _____

Contractor Name: _____ License Number: _____

Contractor Address: _____

Solid Waste Material	**Date Material Disposed/ Diverted**	**Amount Disposed/ Diverted** (ton or cubic yard)	**Municipal Solid Waste Facility** (name, address, & phone number)	**Recycling/ Reuse Facility** (name, address, & phone number)	**Comments** (if disposed, state why not diverted)
Appliances					
Asphalt					
Cardboard					
Carpet					
Concrete					
Gypsum Drywall					
Land Clearing/Soil					
Masonry					
Metals: Ferrous					
Metals: Non-ferrous					
Mixed/Co-mingled Waste					
Plastic					
Roofing: Asphalt-based					
Roofing: EPDM					
Salvaged/Surplus Materials for Reuse					
Wood: Landclearing Debris					
Wood: Scrap Lumber					
Other:					

Signature: _____ Date: _____

SECTION 01611 - ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.1 SUMMARY

A. Section includes:
1. Environmental requirements for products.

1.2 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114.

B. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

1. Biobased content: The amount of biobased carbon in the material or product as a percentage of weight (mass) of the total organic carbon in the material or product.

C. Chain-of-Custody: Process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

D. Environmentally preferable products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on Environmentally Preferable Purchasing for more information http://www.epa.gov/epp/guidance/finalguidancetoc.htm

E. Stewardship: Responsible use and management of resources in support of sustainability.

F. Sustainability: The maintenance of ecosystem components and functions for future generations.

1.3 SUBMITTALS

A. With Record Submittals as specified in Section 01 78 53 (01780) – Sustainable Design Close-Out Documentation, submit the following:
1. Affirmative Procurement Reporting Form. Submit on form in Appendix A of this Section, or similar form as approved by Owner.

2. Submit environmental data in accordance with Table 1 of ASTM E2129 for the following products:
a. Masonry
b. Finish Carpentry
c. Plastic Fabrications
d. Building Insulation
e. Roofing
f. Joint Sealers
g. Wood & Plastic Doors
h. Windows
i. Skylights

j. Glazed Curtain Wall
k. Gypsum Board
l. Tile
m. Acoustical Ceilings
n. Resilient Flooring
o. Carpet
p. Wall Coverings
q. Paints & Coatings
r. Toilet Compartments
s. Loading Dock Equipment
t. Office Equipment
u. Furnishings & Accessories
v. Renewable Energy Equipment
w. Elevators
x. Plumbing fixtures and equipment.
y. HVAC equipment
z. Lighting equipment

3. Material Safety Data Sheets (MSDS): For each product required by OSHA to have a MSDS, submit an MSDS. MSDS shall be prepared **[within the previous five years**. Include information for MSDS Sections 1 – 16 in accordance with ANSI Z400.1 and as follows:
   a. Section 1: Chemical Product and Company Identification.
   b. Section 2: Composition/Information on Ingredients.
   c. Section 3: Hazards Identification.
   d. Section 4: First Aid Measures.
   e. Section 5: Fire Fighting Measures.
   f. Section 6: Accidental Release Measures.
   g. Section 7: Handling and Storage.
   h. Section 8: Exposure Controls/Person Protection.
   i. Section 9: Physical and Chemical Properties.
   j. Section 10: Stability and Reactivity Data.
   k. Section 11: Toxicological Information. Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. **[Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.]**
   l. Section 12: Ecological Information. Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.
   m. Section 13: Disposal Considerations. Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according the US EPA Hazardous Waste Regulations 40 CFR 261.
   n. Section 14: Transportation Information. Identify hazard class for shipping.
   o. Section 15: Regulatory Information. Identify federal, state, and local regulations applicable to the material.
   p. Section 16: Other Information. Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. **[Identify the date MSDS was prepared.]**

4. Life Cycle Assessment (LCA): For the following products, submit LCA data developed in accordance with **ASTM E1991**and where BEES data exists, submit BEES 3.0c analysis using **50 percent** Environmental Performance Weighting and the **EPA Scientific Advisory Board**Environmental Impact Category Weights.
   a. Masonry
   b. Finish Carpentry
   c. Plastic Fabrications
   d. Building Insulation
   e. Roofing
   f. Joint Sealers
   g. Wood & Plastic Doors
   h. Windows
   i. Skylights
   j. Glazed Curtain Wall
   k. Gypsum Board
   l. Tile
   m. Acoustical Ceilings
   n. Resilient Flooring
   o. Linoleum
   p. Carpet
   q. Toilet Compartments
   r. Loading Dock Equipment
   s. Office Equipment
   t. Furnishings & Accessories
   u. Renewable Energy Equipment
   v. Elevators
   w. HVAC equipment
   x. Lighting equipment

5. Chain Of Custody: Submit chain-of-custody documentation for sustainable forestry for the following products:
   a. Rough Carpentry
   b. Finish Carpentry
   c. Wood Doors
   d. Windows
   e. Wood Flooring
   f. Furnishings & Accessories

1.4 SUBSTITUTIONS

A. Notify Owner when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents, but which are more environmentally responsible than materials, equipment, or products specified or indicated in the Contract Documents.
   1. Requirements of Section 01 60 00 (01600), Product Requirements apply except prior to submitting detailed information required under Section 01 60 00 (01600), submit the following for initial review by Owner and Architect:
      a. Product data including manufacturer's name, address, and phone number.
      b. Description of environmental advantages of proposed substitution over specified product.

1.5 PACKAGING

A. Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.

B. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.

C. Provide minimum **45** percent post-consumer recycled content and minimum 100 percent recovered fiber content of industrial paperboard in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

D. Provide minimum **15** percent post-consumer recycled content and minimum **100**percent recovered fiber content of carrier board in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

E. Provide minimum **20** percent post-consumer recycled content and minimum **40** percent recovered fiber content of brown papers (e.g., wrapping papers and bags) in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

1.6 ENVIRONMENTALLY PREFERABLE PRODUCTS

A. Provide environmentally preferable products to the greatest extent possible.

1. To the greatest extent possible, provide products and materials that have a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

Appendix A

AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

Project Name: _____ Project Number: _____

Contractor Name: _____ License Number: _____

Contractor Address: _____

Product	Total $ value provided	Total $ value w/ recycled content Pre-consumer	Total $ value w/ recycled content Post-consumer	Total $ value w/ biobased content	Exempted indicate 1,2,3,4	Comments
Hydraulic Mulch (paper based)						
Hydraulic Mulch (wood based)						
Compost						
Parking Stops (Concrete w/ fly ash, slag cement or low cement content)						
Parking Stops (Plastic/Rubber)						
Patio Blocks/Rubber						
Patio Blocks/Plastic						
Playground Surfaces						
Concrete w/ fly ash						
Concrete w/ slag cement						
Concrete w/ low cement content						
Plastic lumber						
Building Insulation						
Rock Wool						
Fiber glass						
Cellulose						
Perlite Comp Board						
Plastic Rigid Foam						
Glass Fiber Reinf Foam						
Phenolic Rigid Foam						
Ceramic tile						
Resilient flooring						
Floor Tiles/Rubber						
Floor Tiles/Plastic						
Running Tracks						
Carpet (PET)						
Paint						
Reprocessed Latex Paint White & Light Colors						
Reprocessed Latex Dark Colors						

Consolidated Latex Paint						
toilet/shower partitions (plastic or steel)						
Other						

CERTIFICATION

I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content.

The following exemptions may apply to the non-procurement of recycled/recovered content materials:

1) The product does not meet appropriate performance standards
2) The product is not available within a reasonable time frame
3) The product is not available competitively (from two or more sources)
4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product.)

Signature: _____ Date: _____

END OF
AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

Appendix B

See attached Affirmative Procurement Report

SECTION 01780 - SUSTAINABLE DESIGN CLOSEOUT DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Procedures for closeout submittals.
a. Record Documents.
b. Warranties.
c. Operations and Maintenance Manual.
d. Maintenance materials
2. Procedural and administrative requirements for substantial completion and final inspection.

1.2 CLOSEOUT SUBMITTALS

A. Record Documents.
1. Environmental Record Documents: As specified in Divisions 01 – 49 (1 – 16) and as follows:
a. IAQ Management Plan: As specified in Section 01 57 19.11 – Indoor Air Quality (IAQ) Management.
b. Product Data for filtration media: As specified in Section 01 57 19.11 – Indoor Air Quality (IAQ) Management.
c. Moisture Control inspections and reports: As specified in Section 01 57 19.11 – Indoor Air Quality (IAQ) Management.
d. MSDS Data: As specified in As specified in Section 01 57 19.11 – Indoor Air Quality (IAQ) Management and Section 01 67 00 (01611) – Environmental Requirements for Products.
e. Affirmative Procurement Reporting Form: As specified in Section 01 67 00 (01611) - Environmental Requirements for Products.
f. Environmental Product Data: As specified in Section 01 67 00 (01611) – Environmental Requirements for Products.
g. LCA Data: As specified in Section 01 67 00 (01611) – Environmental Requirements for Products.
h. Chain-of-Custody Data: As specified in Section 01 67 00 (01611) – Environmental Requirements for Products.
i. Final Summary Of Solid Waste Disposal And Diversion: As specified in Section 01 74 19 (01351) – Construction Waste Management.
j. Commissioning Report: As specified in Section 01 91 00 (01810) – Commissioning.

B. Warranties.

C. Operations and Maintenance Manual: Include the following:
1. Operations and Maintenance Data: As specified in Section 01 78 23 (01830) – Operation and Maintenance Data.
2. Integrated Pest Management (IPM) Plan: As specified in Section 10 81 50 (10295) – Integrated Pest Management (IPM).
3. Landscape Maintenance Information: As specified in Section 32 90 00 (02900) – Planting.

D. Maintenance materials: Submit as specified in Section 01 78 23 (01830).

1.3 SUBSTANTIAL COMPLETION

A. Prior to notifying the Architect that the project is complete according to the Contract Documents:
   1. Submit approved pre-functional checklists and functional performance testing reports from the commissioning documentation.
      a. Equipment start-up requires coordination with the commissioning process. Refer to Section 01 91 00 (01810). Equipment shall not be "temporarily" started for commissioning.

1.4 FINAL ACCEPTANCE

A. Prior to requesting inspection for verification of completion of all outstanding items:
   1. Complete commissioning requirements of Section 01 91 00 (01810), unless approved in writing by the **Owner**. Exceptions to this are required seasonal and approved deferred testing.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION

SECTION 02900 - PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Planting materials, including: trees, plants, shrubs, ground covers and grasses.
2. Topsoil and soil amendments.
3. Accessories.

B. Related Sections:
1. Section 10 81 50 (10295) – Integrated Pest Management (IPM).
2. Section 31 25 73 (02635) - Stormwater Management By Compost.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:
1. Recycled Content:
a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. Biobased materials:
a. Indicate type of biobased material in product.
b. Indicate the percentage of biobased content per unit of product.
c. Indicate relative dollar value of biobased content product to total dollar value of product included in project.

4. Compost:
a. Evidence of certification under the U.S. Composting Council (USCC) Seal of Testing Assurance (STA) Program.

B. Planting schedule indicating anticipated dates and locations for each type of planting.

C. Landscape Commissioning Submittals:
   1. Material Test Reports: For existing surface soil and imported topsoil.
   2. Plant list: Documenting soil, nutrients, amendments, and plants installed.

D. Integrated Pest Management Plan: As specified in Section 10 81 50 (10295) – Integrated Pest Management (IPM).

E. Operation and Maintenance Manuals Submittals:
   1. Instructions indicating procedures during one typical year including variations of maintenance for climatic conditions throughout the year. Provide instructions and procedures including:
      a. Watering. **[Include recommendations on soil management and potential erodibility as determined per assessment under field quality control.]**
      b. Promotion of growth, including fertilizing, pruning, and mowing.
      c. Integrated pest management.
   2. Pictures of planting materials cross referenced to botanical and common names. Describe normal appearance in each season.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer with minimum 3 years experience with landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

B. Pre-Installation Meetings:
   1. Convene a pre-installation meeting minimum one week prior to commencing work of this Section.
   2. Require attendance of parties directly affecting Work of this Section.
   3. Review conditions of operations, procedures and coordination with related Work.
   4. Agenda:
      a. Tour, inspect, and discuss conditions of planting materials.
      b. Review planting schedule and maintenance.
      c. Review required inspections.
      d. Review environmental procedures.

C. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

D. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name. Do not remove tag unless approved in writing by **[Architect] [Owner]**.

E. Certification: Provide compost products that are certified to specified product parameters in accordance with the U.S. Composting Council (USCC) Seal of Testing Assurance (STA) Program.

F. Landscape Commissioning:
   1. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio' deleterious material; pH; and mineral and plant-nutrient content of topsoil.
      a. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience

and capability to conduct the testing indicated and that specializes in types of tests to be performed.

b. Perform the soil analysis within 10 calendar days of planting. If planting is delayed, re-perform tests.

2. Material Test Reports: For existing surface soil and imported topsoil, report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil as appropriate to each plant type and location.
3. Verify soil conditions are appropriate for plants indicated; provide recommended nutrients and amendments as necessary.
4. Plant list: Submit list of plants in alphabetical order. Indicate type, size, location, and number of plants installed. Indicate the nutrients and amendments recommended form soil analysis and the nutrients and amendments provided.

1.4 MAINTENANCE

A. Minimum one year from date of **[Substantial Completion] [initial acceptance] [xxxx].**

B. Promotion of growth: Weed, water, and perform other operations necessary to promote growth and as approved by **[Owner] [Architect]** and consistent with approved Integrated Pest Management Plan.
1. Inspection: Inspect plants at least once a week and perform needed maintenance promptly.
2. Herbicides and pesticides are not permitted; use organic/natural matter for pest and disease control.
3. Remove noxious weeds common to the area from planting areas by mechanical means.

C. Mowing of groundcover and grass areas:
1. Wildflowers: Mow three times per season above height of the wildflowers (approximately 12 to 15 inches).
2. Native Grasses: Mow above height of native grass seedlings (approximately 3-1/2 to 4 inches). Mow during spring or early summer. Do not mow after early summer during the second growing season.

D. Chemical controls:
1. Wildflowers, groundcover, and grasses: Do not fertilize.
2. Trees, plants, and shrubs: Fertilize exterior planting materials to promote healthy plant growth without encouraging excessive top foliar growth.

E. At end of maintenance period, request End of Maintenance Period Inspection by **[Owner] [Architect].**
1. Final acceptance of wildflower and grass areas will be based upon a satisfactory stand of groundcover and grasses. Stand of groundcover and grass is 95 percent ground cover of established species. Replant areas which do not have a satisfactory stand of groundcover and grasses.
2. Final acceptance of exterior plants will be based upon satisfactory health and growth of plants.
3. Complete Operation and Maintenance Manuals submittals for planting materials.

F. When work is found to be unsatisfactory, maintenance period will be extended at no additional cost to Owner until work has been completed, inspected and accepted by **[Owner] [Architect]**.

1.5 WARRANTY

A. Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period.
   1. Trees.
   2. Shrubs.
   3. Ground covers.
   4. Plants.
   5. Grasses.

B. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.

C. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

PART 2 - PRODUCTS

2.1 PLANTING MATERIALS

A. As indicated on the Drawings and as follows:
   1. Renewable Resources: Plants specified are **[indigenous,] [slow-growing,]** low maintenance varieties, tolerant of site's existing soils and climate without supplemental irrigation or fertilization once established.

2.2 MULCHES

A. Free from noxious weeds, mold, or other deleterious materials.

B. Inert Mulch Materials: Crushed concrete or blast furnace slag complying with ASTM D692; Recycled porcelain or other non-traditional aggregate material complying with ASTM D6155.
   1. Recycled Content: Minimum **[5] [10] [xxxx]** percent post-consumer recycled content, or minimum **[20] [40] [xxxx]** percent pre-consumer recycled content at contractor's option.

C. Organic Mulch Materials:
   1. Mulch from recycled site debris: Coordinate with Section 31 10 00 (02230) - Site Clearing to identify and prepare suitable organic debris for use as mulch on site.
   2. Wood Cellulose Fiber:
      a. Toxicity: Processed to contain no growth or germination-inhibiting factors, dyed with non toxic, biodegradable dye to an appropriate color to facilitate visual metering of materials application.
      b. Recycled content:
         1) Paper-based hydraulic mulch: Minimum **[100] [xxxx]** percent post-consumer recycled content.
         2) Wood-based hydraulic mulch: Minimum **[100] [xxxx]** recycled material.
   3. Biobased Content: Minimum **[100] [xxxx]** percent.

2.3 EROSION CONTROL MATERIAL

A. Biodegradable twisted jute or spun-coir mesh: Minimum 0.92 lb per sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
   1. Biobased Content: Minimum **[100] [xxxx]** percent.

B. Unit Paver System: As specified in Section 32 12 43 (02795) Porous Paving.

C. Compost: As specified in Section 31 25 73 (02635) - Stormwater Management By Compost.

2.4 TOPSOIL

A. Topsoil: Evaluate soil for use as topsoil in accordance with ASTM D 5268.
   1. Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend as necessary. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth. Coordinate with Section 31 1 0 00 (02230) – Site Clearing.
   2. Supplement with imported topsoil when quantities of stockpiled soil are insufficient.
   3. Composted topsoil used for erosion control: As specified in Section 31 25 73 (02635) - Stormwater Management By Compost.

2.5 WATER

A. Water: **[Potable] [Rainwater] [Grey water]**.

B. Irrigation Systems: **[Irrigation systems shall not be permitted.] [Provide high efficiency irrigation systems.]**

2.6 PESTICIDES AND HERBICIDES

A. Pesticides: Not permitted.

B. Herbicides: Not permitted.

C. Sheet Polyethylene: Black, conforming to ASTM D2103, minimum thickness 4 mils.

D. Biological Pest Controls: As approved in the Integrated Pest Management Plan.

2.7 SOIL CONDITIONERS

A. Soil Conditioners: Nontoxic. Use singly or in combinations required to meet requirements for topsoil.

B. Peat: Peat humus derived from a freshwater site and conforming to ASTM D5539 and as follows.
   1. Biobased Content: Minimum **[100] [xxxx]** percent.

C. Sand: Clean and free of materials harmful to plants.

D. Perlite: Horticultural grade for planters.

E. Vermiculite: Horticultural grade for planters.

F. Rotted Manure: Well rotted horse or cattle manure containing maximum 25 percent by volume of straw, sawdust, or other bedding materials; free of seeds, stones, sticks and soil.

G. Compost: Well decomposed, stable, weed free organic matter source; derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 1% by dry weight) of man-made foreign matter. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. Coordinate with Section 31 10 00 (02230) – Site Clearing, Section 01 74 19 (01351) – Construction Waste Management, and Section 31 25 73 (02635) - Stormwater Management By Compost.

1. Biobased Content: Minimum **[100] [xxxx]** percent.

2. Product Parameters: Provide compost products with the following product parameters; certified in accordance with the U.S. Composting Council (USCC) Seal of Testing Assurance (STA) Program:

Parameters	**Reported as (units of measure)**	**Allowable Range**
pH	pH units	6.0 - 8.5
Soluble Salt Concentration (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 – 60
Organic Matter Content	%, dry weight basis	30 – 65
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through 3/4" screen or smaller
Stability Carbon Dioxide Evolution Rate	mg CO_2-C per g OM per day	< 8
Maturity (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (inerts)	%, dry weight basis	< 1
Chemical Contaminants	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

H. Soil amendment from recycled scrap gypsum: Coordinate with Section 09 29 00 (09250) - Gypsum Board to prepare scrap gypsum board for use as soil amendment.

2.8 FERTILIZER

A. Fertilizer for groundcover, wildflowers and grasses: Not permitted.

B. Fertilizer for trees, plants, shrubs: As recommended by plant supplier and as follows:
1. No synthetic chemical fertilizers.

2.9 ACCESSORIES

A. Edging: **[Rot and Insect Resistant Wood Lumber as specified in Section 06 05 73 (06070) – Wood Treatment.] [Plastic lumber as specified in Section 06 60 00 (06600) – Plastic Fabrications]**

B. Plastic Fabrications: As specified in Section 06 60 00 (06600) – Plastic Fabrications.
1. Site Furnishings: **[tree grates] [benches] [xxxx].**
2. Temporary compostable plastic accessories: **[ties] [markers] [xxxx].**

PART 3 - EXECUTION

3.1 PREPARATION

A. Erosion Control:
1. Biodegradable twisted jute or spun-coir mesh: Verify that mesh does not include invasive species.

B. Soil Conditioners:
1. Peat: Verify that peat does not include invasive species, including seeds.
2. Rotted Manure: Verify that manure does not include invasive species, including seeds.
3. Compost: Verify that compost does not include invasive species, including seeds. Coordinate with Section 31 25 73 (02635) - Stormwater Management By Compost. **[Unless otherwise indicated, uniformly apply over the entire planting area at a rate of 25% - 30% compost by volume for planting areas; 15% compost by volume for turf areas.] [Unless otherwise indicated, uniformly apply over the entire planting area at a rate of 2" – 4" of compost into upper 8" – 12" of soil.] [Unless otherwise indicated, uniformly apply over the entire planting area at a rate of xxxx]**

3.2 ALTERNATIVE HERBICIDE TREATMENT (SOLARIZING SOIL)

A. Within 48 hours of subsoil preparation, saturate soil with water to a depth of 3 feet. Immediately stake polyethylene sheeting over area to be planted. Stake tightly to surface of soil. Maintain sheeting in place for a minimum of 6 weeks.

B. Immediately after removing sheeting, cover area to be planted with topsoil. Do not till soil prior to applying topsoil.

3.X FIELD QUALITY CONTROL

A. Water: Coordinate with work specified in Section 01 57 19.13 (01354) – Environmental Management to provide water monitoring for surface and groundwater.
1. Assess potential effects of soil management practices on soil loss in accordance with ASTM D6629. Assess erodibility of soil with dominant soil structure less than 7 to 8 cm in accordance with ASTM D5852.

END OF SECTION

SECTION 03410 - STRUCTURAL PRECAST CONCRETE

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of structural precast concrete work is shown on drawings and in schedules.

Structural precast concrete includes the following:

Hollow slab units.

Structural framing units.

RELATED WORK:

Cast-in-place concrete is specified in another Division-3 section.

Caulking of joints, leveling grout, and skim coat of latex underlayment by this Contractor.

QUALITY ASSURANCE:

Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated:

ACI 301 "Specifications for Structural Concrete for Buildings.

ACI 318 "Building Code Requirements for Reinforced Concrete".

Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

Prestressed Concrete Institute MNL 116, "Manual for Quality Control for Plants and Production of Precast Concrete Products".

Fire-resistance Rated Precast Units: Where precast concrete units are shown or scheduled as requiring fire-resistance classification, provide units tested and listed by U.L. in "Fire Resistance Directory", or with each unit bearing U.L. label and marking. Ratings must conform with State requirements.

SUBMITTALS:

Product Data: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.

Shop Drawings: Submit shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross-section; location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection.

Indicate layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail inserts, connections, and joints, including accessories and construction at openings in precast units.

Provide location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.

Provide complete design calculations prepared by a registered engineer, licensed in State where project is erected. Obtain State plan approval of all systems and members. Cost of State or City permits and plan approvals to be included in Base Bid.

DELIVERY, STORAGE AND HANDLING:

Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation. Store units at project site to prevent cracking, distortion, staining, or other physical damage, and so that markings are

visible. Lift and support units at designated lift points.

Deliver anchorage items which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

PART 2 - PRODUCTS:

Sizes and thickness shown on plans are as preferred by Architect. Contractor to confirm all sizes, thicknesses and loading prior to bidding.

CONNECTION MATERIALS:

Bearing Pads: Provide bearing pads for precast concrete units as required by job conditions and as normally supplied by this Contractor.

GROUT MATERIALS:

Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

FABRICATION:

General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-116, and as specified for types of units required.

Built-in Anchorages: Accurately position built-in anchorage devices and secure to framework. Locate anchorages where they do not affect position of main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Architect.

Cast-in holes for openings larger than 8" diameter or 8" square in accordance with final shop drawings. Other smaller holes will be field cut by trades requiring them, as acceptable to Architect and Precast Contractor.

HOLLOW SLAB UNITS:

Type: Precast prestressed concrete units with open voids running full length of slabs.

Furnish units which are free of voids or honeycomb, with straight true edges and surfaces.

Include cast-in weld plates where required for anchorage or lateral bracing to structural steel members.

Provide headers cast-in-place concrete or structural steel shapes for openings larger than one slab width in accordance with hollow slab unit manufacturer's recommendations.

STRUCTURAL FRAMING UNITS:

Type: Precast prestressed concrete units produced under a rigidly inspected process.

Furnish units which are free of voids or honeycomb, with straight true edges and surfaces.

Provide "Standard Finish" units as specified.

Where ends of strands will not be enclosed or covered, cut flush and cover with a high strength mortar bonded with an epoxy resin bonding agent.

Include cast-in weld plates where required for anchorage or lateral bracing to other supporting members.

PART 3 - EXECUTION

Insulation: Insulate ends of hollow core slab units that terminate at an outside wall to a depth of 16" of fiberglass insulation.

INSTALLATION, GENERAL:

Bearing Pads: Install flexible bearing pads where indicated, as precast units are being erected. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed.

Welding: Perform welding in compliance with AWS D 1.1, including qualification of welders.

Protect units from damage by field welding or cutting operations and provide non-combustible shield as required.

Powder-Actuated Fasteners: Do not used powder-actuated fasteners for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.

Installation Tolerances: Install precast units without exceeding following tolerance limits:

Variations from Plumb: 1/4" in any 20' run or story height. 1/2" total in any 40' or longer run.

Variations from Level or Elevation: 1/4" in any 20' run; 1/2" in any 40' run; total plus or minus 1/2" at any location.

Variation from Position in Plan: Plus or minus 1/2" maximum at any location.

Offsets in alignment of Adjacent Members at Any Joint: 1/16" in any 10' run; 1/4" maximum.

Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at connection and joints as follows:

Cement grout consisting of 1 part portland cement, 2-1/2 parts sand, and only enough water to properly mix and for hydration.

CEILINGS OVER GARAGE AREAS:

Seal underside of all precast joints at first floor precast plank to prevent carbon monoxide penetration. Seal with multi-part polyurethane sealant per Division 7 Section "Sealants".

Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be replaced with precast concrete units that meet requirements of this section. Contractor shall also be responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.

FINISHED CEILINGS

Precast concrete plank scheduled to receive spray applied finishes:

Offsets in Alignment of Adjacent Members at any joint: 1/16” at any point.

Seal Joints with acrylic latex sealant per Division 7 Section “Sealants”.

FINISHED FLOORING

Precast concrete plank scheduled to receive carpet or similar flooring finish:

Offsets in Alignment of Adjacent Members at any joint: 1/8” at any point.

Finish Trowel joints where required to provide carpet ready surface. Feather joints with skim coat of latex underlayment where necessary.

END OF SECTION

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes structural steel.

B. This Section includes structural steel and architecturally exposed structural steel.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

a. Category: Category I, conventional steel structures.

b. Category: Category II, complex steel building structures.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
2. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
3. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
4. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Plates and Bars: Fy2 36 KSI per ASTM A36.

B. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 36 (ASTM A 36M).
2. Unheaded Bolts: ASTM A 687, high strength.
3. Headed Bolts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
4. Washers: ASTM A 36 (ASTM A 36M).

C. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated.
2. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

D. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Interior structural steel to receive application of spray-applied fireproofing and shall be free of primer and paint.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

1. Mark and match-mark materials for field assembly.
2. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
3. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
4. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.4 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2.5 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed-on fireproofing.
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 2 "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.6 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of grade bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean geotextile fabric and ensure that it is level prior to setting structural steel

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Finish sections thermally cut during erection equal to a sheared appearance.

H. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
2. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.
3. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.5 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION

SECTION 05520 - ROOF FALL PROTECTION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Portable, roof fall protection system.

B. Storage cart.

1.2 RELATED SECTIONS

A. Section 07400 - Metal Roofing.

B. Section 07700 - Roof Specialties and Accessories.

1.3 REFERENCES

A. 29 CFR 1926 - Safety and Health Regulations for Construction, Subpart M-Fall Protection.

B. 29 CFR 1910.23 - Occupational Health and Safety Standards for General Industry.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. [Product Data]: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Certification: Provide manufacturer's certifications that the ultimate strength of the fall protection system is equal to or greater than those specified.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: minimum of 15 years experience manufacturing portable railing systems.

B. Installer Qualifications: 1-2 person crew capable of positioning and installing portable roof fall protection system according to manufacturers instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and maintain products in accordance with the manufacturer's printed recommendations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Garlock Equipment Co., which is located at: 2601 Niagara Ln. ; Plymouth, MN 55447; Toll Free Tel: 800-328-9522; Tel: 763-553-1935; Fax: 763-553-1093; Email: request info; Web: www.railguard.net

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 DESIGN REQUIREMENTS

A. Structural Performance: Comply with requirements of applicable local, state, and federal codes.
   1. OSHA: 29 CFR 1926.502 - Safety and Health Regulations for Construction, Subpart M-Fall Protection.
   2. OSHA: 29 CFR 1910.23 - Occupational Health and Safety Standards for General Industry.

B. Structural performance of cable and stanchion supports:
   1. Capable of withstanding a concentrated load of 200 pounds (90.6 kg), applied to the top rail at any point and in any direction.
   2. Capable of withstanding a uniform load of 50 pounds per linear foot (74.3 kg/m) applied to the top rail horizontally with a simultaneous load of 100 pounds per linear foot (148.6 kg/m) applied vertically downward.
   3. Design need not provide for both concentrated and uniform loads to be applied concurrently.

C. Structural performance of cable infill:
   1. Capable of withstanding a horizontal concentrated load of 200 pounds (90.6 kg), applied to one foot (30.5mm) square area at any point on the infill.
   2. Infill includes cable, intermediate posts and other elements.
   3. Design need not provide for infill loads to be applied concurrently with top rail loading.

2.3 EQUIPMENT

A. Fall-Ban CableGuard Fall Protection System: Provide system as follows:
   1. Standard Kits:
      a. Flat Commercial Kit 60 foot (18.3 m): Includes 4 stanchions, 1 spool of cable, braces, flags and hardware intended for straight run applications.
      b. Flat Commercial Kit 200 foot (61 m): Includes 11 stanchions, 3 spools of cable, braces, flags and hardware intended for L-shaped or complete rectangular applications.
      c. Flat Commercial Kit 400 foot (122 m): Includes 21 stanchions, 6 spools of cable, braces, flags and hardware intended for L-shaped or complete rectangular applications.
   2. Optional Equipment: Provide the following options in quantities required for the Commercial Kit specified.
      a. Parapet clamp fabricated to match stanchions. Suitable for up to a 14 inch (356 mm) parapet.
      b. Overhanging roof brace fabricated to match stanchions.
   3. Tensioning Equipment: Provide each kit with one mechanical ratchet type tensioning puller.
   4. Service Cart.
      a. Cart shall attach to the Garlock Fall-Ban 4 Wheel Cart with built-in wheel brakes.
      b. Cart shall be able to carry a complete 400 foot (122 m) Fall-Ban System.
      c. Cart shall have a single point hoisting ring for rooftop transfer.
      d. Cart shall be provided with a bar to permit it to be pushed pulled or

towed.

e. Cart shall be provided with a lockable toolbox for miscellaneous components.

2.4 COMPONANTS

A. Stanchions.
1. Steel 1 inch (25.5 mm) O.D. by 0.065 inch (2.7 mm) EWSQ tubular steel sections with rolled frame support.
2. Cable Connectors: Welded to posts.
3. Finish: Epoxy powder coated safety yellow.
4. Finish: Hot dipped galvanized.

B. Stanchion System Accessories.
1. Braces and Mid-Rail Cable Supports: Steel 1 inch (25.5 mm) O.D. by 0.065 inch (2.7 mm) EWSQ tubular steel sections.
2. Cable anchor plates. Steel plate.
3. Finish: Epoxy powder coated safety yellow.
4. Finish: Hot dipped galvanized.

C. Cable: 1/4 inch (6 mm) stranded marine grade stainless steel cable stored on spools.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Before installation, inspect all parts to insure no damaged parts are used.

C. Lag bolt stanchions to roof header boards 20 feet (6.1 m) O.C.

D. If using parapet wall attachment, clamp stanchions securely onto parapet wall.

E. Install cable anchor plates at each end of the cable run.

F. Install diagonal braces on corner stanchions and at terminations of cable runs.

G. Position cable into each of the three cable connector points on each stanchion.

H. Tension each cables with mechanical ratchet pullers to as recommended by the manufacturer.

I. Coil unused cable lengths onto spools and store at termination point. Do not cut cable.

J. Install cable supports halfway between each stanchion by clipping into tensioned cable.

K. Install flags along the entire length of the upper cable.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Check cable tension each day before starting operations. Retention as required.

END OF SECTION

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes custom ornamental metal [**items**] <**Insert list of items**>.

B. See Division 05 Section "Decorative Metal" for ornamental metal items made from sheet metal.

C. See Division 05 Section "Decorative Metal Railings" for ornamental metal railings.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Show details of fabrication and installation. Indicate materials, finishes, fasteners, anchorages, and accessory items.

C. Patterns, Models, or Plaster Castings: For each custom casting required.

D. Samples: For each type of exposed finish required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ornamental Mechanical Grilles:

a. Architectural Grille; Div. of Giumenta Corporation.
b. Harrington & King Perforating Co.
c. Reggio Registers Co., Inc.
d. Register & Grille Manufacturing Co., Inc.
e. <**Insert manufacturer's name.**>

2. Metal-Clad Doors:

a. Dawson Metal Co., Inc.
b. InKan Limited.
c. Krieger Steel Products Co.
d. <**Insert manufacturer's name.**>

3. Ornamental Castings and Forgings:

   a. Allen Architectural Metals.
   b. Alloy Casting Co., Inc.
   c. Architectural Iron Company, Inc.
   d. Blum, Julius & Co., Inc.
   e. Braun, J. G. Company; a division of the Wagner Companies.
   f. Classic Iron Supply/Craft.
   g. Colonial Castings, Inc.
   h. Cullar/La Cuesta.
   i. Dempsey, Inc.
   j. Historical Arts & Casting, Inc.
   k. Indital USA.
   l. Lawler Foundry Corporation.
   m. Morrow, Frank Company.
   n. Olin Wrought Iron.
   o. OMC Industries, Inc.
   p. Robinson Iron.
   q. Tennessee Fabricating Co.
   r. Texas Metal Industries, Inc.
   s. TT Triebenbacher - Bavarian Iron Works Co.
   t. Universal Manufacturing Co., Inc.
   u. **<Insert manufacturer's name.>**

4. Stainless-Steel Wire Rope and Fittings:

   a. Cable Connection (The).
   b. Esmet, Inc.
   c. Feeney Wire Rope & Rigging.
   d. Hayn Enterprises, LLC.
   e. Johnson, C. Sherman, Co., Inc.
   f. Loos & Co., Inc.; Cableware Division.
   g. Ronstan International Inc.
   h. SAVA Industries.
   i. Seco South, Inc.
   j. **<Insert manufacturer's name.>**

2.2 METALS

A. Aluminum: Provide alloy and temper recommended by aluminum producer and finisher with strength and durability properties not less than that of alloy and temper designated below.

   1. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
   2. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy [**3003-H14**] [**5005-H32**] [**6061-T6**].
   3. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), alloy 6061-T6.
   4. Castings: ASTM B 26/B 26M, alloy A356.0-T6.

B. Copper Alloys:

   1. Extruded Shapes, Bronze: ASTM B 455, alloy UNS No. C38500 (architectural bronze).
   2. Extruded Shapes, Brass: ASTM B 249/B 249M, alloy UNS No. C36000 (free-cutting brass).
   3. Extruded Shapes, Nickel Silver: ASTM B 151/B 151M, alloy UNS No. C74500.

4. Castings, Bronze: [**Composition bronze castings complying with ASTM B 62, alloy UNS No. C83600 (85-5-5-5 or No. 1 composition commercial red brass)**] [**or**] [**sand castings complying with ASTM B 584, alloy UNS No. C86500 (No. 1 manganese bronze)**].
5. Castings, Brass: Sand castings complying with ASTM B 584, alloy UNS No. C85200 (high-copper yellow brass).
6. Castings, Nickel Silver: ASTM B 584, alloy UNS No. C97600 (20 percent leaded nickel bronze).
7. Plate, Sheet, Strip, and Bars; Bronze: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).
8. Plate, Sheet, Strip, and Bars; Brass: ASTM B 36/B 36M, alloy UNS No. C26000 (cartridge brass, 70 percent copper).
9. Plate, Sheet, Strip, and Bars; Copper: ASTM B 152/B 152M, alloy UNS No. C11000 (electrolytic tough pitch copper) or UNS No. C12200 (phosphorous deoxidized, high residual phosphorous copper).

C. Stainless Steel:

1. Tubing: ASTM A 554, Grade MT [**304**] [**316**] [**316L**].
2. Castings: ASTM A 743/A 743M, Grade [**CF 8 or CF 20**] [**CF 8M or CF 3M**].
3. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type [**304**] [**316**] [**316L**].
4. Bars and Shapes: ASTM A 276, Type [**304**] [**316**] [**316L**].
5. Wire Rope: [**1-by-19**] [**7-by-7**] [**7-by-19**] <**Insert configuration**> wire rope made from wire complying with ASTM A 492, Type 316.

D. Steel and Iron:

1. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
2. Plates, Shapes, and Bars: ASTM A 36/A 36M.
3. Castings: Either gray iron, ASTM A 48/A 48M, Class 30, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
4. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), exposed.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners: Same basic metal as fastened metal; concealed, unless otherwise indicated, with Phillips flat-head screws for exposed fasteners.

B. Anchors: Fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined per ASTM E 488.

C. Wire-Rope Fittings: Fabricated from stainless steel and with strength equal to minimum breaking strength of wire rope with which they are used.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

E. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

F. Lacquer for Copper Alloys: Clear, air-drying,[**waterborne**] acrylic lacquer specially developed for coating copper-alloy products.

G. Shop Primers: Provide primers that comply with Division 09 [**painting Sections.**] [**Section "High-Performance Coatings."**]

H. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

I. Zinc-Rich Primer: Comply with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

J. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer compatible with finish paint systems indicated, and complying with SSPC-Paint 5.

2.4 FABRICATION

A. Form ornamental metal true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

B. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

C. Comply with AWS for recommended practices in shop [**welding**] [**and**] [**brazing**]. Clean exposed [**welded**] [**and**] [**brazed**] joints of flux, and dress exposed and contact surfaces.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Protect mechanical finishes by applying a strippable, temporary protective covering before shipping.

B. Aluminum Finishes: Designations are as established by the Aluminum Association.

1. Clear Anodic Finish: Class [**II, AA-M12C22A31**] [**I, AA-M12C22A41**] complying with AAMA 611.
2. Color Anodic Finish: Class [**II, AA-M12C22A32/A34**] [**I, AA-M12C22A42/A44**] complying with AAMA 611.

   a. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**].

3. Baked-Enamel Finish: AA-C12C42R1x, with thermosetting, modified-acrylic enamel primer/topcoat organic coating system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

   a. Color: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**] <**Insert color**>.

4. Siliconized Polyester Finish: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

a. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**] <**Insert color and gloss**>.

5. High-Performance Organic Finish: AA-C12C42R1x, fluoropolymer thermocured system with fluoropolymer coats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with [**AAMA 2604**] [**AAMA 2605**].

a. System: [**Two**] [**Three**] [**Four**] coat.
b. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**] <**Insert color and gloss**>.

C. Copper-Alloy Finishes: Designations are system established for designating copper-alloy finish systems defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

1. Buffed Finish: M21 (smooth specular).
2. Hand-Rubbed Finish: M31-M34 (directionally textured, hand rubbed).
3. Medium-Satin Finish: M32 (directionally textured, medium satin).
4. Fine-Matte Finish: M42 (nondirectional finish, fine matte).
5. Buffed Finish, Lacquered: M21-O6x (smooth specular).
6. Hand-Rubbed Finish, Lacquered: M31-M34-O6x (directionally textured, hand rubbed).
7. Medium-Satin Finish, Lacquered: M32-O6x (directionally textured, medium satin).
8. Fine-Matte Finish, Lacquered: M42-O6x (nondirectional finish, fine matte).

a. Clear, Organic Coating: Two coats lacquer specified for copper alloys; total thickness of 1 mil (0.025 mm).

9. Statuary Conversion Coating over Satin Finish: M31-C55.

a. Color: Match sample.

10. Patina Conversion Coating: M36-C12-C52.

a. Color: Match sample.

11. Statuary Conversion Coating, Bright Relieved and Lacquered: M12-C55-M2x-O6x.

a. Color and Buffing: Match sample.
b. Clear, Organic Coating: Two coats lacquer specified for copper alloys; total thickness of 1 mil (0.025 mm).

12. Blackened, Bright Relieved, and Lacquered: M33-O60-M2x-O6x.

a. Blackening and Buffing: Match sample.
b. Clear, Organic Coating: Two coats lacquer specified for copper alloys; total thickness of 1 mil (0.025 mm).

D. Stainless-Steel Finishes:

1. Bright, Cold-Rolled, Unpolished Finish: No. 2B finish.
2. Directional Satin Finish: No. 4 finish.
3. Dull Satin Finish: No. 6 finish.
4. Reflective, Directional Polish: No. 7 finish.

5. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

E. Steel and Iron Finishes:

1. Galvanizing: Hot-dip galvanize to comply with ASTM A 123/A 123M.

   a. Hot-dip galvanize steel and iron hardware to comply with ASTM A 153/A 153M.

2. Factory-Primed Finish: Prepare surfaces and apply air-dried primer to provide a minimum dry film thickness of 2 mils (0.05 mm) to exposed surfaces and to concealed, nongalvanized surfaces.

   a. Preparation for Galvanized Metal: After galvanizing, clean and treat with metallic-phosphate pretreatment.
   b. Preparation for Uncoated Ferrous Metal: Comply with SSPC-SP 6, "Commercial Blast Cleaning."

3. Powder-Coat Finish: Prepare, treat, and coat ferrous metal to comply with resin manufacturer's written instructions.

   a. Preparation of Uncoated Ferrous Metal: Comply with SSPC-SP 6, "Commercial Blast Cleaning."
   b. Preparation of Galvanized Metal: Thoroughly removing grease, dirt, oil, flux, and other foreign matter.
   c. Treat prepared metal with metallic-phosphate pretreatment, rinse, and seal surfaces.
   d. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
   e. Color: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**] <**Insert color**>.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide anchorage devices and fasteners where necessary for securing to in-place construction.

B. Set products accurately in location, alignment, and elevation. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers.

C. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

D. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

END OF SECTION 057000

SECTION 06073 - EXTERIOR FIRE-RETARDANT TREATED WOOD

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fire-retardant treatment for the following exterior applications:
1. Wood framing.
2. Decking.
3. Wood sheathing.
4. Blocking.
5. Miscellaneous rough carpentry.
6. Wood siding.
7. Wood trim and moldings.
8. Wood frames for doors, windows, and glazed lights.

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry.

B. Section 06110 - Wood Framing.

C. Section 06112 - Wood Framing and Sheathing.

D. Section 06114 - Wood Blocking and Curbing.

E. Section 06130 - Heavy Timber Construction.

F. Section 06150 - Wood Decking.

G. Section 06170 - Prefabricated Structural Wood.

H. Section 06200 - Finish Carpentry.

I. Section 06400 - Architectural Woodwork.

1.3 REFERENCES

A. ASTM D 2898 - Standard Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials

D. NFPA 703 - Standard for Fire-Retardant Treated Wood for Building Materials.

E. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

F. Department of Defense: Mil. Spec. L-19140E Lumber and Plywood, Fire-Retardant Treated.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Product Specifications.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products under shelter, off the ground with proper ventilation allowing for air circulation and protect from construction traffic, and damage.

1.6 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Hoover Treated Wood Products, Inc., which is located at: 154 Wire Rd. ; Thomson, GA 30824; Toll Free Tel: 800-TEC-WOOD; Tel: 706-595-5058; Fax: 706-595-1326; Email: request info; Web: www.frtw.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 APPLICATIONS/SCOPE

A. All lumber and plywood designated to be exterior fire retardant treated shall be pressure impregnated with Exterior Fire-X. Exterior Fire-X is provided in conformance with the following:
   1. International Building Code - Section 2303.2 , Fire retardant, Exterior Type.
   2. International Residential Code - Section R802.1.3, Fire retardant, Exterior Type.
   3. Mil. Spec. L-19140E Lumber and Plywood, Fire-Retardant Treated.
   4. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
   5. UL Listing, Treated Lumber (BPVV).
   6. UL Listing, Treated Plywood (BUGV).
   7. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
   8. NFPA 703 - Standard for Fire-Retardant Treated Wood for Building Materials.
   9. Mil. Spec. L-19140E Lumber and Plywood, Fire-Retardant Treated.

B. After consideration of design value adjustments provide lumber of the appropriate grade and species as specified by the design criteria of the intended application

C. After consideration of span rating adjustments provide plywood of the appropriate size, grade and species as specified by the design criteria of the intended application.

2.3 FIRE RETARDANT TREATMENT

A. Lumber and Plywood: Pressure impregnated with Exterior Fire-X in accordance with the Follow-Up Procedures of Underwriters Laboratories Inc. Fire-retardant treatment shall contain no halogens, sulfates, chlorides, or ammonium phosphate.
   1. Species and Grade as specified in:
      a. Section 06100 - Rough Carpentry.
      b. Section 06110 - Wood Framing.
      c. Section 06112 - Wood Framing and Sheathing.
      d. Section 06114 - Wood Blocking and Curbing.
      e. Section 06130 - Heavy Timber Construction.
      f. Section 06150 - Wood Decking.
      g. Section 06170 - Prefabricated Structural Wood.
      h. Section 06200 - Finish Carpentry.
      i. Section: _____ - _____.
   2. Surface Burning Characteristics: Flame spread index of 25 or less and flame spread not more than 10.5 feet (3.2 m) beyond centerline of burners with no evidence of significant progressive combustion when tested in accordance with ASTM E 84 for 30 minutes.
   3. No increase in flame spread after testing per ASTM D 2898 Standard Test Method for Accelerated Weathering of Fire- Retardant-Treated Wood for Fire Testing.
   4. Moisture Content:
      a. Kiln dry lumber to 19 percent or less moisture content after treatment.
      b. Kiln dry plywood to 15 percent or less moisture content after treatment.
   5. Labeling: Each piece of lumber and plywood shall be labeled with a permanent ink mark.
      a. Each piece of lumber shall bear the UL Classification Mark certifying specified flame spread rating.
      b. Each piece of plywood shall be marked on both sides.
      c. Production and kiln drying after treatment monitored by Timber Products Inspection, Inc., with each piece labeled KDAT.
      d. The mark shall state there shall be no increase in the listed classification when subjected to the Standard Rain test.
   6. Roof Applications: Evaluated for high temperature strength for roof applications.

B. Provide design value adjustments and span ratings when used for roof applications.

2.4 FABRICATION

A. Milling: Lumber shall be ripped or run to pattern, as required, prior to treatment.

B. Surface milling or planning is not allowed after treatment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Discard pieces with defects that might impair quality or work.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 FIELD CUTTING

A. Lumber:
1. Do not rip or mill lumber after fire-retardant treatment; end cuts and joining cuts are permitted.
2. Drilling of holes and notching permitted in accordance with American Forest and Paper Association Wood Construction Data #1.

B. Plywood: Fire-retardant-treated plywood may be cut in any direction.

3.4 APPLICATION

A. Install in accordance with manufacturer's instructions.

B. Comply with additional requirements specified in Section _____.

C. Structural Applications: Use strength tables supplied by Hoover Treated Wood Products, Inc.

D. Provide adequate airflow across at least one surface in wood roof systems to control moisture and reduce temperature.

E. Cover roof sheathing with felt or roofing immediately after installation. If wetted during construction, allow to dry before enclosure or covering with roofing material.

F. Fasteners: Use the following fastener types:
1. Locations exposed to the weather or wet or damp locations: Use hot dip galvanized or stainless steel fasteners for all types of treated wood .
2. Other locations: Use corrosion resistant fasteners for all types of treated wood. Acceptable for use with galvanized nails, truss plates, ductwork, plumbing, conduit and copper.

G. Coordinate surface preparation and applied finishes with the requirements of Section 09900.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06090 - WOOD AND PLASTIC FASTENINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-engineered metal connectors used to support a wood, plated truss, or composite wood member(s) from a concrete, masonry, steel, wood, or composite wood supporting member(s).

1.2 RELATED SECTIONS

A. Section 03300 – Cast-In-Place Concrete – Concrete provides support or anchorage.
B. Section 04050 – Basic Masonry Materials and Methods – Masonry provides support or anchorage.
C. Section 04200 – Masonry Units – Masonry provides support or anchorage.
D. Section 05120 – Structural Steel – Steel provides support or anchorage.
E. Section 06100 – Rough Carpentry – Wood supported by fastenings or providing support or anchorage.

1.3 REFERENCES

A. ASTM A36 – Carbon Structural Steel
B ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
C. ASTM A193-B7 – Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
D. ASTM A307 – Carbon Steel Bolts and Studs
E. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
F. ASTM A625 – Tin Mill Products, Black Plate, Single Reduced
G. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
H. ASTM A706 – Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
I. ASTM A924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
J. ASTM A1011 – Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
K. ASTM F1667 – Driven Fasteners: Nails, Spikes, and Staples
L. ASTM D1761 – Standard Test Methods for Mechanical Fasteners in Wood
M. ICBO AC13 – Acceptance Criteria for Joist Hangers and Similar Devices
N. ICBO AC95 – Acceptance Criteria to Determine Bending Yield Moment for Nails
O. ICBO AC120 – Acceptance Criteria for Wood Screws
P. AISI 1996 – Cold-Formed Steel Specification
Q. 1997 NDS – National Design Specification

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Simpson Strong-Tie Co., Inc.

2.02 MATERIALS

A. Steel:
   1. Sheet: ASTM A625, ASTM A653, ASTM A1011
   2. Fasteners: ASTM F1667, SAE C1022 (SDS Screws)
B. Stainless Steel:
   1. Sheet: ASTM A167
C. Finishes:
   1. Gray paint
   2. Hot-dipped galvanized or electro-plated galvanized: G60, G90, G185 (ZMAX)
   3. Powder-coated paint.
   4. Zinc and dichromate for SDS screws

2.03 FABRICATION

A. Shop assembly to occur per the manufacturer's approved production drawings.
B. Fabrication tolerances per manufacturer.
C. Fabrication requiring welding shall be performed in accordance with the current American Welding Society's standards.
D. The manufacturer's identification shall be stamped into the metal part and/or a label may be attached to the part with adhesive.

2.04 TESTING

A. Allowable loads published in manufacturer's catalog to be determined using the minimum load from static and/or cyclic analysis and one or more of the following test methods:
   1. Static load tests in wood assemblies
   2. Static load tests in steel jigs
   3. Static load tests of products embedded in concrete or masonry
   4. Cyclic or static load tests in wood assemblies (Anchor Tiedown System)
B. Testing to determine allowable loads shall be performed as per ICBO Acceptance Criteria 13 (AC13) and/or ASTM D1761.
C. Allowable loads for hangers are determined by a static load test resulting in not more than a 1/8" deflection of the joist relative to the header, or the lowest test ultimate load divided by 3, or the fastener allowable load as determined by the NDS, whichever is lower.
D. Testing shall be conducted under the supervision of an independent laboratory.
E. Manufacturer to provide code testing data on all products that have been code tested upon request.

PART 3 EXECUTION

3.01 EXAMINATION

A. Unless otherwise noted in the manufacturer's catalog, allowable loads are for Douglas Fir-Larch under continuously dry conditions. Allowable loads for other species or conditions must be adjusted according to the code. See manufacturer's catalog for additional notes and requirements.
B. Built-up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
C. Verify that the dimensions of the supporting member are sufficient to receive the specified fasteners.

3.02 INSTALLATION

A. Unless otherwise noted in the manufacturer's catalog, bolts and nails shall not be combined.
B. All nails shall be common unless otherwise noted in the manufacturer's catalog or substituted, by the engineer of record, with a reduction taken.
C. Unless otherwise noted in the manufacturer's catalog, bending steel in the field may cause fractures at the bend line. Fractured steel will not carry load and must be replaced. When bending is allowed or required in the catalog, the connector shall be allowed one cycle bend, one time only.
D. Galvanized connectors should not be placed in contact with treated wood unless the treated wood is adequately verified to be suitable for such contact. Some wood treatments may accelerate metal deterioration. See wood material supplier for specific recommendations.
E. A fastener that splits the wood will not take the design load. Evaluate splits to determine if the connection will perform as required. Dry wood may split more easily and should be evaluated as required. If wood tends to split, consider pre-boring holes with diameters not exceeding 0.75 of the nail diameter (1997 NDS 12.1.3.1).
F. Wood shrinkage shall be taken into account when designing and installing connections.
G. Built-up lumber (multiple members) must be fastened together to act as one unit to resist the applied load.
H. Top flange hangers may cause unevenness. Possible remedies should be evaluated by a professional and include using a face mount hanger, routering the beam, or cutting the subfloor to accommodate the top flange thickness.
I. Do not overload by exceeding the manufacturer's catalog allowable load values.
J. Unless otherwise noted in the manufacturer's catalog, fill all fastener holes with fastener types as specified in the manufacturer's catalog.
K. All specified fasteners must be installed according to the instructions in the manufacturer's catalog.
L. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter (NDS 8.1.2.1)
M. Install all specified fasteners before loading the connection.
N. Use proper safety equipment.
O. Welding shall be in accordance with the American Welding Society (AWS) standards.
P. Welding galvanized steel may produce harmful fumes, follow proper welding procedures and safety precautions.
Q. Nail tools with hole-location mechanisms may be used to install connectors, provided the correct quantity and type of nails are properly installed in the nail holes.
R. Joist shall bear completely on the connector seat, and the gap between the joist end and the header shall not exceed 1/8".

S. Installer of ATS system to cut rods to length as required.
T. Modifications to products or changes in installation procedures should only be made by a qualified designer. The performance of such modified products or an altered installation procedure is the sole responsibility of the designer.

3.03 FIELD QUALITY CONTROL

A. Determine that the proper part is being used in the correct application and has been fabricated by the approved manufacturer by observation of the stamp into the metal part and/or the adhesive label on the product denoting part and manufacturer name.
B. Before substituting another brand, confirm load capacity based on published testing data and calculations per section 2.04. The engineer/designer of record shall evaluate and give written approval for substitution prior to installation.

SECTION 06100 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Framing with dimension lumber.
2. Engineered wood products.
3. Wood furring, grounds, nailers, and blocking.

B. Related Sections:
1. 06 05 73 (06070) - Wood Treatment.
2. 06 16 00 (06160) – Sheathing.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Recycled Content:
a. Engineered Wood Products:
1) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
3) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
4) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

b. Salvaged Lumber: Provide documentation certifying products are from salvaged lumber sources.
c. Recovered Lumber: Provide documentation certifying products are from recovered lumber sources.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. VOC data:
a. Adhesives:

1) Submit manufacturer's product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
2) Submit Green Seal Certification to GS-36 and description of the basis for certification.

b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products **are third-party certified as meeting ANSI standard requirements for formaldehyde emissions.**
1) ANSI A208.1 – 1999, Particleboard
2) ANSI A208.2 – 2002, Medium Density Fiberboard (MDF) for Interior Applications

B. Letter of Certification(s) for Sustainable Forestry:
1. Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
a. Submit FSC certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the FSC certification numbers.
2. Sustainable Forestry Board: Provide letter of certification signed by lumber supplier. Indicate compliance with the Sustainable Forestry Board's "Sustainable Forestry Initiative" (SFI) and identify certifying organization.
a. Submit SFI certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the SFI certification numbers.
3. Canadian Standards Association (CSA): Provide letter of certification signed by lumber supplier. Indicate compliance with the CSA and identify certifying organization.
a. Submit CSA certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the CSA certification numbers.

1.3 QUALITY ASSURANCE

A. Sustainably Harvested Wood: Certification Organizations shall be accredited by the **Forest Stewardship Council**.

B. Recycled Content Materials: Where recycled lumber materials are used for structural applications, include lumber certification and quality grading.

C. Engineered Wood Products:
1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
2. Determine Volatile Organic Compounds VOC), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:
1. Resource Management:

a. Virgin Lumber: **Lumber fabricated from old growth timber is not permitted.** Provide sustainably harvested; certified or labeled in accordance with **FSC** guidelines.

b. Salvaged Lumber: Lumber from deconstruction or demolition of existing buildings or structures. Unless otherwise noted, salvaged lumber shall be delivered clean, denailed, and free of paint and finish materials, and other contamination.

c. Recovered Lumber: Previously harvested lumber pulled from riverbeds or otherwise abandoned. Unless otherwise noted, recovered lumber shall be delivered clean and free of contamination.

B. Engineered Wood Products:

1. Toxicity/IEQ:

a. Products shall contain no added urea-formaldehyde.

b. shall comply with ICC ES ESR-1387

2. Acceptable Products

a. iLevel Parallam PSL (size varies – see drawings and structural) trademark of Weyerhaeuser

http://www.ilevel.com/

b. iLevel TJI 560 @ 11 7/8" by Weyerhaeuser

http://www.ilevel.com/

2.2 ACCESSORIES

A. Adhesive:

1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, GS-36 for Commercial Adhesive, and as specified.

B. Fasteners:

1. Recycled Content: Fabricated from 100 percent re-melted steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering.

3.X SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:

1. Temporary ventilation: Provide temporary ventilation during work of this Section.

a. During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

B. Waste Management: As specified in Section 01 74 19 (01351) – Construction Waste Management and as follows:

1. Select lumber sizes to minimize waste; reuse scrap lumber to the greatest extent possible. Clearly separate scrap lumber for use on site as accessory components, including: shims, bracing, and blocking.

2. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.
3. Do not burn scrap lumber that has been pressure treated.
   a. Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

END OF SECTION

SECTION 06120 -STRUCTURAL INSULATED PANELS

GENERAL

1.01 SUMMARY

A. Section Includes: Structural Insulated Panels (SIPs).

B. Related Sections: Section(s) related to this section include:

1. Section 06 10 00 Rough Carpentry
2. Section 06 09 00 Wood and Plastics Fastenings

1.02 SYSTEM DESCRIPTION

Structural Insulated Panels (SIPs) consist of oriented strand board (OSB) laminated with structural adhesives to a termite resistant EPS insulation core, a EPA registered treatment for mold, mildew, and termites, and SIP Manufacturer supplied connecting splines, sealants, and SIP screws.

1.03 REFERENCES

A. ACSE 7 - Minimum Loads for Buildings and other Structures.

B. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

C. DOC PS2 – Performance Standard for Wood-based Structural-Use Panels.

D. ICC ES AC04 – Acceptance Criteria for Sandwich Panels.

E. ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives.

F. ICC ES AC12 – Acceptance Criteria for Foam Plastic Insulation.

G. ICC ES EG239 – Evaluation Guideline for Termite-Resistant Foam Plastics.

H. AWPA E1 - Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites.

I. AWPA E12- Standard Method of Determining Corrosion of Metal in Contact with Treated Wood.

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.

K. EPA - Registered products listing.

L. Greenguard Environmental Institute (GEI) - Standard for Low-Emitting Products.

1.04 DESIGN REQUIREMENTS

A. Provide SIPs which have been manufactured, fabricated and installed to withstand loads [Specify code/standard reference.] and to maintain [Specify performance criteria.] performance criteria stated by SIP manufacturer without defects, damage or failure.

1.05 SUBMITTALS

A. Product Data: Submit product data for specified products.

1. SIP Code Compliance: Provide ICC ES code report for SIP with evidence of compliance with code requirements as an alternate method of construction. Submit current compliance report number from ICC ES showing conformance to the International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC04 (Sandwich Panels) dated May 2006.
2. EPS Code Compliance: Provide ICC ES code report for EPS foam with evidence of

compliance with code. Submit current compliance report numbers from ICC ES with conformance to the International Building Code (IBC) and International Residential Code (IRC). Code report shall include compliance with ICC ES AC12 (Foam Plastic) dated June 2006 and ICC ES EG239 (Termite-Resistance) dated November 2003.

3. Manufacturer's Instructions: SIP Manufacturer's construction detail book and load design charts.

B. Calculations: Provide structural calculations by a registered architect or professional engineer [in the state of] qualified to perform such work.

C. Shop Drawings: Submit shop drawings for SIPs showing layout, elevations, product components and accessories.

D. Quality Assurance Submittals: Submit the following:

1. Certificate: Product certificate showing compliance to Third Party Quality Control program of Underwriters Laboratories, Inc.

E. Fire Resistant Assemblies: UL construction number for each fire-rated assembly

F. Warranty: Warranty documents specified herein.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.

B. Source Limitations: Obtain all SIPs through one source. All accessories to be as furnished or recommended by the SIP manufacturer.

1.07 Regulatory Requirements:

A. SIPs shall be recognized for compliance with [International Building Code, International Residential Code, or specify] in a current ICC ES evaluation report

B. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, foundation/structural system/substrate conditions, SIP manufacturer's installation instructions and SIP manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.

1.08 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with SIP manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials from SIP manufacturer with identification labels or markings intact.

C. Off-load SIPs from truck and handle using fork lift or other means to prevent damage to SIPs.

D. SIPs shall be fully supported in storage and prevented from contact with the ground. Stack SIPs on pallets or a minimum of three stickers for every 8 feet of SIP length.

E. SIPs shall be fully protected from weather. Protect against exposure to rain, water, dirt, mud, and other residue that may affect SIP performance. Cover stored SIPs with breathable protective wraps. SIPs shall be stored in a protected area.

1.09 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit SIP manufacturer's standard warranty document. SIP Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: [Specify term.] years commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 Manufacturers/Suppliers:

A. ~~ACH Foam Technologies, LLC, 5250 North Sherman St., Denver, CO 80216~~

B. ~~ACH Foam Technologies, LLC, 111 W. Fireclay Ave., Murray, UT 84107~~

C. ~~ACH Foam Technologies, LLC, 775 Waltham Way, Suite 105, McCarran NV 89434~~

D. ACH Foam Technologies, LLC, 90 Trowbridge Drive, Fond du Lac, WI 54936-0660

E. ~~ACH Foam Technologies, LLC, 4001 Kaw Drive, Kansas City, KS 66102~~

F. ~~ACH Foam Technologies, LLC, 1418 Cow Palace Road, Newton, KS 67114~~

G. ~~ACH Foam Technologies, LLC, 809 East 15th Street, Washington, IA 52353~~

H. ~~ACH Foam Technologies, LLC, 3751 Sunset Avenue, Waukegan, IL 60087~~

I. ~~ACH Foam Technologies, LLC, 2731 White Sulphur Road, Gainesville, GA 30503~~

J. ~~ACH Foam Technologies, LLC, Maquiladoras #331 Interior A y B, Cd. Industrials Nueva Tijuana, Tijuana, BC, Mexico 25000~~

2.02 Materials

A. SIPs consisting of the following:

1. UL certified EPS core with Perform Guard treatment, minimum of 0.95 pcf (15.2 kg/m^3) complying with ASTM C578 Type I and having ICC ES recognition of termite resistance. Insulation manufacturer shall provide Third Party UL certificate. ICC ES report shall be provided for recognition of termite resistance in compliance with ICC EG239.
2. OSB identified with APA or PFS performance mark with Exposure I durability rating and performance in accordance with DOC PS-2 span rating 24/16 or greater.
3. Adhesives shall be in conformance with ICC ES AC05 – Acceptance Criteria for Sandwich Panel Adhesives
4. FrameGuard treatment for mold, mildew, and termite resistance meeting the following requirements:
    a. Registered with EPA.
    b. Indoor Air Quality Certified under GEI Standard for Low-Emitting Products.
    c. Mold growth: 0 rating, tested to ASTM D3273 for 8 weeks at 77 degrees F and 100 percent relative humidity.
    d. Termite resistance: Minimum rating of 7.0, tested to AWPA E-1.
    e. Corrosion potential for metals in contact with treated wood: Maximum 2 mils per year, tested to AWPA E12 for minimum of 60 days on aluminum 2024, carbon steel, hot-dip galvanized steel, and G90 galvanized steel.
    f. Equivalent lateral resistance and tooth holding capacity as untreated wood.

2.03 Accessories

A. Splines: OSB, block splines, or I-beam for use in joining SIPs shall be supplied by SIPs manufacturer.

B. Fasteners: corrosion resistant SIP screws compatible with SIP system shall be provided by the SIPs manufacturer.

1. Wood Screws for attachment to wood members
2. Heavy Duty Metal Screws for attachment to metal members (16 gauge to 3/16")
3. Light Duty Metal Screws for attachment to metal decks (18 gauge or thinner)

C. SIP Sealant: Shall be specifically designed for use with SIPs. Sealant must be compatible with all components of the SIP. Sealant shall be provided by the SIP manufacturer.

D. Dimensional Lumber: SPF, #2 or better, or engineered equivalent unless otherwise required by structural drawings.

E. Vapor Barrier SIP Tape: 40 mil thick, butyl adhesive suitable for indoor use, min. 6 inch wide for use on SIP joints as specified by designer. SIP Tape shall be supplied by the SIP manufacturer.

2.04 Fabrication

A. Sizes: SIPs shall be fabricated in accordance with approved Shop Drawings

B. Thermal Resistance, R-value

Note to Specifier Select the R-value as required for each area of construction.

1. ~~4 1/2" (114 mm) thick SIP with R-value of 15 at 75°F (16 at 40°F)~~
2. ~~6 1/2" (165 mm) thick SIP with R-value of 23 at 75°F (24 at 40°F)~~
3. ~~8 1/4" (210 mm) thick SIP with R-value of 29 at 75°F (32 at 40°F)~~
4. 10 1/4" (260 mm) thick SIP with R-value of 37 at 75°F (40 at 40°F)
5. ~~12 1/4" (311 mm) thick SIP with R-value of 45 at 75°F (48 at 40°F)~~

2.05 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted without fourteen day (14) prior approval.

2.06 RELATED MATERIALS

A. Related Materials: Refer to other sections for related materials as follows:

1. Dimensional Lumber: SPF #2 or better or pre-engineered equivalent: Refer to Division 6 Carpentry Sections.

2.07 SOURCE QUALITY

A. Source Quality Assurance: Each SIP component required shall be supplied by SIP manufacturer and shall be obtained from selected SIP manufacturer or its approved supplier.

1. Each SIP shall be labeled indicating UL Third Party certification.
2. Provide evidence of UL Third Party inspection and labeling of all insulation used in manufacture of SIPs.
3. SIP manufacturer shall provide Lamination, R-Value and mold/mildew/termite resistance warranty documents for building owner acceptance and execution. Manufacturer's standard forms will be submitted.
4. Provide SIPs with Perform Guard treated EPS for termite resistance. Treatment shall be EPA registered with treatment efficacy substantiated by independent research and ongoing in-plant testing.
5. Provide SIPs with FrameGuard treatment for mold. Mildew, and termite resistance. Treatment shall be EPA registered with treatment efficacy substantiated by independent research and ongoing in-plant testing.
6. Dimensional Tolerance - shall comply with values listed in the manufacturer's Quality

Control Manual.

B. Source Quality: Obtain SIPs from a single manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's ICC ES report, Load Design Charts, Detail Book, Shop Drawings, and product data, including product technical bulletins, for installation.

B. Plans shall be reviewed by a qualified architect/engineer and shall be signed and/or sealed. Deviations from standard detail and load design values shall be calculated and signed and/or sealed by a qualified architect/engineer.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

1. Verify conditions of foundation/structural system/substrate and other conditions which affect installation of SIPs. Any adverse conditions shall be reported in writing. Do not proceed with installation until adverse conditions are corrected.

3.03 INSTALLATION

A. SIP Installation:

Note to Specifier Complete installation recommendations are available from the manufacturer. SIP weight and contractor preference will dictate the erection method used. The use of a crane or lift truck may be required for SIP placement. Consult with SIP manufacturer for recommended handling methods. Supplementary lifting clamps and attachments to be provided by the contractor.

1. SIP Supports: Provide level and square foundation/structural system/substrate that support wall and/or roof SIPs. For wall SIPs, hold sill plate back from edge of rim board 7/16" (11 mm) to allow full bearing of OSB skins. Provide 1 1/2" (38 mm) diameter access holes in plating to align with electrical wire chases in SIPs. Provide adequate bracing of SIPs during erection. Remove debris from plate area prior to SIP placement.

2. SIP Fastening: Connect SIPs by nails or staples as shown on drawings. Screws of equal strength may be substituted for nails and staples as specified by engineer. SIP sealant must be used together with each fastening techniques. Where SIP Screw Fasteners are used, provide a minimum of 1" (25.4 mm) penetration into support. Join SIPs using plates and splines. Secure attachment with nails, staples, or screws, and SIP sealant. Apply SIP sealant following SIP manufacturer recommendations.

3. SIP Tape: Provide SIP Tape at joints between SIP roof panels and at intersection of SIP roof and wall.

4. Vapor Retarders: Provide vapor retarders mandated by building code. Provide a vapor retarder, such as 6 mil (0.006") (0.15 mm) polyethylene on SIP applications which are connected using methods other than surface splines.

5. Thermal Barriers: Interior surfaces of SIPs shall be finished with a minimum 15-minute thermal barrier, such as 1/4" (4 mm) gypsum wallboard, nominal 1" (25 mm) wood paneling, or other approved materials. Apply code approved thermal barriers according to SIP manufacturer's recommendations.

6. Restrictions: Do not install SIPs directly on concrete. Do not put plumbing in SIPs without consulting SIP manufacturer. Do not overcut skins for field-cut openings and do not cut skins for electrical chases. SIPs shall be protected from exposure to solvents and their vapors that damage the EPS foam core.

7. Remove and replace insulated wall or roof SIPs which have become excessively wet or damaged before proceeding with installation of additional SIPs or other work.

3.04 FIELD QUALITY REQUIREMENTS

A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

1. Site Visits: [Specify number and duration of periodic site visits.].

3.05 PROTECTION

A. Protection: Protect installed product and finish surfaces from damage during construction.

1. Roof SIPs: Protect roof SIPs from weather by roofing materials to provide temporary protection at the end of the day or when rain or snow is imminent.
2. After installation, cover SIPs to prevent contact with water on each exposed SIP edges and faces.

END OF SECTION

SECTION 06130 - HEAVY TIMBERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heavy Timber for use in structural platform framing.

1.2 RELATED SECTIONS

A. Section 06110 - Wood Framing: Lumber Used in Structural Framing.

B. Section 06150 - Wood Decking: Lumber Used in Flooring and Decking.

C. Section 06200 - Finish Carpentry: Lumber Used in Trim and Casing.

1.3 REFERENCES

A. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. WCLIB - West Coast Lumber Inspection Bureau.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Coordinate products listed in this section with Contract Drawings.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) in length, representing actual product and finish.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All products listed in this section will be provided by a single manufacturer with at least ten (10) years experience in the preparation of Heavy Timber.

B. Material Quality: All materials listed in this section will fall within the tolerances and characteristics described.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within

limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Forest Grove Lumber Company, which is located at: 2700 Orchard Ave. ; McMinnville, OR 97128; Toll Free Tel: 800-647-9663; Tel: 503-472-3195; Fax: 503-434-5805; Email: request info; Web: www.fglco.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 TRU-DRY KILN DRIED DOUGLAS FIR - SELECT STRUCTURAL

A. Visual Characteristics:
1. Stained Sapwood: Allowed.
2. Firm Heart Stain: 10 percent of width equivalent.
3. Seasoning Checks on Wide Faces: Limited; typically to one face.
4. Seasoning Checks at Ends: Single or opposite each other, are limited to a sum total of 1/4 the thickness.
5. Splits: Approximately 1/2 the width or equivalent of end checks.
6. Pin Holes: Max 1/16 (1.6mm) Diameter, limited.
7. Pitch Streaks: Allowed.
8. Pitch Pockets: Medium.
   a. 1/16 inch (1.6mm) In Width and 12 inches (305mm) In Length.
   b. 1/8 inch (3mm) In Width and 8 inches (203mm) In Length.
   c. 3/8 inch (9.5mm) In Width and 4 inches (152mm) In Length.
9. Wane: Not Allowed.

B. Structural Characteristics:
1. Shake On The Faces: Light, 1/32 inch (0.8mm) width.
2. Shake, Through the Ends: 1/6 the thickness at end.
3. Grain: Medium - 4 or more annual rings per inch at either end of the piece.
4. Slope Of Grain - Middle Third: Not to exceed 1 in 15 slope.
5. Slope Of Grain - Outside Thirds: Not to exceed 1 in 12 slope.
6. Crook: Minimized.
7. Twist: Minimized.
8. Cup: Minimized.
9. Bow: Minimized.
10. Free of Heart Center.
11. Knots: Sound, tight and well spaced.

C. Manufacturing Characteristics:
1. Moisture Content: Average 19 percent or less, to the core of each piece. Dried in amplifier based Radio Frequency Vacuum Kilns.
2. Skips: Occasional, Less than 10 percent of the pieces, 1/8 inch (3mm) x 24 inches (610mm) or equivalent.
3. Surfaced Thickness Tolerance: +/- 1/16 inch (1.6mm).
4. Surfaced Tolerance: +/- 1/16 inch (1.6mm).
5. Length Tolerance: At Least.
6. Torn Grain: Heavy, Not to exceed 1/8 inch (3mm) deep.

D. Surfacing:
1. Mill Rough: Rough-sawn surface direct from the mill.
2. S4S: Surfaced on 4 sides.
3. Accuruff: Re-sawn texture. Rough-sawn texture on surfaced Heavy Timber and timbers. Applied to surfaced lumber, ensuring accurate sizing, consistency and dimension. 1/16 inch is removed from each face and is applied to all textured sides simultaneously to ensure consistent texture.
4. Circle Sawn: Textured surface attained from a large circular mill saw.
5. Hand Hewn: Antique texture traditionally created by hand shaping timbers to a rough squared surface with an adze.

2.3 TRU-DRY KILN DRIED DOUGLAS FIR - NO. 1 STRUCTURAL AND BETTER

A. Visual Characteristics:
1. Stained Sapwood: Allowed.
2. Firm Heart Stain: Allowed.
3. Seasoning Checks on Wide Faces: Limited; typically to one face.
4. Seasoning Checks at Ends: Single or opposite each other, are limited to A sum total of 1/4 the thickness.
5. Splits: Approximately equal to the width or equivalent of end checks.
6. Pin Holes: Max 1/16 (1.6mm) Diameter, Limited.
7. Pitch Streaks: Allowed.
8. Pitch Pockets: Allowed
9. Wane: Not Allowed

B. Structural Characteristics:
1. Shake On The Faces: Light, 1/32 inch (0.8mm) width.
2. Shake, Through the Ends: 1/6 the thickness at end.
3. Grain: Medium - 4 or more annual rings per inch at either end of the piece.
4. Slope Of Grain - Middle Third: Not to exceed 1 in 15 slope.
5. Slope Of Grain - Outside Thirds: Not to exceed 1 in 12 slope.
6. Crook: Minimized.
7. Twist: Minimized.
8. Cup: Minimized.
9. Bow: Minimized.
10. Free of Heart Center.
11. Knots: Sound, tight and well spaced.

C. Manufacturing Characteristics:
1. Moisture Content: Average 19 percent or less, evenly to the core of each piece. Dried in amplifier based Radio Frequency Vacuum Kilns.
2. Skips: Occasional, Less than 10 percent of the pieces, 1/8 inch (3mm) x 24 inches (610mm) or equivalent.
3. Surfaced Thickness Tolerance: +/- 1/16 inch (1.6mm).
4. Surfaced Tolerance: +/- 1/16 inch (1.6mm).
5. Length Tolerance: At Least.
6. Torn Grain: Heavy, Not to exceed 1/8 inch (3mm) deep

D. Surfacing:
1. Mill Rough: Rough, un-sanded surface direct from the mill.
2. S4S: Surfaced on 4 sides.
3. Accuruff: Re-sawn texture. Rough-sawn texture on surfaced dimensional lumber and timbers. Applied to surfaced lumber, ensuring accurate sizing, consistency and dimension. 1/16 inch is removed from each face and is applied to all textured sides simultaneously to ensure consistent texture.

4. Circle Sawn: Textured surface attained from a large circular mill saw.
5. Hand Hewn: Antique texture traditionally created by hand shaping timbers to a rough squared surface with an adze.

E. Sizing: As listed in the Lumber Schedules within the Contract Documents.

2.4 MILLING AND PLANING

A. Corbels: Mill produced decorative support members.
1. Material / Surfacing: As specified in this section.
2. Size: As shown on Contract Drawings.
3. Pattern: To be selected by architect from available stock patterns.
4. Pattern: FGL-___.

B. Custom Shapes: Custom Patterns to be provided by the Architect and sawn within tolerances set by Forest Grove Lumber.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install all materials in accordance with local building codes.

B. Coordinate structural framing installation methods with Section 06110.

C. Coordinate heavy timber installation methods with Section 06130.

D. Coordinate timber framing installation methods with Section 06139.

E. Coordinate flooring and decking installation methods with Section 06150.

F. Coordinate interior trim and casing installation methods with Section 06200.

G. Coordinate exterior finish carpentry installation methods with Section 06201.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06150 - WOOD DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wood decking.

B. Sloped wood decking.

1.2 RELATED SECTIONS

A. Section 05090 - Metal Fastenings.

B. Section 06174 - Wood Joists.

C. Section 06175 - Wood Trusses.

1.3 REFERENCES

A. ANSI/AITC A190.1 - Standard for Dimensions of Structural Glued Laminated timber.

B. ASTM D 2559 - Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Technical data indicating compliance with specifications and standards.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Certification: Submit certification that the decking size specified will meet the specified design wind pressure and snow loads.

D. Selection Samples: For each finish product specified, two complete sets of finish samples of the manufacturer's standard stain colors on the specified species and with the specified pattern, size, texture, and finish.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in providing products of the type specified in this section, with minimum of 5 years documented experience with products in use.

1.6 PERFOMANCE REQUIREMENTS

A. Design Wind Pressure: As indicated on the Drawings.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within

limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURE Source

A. All usable wood material donated form the Aldo Leopold Center and is sustainably harvested and milled with no disposable waste.

B. Substitutions: Not permitted.

2.2 MATERIALS

A. Decking:
1. Species: American Black Walnut
2. Grade: Decorative.
3. Pattern: Square Edge.
4. Ends: Square end.
5. Random Length Continuous Spans: 6' to 16', shipped in multiples of 1 foot and 1 inch short of nominal.
6. Specified Lengths:
   a. Decking Length A: 10’
   b. Decking Length B: 12’
   c. Decking Length C:
7. Nominal Size: 2x6.
8. Nominal Size: 2x8.

9. Surface Texture: Smooth Surfaced.
10. Surface Texture: Smooth Sanded.
11. Moisture Content: 10% to 12% average, maximum 15%.
12. Quality Control: Manufactured to Owners Approval
13. Factory Finish - Stain: One coat of factory-applied, oven-dried acrylic, semi-transparent stain with mildewcide/fungicide.
   a. Color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install deck with tongue up on all sloped surfaces.

3.4 PROTECTION

A. Store material on jobsite on blocking which raises material at least 6 inches above the ground. Cover material with vapor barrier with at least 2 inch air space for ventilation.

B. Protect installed products until completion of project. Cover decking with a single layer of roofing felt, lapped 4 inches minimum, immediately after installation.
   1. Use 15 pound felt for slopes 2:12 to 6:12.
   2. Use 30 pound felt for slopes over 6:12.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06160 – SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Sheathing.

B. Related Sections:
1. 06 05 73 (06070) - Wood Treatment.
2. 06 10 00 (06100) – Rough Carpentry.
3. 06 20 00 (06200) – Finish Carpentry.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:
1. Recycled Content:
a. Engineered Wood Products:
1) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
3) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
4) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

b. Salvaged Lumber: Provide documentation certifying products are from salvaged lumber sources.
c. Recovered Lumber: Provide documentation certifying products are from recovered lumber sources.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. VOC data:
a. Adhesives:

1) Submit manufacturer's product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
2) Submit Green Seal Certification to GS-36 and description of the basis for certification.

b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products **are third-party certified as meeting ANSI standard requirements for formaldehyde emissions.**
1) ANSI A208.1 – 1999, Particleboard
2) ANSI A208.2 – 2002, Medium Density Fiberboard (MDF) for Interior Applications

B. Letter of Certification(s) for Sustainable Forestry:
1. Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
a. Submit FSC certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the FSC certification numbers.
2. Sustainable Forestry Board: Provide letter of certification signed by lumber supplier. Indicate compliance with the Sustainable Forestry Board's "Sustainable Forestry Initiative" (SFI) and identify certifying organization.
a. Submit SFI certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the SFI certification numbers.
3. Canadian Standards Association (CSA): Provide letter of certification signed by lumber supplier. Indicate compliance with the CSA and identify certifying organization.
a. Submit CSA certification numbers; identify each certified product on a line-item basis.
b. Submit copies of invoices bearing the CSA certification numbers.

1.3 QUALITY ASSURANCE

A. Sustainably Harvested Wood: Certification Organizations shall be accredited by the **Forest Stewardship Council**.

B. Recycled Content Materials: Where recycled lumber materials are used for structural applications, include lumber certification and quality grading.

C. Engineered Wood Products:
1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
2. Determine Volatile Organic Compounds VOC), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.

PART 2 - PRODUCTS

2.1 SHEATHING MATERIALS

A. Engineered Wood Products:
1. Toxicity/IEQ:
a. Products shall contain no added urea-formaldehyde.

B. Plywood, APA: Provide exterior grade particleboard with phenol resin for interior and exterior applications.

C. Oriented Strand Board: Phenolic-glued, low-formaldehyde board.

D. Fiberboard:
1. Recycled content:
a. Structural: Minmum **80** percent recycled content.
b. Non-Structural: Minimum **100** percent post-consumer recycled content.

E. Cellulose Honeycomb Panels: Panels shall be made of **Kraft paper and shall be impregnated with phenolic resins for moisture resistance.**
1. Recycled content: Minimum 100 percent post-consumer recycled content.

F. Particleboard: Compressed wood fibers with phenol formaldehyde resin binder.

2.2 ACCESSORIES

A. Adhesives: As specified in Section 06 10 00 (06100) – Rough Carpentry.

B. Fasteners: As specified in Section 06 10 00 (06100) – Rough Carpentry.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

A. As specified in Divisions 01 (1) and Section 06 10 00 (06100) – Rough Carpentry.

END OF SECTION

SECTION 06200 – FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Exterior Millwork, including: standing and running trim.
2. Interior Millwork, including: standing and running trim, cabinets and countertops.

B. Related Sections:
1. 06 05 73 (06070) - Wood Treatment.
2. 06 10 00 (06100) – Rough Carpentry.
3. 06 16 00 (06160) – Sheathing.
4. 06 90 00 (06700) – Alternative Agricultural Products.
5. 09 65 16.13 (09654) – Linoleum.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:
1. Recycled Content:
a. Engineered Wood Products:
1) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
3) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
4) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

b. Salvaged Lumber: Provide documentation certifying products are from salvaged lumber sources.
c. Recovered Lumber: Provide documentation certifying products are from recovered lumber sources.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. VOC data:
   a. Adhesives:
      1) Submit manufacturer's product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
      2) Submit Green Seal Certification to GS-36 and description of the basis for certification.

   b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products **are third-party certified as meeting ANSI standard requirements for formaldehyde emissions.**
      1) ANSI A208.1 – 1999, Particleboard
      2) ANSI A208.2 – 2002, Medium Density Fiberboard (MDF) for Interior Applications

B. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

C. Letter of Certification(s) for Sustainable Forestry:
   1. Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
      a. Submit FSC certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the FSC certification numbers.
   2. Sustainable Forestry Board: Provide letter of certification signed by lumber supplier. Indicate compliance with the Sustainable Forestry Board's "Sustainable Forestry Initiative" (SFI) and identify certifying organization.
      a. Submit SFI certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the SFI certification numbers.
   3. Canadian Standards Association (CSA): Provide letter of certification signed by lumber supplier. Indicate compliance with the CSA and identify certifying organization.
      a. Submit CSA certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the CSA certification numbers.

1.3 QUALITY ASSURANCE

A. Sustainably Harvested Wood: Certification Organizations shall be accredited by the **Forest Stewardship Council**.

B. Recycled Content Materials: Where recycled lumber materials are used for structural applications, include lumber certification and quality grading.

C. Engineered Wood Products:
   1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
   2. Determine Volatile Organic Compounds VOC), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: As specified in Section 06 10 00 (06100) – Rough Carpentry and Section 06 05 73 (06070) – Wood Treatment.
1. Finger Jointed Lumber:

1. Recycled Content: Minimum **10** percent post-consumer recycled content, or minimum **20** percent pre-consumer recycled content at contractor's option.

B. Sheathing and Panel Products: As specified in Section 06 16 00 (06160) - Sheathing.
1. Sustainable Hardwood Wood Veneer Plywood: **3/4** inch thick veneer panels made from certified sustainably harvested lumber veneer, over a formaldehyde-free substrate.

C. Alternative Agricultural Products: As specified in Section 06 90 00 (06700) – Alternative Agricultural Products.
1. Strawboard Panels.
2. Biocomposite Panels. Color and style as selected by Architect from manufacturer's standards.

D. Linoleum: As specified in Section 09 65 16.13 (09654) - Linoleum.

E. Glass-Cement Composite: Material shall be polished and sealed. Color and style as selected by Architect from manufacturer's standards.
1. Recycled Content: Minimum **10** percent post-consumer recycled content, or minimum **20** percent pre-consumer recycled content at contractor's option.

2.2 ACCESSORIES

A. As specified in Section 06 10 00 (06100) – Rough Carpentry.

B. Plastic Fabrications: As specified in Section 06 60 00 (06600) – Plastic Fabrications.

2.3 FABRICATION

A. Exterior Millwork:
1. Fascia, Trim, Trellis, Fence, Lattice and miscellaneous millwork:
a. Dimensional lumber **of rot resistant species.**

B. Interior Millwork:
1. Base, casing, trim, interior rail and wall caps and miscellaneous millwork: Select from the following, unless otherwise indicated:
a. Hardwood derived from certified sustainable sources.
b. Salvaged lumber.
c. Finger jointed pine or any western softwood species.
d. Low-emission Medium Density Fiberboard.
2. Veneer panels:
a. Substrate: Select from the following, unless otherwise indicated:
1) Cellulose honeycomb core.
2) Medium Density Fiberboard.
3) Compressed straw particleboard.
3. Veneer:
a. Veneer: Select from the following, unless otherwise indicated:
1) Certified sustainably harvested lumber.

2) Biocomposite.

4. Countertops:
   a. Biocomposite.
   b. Linoleum.
   c. Glass-cement composite.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

A. As specified in Section 06 10 00 (06100) – Rough Carpentry.

END OF SECTION

SECTION 06290 - PLYBOO

PART 1–GENERAL

1.01 SUMMARY

A. Section Includes:

B. Plyboo will be used for all the faces of the cabinetry in the base area of the kitchen. This section describes the quality and precautions used in the construction of the visible panels. SEE RELATED SECTION for more information on cabinetry

1.Species

2. Thickness

3. Banding and accessories

C. Related Sections:
A. Section 12356 – Kitchen Casework

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

ASTM D 1037, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.

ASTM D 3043 Standard Test Methods for Flexural Structural Panels in Flexure

ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials.

ASTM D 4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

ASTM D 3500, Standard Test Method for Structural Panels in Tension

ASTM E 1333, Standard Test Method for Determining Formaldehyde Concentrations in Air Emission Rates from Wood Using a Large Chamber

B. American National Standards Institute/Hardwood Plywood and Veneer Association (ANSI/HPVA): American National Standard for Hardwood and Decorative Plywood, HP-1.

1.03 SUBMITTALS

A. Product Data:
1. Bamboo plywood manufacturer's product data.

2. Compare and verify shop drawings with interior elevations, plans, and casework details

1.07 WARRANTY

A. A Special Warranty for Smith & Fong Plyboo Products referenced at www.plyboo.com

PART 2–PRODUCTS

2.01 MATERIALS

A. Bamboo Plywood:

MANUFACTURER: SMITH & FONG COMPANY, SAN FRANCISCO, CA.
Tel: (866) 835-9859.
http://www.plyboo.com/

1. Species: Moso (Phyllostachys Pubescens). Fire Resistance Classification:

2. [Class A] [Class C]. Test surface burning characteristics in accordance with ASTM E 84.
Type:
1/2 inch thick, 3-ply, Neopolitan.
A. 1/4 inch thick, 3-ply, Neopolitan.

3. Physical/Mechanical Properties:
ASTM D 3043 Method D Flexural Strength (MOE/MOR)
B. ¾ inch thick 3-ply Cross Core: 148 MOE/9,109 MOR average
A. ASTM D 1037 Screw Hold
i. ¾ inch thick 1-ply Edge Grain
a) Face: 261 pounds average
b) Back: 233 pounds average
c) Edge 1: 513 pounds average
d) Edge 2: 636 pounds average
ii. ¾ inch thick 3-ply Cross Core
a) Face: 1009 pounds average
b) Back: 681 pounds average
c) Edge 1: 361 pounds average
d) Edge 2: 670 pounds average
iii. ¾ inch thick Cross Core Strand
a) Face: 742 pounds average
b) Back: 831 pounds average
c) Edge 1: 980 pounds average
d) Edge 2: 759 pounds average
B. ASTM D 4442 Method A Moisture Content
i. ¾ inch thick1-ply Edge Grain: 4.9 percent average
ii. ¾ inch thick 3-ply Cross Core: 5.7 percent average
iii. ¾ inch thick Cross Core Strand: 4.4 percent average
C. ASTM D 1037 Tensile Strength Parallel
i. ¾ inch thick 1-ply Edge Grain: Load 1700 pounds, Strength 7535 psi average
ii. ¾ inch thick 3-ply Cross Core: Load 892 pounds, Strength 3547 psi average
iii. ¾ inch thick Cross Core Strand: Load 1732 pounds, Strength 5968 psi average
D. ASTM D 3500 Tensile Strength Perpendicular
i. ¾ inch thick 1-ply Edge Grain: Load 642 pounds, Strength 428 psi average

ii. ¾ inch thick 3-ply Cross Core: Load 1536 pounds, Strength 1024 psi average
iii. ¾ inch thick Cross Core Strand: Load 1591 pounds, Strength 1061 psi average
E. ASTM D 1037 Dimensional Stability at 20% RH
i. ¾ inch thick 1-ply Edge Grain
a) Linear Expansion: Parallel –0.04 percent; Perpendicular –0.10 percent average
b) Thickness Swell: -0.13 percent average
ii. ¾ inch thick 3-ply Cross Core
a) Linear Expansion: Parallel –0.09 percent; Perpendicular –0.07 percent
b) Thickness Swell: -0.39 percent
iii. ¾ inch thick Cross Core Strand
a) Linear Expansion: Parallel –0.04 percent, Perpendicular –0.07 percent
b) Thickness Swell: -0.13 percent
F. ASTM E 1333 Formaldehyde Emission
i. ¾ inch thick 1-ply Edge Grain: 0.02 ppm
ii. ¾ inch thick 3-ply Cross Core: 0.02 ppm
iii. ¾ inch thick Cross Core Strand: 0.02 ppm
G. ASTM E 84 Surface Burning
i. ¾ inch thick, 3-ply, edge grain cross core: Class C
ii. ¾ inch thick, 3-ply, edge grain cross core Strand: Class C

B. Accessories

a. Edge Banding, 7/8 inch width by 4 millimeters thick by 72 inches length panel Neopolitan Strand

END OF SECTION

SECTION 06412 - CABINET AND DRAWER HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hinge systems.

B. Drawer runner systems.

1.2 RELATED SECTIONS

A. Section 06410 - Custom cabinets.

B. Section 08810 - Glass.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. [Product Data]: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.4 REFERENCES

A. ANSI/BHMA - Meets Grade 1 requirements for cycle life, static load and self-closing performance.

1.5 QUALITY ASSURANCE

A. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturer: Blum, 1nc., which is located at: 7733 Old Plank Rd., Stanley, NC 28164. Toll Free: 800-438-6788. Phone: 704-827-1345. Fax: 704-827-0799. Web: www.blum.com E-mail: sales.us@blum.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 CONCEALED HINGES

A. Approved Product: Blum Clip Top Concealed Hinges.
1. Part Numbers: _____.
2. Cabinet Construction: Face frame.
3. Cabinet Construction: Panel (frameless).
   a. Overlay.
   b. Partial overlay.
   c. Twin overlay.
   d. Inset.
   e. Inside corner.
   f. Flush door.
   g. Offset door.
4. Hinge Type:
   a. Straight-arm.
   b. Angled.
   c. Half-cranked.
   d. Full-cranked.
   e. Inset blind corner.
   f. Diagonal 45 degree.
   g. Overlay blind corner.
   h. Mini.
   i. Bi-fold.
5. Closing: Self closing.
6. Closing: Free swing.
7. Mounting: Screw-on.

8. Mounting: Inserta, tool free assembly.
9. Angle:
   a. 95 degree, aluminum door hinge.
   b. 95 degree, thick door.
   c. 107 degree.
   d. 86 degree Angle Restriction Clip (reduces 107 degrees to 86 degrees).
   e. 110 degree.
   f. 120 degree.
   g. 120 degree Plus.
   h. 155 degree, zero protrusion.
   i. 170 degree.
   j. 130 degree Angle Restriction Clips (reduces 170 degrees to 130 degrees).
10. Suitable for Door Type:
   a. Thick door - twin.

b. Mitered corner door.
c. Lip door.

11. Hinges per Door:
    a. Two.
    b. Three.
    c. Four.
    d. Five.
12. Cover Caps:
    a. Nylon: Black.
    b. Nylon: Black with Blum logo.
    c. Nylon: White.
    d. Nylon: White with Blum logo.
    e. Nickel plated steel.
    f. Nickel plated steel with Blum logo.
    g. Clip Top Hinge Cup Cover Cap: Nickel plated steel.

B. Approved Product: Blum Clip Top Angled Hinges.
1. Cabinet Construction: Panel (frameless).
    a. Maximum overlay.
    b. Partial overlay.
    c. Corner merge.
    d. Inset door.
    e. Mitered corner.
2. Hinge Type: Angled hinge.
3. Angle:
    a. Plus 15 degree.
    b. Plus 20 degree.
    c. Plus 30 degree II.
    d. Plus 30 degree III.
    e. Plus 45 degree I.
    f. Plus 45 degree II.
    g. Plus 45 degree III.
    h. Minus 15 degree.
    i. Minus 30 degree.
    j. Minus 45 degree.
    k. 95 degree Full-OL.
    l. 95 degree Half-OL.
    m. 95 degree Inset.
4. Closing: Self closing.
5. Dampening System: Self-regulates the closing speed of the hinge.
    a. Approved Product: Blumotion 973A.
    b. Approved Product: Blumotion 970A.
6. Mounting: Inserta, tool free assembly.
7. Hinges per Door:
    a. Two.
    b. Three.
    c. Four.
    d. Five.
8. Cover Caps:
    a. Nylon: Black.
    b. Nylon: Black with Blum logo.
    c. Nylon: White.
    d. Nylon: White with Blum logo.
    e. Nickel plated steel.

f. Nickel plated steel with Blum logo.
g. Clip Top Hinge Cup Cover Cap: Nickel plated steel.

C. Approved Product: Blum Clip Concealed Hinges.
1. Cabinet Construction: Face frame.
2. Cabinet Construction: Panel (frameless).
   a. Overlay.
   b. Partial overlay.
   c. Twin overlay.
   d. Inset.
3. Hinge Type:
   a. Straight-arm.
   b. Angled.
   c. Half-cranked.
   d. Full-cranked.
4. Closing: Self closing.
5. Closing: Free swing.
6. Mounting: Screw-on.
7. Mounting: Press-in.
8. Mounting: Inserta, tool free assembly.
9. Angle:
   a. 100 degree.
   b. 107 degree.
   c. 86 degree Angle Restriction Clip (reduces 107 degrees to 86 degrees).
   d. 170 degree.
   e. 130 degree Angle Restriction Clips (reduces 170 degrees to 130 degrees).
10. Hinges per Door:
   a. Two.
   b. Three.
   c. Four.
   d. Five.
   e. Nylon: Black.
   f. Nylon: Black with Blum logo.
   g. Nylon: White.
   h. Nylon: White with Blum logo.
   i. Nickel plated steel.
   j. Nickel plated steel with Blum logo.
   k.

D. Approved Product: Blum Compact Concealed Hinges.
1. Part Number: Compact 38N.
2. Part Number: Compact 38C.
3. Part Number: Compact 39C.
4. Part Number: Compact 33.
5. Part Number: Compact 38.
6. Cabinet Construction: Face frame.
   a. Full overlay.
   b. Partial overlay.
7. Hinge Type:
   a. One piece.
   b. Two piece.
   c. Wrap around.

d. Edge mount.
e. Face mount.

8. Closing: Self closing.
9. Dampening System: Self-regulates the closing speed of the hinge.
   a. Approved Product: Blumotion 971A.
10. Mounting: Screw-on.
11. Mounting: Press-in.
12. Door Overlay:
    a. 1/4 inch (6.35 mm).
    b. 3/8 inch (9.5 mm).
    c. 7/16 inch (11 mm).
    d. 1/2 inch (12.7 mm).
    e. 5/8 inch (15.9 mm).
    f. 3/4 inch (19 mm).
    g. 1 inch (25.4 mm).
    h. 1-1/8 inch (27.6 mm).
    i. 1-1/4 inch (31.8 mm).
    j. 1-5/16 inch (33 mm).
    k. 1-3/8 inch (35 mm).
    l. 1-1/2 inch (38 mm).
    m. 1-9/16 inch (39.7 mm).
    n. 1-5/8 inch (41.2 mm).
13. Angle:
    a. 105 degree.
    b. 110 degree.
14. Hinges per Door:
    a. Two.
    b. Three.
    c. Four.
    d. Five.
15. Cover Caps:
    a. Nickel plated steel.
    b. Nickel plated steel with custom logo.

2.3 DRAWER RUNNER SYSTEMS

A. Approved Product: Blum Solo; concealed runners for wood drawers.
   1. Part Number: Solo 262H Concealed Drawer Runners, for frame cabinets.
   2. Part Number: Solo 262 Concealed Drawer Runner, for panel cabinets.
   3. Part Number: Solo 262F Concealed Drawer Runner, for frame cabinets.
   4. Runner Type: Partial extension, height compatible with Tandem.
   5. Closing: Self closing.
   6. Mounting: Screw-on.
   7. Drawer Length:
      a. 9 inches (229 mm)
      b. 12 inches (305 mm).
      c. 15 inches (381 mm).
      d. 18 inches (457 mm).
      e. 21 inches (533 mm).
      f. 24 inches (610 mm).
   8. Drawer Thickness:
      a. Up to 5/8 inch (16 mm).
      b. Up to 3/4 inch (19 mm).
   9. Drawer Weight Capacity: 75 pounds dynamic/100 pounds static (34/45 kg).

10. Finish: Epoxy coated steel, cream color.
11. Accessories:
    a. Solo Side Spacer: Part No._____.

B. Approved Product: Blum Standard Drawer Runners.
1. Part Number: Standard 230M Drawer Runners.
2. Part Number: Standard 230E Drawer Runners.
3. Part Number: Standard 430E Drawer Runners.
4. Cabinet Construction: Face frame.
5. Cabinet Construction: Panel (frameless).
6. Runner Type:
    a. Single (partial) extension, bottom mounted, self-closing.
    b. Single (partial) extension, bottom mounted with stay closed detents.
    c. Full extension, bottom mounted with stay closed detents and lockout stops.
7. Mounting: Screw-on.
8. Drawer Length:
    a. 10 inches (254 mm).
    b. 12 inches (305 mm).
    c. 15 inches (381 mm).
    d. 18 inches (457 mm).
    e. 21 inches (533 mm).
    f. 24 inches (610 mm).
    g. 26 inches (660 mm).
    h. 28 inches (711 mm).
    i. 30 inches (762 mm).
    j. 32 inches (813 mm).
9. Drawer Weight Capacity: 75 pounds dynamic/100 pounds static (34/45 kg).
10. Finish: Epoxy coated steel.
11. Accessories:
    a. Rear Mount Sockets: Part No._____.
    b. Cabinet Profile Spacers: Part No._____.
    c. Door Protectors: Part No._____.
12.
13. Dampening System: Self-regulates the closing speed of the hinge.
    a. Approved Product: Blumotion.
14. Mounting: Screw-on.

2.4 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.5 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

2.6 INSTALLATION

A. Install in accordance with manufacturer's instructions.

2.7 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Interior frames and jambs.
3. Stairwork[**and rails**].
4. Flush wood paneling[**and wainscots**].
5. Wood cabinets.
6. Plastic-laminate cabinets.
7. Plastic-laminate countertops.
8. Solid-surfacing-material countertops.
9. Shop finishing of woodwork.

B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

C. Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 06 Section "Rough Carpentry."

1.2 SUBMITTALS

A. Product Data: For [**solid-surfacing material**] [**cabinet hardware and accessories**] [**handrail brackets**] [**and**] [**finishing materials and processes**].

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

C. Samples:

1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
3. Plastic-laminates, for each type, color, pattern, and surface finish.
4. Thermoset decorative panels, for each type, color, pattern, and surface finish.
5. Solid-surfacing materials.

D. LEED Submittals:

1. Product Data for Credit EQ 4.4:

a. For each composite-wood product used, documentation indicating that the bonding agent contains no urea formaldehyde.

b. For each adhesive used, documentation indicating that the adhesive contains no urea formaldehyde.

2. Certificates for Credit MR 7: Chain-of-custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include evidence that mill is certified for chain of custody by an FSC-accredited certification body.

a. Include statement indicating costs for each certified wood product.

E. Woodwork Quality Standard Compliance Certificates: [**AWI Quality Certification Program certificates**] [**WI-certified compliance certificates**].

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of woodwork.

B. Quality Standard: Unless otherwise indicated, comply with [**AWI's "Architectural Woodwork Quality Standards."**] [**WI's "Manual of Millwork."**]

1. Provide AWI Quality Certification Program [**labels**] [**and**] [**certificates**] for woodwork[**, including installation**].
2. Provide WI-certified compliance [**labels**] [**and**] [**certificates**] for woodwork[**, including installation**].

C. Forest Certification: Provide interior architectural woodwork produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

A. Wood Species and Cut for Transparent Finish: [**Red oak, plain sawn or sliced**] [**White oak, rift sawn or cut**] [**White ash, plain sawn or sliced**] [**Hickory, plain sawn or sliced**] <**Insert species and cut**>.

B. Wood Species for Opaque Finish: [**Any closed-grain hardwood**] [**Eastern white pine, sugar pine, or western white pine**] <**Insert species**>.

C. Wood Products:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than <**Insert number**> percent.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade MD[**, made with binder containing no urea formaldehyde**].
4. Particleboard: ANSI A208.1, Grade [**M-2**] [**M-2-Exterior Glue**].
5. Softwood Plywood: DOC PS 1[**, Medium Density Overlay**].
6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1[**, made with adhesive containing no urea formaldehyde**].

D. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABA Industries.
b. Avonite, Inc.
c. E. I. du Pont de Nemours and Company.
d. Formica Corporation.
e. LG Chemical, Ltd.
f. Meganite Inc.; a division of the Pyrochem Group.
g. Nevamar Company, LLC; Decorative Products Div.
h. Samsung; Cheil Industries Inc.
i. Swan Corporation (The).
j. Transolid, Inc.
k. Wilsonart International; Div. of Premark International, Inc.
l. <**Insert manufacturer's name.**>

G. Float Glass for Cabinet Doors: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3, [**3.0 mm**] [**4.0 mm**] [**5.0 mm**] [**6.0 mm**] thick.

H. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3[**, with exposed edges seamed before tempering**], 6 mm thick, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use Exterior Type or Interior Type A. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment.

B. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

C. Fire-Retardant Fiberboard: ANSI A208.2 medium-density fiberboard panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, [**100**] [**135**] [**170**] degrees of opening[**, self-closing**].

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid [**metal**] [**plastic**], [**4 inches (100 mm) long, 5/16 inch (8 mm) in diameter**] [**5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter**].

F. Catches: [**Magnetic catches, BHMA A156.9, B03141**] [**Push-in magnetic catches, BHMA A156.9, B03131**] [**Roller catches, BHMA A156.9, B03071**] [**Ball friction catches, BHMA A156.9, B03013**].

G. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted[**and extending under bottom edge of drawer**]; [**full-extension**] [**partial-extension**] type; [**zinc-plated steel**] [**epoxy-coated steel**] with polymer rollers.
2. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; [**full-extension**] [**full-overtravel-extension**] type; zinc-plated steel ball-bearing slides.
3. Box Drawer Slides: [**Grade 1**] [**Grade 1HD-100**]; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
4. File Drawer Slides: [**Grade 1HD-100**] [**Grade 1HD-200**]; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.

5. Pencil Drawer Slides: [**Grade 2**] [**Grade 1**]; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.

H. [**Plastic**] [**Aluminum**] Slides for Sliding Glass Doors: BHMA A156.9, B07063.

I. Door Locks: BHMA A156.11, E07121.

J. Drawer Locks: BHMA A156.11, E07041.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
4. Satin Stainless Steel: BHMA 630.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, [**fire-retardant-treated,**] kiln-dried to less than 15 percent moisture content.

B. Rough Carriages for Stairs: [**Select Structural**] [**No. 1**] [**No. 2**] grade Douglas fir-larch, hem-fir, or southern pine; kiln dried to 15 percent maximum moisture content:

C. Rough Carriages for Stairs: Laminated veneer lumber, made with an exterior-type adhesive complying with ASTM D 2559, and with the following allowable design values as determined according to ASTM D 5456:

1. Extreme Fiber Stress in Bending, Edgewise: 2500 psi (17.2 MPa) for 12-inch nominal-(286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi (12 400 MPa).

D. Handrail Brackets: [**Cast**] [**Extruded**] [**Stamped**] from [**malleable iron**] [**aluminum**] [**bronze**] [**stainless steel**] with wall flange drilled [**for exposed anchor**] [**and tapped for concealed hanger bolt**] and with support arm for screwing to underside of rail. Sized to provide 1-1/2-inch (38-mm) clearance between handrail and wall.

E. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

1. Interior Woodwork Grade: [**Premium**] [**Custom**] [**Economy**].
2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.
3. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

B. Interior Standing and Running Trim:

1. For transparent-finished trim items wider than available lumber, use veneered construction. Do not glue for width.
2. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
3. Assemble casings in plant except where limitations of access to place of installation require field assembly.

C. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Fire Rating: 20 minutes.

D. Stairwork[**and Rails**]:

1. Treads: [**Transparent**] [**Opaque**] finish.
2. Risers: [**Transparent**] [**Opaque**] finish.
3. Stringers: [**Transparent**] [**Opaque**] finish.
4. Balusters: [**Transparent**] [**Opaque**] finish.
5. Handrails: [**Transparent**] [**Opaque**] finish.
6. Scotia, Cove, and Other Moldings: [**Transparent**] [**Opaque**] finish.

E. Flush Wood Paneling[**and Wainscots**]:

1. Lumber Trim and Edges: At fabricator's option, trim and edges indicated as solid wood (except moldings) may be either lumber or veneered construction compatible with grain and color of veneered panels.
2. Matching of Adjacent Veneer Leaves: [**Book**] [**Slip**] [**Random**] match.
3. Veneer Matching within Panel Face: [**Running**] [**Balance**] [**Center-balance**] match.
4. Panel-Matching Method: No matching between panels is required. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
5. Panel-Matching Method: In each separate area, use [**premanufactured sets used full width**] [**premanufactured sets selectively reduced in width**] [**sequence-matched, uniform-size sets**].
6. Fire-Retardant-Treated Paneling: Provide panels consisting of wood veneer and fire-retardant particleboard or fire-retardant medium-density fiberboard. Panels shall have flame-spread index of [**75**] [**25**] or less and smoke-developed index of 450 or less per ASTM E 84.

F. Wood Cabinets for Transparent Finish:

1. AWI Type of Cabinet Construction: [**Flush overlay**] [**Reveal overlay**] [**Reveal overlay on face frame**] [**Flush inset**] [**Flush inset with face frame**] [**As indicated**].
2. WI Construction Style: Style [**A, Frameless**] [**B, Face Frame**].
3. WI Construction Type: Type [**I, multiple self-supporting units rigidly joined together**] [**II, single-length sections to fit access openings**].
4. WI Door and Drawer Front Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush**].
5. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**] <**Insert dimension**>.
6. Grain Direction: [**Vertically for drawer fronts, doors, and fixed panels**] [**Horizontally for drawer fronts, doors, and fixed panels**] [**As indicated**].
7. Matching of Veneer Leaves: [**Book**] [**Slip**] [**Random**] match.

8. Veneer Matching within Panel Face: [**Running**] [**Balance**] [**Center-balance**] match.
9. Semiexposed Surfaces Other Than Drawer Bodies: [**Same species and cut indicated for exposed surfaces**] [**Thermoset decorative panels**] [**Compatible species to that indicated for exposed surfaces, stained to match**].
10. Drawer Sides and Backs: [**Solid-hardwood lumber, same species indicated for exposed surfaces**] [**Solid-hardwood lumber, stained to match species indicated for exposed surfaces**] [**Solid hardwood lumber**] [**Thermoset decorative panels**].
11. Drawer Bottoms: [**Hardwood plywood**] [**Thermoset decorative panels**].
12. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

G. Wood Cabinets for Opaque Finish:

1. AWI Type of Cabinet Construction: [**Flush overlay**] [**Reveal overlay**] [**Reveal overlay on face frame**] [**Flush inset**] [**Flush inset with face frame**] [**As indicated**].
2. WI Construction Style: Style [**A, Frameless**] [**B, Face Frame**].
3. WI Construction Type: Type [**I, multiple self-supporting units rigidly joined together**] [**II, single-length sections to fit access openings**].
4. WI Door and Drawer Front Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush**].
5. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**]. <**Insert dimension**>
6. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.
7. Panel Product for Exposed Surfaces: Medium-density [**fiberboard**] [**overlay**].
8. Semiexposed Surfaces Other Than Drawer Bodies: [**Match materials indicated for exposed surfaces**] [**Thermoset decorative panels**].
9. Drawer Sides and Backs: [**Solid-hardwood lumber**] [**Thermoset decorative panels**].
10. Drawer Bottoms: [**Hardwood plywood**] [**Thermoset decorative panels**].
11. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

H. Plastic-Laminate Cabinets:

1. AWI Type of Cabinet Construction: [**Flush overlay**] [**Reveal overlay**] [**Reveal overlay on face frame**] [**Flush inset**] [**Flush inset with face frame**] [**As indicated**].
2. WI Construction Style: Style [**A, Frameless**] [**B, Face Frame**].
3. WI Construction Type: Type [**I, multiple self-supporting units rigidly joined together**] [**II, single-length sections to fit access openings**].
4. WI Door and Drawer Front Style: [**Flush overlay**] [**Reveal overlay**] [**Lipped**] [**Flush**].
5. Reveal Dimension: [**1/2 inch (13 mm)**] [**As indicated**] <**Insert dimension**>.
6. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:

   a. Horizontal Surfaces Other Than Tops: Grade [**HGS**] [**HGL**].
   b. Postformed Surfaces: Grade [**HGP**].
   c. Vertical Surfaces: Grade [**HGS**] [**VGS**].
   d. Edges: [**Grade HGS**] [**Grade VGS**] [**PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish**] [**PVC T-mold matching laminate in color, pattern, and finish**] [**PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish**].

7. Materials for Semiexposed Surfaces Other Than Drawer Bodies: [**High-pressure decorative laminate, Grade VGS**] [**High-pressure decorative laminate, Grade CLS**] [**Thermoset decorative panels**].
8. Drawer Sides and Backs: [**Solid-hardwood lumber**] [**Thermoset decorative panels**].
9. Drawer Bottoms: [**Hardwood plywood**] [**Thermoset decorative panels**].
10. Colors, Patterns, and Finishes: [**As indicated by manufacturer's designations**] [**Match sample**] <**Insert requirements**>.

11. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of [**solid colors**] [**wood grains**] [**patterns**], [**gloss**] [**matte**] finish.
12. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

I. Plastic-Laminate Countertops:

1. High-Pressure Decorative Laminate Grade: [**HGS**] [**HGP**].
2. Colors, Patterns, and Finishes: [**As indicated by manufacturer's designations**] [**Match sample**] <**Insert requirements**>.
3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of [**solid colors**] [**wood grains**] [**patterns**], [**gloss**] [**matte**] finish.
4. Edge Treatment: [**Same as laminate cladding on horizontal surfaces**] [**Lumber edge for transparent finish matching wood species and cut on cabinet surfaces**] [**As indicated**].
5. Core Material at Sinks: [**Particleboard made with exterior glue**] [**Medium-density fiberboard made with exterior glue**] [**or**] [**exterior-grade plywood**].

J. Solid-Surfacing-Material Countertops:

1. Solid-Surfacing-Material Thickness: [**1/2 inch (13 mm)**] [**3/4 inch (19 mm)**].
2. Colors, Patterns, and Finishes: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**] <**Insert requirements**>.
3. Fabricate tops in one piece with [**shop-applied backsplashes**] [**loose backsplashes for field application**]. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
4. Install integral sink bowls in countertops in shop.

2.7 SHOP FINISHING

A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.

C. Transparent Finish:

1. Grade: [**Premium**] [**Custom**] [**Economy**].
2. AWI Finish System: [**Acrylic lacquer**] [**Conversion varnish**] [**Catalyzed vinyl**].
3. WI Finish System: [**2, water-reducible acrylic lacquer**] [**3b., catalyzed vinyl lacquer**] [**4, conversion varnish**].
4. Staining: [**None required**] [**Match approved sample for color**] [**Match sample**].
5. Wash Coat for Stained Finish: Apply a wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
6. Open-Grain Woods: [**Do not apply filler to open-grain woods**] [**After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood**].
7. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D 523.

D. Opaque Finish:

1. Grade: [**Premium**] [**Custom**] [**Economy**].
2. AWI Finish System: [**Conversion varnish**] [**Catalyzed vinyl**].
3. WI Finish System: [**3b., catalyzed vinyl lacquer**] [**4, conversion varnish**] [**7a., synthetic enamel**].
4. Color: [**As indicated by manufacturer's designations**] [**Match sample**] [**As selected from manufacturer's full range**].
5. Sheen: [**Flat, 15-30**] [**Satin, 31-45**] [**Semigloss, 46-60**] [**Gloss, 61-100**] gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Shim as required with concealed shims.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails [**or finishing screws**] for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.[**Scarf running joints and stagger in adjacent and related members.**] Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

G. Paneling: Anchor paneling to supporting substrate with [**concealed panel-hanger clips**] [**splined connection strips**]. Do not use face fastening, unless [**covered by trim**] [**otherwise indicated**].

H. Stairs: Securely anchor carriages to supporting substrates. Install stairs with treads and risers no more than 1/8 inch (3 mm) from indicated position.

I. Railings: Install rails with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.

1. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.
2. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.

J. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with [**No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips**] [**No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish**] [**toggle bolts through metal backing or metal framing behind wall finish**].

K. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

END OF SECTION 064023

SECTION 06460 - WOOD TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wood products including the following as indicated on the Drawings:
1. Fascia.
2. Soffits.
3. Trim.
4. Window sills.
5. Corners.

1.2 RELATED SECTIONS

A. Section 07460 - Wood Siding.

B. Section 09900 - Painting: Field finish coat over prepared wood substrate.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.
4. Include data for fire-retardant coating from manufacturer.

C. Research/Evaluation Reports: For fire-retardant-coated wood.

D. Verification Samples: For each finish product specified, two samples, representing actual product and color.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be licensed, registered or otherwise acceptable to authorities having jurisdiction to install exterior building products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect the materials upon delivery to assure specified products have been received. Store products in a safe area, away from construction traffic. Store under cover and off the ground, protected from moisture.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Manufacturer warrants product types with extended warranty against rot and finish

deterioration.
1. RealTrim: 10 year substrate warranty.
2. RealCorner: 10 year substrate warranty.
3. RealSoffit: 10 year substrate warranty.
4. RealSill: 10 year substrate warranty.
5. RealPost: 10 year substrate warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Woodtone , which is located at: 8007 Aitken Rd. ; Chilliwack, BC, Canada V2R 4H5; Toll Free Tel: 800-663-9844; Email: request info; Web: www.woodtone.com

B. Substitutions: Must be submitted prior to June 2nd 2009 – Any later substitutions must be equal in quality and appearance to specified trim.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MILLED PROFILES

A. Product; RealTrim as manufactured by Woodtone.
1. Milled Texture: Rougher headed face (also "Comb Face" or "Broken Knife Comb Face").
2. Milled Texture: Rougher headed face & edge.
3. Milled Texture: Rougher headed 4 sides.
4. Milled Texture: Resawn face.
5. Milled Texture: Smooth 4 Sides (S4S).
6. Dimensions: Profile dimensions as scheduled on the drawings from manufacturer's standard width and thickness.
7. Finish: Primed.
8. Finish: Cedartone Color.

B. Product: RealCorner as manufactured by Woodtone.
1. Profile as indicated on drawings from manufacturer's standard profiles.
2. Finish: Primed.
3. Finish: Cedartone Color.

C. Product: RealSoffit as manufactured by Woodtone.
1. Texture: Smooth.
2. Edge: Square edge.
3. Profile: Beaded Soffit.
4. Profile: Custom as indicated on the drawings.
5. Finish: Primed.
6. Finish: Cedartone Color.

D. Product; RealSill as manufactured by Woodtone.
1. RealSill - 2 by 3.
2. RealSill - 2 by 4.
3. Texture: Smooth 4 Sides.
4. Finish: Primer.
5. Finish: RealSill CG (ColorGuard Coating System).

E. Product: Custom Products as manufactured by Woodtone.

1. Notched fascia.
2. Door / window trim.
3. Rail caps.
4. Garage door jamb.
5. Belly Band.
6. Specialty corner trim.
7. Profile series..

2.3 TREATMENTS

A. Product: FireGuard as manufactured by Woodtone.

B. Product: ColorGuard as manufactured by Woodtone.

C. Premium Proprietary Hybrid Alkyd Emulsion Primer.

D. Premium Tinted Primer.

E. Premium Two Coat Primer.

F. Premium Custom Top Coating: Refer to Section 09900.

G. Premium Cedar Tone Coating.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Finish materials on all ends and sides and ends. Apply touch up coating on new cuts. Factory finishing is preferred.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06650 - PAPERSTONE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid Surface Countertop

1.2 RELATED SECTION

A. Section 12356 Kitchen Casework

1.3 REFERANCE

1.4 SUBMITTALS

A. Submit under provisions of Section 01300

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Technical data indicating compliance with specifications and standards.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each finish product specified, two complete sets of finish samples of the manufacturer's standard stain colors on the specified species and with the specified pattern, size, texture, and finish.

PART 2 PRODUCT

A. Provide PaperStone™ surfaces as shown on the drawings and specifications herein:

B. Materials
1. PaperStone™ Sheets shall be supplied by NorthStar, and manufactured by Paneltech International, LLC, Houquim, Washington, and shall be cut to size, seamed and detailed in accordance with approved shop drawings. Color shall be Slate , and surface finish shall be Flat.

http://www.paperstoneproducts.com/

2.1 SHOP DRAWINGS

A. Prior to fabrication, the contractor shall furnish and submit detailed shop drawings for the approval of the architect/designer, showing accurate dimensions and details of all PaperStone™ panel work.

2.2 FABRICATION AND INSTALLATION

A. The fabrication and installation of all PaperStone™ surfaces detailed in this section shall be performed by an approved fabrication shop in accordance with the manufacturers' printed instructions and final shop drawings.

END OF SECTION

Section 07132 Sheet waterproofing
– WALLSHIELD ® Breathable Underlayment

Division 7
07200 Thermal Protection
07270 Air Barriers
07276 – WallShield ® Breathable Underlayment

1.1 SUMMARY

A. This Section provides for the exterior wall, breathable membrane
B. Related Sections include the following:
1. Division 6 Section "Rough Carpentry" for exterior sheathing
2. Division 7 Section "Metal Siding" for wall membrane
3. Division 13 Section "Pre-Engineered Buildings" for metal siding and roofing

1.2 REFERENCES

A. American Association of Textile Chemists and Colorists [AATCC]
B. American Society for Testing and Materials [ASTM]
C. International Code Council Acceptance Criteria [ICC-ES-AC
Shop drawings may be the logical way for the owner (and contractor) to understand the relationship of the actual materials used on the project.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions, technical data, and tested physical and performance properties of breathable membrane.
B. Shop Drawings: Provide 1-1/2” scale drawings (or larger) showing relationship of membrane to:
1. Framing or blocking members
2. Girts
3. Thermal Insulation
4. Sheathing
5. All exterior cladding and corner conditions
6. Door or window frames
7. Sill pans
8. Through-Wall Metal Flashing
9. Balcony and railing penetrations
10. Structural Tie-Back Penetrations
11. Rain Screen Battens / Cavity Design
12. Pipe, Conduit and Duct penetrations

C. Samples:
1. 8-1/2-x-11-inch square of breathable membrane sheet
2. Tapes (Single & Double-Sided)
3. Factory fabricated window opening corners
4. 12” long section of sill pan
5. Sample of Batten 6“ long x ½” depth
6. Provide materials and fasteners for mock-up

D. Manufacturer’s Instructions: Provide manufacturer’s instructions showing the recommended procedures and sequence of installation of breathable

membrane in Rain screen installations. Please see our website www.VaproShield.com for downloadable installation instructions.

1.4 QUALITY ASSURANCE

A. Membrane manufacturer shall have an on-going quality control program with inspections by a nationally recognized independent organization and shall be so labeled.
B. Source Limitations: Obtain all breathable membranes through one source from a single manufacturer.
C. Preinstallation Conference: Conduct conference at project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review requirements for membrane, including surface preparation specified under other sections, substrate condition and pretreatment, temporary weather protection, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original containers with seals unbroken, wrapped in a polythene sleeve, labeled with manufacturer's name, and product brand name.
B. Store rolls under cover, on a clean, level surface, either flat or upright.

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following products:
1. Spun Bonded Polypropylene: Membrane shall be furnished in standard rolls of 59” high (1-1/2 meters) and 164 feet (50 meters) long.
a. WallShield, distributed by VaproShield LLC, Phone (866) 731-7663 www.VaproShield.com
b. Others as may be approved by Addendum. Note: The Architect is not aware of any other material that has the water resistance and high perm rating of the specified product.

2.2 UNDERLAYMENT PHYSICAL PROPERTIES

A. Color: Green on exterior, White on interior of membrane (see website regarding exposed, open joint , rain screen options – Black color option www.VaproShield.com)
B. Thickness and Weight: 0.023 inches thick and 5.161 oz. / sq. yd.
C. Tensile Strength: ASTM D882, Pass
D. Water Resistance (control and weathered specimens): AATCC-127, Pass
E. Water Vapor Transmission: ASTM E96, Pass
F. Low Temperature Bend: AC38, Pass
G. Flamespread Index: ASTM E-84, Pass
1. Smoke Development Index: ASTM E-84, Pass

SECTION 07218 - Icynene® Spray Formula

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyicynene spray insulation at wall surfaces.

1.2 RELATED SECTIONS

A. Section 01575 – Construction Waste Management.

B. Section 06100 – Rough Carpentry.

1.3 REFERENCES

Specifier Notes: List reference standards that appear in this section. Edit this article as required. Use most current edition of standard unless indicated otherwise by manufacturer.

A. American Society for Testing and Materials (ASTM):

1. ASTM C518-[__], Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM D2863-[__], Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index).
3. ASTM E84-[__], Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E90-[__], Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
5. ASTM E96-[__], Test Methods for Water Vapor Transmission Rate of Building Materials.
6. ASTM E283-[__], Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Differences Across the Specimen.

1.4 SUBMITTALS

A. Product Data: Provide data on materials, describing insulation properties, surface burning characteristics.

B. LEED Information: Indicate percentage of waste materials by weight diverted from landfill and recycled.

C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special treatment.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three (3) years [documented] experience.

B. Applicator: Company specializing in performing the work of this section [with minimum 3 years documented experience and certified by the manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to UDC code for [flame and smoke ratings, non-combustibility.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Toxicity/Hazardous Materials:
1. Outgassing/Reactivity:
   a. Formaldehyde: Products containing urea-formaldehyde will not be permitted.

b. Chlorofluorocarbons (CFCs)/HCFCs: Products and equipment requiring or using CFCs or HCFCs during the manufacturing process will not be permitted.

B. Airtightness: Meet specific standards of the Energy Star Program of 1.5 Air Changes/Hour at 50 Pa.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Store materials in an area protected from [freezing and overheating] damage and in accordance with manufacturer's instructions.

C. Protect materials during handling and application to prevent damage and contamination.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Icynene, Inc., 6747 Campobello Rd. Mississauga, Ontario L5N 2L7 Canada. Tel 800-758-7325. Fax 905-363-0102. Web Site: www.icynene.com

2.2 MATERIALS

A. Polyicynene Spray Insulation: Icynene; hydrophobic, low-density, open-cell modified polyicynene; conforming to the following:

1. Thermal Resistance (R-Value/inch): ASTM C518; 3.6 hr/sq ft/degree F/BTU. In.

2. Air Permeance (for 5.25 inches of material): ASTM E283; 0.0049 l/m^2/second.

3. Water Vapor Transmission (for 5 inches of material): ASTM E96; 10 perms.

4. Sound Transmission Class (STC): ASTM E90; STC 37 in wood stud wall.

5. Noise Reduction Coefficient (NRC): ASTM E90; NRC-0.7 in wood stud wall.

6. Corrosion: No significant corrosion when in contact with steel under 85 percent relative humidity.

7. Bacterial or Fungal Growth: No growth; no material deterioration.

8. Flame Spread and Smoke Developed Rating: ASTM E84; <20/<400.

***** [OR] *****

8. Flame Spread and Smoke Developed Rating: CAN 4-S102 PSC 3 Corner Wall Test; 510-530/95-150.

9. Fuel Contribution: ASTM E84; 0.

10. Oxygen Index: ASTM D2863; average value 23.1 percent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrate is free of any foreign material that will impede application.

C. Verify that other work on and within spaces to be insulated is complete prior to application.

D. Notify Architect of conditions that would adversely affect the application.

E. Beginning of installation means applicator accepts existing conditions.

3.2 PREPARATION

A. Comply with manufacturer's written installation instructions for preparing substrates indicated to receive insulation.

B. Mask and protect adjacent surfaces from overspray or damage.

C. Remove foreign materials, dirt, grease, oil, paint, laitance, efflorescence, and other substances that will affect application.

3.3 APPLICATION

A. Apply insulation in accordance with manufacturer’s written application instructions.

B. Apply insulation to a reasonably uniform monolithic density without voids.

C. Apply to minimum cured thickness of 7.25 in exterior walls and 11.88 inch +/- ½ inch in the floor or as scheduled.

D. Apply insulation to fill voids around doors and windows.

E. Apply insulation to fill voids around accessible service and equipment penetrations [as noted on drawings].

F. Apply insulation to seal voids at truss ends to prevent wind scouring of ceiling insulation.

3.7 SCHEDULES

G. Seal plumbing stacks, electrical wiring and other penetrations into attic to control air leakage.

H. Apply insulation to fill voids around bathtubs to point of accessibility [as indicated on drawings].

I. Apply insulation in unvented roof spaces and cathedral ceiling areas [as indicated on drawings].

J. Where building is designed to meet the specific airtightness standards of the Energy Star Program, apply insulation as recommended by manufacturer to provide airtight construction. Apply caulking to seal joints between structural assemblies.

3.4 FIELD QUALITY CONTROL

A. Inspect application for insulation thickness [and density].

3.5 PROTECTION OF FINISHED WORK

A. Do not permit subsequent work to disturb applied insulation.

3.6 CONSTRUCTION WASTE MANAGEMENT

A. Plan and coordinate the insulation work to minimize the generation of offcuts and waste. Reuse insulation scraps to the maximum extent feasible.

B. Separate and recycle waste materials in accordance with the Waste Management Plan and to the extent economically feasible.

Location	Average Cured Thickness
Sound insulation around main drain	[_3.5_] inches
Sound insulation within interior [walls/ceilings] of the [bedrooms/bathrooms/recreation room] and other locations as indicated on drawings.	[_7.25_] inches
Cathedral ceilings	[_n/a_] inches
Unvented roof spaces	[_n/a_] inches
Voids in overhangs such as bay windows and cantilevered floors	[_11.88_] inches
Exterior above grade walls	[_7.25_] inches
Floor headers	[_11.88_] inches

END OF SECTION

SECTION 07276 – WrapShield® Breathable Membrane

PART 1 - GENERAL

1.1 SUMMARY

A. This Section provides for the exterior wall, breathable membrane

B. Related Sections include the following:
1. Division 6 Section "Rough Carpentry" for exterior sheathing
2. Division 7 Section "Metal Siding" for wall membrane
3. Division 13 Section "Pre-Engineered Buildings" for metal siding and roofing

1.2 REFERENCES

A. American Association of Textile Chemists and Colorist [AATCC]
B. American Society for Testing and Materials [ASTM]
C. International Code Council Acceptance Criteria [ICC-ES-AC]

1.3 SUBMITTALS

A. Product Data: Include manufacturer's written instructions, technical data, and tested physical and performance properties of breathable membrane.

B. Shop Drawings: Provide 1-1/2” scale drawings (or larger) showing relationship of membrane to:
1. Framing or blocking members
2. Girts
3. Thermal Insulation
4. Sheathing
5. All exterior cladding and corner conditions
6. Door or window frames
   a. Sill pans
7. Through-Wall Metal Flashing
8. Balcony and railing penetrations
9. Structural Tie-Back Penetrations
10. Rain Screen Battens / Cavity Design
11. Pipe, Conduit and Duct penetrations

C. Samples:
1. 8-1/2-x-11 inch square of breathable membrane sheet
2. Tapes (Single & Double-Sided)
3. Factory fabricated window opening corners
4. 12” long section of sill pan
5. Sample of Batten 6“ long x ½” depth
6. Provide materials and fasteners for mock-up

D. Manufacturer’s Instructions: Provide manufacturer’s instructions showing the recommended procedures and
sequence of installation of breathable membrane in rain screen installation. Please see our website www.VaproShield.com for downloadable installation instructions.

1.4 QUALITY ASSURANCE

A. Membrane manufacturer shall have an on-going quality control program with inspections by a nationally recognized independent organization and shall be so labeled.

B. Source Limitations: Obtain all breathable membrane through one source from a single manufacturer.

C. Preinstallation Conference: Conduct conference at project site to comply with requirements in Division 1 Section"Project Management and Coordination." Review requirements for membrane, including surface preparation specified under other Sections, substrate condition and pretreatment, temporary weather protection, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original containers with seals unbroken, wrapped in a polythene sleeve, labeled with manufacturer's name, and product brand name.

B. Store rolls under cover, on a clean, level surface, either flat or upright.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following products:
1. Spun Bonded Polypropylene: Membrane shall be furnished in standard rolls of 59” high (1-1/2 meters) and 164 feet (50 meters) long
a. WrapShield – Orange (or black for open joint rain screen applications), distributed by VaproShield LLC, Phone (866) 731-7663, www.vaproshield.com
b. Others as may be approved by Addendum. Note: The Architect is not aware of any other material that has the water resistance and high perm rating of the specified product.

2.2 UNDERLAYMENT PHYSICAL PROPERTIES

A. Color: Exterior Orange to weather side, White on interior. (or Black exterior - See website for open joint rain screen application options www.VaproShield.com)
B. Thickness and Weight: 0.020 inches thick and 5.014 oz. / sq. yd.
C. Tensile Strength: ASTM D882, Pass
D. Dry Breaking Force: ASTM D5034, Pass
E. Water Resistance (control and weathered specimens): AATCC 127, Pass
F. Water Resistance (Ponding): ASTM D779, Pass
G. Water Vapor Transmission: ASTM E96, Pass
H. Low Temperature Bend: AC38, Pass
I. Air Permeance of Building Materials: ASTM 2178, Pass
J. Air Leakage through Wall Systems: ASTM E 283, Pass
K. Air Retarder Materials & Systems: ASTM 1677, Pass
L. Flamespread Index: ASTM E-84, Pass
M. Smoke Development Index: ASTM E-84, Pass
N. Water Resistance (UBC Flashing Requirements): ASTM 2112, Pass

2.3 BUILDING OFFICIAL APPROVALS

A. ICC: International Code Council, ICC Certificate #ESR-1916 (Approved).

2.4 AUXILIARY MATERIALS , distributed by VaproShield LLC Phone (866) 731-7663

A. Membrane Flashing

1. Flashing Rolls: VaproFlashing™ 11-3/4” and 14” widths x 164’ long. Orange color (or black for exposed open joint rain screen applications)
2. Factory Formed Corners
    a. VaproFlashing Factory Formed Corners™ 18” x 18”
    b. Others as may be approved by Addendum.

B. VaproSillSaver™

1. Window Sill Pan – VaproSillSaver
    a. 1-5/8”, 2”, 2-3/8”, 3-1/8” Sill Pan for flanged windows with end dams and spacers for field modification and installation
2. Sliding Door Sill Pan
    a. 3-1/8” Sill Pan for flanged sliding doors with end dams and spacers for field modification and installation

C. VaproBatten™ and VaproVent™ Strips (Rain Screen Construction)

1. Battens for a breathable drainage cavity:
    a. VaproBatten 1/2" PVC furring strips for installation by nail gun (see installation guidelines for proper fastening procedure)
    b. VaproVent top and bottom venting protection strips
    c. Others as may be approved by Addendum

D. Tape

1. Single-Sided Tape:
    a. 3” VaproTape™ (Single-Sided) 20 mil., for use to secure WrapShield to itself and to substrates
    b. Others as may be approved by Addendum
2. Double-Sided Sealing Tape
    a. 1” VaproTape™ (Double-Sided) 30 mil., for use to seal WrapShield to itself and to substrates
    b. One inch wide butyl rubber tape, subject to approval of the Architect.
    c. Others as may be approved by Addendum.

E. Caulks and Sealant

1. As approved and recommended by membrane manufacturer.
    F. Fasteners
1. Wood Sheathing/Exterior Gypsum Substrate Application:
    a. Minimum No. 12-gage [.0129-inch-shank-diameter (2.11mm)] corrosion-resistant steel or stainless steel nails having a minimum 3/8-inch diameter (9.5mm) head, OR
    b. No. 14 gage [.083-inch-shank-diameter (2.11mm)] corrosion-resistant galvanized steel or stainless steel nails having a 1-inch diameter (25.4mm) caps, OR
    c. Minimum No. 16 gage [.065-inch-leg-diameter (1.65mm)] stainless steel or galvanized staples having minimum 7/16-inch (11.1 mm) crowns
2. Metal Girt Application:

a. VaproAdhesive™ sprayed at 2" wide and OR
b. Pancake head self-drilling screw with gasket/washer

3. Concrete or Masonry Substrate Application:
a. Spot attach with VaproAdhesive 2" wide at 18" on center. Mechanically attach per cladding manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements and other conditions affecting performance.

3.2 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean and dry substrate for breathable membrane application.

3.3 PENETRATIONS

A. Pipes and Conduit: Install manufactured penetration sleeves sized for the penetration and installed as
recommended by the manufacturer.

B. Windows:
1. Secure prefabricated VaproFlashing and Factory Formed Corners at window sill ends.
2. Next, lay strip of breathable membrane across sill. Secure with tape or mechanical fasteners so that the membrane used for the wall can be slipped underneath the corners and sill, allowing for a minimum lap of 6 inches.
3. Wrap a strip of breathable membrane around jambs extending horizontally along walls a minimum of 9 inches.
4. Secure VaproShield Factory Formed Corners at ends of window head.
5. Next, lay strip of breathable membrane across the opening, extending horizontally beyond the corners a minimum of 6 inches.
a. Cut membrane along the leading edge of the header an inch or two beyond each jamb, so that the nailing flange of the window may side up behind the membrane.

C. Doors:
1. Wrap a strip of breathable membrane around jambs, extending horizontally along walls a minimum of 9 inches.
a. Secure VaproShield Factory Formed Corners at ends of door head.
b. Next, lay strip of breathable membrane across the opening, extending horizontally beyond the corners a minimum of 6 inches.
c. Cut membrane along the leading edge of the header, an inch or two beyond each jamb, so that the nailing flange of the door may side up behind the membrane.

3.4 BREATHABLE UNDERLAYMENT APPLICATION

A. Install membranes in accordance with manufacturer's instructions over [**exterior sheathing or metal purlins**]. Secure the membrane so that the subsurface is protected from weather until cladding can be installed.
1. First, wrap penetrations as specified and detailed.

2. Next, starting from the bottom, unroll the membrane, Orange side out (or black for open joint rain screen applications), mechanically fastening top and bottom, 2'-0" o.c.
3. Seal against jambs of openings with 1" VaproTape (Double-Sided).
4. Vertical laps shall be a minimum of 6" with taped joints or 12" without tape. Horizontal laps shall be a minimum of 6".

3.5 INSTALLATION INSTRUCTIONS:

A. STEP 1 – BEGIN FLASHING PENETRATIONS

1. Cut a piece of WrapShield to act as a "skirt" around counter flashed penetrations i.e. Ducts/housings or pipes. Distance from penetration to edge of barrier "skirt" minimum of 12".
2. Make four cuts to form a star shape and place over penetration snugly.
3. Extend "ears" of material along vertical penetration and seal with VaproTape (Single-Sided).
4. Tape top edge of "skirt" to wall using VaproTape (Single-Sided). Do not tape bottom edge.

B. STEP 2 – ATTACH WATER RESISTIVE/AIR BARRIER

1. Starting at base of wall, unroll WrapShield horizontally across wall. Best Practice: place a continuous bead of non-skinning butyl sealant or butyl tape on foundation wall and seal WrapShield to it.
2. Extend 6" over starting corner.
3. Fasten at top and bottom of roll at 2" from edge of WrapShield to center of fasteners.
4. Fasten at maximum of 2'0" on center.
5. Shingle next layers of WrapShield, ensuring minimum 6" horizontal and minimum 12" vertical laps. Ensure minimum 6" horizontal and minimum 6" vertical laps if taped with VaproTape (Single-Sided) at vertical laps. Do not place vertical laps above windows.
6. For delayed installation of siding/masonry determine fasteners and reduced fastener spacing for wind exposure (i.e. cap nails).

C. STEP 3 – FINISH FLASHING PENETRATIONS

1. Ensure WrapShield is slipped under bottom edge of penetration "skirt" and shingled over taped top edge.
2. Seal top and sides with VaproTape (Double-Sided).
3. Ensure whole "skirt" assembly is flashed appropriately with metal.

D. STEP 4– INSTALL SIDING/MASONRY

1. Cladding boards – per cladding system installation requirements. For information on use of Black WrapShield in open joint applications refer to www.vaproshield.com.
2. Masonry - wall ties/mechanical fasteners/veneer anchors as per building code requirements.

E. AIR BARRIER APPLICATIONS

1. Install WrapShield between sill plate and foundation gasket and seal to foundation wall with a bead of nonskinning butyl or butyl tape (VaproTape Double-Sided).
2. Method A: Flash penetrations and install WrapShield according to water resistive barrier installation instructions.*
3. Fasteners to be a maximum 6" on vertical and maximum 16" on horizontal centers. Increase fasteners where air barrier bridges openings in sheathing board.
4. Method B: Install continuous furring strips vertically along stud lines, vertical fasteners at 12". Best Practice: fasteners at maximum 6" on vertical and maximum 16" on horizontal.

5. Tape all vertical and horizontal laps using VaproTape “AB” (air barrier) or VaproTape Single-Sided.
6. Overlap WrapShield and ceiling air barrier and seal with VaproTape “AB” (air barrier) or use VaproTape (Single-Sided).

F. HIGH RISE APPLICATIONS

For installation instructions for high-rise applications, please contact VaproShield for recommendations.

G. OPEN JOINT APPLICATIONS

Require double layer of membrane material at open joint, due to UV exposure. See www.vaproshield.com for additional information and/or installation instructions or contact VaproShield at (866) 731-7663.

3.6 FIELD QUALITY CONTROL

A. **Meltwater** will engage an independent inspector to observe substrate and installation. Inspector shall provide a written, sign-off log, on all penetrations before the membrane is placed against them. Form of log shall be approved by Architect before contract with inspection service is approved.

3.7 PROTECTING AND CLEANING

A. Protect installed breathable membrane from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Manufacturer suggests a maximum of nine (9) months UV exposure.

1. Repair torn breathable membrane as follows:

a. Insert a full height piece of membrane extending 12 inches horizontally beyond the damage and extend up and under the membrane above. Mechanically attach membrane to substrate top and bottom.

B. Remove mud and similar marks with a water only scrub. If chemicals have been spilled on membrane, treat as a tear and repair as stated above.

END OF SECTION

SECTION 07410 - STANDING SEAM ROOF SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Standing seam roofing system.

1.2 RELATED SECTIONS

A. Section 05120 - Structural Steel: Tolerances for primary and secondary building structure supporting framework.

B. Section 06100 - Rough Carpentry: Blocking and miscellaneous framing.

C. Section 06125 - Wood Decking: Wood deck material and installation.

D. Section 07210 - Building Insulation: Insulation at walls and roof decks.

E. Section 07620 - Sheet Metal Flashing and Trim: Installation requirements.

F. Section 07710 - Gutters and Downspouts: Roof edge coordination and attachment provisions.

G. Section 07900 - Joint Sealants: Installation requirements.

1.3 REFERENCES

A. Sheet Metal and Air Conditioning Contractors National Association, 1nc. (SMACNA) - Architectural Sheet Metal.

B. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength low-Alloy with Improved Formability.

C. ASTM E1592 - Tests for Uplift Resistance of Roof Assemblies.

D. Underwriters Laboratories (UL) - Roofing Materials and Systems Directory.

E. Underwriters Laboratories (UL) 580 - Tests for Uplift Resistance of Roof Assemblies.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Uplift Requirements:
   1. Design wind uplift load capacity of roofing system capable of resisting the negative uplift pressure as follows:
      a. Provide Uplift Class 90 rated roofing system that has been tested in accordance with ASTM E1592 test procedure.
   2. Design wind uplift load capacity of roofing system capable of resisting the negative and positive uplift pressure as calculated for the Project.

B. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from 120 degrees F (49 degrees C) ambient change; 180 degrees F (82 degrees C) material surfaces range without permanent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
   1. Provide clips that resist rotation and avoid shear stress as a result of sheet metal roofing thermal movements.
   2. Provide slip critical details that prevent tension build-up causing buckling, oil canning and "popping" of system components.

C. Because of residual stresses in the coil steel stock metals used to roll form architectural panels and because of the uneven substrates over which these panels are applied, manufacturer can not assure total elimination of waviness, or oil canning in the flats of the panels. This shall not be construed as a product defect and shall not be cause for rejection.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Data substantiating materials comply with requirements.
   2. Detailed specification of construction and fabrication.
   3. Manufacturer's installation instructions.
   4. Certified test reports indicating compliance with performance requirements.
   5. Clip fastener pull-out tests.
   6. Preparation instructions and recommendations.
   7. Storage and handling requirements and recommendations.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:
   1. Indicate material profile, jointing pattern, jointing details, fastening methods, and installation details.

D. Structural Calculations: Submit structural calculations prepared by manufacturer for approval. Submittal shall be sealed by a professional engineer registered in the state of the project.
   1. Description of design criteria.
   2. Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
   3. Selection of framing components, accessories and connection requirements.
   4. Verification of attachments to structure and adjacent framing components.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

G. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have a minimum of 10 years experience supplying metal roofing to the region where the work is to be done.

B. Installer Qualifications:
   1. Acceptable to, licensed or certified by manufacturer.
   2. Not less than 5 years experience with the system.
   3. Successfully completed not less than 5 comparable scale projects using this system.

C. Regulatory Requirements: Comply with local Building Code requirements if more restrictive than those specified.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against damage and discoloration.

B. Handle panels with non-marring slings.

C. Do not bend panels.

D. Store panels above ground, with one end elevated to provide drainage.

E. Protect panels against standing water and condensation between adjacent surfaces.

F. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and allow to air dry.

G. Remove any strippable film coating prior to installation and do not allow it to remain on the panels in extreme cold, heat or in direct sunlight.

H. Store and dispose of solvent-based materials, and solvent contaminated materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 Warranty: Twenty year material and weather tightness warranties are available at additional costs. Warranty provides for repair or stoppage of any roof leaks caused by ordinary wear and tear under normal weather and atmospheric conditions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: A-Lert Roof Systems, which is located at: 2065 FM 1102

; New Braunfels, TX 78132; Toll Free Tel: 800-344-0609; Tel: 830-626-7755; Fax: 830-643-1912 ; Email: bconnors@centurionind.com; Web: www.alertroofsystems.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 STANDING SEAM ROOFING SYSTEM

A. Mechanically seamed concealed fastener UL 90 rated A-Lert Standing Seam Roofing System for new construction.
   1. General: Roof system consists of roof panels, anchor clips, sealants, fascia panels, gutters, downspouts, flashings and accessories.
   2. Panels: One side of panel is female in configuration suitable to accept the adjoining male side and form a lapped seam which is mechanically rolled. All panels have a mechanically applied sealant in the female rib continuous from eave to ridge.
      a. A-Lert KR24-F, flat panel.
      b. A-Lert KR24-S, striated panel.
      c. A-Lert KR24-P, pencil ribbed panel.
   3. Wind Class: UL 90.
   4. Seam Height: 2 inches (51 mm).
   5. Panel Width: 16 inches (406 mm).
   6. Metal:
      a. 24 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
      b. 22 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
      c. 24 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.
      d. 22 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.
   7. Clips: Die-formed G90 galvanized steel, with factory applied sealant.
   8. Fasteners:
      a. Eave and Ridge: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
      b. Clips: Number 12 by 1 inch (25 mm) self drilling screws.
      c. Curbing: Number 12 by 1 inch (25 mm) self drilling screws with neoprene washer.
      d. Ventilators, Pipe and Vent Flashing: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
   9. Finish: Exterior to have a coat of 70 percent Kynar 500. Interior to have a white polyester top coat over an epoxy or water base primer. Color to be selected from manufacturer's standard colors.

B. Mechanically seamed concealed fastener A-Lert Standing Seam Roofing System.
   1. General: Roof system consists of roof panels, anchor clips, sealants, fascia panels, gutters, downspouts, flashings and accessories.
   2. Panels: A-Lert SS216 panels. One side of panel is female in configuration

suitable to accept the adjoining male side and form a lapped seam which is mechanically rolled. All panels have a mechanically applied sealant in the female rib continuous from eave to ridge.

3. Seam Height: 2 inches (51 mm).
4. Panel Width: 16 inches (406 mm).
5. Metal:
   a. 24 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
   b. 22 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
   c. 24 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.
   d. 22 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.
6. Clips: Die-formed G90 galvanized steel, with factory applied sealant.
7. Fasteners:
   a. Eave and Ridge: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
   b. Clips: Number 12 by 1 inch (25 mm) self drilling screws.
   c. Curbing: Number 12 by 1 inch (25 mm) self drilling screws with neoprene washer.
   d. Ventilators, Pipe and Vent Flashing: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
8. Finish: Exterior to have a coat of 70 percent Kynar 500. Interior to have a white polyester top coat over an epoxy or water base primer. Color to be selected from manufacturer's standard colors.

C. Mechanically seamed, concealed fastener A-Lert Standing Seam Roofing System UL 90 rated, with sloped roof secondary framing for existing construction.
1. General: Provide light gauge structural steel secondary framing components including; studs, runners, eave struts, hat and zee sections to provide structural support, and desired pitch for installing roof over existing systems.
2. Roof Panels: One side of panel is female in configuration suitable to accept the adjoining male side and form a lapped seam which is mechanically rolled. All panels have a mechanically applied sealant in the female rib continuous from eave to ridge.
   a. A-Lert KR24-F, flat panel.
   b. A-Lert KR24-S, striated panel.
   c. A-Lert KR24-P, pencil ribbed panel.
3. Wind Class: UL 90.
4. Seam Height: 2 inches (51 mm).
5. Panel Width: 16 inches (406 mm).
6. Metal:
   a. 24 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
   b. 22 gauge G90 galvanized or galvalume steel with 50,000 psi minimum yield strength pre-coated with fluorocarbon (70 percent minimum Kynar 500) coating.
   c. 24 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.

d. 22 gauge zinc-aluminum alloy coated steel with 50,000 psi minimum yield strength.

7. Clips: Die-formed G90 galvanized steel, with factory applied sealant.
8. Fasteners:
   a. Eave and Ridge: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
   b. Clips: Number 12 by 1 inch (25 mm) self drilling screws.
   c. Curbing: Number 12 by 1 inch (25 mm) self drilling screws with neoprene washer.
   d. Ventilators, Pipe and Vent Flashing: Number 18-9 by 1 inch (25 mm) self drilling screws with neoprene washer.
9. Finish: Exterior to have a coat of 70 percent Kynar 500. Interior to have a white polyester top coat over an epoxy or water base primer. Color to be selected from manufacturer's standard colors.
10. Secondary framing:
    a. Roof Slope: As indicated on the Drawings.
    b. Purlins: 4Z16, 4 inch (102 mm) 16 gauge zee shape.
    c. Vertical members: 3.5C16, 3-1/2 inch (89 mm) 16 gauge channels.
    d. Base clips, anchors, and diagonal bracing: See Drawings. Locate base clips over existing joists.
    e. Fascia, eave and ridge materials and details: See Drawings.
    f. Cross bracing: Provide at every third bay, every row.
    g. Finish:
       1) Shop primer.
       2) Galvanized to A653.

2.3 ACCESSORIES

A. General:
   1. Provide manufacturer's standard accessories and other items essential to completeness of roof installation including anchor clips, trim, ridge and hip caps, closures, flashing, and fascias.

B. Concealed Clips:
   1. Clips as determined by manufacturer to suit performance requirements.
   2. Design clips for unlimited, unimpeded panel movement confirmed by testing, certified by an independent professional engineer.
   3. Testing: 100,000 cycles with 2 inch (51 mm) minimum panel movement in relation to anchored clip.

C. Fasteners:
   1. Screws: As specified or as ddetermined by manufacturer to suit specified performance requirements.
   2. Blind Rivets: Solid-treated, sealed stem type with EPDM washer under head.
   3. Wood Deck: Spoiler tip screws spaced 12 inches (305 mm) maximum on centers.
   4. Metal Deck or Purlins: Tek screws spaced 12 inches (305 mm) maximum on centers.

D. Closures:
   1. Precut profile closure from cross-linked, closed cell polyethylene composition foam.
   2. Protect and support ridge and hip foam closures by a formed metal closure

fabricated from same material, color and finish as roofing.

E. Curbs: Custom fabricated from 1/8 inch (3.2 mm) aluminum with a 6 inch (152 mm) wide base and a 6 inch (152 mm) high vertical leg. Corners and other joints shall be welded.

F. Fascia/Wall Panels: Job-site fabricated from roll-formed 24 gauge sheet metal with color and finish to match roof panels.

G. Gutters: Fabricated from 24 gauge sheet metal. Minimum lengths, 20 feet (6096 mm) with expansion joints at 60 feet (18288 mm). Color and finish to match roof panels.

H. Downspouts and Elbows: 24 gauge sheet metal pre-painted to match gutters. Space downspouts to accommodate 150 square feet (13.9 square meters) of roof area per inch circumference of downspout.

I. Flashing at Rake and Eave: Fabricated from 24 gauge sheet metal to match color and finish or roof panels. Install to allow for thermal expansion and contraction.

J. Companion Roof Jacks: Provide at all round roof penetrations complete with storm collars.

K. Ventilators: Penn Ventilator stationary ventilators. Install ventilators at a ratio of one ventilator per 800 square feet (74.3 square meters) of roof area.

L. Sealants: Provide products that do not contain oil, asbestos, or asphalt.
   1. Factory Applied Sidelap Sealant: Non-drying, non-skinning, synthetic polymer-based, designed for metal to metal concealed joints.
   2. Field Applied Sealant: S-M 5522 Acryl-R acrylic sealant. Extruded polymeric butyl tape, non-skinning and not easily displaced under construction to be used at all curbs, roof jacks, ventilators and gutters.
   3. Exposed Sealant: Single component, skinning, polyurethane joint sealant, with color to match panel.

M. Slip Sheeting: Red Rosin paper at areas where roofing system contacts weather treated wood blocking.

2.4 FABRICATION

A. Steel to be stretcher leveled and handled to minimize stress and waviness of sheet steel.

B. Fabricate exposed items of pre-finished sheet metal, color to match panels.

C. Hem exposed edges on underside 1/2 inch (12 mm), miter and seam corners.

D. Provide for thermal expansion and contraction.

E. Panning of panel ends is required at ridge, hip, and headwall conditions when slope is less than 3:12.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6.4 mm) and hemmed to form drip.

G. Panels shall be factory formed to required length. Metal flashings and trim shall be factory formed from the same material, gauge and finish as the roofing panels.

H. Roofing panels are available in unlimited lengths.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
1. Follow roof panel manufacturer's directions.
2. Lap panels away from prevailing wind direction.
3. Do not stretch or compress panel side laps.
4. Secure panels without warp or deflection.
5. Clean and dry surfaces prior to applying sealants,
6. Avoid exposed fasteners, except to fasten flashings, at fixed points, or as indicated on Drawings.

B. Panels: Panels are joined at the side lap with an interlocking seam standing 2 inches (51 mm) above the flat. Panel side laps are seamed by a special mechanical seaming machine. Side lap sealer is machine applied.

C. Cutting and Fitting:
1. Neat, square and true. Torch cutting is prohibited where cut is exposed to final view.
2. Shop fabricate and reinforce openings 6 inches (153 mm) and larger in any direction to maintain load capacity.
3. Where necessary to saw cut panels, debur cut edges.

D. Flashing:
1. Follow manufacturer's directions and approved shop drawings.
2. End splices of panels are not allowed for eave to ridge distances less than 200 feet (60960 mm). Where necessary, overlap roof panels at least 6 inches (153 mm).
3. Install flashings to allow for thermal movement.
4. Remove strippable protection film, if used, immediately preceding flashing installation.

E. Dissimilar Metals:
1. Where sheet metal is in contact with dissimilar metals, execute juncture to

facilitate drainage and minimize possibility of galvanic action.

2. At point of contact with dissimilar metal, coat metal with protective paint or tape placed between metals.

F. Sealants:

1. Field apply sealant to penetrations, transitions, and other locations necessary for an airtight, waterproof installation.

3.4 PROTECTION

A. Protect installed products until completion of project.

1. Require workmen who will be walking on roofing panels to wear clean, soft soled work shoes that will not pick up stones or other abrasive material, which could cause damage or discoloration to the panels.
2. Protect work of other trades against damage and discoloration.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07900 – JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior joint sealants.
2. Exterior joint sealants.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

2. VOC data:
a. Architectural Sealants:
1) Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
2) Submit manufacturer's certification that products comply with Bay Area Resources Board, reg. 8, rule 51.

B. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Architectural Sealants:
1. Toxicity/IEQ:
a. Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Sealants must meet or exceed requirements of Bay Area Resources Board, reg. 8, rule 51.
b. **Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not**

permitted.

B. Backer Rods: Provide composite backer rods.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:
1. Temporary ventilation: Provide temporary ventilation during work of this Section.
a. Coordinate interior application of joint sealants with interior finishes schedule.

END OF SECTION

SECTION 0081400 (SECTION 08210) – WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Solid-core doors with **[wood-veneer] [medium-density overlay] [hardboard]** faces.
2. Hollow-core doors with **[wood-veneer] [hardboard]** faces.
3. Exterior stile and rail wood doors.
4. Interior stile and rail wood doors.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

2. VOC data:
a. Adhesives for **site installation**:
1) Submit manufacturer's product data for adhesives. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
2) Submit Green Seal Certification to GS-36 and description of the basis for certification.

b. Engineered Wood Products: Provide documentation that composite wood and agrifiber products **are third-party certified as meeting ANSI standard requirements for formaldehyde emissions**
1) ANSI A208.1 – 1999, Particleboard
2) ANSI A208.2 – 2002, Medium Density Fiberboard (MDF) for Interior Applications

3. Biobased materials:
a. Indicate type of biobased material in product.
b. Indicate the percentage of biobased content per unit of product.
c. Indicate relative dollar value of biobased content product to total dollar value of product included in project.

B. Letter of Certification(s) for Sustainable Forestry:
   1. Forest Stewardship Council (FSC): Provide letter of certification signed by lumber supplier. Indicate compliance with FSC "Principles for Natural Forest Management" and identify certifying organization.
      a. Submit FSC certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the FSC certification numbers.
   2. Sustainable Forestry Board: Provide letter of certification signed by lumber supplier. Indicate compliance with the Sustainable Forestry Board's "Sustainable Forestry Initiative" (SFI) and identify certifying organization.
      a. Submit SFI certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the SFI certification numbers.
   3. Canadian Standards Association (CSA): Provide letter of certification signed by lumber supplier. Indicate compliance with the CSA and identify certifying organization.
      a. Submit CSA certification numbers; identify each certified product on a line-item basis.
      b. Submit copies of invoices bearing the CSA certification numbers.

C. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

1.3 QUALITY ASSURANCE

A. Sustainably Harvested Wood: Certification Organizations shall be accredited by the **[Forest Stewardship Council] [Sustainable Forestry Board] [Canadian Standards Associations] [xxxxxxxx]**.

B. Engineered Wood Products:
   1. Determine formaldehyde concentrations in air from wood products under test conditions of temperature and relative humidity in accordance with ASTM D6007 or E1333.
   2. Determine Volatile Organic Compounds VOC), excluding formaldehyde, emitted from manufactured wood-based panels in accordance with ASTM D6330.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber for Core, Stile and Rail, and Wood Veneer:
   1. Resource Management:
      a. Virgin Lumber: Lumber fabricated from old growth timber is not permitted. Provide sustainably harvested; certified or labeled in accordance with **FSC** guidelines.
      b. Salvaged Lumber: Lumber from deconstruction or demolition of existing buildings or structures. Unless otherwise noted, salvaged lumber shall be delivered clean, denailed, and free of paint and finish materials, and other contamination.
      c. Recovered Lumber: Previously harvested lumber pulled from riverbeds or otherwise abandoned. Unless otherwise noted, recovered lumber shall be delivered clean and free of contamination.

B. Engineered Wood Products:
1. Toxicity/IEQ:
a. Products shall contain no added urea-formaldehyde.

2.3 FABRICATED PRODUCTS

A. Wood Doors:
1. Biobased Content: Minimum **26** percent biobased material.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:
1. Temporary ventilation: Provide temporary ventilation as specified in Section 01 57 19.11 (01352) – Indoor Air Quality (IAQ) Management, and as follows.
a. During and immediately after installation of prefabricated wood products, and laminated wood products at interior spaces, provide temporary ventilation.

END OF SECTION

Section 08340 - H Window Series 204 Aluminum/Wood Composite Nordic Out-Swing Patio Doors

PART 1: GENERAL

1.01 WORK INCLUDED

A. Provide all labor, materials, tools, equipment and services to furnish and install commercial-grade aluminum/wood composite out-swing patio doors and related components as shown on the drawings and specified in this Section.

B. All doors are to be H Window Series 204 Single Out-Swing Patio Doors with a 13" tall kick panel, as manufactured by the H Window Company, LLC. Other manufacturers requesting approval to bid their product will be viewed as alternate bids and for consideration must submit a request for approval 10 days prior to bid.

1.02 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Section 06100-Rough Carpentry: Wood perimeter shims and blocking

C. Section 07900-Joint Sealers: Perimeter sealant and backer materials

D. Section 08800-Glazing

E. Section 09900-Painting

1.03 REFERENCES

A. AAMA/WDMA 101/I.S. 2-97 "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows & Glass Doors"

B. ASTM E 283-99 "Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors"

C. ASTM E 330-97 "Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference"

D. ASTM E 331-00 "Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference"

E. AAMA 2603/2604/2605 "Specifications for High Performance Organic Coatings on Architectural Extrusions and Panels"

F. AAMA 502-90 "Voluntary Specifications for Field Testing of Windows and Sliding Glass Doors"

1.04 SYSTEM PERFORMANCE

A. General: Provide aluminum/wood composite out-swing patio door units that meet or exceed performance requirements specified:

1. AAMA/WDMA 101/I.S. 2-97 Section 2.2.17 Hinged Glass Doors. Rating shall be: HGD-C40 (Commercial grade 40).

B. Design Requirements: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA/WDMA 101/I.S. 2-97 for type, grade, and performance class of door units required.

C. Testing: Test each type and size of required door unit through a recognized Independent Testing Laboratory or Agency, in accordance with ASTM E283 for air infiltration, and with ASTM E331 for water penetration.

1. Air Infiltration: Exterior doors will not exceed 0.10 CFM per lineal foot of sash crack when tested in accordance with ASTM E 283-99 at a uniform pressure of 6.24 PSF.

2. Water Resistance: No water leakage will occur when doors are tested in accordance with ASTM E 331-00 at a static pressure of 6.00 PSF.

3. Uniform Structural Load: Unit is to be tested at 1.5 x design wind pressure, both positive and
negative, in accordance with ASTM E 330-97. There shall be no glass breakage, permanent damage to fasteners, hardware parts or any other damage to make the door inoperable. There shall be no permanent deformation of any main frame or sash member in excess of 2% of its span.

1.05 SUBMITTALS

A. Shop drawings: Submit drawings and product data under provisions of Section 01300. Include dimensions, relationships to construction of adjacent work, air and vapor barrier seal to adjacent construction, component anchorage, type of caulking, door locations, installation methods and installation materials.

B. Submit manufacturer's installation instructions under provisions of Section 01300.

C. Submit color samples under provisions of Section 01300.

D. Submit details illustrating out-swing door frame sections, corner section and mullion section.

E. Submit two 12 x 12 inch samples of each type of glazing.

F. Test Reports: Provide certification by a recognized Independent Testing Laboratory showing that each type, grade, and size of door unit complies with performance requirements for air infiltration, water resistance and uniform structural load.

1.06 QUALITY ASSURANCE

A. Qualifications: Window and Door Manufacturer must certify that products supplied under this specification have been manufactured for a period of not less than 5 years.

B. Pre-installation Door Test: The owner reserves the right to randomly select one door at the time of delivery and submit it to an Independent Laboratory for testing. Testing will verify compliance of the production run with these specifications. The cost for pre-installation testing shall be paid by the Owner. Any deficiencies discovered on the door by the testing, and deficiencies in any similar models used in the project, will be corrected by the Bidder at no cost to the Owner.

C. Post Installation Field-Testing: Shall be in accordance with AAMA 502-90 using test method A.

1. After installation and before final payment, up to 2%, but not less than 2 doors shall be tested
for air infiltration and water infiltration as specified. Doors will be randomly selected by the Owner on the day of testing.

2. Conduct air infiltration tests at a uniform static pressure of 6.24 PSF. The maximum rate of air
leakage will not exceed 1.5 times the specified air leakage of 0.10 CFM per lineal foot of sash crack for operating doors.

3. Conduct water penetration tests at a static pressure of 6.0 PSF.

4. All cost associated with the Post Installation Field Testing shall be born by the Owner, and required repair or replacements shall be born by the Door Contractor. All tests are to be conducted by an accredited Testing Laboratory in the presence of the Owner or the Owner's Representative.

5. Failure of the door unit or installation to pass these tests shall require the contractor and/or manufacturer to pay costs necessary for correction, including removal of doors and providing new doors from the same or another manufacturer.

6. If one of the two units fails either test, three additional units shall be tested. If one or more of
the three additional units fails either test, three more units shall be tested. This procedure shall continue until all unit tests are passed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle door units under provisions of Section 01600.

B. Store and protect door units under provisions of Section 01600.

1.08 WARRANTY

A. Door Warranty: Submit a written warranty, executed by the Door Manufacturer, against defects in material and workmanship of the doors under normal use.

B. Glass: Warranty period starts from the date of manufacture printed on the insulated glass spacer. Insulating glass shall be warranted against obstruction of vision between interior glass surfaces (seal failure) for a period of 10 years.

C. Hardware: 10 years on hinges, espagnolette and handle assembly from the date of manufacture.

D. Exterior Finishes: 10 years from the date of manufacture.

E. Materials and Workmanship: 10 years from the date of manufacture.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. H Window Company, LLC.
401 17th Avenue West
Ashland, WI 54806
Phone: (800) 843-4929 Fax:(715) 685-9441
www.hwindow.com

B. Alternates: Not Permitted

2.02 MATERIALS

A. Extruded Aluminum: (Exterior) 6063 T-6 tempered aluminum frame, sash and glazing stop. Minimum wall thickness to be 0.059 inches.

B. Interior Wood: Clear Ponderosa Pine, free of finger joints, or veneer wrapped over finger jointed clear cut Ponderosa Pine. Kiln dried to a moisture content of 6-12 percent and preservative treated. Wood frame sash will be a minimum of 1-1/4" thick.
Optional Woods: [Insert Species].

C. Insulating Glass: CBA rated dual seal clear tempered insulating glass, 1" thick; DSB glass interior and exterior with High Performance Low E on surface #2, argon gas filled and warm edge spacer technology.

D. Weather-stripping: Full perimeter high performance weather gasket.

E. Screen: Hamstra rolling fiberglass mesh screen. Screen shall be housed in a metal canister mounted to the extension jamb. Screen shall pull across the door opening and attach to magnetic clips at the astragal or frame.

F. True-Divided-Lite: True-divided-lite to be 2-3/8" tapered to 1-5/8" on exterior aluminum, with individual pieces of glass.

G. Simulated True-Divided-Lite: Simulated true-divided-lite to be 1" extruded aluminum grille, between glass simulated spacer, supplied interior wood grille. Both exterior and interior grilles must be easily removable for cleaning of glass.

H. Removable Exterior Grilles: Exterior grilles to be 1" extruded aluminum with concealed clips for removal and cleaning. Grilles are to be painted to match door.

I. Removable Interior Wood Grilles: Interior grilles to be 1" wide and to be removable without the use of tools.

2.03 DOOR TYPE

A. Door Type: Provide Single Out-Swing patio doors with the leaf having a center slam-shut latch and three point locking hardware. The door shall lock in position anywhere in its 160-degree swing by lifting the handle. All door leaves shall have a 13" tall kick panel.

B. ADA Door: Through the use of a low profile thermally broken aluminum sill provide an ADA compliant door. Federal and local code for clear door opening must be specified. ADA doors shall not be required to meet performance requirements for air filtration and water resistance under this specification.

C. Configure as indicated on the elevation drawings and door details.

2.04 HARDWARE

A. Hinges: Zinc alloy on steel (yellow or chrome).

B. Operating Hardware: Provide Hoppe door hardware in either polished chrome or brass (other finishes are available).

C. Locks: Provide Hoppe full cylinder lock with locks being keyed alike or locks with a thumb turn on the interior only. Finish matching door handle hardware.

D. Espagnolette: Provide a full height espagnolette on the active door leaf. Espagnolette shall have a center slam shut latch and allow the door to lock at three points by lifting the door handle and engaging the deadbolt.

E. Windbrake: Provide a windbrake installed at the head of the active door leaf. The windbrake will allow the door to be locked in any position through its 120 degree swing. The windbrake will engage by lifting the door handle.

2.05 FABRICATION

A. Corner Joinery: Sash and Frame

1. Wood fabrication: Mortise and tenon joints. Glued, stapled and caulked.

2. Aluminum fabrication - Sash: 45 degree-mitered corners, double crimped to aluminum extruded corner keys. Frame: Butt-jointed corners sealed with gasket and silicone.

B. Composite Frame Construction: Fabricate door units with a continuous Butyl tape gasket thermal/moisture barrier, located between exterior aluminum and interior wood. Aluminum is nailed to wood with stainless steel ring-shanked nails on 6 inch spacing around perimeter of frame and sash.

C. Wood Surfaces: Wood shall be smooth and free of surface defects.

D. Insulated glass: Glazing shall be factory-installed.

2.06 FINISHES

A. Anodic (Anodized Finish)

Finish all exterior doors and components with electrolitically deposited color in accordance with the following Aluminum Association Designation:

AA Designation	Architectural Class	Description	AAMA Guide Specification
AA-M12-C22-A41	1	Clear Anodized	AAMA 611-98

AA-M12-C22-A44	1	Color Anodized	AAMA 611-98

B. Organic (Painted Finish)

Finish all exterior doors and components with a factory applied coating in accordance with the following Aluminum Association Designation:

AA Designation	Description	AAMA Guide Specification
AA-M12-C41-R1X	Powder Coat or Kynar based 50% resin	AAMA 2603 or 2604
AA-M12-C41-R1X	Kynar based 70% resin	AAMA 2605

C. Interior Wood: (Edit: Factory Prefinished or Unfinished). See Section 09900 for finish requirements. Wood shall be factory pre-finished utilizing a post-catalyzed conversion varnish sprayed finish prior to door assembly.

D. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

E. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq. ft. or primed with iron oxide paint.

2.07 ACCESSORIES

A. Positioning Fin: Attach vinyl positioning fin with pre-punched installation holes.
B. Mull Covers: Exterior aluminum, interior wood.
C. Extension Jambs: Provide clear pine extension jambs in a depth of 0” – 10”.
D. Receptor Panning: Extruded 6063 T-6 tempered aluminum. .080 wall thickness. Provide in sizes to cover all exterior exposed wood or metal.

PART 3: EXECUTION

3.01 EXAMINATION

A. Re-door: Bidders are expected to visit the job-site and make a complete survey of the Project prior to bid. The Bidder for proper sizing of new doors will measure all door openings. Failure to do so does not relieve the Successful Bidder from the need to furnish any and all materials, which may be required, in accordance with the specifications, without any additional costs to the Owner.

B. New Construction: Verify wall openings and adjoining air and vapor seal materials are clean, dry and ready to receive work of this Section. Verify that rough opening and masonry openings are correct and the sill plate is level.

3.02 PREPARATION

A. Remove new doors from crating and packaging material. Verify that all parts and accessories are included. All door units shall be securely stored, upright and protected from the weather.

B. Remove old doors and accessories from the door opening. Scrape and remove existing sealants from the opening, which will interfere with the installation of the new doors.

C. Install only preservative treated lumber for liners and blocking. The shim space will be adequate in depth to shim the entire depth of the new door frame.

3.03 INSTALLATION

A. Install door frames, glass and glazing and reinforcing in strict accordance with manufacturer's instruction and shop drawings.

B. Align door frame plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.

C. Coordinate attachment and seal of air and vapor barrier materials. Install under sill and sill brake metal flashing.

D. Pack fibrous insulation in shim spaces at perimeter to maintain continuity of thermal barrier.

E. Install perimeter sealant and backing materials in accordance with Section 07900.

3.04 ADJUST AND CLEAN

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water applied with soft, clean wiping cloths. Take care to remove dirt from corners. Remove dirt and window label. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

D. Protect exterior finishes until cleaning of the exterior brick and stone is completed.

E. Adjust operable hardware for smooth operation and tight fit of the door leaves.

3.05 PROTECTION

A. Protect the exterior finish on the doors when cleaning the building.

Section 08570 - H Window Series 204 - Aluminum/Wood Composite Awning Windows

PART 1: GENERAL

1.01 WORK INCLUDED

A. Provide all labor, materials, tools, equipment and services to furnish and install commercial-grade aluminum/wood composite windows and related components as shown on the drawings and specified in this Section.

B. All windows are to be H Window Series 204, as manufactured by the H Window Company, LLC. Other manufacturers requesting approval to bid their product will be viewed as alternate bids and for consideration must submit a request for approval 10 days prior to bid.

1.02 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Section 06100-Rough Carpentry: Wood perimeter shims and blocking

C. Section 07900-Joint Sealers: Perimeter sealant and backer materials

D. Section 08800-Glazing

E. Section 09900-Painting

1.03 REFERENCES

A. AAMA/WDMA 101/I.S. 2-97 "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood & Glass Doors"

B. ASTM E 283-99 "Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors"

C. ASTM E 330-97 "Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference"

D. ASTM E 331-00 "Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference"

E. AAMA 910-93, "Voluntary Life Cycle Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors."

F. ASTM F 588-97 Forced Entry Resistance Test Grade 10

G. AAMA 2603/2604/2605 "Specifications for High Performance Organic Coatings on Architectural Extrusions and Panels"

H. AAMA 502-90 "Voluntary Specifications for Field Testing of Windows and Sliding Glass Doors

1.04 SYSTEM PERFORMANCE

A. General: Provide aluminum/wood composite window units that meet or exceed performance requirements specified:

1. AAMA/WDMA 101/I.S. 2-97 Section 2.2.9 Fixed Windows and Section 2.2.4 Projected Windows. Rating shall be: AP-AW55 or F-AW55. [NOTE: Optional High Performance Rating of AP-AW100 is available. Please consult H Window Company, LLC]

B. Design Requirements: Comply with structural performance, air infiltration, and water penetration indicated in AAMA/WDMA 101/I.S. 2-97 for type, grade, and performance class of window units required.

C. Testing: Test each type and size of required window unit through a recognized Independent Testing Laboratory or Agency, in accordance with ASTM E283 for air infiltration, and with ASTM E331 for water penetration.

1. Air Infiltration: Exterior windows will not exceed 0.10 CFM per lineal foot of sash crack when tested in accordance with ASTM E 283-99 at a uniform pressure of 6.24 PSF.

2. Water Resistance: No water leakage will occur when windows are tested in accordance with ASTM E 331-00 at a static pressure of 10.00 PSF.

3. Uniform Load Deflection Test: No glass breakage, permanent damage to fasteners, hardware parts, or damage to make window inoperable or deflection of any unsupported span (meeting rails, muntins, frames, mullions, or other appurtenances) in excess of L/175 at both a positive and a negative load in minimum of 55 PSF when tested in accordance with ASTM E330-97.

4. Uniform Structural Load: Unit is to be tested at 1.5 x design wind pressure, both positive and negative at 82.50 PSF in accordance with ASTM E 330-97. There shall be no glass breakage, permanent damage to fasteners, hardware parts or any other damage to make the window inoperable. There shall be no permanent deformation of any main frame or sash member in excess of 2% of its span.

1.05 SUBMITTALS

A. Shop drawings: Submit drawings and product data under provisions of Section 01300. Include dimensions, relationships to construction of adjacent work, air and vapor barrier seal to adjacent construction, component anchorage, type of caulking, window locations, installation methods and installation materials.

B. Submit manufacturer's installation instructions under provisions of Section 01300.

C. Submit color samples under provisions of Section 01300.

D. Submit samples illustrating operable window and fixed window frame sections, corner section and section.

E. Submit two 12 x 12 inch samples of each type of glazing.

F. Test Reports: Provide certification by a recognized Independent Testing Laboratory showing that each type, grade, and size of window unit complies with performance requirements for air infiltration, water resistance and uniform structural loads.

1.06 QUALITY ASSURANCE

A. Qualifications: Window Manufacturer must certify that the products supplied under this specification have been manufactured for a period of not less than 5 years.

B. Pre-installation Window Test: The owner reserves the right to randomly select one window at the time of delivery and submit it to an Independent Laboratory for testing. Testing will verify compliance of the production run with these specifications. The cost for pre-installation testing shall be paid by the Owner. Any deficiencies discovered on the window by the testing, and deficiencies in any similar models used in the project, will be corrected by the Bidder at no cost to the Owner.

C. Post Installation Field-Testing: Shall be in accordance with AAMA 502-90 using test method A.

1. After installation and before final payment, up to 2%, but not less than 2 windows shall be tested for air infiltration and water infiltration as specified. Windows will be randomly selected by the Owner on the day of testing.

2. Conduct air infiltration tests at a uniform static pressure of 6.24 PSF. The maximum rate of air leakage will not exceed 1.5 times the specified air leakage of 0.10 CFM per lineal foot of sash crack for operating windows.

3. Conduct water penetration tests at a static pressure of 10.0 PSF.

4. All costs associated with the Post Installation Field Testing and required repair or replacements shall be born by the Window Contractor. All tests are to be conducted by an accredited Testing Laboratory in the presence of the Owner or the Owner's Representative.

5. Failure of the window unit or installation to pass these tests shall require the contractor and/or manufacturer to pay costs necessary for correction, including removal of windows and providing new windows from the same or another manufacturer.

6. If one of the two units fails either test, three additional units shall be tested. If one or more of the three additional units fails either test, three more units shall be tested. This procedure shall continue until all unit tests are passed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle window units under provisions of Section 01600.

B. Store and protect window units under provisions of Section 01600.

1.08 WARRANTY

A. Window Warranty: Submit a written warranty, executed by the Window Manufacturer, against defects in material and workmanship of the windows under normal use.

B. Glass: Warranty period starts from the date of manufacture printed on the insulated glass spacer. Insulating glass shall be warranted against obstruction of vision between interior glass surfaces (seal failure) for a period of 10 years.

C. Hardware: 10 years on hinges and handle assembly from the date of manufacture.

D. Exterior Finishes: 10 years from the date of manufacture.

E. Materials and Workmanship: 10 years from the date of manufacture.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. H Window Company, LLC.
401 17th Avenue West
Ashland, WI 54806
Phone: (800) 843-4929 Fax: (715) 685-9441

www.hwindow.com

B. Alternates: Not Permitted.

2.02 MATERIALS

A. Extruded Aluminum: (Exterior) 6063-T6 tempered aluminum frame, sash and glazing stop. Minimum wall thickness to be 0.059 inches.

B. Interior Wood: Clear Ponderosa Pine, free of finger joints, or veneer wrapped over finger jointed clear cut Ponderosa Pine. Kiln dried to a moisture content of 6-12 percent and preservative treated. Wood frame and sash will be a minimum of 1-1/4” thick. Optional Woods: [Insert species]

C. Insulating Glass: CBA rated dual seal clear insulating glass, 1” thick; DSB glass interior and exterior with High Performance Low E on surface #2, argon gas filled and warm edge spacer technology.

D. Weather-stripping: Full perimeter high performance weather gasket. Double weather-strip at sill (above and below operator).

E. Screen: Extruded aluminum, 6063-T6 tempered aluminum frame with fiberglass mesh screen cloth.

F. True-Divided-Lite: True-divided-light to be 2-3/8” wide, tapered to 1-5/8” on exterior aluminum. Glass to be individual pieces.

G. Simulated True-Divided-Lite: Simulated true-divided-light to be 1” wide extruded aluminum grille, between glass simulated spacer, supplied interior wood grille. Both exterior and interior grilles must be easily removable for cleaning of glass.

H. Removable Exterior Grilles: Exterior grilles to be 1” extruded aluminum with concealed clips for removal and cleaning. Grilles are to be painted to match window.

I. Removable Interior Wood Grilles: Interior grilles to be 1” wide and to be removable without use of tools.

2.03 WINDOW TYPE

A. Window Type: Provide horizontally hinged, outward projecting 180 degree reversing windows, fixed sash or direct set windows.

B. Configure as indicated on the elevation drawings and window details.

2.04 HARDWARE

A. Hinges: Horizontal, 180-degree pivot. Zinc electroplated steel, yellow chromate and finished with a hard clear lacquer. Front arm to be painted to match exterior color.

B. Operators: Provide one or more of the following sash operators.

1. Push bar operator in white, bronze or champagne

2. Roto operator in white, bronze, champagne or brass

3. Euro operator in chrome (no screen available)

4. Keyed custodial operator in chrome (no screen available)

2.05 FABRICATION

A. Corner Joinery: Sash and Frame

1. Wood fabrication: Mortise and tenon joints. Glued, stapled and caulked.

2. Aluminum fabrication: Sash: 45 degree mitered corners, double crimped to extruded aluminum corner keys. Frame: Butt jointed corners sealed with gasket and silicone.

B. Composite Frame Construction: Fabricate window units with a continuous butyl tape or closed cell foam thermal/moisture barrier, located between exterior aluminum and interior wood. Aluminum is nailed to wood with stainless steel ring-shanked nails on 6 inch spacing around perimeter of frame and sash.

C. Weep holes: Weep holes shall be processed into each sill to allow water drainage to exterior.

D. Wood Surfaces: Wood shall be smooth and free of surface defects.

E. Insulated glass: Glazing shall be factory-installed.

2.06 FINISHES

A. Anodic (Anodized Finish)

Finish all exterior windows and components with electrolytically deposited color in accordance with the following Aluminum Association Designation:

AA Designation	Architectural Class	Description	AAMA Guide Specification
AA-M12-C22-A41	1	Clear Anodized	AAMA 611-98

AA-M12-C22-A44	1	Color Anodized	AAMA 611-98

B. Organic (Painted Finish)

Finish all exterior windows and components with a factory-applied coating in accordance with the following Aluminum Association Designation:

AA Designation	Description	AAMA Guide Specification
AA-M12-C41-R1X	Powder Coat or Kynar based 50% resin	AAMA 2603 an 2604
AA-M12-C41-R1X	Kynar based 70% resin	AAMA 2605

C. Interior Wood: [Edit: Factory Pre-finished or Unfinished]. See Section 09900 for finish requirements. Wood shall be factory pre-finished utilizing a 3-coat post-catalyzed conversion varnish sprayed finish prior to window assembly.

D. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact cementitious or dissimilar materials.

E. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq. ft. or primed with iron oxide paint.

2.07 ACCESSORIES

A. Positioning Fin: Attach vinyl positioning fin with pre-punched installation holes.

B. Mull Covers: Exterior aluminum, interior wood.

C. Extension Jambs: Provide clear pine extension jambs in a depth of 0” – 8”. Optional Woods: [Insert Species]

D. Receptor Panning: .080 extruded 6063-T6 aluminum finished to match windows. Provide in sizes to cover all exterior exposed wood or metal.

PART 3: EXECUTION

3.01 EXAMINATION

A. Re-window: Bidders are expected to visit the job-site and make a complete survey of the Project prior to bid. The Bidder for proper sizing of new windows will measure all window openings. Failure to do so does not relieve the Successful Bidder from the need to furnish any and all materials, which may be required, in accordance with the specifications, without any additional costs to the Owner.

B. New Construction: Verify wall openings and adjoining air and vapor seal materials are clean, dry and ready to receive work of this Section. Verify that rough opening and masonry openings are correct and the sill plate is level.

3.02 PREPARATION

A. Remove new windows from crating and packaging material. Verify that all parts and accessories are included. All window units shall be securely stored, upright and protected from the weather.

B. Remove old windows and accessories from the window opening. Scrape and remove existing sealants from the opening, which will interfere with the installation of the new windows.

C. Install only preservative treated lumber for liners and blocking. The shim space will be adequate in depth to shim the entire depth of the new window frame.

3.03 INSTALLATION

A. Install window frames, glazing and reinforcement in strict accordance with manufacturer's instruction and shop drawings.

B. Align window frame plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.

C. Coordinate attachment and seal of air and vapor barrier materials. Install under sill and sill brake metal flashing.

D. Pack fibrous insulation in shim spaces at perimeter to maintain continuity of thermal barrier.

E. Install perimeter sealant and backing materials in accordance with Section 07900.

3.04 ADJUST AND CLEAN

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down exposed surfaces using a solution of mild detergent in warm water applied with soft, clean wiping cloths. Take care to remove dirt from corners. Remove dirt and window label. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

D. Protect exterior finishes until cleaning of the exterior brick and stone is completed.

E. Adjust operable hardware for smooth operation and tight fit of the sash.

3.05 PROTECTION

A. Protect the exterior finish on the windows when cleaning the building.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Commercial door hardware.
2. Cylinders for doors specified in other Sections.
3. Electrified door hardware.

B. See Division 08 door sections for astragals and door silencers.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.4 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Three** years from date of Substantial Completion, except as follows:
   a. Exit Devices: **Two** years from date of Substantial Completion.
   b. Manual Closers: **10** years from date of Substantial Completion.
   c. Concealed Floor Closers: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section[**and door hardware sets indicated in door and frame schedule**] [**and door hardware sets indicated in Part 3 "Door Hardware Sets" Article**].

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and [**named manufacturers' products**] [**products equivalent in function and comparable in quality to named products**] [**products complying with BHMA standard referenced**].

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.2 HINGES, GENERAL

A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: [**Stainless steel, with stainless-steel pin**] [**Brass, with stainless-steel pin body and brass protruding heads**].
2. Interior Hinges: [**Brass, with stainless-steel pin body and brass protruding heads**] [**Steel, with steel pin**] [**Stainless steel, with stainless-steel pin**].
3. Hinges for Fire-Rated Assemblies: [**Steel, with steel pin**] [**Stainless steel, with stainless-steel pin**].

C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for [**outswinging exterior doors**] [**and**] [**outswinging corridor doors with locks**].

D. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

4. Screws: Phillips flat-head; [**machine screws (drilled and tapped holes) for metal doors**] [**wood screws for wood doors and frames**]. Finish screw heads to match surface of hinges.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Template Hinge Dimensions: BHMA A156.7.

C. [**Available**]Manufacturers:

1. Baldwin Hardware Corporation (BH).
2. Bommer Industries, Inc. (BI).
3. Cal-Royal Products, Inc. (CRP).
4. Hager Companies (HAG).
5. Lawrence Brothers, Inc. (LB).
6. McKinney Products Company; an ASSA ABLOY Group company (MCK).
7. PBB, Inc. (PBB).
8. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
9. <**Insert manufacturer's name.**>

2.4 SPRING HINGES

A. Self-Closing Hinges: BHMA A156.17.

B. [**Available**]Manufacturers:

1. Baldwin Hardware Corporation (BH).
2. Bommer Industries, Inc. (BI).
3. Cal-Royal Products, Inc. (CRP).
4. Hager Companies (HAG).
5. Lawrence Brothers, Inc. (LB).
6. McKinney Products Company; an ASSA ABLOY Group company (MCK).
7. PBB, Inc. (PBB).
8. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
9. <**Insert manufacturer's name.**>

2.5 PIVOTS AND PIVOT HINGES

A. Pivots: BHMA A156.4.

B. Self-Closing Pivot Hinges: BHMA A156.17.

C. [**Available**]Manufacturers:

1. Bommer Industries, Inc. (BI).
2. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
3. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
4. Hager Companies (HAG).
5. IVES Hardware; an Ingersoll-Rand Company (IVS).

6. McKinney Products Company; an ASSA ABLOY Group company (MCK).
7. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
8. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
9. <**Insert manufacturer's name.**>

2.6 CONTINUOUS HINGES

A. Standard: BHMA A156.26[**, Grade 1-150**] [**, Grade 1-300**] [**, Grade 1-600**] [**, Grade 2-150**] [**, Grade 2-300**] [**, Grade 2-600**] [**, Grade 3-150**] [**, Grade 3-300**].

B. General: Minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

1. Fire Pins: Steel pins to hold labeled fire doors in place if required by tested listing.

C. Continuous, Barrel-Type Hinges: Hinge with knuckles formed around a pin that extends entire length of hinge.

1. Base Metal for Exterior Hinges: Stainless steel.
2. Base Metal for Interior Hinges: [**Stainless steel**] [**Steel**] [**Aluminum**].
3. Base Metal for Hinges for Fire-Rated Assemblies: [**Stainless steel**] [**Steel**].
4. [**Available**]Manufacturers:

a. Hager Companies (HAG).
b. Markar Architectural Products, Inc.; a Subsidiary of Adams Rite Manufacturing Co. (MP).
c. McKinney Products Company; an ASSA ABLOY Group company (MCK).
d. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
e. Zero International (ZRO).
f. <**Insert manufacturer's name.**>

D. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves; joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. [**Available**]Manufacturers:

a. Bommer Industries, Inc. (BI).
b. Hager Companies (HAG).
c. McKinney Products Company; an ASSA ABLOY Group company (MCK).
d. Pemko Manufacturing Co. (PEM).
e. Select Products Limited (SPL).
f. Zero International (ZRO).
g. <**Insert manufacturer's name.**>

2.7 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Electrified Locking Devices: BHMA A156.25.

D. Lock Trim:

1. Levers: <**Insert model number and description.**>
2. Dummy Trim: Match [**knob**] [**lever**] lock trim and escutcheons.

E. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

F. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

G. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.8 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:

1. Bored Locks: BHMA A156.2.
2. Mortise Locks: BHMA A156.13.
3. Interconnected Locks: BHMA A156.12.

B. Bored Locks: BHMA A156.2[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]; Series 4000.

1. [**Available**]Manufacturers:

a. Arrow USA; an ASSA ABLOY Group company (ARW).
b. Best Access Systems; Div. of The Stanley Works (BAS).
c. Cal-Royal Products, Inc. (CRP).
d. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
e. Falcon Lock; an Ingersoll-Rand Company (FAL).
f. Marks USA (MKS).
g. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
h. PDQ Manufacturing (PDQ).
i. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
j. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
k. Security Door Controls (SDC).
l. Weiser Lock; a Masco Company (WEI).
m. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
n. <**Insert manufacturer's name.**>

C. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]; Series 1000.

1. [**Available**]Manufacturers:

a. Accurate Lock & Hardware Co. (ALH).

b. Adams Rite Manufacturing Co. (ARM).
c. Arrow USA; an ASSA ABLOY Group company (ARW).
d. Best Access Systems; Div. of The Stanley Works (BAS).
e. Cal-Royal Products, Inc. (CRP).
f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
g. Folger Adam Security Inc.; an ASSA ABLOY Group company (FAS).
h. Falcon Lock; an Ingersoll-Rand Company (FAL).
i. Marks USA (MKS).
j. PDQ Manufacturing (PDQ).
k. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
l. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
m. Security Door Controls (SDC).
n. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
o. <**Insert manufacturer's name.**>

D. Interconnected Locks: BHMA A156.12[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]; Series 5000.

1. [**Available**]Manufacturers:

a. Arrow USA; an ASSA ABLOY Group company (ARW).
b. Cal-Royal Products, Inc. (CRP).
c. Falcon Lock; an Ingersoll-Rand Company (FAL).
d. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
e. <**Insert manufacturer's name.**>

2.9 AUXILIARY LOCKS AND LATCHES

A. Auxiliary Locks: BHMA A156.5[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

1. [**Available**]Manufacturers:

a. ABLOY Security, Inc.; an ASSA ABLOY Group company (ABL).
b. Accurate Lock & Hardware Co. (ALH).
c. Adams Rite Manufacturing Co. (ARM).
d. Arrow USA; an ASSA ABLOY Group company (ARW).
e. Best Access Systems; Div. of The Stanley Works (BAS).
f. Cal-Royal Products, Inc. (CRP).
g. Falcon Lock; an Ingersoll-Rand Company (FAL).
h. Marks USA (MKS).
i. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
j. PDQ Manufacturing (PDQ).
k. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
l. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
m. Weiser Lock; a Masco Company (WEI).
n. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
o. <**Insert manufacturer's name.**>

2. Securitron Magnalock Corporation; an ASSA ABLOY Group company (SMC).
3. Security Door Controls (SDC).
4. <**Insert manufacturer's name.**>

2.10 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks: BHMA A156.29, Grade 1, surface mounted, battery powered, housed in metal case; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN--ALARM WILL SOUND."

B. Stand-Alone Exit Alarms: BHMA A156.29, Grade 1, [**surface mounted on door**] [**mounted separate from door and activated by door movement switch**].

C. [**Available**]Manufacturers:

1. Arrow USA; an ASSA ABLOY Group company (ARW).
2. Detex Corporation (DTX).
3. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
4. <**Insert manufacturer's name.**>

2.11 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

B. Dustproof Strikes: BHMA A156.16[**, Grade 1**].

C. Surface Bolts: BHMA A156.16[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

1. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (305-mm-) long rod for doors up to 84 inches (2134 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2134 mm).
2. [**Available**]Manufacturers:

a. Burns Manufacturing Incorporated (BM).
b. Don-Jo Mfg., Inc. (DJO).
c. Door Controls International (DCI).
d. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
e. Hager Companies (HAG).
f. IVES Hardware; an Ingersoll-Rand Company (IVS).
g. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
h. Trimco (TBM).
i. <**Insert manufacturer's name.**>

D. Manual Flush Bolts: BHMA A156.16[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]; designed for mortising into door edge.

1. [**Available**]Manufacturers:

a. Adams Rite Manufacturing Co. (ARM).
b. Burns Manufacturing Incorporated (BM).
c. Don-Jo Mfg., Inc. (DJO).
d. Door Controls International (DCI).
e. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
f. Hager Companies (HAG).
g. Hiawatha, Inc. (HIA).
h. IVES Hardware; an Ingersoll-Rand Company (IVS).

i. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
j. Trimco (TBM).
k. <**Insert manufacturer's name.**>

E. Automatic and Self-Latching Flush Bolts: BHMA A156.3[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]; designed for mortising into door edge.

1. [**Available**]Manufacturers:

a. Cal-Royal Products, Inc. (CRP).
b. Door Controls International (DCI).
c. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
d. Hager Companies (HAG).
e. IVES Hardware; an Ingersoll-Rand Company (IVS).
f. Trimco (TBM).
g. <**Insert manufacturer's name.**>

2.12 EXIT DEVICES

A. Exit Devices: BHMA A156.3[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. Removable Mullions: BHMA A156.3.

G. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

H. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

1. Operation: [**Rigid**] [**Movable**] [**Movable with monitor switch**].

I. Outside Trim: [**Lever**] [**Lever with cylinder**] [**Knob**] [**Knob with cylinder**] [**Pull**] [**Pull with cylinder**] [**Thumb turn with cylinder**]; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

J. Through Bolts: For exit devices and trim on [**metal doors**] [**non-fire-rated wood doors**] [**fire-rated wood doors**].

K. Electronic Exit Bars: Nonlatching electronic releasing device, activated by an adjustable capacitance sensor, with no moving parts; listed and labeled as panic exit hardware. Fabricate bar from extruded aluminum, and provide door and frame transfer device and 16 feet (4.9 m) of cord to route wiring off the door frame.

L. [**Available**]Manufacturers:

1. Adams Rite Manufacturing Co. (ARM).
2. Arrow USA; an ASSA ABLOY Group company (ARW).
3. Cal-Royal Products, Inc. (CRP).
4. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
5. Detex Corporation (DTX).
6. Door Controls International (DCI).
7. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
8. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
9. Locknetics; an Ingersoll-Rand Company (LSE).
10. Monarch Exit Devices & Door Hardware; an Ingersoll-Rand Company (MON).
11. Precision Hardware, Inc. (PH).
12. Rutherford Controls Int'l. Corp. (RCI).
13. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
14. Von Duprin; an Ingersoll-Rand Company (VD).
15. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
16. <**Insert manufacturer's name.**>

2.13 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5[**, Grade 1**] [**, Grade 1A**] [**, Grade 2**] [**, Grade 1 unless Grade 1A is indicated**] [**, Grade 1 unless Grade 2 is indicated**].

B. High-Security Lock Cylinders: BHMA A156.30[**, Grade 1**] [**, Grade 2**] [**, Grade 3**]; [**M, mechanical**] [**E, electrical**].

1. Key Control Level: Category [**A**] [**B**] [**C**].
2. Destructive Test Level: Category [**A**] [**B**] [**C**].
3. Surreptitious Entry Resistance Level: Category [**A**] [**B**] [**C**].

C. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: [**Five**] [**Six**] [**Seven**].
2. High-Security Grade: BHMA A156.5, Grade 1A, listed and labeled as complying with pick- and drill-resistant testing requirements in UL 437 (Suffix A).

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; with [**interchangeable**] [**removable**] cores.

E. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

2. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

   a. Furnish permanent cores to Owner for installation.

F. Manufacturer: Same manufacturer as for locks and latches.

G. [**Available**]Manufacturers:

1. ABLOY Security, Inc.; an ASSA ABLOY Group company (ABL).
2. Arrow USA; an ASSA ABLOY Group company (ARW).
3. ASSA, Inc.; an ASSA ABLOY Group company (ASA).
4. Best Access Systems; Div. of The Stanley Works (BAS).
5. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
6. Falcon Lock; an Ingersoll-Rand Company (FAL).
7. Medeco Security Locks, Inc.; an ASSA ABLOY Group company (MED).
8. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
9. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
10. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
11. <**Insert manufacturer's name.**>

2.14 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into [**master**] [**grand master**] [**great-grand master**] key system.

1. Existing System: Master key or grand master key locks to Owner's existing system.
2. Existing System: Re-key Owner's existing master key system into new keying system.

B. Keys: Nickel silver[**.**] [**; permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."**]

1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five [**master**] [**grand master**] [**great-grand master**] keys.

2.15 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.5, Grade [**1**] [**2**]; [**multiple-drawer**] [**wall-mounted**] [**portable**] metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of [**150**] <**Insert number**> percent of the number of locks.

B. Cross-Index System: [**Multiple**] [**Single**]-index system for recording key information. Include three receipt forms for each key-holding hook. Set up by [**key control manufacturer**] [**Installer**].

1. [**Available**]Manufacturers:

   a. Key Control Systems, Inc. (KCS).
   b. Lund Equipment Co., Inc. (LUN).

c. MMF Industries (MMF).
d. Sunroc Corporation (SUN).
e. <**Insert manufacturer's name.**>

C. Key Control System Software: BHMA A156.5, Grade 1; multiple-index system for recording and reporting key-holder listings, tracking keys and lock and key history, and printing receipts for transactions. Include instruction manual.

1. [**Available**]Manufacturers:

a. Best Access Systems; Div. of The Stanley Works (BAS).
b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
c. <**Insert manufacturer's name.**>

2.16 OPERATING TRIM

A. Standard: BHMA A156.6.

B. Materials: Fabricate from [**aluminum**] [**brass**] [**bronze**] [**stainless steel**], unless otherwise indicated.

C. [**Available**]Manufacturers:

1. Burns Manufacturing Incorporated (BM).
2. Don-Jo Mfg., Inc. (DJO).
3. Forms + Surfaces (FS).
4. Hager Companies (HAG).
5. Hiawatha, Inc. (HIA).
6. IVES Hardware; an Ingersoll-Rand Company (IVS).
7. Rockwood Manufacturing Company (RM).
8. Trimco (TBM).
9. <**Insert manufacturer's name.**>

2.17 ACCESSORIES FOR PAIRS OF DOORS

A. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

1. Material: Polished brass or bronze, with strike plate.

2.18 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

D. Flush Floor Plates: Provide finish cover plates for floor closers unless thresholds are indicated. Match door hardware finish, unless otherwise indicated.

E. Recessed Floor Plates: Provide recessed floor plates with insert of floor finish material for floor closers unless thresholds are indicated. Provide extended closer spindle to accommodate thickness of floor finish.

F. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

G. Surface Closers: BHMA A156.4[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**]. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. [**Available**]Manufacturers:

a. Arrow USA; an ASSA ABLOY Group company (ARW).
b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).
c. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
d. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
e. LCN Closers; an Ingersoll-Rand Company (LCN).
f. Norton Door Controls; an ASSA ABLOY Group company (NDC).
g. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
h. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
i. Yale Commercial Locks and Hardware; an ASSA ABLOY Group company (YAL).
j. <**Insert manufacturer's name.**>

H. Concealed Closers: BHMA A156.4[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

1. [**Available**]Manufacturers:

a. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
b. LCN Closers; an Ingersoll-Rand Company (LCN).
c. Norton Door Controls; an ASSA ABLOY Group company (NDC).
d. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
e. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
f. <**Insert manufacturer's name.**>

I. Closer Holder Release Devices: BHMA A156.15.

1. Life-Safety Type: On release of hold open, door becomes self-closing. Automatic release is activated by [**smoke detection system**] [**loss of power**].
2. [**Available**]Manufacturers:

a. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company (CR).

b. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
c. LCN Closers; an Ingersoll-Rand Company (LCN).
d. Norton Door Controls; an ASSA ABLOY Group company (NDC).
e. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
f. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
g. **<Insert manufacturer's name.>**

J. Coordinators: BHMA A156.3.

2.19 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by height specified in door hardware sets.

B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from [**material indicated in door hardware sets.**] [**the following material:**]

1. Material: 0.050-inch- (1.3-mm-) thick [**aluminum**] [**brass**] [**bronze**] [**stainless steel**].
2. [**Available**]Manufacturers:

a. American Floor Products Co., Inc. (AFP).
b. Baldwin Hardware Corporation (BH).
c. Burns Manufacturing Incorporated (BM).
d. Don-Jo Mfg., Inc. (DJO).
e. Hager Companies (HAG).
f. Hiawatha, Inc. (HIA).
g. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation (IPC).
h. IVES Hardware; an Ingersoll-Rand Company (IVS).
i. Pawling Corporation (PAW).
j. Rockwood Manufacturing Company (RM).
k. Trimco (TBM).
l. **<Insert manufacturer's name.>**

C. Plastic Protective Trim Units: BHMA A156.6; beveled 4 sides; fabricated from [**material indicated in door hardware sets.**] [**the following material:**]

1. Plastic Laminate: 1/8 inch (3.2 mm) thick; NEMA LD 3, Grade HGS.
2. Rigid Plastic: 0.060-inch- (1.5-mm-) thick, PVC or acrylic-modified vinyl plastic.
3. Acrylic: 1/8 inch (3.2 mm) thick.
4. Color and Texture: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**].
5. [**Available**]Manufacturers:

a. American Floor Products Co., Inc. (AFP).
b. Balco Inc. (BAL).
c. Burns Manufacturing Incorporated (BM).
d. Construction Specialties, Inc.; a C/S Group company (CS).
e. Don-Jo Mfg., Inc. (DJO).
f. Hager Companies (HAG).
g. Hiawatha, Inc. (HIA).
h. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation (IPC).
i. IVES Hardware; an Ingersoll-Rand Company (IVS).

j. Korogard Wall Protection Systems, Inc.; Div. of RJF International Corporation (KWS).
k. Pawling Corporation (PAW).
l. Rockwood Manufacturing Company (RM).
m. Tepromark International, Inc. (TEP).
n. Trimco (TBM).
o. <**Insert manufacturer's name.**>

2.20 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Mechanical Door Holders: BHMA A156.16[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

C. Combination Floor and Wall Stops and Holders: BHMA A156.8[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

D. Combination Overhead Stops and Holders: BHMA A156.8[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**].

E. Electromagnetic Door Holders: BHMA A156.15.

F. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame.

G. [**Available**]Manufacturers:

1. Architectural Builders Hardware Mfg., Inc. (ABH).
2. Baldwin Hardware Corporation (BH).
3. Burns Manufacturing Incorporated (BM).
4. Cal-Royal Products, Inc. (CRP).
5. Don-Jo Mfg., Inc. (DJO).
6. Door Controls International (DCI).
7. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
8. Dor-O-Matic; an Ingersoll-Rand Company (DOR).
9. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
10. Hager Companies (HAG).
11. HES, Inc.; an ASSA ABLOY Group company (HES).
12. Hiawatha, Inc. (HIA).
13. IVES Hardware; an Ingersoll-Rand Company (IVS).
14. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
15. Rockwood Manufacturing Company (RM).
16. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
17. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
18. Trimco (TBM).
19. <**Insert manufacturer's name.**>

2.21 DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

G. [**Available**]Manufacturers:

1. Hager Companies (HAG).
2. M-D Building Products, Inc. (MD).
3. National Guard Products (NGP).
4. Pemko Manufacturing Co. (PEM).
5. Reese Enterprises (RE).
6. Sealeze; a unit of Jason Incorporated (SEL).
7. Zero International (ZRO).
8. <**Insert manufacturer's name.**>

2.22 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than [**1/2 inch (13 mm) high**] [**3/4 inch (19 mm) high for exterior sliding doors**].

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

D. [**Available**]Manufacturers:

1. Hager Companies (HAG).
2. M-D Building Products, Inc. (MD).
3. National Guard Products (NGP).

4. Pemko Manufacturing Co. (PEM).
5. Reese Enterprises (RE).
6. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
7. Sealeze; a unit of Jason Incorporated (SEL).
8. Zero International (ZRO).

2.23 SLIDING DOOR HARDWARE

A. General: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Exterior Door Hardware: Galvanized steel or anodized aluminum.

B. Horizontal Sliding Door Hardware: Grade 1; rated for minimum door weight of [**240 lb (109 kg)**] [**320 lb (145 kg)**] [**450 lb (205 kg)**] [**560 lb (254 kg)**] [**640 lb (290 kg)**] [**800 lb (363 kg)**] [**1000 lb (455 kg)**] [**1500 lb (681 kg)**].

C. Bypassing Sliding Door Hardware: Rated for doors weighing up to [**200 lb (91 kg)**] [**125 lb (57 kg)**] [**75 lb (34 kg)**].

D. Pocket Sliding Door Hardware: Rated for doors weighing up to [**200 lb (91 kg)**] [**125 lb (57 kg)**] [**75 lb (34 kg)**].

E. [**Available**]Manufacturers:

1. Cox, Arthur & Sons, Inc. (ACS).
2. Hager Companies (HAG).
3. Henderson, P. C. Inc.; Div. of Hepworth PLC (PCH).
4. Johnson, L. E. Products, Inc. (LEJ).
5. Lawrence Brothers, Inc. (LB).
6. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
7. <**Insert manufacturer's name.**>

2.24 FOLDING DOOR HARDWARE

A. General: BHMA A156.14; consisting of complete sets including overhead rails, hangers, supports, bumpers, floor guides, and accessories indicated.

B. Bifolding Door Hardware: Rated for door panels weighing up to [**125 lb (57 kg)**] [**50 lb (23 kg)**].

C. Multiple Folding Door Hardware: Rated for door panels weighing up to [**75 lb (34 kg)**] [**30 lb (14 kg)**].

D. [**Available**]Manufacturers:

1. Cox, Arthur & Sons, Inc. (ACS).
2. Hager Companies (HAG).
3. Henderson, P. C. Inc.; Div. of Hepworth PLC (PCH).
4. Johnson, L. E. Products, Inc. (LEJ).
5. Lawrence Brothers, Inc. (LB).
6. Stanley Commercial Hardware; Div. of The Stanley Works (STH).

7. <**Insert manufacturer's name.**>

2.25 MISCELLANEOUS DOOR HARDWARE

A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

B. Auxiliary Hardware: BHMA A156.16[**, Grade 1**] [**, Grade 2**] [**, Grade 1 unless Grade 2 is indicated**] [**, Grade 3**].

1. [**Available**]Manufacturers:

a. Baldwin Hardware Corporation (BH).
b. Cal-Royal Products, Inc. (CRP).
c. Don-Jo Mfg., Inc. (DJO).
d. Hager Companies (HAG).
e. Lawrence Brothers, Inc. (LB).
f. Rockwood Manufacturing Company (RM).
g. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
h. Trimco (TBM).
i. <**Insert manufacturer's name.**>

2.26 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

C. Finishes: BHMA A156.18, as indicated in door hardware sets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

C. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, [**above accessible ceilings**] [**in equipment room**]. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening.
2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

G. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

H. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.2 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

3.3 DOOR HARDWARE SETS

Door Hardware Set No. <**Insert number**>
Door No. <**Insert designation(s)**>; each to have the following:

No.	Item	Description	Manufacturer	Finish
*	Hanging Devices	<**Insert description.**>	<**Insert manufacturer.**>	<**Insert finish.**>
[**#**]	Securing Devices (inactive leaf)	<**Insert description.**>	<**Insert manufacturer.**>	<**Insert finish.**>

[#]	Securing Devices (active leaf)	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Operating Trim	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Accessories for Pairs of Doors	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Closing Devices	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Protective Trim Units	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Stops and Holders	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Accessories	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**
[#]	Miscellaneous Items	**<Insert description.>**	**<Insert manufacturer.>**	**<Insert finish.>**

* Number of hinges, as specified.

END OF SECTION

SECTION 08719 - SLIDING AND FOLDING DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Straight and curved track sliding doors.

B. Straight and curved track sliding walls and partitions.

~~C. Multiple panel, straight track folding doors and walls.~~

1.2 RELATED SECTIONS

A. Section 05120 - Structural Steel: Track supports.

B. Section 08110 - Steel Doors and Frames: Hollow steel doors for sliding applications.

C. Section 08120 - Aluminum Doors and Frames: Aluminum doors for sliding applications.

D. Section 08211 - Flush Wood Doors: Wood doors and panels for sliding and folding doors and walls.

E. Section 08710 - Door Hardware: Cylinder locks, pulls.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. [Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Show layout, components, track mounting and support, anchorage details, and interface with adjacent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and finishes.

E. Component Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Approved by hardware supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store in dry, protected, well ventilated area and protect from damage.

1.6 WARRANTY

A. Provide manufacturer's two-year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Hafele America Co., which is located at: 3901 Cheyenne Dr. P.O. Box 4000 ; Archdale, NC 27263; Toll Free Tel: 888-437-7477; Tel: 336-434-8136; Fax: 336-434-8159; Email: Info_us@hafeleamericas.com; Web: www.hafele.com/us

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 SLIDING AND FOLDING DOOR AND WALL HARDWARE

~~A. Hardware for Sliding All-Glass Doors and Walls: Top track, single or two-wheeled trolleys with high-density nylon wheels or nylon-cladded ball bearing wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.~~

~~1. Opening and Closing Force: Not more than 5.2 pounds force (23 n) to ADA requirement certified by independent testing laboratory.~~
~~2. Glass Thickness: 5/16 inch (8 mm).~~
~~3. Glass Thickness: 25/64 inch (10 mm).~~
~~4. Glass Thickness: 15/32 inch (12 mm).~~
~~5. Glass Thickness: 1/2 inch (12.7 mm).~~
~~6. Glass Thicknesses: As indicated on drawings.~~
~~7. Top Fittings: Rounded patch type, requiring cutouts; plastic cover plate in finish selected by Architect from manufacturer's full range (Junior/GP).~~
~~8. Top Fittings: Clamp type, approximately 5 inches (124 mm) wide; aluminum, in finish selected by Architect from manufacturer's full range (Junior/GS).~~
~~9. Top Fittings: Rail full width of panel, requiring cutouts; aluminum, in finish selected by Architect from manufacturer's full range (Junior/GV, Variotec/GV).~~
~~10. Top Fittings: Rounded patch type located at corners, requiring cutouts; plastic cover plate in finish selected by Architect from manufacturer's full range; trolley suspension point laterally adjustable (Cornertec/GV).~~
~~11. Fittings: Stainless steel suspension requiring cut out (HA 70).~~
~~12. Bottom Fittings: None.~~
~~13. Bottom Fittings: Same as top fittings.~~
~~14. Floor Guide: Full width aluminum channel recessed in floor.~~
~~15. Floor Guide: Surface mounted, located out of traffic path.~~
~~16. Stops: Wall mounted rubber bumpers; track stop for each panel, with adjustable spring catch.~~
~~17. Provide matching mounting hardware for adjacent fixed glass panels and~~

~~swing doors.~~

~~18. Locks: Hawa Toplock, side-mounted, with cover plate matching patch fittings; provide wall strike for single panels and matching patch-type strike for bi-parting pairs.~~

~~19. Locks: Bottom rail mounted floor bolt with thumbturn inside.~~

~~20. Locks: Bottom rail mounted floor bolt with thumbturn inside and cylinder outside.~~

~~21. Weatherstripping: Brush type, two rows mounted in top and bottom rails, jamb edges mounted in transparent plastic edge channel.~~

~~22. Edge Protection: Transparent plastic edge channel on each jamb edge.~~

~~23. Edge Profile and Seals: Aluminum jamb profiles, 15/16 inch (24 mm) wide with rubber seals, and two rows of brush type seals mounted in top and bottom rails (Variotec/GR).~~

B. Hardware for Sliding Wood Doors and Walls: Hawa Junior or Variotec series; top track, two-wheeled trolleys with high-density nylon wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.

1. Opening and Closing Force: Not more than 5.2 pounds force (23 n) to ADA requirement certified by independent testing laboratory.
2. Floor Guide: Surface mounted, running in groove in bottom of door.
3. Floor Guide: Surface mounted, running in plastic channel set into bottom of door.
4. Floor Guide: Full width metal channel recessed in floor; projecting plastic slider mounted on or in bottom of door.
5. Stops: Wall mounted rubber bumpers; track stop for each panel, with adjustable catch.
6. Stops: Bumpers mounted in floor channel; track stop for each panel, with adjustable catch.
7. Stops: Wall mounted spring loaded bumpers; track stop for each panel, with adjustable catch.
8. Locks: Projecting dead bolt, mortised into bottom of door, with thumbturn inside.
9. Locks: Projecting dead bolt, mortised into bottom of door, with thumbturn inside and cylinder outside.
10. Locks: Hawa Silent-Stop, with bolt locking into top track, thumbturns both sides at approximately 36 inches (915 mm) above floor; mortised into edge of door.
11. Locks: Hawa Silent-Stop, with bolt locking into top track, thumbturns both sides at approximately 36 inches (915 mm) above floor; mortised into edge of door; cylinder outside, thumbturn inside.
12. Bolts: Hawa Doorfix, floor bolt with socket wrench operation from front and door edge at approximately 36 inches (915 mm) above floor; concealed in door.
13. Leading Edge Bumper: Continuous rubber bumper mortised into edge of door, color to be selected.
14. Meeting Stile Seals: Continuous aluminum retainers mortised into edge of door, with rubber seals (Typical for multiple panel walls).

C. Hardware for Sliding Hollow Steel and Aluminum Doors: Hawa Junior Series; top track, two-wheeled trolleys with high-density nylon wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.

1. Opening and Closing Force: Not more than 5.2 pounds force (23 n) to ADA requirement certified by independent testing laboratory.
2. Floor Guide: Surface mounted, running in groove in bottom of door.
3. Floor Guide: Full width aluminum or brass channel recessed in floor; projecting plastic slider mounted on or in bottom of door.
4. Stops: Wall mounted rubber bumpers; track stop for each panel, with adjustable catch.

~~D. Hardware for Folding Glass Walls: Top track, four-wheeled trolleys with high-density nylon wheels, capacity as recommended by manufacturer for size and weight of door panels; mounting and configuration as indicated on drawings.~~

~~1. Suspension Point Location: Center of each panel; panels hinged to each other; half panel hinged to wall; up to 6-1/2 panels without floor guide (Centerfold).~~
~~2. Suspension Point Location: One edge of each panel; panels hinged to each other; even number of panels; recessed floor guide channel (Variofold).~~
~~3. Glass Thickness: 5/16 inch (8 mm).~~
~~4. Glass Thickness: 25/64 inch (10 mm).~~
~~5. Glass Thickness: 15/32 inch (12 mm).~~
~~6. Glass Thickness: 1/2 inch (12.7 mm).~~
~~7. Glass Thicknesses: As indicated on drawings.~~
~~8. Top and Bottom Fittings: Rail full width of panel, requiring cutouts; aluminum.~~
~~9. Floor Guide: Full width aluminum channel recessed in floor.~~
~~10. Provide matching mounting hardware for adjacent fixed glass panels and swing doors.~~
~~11. Lock on Leading Panel: Bottom rail mounted floor bolt with thumbturn inside.~~
~~12. Lock on Leading Panel: Bottom rail mounted floor bolt with thumbturn inside and cylinder outside.~~
~~13. Weatherstripping: Brush type, two rows mounted in top and bottom rails, jamb edges mounted in transparent plastic edge channel.~~
~~14. Edge Protection: Transparent plastic edge channel on each jamb edge~~.

E. Accessories: Provide all components recommended by hardware manufacturer or required to achieve a complete installation.

F. Fasteners: Provide all fasteners required, of type recommended by hardware manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until support and floor substrates have been properly completed.

B. Verify that structural supports are level and of adequate strength to support the applied loads.

C. Verify opening dimensions prior to fabrication and assembly.

D. Notify Architect of unsatisfactory conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install hardware level, plumb, sure, true and straight.

C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.

D. Clean track and hardware surfaces before hanging sliding doors.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION

Section 08840 - TRANSLUCENT GLAZING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Engineering and drafting of production documents, including structural calculations of the entire skylight system.
B. Fabrication and erection of skylight frames.
C. Fabrication and erection of the aluminum gutter system including, when applicable, insulation and pitched liners.
D. Applied finish of aluminum extrusions and sheet.
E. Skylight polycarbonate glazing.
F. Skylight related flashings.

1.02 RELATED SECTIONS

A. Structural Steel: *Division 05*
B. Space Frames: *Division 05*
C. Metal Fabrications: *Division 05*
D. Flashing and Sheet Metal: *Division 07*
E. Glazing: *Division 08*
F. Glazed Curtain Walls: *Division 08*
G. Roofing: *Division 07*
H. Sealants: *Division 07*

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Extruded aluminum members with a system of alternate serrations for attachment of exterior polycarbonate retainers with 1/4-in. x 20 stainless steel screws.
   2. Condensation guttering system integral with skylight framing members for positive drainage of condensation.
B. Performance Requirements:
   1. Structural Members: Of sufficient sizes to support design loads as prescribed by governing building codes.
   2. The deflection of the framing member in a direction normal to the glazing plane of when subjected to a uniform load deflection test in accordance with ASTM E330, and per the above specified loads, shall not exceed L/100.
   3. Water Penetration: No water penetration shall occur when the system is tested in accordance with ASTM E331 using a differential static pressure of 20% of the inward acting design wind load pressure, but not less than 7 psf. Water penetration is defined as the appearance of uncontrolled water other than condensation on the interior surface of any part of the skylight.

a. Drain water penetrating at joints as well as condensation occurring within the system to exterior face of the work.

4. Thermal Movement: Provide for expansion and contraction of component materials as will be caused by an exterior surface temperature range of (+/-) 85 ºF, ranging from –20 ºF to 150 ºF, and an interior surface temperature range of (+/-) 40 ºF, ranging from 40 ºF to 120 ºF. Adjustments in the exterior and interior temperature ranges should be made, based on specific project locations and conditions. The skylight system should allow for thermal movements without buckling, sealant failure, undue material stress, and other detrimental affects.
5. Where permitted by code, a 1/3 increase in allowable stress for wind or seismic load shall be acceptable, but not in combination with any reduction applied to combined loads. In no case shall allowable values exceed the yield stress.
6. Compression flanges of flexural members may be assumed to receive effective lateral bracing only from anchors to the building structure and horizontal glazing bars or interior trim which are in contact with 50% of the member's total depth.
7. Skylight framing is designed to be self-supporting between the support construction. The skylight(s) will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the skylight(s). Design or structural engineering services for the supporting structure or building components not included in the skylight scope are not included under this section.

1.04 SUBMITTALS

A. Submit (_____) copies of shop drawings plans, elevations, and section as required to fully describe the skylight construction for the Architects' approval prior to starting fabrication.
B. Submit structural calculations prepared in accordance with the Aluminum Association's Specifications for Aluminum Structures (SAS30) by a civil engineer qualified in the design of self-supporting skylights and licensed in the State of _____.
C. Submit test reports from an independent recognized testing laboratory, or a full size system sample, showing the skylight system has been designed to allow the glazing material to expand and contract in both the X and Y axis. In lieu of test reports, a full size skylight sample may be submitted to the architect for his approval.
D. Submit [____] 12-in. x 12-in. samples of the glazing material.
E. Submit [____] 12-in. long snap-on cap.
F Submit [____] 6-in. long samples of extrusions (with appropriate finish).
G. Submit [____] sets of as-built drawings and cleaning and maintenance manuals upon completion of skylight installation.

1.05 QUALITY ASSURANCE

A. Work of this Section, including design, engineering, fabrication, finishing, preparation at the job site, erection and glazing of the skylight system shall be the responsibility of the skylight manufacturer. The manufacturer shall be regularly engaged in the preceding phases of construction of skylights and able to demonstrate that he has performed successfully on comparably sized projects and of comparable design complexity over at least ten years.

1.06 WARRANTY

A. Submit manufacturer's warranty certifying that skylight work was furnished and installed in accordance with the Contract Documents.
B. Certify that skylight system is free of defects in design, material, and construction for a period of ten (10) years from the Date of Skylight Completion including, but not limited to, leakage, thermal stress, buckling, oil canning, seal failure, audible noises due to expansion and contraction.
C. Warrant polycarbonate against defective materials, color change and hail damage per the polycarbonate manufacturer's ten (10) year prorated warranty.
D. Warrant structural sealant for a period of ten (10) years per sealant manufacturer's standard warranty of merchantable quality. Warranty shall certify that cured sealant:
   1. Will not become brittle or crack due to weathering or normal expansion and contraction of adjacent surfaces.
   2. Will not harden beyond a Shore A 50 (+/-5) durometer, nor soften below a minimum of 10 points.
   3. Will not change color significantly when used with compatible back-up materials.
   4. Will not bleed significantly.
E. Warrant finish per the manufacturer's standard warranties.
F. Optional extended warranties may be available on some products at an additional cost.
G. Warranty service becomes effective only following payment in full for the contract amount.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Contract documents are based on products manufactured by Super Sky Products, Inc.; 10301 N. Enterprise Drive; Mequon, WI 53092; Phone (800) 558-0457, (262) 242-2000; Fax (262) 242-7409;
   www.supersky.com.

B. Other manufacturers will be considered when the following conditions have been met.
   1. Optional manufacturers must pre-qualify to bid not less than fourteen (14) days prior to the bid closing date.
   2. Complete details are submitted for review by the Architect showing compliance to the drawings and Contract Documents.
   3. Submit system sample showing system's ability to expand and contract in both the X and Y axis.
      a. Systems which mechanically fasten the glazing material are not allowed.
   4. Certify that system will not be audible to the human ear during a twenty-four hour expansion and contraction cycle.
   5. Submit a 18-in. square sample of cellular glazing material.
      a. Glazing material with a ribbed interior surface plane(s) is not allowed.
      b. Multi-cellular glazing material shall have a minimum .7-in. on center, vertical inner wall spacing and a maximum of six horizontal layers.
   6. Certify that the glazing material freely allows condensation to weep from system and that condensation will not significantly affect light transmission values.
   7. Certify that the glazing material does not have any "blinding" optical characteristics during the daylight period for 365 days.
   8. Submit a 12-in. long sample of the anti-dust impermeable tape.
   9. Submit a 12-in. long sample of the aluminum retainer.

2.02 MATERIALS

A. Framework:
   1. Principal Supporting Members: .125-in. minimum thickness extruded aluminum, alloy 6005-T5 or 6061-T6 per ASTM B221. Sizes, shapes and profiles as indicated on the Contract Drawings.
   2. Snap-on Covers and Miscellaneous Non-supporting Trim: .062-in. minimum thickness extruded aluminum, alloy 6063-T5 per ASTM B221.
   3. Supporting aluminum gutters: thickness as prescribed by skylight engineer, based on skylight reactions and applied design loads.
   4. Principal Formed Metal Members: .125-in. minimum thickness aluminum, alloy (5052) (6061-T6) per ASTM B209.

B. Glazing Strips:
   1. Extruded EDPM rubber designed to comply with the following specifications:
      a. Hardness: ASTM D2240, Type A: Durometer 50 (+/-5).
      b. Tensile Strength: ASTM D412. 800 psi (min.).
      c. Elongation: 300% (min.).
      d. Color: Black.
   2. Compression Set: ASTM D395 Method B, 22 hours @ 212 ºF: 25% (max.).
   3. Heat Aging Characteristics:
      a. 70 hours @ 212 ºF.
      b. Hardness: ASTM D2240, Type A: Durometer 50 (+/-5).
      c. Tensile Change: ASTM D412. -10%.
      d. Elongation Change: ASTM D412: -20%.
   4. ASTM D1171 Weather Resistance at 1 Part Ozone per Million, 500 hours at 20% Elongation: No cracks.
   5. No visual checks, cracks or breaks after completion of tests.

C. Fasteners:
   1. For Exterior Cap Retainers: ASTM A193 B8 300 series stainless steel screws.
   2. For Framework Connections: ASTM B211 2024-T4 aluminum, ASTM A193 B8 300 series stainless steel, and ASTM B316 aluminum rivets, as required by connection.
   3. For Anchoring Skylight to Support Structure: ASTM A307 zinc plated steel fasteners.
   4. Exposed stainless steel truss head mechanical fasteners are utilized in accordance with standard connection details.

D. Flashing:
   1. 5005 H34 aluminum .040-in. minimum thickness.
   2. Sheet metal flashings/closures/claddings are to be furnished shop formed to profile in min. 10-ft. lengths, when lengths exceed 10-ft. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap 6-in. to 8-in. minimum, set in a full bed of sealant and riveted if required.

E. Exposed metal finish [interior and exterior] [interior] [exterior] to comply with the following:

The following is a listing of all types of finishes that can be specified, therefore, only those finishes that apply should be used in an individual specification.

   1 High Performance Pigmented Organic Coatings: AAMA 2605-05 [2-coat] [3-coat] [4-coat] min. 70% PVDF fluropolymers [standard] [custom] [mica] [exotic] [metallic].
   2. Pigmented Organic Coatings: AAMA 2604-05 [2-coat] min. 50% PVDF fluropolymers [standard] [custom] [mica].
   3. Anodized Coatings:
      a. AAMA 611-98 Architectural Class I clear anodized Type AA-M10C22A41: **215-R1**.
      b. AAMA 611-98 Architectural Class I electrolytically deposited color anodized Type

AA-M10C22A44: [light bronze] [medium bronze] [dark bronze] [black].

F. Polycarbonate Glazing Panels:
   1. Thermal and solar performance:
      a. Insulation Value ("U") per ASTM C236 configured for/or NFRC 100 _.26___.
      b. Light Transmission _____/_____; Quadrants (L.T.%) _____ per ASTM E1175.
      c. Solar Transmission _____/_____; Quadrants (L.T.%) _____ per ASTM #1084.
   2. Flammability
      a. The exterior and interior faces shall be an approved light transmitting panel with a CC1 fire rating classification per ASTM D-635. Smoke density no greater than 50 per ASTM D2843 and self-ignition temperature of 1058°F per ASTM 1929.
      b. The exterior and interior faces shall have a flame spread of 5 per ASTM E84.
   3. Weatherability:
      a. The exterior and interior faces shall not change color more than 3.0 units (DELTA-E by ASTM D2244) after 120 months outdoor weathering an average of at least two samples.

      b. The exterior and interior faces shall be tested by recognized laboratory for weathering evaluation per ASTM D4364-84 (EMMAQUA, UNBACKED), after exposure to minimum concentrated natural sunlight radiation of 5600 MJ/M^2 U.V. (200-385 NM). The exterior and interior faces shall not change.
         2.1 Color more than 3.0 units Delta E, 5.0 units Delta L and Delta B
         2.2 Yellowing index more than 10 units Delta Y per ASTM D1925.
      c. The light transmission as measured by ASTM D1003, shall not decrease more than 6% over ten (10) years.
   4. Appearance:
      a. The panels shall be uniform in color, with cellular cross section.
   5. Impact Resistance:
      a. The panels shall provide for the following minimum performance:
         1.1. ASTM E-822-81 - Velocity up to 82-ft. per second using ice balls of up to 1.1-in.
         1.2. ASTM D-3841/SPI - Impact and Shatter Resistance of 200 ft. lbs.

2.03 FABRICATION

A. Construct skylight(s) using extruded aluminum members.
B. Construct skylight(s) using a continuous aluminum curb with expansion joints as required.
C. Insofar as practicable, fit and assemble work in the manufacturer's shop. Work which cannot be permanently assembled shall be shop-assembled, marked, and disassembled before shipment to the jobsite.
D. Design rafter bars for slide-in type spline glazing strips.
E. Design polycarbonate retainer fasteners to resist uplift loadings. Spacing to be determined by structural calculations, when applicable.
F. Shop locate drill and bolt, or weld aluminum clips to framing members.
G. Locate weepholes in curb to positively drain condensation to exterior of skylight at each rafter connection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Upon arrival to the jobsite for installation of the specified work, the manufacturer's erector is to examine the structure and substrate to determine that it is ready to receive the skylight work. Report any faults to the General Contractor prior to proceeding with skylight installation. The skylight manufacturer is not responsible for faulty structure and substrate.

3.02 PREPARATION

A. Contact between aluminum and dissimilar metals shall receive a protective coating of asphaltic paint for the prevention of electrolytic action and corrosion.
B. Skylight manufacturer and manufacturer's erector excludes all field measuring, demolition, removal, replacement, or re-work of any existing material.

3.03 INSTALLATION

A. Install skylight frame, polycarbonate and accessory items as needed in accordance with manufacturer's instructions.
B. Install skylight system under the direction of the skylight manufacturer's designated erector.
C. Erect system plumb and true, in proper alignment and relation to established lines and grades as shown on approved shop drawings.

D. Anchor skylight to structure in strict accordance with approved shop drawings. Apply sealing materials in strict accordance with sealant manufacturer's instructions. Before application remove mortar dirt, dust, moisture and other foreign matter from surfaces it will contact. Mask adjoining surfaces to maintain a clean and neat appearance. Tool sealing compounds to fill the joint and provide a smooth finish.
E. Furnishing of temporary covering and weatherproofing of the skylight openings, if required by the General Contractor, and removal of the protective measures during and after the skylight installation is excluded by the manufacturer and the manufacturer's erector. ANY TEMPORARY COVERINGS THAT MAY BE REQUIRED ARE NOT TO OBSTRUCT OR INTERFERE WITH THE SKYLIGHT INSTALLATION IN ANYWAY.

3.04 FIELD QUALITY CONTROL

A. Water Leakage: Field check in accordance with AAMA 501.2 in proportionate areas. There shall be no uncontrolled water leakage as defined in AAMA 501.2. Water supply to the skylights, with adequate water pressure, is to be furnished by the General Contractor. Tests are to be conducted upon completion of the installation with no remobilization or down time included to accommodate either water supply availability or witness personnel schedules. Testing is to be performed by the manufacturer's authorized personnel with a maximum of five (5) man-hours for set-up, testing and clean-up. Independent laboratory testing and reports, if required, are to be ordered and directed by the Owner and/or General Contractor.

3.05 CLEANING

A. Install skylight frame and associated metal to avoid soiling or smudging the finish.

B. Clean polycarbonate and frame at time of installation. Final cleaning, if required, subsequent to completion of project, is not to be performed by the manufacturer.

3.06 PROTECTION

A. The skylight manufacturer does not provide, nor does it include any temporary protection to the skylight and its materials after the installation is complete. Protection of the skylight from ongoing work by other trades shall be the responsibility of the General Contractor. The manufacturer is responsible only for the damage caused by the personnel under its control and responsibility.

END OF SECTION

SECTION 09250 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.

B. Related Sections include the following:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: [Manufacturer's standard size] <Insert size> for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Moisture- and Mold-Resistant Assemblies: Provide and install moisture- and mold-resistant glass-mat gypsum wallboard products with moisture-resistant surfaces complying with ASTM C 630 and ASTM C 1177 where indicated on Drawings and in all locations which might be subject to moisture exposure during construction.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

D. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

   a. Each level of gypsum board finish indicated for use in exposed locations.
   b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated. 4’ x 12’ (or 8’) typical

2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Basis-of-Design Product: The design for each type of gypsum board and related products is based on G-P Gypsum products named. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

      a. American Gypsum Co.

b. BPB America Inc.
c. Lafarge North America Inc.
d. National Gypsum Company.
e. PABCO Gypsum.
f. Temple.
g. USG Corporation.

B. Regular Type:

1. Basis-of-Design Product: G-P Gypsum; "[DensArmor Plus Paperless Interior Panel] [ToughRock Gypsum Board]."
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

C. Type X:

1. Basis-of-Design Product: G-P Gypsum; "[DensArmor Plus Fireguard Paperless Interior Panel] [ToughRock Fireguard Gypsum Board]."
2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

D. Type C:

1. Basis-of-Design Product: G-P Gypsum; "[DensArmor Plus Fireguard C Paperless Interior Panel] [ToughRock Fireguard C Gypsum Board]."
2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
3. Long Edges: Tapered.

E. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Basis-of-Design Product: G-P Gypsum; "ToughRock FlexRoc Gypsum Board".
2. Thickness: 1/4 inch (6.4 mm).
3. Long Edges: Tapered.

F. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Basis-of-Design Product: G-P Gypsum; "[DensArmor Plus Paperless Interior Panel] [ToughRock CD Ceiling Board]."
2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

G. Foil-Backed Type:
1. Core: [As indicated on Drawings] [3/8 inch (9.5 mm), regular type] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings].
2. Long Edges: [Tapered] [Tapered and featured (rounded or beveled) for prefilling].

H. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.
1. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
2. Long Edges: Tapered.

I. High-Impact Type: Manufactured with Type X core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).
   1. Core: [As indicated on Drawings] [5/8 inch (15.9 mm) thick] <Insert thickness>.
   2. Plastic-Film Thickness: [0.010 inch (0.254 mm)] [0.020 inch (0.508 mm)] [0.030 inch (0.762 mm)] [0.081 inch (2.057 mm)].

J. Examples of moisture- and mold-resistant panels include; moisture- and mold-resistant type with moisture-resistant surfaces: G-P's "DensArmor Plus Paperless Interior Panel" panels, which have coated glass-mat facings and comply with both ASTM C 36/C 36M and ASTM C 1177/C 1177M. Mold-resistant type; USG's "SHEETROCK Brand HUMITEK" panels and National Gypsum's "XP Wallboard," which are both paper faced and comply with ASTM C 36/C 36M.Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

   1. Basis-of-Design Product: G-P Gypsum; "[DensArmor Plus Paperless Interior Panel] [DensArmor Plus Fireguard Paperless Interior Panel] [DensArmor Plus Fireguard C Paperless Interior Panel]."
   2. Core: [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm), Type X] [1/2 inch (12.7 mm), Type C].
   3. Long Edges: Tapered.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 931/C 931M or ASTM C 1396/C 1396M, with manufacturer's standard edges.
   1. Basis-of-Design Product: The design for each type of gypsum board and related products is based on G-P Gypsum products named. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

      a. American Gypsum Co.
      b. BPB America Inc.
      c. Lafarge North America Inc.
      d. National Gypsum Company.
      e. PABCO Gypsum.
      f. Temple.
      g. USG Corporation.
      h. <Insert manufacturer's name.>

   2. Core: [As indicated] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.

   1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum.
   2. Core: [As indicated] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
   3. Long Edges: Square.

2.4 GYPSUM TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M or ASTM C 1396/C 1396M.
   1. Basis-of-Design Product: The design for each type of gypsum board and related products is based on G-P Gypsum products named. Subject to compliance with

requirements, provide the named product or a comparable product by one of the following:

a. American Gypsum Co.
b. BPB America Inc.
c. Lafarge North America Inc.
d. National Gypsum Company.
e. PABCO Gypsum.
f. Temple.
g. USG Corporation.
h. <Insert manufacturer's name.>

2. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings].

B. Glass-Mat, Water-Resistant Backing Board with Water-Resistant Coating:

1. Complying with ASTM C 1178/C 1178M.

a. Product: Subject to compliance with requirements, provide "DensShield Tile Backer" by G-P Gypsum.

2. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].

3. Long Edges: Square.

C. Glass-Mat Water-Resistant Tile-Backing Panel:

1. Complying with ASTM C1177/C 1177M.

a. Product: Subject to compliance with requirements, provide "DensArmor Plus Paperless Interior Panel" by G-P Gypsum.

2. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].

3. Long Edges: Tapered.

4.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: [Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet] [Galvanized or aluminum-coated steel sheet or rolled zinc] [Plastic] [Paper-faced galvanized steel sheet].
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.

d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: [Hot-dip galvanized steel sheet, plastic, or rolled zinc] <Insert material>.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.
d. <Insert manufacturer's name.>

3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
4. Finish: [Corrosion-resistant primer compatible with joint compound and finish materials specified] <Insert requirements for Class II anodic finishes and factory-painted, baked-enamel finishes>.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Basis-of-Design Product: ["G-P Gypsum; ToughRock Tape"] [10-by-10 glass mesh].
2. Interior Gypsum Wallboard: Paper.
3. Exterior Gypsum Soffit Board: Paper.
4. Glass-Mat Gypsum Wallboard: [Paper] [10-by-10 glass mesh].
5. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
6. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints[, rounded or beveled panel edges,] and damaged surface areas, use setting-type taping compound.

a. Basis-of-Design Product: G-P Gypsum; "[ToughRock Setting Compound] [ToughRock Sandable Setting Compound]."

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use [setting-type taping] [drying-type, all-purpose] compound.

   a. Basis-of-Design Product: G-P Gypsum; "[ToughRock Setting Compound] [ToughRock Sandable Setting Compound] [ToughRock Ready Mix All-Purpose Joint Compound]."

   b. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use [setting-type, sandable topping] [drying-type, all-purpose] compound.

   a. Basis-of-Design Product: G-P Gypsum; "[ToughRock Setting Compound] [ToughRock Sandable Setting Compound] [ToughRock Ready Mix All-Purpose Joint Compound] [ToughRock Ready Mix Topping Joint Compound]."

4. Finish Coat: For third coat, use [setting-type, sandable topping] [drying-type, all-purpose] compound.

   a. Basis-of-Design Product: G-P Gypsum; "[ToughRock Setting Compound] [ToughRock Sandable Setting Compound] [ToughRock Ready Mix All-Purpose Joint Compound] [ToughRock Ready Mix Topping Joint Compound]."

5. Skim Coat: For final coat of Level 5 finish, use [setting-type, sandable topping compound] [drying-type, all-purpose compound] [high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish].

   a. Basis-of-Design Product: G-P Gypsum; "[ToughRock Setting Compound] [ToughRock Sandable Setting Compound] [ToughRock Ready Mix All-Purpose Joint Compound] [ToughRock Ready Mix Topping Joint Compound]."

D. Joint Compound for Exterior Applications:

1. Basis-of-Design Product: G-P Gypsum; "ToughRock Setting Compound."
2. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
3. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Basis-of-Design Product: G-P Gypsum; "ToughRock Setting Compound."
2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
3. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
4. Glass-Mat Gypsum Wallboard: As recommended by wallboard manufacturer.
5. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."

F. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

G. Vapor Retarder: As specified in Division 7 Section "Building Insulation."

2.8 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E 84.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide G-P Gypsum; "Georgia Pacific ToughRock Ceiling Textures/Polystyrene", or a comparable product by one of the following:
      a. National Gypsum Company; Perfect Spray.
      b. USG Corporation; SHEETROCK Ceiling Spray Texture, QT.
      c. <Insert manufacturer's name; product name or designation.>

   2. Texture: [Fine] [Medium] [Coarse].

C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide G-P Gypsum; "Georgia-Pacific ToughRock Ceiling Textures/Vermiculite", or a comparable product by one of the following:
      a. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
      b. <Insert manufacturer's name; product name or designation.>

2. Texture: [Light spatter] [Spatter knock-down] <Insert texture>.

D. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. International Cellulose Corp.; SonaSpray "fc."
b. USG Corporation; USG Acoustical Plaster Finish.
c. <Insert manufacturer's name; product name or designation.>

3. Application Thickness: [1/2 inch (12.7 mm)] <Insert thickness>.
4. Fire-Test-Response Characteristics: Indices when tested according to ASTM E 84 as follows:

a. Flame Spread: Less than [25] <Insert index>.
b. Smoke Developed: Less than [450] <Insert index>.

5. NRC: [0.55] <Insert NRC> according to ASTM C 423.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type: [As indicated on Drawings] [Vertical surfaces, unless otherwise indicated].
2. Type X: [As indicated on Drawings] [Where required for fire-resistance-rated assembly] [Vertical surfaces, unless otherwise indicated] <Insert requirements>.
3. Type C: [As indicated on Drawings] [Where required for specific fire-resistance-rated assembly indicated].
4. Flexible Type: [As indicated on Drawings] [Apply in double layer at curved assemblies].
5. Ceiling Type: [As indicated on Drawings] [Ceiling surfaces].
6. Foil-Backed Type: [As indicated on Drawings] <Insert requirements>.
7. Abuse-Resistant Type: [As indicated on Drawings] <Insert requirements>.
8. High-Impact Type: [As indicated on Drawings] <Insert requirements>.
9. Moisture- and Mold-Resistant Type: [As indicated on Drawings] <Insert requirements>.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels [vertically (parallel to framing)] [horizontally (perpendicular to framing)], unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: [Fasten base layers and face layers separately to supports with screws] [Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners].

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

A. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at [showers, tubs, and where indicated] [locations indicated to receive tile]. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

C. Cementitious Backer Units: ANSI A108.11, at [showers, tubs, and where indicated] [locations indicated to receive tile].

D. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

E. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints [at locations indicated on Drawings] [according to ASTM C 840 and in specific locations approved by Architect for visual effect].

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners[, unless otherwise indicated].
2. Bullnose Bead: Use [at outside corners] [where indicated] <Insert requirements>.
3. LC-Bead: Use [at exposed panel edges] <Insert requirements>.
4. L-Bead: Use [where indicated] <Insert requirements>.
5. U-Bead: Use [at exposed panel edges] [where indicated] <Insert requirements>.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use [at exposed panel edges] <Insert requirements>.

E. Aluminum Trim: Install in locations [indicated on Drawings] <Insert requirements>.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints[, rounded or beveled edges,] and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: [Panels that are substrate for tile] [Panels that are substrate for acoustical tile] [Where indicated on Drawings] <Insert locations>.
3. Level 3: [Where indicated on Drawings] <Insert locations>.
4. Level 4: [At panel surfaces that will be exposed to view, unless otherwise indicated] <Insert locations>.

   a. Primer and its application to surfaces are specified in other Division 9 Sections.

5. Level 5: [Where indicated on Drawings] <Insert locations>.

   a. Primer and its application to surfaces are specified in other Division 9 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture[matching approved mockup and] free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.9 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09300 - Tile

PART 1 PRODUCTS

1.1 SECTION INCLUDES

A. Residential tile.
1. Ceramic Floor Tile
2. Metal Border Tile.
3. Glass Wall Tile.

B. Tile setting materials.

1.2 RELATED SECTIONS

A. Section 03505 - Self-Leveling Underlayment.

B. Section 07920 - Joint Sealants.

1.3 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI A108/A118/A136.1 - Specifications for the Installation of Ceramic Tile.
2. ANSI A137.1 - Specifications for Ceramic Tile.

B. American Society for Testing and Materials (ASTM):
1. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
2. ASTM C 150 - Standard Specification for Portland Cement.
3. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
4. ASTM C 503 - Specification for Marble Building Stone (Exterior).
5. ASTM C 615 - Specification for Granite Dimension Stone.
6. ASTM C 629 - Specification for Slate Dimension Stone.
7. ASTM C 847 - Standard Specification for Metal Lath.
8. ASTM C 1028 - Standard Test Method for Determining the Static Coefficient of Friction or Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
9. ASTM D 4397 - Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

C. Tile Council of North America (TCNA): TCA Handbook for Ceramic Tile Installation, 2007.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: Tile on walkway surfaces shall meet or exceed the following values as determined by testing in conformance with ASTM C 1028.
1. Level Surfaces: Minimum of 0.6 (Wet).
2. Step Treads: Minimum of 0.6 (Wet).
3. Ramp Surfaces: Minimum of 0.8 (Wet).

1.5 SUBMITTALS

A. Submit under provisions of Section 01300. Obtain approvals of submittals prior to delivering products to the jobsite.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

D. Selection Samples: Color charts illustrating full range of colors and patterns.

E. Selection Samples: Full-size samples of actual tiles for selection.

F. Verification Samples: For tile 8 by 8 inches (203 by 203 mm) and smaller, mount actual units on minimum 12 by 12 inch (305 by 305 mm) plywood panels and grout with selected grout. For larger tile, submit two units of each type, and grout chart indicating selections.

G. Manufacturer's Certificate: When applicable, submit a Master Grade Certificate signed by the manufacturer and the installer certifying that products meet or exceed the specified requirements of ANSI A137.1.

H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and maintenance coatings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience.

B. Single Source Responsibility: Obtain each type and color of tile from a single source. Obtain each type and color of mortar, adhesive and grout from the same source.

C. General: Provide tile that complies with ANSI A137.1 where applicable for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings.
   1. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.
   2. Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.
   3. Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging until ready for installation.

B. Protect setting materials from freezing or overheating in accordance with

manufacturer's instructions.

C. Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install adhesives in an unventilated environment.

B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during tiling and for a minimum of 7 days after completion.

1.9 EXTRA MATERIALS

A. Provide for Owner's use a minimum of 2 percent of the primary sizes and colors of tile specified, boxed and clearly labeled.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: American Olean Tile Co., which is located at: 7834 C. F. Hawn Fwy. P. O. Box 17130 ; Dallas, TX 75217; Toll Free Tel: 888-AOT TILE; Tel: 214-398-1411; Fax: 215-822-1353; Email: request info; Web: www.americanolean.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 COMMERCIAL TILE

A. Porcelain Tile:
1. Series: Ceramic
a. Floor Tile: 5/16 inch thick, grout width 1/16 inch.
b. Floor Field Tile Size: 12 by 12 inches.
c. Floor Tile Color and Pattern: As selected.
d. Mosaic Tile Size: 2 by 2 inches.

B. Wall Border Tile:
1. Series: Artistic Elements Metalworks.
a. Wall Decorative Tile Size: 4 by 12 inches.

C. Wall Tile:
1. Series: Legacy Glass.
a. Wall Tile: 5/16 inch thick, grout width 1/8 inch.
b. Wall Field Tile Size: 4 by 4 inches.

2.3 TILE SETTING MATERIALS

A. Tile Setting Materials: Comply with ANSI A108/A118/A136.1 as applicable to the installation methods referenced in Part 3 of this Section.

B. Silicone Sealant: Silicone sealant, moisture and mildew resistant type, white; use for shower floors and shower walls.

C. Patching and Leveling Compound: As recommended by tile manufacturer and compatible with both substrate and setting materials.

D. Cleavage Membrane at Floors: Polyethylene film, ASTM D 4397, 4.0 mil thickness.

E. Membrane at Walls: Polyethylene film, ASTM D 4397, 4.0 mil thickness.

F. Cementitious Backer Board: High density, cementitious, glass fiber reinforced with 2 inch (50 mm) wide coated glass fiber tape for joints and corners:
   1. Thickness: 1/4 inch (6 mm).
   2. Thickness: 1/2 inch (13 mm).
   3. Thickness: 5/8 inch (16 mm).

G. Stone Thresholds: Provide stone thresholds uniform in color and finish and fabricated from the following material:
   1. Material: Marble, ASTM C 503.
   2. Material: Granite: ASTM C 615.
   3. Material: Slate: ASTM C 629.
   4. Color and Finish: As selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Acceptability of Surfaces: Inspect surfaces to be tiled to ensure proper bonding can be achieved, and to verify that surfaces are free of curing membranes, oil, grease, wax and dust.

B. Substrate Tolerances: Before tiling, inspect surfaces to be tiled to verify that the following tolerances are not exceeded. If tolerances are exceeded, provide specified leveling coat to achieve specified tolerances.
   1. Walls: 1/8 inch in 8 feet (3 mm in 2.4 m) for dry-set mortar, epoxy and organic adhesives.
   2. Floors: 1/8 inch in 10 feet (3 mm in 3 m) for dry-set mortar and epoxy; 1/16 inch in 3 feet (1.5 mm in 1 m) for organic adhesive.

3.2 PREPARATION

A. Layout: Determine locations of control and expansion joints before starting tile work. Layout tile work to minimize cuts less than one-half tile in size.

3.3 INSTALLATION

A. General: Comply with ANSI A108/A118/A136.1 and manufacturer's recommendations. Comply with applicable TCA Handbook for Tile Installation requirements as listed below.
   1.em.

B. Floors, Interior, Wood Subfloor:
   1. TCA F141, cement mortar.
   2. TCA F149, plywood underlayment, 24 inch on center joist spacing, EGP (exterior glue plywood) latex-Portland cement mortar.

C. Walls, Interior, Wood Studs or Furring:
   1. TCA W231, cement mortar.

D. Ceilings, Soffits, Interior:
   1. TCA C311, general.
   2. TCA C312, gypsum board.
   3. TCA C315, backer board.

E. Bathtub/Shower Walls, Wood or Metal Studs:
   1. TCA B411, cement mortar.
   2. TCA B412, cementitious backer unit/fiber cement underlayment.
   3. TCA B419, coated glass mat water-resistant gypsum backer board.
   4. TCA B425, cementitious-coated foam backer board.
   5. TCA B430, fiber-reinforced water-resistant gypsum backer board.

F. Shower Receptors, Wood or Metal Studs:
   1. TCA B414, cement mortar.
   2. TCA B415, cementitious backer unit/fiber cement underlayment.
   3. TCA B420, coated glass mat water-resistant gypsum backer board.
   4. TCA B421, solid backing, bonded waterproof membrane.
   5. TCA B422, solid backing with integrated bonding flange for bonded waterproof membranes.
   6. TCA B426, cementitious-coated foam backer board.
   7. TCA B431, fiber-reinforced water-resistant gypsum backer board.

G. Tile Tubs, Fountains and Curbs, Waterproof Membrane: TCA B417, cement mortar.

H. Thresholds: TCA TR611.

I. Glass Tile: As recommended by manufacturer.

J. Metal and Metalized Tile: As recommended by manufacturer.

3.4 CLEANING AND PROTECTION

A. Cleaning: Clean tile within time period recommended by manufacturer, using materials recommended by manufacturer.

B. Protection: Prohibit foot and wheeled traffic from floors for a minimum of 3 days. Where traffic is unavoidable, provide large flat boards in walkways and wheelways for a minimum of 7 days after installation. Protect from construction dirt and debris with heavy-duty, non-staining construction paper, masked in place.

3.5 SCHEDULE

A. Schedule of Tile and Setting Methods:

END OF SECTION

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes **field-**finished wood flooring.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each exposed finish.

C. LEED Submittals:

1. Product Data for Credit EQ 4.1: For installation adhesives, including VOC content.
2. Product Data for Credit EQ 4.2: For field-applied finishes for wood flooring, including VOC content.
3. Product Data for Credit EQ 4.4: For composite wood products, documentation indicating that the bonding agent contains no urea formaldehyde.
4. Certificates for Credit MR 7: Chain-of-custody certificates certifying that wood flooring complies with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

    a. Include statement indicating costs for each certified wood product.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Forest Certification: Provide wood components produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. Hardwood Flooring: Comply with NOFMA's "Official Flooring Grading Rules" for species, grade, and cut.

1. Certification: Provide flooring that carries NOFMA grade stamp on each bundle or piece.

D. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.

1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.

E. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.

B. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

1.5 PROJECT CONDITIONS

A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.

1. Environmental Conditioning: Maintain an ambient temperature between 65 and 75 deg F and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.

a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.

B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 FIELD-FINISHED WOOD FLOORING

A. Solid-Wood, **Strip and Plank** Flooring: Kiln dried to 6 to 9 percent maximum moisture content, tongue and groove and end matched, and with backs channeled (kerfed) for stress relief.

1. Manufactured and produced by Meltwater Team

2. Species and Grade: [**Select red oak**] [**No. 1 Common red oak**] [**No. 2 Common red oak**] [**MFMA-RL First Grade hard maple**] [**MFMA-RL Second and Better Grade hard maple**] [**C & BTR - Flooring Douglas fir**] [**D - Flooring Douglas fir**] <**Insert species and grade**>.
3. Cut: [**Plain sawn**] [**Quarter/rift sawn**] [**Edge grain**] [**Vertical grain**] <**Insert description**>.
4. Thickness: [**3/4 inch (19 mm)**] [**25/32 inch (20 mm)**] <**Insert dimension**>.
5. Face Width: [**2-1/4 inches (57 mm)**] [**3-1/8 inches (79 mm)**] [**5-1/8 inches (130 mm)**] <**Insert dimension**>.
6. Lengths: [**Random-length strips complying with applicable grading rules**] [**Lengths required to form pattern indicated**] <**Insert requirements**>.

7. Preservative Treatment: Clear, penetrating, water-repellent wood preservative that protects against mold, mildew, staining, and decay fungi; complying with MFMA's written recommendations and applied by immersion.
8. Simulated Wood Pegs: Contrasting wood pegs at ends of plank flooring pieces.

B. Solid-Wood Parquet Flooring: Kiln dried to 6 to 9 percent maximum moisture content.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Harris Tarkett Wood Floors; <**Insert product**>.
   b. Kentucky Wood Floors; <**Insert product**>.
   c. <**Insert manufacturer's name; product name or designation.**>

3. Species: [**Red oak**] [**White oak**] [**Ash**] [**Maple**] [**Black cherry**] <**Insert species**>.
4. Grade: <**Insert grade.**>
5. Thickness: [**5/16 inch (8 mm)**] [**11/16 inch (17 mm)**] [**1/4 inch (6 mm)**] <**Insert dimension**>.
6. Pattern: <**Insert description.**>
7. Size: <**Insert dimensions.**>

C. Engineered-Wood, [**Strip**] [**and**] [**Plank**] Flooring: HPVA EF[**, except bonding agent contains no urea formaldehyde**].

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Kentucky Wood Floors; <**Insert product**>.
   b. Mannington Mills, Inc.; <**Insert product**>.
   c. Oregon Lumber Company; <**Insert product**>.
   d. Robbins, Division of Armstrong; <**Insert product**>.
   e. <**Insert manufacturer's name; product name or designation.**>

3. Species: [**Red oak**] [**White oak**] [**Ash**] [**Beech**] [**Maple**] [**Black cherry**] <**Insert species**>.
4. Grade: <**Insert grade.**>
5. Thickness: [**1/2 inch (13 mm)**] [**3/8 inch (9.5 mm)**] <**Insert dimension**>.
6. Construction: [**Five**] [**Three**] ply.
7. Width: [**2-1/4 inches (57 mm)**] [**3 inches (76 mm)**] <**Insert dimension**>.
8. Length: Manufacturer's standard.

D. Urethane Finish System: Complete [**solvent-based, oil-modified**] [**water-based**] system of compatible components that is recommended by finish manufacturer for application indicated.

1. VOC Content: When calculated according to 40 CFR 59, Subpart D (EPA Method 24), as follows:

   a. Finish Coats and Floor Sealers: Not more than 350 g/L.
   b. Stains: Not more than 250 g/L.

2. Finish Coats: Formulated for multicoat application on wood flooring.

a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
b. Products: Subject to compliance with requirements, provide one of the following:

1) Basic Coatings, Inc.; <**Insert product**>.
2) BonaKemi USA Inc.; <**Insert product**>.
3) Dura Seal, Sherwin-Williams Company (The); <**Insert product**>.
4) Ecolab Inc., Huntington Brand; <**Insert product**>.
5) Hillyard, Inc.; <**Insert product**>.
6) Polo-Plaz Coatings, National Coatings Company; <**Insert product**>.
7) <**Insert manufacturer's name; product name or designation.**>

3. Stain: Penetrating and nonfading type.

a. Color: [**Match sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

4. Floor Sealer: Pliable, penetrating type.

E. Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.2 ACCESSORY MATERIALS

A. Wood Sleepers and Subfloor: [**As specified in Division 06 Section "Rough Carpentry."**] <**Insert requirements.**>

B. Wood Underlayment: [**As specified in Division 06 Section "Rough Carpentry."**] <**Insert requirements.**>

C. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than [**6.0 mils (0.15 mm)**] [**8.0 mils (0.2 mm)**] thick.

D. Asphalt-Saturated Felt: ASTM D 4869, Type II.

E. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

1. Use adhesives that have a VOC content of not more than [**100 g/L**] <**Insert requirement**> when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

G. Fasteners: As recommended by manufacturer, but not less than that recommended in [**NWFA's "Installation Guidelines: Wood Flooring."**] <**Insert standard or publication.**>

H. Cork Expansion Strip: Composition cork strip.

I. Feature Strips: [**2-inch- (51-mm-) wide, square-edged walnut strips**] <**Insert description**> furnished in lengths as long as practical and in thickness to match wood flooring.

J. Metal Feature Strips: [**1/8-by-1/8-inch (3-by-3-mm) solid-brass strip**] <**Insert description**>, designed for inlaying into routed reveal in wood flooring surface.

K. Trim: In same species and grade as wood flooring, unless otherwise indicated.

1. Base: [**5/8 inch (16 mm) thick by 4 inches (100 mm) high**] <**Insert dimensions**>.
2. Base Shoe Molding: [**1/2 by 3/4 inch (13 by 19 mm)**] <**Insert dimensions**>.
3. Threshold: Tapered on each side and routed at bottom of one side to accommodate wood flooring.
4. Reducer Strip: [**2 inches (51 mm)**] <**Insert dimension**> wide, tapered on 1 side, and in thickness matching wood flooring.

L. Wood air vents and grilles of same species and grade as wood flooring and in sizes indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. For adhesively applied wood flooring, verify that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Substrate Moisture Testing, General: Perform tests recommended by manufacturer or, if none, comply with applicable recommendations in [**NWFA's "Installation Guidelines: Wood Flooring."**] <**Insert standard or publication.**>

1. Proceed with installation only after substrates pass testing.

C. Concrete Substrates:

1. Moisture Testing: Perform anhydrous calcium chloride test per ASTM F 1869, as follows:

a. Perform tests so that each test area does not exceed [**200 sq. ft. (18.6 sq. m)**] <**Insert area**> and perform not less than 2 tests in each installation area with test areas evenly spaced in installation area.
b. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [**3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**] [**4.5 lb of water/1000 sq. ft. (2.04 kg of water/92.9 sq. m)**] in 24 hours.
c. Perform alkalinity and adhesion tests recommended in writing by manufacturer or, if none, according to [**NWFA's "Installation Guidelines: Wood Flooring."**] <**Insert standard or publication.**> Proceed with installation only after substrates pass testing.

2. Grind high spots and fill low spots on concrete substrates to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.

a. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in [**NWFA's "Installation Guidelines: Wood Flooring."**] <**Insert standard or publication.**>

B. Wood Sleepers and Subfloor: [**Install according to requirements in Division 06 Section "Rough Carpentry."**] <**Insert requirements.**>

C. Wood Underlayment: [**Install according to requirements in Division 06 Section "Rough Carpentry."**] <**Insert requirements.**>

D. Provide expansion space at walls and other obstructions and terminations of flooring [**as indicated on Drawings**] [**of not less than 3/4 inch (19 mm)**] <**Insert requirements**>.

E. Asphalt-Saturated Felt: Where strip or plank flooring is nailed to solid-wood subfloor, install flooring over a layer of asphalt-saturated felt.

F. Vapor Retarder:

1. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
2. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet according to flooring manufacturer's written instructions.

G. Solid-Wood, [**Strip**] [**and**] [**Plank**] Flooring: Blind nail or staple flooring to substrate.

1. For flooring of face width more than 3 inches (75 mm), do the following:

a. Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.
b. Install no fewer than 2 countersunk nails at each end of each piece, spaced not more than 16 inches (406 mm) along length of each piece, in addition to blind nailing. Fill holes with matching wood filler.

H. Solid-Wood Parquet Flooring: Set in adhesive.

I. Engineered-Wood Flooring: [**Set in adhesive**] [**Nail or staple**] [**Install floating floor**].

J. Wood Trim: Nail baseboard to wall and nail shoe molding or other trim to baseboard; do not nail to flooring.

3.3 FIELD FINISHING

A. Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.

1. Comply with applicable recommendations in [**NWFA's "Installation Guidelines: Wood Flooring."**] **<Insert standard or publication.>**

B. Fill [**open-grained hardwood**] **<Insert description of wood to be filled>**.

C. Fill and repair wood flooring seams and defects.

D. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and [**three**] **<Insert number>** finish coats.

1. Apply stains to achieve an even color distribution matching approved Samples.
2. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.

E. Cover wood flooring before finishing.

F. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.4 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 09900 – PAINTING & COATING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Interior paint, except clear finishes and stains.
2. Exterior paint, except clear finishes and stains.
3. Specialty coatings.
a. Radiation Control Coatings.
b. Anti-Corrosive Paint

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:
1. Recycled Content:
a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. VOC data: Submit Green Seal Certification to GS-11 and description of the basis for certification.

B. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

1.3 QUALTIY ASSURANCE

SPECIFIER NOTE:
The EPA national VOC rule for architectural and industrial maintenance (AIM) coatings and Green Seal GS-11 reference EPA method 24. The AIM rule also explicitly allows for the use of formulation data with the caveat that formulation must be able to stand up to a check by EPA method 24.

ASTM D3960-04 references ASTM D6886 Test Method for Speciation of the Volatile Organic Compounds (VOCs) in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography. This new ASTM method gives a direct measurement of VOC in these coatings. Both EPA method 24 and ASTM D3960 indirectly measure VOC in waterborne coatings by first measuring total volatiles (using ASTM D2369) and then measuring (using ASTM D3792 or D4017) and subtracting water to get VOC (VOC = total volatiles minus water). The indirect approach may result in less precision for low VOC waterborne coatings.

A. VOC Content: Determine VOC (Volatile Organic Compound) content of solvent borne and waterborne paints and related coatings in accordance with EPA Method 24 or ASTM D3960.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Paints and primers:
1. Recycled Content: Minimum **[20] [xxxx]** percent post-consumer recycled content for light colors; minimum **[50] [xxxx]** percent post-consumer recycled content for dark colors.
2. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.
   a. Interior paint: Comply with GS-11.
   b. Exterior paint: Comply with GS-11.

B. Specialty Coatings:
1. Radiation Control Coatings: Minimum solar reflectance of cured coating 0.8 and minimum ambient temperature total hemispherical emittance of cured coating at least 0.08 in accordance with ASTM C1483.
2. Anti-Corrosive Paint: Comply with GS-03.

PART 3 - EXECUTION

3.X SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality: Provide temporary ventilation as specified in Section 01 57 19.11 (01352) – Indoor Air Quality (IAQ) Management.

B. Waste Management: As specified in Section 01 74 19 (01351) – Construction Waste Management and as follows:
1. Coordinate with manufacturer for **[take-back program].** Set aside scrap to be returned to manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

END OF SECTION

SECTION 09930 - STAINS AND TRANSPARENT FINISHES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Interior Stains and Clear Finishes.

B. Exterior Stains and Clear Finishes.

C. Surface Preparation.

1.2 RELATED SECTIONS

A. Section 06200 - Finish Carpentry: Preparation of wood surfaces to receive finishes.

B. Section 07460 - Wood Siding: Preparation of wood siding to receive finishes.

C. Section 09640 - Wood Flooring: Preparation of wood flooring to receive finishes.

1.3 REFERENCES

A. Green Seal Standard GS-11; May 20, 1993.

B. SCAQMD 1168 - South Coast Air Quality Management District Rule #1168; October 3, 2003.

C. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

1.4 DEFINITIONS

A. Stains are available in a wide range of opacities from transparent stain that allow all the grain and texture to show to solid colors which mastic all the grain but allow the texture to show. The following terms are used to describe the different opacities.
   1. Transparent.
   2. Semi Transparent.
   3. Semi Solid.
   4. Solid Color.

B. Varnishes and clear coats are available in a wide range of sheens or glosses, as measured by a gloss meter from a 60 degree angle from vertical, as a percentage of the amount of light that is reflected. The following terms are used to describe the gloss of our products.
   1. Flat: 10 - 20 Percent.
   2. Satin / Low Lustre: 20 - 35 Percent.
   3. Semi Gloss: 35 - 70 Percent.
   4. Gloss: Over 70 Percent.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Coordinate with Section 01305 - Submittals, for submittal procedures and LEED Submittal Forms MRc3, MRc4, MRc5.

C. LEED Certification Product Data:
   1. See Section 01115 - Green Building Requirements, for LEED certification submittal forms and certification templates.
   2. Submittals Required:
      a. MRc3 Resource Reuse (LEED Form).
      b. MRc4 Recycled Content (LEED Form).
      c. MRc5 Local and Regional Materials (LEED Form).
      d. EQc4.1 Low Emitting Materials - Adhesives and Solvents (VOC Certification Letter).
      e. EQc4.2 Low Emitting Materials - Paint (VOC Certification Letter).
      f. Green Seal Standard GS-11 Certified Product certificates.

D. Product Data: Provide a complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category.
   2. Cross-reference to specified paint system(s) that the product is to be used in; include description of each system.

E. Samples: Submit three paper samples, 5 inches by 7 inches (127mm x 178mm) in size, illustrating selected colors for each color and system selected with specified coats cascaded.

F. Manufacturer's Instructions: Indicate special surface preparation procedures.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-

based materials, in accordance with requirements of local authorities having jurisdiction.

C. Disposal:
1. Never pour leftover coating down any sink or drain. Use up material on the job or seal can and store safely for future use.
2. Do not incinerate closed containers.
3. For specific disposal or recycle guidelines, contact the local waste management agency or district. Recycle whenever possible.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

A. At project closeout, provide to the Owner or owner's representative an executed copy of the Manufacturer's standard form outlining the terms and conditions of and any exclusions to their Limited Warranty against Manufacturing Defect.

1.10 EXTRA MATERIALS

A. At project closeout, supply the Owner or owner's representative one gallon of each product for touch-up purposes.

B. At project closeout, provide the color mixture name and code to the Owner or owner's representative for accurate future color matching.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Benjamin Moore & Co., which is located at: 101 Paragon Dr ; Montvale, NJ 07645; Toll Free Tel: 866-708-9181; Tel: 201-573-9600; Fax: 201-573-6675; Email: request info; Web: www.benjaminmoore.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 LEED CRITERIA

A. All paints and coatings used must meet the VOC limits of Green Seal Standard GS-11:
1. Interior: 50 g/l VOC or less for Flats and 150 g/l VOC for Non Flats.
2. Exterior: 100 g/l VOC for Flats and 200 g/l VOC or Less for Non Flats.

B. EQ CR4.2 Low Emitting Materials: 1 Credit - Paint.

2.3 MATERIALS - GENERAL

A. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

B. Compatibility: Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.4 MIXING AND TINTING

A. Except where specifically noted in this section, all paint shall be ready-mixed and pre-tinted. Agitate all paint prior to and during application to ensure uniform color, gloss, and consistency.

B. Thinner addition shall not exceed manufacturer's printed recommendations. Do not use kerosene or other organic solvents to thin water-based paints.

C. Where paint is to be sprayed, thin according to manufacturer's current guidelines.

2.5 EXTERIOR WOOD

A. Wood - Exterior trim including window and door casing, rakes, fascia and soffits:
   1. Primer: Benjamin Moore Alkyd Primer 366.
   2. Primer Color: _____.
   3. Finish Material: Benjamin Moore Hardwood Finish 321/C321.
   4. Finish Material: Moorcraft Super Spec 100% Acrylic Solid Exterior Stain 177.
   5. Finish Material: Premium Exterior Stain Alkyd Clear Wood Finish N076.
   6. Finish Material: Benjamin Moore Alkyd Semi Transparent Stain 328/C328.
   7. Finish Material: Moorcraft Super Spec Acrylic Solid Color Exterior Stain 179.
   8. Finish Material: Benjamin Moore Alkyd Solid Siding Stain C080.
   9. Finish Material: Benjamin Moore Acrylic Solid Deck Stain 065.
   10. Finish Material: Benjamin Moore Alkyd Transparent Stain 323/C323.
   11. Finish Material: Benjamin Moore Acrylic Solid Siding Stain N089.
   12. Finish Material: Benjamin Moore Alkyd Semi Solid Stain 329/C329.
   13. Finish Color: Clear.
   14. Finish Color: _____.
   15. Finish Coats: One (1) coat.
   16. Finish Coats: Two (2) coats.
   17. Waterproofer: One (1) coat - Benjamin Moore Waterproofer 320.

B. Wood Siding:
   1. Primer: Benjamin Moore Alkyd Primer 366.
   2. Primer Color: _____.
   3. Finish Material: Benjamin Moore Hardwood Finish 321/C321.
   4. Finish Material: Moorcraft Super Spec 100% Acrylic Solid Exterior Stain 177.
   5. Finish Material: Premium Exterior Stain Alkyd Clear Wood Finish N076.
   6. Finish Material: Benjamin Moore Alkyd Semi Transparent Stain 328/C328.
   7. Finish Material: Moorcraft Super Spec Acrylic Solid Color Exterior Stain 179.
   8. Finish Material: Benjamin Moore Alkyd Solid Siding Stain C080.

9. Finish Material: Benjamin Moore Acrylic Solid Deck Stain 065.
10. Finish Material: Benjamin Moore Alkyd Transparent Stain 323/C323.
11. Finish Material: Benjamin Moore Acrylic Solid Siding Stain N089.
12. Finish Material: Benjamin Moore Alkyd Semi Solid Stain 329/C329.
13. Finish Color: Clear.
14. Finish Color: _____.
15. Finish Coats: One (1) coat.
16. Finish Coats: Two (2) coats.
17. Waterproofer: One (1) coat - Benjamin Moore Waterproofer 320.

C. Wood Decking and Railings:
1. Primer: Benjamin Moore Alkyd Primer 366.
2. Primer Color: _____.
3. Finish Material: Benjamin Moore Hardwood Finish 321/C321.
4. Finish Material: Premium Exterior Stain Alkyd Clear Wood Finish N076.
5. Finish Material: Benjamin Moore Alkyd Semi Transparent Stain 328/C328.
6. Finish Material: Benjamin Moore Acrylic Solid Deck Stain 065.
7. Finish Material: Benjamin Moore Alkyd Transparent Stain 323/C323.
8. Finish Material: Benjamin Moore Alkyd Semi Solid Stain 329/C329.
9. Finish Color: Clear.
10. Finish Color: _____.
11. Finish Coats: One (1) coat.
12. Finish Coats: Two (2) coats.
13. Waterproofer: One (1) coat - Benjamin Moore Waterproofer 320.

2.6 INTERIOR WOOD

A. Surface Preparation:
1. Wood Filler: Benwood Interior Wood Finishes Wood Grain Filler 238.
2. Sealer: One (1) coat Benwood Quick Dry Sanding Sealer 413.
3. Sealer Conditioner: One (1) coat Benwood Interior Wood Finishes Wood Conditioner 236.

B. Wood - Millwork including doors, door frames, window frames, window sashes and muntins:
1. Finish Material: Benwood Stays Clear Acrylic Polyurethane Low Lustre 423.
2. Finish Material: Benwood Stays Clear Acrylic Polyurethane High Gloss 422.
3. Finish Material: Benwood Interior Wood Finishes Penetrating Stain 234.
4. Finish Material: Moorcraft Super Spec Masking Stain 246.
5. Finish Material: Benwood Polyurethane Finish High Gloss 428.
6. Finish Material: Benwood Polyurethane Finish Flat C424.
7. Finish Material: Benwood Interior Wood Finishes Polyurethane Stain 228.
8. Finish Material: Benwood Polyurethane Finish Low Lustre C435.
9. Finish Material: Waterborne Urethane Gloss Clear M73.
10. Finish Material: Waterborne Urethane Semi Gloss Clear M73S.
11. Finish Color: Clear.
12. Finish Color: _____.
13. Finish Coats: One (1) coat.
14. Finish Coats: Two (2) coats.
15. Finish Coats: Three (3) coats.

C. Wood - Casework including base and wall mounted kitchen cabinets and bath vanities.

1. Finish Material: Benwood Stays Clear Acrylic Polyurethane Low Lustre 423.
2. Finish Material: Benwood Stays Clear Acrylic Polyurethane High Gloss 422.
3. Finish Material: Benwood Interior Wood Finishes Penetrating Stain 234.
4. Finish Material: Moorcraft Super Spec Masking Stain 246.
5. Finish Material: Benwood Polyurethane Finish High Gloss 428.
6. Finish Material: Benwood Polyurethane Finish Flat C424.
7. Finish Material: Benwood Interior Wood Finishes Polyurethane Stain 228.
8. Finish Material: Benwood Polyurethane Finish Low Lustre C435.
9. Finish Material: Waterborne Urethane Gloss Clear M73.
10. Finish Material: Waterborne Urethane Semi Gloss Clear M73S.
11. Finish Color: Clear.
12. Finish Color: _____.
13. Finish Coats: One (1) coat.
14. Finish Coats: Two (2) coats.
15. Finish Coats: Three (3) coats.

D. Wood - Interior trim including baseboard and millwork casing.
1. Finish Material: Benwood Stays Clear Acrylic Polyurethane Low Lustre 423.
2. Finish Material: Benwood Stays Clear Acrylic Polyurethane High Gloss 422.
3. Finish Material: Benwood Interior Wood Finishes Penetrating Stain 234.
4. Finish Material: Moorcraft Super Spec Masking Stain 246.
5. Finish Material: Benwood Polyurethane Finish High Gloss 428.
6. Finish Material: Benwood Polyurethane Finish Flat C424.
7. Finish Material: Benwood Interior Wood Finishes Polyurethane Stain 228.
8. Finish Material: Benwood Polyurethane Finish Low Lustre C435.
9. Finish Material: Waterborne Urethane Gloss Clear M73.
10. Finish Material: Waterborne Urethane Semi Gloss Clear M73S.
11. Finish Color: Clear.
12. Finish Color: _____.
13. Finish Coats: One (1) coat.
14. Finish Coats: Two (2) coats.
15. Finish Coats: Three (3) coats.

E. Wood - Interior wood flooring, stair treads and risers.
1. Finish Material: Benwood Stays Clear Acrylic Polyurethane Low Lustre 423.
2. Finish Material: Benwood Stays Clear Acrylic Polyurethane High Gloss 422.
3. Finish Material: Benwood Interior Wood Finishes Penetrating Stain 234.
4. Finish Material: Moorcraft Super Spec Masking Stain 246.
5. Finish Material: Benwood Polyurethane Finish High Gloss 428.
6. Finish Material: Benwood Polyurethane Finish Flat C424.
7. Finish Material: Benwood Interior Wood Finishes Polyurethane Stain 228.
8. Finish Material: Benwood Polyurethane Finish Low Lustre C435.
9. Finish Material: Waterborne Urethane Gloss Clear M73.
10. Finish Material: Waterborne Urethane Semi Gloss Clear M73S.
11. Finish Color: Clear.
12. Finish Color: _____.
13. Finish Coats: One (1) coat.
14. Finish Coats: Two (2) coats.
15. Finish Coats: Three (3) coats.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Ensure that surfaces to receive paint are dry immediately prior to application.

C. Ensure that moisture-retaining substrates to receive finishes have moisture content within tolerances allowed by coating manufacturer. Where exceeding the following values, promptly notify Architect and obtain direction before beginning work.
   1. Exterior Wood: 17 percent.
   2. Interior Wood: 15 percent.
   3. Interior Finish Detail Woodwork, Including Trim, and Casework: 10 percent.

D. Examine surfaces to receive coatings for surface imperfections and contaminants that could impair performance or appearance of coatings, including but not limited to, loose primer, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.

E. Correct conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.2 PREPARATION - GENERAL

A. Clean surfaces thoroughly prior to coating application.

B. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.

C. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.

D. Remove Mildew, Algae, and Fungus using materials and methods recommended by coating manufacturer.

E. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.

F. Remove or protect adjacent hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings.

G. Move or protect equipment and fixtures adjacent to surfaces indicated to receive coatings to allow application of coatings.

H. Protect adjacent surfaces not indicated to receive coatings.

I. Prepare surfaces in accordance with manufacturer's instructions for specified coatings and indicated materials, using only methods and materials recommended by coating manufacturer.

3.3 SURFACE PREPARATION

A. Seal knots, pitch streaks, and sap areas with sealer recommended by coating manufacturer; fill nail recesses and cracks with filler recommended by coating

manufacturer; sand surfaces smooth.

3.4 APPLICATION - GENERAL

A. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.

B. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.

C. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).

D. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

E. Where application abuts other materials or other coating color, terminate coating with a clean sharp termination line without coating overlap.

F. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.

G. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.5 CLEANING

A. Clean excess coating materials, and coating materials deposited on surfaces not indicated to receive coatings, as construction activities of this section progress; do not allow to dry.

B. Re-install hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items that have been removed to protect from contact with coatings.

C. Reconnect equipment adjacent to surfaces indicated to receive coatings.

D. Relocate to original position equipment and fixtures that have been moved to allow application of coatings.

E. Remove protective materials.

3.6 PROTECTION

A. Protect completed coating applications from damage by subsequent construction activities.

B. Repair to Architect's acceptance coatings damaged by subsequent construction activities. Where repairs cannot be made to Architect's acceptance, re-apply finish coating to nearest adjacent change of surface plane, in both horizontal and vertical directions.

END OF SECTION

SECTION 10400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
1. Plastic Signage.
2. Metal Signage.

B. Related Sections:
1. 09 90 00 (09900) – Painting & Coating: Painted graphics and signage.

1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Recycled Content:
a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

2. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

B. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

C. Operating And Maintenance Manuals Submittals:
1. Verify that plastic products to be incorporated into the Project are labeled in accordance with ASTM D1972. Where products are not labeled, provide product data indicating polymeric information in Operation and Maintenance Manual.
a. Type 1: Polyethylene Terephthalate (PET, PETE).
b. Type 2: High Density Polyethylene (HDPE).
c. Type 3: Vinyl (Polyvinyl Chloride or PVC).
d. Type 4: Low Density Polyethylene (LDPE).
e. Type 5: Polypropylene (PP).

f. Type 6: Polystyrene (PS).
g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plastic Signs and supports: Plastic fabrications as specified in Section 06 60 00 (06600) – Plastic Fabrications, and as follows:
1. Recycled Content: Minimum **[80] [xxxx]** percent post-consumer recycled content.

B. Aluminum Signs:
1. Recycled Content: Minimum **[25] [xxxx]** percent post-consumer recycled content.

C. Steel posts and supports:
1. Recycled Content: Minimum **[16] [xxxx]** percent post-consumer recycled content.

PART 3 - EXECUTION

END OF SECTION

SECTION 10605 - WIRE MESH Railing Material

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wire mesh Rail Material

1.2 RELATED SECTIONS

A. Section (n/a)

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Preparation instructions and recommendations.
4. Storage and handling requirements and recommendations.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.
1. Provide location template drawings for items supported or anchored to permanent construction.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Keys: Submit keys for door locks to Owner at Substantial Completion of the project.

1.4 QUALITY ASSURANCE

A. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Construct areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Repair and correct mock-up area as required to produce acceptable work.

B. Design Requirements:
1. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
2. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. McNichols Co. - Chicago Distribution Center: 847-635-5100 251 Wille Road Des Plaines IL 60018-1817 Milwaukee Office: 414-570-1881 Fax: 414-570-1882 milwaukee.sales@mcnichols.com

2. Butler Wire and Metal Products Inc. - N60 W15288 Bobolink Ave. Menomonee Falls, WI 53051; Phone: 262-252-3355 Fax: 262-252-5366 info@ButlerWire.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 PRODUCT

A. Product: Series SG2000 as manufactured by SpaceGuard Products.

B. Fabrication:
1. Wire Mesh: #10 W&M Gauge .130 inch (3.3 mm), triple crimped bright basic wire 1-1/2 inches (38 mm) diamond mesh pattern.
2. Wire Mesh: #6 W&M Gauge .192 inch (4.9 mm), welded wire steel mesh, 1-1/2 inches (38 mm) by 2-1/2 inches (64 mm) rectangular pattern.
3. Horizontal Frames: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1/8 inch (3 mm) hot rolled angle, with 1-1/4 inches (32 mm) by 7/16 inch (11 mm) slotted holes punched approximately 24 inches (610 mm) O.C.
4. Vertical Frames: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1/8 inch (3 mm) hot rolled angle notched at both ends. Two 1-1/4 inches (32 mm) by 7/16 inch (11 mm) slotted holes punched approximately 24 inches (610 mm) O.C.
5. Stiffener Bar: 1/4 inch (6 mm) by 3/4 inch (19 mm) thick hot rolled flat stock, center located and tack welded to wire mesh and horizontal frames on panels 1 foot (305 mm) to 5 feet (1524 mm) long. Panels 6 feet (1829 mm) to 10 feet (3048 m) long shall have two stiffeners bars.
6. Panels: Consisting of the above horizontal and vertical members welded at all corners, with mesh securely welded to frame. Stiffener bars, when required, shall be added at the engineered locations.
7. Flex Panels: Two 8 inches (203 mm) -16 gauge .0598 inch (1.5 mm) sheet steel punched and formed.
8. Hinge Doors: Constructed of the same materials as panels. Complete with all necessary mounting and locking hardware to install and operate.
   a. Hinges: Three 3 inches (76 mm) by 3 inches (76 mm) butt hinges, attached to adjacent post and door frame.
   b. Padlock Arrangement: 1-1/2 inches (38 mm) lug; secured to adjacent

lock side post and protrudes through slotted hole in door frame.

c. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.

9. Slide Doors: Constructed of the same materials as panels. Complete with all necessary mounting and locking hardware to install and operate.
   a. Hardware: Two 2-wheel trolleys rolling in an enclosed track, 45 inches (1143 mm) bottom door guide, and heavy-duty 30 inches (762 mm) lock receiver.
   b. Padlock Arrangement: 4 inches (102 mm) by 6 inches (152 mm) cover plate with 1-1/2 inches (38 mm) lug securing into lock opening.
   c. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.
10. Service Window (slide-up type): 24 inches (610 mm) wide by 21-1/2 inches (546 mm) high opening with 22 inches (559 mm) wide by 18 inches (457 mm) deep, #6 W&M Gauge .192 inch (4.9 mm) shelf centered in opening. Secured to base with four 1-1/4 inches (32 mm) by 12 inches (305 mm) long brackets secured by 1/4 inch (6 mm) by 1/2 inch (13 mm) hex head bolts and nuts. Window panel constructed of the same materials as standard panels and has spring bolt latches welded at bottom corners for securing in the open position.
11. Service Window (fold-down type): 24 inches (610 mm) wide by 15 inches (381 mm) high opening with a 23-1/2 inches (597 mm) by 15-3/4 inches (400 mm) by #6 gauge .192 inch (4.9 mm), deep shelf. The sheet metal shelf is hinged at the bottom with a padlock hasp and can be folded up for padlock security when not in use.
12. Corner post: 2 inches (51 mm) by 2 inches (51 mm) by 14 gauge .0747 (1.897 mm) square tube with 2 inches (51 mm) by 7 inches (178 mm) (178 mm) by 1/4 inch (6 mm) steel flat base plate punched to accept two 3/8 inch (9.5 mm) diameter anchors. A series of 5/16 inch (8 mm) diameter holes are drilled on all four sides to accept all hardware for panels and doors.
13. Adjustable Corner post: Four 3 inches (76 mm) by 3 inches (76 mm) butt hinges welded to two 2 inches (51 mm) by 2 inches (51 mm) square tubes with 2 inches (51 mm) by 4-1/2 inches (114 mm) base plates punched to accept 3/8 inch (9.5 mm) diameter anchors. Can adjust to angles other than 90 degrees.
14. Line/Run post: 2 inches (51 mm) by 2 inches (51 mm) by 14 gauge .0747 inch (1.897 mm) square tube with 2 inches (51 mm) by 7 inches (178 mm) by 1/4 inch (6 mm) steel flat base plate punched to accept two 3/8 inch (9.5 mm) diameter anchors. A series of 3/8 inch (9.5 mm) diameter holes are drilled through two sides to accept all hardware for panels.
15. Door post: 2 inches (51 mm) by 2 inches (51 mm) by 14 gauge .0747 inch (1.897 mm) square tube with 2 inches (51 mm) by 7 inches (178 mm) by 1/4 inch (6 mm) steel flat base plate punched to accept two 3/8 inch (9.5 mm) diameter anchors. A series of 3/8 inch (9.5 mm) diameter holes are drilled on all four sides to accept all hardware for panels and doors.
16. 3-Way Post: 2 inches (51 mm) by 2 inches (51 mm) by 14 gauge .0747 inch (1.897 mm) square tube with 2 inches (51 mm) by 7 inches (178 mm) by 1/4 inch (6 mm) steel flat base plate punched to accept two 3/8 inch (9.5 mm) diameter anchors. A series of 3/8 inch (9.5 mm) diameter holes are drilled on all four sides to accept all hardware for panels.
17. Sheet Metal Base - 16 gauge .0598 inch (1.519 mm) hot-rolled sheet metal.
18. Hardware: 5/16 inch (8 mm) flanged hex head bolts and nuts for all panel-to-panel, panel/door to post connections. Field bracing, floor, and wall anchors by erector.
19. Finish: Two stage Phosphate wash with a standard 2 mil (.05 mm) Polyester

Powder Coat finish of

C. Wire Mesh Ceilings:
1. Ceiling Panels: Fabricated from same mesh, framing and reinforcement bars as panels above.
2. Perimeter Angle: 1-1/2 inches (38 mm) by 1-1/2 inches (38 mm) by 14 gauge .0747 inch (1.897 mm) galvanized angle; punched for bolting to top of wire mesh wall panels and to sides of wire mesh ceiling panels.
3. Wall Supports: 1-1/2 inches (38 mm) by 1-1/2 inches (38 mm) by 14 gauge .0747 inch (1.897 mm) galvanized angle, punched for securing to existing walls and supporting wire ceiling panels.
4. Intermediate Beam Support: 2 inches (51 mm) by 4 inches (102 mm) by 14 gauge .0747 inch (1.897 mm) rectangular tube for use in spans exceeding 10 feet (3048 mm) in any two directions.
5. Intermediate Beam Support Post: 2 inches (51 mm) by 2 inches (51 mm) by 14 gauge .0747 inch (1.897 mm) square tube with 4 inches (102 mm) by 7 inches (178 mm) (178 mm) by 3/16 inch (5 mm) base plate (will accept 3/8 inch (9.5 mm) diameter anchors) 4 inches (102 mm) by 7 inches (178 mm) plate at top for support of beams.

2.3 PRODUCT

A. Product: Series FordLogan as manufactured by SpaceGuard Products.

B. Fabrication:
1. Wire Mesh: #10 W&M Gauge .130 inch (3.3 mm), triple crimped bright basic wire 1-1/2 inches (38 mm) diamond mesh pattern.
2. Horizontal Frames: 1 inch (25 mm) by 1/2 inch (13 mm) - 12 gauge .1046 inch (2.657 mm) roll formed channels tenoned at ends. Series of holes for through bolting of top cap bar.
3. Vertical Frames: 1-1/4 inches (32 mm) by 5/8 inch (16 mm) - 14 gauge .0747 inch (1.897 mm) roll formed "C" type channels mortised at ends. Series of slotted holes for securing to adjacent panels and post.
4. Center reinforcement bar: Two 1 inch (25 mm) by 3/8 inch (9.5 mm) - 12 gauge .1046 inch (2.657 mm) roll formed channels riveted together through mesh 42 inches (1067 mm) above finished floor on 7 feet (2134 mm), 8 feet (2438 mm), and 9 feet (2743 mm) high panels. Four channels are used on 10 feet (3048 mm) and 12 feet (3658 mm) high panels.
5. Panels: Consisting of the above horizontal and vertical members mortise and tenon at corners with diamond mesh securely clinched to frames. Center reinforcement bars are attached.
6. Adjustable Panels: 10 gauge .1345 inch (3.416 mm) wire mesh of above specification with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) flat stock (same hole pattern as vertical frames) welded along sides. Two 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) corner angles for bolting to adjacent panels and securing to floor.
7. Flex Panels: Two 8 inches (203 mm) -16 gauge .0598 inch (1.519 mm) hot rolled sheet steel punched and formed. Two 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) corner angles for bolting to adjacent panels and securing to floor.
8. Hinge Doors: Constructed of the same materials as panels, with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) flat steel bar cover on sides. Complete with all necessary mounting and locking hardware to install and operate.
   a. Jambs: Two 1-1/4 inches (32 mm) by 5/8 inch (16 mm) - 14 gauge .0747 inch (1.897 mm) roll formed "C" type channels.

b. Hinges: Three 3 inches (76 mm) by 3 inches (76 mm) butt hinges; welded to door framing and bolted to jamb.
c. Padlock Arrangement: 4 inches (102 mm) by 6 inches (152 mm) cover plate with 1-1/2 inches (38 mm) lug securing into lock opening.
d. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.

9. Hinged Dutch Doors: Constructed of the same materials as panels, with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) flat steel bar cover on all sides.
   a. Jambs: Two 1-1/4 inches (32 mm) by 5/8 inch (16 mm) - 14 gauge .0747 (1.897 mm) roll formed "C" type channels.
   b. Hinges: Two 3 inches (76 mm) by 3 inches (76 mm) butt hinges per section (top and bottom), bolted to door framing and jamb.
   c. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside; mounted to upper section of door.
   d. Lori Latch w/strike: Mounted in and secures bottom section to adjacent strike jamb.
   e. Shelf: Fabricated from 12 gauge .1046 inch (2.657 mm) hot rolled steel, 20 inches (508 mm) deep by 32 inches (813 mm) wide; with corners rounded and front/back edges formed and finished smooth; mounted on top of lower section of door and braced with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) formed flat steel.
10. Slide Doors: Constructed of the same materials as panels, with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) flat steel bar cover on all sides. Complete with all necessary mounting and locking hardware to install and operate.
   a. Jambs: Two 1-1/4 inches (32 mm) by 5/8 inch (16 mm) - 14 gauge .0747 (1.897 mm) roll formed "C" type channels.
   b. Hardware: Two 2-wheel trolleys rolling in an enclosed track, 45 inches bottom door guide for each door, and heavy- duty 24 inches (610 mm) lock receiver.
   c. Padlock Arrangement: 4 inches (102 mm) by 6 inches (152 mm) cover plate with 1-1/2 inches (38 mm) lug securing into lock opening.
   d. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.
11. Service Window (slide-up type): 24 inches (610 mm) wide by 21-1/2 inches high opening with 24 inches (610 mm) wide by 12 inches (305 mm) deep - 12 gauge .1046 inch (2.657 mm) shelf centered in opening. Secured to base with three 1/4 inch (6 mm) by 1 inch (25 mm) flat head screws. Window panel constructed of the same materials as standard panels.
12. Service Window (fold-down type): 24 inches (610 mm) wide by 15 inches (381 mm) high opening with 24 inches (610 mm) wide by 15 inches (381 mm) deep - 12 gauge .1046 inch (2.657 mm) shelf hinged at the bottom of window opening. Shelf is folded in the up position for securing with a padlock when not is use. (Padlock not supplied)
13. Corner post (for 90 degree corner): 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1/8 inch (3 mm) hot rolled angle. With 1-1/4 inches (32 mm) by 3/8 inch (9.5 mm) slotted holes aligning with bolt holes in vertical frames.
14. Adjustable Corner post (other than 90 degrees): Four 3 inches (76 mm) by 3 inches (76 mm) butt hinges welded to two 1-1/4 inches (32 mm) by 5/8 inch (16 mm) roll formed "C" type channels with base plates punched to accept 3/8 inch (9.5 mm) diameter anchors. With 5/16 inch (8 mm) bolt holes aligning with bolt holes in vertical frames.
15. Line/Stiffener post: 3-1/2 inches by 1-1/4 inches (32 mm) - 10 gauge .1345 inch (3.416 mm) with base plates of 4 inches (102 mm) by 7 inches (178 mm)

- 10 gauge .1345 inch (3.416 mm) flat stock, with four 7/16 inch (11 mm) diameter holes to accept 3/8 inch (9.5 mm) diameter anchors. Recommended usage is every 15 feet (4572 mm) linear feet on 7 feet (2134 mm) and 8 feet (2438 mm) high systems and every 10 feet (3048 mm) linear feet on 9 feet (2743 mm), 10 feet (3048 mm) and 12 feet (3658 mm) high systems.

16. Three Way Post: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) U-shaped post with 1-1/4 inches (32 mm) by 2 inches (51 mm) flat stock base plate punched to accept a 3/8 inch (9.5 mm) diameter anchor. All three sides are punched with same hole pattern as vertical frames for bolting to adjacent panels.
17. Top Capping Channel: 1-1/2 inches (38 mm) by 1/2 inch (13 mm) - 14 gauge .0747 (1.897 mm) roll formed channel with holes included for through bolting to panel's horizontal frame.
18. Base Shoes: 2 inches (51 mm) high Die Cast Aluminum with two holes to accept 1/4 inch (6 mm) diameter anchor for securing to floor; and with setscrew for leveling adjustment.
19. Accessories:
    a. Sweep Guards: 5-7/16 inches (138 mm) by 5/8 inch (16 mm) - 20 gauge .0359 inch (0.912 mm) cold-rolled steel; formed at top and bottom; secured with 1-1/4 inches (32 mm) by 1/4 inch (6 mm) hex head bolt and nut to bottom of panel frame; then anchored to finished floor.
    b. Sheet Metal Base: 16 gauge .0598 inch (1.519 mm) Hot Rolled Sheet Metal.
    c. Wall Clips: 3/4 inch (19 mm) wide by 1/8 inch (3 mm) thick cold rolled steel; formed and punched for securing to wall.
20. Hardware: 1/4 inch (6 mm) hex head bolts and nuts for all panel to panel, panel to door, and panel/door to post connections. Field bracing, floor and wall anchors by erector.
21. Finish:Two stage Phosphate wash with a standard 2 mil (.05 mm) Polyester Powder Coat finish.

2.4 PRODUCT

A. Product: Series 2180 as manufactured by SpaceGuard Products.

B. Fabrication:
1. Wire Mesh: #6 W&M Gauge .192 inch (4.88 mm), bright basic wire, resistance welded into a 2-1/2 inches (64 mm) by 1-1/2 inches (38 mm) rectangular pattern.
2. Horizontal Frames: 1 inch (25 mm) by 1 inch (25 mm) - 16 gauge .0598 inch (1.598 mm) structural tube with 1-1/4 inches (32 mm) by 3/8 inch (9.5 mm) slotted holes 12 inches (305 mm) O.C.
3. Vertical Frames: 1 inch (25 mm) by 1 inch (25 mm) - 16 gauge .0598 inch (1.598 mm) structural tubing with 1-1/4 inches (32 mm) by 3/8 inch (9.5 mm) slotted holes approximately 24 inches (610 mm) O.C.
4. Panels: Consisting of the above horizontal and vertical members welded at all intersections, and welded wire mesh securely welded to frame.
5. Adjustable Panels: 6 gauge .1943 inch (4.935 mm) welded wire mesh of above specification with 1-1/4 inches (32 mm) by 1/8 inch (3 mm) flat stock (same hole pattern as vertical frames) welded along sides.
6. Hinge Doors: Constructed of the same materials as panels - Pre-Hung. Complete with all necessary mounting and locking hardware to install and

operate.

a. Hinges: Three 2-1/2 inches (64 mm) by 2-1/2 inches (64 mm) butt hinges.
b. Jambs: One 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) angle with lock receiver attached and slotted holes for securing door frame.
c. Padlock Attachment: 1-1/2 inches (38 mm) lug secured to door frame and protrudes through slotted hole in door panel frame. A 4 inches (102 mm) by 6 inches (152 mm) cover plate to secure lock opening shall be supplied.
d. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.

7. Slide Doors: Constructed of the same materials as panels, hung by 4-wheel trolleys rolling in an enclosed track. Complete with all necessary mounting and locking hardware to install and operate.
   a. Jambs: Two 1 inch (25 mm) by 1 inch (25 mm) - 16 gauge .0598 inch (1.598 mm) structural tubing with slotted holes for securing to adjacent panels.
   b. Header bar: One 1 inch (25 mm) by 1 inch (25 mm) by 16 gauge .0598 inch (1.598 mm) structural tube with an angle clip welded to each for securing to top of jambs.
   c. Hardware: Three track holder assemblies for supporting enclosed track; Two or four 4-wheel trolleys rolling in the enclosed track; bottom door guide, and heavy 30 inches (762 mm) lock receiver.
   d. Padlock Arrangement: 4 inches (102 mm) by 6 inches (152 mm) cover plate with 1-1/2 inches (38 mm) lug securing into lock opening.
   e. Cylinder Lock: Mortise type with keyed different cylinder operated by key outside and recessed knob inside.
8. Service Window (slide-up type): 24 inches (610 mm) wide by 21-1/2 inches (546 mm) high opening with 24 inches (610 mm) wide by 12 inches (305 mm) deep, 12 gauge .1046 inch (2.657 mm) shelf centered in opening. Shelf is secured to opening with three 1-1/4 inches (32 mm) by 1/2 inch (13 mm) flat head screws and nuts. Window panel constructed of the same materials as standard panels.
9. Service Window (fold-down type): 24 inches (610 mm) wide by 15 inches (381 mm) high opening with 24 inches (610 mm) wide by 15 inches (381 mm) deep - 12 gauge .1046 inch (2.657 mm) shelf hinged at the bottom of window opening. Shelf is folded in the up position for securing with a padlock when not is use. (Padlock not supplied)
10. Corner post: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1/8 inch (3 mm) hot rolled angle with 1-1/4 inches (32 mm) by 3/8 inch (9.5 mm) slotted holes aligning with bolt holes in vertical frames.
11. Adjustable Corner: Four 2-1/2 inches (64 mm) by 2-1/2 inches (64 mm) butt hinges and two altered single base shoes used for connecting two panels at an angle other than 90 degrees.
12. Line/Stiffener post: 2 inches (51 mm) by 2 inches (51 mm) - 14 gauge .0747 (1.897 mm) square tube, 4 inches (102 mm) by 7-1/2 inches by 3/16 inch (5 mm) base plate punched with four 7/16 inch (11 mm) diameter holes to accept 3/8 inch (9.5 mm) diameter anchors.
13. Three Way Post: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) U-shaped post with 1-1/4 inches (32 mm) by 2 inches (51 mm) flat stock base plate punched to accept a 3/8 inch (9.5 mm) diameter anchor. All three sides punched with 1-1/4 inches (32 mm) by 3/8 inch (9.5 mm) slotted holes to match up with standard panels and doors.
14. Base Shoes: 2-1/2 inches (64 mm) by 2-1/2 inches (64 mm) by 1/4 inch (6

mm) angle; welded, punched, drilled and tapped to accept two 3/8 inch (9.5 mm) diameter anchors for securing to finished floor; and a 3/8 inch (9.5 mm) by 3/8 inch (9.5 mm) set screw for leveling adjustment.

15. Hardware: 5/16 inch (8 mm) by 3 inches (76 mm) flanged hex head bolt and nut for all panel-to-panel and panel to door connections. 5/16 inch (8 mm) by 1-1/2 inches (38 mm) Carriage bolt and nut for panel/door to corner post connection. (Field bracing, floor and wall anchors by erector)
16. Finish: Two stage Phosphate wash with a standard 2 mil (.05 mm) Polyester Powder Coat finish.
17. Color: SpaceGuard Gray.
18. Color: SpaceGuard Black.
19. Color: SpaceGuard Green.
20. Color: SpaceGuard Blue.
21. Color: SpaceGuard Yellow.
22. Color: SpaceGuard Red.
23. Color: SpaceGuard custom color.

C. Wire Mesh Ceilings:
1. Ceiling Panels: Fabricated from same mesh and framing bars as panels above.
2. Perimeter Angle: 1-1/4 inches (32 mm) by 1-1/4 inches (32 mm) by 1/8 inch (3 mm) hot rolled angle; punched for bolting to top of wire mesh panels and to sides of wire mesh ceiling panels.
3. Wall Supports: 1-1/2 inches (38 mm) by 1-1/2 inches (38 mm) by 14 gauge .0747 (1.897 mm) galvanized angle, punched for securing to existing walls and supporting wire ceiling panels.
4. Intermediate Beam Support: 2 inches (51 mm) by 4 inches (102 mm) by 14 gauge .0747 (1.897 mm) rectangular tube for use in spans exceeding 10 feet (3048 mm) in any two directions.
5. Intermediate Beam Support Post: 2 inches (51 mm) by 2 inches (51 mm) - 14 gauge .0747 (1.897 mm) square tube with 4 inches (102 mm) by 7-1/2 inches (191 mm) by 3/16 inch (5 mm) base plate (will accept 3/8 inch (9.5 mm) diameter anchors); a 2 inches (51 mm) by 7 inches (178 mm) by 1/4 inch (6 mm) plate at top for support of I-beams.

2.5 FABRICATION

A. Fabricate assemblies of framed sections; to sizes and profiles required; with framing members fitted, reinforced and braced to suit design requirements.

B. Fit and assemble in largest practical sections for delivery to Project Site, ready for installation.

C. Fabricate items with joints tightly fitted and secured.

D. Grind exposed welds smooth and flush with adjacent finish surface. Ease exposed edges to small uniform radius.

E. Make exposed joints flush and hairline.

F. Provide components required for anchorage. Fabricate anchorage and related components of same material and finish as framing members.

2.6 FINISH

A. Clean surfaces of rust, scale, grease, and foreign matter before finishing. Clean material using a two-stage phosphate wash system immediately prior to finishing.

B. Prefinished Surfaces: Wire partition manufacturer's polyester powder finishing system.
   1. Finish colors of partitions and accessories: Selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
   1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations.

B. Install partitions and gates plumb and level, accurately fitted, properly aligned, securely fastened, and free from distortion or detects.
   1. Elevator Equipment Enclosure: Erect partitions enclosing elevator equipment to exclude a 2 inch diameter ball at any location.

C. Install field bracing as necessary (not furnished by mesh partition manufacturer) to provide rigid, secure installation.

3.3 TOLERANCES

A. Maximum Variation from Plumb or Level: 1/4 inch (6 mm) in total partition height.

B. Maximum Misalignment from True Position: 1/4 inch (6 mm).

3.4 ADJUSTING

A. Adjust moving components for smooth operation without binding.

B. Adjust locks to provide smooth and secure operation.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 11201 – RAINWATER HARVESTING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes engineering, fabricating, furnishing, and installing:
1. Rainwater Harvesting System.
A. Roof collection system.
B. Related Sections:
1. Divisions 31 – 33 (2) – landscaping and irrigation sections.
2. Division 07 (7) – roofing section(s).
3. Division 22 (15) – plumbing.

1.2 DEFINITIONS

A. Rainwater Harvesting System: An assembly that collects, stores, and distributes rain water for use in situ; including water treatment as appropriate to intended use.

1.3 SUBMITTALS

A. Product Data: Submit product data on all components of the rainwater harvesting system. Unless otherwise indicated, include the following for each type of product provided under work of this Section:
1. Manufacturer's brochure indicating equipment model(s).

2. Recycled Content:
a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

3. Local/Regional Materials:
a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

B. Shop Drawings: **For roof collection system,** include plans, sections, details, and attachments to other work, for the following:
1. Pumps.
2. Storage.
3. Connection to roofing system.

4. Connection to irrigation system.
5. Connection to plumbing system.

C. Calculations: **For roof collection system,** submit the following:
1. Maximum water capacity.
2. Collection data: Include the following:
   a. average rainfall rate (inches annually)
   b. total collection area (s.f.)
   c. potential collection (s.f.= gallons)
   d. peak gallons @ 5"/hour
   e. peak gallons @ 5 min. duration
   f. available gallons
3. Water Demand: Include the following:
   a. Landscaping:
      total estimated planted area (acres)
      application rate / week (high) gallons
      application rate /week (low) gallons
      gallons required
   b. Fixture Demand:

SPECIFIER NOTE:
Typical usage is likely to include:
— # toilets/1.6 gallons flush/ # flush per day
— faucets - 10 gallons/day
— dishwasher 10/galls/load/1 load/day

      Fixtures by type, water use per person/day
      Gallons potable water required
      Gallons non-potable water required

D. Designer/Installer Qualifications.

E. Regulatory Requirements Documentation:

F. Operation and Maintenance Manuals Submittals: Provide the following:
1. Operation and maintenance procedures, including variations of procedures appropriate for normal climatic conditions anticipated throughout an annual cycle of operations.
2. Water testing laboratory contact information.
3. Water testing requirements, schedule, kits, and equipment.

G. Reports for Field Quality Control: Submit test reports and inspection reports to **Owner.**
1. System Inspections.
2. Water Quality Tests.

H. Closeout Submittals:
1. Warranty.

1.4 QUALITY ASSURANCE

A. Designer/Installer Qualifications: For work of this Section, engage an experienced rainwater consultant who has specialized in systems similar to those required for this Project and with a record of successful in-service performance. Consultant shall:

1. be a member in good standing of The American Rainwater Catchment Systems Association.

2. have a minimum **3** years experience designing and constructing rainwater catchment systems similar to requirements for this Project.

3. for potable systems, **comply with agencies having jurisdiction or have a current Class III Water Treatment Specialist license**.

B. Single-Source Responsibility: To the greatest extent possible, obtain the system components from one source and from a single manufacturer.

C. Pre-Construction Meeting: After award of Contract and prior to the commencement of the Work of this Section, schedule and conduct meeting to discuss the Work of this Section and to coordinate with related Work. Convene pre-construction meeting to comply with requirements of Division 01 (1) and as follows:
1. Notify all attendees at least two weeks prior to the conference.
2. Require attendance of parties directly affecting Work of this Section, including, but not limited to:
   a. Owner,
   b. Contractor,
   c. Architect,
   d. Civil Engineer
   e. System Designer/Installer,
   f. Landscape Architect and Irrigation Installer,
   g. Roofing Membrane Provider/Installer,
   h. Owner's insurer, and if applicable; testing and inspecting agency representative.
3. Review methods and procedures related to installation and operation of Work of this Section, including coordination with related Work.
4. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the Work with installation of associated roofing, waterproofing, flashings, and roof accessories specified under other sections as the Work of this Section proceeds.

B. Coordinate the Work with installation of associated irrigation and plumbing systems specified under other sections as the Work of this Section proceeds.

1.6 WARRANTY

A. Warranty: Warrant the system against defects including equipment failure and leakage, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period.
1. Warranty Period: One year after date of Substantial Completion,

PART 2 PRODUCTS

2.1 SYSTEM COMPONENTS

A. Catchment Area:
1. Roofing as indicated.

B. Conveyance:
1. Pump(s), sized as appropriate to water demands of facility.
   a. Roof collection system: **Electric or Wind powered**.

b. Site collection system: **Electric or Wind powered**.

2. Piping. Overflow pipe shall empty into a non-flooding area. Include separate inlet for intermittent treatment as is deemed necessary on basis of regular inspection/testing.

C. Storage:

1. Tank(s), sized as appropriate to water demands of facility. Above ground design. System design shall indicate load requirements for tank foundation. Tanks shall be accessible for routine maintenance.
   a. Potable systems: **Tank shall be fabricated from FDA-approved materials or Tank shall be state-approved as a vessel for potable water storage.**
2. Cisterns. Below ground design; accessible for cleaning and maintenance. Provide screens for all openings.
3. Ponds. Provide soil liner or synthetic liner.
   a. Where on-site soils or clay provide an adequate seal, compaction of these materials may be sufficient to line the pond.
      1) On-site soils may be used if they can be compacted to permeability of <108 ft/sec (<10-6 cm/sec).
   b. Synthetic liners: Asphalt liners are not permitted. Synthetic liners may be fabricated from synthetic butyl rubber or 0.5 to 10.0 mil high density polyethylene.
      1) If the site soils contain angular stones, place sand bedding or geotextile cushions under the liner to prevent punctures.
      2) Cover the liner with 3 - 4 inches of soil to prevent the roots of the vegetation from penetrating the liner.

D. Water Treatment:

1. Filtration. Include automatic catchment tank/pump system to prefilter water prior to entry to storage tank. Carbon is not permitted.
2. Disinfection: Provide disinfection acceptable to agencies having jurisdiction. Provide disinfection necessary to attain **[Advanced Secondary Wastewater] [Advanced Tertiary Wastewater] [Potable Water]** quality.
   [a. Chlorine: Where acceptable to agencies having jurisdiction, prohibit use of chlorine treatment. Verify acceptability of iodine.]
   [b. Potable system shall include automatic ozonation treatment.]

E. Accessories:

1. Joint Sealants: Non-toxic and as specified in Division 07 (7).
2. Fasteners: non-corrosive and compatible with materials being fastened.

F. Lead components are not permitted.

2.2 FABRICATION

A. Design prefabricated components and necessary field connections required for installation to permit easy assembly, repair and maintenance, and disassembly.

B. Design and construct to comply with applicable regulatory requirements.

1. Potable system(s): Provide piping and accessories necessary to operate as a potable water system capable of utilizing municipal water as a supplementary source.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which system will be installed, with Designer/Installer present, for compliance with requirements.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions, approved shop drawings, and applicable regulatory requirements.

3.3 FIELD QUALITY CONTROL

A. General: Comply with requirements of agencies having jurisdiction and as specified herein.

B. System Inspection: System Designer/Installer shall inspect system installation and submit reports to Architect. Notify **Owner** 48 hours in advance of the date and time of inspection.
   1. Provide site inspection of system **at Substantial Completion**.
   2. Provide site inspection of system immediately after storm event that may be severe enough to affect the system; provide inspection services for minimum **12** months after Final Completion.
   3. Provide site inspection of system seasonally, and not less than once every three months; provide inspection services for minimum **12** months after Final Completion.

C. Water Quality tests: Comply with requirements of agencies having jurisdiction and as specified herein. Comply with ASTM D4840 for chain of custody of water samples. **[Provide on-line monitoring consistent with ASTM D3864.]**
   1. Provide data on the following immediately after plants are established and **monthly** thereafter for minimum **12** months:
      a. Biochemical oxygen demand (BOD_5).
      b. Total Suspended Solids (TSS).
      c. Fecal coliform.

   2. Establish baseline water quality for rainwater harvesting systems for both influent and effluent.
   3. Provide comparison of test results with municipal water quality, and maintenance of system.
   4. Water testing shall be performed by a laboratory in compliance with agencies having jurisdiction.

END OF SECTION

SECTION 11450 - RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Residential appliances of the following types:
1. Refrigerators and freezers.
2. Cooking appliances.
3. Venting systems.
4. Dishwashers.
5. Clothes care.

1.2 RELATED SECTIONS

A. Section 06400 - Architectural Woodwork; cabinets and countertops.

1.3 REFERENCES

A. EPA - Energy Star Appliances.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Model number and selected options for each appliance.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.
5. List of maintenance parts.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.

B. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within

limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Provide manufacturer's standard written warranty for each type of appliance specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: See 2.2 Appliances.

B. Substitutions: not permitted

2.2 APPLIANCES

A. Refrigerators and Freezers:
1. Top-Freezer Refrigerator: Sun Frost RF12
2. Dimensions: 34 1/2" W x 27 3/4" D x 49 1/2" H
3. Appearance: Cherry wood veneer with black lacquer to match cabinetry
4. http://www.sunfrost.com/refrigerator_models.html

B. Cooking Appliances:
1. Oven: Gaggenau BO 281-610
2. Dimensions: 29 5/8" W x 21 9/16" D x 26 3/8" H
3. Appearance: Stainless steel-backed full glass door
4. http://gaggenau.visukomm.de/magazine/usa/2007/ovens/ataglance.htm
5. Cooktop: Wolf CT/151\S integrated induction cooktop
6. Dimensions: 15"W x 3 1/2"D x 21"H
7. Appearance: Stainless steel trim finish with black cooktop
8. http://www.wolfappliance.com/InductionCooktops/CT15IInductionCooktop

C. Venting Systems:
1. Hood: Wolf DD30I with internal blower 30" downdraft hood
2. Dimensions: 30"W x 2"D x 9"H
3. Appearance: Carbon Stainless Steel with black trim
4. http://www.wolfappliance.com/resources/products/downloads/DD30.pdf

D. Dishwasher:
1. Dishwasher: Fisher&Paykel DD224-P5 double DishDrawer
2. Dimensions: 23 1/2 W x 24 7/16 D x 33 1/2 H
3. Appearance: Stainless Steel
http://www.fisherpaykel.com/admin/pdfs/pdf_installations/DCS_DD124P5_&_DD224P5_Installation_529636A.pdf

E. Clothes Care:
1. Washer: ASKO W6222 Washer - stackable
2. Dimensions: 23 1/2 W x 24 7/16 D x 33 1/2 H
3. Appearance: Black
4. http://www.askousa.com/laundry/family_size_laundry/w6222-washer/
5. Dryer: ASKO T712 Dryer - stackable
6. Dimensions: 23 1/2 W x 27 7/8 D x 33 1/2 H
7. Appearance: Black

8. http://www.askousa.com/laundry/family_size_laundry/t712-dryer/

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:
   1. Securely mount to substrate.
   2. Install appliances plumb and level and in proper relationship to adjacent construction.
   3. Connect appliances to building utility, supply and waste systems as applicable.
   4. Test for proper operation and drainage. Adjust until proper operation is achieved.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 APPLIANCE DATA SHEETS

A. Refer to the manufacturer's data sheets as attached to this Section for required features and additional requirements.

END OF SECTION

SECTION 12356 - KITCHEN CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood kitchen cabinets.
2. Solid Surface countertops.

B. Related Sections include the following:

1. Division 6 Section “Architectural Woodwork” for custom cabinetry.
2. Division 15 Section "Plumbing Fixtures" for sink units mounted in countertops.

1.3 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

B. Semiexposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semiexposed."

C. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

1.4 SUBMITTALS

A. Product Data: For the following:

1. Cabinets.
2. Solid Surface countertops.

B. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining countertops.

C. Samples for Verification: For the following materials; in sets showing the full range of color, texture, and pattern variations expected:

1. Laminate for casework finish, 12 by 12 inches (200 by 250 mm).
2. Solid Surface for countertops, 12 by 12 inches (200 by 250 mm).

D. Product Certificates: Signed by manufacturers of casework certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations for Cabinets: Obtain cabinets through one source from a single manufacturer.

B. Product Designations: Drawings indicate size, configurations, and finish material of casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes, similar door and drawer configurations, same finish material, and complying with the Specifications may be considered. Refer to Division 1 Section "Substitutions."

C. Quality Standards: Unless otherwise indicated, comply with the following standards:

1. Cabinets: KCMA A161.1.

   a. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semiexposed location of each unit and showing compliance with the above standard.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install kitchen casework until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where kitchen casework is indicated to fit to pre finished construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes if necessary.

C. Field Measurements for Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of kitchen casework.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cabinets:

   a. Custom per Interior Elevations and Plan
      1. The Cabinet Maker – Preferred Fabricator

2. Solid Surface for Countertops:

   a. Paperstone

2.2 COLORS, TEXTURES, AND PATTERNS

A. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range for these characteristics.

B. Base colors to include two shades of Maple w/ Black Lacquer and Clear Coat.

2.3 CABINET MATERIALS

A. Exposed Materials: Comply with the following:

1. Exposed Wood Species: As follows. Do not use two adjacent exposed faces that are noticeably dissimilar in color, grain, figure or natural character markings.

   a. Maple where specified in Drawings; see Interior Elevations
   b. Plyboo where specified in Drawings; see Interior Elevations.

2. Solid Wood: Clear hardwood lumber of species indicated, free of defects, selected for compatible grain and color, and kiln dried to 7 percent moisture content.

3. Plywood: Hardwood plywood complying with HPVA HP-1 with face veneer of species indicated, selected for compatible color and grain with Grad A faces and Grade C backs of same species as faces.

a. Edge band exposed edges with minimum 1/8 inch- (3 mm) thick, solid-wood edging of same species as face veneer.

4. Vinyl-Faced Fiberboard: Medium-density fiberboard complying with ANSI A208.2, milled to required shapes, with a thermoformed vinyl overlay applied in a vacuum or membrane press.

B. Semiexposed Materials: Unless otherwise indicated, provide the following:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects and kiln dried to 7 percent moisture content. Stained to be compatible with exposed surfaces.

2. Plywood: Hardwood plywood complying with HPVA HP-1 with Grade C faces stained to be compatible with exposed surfaces and Grade 3 backs of same species as faces.

C. Concealed Materials: Comply with the following:

1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.

2. Particleboard: ANSI A208.1, Grade M-2.

3. Medium-Density Fiberboard: ANSI A208.2.

4. Hardboard: AHA A135.4, Class 1 Tempered.

2.4 COUNTERTOP MATERIALS

A. Paperstone:

1. Slate Finish – Recycled Paper product

B. Particleboard: ANSI A208.1, Grade M-2.

C. Plywood: Exterior softwood plywood complying with PS 1, Grade C-C Plugged, touch sanded.

2.5 CASEWORK HARDWARE – See Section 06412

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, material, size, and finish as selected from manufacturer's standard choices.

B. Hinges: Concealed face frame European-style hinges.

C. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05091.

D. See Section 06402 for decorative pulls.

2.6 CABINETS

A. Toe Kicks: Toe kick to match cabinets in specie, color and finish.

B. Valances: Provided valances bottoms of cabinets as indicated on the drawings. Specie, finish and color to match cabinets. Valance to be full length; ship loose for field installation.

C. Wood Faced: Provide cabinetry equal to “craftsmanship quality” with plyboo or Maple finish. This

D. Vanity cabinets to be 31-1/2” high.

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. Configuration: Provide countertops with the following front, cove (intersection of top with backsplash), backsplash, and end-splash style:

1. Front: Waterfall.
2. Backsplash: Square edge.
3. End Splash: Square edge.

B. Paperstone Substrate: Particleboard not less than 3/4 inch (19 mm) thick.

1. For countertops at sinks and lavatories, use phenolic-resin particleboard or exterior-grade plywood.
2. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of particleboard laminated to top.

C. Paper Backing: Provide paper backing on underside of countertop substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install casework with no variations in flushness of adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.

B. Install casework without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.

C. Install casework and countertop level and plumb to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).

D. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches (600 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.
2. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches (600 mm) o.c., with toggle bolts through metal backing behind gypsum board.

E. Fasten Paperstone countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

3.2 ADJUSTING AND CLEANING

A. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 12484 - FURNISHINGS – FOOT GRILLE ENTRANCE SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: [Entrance matting systems, recessed aluminum foot grilles]

B. Related Sections: Section(s) related to this section include:

1. Section 03300 - Cast-In-Place Concrete.
2. Section 08110 - Steel Doors and Frames.
3. Section 08212 - Stile and Rail Wood Doors.
4. Section 08710 - Door Hardware.

1.02 REFERENCES

A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. The Standards listed here are identified with a designation number, title or other designation established by the issuing authority.

B. American Society for Testing and Materials (ASTM):

1. ASTM C1028 Static Coefficient of Friction
2. ASTM B117 Product Corrosion to Salt

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide recessed aluminum entrance floor mat system, which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with the Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product data: Submit product data, including manufacturer's specification sheet and installation instructions for specified products. Include methods of installation and substrate preparation for each type of substrate.

C. Shop drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures.

D. Samples: Submit samples for each type and color of exposed entrance mat, frames and accessories required. Provide samples of mat materials.

E. Quality Assurance Submittals: (1) Certified test reports showing compliance with specified performance characteristics and physical properties, and (2) Manufacturer's Installation Instructions.

F. Closeout Submittals: (1) Cleaning & Maintenance Data (Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance), and (2) Warranty.

1.05 QUALITY ASSURANCE

A. Installer: Installer should be highly experienced in performing work of this section, having previously done work similar to that required for this project.

1.06 SEQUENCING/SCHEDULING

A. Ordering: Comply with Manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in Manufacturer's original, unopened, undamaged packaging.

C. Storage: Store materials at temperature and in humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.

D. Installation: Except as otherwise indicated herein, sequencing or scheduling for performance of work of this section in relation with other work is Contractor's option. Delay installation of mats until near time of substantial completion for the project.

1.07 PROJECT CONDITIONS

A. Temperature: Maintain temperature where products will be installed before, during and after installation as recommended by Manufacturer.

B. Field Measurements: Where possible, verify actual measurements by field measuring before fabrication and include measurements in shop drawings. To avoid construction delays, coordinate field measurements and fabrication schedule based upon construction progress.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Provide Safe Track foot grille by **Mats Inc**., 37 Shuman Avenue, Stoughton, MA, 02072; telephone 800-628-7462 or 781-344-1536; fax 781-344-1537; www.matsinc.com.

2.02 MATERIALS

A. Product: Safe Track
   1. **Construction**: Bolt-thru design with individual aluminum spacers. Swedge, welded and key lock fastening of rails is not allowed.

2. **Material**: Aluminum Alloy type 6061-T6. Soft Aluminum alloy (such as 6063-T52) is not allowed
3. **Recycled Content**: Aluminum to be 49% pre-consumer and 6 % post-consumer recycled content
4. **Blades**: T-Shaped blades, 3/8” x 1/8” x 1” Size, spacing between blades not to exceed 3/16 inch.
5. **Dimension**: Grille depth to be 1”, with frame 1-1/8”
6. **Panels**: Foot Grille to be supplied in panels not to exceed 48” x 42”. One Piece design not allowed. All grille panels to be supplied with individual pre-fabricated, factory-assembled frames
7. **Rolling Load Capacity**: 2,032 lbs per 2 foot span.

B. Framing Accessories for Recessed Aluminum Foot Grille: Framing will have the following characteristics:

1. Recessed Frame Integral with Concrete Substrate: The perimeter frames shall be an inverted "T" shape such as model "VV" by Mats Inc, in order to anchor the structure into the concrete. All aluminum frames shall be pre-assembled at factory incorporating welded construction for all joints. Each grille section shall incorporate an invisible section divider integrated and welded within the frame. Frames and grilles shall be shipped fully assembled in protective wooden crating to each jobsite. For sections larger than 6'-0 by 8'-0 a mechanical joint is to be provided, (if specified).

2. Recessed Frame Over Finished Surfaces: The perimeter frames shall be "Z" shape such as model "TT" by Mats Inc. For installation over finished floor surfaces. All aluminum frames shall be pre-assembled at factory incorporating welded construction for all joints. Each grille section shall incorporate an invisible section divider integrated and welded within the frame. Frames and grilles shall be shipped fully assembled in protective wooden crating to each jobsite. For sections larger than 6'-0 by 8'-0 a mechanical joint is to be provided (if specified). A silicone joint is to be applied between the frame and the finished floor to prevent any water infiltration (by others).

3. Recessed Frame for either concrete substrate or finished surface: The perimeter frames shall be an angle AD frame, either “Level” or “Embedded” depending on the installation. For installation with either new construction or retrofits. All aluminum frames shall be pre-assembled at factory incorporating welded construction for all joints. Each grille section shall incorporate an invisible section divider integrated and welded within the frame. Frames and grilles shall be shipped fully assembled in protective wooden crating to each jobsite. For sections larger than 6'-0 by 8'-0 a mechanical joint is to be provided, (if specified).

C. Optional Accessories for Recessed Aluminum Foot Grille

1. Recessed Pan: 20 gauge Aluminum (optional)

2. Accessories: [Stainless steel hinges] [Galvanized Steel key-lock downs (GB-46) attached to each grid section (recommended)] [Galvanized Steel keyless-lock downs attached to each grid section (recommended)] [Engraved Surface Logos] (optional).

D. Product Testing for Recessed Foot Grille

1. ASTM C1028 Static Coefficient of Friction: .94
2. ASTM B117 Product Corrosion to Salt: Product withstands 1000 hours of salt fog without any noticeable changes.

2.03 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

PART 3 – EXECUTION

3.01 SUBSTRATE PREPARATION

A. Examine substrates and conditions where floor mats will be installed. Do not proceed with installation until unsatisfactory conditions are corrected. Sub floor shall be clean and dry, and within acceptable tolerances.

3.02 INSTALLATION

A. Sizes: Shop-fabricate units of floor mat to greatest extent possible in sizes as indicated. Where not indicated otherwise, provide single unit for each mat installation, but do not exceed manufacturer's maximum size recommendation for units intended for removal and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints. Where possible, verify sizes by field measurement before shop fabrication.

B. Accessories: Where indicated for recessed or wall-to-wall applications, provide aluminum framework as recommended by manufacturer.

C. General: Strictly comply with manufacturer’s installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent tripping hazards.

3.03 CLEANING AND PROTECTION

A. General Cleaning: Refer to Manufacturer’s Cleaning and Maintenance Instructions.
B. Owner’s Personnel: Instruct Owner’s personnel in proper maintenance procedures.
C. Protection: Protect installed product and finish surfaces from damage during construction and until acceptance.

END OF SECTION

SECTION 13 600 SPECIAL CONSTRUCTION – SOLAR ENERGY SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: High-efficiency photovoltaic module using silicon nitride multicrystalline silicon cells

1. The system requirements for the design in the DOE Solar Decathlon Competition have several physical parameters.

   a. The National Park Service mandates that no structure can be above 18'-0" in height. The current design of the Photovoltaic array uses panels that are no greater than 66.14" in length, which allows the UWM Solar Decathlon house to stay below the required 18'-0" height limit.

   b. The rules of the Solar Decathlon competition require that no competitor have a footprint greater than 800 square feet. The current design of the UWM Solar Decathlon project uses panels that are on greater than 32.95" in width. As designed, the photovoltaic array is fourteen (14) panels wide, which, in addition to the design of the rest of the house, keeps the UWM Solar Decathlon project below the required 800 square feet.

   c. If the panels exceed the physical parameters specified below, the UWM Solar Decathlon team will not be allowed to compete.

2. The system requirements for the design in the DOE Solar Decathlon Competition have several electrical performance parameters

   a. The electrical performance of the Photovoltaic array design requires that two strings of fourteen (14) panels are connected together in order to function properly with existing inverter technology. Kaco inverters have already been donated to the UWM Solar Decathlon team. Their performance requires that the electrical output be within the following range: If the electrical output of the photovoltaic modules is below this range the inverters will not operate, if the electrical output of the photovoltaic modules is above this range, the inverters are at risk of failure.

B. Related Sections: Section(s) related to this section include:

1. Section 48 14 00 - Solar Energy Collectors.

1.02 REFERENCES

A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. The Standards listed here are identified with a designation number, title or other designation established by the issuing authority.

B. American Society for Testing and Materials (ASTM):

1. ASTM E1038-Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls

2. ASTM E1171- Standard Test Method for Photovoltaic Modules in Cyclic Temperature and Humidity Environments

3. ASTM E1596- Standard Test Methods for Solar Radiation Weathering of Photovoltaic Modules

4. ASTM E1802-Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules

5. ASTM E2047- Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays

6. ASTM E1830- Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules

7. ASTM E782- Standard Practice for Exposure of Cover Materials for Solar Collectors to Natural Weathering Under Conditions Simulating Operational Mode

8. ASTM E1039- Standard Test Method for Calibration of Silicon Non-Concentrator Photovoltaic Primary Reference Cells Under Global Irradiation

9. ASTM E948- Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight

10. ASTM E1021- Standard Test Methods for Measuring Spectral Response of Photovoltaic Cells

11. ASTM E1040- Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells

12. ASTM E1462- Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Mechanical Characteristics

   a. Dimensional Requirements: Length not to exceed 1680mm (66.14”) Width not to exceed 837mm (32.95”) Depth: 50mm (1.97”)

   b. Solar Cell Count 50 cells connected in series

   c. Output cables with polarized weatherproof DC rated multi-contact connectors

   d. Construction Front: High-transmission tempered glass; Back: White or Black Tedlar; encapsulant: EVA

   e. Frame: anodized aluminum alloy

2. Electrical Characteristics

   a. Maximum power (Pmax): 195W to 200W

   b. Voltage at Pmax (Vmp) 24.5V w/ 5% variation

   c. Current at Pmax (Imp) 8.16A w/ 5% variation

   d. Short-circuit current (Isc) 8.7A 8.6A w/ 5% variation

   e. Open-circuit voltage (Voc) 30.8V 30.7V w/ 5% variation

   f. Maximum series fuse rating 15A

   g. Maximum system voltage 600V (U.S. NEC rating)

3. Performance

   a. Rated power (Pmax) 200W

   b. Power tolerance ±9%

   c. Nominal voltage 16V

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with the Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product data: Submit product data, including manufacturer's specification sheet and installation instructions for specified products. Include methods of installation and substrate preparation for each type of substrate.

C. Shop drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures.

D. Samples: Submit samples for each type and color of exposed entrance mat, frames and accessories required. Provide samples of mat materials.

E. Quality Assurance Submittals: (1) Certified test reports showing compliance with specified performance characteristics and physical properties, and (2) Manufacturer’s Installation Instructions.

F. Closeout Submittals: (1) Cleaning & Maintenance Data (Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance), and (2) Warranty.

1.05 QUALITY ASSURANCE

A. Installer: Installer should be highly experienced in performing work of this section, having previously done work similar to that required for this project.

1.06 SEQUENCING/SCHEDULING

A. Ordering: Comply with Manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in Manufacturer's original, unopened, undamaged packaging.

C. Storage: Store materials at temperature and in humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.

D. Installation: Except as otherwise indicated herein, sequencing or scheduling for performance of work of this section in relation with other work is Contractor's option. Delay installation of mats until near time of substantial completion for the project.

1.07 PROJECT CONDITIONS

A. Temperature: Maintain temperature where products will be installed before, during and after installation as recommended by Manufacturer.

B. Field Measurements: Where possible, verify actual measurements by field measuring before fabrication and include measurements in shop drawings. To avoid construction delays, coordinate field measurements and fabrication schedule based upon construction progress.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. BP Solar. 630 Solarex Court, Frederick, MD 21703. T: +1 301.815.5053; C: +1 240.367.4721 www.bpsolar.us

B. Substitution: Not Permitted

2.02 MATERIALS

2.03 PRODUCT SUBSTITUTIONS

A. Substitutions: Substitutions must meet conditions of the competition requirements, and match with existing technology and design of the UWM Solar Decathlon project.

PART 3 – EXECUTION

3.01 SITE ENVIRONMENTAL PROCEDURES

A. Resource Management:

1. Energy Efficiency: Verify equipment is properly installed, connected, and adjusted. Verify that equipment is operating as specified.

2. Renewable Energy: Verify proper operation in all modes of system operation by testing. Verify proper operation under a wide range of conditions to verify energy delivery as calculated for those conditions.

    a. Solar Energy Systems: Comply with ASTM E1799- Standard Practice for Visual Inspections of Photovoltaic Modules

END OF SECTION

SECTION 13640 - Special Construction – Packaged Solar Water Heating Equipment

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solar Pump

B. Solar Flat Plate Collectors

C. Storage Tank

D. Insulated Flexible Stainless Steel Piping

E. Differential Temperature Controller and Solar Station

1.2 RELATED SECTIONS

A. Section 13600 – Special Construction Solar Energy Systems

B. Section 13650 – Special Construction – Grid Tied Inverter

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Caleffi data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Show layout, components, mounting and support, anchorage details, and interface with adjacent construction.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Approved by Inverter supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store in dry, protected, well ventilated area and protect from damage.

C. Upon delivery ensure that proper equipment is included in package. Provide forklift for unloading and positioning of equipment

1.6 WARRANTY

A. Provide manufacturer’s 10 year, 6 Year, and 4 year warranties for the components

within the package

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Caleffi North American Inc. Located at 3883 West Milwaukee Road Milwaukee, WI 53208 Telephone number 1.414.238.2360, Website www.caleffi.us/caleffi/en_US/index.sdo

B. Substitutions: Not permitted.

2.2 INDIVIDUAL PRODUCTS INCLUDED IN PACKAGE

A. Solar Flat Plate Collector

1. http://www.caleffi.us/en_US/caleffi/Details/News/files/Solar-SWH.pdf

B. SolarCon Storage Tank

1. http://www.caleffi.us/en_US/caleffi/Details/News/files/Solar-SWH.pdf

C. Solar Flex Insulated Flexible Stainless Steel Piping

1. http://www.caleffi.us/en_US/caleffi/Details/News/files/Solar-SWH.pdf

D. iSolar Differential Temperature Controller and Solar Station

1. http://www.caleffi.us/en_US/caleffi/Details/News/files/Solar-SWH.pdf

a. Products relating to this section

1. Water Pump – recalculating and supply

b. Product Information

2. Reticulating Pump http://www.lgpc.com/ProductFiles/SpecSheets/995169-CMD-100-3B.pdf

2. Supply Pump

http://www.lgpc.com/ProductFiles/SpecSheets/995259-558274-76-SWJP.pdf

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until wall blocking and support substrates have been properly completed.

B. Verify that structural supports are level and of adequate strength to support the applied loads.

C. Verify spacing dimensions prior to mounting and assembly.

D. Notify Architect of unsatisfactory conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

1. Groups of fittings including each component of the package must be installed with sufficient spacing to the solar collectors because tempetures in the vicinity of the collectors can be very high.

2. Ensure collectors are installed properly in accordance with manufacturer’s instructions and verify that roofing material can handle the temperatures when installed on roof structures

3. Install Tanks in properly sized room to allow for access to all components and fittings for the tank operations

B. Install hardware level (for all interior components of package) or in alignment with the pitch of the roof (for collectors), plumb, sure, true and straight.

C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.

D. Clean mounts and hardware surfaces before installing collectors, tanks or other components of the package.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION

SECTION 13650 - Special Construction - Photovoltaic Collectors

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grid-Tied Inverter

1.2 RELATED SECTIONS

A. Section 13600 – Special Construction Solar Energy Systems

B. Section 13640 – Special Construction – Packaged Solar Equipment (Hot Water)

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. KACO Solar Inverters data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Shop Drawings: Show layout, components, mounting and support, anchorage details, and interface with adjacent construction.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Approved by Inverter supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store in dry, protected, well ventilated area and protect from damage.

C. Store Components face up and do not stack

1.6 WARRANTY

A. Provide manufacturer's 122 day warranty from the date of Delivery and not more than 130 Months from the date of shipment from KACO Solar, Inc.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: KACO Solar, Inc. Located at 1004 B O' Reilly Ave. San Francisco, CA 94129. Telephone number 1.415.931.1688, Website www.kacosolar.com

B. Substitutions: Not permitted.

2.2 KACO Blueplanet 3601xi Grid-Tied Inverter

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until wall blocking and support substrates have been properly completed.

B. Verify that structural supports are level and of adequate strength to support the applied loads.

C. Verify spacing dimensions prior to mounting and assembly.

D. Notify Architect of unsatisfactory conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install mounting hardware level, plumb, sure, true and straight.

C. Adjust hardware as necessary to ensure smooth, quiet, and effortless operation and safety.

D. Clean mounts and hardware surfaces before hanging inverters on vertical surface.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion. Replace damaged products that cannot be repaired to original condition.

END OF SECTION

SECTION 15400 - PLUMBING

PART I - GENERAL

1.01 DESCRIPTION

A. Division 1, General Requirements, and Section 15050, Basic Mechanical Materials and Methods, shall be considered a part of these specifications.

B. Codes, Ordinances, and Permits: All permits, connection fees, tap fees, licenses, approvals, and other arrangements, including plumbing and riser diagrams, if required, shall be obtained by the plumbing contractor at his expense. Should any changes be necessary in the drawings, or specifications, to secure such approval, this contractor shall include in his bid all costs for such changes to comply with these departments without extra costs to Team Meltwater. It will be this contractor's responsibility to provide all systems complete and operable.

C. Scope of Work: Contractor shall furnish all materials, tools, equipment, labor, and services and pay all costs of whatever nature, as may be necessarily expended, for a proper workmanlike and fully operable installation, and completion of all plumbing and related work. The plumbing contractor shall provide the following within, beneath.

1. Complete system of sanitary, soil, waste, and vent piping connecting each and every plumbing fixture or other piece of equipment requiring same, with sanitary sewer including pipe, fittings, and other necessary appurtenances.

2. Complete system of storm water drainage including downspouts, roof drains, pipe, fittings, and other necessary appurtenances.

3. Complete systems shall be connected to adequate source of supply or disposal of the local public utility company or municipality commonly serving the area. It will be the contractor's responsibility to provide all systems complete and operable.

4. Complete system of cold water supply and distributing piping of hot and cold water connecting to every plumbing fixture, cooling tower, evaporative condenser, or other pieces of equipment requiring same, including shut-off valves (for each piece of equipment), hangers, supports, and other necessary appurtenances.

5. Cold water supplies to refrigeration and condensers.

6. Funnel or other drains for air conditioning units, refrigeration, and fire protection piping.

7. All floor and wall sleeves.

8. All plumbing fixtures, except as hereinafter noted.

9. All pipe covering.

10. Water heaters/water coolers.

11. Connections to the supply lines of the fixtures and outlets for equipment furnished by Team Meltwater.

1.02 SUBMITTALS

A. This contractor shall submit product data for all plumbing fixtures, trim and accessories.

1.03 QUALITY ASSURANCE

A. At Team Melwater's discretion, any location where the sewer/drainage system operation, installation or material is considered "suspect" shall be inspected, at the Contractor's expense, using a sewer line video camera. All necessary repairs shall be made at the Contractor's expense.

PART II - PRODUCTS

2.01 PIPING & VALVES

A. All sanitary sewers below floor shall be standard weight cast iron soil pipe.

B. Waste lines shall be standard weight cast- iron pipe conforming to CISI 302 or ANSI/ASTM A74.

C. Drain tile shall be standard form tile to conform with ASTM standards. Drain tile shall be placed with open joints and wrapped with building paper, set true to grade, and pitched to drain to sump. All tile shall be encased with a minimum of 6 inch clean gravel.

D. All rough-ins for plumbing fixtures, including all waste lines and all branch soil pipe below floor from plumbing fixtures, shall be standard weight cast iron pipe, or PVC where acceptable

E. All waste and vent piping above floor, 2 inches and smaller, to be type "M" copper with wrought copper fittings. All fittings and couplings shall be soldered.

F. Where such use is acceptable to the authority having jurisdiction, all storm and sanitary lines and fittings, below floor, above floor, may be schedule 40 PVC DWV with solvent welded joints per ANSI/ASTM D2665 and D3311. All piping, valves, fittings and solvent shall be furnished by the same manufacturer.

G. All hot and cold water lines within the unconditioned space above floor shall be type "L" copper with wrought copper fittings. All fittings and couplings shall be soldered. All hot and cold water lines within the conditioned area shall be PEX

H. Isolation valves shall be *Jomar* Model T/S100 ball type (or equal).

2.02 PLUMBING FIXTURES

A. Contractor shall furnish and install all plumbing fixtures.

B. Water closets for shall be:

WC-1 Water Closet – ADA Compliant
Pressure Lite, floor mounted, tank type, with cover locking device, Vitreous china, 1.0 gpf, bolt caps and Polished Chrome trip lever and French Curve Quiet-Close toilet seat with Quick Release functionality, Kohler "San Raphael", two-piece, Model K-3597, ADA Compliant height elongated bowl.

SEATS Furnish a compatible open front, white, solid plastic seat, with cover, with check hinge for elongated bowl.

2.03 WATER HEATING

A. Storage Type:

1. Water Heater: Provide water heater(s) as shown on plumbing drawings.

2. Flues: This contractor shall furnish and install type "B" vent flue. Flues shall be sized and run as required. Flues to be 3 feet above roof with anti-back draft cap, and Metal-Fab (or approved equal) tall-cone flashing with storm collar.

3. Combination temperature and pressure relief valve, ASME rated, McDonnell and Miller 202-NF 125-195 degrees or Watts 140-210 degrees, where fusible plug type is required by local code.

4. Pipe relief outlets to drain.

5. Thermometer on hot water supply from water heater. Range: 30 to 240 F.

PART III - EXECUTION

3.01 INSTALLATION

A. Cold Water Supply: If water pressure on domestic service exceeds 80 PSI, this contractor to furnish and install pressure reducing valve on main domestic service line set for 65 PSI.

B. Piping in General: All pipes shall be run with proper grades to provide for easy draining. They must be thoroughly reamed and cleaned before installation. This contractor shall consult and cooperate with other piping contractors as to obtain the proper grouping of pipes and to avoid interference. Pipes run overhead shall be placed as close to the roof deck as possible to maintain proper headroom and to present a neat appearance, all consistent with the correct pitching of pipes. The plumbing contractor shall consult with the construction superintendent before installation of any pipe lines which will reduce the proper headroom in any way. Piping shall be run as shown on the drawings, but the construction superintendent

reserves the right to make slight changes (without extra charge) to avoid conflict with other work.

C. Vent Pipes: All vent pipes that pass through roof openings shall be kept at a reasonable distance from the walls to permit proper application of built-up roofing and base and counter-flashings. All vent pipes shall be flashed with 3 pound sheet lead turned down into pipe.

D. Cooler/Freezer Wastes: Condenser wastes from refrigeration equipment shall discharge into a minimum 3 inch combination funnel/floor drain connected to the sewer.

E. Floor Drains: Furnish and install all floor drains.

F. Cleanouts: Full-sized brass screw plugs, cleanout plugs shall be furnished and installed at the foot of all soil and waste stacks, internal downspouts and at all points where necessary to permit the entire drainage system to be rodded out easily. Provide cleanouts at every turn in the waste line.

G. Connections to Equipment Furnished Team Meltwater.: Contractor shall rough-in and connect all fixtures and equipment to be furnished by Team Meltwater. This shall include all hot and cold water, waste, and vent piping required to connect completely to equipment.

3.02 TESTING

A. Domestic Hot and Cold Water Systems: 100 PSI (minimum) air for one hour without leakage.

END OF SECTION

SECTION 15411 RESIDENTIAL FAUCETS, SUPPLIES, AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Residential plumbing fixtures and accessories including the following:
1. faucets.
2. bath Accessories.
3. Shower heads.
4. Shower fittings.
5. Specialty items.
6. Sinks.
7. Sink fittings.
8. Drains.
9. Basket strainers and dispenser flanges.
10. Grab Bars

1.2 RELATED SECTIONS

A. Section 15400 - Basic Plumbing Materials and Methods: Related accessories, materials and miscellaneous fittings.

1.3 REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum of two years installing similar equipment.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Mechanical Warranty:
1. Residential Applications: Kohler Co. warrants its faucets manufactured after January 1, 1997, to be leak and drip free during normal residential use for as long as the original consumer purchaser owns his or her home. If the faucet should leak or drip during normal use, Kohler Co. will, free of charge, mail to the purchaser the cartridge necessary to put the faucet in good working condition. This warranty applies only to Kohler Faucets installed in the United States of America, Canada or Mexico (North America).

B. Finish Warranty:
1. Kohler Co. also warrants all other aspects of the faucet or accessories ("Faucet"), (except gold, non-PVD Vibrant®, non-chrome finishes) to be free of defects in material and workmanship during normal residential use for as long as the original consumer purchaser owns his or her home. If a defect is found in normal residential use, Kohler Co. will, at its election, repair, provide a replacement part or product, or make appropriate adjustment. Damage to a product caused by accident, misuse, or abuse is not covered by this warranty. Improper care and cleaning will void the warranty. Proof of purchase (original sales receipt) must be provided to Kohler Co. with all warranty claims. Kohler Co. is not responsible for labor charges, installation, or other incidental or consequential costs. In no event shall the liability of Kohler Co. exceed the purchase price of the Faucet.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Kohler Co, which is located at: 444 Highland Drive Kohler, WI 53044; Toll Free Tel: 1-800-4KOHLER; Web: www.us.kohler.com

B. Substitutions: Not permitted.

2.2 FAUCETS

A. Carbon by Kohler Co.
1. Model K-6227; Articulating design provides task configurable functionality allowing you to position the spray deep into the bowl or offer up to 18"

clearance for filling even the largest vase. Faucet reach is also variable from less than 2" to over 13".Flow Rate: 2.2 gpm at 80 psi.
2. Finish: Chrome.
3. Finish: Stainless Steel
4. www.us.kohler.com/onlinecatalog/detail.jsp?item=13820902&section=1&category=4&subcategory=32

B. Fountainhead integral laminar by Kohler Co.
1. Model K-2442-4 Part of Fountainhead suite used with 21" Wall Cabinet K-2431 Flow Rate: 2.2 gpm at 80 psi.
2. Solid Brass Faucet Construction
3. Finish: Chrome.
4. Finish: Mirrored Glass
5. Stained Wood Surround
6. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=null&module=Lavatory+Faucets&item=12248202&prod_num=2443-4&section=2&category=8&resultPage=0-440049023 & www.us.kohler.com/onlinecatalog/detail.jsp?item=12389802&prod_num=2432

2.3 TOILET AND BATH ACCESSORIES

A. Towel Ring:
1. Model K-14451 Stillness by Kohler Co. Chrome finish.
2. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Accessory+Collection+-+Bath&item=7674802&prod_num=14456&section=2&category=19&resultPage=0--1335985871

B. Robe Hook:
1. Model K-14458 Stillness by Kohler Co. Chrome finish.
2. www.us.kohler.com/onlinecatalog/detail.jsp?item=7674902&section=2&category=19

C. Towel Bar:
1. Model K-14551 Stillness by Kohler Co. 24 inches Chrome finish.
2. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Accessory+Collection+-+Bath&item=7674502&prod_num=14451&section=2&category=19&resultPage=0--412245943

D. Toilet Tissue Holder:
1. Model K-14463 Stillness by Kohler Co. Chrome finish.
2. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Accessory+Collection+-

+Bath&item=7675002&prod_num=14459&section=2&category=19&resultPage=0-1177296432

E. Glass Shelf:
1. (5) Model K-14455-CP Stillness by Kohler Co. Chrome finish.
2. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Accessory+Collection+-+Bath&item=7674702&prod_num=14455&section=2&category=19&resultPage=0-1323987972

2.4 SHOWER HEADS

A. SHOWER HEAD, 5.5 inches Diameter with Curtain Front.
1. Model Purist K-997 by Kohler Co..
2. 1/2 inch inlet and 3/4 inch inlet; Solid Brass Construction; Flow Rate: 1.75 gpm at 80 psi.
3. Finish: Chrome.
4. www.us.kohler.com/onlinecatalog/detail.jsp?item=13323902&section=2&category=8&subcategory=50

2.5 SINKS

A. SINK, RECTANGLE,
1. Model: Iron/Tones Cast Iron Lavatory K-2827 by Kohler Co.
2. Length: 16 3/8 inches, Width: 15 5/8 inches, Depth: 5.125 inches.
3. 18/8.5 Cast Iron; 3-1/2 inch Drain opening; Drop-In.
4. Finish: White Glazed.
5. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=null&module=Lavatories&item=10452302&prod_num=2827&section=2&category=16&resultPage=0-29106478

B. SINK, RECTANGLE,
1. Model: Poise K-3160.
2. Length: 18 inches, Width: 33 inches, Depth: 9.5 inches.
3. 18/8.5 Stainless Steel; 3-1/2 inch Drain opening Undercounter.
4. Cutting Board and Rack w/ matching finish included. Finished both sides.
5. Finish: Stainless Steel, Polished.
6. www.us.kohler.com/onlinecatalog/detail.jsp?item=8090602&section=1&category=5&subcategory=36

2.6 SINK FITTINGS

A. SINK TRAP Model K-9018 by Kohler Co.

B. SINK SUPPLY Model K-7666 by Kohler Co.

2.7 DRAINS

A. SHOWER DRAIN, 2-1/2 inch w/o OVERFLOW
1. Model: Square Design Tile in Drain K-9136.

2. All Brass Construction 2" and 3" tailpiece connections
3. Finish: Chrome.
4. www.us.kohler.com/onlinecatalog/detail.jsp?item=13190702

2.8 BASKET STRAINERS AND DISPENSER FLANGES

A. DRAIN, GRID STRAINER
1. Model K-8801 - Staggered Hole Pattern by Kohler Co.
2. All Brass Construction; Scratch Resistant PVD Finish; Gasket, Nut and Slip Washer; Fits: 2 inches & 2-1/2 inch Sink Openings; Requires: 90102 Tail Piece.
3. Finish: Chrome.
4. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Duostrainers&item=468302&prod_num=8801&section=1&category=7&resultPage=0--1195974031

2.9 GRAB BARS

A. 42" Grab Bar

1. Model K-10545 – Traditional

2. Finish: Stainless Steel

B. 32" Grab Bar

1. Model K-10543 – Traditional

2. Finish: Stainless Steel

C. 18" Grab Bar

1. Model K-10541 – Traditional

2. Finish: Stainless Steel
3. www.us.kohler.com/onlinecatalog/detail.jsp?from=thumb&frm=&module=Accessory+Collection+-+Bath&item=10923002&prod_num=10541&section=2&category=19&resultPage=0-2024588478

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and applicable building code.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 15480 - Water Heaters

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heating Ventilation and Cooling equipment:
   1. Energy Recovery Ventilator.
   2. Heat Pump.
   3. Vents and Ducts.

1.2 RELATED SECTIONS

A. Section 15400 - Basic Plumbing Materials and Methods: Related accessories, materials and miscellaneous fittings.

B. Section 15411 - RESIDENTIAL FAUCETS, SUPPLIES, AND TRIM

1.3 REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Model number and selected options for each element.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.
   5. List of maintenance parts.

1.5 QUALITY ASSURANCE

A. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.

B. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Provide manufacturer's standard written warranty for each type of appliance specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Acceptable Manufacturers: See 2.2 Water Heaters
- B. Substitutions: not permitted

2.2 Water Heaters

A. Tankless Water Heaters
1. Tempra 15
2. Dimensions: 16 5/8" W x 4 5/8" D x 14 1/2" H
3. Maximum Temperature Increase: 65 degrees Fahrenheit
4. Minimum water flow to activate unit: .58 / 2.2
5. Nominal Water Volume: .26 / 1.0
6. http://www.stiebel-eltron-usa.com/techdata_tempranew.html

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate instillation with sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. Remove all debris and confirm structural support for connections and supporting elements.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Verify all clearances and requirements as specified by manufacturer.

3.3 INSTALLATION

A. Assemble equipment and install in accordance with manufacturer's instructions and the following:
1. Securely mount to substrate.
2. Install plumb and level and in proper relationship to adjacent construction.
3. Connect to building utility, supply and waste systems as applicable.
4. Test for proper operation and drainage. Adjust until proper operation is achieved.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 DATA SHEETS

A. Refer to the manufacturer's data sheets as attached to this Section for required features and additional requirements.

END OF SECTION

SECTION 15700

HVAC Equipment

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heating Ventilation and Cooling equipment:
1. Energy Recovery Ventilator.
2. Heat Pump.
3. Vents and Ducts.

1.2 RELATED SECTIONS

A. None.

1.3 REFERENCES

A. UL

B. NFPA

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Model number and selected options for each element.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.
5. List of maintenance parts.

1.5 QUALITY ASSURANCE

A. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.

B. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Provide manufacturer's standard written warranty for each type of appliance specified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: See 2.2 Mechanical Equipment

B. Substitutions: not permitted

2.2 Mechanical Equipment

A. Energy Recover Ventilator: RenewAire

B. http://www.renewaire.com/technical/downloadResidential.php

A. Product Specification

The unit shall be a packaged static plate energy recovery ventilator. RenewAire shall be the basis of design.

B. Quality Assurance

1. The energy recovery ventilator shall be certified by the Home Ventilating Institute (HVI) under CSA 439. Both a heating and an air conditioning test must be run to demonstrate year round energy recovery.
2. Unit shall be Listed under UL 1812, Standard for Ducted Air to Air Heat Exchangers.
3. The energy recovery core shall meet NFPA 90A and 90B requirements for flame spread, not to exceed 25, and smoke generation, not to exceed 50, through an on going testing and verification program using UL Standard 723.
4. The RenewAire core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase. Balance of Unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

Performance

A. Energy Transfer

The energy recovery core shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished by direct water vapor transfer using molecular transport by hydroscopic resin.

B. Passive Frost Control

The energy recovery core shall perform without the occurrence of condensation or frosting under normal operating conditions (defined as outside temperatures above -10°F and inside relative humidity below 40%). Occasional extreme conditions shall not affect the usual function or performance of the energy recovery core.

C. Continuous Ventilation

The unit shall accomplish energy recovery in both heating and cooling seasons and shall have the capacity to operate continuously without the need for bypass, recirculation, pre-heaters or other defrost cycles under normal operating conditions.

D. Positive Air Stream Separation

Exhaust and fresh airstreams shall at all times travel in separate passages, and airstreams shall not mix.

E. Laminar Flow

Airflow through the energy recovery core shall be laminar, avoiding deposition of particulates on the interior of the exchange plate material.

Construction

1. The energy recovery core shall be of static plate, cross-flow construction, with no moving parts.
2. No condensate pan or drain shall be required.
3. The unit shall be supplied with an internal 24 VAC transformer and relay.
4. The unit shall have line cord for easy plug-in operation.
5. A latched and hinged door shall provide access to blowers, energy recovery core, and filters.
6. Cabinet walls and doors shall be insulated with 1" FSK high-density board insulation, with additional ¼" foam insulation on access door for thermal and sound insulation.
7. The energy exchange element and blowers shall be protected by a polyester filter in both exhaust air and fresh air streams.

http://www.renewaire.com/_assets/files/catalog/10pg_ResidentialCatalog_lo.pdf

B. Heat Pump: SolCool 18000Btu heat pump with dual air handlers
http://www.gjsolar.com/Senergy-cooling.html

C. Vents and Ducts

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Coordinate instillation with sizes and utility requirements.

B. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation. Remove all debris and confirm structural support for connections and supporting elements.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Verify all clearances and requirements as specified by manufacturer.

3.3 INSTALLATION

A. Assemble equipment and install in accordance with manufacturer's instructions and the following:
   1. Securely mount to substrate.
   2. Install plumb and level and in proper relationship to adjacent construction.
   3. Connect to building utility, supply and waste systems as applicable.
   4. Test for proper operation and drainage. Adjust until proper operation is achieved.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 DATA SHEETS

A. Refer to the manufacturer's data sheets as attached to this Section for required features and additional requirements.

END OF SECTION

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART I - GENERAL

1.01 ELECTRICAL GENERAL REQUIREMENTS

A. This section applies to all electrical work. The contractors involved shall check all sections of the specifications in addition to the particular section covering their specific trade. Each distinct section of the specifications aimed for one trade may have detailed information with regards to other trades. Therefore, it is imperative that all sections be reviewed to get a complete picture of all other trades' functions and work required.

B. The Team Meltwater drawings, which constitute an integral part of this contract, shall serve as the working plans. They indicate the general layout of the complete electrical system.

1. "Field verification, of scaled dimensions on plans, is directed since actual locations, distances and levels will be governed by actual field conditions." All measurements shall be verified at the site.

2. The mechanical and electrical contractors shall check architectural, structural, plumbing, heating, ventilation, and air conditioning plans to avert possible installation conflicts. Should drastic changes from original plans be necessary to resolve such conflict, the contractor shall notify the architect and secure written approval and agreement on necessary adjustment before the installation is started.

3. Discrepancies shown between plans, or between plans and actual field conditions, or between plans and specifications shall be brought promptly to the attention of Team Meltwater for a decision.

4. Drawings and specifications are intended to cover the completed installation of systems to function as described. The omission of the expressed reference to any item of labor and material necessary to comply to practice codes, ordinances, etc. shall not relieve the contractor from providing such additional labor and material.

5. The contract drawings serve as working drawings for the general layout of the various services. However, layout of equipment accessories, specialties, piping systems, and conduit runs are diagrammatic unless specifically dimensioned and do not necessarily indicate every required valve, fitting, transition, turning vane, junction box, pull box, conduit size, etc. It will be the contractor's responsibility to provide all systems complete and operable. The contractor is to make field verification of all services, systems, etc. as part of the total work required and the cost to be included in his base bid.

C. Accessibility: Do not locate traps, controls, unions, pull boxes, etc. in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in mechanical, electrical, and plumbing systems.

D. Cutting and Patching: All cutting required shall be done by the contractor whose work is involved, without extra cost to Team Meltwater. All patching and restoration including the furnishing and installation of access panels in ceiling, walls, etc. within the building lines shall be done by the respective, responsible contractor. No cutting of structural steel, concrete, or wood shall be done without prior approval and explicit directions of the architect and Team Meltwater All duct openings in walls, floors, ceiling, and roof shall be cut and patched by the respective, responsible contractor.

E. Relocation of Existing Duct, Conduits, Pipes and Utilities: The contractor, under whose jurisdiction the work may fall, shall provide labor, material, and tools required to cut, repair, protect, cap, or relocate existing pipes, conduits, or utilities interfering with or uncovered during work, per regulations of the authorities having jurisdiction.

F. Excavation and Backfill: Excavation and removal of material, shoring, and backfilling required for the proper laying of all pipes and conduits inside the building and premises, and outside as may be necessary, shall be done by the contractor whose work is involved, without extra cost to Team Meltwater

G. Vibration Eliminators: Rotating or reciprocating equipment, ducts, piping, etc. shall be isolated from the structure by means of approved vibration absorbing units as provided or recommended by the equipment manufacturer or architect.

H. Sleeves: Each contractor shall furnish required sleeves. Sleeves shall be extended 2” above the floor, wall, etc. unless noted otherwise and shall be galvanized steel pipe and of the required size. The contractor responsible for running pipes in the sleeve shall caulk the space between pipe and sleeve with oakum and seal with mastic cement or other approved material.

I. Electric Motors: Each contractor shall provide all electric motors for their respective work. Verify building voltage prior to ordering motors. Motors shall be N.E.M.A. standard design for quiet operation and of ample size to operate at their proper load and full speed continuously without causing undue noise or vibration. All motors to be drip-proof construction and have ball bearings. Provide all belted motors with guide rails, adjusting screws, anchor bolts, and cast iron bed plates. Furnish standard size V belts and pulleys. Provide full voltage magnetic starters for all three-phase motor-driven equipment. (General Electric CR7006 or Allen-Bradley Bul. 709.)

J. Electrical Wiring: The electrical contractor shall furnish all wiring required for the operation of motors and controls.

K. Damage to Other Work: Each contractor will be held rigidly responsible for all damages to their own or any other trades’ work resulting from the execution of the involved contractor’s work.

L. Large Equipment: All large equipment which is to be installed in the building that may be too large to enter through stairways, doorways, or shaft shall be brought on the job and placed in the proper space before the enclosing structure is completed, unless arrangements are made with other contractors to permit access at a later date, without additional cost to Team Meltwater.

M. Rough-in for Connection to Equipment: It shall be the responsibility of each contractor to study the architectural, structural, electrical, and mechanical drawings, conferring with the various trades involved and checking with the supplier of equipment in order to properly rough-in for all equipment.

N. Material and Equipment: All material and equipment shall be new and of the best quality used for the purpose in good commercial practice, and shall be the standard product of reputable manufacturers. The material and equipment must meet approval of state and local codes in the area it is being used.

O. Construction Superintendent: The term “construction superintendent” shall herein be referred to synonymously as Team Meltwater’s construction superintendent.

P. Performance of Work: All work outlined in the various mechanical and electrical sections shall be done by the contractor under whose jurisdiction the work may fall. See drawings and specifications.

Q. Roof decks shall not be used to support piping, conduit, equipment (except roof mounted) devices, etc.

1.02 SUPPLEMENTARY CONDITIONS

A. Refer to other requirements of mechanical and electrical work in Division 1 without exception.

B. Visit to Site: Each contractor is directed to visit the site to verify dimensions and existing conditions of mechanical, electrical, and plumbing systems, and will thoroughly acquire information regarding grades, space conditions, limitations, and peculiarities of construction required for the building and site and will give due consideration to same in preparation of proposal. No exceptions will be considered after award of a contract, nor will the contractor be entitled to any extra compensation for their failure to verify conditions at the site.

C. Permits, Inspections, and Tests: All work is to be executed in compliance with, and each contractor is to observe and abide by, all applicable laws, regulations, ordinances, and rules of the national, state, county, and local governing agencies, or any other duly constituted public authority. Each contractor will, at all times, maintain proper facilities and provide safe access for inspection to all parts of the work and to the shops wherein the work is in preparation. No work will be enclosed or covered until approved by the architect, and should any work be enclosed or covered before all necessary inspections are completed, same will be opened for examination at the contractor’s expense. All fees, licenses, tests, costs, etc. are contractor’s responsibility.

D. Rules, Regulations, and Codes:

1. All material and equipment shall conform to the standards, where available, or the National Electrical Manufacturers Association (N.E.M.A.), National Fire Protection Association (N.F.P.A.), National Electrical Code (N.E.C.), and Underwriters Laboratories (U.L.).

2. All work shall conform to all applicable federal, state, and local codes and utility companies' regulations.

E. Workmanship and Installation: Team Meltwater shall decide whether or not the finished work is satisfactory in their judgment. If any material and/or equipment has not been properly installed or finished, this contractor is obligated to replace the material or equipment wherever required and to reinstall the material or equipment in a manner entirely satisfactory at this contractor's expense (without additional cost to Team Meltwater.).

F. Guarantee: Each contractor shall guarantee each complete system for a period of one (1) year from the date of acceptance of the work by Team Meltwater. to be free of defects of material and workmanship and that any faulty material or workmanship will be repaired or replaced without additional cost to Team Meltwater.

G. Cooperation: There shall be complete cooperation with all trades in the matter of planning and execution of the work. Every reasonable effort shall be made to prevent conflict as to space requirements, dimensions, locations, leaving of opening, or other matters to obstruct or delay the work.

1.03 SUBSTITUTIONS

A. Material Substitution: The name of an article or its make, as given in the specifications and drawings, is used to establish a standard for the guidance of the contractor. He may propose substitution of other material or equipment (unless specifically stated no substitution accepted).

B. Should the contractor propose to furnish materials and equipment other than those specified, as permitted by the "acceptable alternate" clause, he shall submit a written request for any or all substitutions to Team Meltwater. Such a request shall be accompanied with complete descriptive and technical data for all items (manufacturer, brand name, catalog number, descriptive literature, and capacity tables); stating in each case what addition to or deduction from the main bid is to be made if such alternates are accepted.

Where such substitutions alter the design or space requirements indicated on the plans, the contractor shall include all items of cost for the revised design and construction including cost of all allied trades involved.

C. Acceptance or rejection of the proposed substitutions shall be subject to the approval of Team Meltwater, and if specific approval in writing is not received, it is understood that the requirements as outlined in the Team Meltwater plans are to be met.

END OF SECTION

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Wall-box motion sensors.
5. Isolated-ground receptacles.
6. Snap switches and wall-box dimmers.
7. Solid-state fan speed controls.
8. Wall-switch and exterior occupancy sensors.
9. Communications outlets; see Section 16741.
10. Pendant cord-connector devices.
11. Cord and plug sets.
12. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 16 Section 16741 “Communication Cabling and Wiring."

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).

b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 8300 (duplex).
b. Hubbell; HBL8310 (single), HBL8300H (duplex).
c. Leviton; 8310 (single), 8300 (duplex).
d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).

3. Hospital Grade, white colored, except critical branch receptacles to be red. Each receptacle to have green hospital grade identification mark.

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; CR 5253IG.
b. Leviton; 5362-IG.
c. Pass & Seymour; IG6300.

3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, **feed, non-feed**-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 5362BLS.
   b. Hubbell; HBL5362SA.
   c. Leviton; 5380.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; IG5362BLS.
   b. Hubbell; IG5362SA.
   c. Leviton; 5380-IG.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

4. Hospital Grade: White colored, except critical branch receptacles to be red. Each receptacle to have green hospital grade identification.

5. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cooper Crouse-Hinds.
    b. EGS/Appleton Electric.
    c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; L520R.
    b. Hubbell; HBL2310.
    c. Leviton; 2310.
    d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; IG2310.
    b. Leviton; 2310-IG.

3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; (single pole), (two pole), (three way), (four way).
b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton; (single pole), (two pole), (three way), (four way).
d. Pass & Seymour; (single pole), (two pole), (three way), (four way).

C. Rocker Switches: General-duty, quiet, rocker decorator type, white color:

1. Apartment units, Independent Living, Assisted Living units, Commons areas, Corridors, etc., Offices.

D. Snap Switches: General duty grade, quite type:
1. All utility areas, commercial kitchens, trash rooms, storage rooms, garages, maintenance.

E. Skilled Nursing Facility: Snap switches: general duty, quiet type, white color, except emergency generator circuit switch to be red color.

F. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221PL for 120 V and 277 V.

b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

G. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

3. Description: Single pole, with factory-supplied key in lieu of switch handle.

H. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 1995.
b. Hubbell; HBL1557.
c. Leviton; 1257.
d. Pass & Seymour; 1251.

I. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 1995L.
b. Hubbell; HBL1557L.
c. Leviton; 1257L.
d. Pass & Seymour; 1251L.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable **slider, toggle switch, or rotary knob**; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. **Illuminated when "OFF."**

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable
2. Three-speed adjustable

2.12 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 6111 for 120 V, 6117 for 277 V.
b. Hubbell; WS1277.
c. Leviton; ODS 10-ID.
d. Pass & Seymour; WS3000.
e. Watt Stopper (The); WS-200.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view.

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; AT120 for 120 V, AT277 for 277 V.
b. Leviton; ODS 15-ID.

3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view.

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATP1600WRP.
    b. Leviton; ODWWV-IRW.
    c. Pass & Seymour; WA1001.
    d. Watt Stopper (The); CX-100.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view.

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATD1600WRP.
    b. Leviton; ODW12-MRW.
    c. Watt Stopper (The); DT-200.

3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view.

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATP120HBRP.
    b. Leviton; ODWHB-IRW.
    c. Pass & Seymour; HS1001.
    d. Watt Stopper (The); CX-100-3.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view.

F. Exterior Occupancy Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Leviton; PS200-10.
    b. Watt Stopper (The); EW-100-120.

3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view.

2.13 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch- (1-mm-) thick. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
3. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant**,** die-cast aluminum thermoplastic with lockable cover.

2.14 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, flap-type**,** dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, Round solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.15 POKE-THROUGH ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
2. Size: Selected to fit nominal **3-inch (75-mm) 4-inch (100-mm)** cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

4. Closure Plug: Arranged to close unused [**3-inch (75-mm)**] [**4-inch (100-mm)**] cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.16 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: Metal, with manufacturer's standard finish.

E. Wire: No. 12 AWG.

2.17 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: White (verify final color selection with Architect), unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with [**black**] [**white**] [**red**]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Switch-box occupancy sensors.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Multipole contactors.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.
2. Division 16 Section "Dimming Controls" for architectural dimming system equipment.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 TIME SWITCHES

A. Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Leviton Mfg. Company Inc.
6. Lightolier Controls; a Genlyte Company.
7. Lithonia Lighting.
8. Paragon Electric Co.
9. Square D.
10. TORK.
11. Touchplate Technologies, Inc.
12. Watt Stopper (The).

B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: SPST or DPST.
2. Contact Rating: 20-A ballast load, 120/240-V ac.
3. Program: Single channel, 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
5. Astronomical Time: All channels.
6. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: SPST or DPST.
2. Contact Rating: 20-A ballast load, 120/240-V ac.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program.
4. Astronomical time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers:

1. Area Lighting Research, Inc.
2. Fisher Pierce.
3. Grasslin Controls Corporation.
4. Intermatic, Inc.
5. Lithonia Lighting.
6. Novitas, Inc.
7. Paragon Electric Co.
8. Square D.

9. TORK.
10. Touchplate Technologies, Inc.
11. Watt Stopper (The).

B. Description: Solid state, with SPST or DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (6 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

2.5 SWITCH-BOX OCCUPANCY SENSORS

A. Available Manufacturers:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting Inc.
3. Leviton Mfg. Company Inc.
4. Lightolier Controls; a Genlyte Company.
5. Lithonia Lighting.
6. MYTECH Corporation.
7. Novitas, Inc.
8. RAB Electric Manufacturing, Inc.
9. Sensor Switch, Inc.
10. TORK.
11. Unenco Electronics; a Hubbell Company.
12. Watt Stopper (The).

B. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, flourescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, flourescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.

1. Include ground wire.
2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present, where indicated on plans.

2.6 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers:

1. Hubbell Lighting Inc.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting.
4. MYTECH Corporation.
5. Novitas, Inc.
6. RAB Electric Manufacturing, Inc.
7. Sensor Switch, Inc.
8. TORK.
9. Unenco Electronics; a Hubbell Company.
10. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted though a ½-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present, where indicated on plans.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on an 8-foot- (2.4-m-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

meltwater

sponsors

The U.S. Department of Energy provides $100,000 in funding to support students and other labor expenses. WE Energies, continuing its support for renewable sources of energy, is a Title Sponsor for the project. The total project budget, including cash donations, in-kind donations of services and materials, and student and faculty labor is approximately $650,000. We are hoping for additional primary sponsors to step forward with cash, material, and in-kind donations of approximately $25,000.

for sponsorship opportunities:

Debbie Mitchelson
e: mitched@uwm.edu
t: 414.229.2573 f: 414.229.6976

for additional information on the solar decathlon competition, contact:

Gregory D. Thomson
e: thomsong@uwm.edu
t: 414.229.4014 f: 414.229.6976

Christ T. Cornelius
e: christc@uwm.edu
t: 414.229.4014 f: 414.229.6976

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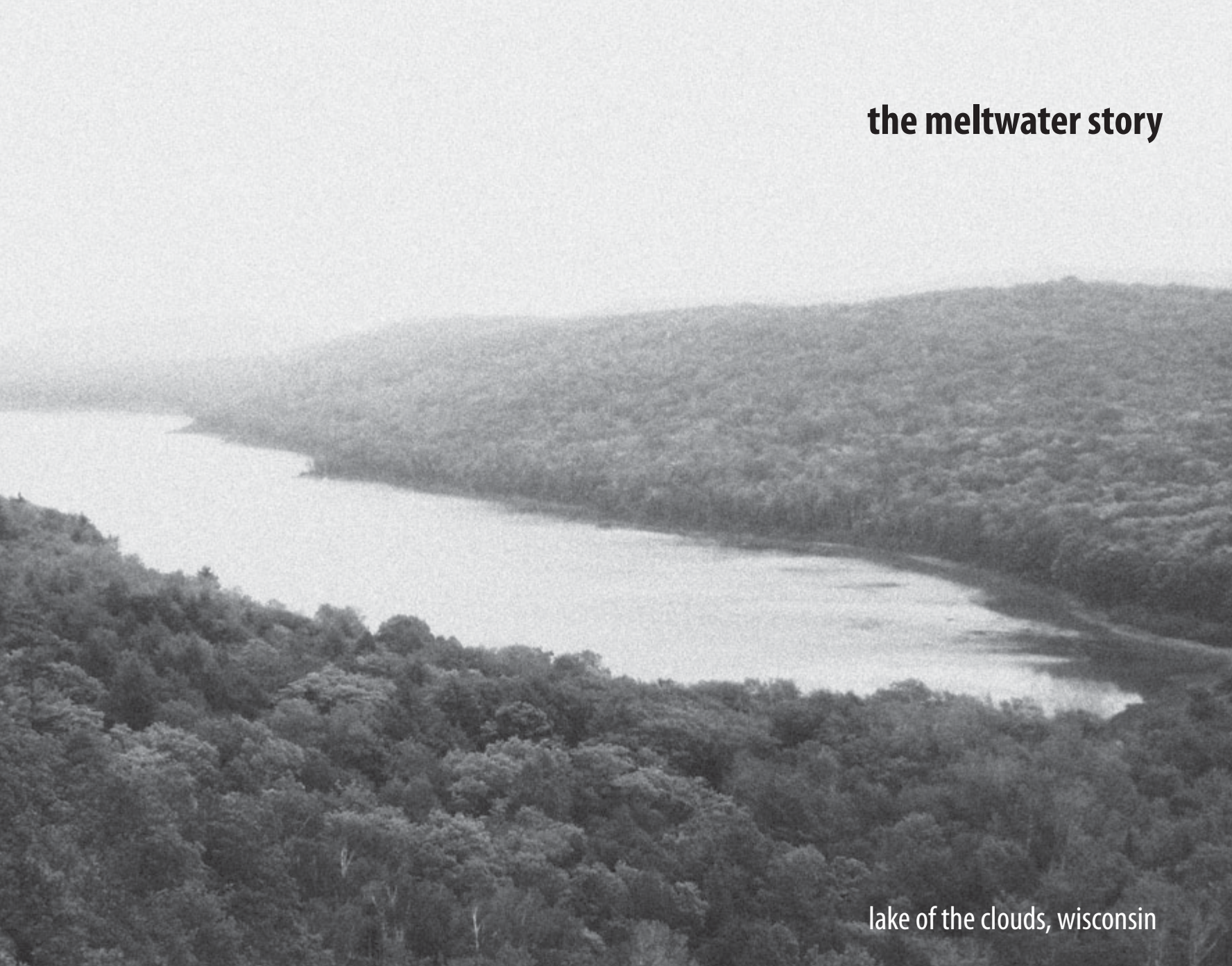
THE IDEA

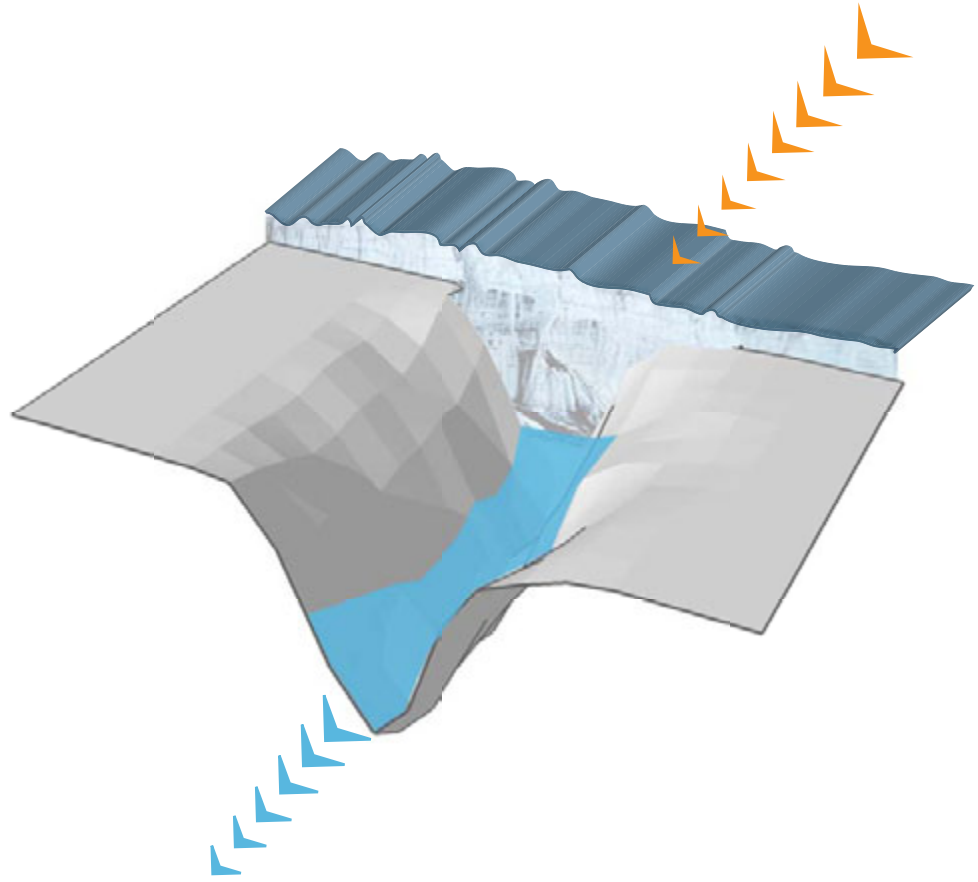
the meltwater story



lake of the clouds, wisconsin

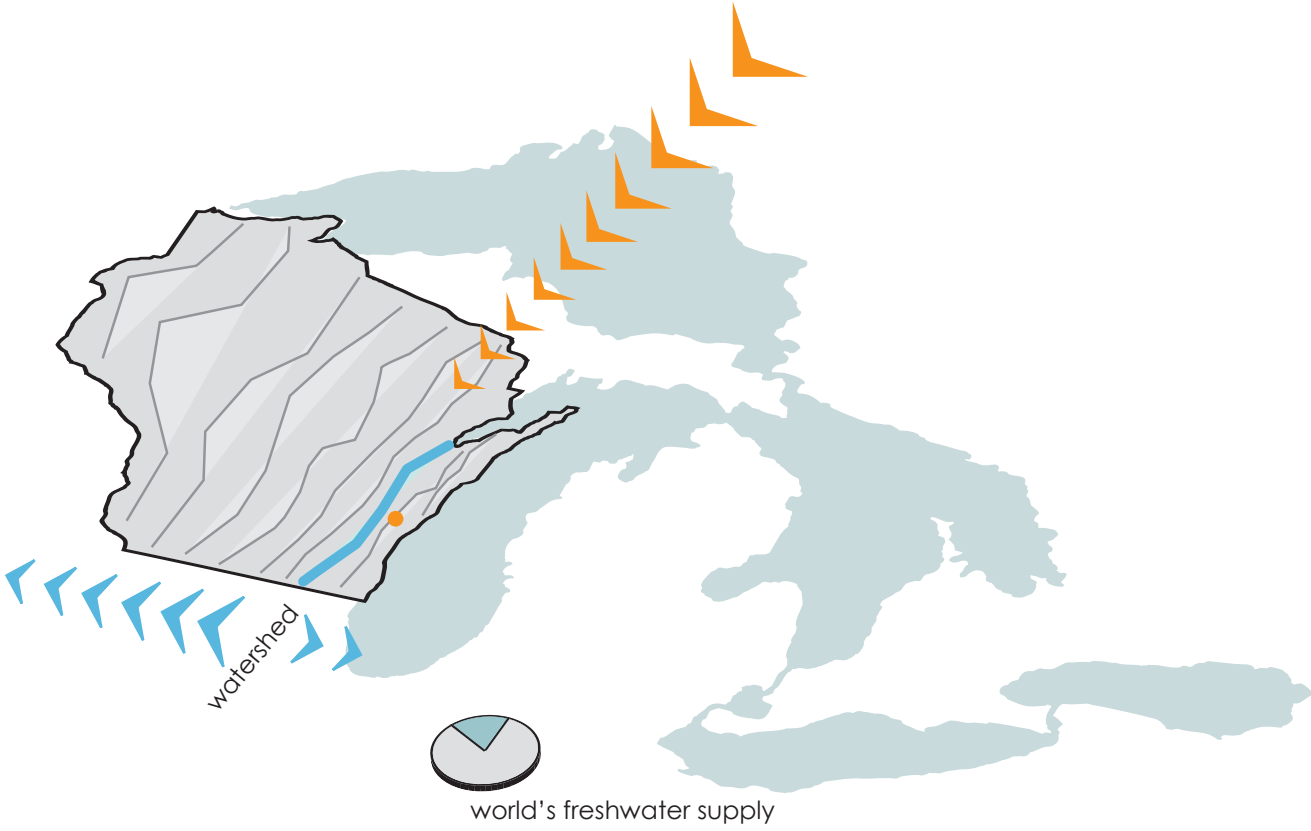
origin

At the end of the Last Glacial Period 10,000 years ago, also called the Wisconsin Glaciation Period, the intense power of the sun began melting the glaciers that blanketed Wisconsin. The sun released the energy embodied in the ice, and the meltwater running off glacial ice in Wisconsin transported and reworked the stratified drift, carving river valleys and basins into our topography -- creating the largest body of freshwater on earth: the Great Lakes. Lying in between Lake Michigan and the Mississippi River, Wisconsin is in a unique position to marshal these valuable freshwater resources.



region

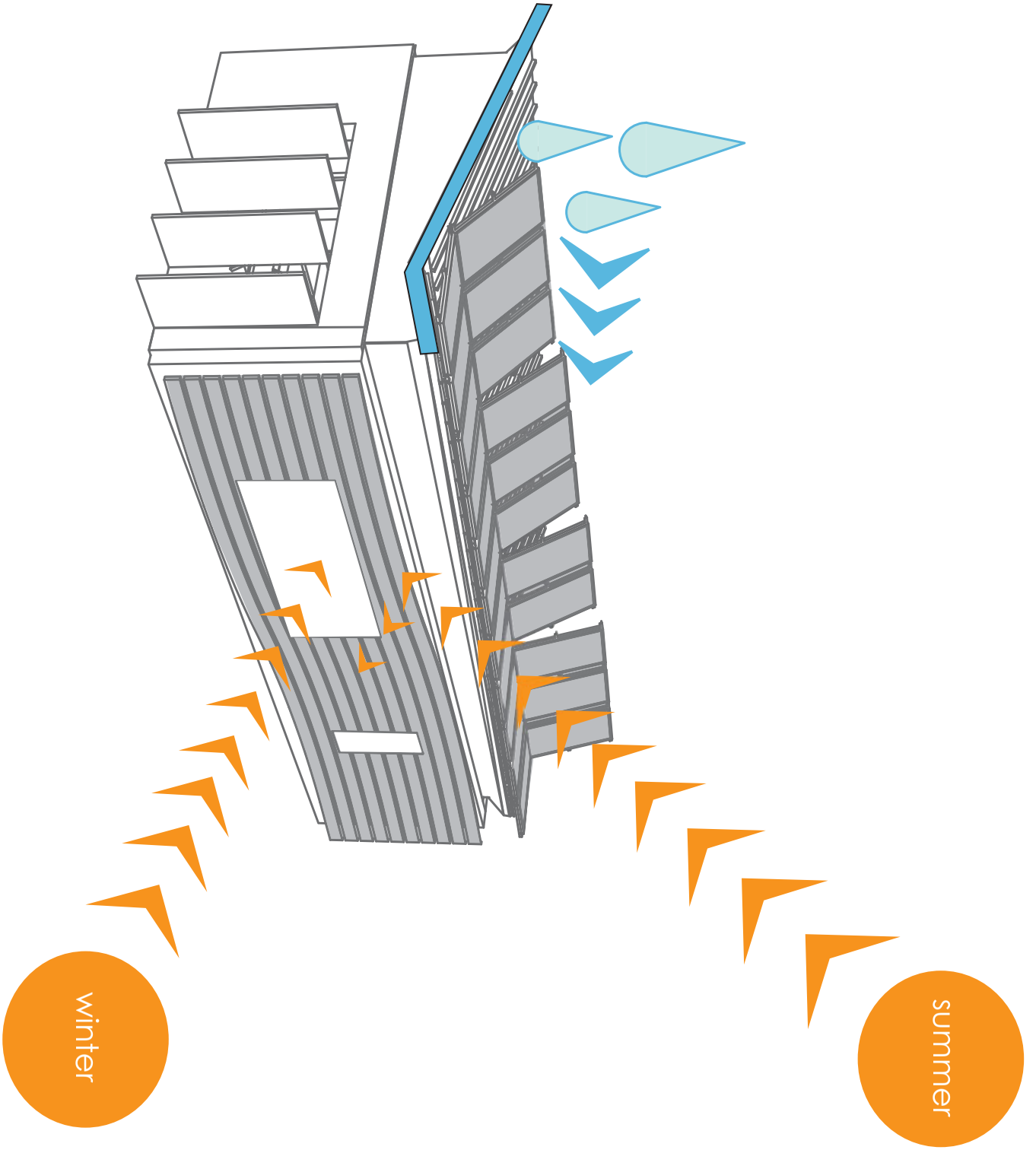
The formation of the Great Lake exhibits nature's capacity for renewal, reciprocity and life, as well as the potential to harness the energy embodied in solar rays and water. This renewal is exhibited each year in Wisconsin as the melting snow and ice allows for a fertile, plentiful landscape.



response

The ability to harness the limitless power of solar energy, and foster the collection of our finite freshwater resources is the genesis of our idea. Just as the glaciers transformed our landscape thousands of years ago, many components of our design have the ability to change states, breathing new life and energy into their forms.

Using nature not only as a resource, but as a model, Meltwater raises awareness of the possibilities of our particular region and the distinct responsibilities we have to it.



11 the idea: meltwater story

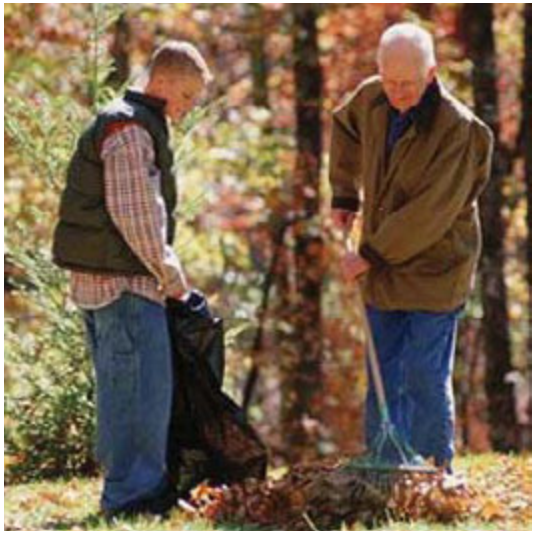
THE PEOPLE

our target market

family

A family is looking to buy a new home that is going to both benefit their family and the environment. Adults, young and old, understand that the planet will belong to the generations to come, thus is intent on making ecologically responsible decisions, however, they may have heard that buying "green" can be an expensive and complicated process. A net-zero unit in the Bay View neighborhood, would fulfill the needs of the family or seniors who want to be close to family, as well as making a environmentally responsible choice. Engergy produced on-site increases the value of their property and Wisconsin does not tax the property on value-added by energy producing components.

invest in the future



Eco Bay, the first 100% solar development of its kind has been proposed for an old army reserve has been proposed for the Bay View neighborhood.

Financial correlation between the site and the target market has been drawn, enabling the community to be able to support the cost and potential of the property.

Understanding the demographics of the neighborhood by looking at average age and income, the house would be marketed for both families and seniors.

"We did not simply inherit this world from our parents, we merely borrowed it from our children"
-Datu Paglas

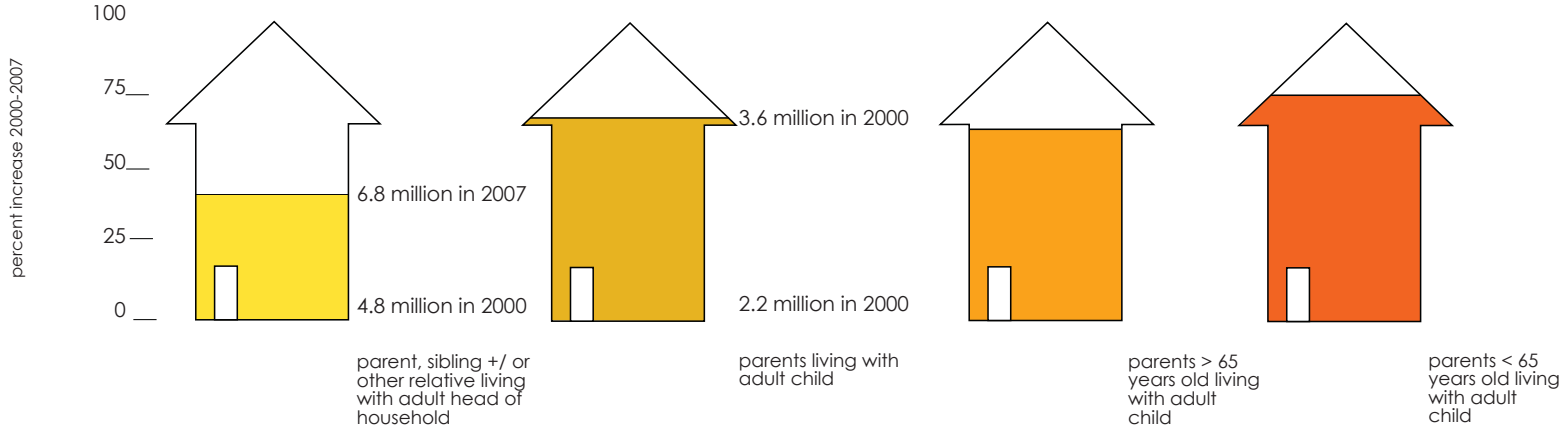
enriching lives

New and old families are happy to live a 'greener' life. The Eco Bay development in Bay View is within walking distance to several forms of public transportation, including the proposed extension of the Kenosha-Racine-Milwaukee (KRM) rail line. The solar home will be just one of among many other solar homes. Owners of the solar home will be doing their part in contributing to living a greener lifestyle.
Each unit will be configured to suit the needs of multi or single families. The development also requests units for seniors, who wish to live greenly independent.

Energy produced on-site increases the value of their property and Wisconsin does not tax the property on value-added by energy producing components. The development will also serve as an example for not only Milwaukee, but the entire country to follow.

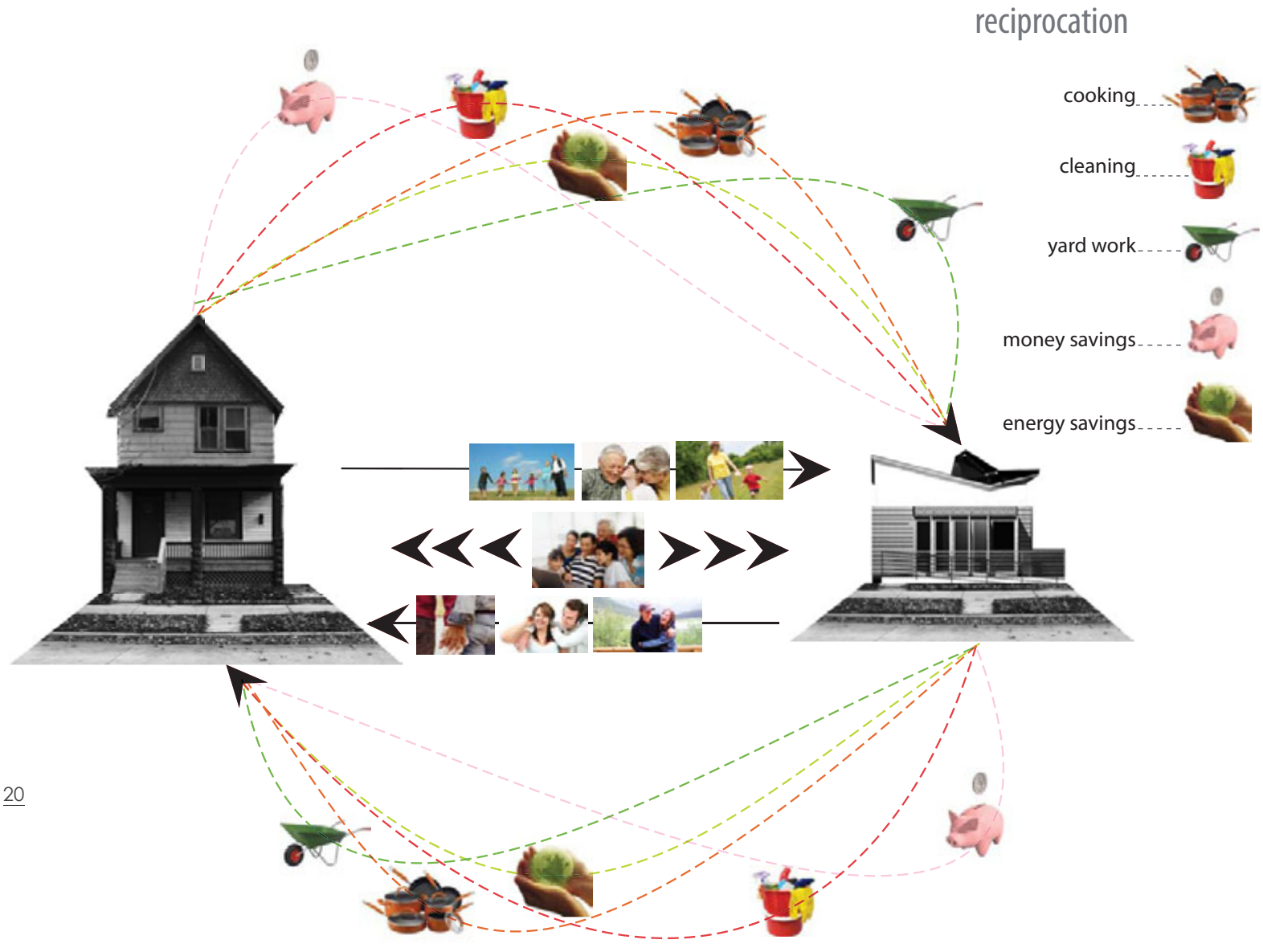
current trends

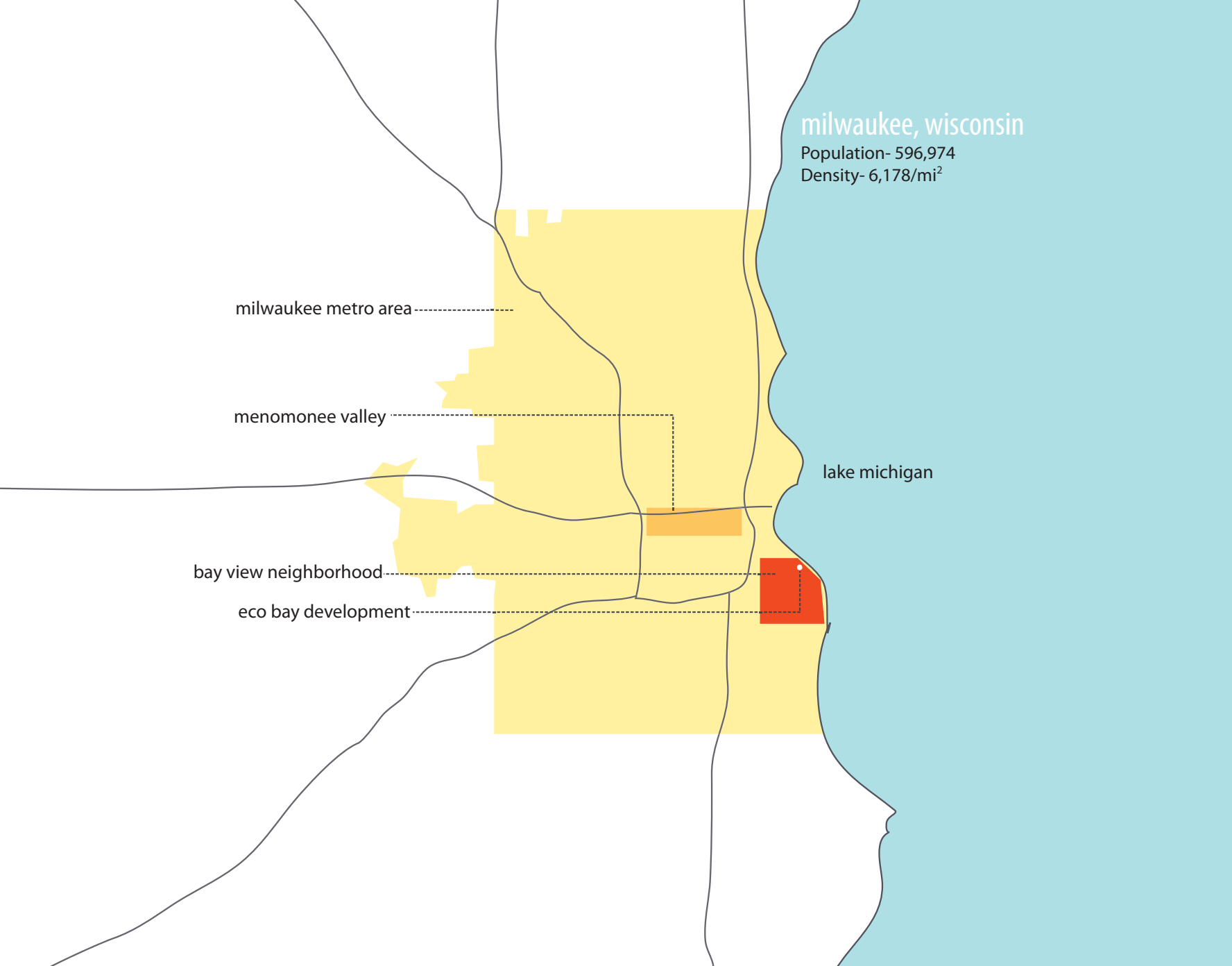
Boomerang Parents: the number of parents moving back in with children over the past seven years has increased by more than 50%. Higher housing costs and the nation's struggling economy are just a couple factors that could be causing this trend. Also, inter-generational households are more common among the country's growing number of immigrants.



ancillary

The family decides that adding an ancillary unit to the back of their lot would be a positive ecological and financial choice for both homeowners, and it would contribute to the well-being of the family.

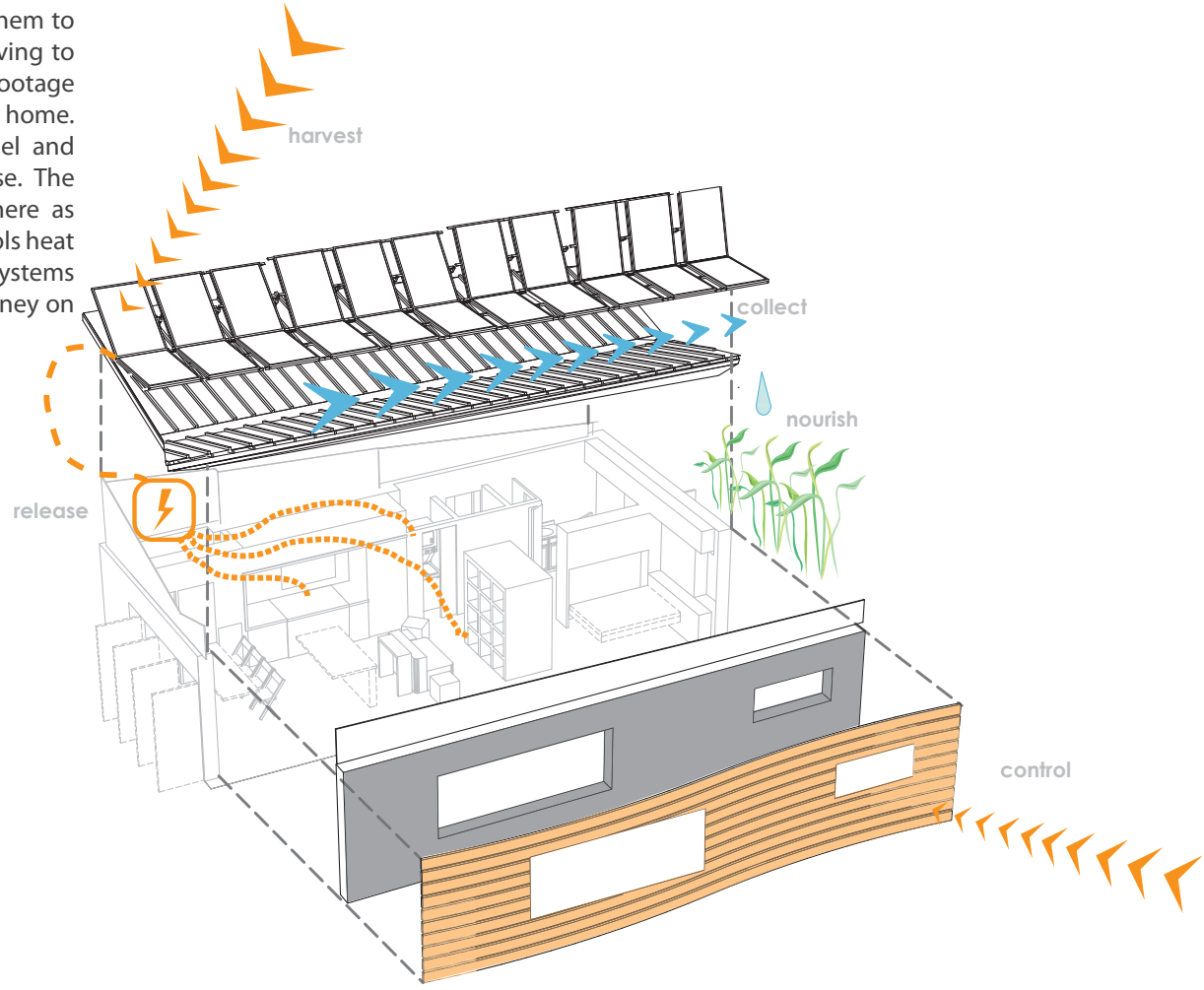

reciprocation
cooking
cleaning
yard work
money savings
energy savings


milwaukee, wisconsin
Population- 596,974
Density- 6,178/mi²
milwaukee metro area
menomonee valley
lake michigan
bay view neighborhood
eco bay development

THE HOME

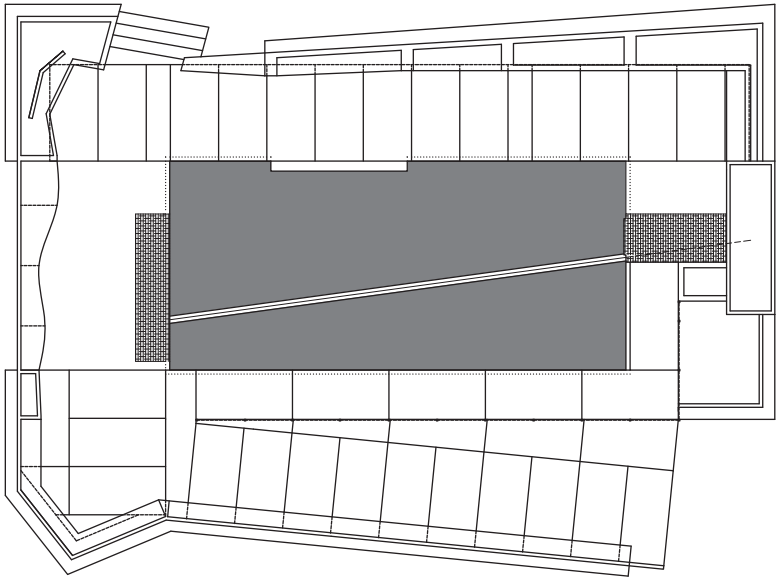
net zero

The residents of Eco Bay are proud that their home is not negatively impacting the environment for future generations. They are drawn to complex systems that power the home in a net-zero energy fashion, wedded with the simple and elegant design that allows them to entertain family and friends without having to maintain and power the excess square footage associated with a larger single-family home. The roof has been designed to channel and collect water for use around the house. The photovotaic panels harvest energy, where as the paneling system on the facade controls heat gain and loss. Although these complex systems can be expensive, the residents save money on their monthly energy bills.

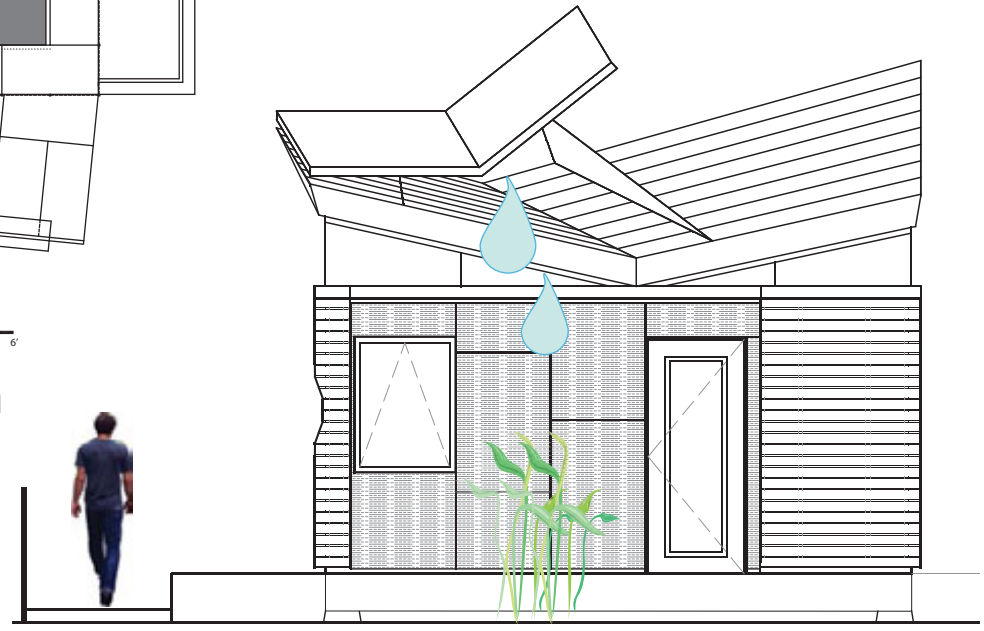


meltwater water collection

The deck is designed to work together with the roof to gather rainwater. A scupper delivers rainwater from the rooftop and delivers it to a collection pond where it can run over into the meltwater garden.



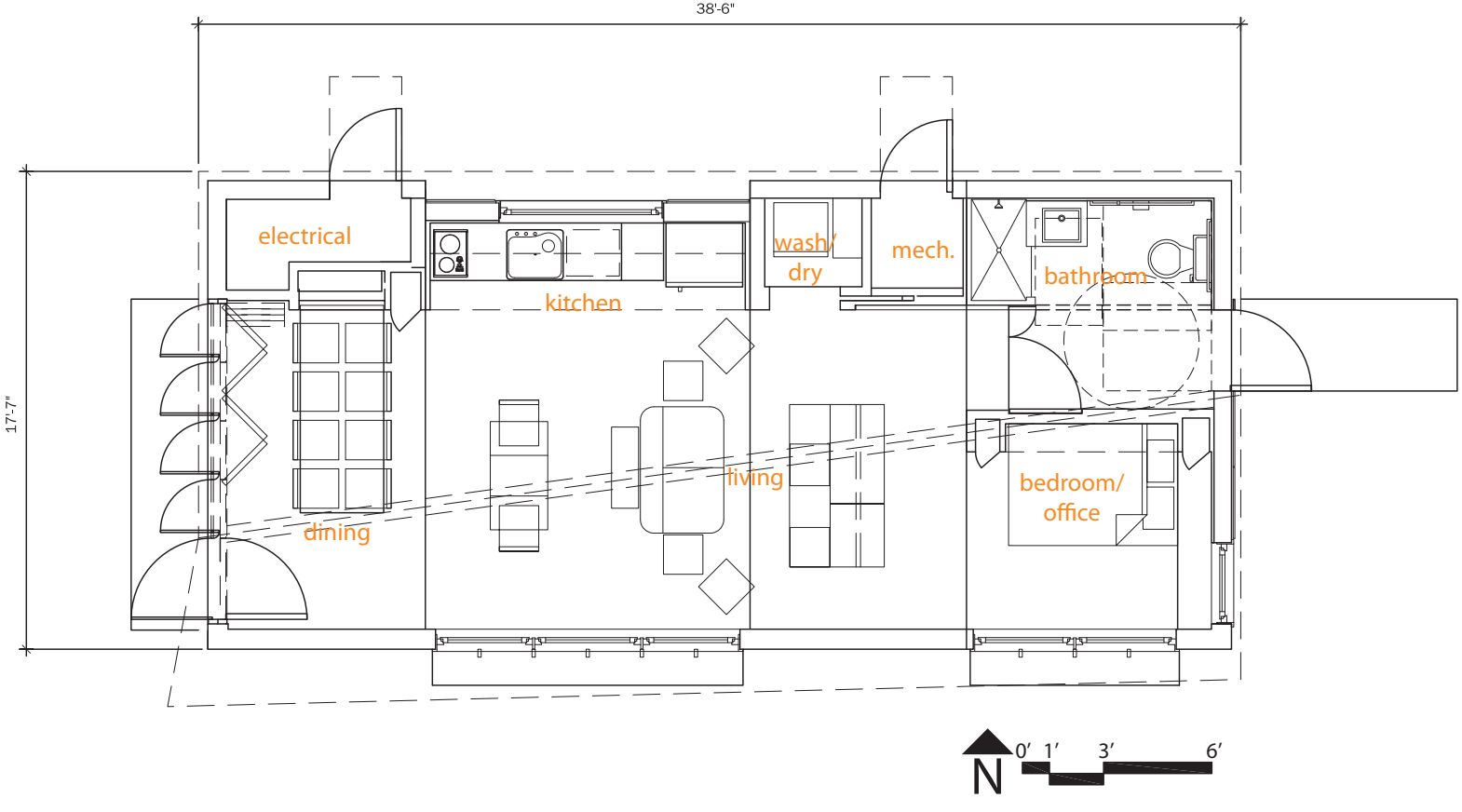
deck plan



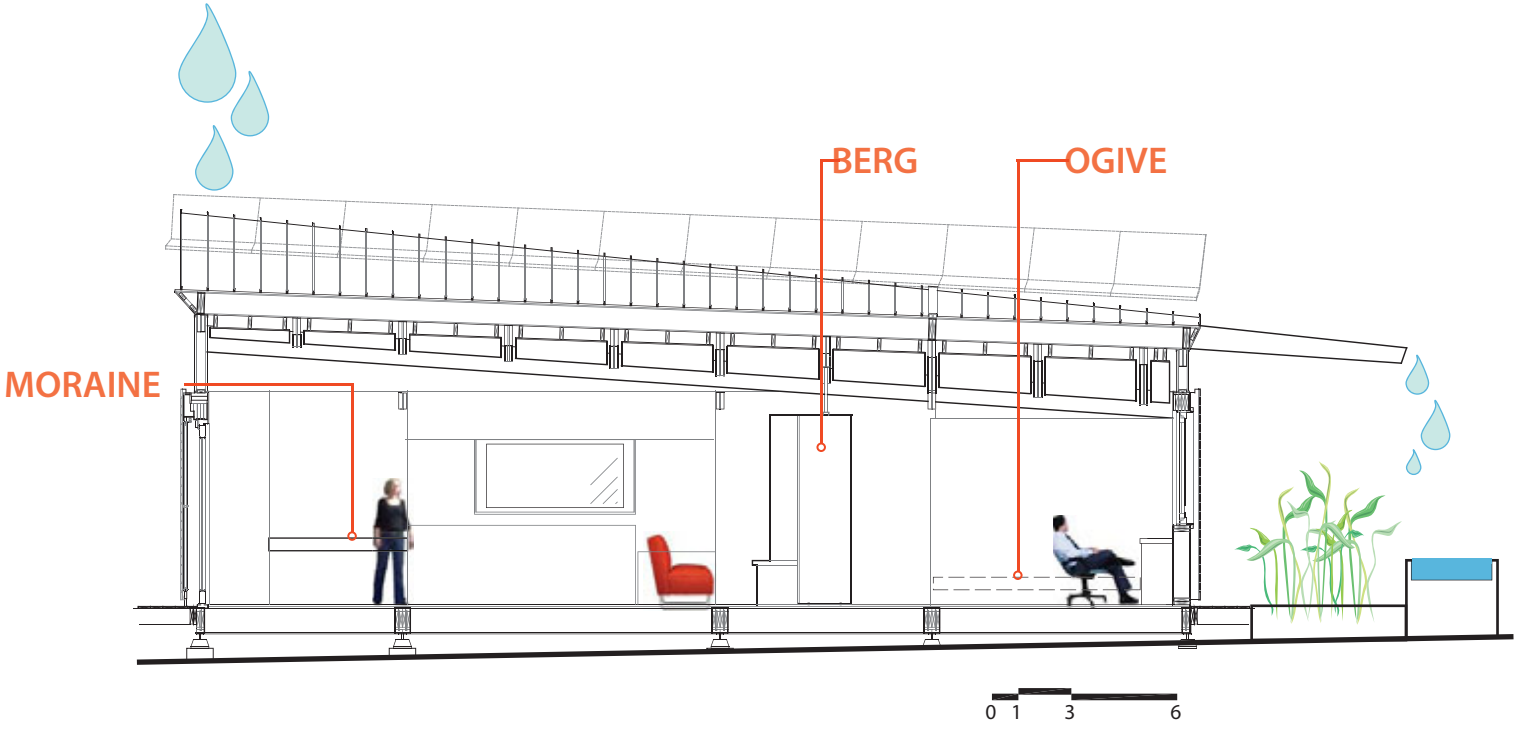
0 1′ 3′ 6′

east elevation

meltwater plan

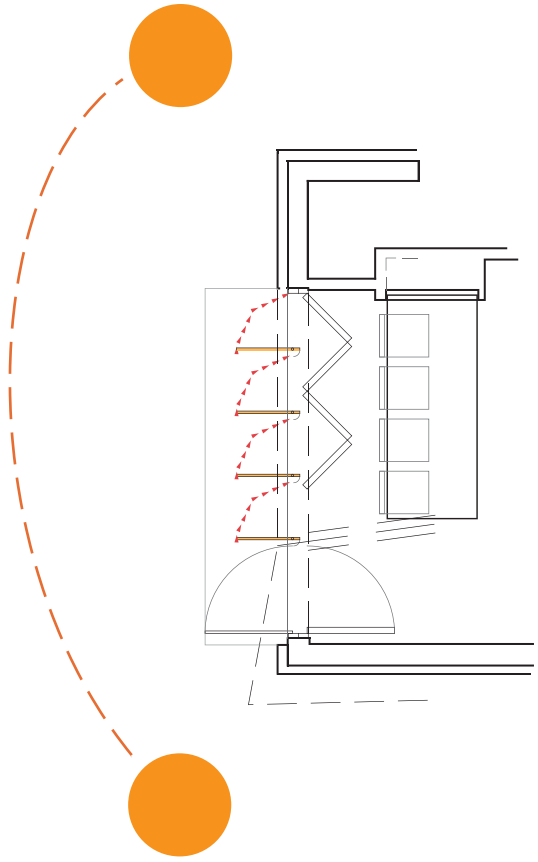


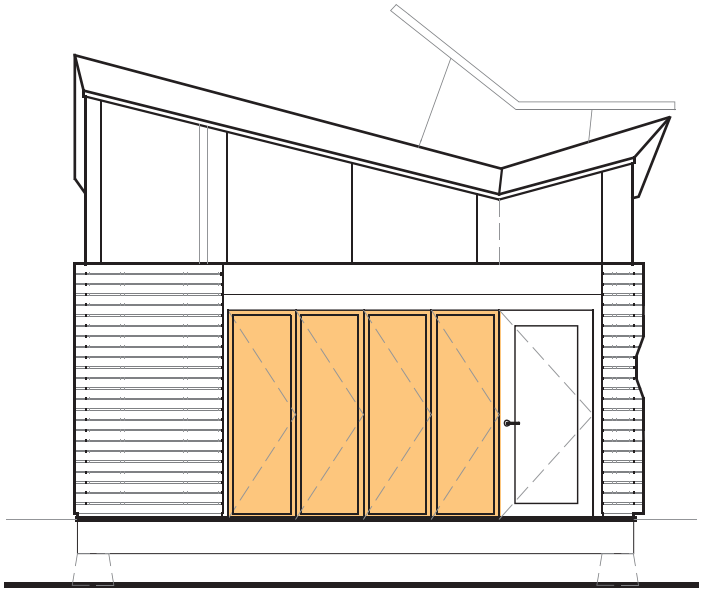
meltwater section



meltwater adaptability

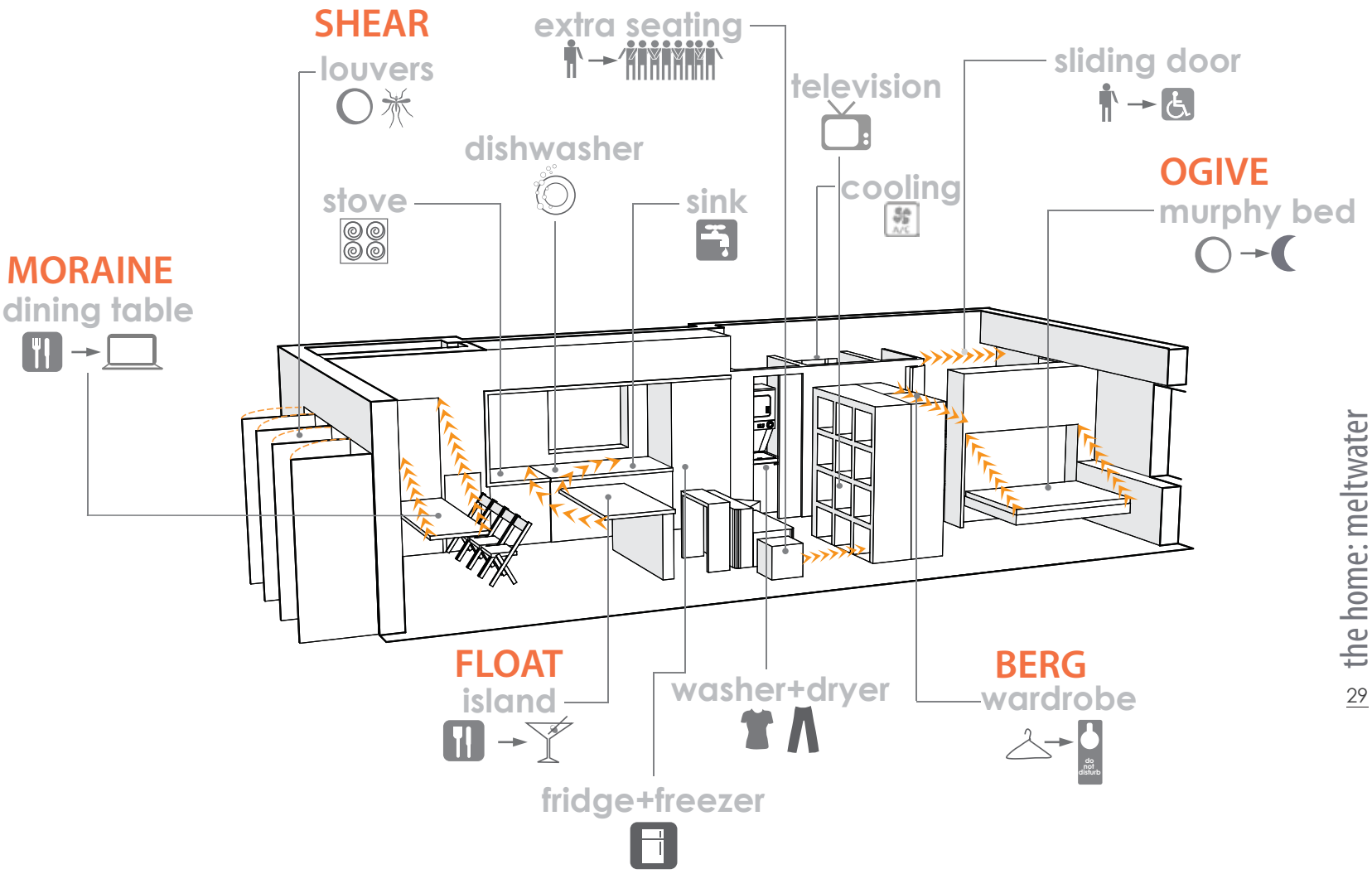
As the sun moves throughout the day, the louvers protecting the glass west doors automatically track the sun to minimize heat gain.



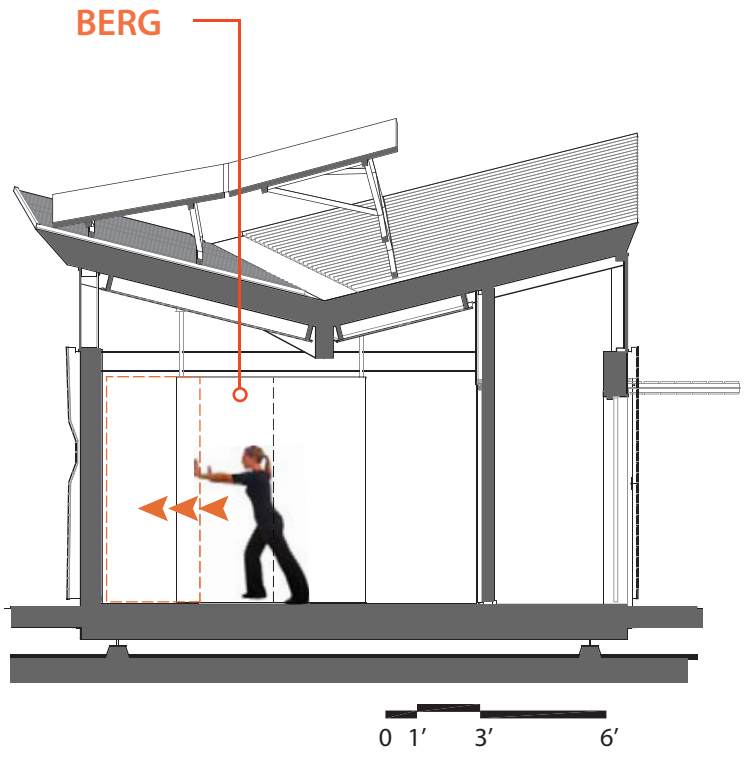


0 1′ 3′ 6′

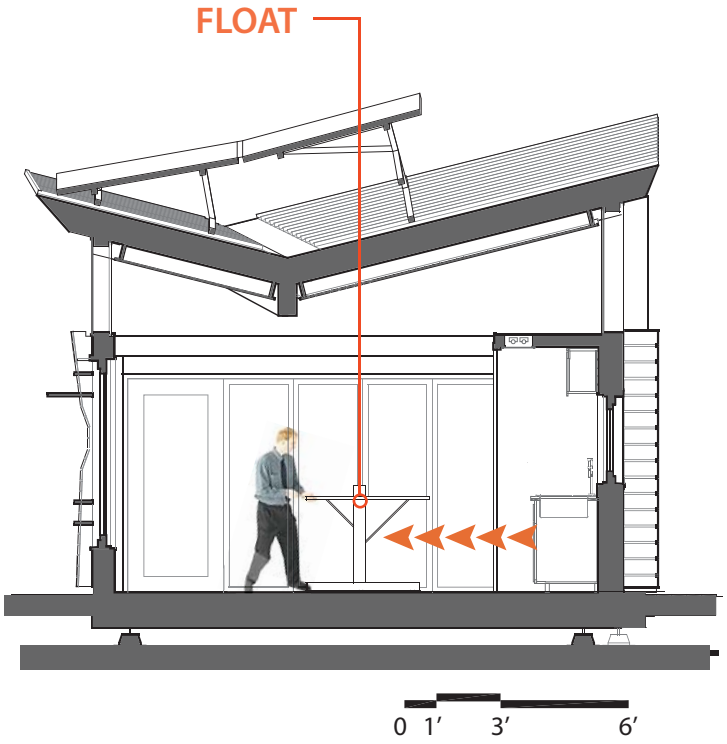
west elevation

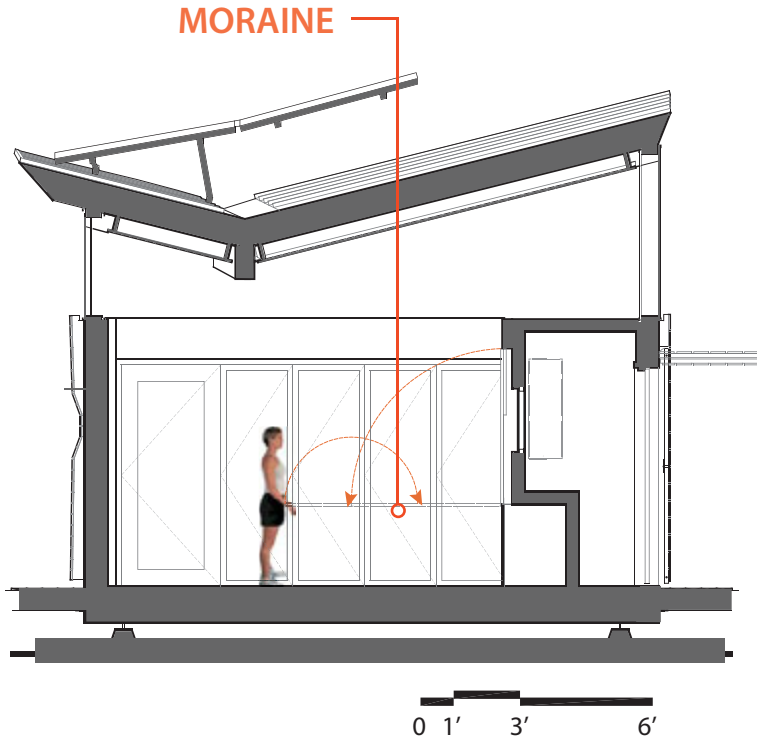

SHEAR
louvers
extra seating
television
sliding door
dishwasher
stove
sink
cooling
OGIVE
murphy bed
MORAINE
dining table
FLOAT
island
washer+dryer
BERG
wardrobe
fridge+freezer

meltwater adaptability



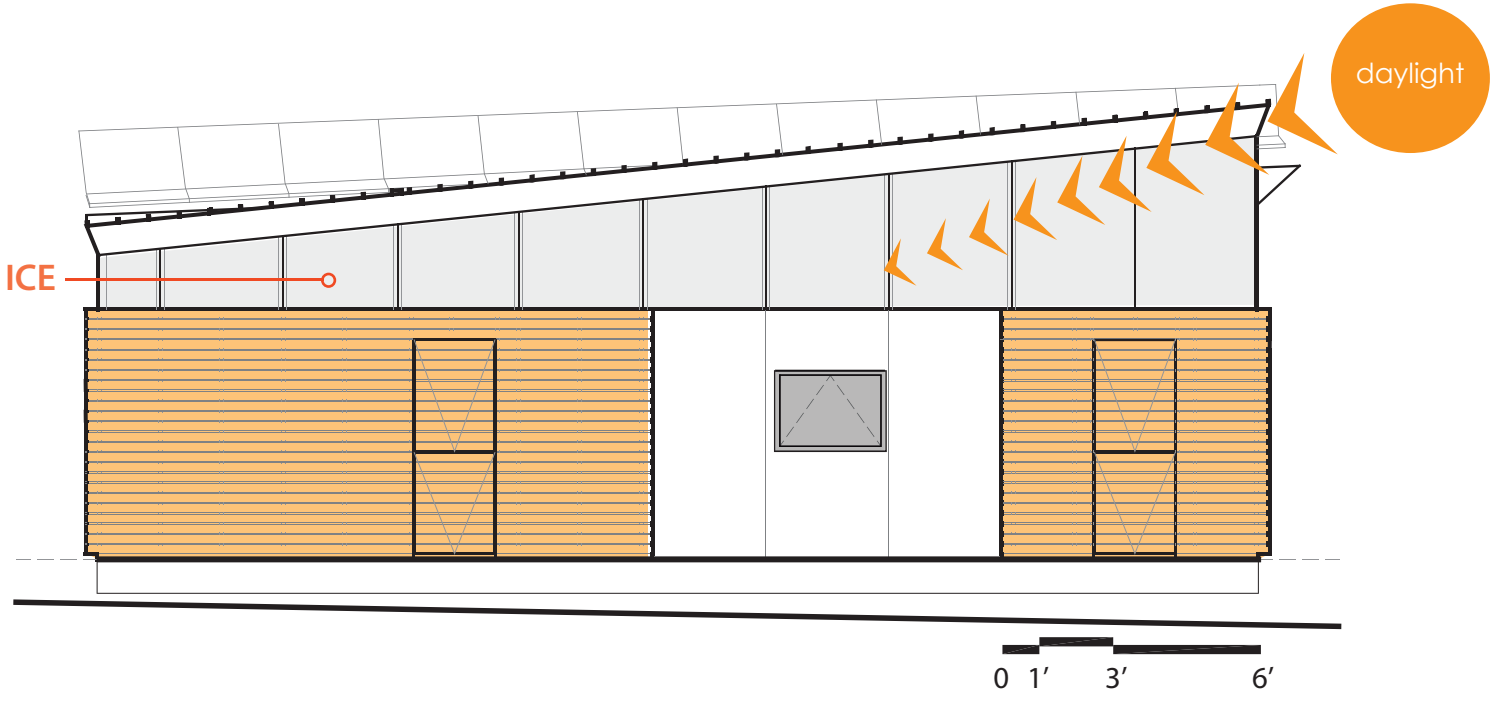
meltwater adaptability





meltwater sunlight

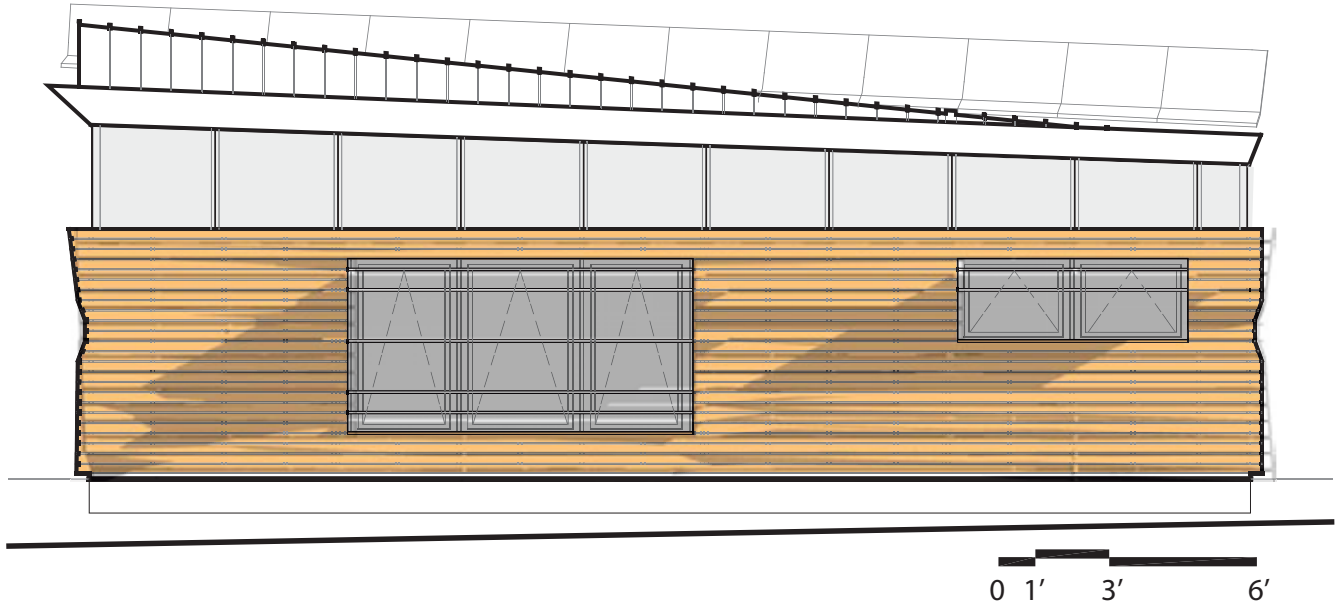
Daylight is allowed to enter through Meltwater's clearstory (ICE) to illuminate the space, reducing energy used by lighting.



north elevation

meltwater sunlight

Carefully placed louvers provide shade from the strong southern sun during the summer months while allowing it to enter during winter months as a source of heat.



south elevation

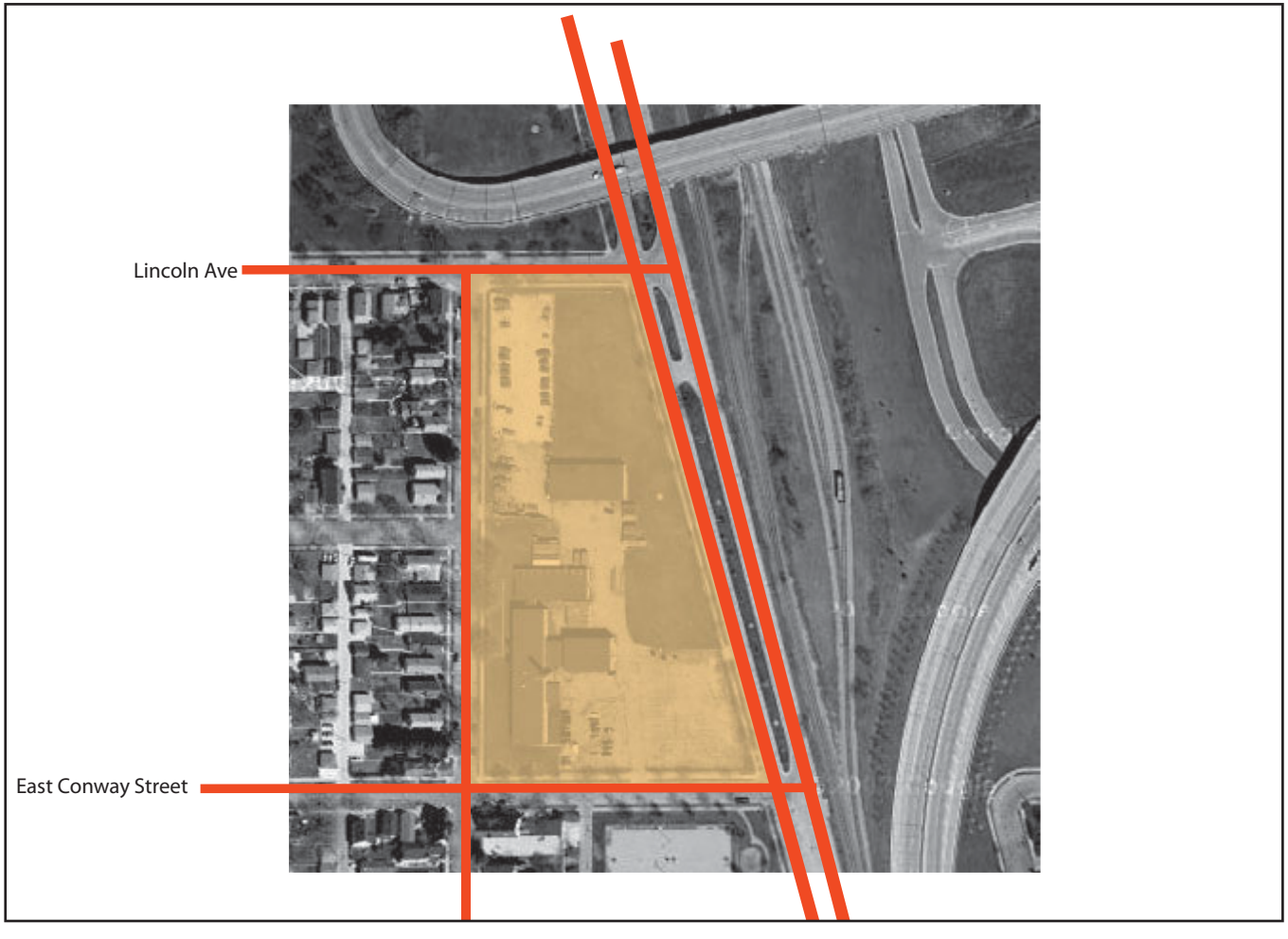
THE SITE

bay view
bay view, milwaukee, wi

bay view
milwaukee, wi

eco bay, bay view

Population-18,071
Median Income- $42,954
Average Age Range- 38 years old
Average Assessed Residential Value- $129,415



community

District alderman requested a proposal for development of the old army reserve site. The site, named Eco Bay, is welcomed by the Bay View community to increase density and provide a home for eco-conscious homeowners.

The ancillary units are a positive addition to the neighborhood as they add density on an as-needed basis, yet retain the fabric of the Bay View neighborhood. As more people in Bay View follow this model, the neighborhood becomes safer as areas that typically are empty are filled with responsible adults.

THE DETAILS

cost analysis

materials

logistics

environment

cost analysis

cost comparison

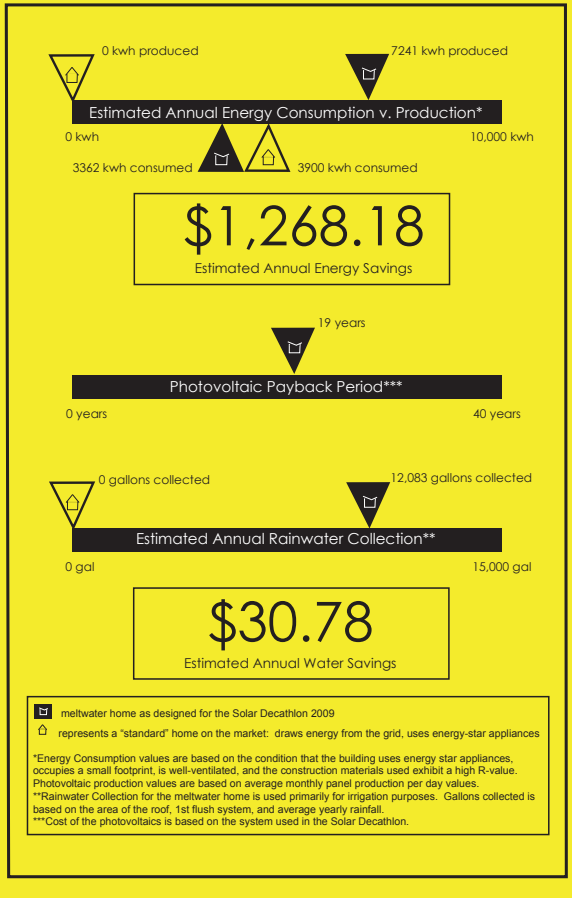
Buying "green" can be an expensive and complicated process. The performance label is designed as a straightforward, familiar method of communicating how the home performs in both ecological and financial terms. This label doesn't reflect actual performance, but is shown as an example.

meltwater home as designed for the Solar Decathlon 2009

represents a "standard" home on the market: draws energy from the grid, uses energy-star appliances

*Energy Consumption values are based on the condition that the building uses energy star appliances, occupies a small footprint, is well-ventilated, and the construction materials used exhibit a high R-value. Photovoltaic production values are based on average monthly panel production per day values.
**Rainwater Collection for the meltwater home is used primarily for irrigation purposes. Gallons collected is based on the area of the roof, 1st flush system, and average yearly rainfall.
***Cost of the photovoltaics is based on the system used in the Solar Decathlon.

model ***meltwater***
sq ft ***780***



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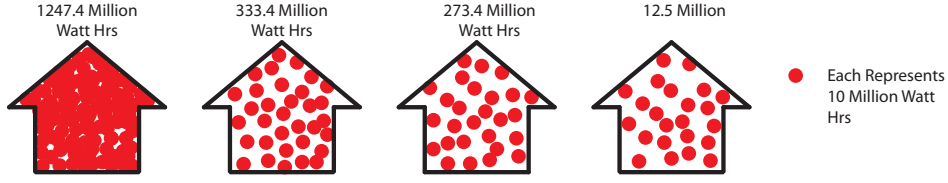
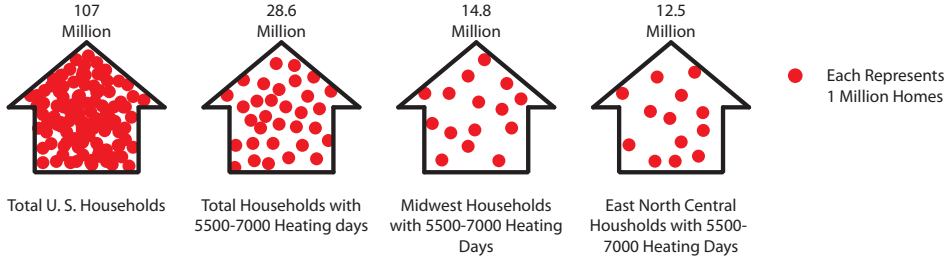
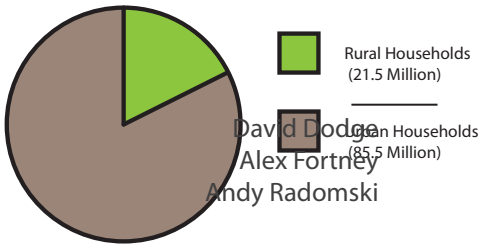
***Cost of the photovoltaics is based on the system used in the Solar Decathlon.

LPG Consumption for Residential Construction United States, Midwest, and East North Central Zone Comparison

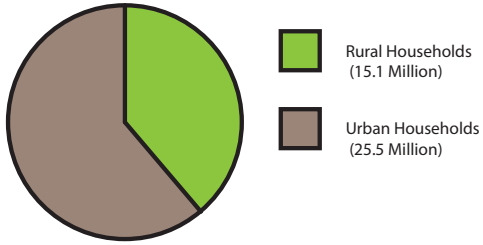
Climate Zone (5500 - 7000 Heating Days):
28,600,000 Households
333.4 Million Watt Hrs



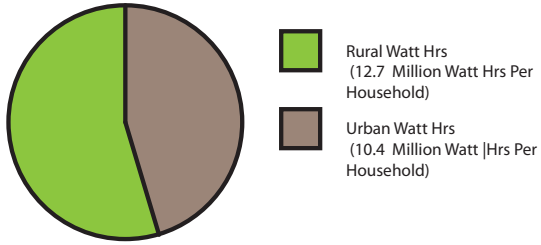




Metropolitan Statistical Breakdown for U.S. Households



Metropolitan Statistical Breakdown for Households with 5500 - 700 Heating Days



Watt Hr Consumption Breakdown for Households with 5500 - 7000 Heating Days

David Dodge
Alex Fortney
Andy Radomski

carbon neutrality

670 sqft	YR1	YR10	YR20	YR30
GPI				
WFOE	$10,000	-	-	-
WE Engergies	$6,144	-	-	-
Grant	-	-	-	-
Energy Production	$923	$1432	$2333	$3800
Effective Income	$17,065	$1432	$2333	$3800
Expenses				
Electricity	-$564	-$874	-$1424	-$2319
Gas	-	-	-	-
Property Tax	-$15,900	-$17,250	-$18,886	-$20,676
NOI	$604	-$16,692	-$17,977	-$19,196
Debt Service	$36,743	$36,743	$36,743	$36,743
Cash Flow	$36,139	-$53,435	-$54,720	-$55,939
WI Tax Exemption				
Property	$1,333	$1,333	$1,333	$1,333
Sales	$2,618	-	-	-
Fed Tax Break				
Solar Energy	$9,473	-	-	-
Solar Water	$2,000	-	-	-
E Efficent Home	$1,500	-	-	-
Savings				
Interest	-$10	-$11	-$12	-$12
Total	-$19,241	-$52,085	-$53,360	-$54,562

-$338,048 -$716,379 -$1,101,563

11
years to break even

0 net operating income

total of Wisconsin Tax Emeptions **$3,951**

$375
average annual PAYBACK from electric company

10,000 dollar grant from Wisconsin Focus On Energy. Electrical energy consumption in agriculture has been steadily rising due to increases in mechanization, use of confinement housing, and farm size. The State of Wisconsin has recognized that individuals and business owners can reduce costs by adopting energy saving technologies. *

fedreal tax break in dollars from Solar Energy = **9437**

*http://www.soils.wisc.edu/foe/login

800 sqft	YR1	YR10	YR20	YR30
GPI				
WFOE	-	-	-	-
WE Engergies	-	-	-	-
Grant				
Energy Production	$0	$0	$0	$0
Effective Income	$0	$0	$0	$0
Expenses				
Electricity	-$724	-$1,123	-$1,830	-$2,980
Gas	-$184	-$285	-$464	-$757
Property Tax	-$3,500	-$3,797	-$4,157	-$4,552
NOI				
Debt Service	$8,672	$8,672	$8,672	$8,672
Cash Flow	-$13,080	-$13,878	-$15,124	-$16,961
WI Tax Exemption				
Property	-	-	-	-
Sales	-	-	-	-
Fed Tax Break				
Solar Energy	-	-	-	-
Solar Water	-	-	-	-
E Efficent Home	-	-	-	-
Savings				
Interest	-	-	-	-
Total	-$13,080	-$13,878	-$15,124	-$16,961

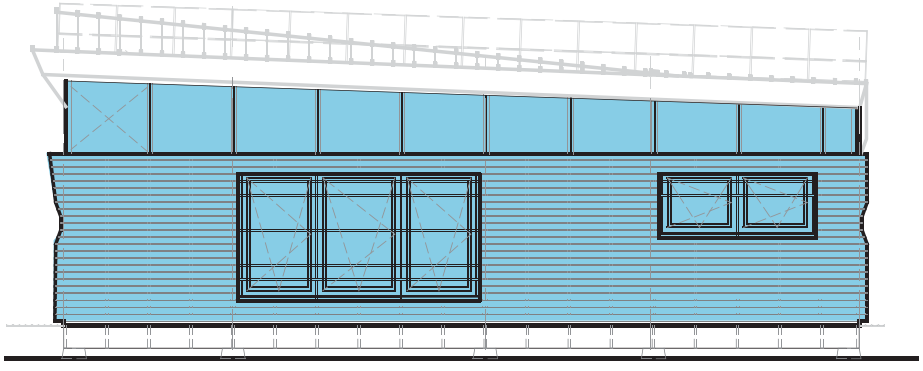
-$134,608 -$279,856 -$440,588

performance comparison

informed, ecological + economic decisions

Buying "green" can be an expensive and complicated process. The performance label is designed as a straightforward, familiar method of communicating how the home performs in both ecological and financial terms. The two major systems that were the genesis of the meltwater idea, solar energy and water collection, are addressed in comparison with that of a standard home. Knowing both the ecological and financial impact of the home you are going to buy is particularly poignant considering the presently unstable state of energy prices, and by extension, our economy.

With the GWP of the material and assemblies used to construct the south wall you could drive to one of these cities located within 286 miles of Milwaukee.

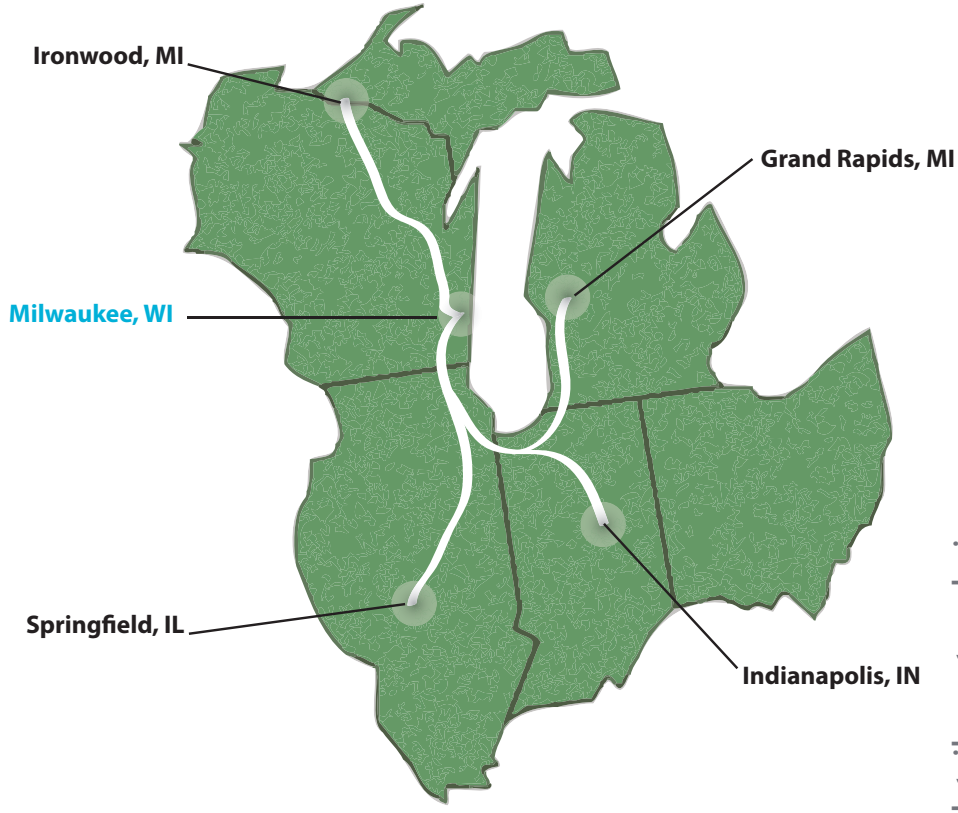


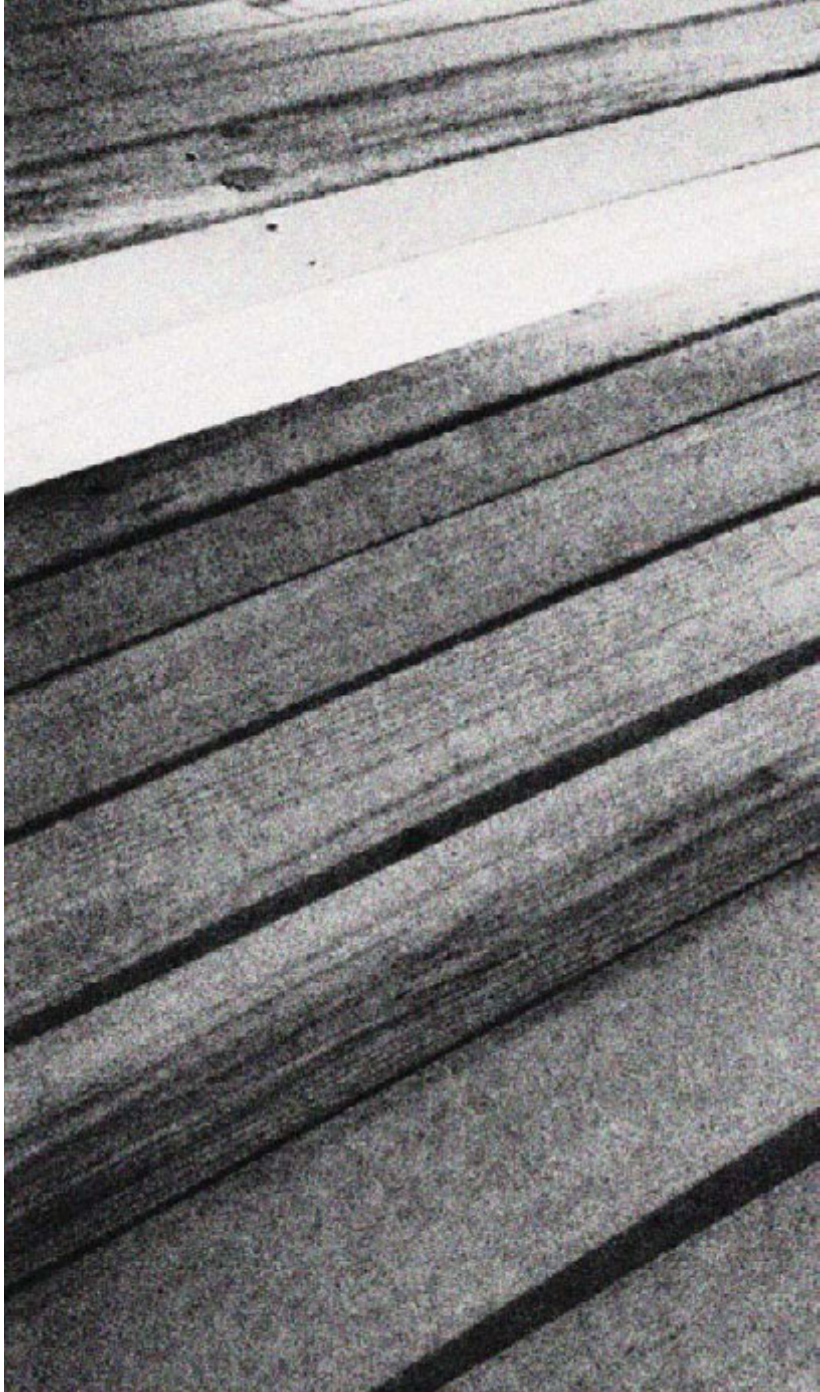
Total GWP of South Wall: 127 kg CO_2

=

25 mpg

traveling 286 miles



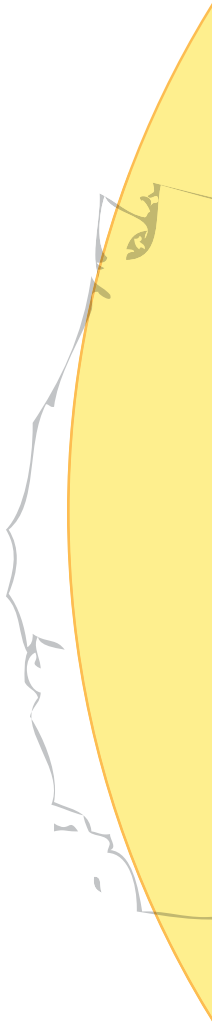


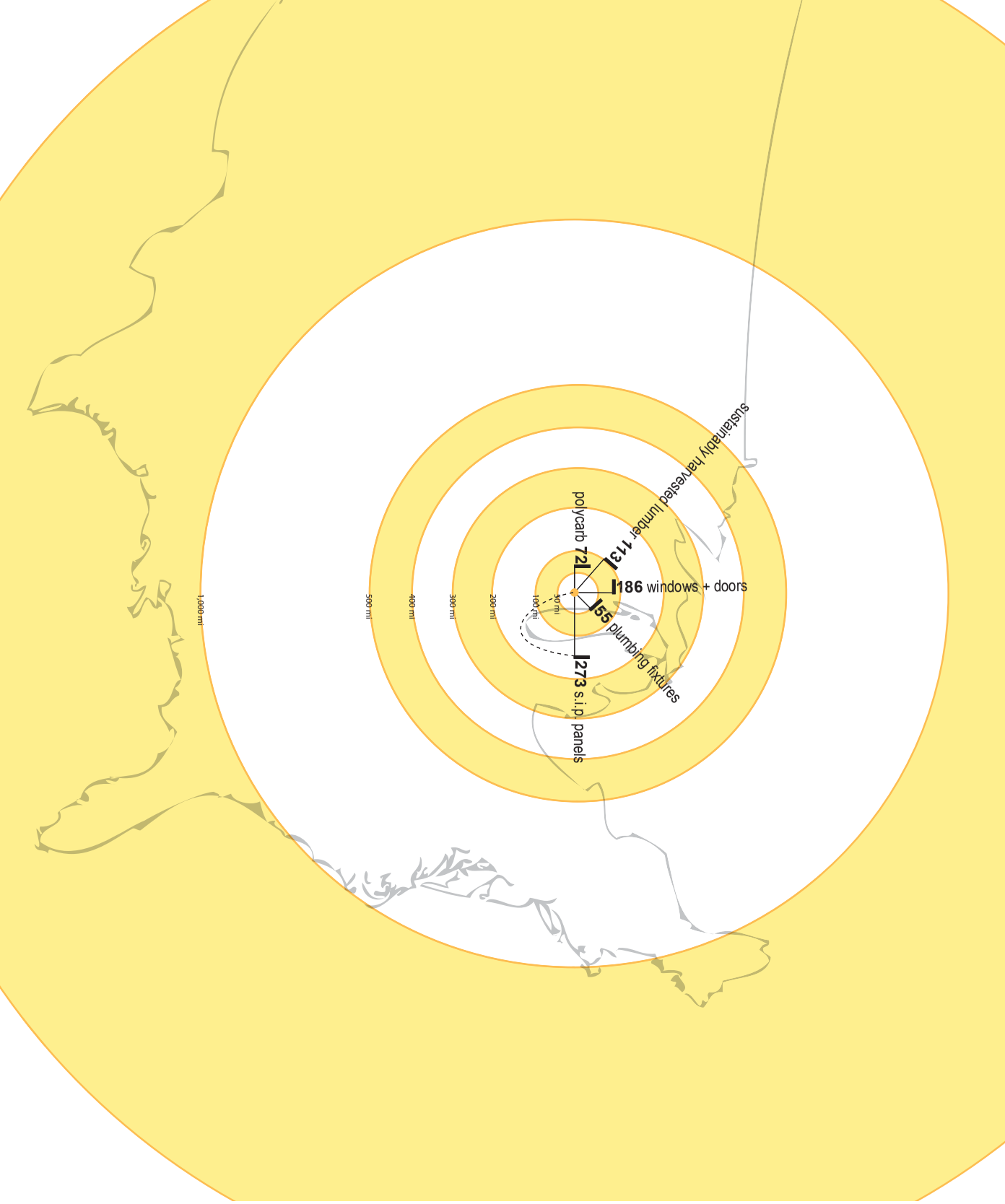
materials

rain screen mock-up, fall 2008

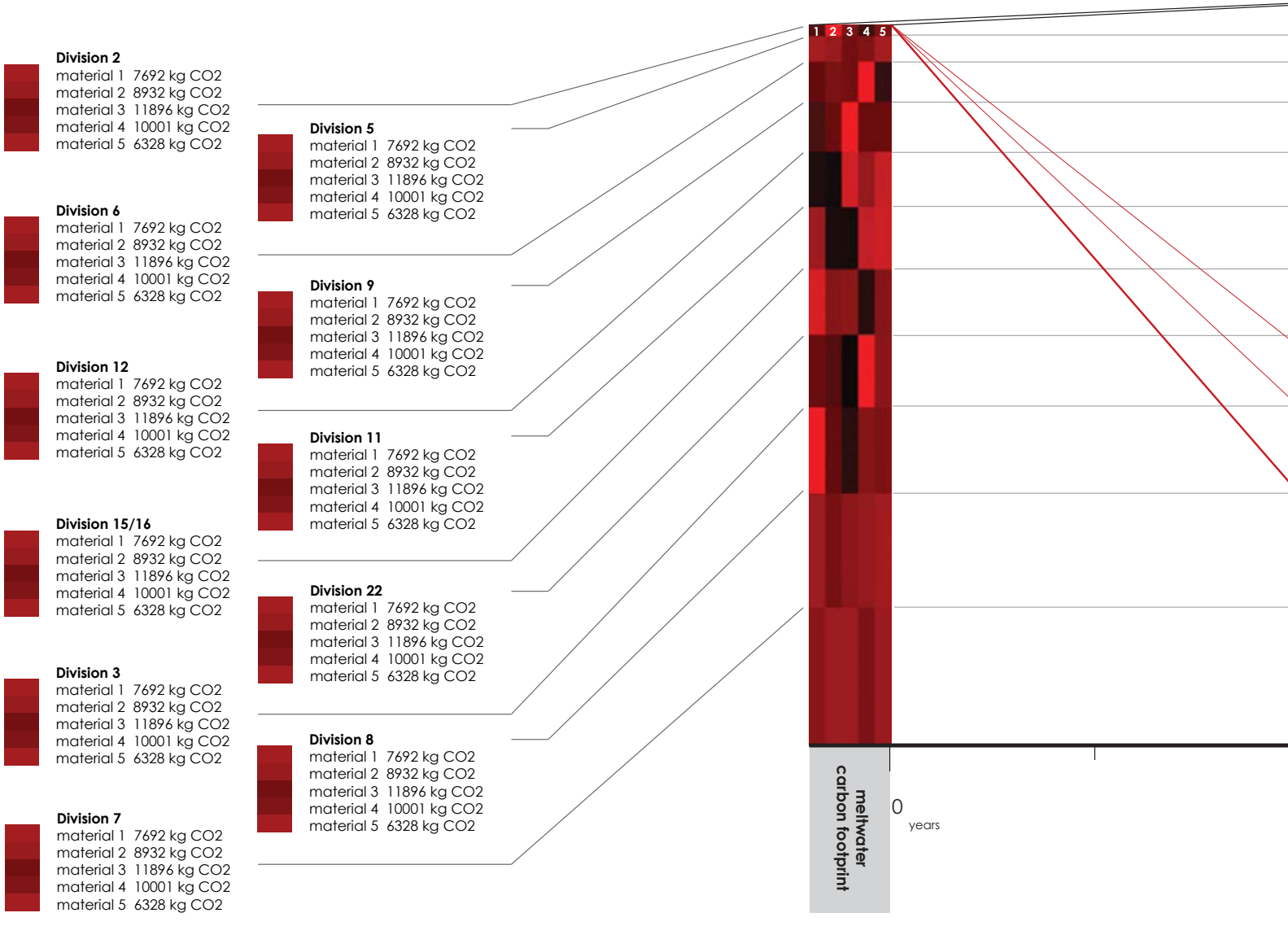
distance travelled by material

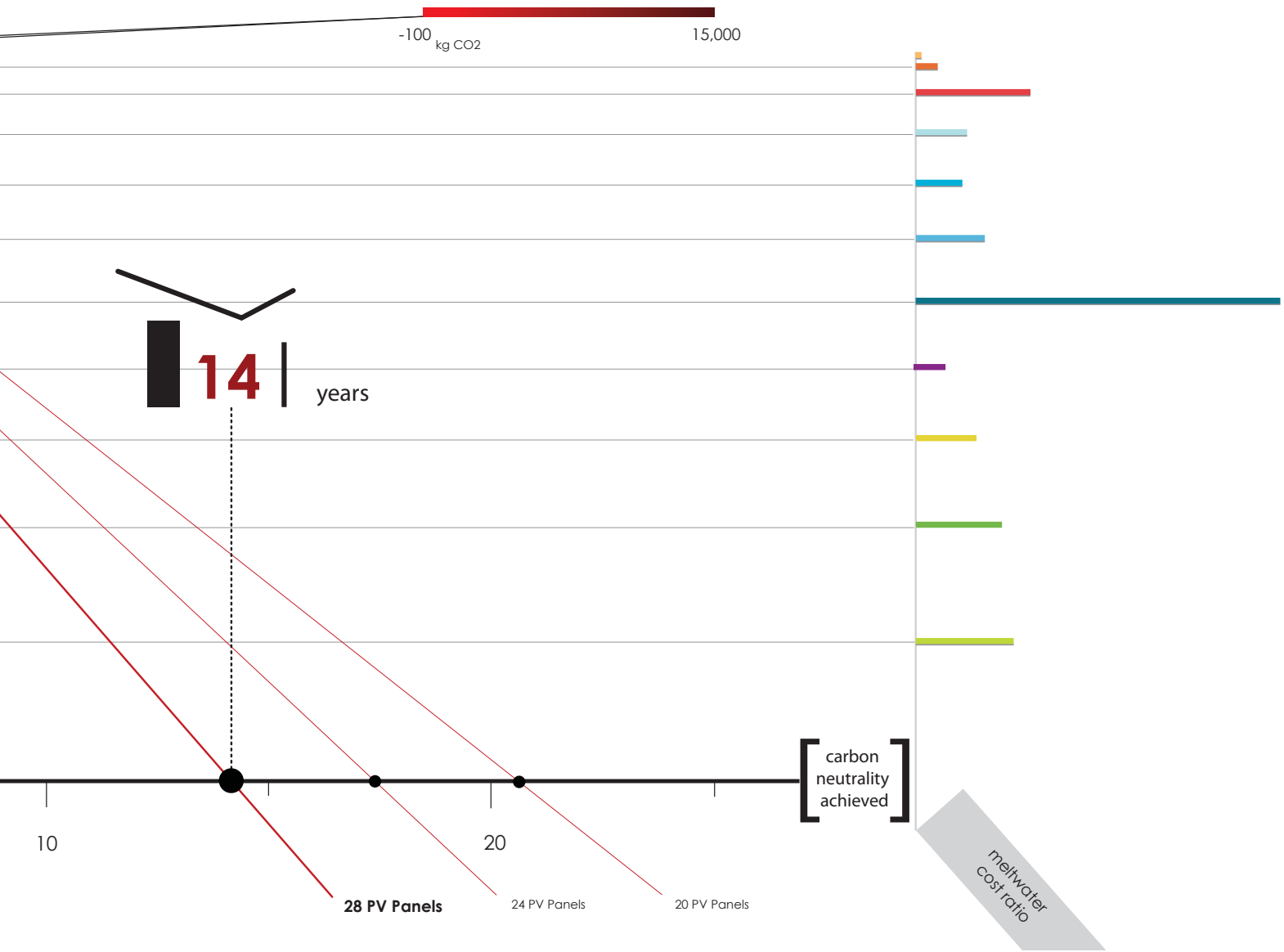
In order to reduce meltwater's carbon footprint, careful consideration was given to the origin of materials. The meltwater team strived to use reclaimed and recycled materials. Also, priority was given to materials from the greater Milwaukee area.




sustainably harvested lumber 113
186 windows + doors
55 plumbing fixtures
273 s.i.p. panels
polycarb 72
50 mi
100 mi
200 mi
300 mi
400 mi
500 mi
1,000 mi

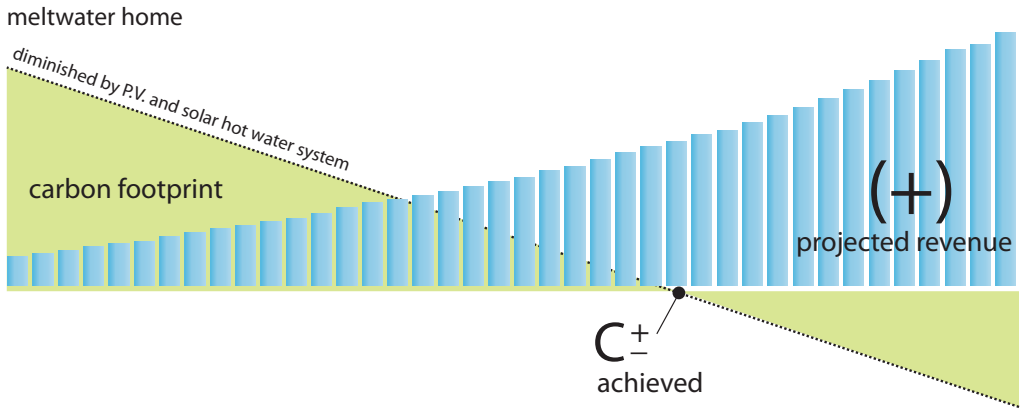
carbon neutrality

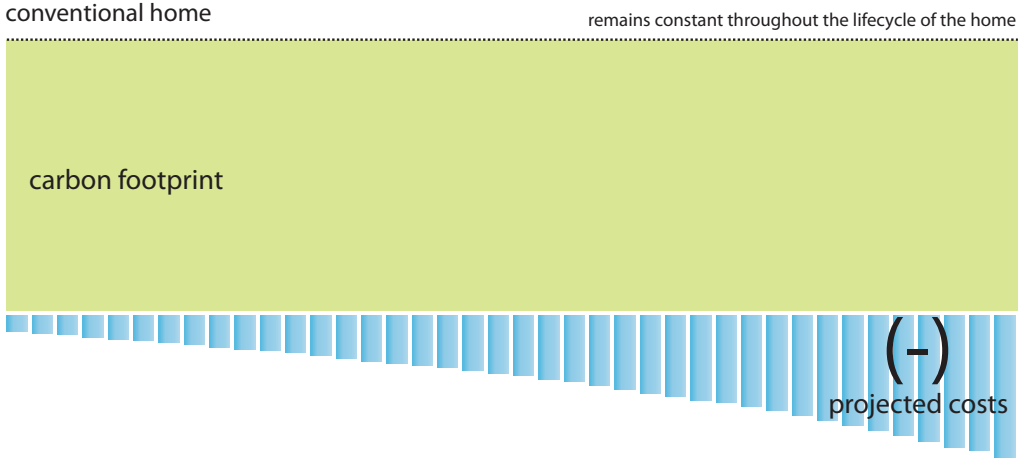



-100
kg CO2
15,000
14
years
carbon
neutrality
achieved
10
20
28 PV Panels
24 PV Panels
20 PV Panels
meltwater
cost ratio

carbon neutrality

Meltwater is environmental conscience. Utilizing materials, such as sustainably harvested wood and reclaimed metal, the initial carbon footprint of meltwater is substantially smaller than a conventional home. Additionally, meltwater employs the use of photovoltaics and a solar hot water system to further diminish its carbon footprint over time. Not only is meltwater improving the environment, its also generating financial revenue from the power it's producing from the photovoltaics and selling back to the electric company, this being something a conventional home can not accomplish.





sustainably harvested wood

Considered by many as the father of wildlife management and of the United States' wilderness system, Aldo Leopold was a conservationist, forester, philosopher, educator, writer, and outdoor enthusiast who spent much of his life in Wisconsin. In 1935, he and his family initiated their own ecological restoration experiment on a worn-out farm along the Wisconsin River outside of Baraboo, Wisconsin. Planting thousands of pine trees, restoring prairies, and documenting the ensuing changes in the flora and fauna further informed and inspired Leopold.

Leopold's respect for the land motivated him and his family to plant thousands of trees on a farm ravaged by the Dust Bowl. Leopold did not live to see the trees mature, but those pines have yielded strong and beautiful building material—a harvest we owe to Leopold's foresight, persistence and patience. In 2003, foresters determined that the Leopold pines were overcrowded and were suffering from competition; drought, disease, wind throw, or an insect outbreak could kill large numbers of them. A careful thinning of the smallest trees was recommended, in order to allow a slow but steady improvement in the health of the forest. The white pines could survive another 150 years or more, providing many future generations with a living connection to the life and work of Aldo Leopold.

The harvest met the standards of the Forest Stewardship Council (FSC). FSC is a world-wide program that sets high standards to ensure forestry is practiced in an environmentally responsible, socially beneficial, and economically viable way.

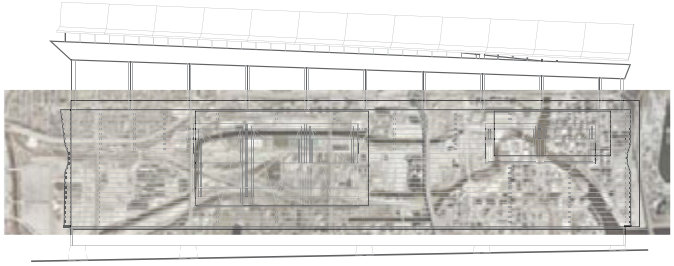
The white pine was used to build the Platinum LEED ® Certificatied Aldo Leopold Legacy Center just outside of Baraboo, WI. The remaining supply was generously donated by the Aldo Leopold Foundation to be used in the building of the UW-Milwaukee's Solar Decathlon entry, Meltwater.

-text adapted from www.aldoleopold.org

meltwater topographic facade

transpose

map of menomonee valley onto the south facade.



position

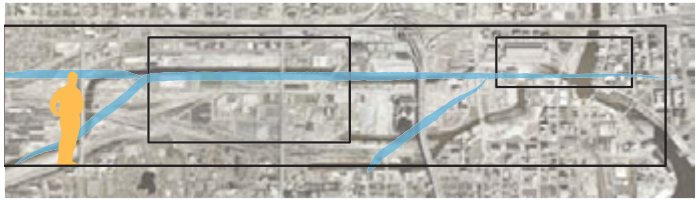
monomonee river at human eye level.

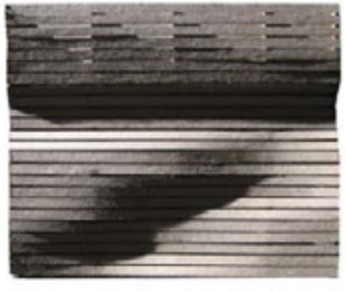
abstract

curves of the menomonee river to aid contractibility.

form

nailers according to the topography and apply rain screen slats.





mock-ups

The UWM solar decathlon studios built a series of mock ups over the summer and fall of 2008. After the initial concept of superimposing a terrain on the south facade was initiated, it took many iterations to find a method by which the rain screen boards could be formed. Investigations included developing the shape of the nailers and steaming the rain screen boards to warp them around the nailers.

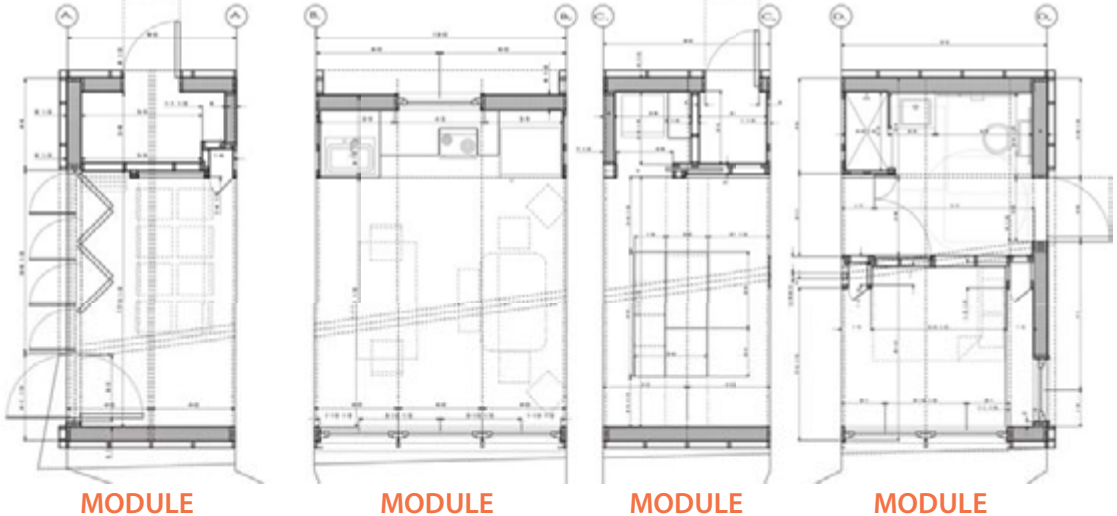
logistics

mock-up construction, fall 2008

modular benefits

In addition to the other factors that make meltwater an energy efficient home, modular home building is an inherently sustainable process. Recycling processes in factories are far superior to those currently present in the field, and manufacturers are able to buy materials in bulk, reducing the shipments suppliers are required to make over the course of a year.

The construction of modular homes is also high in quality and efficient from both a monetary and time perspectives. Since modular homes are built in a quality-controlled environment, there is less of a chance that there will be expensive delays or damages due to weather; an aspect of construction that is prevalent in Wisconsin's sometimes unpredictable climate. The craftsmen building the homes are skilled in the construction of this particular type of home and are able to use jigs and other tools that may not be available in the field to yield the highest quality product possible.



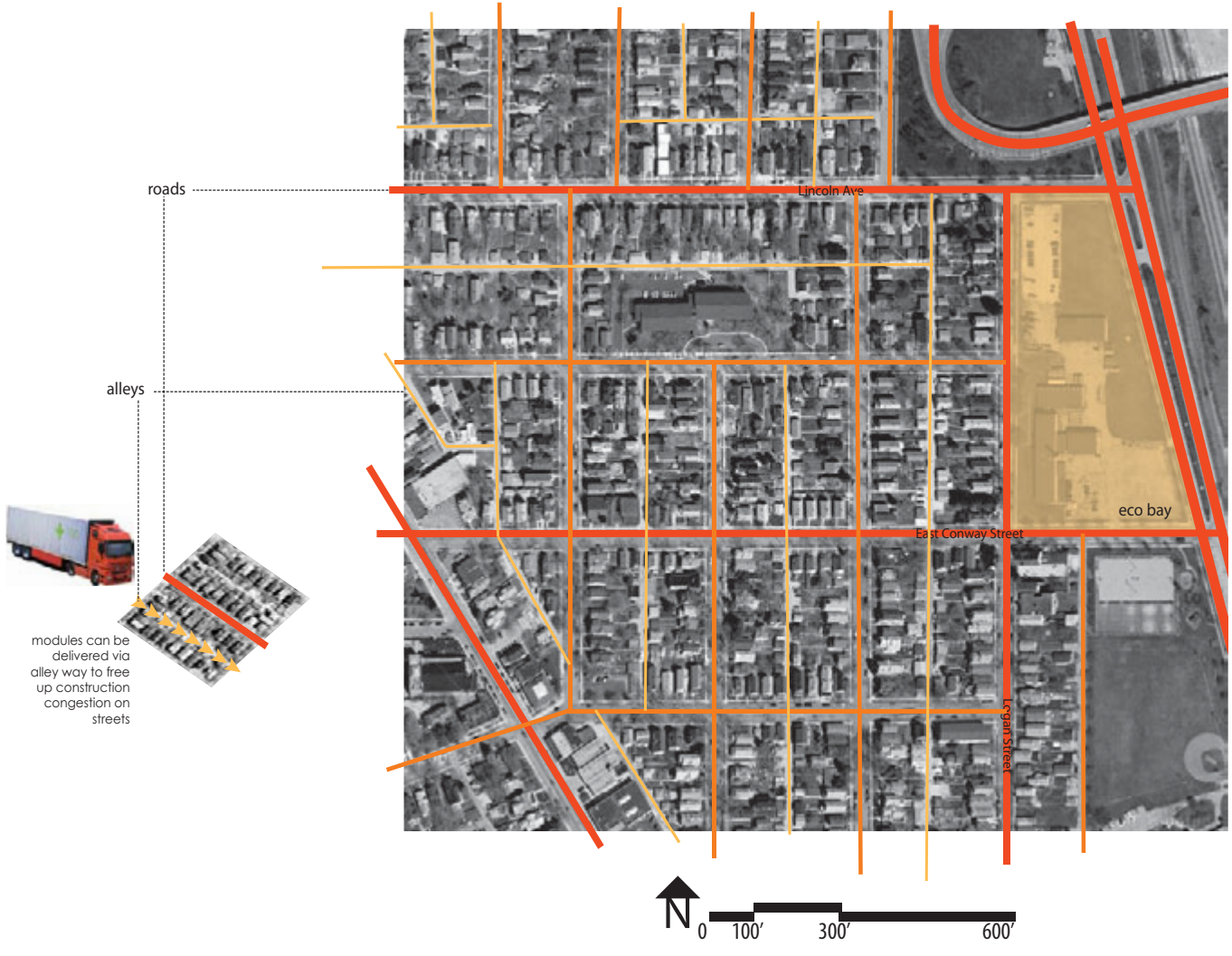
MODULE A

MODULE B

MODULE C

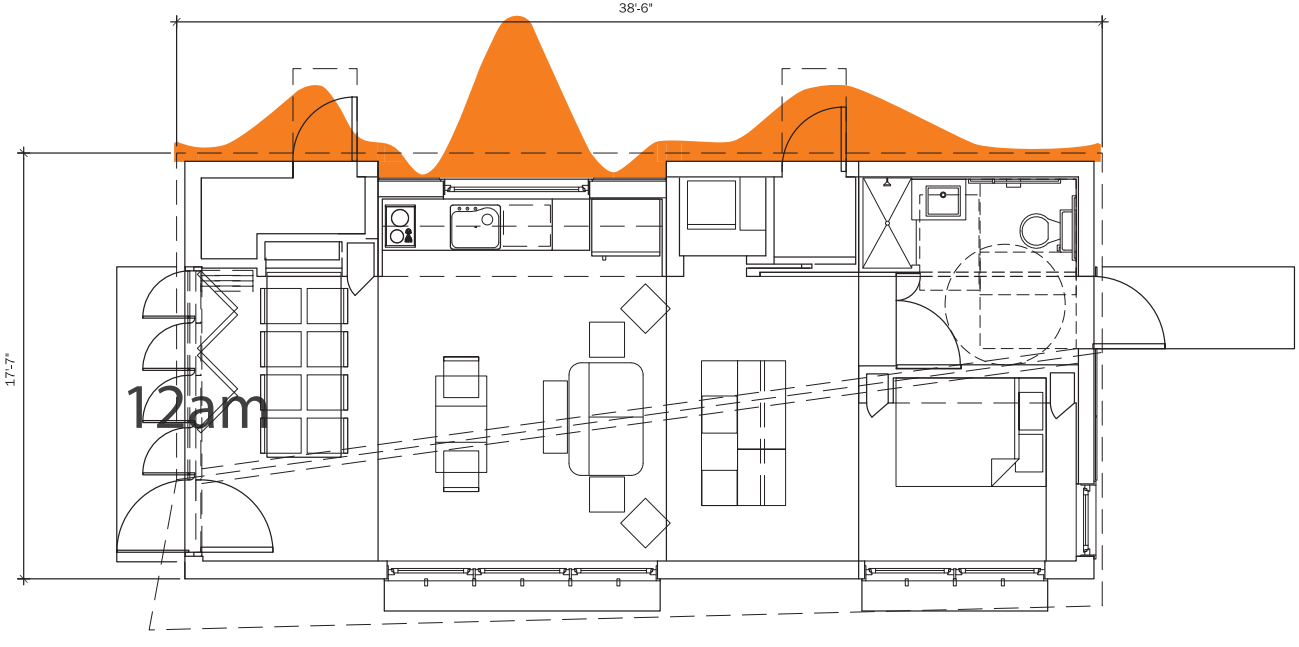
MODULE D

site access

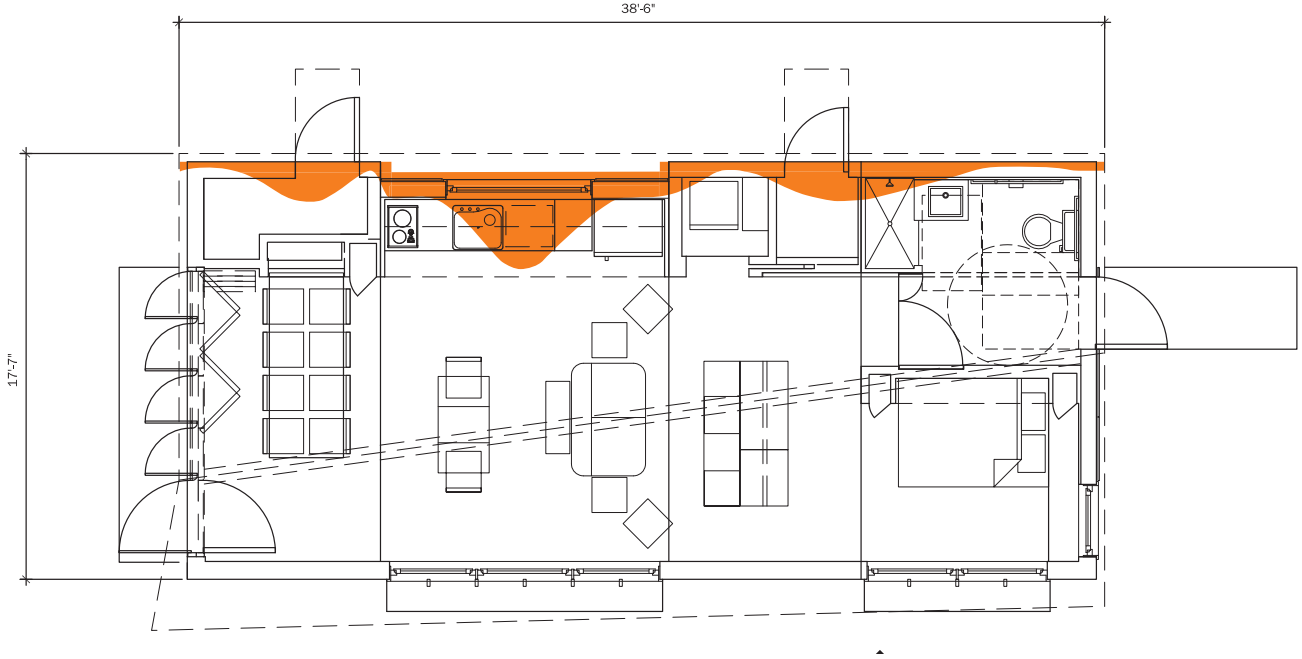

roads
alleys
modules can be delivered via alley way to free up construction congestion on streets
Lincoln Ave
East Conway Street
Logan Street
eco bay
N
0
100'
300'
600'

Thermal Flows

Visualization of heat gain and losses in Milwaukee, WI.



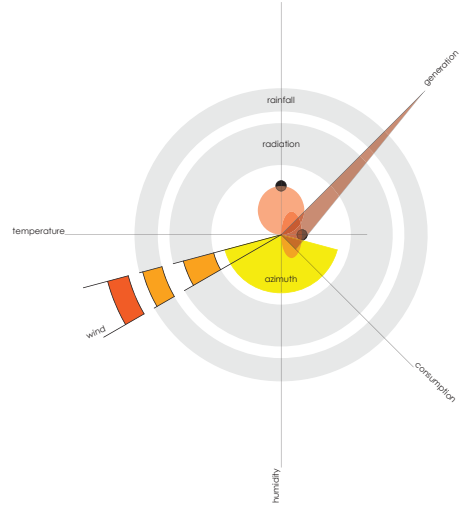
Thermal Flows



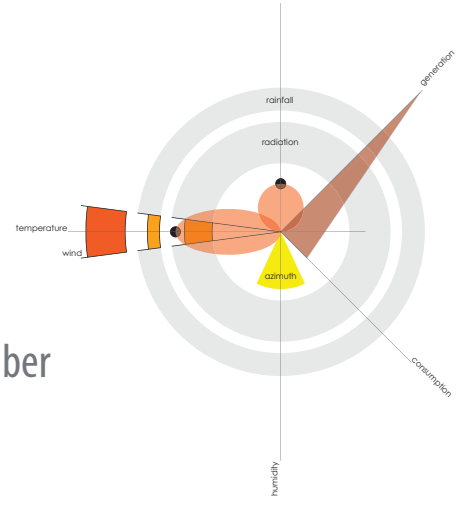
12pm

the environment

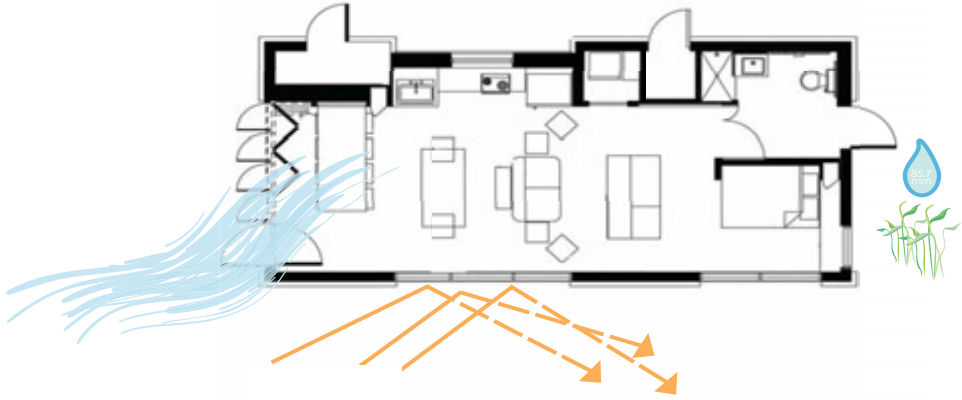
responding to the environment



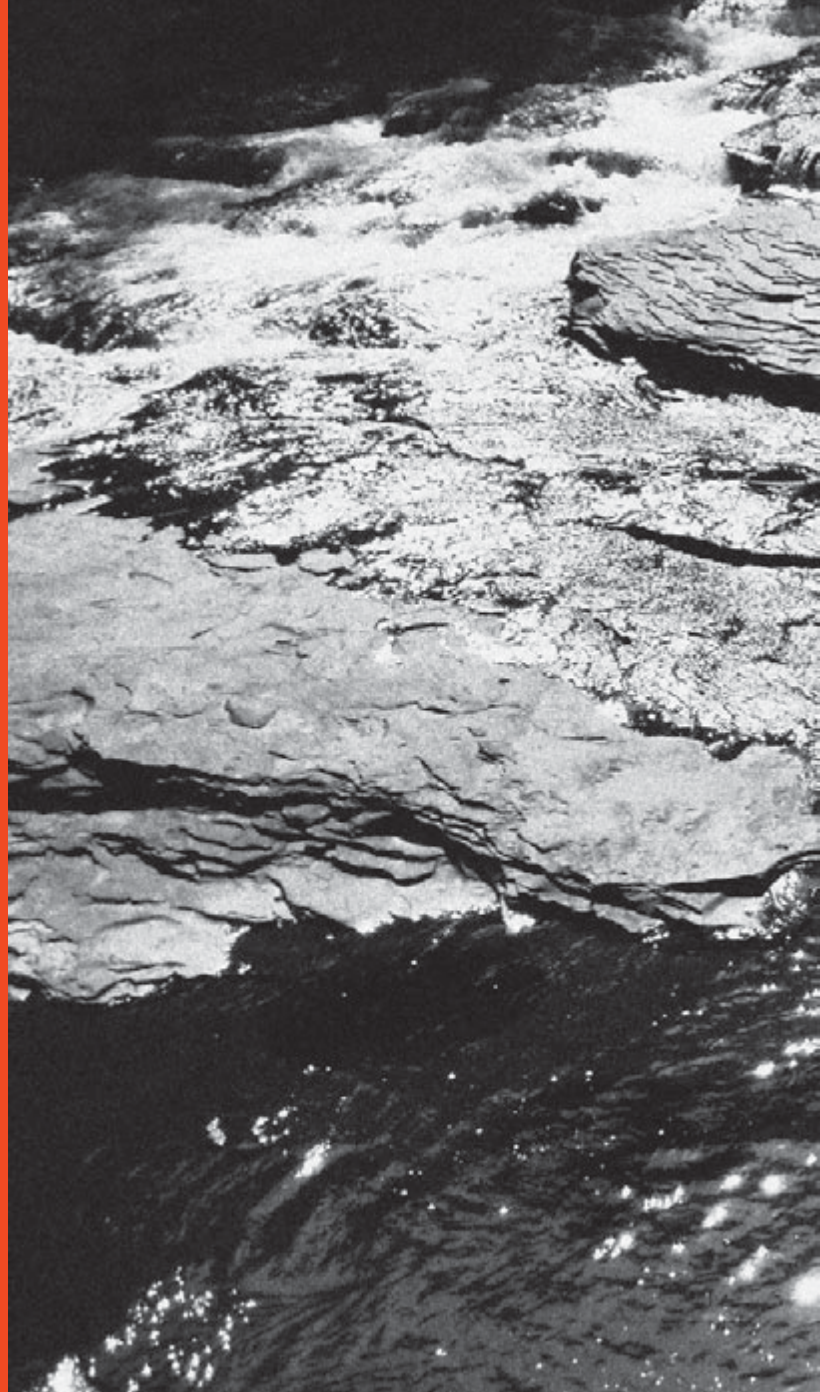
june



december



THE CONCLUSION



meltwater

regional . sustainable . modular

presque isle, wisconsin

Meltwater means:

earth-shaping strength.

The concept of the home is wedded to our region, as meltwater landforms makeup much of our recognizable landscape. Using nature as a model, the form of the roof signifies the carving away of the earth's surface while the facade represents the layers of subsurface stratification. The sustainably harvested white pine from the Aldo Leopold Foundation forms the topographical façade sweeping across the front of the building, reminding us where the building and its makers come from, and our indelible ties to our region. The powerful change-of-state involved in melting the glaciers of the Wisconsin Glaciation Period provided the model for the homes many multi-functional components that adapt to the changing needs of its inhabitants. The form and potential of the home takes on the strength characterized by the natural processes that reworked our regional landscape.

Meltwater is:

energy collection, release + reciprocity.

Using nature as a resource, Meltwater harnesses infinite solar power and fosters the collection of our finite freshwater supply. The distinct valley of the roof and the prominent placement of the photovoltaic panels communicate the value placed on these resources in the functioning of not only the home and our environment. Additionally, each material was carefully chosen with respect to the location of origin and quality in order to create a home that is both sustainable and has the ability to capture the essence of our region. Created of our region and for our region, meltwater addresses the resources and needs specific to our place.

Meltwater is:

a dynamic response.

In a time when high housing costs are coupled with unstable energy prices and individuals across the United States are struggling to retain their jobs and balance their ever-increasing workload, there is a world of potential in a self-sufficient ancillary home that has the ability to generate income. Many cultures across history have found value in multi-generational living and these benefits are accessible with the addition of an ancillary unit, without losing the independence valued by each household. Although Meltwater has the potential to function as a separate, singular unit, there are many socioeconomic benefits to be had from multi-generational living through the addition of ancillary units.

Meltwater means:

renewal and life.

The purchase of single family homes to be placed on large suburban lots is no longer ethical or ecologically responsible, and Milwaukee already has a model in place for cooperatively owned sites in the city, as shown in the plethora of condos and duplexes available. The benefit of ancillary units as opposed to the overabundance of condos being built is that density is created on an as needed basis, so large buildings are not developed and then left empty. Unoccupied areas do not create good communities, and are known to breed crime and violence. Instead of creating more unoccupied spaces, ancillary units improve a space, putting watchful eyes on the alleyway making neighborhoods safer places to live. The increase in density contributes to the fabric of the neighborhood, all without negatively impacting the environment.