



# PROJECT MANUAL

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Interlock House

Date Prepared: JUNE 2, 2009



Rendered By  
Jason Arnold

Prepared By:

IOWA STATE UNIVERSITY

156 College of Design

Ames, IA 50011

[www.solard.iastate.edu](http://www.solard.iastate.edu)

Prepared For:

National Renewable Energy Laboratory

1617 Cole Boulevard

Golden, CO 80401

[www.nrel.gov](http://www.nrel.gov)



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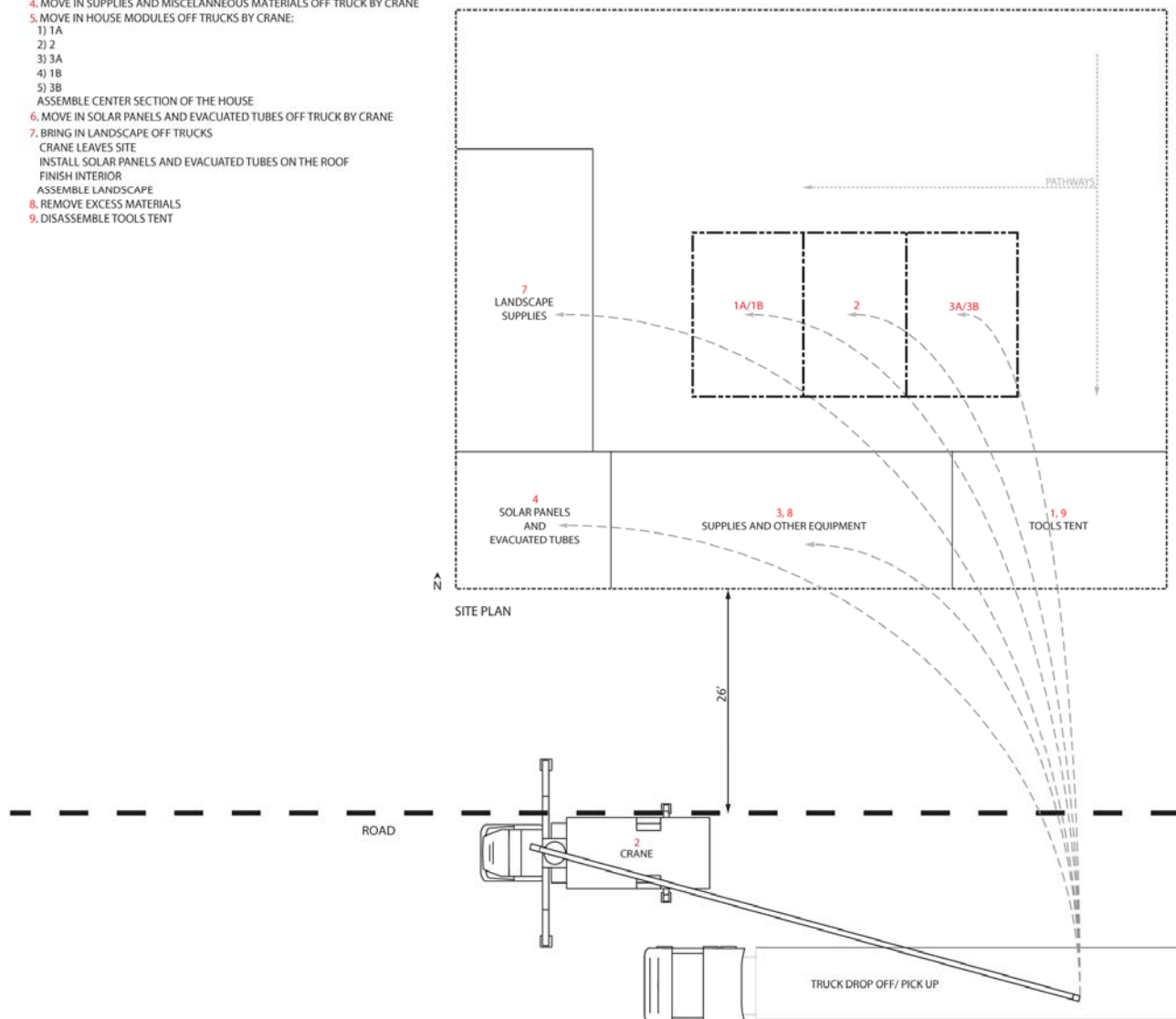
## CHAPTER 1: Rules Compliance Checklist

### Rule 4-2: Construction Equipment

*Drawings(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site.*

#### CONSTRUCTION OPERATIONS SCHEDULE

1. MOVE IN TOOLS, EQUIPMENT, AND SCAFFOLDING FROM TRUCK
2. MOVE IN BUILDING PADS OFF TRUCKS AND SETUP
3. MOVE IN CRANE
4. MOVE IN SUPPLIES AND MISCELLANEOUS MATERIALS OFF TRUCK BY CRANE
5. MOVE IN HOUSE MODULES OFF TRUCKS BY CRANE:
  - 1) 1A
  - 2) 2
  - 3) 3A
  - 4) 1B
  - 5) 3B
- ASSEMBLE CENTER SECTION OF THE HOUSE
6. MOVE IN SOLAR PANELS AND EVACUATED TUBES OFF TRUCK BY CRANE
7. BRING IN LANDSCAPE OFF TRUCKS  
CRANE LEAVES SITE  
INSTALL SOLAR PANELS AND EVACUATED TUBES ON THE ROOF  
FINISH INTERIOR  
ASSEMBLE LANDSCAPE
8. REMOVE EXCESS MATERIALS
9. DISASSEMBLE TOOLS TENT



Rule 4-2: Construction Equipment

*Data sheets for heavy machinery.*

TEREX Stinger 70100: Boom Truck Crane

Data sheets begin on the next page. . .



## STINGER 70100 | Boom Truck Crane

# BOOM TRUCK CRANE STINGER 70100



### FEATURES

- ▶ 70,000 lb (31 752 kg) maximum lifting capacity
- ▶ 110' (33.53 m) maximum sheave height
- ▶ 163' (49.68 m) maximum sheave height with 30.5-55' (9.30-16.76 m) jib
- ▶ 30.5-100' (9.30-30.48 m) four-section full power fully synchronized boom
- ▶ Exclusive color coded boom and load charts
- ▶ Easy-to-install optional 30.5' (9.30 m) one stage or 30.5-55' (9.30-16.76 m) two stage telescoping jib, man baskets or work platform increase job capacities
- ▶ Electronic Load Moment Indicator and anti-two-block device standard with internal cable
- ▶ Externally located planetary rotation drive for easy accessibility for maintenance
- ▶ 2-speed planetary winch has 12,900 lb (5 851 kg) maximum permissible 1 part line, 45,400 lb (20 593 kg) breaking strength, 196 ft/min (60 m/min) maximum line speed
- ▶ Dual control station with direct mechanically controlled hydraulic system
- ▶ 90 gal (342 L) capacity hydraulic tank



# BOOM TRUCK CRANE STINGER 70100

## BT MODEL

### LOAD RATINGS



CAUTION Do not use this specification sheet as a load rating chart. The format of data is not consistent with the machine chart and may be subject to change.

#### BOOM LENGTH

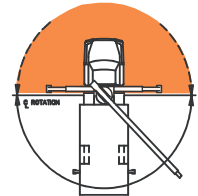
Maximum Load Chart in pounds (lbs) with fully extended outrigger

OPERATING RADIUS (FT)	30.5 FT		44 FT		58 FT		72 FT		86 FT		100 FT	
	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)
5	78	70,000*										
8	72	60,800*										
10	68	44,800*	75	31,300*								
12	64	40,000*	72	31,700*	77	31,100*						
15	58	33,200*	68	31,600*	74	30,500*	77	27,600*				
20	45	24,400*	61	24,500*	68	23,600*	73	21,200*	76	19,000*		
25	29	18,300*	53	19,100*	63	19,100*	69	17,200*	72	15,300*	75	12,100*
30			44	15,000*	57	15,400*	64	14,400*	69	12,900*	72	10,500*
35			34	11,400	51	11,800	60	12,000	65	11,100*	69	9,100*
40			18	8,700	44	9,300	55	9,400	61	9,500	66	7,000*
45					36	7,300	50	7,600	57	7,700	62	6,000*
50					27	5,800	44	6,100	53	6,200	59	5,100*
55					11	4,600	38	5,000	49	5,100	56	4,500*
60							31	4,000	44	4,200	52	3,900*
65							22	3,200	39	3,400	48	3,400*
70									34	2,800	44	2,900
75									27	2,200	40	2,400
80									18	1,700	35	1,900
85											30	1,500
90											24	1,100
95											15	800

NOTE: STRUCTURAL STRENGTH RATINGS IN CHART ARE INDICATED WITH AN ASTERISK \*

#### AREA OF OPERATION

DO NOT OPERATE  
IN SHADED AREA  
WITHOUT  
OPTIONAL FRONT  
STABILIZER



#### Deductions from rate loads for load handling devices BT

Overhaul Ball	200 lbs
1 Sheave Load Block	225-550 lbs
2 Sheave Load Block	300-650 lbs

#### STOWED JIB DEDUCTIONS (POUNDS)

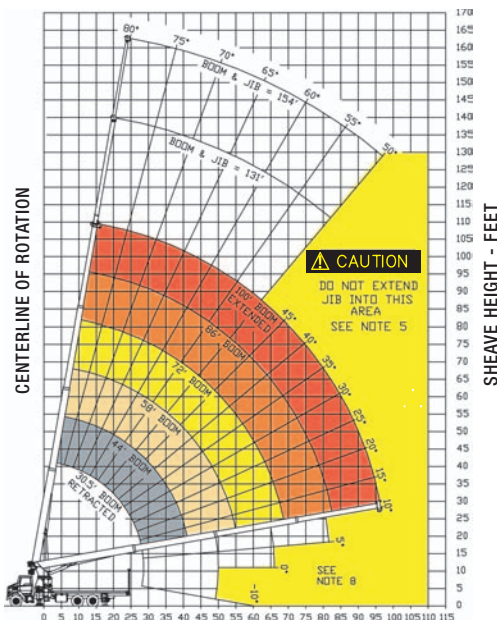
	900	700	500	400	335	300
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#### JIB CAPACITIES FOR ALL BOOM LENGTHS

VERIFY OPERATIONAL MODE SETTING ON LMI DISPLAY BEFORE LIFTING WITH JIB

Loaded Boom Angle	50°	55°	60°	65°	70°	75°	78°	80°
Retracted 30.5 ft Jib	800	1,400	2,300	3,300	4,000	5,300	6,000	6,450
Extended 55 ft Jib	700	1,050	1,700	2,300	3,000	3,500	3,500	3,500

#### RANGE DIAGRAM (30.5 - 100 FT BOOM)



#### GENERAL NOTES

- The operator must read and understand the Owner's Manual before operating this crane.
- Positioning or operation of crane beyond areas shown on this chart is not intended or approved except where specified in Owner's Manual.
- Loaded boom angles at specified boom lengths give only an approximation of the operating radius. The boom angle before loading should be greater to account for deflections. Do not exceed the operating radius for rated loads.
- Use rating of next longer boom for boom lengths not shown. Use rating of next greater radius for load radii not shown.
- Boom must be fully retracted when jib is erected before lowering below minimum angle. Retracted jib has no lifting capacity below a 50° boom angle.
- Use rating of next lower boom angle for boom angles not shown on jib load rating chart.
- Lifting off the main boom point while the swing around jib is erected is not intended or approved.
- Do not lower boom into this area, as hydraulic pressure will not allow raising the boom without retracting boom first.
- Crane load ratings on outriggers are based on freely suspended loads with the machine leveled and standing on a firm uniform supporting surface. No attempt shall be made to move a load horizontally on the ground in any direction.
- Practical working loads depend on supporting surface, wind and other factors affecting stability such as hazardous surroundings, experience of personnel, and proper handling, must all be taken into account by the operator.
- The maximum load which may be telescoped is limited by hydraulic pressure, boom angle, and boom lubrication. It is safe to attempt to telescope any load within the limits of the load rating chart.

#### INFORMATION

- Deductions must be made from rated loads for stowed jib, optional attachments, hooks and loadblocks (see deduction chart). Weights of slings and other load handling devices shall be considered a part of the load.
- Crane load ratings with outriggers are based on outriggers and stabilizers extended and set with all load removed from the carrier wheels.
- Load ratings do not exceed 85% of tipping load.

#### DEFINITIONS

- Operating radius is the horizontal distance from the axis of rotation to the center of the vertical hoist line or load hook with load suspended.
- Loaded boom angle as shown in the Load Ratings Chart is the included angle between the horizontal and longitudinal axes of the boom base after lifting rated load at rated radius.





# TEREX

## BOOM TRUCK CRANE STINGER 70100

### RS MODEL

#### LOAD RATINGS

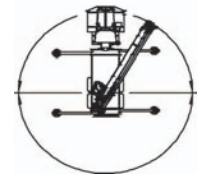


CAUTION Do not use this specification sheet as a load rating chart. The format of data is not consistent with the machine chart and may be subject to change.

BOOM LENGTH				Maximum Load Chart in pounds (lbs) with fully extended outrigger								
OPERATING RADIUS (FT)	30.5 FT		44 FT		58 FT		72 FT		86 FT		100 FT	
	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)	LOADED BOOM ANGLE (DEG)	LOAD RATING (LB)
5	74	70,000*										
8	67	44,900*										
10	63	39,000*	72	31,100*								
12	59	34,400*	69	31,100*	74	31,100*						
15	52	29,190*	65	27,800*	71	26,700*	75	24,200*				
20	38	22,300*	57	22,000*	66	21,200*	71	19,200*	74	17,000*		
25	17	14,900*	49	18,000*	60	17,500*	67	16,000*	71	14,400*	73	12,100*
30			40	14,800*	54	14,700*	62	13,300*	67	12,000*	70	10,500*
35			27	11,600	48	12,000	57	11,500*	63	10,300*	67	9,100*
40					41	9,200	53	9,400	59	9,100*	64	6,500*
45	NOTE: STRUCTURAL STRENGTH RATINGS IN CHART ARE INDICATED WITH AN ASTERISK *				32	7,200	47	7,400	55	7,500	61	5,600*
50					21	5,700	42	5,900	51	6,000	58	4,900*
55							35	4,700	47	4,900	54	4,200*
60							27	3,800	42	3,900	50	3,600*
65							16	3,000	37	3,200	47	3,100*
70									31	2,500	42	2,600*
75									23	2,000	38	2,100
80									12	1,500	33	1,600
85											27	1,200
90											20	900
95											7	600

#### AREA OF OPERATION

360° Full Capacity  
Area of  
Operation



#### Deductions from rate loads for load handling devices BT

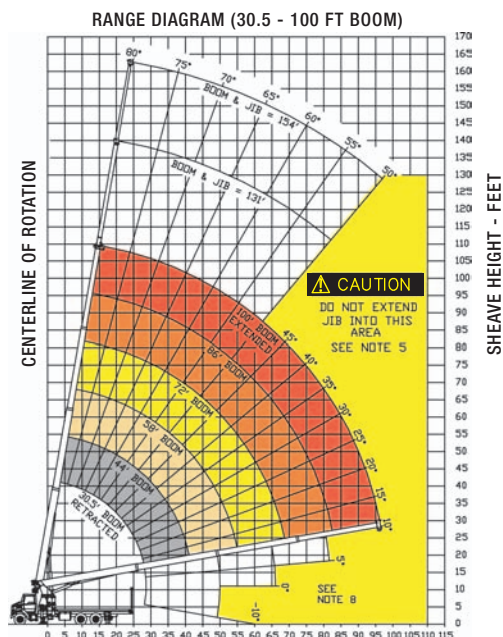
Overhaul Ball	200 lbs
1 Sheave Load Block	225-550 lbs
2 Sheave Load Block	300-650 lbs

#### STOWED JIB DEDUCTIONS (POUNDS)

900	700	500	400	335	300
-----	-----	-----	-----	-----	-----

#### JIB CAPACITIES FOR ALL BOOM LENGTHS VERIFY OPERATIONAL MODE SETTING ON LMI DISPLAY BEFORE LIFTING WITH JIB

Loaded Boom Angle	50°	55°	60°	65°	70°	75°	78°	80°
Retracted 30.5 ft Jib	800	1,400	2,300	3,300	4,000	5,300	6,000	6,450
Extended 55 ft Jib	700	1,050	1,700	2,300	3,000	3,500	3,500	3,500



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#### INFORMATION

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- Load ratings do not exceed 85% of tipping load.

#### DEFINITIONS

- Operating radius is the horizontal distance from the axis of rotation to the center of the vertical hoist line or load hook with load suspended.
- Loaded boom angle as shown in the Load Ratings Chart is the included angle between the horizontal and longitudinal axes of the boom base after lifting rated load at rated radius.



# BOOM TRUCK CRANE STINGER 70100

## BT MODEL

### WINCH DATA

		1 Part Line	2 Part Line	3 Part Line	4 Part Line	5 Part Line	6 Part Line
Winch	Cable Supplied	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed
Standard Stationary Winch	5/8" Diam IWRC XXIP	12,971 lb 196 fpm	25,942 lb 98 fpm	38,913 lb 65 fpm	51,844 lb 49 fpm	64,855 lb 39.2 fpm	70,000 lb 32.7 fpm
	5/8" Diam Rotation Resistant	9080 lb 196 fpm	18,160 lb 98 fpm	27,240 lb 65 fpm	36,320 lb 49 fpm	45,400 lb 39.2 fpm	54,480 lb 32.7 fpm

### BLOCK TYPE

Overhaul Ball	Rating: 7.0 ton (6.3 mt)
1 Sheave Block	Rating: 20 ton (18.1 mt)
2 Sheave Block	Rating: 30 ton (27.2 mt)
3 Sheave Block	Rating: 35 ton (31.7 mt)

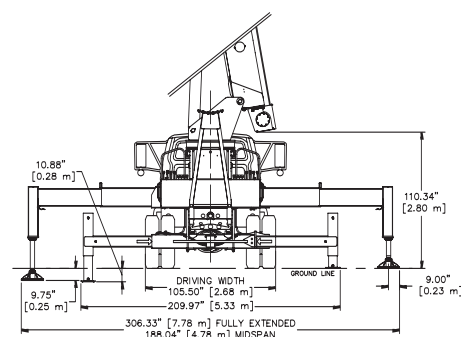
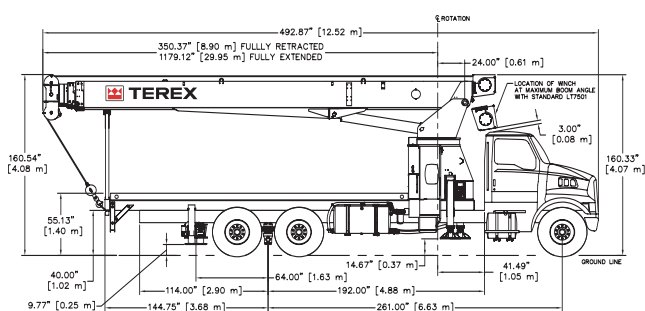
### CAUTION

Overload and anti-two-block systems must be in good operating condition before operating crane. Refer to Owners Manual.

Keep at least 3 wraps of loadline on drum at all times.

Use only 5/8" diameter cable with 45,400 lb breaking strength on this machine.

### 2 MOUNTING CONFIGURATIONS



### CARRIER PROVIDED BY TEREX

#### STINGER BT70100 - Behind Cab Mounting Configuration

Manufacturer	Sterling LT7501 6 x 4 (60 000)
Standard Engine	Caterpillar C-7 7.2 L I-6
Standard Horsepower	300 hp @ 2,200 rpm
Standard Torque	860 lb. Ft. @ 1,440 rpm
Full Tank Capacity	120 gal (454 L)
Standard Transmission	Eaton Fuller RT-8908LL
Speed Standard Transmission	Manual 10-speed
Max Speed Standard Transmission	74 mph (120 km/h)
Max Gradeability	54%
Standard Transmission	
Optional Transmission	Allison
Speed Optional Transmission	Automatic 6-speeds
Max Speed Optional Transmission	74 mph (120 km/h)
Max Gradeability	17%
Optional Transmission	
Gross Vehicle Weight Rating	60,000 lb (27 210 kg)
Front Axle Weight Rating	20,000 lb (9 067 kg)
Rear Axle Weight Rating	40,000 lb (18 144 kg)
Front Tires	425/65R 22.5 Michelin XZY (20 ply)
Rear Tires	11R 22.5 Michelin XDE M/S (14 ply)
Brakes	Air, Hydraulic Anti-Lock System
Exhaust Position	Vertical Right Side

### INCLUDED OPTIONS

- Dual Fuel Tanks (120 gal-454L)
- Power steering
- Electric Horn
- Factory A/C
- Power Port (Cigar lighter)
- AM/FM Radio w/ Clock
- Dual West Coast Stainless Rear View Mirrors
- Standard Factory Warranty

### CHASSIS RECOMMENDATIONS

#### STINGER BT70100 - Behind Cab Mounting Configuration

Combined Axle Weight Rating	60,000 lb (27 210 kg)
Front Axle Weight Rating	20,000 lb (9 067 kg)
Rear Axle Weight Rating	40,000 lb (18 144 kg)
Wheel base	261" (6.62 m)
Cab to Axle	192" (4.87 m)
Afterframe	114" (2.90 m)
Frame Section Modulus	30.0 in <sup>3</sup> (491 cm <sup>3</sup> )
RBM per Frame Rail	3,300,000 in/lb (38 020 kg/m)
Frame Height (Unloaded)	40" (7.62 m)
Exhaust Position	Vertical Right Side



# BOOM TRUCK CRANE STINGER 70100

## RS MODEL

### WINCH DATA

		1 Part Line	2 Part Line	3 Part Line	4 Part Line	5 Part Line	6 Part Line
Winch	Cable Supplied	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed	Lift and Speed
Standard Stationary Winch	5/8" Diam IWRC XXIP	12,971 lb 196 fpm	25,942 lb 98 fpm	38,913 lb 65 fpm	51,844 lb 49 fpm	64,855 lb 39.2 fpm	70,000 lb 32.7 fpm
	5/8" Diam Rotation Resistant	9080 lb 196 fpm	18,160 lb 98 fpm	27,240 lb 65 fpm	36,320 lb 49 fpm	45,400 lb 39.2 fpm	54,480 lb 32.7 fpm

### BLOCK TYPE

Overhaul Ball	Rating: 7.0 ton (6.3 mt)
1 Sheave Block	Rating: 20 ton (18.1 mt)
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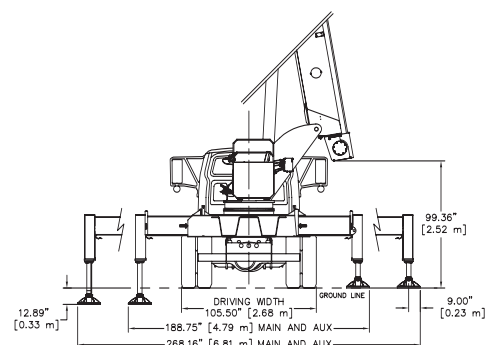
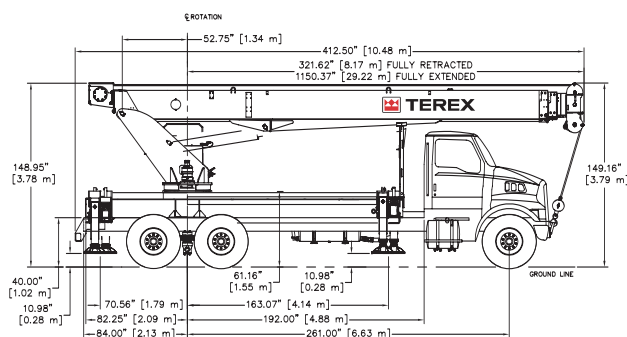
### CAUTION

Overload and anti-two-block systems must be in good operating condition before operating crane. Refer to Owners Manual.

Keep at least 3 wraps of loadline on drum at all times.

Use only 5/8" diameter cable with 45,400 lb. breaking strength on this machine.

### 2 MOUNTING CONFIGURATIONS



### CARRIER PROVIDED BY TEREX

#### STINGER RS70100 Riding Seat Mounting Configuration

Manufacturer	Sterling LT7501 6 x 4 (60 000)
Standard Engine	Caterpillar C-7 7.2 L I-6
Standard Horsepower	300 hp @ 2,200 rpm
Standard Torque	860 lb. Ft. @ 1,440 rpm
Full Tank Capacity	120 gal (454 L)
Standard Transmission	Eaton Fuller RT-8908LL
Speed Standard Transmission	Manual 10-speed
Max Speed Standard Transmission	74 mph (120 km/h)
Max Gradeability	54%
Standard Transmission	
Optional Transmission	Allison
Speed Optional Transmission	Automatic 6-speeds
Max Speed Optional Transmission	74 mph (120 km/h)
Max Gradeability	17%
Optional Transmission	
Gross Vehicle Weight Rating	60,000 lb (27 210 kg)
Front Axle Weight Rating Rating	20,000 lb (9 067 kg)
Rear Axle Weight Rating Rating	40,000 lb (18 144 kg)
Front Tires	425/65R 22.5 Michelin XZY (20 ply)
Rear Tires	11R 22.5 Michelin XDE M/S (14 ply)
Brakes	Air, Hydraulic Anti-Lock System
Exhaust Position	Vertical Right Side

### INCLUDED OPTIONS

- Dual Fuel Tanks (120 gal-454 L)
- Power steering
- Electric Horn
- Factory A/C
- Power Port (Cigar lighter)
- AM/FM Radio w/ Clock
- Dual West Coast Stainless Rear View Mirrors
- Standard Factory Warranty

### CHASSIS RECOMMENDATIONS

#### STINGER RS70100 Riding Seat Mounting Configuration

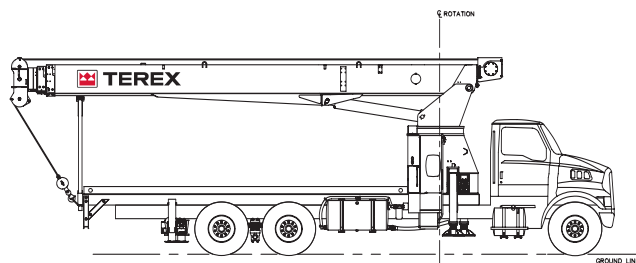
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Front Axle Weight Rating	20,000 lb (9 067 kg)
Rear Axle Weight Rating	40,000 lb (18 144 kg)
Wheel base	261" (6.62 m)
Cab to Axle	192" (4.87 m)
Afterframe	114" (2.90 m)
Frame Section Modulus	30.0 in <sup>3</sup> (491 cm <sup>3</sup> )
RBM per Frame Rail	3,300,000 in/lb (38 020 kg/m)
Frame Height (Unloaded)	40" (7.62 m)
Exhaust Position	Vertical Right Side



## BOOM TRUCK CRANE STINGER 70100

### BT MODEL

#### SPECIFICATIONS



#### BOOM

- ▶ 30.5-100' (9.30-30.48 m) four-section full power fully synchronized boom. Patented keel boom design utilizes a keel shaped base plate combined with a deep, four plate boom section to optimize strength / rigidity-to-height ratio. Exclusive, patented color-coded boom and load charts allow the operator to easily determine boom extension, boom angle and load capacity. Maximum tip height with four-section 30.5-100' (9.30-30.48 m) boom is 110' (33.53 m). Maximum tip height with optional two-stage 30.5-55' (9.30-16.76 m) jib is 163' (49.68 m).

#### WINCH

- ▶ Hydraulic winch with gear motor and planetary reduction gearing provides 2-speed operation. First layer rope pull is 15,000 lb (6 804 kg). Wire rope size is 5/8" (16 mm) with 45,400 lb (20 593 kg) breaking strength.

#### OPERATING SPEEDS

- ▶ Mainframe / turret assembly planetary gear rotation provides 180° rotation (370° with optional front bumper outrigger). Swing rotation is 75 seconds. Boom up/down is 60/41 seconds and boom extend/retract is 108/50 seconds.

#### HYDRAULICS

- ▶ Three-section pump allows the operator to perform simultaneous crane operations (winch, boom and swing). Capacities are 32, 17 and 8 gpm (122, 64 and 30 L/m). Hydraulic tank capacity is 90 gal (342 L).

#### CONTROLS

- ▶ Fully proportional, excellent metering characteristics for precise boom movements. Independent outrigger controls allow the crane to be stable and level in rigorous working conditions. Load Moment Indication System has audio alarm and functional shut down when operator encounters an overload situation.

#### OUTRIGGERS

- ▶ Front outriggers are Out & Down. The maximum width over main outrigger pads is 25' 6" (7.78 m).
- ▶ Rear outriggers are Out & Down. The maximum width over auxiliary outrigger pads is 17' 6" (5.33 m).

#### SUBFRAME

- ▶ Single fabricated, closed-box style subframe yields greater strength and rigidity. Wheelbase for standard truck crane mounting configuration is 261" (6.62 m).

#### OPTIONS AND ACCESSORIES

- ▶ Single and two-stage jibs
- ▶ Multi-part load blocks
- ▶ Main winch with 2 speed motor
- ▶ Auxiliary winch
- ▶ Rotation-resistant load line
- ▶ Heavy duty wood flatbeds
- ▶ Extra heavy duty wood flatbeds
- ▶ Extra heavy duty steel flatbeds
- ▶ Radio remote controls
- ▶ One-man or two-man baskets
- ▶ Self-leveling work platform
- ▶ Winch drum tensioner
- ▶ Continuous rotation
- ▶ Oil cooler
- ▶ Single front bumper outrigger (required for 370° or continuous rotation)
- ▶ Hydraulic hose reel
- ▶ Hydraulic auxiliary tool circuit
- ▶ Tool box

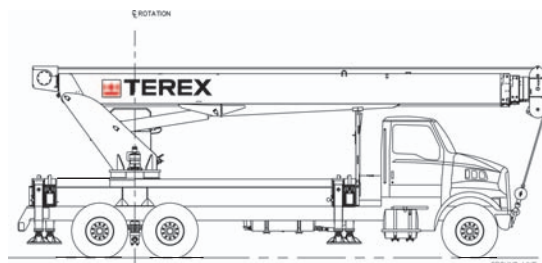




# BOOM TRUCK CRANE STINGER 70100

## RS MODEL

### SPECIFICATIONS



#### BOOM

- ▶ 30.5-100' (9.30-30.48 m) four-section full power fully synchronized boom. Patented keel boom design utilizes a keel shaped base plate combined with a deep, four plate boom section to optimize strength / rigidity-to-height ratio. Exclusive, patented color-coded boom and load charts allow the operator to easily determine boom extension, boom angle and load capacity. Maximum tip height with four-section 30.5-100' (9.30-30.48 m) boom is 110' (33.53 m). Maximum tip height with optional two-stage 30.5-55' (9.30-16.76 m) jib is 163' (49.68 m).

#### WINCH

- ▶ Hydraulic winch with 2-speed gear motor and planetary reduction gearing provides 2-speed operation. First layer rope pull is 15,000 lb (6 804 kg). Wire rope size is 5/8" (16 mm) with 45,400 lb (20 593 kg) breaking strength.

#### OPERATING SPEEDS

- ▶ Mainframe / turret assembly planetary gear rotation provides 180° rotation (370° with optional front bumper outrigger). Swing rotation is 75 seconds. Boom up/down is 60/41 seconds and boom extend/retract is 108/50 seconds.

#### HYDRAULICS

- ▶ Three-section pump allows the operator to perform simultaneous crane operations (winch, boom and swing). Capacities are 32, 17 and 8 gpm (122, 64 and 30 L/m). Hydraulic tank capacity is 90 gal (342 L). Hydraulic oil cooler is standard.

#### CONTROLS

- ▶ Fully proportional, excellent metering characteristics for precise boom movements. Independent outrigger controls allow the crane to be stable and level in rigorous working conditions. Load Moment Indication System has audio alarm and functional shut down when operator encounters an overload situation.

#### OUTRIGGERS

- ▶ Front and Rear outriggers are Out & Down type. The maximum width over outrigger (Front and Rear) pads is 22' 4" (6.81 m).
- ▶ Front bumper outrigger is standard

#### SUBFRAME

- ▶ Single fabricated, closed-box style subframe yields greater strength and rigidity. Wheelbase for standard truck crane mounting configuration is 261" (6.62 m).

#### OPTIONS AND ACCESSORIES

- ▶ Single and two-stage jibs
- ▶ Multi-part load blocks
- ▶ Radio Remote Controls
- ▶ Enclosed Operators Cab
- ▶ Cab Heater
- ▶ Auxiliary winch
- ▶ Rotation-resistant load line
- ▶ One-man or two-man baskets
- ▶ Self-leveling work platform
- ▶ Winch drum tensioner
- ▶ Continuous rotation
- ▶ Hydraulic hose reel
- ▶ Hydraulic auxiliary tool circuit
- ▶ Tool box

**Rule 4-3: Ground Penetration**

*Drawing(s) showing the locations and depths of all ground penetrations on the competition site.*

Please refer to:

Construction Documents, Sheet A-101: Site Plan

**Rule 4-4: Impact on Turf**

*Drawing(s) showing the location, contact area, and soil-bearing pressure of every component resting directly on the turf.*

For location and contact area please refer to:

Construction Documents, Sheet S-101: Temporary Foundation Plan

For soil-bearing pressure please refer to:

Project Manual, Chapter 4: Structural Calculations

**Rule 4-5: Generators**

*Specifications for generators.*

**2009 Honda EB3800XA**

GENERAL INFORMATION	
Manufacturer	Honda Power Equipment
Model Year	2009
Model	EB3800XA
ENGINE	
Engine	Honda GX240
Displacement	242 cc
Starting System	Recoil
Fuel Tank Capacity	6.6 gal.
OPERATIONAL	
Maximum AC Output	3,800W (31.6 / 15.8A)
Rated AC Output	3,300W (27.5 / 13.7A)
Rated AC Current	120 / 240V
Continuous Operating Hours	10.4 hrs. @ rated load 15.6 hrs. @ 1/2 load
Noise Level	71 dB @ rated load
MEASUREMENTS	
Length	41.9 in.
Height	29.2 in.
Width	27.2 in.
OTHER	
Dry Weight	185 lbs.
Receptacles	20A 125V Duplex (2), 30A 125V Locking Plug, 20A 125 / 250V Locking Plug

## Rule 4-6: Spill Containment

*Drawing(s) showing the locations of all equipment, tanks, and pipes that will contain fluids at any point during the event.*

Please refer to:

# Construction Documents, Sheet A-101: Site Plan

Construction Documents, Sheet A-111A: Enlarged West Module Plan

Construction Documents, Sheet A-111C: Enlarged East Module Plan

Construction Documents, Sheet A-304: North Site Section

Construction Documents, Sheet I-214: Kitchen North Elevation

Construction Documents, Sheet I-231: Bathroom West Elevation

Construction Documents, Sheet I-232: Bathroom North Elevation

Construction Documents, Sheet I-233: Bathroom East Elevation

Construction Documents, Sheet I-241: Mechanical Room Elevations

Construction Documents, Sheet P-103: Plumbing Return

Construction Documents, Sheet P-901: Plumbing Supply / Removal

## Rule 4-6: Spill Containment

*Specifications for all equipment, tanks, and pipes that will contain fluids at any point during the event.*

Please refer to:

## Project Manual, Chapter 3: Project Specifications:

### §11 31 00: Residential Appliances

§15 77 00: Radiant Subflooring

## §22 11 16: Domestic Water Piping

§22 33 30.26: Residential, Collector-to-Tank, Heat Exchanger Coil, Solar Electric Domestic Water Heaters

## §22 41 16: Residential Lavatories and Sinks

## §22 41 23: Residential Shower Receptors and Basins

## §22 41 39: Residential Faucets, Supplies, and Trim

### §23 21 23.13: In-line Centrifugal Hydronic Pumps

## §23 56 13.19: Heating Solar Vacuum-Tube Collectors

## §23 57 19.16: Shell-type Liquid-to Liquid Heat Exchangers

§23 62 13: Packaged Air-cooled Refrigerant Compressor and Condenser Units

## §23 84 16: Dehumidifiers

**Rule 4-7: Lot Conditions**

*Calculations showing that structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists.*

Please refer to:

Project Manual, Chapter 4: Structural Calculations

**Rule 4-7: Lot Conditions**

*Drawing(s) showing shimming methods and materials to be used if 18 in. (45.7 cm) of vertical elevation change exists on the lot.*

Please refer to:

Construction Documents, Sheet S-501: Foundation Details

**Rule 5-2: Solar Envelope Dimensions**

*Drawing(s) showing the location of all house and site components relative to the solar envelope.*

Please refer to:

Construction Documents, Sheet A-301: Site Sections

**Rule 5-2: Solar Envelope Dimensions**

*List of solar envelope exemption requests accompanied by justifications and drawing references.*

This rule is not applicable.

**Rule 6-1: Structural Design Approval**

*List of, or marking on, all sheets in the complete electronic Construction Documents that have been or will be stamped by the structural engineer in the hard-copy, stamped structural submission; the stamped submission shall consist entirely of sheets or pages that also appear in the complete electronic construction document set.*

Please refer to:

Construction Documents, Coversheet

Project Manual, Chapter 4: Structural Calculations



**Rule 6-2: Maximum Architectural Footprint**

*Drawing(s) showing all information needed by the Rules Officials to measure the architectural footprint electronically.*

Please refer to:

Construction Documents, Sheet A-115: Footprint Area Plan

**Rule 6-2: Maximum Architectural Footprint**

*Drawing(s) showing all movable components that may increase the footprint if operated during contest week.*

This rule is not applicable.

**Rule 6-2: Maximum Architectural Footprint**

*Shading calculations and/or diagrams for components that DO NOT shade the building above its finished floor height between 9 a.m. and 5 p.m. EDT on October 1 (shading calculations and/or diagrams are not necessary for components that are either shorter than finished floor height or obviously do not shade the building).*

Please refer to:

Construction Documents, Sheet A-114: Shading Studies

**Rule 6-3: Minimum Conditioned Space**

*Drawing(s) showing space conditioning means in primary living spaces.*

Please refer to:

Construction Documents, Sheet A-116: Conditioned Area Plan

**Rule 6-4: Entrance and Exit Routes**

*Drawing(s) showing the accessible public tour route and the ground surface area that will be covered by organizer-provided walkway material.*

Please refer to:

Construction Documents, Sheet X-103: Tour Plan

**Rule 7-1: Placement**

*Drawing(s) showing the location of all vegetation and, if applicable, the movement of vegetation designed as part of an integrated mobile system.*

Please refer to:

Construction Documents, Sheet L-211: Landscape Elevations

Construction Documents, Sheet L-212: Landscape Elevations

Construction Documents, Sheet L-601: Site Finishes Schedule

Construction Documents, Sheet A-101: Site Plan

**Rule 7-2: Watering Restrictions**

*Drawings showing the layout and operation of greywater irrigation systems.*

This rule is not applicable.

**Rule 8-1: PV Technology Limitations**

*Specifications for photovoltaic components.*

Please refer to:

Project Manual, Chapter 3: Project Specifications:

§23 31 00: Photovoltaic Collectors

**Rule 8-1: PV Technology Limitations**

*Contractor price quote for photovoltaic components.*

Price quote without dealer markup is \$5.11/Wp for Sanyo HIT 205W modules. Price quoted by Dennis Pottratz of GoSolar on October 11.

Quote for Powerfilm products pending

**Rule 8-3: Thermal Energy Storage**

*Drawing(s) showing the location of thermal energy storage components.*

Please refer to:

Construction Documents, Sheet I-241: Mechanical Room Elevations

Construction Documents, Sheet M-101: Enlarged Mechanical Room Plan

**Rule 8-3: Thermal Energy Storage**

*Specifications for thermal energy storage components.*

Please refer to:

Project Manual, Chapter 3: Project Specifications:

§22 33 30.26: Residential, Collector-to-Tank, Heat-Exchanger Coil, Solar-Electric Domestic Water Heaters

**Rule 8-3: Thermal Energy Storage**

*Shading calculations and/or diagrams for thermal energy storage components (if necessary).*

This rule is not applicable.

**Rule 8-4: Batteries**

*Drawing(s) showing the location(s) and quantity of stand-alone, PV powered devices.*

Please refer to:

Construction Documents, Sheet A-101: Site Plan

**Rule 8-4: Batteries**

*Specifications for all stand-alone, PV-powered devices.*

Please refer to:

Project Manual, Chapter 3: Project Specifications:

§26 56 33: Exterior Lighting

**Rule 8-5: Desiccant System**

*Drawing(s) describing the operation of the desiccant system.*

Please refer to:

Construction Documents, Sheet M-606: Desiccant System Schematic

Rule 8-5: Desiccant System

*Specifications for desiccant system components.*

Please refer to:

Project Manual, Chapter 3: Project Specifications:  
§23 84 16: Dehumidifiers

Rule 8-6: Village Grid

*Completed Interconnection Application form.*

Please refer to:

Project Manual, Chapter 8: Interconnection Application Form

Rule 8-6: Village Grid

*Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means.*

Please refer to:

Construction Documents, Sheet A-101: Site Plan  
Construction Documents, Sheet A-112: Roof Plan  
Construction Documents, Sheet A-212: East Elevation  
Construction Documents, Sheet I-241: Mechanical Room Elevations

Rule 8-6: Village Grid

*Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means.*

Please refer to:

Project Manual, Chapter 3: Project Specifications:  
§26 05 28: Grounding and Bonding for Electrical Systems  
§26 22 00: Low Voltage Electrical Transformers  
§26 24 16.12: I-Line Panelboards  
§26 28 13: Fuses  
§26 28 16: Enclosed Switches and Circuit Breakers  
§26 28 16.12: Disconnect Switches – General Duty  
§26 31 00: Photovoltaic Collectors



**Rule 8-6: Village Grid**

*One-line electrical diagram.*

Please refer to:

Construction Documents, Sheet E-601: Wiring Schematics

Construction Documents, Sheet E-602: Wiring Schematics

Construction Documents, Sheet E-606: PV Wiring Schematic

Construction Documents, Sheet E-607: PV Wiring Schematic

**Rule 8-6: Village Grid**

*Calculation of service/feeder net computed load per NEC 220.*

Please refer to:

Project Manual, Chapter 8: Interconnection Application Form

**Rule 8-6: Village Grid**

*Site plan showing the house, decks, ramps, tour paths, and terminal box.*

Please refer to:

Construction Documents, Sheet A-101: Site Plan

Construction Documents, Sheet X-103: Tour Plan

**Rule 8-6: Village Grid**

*Elevation(s) showing the terminal box, meter housing, main utility disconnect, and other service equipment.*

Please refer to:

Construction Documents, Sheet A-212: East Elevation

Construction Documents, Sheet I-241: Mechanical Room Elevations

**Rule 9-4: Rainwater Collection**

*Drawing(s) showing the layout and operation of rainwater collection systems.*

Please refer to:

Construction Documents, Sheet A-506: Downspout Details

Construction Documents, Sheet A-507: Downspout Details

Rule 9-6: Thermal Mass

*Drawing(s) showing the locations of water-based thermal mass systems.*

This rule is not applicable.

Rule 9-6: Thermal Mass

*Specifications for components of water-based thermal mass systems.*

This rule is not applicable.

Rule 10-2: Event Sponsor Recognition

*Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage.*

Please refer to:

Construction Documents, Sheet X-104: Public Exhibit

Rule 10-3: Team Sponsor Recognition

*Drawing(s) showing the dimensions, materials, artwork, and content of all communications materials, including signage.*

Please refer to:

Construction Documents, Sheet X-104: Public Exhibit

Rule 11-4: Public Exhibit

*Interior and exterior plans showing entire accessible tour route.*

Please refer to:

Construction Documents, Sheet X-103: Tour Plan

Rule 11-4: Public Exhibit

*Drawing(s) showing the dimensions, materials, artwork, and content of the handout.*

This rule is not applicable.

Rule 11-4: Public Exhibit

*Drawing(s) showing the artwork and content of the team uniform.*

Please refer to:

Construction Documents, Sheet X-201: Team Uniform

## CHAPTER 2: Summary of Changes

The following list summarizes the architectural and engineering design changes which have occurred since the construction document set dated and submitted on December 16<sup>th</sup>, 2008:

1. Due to solar envelope infractions, the house deck has been redesigned. Deck square-footage has been reduced by nearly fifty percent and has been modularized but utilizes similar detailing and structural details as the original system. The height of the railing system has been amended to meet code as a guardrail in case the deck ends up higher than 30 inches above ground due to uneven ground conditions on the mall. *Reference Construction Documents, Sheet A-101: Site Plan and Sheet A-521: Site Details.*
2. The moving glass panel door system (NanaWall) bordering both sides of the Hall has been removed. The sunporch is still bound by 2 partition systems. This allows for fire egress from the bedroom out the north doors and maintains accessibility in front of the bathroom. *Reference Construction Documents, Sheet A-110: Floor Plan.*
3. The exterior cladding system has changed from a modularized removable panel grid system to a permanently attached ship-lap siding accented by extruded aluminum. *Reference Construction Documents, Sheet A-220: South Cladding Elevation, Sheet A-221: East Cladding Elevation, Sheet A-222: West Cladding Elevation, Sheet A-223: North Cladding Elevation, Sheet A-224: South Channel Elevation, Sheet A-225: East Channel Elevation, Sheet A-226 West Channel Elevation, and Sheet A-227: North Channel Elevation.*
4. The center roof module was originally designed to be flat-packed and assembled on site. This was also to allow for the safe transport and installation of the skylight found above the sunporch. Given the new modular skylight system to be used, the center roof module is being framed and shipped in its entirety. *Reference Construction Documents, Sheet S-115: Upper Module Beam Plan and Sheet S-121 Roof Framing Plan.*
5. The ceiling condition over the mechanical room, linen closet, and washroom has been resolved in much greater detail. A light shelf and plant ledge has been incorporated into the ceiling structure. This area is not to be occupied. *Reference Construction Documents, Sheet S-231: Bed/Bath Wall Framing Elevation, Sheet S-232: Light Shelf Framing Sections, Sheet A-118: Clerestory Plan, Sheet A-310: Kitchen Section, and Sheet A-314: Laundry Closet Section.*

6. The cooling system has been changed from a chilled-beam/absorption chiller system to a small forced air system. The desiccant system has been scaled down and the radiant floor system remains. A small A/C condenser has been placed on the deck for the forced-air system. Due to the reduced need of hot water, one set of evacuated tubes has been removed from the roof. *Reference Construction Documents, Sheet A-101: Site Plan and Sheet A-112: Roof Plan.*
7. Interior finishes and materials have been detailed. *Reference Construction Documents, Sheet A-601: Finish Schedule*
8. The bathroom door has been changed from an in-wall pocket door to a top-hung, face-mounted, sliding door. *Reference Construction Documents, Sheet A-111A: Enlarged West Module Plan and Sheet A-603: Door Schedule.*
9. Although the kitchen location has not changed, the layout has been altered for reasons of greater accessibility. *Reference Construction Documents, Sheet I-214: Kitchen North Elevation.*
10. The lighting design has been changed drastically in order to accommodate changes in space arrangement and for increased efficiency. *Reference Construction Documents, Sheet E-104: Lighting Plan and Sheet E-605: Electrical Schedules.*
11. The temporary steel foundation called out in the last submittal has been eliminated due to cost constraints. This was not structural in any way and was used solely as a module alignment aid.
12. Channel glass was originally specified for the windows at the bedroom/bathroom wall. A quantity of glass that small could not be allocated, so site-framed polycarbonate windows have been substituted. *Reference Construction Documents, Sheet A-602: Window Schedule, Sheet I-225: Bedroom North Elevation, and Sheet I-234: Bathroom South Elevation.*
13. The size of the north clerestory windows has been drastically reduced. Cross-bracing was originally specified to accommodate for shear at these large openings. This cross-bracing has been removed with the consent of our structural engineer.

14. Phase change material has been eliminated due to cost constraints and lack of availability. It has been exchanged for blue jean insulation in the wall sections.  
*Reference Construction Documents, Sheet A-315: Wall Sections, Sheet A-316: Wall Sections, and Sheet A-317: Wall Sections.*





# PROJECT SPECIFICATIONS

Interlock House

Date Prepared: JUNE 2, 2009



Prepared By:

IOWA STATE UNIVERSITY

156 College of Design  
Ames, IA 50011  
[www.solard.iastate.edu](http://www.solard.iastate.edu)

Prepared For:

National Renewable Energy Laboratory

1617 Cole Boulevard  
Golden, CO 80401  
[www.nrel.gov](http://www.nrel.gov)



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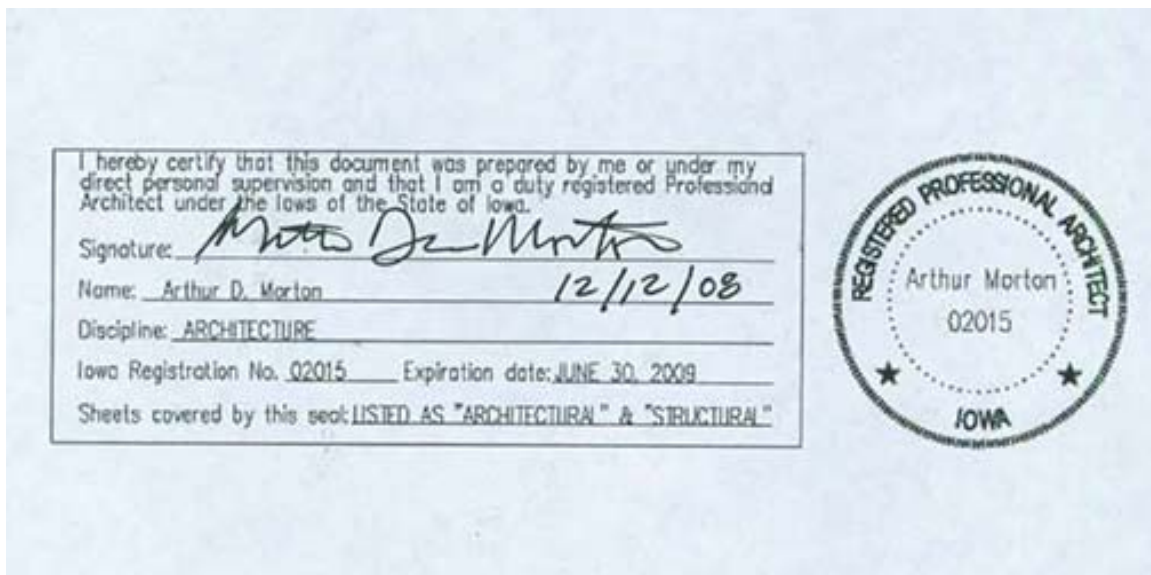
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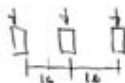
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SECTION 00 01 07  
STRUCTURAL CALCULATIONS



Solar Decathlon  
2009A - DETERMINE LOADS:

## ROOF DEAD LOADS:



$$\frac{33 \text{ plf}}{\frac{16}{12}} = 2.48 \text{ psf}$$

Photovoltaic: 2.43 psf

TUBES: 9.54 psf

METAL PANEL: 0.90 psf

Masome 26GA

PLYWOOD DECK: 1.8 psf

 $\frac{1}{2}$ " ( $\frac{1}{8}$ "- $\frac{3}{8}$ ")

ROOF FRAMING: 2.48 psf

2x10's @ 16" oc

INSULATION: 1.67 psf

10" THICK

DRYWALL:  $\frac{73.6}{32} = 2.30 \text{ psf}$  $\frac{7}{8}$ "

ROOF DEAD: 9.15 + 10% =

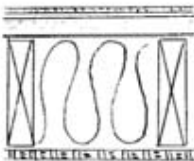
ROOF DEAD = 10 psf

(2" spray insulation)

Roof w/ PV = 13 psf

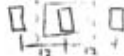
Roof w/ tubes = 20 psf

## FLOOR DEAD LOADS:



Doug Fir 33 plf

$$2 \times 10 = 33 \text{ psf} \left( \frac{15}{12} \right) \left( \frac{9.5}{12} \right) = 3.3 \text{ plf} \div 1' = 3.3 \text{ psf}$$



## FLOORING:

 $\frac{1}{4}$ " CERAMIC TILE: 3.13 psf

$$150 \frac{16}{48} \times \frac{0.25}{12} = 3.125$$

FLOOR PANEL: 3.6 psf

1  $\frac{1}{4}$ " plywood

FLOOR JOISTS: 3.3 psf

2x10 @ 12" oc

INSULATION: 1.67 psf

10" thick

Drywall: 2.6 psf

$$\frac{3}{4} < \frac{2.3}{\frac{1}{8}} = \frac{18.4}{1}$$

FLOOR DEAD: 14.3 psf

10%

 $\Rightarrow$  FLOOR DEAD = 16 psf

## SNOW LOADS:

IOWA (AMES) = 30 psf (2000 IBC p291) (2006 IRC p39) ← controls!

ROOF LIVE = 20 psf (2009 Solar Decathlon p4)

## FLOOR LOADS:

FLOOR LIVE = 50 psf (2009 Solar Decathlon p4)

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B- WIND LOADS:

1- Solar Decathlon building code - 2009

wind: 60 mph (3 sec gust)  
exposure category "C"

Main wind - Force Resisting Systems ASCE/SEI 7-05

Low Rise buildings: 6-18 p 28

$$P = q_n ((GC_{pf}) - (GC_{pi}))$$

$$q_h = 0.00256 K_z K_{zt} K_d V^2 I$$

$$V = 60 \text{ mph (3 sec)}$$

$$I = 1.0 \text{ (table 6-1) p77} \rightarrow \text{category II (non hurricane)}$$

$$K_z = 2.01 \left( \frac{z}{2.5} \right)^{2.5} \sim 9.5 \text{ (table 6-2) p78}$$

$$= 2.01 \left( \frac{16}{2.5} \right)^{2.5} \sim 9.5 \text{ (table 6-2) p78}$$

$$K_z = 0.86$$

$$K_{zt} = (1 + K_1 K_2 K_3)^2 \text{ USE } K = 1 \text{ (presume no hills or escarpments} \rightarrow \text{mall area)}$$

$$K_{zt} = 1$$

$$K_d = 0.85 \leftarrow \text{main building (table 6-4 p80)}$$

$$q_w = 0.00256 (0.86)(1)(0.85)(60)^2 (1)$$

$$q_w = 6.74 \text{ psf}$$

(roof slope  $\approx 20^\circ \rightarrow 4/11$ )

$$GC_{pf} = -0.64 \text{ (Fig 6-10 p53)}$$

$$GC_{pi} = \pm 0.55 \text{ (Fig 6-5 p47) assume partially enclosed for summer!}$$

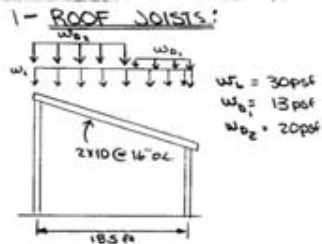
$$P = 6.74 (-0.64 - 0.55) = -8.02 \text{ psf}$$

2- FOR IOWA:

wind: 90 mph (3 sec gust)  
EXPOSURE "B"

$$P = 13 \text{ psf IRC 2006 p25,41}$$

← USE THIS  
FOR DESIGN!  
Page 9 of 30



Worst Case:  $M = \frac{wL^2}{8} = \frac{(30+20) \text{ psf} (1.33 \text{ ft}) (18.5')^2}{8}$

$M_{\text{roof}} = 2844 \text{ ft}\cdot\text{lb}$

$S_{\text{reqd}} = 21.39 \text{ in}^3$

$f_b = \frac{M_{\text{roof}}}{S_{\text{reqd}}} = \frac{2844 (12)^{1/4}}{21.39 \text{ in}^3}$

$f_{b\text{joist}} = 1596 \text{ psi}$

$F_b' = F_b C_D C_L C_F C_R \quad \text{SPF \#1/\#2}$   
 $= 875 \text{ psi} (1.15) (0.98) (1.1) (1.15)$   
 $= 1247 \text{ psi} < 1596$

(per NDS)  $F_b' = F_b C_D C_L C_F C_R \quad \text{SPF - Select Structural}$   
 $= 1250 \text{ psi} (1.15) (0.98) (1.1) (1.15)$   
 $= 1782 \text{ psi} > 1596 \text{ psi} \quad \text{OK}$

Select Structural:  $E = 1,500,000 \text{ psi}$

$\Delta_{\text{max}} = \frac{5}{384} \frac{(30+20) \text{ psf} (1.33) (18.5')^4 (12)^3}{1,500,000 \text{ psi} (98.93) \text{ in}^4} = 1.18 \text{ in}$

$\Delta_{\text{allow}} = \frac{L}{360} = \frac{18.5 (12)}{360} = 0.617 \text{ in}$

$\Delta_{\text{allow}} = \frac{L}{240} = \frac{18.5 (12)}{240} = 0.925 \text{ in}$

BMI: span 18.5 ft

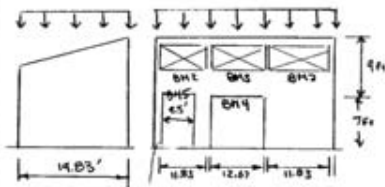
2x10 @ 16" o.c.

S-P-F (select structural)  $F_b = 1250 \text{ psi}$   
 $E = 1,500,000 \text{ psi}$



2- CLERE STORY WINDOW LINTEL:

BM2 &amp; BM3



$$W_{dead} = 20 \text{ psf}$$

$$W_{live} = 30 \text{ psf}$$

$$\text{TRIB WIDTH} = \frac{19.83}{2} \approx 10'$$

$$\text{BM2 span} = 11.83 \text{ ft} : (3) 2 \times 12 \text{ w/ (2) stud each side}$$

$$\text{BM3 span} = 12.67 \text{ ft} : (3) 2 \times 12 \text{ w/ (2) studs each side}$$

$$\text{S-P-F } F_b = 1230 \text{ psi } \text{SS - select structural}$$

$$E = 1,500,000 \text{ psi}$$

4- N. Elevation DOOR HEADER

$$\text{Beam 4: } 9(15 \text{ psf}) = 135 \text{ psf (wall load)} \rightarrow \text{add to roof load (13.5 psf)}$$

(divide by roof trib width)

$$W_{dead} = 20 + 13.5 = 33.5 \text{ psf}$$

$$W_{live} = 30 \text{ psf}$$

$$\text{BM4 - SPAN} = 12.67 \text{ ft}$$

$$\text{Trib width} = \frac{19.83}{2} \approx 10'$$

$$\text{BM4: } (2) 1 \frac{3}{4} \times 11.25' \text{ MICROLAM w/ (2) Jack studs each side}$$

$$F_b = 2600 \text{ psi}$$

$$E = 1,900,000 \text{ psi}$$

5- N. Elevation Mechanical DOOR HEADER

$$\text{Beam 5: } W_{dead} = 33.5 \text{ psf (see Door header above \#4)}$$

$$W_{live} = 30 \text{ psf}$$

$$\text{BM5 span} = 9.5 \text{ ft (see sketch above)}$$

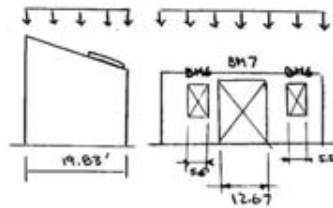
$$\text{Trib width} = \frac{19.83}{2} \approx 10'$$

$$\text{BM5: } (3) 2 \times 12 \text{ w/ (2) Jack studs each side}$$

$$\text{S-P-F - \#1/\#2}$$

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

6 - S. Elevation Window lintel

$$W_{\text{dead}} = 20 \text{ psf}$$

$$W_{\text{live}} = 30 \text{ psf}$$

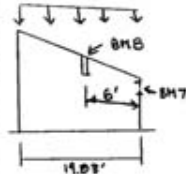
$$\text{Trib width} = \frac{19.83'}{2} = 10'$$



splitline

$$\text{SPAN}_6 = 5.5'$$

BM6: 2-(3) ply beams (stacked)  
 2X6 plys w/(1) Jackstud each side  
 S-P-F #1/#2  
 $F_b = 875 \text{ psi}$   
 $E = 1,400,000 \text{ psi}$

7 - S. Elevation DOOR HEADER (SKY WINDOW)

(center module)

$$\text{BM7: } W_{\text{dead}} = 20 \text{ psf} + 20 \text{ psf} = 40 \text{ psf}$$

$$W_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = \frac{6'}{2} = 3'$$

$$\text{SPAN}_7 = 12.67' \text{ (see sketch above)}$$

BM7: (3) 2X8 w/(1) JACK STUD EACH END  
 S-P-F  $F_b = 1250 \text{ psi}$   $E = 1,500,000 \text{ psi}$  Select Structural

8 - CENTER MODULE ROOF BEAM

BMB: (see sketch above)

$$W_{\text{dead}} = 40 \text{ psf (see BM7)}$$

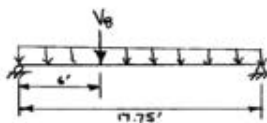
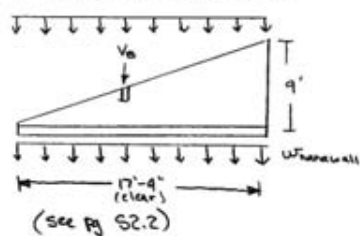
$$W_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = \frac{13.83 + 6}{2} = 10 \text{ ft}$$

$$\text{BM span} = 13 \text{ ft (51.4)}$$

BMB: (2) ply  $1\frac{3}{4} \times 11\frac{1}{4}$ "  
 MICROLAM w/  $1\frac{1}{2}$ " Bearing  
 $F_b = 2600 \text{ psi}$   
 $E = 1,900,000 \text{ psi}$

## 9 - SHEAR TRUSS



$$V_{max} = \frac{wL}{2} = \frac{204(17.75)}{2} = 18,112 \text{ lb}$$

$$V_{max} = \frac{4500(11.75)}{17.75} = 30,121 \text{ lb}$$

$$V_{total} = 48,233 \text{ lb}$$

$$\text{equivalent } w = \frac{8M}{L^2} = \frac{8(26,106)}{(17.75)^2} = 66.3 \text{ plf}$$

$$w_{roof} = (20 \text{ psf dead} + 30 \text{ psf live}) \times 1.33 = 66.5 \text{ plf}$$

$$V_B = 4550 \text{ lb}$$

$$w_{horizontal} = 10 \text{ psf}(7 \text{ ft}) = 70 \text{ plf}$$

$$w_{sheartruss} = 15 \text{ psf} \left( \frac{9'}{2} \right) = 67.5 \text{ plf}$$

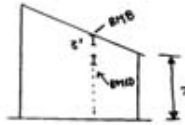
$$M_{max} = \frac{(66.5 + 70 + 67.5) \text{ plf} (17.75)^2}{8} = 80,34 \text{ ft} \cdot \text{lb}$$

$$M_{max} = \frac{4550(6)(11.75)}{17.75} = 18,072 \text{ ft} \cdot \text{lb}$$

$$M_{max} = 80,34 + 18,072 = 26,106 \text{ ft} \cdot \text{lb}$$

23,148.7  
if no roof (load)

### 10 - LOWER MODULE - NANA WALL (BELOW BM8)



$$W_{dead} = 10(3) = 30 \text{ plf}$$

$$W_{live} = 10(7) = 70 \text{ plf}$$

$$\text{Trib width} = 1 \text{ ft}$$

$$\text{BM span} = 13 \text{ ft (51.4)}$$

BM10: (2)ply 2x8  
w/ 1.5" BRG SEAT

S-P-F #1/#2

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

### 11 - LOWER MODULE - NANA WALL STORAGE

$$W_{live} = 7 \text{ panels @ } 3 \text{ ft} \times 10 \text{ psf} = 84 \text{ plf,}$$

2.5 ft  
BM11 span

$$\text{Trib width} = 1 \text{ ft}$$

$$\text{BM span} = 2.5 \text{ ft}$$

BM11: (2)ply 2x8  
w/ 1.5" BRG SEAT

S-P-F #1/#2

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

20 - FLOOR JOISTS

$W_{dead} = 16 \text{ plf}$   
 $W_{live} = 50 \text{ plf}$   
 Trib width = 1'  
 BM Span = 12'-9"

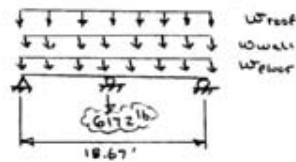
BM20 2XB @ 12" o.c.  
 1.5" BRG AREA

S-P-F #1/#2

$F_b = 875 \text{ psi}$

$E = 1,400,000 \text{ psi}$

\* close on deflection! bending!

21 - RIM JOIST (VIC Grid-G)

(2x2 pod)

Assume Simple Span!

$$W_{roof} = (20 + 30) (1.33) = 66 \text{ plf} \quad (40 \text{ live}) (26 \text{ dead})$$

$$W_{wall} = 7(15) + \frac{1}{2} 9(15) = 173 \text{ plf (dead)}$$

$$W_{floor} = \frac{16(12.75)}{2} = 102 \text{ plf (dead)}$$

$$= \frac{50(12.75)}{2} = 319 \text{ plf (live)}$$

$$\text{Live} = 359 \text{ plf} \quad \text{Dead} = 301 \text{ plf}$$

$$\text{Trib width} = 1'$$

$$\text{Beam Span} = \frac{18.67}{2} = 9.35'$$

(May need short span!)

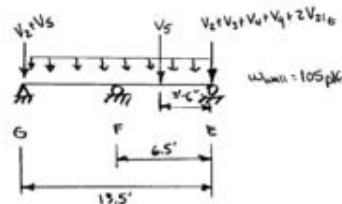
3 1/2 x 7 1/4 LVL  
 FAILS IN BENDING  
 shorten span

RIM JOIST (VIC Grid-E)

$W_{live} = 319 \text{ plf}$   
 $W_{dead} = 102 \text{ plf}$   
 Trib width = 1'  
 Beam Span = 9.35'

3 1/2 x 7 1/4 LVL OK

$$V_{elg} = 1968 \text{ lb}$$

RIM JOIST (LINE 4 E to F)

$$M = \frac{V_s(3.5)}{6.5} = 1624 \text{ ft-lb} \quad \text{max}$$

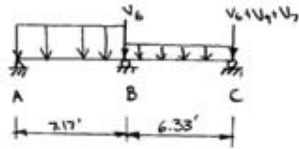
$$M = \frac{105(6.5)^2}{8} = 5594 \text{ ft-lb (dead)}$$

$$V = 1336 \text{ lb}$$

$$\frac{2178(6)}{(6.5)^2} = 412 \text{ plf}$$

3 1/2 x 7 1/4 LVL  
 FAILS IN ~~WEAR~~ BENDING  
 Thicken member  
 need 9" wide

## 21 - RIM JOIST LINE 1 GRID C-B



A-B:  
 $w_{\text{dead}} = 33.5 \text{ plf}$  (Sec #4)  
 $w_{\text{live}} = 30 \text{ plf}$   
 Trib width = 10'  
 BH span = 7'-2" (7.17')  
 $V_6 = 1375 \text{ lb}$

$3\frac{1}{2} \times 7\frac{1}{4}$  LVL OK  $V_{\text{max}} = 3651 \text{ lb}$

C-B

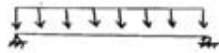
$w_{\text{dead wall}} = 7 \times 15 = 255 \text{ plf}$   
 Trib width = 1'  
 BH span = 6.33'

$V_{\text{max}} = V_6 + V_4 + V_7 + \frac{1}{2} wL$   $V_{\text{max}} = 9504 \text{ lb}$

$3\frac{1}{2} \times 7\frac{1}{4}$  LVL  
 FAILS IN SHEAR

needs (3) 1.75" dlys or  $b = 5.25"$   
 BRG reqd reqd = 4.5"

## 21 - RIM JOIST LINE 1 GRID C-E



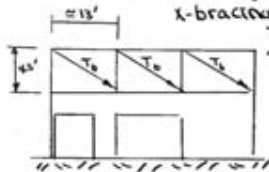
$w_{\text{wall}} = 255 \text{ plf}$   
 $w_{\text{floor}} = 50 \text{ plf}$   
 $w_{\text{floor dead}} = 15 \text{ plf}$

BH span = 12'-0" (12.67')

$3\frac{1}{2} \times 7\frac{1}{4}$  LVL OK

### 60 - NORTH CLERESTORY CROSS-BRACING

\* clerestory framing is adequate structurally  
x-bracing is added to control deflection



$$T_b = 13.8 \left( \frac{H_1}{13} \right) = \frac{13.8}{13} \times \frac{2340}{3}$$

$$T_b = 826 \text{ lb}$$

\* x-bracing in tension only!

$$L_{br} = \sqrt{4.5^2 + 13^2} = 13.8'$$

w/ 1/4" A36 SIDE PLATE: (p61 NDS m1)

$$\# \text{ 1/4 LAG BOLTS} = \frac{T_b}{Z_{\perp}} = \frac{826 \text{ lb}}{190 \text{ lb}} = 4.34 \text{ or (5)}$$

$$\# \text{ 3/8 LAG BOLTS} = \frac{826 \text{ lb}}{290 \text{ lb}} = 2.84 \text{ or (3)}$$

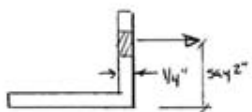
ROD SIZE:

1/2" ROD

$$A = \pi r^2 = \pi (.25)^2 = 0.19 \text{ in}^2$$

$$\phi P_n = 0.9 F_y A_g = 0.9 (36 \text{ ksi}) (0.19 \text{ in}^2) = 6.15 \text{ K} \gg 1.07 \text{ K} \text{ OK}$$

$$\frac{KL}{r} = \frac{(1)(13.8)(12)}{\frac{.25}{2}} = 662 \gg 300 \text{ pretty slender!}$$

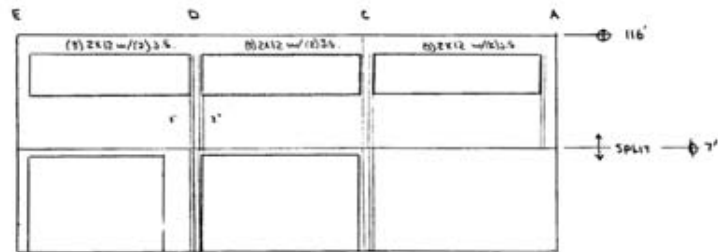


$$M = P(L) = \overbrace{1.3(826)}^{1.07 \text{ K}} (2'') = 2,148 \text{ in-lb}$$

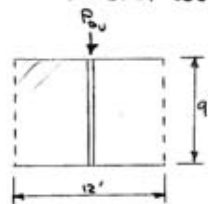
$$S_x = \frac{1}{6} b h^2 = \frac{0.25}{6} (h^2) = 0.166 \text{ in}^3$$

$$S_{x \text{ reqd}} = \frac{2,148 \text{ in-lb}}{.6 (36,000 \text{ psi})} = 0.099 \text{ in}^3 < 0.166 \text{ in}^3 \text{ OK}$$



40- NORTH WALL (OUT OF PLANE)

## 41- UPPER BEAM COLUMN - "D" (Worst case - upper)



Trib width = 12'

90 mph wind exposure "B"

 $U_{wind} = 13 \text{ psf}$   
 (IRC 2006) p25,41

$$\tan \theta = \frac{9}{20}$$

$$\theta = 24^\circ$$

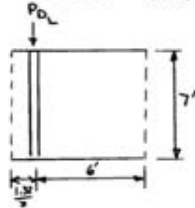
$$P_u = V_2 + V_3 + V_4 = 2950 + 3168 + 5884 = 12,002 \text{ lb}$$

BC 41: (4) ply 2x6

S-P-F #1/#2

 $F_b = 875 \text{ psi}$  $E = 1,400,000 \text{ psi}$ 

## 42- LOWER BEAM COLUMN "D" worst case lower



Trib width = 6.7 ft

90 mph wind exposure "B"

 $U_{wind} = 13 \text{ psf}$  (see above)

$$P_{u, lower} = V_2 + V_3 + V_4 + V_5$$

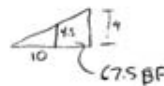
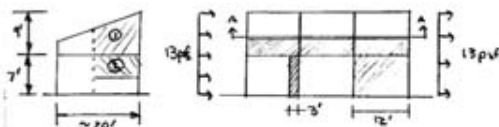
$$= 2950 + 3168 + 5884 + 4023 = 16,025 \text{ lb}$$

BC 42: (4) ply 2x6

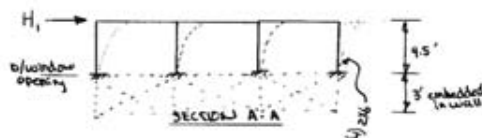
SPF #1/#2

 $F_b = 875 \text{ psi}$  $E = 1,400,000 \text{ psi}$

## 43- North Wall - IN PLANE



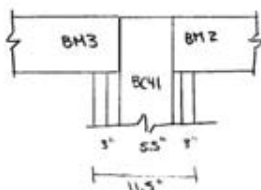
## 44- CLERESTORY POSTS (TAKE WIND INTO WOOD POSTS)



$$\begin{aligned}
 P_{\text{dead}} &= V_{\text{z dead}} + V_{\text{z dead}} + V_{\text{z dead}} = \\
 &= \frac{2}{3} (V_z) + 0.52 V_z + \frac{6.4}{20.4} (V_z) \\
 &= \frac{2}{3} (2950) + 0.52 (3160) + \frac{6.4}{20.4} (5894)
 \end{aligned}$$

$$P_{\text{dead}} = 7558 \text{ lb}$$

$$P_{\text{dead}} + \text{live} = 16,025 \text{ lb}$$



$$\begin{aligned}
 I_{\text{unbraced}} &= 4(20.8) + \frac{5.5^3 (8.5)}{12} \\
 &= 288.1
 \end{aligned}$$

$$\begin{aligned}
 H_1 &= \text{Diaphragm load} \\
 &= 26 \text{ psf} (9 \text{ ft}) (10 \text{ ft}) \\
 &= \text{trik width}
 \end{aligned}$$

$$H_1 = 2340 \text{ lb}$$

$$\begin{aligned}
 M_{\text{wind}} &= \frac{H_1}{4} \times 4.5' = \frac{2340}{4} (4.5) \\
 M_{\text{wind}} &= 2633 \text{ ft-lb}
 \end{aligned}$$

$$\begin{aligned}
 \Delta_{\text{max}} &= \frac{H_1^3}{3EI} = \frac{(2340)^3 (4.5)^3 (12)^3}{3(1,400,000)(4)(20.80)} \\
 \Delta_{\text{max}} &= 0.26"
 \end{aligned}$$

$$\Delta_{\text{allow}} = \frac{4.5(12)}{360} = 0.15"$$

Since I does not include sheathing & shoulder studs. This is probably OK

POST 44: (AKA BC 41)

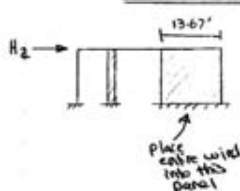
(4) PLY 2X6

SPF #1/#2

 $F_b = 875 \text{ psi}$  $E = 1,400,000 \text{ psi}$ 

$\Delta = 0.05"$   
 $I = 288.4$   
 w/ Jack studs  
 OK

## 45- LOWER MODULE SHEAR



$$\begin{aligned}
 H_2 &= H_1 + 26(10) \left( \frac{7}{8} \right) \\
 &= 2340 + 910 \\
 &= 3250 \text{ lb}
 \end{aligned}$$

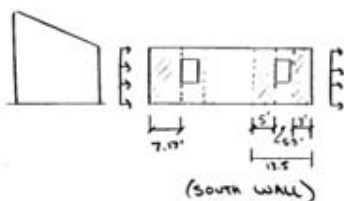
$$\text{SHEAR: } U_s = \frac{V}{A} = \frac{3250 \text{ lb}}{13.67'} = 238 \text{ plf}$$

$$U_{s2} \text{ drywall} = 100 \text{ plf}$$

$$U_{s1/2} \text{ sheathing} = 170 \text{ plf}$$

$$U_{\text{total}} = 270 \text{ plf} > 238 \text{ plf} \text{ OK}$$

#### 46 - SOUTH WALL - IN PLANE



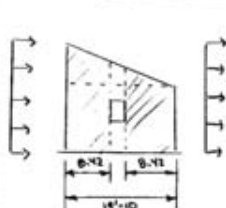
add up shear sections:

$$d = 7.17 + 5' + 3' = 15.17'$$

\* since this is greater than N wall shear  
 & H is smaller on S wall;

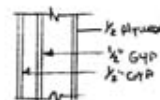
**SHEAR IS OK**

#### 47 - EAST & WEST WALL - IN PLANE



$$\text{Diaphragm Load} = \frac{1}{2} 26 \text{ psf} (125 \text{ ft}) (40 \text{ ft}) = 6500 \text{ lb}$$

$$U_s = \frac{6500 \text{ lb}}{16.84 \text{ ft} (8.42 \times 2)} = 385 \text{ plf}$$



$$U_{\text{shear}} = 100 \text{ plf} \times 2 = 200 \text{ plf}$$

$$U_{\text{shear}} = 180 \text{ plf}$$

1 1/2"

380 plf ← This is min cap. there is more capacity w/ nail spacing.

**VERY CLOSE! ENSURE proper nail spacing & blocking**

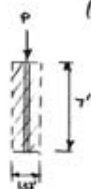
Blocked Diaphragms:

$$U_{\text{shear}} = 2 (125) = 250 \text{ plf (blocked w/ 7" spacing)}$$

$$U_{\text{shear}} = 270 \text{ plf (blocked w/ 6" spacing (Ed))}$$

> 520 plf

#### 48 - WALL STUDS - OUT OF PLANE (S-WALL STUD)



Wind = 26 psf

.56 lb

$$P = 15 \text{ psf} \times 9' (1.33') + (30+20)(1.33)(1.33) = 224.8 \text{ lb}$$

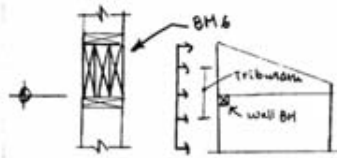
all studs!



$$P = (30+20)(1.33)(10') = 665 \text{ lb} \leftarrow \text{worst case}$$

add 136 lb

**2X6 WALL STUDS  
 @ 16" O.C.  
 SPF #1/#2  
 $F_b = 975 \text{ psi}$   
 $E = 1,400,000 \text{ psi}$**

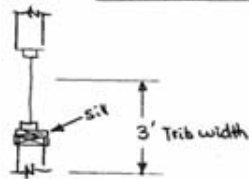
49 - MODULE SPLIT BEAM - OUT OF PLANE

$$\text{Trib width} = \frac{9}{2} + \frac{7}{2} = 8'$$

$$\text{BM length} = 13' \text{ (max bay or module)}$$

BM49: BM 6 check for weak axis wind

BM 6 OK for wind loading

50 - WINDOW SILL - OUT OF PLANE

BM length: 12.67 (same as BM3)

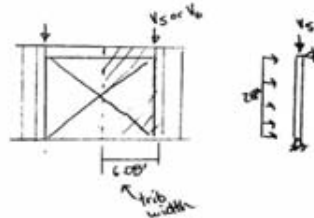
BM50: (2)ply 2x6

SPF #1/#2

$F_b = 875 \text{ psi}$

$E = 1,400,000 \text{ psi}$

BM51:  
(1) PLY 2x6  
S-wall sills

51 - WINDOW & DOOR POST - OUT OF PLANE

$$V_{max} = 3016 \text{ lb } (V_5)$$

$$M = \frac{wL^2}{8} = \frac{26 \text{ psf } (6.00)(9')^2}{8}$$

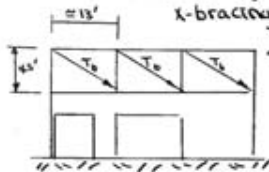
BC 51:  
(2) PLY 2x6

SPF: #1/#2

$F_b = 875 \text{ psi}$

### 60 - NORTH CLERESTORY CROSS-BRACING

\* clerestory framing is adequate structurally  
x-bracing is added to control deflection



$$H_1 = \frac{2340}{3} \text{ (H44)}$$

$$T_b = 13.8 \left( \frac{H_1}{12} \right) = \frac{13.8}{12} \times \frac{2340}{3}$$

$$T_b = 826 \text{ lb}$$

\* x-bracing in tension only!

$$L_{br} = \sqrt{4.5^2 + 13^2} = 13.8'$$

w/ 1/4" A36 SIDE PLATE: (p61 NDS m1)

$$\# \text{ 1/4 LAG BOLTS} = \frac{T_b}{Z_{\perp}} = \frac{826 \text{ lb}}{190 \text{ lb}} = 4.34 \text{ or (5)}$$

$$\# \text{ 3/8 LAG BOLTS} = \frac{826 \text{ lb}}{290 \text{ lb}} = 2.84 \text{ or (3)}$$

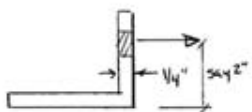
ROD SIZE:

1/2" ROD

$$A = \pi r^2 = \pi (.25)^2 = 0.19 \text{ in}^2$$

$$\phi P_n = 0.9 F_y A_g = 0.9 (36 \text{ ksi}) (0.19 \text{ in}^2) = 6.15 \text{ K} \gg 1.07 \text{ K} \text{ OK}$$

$$\frac{KL}{r} = \frac{(1)(13.8)(12)}{\frac{.25}{2}} = 662 \gg 300 \text{ pretty slender!}$$

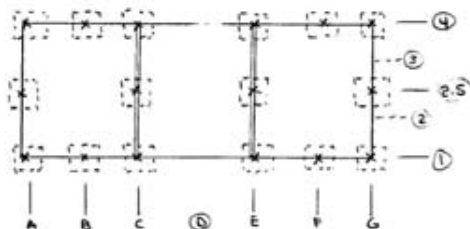


$$M = P(L) = \overbrace{1.3(826)}^{1.07 \text{ K}} (2'') = 2,148 \text{ in-lb}$$

$$S_x = \frac{1}{6} b h^2 = \frac{0.25}{6} (h^2) = 0.166 \text{ in}^3$$

$$S_{x \text{ reqd}} = \frac{2,148 \text{ in-lb}}{.6 (36,000 \text{ psi})} = 0.099 \text{ in}^3 < 0.66 \text{ in}^3 \text{ OK}$$

#	Member	Section	Species	#	Phys	BMS	length ft	V applied lb	Mappped A req'd ft-lb	Mappped A req'd in2	# studs Req'd	Beam Seat [in]
1	Roof Joists	2x10	SS	1	1	1	18.5	615	2845	1.45	1	1.5 joist hanger req'd
2	Clerestory window lintels	2x10	SS	3	3	3	11.8	2950	8703	6.94	2	3
3	Clerestory window lintels	2x12	SS	3	3	3	11.8	2950	8703	6.94	2	3
3	Clerestory window lintels	2x12	SS	3	3	3	12.67	3168	10033	7.45	2	3
3	Clerestory window lintels	1.75 x 11.25	1.9E Micro	2	2	2	12.67	3168	10033	4.22	1	1.5
3	Clerestory window lintels	1.75 x 11.25	1.9E Micro	3	3	3	12.67	3168	10033	4.22	1	1.5
4	N Elev. Downway Header	2x12	SS	3	3	3	12.67	4023	12742	9.47	2	3
4	N Elev. Downway Header	1.75 x 11.25	1.9E Micro	2	2	2	12.67	4023	12742	5.36	1	1.5
5	N Elev. Mechanical Door Header	2x12	SPF #1/W2	3	3	3	9.5	3016	7164	7.10	2	3
6	S Elev. window lintels	2x6	SPF #1/W2	3	3	3	5.5	1375	1891	3.24	1	1.5
7	S Elev. Door Header	2x8	SPF #1/W2	3	3	3	12.67	1390	4214	3.33	1	1.5
7	S Elev. Door Header	2x8	SS	3	3	3	12.67	1390	4214	3.33	1	1.5
8	Center Module Roof Beam	2x12	SS	2	2	2	13	4550	14788	6.07	1	1.5
8	Center Module Roof Beam	1.75 x 11.25	1.9E Micro	2	2	2	13	4550	14788	6.07	1	1.5
9	Shear Truss bottom Chord	1.75 x 11.25	1.9E Micro	4	4	4	17.75	5884	26111	7.85	1	1.5
9	Shear Truss bottom Chord	1.75 x 11.25	1.9E Micro	3	3	3	17.75	5290	23472	7.05	1	1.5
9	Shear Truss top/bottom Chord	2x6	SS	4	4	4	17.75	5884	26111	13.85	2	3
9	Shear Truss top/bottom Chord	2x12	SS	3	3	3	17.75	5884	26111	13.85	3	4.5
10	Lower Module Nanawall	2x8	SPF #1/W2	2	2	2	13	650	2113	1.53	1	1.5
11	Nanawall Storage	2x8	SPF #1/W2	2	2	2	2.5	105	66	0.25	1	1.5
10	Floor Joists	2x8	SPF #1/W2	1	1	1	12.67	413	1307	0.97	1	1.5 joist hangers
21	Rim Joist (grid G)	1.75 x 11.25	1.9E Micro	2	2	2	9.35	3086	7232	4.11	1	1.5 beam seat
21	Rim Joist (grid E)	1.75 x 11.25	1.9E Micro	2	2	2	6.5	1933	4601	2.62	1	1.5
21	Rim Joist (line 4 grid E-F)	1.75 x 11.25	1.9E Micro	2	2	2	6.5	1933	2578	5.75	1	1.5
21	Rim Joist (line 1 grid A-B)	1.75 x 11.25	1.9E Micro	2	2	2	7.17	3651	4081	4.87	1	1.5
21	Rim Joist (line 1 grid B-C)	1.75 x 11.25	1.9E Micro	2	2	2	7.17	9504	1639	12.67	3	4.5
21	Rim Joist (line 1 grid C-E)	1.75 x 11.25	1.9E Micro	2	2	2	12.67	2034	6441	2.71	1	1.5
49	Module Split wind beams NS	2x6	SPF #1/W2	2	2	2	13	549	1785	1.29	1	1.5
49	Module Split wind beams NS	2x6	SPF #1/W2	2	2	2	13	549	1785	1.29	1	1.5
49	Module Split wind beams EWR	2x6	SPF #1/W2	3	3	3	20	465	2275	1.07	1	1.5
50	Window Sill	2x6	SPF #1/W2	1	1	1	12.67	247	783	0.58	1	1.5
51	Window Sill	2x6	SPF #1/W2	1	1	1	5.5	307	147	0.25	1	1.5

70 - BEARING PADS

$$A1: P = V_{21G} + V_{21AB} = 3086 \text{ lb} + 3651 \text{ lb} = 6737 \text{ lb}$$

$$A_{reqd} = \frac{6737 \text{ lb}}{1500 \text{ psf}} = 4.5 \text{ SF} \rightarrow (2.11' \times 2.11')$$

$$A2.5 \pm G2.5: P = 2(V_{21G}) = 2(3086) \text{ lb} = 6172 \text{ lb}$$

$$A_{reqd} = \frac{6172}{1500} = 4.11 \rightarrow [2.03' \times 2.03']$$

G4 / A4 / G1 :

$$P = \frac{1}{2}(255)(7.12) + V_2 + V_5 + V_{21G}$$

$$= 908 + 2950 + 3016 + 3086 = 9960 \text{ lb}$$

$$A_{reqd} = \frac{9960}{1500} = 6.64 \text{ SF} \rightarrow [2.6' \times 2.6']$$

B1 / B4 / F1 / F4 :

$$P = \frac{1}{2}(255)(6.33) + V_5 \begin{matrix} \nearrow 3016 \\ \nwarrow 3016 \end{matrix} = 3823 \text{ lb}$$

$$A_{reqd} = \frac{3823}{1500} = 2.55 \text{ SF} \rightarrow [1.6' \times 1.6']$$

E4 / C4 / C1 / E1 :

$$P = V_{24DEF} + V_{21E} + V_{21CE}$$

$$= 19,332 + 1968 + 2034 = 23,334 \text{ lb}$$

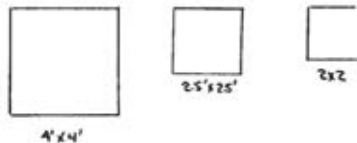
$$A_{reqd} = \frac{23,334}{1500} = 15.6 \text{ SF} \rightarrow [3.9' \times 3.9']$$

C2.5 / E2.5 :

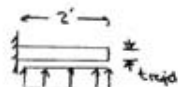
$$P = 2V_{21E} = 2(1968) = 3936 \text{ lb}$$

$$A_{reqd} = \frac{3936}{1500} = 2.6 \text{ SF} \rightarrow [1.6' \times 1.6']$$



71 - DESIGN BEARING PADS4x4 PADS

Worst case: all will be applied w/ 1500psf



$$M = \frac{WL^2}{2} = \frac{1500 \text{ psf} (4\text{ft}) (2')^2}{2} = 12,000 \text{ ft}\cdot\text{lb}$$

$$S_x = \frac{1}{6} b h^2 = \frac{1}{6} (40") (3.5")^2 = 98 \text{ in}^3$$

$$S_{x \text{ reqd}} = \frac{12,000 \text{ ft}\cdot\text{lb} (12 \text{ in/ft})}{875 \text{ psi}} = 165 \text{ in}^3$$

$$\# \text{ Sections reqd} = \frac{165}{98} = 1.68 \text{ or } (2) \text{ layers}$$

2x2 PADS:

$$M = \frac{1500 (2') (1')^2}{2} = 1500 \text{ ft}\cdot\text{lb}$$

$$S_x = \frac{1}{6} (24) (3.5")^2 = 49 \text{ in}^3$$

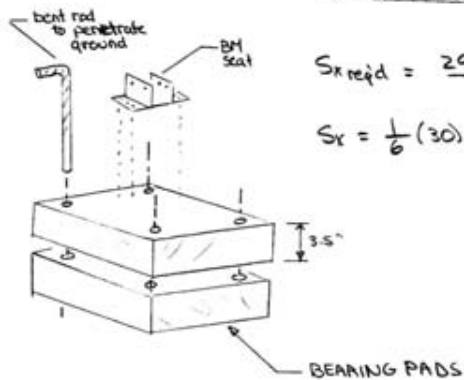
$$S_{x \text{ reqd}} = \frac{1500 (12)}{875} = 20.5 < 49 \text{ OK use } (1) \text{ layer}$$

2.5 X 2.5 PADS:

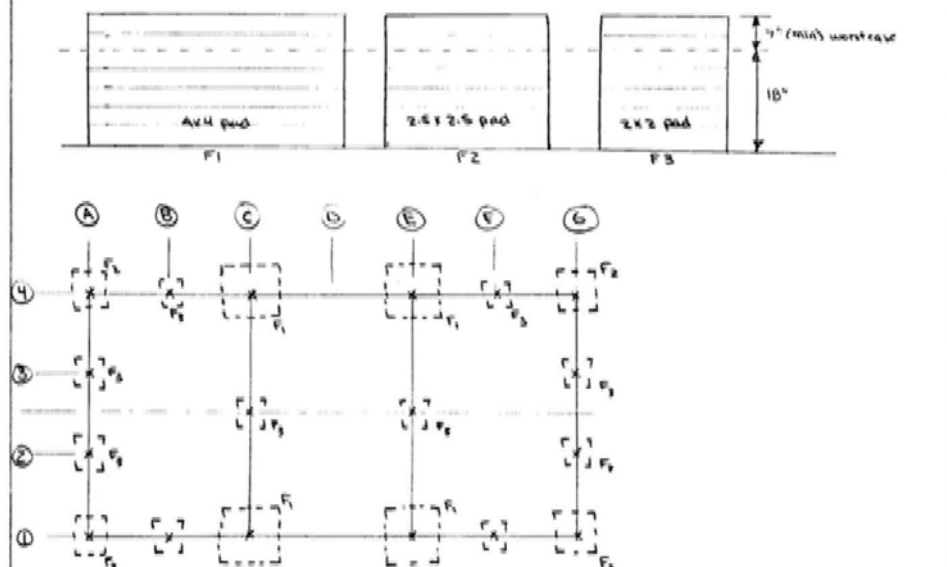
$$M = \frac{1500 (2.5') (1.25')^2}{2} = 2929.68$$

$$S_{x \text{ reqd}} = \frac{2929.68 (12)}{875} = 40.2 \text{ in}^3$$

$$S_x = \frac{1}{6} (30) (3.5")^2 = 61.25 > 40.2 \text{ OK use } (1) \text{ layer}$$



## 72 - CHECK BRG PAD STABILITY



## Wind SHEAR Grid line "A"

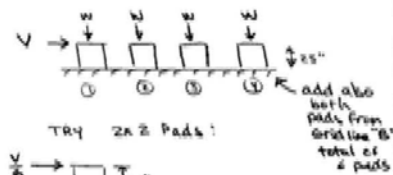
$$V = 26 \text{ psf} \left( \frac{13.3}{2} \right) \times 16' = 2773.6$$

weight on wall 31

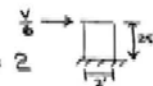
Assume  $W = \text{dead load} = \frac{46K}{6} = 7.67K$   
 $\rightarrow W \times \frac{7.67K}{4} = 1,920.16$

$$FS_{\text{overturning}} = \frac{W \left( \frac{24}{2} \right)}{\frac{V}{6} (25)} = \frac{1920 (12)}{\frac{2773}{6} (25)} = 2$$

$$FS_{\text{overturning}} = \frac{1920 \left( \frac{30}{2} \right)}{\frac{2773}{2} (25)} = 2.5$$



TRY 2x2 Pads:

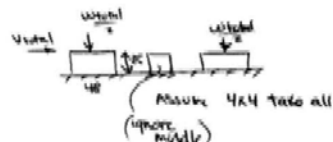


add also both pads from Grid line "B" total of 2 pads

## Wind shear Grid line "C"

Assume  $W_{\text{total}} = \frac{46K}{8} = 5.75K$   
 $V_{\text{total}} = 5546$

$$FS_{\text{overturning}} = \frac{15330 (24)}{\frac{5546}{2} (25)} = 2.7$$



Assume 4x4 take all (ignore middle)

BRG PADS OK

\* if solar D wind is used  
FS would increase by 1.6!

## Solar Decathlon: Structural Calcs - Deck

Uniformly Distributed Loads:

Uniformly Distributed Loads:																													
#	Member	Section	b	d	s	#	Phys	BMS	Length	Loads & Loading				Section Properties				BENDING CAPACITY						DEFLECTION					
										W <sub>dead</sub> pcf	W <sub>live</sub> pcf	W <sub>total</sub> pcf	trib width ft	V <sub>max</sub> -lb	M <sub>max</sub> -ft-kb	S <sub>x</sub> in <sup>3</sup>	I <sub>x</sub> in <sup>4</sup>	S <sub>x</sub> in <sup>3</sup>	C <sub>x</sub>	C <sub>y</sub>	C <sub>z</sub>	C <sub>z</sub>	F <sub>b</sub> psi	F <sub>v</sub> psi	loading dead	live	total	Δ <sub>max</sub> in	Δ <sub>max</sub> in
$W_{\text{Applied}} = \frac{W_{\text{Dead}} + W_{\text{Live}} + W_{\text{Wind}} + W_{\text{Seismic}}}{B}$																													
$S_x = \frac{M_{\text{Applied}} \times 12 \text{ in/ft}}{F_b}$																													
$F_b = F_b \times C_p \times C_d \times C_e \times C_g \times C_H$																													
100	Deck Joists	2x6	1.5	7.25	7.25	1	1		11	50	10	1.31	439	1207		13.14	1182 S9F #1,82		875	1	0.99	1.2	1.15	1195	ok	0.39	0.13		
110	Deck Joists - edge	2x6	1.5	7.25	7.25	2	1		9	50	10	1.5	945	2136		13.14	971 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.13	0.13		
111	Ramp deck Joists	2x6	1.5	7.25	7.25	3	1		6	50	10	1.0	1800	2700		13.14	822 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.09	0.07		
112	Ramp/Landing Joists	2x6	1.5	7.25	7.25	2	1		5	50	10	1.0	1200	1800		13.14	685 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.05	0.04		
112b	Ramp/Landing Joists	2x6	1.5	7.25	7.25	2	1		5	50	10	1.1	1650	2063		13.14	942 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.07	0.06		
113	Ramp/Landing Joists	2x6	1.5	7.25	7.25	1	1		5	50	10	1.0	4	600	750		13.14	685 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.05	0.04	
114	Ramp Joists	2x6	1.5	7.25	7.25	2	1		6	50	10	1.0	5	900	1350		13.14	625 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.07	0.05	
115	Landing Joists	2x6	1.5	7.25	7.25	2	1		8	50	10	1.0	4.5	1080	2160		13.14	986 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.19	0.16	
116	Landing Joists	2x6	1.5	7.25	7.25	1	1		10	50	10	1.5	450	1125		13.14	2027 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.30	0.25		
117	deck rim Joists	2x6	1.5	7.25	7.25	2	1		9	50	10	1.5	945	2136		13.14	971 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.13	0.13		
117b	deck rim Joists	2x6	1.5	7.25	7.25	2	1		7	50	10	1.0	4	840	1470		13.14	671 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.10	0.08	
118	deck rim Joists	2x6	1.5	7.25	7.25	3	1		5	50	10	1.0	1500	1875		13.14	571 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.04	0.04		
118b	deck rim Joists	2x6	1.5	7.25	7.25	1	1		5	50	10	1.5	750	938		13.14	856 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.06	0.05		
119	deck rim Joists	2x6	1.5	7.25	7.25	1	1		7	50	10	1.0	3	630	1103		13.14	2007 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.15	0.12	
120	deck rim Joists	2x6	1.5	7.25	7.25	4	1		8	50	10	1.0	9	2160	4320		13.14	986 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.19	0.16	
121	deck rim Joists	2x6	1.5	7.25	7.25	2	1		8	50	10	1.0	4.5	1080	2160		13.14	986 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.19	0.16	
122	deck rim Joists	2x6	1.5	7.25	7.25	2	1		7	50	10	1.5	1155	2011		13.14	923 S9F #1,82		875	1	0.99	1.2	1	1040	ok	0.13	0.11		

Deck P.2

[illegible]

2.1

Uniformly Distributed Loads:

S<sub>1</sub>S<sub>2</sub>S<sub>3</sub>S<sub>4</sub>S<sub>5</sub>S<sub>6</sub>S<sub>7</sub>S<sub>8</sub>S<sub>9</sub>S<sub>10</sub>S<sub>11</sub>S<sub>12</sub>S<sub>13</sub>S<sub>14</sub>S<sub>15</sub>S<sub>16</sub>S<sub>17</sub>S<sub>18</sub>S<sub>19</sub>S<sub>20</sub>S<sub>21</sub>S<sub>22</sub>S<sub>23</sub>S<sub>24</sub>S<sub>25</sub>S<sub>26</sub>S<sub>27</sub>S<sub>28</sub>S<sub>29</sub>S<sub>30</sub>S<sub>31</sub>S<sub>32</sub>S<sub>33</sub>S<sub>34</sub>S<sub>35</sub>S<sub>36</sub>S<sub>37</sub>S<sub>38</sub>S<sub>39</sub>S<sub>40</sub>S<sub>41</sub>S<sub>42</sub>S<sub>43</sub>S<sub>44</sub>S<sub>45</sub>S<sub>46</sub>S<sub>47</sub>S<sub>48</sub>S<sub>49</sub>S<sub>50</sub>S<sub>51</sub>S<sub>52</sub>S<sub>53</sub>S<sub>54</sub>S<sub>55</sub>S<sub>56</sub>S<sub>57</sub>S<sub>58</sub>S<sub>59</sub>S<sub>60</sub>S<sub>61</sub>S<sub>62</sub>S<sub>63</sub>S<sub>64</sub>S<sub>65</sub>S<sub>66</sub>S<sub>67</sub>S<sub>68</sub>S<sub>69</sub>S<sub>70</sub>S<sub>71</sub>S<sub>72</sub>S<sub>73</sub>S<sub>74</sub>S<sub>75</sub>S<sub>76</sub>S<sub>77</sub>S<sub>78</sub>S<sub>79</sub>S<sub>80</sub>S<sub>81</sub>S<sub>82</sub>S<sub>83</sub>S<sub>84</sub>S<sub>85</sub>S<sub>86</sub>S<sub>87</sub>S<sub>88</sub>S<sub>89</sub>S<sub>90</sub>S<sub>91</sub>S<sub>92</sub>S<sub>93</sub>S<sub>94</sub>S<sub>95</sub>S<sub>96</sub>S<sub>97</sub>S<sub>98</sub>S<sub>99</sub>S<sub>100</sub>S<sub>101</sub>S<sub>102</sub>S<sub>103</sub>S<sub>104</sub>S<sub>105</sub>S<sub>106</sub>S<sub>107</sub>S<sub>108</sub>S<sub>109</sub>S<sub>110</sub>S<sub>111</sub>S<sub>112</sub>S<sub>113</sub>S<sub>114</sub>S<sub>115</sub>S<sub>116</sub>S<sub>117</sub>S<sub>118</sub>S<sub>119</sub>S<sub>120</sub>S<sub>121</sub>S<sub>122</sub>S<sub>123</sub>S<sub>124</sub>S<sub>125</sub>S<sub>126</sub>S<sub>127</sub>S<sub>128</sub>S<sub>129</sub>S<sub>130</sub>S<sub>131</sub>S<sub>132</sub>S<sub>133</sub>S<sub>134</sub>S<sub>135</sub>S<sub>136</sub>S<sub>137</sub>S<sub>138</sub>S<sub>139</sub>S<sub>140</sub>S<sub>141</sub>S<sub>142</sub>S<sub>143</sub>S<sub>144</sub>S<sub>145</sub>S<sub>146</sub>S<sub>147</sub>S<sub>148</sub>S<sub>149</sub>S<sub>150</sub>S<sub>151</sub>S<sub>152</sub>S<sub>153</sub>S<sub>154</sub>S<sub>155</sub>S<sub>156</sub>S<sub>157</sub>S<sub>158</sub>S<sub>159</sub>S<sub>160</sub>S<sub>161</sub>S<sub>162</sub>S<sub>163</sub>S<sub>164</sub>S<sub>165</sub>S<sub>166</sub>S<sub>167</sub>S<sub>168</sub>S<sub>169</sub>S<sub>170</sub>S<sub>171</sub>S<sub>172</sub>S<sub>173</sub>S<sub>174</sub>S<sub>175</sub>S<sub>176</sub>S<sub>177</sub>S<sub>178</sub>S<sub>179</sub>S<sub>180</sub>S<sub>181</sub>S<sub>182</sub>S<sub>183</sub>S<sub>184</sub>S<sub>185</sub>S<sub>186</sub>S<sub>187</sub>S<sub>188</sub>S<sub>189</sub>S<sub>190</sub>S<sub>191</sub>S<sub>192</sub>S<sub>193</sub>S<sub>194</sub>S<sub>195</sub>S<sub>196</sub>S<sub>197</sub>S<sub>198</sub>S<sub>199</sub>S<sub>200</sub>S<sub>201</sub>S<sub>202</sub>S<sub>203</sub>S<sub>204</sub>S<sub>205</sub>S<sub>206</sub>S<sub>207</sub>S<sub>208</sub>S<sub>209</sub>S<sub>210</sub>S<sub>211</sub>S<sub>212</sub>S<sub>213</sub>S<sub>214</sub>S<sub>215</sub>S<sub>216</sub>S<sub>217</sub>S<sub>218</sub>S<sub>219</sub>S<sub>220</sub>S<sub>221</sub>S<sub>222</sub>S<sub>223</sub>S<sub>224</sub>S<sub>225</sub>S<sub>226</sub>S<sub>227</sub>S<sub>228</sub>S<sub>229</sub>S<sub>230</sub>S<sub>231</sub>S<sub>232</sub>S<sub>233</sub>S<sub>234</sub>S<sub>235</sub>S<sub>236</sub>S<sub>237</sub>S<sub>238</sub>S<sub>239</sub>S<sub>240</sub>S<sub>241</sub>S<sub>242</sub>S<sub>243</sub>S<sub>244</sub>S<sub>245</sub>S<sub>246</sub>S<sub>247</sub>S<sub>248</sub>S<sub>249</sub>S<sub>250</sub>S<sub>251</sub>S<sub>252</sub>S<sub>253</sub>S<sub>254</sub>S<sub>255</sub>S<sub>256</sub>S<sub>257</sub>S<sub>258</sub>S<sub>259</sub>S<sub>260</sub>S<sub>261</sub>S<sub>262</sub>S<sub>263</sub>S<sub>264</sub>S<sub>265</sub>S<sub>266</sub>S<sub>267</sub>S<sub>268</sub>S<sub>269</sub>S<sub>270</sub>S<sub>271</sub>S<sub>272</sub>S<sub>273</sub>S<sub>274</sub>S<sub>275</sub>S<sub>276</sub>S<sub>277</sub>S<sub>278</sub>S<sub>279</sub>S<sub>280</sub>S<sub>281</sub>S<sub>282</sub>S<sub>283</sub>S<sub>284</sub>S<sub>285</sub>S<sub>286</sub>S<sub>287</sub>S<sub>288</sub>S<sub>289</sub>S<sub>290</sub>S<sub>291</sub>S<sub>292</sub>S<sub>293</sub>S<sub>294</sub>S<sub>295</sub>S<sub>296</sub>S<sub>297</sub>S<sub>298</sub>S<sub>299</sub>S<sub>300</sub>S<sub>301</sub>





Beam Columns P.2

$$\frac{F_c}{F_c'} + \frac{M_u}{F_c' \Delta L} \leq 1$$

$$F_c' = F_c \left( 1 - \frac{F_c}{F_c'} \right)$$

$$F_c' = F_c \left( 1 - \frac{F_c}{F_c'} \right)$$

$$F_c' = F_c \left( 1 - \frac{F_c}{F_c'} \right)$$

$$F_c' = F_c \left( 1 - \frac{F_c}{F_c'} \right)$$

Loads & Loading				Section Properties			BENDING CAPACITY										Axial				Compression										INTERACTION	
W steel	W10 width	P number	M <sub>nom</sub>	S <sub>x</sub>	I <sub>x</sub>	Species	F <sub>y</sub>	C <sub>x</sub>	C <sub>y</sub>	C <sub>z</sub>	E	A	I <sub>x</sub>	I <sub>y</sub>	I <sub>xy</sub>	F <sub>c</sub>	F <sub>t</sub>	C <sub>x</sub>	C <sub>y</sub>	C <sub>z</sub>	P <sub>n</sub>	P <sub>c</sub>	P <sub>t</sub>	P <sub>c</sub>	P <sub>t</sub>	P <sub>c</sub>	P <sub>t</sub>	P <sub>c</sub>	P <sub>t</sub>	Interaction		
20	9	14000	1300	7.56	2285	SF4 #1/2	3600	1.1	1.1	1	1400000	33	450000	33	36370	34810	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.72 ok	
13	12	12000	1500	7.56	627	SF4 #1/2	3600	1.1	1.1	1	1400000	33	36370	33	36370	29640	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.72 ok	
13	6.7	26025	510	7.56	282	SF4 #1/2	3600	1.1	1.1	1	1400000	24.75	46747	24.75	46747	15270	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.56 ok	
26	-	7558	2635	7.56	2644	SF4 #1/2	3600	1.1	1.1	1	1400000	33	22983	33	22983	9820	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.68 ok	
26	-	26025	2635	7.56	2644	SF4 #1/2	3600	1.1	1.1	1	1400000	33	48561	33	48561	9820	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.88 ok	
26	1.13	4051	350	7.56	556	SF4 #1/2	3600	1.1	1.1	1	1400000	8.25	9729	8.25	9729	29640	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.35 ok	
26	6.08	30716	1602	7.56	1279	SF4 #1/2	3600	1.1	1.1	1	1400000	26.5	18279	26.5	18279	29640	3600	3600	3600	3600	3600	1400000	3600	3600	3600	3600	3600	3600	3600	3600	0.91 ok	

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## SECTION 01 10 00

## SUMMARY

**PART 1 GENERAL****1.1 SUMMARY**

- A. Project Identification: Interlock House (Ames , IA).
- B. Project Summary: The Interlock House is a small 800 SF residential dwelling unit to be built in Ames, Iowa for transport to the National Mall in Washington D.C. for competition in the 2009 Solar Decathlon.
- C. Particular Project Requirements:
  - 1. Existing site conditions and restrictions:
    - a. Temporary site on the National Mall, Washington D.C.
  - 2. Requirements for transportation and completion date
    - a. House must be safely be disassembled and transported between sites.
    - b. House must be completed by 07 October, 2009.
- 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.
- K. 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.
- L. 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.
- M. 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 PRODUCTS - Not Applicable To This Section**

**PART 3 EXECUTION - Not Applicable To This Section**

END OF SECTION

## SECTION 01 30 00

## ADMINISTRATIVE REQUIREMENTS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Administration of Contract: Provide administrative requirements for the proper coordination and completion of work including the following:
  - 1. Supervisory personnel.
  - 2. Preconstruction conference.
  - 3. Project meetings, minimum of two per month; prepare and distribute minutes.
- B. Reports: Submit daily and special reports.
- C. Work Schedule: Submit progress schedule, updated monthly.
- D. Submittal Schedule: Prepare submittal schedule; coordinate with progress schedule.
- E. Schedule of Values: Submit schedule of values.
- F. Schedule of Tests: Submit schedule of required tests including payment and responsibility.
- G. Perform Surveys: Lay out the work and verifying locations during construction. Perform final site survey.
- H. Emergency Contacts: Submit and post a list of emergency telephone numbers and address for individuals to be contacted in case of emergency.
- I. Record Documents: Submit record drawings and specifications; to be maintained and annotated by Contractor as work progresses.

**1.2 SUBMITTALS**

- A. Types of Submittals: Provide types of submittals listed in individual sections and number of copies required below.
  - 1. Shop drawings, reviewed and annotated by the Contractor - 4 copies.
  - 2. Product data - 4 copies.
  - 3. Samples - 2, plus extra samples as required to indicate range of color, finish, and texture to be expected.
  - 4. Inspection and test reports - 4 copies.
  - 5. Warranties - 4 copies.
  - 6. Survey data - 4 copies.
  - 7. Closeout submittals - 4 copies.

8. Project photographs - 12 digital images each month submitted on CD. Submit cumulative CD at each subsequent submittal. Label each image with date.
- B. Submittal Procedures: Comply with project format for submittals. Comply with submittal procedures established by Architect including Architect's submittal and shop drawing stamp. Provide required resubmittals if original submittals are not approved. Provide distribution of approved copies including modifications after submittals have been approved.
- C. Samples and Shop Drawings: Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note special coordination required. Note any deviations from requirements of the Contract Documents.
- D. Warranties: Provide warranties as specified; warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Contractor, supplier or installer responsible for performance of warranty shall sign warranties.

**PART 2 PRODUCTS - Not Applicable To This Section**

**PART 3 EXECUTION - Not Applicable To This Section**

END OF SECTION

## SECTION 01 40 00

## QUALITY REQUIREMENTS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Quality Monitoring: Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality. Perform quality control procedures and inspections during installation.
- B. Standards: Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Tolerances: Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate. Comply with manufacturers' tolerances.
- D. Reference Standards: For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- E. Manufacturer's Field Services: When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to perform the following as applicable, and to initiate instructions when necessary.
  - 1. Observe site conditions.
  - 2. Conditions of surfaces and installation.
  - 3. Quality of workmanship.
  - 4. Start-up of equipment.
  - 5. Test, adjust and balance of equipment.
- F. Mock-Ups: Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes. Accepted mock-ups shall be a comparison standard for the remaining Work.
- G. Removal of Mock-Ups: Where mock-up has been accepted by Architect and no longer needed, remove mock-up and clear area when directed to do so.

**PART 2 PRODUCTS - Not Applicable To This Section****PART 3 EXECUTION - Not Applicable To This Section**

END OF SECTION

## SECTION 01 51 36

## TEMPORARY WATER STORAGE

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide sanitary water storage, waste water storage and storm water collection

**1.2 RELATED SECTIONS**

- A. Section 01 53 16 – Temporary Wood Decking

**1.3 REFERENCES**

- A. ASTM—American Society for Testing and Materials [www.astm.org](http://www.astm.org)

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 SANITARY WATER TANK, WASTE WATER TANK**

- A. General: Exterior tank to store and collect waste water for competition
- B. Manufacturer: ProTank
- C. Product: Shall contain the following requirements:
  - 1. Polyethylene Tank

- 2. Maximum dimensions 48"H x 48"W x 216"L
  - 3. Minimum of 800 gallon tank
- D. Acceptable Manufacturers: An attempt to use a local manufacturer. Submit shop drawings and specifications for architect for approval.
  - E. Substitutions: Products of equal or greater quality will be considered.
  - F. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## **2.2 STORM WATER COLLECTION TANK**

- A. General: Tank for storing rain water for reuse
- B. Manufacturer: ATL
- C. Product: Shall contain the following requirements:
  - 1. 18" maximum clearance
  - 2. 200 gallon minimum
- D. Acceptable Manufacturers: An attempt to use a local manufacturer. Submit shop drawings and specifications for architect for approval.
- E. Substitutions: Products of equal or greater quality will be considered.
- F. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Installation of wood surface for tank to bear on.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Coordinate with work of other sections; provide inset and templates as needed. Install work plumb and level with uniform appearance.

### **1.1 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

**SECTION 01 53 16****TEMPORARY WOOD DECKING****PART 1 GENERAL****1.1 SUMMARY**

- A. Temporary deck structure for use on the Mall in Washington D.C.

**1.2 RELATED SECTIONS**

- A. Section 01 51 36 – Temporary Water Storage
- B. Section 05 52 00 – Metal Railings
- C. Section 06 20 13 – Exterior Finish Carpentry
- D. Section 06 11 13 - Engineered Wood Products

**1.3 REFERENCES**

- A. ASTM – D07.02.01 Solid Sawn Timber
- B. ASTM – D07.01.04 Methods and Evaluation of Duration of Load and Creep Effects

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 DECKING**



- A. General: Temporary structure for Mall in Washington D.C.
- B. Manufacturer: Acceptable Manufacturers as approved by architect.
- C. Product: Shall contain the following requirements:
  - 1. Typical dimensional lumber as specified in drawings
  - 2. Treated lumber or Cedar
  - 3. Use of local wood
  - 4. Submit shop drawings and specifications for wood to be used

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Installation of wood surface for tank to bear on.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Coordinate with work of other sections; provide inset and templates as needed. Install work plumb and level with uniform appearance.

#### **1.1 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 01 60 00

## PRODUCT REQUIREMENTS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Manufactures: Provide products from one manufacturer for each type or kind as applicable. Provide secondary materials as acceptable to manufacturers of primary materials.
- B. Product Selection: Provide products selected or equal approved by Architect. Products submitted for substitution shall be submitted with complete documentation, and include construction costs of substitution including related work.
- C. Substitutions: Request for substitution must be in writing. Conditions for substitution include:
  - 1. An 'or equal' phrase in the specifications.
  - 2. Specified material cannot be coordinated with other work.
  - 3. Specified material is not acceptable to authorities having jurisdiction.
  - 4. Substantial advantage is offered to the Owner in terms of cost, time, or other valuable consideration.
- D. Substitution Requests: Substitutions shall be submitted prior to award of contract, unless otherwise acceptable. Approval of shop drawings, product data, or samples containing substitutions is not an approval of a substitution unless an item is clearly presented as a substitution at the time of submittal.

**PART 2 PRODUCTS** - Not Applicable To This Section

**PART 3 EXECUTION** - Not Applicable To This Section

END OF SECTION

## SECTION 05 12 00

## STRUCTURAL STEEL FRAMING

**PART 1 GENERAL****1.1 SUMMARY**

- A. Structural steel framing for module connections and cross-bracing applications with hardware.

**1.2 RELATED SECTIONS**

- A. Section 06 11 00 - Rough Carpentry
- B. Section 06 11 13 - Engineered Wood Products.
- C. Section 06 16 00 - Sheathing

**1.3 REFERENCES**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Standards: AISC, Code of Standard Practice for Steel Buildings and Bridges, and applicable regulations.
- C. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, and installation tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
- D. Testing: Independent testing laboratory.
- E. Erection Tolerances: AISC standards.

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings for structural steel shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 Structural Steel**

- A. Structural steel for module connection and rigging.
- B. Manufacturer: Use locally available steel. Submit shop drawings and specifications for steel to be used to architect for approval.
- C. Product:
  - 1. Application: Module connection and rigging.
    - a. Refer to drawings for steel size, shape and dimensions.
    - b. Structural Steel Shapes: ASTM A 572.
  - 2. Application: Threaded rigging rod and plates.
    - a. Refer to drawings for steel sizes, shapes, and dimensions
    - b. Structural Steel Shapes and Rods: ASTM A 572.
  - 3. Application: High-Strength Threaded Fasteners: ASTM A 325 or ASTM A 490, as applicable.
  - 4. Auxiliary Materials:
    - a. Electrodes for Welding: AWS Code.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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. Comply with AISC codes and specifications, and with AWS "Structural Welding Code".
- B. Architecturally exposed steel: Fabricate with special care using materials carefully selected for best appearance. Store materials off ground and keep clean. Cut, fit and assemble work with surfaces smooth, square and with complete contact at joints. Set all cambers up. Weld all work continuously unless noted otherwise; grind smooth and flush to make seams not visible after priming. Prepare surfaces to comply with SSPC-SP6; apply prime coat within 24 hours after cleaning.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 05 14 00

## METAL ENDWALL FABRICATIONS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide metal fabrications using aluminum angle and aluminum flat for prefabricated endwall structure on south side of building.

**1.2 RELATED SECTIONS**

- A. NA

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings where necessary indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- D. Selection Samples: NA
- E. Verification Samples: NA

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Metal Fabrications:
  - 1. Aluminum Materials:
    - a. Extruded Bars and Shapes: ASTM B 221 aluminum alloy.
    - b. Fasteners: ASTM A 153.
    - c. Finish: Clear anodized.
  - 2. Fasteners:
    - a. Lag Bolts: Square head, FS FF-B-561.
    - b. Machine Screws: Cadmium plated steel, FS FF-S-92.
    - c. Zinc-Coating: Fasteners in exterior assemblies or exterior walls.
  - 3. Connections:
    - a. All joints to be continuous welds ground flush.

## **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. Install formed metal materials plumb, square, and rigidly coupled and adequately anchored, maintaining uniformed clearances and accurate alignment.
- C. Restore damaged finishes that require field cutting, welding, or grinding.
- D. Take field measurements prior to preparation of shop drawings and fabrication. Do not delay job; allow for cutting and fitting if field measurement not practical.
- E. Allow for repeated installation and removal of endwalls by using a slightly greater than normal construction tolerance.

### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

**SECTION 05 52 00****METAL RAILINGS****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide handrails and railing systems.

**1.2 RELATED SECTIONS**

- A. Section 01 53 16 – Temporary Decking

**1.3 REFERENCES**

- A. ASTM—American Society for Testing and Materials [www.astm.org](http://www.astm.org)

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Take field measurements prior to fabrication, where possible. Form to required shaped and sizes with true, straight edges, lines and angles. Provided light-tight, hairline joints.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: An attempt to use a local manufacturer. Submit shop



drawings and specifications for architect for approval.

- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## **2.2 MATERIALS**

### **A. Railing Systems**

- 1. Steel, Galvanized Finish: ASTM A 53.
- 2. Steel: ASTM A 500 or A 501.
- 3. Steel Plates, Shapes and Bars: ASTM A 36.
- 4. Gray Iron Castings: ASTM A 48, Class 30.
- 5. Malleable Iron Castings: ASTM A 47, Grade 32510

### **B. Steel Finish: Galvanized and shop primed.**

### **C. Auxiliary Materials**

- 1. Nonshrink Nonmetallic Grout: CE CRD-C621.
- 2. Interior Anchoring Cement: Hydraulic expansion cement.
- 3. Exterior/Interior Anchoring Cement: Erosion-resistant hydraulic expansion cement.
- 4. Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79, compatible with topcoats.
- 5. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
- 6. Galvanizing Repair Paint: SSPC - Paint 20.
- 7. Bituminous Paint: Asphalt mastic, SSPC - Paint 12.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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 and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Coordinate with work of other sections; provide inset and templates as needed. Install work plumb and level with uniform appearance.

### **1.1 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 05 75 00

## DECORATIVE FORMED METAL

**PART 1 GENERAL****1.1 SUMMARY**

- A. Textured metal fabrications for the following applications:
  - 1. Exterior Cladding.

**1.2 RELATED SECTIONS**

- A. Section 07 46 00 - Siding.
- B. Section 07 46 43 - Composite Siding.
- C. Section 07 91 16 - Joint Gaskets

**1.3 REFERENCES**

- A. American Society for Testing and Materials (ASTM): ASTM A 240 -Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- B. American Society for Testing and Materials (ASTM): ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM Metal Finishes Manual for Architectural and Metal Finishes.

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods.
  - 5. Maintenance methods.
  - 6. Cleaning methods.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.
- D. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.

- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

## **1.5 QUALITY ASSURANCE**

- A. Mock-Up: Provide a mock-up for evaluation of application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship and materials 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 accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Acceptable Manufacturer:  
Fry Reglet Corporation  
1377 Stonefield Ct  
Alpharetta, GA 30004  
(770) 521-9660  
Web: [www.fryreglet.com](http://www.fryreglet.com)
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. APPLICATIONS
- E. Aluminum: Provide embossed materials without blemishes, including seam and roller marks. Provide manufacturer's recommended alloy, strength, and thickness for application and finish indicated. Protect finish from damage during shipping, handling, storage, and installation with strippable film.
  - 1. Alloy: 3003 H14.
  - 2. Alloy: 5005 H34 (for anodized aluminum products).

3. Finish: Clear anodic.
  4. Finish: Mill finish.
  5. Thickness: As required by application.
- F. Fry Reglet Architectural Metal Patterns: Fabricate metal shapes in manufacturer's standard pattern as scheduled.
1. Pattern Name: PCS-150-150.
  2. Pattern Name: DMCT-375.
  3. Pattern Name: PCS-75-100
  4. Pattern Name: DMOS-150
  5. Pattern Name: FDM-625-150

### **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. Install formed metal materials plumb, square, and rigidly coupled and adequately anchored, maintaining uniformed clearances and accurate alignment.
- C. Restore damaged finishes that require field cutting, welding, or grinding.

#### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

SECTION 06 11 00  
ROUGH CARPENTRY

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Structural framing materials including but not limited to:
  - 1. Stud Walls, Rafters, Floor Joists, Furring, Blocking, Headers, Bearing Pads, and Framing Anchors and Fasteners

**1.2 RELATED SECTIONS**

- A. Section 06 11 13 - Engineered Wood Products.
- B. Section 06 16 00 - Sheathing
- C. Section 06 20 13 - Exterior Finish Carpentry
- D. Section 07 21 19.05 - Biobased Spray Foam Insulation

**1.3 REFERENCES**

- A. AITC- American Institute of Timber Construction [www.aitc-glulam.org](http://www.aitc-glulam.org)
- B. ALSC- American Lumber Standards Committee [www.alsc.org](http://www.alsc.org)
- C. ANSI- American National Standards Institute [www.ansi.org](http://www.ansi.org)
- D. AWP- American Wood Preserver's Association [www.awpa.com](http://www.awpa.com)

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

## 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Dimensional Lumber, Acceptable Manufacturers: An attempt to use locally available wood is desired. Submit shop drawings and specifications for wood to be used to architect for approval.
- B. Framing Anchors and Fasteners, Acceptable Manufacturers: Simpson Strong-Tie or equivalent.

[www.strongtie.com/products/Category\\_list.html?source=topnav](http://www.strongtie.com/products/Category_list.html?source=topnav)

### 2.2 MATERIALS

- A. Dimensional Lumber
  - 1. Application: Framing, Jack Studs, King Studs
    - a. Species/Grade: SPF #1 or #2
  - 2. Application: Rooftop equipment bases and support curbs.
    - a. Species/Grade: SPF #1 or #2
  - 3. Application: Wood grounds, nailers, and blocking.
    - a. Species/Grade: SPF #1 or #2
  - 4. Application: Wood furring.
    - a. Species/Grade: SPF #1 or #2
  - 5. Application: Rafters
    - a. Species/Grade: SPF Structural Select
  - 6. Application: Headers and Beams
    - a. Species/Grade: SPF Structural Select
  - 7. Application: Bearing Pads
    - a. Species/Grade: SPF #1 or #2
- B. Framing Anchors and Fasteners
  - 1. Application: Joist hangers, gusset plates, strip ties and column and beam ties.

- a. Refer to Structural Drawings for fastener shear and beam seat requirements.
2. Application: Hurricane Clips
3. Application: Moment Resistant Column Caps and Bases

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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. Construct and assemble rough carpentry elements plumb, square, and rigidly coupled and adequately anchored, maintaining uniformed clearances and accurate alignment.
- C. Securely attach all rough carpentry to substrate as required by code and as illustrated in drawings.
- D. Provide nailers, blocking and grounds where required.
- E. Restore damaged components. Protect work from damage.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION



## SECTION 06 11 13

### ENGINEERED WOOD PRODUCTS

#### **PART 1 GENERAL**

##### 1.1 SUMMARY

- A. Engineered wood products including:
  - 1. Rim joists, beams and headers with associated anchors and fasteners

##### 1.2 RELATED SECTIONS

- A. Section 06 11 13 - Engineered Wood Products.
- B. Section 06 16 00 - Sheathing
- C. Section 06 20 13 - Exterior Finish Carpentry
- D. Section 06 11 00 - Rough Carpentry

##### 1.3 REFERENCES

- A. APA- Engineered Wood Association [www.apawood.org](http://www.apawood.org)

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

##### 1.5 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

#### **PART 2 PRODUCTS**

##### 2.1 LAMINATED VENEER LUMBER

- A. General: Rim joists, beams and headers.
- B. Manufacturer: iLevel by Weyerhouser or equivalent.  
Product Spec Sheets and Load Tables: <http://ilevel.com/literature/tj-9000.pdf>
  - 1. Application: Rim Joists (See structural drawings and schedules S-601 and S-602 for individual beam sizes and spans).
    - a. Grade: 1.9E
  - 2. Application: Headers and Beams (See structural drawings and schedules

S-601 and S-602 for individual beam sizes and spans).

- a. Grade: 1.9E

## 2.2 FRAMING ANCHORS AND FASTENERS

- A. General: All associated anchors and fasteners for use in assembly of engineered wood products.
  - 1. Substitutions: Products of equal or greater quality will be considered. All substitutions must meet all loading requirements as specified in beam schedules and may not be field modified in any way that may alter the product's structural integrity
  - 2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- B. Manufacturer: Simpson Strong-Tie or equivalent.
  - 1. Application: Joist hangers, gusset plates, strip ties and column and beam ties.
    - a. Refer to Structural Drawings for fastener shear and beam seat requirements.
    - b. Metal: Galvanized Steel
  - 2. Application: Hurricane Clips
    - a. Metal: Galvanized Steel

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. 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. Construct and assemble engineered wood products plumb, square and rigidly coupled and adequately anchored, maintaining uniformed clearances and accurate alignment.
- C. Securely attach all engineered wood products to substrate as required by code and as illustrated in drawings.
- D. Restore damaged components. Protect work from damage.

### 3.3 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

**SECTION 06 16 00****SHEATHING****PART 1 GENERAL****1.1 SUMMARY**

- A. Orient strand board for application in, but not limited to:
  - 1. Roof, wall, and beam filler, and shimming applications

**1.2 RELATED SECTIONS**

- A. Section 06 11 00 - Rough Carpentry
- B. Section 06 11 13 - Engineered Wood Products.
- C. Section 06 16 00 - Sheathing
- D. Section 06 20 13 - Exterior Finish Carpentry
- E. Section 23 83 16 - Radiant Wood Flooring

**1.3 REFERENCES**

- A. APA- Engineered Wood Association [www.apawood.org](http://www.apawood.org)

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.
- C. Product Data: Manufacturers data sheets on each product to be used including:
  - 1. Preparation instructions and recommendations
  - 2. Description of materials, finishes, and construction
  - 3. Storage and handling requirements and recommendations

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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. Oriented Strand Board Sheathing, Manufacturers:
  - LP (Louisiana-Pacific Corp.) or equivalent.  
[www.lpcorp.com/Literature/LP\\_OSB\\_Sheathing\\_Specifications\\_Spec\\_Applications.pdf](http://www.lpcorp.com/Literature/LP_OSB_Sheathing_Specifications_Spec_Applications.pdf)
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### **2.2 MATERIALS**

- A. Oriented Strand Board
  - 1. Application: Wall Sheathing
    - a. Thickness: ½"
  - 2. Application: Roof Decking
    - a. Thickness: ½"
  - 3. Beam Filler and Shim Material
    - a. Thickness: ½"

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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. Comply with the following manufacturer's instructions and with APA's Engineered Wood Guide," Form No. E30T/Revised March 2005.
- B. Install in accordance with manufacturer's instructions.
- C. Restore damaged components. Protect work from damage.
- D. Comply with local safety regulations when installing roof and wall sheathing

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 06 20 13

## EXTERIOR FINISH CARPENTRY

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide exterior finish carpentry for soffit and fascia. Soffit and fascia are to be Eastern White Cedar or a natural material of equal weather resistance. Soffit and fascia is to be constructed using clear board.

**1.2 RELATED SECTIONS**

- A. NA

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings when necessary indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- E. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship of each type of finish carpentry and application of sealer.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Acceptable Manufacturer: Any local supplier of FSC and/or SFI\_US\_PERFC cedar lumber products.
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. Fascia and Parapet:
  - 1. Apply boards to substrates using appropriate fasteners, sizes and dimensions as specified by drawings.
- E. Grade- Standard and Better White Cedar Board.
- F. Exterior Fasteners:
  - 1. Nails: Stainless steel siding nails.
  - 2. Screws and Anchors: Noncorrosive, type required for secure anchorage.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until board has been properly checked for defects and has been sealed.
- 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 of sealing product for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Provide work to sizes, shapes, and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Use non-corrosive fasteners for exterior work. Coordinate with work of other sections.
- C. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.

- D. Repair minor damage, clean and protect.

END OF SECTION

**SECTION 06 40 23****INTERIOR ARCHITECTURAL WOODWORK****PART 1 GENERAL****1.1 SUMMARY**

- A. Hardwood doors and other related wood trims.

**1.2 RELATED SECTIONS**

- A. Section 06 20 23 – Interior Finish Carpentry
- B. Section 06 41 13 – Wood-Veneer-Faced Architectural Cabinets
- C. Section 08 16 73 – Sliding Composite Doors

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

**1.4 REFERENCES**

- A. AWPA C20, non-corrosive type. Lumber Fire-Retardant Treatment.
- B. AWPA C27, non-corrosive type. Plywood Fire-Retardant Treatment.
- C. ASTM E 84, flame spread 20 or less. Particleboard Plywood Fire-Retardant Treatment.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in the Project Conditions article below.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.

- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 BASEBOARD TRIM**

- A. General: Trim to be added around the base of the interior exposed walls.
- B. Manufacturer: [SelecTrim Inc.](#), [Contact Industries Inc.](#), [Gossen Corp](#), [Kleer Lumber, LLC](#).
- C. Product:
  - 1. Baseboard Trim, Molding, and Door Trim and Jambs. Wood Shelves.
  - 2. 1x12", 1x10" Maple Boards. Trim and molding: see Finish Schedule.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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. Provide work to sizes, shapes, and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Quality Standard: Install woodwork to comply with [AWI Section 1700] [WIC Section 26] for the same grade specified for type of woodwork involved.
- C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Use non-corrosive fasteners for exterior work. Coordinate with work of other sections.
- D. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.
- E. Repair minor damage, clean and protect.
- F. Protect adjacent materials and surfaces; bear responsibility for repair of damage to other finished materials caused by work of this Section.
- G. Secure trim with fine finishing nails, screws, or glue as required.
- H. Plumb and level items unless shown otherwise.
- I. Nail finish at each blocking, lookout, or other nailer and intermediate points; toggle or expansion bolt in place where nails are not suitable.
- J. Prepare trim by cleaning and sanding as required to receive factory finishes specified in PAINTING, Section 099000.

- K. After completion, marks and stains shall be removed and the work left clean for factory finishing. Surfaces to receive finish shall be smoothly dressed and sand papered. Nail heads shall be set below the surface of the wood.
- L. Materials involved in this section should not be installed until after building is enclosed, wet work has been completed and operations that could damage the woodwork have been completed.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

## SECTION 06 41 00

## INTERIOR CABINETRY HINGES

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes: Non-rated and fire rated hinges that swing open 170°.

**1.2 RELATED SECTIONS**

- A. Section 06 40 23 Interior Architectural Woodwork
- B. Section 10 57 00 Wardrobe and Closet Specialties
- C. Section 12 35 30 Residential Casework
- D. Section 12 35 30.13 Kitchen Casework

**1.3 REFERENCES**

- A. American National Standards Institute (ANSI), Inc.: ANSI A156.18:Materials and Finishes

**1.4 SUBMITTALS**

- A. Provide in accordance with Section 01330 - Submittal Procedures:
  - 1. Product data for 170° Free Swing Hinge.
  - 2. Certificates documenting: Fire-rated hinges have been successfully tested in accordance with Paragraph 1.4.
  - 3. Sample of hinge with selected finish and illustrating installation method.
  - 4. Installation instructions.
  - 5. Shop drawings indicating hinge quantity, placement, and method of installation [including reinforcement drawings for metal door applications].
- B. QUALITY ASSURANCE
  - 1. Manufacturer qualifications: Firm specializing in manufacture of 170° Free Swing Hinges with 10 years minimum successful experience.
  - 2. Fire rated door assemblies: Provide hinges identical to items tested and listed by Underwriters Laboratories (UL).

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 INVISIBLE HINGES**

- A. General: Hinge has 170° opening angle with 3-dimensional adjustment as manufactured by Blum USA.
- B. Manufacturer: Blum USA  
<http://www.blum.com/us/en/index.php>
- C. Product: Shall contain the following requirements:
  - 1. Construction: Constructed with interpolated, laminated links connected with non-removable, riveted pins which provide moving pivot points and allow 180 degrees opening.
  - 2. Material: High strength, nickel-plated steel
  - 3. Fasteners: Types, size, and quantity as recommended by hinge manufacturer for properly installing invisible hinges for type of application and substrate

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Coordination: Coordinate provision of 170° Free Swing Hinges to ensure functional, secure installation.
- B. Provide templates [and reinforcements] to door fabricators in sufficient time to ensure proper preparation for installation of hinges.
- C. Prior to installation, verify that doors and frames are ready to receive hardware.

### **3.2 INSTALLATION**

- A. Install 170° Free Swing Hinges in accordance with manufacturers installation instructions and approved shop drawings.
- B. Install quantity of hinges as recommended by manufacturer for specific application.

- C. Placement: Locate hinges as recommended by manufacturer and indicated on approved shop drawings.
- D. Use manufacturer recommended router guides and equipment for hinge installation.
- E. Fit doors accurately in frames within standard industry clearances for specific applications.
- F. Thoroughly clean, polish, and protect hinge finish until painting and other work is completed.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 06 80 00  
COMPOSITE FABRICATION

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section includes the following:

1. North side entry door

**1.2 RELATED SECTIONS**

- A. Section 08 10 00 – Doors and Frames  
B. Section 08 14 23 – Out-swing entry doors  
C. Section 08 71 00 – Door Hardware

**1.3 REFERENCES**

- A. ASTM E84-04 – Test Method for Surface Burning Characteristics of Building Materials.  
B. ASTM D2126-04 – Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.  
C. ASTM E96 – Test Method for Water Vapor Transmission of Materials.  
D. ASTM 2842-01 – Test Method for Water Absorption of Rigid Cellular Plastics.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.  
B. Storage: Store flat and supported. Product should be stored inside and out of direct sunlight.  
C. Handling: Protect materials and finish during handling and installation to prevent damage.

**PART 2 PRODUCTS****2.1 MANUFACTURER**

Mckee Surface  
1000 Hershey Ave. Muscatine, IA 52761  
Office: 563-263-2421  
E-mail: [info@mckeesurfaces.com](mailto:info@mckeesurfaces.com)

- A. Mckee Surfaces Custom Bio-Tahiti Corn Starch Composite
- B. Mckee Surfaces Custom Suspended Corn Cob
- C. Mckee Surfaces Custom Lemon Grass/Bio-Tahiti Composite

## **2.2 CARE AND MAINTENANCE**

- A. Clean with any common nonabrasive, non-chlorinated household cleaner and a soft cloth.
- B. Avoid using bleach or other oxidizing cleaners.
- C. Avoid temperatures above 120 degrees F.
- D. Product should be stored inside and out of direct sunlight.
- E. Product color will naturally age with time.

## **2.3 FINISH GUIDE**

- A. Product can come pre-finished if no further sanding will be required.

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

## **3.2 INSTALLATION**

- A. A 3/8" diameter two fluted router bit for seams should be used.
- B. For drilling a bit with a 60 degree angle is preferred.
- C. Any adhesive that can be used with a nonporous material is suitable. If attaching to a board Chemique Adhesives product #: XP1880 (parts A&B) is good. A two-part polyurethane works well and a 100% silicone RTV is also a good choice. Avonite glue is another good choice.

END OF SECTION

SECTION 07 21 00  
THERMAL INSULATION

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Provide thermal insulation and vapor retarders.
- B. This section includes:
  - 1. Blow-In Biocomposite Insulation
  - 2. Recycled blue jean insulation
- C. Related Sections:
  - 1. Section 60 11 00 – Wood Framing

**1.2 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Submit for approval test reports.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.1 SPRAY APPLIED BIOCOMPOSITE INSULATION**

- A. General: Applied to exterior walls interior walls, roof, and deck
- B. Manufacturer: BioBased® Insulation, LLC
- C. Product: BioBased® 1701s Insulation.  
[http://www.biobased.net/products/SpecSheets/Spec\\_BBI\\_1701s\\_Architectural%20\(2008-07-14\).pdf](http://www.biobased.net/products/SpecSheets/Spec_BBI_1701s_Architectural%20(2008-07-14).pdf)

**2.2 RECYCLED BLUE JEANS INSULATION**

- A. General: Insulation for floor and exterior wall.



- B. Manufacturer: [Creative Composites](#)
- C. Product: Recycled Blue Jean batt insulation

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections. Provide full thickness in one layer over entire area, tightly fitting around penetrations..
- B. Install vapor retarder over entire area of inside face of exterior walls and elsewhere as indicated. Seal all seams and around perimeter and penetrations with duct tape to form a continuous vapor retarder free of holes.
- C. Protect installed insulation and vapor retarder.
- D. Remove overspray and/or repair damage to adjacent materials caused by insulation installation.

### **3.2 CLEANING**

- A. Perform cleanup in accordance with Section and Section.
- B. Upon completion, remove surplus materials, rubbish, tools and equipment in accordance with Section.
- C. Waste Management:
  - 1. Coordinate recycling of waste materials.
  - 2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.

END OF SECTION

## SECTION 07 21 19.05

## BIOBASED SPRAY FOAM INSULATION

**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section of Specification describe requirements to provide labor, equipment and materials for installation and application of foamed-in-place insulation.

**1.2 RELATED SECTIONS**

- A. Section 06 10 00 – Rough Carpentry.

**1.3 REFERENCES**

- A. ASTM C518-02 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- B. ASTM D2856 - Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer.
- C. ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Plastics.
- D. ASTM D1623 - Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- E. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.
- F. ASTM C1338 - Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- G. ASTM E84-04 - Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM D2126-04 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- I. ASTM E96 - Test Method for Water Vapor Transmission of Materials.
- J. ASTM 2842-01 - Test Method for Water Absorption of Rigid Cellular Plastics.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.5 DELIVERY, STORAGE AND HANDLING**

- A. Observe all safety precautions and handling instructions on Material Safety Data Sheets for products.

- B. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- C. Store materials in a dry area protected from precipitation, freezing and overheating, at temperatures not lower than 60 F (16 C) or above 90 F (32 C).
- D. Protect materials during handling and application to prevent damage and contamination.
- E. Air tightness: Meet specific standards of the Energy Star Program of 1.5 Air Changes/Hour at 50 Pa.

## 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Toxicity/Hazardous Materials—Out gassing/Reactivity
  - 1. Formaldehyde: Products containing urea-formaldehyde will not be permitted.
  - 2. Chlorofluorocarbons (CFCs)/HCFCs: Products and equipment requiring or using CFCs or HCFCs during the manufacturing or installation process will not be permitted.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. The following shall be used in areas for spray insulation
  - 1. Spray foam semi-open cell insulation shall be a spray-applied semi-rigid, low-density, air impenetrable cellular polyurethane foam plastic insulation produced in the field by combining a part A polymeric isocyanurate component with a part B resin-based component. The material shall be job-site mixed in and spray applied by and through equipment designed especially for this purpose
  - 2. BioBased<sup>®</sup> 1701s Insulation<sup>™</sup>, 1.7 lb/ft<sup>3</sup> spray foam, a two-part, soy-based product, shall conform to the following:

TEST STANDARD	DESCRIPTION	VALUE
ASTM C518-02	Thermal Resistance	
	1" nominal	R – 5.9
	2" nominal	R – 12
	2.5" nominal	R – 15
	3" nominal	R – 18
	3.5" nominal	R – 19
	5" nominal	R – 28

	7" nominal 8" nominal 9" nominal	<b>R – 39</b> <b>R – 44</b> <b>R – 50</b>
<b>ASTM D2856</b>	Closed Cell Content	<b>&gt;90%</b>
<b>ASTM D1622</b>	Core Density (nominal)	<b>1.7 lbs/ft<sup>3</sup></b>
<b>ASTM D1623</b>	Tensile Strength	<b>19 p.s.i.</b>
<b>ASTM D1621</b>	Compressive Strength	<b>23 p.s.i.</b>
<b>ASTM C1338</b>	Criteria for Fungi Resistance	<b>Pass</b>
<b>ASTM E84-04</b>	Surface Burning Characteristics Flame Spread Smoke Development Index	<b>1.625"</b> <b>&lt;25</b> <b>&lt;450</b>
<b>ASTM D2126-04</b>	Dimensional Stability 82°C, Ambient Humidity 23°C, 50% Relative Humidity -20°C, Ambient Humidity	<b>Less than 1%</b> <b>Less than 1%</b> <b>Less than 1%</b>
<b>ASTM E96</b>	Water Vapor Permeability 1" Thick Foam 2.5" Thick Foam	<b>2.06 perms</b> <b>0.73 perms</b>
<b>ASTM D2842-01</b>	Water Absorption	<b>0.2%</b>

- B. Manufacturer: BioBased® Insulation, LLC
- C. Products shall be BioBased® 1701s Insulation.  
[http://www.biobased.net/products/SpecSheets/Spec\\_BBI\\_1701s\\_Architectural%20\(2008-07-14\).pdf](http://www.biobased.net/products/SpecSheets/Spec_BBI_1701s_Architectural%20(2008-07-14).pdf)
- D. Substitutions are not acceptable.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Mask and protect adjacent surfaces from overspray or damage.
- B. Prepare all substrates scheduled or intended to receive material in accordance with manufacturer's written instructions.
  - 1. Prepare all surfaces to receive spray foam application.
  - 2. Properly seal all areas that require sealant to insure a proper air seal when complete.
  - 3. Properly mask all windows, doors and areas to be protected from overspray.
  - 4. Protect floors and drywall areas from overspray.
- C. Remove foreign materials from substrates that may affect application of products of this Section.
- D. Application of materials by spray foam contractor shall constitute acceptance of job-site conditions and substrates and therefore negate future claims of insulation failure due to those conditions or substrates.

### 3.2 APPLICATIONS

- A. Apply insulation in accordance with manufacturer's written application instructions.
  - 1. Insure all equipment is clean and ready for spraying foam using safety guidelines as offered by the Spray Foam Insulation Association.
  - 2. Turn on equipment and set temperature and pressure settings as required.
  - 3. Spray foam to specified thickness.
  - 4. Trim foam as necessary to framed wall thickness when filling cavity.
- B. Apply insulation to a reasonably uniform monolithic density without voids.
- C. Apply to a minimum cured thickness ½" inch +/- ¼ inch [or as scheduled].
- D. Apply minimal expanding foam 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 approved sealant where needed to fill small voids in areas to receive foam.
- G. Apply insulation around ventilation panels between roof rafters [as indicated on drawings].
- H. Where building is designed to meet the specific air tightness standards of the Energy Star Program, apply insulation as recommended by manufacturer to provide airtight construction. Apply caulking to seal joints between structural assemblies.

### 3.3 EXAMINATION

- A. Verify that all members and substrates scheduled or intended to receive products of this Section are in place and suitable for application of products.
- B. Verify that all rough-ins for electric and plumbing or other work on and within spaces to be insulated is complete prior to application.
- C. Notify General Contractor of conditions that may adversely affect application of material.
- D. Inspect application for proper density and thickness of insulation upon completion.

### 3.4 PROTECTION

- A. Do not permit subsequent work to disturb applied insulation.
- B. Any "hot work" repairs such as welding or soldering etc. must follow appropriate standards and practices (such as "fire watch") to prevent fire.
- C. Exposed foam must be covered with wall board as soon as possible. Insulation shall be separated from the interior of the building by ½" (12.7 mm) gypsum board or equivalent approved 15 minute thermal barrier.

END OF SECTION

**SECTION 07 25 00****WEATHER BARRIERS****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide air and moisture barriers.

**1.2 RELATED SECTIONS**

- A. Not Applicable

**1.3 REFERENCES**

- A. ASTM—American Society for Testing and Materials [www.astm.org](http://www.astm.org)

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

**PART 2 PRODUCTS****2.1 WEATHER BARRIER**

- A. General: Allows moisture to escape quickly before it damages the sidewall materials

- B.     Manufacture: Benjamin Obdyke  
                    00 Babylon Rd. Suite A  
                    Horsham, PA 19044  
                    Telephone: 215-672-7200  
                    Fax: 512-652-3731  
                    info@benjaminobdyke.com
- C.     Product: Home Slicker
1.       Width: 39.7" (1 m)
  2.       Length: 46.7' (14,17m)
  3.       Coverage: 150 sq ft (45,72 m)
  4.       Thickness: .25"
  5.       Weight: 7.2 lbs per roll
  6.       UV Exposure: 30 days (max)
  7.       Warranty: 50-year Limited
  8.       Mounting: Base-plate mounting.  
            <http://www.benjaminobdyke.com/visitor/product/key/homeSlicker.com>

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A.     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 and approved submittals.
- B.     Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- C.     Install over entire area, tightly fitting around penetrations and at perimeters.

### **1.1 PROTECTION**

- A.     Protect installed products until completion of project.

END OF SECTION

**SECTION 07 46 63****FABRICATED PANEL ASSEMBLIES WITH SIDING****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide locally harvested cedar from distributor of said materials.
- B. Provide exterior grade anodized aluminum extruded channel for edging of cladding panels as delineated in construction documents.

**1.2 RELATED SECTIONS**

- A. Section 05 75 00 – Ornamental Metals
- C. Section 07 91 16 – Joint Gaskets

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Samples: Submit one representative sample of a full scale cladding panel indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- D. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide wood of acceptable quality, free from checking, warping, splitting and other defects. Other materials are to be from manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Preservative Treatment: Where noted in drawings, AFM Safecoat Naturals Clear Penetrating Oil to be applied in a minimum of two coats following manufacturer's application recommendations.
- C. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship of each type of finish carpentry and application of sealer.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.



- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Exterior Lumber Siding:
  - 1. Type: Eastern White Cedar or other local cedar product
  - 2. Species and Grade: Standard and Better.
  - 3. Profile: Planed, dolly varden
  - 4. Texture: Smooth.
  - 5. Finish: Shop-applied AFM Safecoat Naturals Clear Penetrating Oil where noted in drawings
  - 6. Siding Accessories:
    - a. 2 1/2" stainless steel allen style cap lag bolt
- B. Exterior Aluminum Extruded Channel:
  - 1. Fry Reglet Aluminum Channel
- C. Rubber gaskets and seals.
- D. Exterior Fasteners:
  - 1. Nails: Stainless steel or hot-dip galvanized siding nails.
  - 2. Screws and Anchors: Noncorrosive, type required for secure anchorage.
- E. Exterior Walls:
  - 1. Siding is to be integrated with aluminum channel and is to be affixed to exterior of house as directed in drawings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until board has been properly checked for defects and has been sealed.
- 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 of sealing product for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Provide work to sizes, shapes, and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Allow for expansion and contraction. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- C. Restore damaged components. Clean and protect work from damage.

END OF SECTION

## SECTION 07 61 00

## SHEET METAL ROOFING

**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Prefinished, prefabricated, structural exposed fastener roof

**1.2 RELATED SECTIONS**

- A. Section 06 11 20 - Framing and Sheathing: Plywood roof deck substrate..
- B. Section 07 22 00 - Roof and Deck Insulation.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim.
- D. Section 07 71 23 - Gutters and Downspouts.
- E. Section 07 90 00 - Joint Sealers

**1.3 REFERENCES**

- A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- C. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- E. ASTM D 2178 - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
- F. ASTM E 84 - Standard Test for Surface Burning Characteristics of Building Materials.
- G. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- H. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- I. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
- J. FM 4471 - Class 1 Panel Roof (Uplift Evaluation); Factory Mutual Research Corporation.
- K. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies.
- L. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.

- M. FM 4471 - Class 1 Roofing Panels.
- N. SMACNA - Architectural Sheet Metal Manual.
- O. NRCA - The NRCA Roofing and Waterproofing Manual.

#### **1.4 SUBMITTALS**

- A. Submit under provisions of Section 01300.
- B. Manufacturer's catalog data, detail sheets, and specifications.
- C. Shop Drawings: Prepared specifically for this project; showing dimensions of metal roofing and accessories, fastening details and connections and interface with other products.
- 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: Certified and approved installer of the sheet metal roofing manufacturer FABRAL.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store materials above ground, on skids.
  - 2. Protect material with waterproof covering and allow sufficient ventilation to prevent condensation buildup or moisture entrapment on the materials.

#### **1.7 WARRANTY**

- A. Panel manufacturer shall provide a twenty (20) year warranty on the paint finish covering chalking, cracking, checking, chipping, blistering, peeling, flaking, and fading.
- B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain wall and flashings in watertight conditions.

### **PART 2 PRODUCTS**

#### **2.1 ROOFING**

- A. General: Exposed fastener roofing system.

## B. Acceptable Manufacturer:

FABRAL,  
3449 Hempland Rd.  
Lancaster, PA 17601  
Tel: 717-397-2741; Fax: 717-397-1040  
Web: [www.fabral.com](http://www.fabral.com)

## C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## D. Provide all sheet metal roofing and accessories from a single manufacturer.

## E. MATERIALS AND FINISHES

## 1. Panel materials

- a) 26 ga. Grade 80 (80 ksi yield strength), 24 or 22 ga. Grade 50 (50 ksi yield strength), 18 ga. Grade 40 (40 ksi yield strength) structural steel with G90 (0.90 oz./ft.<sup>2</sup>) hot dipped galvanized coating, both conforming to ASTM A 653.
- b) 26 ga., Grade 80 (80 ksi yield strength), 24 or 22 ga. Grade 50 (50 ksi yield strength), 18 ga. Grade 40 (40 ksi yield strength) structural steel with AZ50 (0.50 oz./ft.<sup>2</sup>) aluminum-zinc alloy coating, both conforming to ASTM A 792.
- c) 0.032, 0.040, or 0.050", 3004H36 or equivalent (28 ksi yield strength) aluminum alloy conforming to ASTM B 209.

## F. Texture: panels shall be smooth.

G. Finish: Refer to manufacturer's standard color card to determine appropriate finish and color. All panels shall receive a factory-applied exterior coating (siliconized polyester) (Kynar<sup>®</sup> 500/Hylar<sup>®</sup> 5000\*) (vinyl plastisol) (26 ga. panels will have Super Alurite paint) conforming to the following:

- a) Metal preparation: all metal shall have the surfaces carefully prepared for painting on a continuous process coil coating line by alkali cleaning, hot water rinsing, application of chemical conversion coating, cold water rinsing, sealing with an acid rinse, and thorough drying.
- c) Prime coating: a base coat of epoxy paint, specifically formulated to interact with the top-coat, shall be applied to the prepared surfaces by roll coating to a dry film thickness of  $0.20 \pm 0.05$  mils. This prime coat shall be oven cured prior to application of finish coat.
- d) Exterior coating: a finish coating (from above) shall be applied over the primer by roll coating to a dry film thickness of  $0.80 \pm 0.05$  mils ( $3.80 \pm 0.05$  mils for vinyl plastisol) for a total dry film thickness of  $1.00 \pm 0.10$  ( $4.00 \pm 0.10$  mils for vinyl plastisol). This finish coating shall be oven-cured.
- e) Interior coating: a washcoat shall be applied on the reverse side over the primer by roll coating to a dry film thickness of  $0.30 \pm$

0.05 mils for a total dry film thickness of  $0.50 \pm 0.10$  mils. The washcoat shall be oven-cured.

- f) Color: the color of the exterior finish shall be gunmetal gray as chosen from the manufacturer's standard color chart.
- g) Physical properties: the coating shall conform to the manufacturer's standard performance criteria as listed by certified test reports for fade, chalk, abrasion, humidity, adhesion, pollution resistance, and others as required and standard within the industry.

J. ACCESSORIES

- a) Fasteners: As recommended by panel manufacturer for the system specified.
- b) Sealant: Sealant as recommended by panel manufacturer.
- c) Flashings and Trim: As recommended by panel manufacturer or drawings.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Examine surfaces to receive sheet metal roofing. Notify the Architect in writing of any defective conditions encountered. Starting of work shall constitute acceptance of such conditions.
- B. Wood and Metal Deck Substrate:
  - 1. Verify deck is dry and joints are solidly supported and fastened.
- C. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.
- D. Correct defective conditions before beginning work.

**3.2 INSTALLATION**

- A. Install in conformance with the NRCA Roofing and Waterproofing Manual and manufacturers installation instructions and recommendations.
- B. Form panel shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.
- C. Install base sheet and eave protection sheet underlayment as recommended by the manufacturer.
- D. Install all panels continuous from ridge to eave. Transverse seams are not permitted.
- E. Where not otherwise indicated conform to SMACNA details including flashings and trim.
- F. Install sealants where indicated to clean dry surfaces only without skips or voids..

### **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 07 62 00****SHEET METAL FLASHING AND TRIM****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide flashing and sheet metal, using copper for parapet caps and gutter cap. Continuously solder all seams.

**1.2 RELATED SECTIONS**

- A. Section 07 61 00 – Sheet Metal Roofing.

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings when necessary indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- E. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Mock-Up: Provide a mock-up for evaluation of application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship and materials are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready



for installation.

## 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## PART 2 PRODUCTS

- A. Acceptable Manufacturer: Beach Sheet Metal C., Inc.
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. Gutter and Wall Cap:
  - 1. Copper: Provide copper complying with ASTM B370, with standard hardness required for fabrication, strength and durability.
- E. Flashing and Sheet Metal:
  - 1. Application: Exterior wall flashing and expansion joints.
  - 2. Application: Built-in metal valleys, gutters, and scuppers.
  - 3. Application: Gutters and downspouts.
  - 4. Application: Ridge and soffit vents.
  - 5. Metal: Zinc-coated steel.
    - a. Standard: ASTM A 653, G90 hot-dip galvanized, 2-Coat 70% Fluoropolymer, 20-gauge (.0359 inch).
  - 6. Metal: Stainless steel.
    - a. Standard: AISI Type 302/304, ASTM A 666, 2D annealed finish, 28 gauge (.0156 inch).
  - 7. Metal: Copper.
    - a. Standard: ASTM B 370, 16 ounces per square foot.
  - 8. Flexible Sheet Membrane Flashing: GRACE nonreinforced flexible black ice and water shield or product of equal quality.
- F. Auxiliary Materials:
  - 1. Solder compatible with metal.
  - 2. Mastic and elastomeric sealants.
  - 3. Epoxy seam sealer.

4. Reglets and metal accessories.
5. Gutter and conductor head guards.
6. Asphaltic roofing cement.

### **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. Follow recommendations of SMACNA Sheet Metal Manual. Allow for expansion. Isolate dissimilar materials.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- C. Restore damaged components and finishes. Clean and protect work from damage.

#### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

## SECTION 07 71 23

## GUTTERS AND DOWNSPOUTS

**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Downspouts and accessories.

**1.2 RELATED SECTIONS**

- A. Section 07610 - Sheet Metal Roofing.
- B. Section 07900 - Joint Sealers.
- C. Section 15160 - Storm Drainage Piping.

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01300.
- B. Manufacturer's data sheets on each product to be used.

**1.4 REFERENCES**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B. ASTM B32 - Standard Specification for Solder Metal
- C. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction
- D. CDA - Copper in Architecture - Handbook
- E. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store to avoid twisting, bending, abrasion and other permanent damage.
- C. Avoid contact with materials causing discoloration, staining or other damage

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## PART 2 PRODUCTS

### 2.1 DOWNSPOUTS

- A. Acceptable Manufacturer:  
  
Park City Rain Gutter  
6421 Business Pk. Loop Rd. Unit F ; Park City, UT 84098  
Tel: 435-649-2805; Fax: 435-649-2605  
Email: [request info](mailto:requestinfo@pcraingutter.com)  
Web: [www.pcraingutter.com](http://www.pcraingutter.com)
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.
- D. Downspouts: Copper, cold rolled; Round style:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm), Code 50006.
- E. Downspout Brackets: Copper, screw type:
  - 1. Size: 4 inch (100 mm), Code 46404.
- F. Downspout Bracket Covers: Copper:
  - 1. Size: 4 inch Single (100 mm), Code 46906
  - 2. Size: 4 inch Double (100 mm), Code 46926.
- G. Downspout Elbows 40 degree radius: Copper:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm), Code 42006.
- H. Downspout Elbows 72 degree radius: Copper:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm), Code 42056.
- I. Downspout Elbows 85 degree radius: Copper:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm), Code 42081.
- J. Downspout Double Elbow: Copper:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm), Code 43006.
- K. Downspout Connector: Copper:
  - 1. Size: 4 inch (100 mm), thickness .024 inch (0.6 mm). Code 50307.
- L. Fasteners: Same material and finish as gutters and downspouts.
- M. MISCELLANEOUS MATERIALS
  - 1. Protective Backing Paint: FS TT-C-494, bituminous.
  - 2. Solder: ASTM B32; 50/50 type.

**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.
- C. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to minimum dry film thickness of 15 mil (0.4 mm).

**3.3 INSTALLATION**

- A. Perform Work in accordance with CDA Handbook and the Drawings.
- B. Sheet metal join lengths with watertight joints. Flash and solder gutters to downspouts and accessories.
- C. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water
- D. Connect downspouts to storm sewer system as indicated. Seal connection watertight
- E. Set splash pans or pads under downspouts. Secure in place

**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 07 91 16

## JOINT GASKETS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide joint gaskets where appropriate, and as specified in drawings.

**1.2 RELATED SECTIONS**

- A. Section 05 70 00 – Ornamental Metal.
- B. Section 07 46 00 – Siding.

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.
- D. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Field-Constructed Mock-Ups: Each joint type.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.

- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Acceptable Manufacturer: Aero Rubber Company, INC.
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. Exterior cladding panels:
  - 1. Apply in areas designated in drawings.
- B. Other exposed joints:
  - 2. Apply in areas designated in drawings.
- E. Exterior Joints in Vertical Surfaces, Rubber membrane:
  - 1. Materials: Natural rubber sheet:
- F. Exterior Joints in Horizontal Surfaces, Rubber membrane:
  - 1. Materials: Natural rubber sheet:

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until board has been properly checked for defects and has been sealed.
- 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 of sealing product for achieving the best result for the substrate under the project conditions.

### **3.3 INSTALLATION**

- A. Examine carpentry and metalwork; report unsatisfactory conditions in writing. Beginning work means acceptance of carpentry and metalwork..
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints.
- C. Cut and protect rubber as directed by manufacturers. Replace or restore damaged rubber. Clean adjacent surfaces.

END OF SECTION

## SECTION 07 92 00

## JOINT SEALANTS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide joint sealers and fillers.

**1.2 RELATED SECTIONS**

- A. Section 06 20 13 – Exterior Finish Carpentry.
- B. Section 07 61 00 – Sheet Metal Roofing.
- C. Section 07 71 23 – Gutters and Downspouts

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.
- D. Selection Samples: For each finish product specified, two complete sets of pattern samples representing manufacturer's full range of available finishes and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 3 inches (76 mm) by 4 inches (101 mm) representing actual product, color, finish, and pattern.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Field-Constructed Mock-Ups: Each joint type.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.

- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

- A. Acceptable Manufacturer: Sandell Construction Solutions.
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- D. Fascia and parapet, all other exterior exposed joints:
  - 1. Apply in continuous beads or as expressed by the manufacturer at all necessary joints.
- E. Exterior Joints in Vertical Surfaces, Silicone:
  - 1. Materials: Two component silicone sealant.
- F. Exterior Joints in Vertical Surfaces, Urethane:
  - 1. Materials: Two-component urethane sealant.
- G. Exterior Joints in Vertical Surfaces, Preformed Compression Seals:
  - 1. Materials: Preformed precompressed foam sealant.
- H. Exterior Joints in Horizontal Surfaces, Urethane:
  - 1. Materials: Self-leveling urethane sealant, ASTM C 920.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until board has been properly checked for defects and has been sealed.

### **3.2 PREPARATION**

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

### **3.3 INSTALLATION**

- A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of substrates.
- B. Provide sealants in colors as selected from manufacturer's standards.
- C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints, and install bond breakers, backer rods and sealant as

recommended by manufacturers.

- D. Depth shall equal width up to 1/2 inch wide; depth shall equal 1/2 width for joints over 1/2 inch wide.
- E. Cure and protect sealants as directed by manufacturers. Replace or restore damaged sealants. Clean adjacent surfaces to remove spillage.

END OF SECTION

SECTION 08 11 66  
RETRACTABLE SCREEN SYSTEMS

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section includes the following:
  - 1. Manual Retractable Door Screens

**1.2 RELATED SECTIONS**

- A. Section 06 80 00 – Composite fabrication
- B. Section 08 10 00 – Doors and Frames
- C. Section 08 14 23 – Out Swing Entry Door

**1.3 REFERENCES**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- B. Reference Section 01230- Alternates

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Reference Section 01660 – Product Storage and Handling Requirements
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Follow manufacturer's instructions
- D. Special Instructions: Store packaged units in horizontal position, evenly supported, and without top loading
- E. Protect materials from exposure to moisture. Do not deliver until after painting and wet work is complete and dry.
- F. Protect factory finishes from damage, precipitation and construction materials until ready for installation.

**1.5 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 RETRACTABLE SCREENS DOOR**

- A. General: Screen for the north door

- B. Manufacturer: Pella Screens  
www.pella.com
- C. Product: Manual operated
  - 1. Door Screens: 18/14 Charcoal Fiberglass Mesh.
  - 2. Standard Features:
    - a. Adjustable Spring Tension.
    - b. Super Magnet Latch: Corrosion Resistant Super Magnet latch system.
    - c. Track Depth: 1/2 inch (12,5 mm).
    - d. Track Height: Maximum height 1 inch (25.5 mm).
    - e. Easy Grip sliding latches
    - f. 18/14 Charcoal Fiberglass Mesh.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Verify that openings are within allowable dimensional tolerances, plumb, level, and clean, provide solid anchoring surface, and are in accordance with approved shop drawings
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- D. Beginning construction activities of this section indicates installer's acceptance of conditions.
- E. Clean surfaces thoroughly prior to installation

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Restore damaged finishes and protect work
- C. Anchor to adjacent construction without distortion or stress.
- D. Fit and align screen assembly including hardware, plumb, level and square to ensure smooth operation.
- E. Install doors with not more than 1/8 inch clearance at top and sides, 1/4 inch at

bottom. Comply with NFPA 80 for rated assemblies.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion  
Protect installed products until completion of project.

END OF SECTION

SECTION 08 14 23  
OUT-SWING ENTRY DOORS

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section includes the following:
  - 1. North side entry door
  - 2. Mechanical room door

**1.2 RELATED SECTIONS**

- A. Section 06 80 00 – Composite fabrication
- B. Section 07 21 00 – Thermal Insulation
- C. Section 07 27 00 – Air Barriers: Water-resistant barrier
- D. Section 07 92 00 – Joint Sealants: Sealants and caulking
- E. Section 08 10 00 – Doors and Frames
- F. Section 08 71 00 – Door Hardware

**1.3 REFERENCES**

- A. American Architectural Manufacturers Association (AAMA)
  - 1. AAMA 502 – Voluntary Specification for Field Testing of Windows and Sliding Doors.
  - 2. AAMA2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM B 368 – Copper-Accelerated Acetic Acid – Salt Spray (Fog) Testing (CASS Test).
  - 2. ASTM C 1036 – Flat Glass.
  - 3. ASTM C 1048 – Heat- Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.
  - 4. ASTM D 1149 – Rubber Deterioration – Surface Ozone Cracking in a Chamber.
  - 5. ASTM D 2803 – Filiform Corrosion Resistance of Organic Coatings on Metal.
  - 6. ASTM D 4060 – Abrasion Resistance of Organic Coatings by the Taber Abraser.

7. ASTM E 283 – Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
  8. ASTM E 330 – Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  9. ASTM E 331 – Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
  10. ASTM G 85 – Modified Salt Spray (Fog) Testing.
- C. Window and Door Manufacturers Association (WDMA):
1. AAMA/WDMA/CSA 101/I.S.2/A440 – Windows, Doors and Unit Skylights.
  2. WDMA I.S.4 – Water Repellent Preservative Treatment for Millwork

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURER**

- A. Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website [www.pella.com](http://www.pella.com).

#### **2.2 ALUMINUM – CLAD WOOD FRENCH HINGED DOORS**

- A. Aluminum-Clad Wood Out-swing French Doors: Architect Series factory-assembled aluminum-clad wood French doors with outward swing door panels installed in frame.
- B. Frame:
1. Select woods, water-repellent, preservative-treated with EnduraGuard in accordance with WDMA I.S.-4. EnduraGuard includes water-repellency, three active fungicides and an insecticide applied to the frame.
  2. Interior Exposed Surfaces: Clear pine, veneered and edge-banded. Curved members may have visible finger joints.
  3. Exterior Surfaces: Clad with aluminum at head and jambs.

4. Sill: ½-inch low-profile extruded aluminum with mill finish.
5. Overall Frame Depth: 5-7/8 inches (149 mm) to 8-5/16 inches (211 mm).

C. Door Panel:

1. Select woods, water-repellent, preservative-treated with EnduraGuard in accordance with WDMA I.S.-4. EnduraGuard includes water-repellency, three active fungicides and an insecticide applied to the panel.
2. Vacuum Insulated Panel inserted (For North Entry Door Panel).
3. Panel Rains and Stiles: Three-ply construction. Randomly finger-jointed blocks laminated with water-resistant glue and veneered both sides.
4. Interior Exposed Surfaces: Veneered.
5. Exterior Surfaces: Clad with aluminum.
6. Corners: Urethane-sealed and secured with metal fasteners and structural adhesive.
7. Panel Thickness: 2-1/16 inches (52 mm).

## 2.3 GLAZING

A. Float Glass: ASTM C 1036, Quality 1.

1. Tempered Glass: ASTM C 1048

B. Type: Urethane-glazed 13/16-inch, dual-seal, fully tempered, insulating glass.

C. Integral Light Technology Glazing and Grilles:

1. Insulating glass contains non-glare grille grid between 2 panes of glass.
2. Non-glare Grid: Adhered to glass.
3. Bars shall be adhered to both sides of insulating glass with VHB acrylic adhesive tape and aligned with non-glare grid.
4. Finish: Exterior surfaces finished to match door cladding; interior surfaces unfinished, ready for site finishing.

## 2.4 OPTIONS

A. Insect Screens:

1. Compliance: ASTM D 3656 and SMA 1201.
2. Screen Cloth: Vinyl-coated fiberglass, 18/16 mesh.
3. Extruded-aluminum frame, hinged to door frame.
4. Complete with necessary hardware.
5. Finish: Same finish and color as exterior door cladding.



## **2.5 TOLERANCES**

- A. Doors shall accommodate the following opening tolerances:
  - 1. Vertical Dimensions Between High and Low Points: Plus 1/8 inch, minus 0 inch.
  - 2. Width Dimensions: Plus 1/8 inch, minus 0 inch.
  - 3. Building Columns or Masonry Openings: Plus or minus 1/8 inch from plumb.

## **2.6 INSTALLATION ACCESSORIES**

- A. Flashing/Sealant Tape: Pella SmartFlash.
  - 1. Aluminum-foil-backed butyl window and door flashing tape.
  - 2. Maximum Total Thickness: 0.013 inch.
  - 3. UV resistant.
  - 4. Verify sealant compatibility with sealant manufacturer.
- B. Insulating-Foam Sealant: Dow Great Stuff Window & Door.
  - 1. Low-pressure, polyurethane window and door insulating-foam sealant.

# **PART 3 EXECUTION**

## **3.1 EXAMINATION**

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation of subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

## **3.2 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and approved shop drawings.
- B. Install doors to be weather-tight and freely operating.
- C. Maintain alignment with adjacent work.
- D. Secure assembly to frame openings, plumb and square, without distortion.
- E. Integrate door system installation with exterior water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-resistant barrier using watershed principles in accordance with door manufacturer's instructions.

- F. Place interior seal around door perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant.
- G. Seal door to exterior wall cladding with sealant and related backing materials at perimeter of assembly.
- H. Leave doors closed and locked with shoot bolts extended.

### **3.3 FIELD QUALITY CONTROL**

- A. Field Testing: Field-test windows in accordance with AAMA 502, Test Method A. Manufacturer's representative shall be present.

### **3.4 CLEANING**

- A. Clean door frames and glass in accordance with Division 1 requirements.
- B. Do not use harsh cleaning materials or methods that would damage finish.
- C. Remove labels and visible markings.

### **3.5 PROTECTION**

- A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

## SECTION 08 16 73

## SLIDING COMPOSITE DOORS

**PART 1 GENERAL**

## 1.1 SUMMARY

- A. This section includes the following:
  - 1. Custom fabricated bathroom composite door
  - 2. Sliding wall mount door
  - 3. ADA handle

## 1.2 RELATED SECTIONS

- A. Section 06 80 00 – Composite fabrication
- B. Section 08 10 00 – Doors and Frames
- C. Section 08 71 00 – Door Hardware

## 1.3 REFERENCES

- A. ASTM C518-02 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- B. ASTM D2856 - Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer
- C. ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Plastics
- D. ASTM D1623 - Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- E. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics
- F. ASTM C1338 - Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- G. ASTM E84-04 - Test Method for Surface Burning Characteristics of Building Materials
- H. ASTM D2126-04 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- I. ASTM E96 - Test Method for Water Vapor Transmission of Materials
- J. ASTM 2842-01 - Test Method for Water Absorption of Rigid Cellular Plastics

## 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## 1.5 PROJECT CONDITIONS

- A. Environmental Requirements: 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 COMPOSITE INSULATION MATERIAL

- A. General: Insulation material for the bathroom door
- B. Manufacturer:
  - Creative Composites, Ltd
  - PO Box 506
  - Brooklyn, IA 52211
  - Phone: 641 522 3034
- C. Product: Insulated compress blue jeans

### 2.2 BIOCOMPOSITE PLASTIC

- A. General: Surface panels on door
- B. Manufacturer:
  - 1. MCKEE
  - PO Box 230
  - Muscatine, IA 52761
  - Phone: (563) 263-2421
  - [www.mckeesurfaces.com](http://www.mckeesurfaces.com)

### 2.3 HARDWARE

- A. General: Wall mount bathroom door
- B. Product: Shall contain the following requirements:
  - 1. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines
- C. Handles:
  - 1. Manufacturer: Baldwin
    - <http://www.woodwardsace.com/baldwin/general/pocketdoors/adapocket.htm>
  - 2. Finish : Stainless steel finish
  - 3. To meet ADA 4.13.9 Door hardware and 4.13.11 Door Opening Force requirements, the handle pulls need to always be exposed in the opening and the maximum force to move the door is 5lbs.
- D. Sliding door track

1. Manufacturer : Johnson Hardware  
<http://www.johnsonhardware.com/2610f.htm>
2. Type: 2610F961 Series Wall Mount
  - a. Track length 96 inches
  - b. Max door weight 125lbs
  - c. 1120 Hangers
  - d. 12 door guides
  - e. 1155 track stops
  - f. 1712 Wrench

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings

#### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Restore damaged finishes and protect work
- C. Install doors with not more than 1/8 inch clearance at top and sides, 1/4 inch at bottom. Comply with NFPA 80 for rated assemblies.

#### **3.3 PROTECTION**

- A. Protect installed products until completion of project

END OF SECTION

SECTION 08 31 00  
ACCESS DOORS AND PANELS

**PART 1 GENERAL**

**1.1 SUMMARY**

A. This section includes the following:

1. Interior access panels.
2. Exterior access panels.

**1.2 RELATED SECTIONS**

A. Section

**1.3 SUBMITTALS**

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

**1.4 DELIVERY, STORAGE, AND HANDLING**

A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

**1.5 QUALITY ASSURANCE**

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.1 MANUFACTURES**

A. SquareD

939 Office Park Road, Ste. 223  
Des Moines, IA

**2.2 MATERIALS**

A. Access Doors:

1. Manufacturers: SquareD

B. Frames: 16-gauge (.0598 inch) stainless steel, AISI No. 4 satin finish with flange.

C. Doors: 14-gauge (.0625 inch) stainless steel, AISI No. 4 satin finish.

D. Door Type: Flush panel.

E. Locking Devices: Cylinder locks.

- F. Fire Rating: NFPA 80.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Restore damaged finishes and protect work
- C. Install doors with not more than 1/8 inch clearance at top and sides, 1/4 inch at bottom. Comply with NFPA 80 for rated assemblies.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 08 41 13

## ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

**PART 1 GENERAL****1.1 SUMMARY****A. Section Includes:**

1. South side of Sun Porch Door: Sliding/folding aluminum and glass door system, including aluminum frame, threshold, panels, sliding/folding and locking hardware, weather stripping, glass and glazing; designed to provide an opening glass wall, with sizes and configurations as shown on drawings and specified herein, NanaWall SL70, Monumental, Thermally Broken Aluminum Framed Folding System as supplied by NANA WALL SYSTEMS, INC
2. North side of Sun Porch Door: Individual panel aluminum and glass door system, including aluminum frame, tracks, threshold, sliding panels, swing panels. Sliding L frame panels with incorporated swing doors, stacking bays, sliding/swinging and locking hardware, weather stripping, glass and glazing; designed to provide an opening glass wall or storefront, with sizes and configurations as shown on drawings and specified herein, with the HSW 50 NanaWall, the Thermally Broken Aluminum Framed Individual Panel Sliding System as supplied by NanaWall Systems, Inc.

**1.2 RELATED SECTIONS**

- A. Section 08 10 00 – Doors & Frames
- B. Section 08 71 00 - Door hardware

**1.3 REFERENCES**

- A. American Architectural Manufacturers Association (AAMA):
  1. AAMA 611.98, Voluntary Specification for Anodized Architectural Aluminum.
  2. AAMA 2603.02, Voluntary Specifications, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  3. AAMA 1304, Voluntary Specifications for Forced Entry Resistance of Side-Hinged Door Systems.
- B. American National Standards Institute (ANSI):
  1. ANSI Z 97.1, Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in buildings.
- C. American Society for Testing and Materials (ASTM):
  1. ASTM E 283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure



Difference.

2. ASTM E 330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
  3. ASTM E 547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
  4. ASTM 1886.02, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
  5. ASTM E 1996. 02, Standard Specifications for performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Wind Borne Debris in Hurricanes.
- D. Consumer Product Safety Commission (CPSC):
1. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials.
- E. National Fenestration Rating Council (NFRC):
1. NFRC 100, Procedure for determining Fenestration Product Thermal Materials.
  2. NFRC 200, Procedure for determining Solar Heat Gain Coefficient.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer: Provide complete, precision built, engineered, pre-fitted unit by a single source manufacturer with at least 15 years experience in providing folding/sliding door systems for large openings in the North American market.
- B. Performance Requirements: Unit to comply with applicable manufacturer's independently certified testing results. Testing results include air infiltration in accordance with ASTM E 283, water penetration in accordance with ASTM E 547, structural loading in accordance with ASTM E Missile Impact in Accordance with ASTM E 1886. 02 and ASTM E 1996.02.
- C. Thermal Performance: Unit to comply with the U value, rated, certified and labeled or simulated in accordance with NFRC 100, shown in manufacturer's latest published data for the glazing and sill specified.
- D. Solar Heat Gain Coefficient: Unit to comply with the solar heat gain coefficient, simulated in accordance with NFRC 200, shown in manufacturer's latest published data for the glazing specified.
- E. Installer Qualification: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least 3 projects locations, completion dates, names and telephone numbers of General Contractor and Owner's contact person.

#### **1.5 WARRANTY**

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.
- B. Warranty Period: Ten years for rollers and for seal failure of insulated glass

supplied. For all other components, one year (two years if unit is installed by manufacturer's certified trained installer) from date of delivery by manufacturer.

## **1.6 SITE CONDITIONS, DELIVERY, STORAGE AND HANDLING**

A. In addition to general delivery, storage and handling requirements specified in Section 01600, comply with the following:

1. Deliver materials to job site in sealed, unopened cartons or crates. Protect units from damage. Store material under cover, protected from weather and construction activities.

## **PART 2 PRODUCTS**

### **2.1 SUPPLIER**

A. NANA WALL SYSTEMS, INC.  
707 Redwood Highway, Mill Valley, CA 94941  
Toll Free: (800) 873-5673  
Telephone: (415) 383-3148  
Fax: (415) 383-0312  
Website: [www.nanawall.com](http://www.nanawall.com)  
E-mail: [info@nanawallsystems.com](mailto:info@nanawallsystems.com)

### **2.2 MATERIALS**

- A. Frame and Panels: From manufacturer's standard profiles, provide head jamb, side jambs, and panels with dimensions shown on drawings.
1. Providing panels with standard one lite with simulated divided lites in pattern as shown on drawings.
  2. Provide standard bottom rail.
  3. Aluminum Extrusion: Extrusions with nominal thickness of .098" (2.5 mm). Alloy specified as AlMgSi0.5 with strength rated as 6063-T5 or F-22 (European standard). Anodized conforming to AAMA 611.98 or powder coated conforming to AAMA 2603.02.
  4. Thermally broken with ¾" (18.5 mm) polyamide plastic reinforced with glass fibers with additional insulating foam.
  5. Aluminum Finish: Dark bronze anodized, E6 C34. Same finishes on inside and outside.
- B. Glass: Provide manufacturer's standard glass with dry glazing 15/16" (24 mm) insulating clear safety glass to be acquired and glazed separately in accordance with manufacturer's instructions only. Exact glass dimensions to be provided by manufacturer. ASTM C 1048 Kind FT, select glazing quality float glass; fully tempered safety glass complying with applicable codes. Provide EPDM gaskets and extruded aluminum snap-in glazing bead for dry glazing per manufacturer's instructions. Stops to provide for total glass thickness of 24 mm (15/16"). All glass to comply with safety glazing requirements of ANSI Z 97.1 and CPSC 16CFR 1201.

- C. Locking Hardware and Handles: Provide manufacturer's standard nylon handle and concealed two point locking hardware operated by 180 degree turn of handle between each pair of folding panels and on any secondary swing panel. Face applied flush bolt locking will not be allowed.
- D. Sliding/Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top, bottom tracks and threshold. All running carriages to be with sealed, self-lubrication, ball bearing multi-rollers. Surface mounted hinges and running carriages will not be allowed. Weight of panels to be borne by the bottom of the track will not be allowed.
  - 1. Provide upper guide carriage and lower running carriage with four vertical fiber glass reinforced polyamide wheels and two horizontal wheels. The vertical wheels to ride on top of sill track and lie above the water run-off level. Carrying capacity of lower running carriage to be 440 lbs.
  - 2. Threshold: Provide matching, thermally broken with  $\frac{3}{4}$ " polyamide raised sill.
  - 3. Hinges: Zinc die cast. Finish: Closest match to finish of frame and panels. Provide stainless steel security hinge pins with set screws.
  - 4. Adjustment: Provide folding/sliding hardware capable of specified amount of compensation and adjustments without needing to remove panels from tracks, in width,  $\frac{1}{8}$ " (3 mm) per hinge and in height,  $\frac{3}{16}$ " (4 mm) up and down.
- E. Other Components:
  - 1. Weather Stripping: Provide manufacturer's standard double layer EPDM or brush seals with a two layer fiber glass reinforced polyamide fin at both the inner and outer edge of door panels or on frame for sealing between panels and between panel and frame.
  - 2. Provide tapered pins or stainless steel screws for connecting frame components.

## 2.3 FABRICATION

- A. Use extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.
  - 1. Sizes and Configurations: see drawings for selected custom dimensions within maximum frame sizes possible as indicated in manufacturer's literature. See drawings for selected number of panels and configuration.

## 2.4 ACCESSORIES

- A. Provide the Nana Screen, a series of vertical, collapsible, pleated screen panels. Provide top track, side jambs, and vertical struts in white anodized aluminum. Provide pleated, polypropylene screen material with patented, floor tracking chain with  $\frac{1}{4}$ " (5 mm) floor track. /see drawings for selected number of panels and configuration

- B. Provide other side lites, transoms, corner posts, or single or double doors as per drawings provided.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Because of the large dimensions involved and the weight and movement of the panels, verify the structural integrity of the header such that the deflection with the live load is limited to the lesser of  $L/720$  of the span and  $\frac{1}{4}$ ".
- B. Examine surface of openings and verify dimensions; verify rough openings are level, plumb, and square, with no unevenness, bowing, or bumps on floor.
- C. Installation of units constitutes acceptance of existing conditions.

### **3.2 INSTALLATION**

- A. Install frame in accordance with manufacturer's recommendations and installation instructions. Properly flash and waterproof around the perimeter of the opening.
- B. Installer to provide appropriate anchorage devices and to securely and rigidly fit frame in place, absolutely level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. If necessary, provide drain connections from lower track.
- D. Install panels, handles and lock set in accordance with manufacturer's recommendations and installation instructions.
- E. If necessary, adjust hardware for proper operation.
- F. Accessories: Screens; install in accordance with screen manufacturer's recommendations and installation instructions.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 08 54 13

## FIBERGLASS WINDOWS

**PART 1 GENERAL****1.1 SUMMARY**

- A. The supply and installation of all factory assembled and prefinished Pultruded Fiberglass Windows, complete with glass and glazing, operable hardware, screens weather-stripping, weatherseals and interior and exterior trims.

**1.2 RELATED SECTIONS**

- A. Section 06 11 00—Rough Carpentry
- B. Section 07 92 00--Joint Sealant
- C. Section 09 91 00—Painting

**1.3 REFERENCED STANDARDS**

- A. American Architectural Manufacturers Association/Window and Door Manufacturers Association Standards (AAMA/WDMA):
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM E 283-91: "Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen."
  - 2. ASTM E 547-97: "Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential."
  - 3. ASTM E 774-92: "Specification for Sealed Insulating Glass Units."
- C. American Society of Civil Engineers (ASCE)
  - 1. ASCE 7-02: "Minimum Design Loads for Buildings and Other Structures"
- D. National Fenestration Rating Council (NFRC) NFRC 100-97: "Procedure for Determining Fenestration Product Thermal Performance".

**1.4 DESIGN AND PERFORMANCE REQUIREMENTS:**

- A. Window units shall be designed to comply with AMMA/WDMA I.S.2-97. Design Pressure Awning Windows DP - HC55.

- B. Wind Pressures for calculation Design Pressures for building shall be based on ANSI/ASCE 7-95.
- C. Air leakage shall not exceed 0.010 cfm per square foot of frame, when tested at 1.57 psf according to ASTM E 283-91.
- D. No water shall penetration the window assembly, when tested at a pressure of 14.5 psf, according to ASTM E 547-93.
- E. Assembly shall withstand positive and negative uniform static air pressure difference of 84 psf.

## **1.5 SUBMITTALS**

- A. Shop Drawings:
- B. Submit under provisions of Section 01330. Full Size Shop Drawings, Including elevation of all units, structural or reinforcing members and anchoring details.
- C. Product Data: Submit catalog data under provisions of Section 01330
- D. Quality Control Submittals:
  - 1. Submit a detailed proposal of schedule and method of installation, including: number of windows to be installed per day, length of time room will be occupied by Installers, time of day windows will be delivered to site, proposed start of installation, proposed date of completion of installation.

## **1.6 WARRANTY:**

- A. Windows shall be covered by a written warranty stating that the Pultruded Fiberglass windows are guaranteed against defects in manufacturing, materials and workmanship defects, for a period of:
  - 1. 20 Years for Frames and Sash (except Insulating Glass and Hardware);
  - 2. 10 Years for Insulating Glass assembly;
  - 3. 5 Years for Hardware.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURED WINDOWS**

- A. Windows shall be of a standard of quality and performance as Manufactured by INLINE FIBERGLASS Limited.-Series 325 Awning Pultruded Fiberglass Windows.

## 2.2 MATERIALS

- A. Window Frames shall be Pultruded Fiberglass, having a minimum glass content of 60%, meeting and exceeding AAMA/NWDA 305-98 Standard for Fiberglass Reinforced Thermoplastic Profiles.
- B. Frame and Sash: Frame and sash profiles shall be made with 0.090 inch thick Pultruded Fiberglass. Non-structural accessory members are permitted to be vinyl or aluminum and are to be identified as such on Shop Drawings.
- C. Frame Depth: 3-1/4 inches (82.5 mm).
- D. Glass as specified in Section 08800, shall comply with the following Glass Standards:
  - 1. ASTM C 1036-91 (Specification for Flat Glass.)
  - 2. ASTM E1300-98 (for determining the Minimum Thickness and Type of Glass). Single Strength Glass is not acceptable for this Project.
  - 3. ASTM E774-92 Specification for Sealed Units.
  - 4. Clear insulating glass shall be [7/8"(22 mm)] [1-3/8" 35 mm overall thickness.
  - 5. All Insulating glass shall be supplied by a manufacturer that is Certified under SIGMA/IGCC or IGMAC and the Sealed Units shall bear such a label.
- E. Glazing: Provide glass stops which will permit glass replacement without the use of special tools. Glaze using standard industry (FGMA, SIGMA, and AAMA) recommendations for insulating glass, with approved Heat Mirror sealant. For example, the glazing system must include compatible glazing caulks, proper drainage, adequate support, and clearance for both lites, and protection of Alpenglass unit sealant from direct ultraviolet exposure through the glass.
  - 1. Heat Mirror insulating glass units must be installed with glazing materials and sealants compatible with PRC-DeSoto PRC 4429HM polyurethane sealant, or with Dow CorningT 3-0117 silicone insulating glass sealant. It is the glazier/installer's responsibility to verify framing design compliance and glazing material compatibility prior to installation. For compatibility information please call Alpen Energy Group.
  - 2. Neoprene gaskets or non-hardening, non-corrosive glazing tapes or sealants must be applied in such manner as to effect and maintain a watertight, weatherproof seal for a period of time equal to the Heat Mirror warranty. All glazing materials must be compatible with polyurethane for Heat Mirror units sealed with this material.
  - 3. Type 1 Wavelength Selective Suspended Coating:
    - a. Outboard Lite: 3/16" Clear Annealed
    - b. Spacer Thickness & Color : Two Thermally Improved Steel 3/8"

- c. Alpenglass Type: Double TC-88
  - d. Inboard Lite: (glass thickness) 3/16" Clear Annealed
  - e. Overall unit thickness: 1 3/8"
- 4. Glass shall have a winter nighttime U-Value of: .08, Solar Heat Gain Coefficient: 0.41, Shading Coefficient shall be: 0.48, Daylight Transmittance shall be .52%, Ultraviolet blockage shall be at least 99.8%
- 5. Type 2 Wavelength Selective Suspended Coating:
  - a. Outboard Lite: 3/16" Clear Low Iron
  - b. Spacer Thickness & Color : Two Thermally Improved Steel 3/8"
  - c. Alpenglass Type: Double HM-88 (low Iron)
  - d. Inboard Lite: (glass thickness) 3/16" Clear Annealed
  - e. Overall unit thickness: 1 3/8"
- 6. Glass shall have a winter nighttime U-Value of .18, Solar Heat Gain Coefficient: 0.62, Shading Coefficient shall be: 0.71, Daylight Transmittance shall be 73%, Ultraviolet blockage shall be at least 99.8%
- F. Glazing Seal: Laid-in glazing using polyethylene closed cell adhesive tape or shimmed butyl tape on the exterior and a removable glass stop locked in on the interior provide a secure and positive seal for the glass.
- G. Finish: All exposed surfaces coated with Isocyanate- free two part Polymer Enamel in compliance to fiberglass finish Standard AAMA [613-98] [615-98]. Color to be White Finish- both inside and outside.
- H. Hardware: Concealed Stainless Steel Hinges, E-Gard Roto Gear Operators multi-point lock by Truth Hardware. Hardware is fastened in patented reinforcements.
- I. Weather strip: Q-Lon air seal gasket on interior of frame with Santopreme bulb type rain screen gasket on the exterior to provide double weather barrier.
- J. Insect Screens: Roll-formed aluminum frame with friction fit corner key, with Fiberglass mesh. Screens are mounted on the interior of operating window and are removable.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Verify that openings are plumb and square and of proper dimension as required in Section 01710. Report frame defects or unsuitable conditions to the General



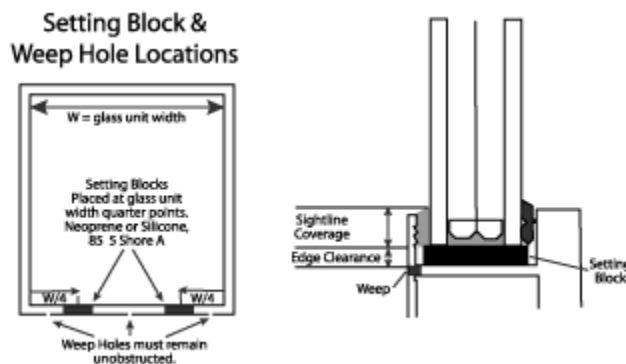
Contractor before proceeding.

### 3.2 INSTALLATION

- A. Assemble and install windows according to manufacturer's instructions and reviewed shop drawings.
1. Store with non-abrasive separators between frames. Windows should be stored in a place protected from weather
  2. Alterations - windows should not be load bearing after installation. Windows should not be modified to accommodate air conditioners, exhaust fans, etc
  3. Perimeter cavities - between window frames and rough opening (R.O.) should be filled with loose insulation or expanding foam. Do not distort frame by over packing. Note that a well filled cavity improves thermal performance
  4. Caulking of exterior perimeter - should provide seal between wall and window to ensure continuity of weather tightness. (air barrier)
  5. Caulking and/or taping of interior perimeter - should promote continuity of vapor barrier to minimize risk of condensation with the cavity and to ensure meeting advertised water and air resistance
  6. Anchorage - window frames should be set plumb, square, shimmed and secured to surroundings structure. Window anchorage must be sufficient to meet structural requirements of local building codes. Allow at least 6mm (+1/4") space between the frame and rough opening for shimming and adjust. Always adjust anchor position, shimming thickness to maintain straight and parallel lines between sash and frame. Ensure adequate and level support of the sill
  7. Conner anchors - secure within 100mm (4") from the corners
  8. Perimeters anchors - spacing should not exceed 450mm (18") on center Mullion and transom anchors - always anchor within 100mm (4") from mullion or transom (it is always a critical area for anchorage)
- B. Design anchorage to withstand mph. wind load as outlined in AAMA/NWDA101/I.S.2-97 Appendix B and "Windloads on Components and Cladding for Buildings less than 90 feet tall", based on ANSI/ASCE 7-95, "Minimum Design Loads for Buildings and other Structures."
- C. Window frames should be set level and true and secured to surrounding structure. Do not exceed 1/8" in 10'0" variation from plumb and level. Adjust shimming thickness to maintain straight and parallel lines between sash and frame. Ensure adequate and level support of the sill.
- D. Insulate between frame members and window opening in accordance with Section 07920, provide related backing materials at perimeter of unit and seal joints between frame members and window opening with sealant to provide a weather tight seal at outside and air vapor seal on the inside. Maximum caulk joint of 3/8". Ensure that all occupied areas can be used immediately following window installation, use fast curing caulking compound having minimal odor. Install sealant and related backing materials at perimeter of unit or assembly in accordance with

## Section 07 92 00 Joint Sealers.

- E. Install accessory items as required.
- F. Comply with skylight, window, storefront or curtainwall manufacturer guidelines for glazing Alpenglass units in their framing systems.
- G. Setting blocks should be 85 Shore A durometer neoprene, 4" length, width equal to glass thickness and placed at the quarter points of the glazing unit base. Anti-walk (edge) blocks should be 55-65 durometer neoprene with at least 1/16" clearance between block and glass.
- H. Be sure exterior of the lite is set toward the building exterior.
- I. Skylights should include a weep system specifically designed for sloped applications of 15 to 60 degrees. Drainage must be provided for both the unit surface weather seal and internal channels.
- J. Setting Blocks: Neoprene or silicone blocks must be placed at unit "quarter points" and equally support insulating glass unit inner and outer lites. Setting blocks should be 4" to 6" long and 1/8" wider than the thickness of the unit as indicated in the GANA Glazing Manual.
- K. Edge Clearance: Unit must be centered in the opening so that minimum spacing (1/4") exists between edge of glass and frame (1/8" on small units.) No wood or metal shall contact the glass at any point in the frame. Face and edge clearances shall comply with GANA Glazing Manual, Chapter IX minimum recommendations.
- L. Weep (Condensate) System: Insulating glass units must not be exposed to moisture accumulation or high humidity dew points. The glazing system design and installation must provide a positive weather seal and unobstructed weep drainage. (See illustration below)
- M. Sight Line Coverage (Bite): Frame and gasket materials must provide at least 9/16" sight line coverage (bite). Insulating glass sealants and spacers must be completely covered by the framing system. (See illustration below)



### 3.3 ADJUSTING AND CLEANING

- A. Leave final installation water and weathertight.

- B. Adjust all operating hardware for smooth operation.
- C. Leave windows and glass in a clean condition free from sealant, caulking or other foreign materials. Final cleaning as required in Section 01740.
- D. Remove visible labels and adhesive residue according to Manufacturer's Instructions.

### **3.4 PROTECTION**

- A. Protect windows from damage by chemicals, solvents, paint, or other construction operations that may cause damage.

END OF SECTION

**SECTION 08 61 00****WOOD WINDOWS - SKYLIGHTS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Production fabricated wood fixed skylight and exterior maintenance free cladding with [electrically] [manually] operated accessories as indicated on window schedule.

**1.2 REFERENCE STANDARDS**

- A. ANSI/ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- B. ANSI/ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- C. ANSI/ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Static Air Pressure Difference.
- D. ANSI/ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials. (impact glazing only)
- E. ANSI/ASTM 1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Windborne Debris in Hurricanes. (impact glazing only)
- F. AAMA/WDMA 1600/IS7 - Voluntary Specifications for Skylights.
- G. ICBO Evaluation Services Acceptance Criteria AC 17 – Acceptance Criteria for Sloped Glass Glazing in Solariums, Patio Covers and Prefabricated Skylights.
- H. National Evaluation Service Committee Report No. NER-216.
- I. National Fenestration Rating Council, NFRC – 100, Procedure for Determining Fenestration Product U-factors.
- J. National Fenestration Rating Council, NFRC – 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
- K. National Fenestration Rating Council, NFRC 300, Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
- L. Occupational Safety & Health Administration, OSHA (Standards – 29 CFR 1910.23, Guarding Floor and Wall Openings and Holes.

**1.3 QUALITY ASSURANCE**

- A. Wood fixed skylight with exterior maintenance free cladding and all accessories and components required for complete and weatherproof installation shall be manufactured to the highest standards of quality and craftsmanship in accordance with VELUX Manufacturing Standards.

## 1.4 SYSTEM DESCRIPTION

- A. Skylight: Wood frame, exterior maintenance free cladding, production fabricated, flashings, glass and glazings, and anchorage.
- B. Configuration: Fixed.

## 1.5 PERFORMANCE REQUIREMENTS

- A. Model FS fixed skylight to withstand dead and live loads caused by pressure and uplift of wind acting normal to plane of roof as tested to AAMA/WDMA 1600/IS7 to an exterior pressure of 2.30 – 7.13 KPa (48 -149 psf) and an interior pressure of 2.68 – 7.95 KPa (58 - 166 psf) and measured in accordance with ANSI/ASTM E 330.
- B. Limit member deflection to flexure limit of glass with full recovery of glazing materials.
- C. System to accommodate, without damage to components or deterioration of seals, movement between I.G. unit and perimeter framing.
- D. Air leakage through assembly limited to 0.25 L/s/m2 (0.05 cfm/ft2) of total unit inside perimeter, measured at a reference differential pressure across assembly of 75 Pa (1.57 psf) as measured in accordance with AAMA/WDMA/1600/IS7 and ANSI/ASTM E 283.
- E. Water infiltration: No water penetration noted when measured in accordance with AAMA/WDMA/1600/IS7 and ANSI/ASTM E 331 with a test pressure differential of 290 Pa (6.0 psf).
- F. Gasketing designed to drain water entering joints, condensation occurring in glazing channel, or migrating moisture occurring within system, to exterior by drainage network.
- G. Thermal Performance: Tested and certified in accordance with NFRC 100 and 200 procedures.
- H. Model FS with impact glazing (0099 69): Tested and certified in accordance with ANSI/ASTM E 1886 and ANSI/ASTM E 1996-01.
- I. Fall Protection: Model FS with laminated glass (0074) tested to meet or exceed the intent of OSHA 29 CFR 1910.23(e)(8) for fall protection. Model FS tested to 1400 ft/lbs with no glass breakage.

## 1.6 SUBMITTALS

- A. Manufacturer's unit dimensions, rough opening and finished framing dimensions, affected related work, and installation requirements are shown in manufacturer's installation instructions.
- B. Product Data: For Model FS fixed skylight, glazing options, accessories and electrical/manual control options of accessories are indicated in manufacturer's printed material.

## 1.7 DELIVERY, HANDLING, STORAGE

- A. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.

- B. Store and protect products in accordance with manufacturer's recommendations.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. VELUX America Inc. product Model FS fixed skylight and flashing systems as specified in this section and as manufactured by VELUX America Inc.

### **2.2 MATERIALS**

- A. Wood: Kiln-dried, laminated Nordic Pine (Specific Gravity 0.51), temporarily treated for mold and mildew for transparent or opaque interior finish.
- B. Maintenance free exterior cladding: Roll formed [0.65 mm aluminum] [0.55mm copper] pre-finished production engineered and fabricated to fit exterior exposed surfaces (Alloy AA 3003 H12 and AA 3003 H16).
- C. Fasteners: #8x1 washerhead, Phillips, 1/1, stainless steel, black for exterior maintenance free cladding.

### **2.3 COMPONENTS**

- A. Weather stripping: Factory applied neoprene weather stripping throughout entire frame, profiled to effect weather seal.
- B. Fittings: Surface treatment with electro-galvanized, chromate passivated yellow.
- C. Mounting brackets: Factory installed stamped steel, surface treatment electrogalvanized,chromate passivated yellow.
- D. Fasteners: 1¼" galvanized ring shank nail for mounting brackets, six per bracket.

### **2.4 GLASS AND GLAZING MATERIALS**

- A. Standard 5/8" overall dual sealed insulated glass unit with 9.1 mm (0.358") air space. Stainless steel spacer with desiccant, primary seal polyisobutylene, secondary seal silicone.
- B. Gasketing: Each I.G. unit dry glazed with chloroprene gasket, no sealants.
- C. Description of glazing options:
  - Type 74 Laminated Low-E Gas Filled: Exterior lite 3 mm (1/8") clear tempered with Low-E2 coating on surface #2, 11.1 mm (0.44") air space filled with argon gas, interior lite two plies of 2.3 mm (0.090") heat-strengthened laminated with 0.76 mm (0.030") vinyl interlayer.
  - Type 75 Low-E Gas Filled: Two lites 3 mm (1/8") clear tempered with 11.1 mm (0.44") airspace filled with argon gas. Low-E2 coating is applied to surface #2.
  - Type 0099 10 (Snowload Glazing) Laminated Low-E Gas Filled: Exterior lite 3.mm (1/8") clear tempered with Low-E2 coating on surface #2, 11.1 mm (0.44") air space filled with argon gas, interior lite two plies of 3.mm (1/8") tempered laminated with 0.76 mm 0.030") vinyl interlayer.

Type 0099 23 (White Laminated) Laminated Low-E Gas Filled: Exterior lite 3 mm (1/8") clear tempered with Low-E2 coating on surface #2, 11.1 mm (0.44") air space filled with argon gas, interior lite two plies of 2.3 mm (0.090") heat-strengthened laminated with 0.76 mm (0.030") white vinyl interlayer.

Type 0099 69 (Impact Glazing) Laminated Low-E Gas Filled: Exterior lite 3 mm (1/8") clear tempered with Low-E2 coating on surface #2, 11.1 mm (0.44") air space filled with argon gas, interior lite two plies of 2.3 mm (0.090") heat-strengthened laminated with 2.3 mm (0.090") vinyl interlayer.

## 2.7 FABRICATION

- A. Fabricate frame with slip joint/lock corners glued and nailed for hairline, weather tight fit.
- B. Fabricate frame components within minimum tolerances enabling installation and movement of frame and dynamic movement of perimeter weather stripping.
- C. Permit external drainage channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through gasketing.
- D. All units factory glazed with chloroprene gasketing.

## **2.8 FINISHES**

- A. Exterior surfaces: Exposed exterior wood surfaces to be covered with rollformed maintenance free cladding pieces. Aluminum has umber grey, Kynar\_ 500 polyvinylidene fluoride resin finish. Copper is roll-formed mill finish.
- B. Maintenance free flashing: Roll formed aluminum, umber grey, baked on polyester polyamid primer and finish coats. Copper is roll formed mill finish.
- C. Interior surface: All exposed interior wood surfaces to be clear unfinished wood.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify rough opening dimensions and proper orientation of skylight.

### **3.2 INSTALLATION**

- A. Install skylight in accordance with manufacturer's installation instructions.
- B. Align skylight level, free of warp or twist, maintain dimensional tolerances.
- C. Attach skylight to roof sheathing with manufacturer's brackets and screws and nails to accommodate construction tolerances and other irregularities.
- D. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.
- E. Coordinate attachment and seal of perimeter air and vapor barrier material.
- F. Install manufacturer's engineered perimeter flashing in accordance with manufacturer's installation instructions to achieve weather tight installation.

END OF SECTION



## SECTION 08 71 00

## DOOR HARDWARE

**PART 1 GENERAL**

## 1.1 SUMMARY

- A. This section includes the following:
  - 1. Exterior door hardware
  - 2. Interior doors hardware
- B. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
  - 1. Pivots thresholds weather stripping and to be installed under other Sections.
  - 2. Permanent lock cores to be installed by Owner

## 1.2 RELATED SECTIONS

- A. Section 08 14 23- Out Swing Entry Door
- B. Section 08 41 13- Aluminum-Framed Entrances and Storefronts
- C. Section 008 16 73- Sliding Composite door

## 1.3 REFERENCES

- A. Architectural Hardware Consultant (AHC)
- B. Architectural Openings Consultant (AOC)
- C. The U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines
- D. American National Standards Institute (ANSI), Inc.
- E. A NSI A117.1 - American National Standard for Accessible and Useable Buildings and Facilities.
- F. ANSI A156.2 - American National Standard for Bored and Preamsembled Locks & Latches
- G. ANSI A156.5 - American National Standard for Auxiliary Locks and Associated Products.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Requirements: 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 OUT SWING ENTRY DOOR

- A. General: North entry door and mechanical door hardware
- B. Manufacturer: YALE  
100 Yale Ave.  
Lenoir City, TN 37771.  
Tel: (800) 438-1951  
Fax: (800)338-0965  
Email: webmaster@yalecommercial.com.  
Web: www.yalecommercial.com.
- C. Product: Shall contain the following requirements:
  - 1. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [ICC/ANSI A117.1] [HUD's "Fair Housing Accessibility Guidelines"] [and] <Insert regulation.
- D. Entrance door and storeroom lock locking system
  - 1. Handle model: Reflection TC
  - 2. Trim: YM100 Series Standard
  - 3. Finish: 619 Satin Nickel Plated, Clear Coated
  - 4. Locking System: Entrance door mechanism
    - a. Mortised and keyed multi-point locking system
    - b. Armor Front - 8 inches x 1 1/4 inches
    - c. Deadbolt - 1 inch throw, stainless steel with two enclosed hardened steel roller armor pins
    - d. Backset - 2 3/4 inch
    - e. Door thickness: 2 1/4"
- E. Exit lock system for interior door hardware
  - a. Handle model: Reflection UB

- b. Trim: YM100 Series Standard
- c. Finish: 619 Satin Nickel Plated, Clear Coated
- d. Locking System: Entrance door mechanism
- e. Mortised and keyed multi-point locking system
- f. Armor Front - 8 inches x 1 1/4 inches
- g. Deadbolt - 1 inch throw, stainless steel with two enclosed hardened steel roller armor pins
- h. Backset - 2 3/4 inch

F. Hinges:

- 1. Swing out hinges
- 2. Corrosion-resistant leaves with wear-resistant hinge bushings and stainless steel pin and decorative cap.
- 3. Doors with Frame Heights 6' 10" and Under: 3 hinges.

## 2.2 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

A. General: Four panel sliding door system.

B. Manufacturer: NANA WALL SYSTEMS, INC.

C. Product: Nana Wall S70

<http://www.nanawall.com/example/donotcopy/s70/pdf.com>

- 1. Locking Hardware and Handles: Provide manufacturer's standard flat handle on inside only and concealed two point locking hardware operated by 180° turn of handle as needed on system.
- 2. For panel to be opened first, either a swing panel or sliding panel, provide manufacturer's standard L-shaped handles on the inside and outside with two or three point locking hardware operated by 180° turn of handle and a lockset that locks with turn of key or thumbturn
- 3. For incorporated swing panel in a sliding L frame panel, provide locking to engage (disengage) swing panel to sliding L frame panel

D. Handles

- 1. Powder coated flat handle finish: white, RAL 9016 match panel profile.
- 2. Nylon handle color: closest match to flat handle color from available colors.
- 3. Standard locking rods capped by Polyamide at top and bottom tracks.
- 4. Provide handle height centered at 41 3/8" from bottom of panel.

E. Sliding & Swinging Hardware: Provide manufacturer's standard hardware.

- 1. For each sliding panel, provide 2 two wheeled, toughened Polyamide

covered stainless steel uni-directional sliding door carriers. Carrying capacity of each carrier to be 220 lbs.

2. Provide on all four corners of sliding panels, sliding L frame panels and swing panels, thermally broken, die cast zinc multi-functional corner fittings with carrier connectors, male and female locking receptacles, hinges and hinge pins as required. Finish: Powder coated, closest match to finish of frame and panels.
3. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks

## 2.3 SLIDING COMPOSITE DOOR

- A. General: Sliding Composite door for bathroom
- B. Manufacturer: Custom
- C. Product: Shall contain the following requirements:
  1. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines] [ICC/ANSI A117.1] [HUD's "Fair Housing Accessibility Guidelines"]
- D. Handles:
  1. Manufacturer: Baldwin  
<http://www.woodwardsace.com/baldwin/general/pocketdoors/adapocket.htm>
  2. Finish : Stainless steel finish
- E. Sliding door track
  1. Manufacturer : Johnson Hardware  
<http://www.johnsonhardware.com/2610f.htm>
  2. Type: 2610F961 Series Wall Mount
    - a. Track length 96 inches
    - b. Max door weight 125lbs
    - c. 1120 Hangers
    - d. 12 door guides
    - e. 1155 track stops
    - f. 1712 Wrench

## PART 3 EXECUTION

### 3.1 PREPARATION

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

- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings.
- C. Track must be perfectly level before installing door

### 3.2 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Restore damaged finishes and protect work
- C. Install doors with not more than 1/8 inch clearance at top and sides, 1/4 inch at bottom. Comply with NFPA 80 for rated assemblies.

### 3.3 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 08 80 00

## GLAZING

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide glass and glazing.

**1.2 RELATED SECTIONS**

- A. Section

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
- D. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.
  - 1. Laminated Glass: Manufacturer's 5-year warranty.
  - 2. Coated Glass: Manufacturer's 10-year warranty.
  - 3. Insulating Glass: Manufacturer's 10-year warranty.
  - 4. Mirror Glass: Manufacturer's 5-year warranty.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Glazing for Fire-Rated Assemblies: Glazing for assemblies that comply with NFPA 80
- C. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.
- D. Glazing Publications:
  - 1. GANA Publications: GANA's 'Glazing Manual.' and 'Laminated Glass Design Guide.'
  - 2. AAMA Publications: AAMA GDSG-1, 'Glass Design for Sloped Glazing,' and AAMA TIR-A7, 'Sloped Glazing Guidelines.'

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, 'Sloped Glazing Guidelines.'
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, 'Glazing Guidelines for Sealed Insulating Glass Units.'

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

#### **A. Glass and Glazing:**

1. Manufacturers: Pilkington; Tremco Commercial Sealants & Waterproofing; Zeledyne (formerly ACH Glass Operations).
2. Type: Single glass units, tempered at locations as required by Code.
3. Type: Insulating glass units, tempered at locations as required by Code.
4. Type: High-performance insulating glass units with low-e coating, tempered at locations as required by code.
5. Auxiliary Materials:
  - a. Compression gaskets.
  - b. Elastomeric glazing sealants.
  - c. Preformed glazing tapes.
  - d. Glazing gaskets.
  - e. Setting blocks, spacers, and compressible filler rods.
  - f. Mirror adhesive, top and bottom angles and clips.

#### **B. Glazing Films:**

1. Manufacturers: 3M Window Film ; Bekaert ; CPFilms, Inc.; Madico, Inc.; V-KOOL, Inc..
2. Type: Architectural glazing film.
3. Type: Solar and architectural glazing film.
4. Type: View control glazing film.
5. Type: Blast-resistant safety glazing film.
6. Film: Self-adhesive polyester film suitable for application.

#### **C. Clamped Glazing Assemblies:**

1. Manufacturers: TACO Metals, Inc..
2. Type: Clamped glass shelving assemblies.

3. Type: Clamped glass partition assemblies.
4. Type: Clamped glass displays.
5. Type: Clamped glass signage.
6. Glass Material: Transparent flat glass.
7. Glass Material: Transparent tempered glass.
8. Clamp Material: Polished die casting.
9. Clamp Material: Stainless steel.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Inspect framing and report unsatisfactory conditions in writing.
- B. Comply with GANA "Glazing Manual" and manufacturers instructions and recommendations. Use manufacturer's recommended spacers, blocks, primers, sealers, gaskets and accessories.
- C. Install glass with uniformity of pattern, draw, bow and roller marks.
- D. Install sealants to provide complete wetting and bond and to create a substantial wash away from glass.
- E. Set mirrors on stainless steel clips and adhere to wall with mirror adhesive.
- F. Remove and replace damaged glass and glazing. Wash, polish and protect all glass supplied under this section.

**(1) Glazing Materials:** Neoprene gaskets or non-hardening, non-corrosive glazing tapes or sealants must be applied in such manner as to effect and maintain a watertight, weatherproof seal for a period of time equal to the Heat Mirror warranty. All glazing materials must be compatible with polyurethane for Heat Mirror units sealed with this material.

**(2) Setting Blocks:** Neoprene or silicone blocks must be placed at unit "quarter points" and equally support insulating glass unit inner and outer lites. Setting blocks should be 4" to 6" long and 1/8" wider than the thickness of the unit as indicated in the GANA Glazing Manual.

**(4) Weep (Condensate)**

**System:** Insulating glass units must not be exposed to moisture accumulation or high humidity dew points. The glazing system design and installation must provide a positive weather seal and unobstructed weep drainage.

**(5) Sight Line Coverage**

**(Bite):** Frame and gasket materials must provide a least 9/16" sight line coverage (bite). Insulating glass sealants and spacers must be completely covered by the framing



system.

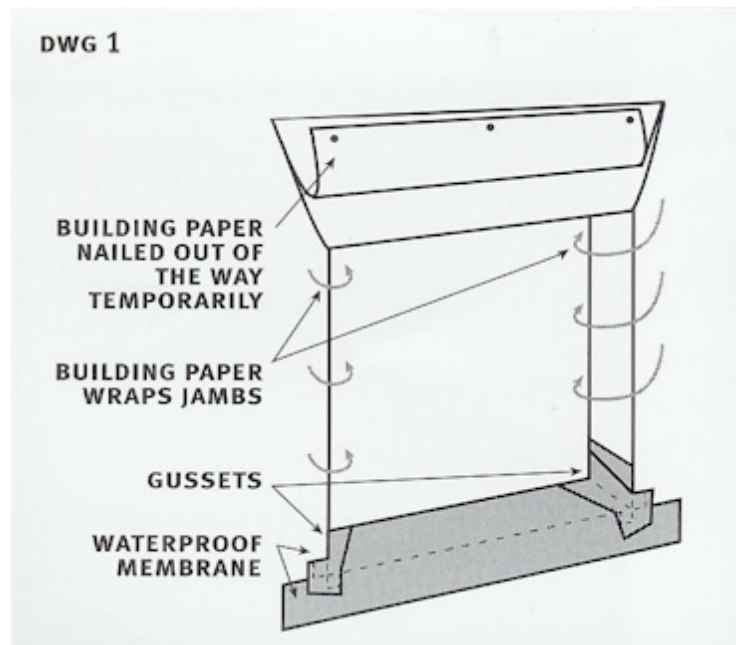
**(3) Edge Clearance:** Unit must be centered in the opening so that minimum spacing (1/4") exists between edge of glass and frame (1/8" on small units). No wood or metal shall contact the glass at any point in the frame. Face and edge clearances shall comply with IANA Glazing Manual, Chapter IX minimum recommendations.

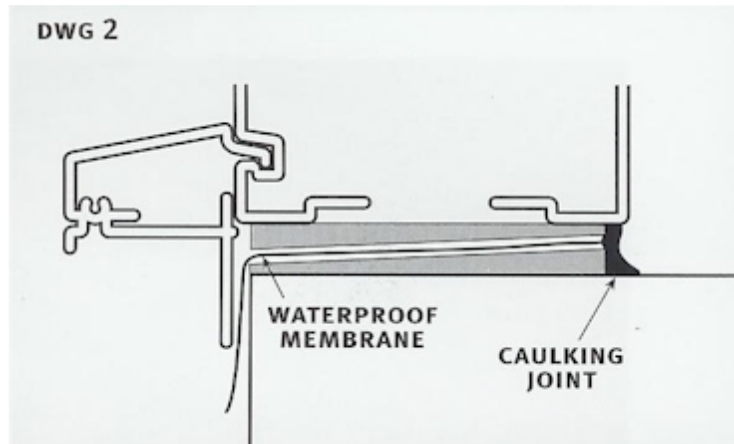
Specific installation instructions from Thermotech Fiberglass Fenestration guide. <http://www.thermotechfiberglass.com/awn9.htm>

**Step 1: Handle Carefully.** Store upright, under cover. Separate windows with non-abrasive material.

**Step 2: Verify size and location.**

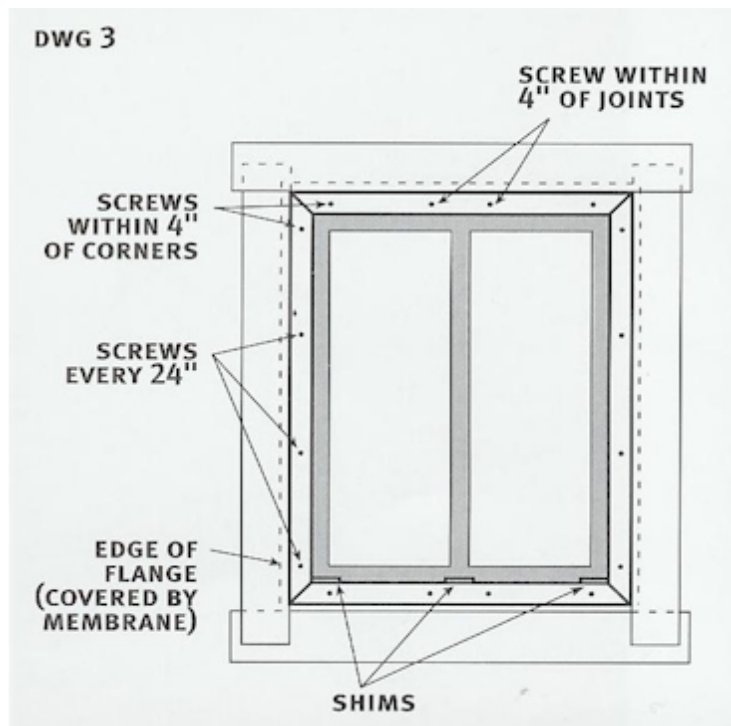
**PART 6 Step 3: Prepare rough opening (See DWG 1).** At the top of the window, cut and fold up exterior building paper revealing about 6" (150mm) of sheathing. Create a sloped sill with a piece of clapboard. (See DWG 2) The clapboard needs to be at least as deep as the window. Cover the clapboard with a self-adhering waterproof membrane. It must overlap the clapboard by 6" (150mm) both up each jamb and down over the building paper. Apply gussets in the bottom corners to ensure membrane is continuous.





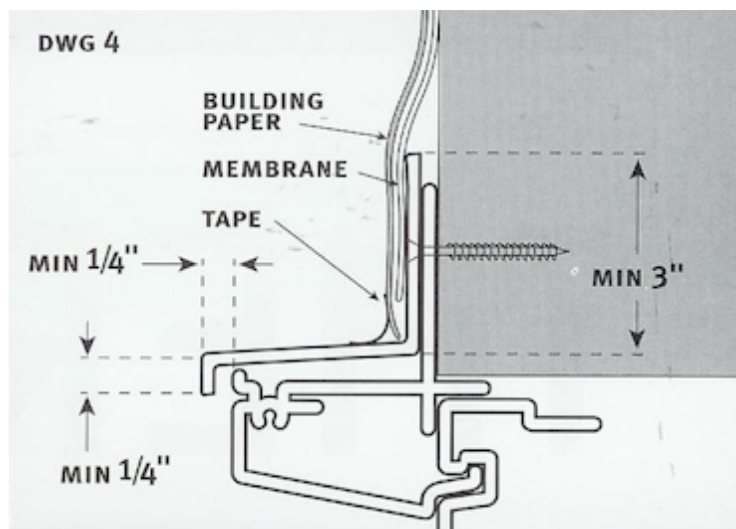
**Step 4: Set window in rough opening.** Ensure visible drainage hole covers are on the outside and the bottom of window.

**Step 5: Shim window so that it is plumb, square, and level.**  
**(See DWG 3)** There must be shims under bottom right and bottom left corners of all windows, as well as under all vertical mullions. Add other shims as necessary to support the window, (typically ever 24" (600mm)). Ensure that the window is not carrying any structural loads. Adjust shims to ensure a uniform clearance/reveal between sash and frame.



**Step 6: Secure installation flange to the building with screws.**  
**(See DWG 4)** There must be screws within 4" (100mm) of each corner and within 4" (100mm) of each mullion – in both directions. That means two per corner and two per mullion. Additionally there must also be a screw every 24" (600mm). Verify that the window

opens and closes smoothly. If not, reconfirm step 5, removing and reinstalling screws as required. If that doesn't work, contact your dealer before proceeding.



**Step 7: Join the flange to the rest of the building to maintain a continuous drainage plane.** Cover the installation flanges with a self-adhering waterproof membrane.

**Step 8: Install a drip edge/cap over the window. (See DWG 4)** It must extend at least 3" (75mm) upwards against the sheathing. It must also extend both out past and down over the outer face of the window by at least 1/4" (6mm). Additionally, the drip edge must extend past each end of the window by 1/4" (6mm). Cover the vertical leg of the drip edge to the wall with a self-adhering waterproof membrane that completely overlaps the jamb membranes. Unfold the building paper down over the taped edge. A properly installed drip edge is required over the top of each window.

**Step 9: Join the window to the rest of the building to maintain a continuous air barrier. (see DWG 3)** Caulk the interior edge of the sill to the self-adhering waterproof membrane below it. (See DWG 2) along the jambs and head insulate between the rough opening and the window. Careful installers do this by using low expansion urethane foam. Be sure to carefully follow all the directions and warnings from the foam supplier. Be careful not to distort the frame by over insulating.

END OF SECTION

## SECTION 09 28 00

## BACKING BOARD AND UNDERLAYMENT

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide backing board at locations expressed in drawings including:
  - 1. Shower
  - 2. Kitchen
  - 3. Sunporch
  - 4. Mechanical Room

**1.2 RELATED SECTIONS**

- A. Section 06 16 00 - Sheathing
- B. Section 06 11 00 - Rough Carpentry
- C. Section 09 29 00 - Gypsum Board
- D. Section 09 30 00 - Tiling
- E. Section 09 30 13 - Ceramic Tiling

**1.3 REFERENCES**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Tolerances: Not more than 1/16-inch difference in true plane at joints between adjacent boards before finishing. After finishing, joints shall be not be visible. Not more than 1/8 inch in 10 feet deviation from true plane, plumb, level and proper relation to adjacent surfaces in finished work.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in their original unopened packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes.
- C. Protect tile setting and grouting materials from freezing. Neatly stack tile backer boards to prevent sagging; stack flat, on continuous surface, and without skids.
- D. Handle tile backer boards to prevent damage to edges, ends or surfaces. Remove damaged or deteriorated materials from site.

## 1.5 PROJECT CONDITIONS

- A. Cold Weather Protection: In cold weather, maintain continuous, uniform, building temperatures of not less than 45 deg F (13 deg C) or more than 100 deg. F (38 deg. C) for a minimum period of 48 hours prior to, during, and following tile backer board and tile installation
- B. Conditioning: Store tile backer board in spaces where it is to be installed for 48 hours prior to installation. Do not install board when it is wet.
- C. Ventilation: Ventilate building spaces as required to remove excess moisture.

## PART 2 PRODUCTS

### 2.1 CEMENT BACKER BOARD

- A. General: Provide backing board at all tiled locations.
- B. Manufacturer: USG or equivalent.
- C. Substitutions: Products of equal or greater quality will be considered.
- D. Product:
  - 1. Cement Backer Board: DUROCK Exterior Cement Board:
  - 2. Thickness: 1/2 inch minimum.
  - 3. Faces: Smooth on one side, textured on other side.
  - 4. Edges: Formed smooth edges; square cut ends.
  - 5. Underlayment: DUROCK Underlayment.
  - 6. Associated Materials:
    - a. Tape and Joint Compound: Install gypsum board for tape and 3-coat joint compound finish in compliance with ASTM C 840 and GA 216, Level 4 finish. Install gypsum board assemblies true, plumb, level and in proper relation to adjacent surfaces.
    - b. Metal reveals and beading: Install J-reveals and beading at all outside corners to protect said corners from damage.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Examine substrates and framing for compliance with requirements and conditions affecting work of this Section. Do not proceed with installation until piping, waterproofing, and other in-wall work has been installed and accepted by Architect/Engineer and unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's printed installation instructions applicable to products and applications indicated, except when more stringent requirements apply.

- B. Tape and Joint Compound: Install gypsum board for tape and 3-coat joint compound finish in compliance with ASTM C 840 and GA 216, Level 4 finish. Install gypsum board assemblies true, plumb, level and in proper relation to adjacent surfaces.
- C. Provide continuous vapor retarder at exterior walls.
- D. Do not allow butt-to-butt joints and joints that do not fall over framing members.
- E. Install trim in strict compliance with manufacturer's instructions and recommendations.
- F. Repair surface defects. Leave ready for finish painting or wall treatment.
- G. Install in accordance with manufacturer's instructions.
- H. Conform to construction requirements of tested assemblies used to demonstrate required sound attenuation and fire resistance. Before installation, cut tile backer boards to required sizes, make necessary cut-outs for penetrations, and grind or drill to provide relief at bolts and screw heads which project beyond face of substrate.
- I. Control Joints: Do not install tile backer board continuously through building movement and control joints or where control joints are required in ceramic tile.
  - 1. Water Barrier: Install over gypsum board base layer at tubs, showers, and other wet areas and where indicated. Lap joints to shed water towards face of partition. Bottom edge shall overhang lip of tub, shower pan, or shower receptor.
  - 2. Apply tile backer boards to framing with long dimension parallel to or across framing. Fit ends and edges closely but not forced together. Center end or edge joints on framing and stagger joints in adjacent rows.
  - 3. At tub, shower pan, or shower receptor, place temporary 1/4 inch spacer strips around lip of fixture. Install board abutting top of spacer. Remove spacer before installing tile. Joint sealants are specified in another section.
  - 4. Fasten tile backer board to framing. Locate screws at least 3/8 inch from edge of board and as follows:
    - a. Walls - Wood Framing: 8 inches o.c.

J. JOINT TREATMENT

- 1. Tiled Surfaces: Apply joint reinforcing over joints and corners. Embed with mortar or adhesive used to set tile.
- 2. Securely attach all gypsum products to substrate as required by code and as illustrated in drawings.

3.3 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 09 29 00

## GYPSUM BOARD

**PART 1 GENERAL**

## 1.1 SUMMARY

- A. Provide gypsum board assemblies, applications including:
  - 1. Walls, soffits.

## 1.2 RELATED SECTIONS

- A. Section 06 16 00 - Sheathing
- B. Section 06 11 00 - Rough Carpentry
- C. Section 09 28 00 - Backing Boards and Underlayment

## 1.3 REFERENCES

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Tolerances: Not more than 1/16-inch difference in true plane at joints between adjacent boards before finishing. After finishing, joints shall be not be visible. Not more than 1/8 inch in 10 feet deviation from true plane, plumb, level and proper relation to adjacent surfaces in finished work.
- C. Fire Resistance for Fire-Rated Assemblies: ASTM E 119.
- D. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship and level of finish.
- E. Performance: Fire, structural, and seismic performance meeting requirements of building code and local authorities.

## 1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturers data sheets on each product to be used including:
  - 1. Preparation instructions and recommendations
  - 2. Description of materials, finishes, and construction
  - 3. Storage and handling requirements and recommendations

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

## 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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 GYPSUM BOARD

- A. General: Provide gypsum board for all interior walls, partitions, and soffits as illustrated in architect's drawings.
- B. Manufacturer: USG or equivalent.
- C. Product:
  - 1. Application: Gypsum drywall at interior walls, partitions and soffits.
    - a. Material Standard: ASTM C1396.
    - b. Type: Board for tape and joint compound finish.
    - c. Type: Regular, moisture-resistant and fire-rated types as required.
    - d. Typical Thickness: 1/2 inch.
  - 2. Application: Soffit board at exterior ceilings and soffits.
  - 3. Application: Insulation and vapor barrier systems in gypsum board assemblies.
  - 4. Auxiliary Materials:
    - a. Joint Treatment: ASTM C474 and ASTM C840, 3-coat system, paper or fiberglass tape.
    - b. Gypsum-based joint compound.
    - c. Corner bead, edge trim and control joints.
    - d. Gypsum board screws, ASTM C 1002.
    - e. Fastening adhesive.
    - f. Concealed acoustical sealant.
    - g. Recycled denim insulation pads.
    - h. Polyethylene vapor retarder, 6 mils.
    - i. Polystyrene aggregated finish for ceilings.

### 2.2 GYPSUM BOARD REVEALS

- A. General: Provide reveals and caps as illustrated in architect's drawings.
- B. Manufacturer: USG, Trim-Tex, Fry-Reglet or equivalent.



1. Substitutions: Products of equal or greater quality will be considered.
  2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.
- C. Product:
1. Use shapes and dimensions as illustrated in architect's drawings.
  2. Material: Sheet metal unless noted otherwise in drawings.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. 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. Wood Framing: Install wood framing in compliance with Section 06 11 00 - Rough Carpentry. Install with tolerances necessary to produce substrate for gypsum board assemblies with tolerances specified. Include blocking for items such as railings, grab bars, casework, toilet accessories, window treatment and similar items.
- B. Tape and Joint Compound: Install gypsum board for tape and 3-coat joint compound finish in compliance with ASTM C 840 and GA 216, Level 4 finish. Install gypsum board assemblies true, plumb, level and in proper relation to adjacent surfaces.
- C. Provide continuous vapor retarder at exterior walls.
- D. Provide fire-rated systems where indicated and where required by authorities having jurisdiction.
- E. Install boards vertically. Do not allow butt-to-butt joints and joints that do not fall over framing members.
- F. Provide insulation full height and thickness in partitions at bathroom and mechanical room wall.
- G. Provide acoustical sealant at both faces at top and bottom runner tracks, wall perimeters, openings, expansion and control joints.
- H. Install trim in strict compliance with manufacturer's instructions and recommendations. Place expansion joints as illustrated in architect's drawings.
- I. Repair surface defects. Leave ready for finish painting or wall treatment.
- J. Install in accordance with manufacturer's instructions.
- K. Securely attach all gypsum products to substrate as required by code and as illustrated in drawings.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

**SECTION 09 30 00****TILING****PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes the following:
  - 1. Tiling for bathroom
  - 2. Tiling for sun porch
  - 3. Tiling for kitchen backsplash

**1.2 RELATED SECTIONS**

- A. Section 06 40 23 Interior Architectural Woodwork
- B. Section 09 29 00 Gypsum Board
- C. Section 09 64 00 Wood Flooring
- D. Section 12 35 30 Residential Casework
- E. Section 12 35 30.13 Kitchen Casework
- F. Section 12 36 00 Countertops

**1.3 REFERENCES**

- A. ANSI American National Standards Institute [www.ansi.org](http://www.ansi.org)

**1.4 SUBMITTALS**

- A. Product Data: Manufacturer's data sheets on product to be used, including:
  - 1. Preparation instructions and recommendations
  - 2. Description of materials, finishes, and construction
  - 3. Storage and handling requirements and recommendations.
  - 4. Installations methods.
  - 5. Maintenance methods
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturers full range of color and finish options if additional selection is required.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened

packaging with labels intact until ready for installation.

## 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Comply with governing codes and regulations. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Tile: ANSI A 137.1.
- D. Tile Setting Materials: ANSI A 118 series standard specifications.
- E. Tile Installation: ANSI 108 series standard specifications and Tile Council of America, Handbook for Ceramic Tile Installation.
- F. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

## PART 2 PRODUCTS

### 2.1 STONE TILE

- A. General: Tile for bathroom shower floor, shower wall, sunporch floor.
- B. Manufacturer: Maniscalco
- C. Product:
  - 1. Sliced Black Botany Bay Pebbles Q204  
<http://www.maniscalcostone.com/NormalProductL2.aspx?CategoryId=8&GroupID=1>

### 2.2 PORCELAIN TILES

- A. General: Tile for bathroom walls
- B. Manufacturer: Crossville
- C. Product: Eco-Cycle Tile  
[http://www.crossvilleinc.com/products\\_series.cfm?SeriesID=13&ref=products](http://www.crossvilleinc.com/products_series.cfm?SeriesID=13&ref=products)

### 2.3 CERAMIC TILE

- A. General: Tile for window sills
- B. Manufacturer: Iowa State University Ceramics Studio
- C. Product: Printed ceramic tile
  - 1. Size: 4" h x 5" w x ¼" d
  - 2. Pattern: Grass Print

## 3. Color: Ivory print

**2.4 GROUT**

- A. General: Grout for tile installation
- B. Manufacturer: StarQuartz
- C. Quartz-Lock Grout  
<http://www.starquartz.com/>
- D. Mortar setting bed.
  - 1. Latex additive.
- E. Thin-set mortar.
  - 1. Dry-set Portland cement mortar.
  - 2. Latex-Portland cement mortar.
  - 3. Conductive dry-set mortar.
  - 4. Chemical-resistant epoxy adhesive.
  - 5. Chemical-resistant furan mortar.
  - 6. Modified epoxy emulsion mortar.
- F. Organic adhesive.
- G. Grout.
  - 1. Sand-Portland cement grout.
  - 2. Dry-set grout.
  - 3. Latex-Portland cement grout.
  - 4. Chemical-resistant epoxy grout.
  - 5. Chemical-resistant furan resin grout.
  - 6. Silicone rubber elastomeric grout for pregrouted sheets.
- H. Waterproofing membrane under tile.
  - 1. ANSI A 118.10.
- I. Crack suppression membrane under tile.
  - 1. ANSI A 118.10.
- J. Elastomeric sealants.
- K. Stone thresholds.

**PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Comply with Tile Council of America and ANSI Standard Specifications for Installation for substrate and installation required. Comply with manufacturer's instructions and recommendations.
- B. Install waterproof membrane in accordance with manufacturer's instructions and recommendations.
- C. Lay tile in grid pattern with alignment grids. Layout tile to provide uniform joint widths and to minimize cutting; do not use less than 1/2 tile units.
- D. Provide sealant joints where recommended by TCA and approved by Architect.
- E. Grout and cure, clean and protect.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 09 72 00

## WALL COVERINGS

**PART 1 GENERAL****1.1 SUMMARY**

A. This section includes the following:

1. Wall Covering Material

**1.2 RELATED SECTIONS**

- A. Section 09 29 00 – Gypsum Board
- B. Section 08 95 16 – Wall Vents
- C. Section 06 40 23 – Interior Architectural Woodwork
- D. Section 12 35 30.13 – Kitchen Casework
- E. Section 12 35 30 – Residential Casework
- F. Section 08 11 16 – Aluminum Doors and Frames
- G. Section 08 54 13 – Fiberglass Windows
- H. Section 07 91 16 – Joint Gaskets
- I. Section 07 92 00 – Joint Sealants
- J. Section 08 10 00 – Doors and Frames
- K. Section 09 30 00 – Tiling
- L. Section 09 91 00 – Painting

**1.3 REFERENCES**

- A. N/A.

**1.4 SUBMITTALS**

- A. Product Data: Manufacturer's data sheets on product to be used, including:
1. Preparation instructions and recommendations
  2. Description of materials, finishes, and construction
  3. Storage and handling requirements and recommendations.
  4. Installations methods.
  5. Maintenance methods
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is

anticipated.

- C. Extra Stock: Submit extra stock equal to 2 unopened rolls of each type of wall covering used.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 WALL COVERING MATERIAL**

- A. General: Environmentally sustainable wall covering.
- B. Manufacturer: Schumacher & Co.
- C. Product: Karami Weave – Rice (5003010).

<http://www.fschumacher.com/search/ProductDetail.aspx?sku=5003010>

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

## **3.2 INSTALLATION**

- A. Acclimatize materials; prime and seal substrates; test substrates for moisture content and prepare surfaces in compliance with manufacturer's recommendations.
- B. Install in accordance with manufacturer's instructions. Apply adhesive and install with seams plumb and overlapped and double-cut to ensure tight closure except where pattern would not match. Do not place seams within 6" of corners.
- C. Remove air bubbles, blisters, wrinkles and other defects; horizontal seams are not permitted. Remove excess adhesive immediately; clean walls and protect surfaces.

## **3.3 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**



## SECTION 09 91 00

## PAINTING

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section includes the following:
  - 1. Painting and coating for new construction
    - a. Exterior surfaces and items
    - b. Interior surfaces and items

**1.2 RELATED SECTIONS**

- A. Section 05 70 00 – Ornamental Metal
- B. Section 08 10 00 – Doors and Frames
- C. Section 08 54 13 – Fiberglass Windows
- D. Section 09 29 00 – Gypsum Board

**1.3 REFERENCES**

- A. ASTM D 3960-2005 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- B. ASTM D 6670-2001 Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products
- C. ASTM E 2129-2005 Standard Practice for Data Collection for Sustainability Assessment of Building Products
- D. MPI Architectural Painting Specification Manual [www.specifypaint.us](http://www.specifypaint.us)
- E. PDCA P5

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
  - 1. Include manufacturer's full range of color and finish options if additional selection is required.
- C. Extra Stock: Submit 2 unopened gallons of each paint and color used in the project.

## **1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Regulations: Compliance with VOC and environmental regulations.
- C. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.
  - 1. Provide 4 foot x 4 foot mock-ups of each type of surface.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 FIRST PRODUCT**

- A. General: Zero VOC paint for interior and exterior unfinished surfaces as defined in the construction documents.

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verify of Conditions: Verify openings are in accordance with approved shop drawings.
- C. Beginning construction activities of this section indicates installer's acceptance of conditions

## **3.2 INSTALLATION**

- A. Inspect surfaces, report unsatisfactory conditions in writing; beginning work means acceptance of substrate.
- B. Comply with manufacturer's instructions and recommendations for preparation, priming and coating work. Coordinate with work of other sections.

- C. At existing areas to be repainted, remove blistered or peeling paint to sound substrates. Remove chalk deposits and mildew and wash all surfaces with mild detergent. Perform related minor preparation including caulk and glazing compounds. Spot prime bare areas before priming and painting as specified.
- D. Match approved mock-ups for color, texture, and pattern. Re-coat or remove and replace work which does not match or shows loss of adhesion. Clean up, touch up and protect work.

### 3.3 PAINT SCHEDULE

- A. Gypsum Drywall Walls and Soffits:
  - 1. Gloss:
    - a. Flat
  - 2. System:
    - a. 1 coat latex primer
    - b. 2 coats latex finish
- B. Gypsum Drywall Walls and Soffits in Bathrooms, Kitchens and Wet Areas:
  - 1. Gloss:
    - a. Semi
  - 2. Texture:
    - a. Stipple
  - 3. System:
    - a. 1 coat latex primer
    - b. 2 coats latex finish
- C. Gypsum Drywall Walls to Receive Wall Covering:
  - 1. System:
    - a. 1 coat latex primer
- D. Wood Paneled Ceilings:
  - 1. Gloss:
    - a. Semi
  - 2. System:
    - a. 1 coat latex primer
    - b. 2 coats latex finish

### 3.4 PROTECTION

- A. Protect installed products until completion of project.

**END OF SECTION**

**SECTION 09 93 13****EXTERIOR STAINS AND TRANSPARENT FINISHES****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Wood stains and transparent finishes.
- B. Wood repair products.

**1.2 RELATED SECTIONS**

- A. Section 06 20 13 – Exterior Finish Carpentry: Wood items for transparent finish.
- B. Section 07 46 23 – Fabricated Panel Assemblies with Siding: Wood items for transparent finish.

**1.3 SUBMITTALS**

- A. Submit under provisions of Section 01300.
- B. 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 finishes.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color and finish on wood of type to be finished.

**1.4 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.

**1.5 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.

## 1.6 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

- A. Acceptable Manufacturer: AFM SafeCoat.
- B. Substitutions: Products of equal or greater quality will be considered.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.
- D. Stains and Coatings - General:
  - 1. Unless otherwise indicated, provide factory-mixed materials. Mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials unless such procedure is specifically described in manufacturer's product instructions.
  - 2. Supply each material in quantity required to complete entire project's work from a single production run.
- E. Back Primer for Transparent-Finished Woodwork:
  - 1. Same as finish coat.
- F. Application Accessories: Provide all primers, sealers, cleaning agents, tools, cleaning cloths, sanding materials, and clean-up materials required.
- G. Exterior Wood - Natural Clear Finish: Including doors, trim, soffits, fascia, and siding.
  - 1. AFM Naturals Clean Penetrating Oil

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin application of coatings 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. Stir before and during application as recommended by manufacturer.

- C. Do not apply to wet or damp surfaces.
- D. Apply using methods recommended by manufacturer.
- E. Apply without runs, drips, or sags, without brush marks, and with consistent sheen.
- F. Apply at spreading rate required to achieve the manufacturer's recommended film thickness.

#### **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 10 14 00****SIGNAGE****PART 1 SIGNAGE GENERAL****1.1 SUMMARY**

- A. Provide signage.

**1.2 RELATED SECTIONS**

- A. Not Applicable

**1.3 REFERENCES**

- A. Not Applicable

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
  - 3. Storage and handling requirements and recommendations.
- C. Shop Drawings: Submit shop drawings when necessary, showing plans, sections, and elevations. Show edge conditions, attachment to other work, profiles and finishes of each metal member, and joinery to other metal members and to adjacent work. Show mounting types, heights, anchorage methods, and attachment devices.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

**PART 2 PRODUCTS****2.1 INTERIOR SIGNAGE:**

- A. General:
- B. Manufacturer: An attempt to use a local manufacturer. Submit shop drawings and



specifications to architect for approval.

C. Products:

1. Signage: Unframed, Stainless steel / Wood, Raised lettering.

## **2.2 EXTERIOR SIGNAGE**

- A. General: Fabricated Signage according to design document specifications.
- B. Manufacturer: An attempt to use a local manufacturer. Submit shop drawings and specifications to architect for approval.
- C. Product: Fabricated, painted steel / wood, with satin finish.

## **2.3 EXTERIOR PANEL SIGNS**

- A. General: Post mounted framed single-sheet and box-type panels.
- B. Manufacturer: An attempt to use a local manufacturer. Submit shop drawings and specifications to architect for approval.
- C. Product: Painted steel / wood signage on galvanized steel posts with base-plate mounting.

# **PART 3 EXECUTION**

## **3.1 PREPARATION**

- A. 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 and approved submittals..
- B. Install materials and systems in proper relations with adjacent construction and with uniform appearance.
- C. Coordinate with work of other sections.

## **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 10 28 13

### TOILET ACCESSORIES

#### **PART 1 GENERAL**

##### **1.1 SUMMARY**

- A. This section includes the toilet mounting instructions.

##### **1.2 RELATED SUBJECTS**

- A. Section 06 11 00 Rough Carpentry
- B. Section 09 30 00 Tiling
- C. Section 10 28 16 Bath Accessories
- D. Section 22 00 00 Plumbing
- E. Section 22 07 19 Plumbing Piping Insulation
- F. Section 22 09 00 Instrumentation and Controls for Plumbing

##### **1.3 REFERENCES**

- A. ANSI A117.1 - Specificatino for Providing Accessibility and Usability for Handicapped People Using Buildings and Facilities
- B. ASME A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use
- C. ASME A112.19.2 Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals

##### **1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
- C. Storage and handling requirements and recommendations.
- D. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

##### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

##### **1.6 PROJECT CONDITIONS**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years.

Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

- B. Environmental Requirements: 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 PRODUCTS**

A. General: Wall-Mounted Toilet

B. Manufacturers

1. Ira Woods  
<http://www.irawoods.com/Home/Toilets-Wall-Hung?gclid=CL2T2Nzi0pkCFR7yDAodTEffvA>
2. American Standard  
[https://www.homecenter.com/product\\_American\\_Standard\\_Toilet\\_-\\_One-piece\\_Afwall\\_2257.103.020\\_45406.html](https://www.homecenter.com/product_American_Standard_Toilet_-_One-piece_Afwall_2257.103.020_45406.html)
3. Duravit  
[http://www.duravit.com/products/categories/toilets/duraplus--s-2200\\_useo6ptmaz.html](http://www.duravit.com/products/categories/toilets/duraplus--s-2200_useo6ptmaz.html)

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 10 28 16  
BATH ACCESSORIES

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Provide toilet, bath and laundry accessories.

**1.2 RELATED SUBJECTS**

- A. 10 28 13 Toilet Accessories
- B. 09 30 00 Tiling

**1.3 REFERENCES**

- A. ANSI A117.1 - Safety Standards for the Handicapped.
- B. ASTM F 446 - Standard Consumer Safety Specification for Grab bars and Accessories Installed in the Bathing Area.
- C. ASTM C 1503 - Mirror Glazing Quality
- D. ASTM A 666 - Stainless Steel Nominal Thickness
- E. ADA Accessibility Guidelines for Buildings and Facilities --July 23, 2004 – Provisions for Children
- F. ASTM A123 /A123M-02 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A167-99 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
- H. ASTM A269-02 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- I. ASTM A794-97 Standard Specifications for Commercial Steel, Carbon, Cold-Rolled
- J. ASTM B456-95 - Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Description of materials, finishes, and construction.
- C. Storage and handling requirements and recommendations.
- D. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

## **1.6 PROJECT CONDITIONS**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Environmental Requirements: 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 Manufacturers:
  - 1. Manufacturers:
    - a. American Specialties, Inc.  
[http://www.americanspecialties.com/new\\_website/contents.htm](http://www.americanspecialties.com/new_website/contents.htm)
    - b. Bradley Corp.  
<http://www.bradleycorp.com/products/accessories/>
    - c. Tubular Specialties Mfg. Inc. (TSM)  
<http://www.calltsm.com/catalog825.htm>
    - d. Universal Bath Systems  
<http://www.universalplastics.com/pages/bath>

## **2.2 MATERIALS**

- A. Toilet and Bath Accessories:
  - 1. Accessory: Toilet tissue dispensers, single roll.
  - 2. Accessory: Grab bars.
  - 3. Accessory: Towel bars.
  - 4. Accessory: Folding shower seats.
  - 5. Accessory: Shower liner
  - 6. Finish: Stainless steel.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

**SECTION 10 57 00****WARDROBE AND CLOSET SPECIALTIES****PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes the following:
  - 1. Wardrobe and closet specialties.

**1.2 RELATED SECTIONS**

- A. Section 12 35 30 – Residential Casework
- B. Section 06 41 13 – Wood-Veneer-Faced Architectural Cabinets
- C. Section 12 22 00 – Curtains and Drapes
- D. Section 12 22 16 – Curtain Track

**1.3 REFERENCES**

- A. NA

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data:
  - 1. Medium-density Fiberboard
  - 2. Maple Flat Cut Veneer
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.



## **1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 WARDROBE AND CLOSET SPECIALITIES**

- A. General: Wardrobe and Closet Specialities to allow for storage in the house.
- B. Manufacturer: George Granseth, DMACC
- C. Product:
  - 1. Medium-Density Fiberboard
  - 2. Maple Flat Cut Veneer
  - 3. Solid Veneer Face Style
  - 4. Frameless
  - 5. Clear Coat Water Based Finish

## **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. Before application, allow particleboard to stabilize to the same conditions as are expected after the panel is installed. Conditions 48 to 72 hours prior to lamination.

### **3.3 INSTALLATION**

- A. Provide work to sizes, shapes, and profiles indicated. Install work to comply with quality standards referenced. Back prime work and install plumb, level and straight with tight joints; scribe work to fit.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Use non-corrosive fasteners for exterior work. Coordinate with work of other sections.
- C. Comply with manufacturer's requirements for cutting, handling, fastening and working treated materials.
- D. Repair minor damage, clean and protect.

- E. Protect adjacent materials and surfaces; bear responsibility for repair of damage to other finished materials caused by work of this Section.
- H. Plumb and level items unless shown otherwise.
- K. After completion, marks and stains shall be removed and the work left clean for factory finishing. Surfaces to receive finish shall be smoothly dressed and sand papered. Nail heads shall be set below the surface of the wood.
- L. Materials involved in this section should not be installed until after building is enclosed, wet work has been completed and operations that could damage the woodwork have been completed.

### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

**END OF SECTION**

## SECTION 10 71 13

## EXTERIOR SUN CONTROL DEVICES

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide exterior sun control

**1.2 RELATED SECTIONS**

- A. Section 079000 – Joint Sealers: Sealing around perimeter of louvers.
- B. Section 099000 – Paints and Coatings: Field painting.

**1.3 REFERENCES**

- A. AMCA 500-L – Laboratory Methods of Testing Louvers for Rating; Ait Movement and Control Association International, Inc.; 1999

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 013000.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes, and 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. Certificate of Compliance: Product certificate from the louver manufacturer certifying that the applicable products being supplied complies with specified requirements and has been tested in accordance with procedures stipulated in AMCA 500-L of the Air Movement and Control Association (AMCA).
- D. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, blackout areas required, and frames.
  - 1. Take necessary field dimensions or receive verification of finished sizes from installation trades or general contractor.
- 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, three samples, minimum size 23 ½ inches (600mm) square, representing actual product.

**1.5 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.

## **1.6 WARRANTY**

- A. Warranty: Work warranted against defects and deficiencies for 2 years.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturer:

LouvreTecUSA, Inc.  
725 E. Figueroa St.  
Santa Barbara, CA 93103  
[www.louvretecusa.com](http://www.louvretecusa.com)  
PH: 805.966.1977  
FAX: 805.962.7757

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

### **2.2 WALL LOUVERS**

- A. Louvers - General: Factory fabricated and assembled; AMCA tested under AMCA 500-L.
1. Wind Load Resistance: Design to resist positive and negative wind load of \_\_\_\_ psf (\_\_\_\_ kPa) without damage or permanent deformation.
  2. Blades: One piece extrusions with reinforcing bosses, supported and lined up with heavy-gage extruded aluminum blade braces, positively interlocked to each blade and mechanically secured to structure by aluminum and stainless steel fastenings.
  3. Where louver exceeds manufacturer's recommended unsupported width or height, concealed, provide back-of-louver structural supports consisting of minimum 2 inch by 2 inch by 1/4 inch (50 mm by 50 mm by 6 mm) aluminum angles, designed to resist specified wind loads; location of angles coordinated to suit penetrations of mechanical air systems.
  4. Exposed edges and ends of metal dressed smooth, free from sharp edges.
  5. Exposed connections and joints constructed to exclude water.
  6. For horizontal louver blades butt jointed with expansion allowance, provide concealed method of aligning blades of adjacent panels so that blades appear to be continuous without any face frame.
  7. For louvers immediately adjacent to existing louvers, match style of louver blades and line up blades with existing blades.
- B. Operable Louvers: Operable horizontal blades, extruded aluminum construction;

frame with channel profile; corner joints mitered and mechanically fastened; continuous recessed caulking channel each side; integral seal reducing air leakage and water penetration; blades operating on aluminum pins with nylon bushings and opening to 45 degrees.

1. Acceptable Product: S 445.
  - a. Free Area: 56 percent, minimum.
  - b. Frame: 6 inches (152 mm) deep.
2. Operation: Chain.
3. Operation: Manual quadrant wheel.
4. Movable Blades: Pivot where?
5. Fixed Blades: Straight.
6. Metal Thickness: Frame 0.080 inch (2 mm); blades 0.080 inch (2 mm).
7. Finish: Fluoropolymer coating, finished after fabrication.
8. Color: As scheduled

## 2.3 ACCESSORIES

- A. Sills: Minimum 0.06 inch (1.27 mm) thick aluminum.
  1. Formed back edge turned up at underside of louver sill sections.
  2. Louvers With Jambs Designed to Drain Water: Extend sill under entire frame section.
  3. Other Louvers: Locate turned up back edge under bottom frame member.
- B. Hanging aluminum track slide system with steel roller wheels on top of framed out louver assembly and a steel tab and slot system on the bottom of framed out louver assembly. Louvers within frame and hanging aluminum track slide system all assembled as one unit. Five identical units.
- C. Steel brackets to fasten bottom steel louver slide and top hanging track slide to exterior façade of house to be fabricated from steel angle iron.
- D. Fasteners and Anchors:
  1. For Aluminum: Series 300 or 400 stainless steel.
  2. For Steel Exposed to Weather: Series 300 stainless steel.
  3. For Steel Not Exposed to Weather: Hot-dipped galvanized or cadmium plated.
- E. Flashings: Same material as louver frame, formed to required shape, single length in one piece per location.

- F. Sealant: As specified in Section 07900.

## **2.3 MATERIALS**

- A. General: Provide metal framing, furring, brackets, clips, hangers, and incidental components included as required for secure fastening; weather-tight installation with non-corrosive fasteners provided.
- B. Bird Screen: Interwoven wire mesh, 1/2 inch (13 mm) open weave.
  - 1. Aluminum mesh.
  - 2. Stainless steel mesh
- C. Anodized Finishes:
  - 1. Class I Clear Anodized Finish (.0007")
- D. Primer: Zinc chromate, alkyd type; dry film thickness of 25 micrometers; field welds spot primed after roughness and irregularities removed by grinding and cleaning with wire brush.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### **3.2 INSTALLATION**

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb, true to dimensions, and free from distortion or defects detrimental to appearance and performance; plumb louvers within a tolerance of 1:175.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.
- E. Provide adequate reinforcing and anchorage to ensure a rigid installation.
- F. Install perimeter sealant and backing rod in accordance with Section 07900; where sills are integral, set in two continuous beads of sealant.
- G. Coat all aluminum surfaces in contact with cement, concrete, masonry, or dissimilar metals with heavy coat of non-staining alkali resistant bituminous paint.

### **3.3 CLEANING**

- A. Strip protective finish coverings.
- B. Clean surfaces and components.
- C. Remove any trademarks or labels from exposed finished surfaces.

END OF SECTION

SECTION 11 31 00  
RESIDENTIAL APPLIANCES

**PART 1 GENERAL**

**1.1 SUMMARY**

A. Section includes the following:

1. Microwave
2. Oven
3. Dishwasher
4. Range
5. Range Hood
6. Refrigerator / Freezer
7. Washer/dryer

**1.2 REFERENCES**

A. American National Standards Institute (ANSI)

1. A117.1 Guidelines for Accessible and Useable Buildings and Facilities

B. Environmental Protection Agency

1. Energy Star Appliances

C. Americans with Disabilities Act of 1990 – Public Law

1. 101-336 Americans with Disabilities Act

**1.3 SUBMITTALS**

A. Manufacturer's published data sheets, including:

1. Model Number
2. Preparation instructions and recommendations
3. Rough dimensions and utility connections
4. Storage and handling requirements
5. Installation tools and methods



## 6. List of maintenance parts

### 1.4 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspect appliances upon delivery. Report any damaged or missing components.
- B. Store appliance in manufacturer's packaging until ready for installation.
- C. Store packed appliances in a fully enclosed structure that will provide protection from exposure to wind, rain, moisture, and ultraviolet light. Be sure the storage surface is level and sound.

### 1.6 PROJECT CONDITIONS

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before installation.

### 1.7 WARRANTY

- A. Provide manufacturer's warranty, with manufacturer's installation instructions, in the CUSD Operations Manual.

## PART 2 PRODUCTS

### 2.1 Appliances

- A. General: Provide these specific appliances from these specific manufactures.
- B. Manufacturers: Frigidaire, GE, Summit, Whirlpool, Conserve (Vestfrost), Equator
- C. Product: Substitutions are not allowed for the following items.

- 1. GE 0.7 Cubic Foot Microwave Oven

Model: JES0736SMSS

Web:<http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10051&langId=1&catalogId=10053&productId=100593685&N=10000003+780+10158007>

- 2. Whirlpool Built-In-Oven

Model: RBS245PRS

Web:[http://www.whirlpool.com/catalog/product.jsp?categoryId=83&productId=1369&successful\\_search=RBS245PRS](http://www.whirlpool.com/catalog/product.jsp?categoryId=83&productId=1369&successful_search=RBS245PRS)

- 3. Frigidaire 18" Under-Counter Dishwasher

Model: FMB330RGC

Web: [http://www.frigidaire.com/products/Dishwashers/Built-In\\_Dishwashers/18\\_inch/prod\\_FMB330RGC.asp](http://www.frigidaire.com/products/Dishwashers/Built-In_Dishwashers/18_inch/prod_FMB330RGC.asp)

4. Summit Induction Cook top

Model: SINC2-220

Web: <http://www.summitappliance.com/>

5. Whirlpool Range Hood

Model: GZ7736XGS

Web: [http://www.whirlpool.com/catalog/product.jsp?categoryId=86&productId=1339&successful\\_search=GZ7736XGS](http://www.whirlpool.com/catalog/product.jsp?categoryId=86&productId=1339&successful_search=GZ7736XGS)

6. Conserve Free Standing Refrigerator

Model: CP171SS

Web: <http://www.conservrefrigerators.com/>

7. Equator Combo washer/dryer

Model: EZ 3720 CEE

Web: <http://www.equatorappliance.com/>

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings.
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Refer to manufacturer's data and installation sheets located in the CUSD Operations manual for additional instructions.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation

END OF SECTION

## SECTION 12 22 00

## CURTAINS AND DRAPES

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes the following:
  - 1. Curtain and shade Fabric
  - 2. Curtain and shade Liner

**1.2 RELATED SECTIONS**

- A. Section 06 10 00 - Rough Carpentry
- B. Section 12 22 16 - Ceiling Mounted Curtain Track

**1.3 REFERENCES**

- A. ASTM E84 – Test Method for Fabric's ability to resist burning.
- B. AATCC 16 – Test Method for determining the colorfastness to light of textile materials.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store curtains and shades in unopened packaging until ready for installation on curtain track.

**1.5 PROJECT CONDITIONS**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**PART 2 PRODUCTS****2.1 CURTAIN FABRIC**

- A. General: Fabric that will be used to manufacture the curtains throughout the house.
- B. Manufacturers: Herman Miller (Distributed by Pigott, Inc.)
- C. Product: Luminary – Glow (2U05)

<https://www4.hermanmiller.com/CMF/CDA/index.html#fid=27>

**2.2 CURTAIN LINER**

- A. General: Fabric that will act as a liner in between the sheets of fabric for extra thickness, weight, noise and light blocking.
- B. Manufacturers: local product preferred

- C. Product: 100% white cotton curtain liner.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Verify of Conditions: Verify openings are in accordance with approved shop drawings.
- B. Beginning construction activities of this section indicates installer's acceptance of conditions

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Hang a single curtain onto roller with hook.
- C. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**

**SECTION 12 22 16****CEILING MOUNTED CURTAIN TRACK****PART 1 GENERAL****1.1 SUMMARY**

- A. Section includes the following:
  - 1. Ceiling Mounted Curtain Track

**1.2 RELATED SECTIONS**

- A. Section 06 10 00 - Rough Carpentry
- B. Section 12 22 00 - Curtains and Drapes

**1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements in unopened packaging with labels intact until ready for installation.

**1.4 PROJECT CONDITIONS**

- A. Environmental Requirements: 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 CEILING MOUNTED CURTAIN TRACK**

- A. General: Track system mounted to the ceiling to hang curtains.
- B. Manufacturer: [Konnect International](#)
- C. Product: Shall contain the following pieces:
  - 1. Medium Duty Straight Track
  - 2. Medium Duty Rollers
  - 3. Medium Duty End Caps
  - 4. Ceiling Mount Cartridges
  - 5. #8 x 1" Flat Head Screws
  - 6. #8-10 x 1" Ribbed Plastic Anchors

**PART 3 EXECUTION****3.1 PREPARATION**

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

- B. Verify of Conditions: Verify openings are in accordance with approved shop drawings.
- C. Beginning construction activities of this section indicates installer's acceptance of conditions

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Draw a line along the ceiling where the curtain is being stalled. In the situation where a curved line is difficult to draw, create a template by first drawing the line on a piece of construction paper or cardboard and attaching this to the ceiling. Depending on how sharp the curve is, mount the ceiling cartridge on the ceiling approximately 10-12 inches apart along the line with the lockable clips facing the same direction. Tightly secure the cartridge with screws. Add additional cartridges as needed where a sharp turn occurs. For a conventional drywall hallow ceiling, it is suggested to use #8 x 1" flat head screws with #8-10 x 1" ribbed plastic anchors.
- C. Measure the overall length of the line as described, use this measure minus 1" and cut the track as needed with a hacksaw. Starting from one end, lock the cut-to-length track into one cartridge after another by pushing the clip on the cartridge tightly against the track, use pliers if necessary. Ensure the flat surface of the track faces up.
- D. Fasten the end cap on one end of the track, insert the track rollers into the track and then fasten the other end cap in place to lock in the rollers.
- E. Do not try to force bend the track. Curvature of the track will be automatically accomplished by fastening the track to the mounting cartridges.
- F. For straight run application, make certain all mounting cartridges are 8"-10" apart and are installed in line without any offset. Place additional cartridge 2"-3" near both ends.
- G. Test for proper operation. Restore damaged finishes and protect work.

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**

SECTION 12 35 30  
RESIDENTIAL CASEWORK

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Provide Dile (Sofa) Bed Surround and Storage Cabinetry.

**1.2 RELATED SECTIONS**

- A. Section 06 40 26 – Wood Veneer
- B. Section 10 57 00 – Wardrobe and Closet Specialties
- C. Section 12 58 83 – Custom Residential Furniture
- D. Section 12 36 00 – Counter Tops

**1.3 REFERENCES**

- A. ASTM E 84 Standard Test for Surface Burning Characteristics of Building Material

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data:
  - 1. Medium-density Fiberboard
  - 2. Maple Flat Cut Veneer
  - 3. Water based finish sealant
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.



## **1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 CASEWORK**

- A. General: Casework to house appliances and furbish the kitchen
- B. Manufacturer: George Granseth, DMACC
- C. Product:
  - 1. Medium-Density Fiberboard
  - 2. Maple Flat Cut Veneer
  - 3. Solid Veneer Face Style
  - 4. Frameless
  - 5. Clear Coat Water Based Finish
- D. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

## **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 materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

### **3.4 PROTECTION**

- A. Medium-Density Fiberboard: Should never be stored or used outdoors. The indoor storage area should be clean, dry, well-ventilated, and free of dust, dirt or particles

that could contaminate the particleboard. Store flat on stickers on a level, hard, dry surface. Constant relative humidity and temperature should be maintained.

- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

## SECTION 12 35 30.13

## KITCHEN CASEWORK

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide pullout pantry, pullout trash and recycling receptacle, microwave nook, kitchen base and upper cabinets, removable lower sink cabinet for ADA accessibility.

**1.2 RELATED SECTIONS**

- A. Section 12 36 00 – Counter Tops
- B. Section 06 41 00 – Kitchen Cabinet Hinges
- C. Section 12 58 83 – Custom Residential Furniture
- D. Section 11 31 00 – Residential Appliances

**1.3 REFERENCES**

- A. ASTM E 84 Standard Test for Surface Burning Characteristics of Building Material

**1.4 SUBMITTALS**

- A. Submit under provision of Section 01 30 00.
- B. Product Data:
  - 1. Medium-density Fiberboard
  - 2. Maple Flat Cut Veneer fused using PVA
  - 3. Water based finish sealant
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- D. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 KITCHEN CASEWORK**

- A. General: Casework to house appliances and furbish the kitchen
- B. Manufacturer: George Granseth, DMACC
- C. Product:
  - 1. Medium-Density Fiberboard
  - 2. Maple Flat Cut Veneer
  - 3. Solid Veneer Face Style
  - 4. Frameless
  - 5. Clear Coat Water Based Finish

## **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. Before application, allow particleboard to stabilize to the same conditions as are expected after the panel is installed. Conditions 48 to 72 hours prior to lamination.

### **3.3 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

### **3.4 PROTECTION**

- A. Medium-Density Fiberboard: Should never be stored or used outdoors. The indoor storage area should be clean, dry, well-ventilated, and free of dust, dirt or particles that could contaminate the particleboard. Store flat on stickers on a level, hard, dry surface. Constant relative humidity and temperature should be maintained.

- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

**END OF SECTION**

## SECTION 12 36 00

## COUNTERTOPS

**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Liquid Stone Custom Composite 80% recycled Concrete Kitchen Countertop
- B. Liquid Stone Custom Composite 80% recycled Concrete Bathroom Countertop with integral basin.

**1.2 SUBMITTALS**

- A. Product Data
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Shop Drawings:
  - 1. Details of sub-structure and cabinetry
  - 2. Details of Rough Openings
  - 3. Details of Overall Slab Dimensions
- C. Verification Samples:
  - 1. Submit 6 by 6 inch samples of each pattern type required.
  - 2. Submit 1 cup of Recycled Glass content for Manufacturer Approval

**1.3 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Materials require support during delivery

**1.4 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: Liquid Stone

- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

## **2.2 MATERIALS**

Liquid Stone Recycled Glass Polished Concrete Slab

- 1. Recycled Crushed Glass (.25 - .5 in diameter), Recycled Silica, Portland (25% fly-ash content), steel, impregnating hardener, surface sealant.
- 2. Proper manufacturing gives a polished concrete slab with closed surface.

## **2.3 ACCESSORIES**

Approved Adhesive and mounting hardware

# **PART 3 EXECUTION**

## **3.1 EXAMINATION**

Do not begin installation until substrates have been properly prepared.

Structural Support and cabinetry should be completed prior to installation

## **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.

## **3.3 CLEANING**

- A. Remove trash and construction debris before application.

## **3.4 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION

**SECTION 12 40 00**  
**FURNISHINGS AND ACCESSORIES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section includes the following:
  - 1. Murphy Bed.
  - 2. Other Furnishing accessories.

**1.2 RELATED SECTIONS**

- A. Section 12 35 30 – Residential Casework.
- B. Section 12 92 00 – Interior Planters and Artificial Plants.

**1.3 REFERENCES**

- A. NA

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.



- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 MURPHY BED**

- A. General: Modern Murphy bed with shelving that converts into a sofa.
- B. Manufacturer: FlyingBeds
- C. Product: The Sofa Bed (Dile).

<http://www.flyingbeds.com/14.SmartBeds/Dile.SofaBed.htm>

### **2.2 OTHER FURNISHING ACCESSORIES**

- A. General: UNKNOWN.
- B. Manufacturer: UNKNOWN.
- C. Product: UNKNOWN.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Verification of Conditions: Verify openings are in accordance with approved shop drawings
- C. Beginning construction activities of this section indicates installer's acceptance of conditions.

### **3.2 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Restore damaged finishes and protect work

### **3.3 PROTECTION**

- A. Protect installed products until completion of project.

**END OF SECTION**

## SECTION 12 58 83

## CUSTOM RESIDENTIAL FURNITURE

**PART 1 GENERAL****1.1 SUMMARY**

- A. Dile Sofa Bed (Double Sized)

**1.2 RELATED SECTIONS**

- A. Section 12 35 30 Residential Casework

**1.3 REFERENCES**

- A. ANSI- American National Standards Institute
- B. ASTM- American Society for Testing and Materials
- C. ANSI- American National Standards Institute

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.5 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

**PART 2 PRODUCTS****2.1 DILE SOFA BED**

- A. General: Modern Murphy bed
- B. Manufacturer: <http://www.flyingbeds.com>
- C. Product: Shall contain the following requirements:
  - 1. Acero Maple (Melamine)
  - 2. Aluminum Finished Metal Frame
  - 3. Panna White Fabric

**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 materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
- B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.
- C. Wall fastening is mandatory.

### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

## SECTION 15 77 00

## RADIANT SUBFLOORING

**PART 1 GENERAL****1.1 SUMMARY**

- A. Radiant Subflooring.
- B. Radiant Heat Carriers.

**1.2 RELATED SECTIONS**

- A. Section 06 11 00 - Rough Carpentry

**1.3 REFERENCES**

- A. APA - American Plywood Association: Testing and rating procedures for plywood sheathing.
- B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
- C. ASTM D 3498 - Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- D. ASTM F 876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- E. UPC - Uniform Plumbing Code: Construction codes applicable to radiant heating systems.

**1.4 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.

**1.5 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.

**1.6 WARRANTY**

- A. At project closeout, provide to the owner a copy of the manufacturer's standard warranty form outlining the terms and conditions of their limited warranty against manufacturing defect.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Acceptable Manufacturer: Warmboard Radiant Subfloor, which is located at: 8035



Soquel Dr. Suite 41 - A ; Aptos, CA 95003; Toll Free Tel: 877-338-5493; Tel: 831-685-9276; Fax: 831-685-9278; Email: [nicole@warmboard.com](mailto:nicole@warmboard.com); Web: [www.warmboard.com](http://www.warmboard.com)

## 2.2 MATERIALS

- A. Warmboard Radiant Subfloor: Nominal 1 1/8 inch (28mm) thick plywood subfloor with pre-routed channels for installation of Radiant Heat Tubing.
  - 1. Panel Dimensions: 48 inches x 96 inches (1219mm x 2438mm).
  - 2. Panel Base: 1 3/32 inch (27.8mm) 7-Layer douglas fir tongue-and-groove plywood; APA Rated, Sturd-I-Floor.
  - 3. Radiant Barrier Overlay: 0.025 inch (0.6mm) glare resistant light green aluminum sheet bonded to plywood and conforming to channels
  - 4. Channel Size: Nominal 21/32 inch (16.7mm) diameter.
  - 5. Channel Spacing: 12 inches (305mm) o.c. parallel to panel's long dimension.
- B. Radiant Heat Tubing: Cross Linked Polyethylene (PEX) based tubing designed for transmission of hot water.
  - 1. Tubing Size: 1/2 inch (13mm) inside diameter per ASTM F 876.
  - 2. Hydrostatic Design and Pressure Ratings per Plastic Pipe Institute (PPI):
    - a. 200 F degrees F at 80 psi (93.3 C at 552 KPa).
    - b. 180 F degrees F at 100 psi (82.2 C at 689 KPa).
    - c. 73.4 F degrees F at 160 psi (23 C at 1103 KPa).
  - 3. Maximum Length: 300 feet (91440mm).
- C. Fasteners, Adhesives and Sealants:
  - 1. Nails: 10d - 3 inch (76mm) nails with twist, ring or otherwise deformed shank.
  - 2. Screws: Minimum 2 1/2 inch (64mm) long coarse thread deck or subfloor screws.
  - 3. Construction Adhesive: Elastomeric Resin Adhesive meeting or exceeding the requirements of ASTM D 3498.

## PART 3 EXECUTION

### 3.1 DESIGN

- A. Contractor shall provide Project Information to the manufacturer which includes a comprehensive plan view of the structure to receive radiant subfloor which includes the following:

1. Locations of all exterior and interior walls
  2. Floor joist location and configuration
  3. Heating zones
  4. Radiant manifold and associated plumbing component locations.
  5. Penetrations in the floor
  6. Locations of fixtures which may interfere with panel routing.
- B. Upon receipt of Project Information, the Manufacturer shall provide a D size plot that displays the radiant panel configuration, heating zones, PEX tubing configuration and routing and location of radiant manifold and associated plumbing components.

### **3.2 EXAMINATION**

- A. Do not begin installation until floor joists and associated framing components have been properly prepared.
- B. Carefully examine joist spacing and direction to ensure proper location and support of radiant subfloor panels. Floor joists shall be installed plumb, level and square, without warp, rake or skew and must be evenly spaced to ensure panel ends are supported properly. Correct any deficiencies prior to installation of the radiant subfloor.
- C. Unsupported or poorly supported panel ends shall be considered defective work and will be rejected by the Architect.
- D. If floor framing is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

### **3.3 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer and APA for achieving the best result for the substrate under the project conditions.
- C. Remove all dust, debris and dirt from joist tops. Trim joist hangers and mounting hardware that may interfere with the installation.

### **3.4 PANEL INSTALLATION**

- A. Install in accordance with manufacturer's current application instructions.
- B. Locate panels as shown on the manufacturer's provided panel configuration.
- C. Apply 1/4 inch wide beads of construction adhesive to the tops of the floor joists following the adhesive manufacturer's recommendations for use and open time. Apply two beads on joists where panels meet.
- D. Install Panels perpendicular to floor joists. Space panels 1/8 inch (3mm) apart on all sides to allow for thermal and moisture expansion. Tongue ends shall only interface with groove ends. Non-interlocked ends shall be considered defective work and will be rejected by the Architect.

- E. Fasten panels spacing 6 inches (152mm) on center into every joist. Fastener heads must be flush or just below flush.
- F. Where unusual architectural features require custom grooves to be created. Follow the manufacturer's instructions on shaping and finishing grooves.

### **3.5 RADIANT TUBING INSTALLATION**

- A. Do not install radiant tubing until the subfloor has been installed over the entire floor.
- B. Individual tubing runs shall not exceed 300 feet (91440mm).
- C. Carefully position and lock into place the tubing, avoiding sharp bends which may kink or otherwise damage the tubing.
- D. Using a weighted roller, roll tubing into place. Tubing must be flush with the top surface of the subfloor in all locations.

### **3.6 PLUMBING CONNECTIONS**

- A. Plumbing connections are to be performed in accordance with Uniform Plumbing Code (UPC) and local building codes.

### **3.7 FINISHED FLOORING**

- A. Install flooring in accordance with requirements of Section 09600.

### **3.8 PROTECTION**

- A. Protect installed products until finished floor surface is installed.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 22 07 19

## PLUMBING PIPING INSULATION

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section covers piping insulation for copper hot and cold supply lines.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. International Thermo Polymer Limited  
153 Van Kirk Drive  
Brampton, Ontario, Canada L7A 1A4  
Toll-Free: (800) 387-3847  
Phone: (905) 846-3666  
Fax: (905) 846-0363  
Email: info@tundrafoam.com

**2.2 PRODUCTS**

- A. Tundra Self Sealing Polyethylene Pipe Insulation <http://www.tundrafoam.com/pdf-docs/PipeInsulation/SpecSheets/Tundra.Pipe.Retail.pdf>
  - 1. Size: ¾" and ½"



2. Quantity: Adequate to cover all copper piping.

### **2.3 PRODUCT SUBSTITUTION**

- A. Products with equal or greater performance characteristics will be considered

### **2.4 MATERIALS**

- A. Closed Cell Polyolefin

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label and tag all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 22 09 00

## INSTRUMENTATION AND CONTROLS FOR PLUMBING

## PART 1 GENERAL

## 1.1 SUMMARY

- A. Section Includes: Non-Surge Check valves providing a control valve designed to control pipeline surges caused by flow reversal. Gate valves for piping section isolation.

## 1.2 RELATED SECTIONS

- A. Section 22 11 16 – Domestic Water Piping
- B. Section 23 21 23.13 – In-Line Hydronic Pump
- C. Section 23 83 16 – Radiant Heat Floor Piping

## 1.3 REFERENCES

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

## 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.  
<http://www.aymcdonald.com/ProdImages/Plumbing/cad/GATE%20STOP%20CHECK%20SILLCOCK.pdf>
- B. Shop Drawings: Provide installation drawings indicating Non-Surge Check valve locations, required supports and schedules with details required for installation of the system. .
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein
  - 2. Operation and maintenance data

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of Non-Surge Check valves installation.
- B. Certifications:
  - 1. Installer is trained to install Non-Surge Check valves.

2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trade professional.

## 1.6 DELIVERY, STORAGE, & HANDLING

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  1. Store Non-Surge Check valves in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. A.Y. McDonald Manufacturing Co.  
4800 Chavenelle Rd  
Dubuque, IA 52002  
Phone: (563)583-7311  
Fax: (563)588-0720

### 2.2 PRODUCTS

1. ½" 2050S Directional Brass Check Valve
2. ¾" 2050S Directional Brass Check Valve
3. ½" 2034S Brass Gate Valve
4. ¾" 2034S Brass Gate Valve
5. ¾" 2034SP Brass Gate Valve – PEX Connection

### 2.3 MATERIALS

- A. Brass ASTM B584

## PART 3 EXECUTION

### 3.1 MANUFACTURER INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### 3.2 EXAMINATION

- A. Site Verification of Conditions:

1. Verify that site conditions are acceptable for installation of the Non-Surge Check valves.
2. Do not proceed with installation until site conditions are acceptable.

### 3.3 INSTRUCTIONS

- A. Provide Manufacturer's Installation Instructions.

### 3.4 FIELD QUALITY CONTROL

- A. Site Test

1. Pressure/leak test

### 3.5 CLEANING

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### 3.6 PROTECTION

- A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

SECTION 22 11 16  
DOMESTIC WATER PIPING

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Plumbing Piping for domestic water delivery and removal.

**1.2 RELATED SECTIONS**

- A. Section 22 09 00 – Instrumentation and Control For Plumbing
- B. Section 23 21 23.13 – In-Line Hydronic Pump
- C. Section 23 83 16 – Radiant Heat Floor Piping
- D. Section 22 33 30.26 - Residential Collector-to-Tank Heat Exchanger Coil Solar Electric Domestic Water Heaters
- E. Section 22 07 19 – Plumbing Piping Insulation
- F. Section 22 41 13 – Residential Water Closets, Urinals, and Bidets
- G. Section 22 41 16 – Residential Lavatories and Sinks
- H. Section 22 41 23 – Residential Shower Receptors and Basins

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.
- B. Shop Drawings: Provide installation drawings indicating Plumbing Piping locations, required supports and schedules with details required for installation of the system. .
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein
  - 2. Operation and maintenance data

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion

of Plumbing Piping installation.

**B. Certifications:**

1. Installer is trained to install Plumbing Piping.
2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trade professional.

**1.6 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  1. Store Plumbing Piping in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

**PART 2 PRODUCTS**

**2.1 MANUFACTURER**

- A. Zurn Industries, LLC.

**2.2 PRODUCTS**

1. ½" PEX Tubing
2. ¾" PEX Tubing
3. ½" Copper Tubing
4. ¾" Copper Tubing
5. 2" PVC Pipe
6. 3" PVC Pipe

**2.3 MATERIALS**

- A. Cross linked polyethylene (PEX)
- B. Copper – K Type
- C. Polyvinyl Chloride (PVC)

**PART 3 EXECUTION**

**3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and

approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

#### **A. Site Verification of Conditions:**

1. Verify that site conditions are acceptable for installation of the Plumbing Pipings.
2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

#### **A. Provide Manufacturer's Installation Instructions.**

### **3.4 FIELD QUALITY CONTROL**

#### **A. Site Test**

1. Pressure/leak test

### **3.5 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

- A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

## SECTION 22 33 30.26

RESIDENTIAL, COLLECTOR-TO-TANK, HEAT-EXCHANGER-COIL, SOLAR-ELECTRIC  
DOMESTIC WATER HEATERS**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide solar hot water heat-exchanger tank systems.

**1.2 SUBMITTALS**

- A. Product  
Data: [http://waterheating.rheem.com/content/resources/documents/specsheets/RH SolaraideHE.pdf](http://waterheating.rheem.com/content/resources/documents/specsheets/RH%20SolaraideHE.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- C. Operation and Maintenance  
Data: [http://waterheating.rheem.com/content/resources/documents/use\\_care/ResSolarHE.pdf](http://waterheating.rheem.com/content/resources/documents/use_care/ResSolarHE.pdf)

**1.3 RELATED SECTIONS**

- A. 23 83 16 RADIANT HEATING HYDRONIC PIPING
- B. 23 56 13.19 HEATING SOLAR VACUUM TUBE COLLECTORS
- C. 22 11 16 DOMESTIC WATER PIPING

**1.4 QUALITY ASSURANCE**

- A. UL 786H Listed
- B. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- C. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Rheem Water Heating  
101 Bell Road  
Montgomery, AL 36117

**2.2 PRODUCTS**



- A. Rheem Solaraide HE 81V80HE-1  
Quantity: 1
- B. Rheem Solaraide HE 82V120HE-1  
Quantity: 1

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label and tag all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

**SECTION 22 41 13****RESIDENTIAL WATER CLOSETS, URINALS, BIDETS****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide residential water closets, urinals and bidets.

**1.2 SUBMITTALS**

- A. Product  
Data: [http://www.americanstandard-us.com/Assets/pdfs/as/install/Install\\_1951.pdf](http://www.americanstandard-us.com/Assets/pdfs/as/install/Install_1951.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Residential Water Closet:
  - 1. Manufacturers: American Standard  
P.O. Box 6820  
1 Centennial Plaza  
Piscataway, NJ 08855-6820
  - 2. Type: AFWALL™ FloWise® ADA RETROFIT 1.28 GPF FLUSHOMETER TOILET
  - 3. Substitutions will be considered if design requirements are met

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label and tag all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 22 41 16

## RESIDENTIAL LAVATORIES AND SINKS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide residential lavatories and sinks.

**1.2 SUBMITTALS**

- A. Product Data: [http://www.americanstandard-us.com/Assets/pdfs/as/install/Install\\_2143.pdf](http://www.americanstandard-us.com/Assets/pdfs/as/install/Install_2143.pdf)  
  
[http://www.americanstandard-us.com/Assets/pdfs/as/specsheet/SpecSheet\\_2143.pdf](http://www.americanstandard-us.com/Assets/pdfs/as/specsheet/SpecSheet_2143.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Residential Sink:
  - 1. Manufacturers:
    - American Standard
    - P.O. Box 6820
    - 1 Centennial Plaza
    - Piscataway, NJ 08855-6820
  - 2. Type: Studio Above Counter Rectangular Sink

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label and tag all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 22 41 23

## RESIDENTIAL SHOWER RECEPTORS AND BASINS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide residential shower receptors and basins.

**1.2 SUBMITTALS**

Product Data: [Tuff Form](#)

- A. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Plumbing Systems:
  - 1. Manufacturers: [Tuff Form](#) wet floor shower system.

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

## SECTION 22 41 39

## RESIDENTIAL FAUCETS, SUPPLIES, AND TRIM

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide residential faucets, supplies, and trim..

**1.2 SUBMITTALS**

- A. Product Data: [http://www.americanstandard-us.com/Assets/pdfs/as/specsheet/SpecSheet\\_1773.pdf](http://www.americanstandard-us.com/Assets/pdfs/as/specsheet/SpecSheet_1773.pdf)  
[http://www.americanstandard-us.com/Assets/pdfs/as/install/Install\\_1773.pdf](http://www.americanstandard-us.com/Assets/pdfs/as/install/Install_1773.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
  - 2. Provide hydraulic calculations for pipe sizing.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Plumbing Systems:
  - Manufacturers:
    - American Standard.
    - P.O. Box 6820
    - 1 Centennial Plaza
    - Piscataway, NJ 08855-6820
  - 1.1 Type: 2064.151 One Single Control Vessel Faucet
  - 2.1 Type: Pressure Balance Bath/Shower Fitting (with built-in diverter)

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Clearly label and tag all valves and components.
- E. Sterilize water distribution system. Flush and test all systems for proper operation. Adjust system to prevent water hammer.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



## SECTION 23 07 13.23

## DUCT INSULATION

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains HVAC duct insulation.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Reflectix Inc
- B. Frost King
- C. Ace
- D. Wrap On

**2.2 PRODUCTS****A. Reflective Duct Wrap**

- 1. R value: 6 or higher
- 2. Vapor barrier included
- 3. Mold resistant
- 4. Reflective radiation barrier

## 5. Self adhesive

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

**SECTION 23 09 13.13****ACTUATORS AND OPERATORS****PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: Motorized Valve Actuator providing open/closed control in piping branch loops.

**1.2 RELATED SECTIONS**

- A. Section 23 83 16 – Radiant Heat Floor Piping

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.
- B. Shop Drawings: Provide installation drawings indicating Motorized Valve Actuator with balancing and isolation valve locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein
  - 2. Operation and maintenance data

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of Motorized Valve Actuators with balancing and isolation valves.
- B. Certifications:
  - 1. Installer is trained to install Valve Actuators with balancing and isolation valves.
  - 2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trade professional.

**1.6 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store Valve Actuators with balancing and isolation valves in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Colonial Engineering
- B. Ironbound Valve Actuation Company
- C. Valtorc

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: Products with similar performance characteristics will be considered.

### **2.3 PRODUCTS**

- A. Brass Water Gate or Butterfly valve with electric actuator
  - 1. 100+ psi rated
  - 2. 200°F rated
  - 3. Quantity: 4

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation of the Motorized Valve Actuators with balancing and isolation valves.
  - 2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.4 FIELD QUALITY CONTROL**

A. Site Test

1. Pressure/leak test

**3.5 CLEANING**

A. Repair or replace damaged installed products.

B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

C. Remove construction debris from project site and legally dispose of debris.

**3.6 PROTECTION**

A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

## SECTION 23 09 13.23

## SENSORS AND TRANSMITTERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains sensors used for controlling the HVAC systems using the LONWorks control system.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.  
<http://tac.com/data/internal/data/07/77/1229968951141/FDTemperatureSensors.pdf>
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. TAC by Schneider Electric  
Americas Headquarters  
1650 Crosby Road  
Carrollton, TX 75006  
Phone: +1(972)323-1111  
Toll-Free: +1(866)TAC-INFO  
Fax: +1(972)242-0046  
Website: [www.tac.com](http://www.tac.com)

**2.2 PRODUCTS**

- A. Indoor Temperature/Relative Humidity Sensor
  - 1. Quantity: 3
- B. Outdoor Temperature/Relative Humidity Sensor

- 1. Quantity: 1
- C. Duct Temperature/Humidity Sensor
  - 1. Quantity: 1
- D. Indoor CO<sub>2</sub> Sensor
  - 1. Quantity: 1
- E. Solar Sensor
  - 1. Quantity: 1

## **2.3 SUBSTITUTIONS**

- A. Substitutions with similar performance characteristics will be considered.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

END OF SECTION

## SECTION 23 21 23.13

## IN-LINE CENTRIFUGAL HYDRONIC PUMPS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: In-line Hydronic pump providing power to the chilled and hot water systems.

**1.2 RELATED SECTIONS**

- A. Section 22 09 00 – Instrumentation and Controls for Plumbing
- B. Section 22 11 16 – Domestic Water Piping
- C. Section 23 83 16 – Radiant Heat Floor Piping

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.

[http://www.us.grundfos.com/Web/Download.nsf/Pages/D0EC3DF6E3305A3E0825691A00637AF3/\\$File/L-UP-TL-008.pdf](http://www.us.grundfos.com/Web/Download.nsf/Pages/D0EC3DF6E3305A3E0825691A00637AF3/$File/L-UP-TL-008.pdf)

[http://www.us.grundfos.com/Web/Download.nsf/Pages/CB0DD920244366288825650C0067D3BC/\\$File/L-UP-TL-107.PDF](http://www.us.grundfos.com/Web/Download.nsf/Pages/CB0DD920244366288825650C0067D3BC/$File/L-UP-TL-107.PDF)

- B. Shop Drawings: Provide installation drawings indicating In-line Hydronic pump locations, required supports and schedules with details required for installation of the system.

- C. Closeout Submittals: Submit the following:

- 1. Warranty documents specified herein

- 2. Operation and maintenance data

[http://www.us.grundfos.com/web/download.nsf/Pages/66D8FEAE045F0F2588256B020059F20B/\\$File/L-UP-TL-043.pdf](http://www.us.grundfos.com/web/download.nsf/Pages/66D8FEAE045F0F2588256B020059F20B/$File/L-UP-TL-043.pdf)

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of In-line Hydronic pump installation.

- B. Certifications:



1. Installer is trained to install In-line Hydronic pump.
2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trade professional.

## **1.6 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  1. Store In-line Hydronic pump in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Grundfos Pumps Corporation  
17100 W. 118<sup>th</sup> Terrace  
Olathe, KS 66061  
Phone: (913)227-3400  
Fax: (913)227-3500

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: Products with similar performance characteristics will be considered.

### **2.3 PRODUCTS**

- A. UP26-64 Centrifugal Circulator Pump
  1. Quantity: 4

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

- A. Site Verification of Conditions:
  1. Verify that site conditions are acceptable for installation of the In-line Hydronic pump.
  2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.4 FIELD QUALITY CONTROL**

- A. Site Test

- 1. Pressure/leak test

### **3.5 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

- A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

**SECTION 23 31 13.13****RECTANGULAR METAL DUCTS****PART 1 GENERAL****1.1 SUMMARY**

- A. This section includes rectangular metal ducts.

**1.2 RELATED SECTIONS**

- A. 23 31 13.16 Round and Flat-Oval Spiral Ducts

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 Rectangular Metal Duct**

- A. General: AHU Discharge Duct
- B. Dimensions: 14" x 10"

**2.2 Rectangular Metal Duct**

- A. General: AHU Air Return Duct
- B. Dimensions: 20" x 10"

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.

- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 31 13.16

## ROUND AND FLAT-OVAL SPIRAL DUCTS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section includes round and flat-oval spiral metal ducts for air delivery and return.

**1.2 RELATED SECTIONS**

- A. 23 31 13.13 Square Metal Ducts
- B. 23 31 13.19 Metal Duct Fittings
- C. 23 33 46 Flexible Ducts
- D. 23 34 13 Axial HVAC Fans
- E. 23 37 13 Diffusers, Registers, and Grilles
- F. 23 38 13 Commercial-Kitchen Hoods
- G. 23 41 16 Renewable-Media Air Filters
- H. 23 72 19 Fixed-Plate Air-to-Air Energy-Recovery Equipment
- I. 23 73 00 Indoor Central Station Air-Handling Units
- J. 23 84 16 Dehumidifiers

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 Metal Circular Spiral Duct**

- A. General: Spiral Metal Air Duct
- B. Diameter: 6"

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction

and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 31 13.19

## METAL DUCT FITTINGS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section includes metal duct fittings.

**1.2 RELATED SECTIONS**

- A. 23 31 13.16 Round and Flat-Oval Spiral Ducts
- B. 23 33 46 Flexible Ducts
- C. 23 34 13 Axial HVAC Fans
- D. 23 37 13 Diffusers, Registers, and Grilles
- E. 23 38 13 Commercial-Kitchen Hoods
- F. 23 41 16 Renewable-Media Air Filters
- G. 23 72 19 Fixed-Plate Air-to-Air Energy-Recovery Equipment
- H. 23 73 00 Indoor Central Station Air-Handling Units
- I. 23 84 16 Dehumidifiers

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 Metal Circular Duct Tee**

- A. General: Metal spiral duct tee fitting
- B. Dimensions: 6" Diameter all branches

**2.2 Metal Circular Duct Elbow**

- A. General Metal spiral duct elbow fitting
- B. Dimensions: 6" Diameter

**2.3 Metal Circle to square duct adapter**

- A. General: Metal duct adapter fitting

- B. Dimensions: 6" diameter to 6" x 3" rectangular

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



## SECTION 23 32 39

## AIR DISTRIBUTION WALL PLENUMS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide heat transfer equipment for building HVAC systems.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Heating, Ventilating and Air-Conditioning Systems:
1. Manufacturers, Piping, Valves and Fittings: Anvil International; e.z. barrier; MAPA Products; Natural Light Energy Systems; Taco Inc.
  2. Manufacturers, Sleeves, Hangers and Supports: Advanced Support Products, Inc.; Anvil International; JV-Industries, LLC; MAPA Products; PHP Systems/Design.
  3. Manufacturers, Duct Liner/Wrap: Innovative Energy Inc.
  4. Manufacturers, Insulation: Knauf Insulation.
  5. Manufacturers, Small Duct HVAC Systems: Unico System, Inc.
  6. Manufacturers, Radiant Heating: Orbit Radiant Heating; Solid State Heating Inc. (SSHC, Inc); SunTouch Floor Warming Systems / A Div. of Watts Radiant; Watts Radiant, Inc. Subsidiary of Watts Water Technologies, Inc.
  7. Manufacturers, Thermostats: Emerson Climate Technologies.
  8. Application: Central heating systems.
  9. Application: Central cooling systems.
  10. Application: Central heating, ventilating and air-conditioning systems.
  11. Components: Suitable for service.
    - a. Motors.

- b. Meters and gages.
- c. General-duty valves.
- d. Hangers and supports.
- e. Testing, adjusting, and balancing devices.
- f. Duct insulation.
- g. Piping insulation.
- h. Instrumentation and control devices.
- i. Hydronic piping and pumps.
- j. Refrigerant piping.
- k. HVAC water treatment.
- l. HVAC ducts and casings.
- m. Air duct accessories.
- n. HVAC fans.
- o. Special exhaust systems.
- p. Air outlets and inlets.
- q. Ventilation hoods.
- r. Particulate air filtration.
- s. Solar energy heating equipment.
- t. Heat exchangers.
- u. Thermal storage.
- v. Air-to-air energy recovery equipment.
- w. Radiant heating units.
- x. Humidity control equipment.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 33 13.13

## VOLUME CONTROL DAMPERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains volume control dampers for airflow in ductwork.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Ameriflow
- B. Lambro Industries
- C. Broan

**2.2 PRODUCTS**

- A. Manual airflow balancing damper
  - 1. Diameter: 6"
  - 2. Quantity: 3

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction

and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

**SECTION 23 33 46****FLEXIBLE DUCTS****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains flexible ducts for air distribution.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Lambro
- B. ATCO
- C. Deflect-O Corp.

**2.2 PRODUCTS**

- A. Wire and aluminum flexible duct
  - 1. Diameter: 6"

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other

sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 34 13

## AXIAL HVAC FANS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: Duct Vane Axial Fan providing the required CFM and static pressure for the primary air to the Active Chilled Beam system.

**1.2 RELATED SECTIONS**

- A. Section 23 31 13.13 – Rectangular Duct
- B. Section 23 31 13.16 – Round and Oval Spiral Duct
- C. Section 23 37 13 – Diffusers, Registers, Grilles
- D. Section 23 41 16 – Renewable Air Media Filter

**1.3 SUBMITTALS**

- A. Product Data: <http://www.fantech.net/fr.pdf>
- B. Shop Drawings: Provide installation drawings indicating media Duct Vane Axial Fan locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein
  - 2. Operation and maintenance data [http://www.fantech.net/fr\\_inst.pdf](http://www.fantech.net/fr_inst.pdf)

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of Duct Vane Axial Fan installation.
- B. Certifications:
  - 1. Installer is trained to install Duct Vane Axial Fan.
  - 2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.

**1.5 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store Duct Vane Axial Fan in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Fantech  
1712 Northgate Blvd.  
Sarasota, FL 34234  
Phone: (800)747-1762  
Website: [www.fantech.net](http://www.fantech.net)

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: Products with similar performance characteristics will be considered.

### **2.3 PRODUCTS**

- A. FR140 Inline Duct Fan
  1. Quantity: 1
  2. Outlet Diameter: 6"
  3. Wattage: 61 W

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Site Verification of Conditions:
  1. Verify that site conditions are acceptable for installation of the Duct Vane Axial Fan.
  2. Do not proceed with installation until site conditions are acceptable.

### **3.2 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.3 FIELD QUALITY CONTROL**

- A. Site Test
  1. Test and Balance

### **3.4 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.5 PROTECTION**

- A. Protect installed work from damage until construction on site is completed.

END OF SECTION



**SECTION 23 37 13****DIFFUSERS, REGISTERS, GRILLES****PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: Return grille and supply diffusers

**1.2 RELATED SECTIONS**

- A. Section 23 34 13 – Axial HVAC Fan

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

**1.4 SUBMITTALS**

- A. Product Data: <http://www.hartandcooley.com/submittals/grd/SD-2430-Model.pdf>  
<http://www.hartandcooley.com/engineering%20data/pg%20111.pdf>  
<http://www.hartandcooley.com/engineering%20data/pg%20108.pdf>
- B. Shop Drawings: Provide installation drawings indicating Return grille locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.

**1.6 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store Return grille in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Hart and Cooley, Inc.  
500 E. Eighth St.  
Holland, MI 49423  
Phone: (616)392-7855  
Fax: (800)223-8461

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: No substitutions permitted.

### **2.3 PRODUCTS**

- A. 672 Return Grille
  - 1. Dimensions: 30" x 10"
  - 2. Sidewall mount
  - 3. Quantity: 2
- B. A613 3-way Supply diffusers
  - 1. Dimensions: 12" x 6"
  - 2. Sidewall mount
  - 3. Quantity: 3

### **2.4 MATERIALS**

- A. Galvanized Steel
- B. White Enamel Paint

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation of the Return Grille
  - 2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.4 FIELD QUALITY CONTROL**

#### **A. Site Test**

##### **1. Test and Balance**

### **3.5 CLEANING**

A. Repair or replace damaged installed products.

B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

## SECTION 23 38 13.16

## STANDARD COMMERCIAL-KITCHEN HOODS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section contains information for kitchen exhaust hoods for general cooking exhaust.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- [http://www.whirlpool.com/assets/pdfs/product/ZUSECARE/GH7208XRS\\_Use%20and%20Care.pdf](http://www.whirlpool.com/assets/pdfs/product/ZUSECARE/GH7208XRS_Use%20and%20Care.pdf)
- [http://www.whirlpool.com/assets/pdfs/product/ZINSTALL/GH7208XRS\\_Installation%20Instruction.pdf](http://www.whirlpool.com/assets/pdfs/product/ZINSTALL/GH7208XRS_Installation%20Instruction.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.
- [http://www.whirlpool.com/assets/pdfs/product/ZUSECARE/GH7208XRS\\_Use%20and%20Care.pdf](http://www.whirlpool.com/assets/pdfs/product/ZUSECARE/GH7208XRS_Use%20and%20Care.pdf)
- [http://www.whirlpool.com/assets/pdfs/product/ZINSTALL/GH7208XRS\\_Installation%20Instruction.pdf](http://www.whirlpool.com/assets/pdfs/product/ZINSTALL/GH7208XRS_Installation%20Instruction.pdf)

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Whirlpool USA  
2000 N. M-63  
Benton Harbo, MI 49022  
Phone (269) 923-5000

**2.2 PRODUCTS**

- A. GH7208XRS Microwave with integrated exhaust hood

## **2.3 PRODUCT SUBSTITUTIONS**

- A. Products with similar or superior performance characteristics will be considered

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 41 16

## RENEWABLE MEDIA AIR FILTERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: Media air filter and filter cabinet providing air filtration to the primary supply air.

**1.2 RELATED SECTIONS**

- A. Section 23 31 13.13 – Rectangular Duct
- B. Section 23 34 13 – Axial HVAC Fan

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. American National Standards Institute (ANSI)/American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE)
  - 1. ANSI/ASHRAE 52.1 – 1992 MERV 11 Performance Standards

**1.4 SYSTEM DESCRIPTION**

- A. Design Requirements
  - 1. Filter shall be of a pleated, progressive filter construction laminated to a heavy-duty galvanized, rust resistant metal backing to stabilize the media during operation. Pleats are to be formed in a radial configuration to ensure proper duct loading. Media pack shall be adhered to the peripheral interior of a heavy-duty die cut frame with surrounding gasket to prevent air bypass.
    - a. Filter Medias are of the following sizes.
      - 1) 16" x 25" x 5"
      - 2) 20" x 25" x 5"
    - b. Filter Cabinets are of the following sizes.
      - 1) 16" x 25" x 6"
      - 2) 20" x 25" x 6"
- B. Performance Requirements: To provide an air filtration system
  - 1. Standard MERV 11 Performance Standards are a minimum requirement according to ANSI/ASHRAE 52.2 – 1992

**1.5 SUBMITTALS**

- A. Product Data: Submit manufacturer's product submittal data and installation instructions.
- B. Shop Drawings: Provide installation drawings indicating media filter and filter cabinet locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein
  - 2. Operation and maintenance data

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving successful completion of Ultravation MERV 11 Progressive Media Air Filter installation.
- B. Certifications:
  - 1. Installer is trained to install MERV 11 Progressive Media Air Filter.
  - 2. Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.

## **1.7 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store Filter Media and Filter Cabinet in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **1.8 WARRANTY**

- A. Manufacturer provides a 10-year cabinet warranty.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Ultravation, Inc.
  - 218 Jones Drive
  - Brandon, Vermont 05733
  - Phone: (866)468-8247
  - Fax: (802)247-0033

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: No substitutions permitted.

## **2.3 MATERIALS**

### **A. Filter Media**

1. 100% synthetic, continuous thermally bonded (no chemical adhesives), high surface area media fibers.
2. Heavy-duty, galvanized, rust resistant metal backing.
3. Heavy-duty, die cut board frame for double-wall thickness around the perimeter of the filter.
4. Foam gasket seal.

### **B. Filter Cabinet**

1. Rust resistant metal casing.

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

#### **A. Site Verification of Conditions:**

1. Verify that site conditions are acceptable for installation of the MERV 11 Progressive Media Air Filter.
2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.4 FIELD QUALITY CONTROL**

#### **A. Site Test**

1. Test and Balance

### **3.5 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

- A. Protect installed work from damage until construction on site is completed.

END OF SECTION



## SECTION 23 56 13.19

## HEATING SOLAR VACUUM-TUBE COLLECTORS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains information on the evacuated tube thermal collectors.

**1.2 SUBMITTALS**

- A. Product Data: [http://www.apricus.com/html/solar\\_collector\\_technical\\_info.htm](http://www.apricus.com/html/solar_collector_technical_info.htm)  
[http://www.apricus.com/html/solar\\_collector\\_installation\\_basics.htm](http://www.apricus.com/html/solar_collector_installation_basics.htm)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.
- D. Test Reports: Submit manufacturer's collector test report.
- E. Warranty: Submit manufacturer's warranty with manufacturer's instructions.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Apricus Solar Co.  
USA Branch Office  
965 West Main Street  
Branford, CT 06405  
Phone: (203) 488-8215  
Website: [www.apricus.com](http://www.apricus.com)

**2.2 PRODUCTS**

- A. Apricus 30-tube collector
  1. Dimensions: 86.4" x 80" x 6.14"
  2. 30 tubes per module
  3. Collector surface area: 46.8 sq ft
  4. Absorber surface area: 25.8 sq ft
  5. Angle of inclination: 0-90°
  6. Module weight: 208.5 lb

- 7. Absorption coefficient: 92%
- 8. Emission coefficient: 8%
- 9. Maximum operating pressure: 116 psi
- 10. Operating flow rate: 1.56 gpm
- 11. Quantity: 2

## **2.3 PRODUCT SUBSTITUTIONS**

- A. No substitutions will be accepted

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.

END OF SECTION

**SECTION 23 57 19.16****SHELL-TYPE, LIQUID-TO-LIQUID HEAT EXCHANGERS****PART 1 GENERAL****1.1 SUMMARY**

- A. Section contains shell and tube liquid to liquid heat exchanger.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Trumbo Incorporated
- B. PEP
- C. GEA PHE Systems North America Inc
- D. Quintel, Inc

**2.2 PRODUCTS**

- A. Shell and tube heat exchanger for liquid to liquid heat transfer. Corrosion resistant against calcium chloride salt. No more than 3' long.

**2.3 MATERIALS**

- A. Titanium
- B. Nickel

- C. Stainless Steel
- D. Polyethylene

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 23 62 13

### PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSER UNITS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Condenser unit for air conditioning system.

##### 1.2 RELATED SECTIONS

- A. Section 23 72 23 – Custom Indoor Central-Station Air-Handling Units

##### 1.3 REFERENCES

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

##### 1.4 SUBMITTALS

- A. Product Data:
  - [http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20\(ss\)/product/22-1825-02\\_02012009.pdf](http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20(ss)/product/22-1825-02_02012009.pdf)
  - [http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20\(ss\)/service/22-5213-05\\_02012009.pdf](http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20(ss)/service/22-5213-05_02012009.pdf)
- B. Shop Drawings: Provide installation drawings indicating Condenser unit locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.

##### 1.6 DELIVERY, STORAGE, & HANDLING

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store Condenser unit in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

**PART 2 PRODUCTS****2.1 MANUFACTURER**

- A. Trane Inc.
  - 1 Centennial Ave.
  - Piscataway, NJ 08855-6820
  - Phone: (732)980-6000
  - Fax: (732)980-3340

**2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: No substitutions permitted.

**2.3 PRODUCTS**

- A. Trane XL20i Condenser unit 4TTZ0024
  - 1. 2-ton cooling capacity
  - 2. 410a Refrigerant
  - 3. Dual compressors

**2.4 MATERIALS**

- A. Galvanized Steel
- B. Enamel Paint
- C. Copper coil

**PART 3 EXECUTION****3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

**3.2 EXAMINATION**

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation of the Condenser unit
  - 2. Do not proceed with installation until site conditions are acceptable.

**3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

**3.4 FIELD QUALITY CONTROL**

- A. Site Test
  - 1. Test and Balance

### **3.5 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

- A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

## SECTION 23 72 19

## FIXED-PLATE AIR-TO-AIR RECOVERY EQUIPMENT

**PART 1 GENERAL****1.1 SUMMARY**

- A. Section fixed plate energy recovery ventilator.

**1.2 SUBMITTALS**

- A. Product  
Data: [http://www.renewaire.com/\\_assets/files/TechDrawings/EV70DIMS.pdf](http://www.renewaire.com/_assets/files/TechDrawings/EV70DIMS.pdf)  
[http://www.renewaire.com/\\_assets/files/installation/EV70\\_130\\_200\\_300Man\\_MAR08.pdf](http://www.renewaire.com/_assets/files/installation/EV70_130_200_300Man_MAR08.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance  
Data: [http://www.renewaire.com/\\_assets/files/GuideSpecifications/BREV130\\_200\\_300GuideSpecs06.pdf](http://www.renewaire.com/_assets/files/GuideSpecifications/BREV130_200_300GuideSpecs06.pdf)

**1.3 RELATED SECTIONS**

- A. Section 23 33 46 Flexible Ducts
- B. Section 23 73 23 Custom Indoor Central-Station Air-Handling Units

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. RenewAire LLC  
4510 Helfesen Drive  
Madison, WI 53718  
Phone: (800)627-4499  
Fax: (608)221-2824

**2.2 PRODUCTS**

- A. EV70 Energy Recovery Ventilator



Quantity: 1

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

**SECTION 23 73 23****CUSTOM INDOOR CENTRAL-STATION AIR-HANDLING UNITS****PART 1 GENERAL****1.1 SUMMARY**

- A. Section Includes: Air handler equipment.

**1.2 RELATED SECTIONS**

- A. Section 23 62 13 – Packaged Air-Cooled Refrigerant Compressor and Condenser Units
- B. Section 23 31 13.13 – Rectangular Metal Ducts

**1.3 REFERENCES**

- A. General: Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

**1.4 SUBMITTALS**

- A. Product Data:  
[http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20\(ss\)/product/22-1753-05\\_01012009.pdf](http://www.trane.com/webcache/un/split%20system%20air%20conditioners%20(ss)/product/22-1753-05_01012009.pdf)
- B. Shop Drawings: Provide installation drawings indicating Air handler locations, required supports and schedules with details required for installation of the system.
- C. Closeout Submittals: Submit the following:
  - 1. Warranty documents specified herein

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Installer will use skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.

**1.6 DELIVERY, STORAGE, & HANDLING**

- A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
  - 1. Store Air handler in cartons or under cover to avoid dirt or foreign material from being introduced to the materials.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Trane Inc.
  - 1 Centennial Ave.
  - Piscataway, NJ 08855-6820
  - Phone: (732)980-6000
  - Fax: (732)980-3340

### **2.2 PRODUCT SUBSTITUTIONS**

- A. Substitutions: No substitutions permitted.

### **2.3 PRODUCTS**

- A. Vertical Upflow Air handler with Electric Heat 4TFB3F24A1D05A
  - 1. 2-ton cooling capacity
  - 2. 410a Refrigerant
  - 3. Dimensions: 39" x 22" x 19.37"

### **2.4 MATERIALS**

- A. Galvanized Steel
- B. Enamel Paint
- C. Copper coil

## **PART 3 EXECUTION**

### **3.1 MANUFACTURER INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

### **3.2 EXAMINATION**

- A. Site Verification of Conditions:
  - 1. Verify that site conditions are acceptable for installation of the Air handler
  - 2. Do not proceed with installation until site conditions are acceptable.

### **3.3 INSTRUCTIONS**

- A. Provide Manufacturer's Installation Instructions.

### **3.4 FIELD QUALITY CONTROL**

- A. Site Test
  - 1. Test and Balance

### **3.5 CLEANING**

- A. Repair or replace damaged installed products.
- B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- C. Remove construction debris from project site and legally dispose of debris.

### **3.6 PROTECTION**

- A. Protect installed work from damage until construction on the site is completed.

END OF SECTION

**SECTION 23 84 16****DEHUMIDIFIERS****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains liquid desiccant dehumidifier.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURER**

- A. Custom fabrication

**2.2 MATERIALS**

- A. Calcium Chloride (95% by weight or higher)
- B. Water
- C. Sheet steel
- D. Teflon coating on all wetted surfaces

**2.3 SUBSTITUTIONS**

- A. In lieu of custom fabricated liquid desiccant product, a similar solid desiccant dehumidifier wheel system may be used.

**PART 3 EXECUTION**

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Support piping properly. Pitch to drain points. Install with pipe expansion loops, mechanical expansion joints, and anchors.
- C. Install shutoff valves on each piece of equipment on both hot and cold water supply.
- D. Install ductwork in accordance with SMACNA recommendations. Seal duct seams with sealer. Provide splitters and balancing dampers. Provide fire dampers and automatic smoke and fire dampers where required. Provide flexible connectors and inlet and discharge connections. Clean before testing and balancing.
- E. Clearly label and tag all components.
- F. Test and balance all systems for proper operation.
- G. Restore damaged finishes. Clean and protect work from damage.
- H. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

## SECTION 25 36 16

## INTEGRATED AUTOMATION SENSORS AND TRANSMITTERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide integrated automation systems.

**1.2 SUBMITTALS**

- A. Product  
Data: [http://www.tac.com/data/internal/data/07/75/1229539863321/SDS\\_Xenta280\\_A4\\_Salesdatasheet.pdf](http://www.tac.com/data/internal/data/07/75/1229539863321/SDS_Xenta280_A4_Salesdatasheet.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
  - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Coordinate location of systems to avoid interference with location of structure and other building systems. Notify Owner prior to construction of conflicts which cannot be resolved.

**PART 2 PRODUCTS****2.1 MANUFACTURER**

- A. TAC by Schneider Electric  
Americas Headquarters  
1650 Crosby Road  
Carrollton, TX 75006  
Phone: +1(972)323-1111  
Toll-Free: +1(866)TAC-INFO  
Fax: +1(972)242-0046  
Website: [www.tac.com](http://www.tac.com)

**2.2 PRODUCTS**

- A. TAC Xenta 282 Controller

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Install light switches at uniform height above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other.
- G. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- H. Test all systems for proper operation. Label circuits in electrical panels.
- I. Restore damaged finishes. Clean and protect work from damage.
- J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION



**SECTION 26 05 19****LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains electrical wires and conductors.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches
- D. Section 26 27 19 Multi-Outlet Assemblies
- E. Section 26 05 26 Grounding and Bonding For Electrical Devices
- F. Section 26 05 33 Raceway and Boxes for Electrical Systems
- G. Section 26 28 16 Enclosed Switches and Circuit Breakers

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.

- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Southwire
- B. Essex

### **2.2 PRODUCTS**

- A. #10 AWG THWN-2 wire
- B. #12 AWG THWN-2 wire
- C. #14 AWG THWN-2 wire
- D. #18 AWG THWN-2 wire
- E. #6 AWG THHN wire
- F. #8 AWG THHN wire
- G. #12 AWG THHN wire
- H. #14 AWG THHN wire

### **2.3 MATERIALS**

- A. Copper

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

**SECTION 26 05 26****GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains grounding and bonding information and devices for electrical systems.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches
- D. Section 26 31 00 Photovoltaic Panels
- E. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring,

which are abandoned.

- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Caddy
- B. Gemini
- C. Skywalker
- D. Petra

### **2.2 PRODUCTS**

- A. 8 FT grounding rod  
Quantity: 1  
Shall be made of copper or copper bonded steel  
Must comply with NEC
- B. Bare copper conductor of equal or larger size to largest conductor in electrical power System.

### **2.3 MATERIALS**

- A. Copper
- B. Steel

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.

- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

**SECTION 26 05 33****RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains conduit and raceways for electrical wiring.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches
- D. Section 26 05 09 Low-Voltage Electrical Power Conductors and Cables

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.

- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Power First
- B. Allied Tube & Conduit

### **2.2 PRODUCTS**

- A. ½" EMT Electrical Conduit
- B. ½" Conduit Elbow
- C. Electrical Transition Box

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION



## SECTION 26 09 13

## ELECTRICAL POWER MONITORING AND CONTROL

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide power monitoring and control systems.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.  
<http://www.powerlogic.com/literature/3020HO9902R607.pdf>
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.

- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Square D by Schneider Electric  
295 Tech Park Drive  
LaVergne, TN 37086  
Phone: (866) 466-7627

### **2.2 PRODUCTS**

- A. PowerLogic Enercept meter  
Quantity: 1

### **2.3 MATERIALS**

- A.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and

protect work from damage.

END OF SECTION

**SECTION 26 09 23****LIGHTING CONTROL****PART 1 GENERAL****1.1 SUMMARY**

- A. Provide lighting control systems.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract

areas.

- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Square D by Schneider Electric  
295 Tech Park Drive  
LaVergne, TN 37086  
Phone: (866) 466-7627

### **2.2 PRODUCTS**

- A.  
Quantity: 1

### **2.3 MATERIALS**

- A.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

## SECTION 26 22 00

## LOW VOLTAGE ELECTRICAL TRANSFORMERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section describes photovoltaic inverters.

**1.2 RELATED SECTIONS**

- A. SECTION 26 31 00 Photovoltaic Collectors

**1.3 SUBMITTALS**

- A. Product Data: <http://www.xantrex.com/web/id/172/p/2604/pt/25/product.asp>  
[http://www.enphaseenergy.com/downloads/8261\\_Datasheet\\_24\\_32.pdf](http://www.enphaseenergy.com/downloads/8261_Datasheet_24_32.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance  
Data: <http://www.xantrex.com/web/id/1890/docserve.aspx>  
[http://www.enphaseenergy.com/downloads/M200\\_M175\\_User\\_Manual\\_20081110.pdf](http://www.enphaseenergy.com/downloads/M200_M175_User_Manual_20081110.pdf)

**1.4 QUALITY ASSURANCE**

- A. Complies with UL 1741
- B. Complies with CSA 107.1-01

**PART 2 PRODUCTS****2.1 MANUFACTURERS**

- A. Xantrex Technology Inc  
8999 Nelson Way Burnaby, BC  
Canada V5A 4B5  
Phone: (604)422-8595  
Fax: (604)420-1591
- B. Enphase Energy  
201 1<sup>st</sup> Street Suite 300  
Petaluma, CA 94952  
Phone: (877) 797-4743  
Fax: (707) 763-0784

**2.2 PRODUCTS**

- A. Xantrex GT5.0  
Quantity: 1
- B. Xantrex GT3.8  
Quantity: 1

- C. Enphase M175-24-240-S2  
Quantity: 2

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

END OF SECTION



## SECTION 26 24 16.12

## I-LINE PANELBOARDS

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Power Distribution Panelboard - Furnish and install distribution panelboard(s) as specified herein and where shown on the associated [schedules] [drawings].

**1.02 REFERENCES**

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. NEMA PB 1 - Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. UL 50 - Enclosures for Electrical Equipment
- E. UL 67 - Panelboards
- F. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- G. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- H. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- I. Federal Specification W-P-115C - Type I Class 1
- J. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
- K. Federal Specification W-C-865C - Fusible Switches
- L. NFPA 70 - National Electrical Code (NEC)
- M. ASTM - American Society of Testing Materials

**1.03 SUBMITTAL AND RECORD DOCUMENTATION**

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions.

The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

#### **1.04 QUALIFICATIONS**

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
- B. Panelboards shall be manufactured in accordance with standards listed Article 1.02 - REFERENCES.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

#### **1.06 OPERATIONS AND MAINTENANCE MATERIALS**

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

#### **1.07 WARRANTY**

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

#### **1.08 RELATED WORK**

- A. Section 16440-9 - Remote Controlled Lighting Panelboard System
- B. Section 16280-1.2 – Transient Voltage Surge Suppression

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Shall be Square D Company I-LINE – Class 2110
- B. Substitutions must be submitted in writing three weeks prior to original bid date with supporting documentation demonstrating that the alternate manufacturer meets all aspects of the specification herein.

### **2.02 POWER DISTRIBUTION PANELBOARDS**

- A. I-LINE Circuit Breaker Distribution Panelboard
  - 1. Interior
    - a. Shall be Square D I-LINE type rated 600 Vac or 250 Vdc maximum.  
Continuous main current ratings as indicated on associated [schedules] [drawings] not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
    - b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated [schedules] [drawings] not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.
    - c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
    - d. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated [copper] [aluminum]. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire

interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.

- e. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
  - f. A solidly bonded [aluminum] [copper] equipment ground bar shall be provided. [An additional [aluminum] [copper] isolated/insulated ground bar shall also be provided.]
  - g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. [UL Listed panelboards with 200% rated solid neutrals shall have plated copper neutral bus for non-linear load applications.] Gutter-mounted neutral will not be acceptable.
  - h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.
2. Group mounted circuit breakers through 1200A
- a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
  - b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
  - c. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted

position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

- d. Line-side circuit breaker connections are to be jaw type.
- e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

(Select Electronic trip 100%, Electronic trip 80% or Thermal Magnetic)

- 3. [Electronic trip molded case full function 100% rated circuit breakers]
  - a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, [Short Time Pickup], [Short Time Delay], [Ground Fault Pickup] [Ground Fault Delay] and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
  - b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13<sup>th</sup>) harmonic. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].
  - c. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
  - d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
  - e. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.
  - f. Circuit breaker shall be provided with Zone selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions

compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on [schedules] [drawings]

- g. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

3. [Electronic trip molded case standard function 80% rated circuit breakers]

- a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, [Short Time Pickup], [Short Time Delay], [Ground Fault Pickup] [Ground Fault Delay] and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
- b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13<sup>th</sup>) harmonic. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].
- c. Local visual trip indication for overload, short circuit and ground fault trip occurrences
- d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
- e. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

4. [Thermal magnetic molded case circuit breakers]

- a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
- b. Circuit protective devices shall be Square D molded case circuit breakers. Circuit breakers shall be [standard interrupting] [high interrupting] [extra high interrupting] [true current limiting\*]. Ampere ratings shall be as shown on the drawings.

\* Manufacturer shall submit one set of published  $I_p$  and  $I^2t$  let-through

curves (as required by UL) to the owner.

5. Enclosures

a. Type 1 Boxes

- 1) Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
- 2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
- 3) Maximum enclosure dimensions shall be 44" wide and 9.5" deep.

b. Type 1 Trim Fronts

- 1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
- 2) Trim front shall be [4-piece surface] [4-piece with door] [hinged 1-piece with door] available in [flush] [surface] mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
- 3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

c. Type 3R, 5, and 12

- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of door. All lock assemblies shall be keyed alike. One (1) key shall be provided with

each lock.

- 3) Maximum enclosure dimensions shall not exceed 44" wide and 14.5" deep.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION



SECTION 26 27 13  
ELECTRICITY METERING

**PART 1 GENERAL****1.1 SUMMARY**

- A. Provide electricity metering systems.

**1.2 SUBMITTALS**

- A. Product  
Data: <http://ecatalog.squared.com/catalog/174/html/sections/02/17402002.html>
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 28 16.12 Disconnect Switches
- B. Section 26 09 13 Electrical Power Monitoring and Control

**1.4 QUALITY ASSURANCE**

- A. Meter housing is UL listed
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.

**PART 2 PRODUCTS****2.1 MATERIALS**

- A. Manufacturers:  
  
Square D by Schneider Electric  
295 Tech Park Drive  
LaVergne, TN 37086  
Phone: (866) 466-7627
- B. Products
  - 1. UTRS213B Meter Socket
    - a. Quantity: 1

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

## SECTION 26 27 19

## MULTI-OUTLET ASSEMBLIES

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains multi-outlet assemblies.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 05 09 Low Voltage Electrical Power Conductors and Cables

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference

with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.

- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Leviton
- B. Eagle Electric / Cooper Wiring
- C. Thomas and Betts

### **2.2 PRODUCTS**

- A. 120V Grounded Wall Duplex Electrical Receptacle GFI  
Quantity: See drawings
- B. 240V Wall Single Electrical Receptacle – Locking and grounding  
Quantity: 1
- C. 120V Grounded Wall Duplex Electrical Receptacle  
Quantity: See drawings
- D. 120V Grounded Floor Duplex Electrical Receptacle GFI  
Quantity: 1

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.

- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

**SECTION 26 28 13****FUSES****PART 1 GENERAL****1.1 SUMMARY**

- A. This section contains electrical fuses for overcurrent protection.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches
- D. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.

- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Outback Power Systems
- B. Fluke
- C. Littelfuse

### **2.2 PRODUCTS**

- A. 125Aac, 240Vac rated fuse  
Quantity: 2
- B. 30Aac, 240Vac rated fuse  
Quantity: 4
- C. 15Adc, 600Vdc rated fuse  
Quantity: 4

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.

- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION



## SECTION 26 28 16

## ENCLOSED SWITCHES AND CIRCUIT BREAKERS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This system contains enclosed switches and circuit breakers.

**1.2 SUBMITTALS**

- A. Product Data:
  - <http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/QO-QOB%20Circuit%20Breakers/48840-123-04.pdf>
  - <http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/Homeline/48840-122-03.pdf>
  - [http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/Arc%20Fault%20Circuit%20Interrupters%20\(AFCI\)/0760DB0201R1102.pdf](http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/Arc%20Fault%20Circuit%20Interrupters%20(AFCI)/0760DB0201R1102.pdf)
  - <http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/QO-QOB%20Circuit%20Breakers/QO-GFI/48840-088-01.pdf>
  - <http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/QO-QOB%20Circuit%20Breakers/QO-EPD/48840-473-01.pdf>
  - <http://ecatalog.squared.com/pubs/Circuit%20Protection/Miniature%20Circuit%20Breakers/QO-QOB%20Circuit%20Breakers/0730CT9801R108.pdf>
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformers
- B. Section 26 27 13 Electricity Metering
- C. Section 26 28 16.12 Disconnect Switches
- D. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the

actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.

- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Square D by Schneider Electric  
295 Tech Park Drive  
LaVergne, TN 37086  
Phone: (866) 466-7627

### **2.2 PRODUCTS**

- A. 20 Amp AFCI circuit breaker – QO Series  
Quantity: 1
- B. 40 Amp AFCI circuit breaker – QO Series  
Quantity: 1
- C. 50 Amp AFCI circuit breaker – QO Series  
Quantity: 1
- D. 15 Amp GFI circuit breaker – QO Series  
Quantity: 1
- E. 20 Amp GFI circuit breaker – QO Series  
Quantity: 5
- F. 15 Amp AFCI circuit breaker – QO Series  
Quantity: 5

## **PART 3 EXECUTION**

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

**SECTION 26 28 16.12****DISCONNECT SWITCHES - GENERAL DUTY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Switches shall be furnished and installed at locations as shown on the drawings. Switches shall be of the type approved, indicated and specified herein.

**1.02 REFERENCES**

Switches shall be manufactured in accordance with the following standards:

- A. UL 98 - Enclosed and Dead Front Switches
- B. NEMA KS 1 - Enclosed Switches
- C. NEMA 250 - Enclosures for Electrical Equipment

**1.03 SERVICE ENTRANCE**

- A. Switches identified for use as service equipment are to be labeled for this application.

**1.04 DRAWINGS**

- A. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Switches shall be manufactured by Square D Company [no equal] [or approved equal].

**2.02 SWITCH INTERIOR**

- A. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
- B. Lugs shall be UL Listed for [60° C or 75° C conductors (30-100 ampere)], [75° C conductors (200-800 ampere)], aluminum or copper.
- C. All current carrying parts shall be plated to resist corrosion.

**2.03 SWITCH MECHANISM**

DISCONNECT SWITCHES

26 28 16.12-1

- A. The switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- B. The operating handle shall be an integral part of the box, not the cover.
- C. Provisions shall be provided for padlocking the switch in the OFF position.

#### **2.04 SWITCH ENCLOSURES**

- A. The enclosure shall be finished with [gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1)], [gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvanized steel (Type 3R)].
- B. Tangential knockouts shall be provided to facilitate ease of conduit entry on switches through 200 ampere.
- C. Enclosures for Type 3R switches through 200 ampere shall have provisions for interchangeable bolt-on hubs in the top endwall. Hubs shall be Square D B-Type hubs sized as indicated on the plans.

#### **2.05 SWITCH RATINGS**

- A. Switches shall be horsepower rated for 240Vac as indicated on the plans.
- B. The UL Listed short circuit rating shall be [10,000 rms symmetrical amperes when used with or protected by class H or K fuses (30-600 amperes)], [100,000 rms symmetrical amperes when used with or protected by Class R fuses (30-600 ampere switches employing appropriate fuse rejection scheme)], [100,000 rms symmetrical amperes when used with Class T fuses (400-800 ampere switches designated as Class T Fusible Switches)].

### **PART 3 EXECUTION**

#### **NOT USED**

END OF SECTION

## SECTION 26 31 00

## PHOTOVOLTAIC COLLECTORS

**PART 1 GENERAL****1.1 SUMMARY**

- A. This section describes the photovoltaic modules

**1.2 SUBMITTALS**

- A. Product  
Data: <http://us.sanyo.com/dynamic/product/Downloads/HITPower205DataSheet-35558646.pdf>  
[http://www.powerfilmsolar.com/downloads/pdf/OEM%20Flysheet\\_LOWRES.pdf](http://www.powerfilmsolar.com/downloads/pdf/OEM%20Flysheet_LOWRES.pdf)
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance  
Data: [http://us.sanyo.com/dynamic/product/Downloads/HITPowerInstallation\\_manual-32714277.pdf](http://us.sanyo.com/dynamic/product/Downloads/HITPowerInstallation_manual-32714277.pdf)

**1.3 RELATED SECTIONS**

- A. Section 26 22 00 Low Voltage Electrical Transformer
- B. Section 26 09 13 Electrical Power Monitoring and Control

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- F. Maintain fire alarm system in operation during construction.
- G. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. SANYO Energy (U.S.A.) Corp.  
2600 Network Blvd., Suite 600  
Frisco, TX 75034, U.S.A.  
E-mail: solar@sec.sanyo.com
- B. PowerFilm, Inc.  
2337 230<sup>th</sup> Street  
Ames, IA 50014  
Phone: (515) 292-7606  
Fax: (515) 292-1922

### 2.2 PRODUCTS

- A. SANYO HIP-205BA19 Photovoltaic Modules
  - 1. Quantity: 38
  - 2. 96 single-crystal cells with hetero intrinsic thin film layer connected in series.
  - 3. Double walled aluminum frame
  - 4. Properties
    - a. Dimensions: 35.2 inches W x 51.9 inches L x 1.4 inches D
    - b. Weight: 30.86 lbs
    - c. Hail impact rating: 1 inch hailstone at 52 mph
    - d. Static load wind/snow: 50 psf / 39 psf
    - e. Peak Power (Wp): 205 W
    - f. Max. Peak Voltage (Vmp): 56.7 V
    - g. Max. Peak Power Current (Imp): 3.62 A
    - h. Open Circuit Voltage (Voc): 68.8 V
    - i. Short Chircuit Current (Isc): 3.84 A
    - j. Power Temperature Coefficient: -0.29 %/°C
    - k. Open Circuit Voltage Temperaure Coefficient: -0.172 V/°C
    - l. Short Circuit Current Temperature Coefficient: 0.88 A/°C
    - m. Module Efficiency: 17.4%
    - n. Power per Sq. Foot: 16.2 W/ft<sup>2</sup>
- B. PowerFilm Custom Thin Film Photovoltaic Modules MPT15-75
  - 1. 50mA @ 45V

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.

- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION



SECTION 26 51 13  
INTERIOR LIGHTING

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Provide interior lights.

**1.2 RELATED SECTIONS**

- A. Section 12 35 30.13 – Kitchen Casework
- B. Section 26 56 00 – Exterior Lighting
- C. Section 12 35 30 – Residential Casework
- D. Section 26 09 23 – Lighting Control Devices

**1.3 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

**1.4 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the Nation Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power, and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- F. Coordinate location of ductwork to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Manufacturers: Alfa, Juno, DanaLite, Indy, AccuLite
- B. Electrical Standards:
  - 1. Code: NFPA 70 National Electrical Code
  - 2. Incandescent Fixtures: UL 1571
  - 3. Track Lighting Systems: UL 1574
  - 4. Lamps: ANSI Standards, C78 series

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install thermostats centered above light switches at 60" above finished floor.
- E. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above the finished floor.
- F. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise
- G. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

### **3.2 PROTECTION**

- A. Protect installed products until completion of project.

END OF SECTION



## SECTION 26 56 33

## EXTERIOR LIGHTING

## PART 1 GENERAL

## 1.1 SUMMARY

- A. This section covers exterior lighting powered by photovoltaic devices.

## 1.2 SUBMITTALS

- A. Product Data: [http://solarilluminations.com/acatalog/info\\_206.html](http://solarilluminations.com/acatalog/info_206.html)  
<http://www.solarlightstore.com/solar-specialty-lights/misc/solarstringlights102leds.cfm>

## 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories..
- E. Maintain fire alarm system in operation during construction.
- F. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- G. Coordinate location of ductwork to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.

## PART 2 PRODUCTS

## 2.1 MANUFACTURES

Flipo

[www.shopflipo.com](http://www.shopflipo.com)

Boston Harbor, Norwood Inc

[www.norwood.com](http://www.norwood.com)

## 2.2 MATERIALS

- A. Manufacturers: Flipo, Boston Harbor
- B. Products:
  - 1. Flipo FPO0007 Solar Strand Lights
    - a. 50 LED Bulbs per string
    - b. Integrated rechargeable battery
    - c. 31ft of cable
    - d. 8 to 10 hours of light per night
    - e. Quantity: 3
  - 2. Flipo FPO0008 Solar Strand Lights
    - a. 102 LED Bulbs per string
    - b. Integrated rechargeable battery
    - c. 40 ft of cable
    - d. 8 to 10 hours of light per night
    - e. Quantity: 2
  - 3. Boston Harbor 03765 Solar Strand Lights
    - a. 24 LED Bulbs per string
    - b. Integrated rechargeable battery
    - c. 8 to 10 hours of light per night
    - d. Quantity: 1

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

**SECTION 32 84 00****PLANTING IRRIGATION****PART 1 PLANTING IRRIGATION GENERAL****1.1 SUMMARY**

- A. Provide planting irrigation defined by landscape design.

**1.2 RELATED SECTIONS**

- A. Section 32 93 00 – Plants

**1.3 REFERENCES**

- A. NA

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.
- B. Existing Conditions: Field measure to verify dimensions before fabrication.

**PART 2 PRODUCTS****2.1 RAINWATER CISTERN**

- A. General: Rainwater collection system.

- B. Manufacturer: An attempt to use a local manufacturer. Submit shop drawings and specifications to architect for approval.
- C. Products:
  - 1. Rainwater Cistern.

## **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. Take field measurements prior to fabrication, where possible. Form to required shapes and sizes with true, straight edges, lines and angles.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- C. Restore damaged finishes and protect work.

### **3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

**SECTION 32 93 00****PLANTS****PART 1 PLANTS GENERAL****1.1 SUMMARY**

- A. This section includes:
  - 1. Trees
  - 2. Shrubs
  - 3. Grasses
  - 4. Herbs & Vegetables

**1.2 RELATED SECTIONS**

- A. Section 32 84 00 – Planting Irrigation
- B. Section 32 94 00 – Planting Accessories

**1.3 REFERENCES**

- A. NA

**1.4 SUBMITTALS**

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- C. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

**1.5 QUALITY ASSURANCE**

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in accordance with manufacturer's requirements.
- B. Store products in manufacturer's unopened packaging with labels intact until ready for installation.

**1.7 PROJECT CONDITIONS**

- A. Environmental Requirements: 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.

- B. Existing Conditions: Field measure to verify dimensions before fabrication.

## **PART 2 PRODUCTS**

### **2.1 PLANTS**

- A. General: Provide specific plants to meet design criteria of the landscape design.
- B. Distributor: Bluebird Nursery or other approved retailer.
- C. Products:
  - 1. Quercus rubra – Northern Red Oak
  - 2. Viburnum trilobum – American Cranberry Bush Viburnum
  - 3. Andropogon gerardii – Big Bluestem
  - 4. Sorghastrum nutans – Indian Grass
  - 5. Bouteloua curtipendula – Sideoats Grama
  - 6. Herb/Vegetable Mix

### **2.2 CONTAINERS**

- A. General: Provide specific containers to meet criteria of the landscape design.
- B. Distributor: Any major retailer.
- C. Products:
  - 1. 25 gallon blow mold container
  - 2. 15 gallon container
  - 3. 1 gallon container

### **2.3 SOIL**

- A. General: Provide soil mix to meet design criteria of landscape design.
- B. Distributor: Any major retailer or local source.
- C. Products:
  - 1. Standard potting mix.

## **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. Take field measurements prior to fabrication, where possible. Form to required shapes and sizes with true, straight edges, lines and angles.
- B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- C. Restore damaged finishes and protect work.

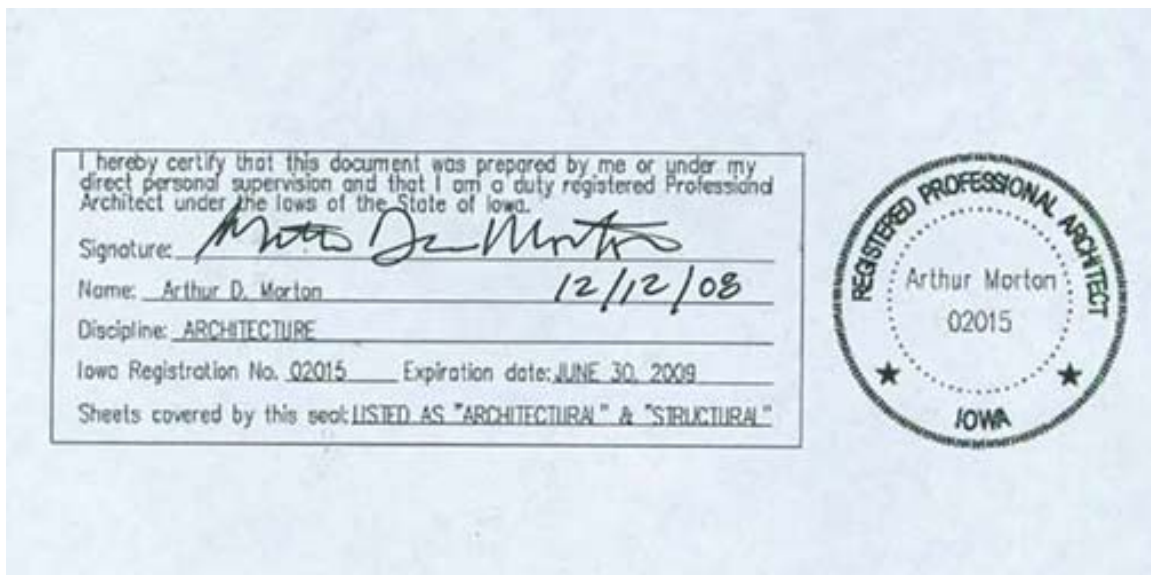
**3.4 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.
- C. Restore manufacturer's protective films and coverings damaged during installation.

END OF SECTION

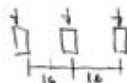
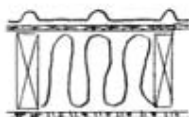
**CHAPTER 4: Structural Calculations**

This section is a duplicate of the structural calculations found in Project Manual, Chapter 3: Specifications, §00 01 07: Structural Calculations.



Solar Decathlon  
2009A - DETERMINE LOADS:

## ROOF DEAD LOADS:



$$\frac{33 \text{ plf}}{\frac{16}{12}} = 2.48 \text{ psf}$$

Photovoltaic: 2.43 psf

TUBES: 9.54 psf

METAL PANEL: 0.90 psf

Masme 26GA

PLYWOOD DECK: 1.8 psf

 $\frac{1}{2}" (\frac{15}{16} - \frac{5}{16})$ 

ROOF FRAMING: 2.48 psf

2x10's @ 16" oc

INSULATION: 1.67 psf

10" THICK

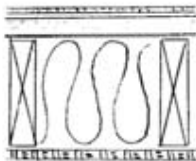
DRYWALL:  $\frac{73.6}{32} = 2.30 \text{ psf}$  $\frac{5}{8}"$ ROOF DEAD: 9.15 + 10%  
ROOF DEAD = 10 psf

(2" spray insulation)

Roof w/ PV = 13 psf

Roof w/ tubes = 20 psf

## FLOOR DEAD LOADS:



## FLOORING:

 $\frac{1}{4}"$  CERAMIC TILE: 3.13 psf

$$150 \frac{16}{48} \times \frac{0.25}{12} = 3.125$$

FLOOR PANEL: 3.6 psf

 $1\frac{1}{4}"$  plywood

FLOOR JOISTS: 3.3 psf

2x ? @ 12" oc

INSULATION: 1.67 psf

10" thick

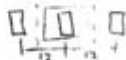
Drywall: 2.6 psf

$$\frac{3}{4}" < \frac{2.3}{\frac{5}{8}"}$$

FLOOR DEAD: 14.3 psf  
10% $\Rightarrow$  FLOOR DEAD = 16 psf

Doug Fir 33 plf

$$2 \times 10 = 33 \text{ psf} \left( \frac{15}{12} \right) \left( \frac{9.5}{12} \right) = 3.3 \text{ plf} \div 1' = 3.3 \text{ psf}$$



## SNOW LOADS:

IOWA (AMES) = 30 psf (2000 IBC p291) (2006 IRC p39) ← controls!

Roof LIVE = 20 psf (2009 Solar Decathlon p4)

## FLOOR LOADS:

FLOOR LIVE = 50 psf (2009 Solar Decathlon p4)

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B - WIND LOADS:

1- Solar Decathlon building code - 2009

wind: 60 mph (3 sec gust)  
exposure category "C"

Main wind - Force Resisting Systems ASCE / SEI 7-05

Low Rise buildings: 6-18 p 28

$$P = q_n ((GC_{pf}) - (GC_{pi}))$$

$$q_n = 0.00256 K_z K_{zt} K_d V^2 I$$

$$V = 60 \text{ mph (3 sec)}$$

$$I = 1.0 \text{ (table 6-1) p77} \rightarrow \text{category II (non hurricane)}$$

$$K_z = 2.01 \left( \frac{z}{2.5} \right)^{2.5} \sim 9.5 \text{ (table 6-2) p78}$$

$$= 2.01 \left( \frac{16}{2.5} \right)^{2.5}$$

$$K_z = 0.86$$

$$K_{zt} = (1 + K_1 K_z K_3)^2 \text{ USE } K = 1 \text{ (presume no hills or escarpments} \rightarrow \text{mall area)}$$

$$K_{zt} = 1$$

$$K_d = 0.85 \leftarrow \text{main building (table 6-4 p80)}$$

$$q_w = 0.00256 (0.86)(1)(0.85)(60)^2 (1)$$

$$q_w = 6.74 \text{ psf}$$

(roof slope  $\approx 20^\circ \rightarrow 4/11$ )

$$GC_{pf} = -0.64 \text{ (Fig 6-10 p53)}$$

$$GC_{pi} = \pm 0.55 \text{ (Fig 6-5 p47) assume partially enclosed for summer!}$$

$$P = 6.74 (-0.64 - 0.55) = -8.02 \text{ psf}$$

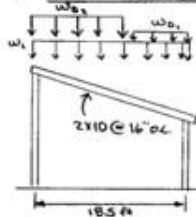
2- FOR IOWA:

wind: 90 mph (3 sec gust)  
EXPOSURE "B"

$$P = 13 \text{ psf IRC 2006 p25,41}$$

← USE THIS  
FOR DESIGN!  
Page 9 of 300

## 1 - ROOF JOISTS:



$$w_L = 30 \text{ psf}$$

$$w_{D1} = 13 \text{ psf}$$

$$w_{D2} = 20 \text{ psf}$$

$$\text{Worst Case: } M = \frac{wL^2}{8} = \frac{(30+20) \text{ psf} (13.3 \text{ ft}) (18.5 \text{ ft})^2}{8}$$

$$M_{\text{joint}} = 2844 \text{ ft}\cdot\text{lb}$$

$$S_{\text{reqd}} = 21.39 \text{ in}^3$$

$$f_b = \frac{M_{\text{joint}}}{S_{\text{reqd}}} = \frac{2844 (12)}{21.39 \text{ in}^3}$$

$$f_{b\text{joint}} = 1596 \text{ psi}$$

$$F_b' = F_b C_D C_L C_F C_R \quad \text{SPF \#1/\#2}$$

$$= 875 \text{ psi} (1.15) (0.90) (1.1) (1.15)$$

$$= 1247 \text{ psi} < 1596$$

$$(\text{p22 NDS}) \quad F_b' = F_b C_D C_L C_F C_R \quad \text{SPF - Select Structural}$$

$$= 1250 \text{ psi} (1.15) (0.90) (1.1) (1.15)$$

$$= 1782 \text{ psi} > 1596 \text{ psi} \quad \text{OK}$$

$$\text{Select Structural: } E = 1,500,000 \text{ psi}$$

$$\Delta_{\text{max}} = \frac{5}{384} \frac{(30+20) \text{ psf} (13.3 \text{ ft}) (18.5 \text{ ft})^4}{1,500,000 \text{ psi} (98.93 \text{ in}^4)} = 1.18 \text{ in}$$

$$\Delta_{\text{allow}} = \frac{L}{360} = \frac{18.5 (12)}{360} = 0.617 \text{ in}$$

$$\Delta_{\text{allow}} = \frac{L}{240} = \frac{18.5 (12)}{240} = 0.925 \text{ in}$$

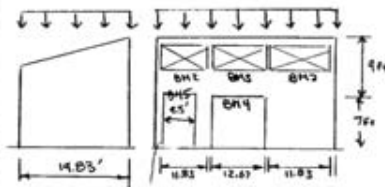
BM1: span 18.5 ft

2x10 @ 16" o.c.

S-P-F (select structural)  $F_b = 1250 \text{ psi}$   
 $E = 1,500,000 \text{ psi}$

2- CLERE STORY WINDOW LINTEL:

BM2 &amp; BM3



$$W_{dead} = 20 \text{ psf}$$

$$W_{live} = 30 \text{ psf}$$

$$TRIB \text{ WIDTH} = \frac{19.83}{2} \approx 10'$$

BM2 span = 11.83 ft : (3) 2x12  
w/ (2) studs each side

BM3 span = 12.67 ft : (3) 2x12  
w/ (2) studs each side

S-P-F  $F_b = 1230 \text{ psi}$  SS - Select Structural  
 $E = 1,500,000 \text{ psi}$

4- N. Elevation DOOR HEADER

Beam 4:  $9(15 \text{ psf}) = 135 \text{ psf}$  (wall load)  $\rightarrow$  add to roof load (13.5 psf)  
(divide by roof trib width)

$$W_{dead} = 20 + 13.5 = 33.5 \text{ psf}$$

$$W_{live} = 30 \text{ psf}$$

$$BM4 - \text{SPAN} = 12.67 \text{ ft}$$

$$\text{Trib width} = \frac{19.83}{2} \approx 10'$$

BM4: (2)  $1\frac{3}{4} \times 11.25'$   
MICROLAM  
w/ (2) Jack studs each side  
 $F_b = 2600 \text{ psi}$   
 $E = 1,900,000 \text{ psi}$

5 - N. Elevation Mechanical DOOR HEADER

Beam 5:  $W_{dead} = 33.5 \text{ psf}$  (see door header above #4)

$$W_{live} = 30 \text{ psf}$$

$$BM5 \text{ span} \approx 9.5 \text{ ft} \text{ (see sketch above)}$$

$$\text{Trib width} = \frac{19.83}{2} \approx 10'$$

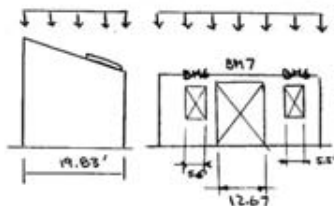
BM5: (3) 2x12  
w/ (2) Jack studs each side

S-P-F - #1/#2

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

## 6 - S. Elevation Window lintel



$$W_{\text{dead}} = 20 \text{ psf}$$

$$W_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = \frac{19.83'}{2} = 10'$$

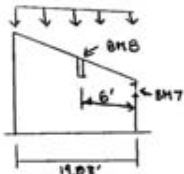


splitline

$$\text{SPAN}_6 = 5.5'$$

BM6: 2-(3) ply beams (stacked)  
 2X6 plys w/ (1) Jack stud each side  
 S-P-F #1/#2  
 $F_b = 875 \text{ psi}$   
 $E = 1,400,000 \text{ psi}$

## 7 - S. Elevation DOOR HEADER (SKY WINDOW)



(center module)

$$\text{BM7: } W_{\text{dead}} = 20 \text{ psf} + 20 \text{ psf}^{\text{UNKNOWN}} = 40 \text{ psf}$$

$$W_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = \frac{6'}{2} = 3'$$

$$\text{SPAN}_7 = 12.67' \text{ (see sketch above)}$$

BM7: (3) 2X8 w/ (1) JACK STUD EACH END

S-P-F  $F_b = 1250 \text{ psi}$  Select  
 $E = 1,500,000 \text{ psi}$  Structural

## 8 - CENTER MODULE ROOF BEAM

BM8: (see sketch above)

$$W_{\text{dead}} = 40 \text{ psf (see BM7)}$$

$$W_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = \frac{13.83 + 6}{2} = 10 \text{ ft}$$

$$\text{BM span} = 13 \text{ ft (sl.4)}$$

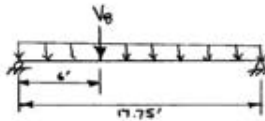
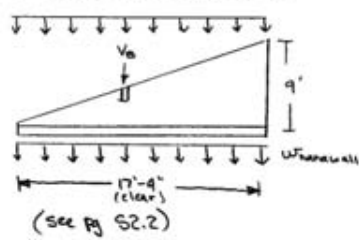
BM8: (2) ply  $1\frac{3}{4} \times 11\frac{1}{4}$   
 MICROLAM w/  $1\frac{1}{2}$ " Beams

$$F_b = 2600 \text{ psi}$$

$$E = 1,900,000 \text{ psi}$$



## 9 - SHEAR TRUSS



$$V_{max} = \frac{wL}{2} = \frac{204(17.75)}{2} = 1811 \text{ lb}$$

$$V_{max} = \frac{4500(11.75)}{17.75} = 3012 \text{ lb}$$

$$V_{total} = 4823 \text{ lb}$$

$$W_{roof} = (20 \text{ psf dead} + 30 \text{ psf live}) \times 1.33 = 66.5 \text{ plf}$$

$$V_B = 4550 \text{ lb}$$

$$W_{transverse} = 10 \text{ psf}(7 \text{ ft}) = 70 \text{ plf}$$

$$V_{sheartruss} = 15 \text{ psf} \left( \frac{q'}{2} \right) = 67.5 \text{ plf}$$

$$M_{tr} = \frac{(66.5 + 70 + 67.5) \text{ plf} (17.75)^2}{8} = 8034 \text{ ft} \cdot \text{lb}$$

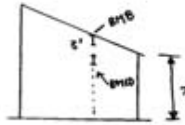
$$M_{tr} = \frac{4550(6)(11.75)}{17.75} = 18,072 \text{ ft} \cdot \text{lb}$$

$$M_{max} = 8034 + 18,072 = 26,106 \text{ ft} \cdot \text{lb}$$

23,148.7  
if no foot load

$$\text{equivalent } w = \frac{8M}{L^2} = \frac{8(26,106)}{(17.75)^2} = 663 \text{ plf} \quad (596)$$

# 10 - LOWER MODULE - NANAWALL (BELOW BMB)



$$w_{dead} = 10(3) = 30 \text{ plf}$$

$$w_{live} = 10(7) = 70 \text{ plf}$$

$$\text{Trib width} = 1 \text{ ft}$$

$$\text{BM span} = 13 \text{ ft (sl. 4)}$$

BM10: (2)ply 2x8  
w/ 1.5" BRG SEAT

S-P-F #1/#2

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

# 11 - LOWER MODULE - NANAWALL STORAGE

$$w_{live} = \frac{7 \text{ panels} @ 3 \text{ ft} \times 10 \text{ psf}}{2.5 \text{ ft BM11 span}} = 84 \text{ plf}$$

$$\text{Trib width} = 1 \text{ ft}$$

$$\text{BM span} = 2.5 \text{ ft}$$

BM11: (2)ply 2x8  
w/ 1.5" BRG SEAT

S-P-F #1/#2

$$F_b = 875 \text{ psi}$$

$$E = 1,400,000 \text{ psi}$$

20 - FLOOR JOISTS

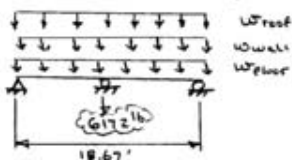
$$W_{dead} = 16 \text{ plf}$$

$$W_{live} = 50 \text{ plf}$$

$$\text{Trib width} = 1'$$

$$\text{BM span} = 12'-9"$$

BM20 2X8 @ 12" o.c.  
1.5" BRG AREA  
S-P-F #1/#2  
 $F_b = 875 \text{ psi}$   
 $E = 1,400,000 \text{ psi}$   
\* close on deflection! bending!

21 - RIM JOIST (VIC Grid-G)

(2X2 pad)

Assume Simple Span!

$$W_{roof} = (20 + 30) (1.33) = 66 \text{ plf} \quad (\text{trib width } 40 \text{ live } (26 \text{ dead}))$$

$$W_{wall} = 7(15) + \frac{1}{2} 9(15) = 173 \text{ plf (dead)}$$

$$W_{floor} = \frac{16(12.75)}{2} = 102 \text{ plf (dead)}$$

$$= \frac{50(12.75)}{2} = 319 \text{ plf (live)}$$

$$\text{Live} = 359 \text{ plf} \quad \text{Dead} = 301 \text{ plf}$$

$$\text{Trib width} = 1'$$

$$\text{Beam span} = \frac{18.67}{2} = 9.35'$$

(May need short span!)

3 1/2 x 7 1/4 LVL  
FAILS IN BENDING  
shorten span

RIM JOIST (VIC Grid-E)

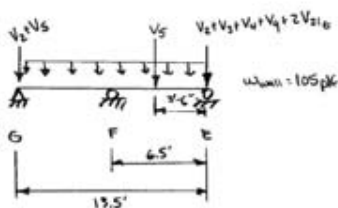
$$W_{live} = 319 \text{ plf}$$

$$W_{dead} = 102 \text{ plf}$$

$$\text{Trib width} = 1'$$

$$\text{Beam span} = 9.35'$$

3 1/2 x 7 1/4 LVL ok  
 $V_{all} = 1968 \text{ lb}$

RIM JOIST (LINE 4 E to F)

$$W_{wall} = 105 \text{ plf}$$

$$M = \frac{V_s(3.5)}{6.5} = 1624 \text{ ft-lb}$$

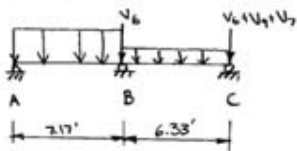
$$M = \frac{105(6.5)^2}{8} = 5594.1 \text{ ft-lb (dead)}$$

$$V = 1336 \text{ lb}$$

$$\frac{2178(6)}{(6.5)^2} = 412 \text{ plf}$$

3 1/2 x 7 1/4 LVL  
FAILS IN BENDING  
Thicken member  
need 4" wide

## 21 - RIM JOIST LINE 1 GRID C-B



A-B:

$$w_{\text{dead}} = 33.5 \text{ psf (see #4)}$$

$$w_{\text{live}} = 30 \text{ psf}$$

$$\text{Trib width} = 10'$$

$$\text{BH span} = 7'-2" (7.17')$$

$$V_6 = 1375 \text{ lb}$$

$$\boxed{3\frac{1}{2} \times 7\frac{1}{4} \text{ LVL OK}} \quad V_{\text{max}} = 3651 \text{ lb}$$

C-B

$$w_{\text{dead}} = 7 \times 15 = 255 \text{ plf}$$

$$\text{Trib width} = 1'$$

$$\text{BH span} = 6.33'$$

$$V_{\text{max}} = V_6 + V_9 + V_7 + \frac{1}{2} wL$$

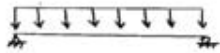
$$V_{\text{max}} = 9504 \text{ lb}$$

$$\boxed{3\frac{1}{2} \times 7\frac{1}{4} \text{ LVL}} \\ \text{FAILS IN SHEAR}$$

$$\text{needs (3) } 1.75" \text{ plys or } b = 5.25"$$

$$\text{BRI Area req'd} = 4.5"$$

## 21 - RIM JOIST LINE 1 GRID C-E



$$w_{\text{wall}} = 255 \text{ plf}$$

$$w_{\text{floor live}} = 50 \text{ plf}$$

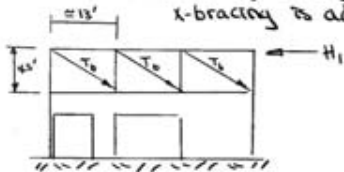
$$w_{\text{floor dead}} = 16 \text{ plf}$$

$$\text{BH span} = 12'-0" (12.67')$$

$$\boxed{3\frac{1}{2} \times 7\frac{1}{4} \text{ LVL OK}}$$

# 60 - NORTH CLERESTORY CROSS-BRACING

\* clerestory framing is adequate structurally  
x-bracing is added to control deflection



$$T_0 = 13.8 \left( \frac{H_1}{12} \right) = \frac{13.8}{13} \times \frac{2340}{3}$$

$$T_0 = 826 \text{ lb}$$

\* X-bracing in tension only!

$$L_{brac} = \sqrt{4.5^2 + 13^2} = 13.8'$$

ω 1/4" A36 SIDE PLATE: (p61 NDS 1991)

$$\# \text{ 1/4 LAG BOLTS} = \frac{T_0}{Z_{\perp}} = \frac{826 \text{ lb}}{190 \text{ lb}} = 4.34 \text{ or (5)}$$

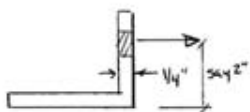
$$\# \text{ 3/8 LAG BOLTS} = \frac{826 \text{ lb}}{290 \text{ lb}} = 2.84 \text{ or (3)}$$

ROD SIZE:

$$\frac{1}{2}" \text{ ROD} \quad A = \pi r^2 = \pi (.25)^2 = 0.19 \text{ in}^2$$

$$\phi P_n = 0.9 F_y A_g = 0.9 (36 \text{ ksi}) (0.19 \text{ in}^2) = 6.15 \text{ k} >> 1.07 \text{ k} \quad \text{OK}$$

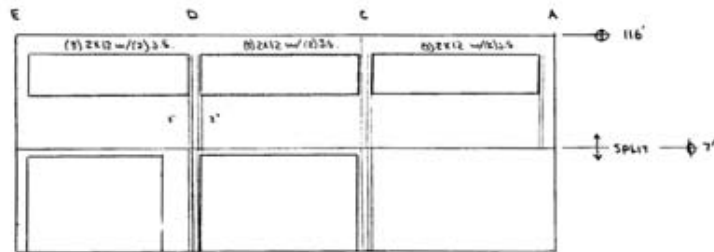
$$\frac{KL}{r} = \frac{(1)(13.8)(12)}{\frac{.25}{2}} = 662 >> 300 \text{ pretty slender!}$$



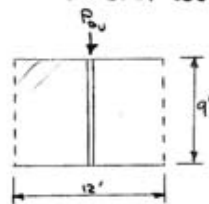
$$M = P(L) = \overset{1.07 \text{ k}}{1.3 (826)} (2") = 2,148 \text{ in}\cdot\text{lb}$$

$$S_x = \frac{1}{6} b h^2 = \frac{0.25}{6} (h^2) = 0.166 \text{ in}^3$$

$$S_{x \text{ reqd}} = \frac{2,148 \text{ in}\cdot\text{lb}}{.6 (36,000 \text{ psi})} = 0.099 \text{ in}^3 < 0.66 \text{ in}^3 \quad \text{OK}$$

40- NORTH WALL (OUT OF PLANE)

## 41- UPPER BEAM COLUMN - "D" (worst case - upper)



Trib width = 12'

90 mph wind exposure "B"  
 $w_{wind} = 13 \text{ psf}$   
 (IRC 2006) p25,41

$$\tan \theta = \frac{9}{20} \quad \theta = 24^\circ$$

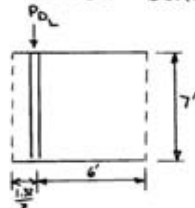
$$P_u = V_2 + V_3 + V_4 = 2950 + 3168 + 5884 = 12,002 \text{ lb}$$

BC 41: (4) ply 2x6

S-P-F #1/#2

 $F_b = 875 \text{ psi}$  $E = 1,400,000 \text{ psi}$ 

## 42- LOWER BEAM COLUMN "D" worst case lower



Trib width = 6.7 ft

90 mph wind Exposure "B"

 $w_{wind} = 13 \text{ psf}$  (see above)

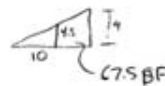
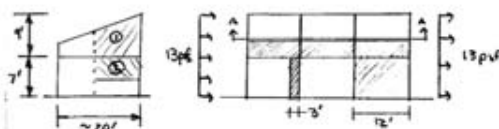
$$P_{u, lower} = V_2 + V_3 + V_4 + V_5 = 2950 + 3168 + 5884 + 4023 = 16,025 \text{ lb}$$

BC 42: (4) ply 2x6

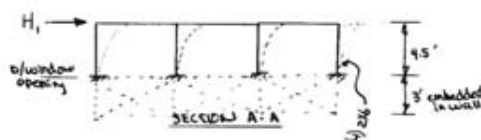
SPF #1/#2

 $F_b = 875 \text{ psi}$  $E = 1,400,000 \text{ psi}$

## 43- North Wall - IN PLANE



## 44- CLERESTORY POSTS (TAKE WIND INTO WOOD POSTS)



$H_1$ : Diaphragm load  
 $26 \text{ psf} (9 \text{ ft}) (10 \text{ ft})$   
 (wind outside)  $\leftarrow$  trix width  
 $H_1 = 2340 \text{ lb}$

$$P_{\text{dead}} = V_{2 \text{ dead}} + V_{4 \text{ dead}} + V_{6 \text{ dead}} =$$

$$= \frac{2}{3} (V_2) + 0.52 V_3 + \frac{164}{204} (V_4)$$

$$= \frac{2}{3} (2950) + 0.52 (3160) + \frac{164}{204} (5884)$$

$$P_{\text{dead}} = 7558 \text{ lb}$$

$$P_{\text{dead} + \text{live}} = 16,025 \text{ lb}$$

$$M_{\text{wind}} = \frac{H_1}{4} \times 4.5' = \frac{2340}{4} (4.5)$$

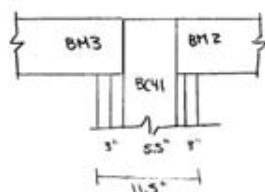
$$M_{\text{wind}} = 2633 \text{ ft} \cdot \text{lb}$$

$$\Delta_{\text{max}} = \frac{H L^3}{3 E I} = \frac{(2340/4) (4.5)^3 (12)^3}{3 (1,400,000) (4) (20.80)}$$

$$\Delta_{\text{max}} = 0.26''$$

$$\Delta_{\text{allow}} = \frac{4.5 (12)}{360} = 0.15''$$

Since I does not include sheathing & shoulder studs. This is probably OK



$$I_{\text{wall stud}} = \frac{4 (20.8) + 5.3 \left[ \frac{(8')^3}{12} \right] (1.5')}{12}$$

$$= 288.7$$

POST 44: (AKA BC 41)

(4) PLY 2X6

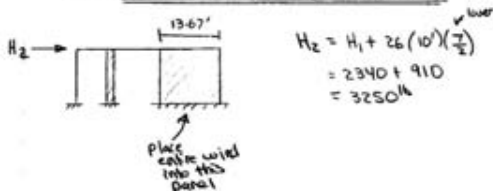
SPF #1/#2

$F_b = 875 \text{ psi}$

$E = 1,400,000 \text{ psi}$

$\Delta = 0.075''$   
 $I = 288.4$   
 w/ Jack studs  
 OK

## 45- LOWER MODULE SHEAR



$$H_2 = H_1 + 26 (10') \left( \frac{7}{12} \right)$$

$$= 2340 + 910$$

$$= 3250 \text{ lb}$$

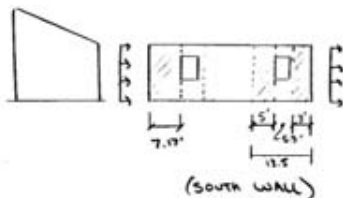
$$\text{SHEAR: } U_s = \frac{V}{d} = \frac{3250 \text{ lb}}{13.67'} = 238 \text{ plf}$$

$$U_{5/8" \text{ drywall}} = 100 \text{ plf}$$

$$U_{7/16" \text{ sheathing}} = 170 \text{ plf}$$

$$U_{\text{total}} = 270 \text{ plf} > 238 \text{ plf} \quad \text{OK}$$

#### 46 - SOUTH WALL - IN PLANE



add up shear sections:

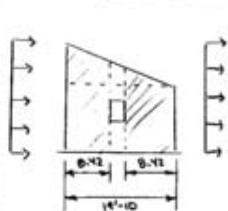
$$d = 7.17 + 5' + 3' = 15.17'$$

\* since this is greater than N wall shear

∴ H is smaller on S wall;

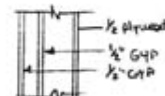
**SHEAR IS OK**

#### 47 - EAST & WEST WALL - IN PLANE



$$\text{Diaphragm Load} = \frac{1}{2} 26 \text{ psf} (125 \text{ ft}) (40 \text{ ft}) = 6500 \text{ lb}$$

$$U_s = \frac{6500 \text{ lb}}{16.84 \text{ ft} \times 2} = 385 \text{ plf}$$



$$U_{\text{ply}} = 100 \text{ plf} \times 2 = 200 \text{ plf}$$

$$U_{\text{plywood}} = 180 \text{ plf}$$

$$1 \frac{1}{2} \text{ s2}$$

380 plf ← This is min cap. there is more capacity w/ nail spacing.

**VERY CLOSE! ENSURE proper nail spacing & blocking**

Blocked Diaphragms:

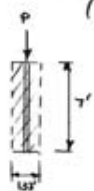
$$U_{\text{ply 1/2}} = 2 (125) = 250 \text{ plf (blocked w/ 7" spacing)}$$

$$U_{\text{sheathing 1/2}} = 270 \text{ plf [blocked w/ 6" spacing (Ed)]}$$

> 520 plf

#### 48 - WALL STUDS - OUT OF PLANE

(S-WALL STUD)

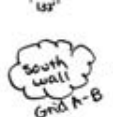


Wind = 26 psf

.36 lb

$$P = 15 \text{ psf} \times 9' (1.33') + (30 + 20) (1.33) (1.33) = 224.8 \text{ lb}$$

all studs!



$$P = (30 + 20) (1.33) (10') = 665 \text{ lb} \leftarrow \text{worst case}$$

add 136 lb

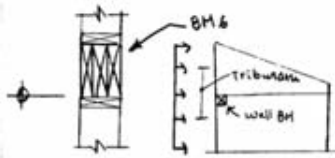
2X6 WALL STUDS @ 16" O.C.

SPF #1/#2

$F_b = 975 \text{ psi}$

$E = 1,400,000 \text{ psi}$



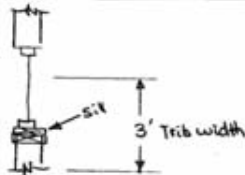
49 - MODULE SPLIT BEAM - OUT OF PLANE

$$\text{Trib width} = \frac{9}{2} + \frac{7}{2} = 8'$$

$$\text{BM length} = 13' \text{ (max bay or module)}$$

BM49 = BM 6 check for weak axis wind

BM 6 OK for wind loading

50 - WINDOW SILL - OUT OF PLANE

BM length: 12.67 (same as BM 3)

BM 50: (2) ply 2x6

SPF #1/#2

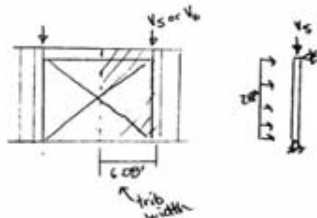
$F_b = 875 \text{ psi}$

$E = 1,400,000 \text{ psi}$

BM 51:

(1) PLY 2x6

S-wall sills

51 - WINDOW & DOOR POST - OUT OF PLANE

$$V_{max} = 3016 \text{ lb (Vs)}$$

$$M = \frac{wL^2}{8} = \frac{25 \text{ psf} (6.00) (9')^2}{8}$$

BC 51:

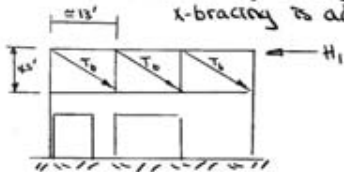
(2) PLY 2x6

SPF: #1/#2

$F_b = 875 \text{ psi}$

# 60 - NORTH CLERESTORY CROSS-BRACING

\* clerestory framing is adequate structurally  
x-bracing is added to control deflection



$$T_6 = 13.8 \left( \frac{H_1}{12} \right) = \frac{13.8}{13} \times \frac{2340}{3}$$

$$T_6 = 826 \text{ lb}$$

\* X-bracing in tension only!

$$L_{brac} = \sqrt{4.5^2 + 13^2} = 13.8'$$

ω 1/4" A36 SIDE PLATE: (p61 NDS 1991)

$$\# \text{ 1/4 LAG BOLTS} = \frac{T_6}{Z_{\perp}} = \frac{826 \text{ lb}}{190 \text{ lb}} = 4.34 \text{ or (5)}$$

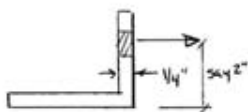
$$\# \text{ 3/8 LAG BOLTS} = \frac{826 \text{ lb}}{290 \text{ lb}} = 2.84 \text{ or (3)}$$

ROD SIZE:

$$\frac{1}{2}" \text{ ROD} \quad A = \pi r^2 = \pi (.25)^2 = 0.19 \text{ in}^2$$

$$\phi P_n = 0.9 F_y A_g = 0.9 (36 \text{ ksi}) (0.19 \text{ in}^2) = 6.15 \text{ k} >> 1.07 \text{ k} \text{ OK}$$

$$\frac{KL}{r} = \frac{(1)(13.8)(12)}{\frac{.25}{2}} = 662 >> 300 \text{ pretty slender!}$$



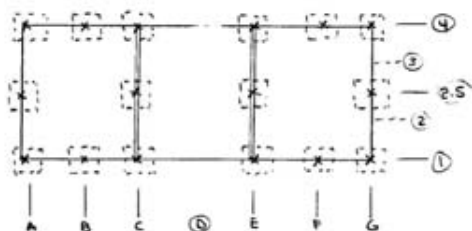
$$M = P(L) = \overbrace{1.3(826)}^{1.07 \text{ k}} (2") = 2,148 \text{ in}\cdot\text{lb}$$

$$S_x = \frac{1}{6} b h^2 = \frac{0.25}{6} (h^2) = 0.166 \text{ in}^3$$

$$S_{x \text{ reqd}} = \frac{2,148 \text{ in}\cdot\text{lb}}{.6 (36,000 \text{ psi})} = 0.099 \text{ in}^3 < 0.66 \text{ in}^3 \text{ OK}$$

#	Member	Section	Species	#	Phys	BAMS	length ft	# applied lb	Applied ft-lb	A req'd in <sup>2</sup>	# studs Req'd	Beam Seat (in)
1	Roof Joists	2x10	SPF #1/W2	1	1	1	18.5	615	2845	1.45	1	1.5 joist hanger req'd
2	Clerestory window lintels	2x10	SS	3	3	3	11.8	2950	8703	6.94	2	3
3	Clerestory window lintels	2x12	SS	3	3	3	11.8	2950	8703	6.94	2	3
3	Clerestory window lintels	2x12	SS	3	3	3	12.67	3168	10033	7.45	2	3
3	Clerestory window lintels	1.75 x 11.25	1.9E Micro	2	2	2	12.67	3168	10033	4.22	1	1.5
3	Clerestory window lintels	1.75 x 11.25	1.9E Micro	3	3	3	12.67	3168	10033	4.22	1	1.5
4	N.Elev. Downway Header	2x12	SS	3	3	3	12.67	4023	12742	9.47	2	3
4	N.Elev. Downway Header	1.75 x 11.25	1.9E Micro	2	2	2	12.67	4023	12742	5.36	1	1.5
5	N.Elev. Mechanical Door Header	2x12	SPF #1/W2	3	3	3	9.5	3016	7164	7.10	2	3
6	S.Elev. window lintels	2x6	SPF #1/W2	3	3	3	5.5	1375	1891	3.24	1	1.5
7	S.Elev. Door Header	2x8	SPF #1/W2	3	3	3	12.67	1330	4214	3.13	1	1.5
7	S.Elev. Door Header	2x8	SS	3	3	3	12.67	1330	4214	3.13	1	1.5
8	Center Module Roof Beam	2x12	SS	3	3	3	13	4550	14788	6.07	1	1.5
8	Center Module Roof Beam	1.75 x 11.25	1.9E Micro	2	2	2	13	4550	14788	6.07	1	1.5
9	Shear Truss bottom Chord	1.75 x 11.25	1.9E Micro	4	4	4	17.75	5884	26311	7.85	1	1.5
9	Shear Truss bottom Chord	1.75 x 11.25	1.9E Micro	3	3	3	17.75	5290	23472	7.05	1	1.5
9	Shear Truss top/bottom Chord	2x6	SS	4	4	4	17.75	5884	26311	13.85	2	3
9	Shear Truss top/bottom Chord	2x12	SS	3	3	3	17.75	5884	26311	13.85	3	4.5
10	Lower Module NanaWall	2x8	SPF #1/W2	2	2	2	13	650	2113	1.53	1	1.5
11	NanaWall Storage	2x8	SPF #1/W2	2	2	2	2.5	105	66	0.25	1	1.5
10	Floor Joists	2x8	SPF #1/W2	1	1	1	12.67	413	1307	0.97	1	1.5 joist hangers
21	Rim Joist (grid E)	1.75 x 11.25	1.9E Micro	2	2	2	9.35	3086	7232	4.11	1	1.5 beam seat
21	Rim Joist (grid E)	1.75 x 11.25	1.9E Micro	2	2	2	9.35	1568	4601	2.62	1	1.5
21	Rim Joist (line 4 grid E-F)	1.75 x 11.25	1.9E Micro	2	2	2	6.5	1932	2176	25.78	5	7.5
21	Rim Joist (line 1 grid A-B)	1.75 x 11.25	1.9E Micro	2	2	2	7.17	3651	4081	4.87	1	1.5
21	Rim Joist (line 1 grid B-C)	1.75 x 11.25	1.9E Micro	2	2	2	7.17	9504	1839	12.67	3	4.5
21	Rim Joist (line 1 grid C-E)	1.75 x 11.25	1.9E Micro	2	2	2	12.67	2034	6441	2.71	1	1.5
49	Module Split wind beams NS	2x6	SPF #1/W2	2	2	2	13	549	1785	1.29	1	1.5
49	Module Split wind beams NS	2x6	SPF #1/W2	2	2	2	13	549	1785	1.29	1	1.5
49	Module Split wind beams EW	2x6	SPF #1/W2	3	3	3	20	455	2275	1.07	1	1.5
50	Window Sill	2x6	SPF #1/W2	1	1	1	12.67	247	783	0.58	1	1.5
51	Window Sill	2x6	SPF #1/W2	1	1	1	5.5	307	147	0.25	1	1.5

## 70 - BEARING PADS



$$A1: P = V_{21G} + V_{21AB} = 3086 \text{ lb} + 3651 \text{ lb} = 6737 \text{ lb}$$

$$A_{reqd} = \frac{6737 \text{ lb}}{1500 \text{ psf}} = 4.5 \text{ SF} \rightarrow (2.11' \times 2.11')$$

$$A2.5 \div G2.5: P = 2(V_{21G}) = 2(3086) \text{ lb} = 6172 \text{ lb}$$

$$A_{reqd} = \frac{6172}{1500} = 4.11 \rightarrow [2.03' \times 2.03']$$

$$G4 / A4 / G1:$$

$$P = \frac{1}{2}(255)(7.12) + V_2 + V_5 + V_{21G}$$

$$= 908 + 2950 + 3016 + 3086 = 9960 \text{ lb}$$

$$A_{reqd} = \frac{9960}{1500} = 6.64 \text{ SF} \rightarrow [2.6' \times 2.6']$$

$$B1 / B4 / F1 / F4:$$

$$P = \frac{1}{2}(255)(6.33) + V_5 \text{ or } V_6$$

$$= 8016 + 3016 = 3823 \text{ lb}$$

$$A_{reqd} = \frac{3823}{1500} = 2.55 \text{ SF} \rightarrow [1.6' \times 1.6']$$

$$E4 / C4 / C1 / E1:$$

$$P = V_{24DEF} + V_{21E} + V_{21CE}$$

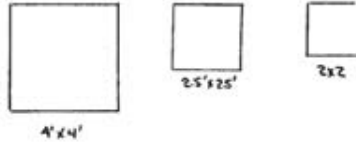
$$= 19,332 + 1968 + 2034 = 23,334 \text{ lb}$$

$$A_{reqd} = \frac{23,334}{1500} = 15.6 \text{ SF} \rightarrow [3.9' \times 3.9']$$

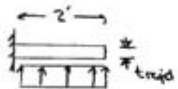
$$C2.5 / E2.5:$$

$$P = 2V_{21E} = 2(1968) = 3936 \text{ lb}$$

$$A_{reqd} = \frac{3936}{1500} = 2.6 \text{ SF} \rightarrow [1.6' \times 1.6']$$

71 - DESIGN BEARING PADS4x4 PADS

Worst case: all will be applied w/ 1500psf



$$M = \frac{WL^2}{2} = \frac{1500 \text{ psf} (4 \text{ ft}) (2')^2}{2} = 12,000 \text{ ft}\cdot\text{lb}$$

$$S_x = \frac{1}{6} b h^2 = \frac{1}{6} (48") (3.5')^2 = 98 \text{ in}^3$$

$$S_{x \text{ req'd}} = \frac{12,000 \text{ ft}\cdot\text{lb} (12 \text{ in/ft})}{875 \text{ psi}} = 165 \text{ in}^3$$

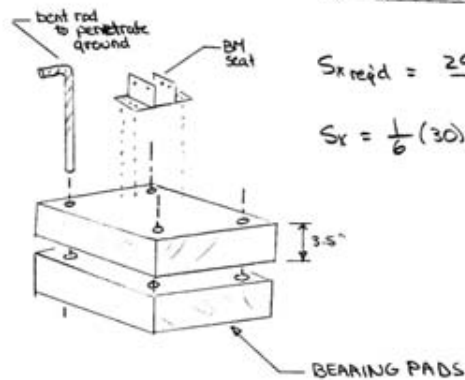
$$\# \text{ Sections req'd} = \frac{165}{98} = 1.68 \text{ or } (2) \text{ layers}$$

2x2 PADS:

$$M = \frac{1500 (2) (1)^2}{2} = 1500 \text{ ft}\cdot\text{lb}$$

$$S_x = \frac{1}{6} (24) (3.5)^2 = 49 \text{ in}^3$$

$$S_{x \text{ req'd}} = \frac{1500 (12)}{875} = 20.5 < 49 \text{ } \underline{\text{OK}} \text{ use (1) layer}$$

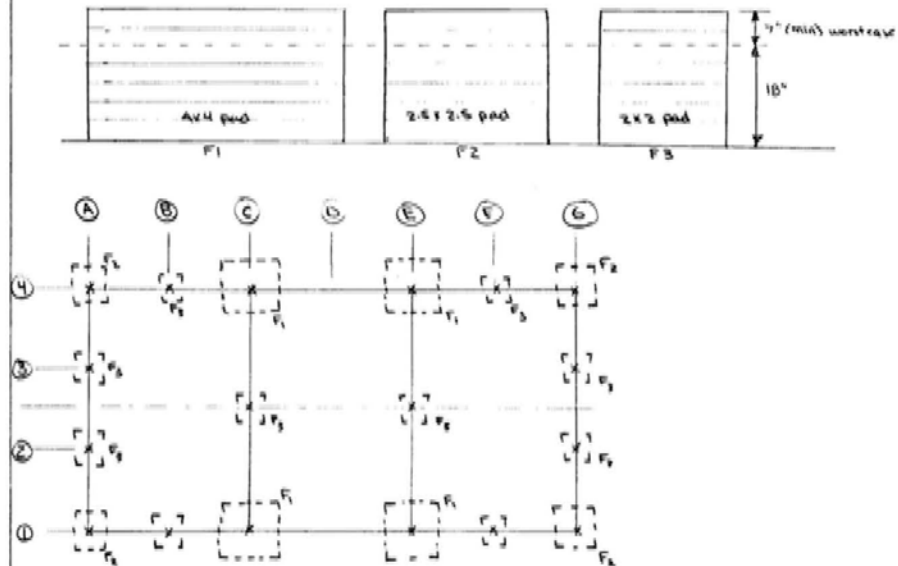
2.5 X 2.5 PADS:

$$M = \frac{1500 (2.5) (1.25)^2}{2} = 2929.68$$

$$S_{x \text{ req'd}} = \frac{2929.68 (12)}{875} = 40.2 \text{ in}^3$$

$$S_x = \frac{1}{6} (30) (3.5)^2 = 61.25 > 40.2 \text{ } \underline{\text{OK}} \text{ use (1) layer}$$

## 72 - CHECK BRG PAD STABILITY



## Wind SHEAR Grid line "A"

$$V = 26 \text{ psf} \left( \frac{13.3}{2} \right) \times 16' = 2773.16$$

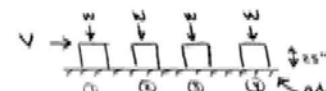
weight  
Gravel 31

$$\text{Assume } W = \text{dead load} = \frac{46K}{6} = 7.67K$$

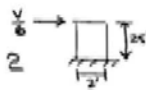
$$\rightarrow W \times \frac{7.67K}{4} = 1,920.12$$

$$FS \text{ overturning} = \frac{W \left( \frac{24}{2} \right)}{\frac{V}{6} (25)} = \frac{1920 (12)}{\frac{2773}{6} (25)} = 2$$

$$FS \text{ overturning} = \frac{1920 \left( \frac{30}{2} \right)}{\frac{2773}{6} (25)} = 2.5$$



TRY 2x2 Pads:

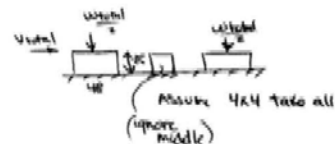
add also  
both  
pads from  
Grid line "B"  
total of  
2 pads

## Wind shear Grid line "C"

$$\text{Assume } W_{\text{total}} = \frac{46K}{8} = 5.75K$$

$$V_{\text{total}} = 5546$$

$$FS \text{ overturning} = \frac{15330 (24)}{\frac{5546}{2} (25)} = 2.7$$

(Assume 4x4 take all  
(ignore middle))

BRG PADS OK

\* if solarD wind is used  
FS would increase by 1.6!

## Solar Decathlon: Structural Calcs - Deck

Uniformly Distributed Loads:

PA

Uniformly Distributed Loads:																												
#	Member	Section	b	d	smax	#	Pys	BMS	th	Length & Loading				Section Properties				BENDING CAPACITY				DEFLECTION						
										W <sub>max</sub> psf	W <sub>dead</sub> psf	W <sub>live</sub> psf	W <sub>total</sub> psf	S <sub>x</sub> in <sup>3</sup>	I <sub>x</sub> in <sup>4</sup>	S <sub>y</sub> in <sup>3</sup>	I <sub>y</sub> in <sup>4</sup>	R <sub>x</sub> psf	C <sub>x</sub>	C <sub>y</sub>	C <sub>u</sub>	R <sub>y</sub> psf	Δ <sub>max</sub> in	Δ <sub>max</sub> in	Δ <sub>max</sub> in	Δ <sub>max</sub> in		
100	Deck Joists	2x6	1.5	7.25	7.25	1	1			50	10	1.31	439	1207	13.14	1102	395 #1, #2	875	1	0.99	1.2	1.15	1195	ok	1,400,000	47.63	0.39	0.33
110	Deck Joists - edge	2x6	1.5	7.25	7.25	2	1			50	10	3.5	945	2126	13.14	971	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.23	0.19
111	Ramp deck Joists	2x6	1.5	7.25	7.25	3	1			50	10	10	1800	2700	13.14	822	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.09	0.07
112	Ramp/Landing Joists	2x6	1.5	7.25	7.25	2	1			50	10	8	1200	1500	13.14	685	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.05	0.04
112b	Ramp/Landing Joists	2x6	1.5	7.25	7.25	2	1			50	10	11	1650	2063	13.14	942	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.07	0.06
113	Ramp/Landing Joists	2x6	1.5	7.25	7.25	1	1			50	10	4	600	750	13.14	485	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.05	0.04
114	Ramp Joists	2x6	1.5	7.25	7.25	2	1			50	10	5	900	1350	13.14	625	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.07	0.05
115	Landing Joists	2x6	1.5	7.25	7.25	2	1			50	10	4.5	1080	2160	13.14	986	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.19	0.16
116	Landing Joists	2x6	1.5	7.25	7.25	1	1			50	10	1.5	450	1125	13.14	2027	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.30	0.25
117	deck rim joists	2x6	1.5	7.25	7.25	2	1			50	10	3.5	945	2126	13.14	971	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.13	0.19
117b	deck rim joists	2x6	1.5	7.25	7.25	2	1			50	10	4	840	1470	13.14	671	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.10	0.08
118	deck rim joists	2x6	1.5	7.25	7.25	3	1			50	10	10	1500	1875	13.14	571	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.04	0.04
118b	deck rim joists	2x6	1.5	7.25	7.25	1	1			50	10	5	750	938	13.14	856	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.06	0.05
119	deck rim joists	2x6	1.5	7.25	7.25	1	1			50	10	3	630	1103	13.14	3007	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.15	0.12
120	deck rim joists	2x6	1.5	7.25	7.25	4	1			50	10	9	2160	4320	13.14	986	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.19	0.16
121	deck rim joists	2x6	1.5	7.25	7.25	2	1			50	10	4.5	1080	2160	13.14	986	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.19	0.16
122	deck rim joists	2x6	1.5	7.25	7.25	2	1			50	10	5.5	1155	2022	13.14	923	395 #1, #2	875	1	0.99	1.2	1	1040	ok	1,400,000	47.63	0.13	0.12

Deck P.2

[illegible]



### Uniformly Distributed Loads

[illegible]

Un: Dist- Loads P.2

Material	M <sub>max</sub> lb-ft	S <sub>y</sub> in <sup>3</sup>	Section Properties		BENDING CAPACITY							DEFLECTION				ROTATION				SHEAR									
			psi	Species	f <sub>b</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	F <sub>b</sub> psi	allowing max	E	I	Δ <sub>max</sub> in	Δ <sub>max</sub> in	Δ <sub>max</sub> in	F <sub>r</sub> Δ <sub>max</sub> psi in <sup>3</sup>	F <sub>r</sub> Δ <sub>max</sub> psi in <sup>3</sup>	# max Revol	F <sub>v</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	F <sub>v</sub> psi				
$F_b = M_{max} \times 12 \text{ in}^3 / I_x \times C_p$ $F_v = F_b \times C_{11} \times C_2 \times C_3 \times C_4$ $\Delta_{max} = \frac{5 \text{ wL}^4}{384 \text{ EI}}$ $R_{max} = \frac{V}{F_{allow}}$																													
615	2845	21.39	1296	SPP #1/2	875	1.25	0.98	1.1	1.25	1267	965	1.37	0.70	0.62	160	0.93	0.8	1	425	1.45	1	105	70	1.15	1	1.13	107	0.8	
615	2845	21.39	1596	SS	1250	1.25	0.98	1.1	1.25	1382	08	1.18	0.71	0.62	160	0.93	0.8	1	425	1.45	1	105	70	1.15	1	1.13	107	0.8	
2850	8703	21.39	1627	SS	1250	1.25	0.98	1.1	1	1409	965	0.89	0.29	0.19	08	0.59	0.8	1	425	6.94	2	106	70	1.15	1	1.13	107	0.8	
2850	8703	21.39	1300	SS	1250	1.25	0.98	1	1	1409	965	0.27	0.36	0.19	08	0.59	0.8	1	425	6.94	2	106	70	1.15	1	1.13	107	0.8	
3164	1268	31.64	1268	SS	1250	1.25	0.98	1	1	1409	965	0.36	0.22	0.42	08	0.63	0.8	1	425	7.45	2	94	70	1.15	1	1.13	107	0.8	
3164	1268	31.64	1268	SS	1250	1.25	0.98	1	1	1409	965	0.36	0.22	0.42	08	0.63	0.8	1	425	7.45	2	94	70	1.15	1	1.13	107	0.8	
3584	15023	35.84	1628	1.98 Micro	2690	1	0.98	1	1	2548	08	0.22	0.32	0.42	08	0.63	0.8	1	425	4.22	1	121	285	1	1	1	1.13	107	0.8
3584	15023	35.84	1628	1.98 Micro	2690	1	0.98	1	1	2548	08	0.24	0.35	0.42	08	0.63	0.8	1	425	4.22	1	80	285	1	1	1	1.13	107	0.8
4023	1815	31.64	1615	SS	1250	1.25	0.95	1	1	1409	965	0.86	0.22	0.42	08	0.63	0.8	1	425	9.47	2	129	70	1.15	1	1.13	107	0.8	
4023	1815	31.64	2575	1.98 Micro	2690	1	0.95	1	1	2470	08	0.87	0.22	0.42	08	0.63	0.8	1	425	5.96	1	153	285	1.15	1	1.13	107	0.8	
3076	7164	31.64	906	SPP #1/2	875	1.25	0.95	1	1	956	08	0.16	0.37	0.12	08	0.48	0.8	1	425	7.50	2	89	70	1.15	1	1.13	107	0.8	
1375	3892	7.56	506	SPP #1/2	875	1.25	0.98	1.3	1	1282	08	0.12	0.37	0.18	08	0.28	0.8	1	425	3.24	1	42	70	1.15	1	1.13	107	0.8	
1330	4214	13.34	1263	SPP #1/2	875	1.25	0.98	1.2	1	1383	965	0.63	0.26	0.42	08	0.63	0.8	1	425	3.13	1	61	70	1.15	1	1.13	107	0.8	
1330	4214	13.34	1263	SS	1250	1.25	0.98	1.2	1	1593	08	0.57	0.34	0.42	08	0.63	0.8	1	425	3.13	1	61	70	1.15	1	1.13	107	0.8	
4550	14786	31.64	1840	SS	1250	1.25	0.98	1	1	1409	965	0.56	0.24	0.43	08	0.65	0.8	1	425	10.71	2	135	70	1.15	1	1.13	107	0.8	
4550	14786	31.64	2646	1.98 Micro	2690	1	0.98	1	1	2548	08	0.57	0.34	0.43	08	0.65	0.8	1	425	6.97	1	175	285	1.15	1	1.13	107	0.8	
5884	26113	35.81	2123	1.98 Micro	2690	1	0.98	1	1	2548	08	0.94	0.56	0.59	08	0.89	0.8	1	425	7.85	1	132	285	1.15	1	1.13	107	0.8	
5296	20712	35.81	2543	1.98 Micro	2690	1	0.98	1	1	2548	08	1.23	0.87	0.59	08	0.89	0.8	1	425	7.05	1	134	285	1.15	1	1.13	107	0.8	
5884	26113	21.39	1810	SS	1250	1.25	0.98	1.1	1	1550	965	0.85	0.25	0.75	0.59	08	0.89	0.8	1	425	13.85	2	134	285	1.15	1	1.13	107	0.8
5884	26113	31.64	1858	SS	1250	1.25	0.98	1	1	1409	965	0.92	0.55	0.59	08	0.89	0.8	1	425	13.85	2	87	70	1.15	1	1.13	107	0.8	
652	2133	13.34	962	SPP #1/2	875	1.25	0.98	1.2	1	1383	08	0.68	0.34	0.43	08	0.65	0.8	1	425	1.53	1	45	70	1.15	1	1.13	107	0.8	
305	66	13.34	30	SPP #1/2	875	1.25	0.98	1.2	1	1383	08	0.0006	0.0006	0.08	08	0.33	0.8	1	425	0.25	1	7	70	1.15	1	1.13	107	0.8	
413	1207	13.34	1230	SPP #1/2	875	1	0.99	1.2	1.25	1295	08	0.57	0.43	0.42	160	0.83	0.8	1	425	0.97	1	57	70	1.25	1	1.13	107	0.8	
3086	7121	15.33	2823	1.98 Micro	2690	1	0.99	1	1	2574	965	0.54	0.29	0.11	08	0.47	0.8	1	425	4.11	1	182	285	1.25	1	1.13	107	0.8	
1298	4021	15.33	1805	1.98 Micro	2690	1	0.99	1	1	2574	08	0.34	0.26	0.11	08	0.47	0.8	1	425	2.62	1	116	285	1.25	1	1.13	107	0.8	
25132	2176	15.33	825	1.98 Micro	2690	1	0.99	1	1	2574	08	0.08	0.25	0.12	08	0.33	0.8	1	425	23.78	5	124	285	1.25	1	1.13	107	0.8	
3853	4281	15.33	1297	1.98 Micro	2690	1	0.99	1	1	2574	08	0.29	0.24	0.18	08	0.36	0.8	1	425	4.87	1	126	285	1.25	1	1.13	107	0.8	
9504	1039	15.33	642	1.98 Micro	2690	1	0.99	1	1	2574	08	0.07	0.20	0.14	08	0.26	0.8	1	425	12.67	3	142	285	1.25	1	1.13	107	0.8	
2034	6413	15.33	2512	1.98 Micro	2690	1	0.99	1	1	2574	08	0.14	0.44	0.42	08	0.63	0.8	1	425	2.71	1	58	285	1.25	1	1.13	107	0.8	
549	2785	2.56	1731	SPP #1/2	875	1.6	0.98	1.3	1	1784	08	12.54	12.54	0.43	160	0.83	0.8	1	425	1.29	1	17	70	1.6	1	1.13	107	0.8	
549	2785	7.56	1415	SPP #1/2	875	1.6	0.98	1.3	1	1784	08	0.93	0.93	0.43	160	0.83	0.8	1	425	1.29	1	50	70	1.6	1	1.13	107	0.8	
435	2275	7.56	1283	SPP #1/2	875	1.6	0.98	1.3	1	1784	08	1.88	1.88	0.87	160	0.83	0.8	1	425	1.07	1	28	70	1.6	1	1.13	107	0.8	
247	783	7.56	621	SPP #1/2	875	1.6	0.98	1.3	1	1784	08	0.39	0.39	0.41	08	0.63	0.8	1	425	0.58	1	22	70	1.6	1	1.13	107	0.8	
347	147	7.56	117	SPP #1/2	875	1.6	0.98	1.3	1	1784	08	0.01	0.01	0.38	08	0.28	0.8	1	425	0.25	1	10	70	1.6	1	1.13	107	0.8	

Beam Columns

$$M_{\text{Applied}} = \frac{W_{\text{Dead}} \times L^2}{8}$$

$$f_b = \frac{M_{\text{Applied}} \times 12 \text{ in./ft}}{S_x}$$

$$F'_2 = F_2 \times C_D \times C_1 \times C_2 \times C_3$$

$$F'_2 = F_2 \times C_D \times C_1 \times C_2 \times C_3$$

#	Member	Section	b	d	# Phys BM's	length ft	Loads & Loading			Section Properties			BENDING CAPACITY										Actual			
							Wind psf	trib width ft	P-uniform lb	M-uniform ft-kb	$S_x$ in <sup>3</sup>	$I_x$ in <sup>4</sup>	Species	$F_y$ ksi	$C_D$	$C_1$	$C_2$	$C_3$	$C_4$	$F_b$ ksi	loading ksi	A in <sup>2</sup>	$E_x = 29,000$ ksi	$L_u / d$ inches	$F_{cd}$ ksi	
1	Test	2x6	1.5	5.5	4	20	9	14850	5760	7.56	2285	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	33	450.00	34.91	ok	181.8	
41	Upper BM-Column "Q"	2x6	1.5	5.5	4	9	13	12002	2580	7.56	627	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	33	361.70	29.64	ok	1088.2	
42	Lower BM-Column "Q"	2x6	1.5	5.5	3	7	13	6.7	14625	533	7.56	282	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	24.75	647.47	25.27	ok	1806.8
44	Chimney posts - in plane	2x6	1.5	5.5	4	4.5	26	-	7558	2633	7.56	1044	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	33	229.88	9.82	ok	4157.2
44	Chimney posts - in plane	2x6	1.5	5.5	4	4.5	26	-	14625	2633	7.56	1044	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	33	485.61	9.82	ok	4157.2
48	Wall Studs	2x6	1.5	5.5	1	9	26	1.33	801	350	7.56	556	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	8.25	97.29	29.64	ok	1088.2
51	Window & Door Posts	2x6	1.5	5.5	2	9	26	6.08	3016	2421	7.56	1270	SPP #L/Q	875	1.6	1	3.3	1	1820	ok	1,400,000	16.5	182.79	29.64	ok	1088.2

Beam Columns P.2

Loads & Loading				Section Properties				BENDING CAPACITY										Axial				Compression										INTERACTION			
W-shape	Size	Depth	P-unbr	M-unbr	$S_x$	$S_y$	Species	$F_b$	$C_b$	$C_s$	$C_t$	$C_e$	$F_b$	$F_y$	bracing	$E$	$A$	$I_x$	$I_y$	$r_x$	$r_y$	$P_c$	$P_c$	$P_c$	$C_b$	$C_s$	$C_t$	$C_e$	$F_c$	$F_y$	$F_c$	compression	interaction		
20	9	244500	5750	756	2285	197	#1, #2	875	1.6	1	1.3	1	3820	960	event	1,400,000	33	450,000	34,51	ok	393.88	1.00	1.3	1	0.8	2944	976	976	976	976	976	976	976	4.83	NG
13	12	230020	1580	756	627	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	33	361.70	29.64	ok	208.25	1.00	1.3	1	0.8	2944	919	919	919	919	919	919	919	0.72	ok
13	6.7	260025	510	756	282	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	24.75	647.47	15.27	ok	1800.69	1.00	1.3	1	0.8	2944	1291	1291	1291	1291	1291	1291	1291	0.56	ok
28	-	7558	2610	756	3044	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	33	229.83	9.82	ok	4157.00	1.00	1.3	1	0.8	2944	1719	1719	1719	1719	1719	1719	1719	0.88	ok
28	-	260025	2610	756	3044	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	33	485.61	9.82	ok	4157.00	1.00	1.3	1	0.8	2944	1719	1719	1719	1719	1719	1719	1719	0.88	ok
28	1.13	801	350	756	506	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	8.25	97.29	29.64	ok	208.25	1.00	1.3	1	0.8	2944	919	919	919	919	919	919	919	0.35	ok
28	6.08	30716	1602	756	1279	197	#1, #2	875	1.6	1	1.3	1	3820	ok	ok	1,400,000	26.5	182.79	29.64	ok	208.25	1.00	1.3	1	0.8	2944	919	919	919	919	919	919	919	0.91	ok

$$F'_b = F_b \times C_b \times C_s \times C_t \times C_e$$
$$F'_c = F_c \times \left( 1 + \frac{F_c}{F_y} \right)^2 + \frac{F_c}{F_y} \left( 1 + \frac{F_c}{F_y} \right) \leq 1$$
$$F_b = \frac{M_{unbr} \times \frac{12 I_y}{L^2}}{S_y}$$
$$F_c = \frac{P_c}{A}$$

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## CHAPTER 5: Detailed Water Budget

The water budget has been based both on what is required for the competition and what is required by the thermal systems of the house. The thermal system requires 250 gallons of water with piping volumes being estimated. Water consumed by contests comes to 451.5 gallons. Landscape watering requires 25 gallons of water to maintain attractive living plants. A safety factor of 10% is used to account for accidental water usage in the house beyond what is planned for competitions as well as spillage. The total amount of water required with this safety factor is 799.15 gallons. An 800-gallon water storage tank will be used to hold this water for the competition. A 600-gallon tank will also hold used water drained from the house. In a normal non-competition setting water will be provided by the city main water line and carried away by the city sewage system so tanks will not be necessary.

Use	Volume (gal)	Number	Total (gal)
Hot Water	15	20	300
Vaporization	0.625	4	2.5
Washing Towels	11	10	110
Dishwasher	7.8	5	39
Hot Tank	-	-	120
Cold Tank	-	-	80
Desiccant System	-	-	20
Piping	-	-	30
Plant Watering	25	1	25
<b>Total</b>			<b>726.5</b>
Safety Factor			1.1
<b>Total Water Needed</b>			<b>799.15</b>

**CHAPTER 6: Summary of Unlisted Electrical Components**

The Interlock House uses Powerfilm thin film photovoltaic modules on the southern façade louvers and on the tracking louver system. This product is normally intended for recharging small portable devices and as such, is not listed under UL 1703. As a precaution, all unlisted thin film applications will be kept under 60V operating voltage. Although the modules are not UL listed, several of the tests contained in UL 1703 have been conducted and the module has performed safely. A proposal describing the testing is forthcoming.

## CHAPTER 7: Summary of Reconfigurable Features

The Interlock House incorporates several reconfigurable features that allow its spaces to function differently for various activities and at different times of the year. The main reconfigurable feature is the sun porch on the south side. In the winter, the sunspace is closed on all four sides and acts as a thermal battery to heat the whole home. This space can be used as a winter garden or simply a warm place to lounge. The porch's air and tiles store thermal energy during the day and release it back into the house at night. During the summer, the sunspace opens up completely and a portion of the southern exterior wall becomes a semi-shaded, integrated porch. Moveable NanaWall partitions enable the center module to open up and create a breezeway from north to south. During the fall and spring, the interior and exterior walls of the porch can be opened for better natural ventilation within the living space.

The second reconfigurable feature allows the interior spaces of the house to be changed. Curtains allow the three modules to be separated from each other, opened completely, or any combination in-between. When the sunspace is opened during the fall and spring, the curtains can be used to close the west module off from the Hall.

The entire southern façade is also reconfigurable with movable louvered panels that control daylight and privacy. For example, while watching a movie in the living room the panels can be moved to make the room darker and avoid glare. In the bedroom, the panels can be shifted to offer more privacy. Additionally the bedroom features a retractable bed that folds into a wall of storage and display units. When folded up, the bed turns into a sofa.

Furniture in the center flex space, including the dining room table and chairs, were designed to be broken down into smaller components and rearranged. This offers the ability to host larger dinner parties or to have the space completely free.

The north exterior wall of the center module contains four doors. The entire span can open up in nice weather or be used for everyday access.



All of these features offer more flexibility for the Interlock House and make an 800-square-foot house seem much bigger.





2 people	<b>ACTIVITY</b>	<b>Meals</b>	<b>Entertainment</b>	<b>Sleep</b>
<b>SEASON</b>				
Winter		closed; eat in kitchen	closed; use hall or kitchen	closed
Spring		part open; eat in kitchen	open inner and north; use hall	outer open
Summer		all open; eat in kitchen or south porch	all open; use hall	outer open; vents open
Fall		inner open; eat in kitchen	part open; use hall	closed; vents open
4 people	<b>ACTIVITY</b>	<b>Meals</b>	<b>Entertainment</b>	<b>Sleep</b>
<b>SEASON</b>				
Winter		closed; eat in hall	closed; use hall or bedroom	na
Spring		part open; eat in hall	open inner and north; use hall	na
Summer		all open; eat in hall	all open; bed up; use hall and bedroom	na
Fall		part open; eat in hall	inner open; use hall and kitchen	na
6 people	<b>ACTIVITY</b>	<b>Meals</b>	<b>Entertainment</b>	<b>Sleep</b>
<b>SEASON</b>				
Winter		closed; eat in hall	open inner; use hall space or bedroom	na
Spring		part open; eat in hall	open inner and north; use hall	na
Summer		all open; eat in hall	all open; use hall and kitchen	na
Fall		part open; eat in hall	open inner and north; use hall	na



### Grounding Method

A safe electrical ground will be provided by a 5/8" x 8' galvanized steel grounding rod. The rod will be driven into the ground not more than 1' from the North-East corner of the house. A #0/1 AWG copper wire will connect the rod to the main grounding point in the mechanical room.

### Main Disconnect

A Square D disconnect switch will be located between the meter housing and the AC load center. This will serve as the team's main disconnect from the grid. The disconnect will be locked out and tagged out until the team's grid interconnection application is approved by the organizers.

### Feeder Sizing Explanation

The main feeder calculations for the Interlock House follow the National Electric Codebook based on section 220.82 for a dwelling unit. The feeder size calculation consists of combining the volt-ampere ratings set for general lighting and general use receptacles, the twenty ampere branches in the house, branches for permanently mounted appliances, permanently mounted motors, and the heating ventilation air conditioning system (HVAC). The codebook requires 3 volt-amperes/ft<sup>2</sup> for general lighting and general-use receptacles. The Interlock House is approximately 800 ft<sup>2</sup>, therefore the general lighting and general-use receptacles total 2400 VA. In addition, the codebook requires 1500 volt-amperes for each 2-wire, 20-ampere small-appliance branch circuit and each laundry branch circuit covered in 210.11(C)(1) and (C)(2). Currently, the house has five 20-Amp circuits accounting for 9000 VA. Furthermore, the total nameplate power ratings of all the permanent appliances and motors add to both the general lighting/receptacles and the 20-amp circuits to make up the general load of the house. The first 10 kVA of the general load is rated at 100% demand. The amount of general load remaining from the 10 kVA rates at 40% demand. However, the HVAC system is separate load. According to the codebook, one must choose the largest value between the heating and air conditioning options. In the case of the Interlock House HVAC system, the cooling system is the larger consumer of power, therefore the cooling system, and the necessary system components rate at 100% demand. The total demand for the feeder is 25751.5 VA. Dividing the power demanded by the phase voltage (240 V) of the service panel gives the feeder size. Most breakers have an 80% load factor so the feeder needs to account for this load factor.

**Therefore, the solar decathlon house requires at least a 150-amp service feeder to efficiently operate.**

Feeder Sizing Calculations

<b>Total General Load</b>		
<b>General Lighting and Outlets</b>	<b>ft<sup>2</sup></b>	<b>Power Volt-Amps</b>
3VA/ft <sup>2</sup>	800 sq ft	<b>2400</b>
<b>20 Amps Branch Circuits in House</b>	<b>Number of branches</b>	
1500VA each	6	<b>9000</b>
<b>Appliances</b>	<b>Amps</b>	
Refrigerator	1.04	130
Stovetop	40	3000
Oven	30	7200
Microwave	15	700
Dishwasher	9	1080
Washer/Dryer	10	1200
<b>Total Appliances</b>		<b>13310</b>
<b>Total General Load</b>		<b>24710</b>

<b>HVAC components</b>	<b>Amps</b>	
Ventilator	0.825	99
Evacuated Tubes Pump	0.166666667	20
Domestic Heated Water Pump(DHW)	0.166666667	20
Domestic Cooled Water Pump(DCW)	0.166666667	20
Warmboard pump	0.166666667	20
Tank exchange pump	0.041666667	5
Desiccant pump	0.041666667	5
Scavenging air stream fan	0.320833333	38.5
AHU/AC	41	9700
Supplemental Heat		4500
<b>Total HVAC Power</b>		<b>14427.5</b>
<b>Total Heating</b>		<b>4659</b>
<b>Total Cooling</b>		<b>9867.5</b>

<b>Demand Factor</b>		
General Load 10kVA 100% demand		10000
Use cooling system at 100% demand		9867.5
General Load 40% demand		5884
Total Demand for Feeder Sizing		25751.5

Feeder Size

107.2979167

Feeder Size to Account for 80% Trip Rating

134.1223958

**Recommendation****150 Amp Feeder  
or larger**

### Service Point

Reference Construction Documents, Sheet A-101: Site Plan and Sheet X-103: Tour Plan for service point location.

### Additional Information

Calculations concerning the size and loading of the main PV array can be found in Project Manual, Appendix A: Main Photovoltaic Array Sizing Calculations.

## CHAPTER 9: Energy Analysis Results and Discussion

### Phase I – Energy Analysis Influencing Design

The philosophy of the energy usage in the Interlock House is to use various forms of energy responsibly. This means using efficiently collected thermal energy in as many places as possible as opposed to using electricity which is less efficient to generate from photovoltaic modules. The energy analysis performed during the initial design stage helped give the team an idea of where thermal and electrical energy could best be used and/or conserved.

#### *Thermal Energy Analysis*

Various aspects of a building can be altered to change how a house is passively heated and cooled. This study was performed to evaluate how the envelope, spatial composition and window placement affected the thermal performance of the Interlock House. A digital model was built and placed in Ames, IA using EnergyPlus and DesignBuilder and tests were conducted to evaluate window placement, R-value of walls and thermal mass.

This preliminary analysis led to the reduction and replacement of windows as well as adjusting the amount of thermal mass. Individual room analyses of solar heat gain are shown in Figures 1 – 5. The total solar heat gain for various window configurations is shown in Figure 6. Ultimately, case 6 proved to have the best performance over the course of the entire year, with case 3 being a close second.

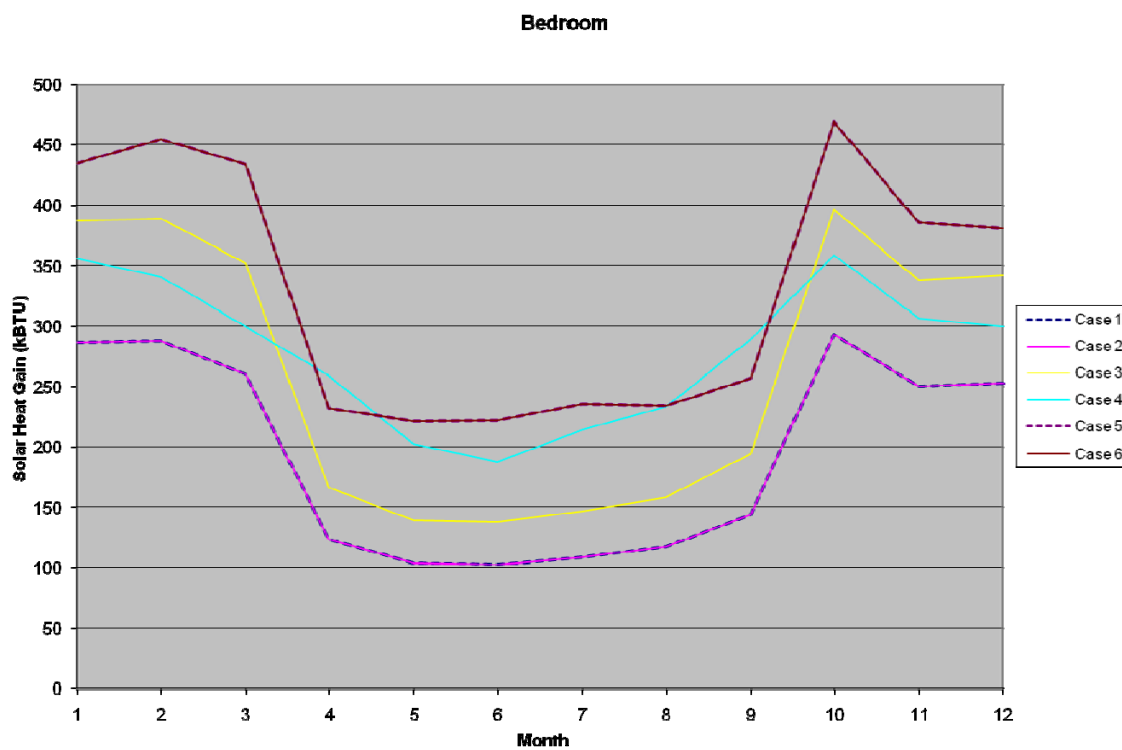


Figure 1 Bedroom Solar Gains

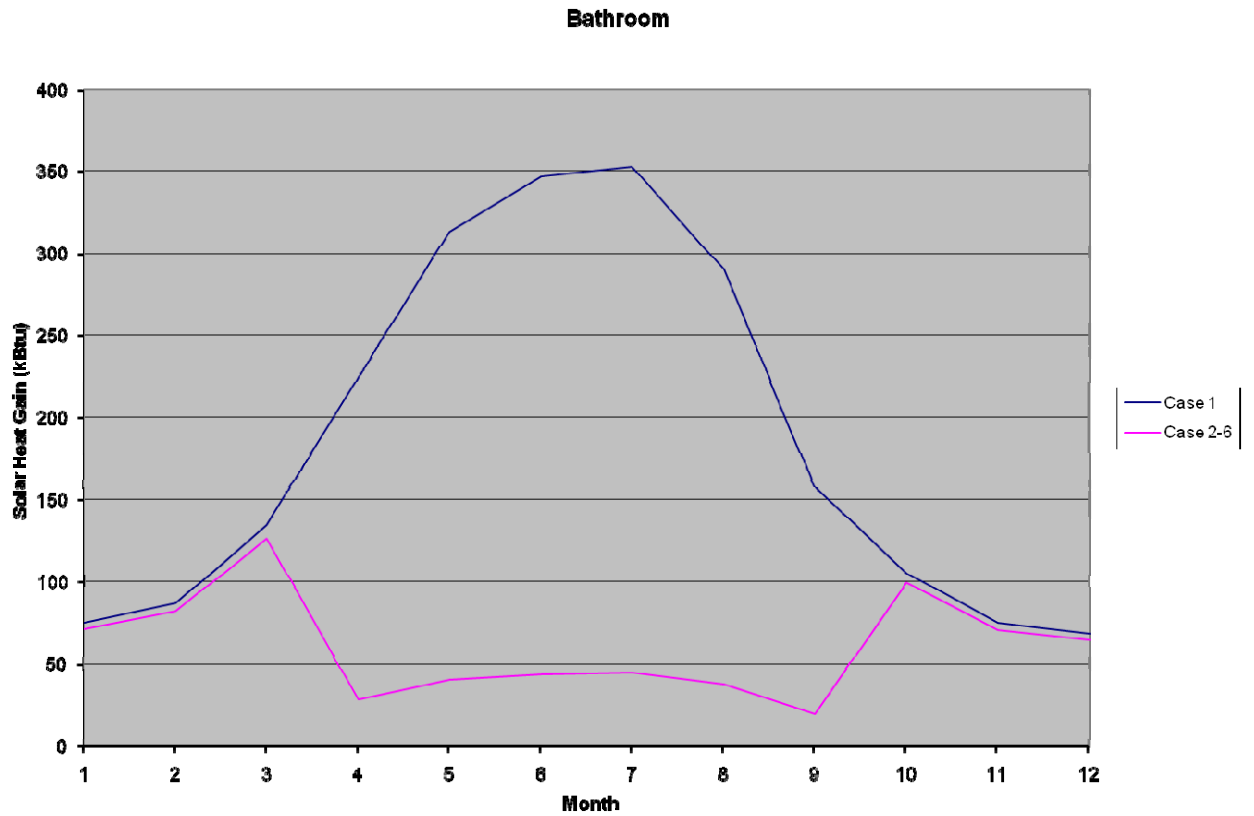


Figure 2 Washroom Solar Gains

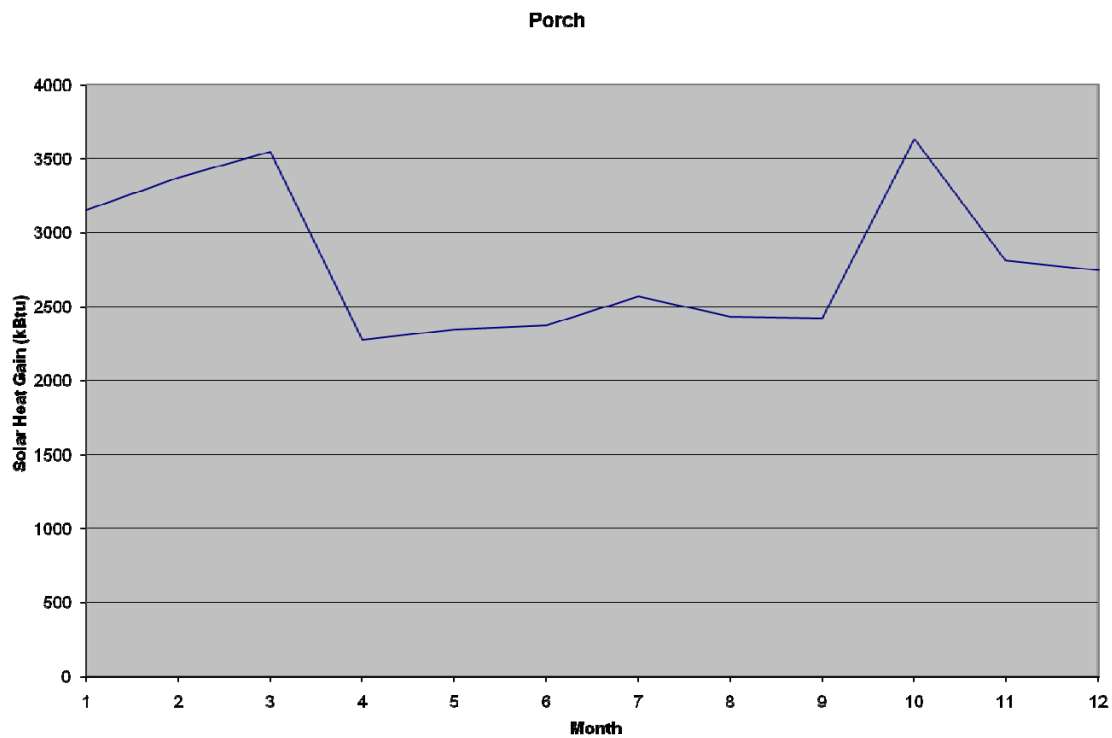


Figure 3 Sunporch Solar Gains

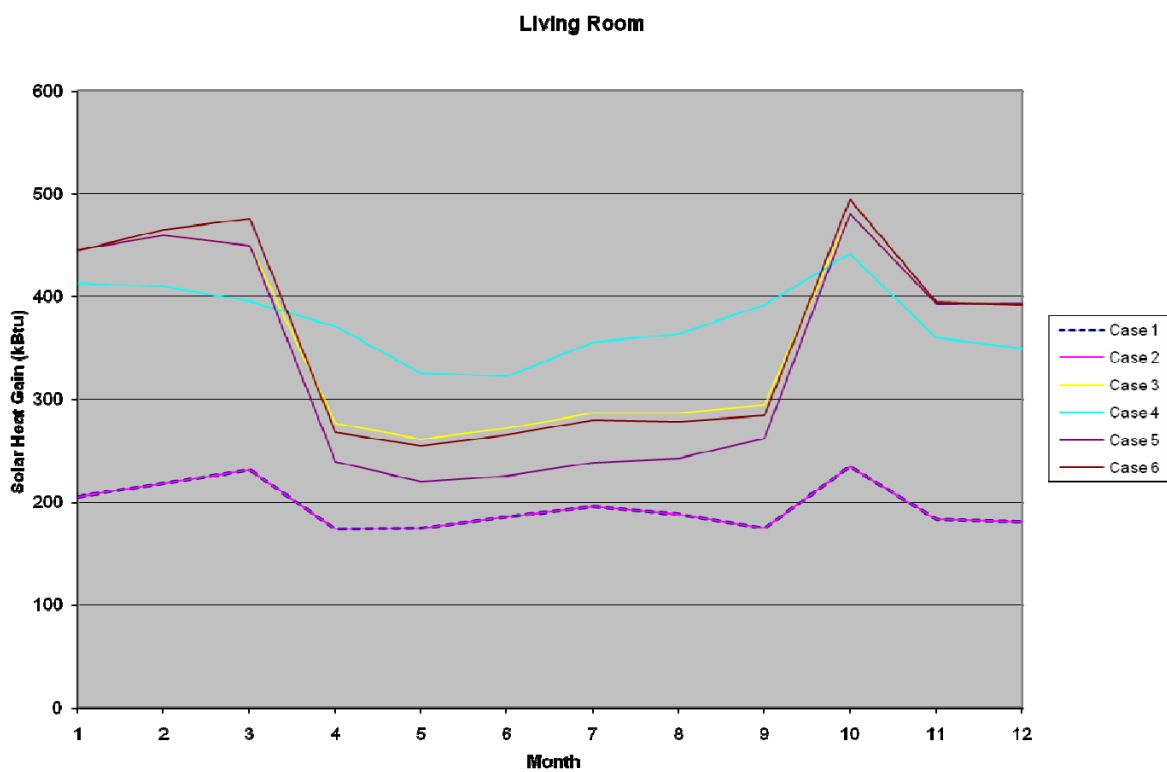


Figure 4 Hall Solar Gains

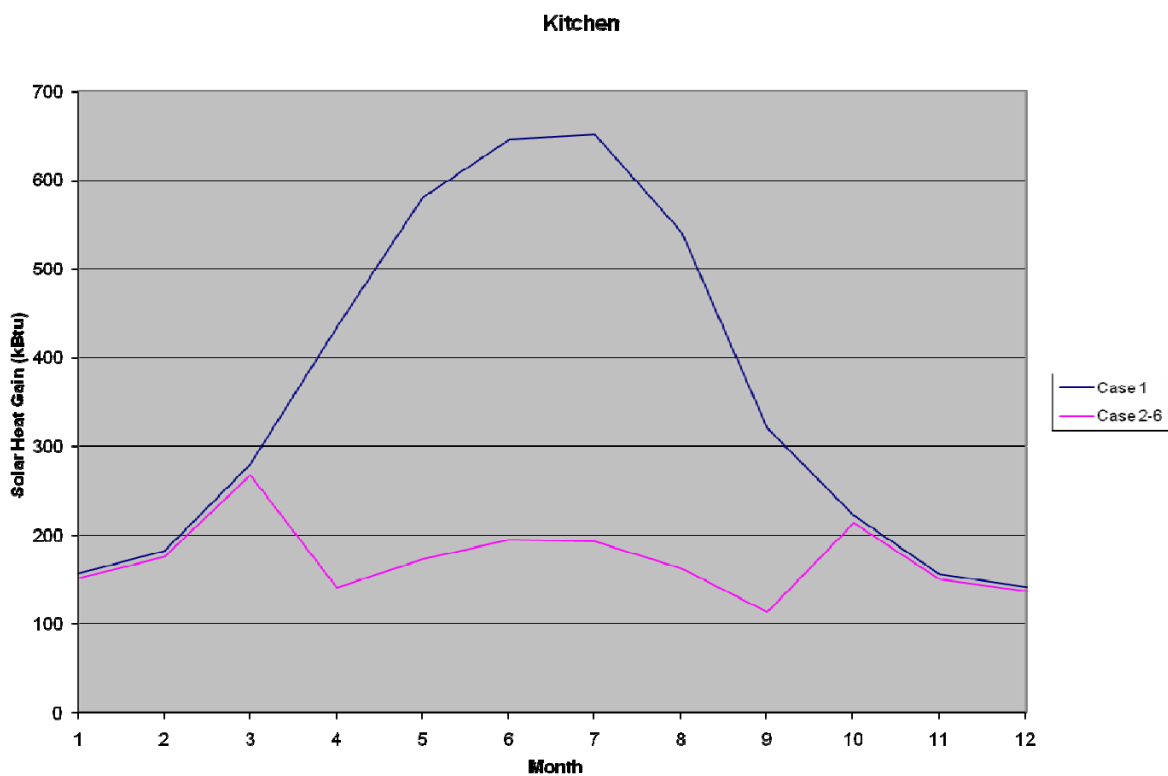
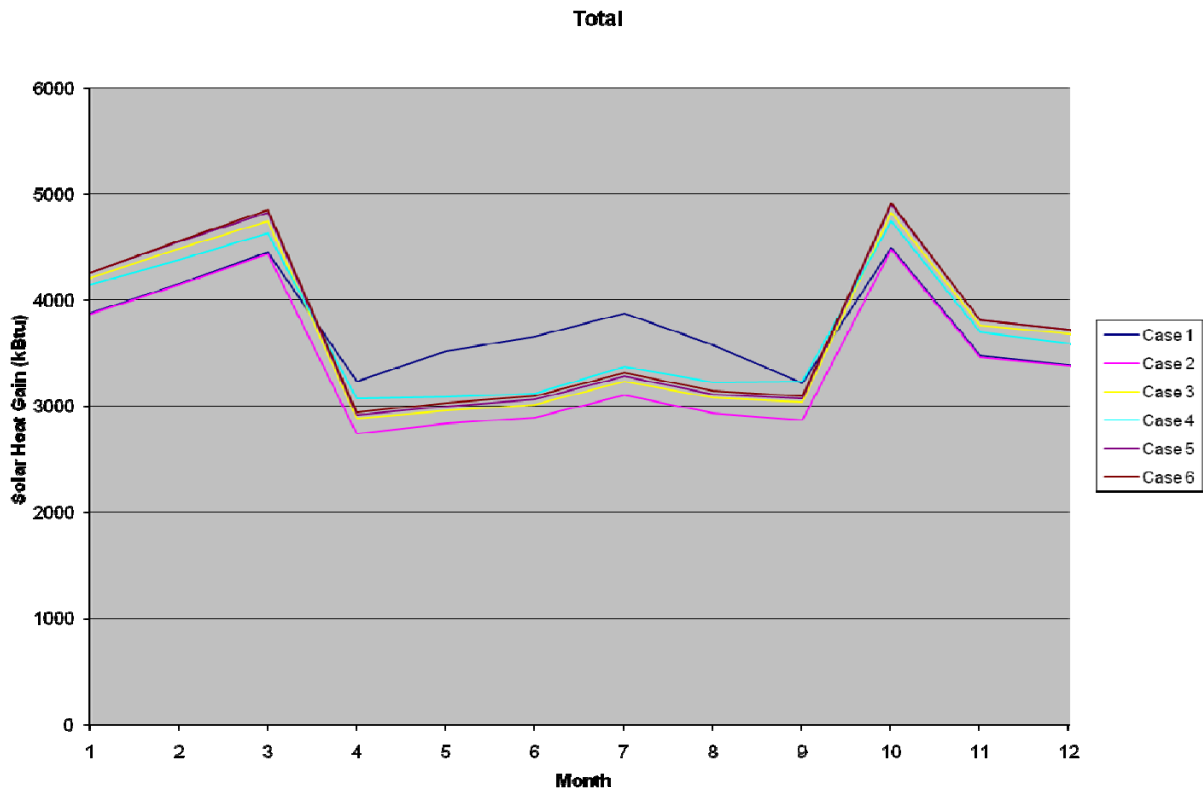


Figure 5 Kitchen Solar Gains





**Figure 6 Total Solar Gains**

These analyses yielded a major design change. Shaded clerestory windows that were angled inward into the house were found to be large sources of thermal gain in the summer. EnergyPlus revealed that these windows had far less gain when they were vertical as opposed to angled, even with the same amount of shading.

Further thermal analysis of the Interlock House was carried out using the Ecotect program package. The main purpose of the analysis was to determine the heating and cooling loads that the home will have to sustain due to solar gain and diffusive thermal loss. The first design of the house was used as a baseline test case. The baseline case did not include thermal mass or phase change materials.

The primary testing was done on the window configuration. The bulk of the thermal testing was done on the windows in order to strike a balance that limits thermal losses, maximizes winter solar gains, and minimizes summer solar gains. The window layouts are summarized in Table 1. A default heating and cooling system with a COP of one was used to determine the actual amount of heating or cooling that needs to be delivered to the space. Occupancy of six people was used to estimate a worst case scenario for human heat load contribution.

**Table 1 Ecotect Test Case Descriptions**

Case	Windows (ft <sup>2</sup> )					PCM	Thermal Mass
	N	E	S	W	Total		
Baseline	181	35	32	20	399	N	N
1	181	16	32	0	360	N	N
2	181	16	64	0	392	N	N
3	181	16	32	0	360	Y	Y

Test case 1 proved to be the best window configuration, as can be seen in Figure 7. The main design change brought about by the results of this round of testing was to remove the western windows from the house to prevent late day heat gains.

Upon determining the optimum window arrangement, thermal mass was added to the sunspace and phase change material was added to the interior walls to give a more accurate description of the functionality of the house. Thermal mass in the sunspace is intended to hold a large amount of the incident solar radiation from the day and release that energy at night, reducing the need for mechanical heating. The phase change material (PCM) is a wax type material that is contained in gypsum wall boards. The PCM melts and freezes at 26°C (80°F). During both of these processes, the temperature remains constant. This mitigates the temperature swings throughout the day in both winter and summer, which reduces the demand on the HVAC systems. The effects are evident in test case 3, where energy requirement is severely reduced, especially on the heating side. Human and appliance loads have not been assessed. Thermal analysis for all cases is summarized in Figure 7.

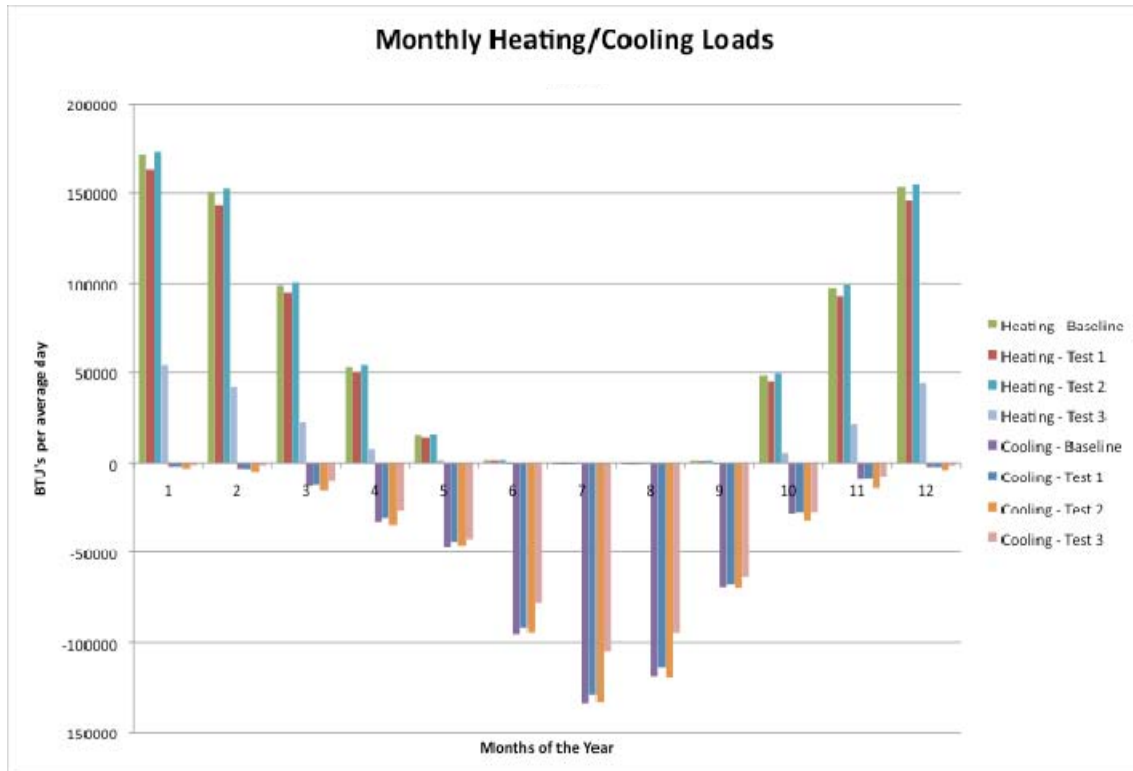


Figure 7 Ecotect Test Results

### Electrical Energy Consumption

The electrical energy consumption was modeled in several different ways. The first was to determine the power consumption of the absolute worst case scenario. This would mean every electrical device in the house operating at full power. The total operating power came out to be around 42kW. The photovoltaic array is only sized at 8.6kW and could not keep up with this demand even at standard test conditions. Although this seems dire, there will never be a case where the worst case scenario will occur, since the main breakers of the house would trip before this could happen. A more realistic analysis is using operating metrics for various devices based on the contest rules and schedule for the Solar Decathlon is shown in the next paragraph.

Maximum power consumption by category:

Entertainment: 0.430 kW

Kitchen: 18.675 kW

HVAC: 20.626 kW

Lighting: 0.747 kW

Miscellaneous: 1.2 kW

Table 2 lists every electrical device in the house along with power consumption and estimated amount of time the device will be used during the competition. The final

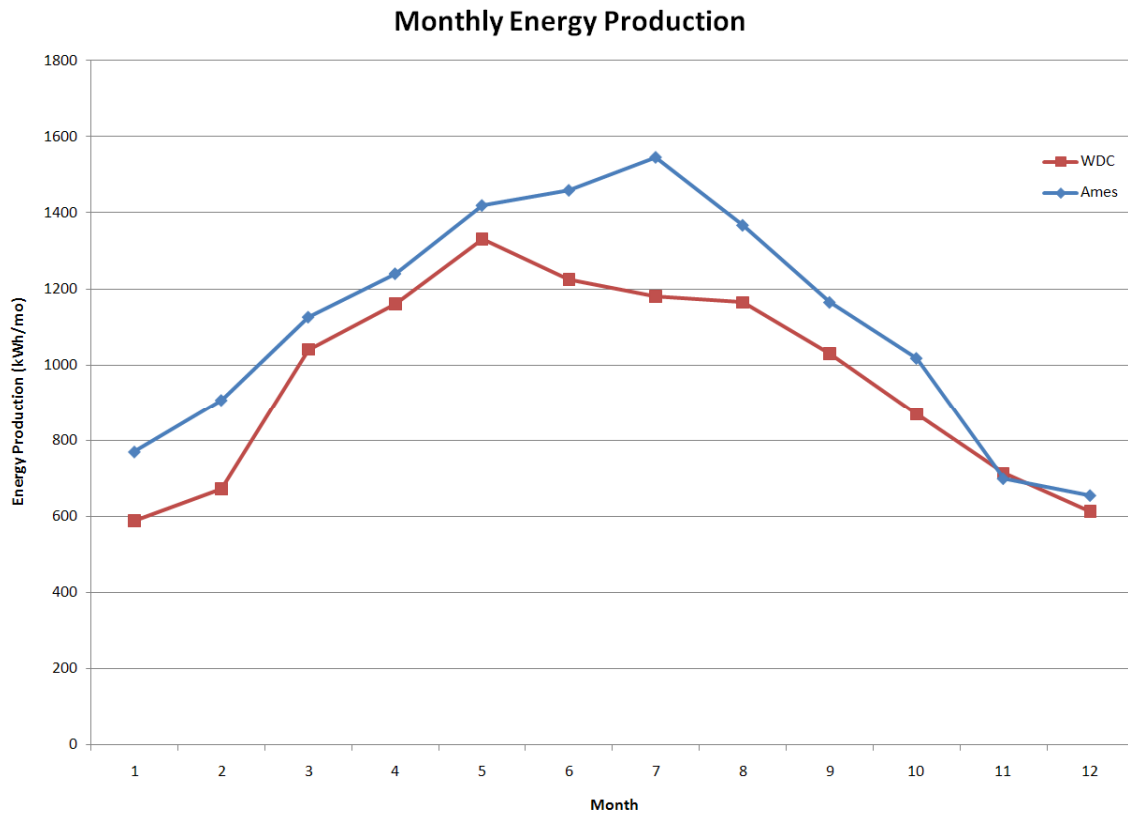
column lists how much energy each device will use. The table shows an estimated total usage of 357.31 kWh of energy being used during the competition. Note the pump power is estimated and is not associated with a specific product. Dishwasher and washing machine energy consumption is based on energy used per load, not a continuous level of operating power.

**Table 2 Estimated Electrical Usage During Competition**

Device	Power (W)	Time (h)	Energy (kWh)
Dishwasher	X	X	8.1
Washing Machine	X	X	5.9375
Dryer	5600	2	11.2
Refrigerator	39.6	312	12.3552
Cooktop	3700	1	3.7
Oven	3900	1	3.9
Television	121	50.5	6.1105
Computer	30	48	1.44
Surround Sound	150	2.5	0.375
Lights	934	36	33.624
Controls	500	312	156
Ventilator	99	156	15.444
ET Pump	20	156	3.12
Microwave	1100	0.67	0.737
DHW Pump	20	3.33	0.0666
Cooling Circuit Feed Pump	20	312	6.24
DCW Pump	157	5	0.785
Cooling Circuit Product Pump	20	257	5.14
Warmboard Pump	20	10	0.2
Desiccant Pump	5	312	1.56
Scavenging Air Stream Fan	38.5	312	12.012
Chiller	1110	62.4	69.264
<b>Total</b>			<b>357.3108</b>

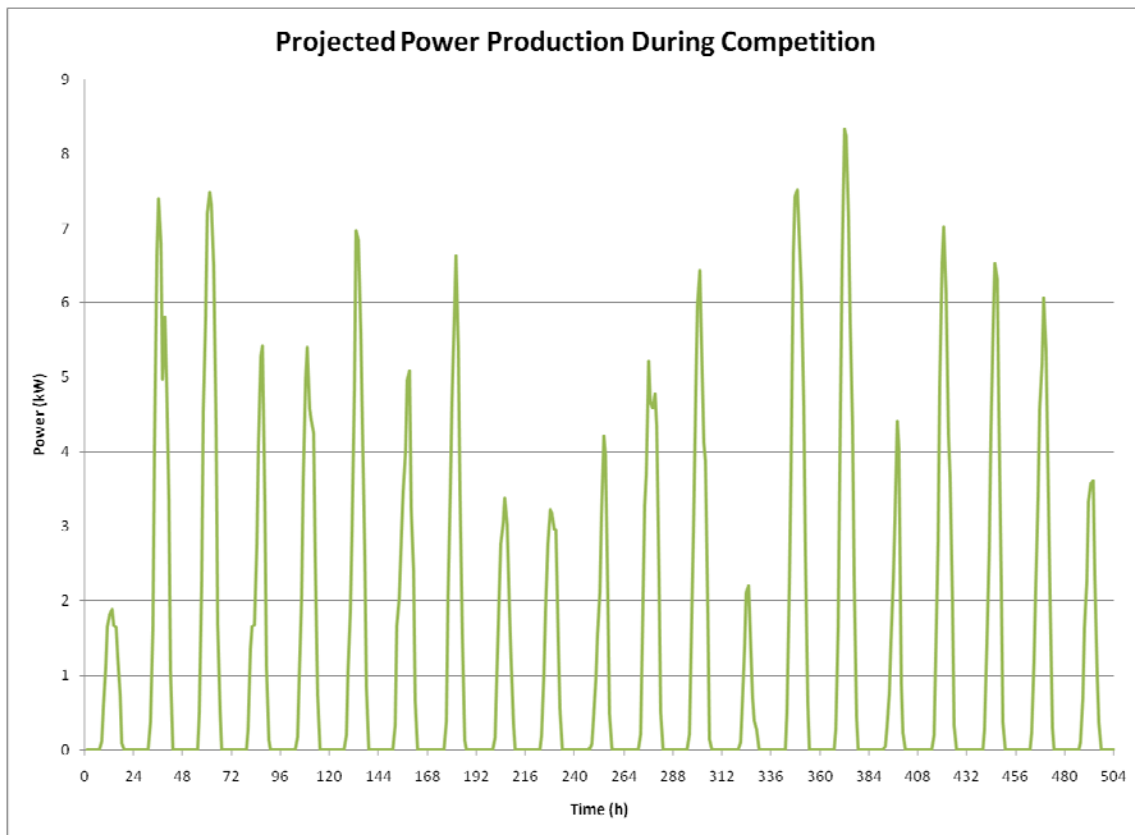
### Production

Power produced by the photovoltaic array was analyzed using the one diode method. DesignBuilder was used to model a simple collector at the proper angle. EnergyPlus analysis was run on the model to produce the amount of incident sunlight. This data, along with manufacturer's specifications, was compiled in a spreadsheet that performed the calculations for every hour of the year. The computation was performed for both Ames, IA and Washington, DC. The monthly average power production for each city is shown in Figure 8.



**Figure 8 Main PV Array Energy Production**

As the graph shows, more power is produced in Ames, IA than in Washington, DC. This is due to better solar insolation. The angle of inclination of the solar array ( $23^{\circ}$ ) would favor the latitudinal location of Washington ( $38^{\circ}\text{N}$ ) over Ames ( $42^{\circ}\text{N}$ ). A more detailed hourly analysis of the competition week in Washington, DC is shown in Figure 9.



**Figure 9 Main Array Power Production During Competition**

The total power produced during the competition is projected to be 373.16 kWh. Taking the estimated power usage into account, this leaves an extra 15.85 kWh of energy. This equates to 4.44% of the total amount of energy required to operate the house. The power production numbers are only for the main array. Any power produced by the tracking louver array and the thin film array will contribute directly to the surplus power competition.

**Table 3 Energy Balance During Competition**

Competition	
Produced	373.16 kWh
Used	357.31 kWh
Balance	15.85 kwh
Need	104.44 %

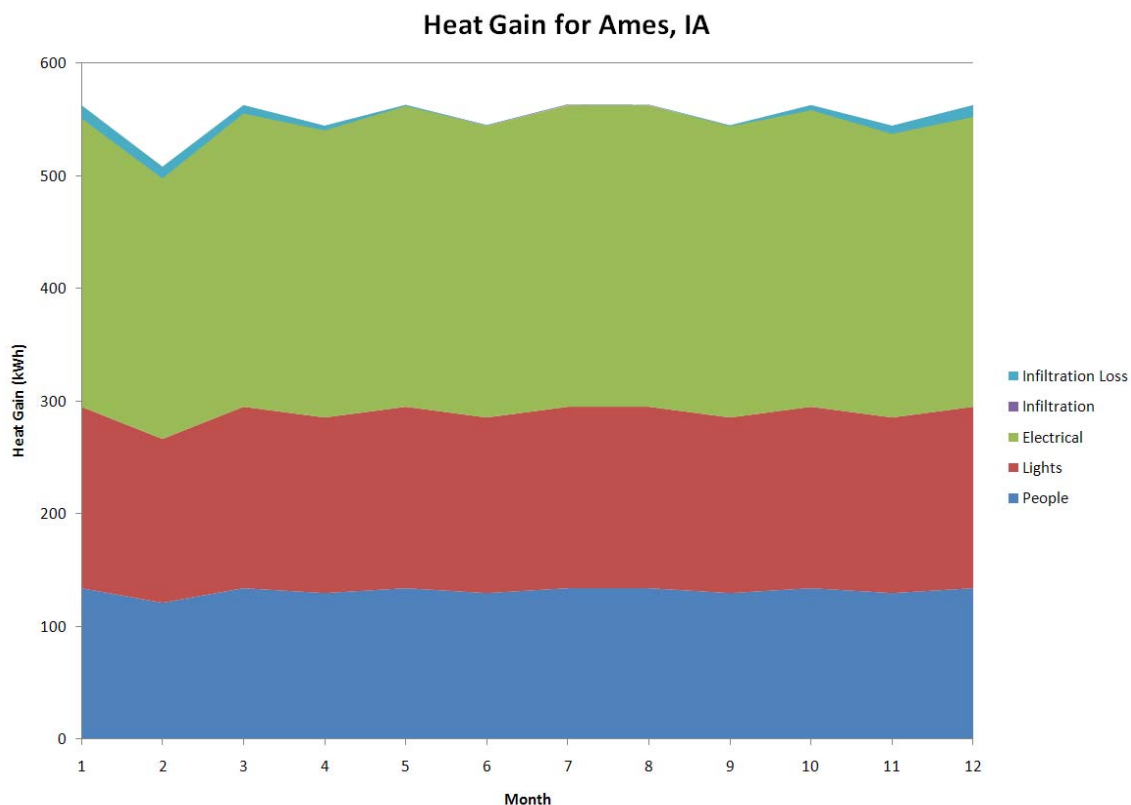
## Phase II – Energy Analysis for Performance Prediction

As a result of the previous energy analysis and various other design revisions, the previous house model became obsolete. A new model for the final house design was created using EnergyPlus and Google Sketchup. The new module should give results that will closely predict the actual functionality of the house when it is built.

The new model accurately reflects the construction of the house including placement of photovoltaics and thermal collectors. The HVAC systems have changed and are modeled more accurately than in the original energy model. Originally, the cooling system used an absorption chiller with active chilled beams, but this setup has been replaced with an efficient 2-ton electric split system. The lighting went through several changes during the design process and was one of the last items to be solidified. The new EnergyPlus model includes the actual lighting power per area. The only major component that could not be modeled properly is the desiccant dehumidifier.

### *Thermal Energy Analysis*

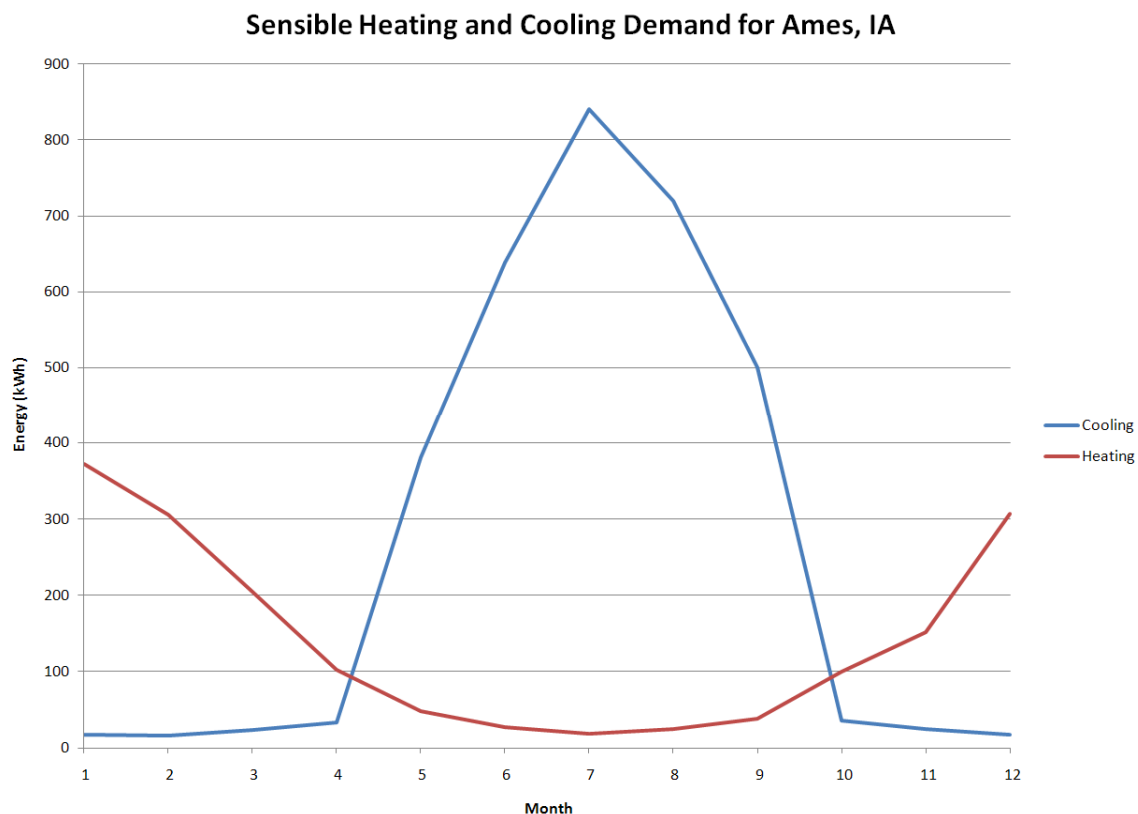
The new EnergyPlus model includes the solar and envelope loads as well as internal sources of heat gain. Figure 10 shows the contribution of people, lighting, electrical appliances and infiltration to the total heat gain in the conditioned space. Electrical is the largest portion since many appliances reject heat to the space to maintain a steady operating temperature. The effect of humans on the internal heat load cannot be ignored approximately 25% of the internal heat gain in the conditioned space comes from the people occupying the space. These internal gains are useful in the winter but become an obstacle to overcome in the summer months.



**Figure 10 Monthly Internal Heat Gains, Ames, IA**

While the internal heat gains mentioned above remain fairly constant throughout the year, the demand for heating and cooling varies with the month. The trends shown in

Figure 11 are typical for what someone would expect for a house in the northern hemisphere. The unusual part of the graph is that the cooling demand is much higher than the heating demand at their respective maximums. This is likely due to the simulation being run without shades over the windows in the summertime. The sunspace was also not modeled in its open position so it would be creating a hot space directly next to the conditioned space. The internal gains would also account for the difference in peaks between cooling and heating. The added heat would lower the need for heat in the winter while increasing the need for cooling in the summer. The internal gains shown in Figure 10 are approximately 550 kWh every month. If this amount were added to the heating demand in the winter, the peak values for heating and cooling energy would be quite similar. These loads are only the sensible load as well. In the winter, the latent load is very low due to the reduced relative humidity of the outside air and in the summer, the desiccant dehumidifier will handle the majority of the latent load. The EnergyPlus model does not take into account the days when the house can be passively cooled in the summer months. This would reduce the amount of cooling required during the summer and would almost eliminate the cooling demand from October through April. Likewise, the heating demand from May through September would be severely reduced using passive means.

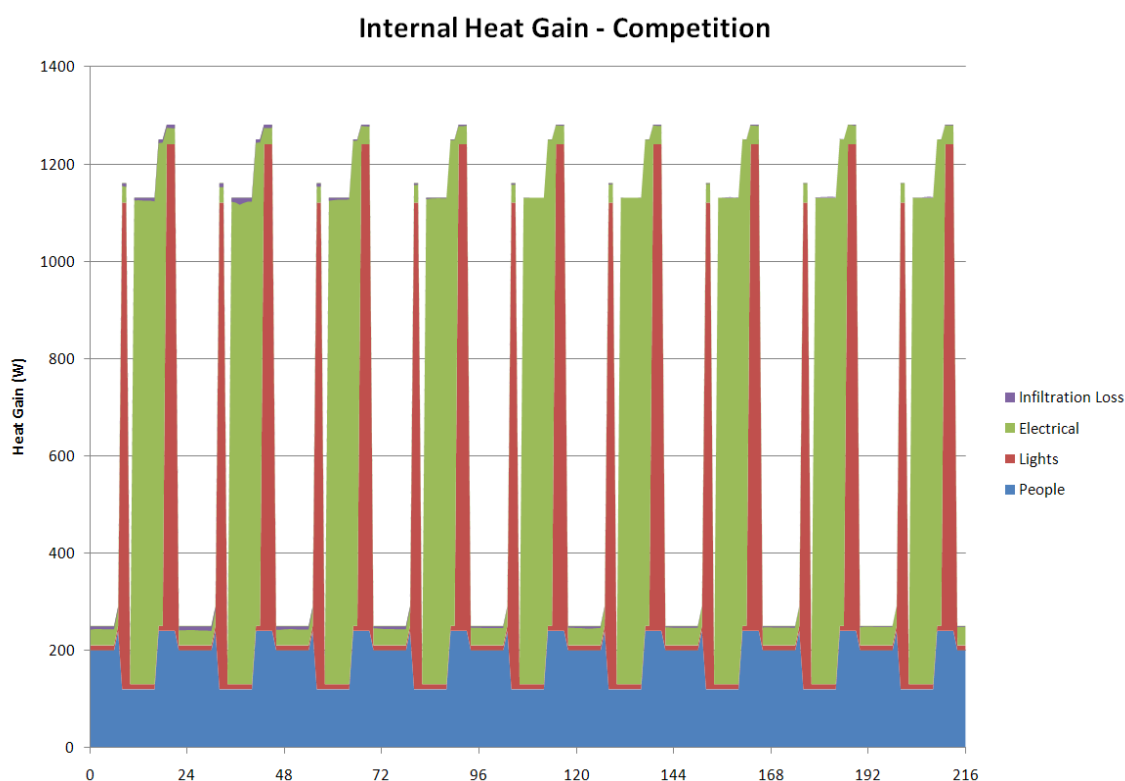


**Figure 11 Monthly Heating and Cooling Demand, Ames, IA**

Simulations were also conducted for Washington, DC. The hourly internal heat gains for the competition dates are shown in Figure 12. The heat load contributed by the



occupants is fairly constant when compared to the other sources of heat gain. The human load is also the highest constant load. The electrical equipment and lights are intermittent sources of heat gain. These two sources contribute a relatively small amount of heat in the mornings and nights but at times during the day they contribute about five times as much heat to the space as the occupants do. The large swing in heat gains from lights and electrical equipment can be directly related to those devices being turned on and off. Knowledge of the internal heat gains will be useful during the competition and after. The internal gains can be used to the advantage of the house by helping the heating systems. This analysis also suggests that, in the event of a hot October week in Washington, DC, electrical device and light use should be kept to a minimum so as to not burden the air conditioning system.

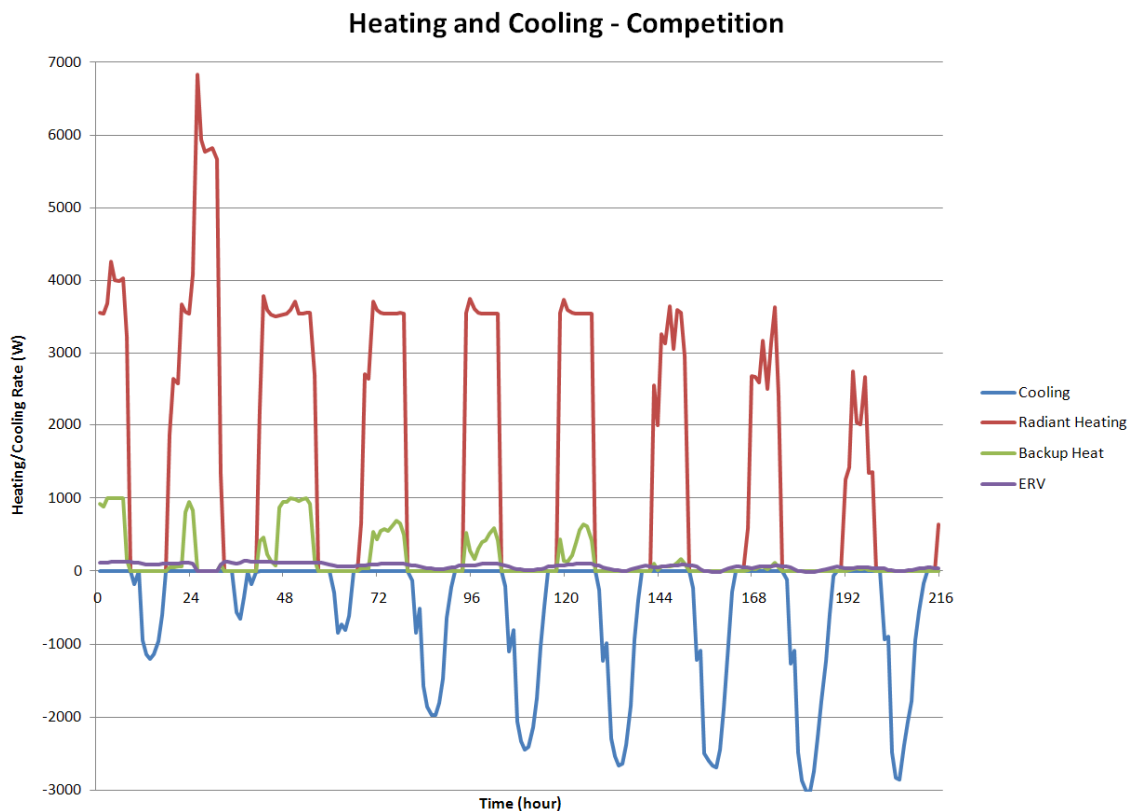


**Figure 12 Hourly Internal Gains, Competition**

The TMY3 data file for Arlington, VA, was used to model the conditions for Washington, DC. For the competition time period (October 8 to 16), the temperatures ranged from a low of 3.9 °C (39 °F) near the beginning of the period to a high of 26.1 °C (79 °F) near the end of the period. Thus, both heating and cooling were needed during simulation of the competition. A dual setpoint thermostat was used to turn cooling on when space temperatures were above 24 °C (75 °F) and heating when space temperatures were below 21 °C (70 °F). The cooling rate from the DX coil, the heating rate from the radiant floor, and the heating rate from the electric resistance heater in the supply air system are shown in Figure 13 along with the contribution of the energy recovery ventilator. According to the graph, heating will be required from the evening through the late

morning every day with cooling will be needed during the middle part of the day. Fortunately, the majority of the contest days do not call for the comfort zone contest to be measured in the middle of the day because the public tours. This will reduce the need for the air conditioning system to run as much as is shown in Figure 13. While the air conditioning will be off during most of the hours called for in Figure 13, it will have to run when the house is initially closed up after the public tours. The large number of people going through the house during the tours will undoubtedly cause substantial heating of the interior. This heating will be countered by passive cooling means during the tours, but there is a limit to the amount of cooling that passive modes can handle.

Figure 13 shows the heating rate to be much larger than the cooling rate. This not a huge cause for concern since most of the heating is done using the radiant floor system, which draws only the electricity needed by the pumps. The greater concern with the heating system is the backup resistance heater in the air distribution system. This heating element has a COP of 1 and draws a lot of electricity while it is being used. Fortunately, the backup heating element is only required minimally at night when the hot water reserves start to be depleted.



**Figure 13 Hourly Heating and Cooling Rates, Competition**

### *Electrical Energy Analysis*

### Consumption

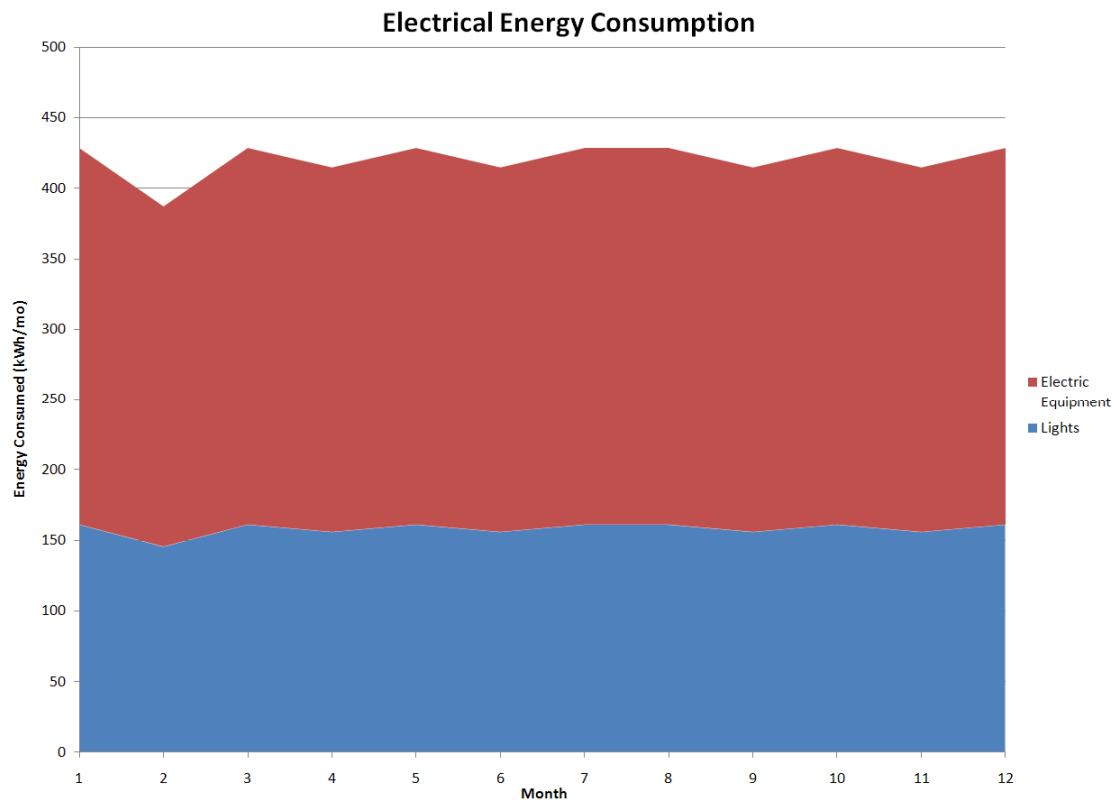
Electrical consumption was calculated using two methods. The first method, referred to as the by-hand method, involved setting up a table which listed all of the appliances and electricity consuming devices in the house. The power and runtime of each device was entered into the table so that total energy use could be calculated. The runtime was only calculated for the competition schedule but since the schedule of contests is meant to reflect normal functionality of the house, the consumption could be extrapolated for an entire year. The calculations are shown below in Table 4. As the table shows, the HVAC equipment and lights are the largest consumers of energy. Several of the kitchen appliances use lots of power but are only used for a short time which results in only moderate energy consumption. The power consumption for the control system is estimated at 100W but the actual number should end up being much lower since the systems operate with low voltage and amperage.

**Table 4 Estimated Electrical Usage During Competition**

<b>Device</b>	<b>Power (W)</b>	<b>Time (h)</b>	<b>Energy (kWh)</b>
Dishwasher	X	X	8.1
Washer/Dryer	X	X	15
Refrigerator	39.6	216	8.5536
Cooktop	3000	1	3
Oven	5760	1	5.76
Television	121	50.5	6.1105
Computer	30	48	1.44
Surround Sound	150	2.5	0.375
Lights	1434	36	51.624
Controls	100	216	21.6
Ventilator	99	108	10.692
ET Pump	20	108	2.16
Microwave	700	0.67	0.469
DHW Pump	25	3.33	0.08325
Tank Exchange Pump	25	216	5.4
DCW Pump	25	5	0.125
Warmboard Pump	25	10	0.25
Desiccant Pump	25	216	5.4
Scavenging Air Stream Fan	38.5	216	8.316
AHU	322	64.25	20.6885
Air Conditioner	2001	64.25	128.56425
<b>Total</b>			<b>175.14685</b>

The second method of calculating energy use is with the EnergyPlus model. For the model lights were estimated at 1000W running for 5 hours a night and internal electrical loads were estimated at 1000W running 9 hours a day. These changes were made to simplify the model since entering a complete competition schedule would be

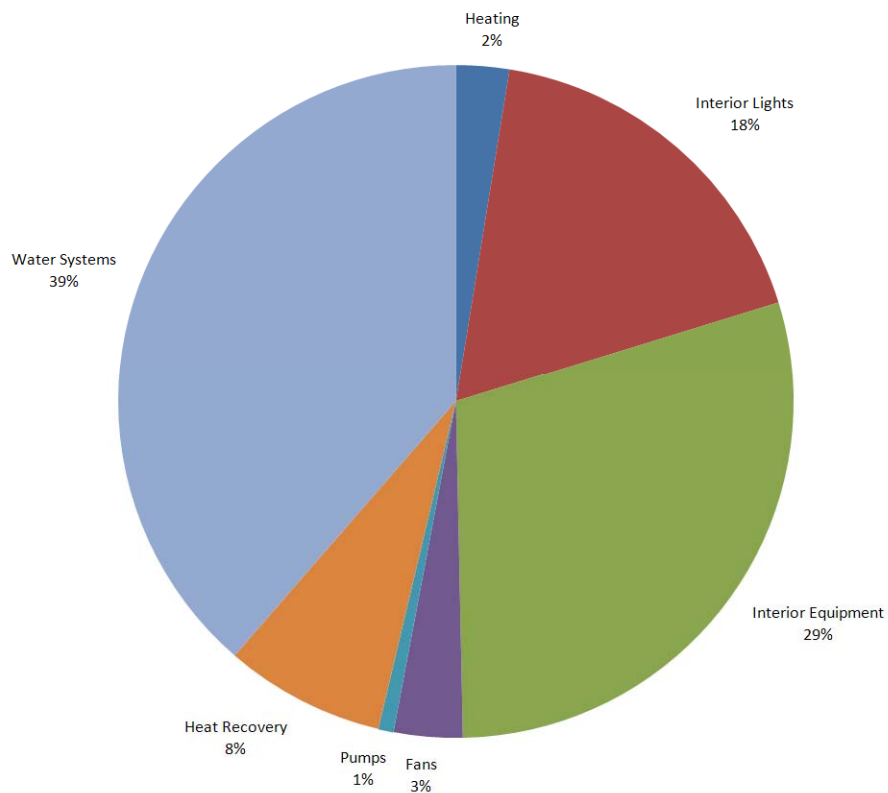
painstaking. This also allows the simulation to be more accurately run for the entire year. The internal energy consumption for lights and other electric equipment in the conditioned space is shown in Figure 14. This figure is a monthly breakdown for the entire year.



**Figure 14 Monthly Internal Electrical Energy Consumption, Ames, IA**

For the competition, the percentage breakdown of electrical end uses is shown in Figure 15. From this EnergyPlus simulation, the largest end use of electricity is water heating. Although the thermal collectors are used to heat domestic hot water, there is also a backup heating element in both the DHW tank and the thermal storage tank. The excessive amount of hot water draws and laundry loads during the competition has been cause for the backup heating elements to turn on. These heating elements are resistance heaters and draw a lot of power. It is possible that both heaters are turning on in the simulation, when in reality only the DHW heater would need to turn on to meet the hot water needs of the house. In reality, no one occupying the house would take three showers and do two loads of laundry everyday each week. The actual hot water needs of the house are likely much less than what is shown in the simultion, so the electricity going to hot water heating will be much less. The other large consumers of energy are interior lights and interior equipment. The comparison of these two percentages appears to agree with the comparison shown in Figure 14.

### Breakdown of Energy Use During Competition in Washington, DC



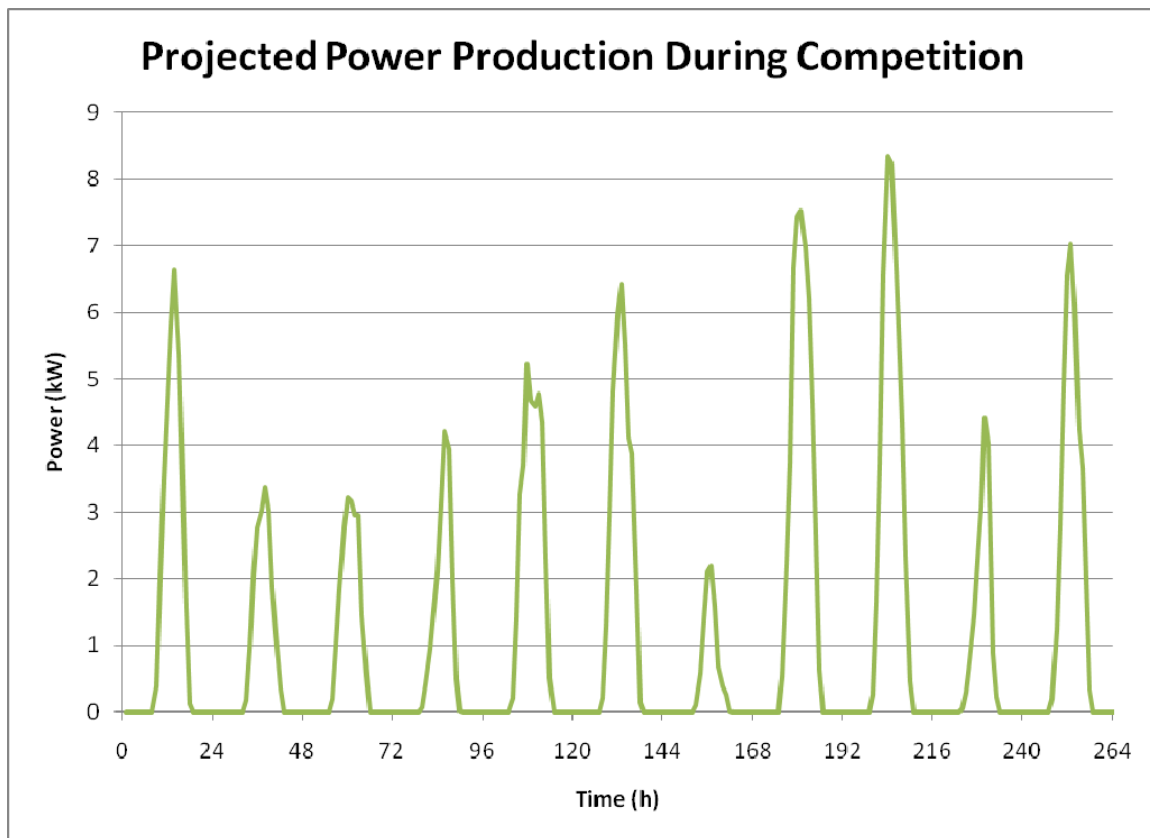
**Figure 15 EnergyPlus Energy Usage During Competition Percentages**

Total energy use during the competition and throughout a typical year is shown in Table 5 in the Production section of this report. The table also compares the electrical usage with power produced by the main photovoltaic array, giving a good estimate of the energy balance for both the competition and annually.

#### Production

The electrical energy production from photovoltaic modules will remain the same as predicted in Phase I of the energy analysis since the array is exactly the same. The monthly power production over the course of a typical year for both Ames, IA and Washington, DC is shown in Figure 8 above. The power output of the thin film components has not been modeled. The main array will be able to handle the power needs of the house on its own. Any electricity produced by the thin film components will be surplus energy that can be fed back to the grid.

The Phase I simulation for the competition power production showed that the Interlock House would produce an extra 15 kWh of energy. This was revised to take the event schedule into account. Figure 9 shows the main array power output over the course of 21 days in Washington, DC, as calculated for Phase I. Figure 16 shows the more accurate power production for the contest dates as calculated by Energy Plus for the 9 net metering days of the competition.

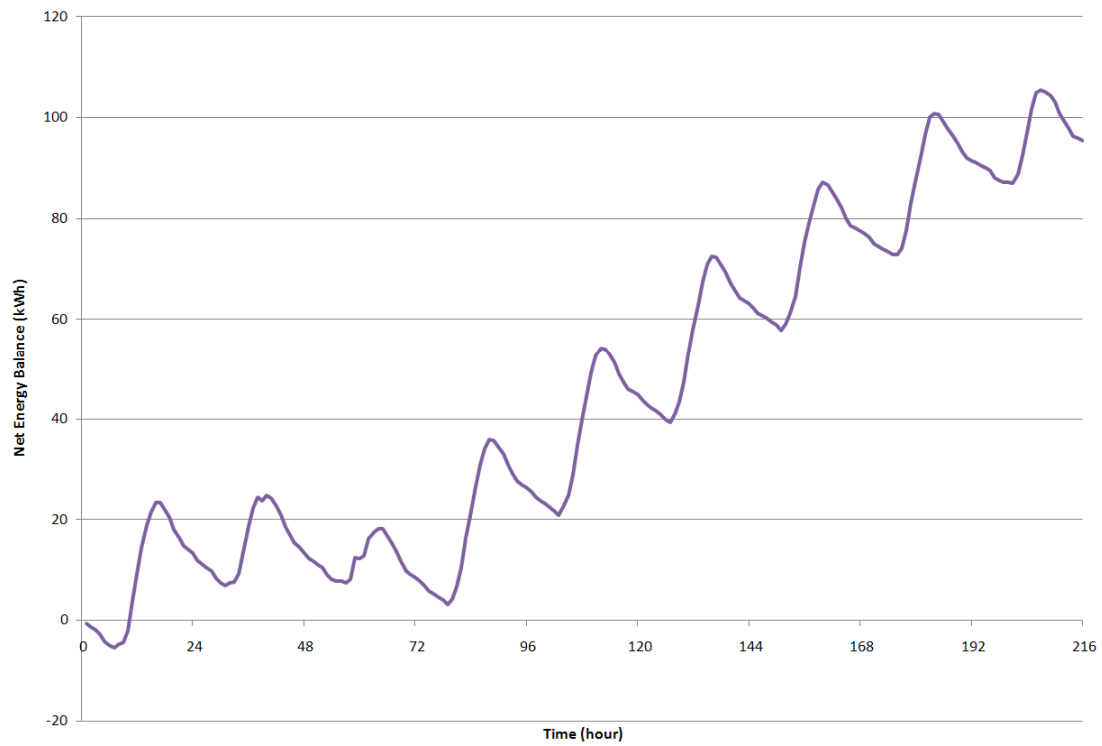


**Figure 16 Main Array Power Production During Competition**

Along with the hand calculations, EnergyPlus was also used to estimate power production and consumption during the competition and throughout the year. While the hand calculations used a combination of the contest schedule and educated guesswork, the EnergyPlus model used one value for all appliances and electronics operating for a total of 9 hours per day. Lighting was also estimated to be on for a total of 5 hours per day. The comparison of energy consumption to energy production is shown in Table 5 and the hourly net energy balance as predicted by EnergyPlus is shown in Figure 17. The differences between the two forms of calculation were noticeable but were minimal. All four calculations showed that the house will produce more energy than it consumes both over the course of a year and during the competition in October. This is good evidence that a house that is well designed for efficiency can support its energy needs with a rooftop photovoltaic array. The house will indeed act as a net-source of green energy for the electrical grid and will be a model of effective and efficient energy use.

**Table 5 Energy Balances For Whole Year and Competition**

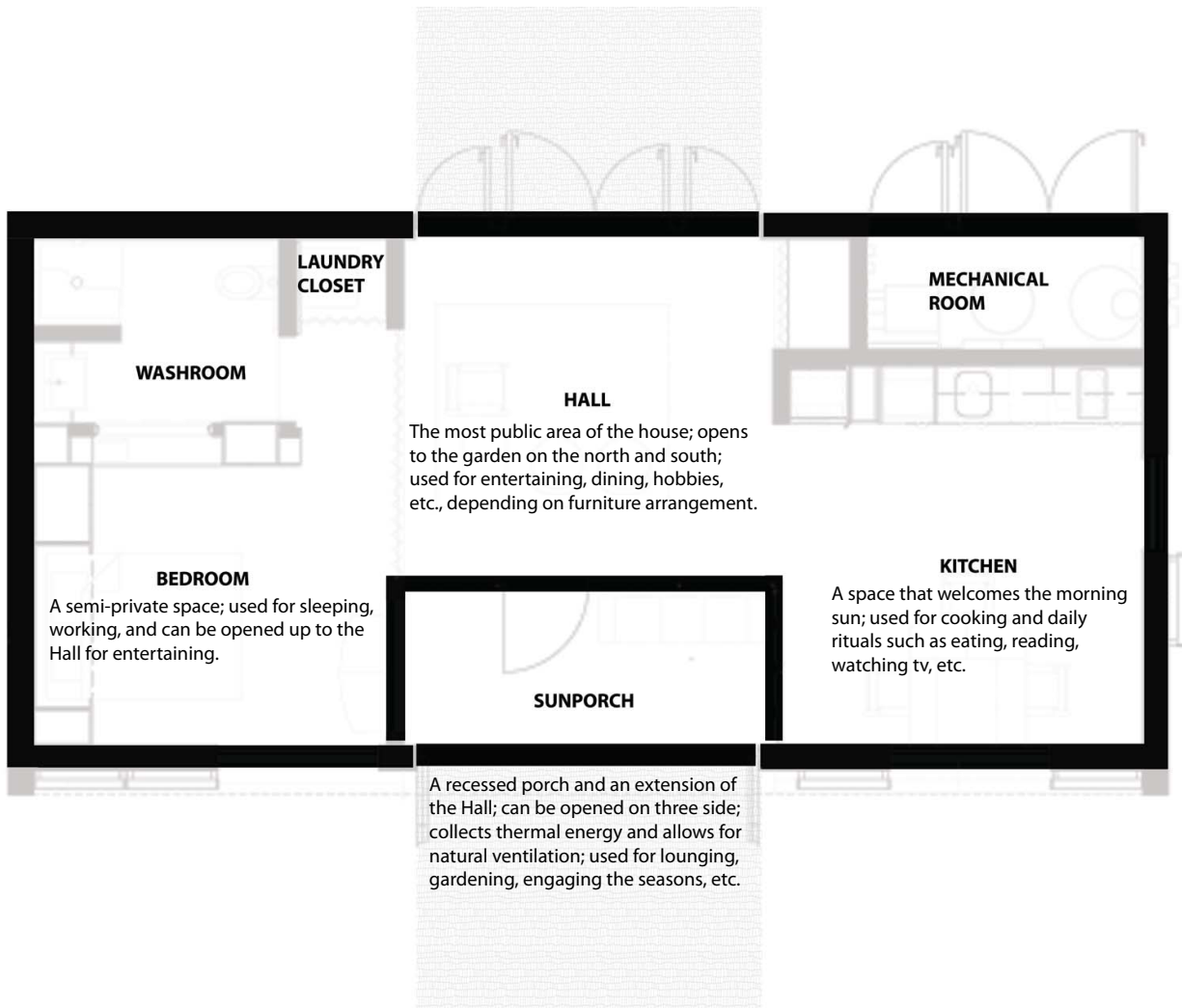
	Annual		Competition	
	By-hand	Eplus	By-hand	Eplus
Produced (kWh)	12775.4	13396.4	258.51	355.91
Used (kWh)	11057.1	12779.9	175.15	264.11
Balance (kWh)	1718.25	616.44	83.36	91.8
Balance (%)	115.54%	104.82%	147.59%	134.76%

**Energy Balance - Competition****Figure 17 Hourly Net Energy Balance During Competition**

## CHAPTER 10: Architecture Design Narrative

### INTERLOCK

*In-ter-lock vti -to fit or fasten two or more things together closely and firmly, especially by means of parts that mesh, hook, or dovetail together.*



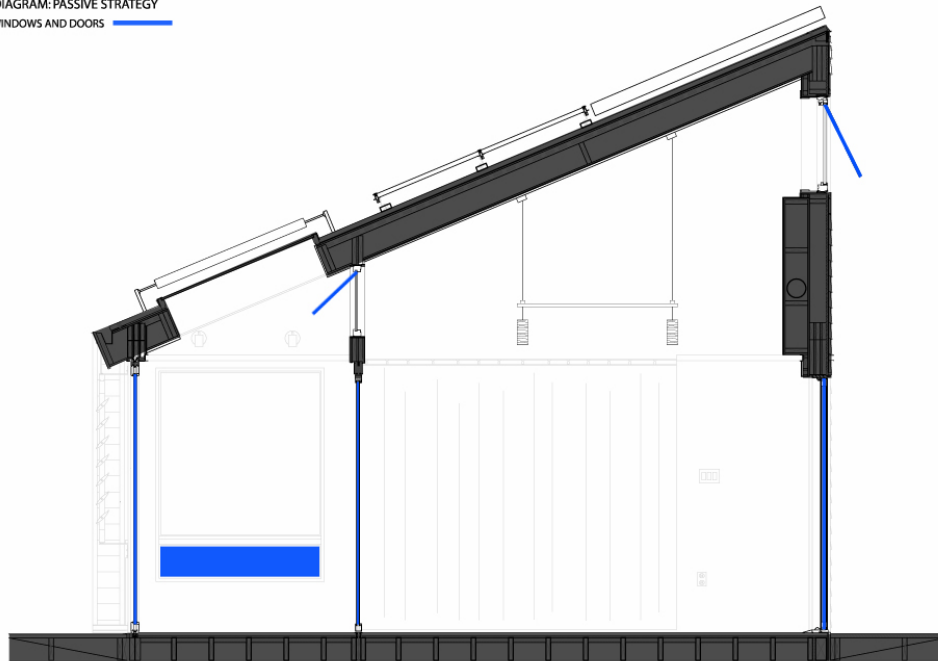
The Iowa State University Solar Decathlon Team designed the Interlock House for an older couple in transition from a larger family house to something much smaller and easier to maintain; from work to retirement; or from a situation that no longer requires more space than they really need. This target market is still active, still connected to established, diverse neighborhoods, and is concerned about reducing their carbon footprint. The Interlock House, at once sensible and delightful, provides one example of how net-zero energy living is affordable and possible today. Transforming to accommodate the extremes of the Iowa seasons and interlocking with the outdoors, this house balances a reduction of energy consumption with solar power production.

The spatial composition of the Interlock House is seasonal. The Hall and Sun Porch can be reconfigured and opened to the elements. The Sun Porch, with added thermal mass in the floor, mediates light and heat and encourages convective loops to heat and cool the house. A louver system spanning the south façade also mediates light and heat and reduces the active cooling load in summer months. The



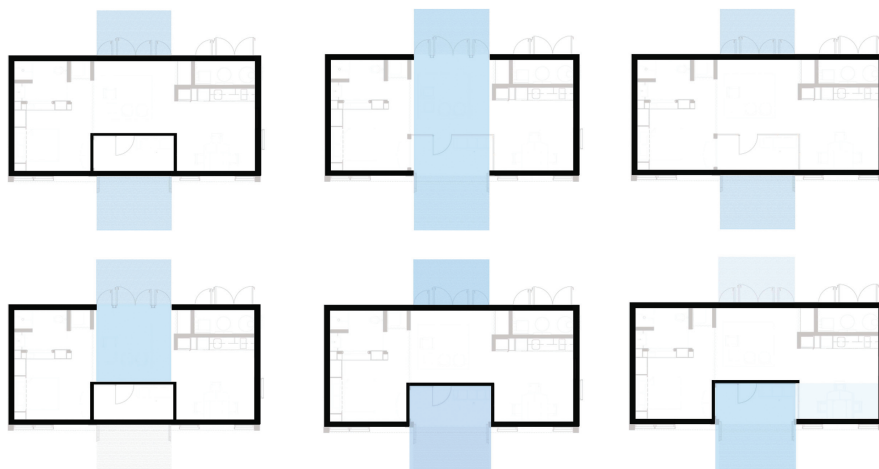
louvers allow occupants to manipulate light and heat according to activities and privacy needs. The house requires active manipulation of its doors, windows, and exterior louvers to influence airflow and to maximize or minimize heat gain and loss. This reliance on several basic passive solar and ventilation techniques helps reduce the energy demands for the active systems. The effective meshing of the active and passive systems needs an alert and motivated resident, but the Interlock House's systems monitors make it easy for anyone to live comfortably with solar energy.

SECTION DIAGRAM: PASSIVE STRATEGY  
OPERABLE WINDOWS AND DOORS



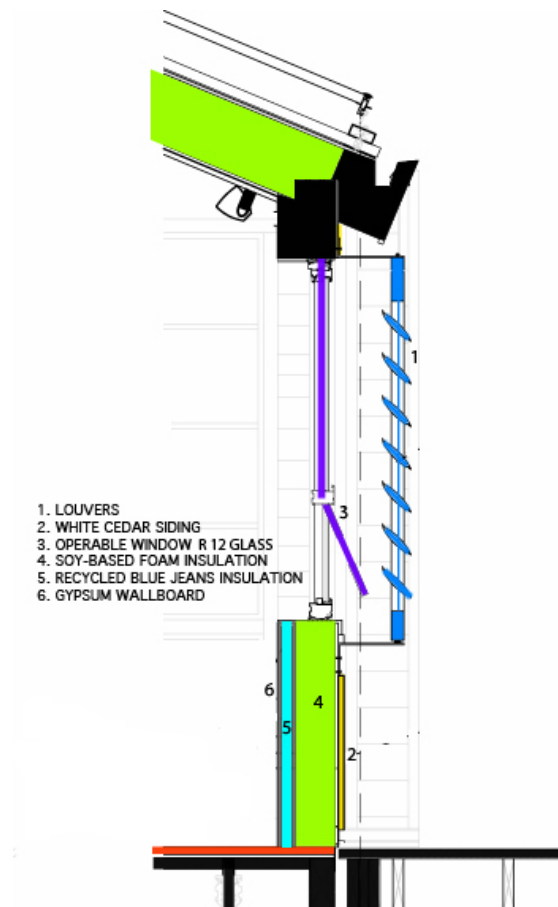
***Passive solar heating and ventilation demands active users.***

Adjusting the house to suit the weather also allows for seasonal changes in lifestyle. For example, the Hall is protected in winter by the closed Sun Porch, which warms the house. In winter, activities may re-focus inward and rearrange the furniture to fit patterns of living at that time of year. The Hall might be arranged as a place to watch movies with the neighbors on dark winter nights. In the spring the Hall could serve as a rainy day play space for visiting grandchildren or a raceway for their tricycles. The wide range of climate conditions in Iowa creates special design challenges and opportunities.



A smart and dynamic building envelope is necessary to be energy efficient. On the north, east, and west, the Interlock House's exterior wall construction is a double cavity with an R value of 48-- two by six framing twenty-four inches on center with another one and one half inch layer for wiring, plumbing and additional insulation. Glass is minimized on north, east, and west to prevent unwanted heat gains and losses. The fenestration patterns provide adequate day lighting throughout the year. The east and south windows are multilayered systems and, like all the house's windows, open to admit fresh air and optimize passive ventilation. The house is tightly wrapped against extremes on three sides and topped off with an R-60 roof. On the south the Sun Porch can be opened and closed to the suit the season.

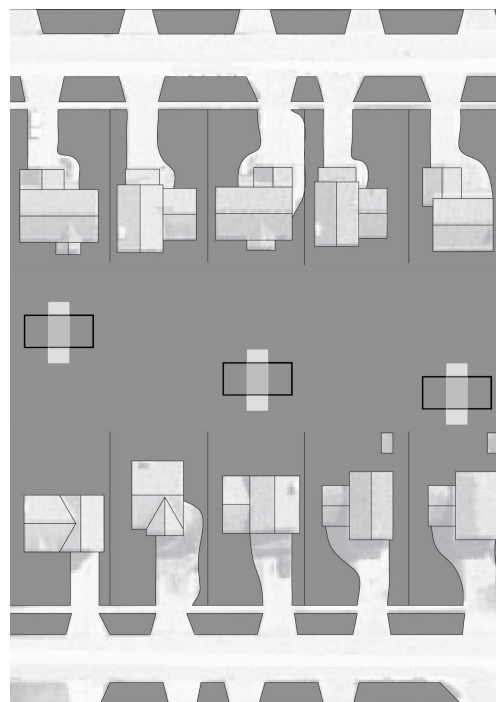
*In extreme climates, houses, like people,  
need to dress appropriately.*





The Interlock House targets a market that is downsizing, but wants to live independently with the option of keeping pets and gardening in an established and diverse neighborhood. The Interlock House offers an alternative to a homogenous retirement community. The compact but flexible design works well for those who seek a small, efficient, low-maintenance dwelling for living full-time, or for those who travel and want a second home near adult children. Ideally, the Interlock House is built on the oversize lot of a family member or friend, tying into existing technological and social infrastructure, and making existing neighborhoods denser. Staying in touch with family, friends, and amenities is important for the Interlock House target market.

***Sprawl is not sustainable—ecologically or socially.***



The house also works with its site to conserve water. The landscaping includes a greywater system, a stormwater collection cistern, native prairie grasses and a kitchen garden. By placing less of a burden on existing infrastructure (water and sewer systems), the Interlock House is a good neighbor. Altogether the photovoltaic panels, thin film, and evacuated tubes collect more energy than is usually needed for a house this size. Excess power can be net-metered or supplement the needs of another house nearby. As an infill concept, the Interlock House rejects the prevailing pattern of residential development in the United States.

The Interlock House embraces conventional methods of construction and readily available mechanical



systems. With only a few modifications of convention, any contractor, just about anywhere in the United States could build this house.

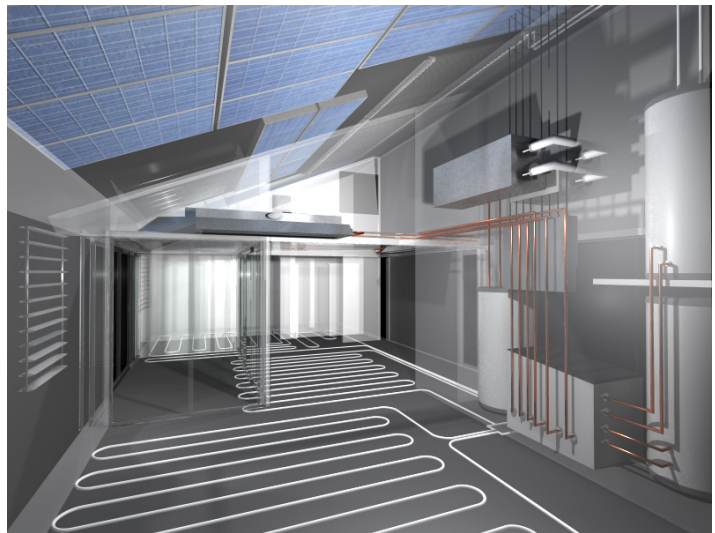
The framing for the prototype transported to Washington DC takes into account the necessity to assemble the prefabricated house in a few days. The house will be transported via three tractor-trailers (semi-trucks). Two of the trailers will each hold two of the main home sections, while the third will hold a third section and the landscape materials. Once these sections arrive on the site in Washington DC, they will be assembled using a mobile truck crane with appropriately designed rigging. In the real world, however, this house could be site-built using less lumber and labor. The construction cost of the house would be about 25% less.

While the Interlock House does include some materials and methods of construction uncommon in conventional commercial practice in the United States, and some of these assemblies required custom manufacturing for the prototype, the house is substantially off-the-shelf. The house fabric simply demonstrates best practices and smart choices as defined by LEED or other green building standards that can be easily implemented by any builder.

A good example of a cost effective, smart choice that is readily available on the US market is WarmBoard combination subfloor and hydronic radiant heating, a superior heating system chosen for the Interlock House. The house also makes use of many locally sourced materials, biobased materials, and products with high recycled or recyclable content. Cladding and interior finishes have been selected for environmental impact, durability and easy maintenance.

The Iowa State University Solar Decathlon Team initiated an alliance between Acutemp and Pella Corporation to manufacture doors with vacuum-insulation for the north wall of the Interlock House with an R value of 50. While vacuum-insulated doors can be easily specified in Germany, there are none yet available in the affordable range in the United States. We hope that Pella will be mass-producing these high R value doors soon.

***A solar-powered house does not require revolutionary technologies.***



The Interlock House promotes living with less--and using less--energy and space without editing the full-range of domestic activities and pleasures. This is primarily accomplished through a transformable spatial core that easily reconfigures interior and exterior spaces into expandable living rooms. The Interlock House is composed of three modules with the more private functions located in the western third. Easily moveable curtain panels allow for quick, daily transformations of the private space. The NanaWalls defining the relationship between the Sun Porch, the Hall, and the kitchen garden can be opened more occasionally but are also relatively easy to move. Depending on the weather, some functions can move into the Sun Porch and surrounding decks. The



Sun Porch is a semi-private indoor and/or outdoor space with a southern exposure that creates a warm microclimate. The north side of the house has a cooler microclimate, providing respite from summer heat and creating a more public, sociable space where inhabitants can interact with surrounding residents, enabling front-porch living.

The north entry doors are vacuum-insulated for maximum efficiency during cold months. In the winter, only one of the four doors is likely to be used or the inhabitants might come and go exclusively through the Sun Porch, leaving snow boots and heavy coats to drip and dry in a space that functions as an airlock. The Sun Porch is enclosed on three sides by two different NanaWalls. When the *exterior* NanaWall is fully open, the porch is open to the deck and garden. In the summer, the Sun Porch can serve as a shaded outdoor room.



***Flexibility makes a small house bigger.***

When the *interior* NanaWall is fully open and the *exterior* NanaWall is closed, the Hall, Sun Porch and Kitchen merge. The Kitchen and Hall can be used interchangeably for dining, entertaining, display, or general gathering. For the everyday inhabitants, the sunny Kitchen is room enough for daily meals and lounging in front of the TV. When guests arrive, the Hall can support a large dinner party without crowding the cook. Smaller scaled equipment and well-designed lighting and storage contribute to the Interlock House's aesthetic elegance and roominess.

Carefully studied and detailed to maximize available storage and functional flexibility, the west module—the most private area of bedroom, bathroom and office—can be a fully enclosed, or opened to the rest of the house with minimal effort. Selective control of daylighting, which arrives from three sides, and artificial lighting in the western module enhances its adaptability. Built-in storage defines the boundary between the Washroom and Bedroom. When the bed folds up into its storage wall, a sofa folds down. The functional definition of the Bedroom is elusive, like so many bedrooms in very small houses.



The Interlock House is designed for the adult who wants to simplify and downsize, but wants none of the age segregation found in retirement communities or the restrictions against pets, gardening, noise, or grilling outside that can be associated with living in apartments or townhouses. At the same time, the Interlock House is designed for the homebuyer to “age in place” in the comfort of a wide range of physical accommodations. Using Universal Design principles, the Interlock House is wheelchair and walker-friendly. The Washroom is completely ADA accessible and the Kitchen cabinetry can be modified for temporary or permanent wheelchair access. An interior color palette that emphasizes contrasting colors and edge detailing, surface finishes that decrease glare, and continuous low-level lighting along paths allow occupant or visitor to optimize their sight, especially if they suffer from low vision.

***The best prescription for aging: stay physically active, mentally alert, socially engaged.***



- 1-FREEZER ON BOTTOM FOR EASIER ACCESS
- 2-LOWER MICROWAVE HEIGHT
- 3-PULL OUT SHELVES & CUTTING BOARDS
- 4-REMOVABLE CUPBOARDS BELOW SINK FOR ROLL UNDER ACCESS
- 5-REMOVABLE BOTTOM PORTION OF CABINETS TO CHANGE TO AN ACCESSIBLE HEIGHT
- 6-HIGH CONTRAST COLORS BETWEEN VERTICAL AND HORIZONTAL SURFACES

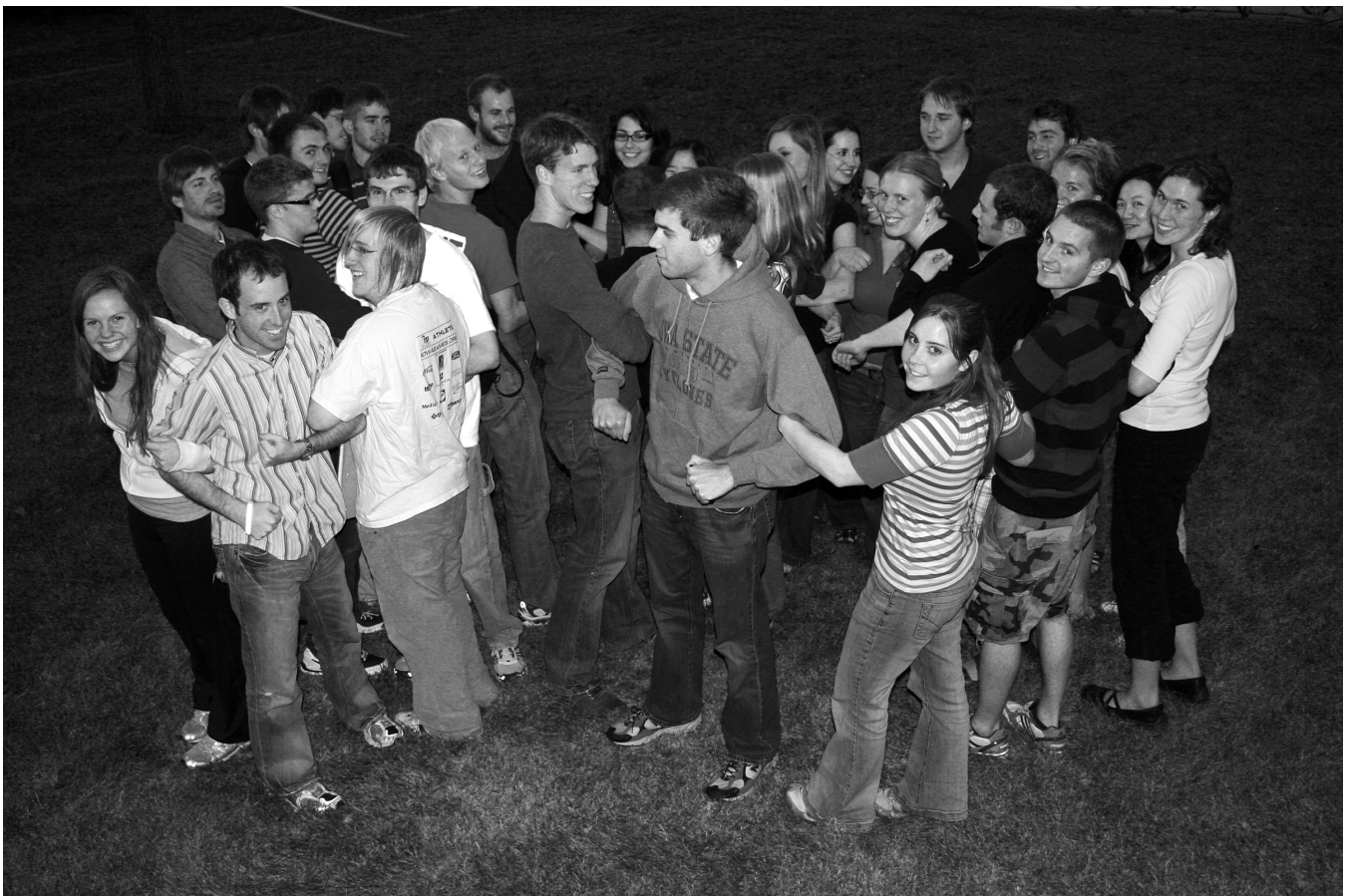
The Interlock House’s architectural strategy is responsive to the seasons, interconnected with the out-of-doors. The house is designed for active, older adults who want to live independently, economically, and sustainably in their own house and garden, with the security of being part of an established, sociable, support network. Well-suited to its target market, the house offers multiple and reconfigurable patterns of inhabitation within a compact, energy efficient footprint. For this emerging market, the Interlock House creates a comfortable, affordable platform for a healthy and ‘greener’ lifestyle.



During the Solar Decathlon competition on the Mall in Washington DC, the Interlock House will provide a dynamic learning opportunity for visitors, exposing them to emerging green practices used in combination with tried and true methods of construction. As the end product of a multi-year effort, the Interlock House will also demonstrate the power of interdisciplinary teamwork and collaboration. This project involved over 200 students and 20 faculty from 11 departments at Iowa State University. The website and exhibit materials were produced by Iowa State students in Graphic Design and Journalism. Many local craftspeople and businesses got involved, offered services, and contributed ideas. The University was very supportive.

Much of the work for the competition was completed in classes devoted to the effort. An interdisciplinary workshop with students from Engineering (construction, mechanical, electrical), Architecture, Landscape Architecture, and Interior Design, made all of the primary design decisions. These students actively engaged students in other courses such as Graphic Design and Journalism. The house is furnished with tables, chairs, and a bench crafted by students in a furniture design course. Dinner will be served on pottery thrown by ceramics students. Tablemats and rugs were woven by a textiles class. Students in the Architectural Millwork Program at Des Moines Area Community College detailed and crafted the cabinetry. The Gaffers Guild, an artistic glass blowing club at Iowa State University, produced ornamental glass objects for the house. A local chef offered advice for the dinner party menus; the kitchen garden was nurtured over the summer by a local organic farmer. And a Landscape Architecture alumnus in the DC area tended scores of native grass plants, shrubs and red oak trees in his yard over the summer.

Finally we hope the integrity of the Interlock House demonstrates that interdisciplinary collaboration is necessary to build sustainably.



## CHAPTER 11: Market Viability Justification

The Interlock House targets older adults who want to live independently, economically, and sustainably in their own house and garden, with the security of being part of an established neighborhood and support network.

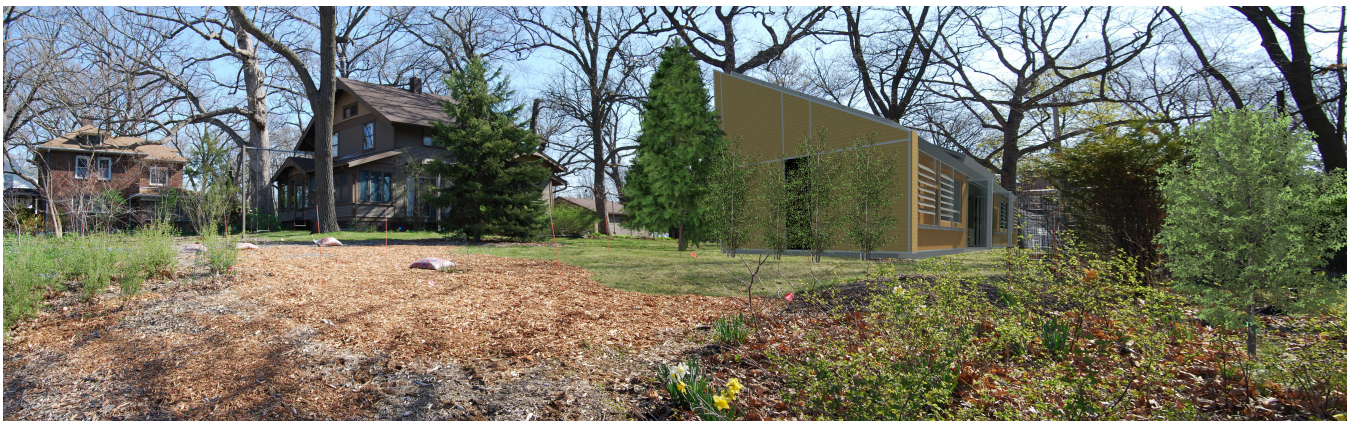
Location \_\_\_\_\_ Established neighborhood in Midwest city or college town: Ames IA.  
Housing Type \_\_\_\_\_ Retirement cottage  
# of Occupants \_\_\_\_\_ 2  
Demographic \_\_\_\_\_ 60-80 years old (the first baby boomers are 65 in 2010)  
Owner annual income \_\_\_\_\_ \$60,800  
# of bedrooms \_\_\_\_\_ 1

### **Livability: The design is responsive to basic needs & desires of homebuyers.**

The Interlock House is a small house designed to feel roomy. Composed of 3 spatial modules, the private zone of sleeping and bathing are located in the western third, with the kitchen and everyday dining in the eastern third. The center is a luminous Hall and a Sun Porch enclosed on 3 sides by easily movable walls that separate or link activities within these zones or to the decks outside.

The Interlock House is controlled by the inhabitant, not by technological systems, only. The Interlock House has many features that are adjustable. For example, by manipulating an exterior louver system that spans the south façade, one can change the amount of light, heat, and degree of visual privacy. Other features, such as the Sun Porch can be used to transform the house's activity space with its movable panels, and yet, the Sun Porch is always furthering the house's comfort and sustainability because thermal mass in the floor encourages convective loops to heat and cool the house.

The Interlock House is designed and engineered to provide thermal comfort with energy to spare. The photovoltaic panels and evacuated tubes collect more energy than is likely to be used by residents of the Interlock House. Excess power can be net-metered.



### **Livability: The design is responsive to the unique needs & desires of older homebuyers.**

The Interlock House is designed to prolong the years that a person can live independently and comfortably. Featuring universal design throughout the house, with no steps, or difficult places to reach, the Interlock House ensures uninterrupted ease of use across the normative sensory or mobility losses associated with aging.



The Interlock House also has built-in health benefits for people with chronic conditions. For example, some circulatory and arthritis sufferers will find therapeutic warmth by sitting in the enclosed the Sun Porch on a winter day.

The Interlock House introduces a new housing stock and a new homebuyer into established neighborhoods where older people, who want to remain in their homes, organize self-help networks, known as naturally occurring retirement communities (NORC).

Ideally, the Interlock House would be built on the oversized lot of a friend or family member or acquaintance in a neighborhood where they would increase the density of people who wish to



participate in a NORC. The emergence of grass-roots organizations that share, coordinate, and barter for services and daily assistance has quickly become the leading indicator of how baby boomers—who will be 20% of the population in ten years—will manage to “age in place” while securing the backup and assistance they will eventually need.

**Buildability:** While the Interlock House does include some materials and methods of construction uncommon in conventional commercial practice in the United States, and some of these assemblies required custom manufacturing for the prototype, the house is substantially off-the-shelf. The house fabric simply demonstrates best practices and smart choices as defined by LEED or other green building standards that can be easily implemented by any builder.

The framing for the prototype transported to Washington DC takes into account the necessity to assemble the prefabricated house in a few days. In the real world, however, this house could be site-built using less lumber and labor. The construction cost of the house would be about 25% less. *See the Construction Documents and Specifications for more detail.*

**Marketability:** The Interlock House has curb appeal for the older adult who is looking to downsize and simplify, but who wants to keep pets, to garden, and to live in an indoor-outdoor environment when the weather permits.

A small house is appealing – but only if it feels spacious. The Interlock House is roomier because of built-in storage, and movable wall panels that allow activity to flow indoors and out. The easily movable enclosures of the Sun Porch can also serve as overflow space: a rainy day play place for visiting grandchildren, parking of buggies, walkers, bicycles, etc. High ceilings and lots of daylight psychologically enlarges the small footprint

The Interlock House competes well among solar home alternatives because of an advanced water conservation and living landscape design. Designed to eliminate demand on infrastructure, the Interlock House has a greywater system, a storm water collection cistern. It is planted with native Iowa prairie grasses, and an edible garden.

The Interlock House is a better value than retirement communities. While both offer Universal Design features, and may be comparable in initial purchase price, the Interlock House has none of the escalating costs of utilities and maintenance fees.

<b>Cost Estimate:</b>	Home Value_____	\$339,000
	Down Payment	
	from previously owned home_____	\$167,000
	Loan amount_____	\$172,000
	Interest rate_____	4.8%, 15 year fixed rate mortgage
	Property tax for Ames, IA_____	1.4%
	Monthly payment_____	\$1,420

Max housing expense (Household income X 28%)/12=monthly payments

**Household Yearly Income needed\_\_\_\$60,800**

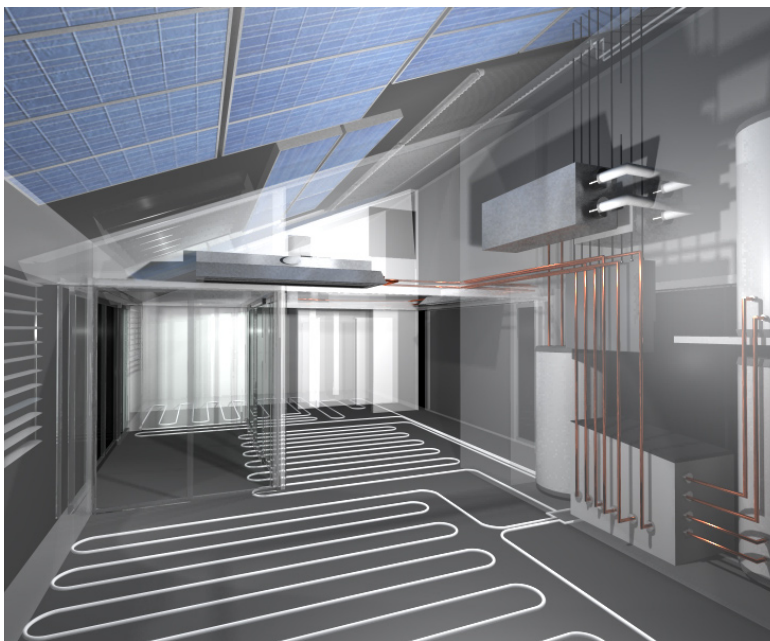
## CHAPTER 12: Engineering Design Narrative

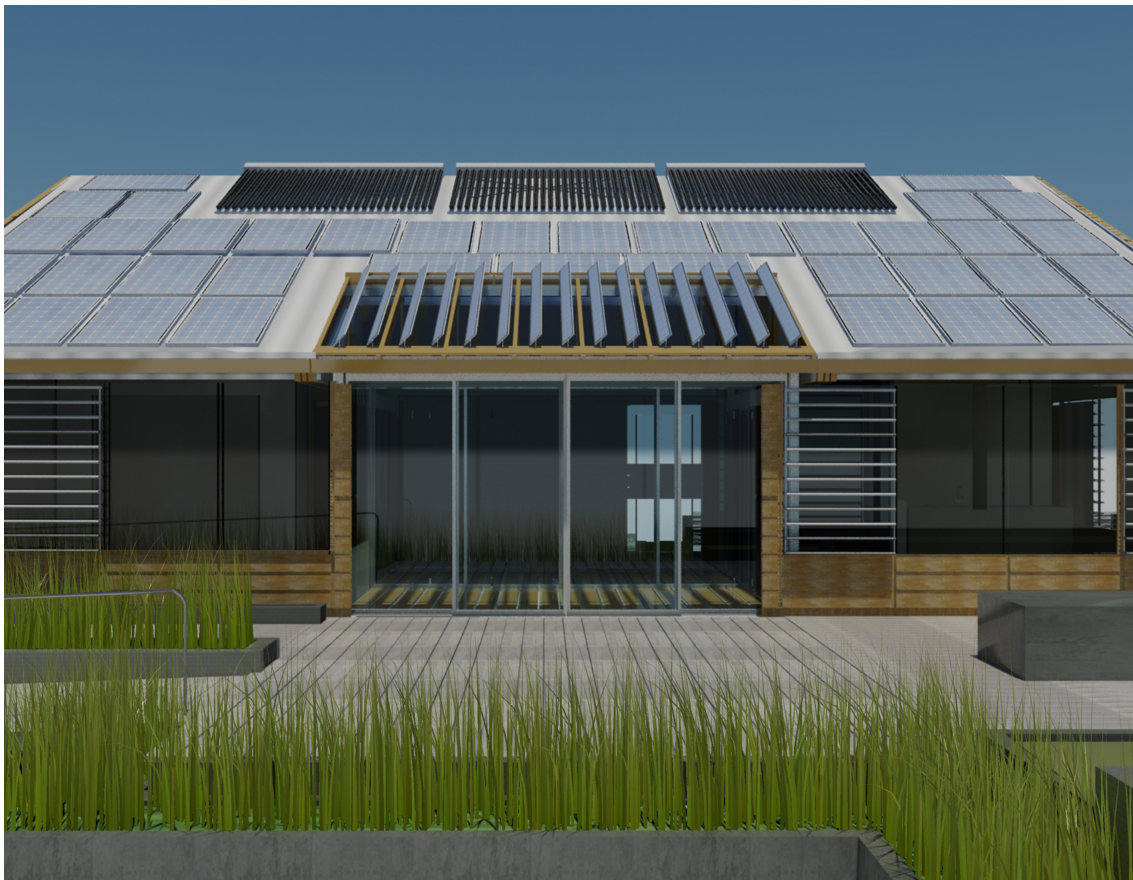
The Iowa State University Solar Decathlon Team's Interlock House is designed for an older couple in transition from a larger family house to something much smaller and easier to maintain; from work to retirement; or from a situation that no longer requires more space than they really need. This target market is still active and concerned about reducing their carbon footprint. The Interlock House provides one example of how net-zero energy living is affordable and possible today. Transforming to accommodate the extremes of the Iowa seasons and interlocking with the outdoors, this house is designed to balance a reduction of energy consumption with solar power production.

The heating and cooling system of the Interlock House is based on year-round solar thermal collection. Thermal collection has a much higher efficiency than photovoltaic electric conversion. The heating and cooling are both powered by solar thermal energy. A propylene glycol and water solution functions as the working fluid for thermal energy collection. The glycol solution is heated by a large bank of 60 Apricus evacuated tube collectors. These collectors are capable of heating the fluid to much higher temperatures than those attainable with flat plate collectors. The evacuated tubes are oriented to the south at the same 23° angle as the roof. The heated glycol solution passes through a heat exchanger that heats thermal storage water. This water is stored in a large insulated tank.

For winter heating, the hot water is circulated through a 3-loop Warmboard radiant floor heating system. For summer cooling, the hot water is used as the heat source to recharge a liquid desiccant dehumidifier. The desiccant dehumidifier removes the latent cooling load. A traditional vapor compression air conditioning system handles the sensible cooling load. Since the dehumidifier handles the latent cooling, the electrically run air conditioner can be smaller than a normal system for this size of house. The air conditioning system is widely commercially available and is an efficient version of what homeowners and HVAC installers are already familiar with.

In addition to the radiant heating, desiccant and electric cooling systems, an electrically powered energy recovery ventilator provides fresh air to the interior space. The incoming air is conditioned to have the same temperature and humidity as the air in the conditioned space using recovered heat and moisture from the outgoing airstream. Domestic hot water is heated by a heat exchanger tied to the main thermal water storage tank. An electric resistance heater is integrated into the DHW tank as a backup heat source.





**PV Array Description:** The main photovoltaic array is composed of Sanyo HIT modules rated at 205W each. The HIT modules incorporate a thin film layer that helps the panels function better in low light and in high-temperature situations. There are 38 Sanyo modules for a total main array rating of 7.79kW.

Thin film photovoltaic cells made by PowerFilm are located on passive tracking louvers above the porch. These tracking louvers help the cells receive increased amounts of sunlight while shading the porch below. The tracking louver array is rated at 180W. PowerFilm thin film photovoltaics are used on the surfaces of the southern and eastern façade louvers. The southern and eastern louvers have a total rated capacity of 270W. The entire thin film array is rated at 0.45kW.

Two Xantrex GT inverters convert the direct current electricity created by the main array into 240V/60Hz alternating current for use by the appliances and lighting in the house. The Xantrex GT inverter includes maximum power point tracking to ensure the most power possible is being produced by the photovoltaic panels. Enphase microinverters are used with all of the thin film components including the tracking louvers. Enphase inverters are specially designed to work with low input voltage. Since the thin film and louvers are not UL listed, they have been designed to operate at less than 60V. This makes the Enphase inverters ideal for this application.

A Square D AC circuit-breaker panel acts both as the point of electrical distribution and as a circuit overload deterrent. A net electricity meter on the grid connection measures net energy fed to or from the electrical grid. A grounding rod is also used to provide a safe electrical grounding point for all equipment and wiring.

**Smart House System:** Sensors located both in the living space and within the HVAC system are used to monitor conditions within the house. These sensors tie into a building control system which is used to



run the HVAC systems and plumbing pumps. A central touch screen command center functions as an information source, reporting statistics and current operational data about the house and HVAC and PV systems. Weather data is received from an internet feed. This information, along with the interior data, is used to suggest adjustments to aid in passive heating or cooling.

**Natural Ventilation Strategy:** In the fall, spring, and milder summer months, the Interlock House can be cooled using natural ventilation. In order for natural ventilation to be effective as a passive cooling mode, there must be at least ten air changes per hour. The evaluation of the operable area of windows has been based on the wind speed required for each room to achieve ten air changes per hour. The Beaufort scale describes wind speeds in qualitative terms, but there are also numerical values associated with each level of the scale. Ideally, the wind speed necessary to have ten air changes per hour in a given room would be less than a three on the scale, with the lowest number being the most desirable. The average summer wind speed for both Iowa and Washington, DC, falls in the three Beaufort scale range. Average wind directions for both locations are generally from south to north. The north-south orientation of the house lends itself easily to natural cross ventilation. According to the calculations below, even the slightest breezes will effectively cool the house. This is largely in part due to the sizable openings of the operable windows. This means that on days that actually have a breeze above a one on the Beaufort scale, only a few windows need to be opened for effective natural ventilation.

Scale Number	Speed (mph)	Description
0	0	Calm; Smoke rises vertically
1	1–3	Wind motion visible in smoke
2	4–7	Wind felt on exposed skin; Leaves rustle
3	8–12	Leaves and smaller twigs in constant motion

#### Current Design Results—Minimum Required Wind Speeds for 10ac/h

Room	South (mph)	North (mph)	South (Beaufort)	North (Beaufort)
Kitchen	0.79	0.17	~1	~0
Hall	0.06	0.05	~0	~0
Bed/Bath Rooms	0.77	0.17	~1	~0
Whole House	0.14	0.09	~0	~0

*(Values recalculated May 26, 2009)*

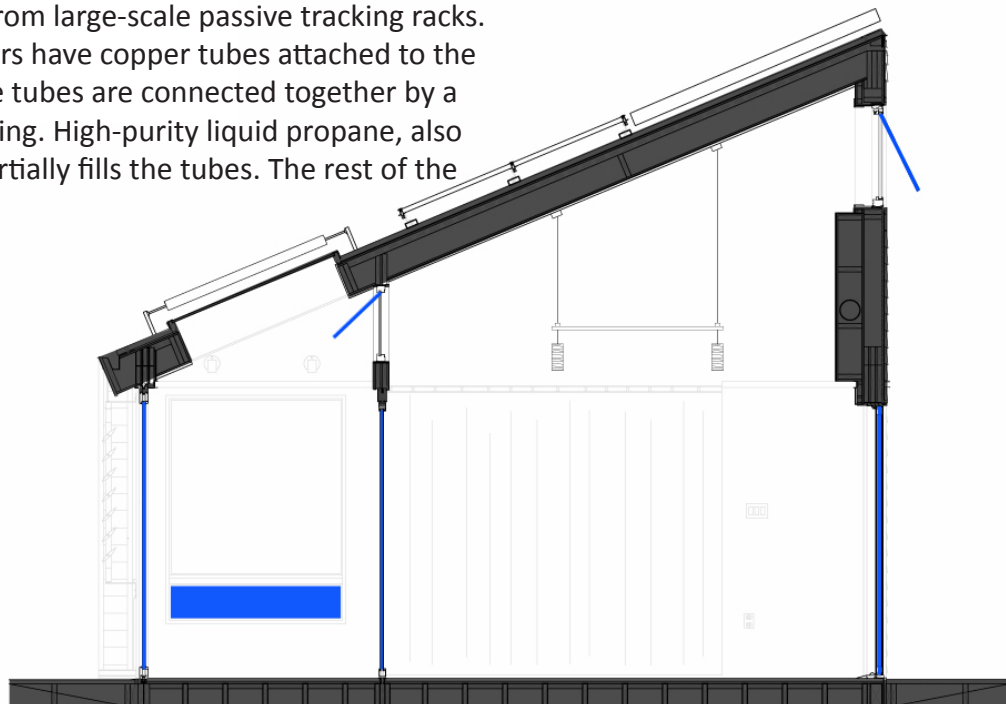
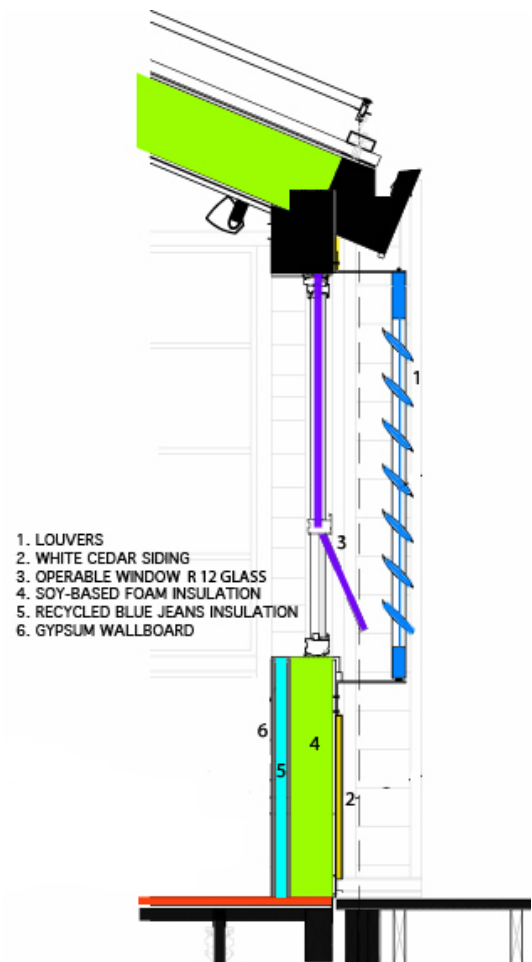
**Efficiency:** The Interlock House focuses on efficient use of energy. This is done by using high-grade electrical energy only when necessary. Thermal energy is a lower grade form of energy and as such is used for tasks that can be accomplished by low-grade energy. The heating, dehumidification and domestic water heating are all accomplished with low-grade thermal energy. These tasks would normally require a large amount of electricity or natural gas. Evacuated tube thermal collectors have a much higher efficiency (70%) than photovoltaic electric panels (17%).

The Interlock House boasts multiple efficient systems. One of the most important areas of efficient design is the envelope of the house. The envelope is designed to be both thermally efficient and extremely tight. This efficiency lessens the need to run the HVAC systems at any time during the year. The house also boasts energy-efficient LED and fluorescent lighting. Small appliances fit the scale of the

interior space and reduce the electrical and water usage. Other energy efficient electronics and household devices all reduce the power needed to operate the house. The passive tracking louver system is a highly efficient system since it boosts the power output of the photovoltaic cells without consuming any power.

The spatial composition of the Interlock House is seasonal. The Hall and Sun Porch can be reconfigured and opened to the elements. The Sun Porch, with added thermal mass in the floor, mediates light and heat and encourages convective loops to heat and cool the house. A louver system spanning the south façade also mediates light and heat and reduces the active cooling load in summer months. The louvers allow the occupants to manipulate light and heat according to activities and privacy needs. The house requires active manipulation of its doors, windows, and exterior louvers to influence airflow and to maximize or minimize heat gain and loss. This reliance on several basic passive solar and ventilation techniques helps reduce the energy demands for the active systems. The effective meshing of the active and passive systems needs an alert and motivated resident but the Interlock House's systems monitoring make it easy for anyone to live comfortably with solar energy.

**Innovation:** The Interlock House features several innovative systems. The first system is the passive tracking photovoltaic louver array over the sunspace. The louver array uses balancing fluids to track the sun. The concept has been adapted from large-scale passive tracking racks. Several of the louvers have copper tubes attached to the two long edges. The tubes are connected together by a small section of tubing. High-purity liquid propane, also known as R-290, partially fills the tubes. The rest of the



space in the tubes contains gaseous propane. Shades shield 50% of the each tube's surface. When the louver is directly normal to the sun, both tubes receive equal amounts of thermal radiation. This keeps the vapor pressure of the propane equal between the two tubes. When the sun moves, one tube receives more radiation than the other, increasing the vapor pressure in that tube. The increased pressure forces some of the liquid propane into the other tube, increasing the weight on that end of the louver. The increased weight rotates the louver toward the sun until the vapor pressure becomes equal in both tubes, balancing the system normal to the sun. A linkage arm rotates several louvers at a time.

The dehumidification system of the Interlock House incorporates liquid desiccants. Desiccant dehumidifiers are common but typically use a solid desiccant. The advantage of a liquid desiccant system is that it can be modified to fit into many different spaces. The desiccant material is calcium chloride, or common road salt. This desiccant salt absorbs moisture from the air and eventually becomes a liquid. This liquid can still absorb more moisture from the air. The absorber unit is contained within the ducted air system. The absorber is made up of several Teflon-coated plates. A reservoir at the top of the plate stack holds the liquid desiccant, which runs down the sides of the plates. Air is blown across the plates where the desiccant draws out the moisture. A lower reservoir collects the saturated liquid desiccant.

The main factor in desiccant dehumidification is the surface area of the desiccant. By having several long plates with desiccant running over their surfaces, the surface area can be increased while keeping the footprint of the absorber relatively small. The dehumidified air goes onto the air-handling unit where it is cooled, while the saturated desiccant is pumped to the recharger unit. The recharger unit is nearly identical to the absorber unit except that solar-heated water is pumped along the backside of the plates. When the desiccant runs down the surface of the heated plates it is heated, which drives off the moisture. The moisture is picked up by a scavenging air stream, which is vented to the exterior of the house. The concentrated liquid desiccant is fed back to the absorber unit. The main concern is to keep the concentration of the desiccant lower than 33%. Higher concentrations start to crystallize, which could severely damage the pumps within the system.

**Reliability:** The main photovoltaic array features no moving parts. This means that the array should deliver reliable power and require no maintenance throughout the lifetime of the panels. The tracking louver array only has one point of movement and is entirely self-calibrating. The propane refrigerant that enables the passive tracking should have no deterioration over the lifetime of the system. All of the hydronic system components are expected to last over ten years. The only system that could possibly be easily damaged is the desiccant system. Special consideration was given to all the components in the desiccant system to prevent corrosion from the calcium chloride. As a whole, the power, heating, cooling and dehumidification systems are designed to reliably operate without maintenance for years at a time.

## CHAPTER 13: Lighting Narrative

The Interlock House is solely solar powered and full of light and air. Designed with high north clerestories and interlocking spatial volumes, daylight and artificial light wash the walls and ceiling, animating their sculptural quality, making the interior appear larger, and brighter. The Interlock House's lighting strategy is layered and hierarchical in order to enhance the aesthetic experience and functional needs of occupants and to address the comfort and safety of our target market. Special attention is given to the role of light, and color surfaces in supporting normative changes in vision that occur with aging.

Keeping Universal Design principles in mind, depth perception is enhanced by selecting colors that sharpen edge contrast, and low-level continuous lighting along walking paths enhance one's sense of security. Through the selection of non-shiny surfaces, and the use of adjustable louvers to diffuse daylight, the Interlock House is able to increase the level of illumination needed, without increasing glare.



**Daylighting:** The Interlock House lighting strategy begins by optimizing daylight and minimizing the need for artificial illumination through the use of windows on the south, east and west sides of the house and high north clerestories. Large windows on the south side and Sun Porch, allow a maximum amount of daylight into the house, while built-in movable louvers adjust the quality and quantity of light as needs and activities change across the day and season. A sunny summer breakfast is even more delightful when warmth, brightness and glare can be modified by simply sliding a louvered panel that diffuses light without blocking it out.



On the east side of the house, a generous window allows morning light to filter into the Kitchen. This window also sustains a visual connection to the oak trees across the seasons. On the west side, the bedroom windows have roman shades for additional privacy, sunlight control, and warmth. The north clerestories supply indirect daylight deep into all spaces across the length of the house, reducing the overall need for artificial illumination, and adding the pleasant sounds of falling rain and snow.



**Artificial Lighting:** The Interlock House lighting design ensures that after spending a rainy day at a well-lit home-workstation, a resident can spend a romantic evening entertaining in a softly illuminated open-plan. Ambient lighting fixtures contribute to both scenarios. The ambient light is indirect, providing a soft illumination that is visually appealing for entertaining, as well as particularly important for resting eyes after spending hours looking at a screen, or doing close work, such as sewing.

The combination of ambient wall and ceiling lighting, and small and task-oriented fixtures allows the occupant to modify the light levels by task and mood across the day and season. In the Bedroom and Kitchen, wall wash-lights splash the sloped ceiling with indirect light. This technique brightens without the sharp glare of a bulb. In the Hall, four pendant fixtures with fluorescent bulbs can be operated separately or together to vary illumination levels. Fluorescent lights are selected for efficiency and color rendering of around 3800 Kelvin with a yellow, warmer hue. Fixtures for task lighting provide increased illumination levels near the bed for reading, at the desk for paper work, on kitchen counters for cooking. Suspended pendant fixtures by the bathroom mirror provide a soft brightness for grooming. A second set of small MR-16 lamps provide low-voltage fixtures in the bathroom to increase the range of light levels.

To avoid the light pollution often associated with urban night lighting, the Interlock House exterior lighting design is focused on *comfort & safety*. Low-level lighting utilizing stand-alone solar-powered







lamps define the main outdoor paths. Edges of planters and benches twinkle with strings of stand-alone, efficient LED lights.



**Evaluating Lighting Levels:** The Interlock House Team has had the privilege of working with the Juno Lighting Group of Schneider Electric. The Juno Group assisted in evaluating the lighting scheme, and making equipment choices based on energy efficiency and the selection of appropriate technologies. To better predict the lighting design performance, we digitally modeled the Interlock House daylight and artificial lighting by using the computer application AGI32 v2.03 also provided by Schneider Electric. This software platform is a lighting industry standard for simulating the performance of lighting fixtures, and sun and sky light conditions to analyze luminance.

**Evaluating Daylight:** Light levels throughout the house are considered, with special attention to maintaining the workstation surface in the bedroom at a 50 foot candle level of consistency. Conditions were studied for October 12th 2009, the sun angles are specific to that date and the longitude and latitude locate the structure towards the eastern end of the National Mall in Washington DC. The period of time studied—from 6:00 AM until 5:30 PM—includes sunrise and sunset. We studied three atmospheric conditions—clear skies, partly cloudy and overcasts conditions—as they each yield very different lighting effects.

The table below demonstrates the results for lighting levels, in foot candles, in half hour intervals at the southern lip of the work station centered in front of the bathroom window. The highlighted rows relate to the times found in images 1, 2 & 3. Images 1, 2 & 3 represent the three atmospheric conditions

at different times. This data represents the maximum daylight levels when the Sun Porch is in an open position, and all operable doors and NanaWall panels are in the open position. Measuring this condition also provides a good point of comparison for other Sun Porch configurations.

**Workstation Daylighting Calculations:** for 12-Oct 09

Washington DC      Lon 38d 52'23 N      Lat 77d 1'10 W      In Foot Candles

Time	Sky Conditions		
	Clear Sky	Partly Cloudy	Overcast
6:00	0.0	0.0	0.0
6:30	11.4	4.4	1.2
7:00	34.9	15.8	3.6
7:30	57.6	29.0	6.0
8:00	74.7	43.7	8.3
8:30	87.1	57.9	10.3
9:00	97.1	70.5	12.2
9:30	101.0	79.4	13.8
10:00	105.0	86.5	15.2
10:30	102.0	89.0	16.2
11:00	107.0	92.3	17.0
11:30	103.0	90.4	17.4
12:00	97.0	86.1	17.5
12:30	86.1	78.4	17.3
13:00	77.8	70.8	16.8
13:30	66.8	61.5	15.9
14:00	58.7	53.0	14.7
14:30	50.9	44.6	13.3
15:00	43.2	36.1	11.6
15:30	34.5	27.5	9.6
16:00	24.6	19.7	7.5
16:30	18.1	12.7	5.2
17:00	10.9	6.5	2.8
17:30	0.0	0.0	0.0

Note: all point data are calculated at 32" above the finish floor.

Plan-view images (looking directly down into the house) include data points showing light levels in foot-candles. Perspective images represent a qualitative picture of the lighting conditions. These images were produced with the sunspace completely closed, so that it is easier to read the interior spaces, and to provide a comparison to the data in the table.

**Evaluating Artificial Illumination:** The interior electric lighting design was also analyzed using AGi32. Each fixture and lamp is incorporated into the model via the industry standard .ies type which are produced and made available by manufactures. The .ies files include photometry information for lamps, fixtures and power settings and accurately model lighting casting behavior. The analysis



Image 1  
Clear Sky Conditions

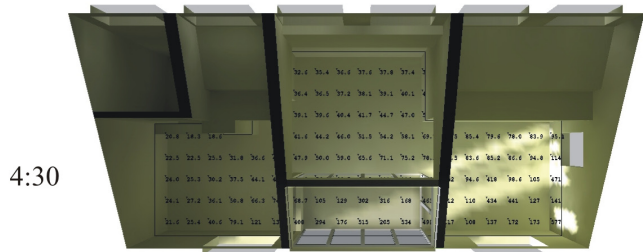
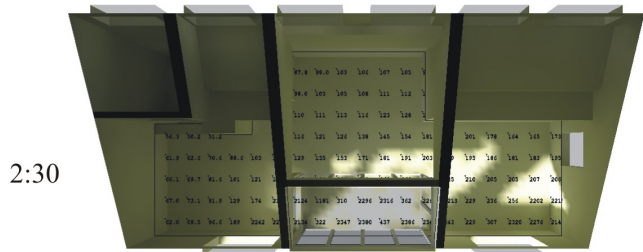
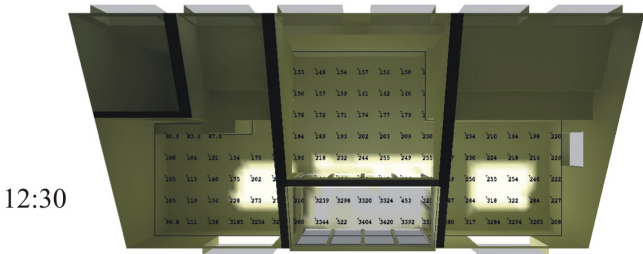
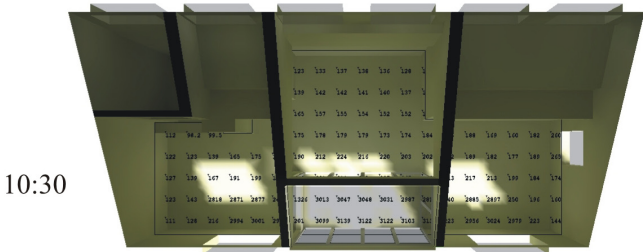
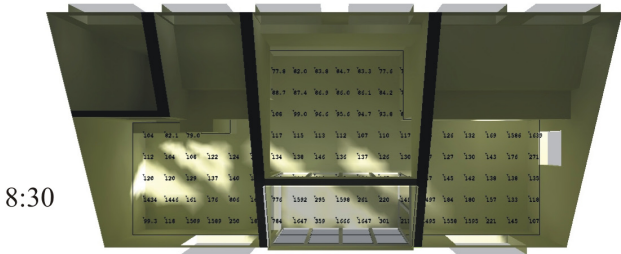
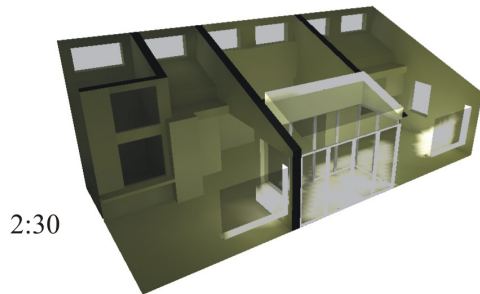
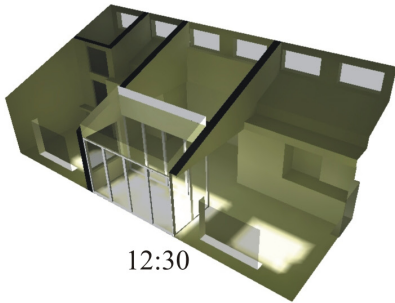
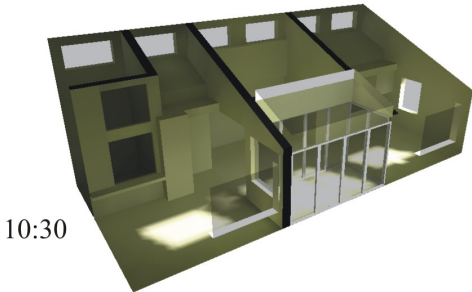


Image 2  
Partly Cloudy Sky Conditions

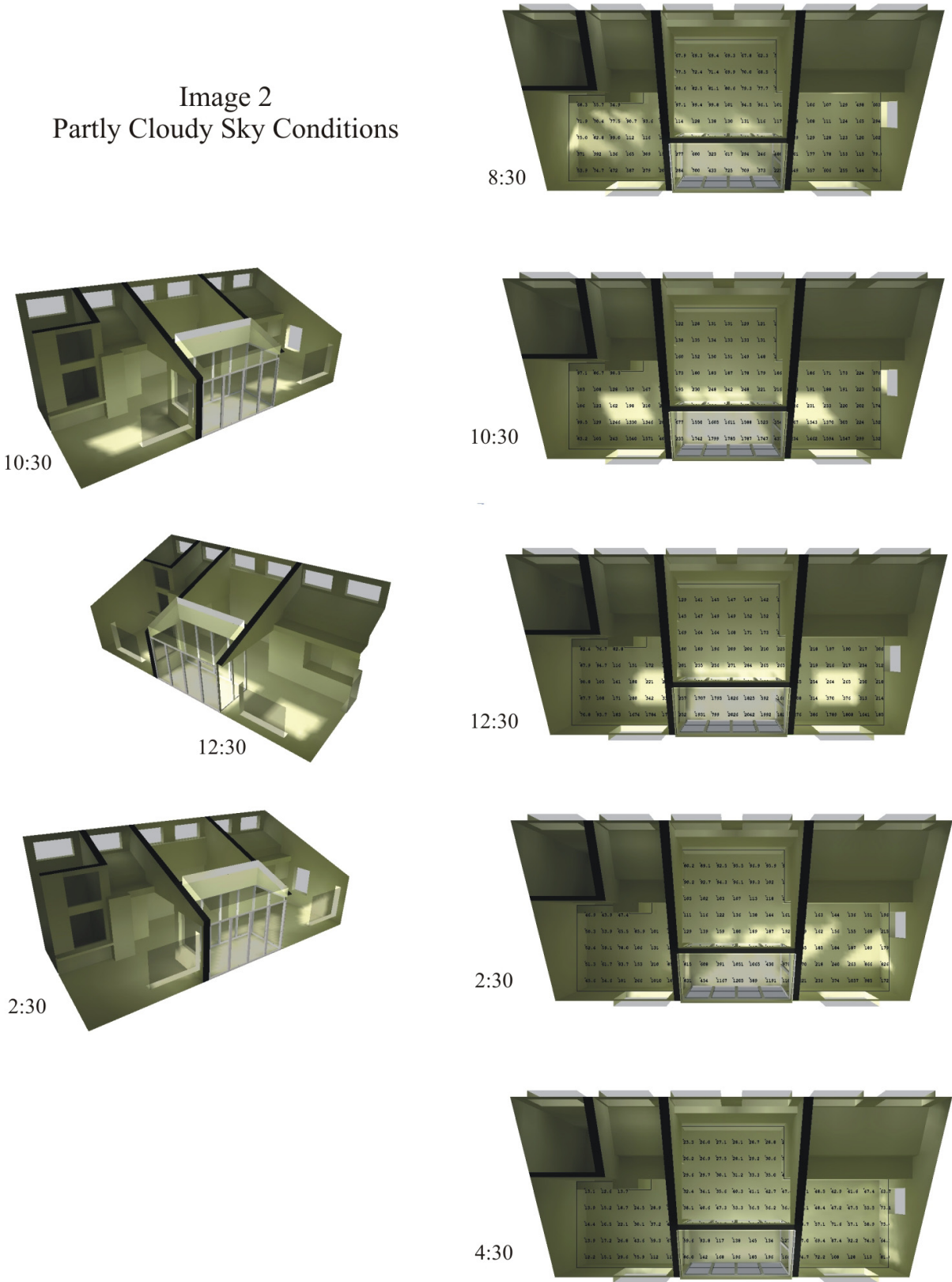


Image 3  
Overcast Sky Conditions

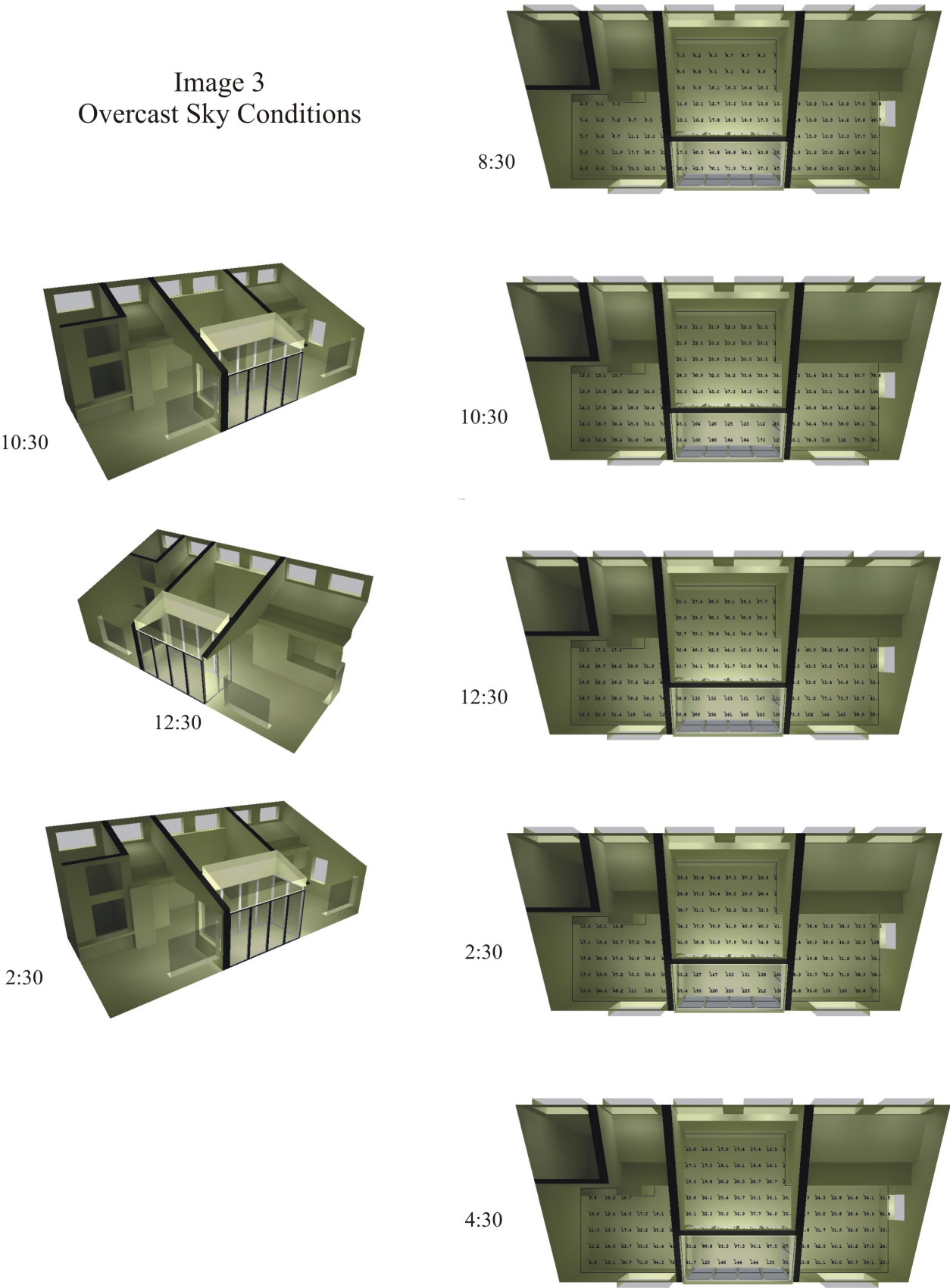
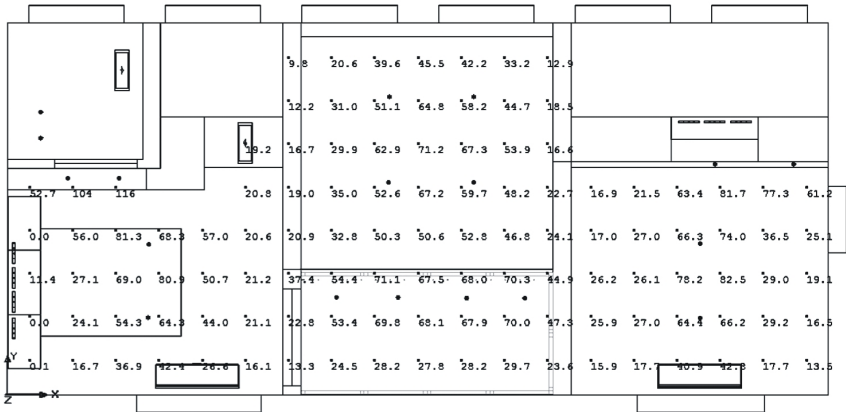
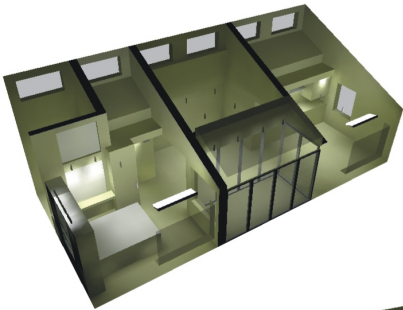




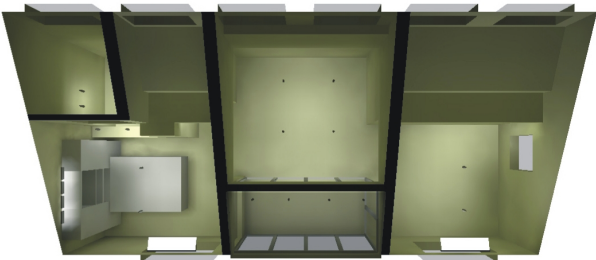
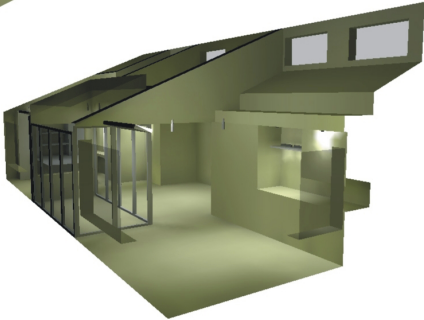
Image 4  
Artificial Lighting



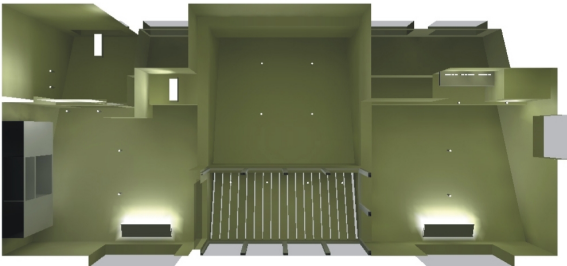
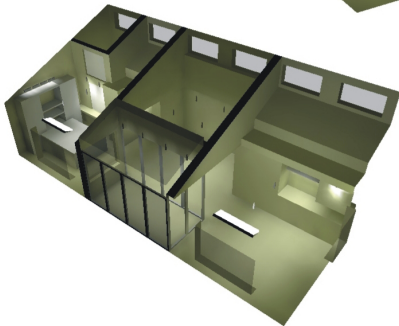
Lighting performance plan



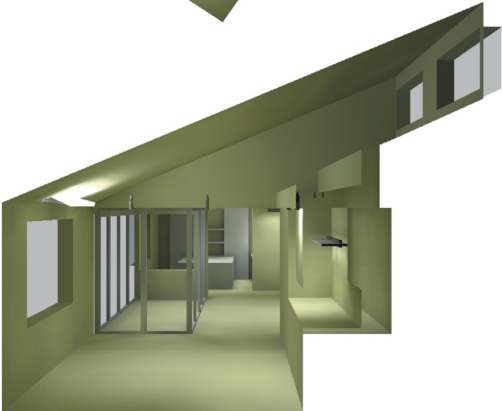
Isometric  
Views



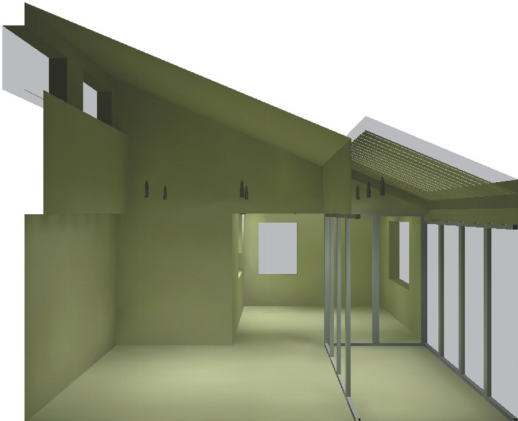
Top View



Reflected Ceiling View



Looking West



Looking East

presented here is only for electric light and does not incorporate any additional daylighting in order to focus on the performance of the lighting design.

Fixtures located in the bathroom are included though no data points are plotted inside the bathroom: the windows between the bathroom and bedroom transmit some light and that condition is represented by this approach. Image 4 shows the foot-candle readings present with all interior lights on as well a various qualitative perspective views.

**Conclusions:** Daylighting performance appears to be satisfactory during the morning and early afternoon when light is coming in through the south and eastern windows. However around 2:30 in the afternoon begin to slowly drop around the workstation--artificial lighting will eventually be needed to achieve the 50 foot candle level called for in the rubric. Also heavily overcast conditions may prevent light levels from ever reaching the 50 foot candle level. This light level goal aside the general lighting performance seems that it will be pleasant in most sky conditions throughout the day providing well diffused light through most of the house.

The artificial lighting design also tests according to plan. Lighting will be variably distributed creating areas of interest and highlight around the workstation and kitchen areas, but harsh contrasts are avoided and no spot will be awkwardly dim. In general the lighting design appears to perform as desired. The Interlock House Team is looking forward to verifying these predictions during the competition.



**APPENDIX A: Main Photovoltaic Array Sizing Calculations**

Modules: Sanyo HIT 205W

$P_{\max}$ : 205 W

$V_{pm}$ : 56.7 V<sub>dc</sub>

$I_{pm}$ : 3.62 A<sub>dc</sub>

$V_{oc}$ : 68.8 V<sub>dc</sub>

$I_{sc}$ : 3.84 A<sub>dc</sub>

$\mu_{Voc}$ : -0.172 V/°C

$\mu_{Isc}$ : 0.88 mA/°C

(at STC: 1000W/m<sup>2</sup> and 25°C)

Inverter: Xantrex GT 5.0

Max  $V_{oc}$ : 600 V<sub>dc</sub>

MPPT operating range: 235-550 V<sub>dc</sub>

Max  $I_{sc}$ : 24 A<sub>dc</sub>

Inverter: Xantrex GT 3.3

Max  $V_{oc}$ : 600 V<sub>dc</sub>

MPPT operating range: 200-550 V<sub>dc</sub>

Max  $I_{sc}$ : 24 A<sub>dc</sub>

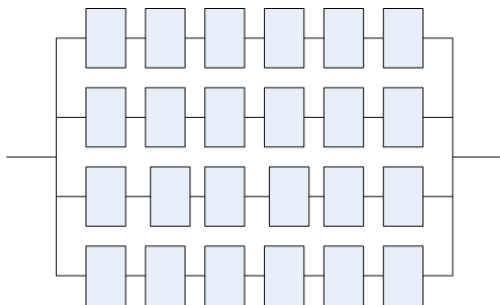
Ames, IA Temperatures

Record Low: -33° C

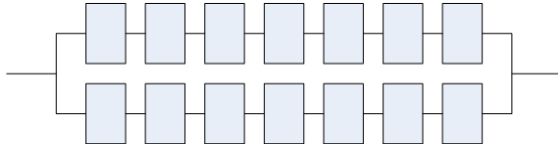
Record High: 39° C

**Configuration**

GT 5.0: 4 strings in parallel X 6 modules per string



## GT 3.3: 2 strings in parallel X 7 modules per string



Total quantity: 38 Modules

Total rated size: 7.79 kW

Cold weather derating:

$$\Delta T = -33^{\circ}\text{C} - 25^{\circ}\text{C} = -58^{\circ}\text{C}$$

$$\Delta V_{oc} \text{ per module} = \left( -0.172 \frac{V_{dc}}{^{\circ}\text{C}} \right) (-58^{\circ}\text{C})$$

$$\Delta V_{oc} \text{ per module} = 9.976 V_{dc}$$

$$6 \text{ module string: } \max V_{oc} = (6 \text{ modules})(68.8 V_{oc} + 9.976 V_{oc}) = 472.66 V_{dc}$$

$$7 \text{ module string: } \max V_{oc} = (7 \text{ modules})(68.8 V_{oc} + 9.976 V_{oc}) = 551.432 V_{dc}$$

Both string sizes are under the  $600 V_{dc}$  limit of both inverters. The 7 module string is slightly outside of the maximum power point tracking range, this is acceptable since it equates to a loss of efficiency and not a safety hazard.

Warm weather derating:

$$\Delta T = 39^{\circ}\text{C} - 25^{\circ}\text{C} = 14^{\circ}\text{C}$$

$$\Delta I_{sc} \text{ per string} = \left( 0.00088 \frac{A_{dc}}{^{\circ}\text{C}} \right) (14^{\circ}\text{C})$$

$$\Delta I_{sc} \text{ per string} = 0.0123 A_{dc}$$

$$4 \text{ strings in parallel: } I_{sc} = (4 \text{ strings})(3.84 A_{dc} + 0.00123 A_{dc}) = 15.4 A_{dc}$$

$$2 \text{ strings in parallel: } I_{sc} = (2 \text{ strings})(3.84 A_{dc} + 0.00123 A_{dc}) = 7.7 A_{dc}$$