

# Project Manual

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Team China 20110715

Project Name: Y container, Solar Decathlon 2011 USA.

Team Name: Team China, Tongji University

Primary Student: HuaGuodong

Faculty Advisor: Prof.TanHongwei

Contact: , jellyhua@gmail.com,tong\_team@yahoo.com

Address: 1239 Siping Rd, Shanghai, China 200092

Tel: +86 65987788-8074



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## 1. Summary of Changes

20110811

### **RULES COMPLIANCE CHECK**

Red font words in the rules compliance form have been revised or updated, details mentioned below.

Rule 4-2 Construction Equipment Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site O-101 to O-101E

#### RULE8-5 VILLAGE GRID DRAWINGS

Drawing showing the locations of the inverters: E-105

Drawing showing the locations of the terminal box: E-101

Drawing showing the locations of the meter housing: E-105

Drawing showing the locations of the service equipment: E-101

Drawing showing the locations of the grounding means: E-104

#### RULE8-5 VILLAGE GRID SPECIFICATIONS

Specifications for the inverters: 7.3.2/7.4

Specifications for the terminal box: 26 27 26

Specifications for the meter housing: 26 27 11

Specifications for the service equipment: 26 20 00/26 27 16

Specifications for the grounding means: 28 05 26

#### RULE8-5 VILLAGE GRID SPECIFICATIONS CALCULATION

Please refer to the content of “Calculation of Y House” in E-502 Data Sheet

#### RULE8-5 VILLAGE GRID ELEVATION

Elevation showing the locations of the inverters: A4/E-201

Elevation showing the locations of the terminal box: E-204

Elevation showing the locations of the meter housing: A4/E-203

Elevation showing the locations of the service equipment: E-203

Rule 4-5 Generators Specifications for generators Manual Part 9

Rule 4-6 Spill Containment Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event 22 10 00 part 3

Rule 4-6 Spill Containment Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event 22 10 00 part 3

Rule 7-2 Watering Restrictions Drawing(s) showing the layout and operation of greywater irrigation systems

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P-501,P-502

Rule 8-1 PV Technology

Limitations Specifications for photovoltaic components Manual 7/E-602

Rule 9-8 Water Delivery Drawing(s) showing the complete sequence of water delivery and distribution events  
P-101,P-102,P-501,P-502

Rule 9-9 Water Removal Drawing(s) showing the complete sequence of water consolidation and removal events  
P-501,P-502

### Architecture

01 54 00 have updated the contact method of heavy machinery agent in American.

James Chen

Tel: 001-626-457-5288 Fax:001-626-457-8886

Cell: 001-626-318-5078

Email: [jamesc@greating-shipping.com](mailto:jamesc@greating-shipping.com)

Bryon informs us details would be decided on construction site.

### REVIT FILES UPDATED

A-701

O-101

O-101A

O-101B

O-101C

O-101D

O-101E

### HVAC

1. Thanks for your comments in section 7 and corresponding modification is revised. All the modifications are marked in red. Meanwhile E-602 drawing is revised to comply with the US 2008 National Electrical Code.
2. The chemical composition of the PCMs we used in the house is listed as attachment 8 DuPont™ Energain® PCM Thermal Mass Panels.
3. Generator is reselected and approved by Stafford Byron. New model is YAMAHA EF6300iSDE.
4. Load calculation for Y-Box in section 6. Interconnection Application Form is revised
5. Figure 8.5 Solar water system is revised. Details please refer to TONG\_CD P-903.
6. English version of Vacuum Insulation Panel's properties please refer to attachment 11 "Vacuum Insulation Panel Properties and Building Applications".
7. Fire Performance of XPS board please refer to attachment 12 "Fire Performance of Knauf Insulation Panel"
8. 8.2.4.4.2 –HVAC System Design and Sizing is revised.

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**Electrical engineering**

Manual Division 25 26 28 amended

E001 ELECTRICAL SHEET INDEX AND NOTES

REVIEW FROM DUBUTT:

Electrical Symbols?

REVISION FROM MA WEINAN:

Symbols are added in E001 ELECTRICAL SHEET INDEX AND NOTES.

E101 ELECTRICAL DISTRIBUTION PLAN

REVIEW FROM Harold Willman:

Typical: Missing receptacles. NEC 210.52(A)(1)(2)

REVISION FROM MA WEINAN:

Four Chinese standard receptacles are located reasonably on the wall. And the details can be reviewed on E101 ELECTRICAL DISTRIBUTION PLAN.

E101 ELECTRICAL DISTRIBUTION PLAN

REVIEW FROM Harold Willman:

Reciew NEC 210.52(E)(1) for outdoor receptacles

REVISION FROM MA WEINAN:

Two Chinese standard protected outdoor receptacles are located reasonably on the wall of outside. And the details can be reviewed on E101 ELECTRICAL DISTRIBUTION PLAN

E101 ELECTRICAL DISTRIBUTION PLAN

REVIEW FROM Harold Willman:

All exterior receptacles shall be weather-resistant. NEC 406.8(B)(1).

REVISION FROM MA WEINAN:

All exterior receptacles are chinese standard protected outdoor sockets from Scheider Electric with the feature of weather resistant.

E103 LIGHTING PLAN

REVIEW FROM Harold Willman:

Provide switching to verify compliance with NEC 210.70(A)(B)(C).

REVISION FROM MA WEINAN:

Main switches with function of multimode control have been arranged in E103 LIGHTING PLAN and E 204 TERMINAL BOX ELEVATION.

E103 LIGHTING PLAN

REVIEW FROM Harold Willman:

Review NEC 210.70(A)(2)(b) for missing exterior switched luminaires.

REVISION FROM MA WEINAN:

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Exterior lights are located in E-103 LIGHTING PLAN.

E104 GROUDING PLAN

REVIEW FROM Harold Willman:

Verify that this is necessary for your design by IRC.

REVISION FROM MA WEINAN:

This part lines are removed and The drawing is revised in E-104 GROUNDING PLAN.

E104 GROUDING PLAN

REVIEW FROM RUBUTT:

Suggest just a single ground rod.

REVISION FROM MA WEINAN:

A single ground rod is applied for grounding plan and the drawing is revised in E-104 GROUNDING PLAN.

E201 ELECTRICAL DISTRIBUTION PLAN

REVIEW FROM Harold Willman:

Note that your team will have 2 meters. One 50 hZ consumption, one 60hZ production.

REVISION FROM MA WEINAN:

Meter housing is located in the north outside wall of mechanical room and the drawings are revised in E105 ORGRANIZER PLAN and in A4 of E203 ORGANIZER ENCLOSURES SECTIONS

E201 ELECTRICAL DISTRIBUTION PLAN

REVIEW FROM Harold Willman:

The organizers will require space near your Panel Board to install the Organizer Enclosure which contains the PV Monitor and the IT Switch.

REVISION FROM MA WEINAN:

Organizer enclosure is located in the north inside wall of mechanical room and the drawings are revised in E105 ORGRANIZER PLAN and in A1 of E203 ORGANIZER ENCLOSURES SECTIONS.

E501 SCHEDULE

REVIEW FROM Harold Willman:

Refer to specifications

REVISION FROM MA WEINAN:

Please refer to E605 THREE-LINE DIAGRAM (DB)

E502 DATA SHEET

REVIEW FROM Harold Willman:

Review NEC Annex D Examples for dwelling unit load calculations.

REVISION FROM MA WEINAN:

The load calculation is finished. And the details can be reviewed in E502 DATA SHEET

E502 DATA SHEET

REVIEW FROM Harold Willman:

This information needs to be provided

REVISION FROM MA WEINAN:

The information is finished. And the details can be reviewed in E502 DATA SHEET.

E502 DATA SHEET

REVIEW FROM RUBUTT:

Clarify

REVISION FROM MA WEINAN:

The specification is renewed in E502 DATA SHEET

E601 ONE-LINE DIAGRAM

REVIEW FROM Harold Willman:

The one-line diagram shall include all electrical equipment, overcurrent protection, conduit and conductors sizes, and the grounding electrode system.

REVISION FROM MA WEINAN:

1. Electrical equipment and overcurrent protection are listed in E-601.
2. Conduit and conduct sizes are listed in accordance with IRC and the description of sizes follows the requirements of Chinese standard which satisfy the rules of IRC in E-601.
3. The grounding electrode system is listed briefly in E-601 and the details of system refer to E-104

E601 ONE-LINE DIAGRAM

REVIEW FROM Harold Willman:

Missing range and clothes dryer. NEC 220.19(A)(3), NEC 220.54, and NEC 220.55.

REVISION FROM MA WEINAN:

Clothes dryer circuit is WC4 in E-601.

Range circuit is WC5 in E-601.

E601 ONE-LINE DIAGRAM

REVIEW FROM Harold Willman:

Review NEC 210.11(C)(1)(2)(3) for the correct branch circuit sizing.

REVISION FROM MA WEINAN:

The wires 2.5mm<sup>2</sup> copper conducts are applied in the branch circuits of small appliance, laundry branch and bathroom and promise 32-ampere in accordance with NEC 210.11(C) (1)(2)(3).

E601 ONE-LINE DIAGRAM

REVIEW FROM RUBUTT:

Conductor sizes?

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REVISION FROM MA WEINAN:

The conductor sizes are provided by manufacture.

E601 ONE-LINE DIAGRAM

REVIEW FROM RUBUTT:

Organizers

REVISION FROM MA WEINAN:

It is connected to Team Meter and the drawing of E601 is revised.

E604 GRID INTETCONNECTION

REVIEW FROM RUBUTT:

Please clarify house service, utility source and PV source.

REVISION FROM MA WEINAN:

The drawing of E603 former is revised the drawing of E604 now.

House service, utility and PV source are marked in E604 GRID INTETCONNECTION

E604 GRID INTETCONNECTION

REVIEW FROM RUBUTT:

Neutral to ground bond?

REVISION FROM MA WEINAN:

The drawing of E603 former is revised the drawing of E604 now.

It is sure that Neutral is connected to ground bond?

**20110723**

**Architecture**

1. SECTION 26 51 00 Interior Lighting Fixtures, Lamps and Ballasts amended
2. SECTION 26 56 00 Exterior Lighting amended
3. SECTION 11 26 00 UNIT KITCHENS amended
4. SECTION 11 31 00 RESIDENTIAL KITCHEN APPLIANCEs amended

Try to find English specification as much as possible, if only see Chinese contents when you open PDF files, please look at the latter part.

**HVAC**

9. Add a code compliance (2009 IECC) analysis for the building in the end of this file. Please see attachment 5. Team China REScheckWebcompliancereport.
10. 7.2.2 Inverter(s) : One SUNNY BOY 8000-US inverteris installed in our system.
11. Add specification website of Section 9.YAMAHA EF6600E Generator
12. For B. 07 21 23.19 Mineral board Insulation you asked, VIPS are made of highly refined fiber glass.Details please see in the end of this file attachment 1. and 6. As fiber glass, which is flame retardant material, is the core material of VIP, VIP is consequentlyflame retardant and can reach Class B: Flame Spread 26-75;

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smoke-developed 0-450. According to GB/T 85296-2006 if VIP is covered with inorganic materials, like aluminum foil, VIP can reach Class A: Flame Spread 0-25; smoke-developed 0-450. The VIP we used is packaged and sealed with aluminum foil and protected by pearl wool, which is also flame retardant.

13. Specific product type information of knaufPolyfoam XPS board is added to Division 07, SECTION 07 21 00 Thermal Insulation, 1.2 SUBMITTALS, which is red highlighted.
14. In Division 07, SECTION 07 21 00 Thermal Insulation,2.1 MANUFACTURER, *A AMF China - AMF Mineralplatten GmbH* is replaced by *A. Knauf Insulation Ltd*. Fire performance data can also be found on the provided Web-links.
15. Add English version website of Fujian Super Tech Advanced Material Co., Ltd in SECTION 07 21 00 Thermal Insulation, PART 2-PRODUCTS
16. Details about water management issues please refer to Division 22 Plumbing, PART 3 – EXECUTION.
17. Add envelope constructions' pictures at the end of this file. It will be much more easier for you to know and comprehend the real construction of the envelope of Y-Box.
18. Add English versions of specifications of Daikin air-conditioning equipments. Please see the attached files: 1.ED71-613; 2. FHYB-F

### Structure

All pictures in part3 have been replaced with high resolution ones.  
Fixed an error of “Bamboo material” mention.

### Electrical engineering

1. SECTION 26 05 00 Common Work Results for Electrical  
Revision:  
The contents of Manufacturers and Products in Part 2 PRODUCTS are completed by person charging for fire alarm system with manufacturer’s specification.
2. SECTION 26 27 11 Electrical Metering  
Revision:  
Manufacturer’s instructions and instruction in Part 3 EXECUTION is added entirely.
3. SECTION 26 27 16 Electrical Cabinets and Enclosures  
Revision:  
The information of AISI 316L stainless-steel wall-mounting enclosures in Part 2 Products is omitted.  
Manufacturer’s instructions and instruction in Part 3 EXECUTION is added entirely.
4. SECTION 28 05 26 Grounding and Bonding for Electronic Safety and Security  
Manufacturer’s instructions and instruction in Part 3 EXECUTION is added entirely.
5. SECTION 28 20 00 Electronic Surveillance  
Revision:  
Section requirements in Part 1 GENERAL is added new information on Electronic Surveillance system function.  
The contents of Manufacturers and Products in Part 2 PRODUCTS are completed by person charging for fire alarm system with manufacturer’s specification.

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Manufacturer's instructions and instruction in Part 3 EXECUTION is added entirely.

6. SECTION 28 31 00 Fire Detection and Alarm

Revision:

Section requirements in Part 1 GENERAL is added new information on system function.

The contents of Manufacturers and Products in Part 2 PRODUCTS are completed by person charging for fire alarm system with manufacturer's specification.

Manufacturer's instructions and instruction in Part 3 EXECUTION is added entirely.

## 20110506

### Rules Compliance

Red font words in the rules compliance form have been revised

### Architecture

19. Add SECTION 10 22 26 OPERABLE PARTITIONS
20. Revised SECTION 11 26 00 UNIT KITCHENS
21. Revised SECTION 11 31 00 RESIDENTIAL KITCHEN APPLIANCES
22. Revised SECTION 12 60 00 Multiple Seating
23. Add SECTION 10 11 46 Wall Paper for Visual display fabrics
24. Revised 08 10 00
25. Revised 08 50 00
26. Revised 08 91 00

### Structure

1. Revised 3.1 Project Overview
2. Add 3.2.1 Design building code.
3. Add 3.2.2 Design Loads
4. Add 3.2.3 Material Parameter and Constant
5. Add 3.2.4 Y-container Modified Frame
6. Add 3.2.5 Construction Calculation
7. Add 3.2.6 Calculation Results of Inner Force and Sectional Checking
8. Add 3.2.7 The Uplift, Sliding, Overturning Forces Calculation
9. Revised 3.3 Specifications

### HVAC & Plumbing

1. Add Detailed water budget
2. Interconnection Application Form
3. Specifications for photovoltaic components
4. Energy Analysis Results and Discussion
5. Add Part 9, Generator Specification
6. SECTION 07 21 00 Thermal Insulation
7. SECTION 09 20 00 Phase Change Materials (PCMs)
8. SECTION 22 10 00 PLUMBING PIPING AND PUMPS, PART 3- EXECUTION
9. SECTION 48 14 00 Solar Energy Electrical Power Generation Equipment

- 
10. SECTION 48 19 00 Electrical Power Control Equipment
  11. Add several attachments in the end of the file.

**Electrical engineering**

1. Revised SECTION 25 14 19
2. Revised SECTION 25 30 00
3. Revised SECTION 25 35 16
4. Revised SECTION 25 37 00
5. Revised SECTION 26 05 00
6. Revised SECTION 26 20 00
7. Revised SECTION 26 24 00
8. Revised SECTION 26 27 11
9. Revised SECTION 26 27 16
10. Revised SECTION 26 27 26
11. Add SECTION 26 30 00
12. Revised SECTION 26 51 00
13. Add SECTION 26 56 00
14. Revised SECTION 27 13 43
15. Add SECTION 27 20 00
16. Revised SECTION 28 05 26
17. Add SECTION 28 31 00

**20110322**

1. Add Specifications about PV pane.
2. SECTION 08 10 00 08 50 00 Energate is updated to Silber.
3. SECTION 23 21 13 add contents.
4. SECTION 25 14 19 add contents.
5. SECTION 42 31 16 updated in part 3.

**20110103**

1. SECTION 42 31 16 Add contents.
2. SECTION 22 10 00 Add contents.
3. Interconnection Application Form revised 1-2
4. Energy Analysis Results and Discussion Revised 1-1
5. Detailed water budget revised 1-2

## 20101123

After the last Schematic Design Proposal delivered, the Tongji Solar Decathlon Team reviewed the draft rules and bearing several new ideas and possibilities in different aspects. Taking the architecture, market appeal and engineering into consideration, the optimization process causes a vast number of changes. The significant changes are listed as follows:

1. Add another three containers, and the total foot print area is 938 square feet.
2. Cancel the movable façade louvers and the movable thin film modules. Add some fixed wood louvers in the facade.
3. Change the form and the extent of the exterior deck. Therefore, the visit routes are changed.
4. Add the weather cap in the roof to optimize the ventilation.
5. Add detailed light design to optimize both the interior and exterior lumination.

### 2. Rules Compliance Checklist

RULE	RULE DESCRIPTION	LOCATION DESCRIPTION	LOCATION
Rule 4-2	Construction Equipment	Drawing(s) showing the assembly and disassembly sequences and the movement of heavy machinery on the competition site	O-101 to O-101E
Rule 4-2	Construction Equipment	Specifications for heavy machinery	01 54 00
Rule 4-3	Ground Penetration	Drawing(s) showing the locations and depths of all ground penetrations on the competition site	S-701,S-702,S-703
Rule 4-4	Impact on the Turf	Drawing(s) showing the location, contact area, and soil-bearing pressure of every component resting directly on the turf	Manual 3.2.6.4
Rule 4-5	Generators	Specifications for generators	Manual Part 9
Rule 4-6	Spill Containment	Drawing(s) showing the locations of all equipment, containers, and pipes that will contain liquids at any point during the event	22 10 00 part 3
Rule 4-6	Spill Containment	Specifications for all equipment, containers, and pipes that will contain fluids at any point during the event	22 10 00 part 3
Rule 4-7	Lot Conditions	Calculations showing that the structural design remains compliant even if 18 in. (45.7 cm) of vertical elevation change exists	C-101/S-701/S-702/S-703

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	C-501
Rule 5-2	Solar Envelope Dimensions	Drawing(s) showing the location of all house and site components relative to the solar envelope	A2/G-101,201
Rule 5-2	Solar Envelope Dimensions	List of solar envelope exemption requests accompanied by justifications and drawing references	NA
Rule 6-1	Structural Design Approval	List of, or marking on, all drawing and project manual sheets that have been or will be stamped by the qualified, licensed design professional in the stamped structural submission; the stamped submission shall consist entirely of sheets that also appear in the drawings and project manual	S-001/Manual 3.1
Rule 6-2	Finished Square Footage	Drawing(s) showing all information needed by the rules officials to measure the finished square footage electronically	A2/G-101
Rule 6-2	Finished Square Footage	Drawing(s) showing all movable components that may increase the finished square footage if operated during contest week	NA
Rule 6-3	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	A2/G-102
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	A1/L-101
Rule 7-2	Watering Restrictions	Drawing(s) showing the layout and operation of greywater irrigation systems	P-501,P-502
Rule 8-1	PV Technology Limitations	Specifications for photovoltaic components	Manual 7/E-602
Rule 8-3	Batteries	Drawing(s) showing the location(s) and quantity of all primary and secondary batteries and stand-alone, PV-powered devices	NA
Rule 8-3	Batteries	Specifications for all primary and secondary batteries and stand-alone, PV-powered devices	NA

Rule 8-4	Desiccant Systems	Drawing(s) describing the operation of the desiccant system	NA
Rule 8-4	Desiccant Systems	Specifications for desiccant system components	NA
Rule 8-5	Village Grid	Completed interconnection application form.	NA
Rule 8-5	Village Grid	Drawing(s) showing the locations of the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	E-105/E-101/ E-104
Rule 8-5	Village Grid	Specifications for the photovoltaics, inverter(s), terminal box, meter housing, service equipment, and grounding means	7.3.2/7.4/262726/ 262711/262000/ 262716/280526
Rule 8-5	Village Grid	One-line electrical diagram	A1/E-601
Rule 8-5	Village Grid	Calculation of service/feeder net computed load per NEC 220	E-502DATA SHEET
Rule 8-5	Village Grid	Site plan showing the house, decks, ramps, tour paths, and terminal box	G-102
Rule 8-5	Village Grid	Elevation(s) showing the meter housing, main utility disconnect, and other service equipment	A4/E-201/E-204/ E-203
Rule 9-1	Container Locations	Drawing(s) showing the location of all liquid containers relative to the finished square footage	P-102/P-501
Rule 9-1	Container Locations	Drawing(s) demonstrating that the primary supply water tank(s) is fully shaded from direct solar radiation between 9 a.m. and 5 p.m. EDT or between 8 a.m. and 4 p.m. solar time on October 1	G-601
Rule 9-2	Team-Provided Liquids	Quantity, specifications, and delivery date(s) of all team-provided liquids for irrigation, thermal mass, hydronic system pressure testing, and thermodynamic system operation	22 10 00
Rule 9-3	Greywater Reuse	Drawing(s) showing the layout and operation of greywater reuse systems	P-501/P-904
Rule	Rainwater Collection	Drawing(s) showing the layout and operation of	P-501/P-904

9-4		rainwater collection systems	
Rule 9-6	Thermal Mass	Drawing(s) showing the locations of liquid-based thermal mass systems	NA
Rule 9-6	Thermal Mass	Specifications for components of liquid-based thermal mass systems	NA
Rule 9-7	Greywater Heat Recovery	Drawing(s) showing the layout and operation of greywater heat recovery systems	NA
Rule 9-8	Water Delivery	Drawing(s) showing the complete sequence of water delivery and distribution events	P-101,P-102,P-501,P-502
Rule 9-8	Water Delivery	Specifications for the containers to which water will be delivered	22 10 00 part 3
Rule 9-9	Water Removal	Drawing(s) showing the complete sequence of water consolidation and removal events	P-501,P-502
Rule 9-9	Water Removal	Specifications for the containers from which water will be removed	23 30 00
Rule 11-4	Public Exhibit	Interior and exterior plans showing entire accessible tour route	G-102/G-103

### 3.Structural Calculation

#### 3.1 Project Overview

This project manual provided structural calculations and evaluation of atypical construction methods and loading conditions not covered in applicable building codes.

The objective of the structures group is to create a safe and sensible structural design that maximizes efficiency and minimizes the use of materials that require high energy during production.

The roofing system was designed to maximize its R-value, given deflection constraints for the additional loads of a green roof and height constraints during transportation.

High performance computer programs (ANSYS) were used to evaluate all feasible load combinations to find and design to the critical load scenario. Some programs were commercially available, but when necessary, members of the structures group wrote custom computer programs. The main reason for the use of programs as opposed to hand calculations was to provide the designers with flexibility throughout the process. Alterations are easy to implement and check.

#### 3.2 Structural Design Calculations

##### 3.2.1.Design Building Code

National Standard of The People's Republic of China

Load Code for the Design of Building Structures (GB 50009-2001)

- Code for Design of Steel Structures (GB 50017-2003)
- Code for Design of Timber Structures (GB 50005-2003)

The European Standard EN:

- EN 1990 Eurocode 0: Basis of Structural Design
- EN 1991 Eurocode 1: Actions on structures
- EN 1992 Eurocode 2: Design of concrete structures
- EN 1993 Eurocode 3: Design of steel structures
- EN 1995 Eurocode 5: Design of timber structures

Reference Building Code:

- Solar Decathlon Building Code 2011

### 3.2.2 Design Loads

1) Dead Load:

- The dead load is calculated by actual material condition.

2) Roof Design Loads:

- Roof Live Load = 0.958kPa (Roof Inaccessible)

3) Floor design Loads:

- a. The Indoor Floor Dead Load = 2.00 kPa
- b. Floor Live Load:
  - Livelihood Space : 2.5 kPa
  - Storage : 3.5 kPa

4) Wind Load:

When year  $n=10$  years, basic wind pressure  $\omega_0 = 0.4kPa$ .

Coefficient of wind pressure variation with height  $\mu_z = 1.0$ .

Gust response coefficient  $\beta_z = 1.0$ .

Shape coefficient of wind load is adopted by Load Code for the Design of Building Structures (GB 50009-2001)

5) Combination of load effects: (Coefficient of structure importance  $\gamma_0 = 0.9$ )

- ① 1.35 x 0.90 dead load + 1.50 x 0.90 live load
  - ② 1.35 x 0.90 dead load + 1.50 x 0.54 wind (X →)
  - ③ 1.35 x 0.90 dead load + 1.50 x 0.54wind (Y ↑)
  - ④ 1.35 x 0.90 dead load + 1.50 x 0.90 live load + 1.50 x 0.54 wind (X →)

- ⑤ 1.35 x 0.90 dead load + 1.50 x 0.90 live load + 1.50 x 0.54 wind (Y ↑)
- ⑥ 1.35 x 0.90 dead load + 1.50 x 0.63 live load + 1.50 x 0.90 wind (X →)
- ⑦ 1.35 x 0.90 dead load + 1.50 x 0.63 live load + 1.50 x 0.90 wind (Y ↑)

### 3.2.3 Material Parameter and Constant

The grades of structural steel material are as follows:

- Plates and bars Q345  $f_y = 310N/mm^2$

- Pipes Q345  $f_y = 310N/mm^2$

Anchor bolts and miscellaneous bolts 4.6:

$$f_t^b = 170N/mm^2; f_v^b = 140N/mm^2;$$

- High strength bolts 8.8:  $f_t^b = 400N/mm^2; f_v^b = 250N/mm^2;$

All structural steel materials should have well weldability and impulsive toughness.

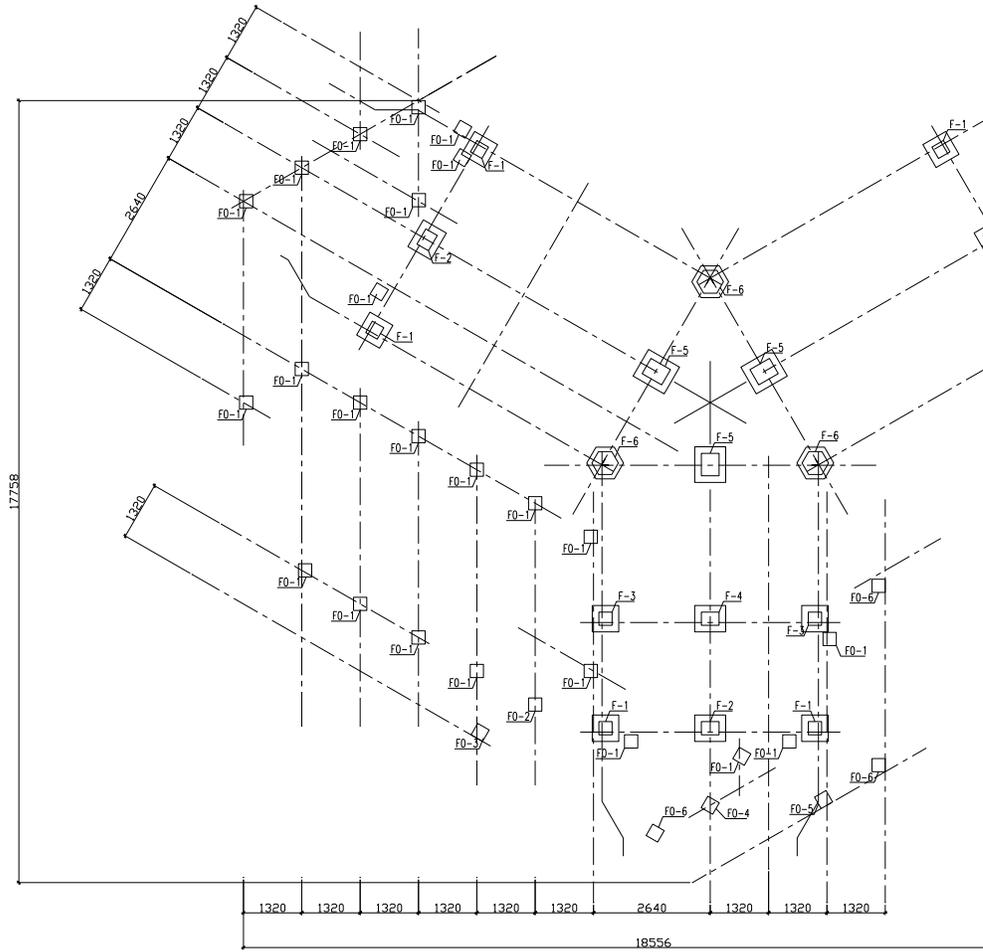
### 3.2.4 Y-container Modified Frame

1) Form of Structures:

① The whole structure adopts standard containers as the main load-bearing frame instead of traditional steel frame with the advantage of high construction efficiency. Some enhanced structure members are added, based on the original frame of standard containers. Since there is no special code for this kind of special structures up to now, we refer to some basic design specification in the design process, especially the design of enhanced structures.

② The form of Structures is post and beam construction, and the wall and roof adopt the profiled steel sheet; the foundation of the structure is individual foundation under column.

2) The plan of the modified structure is as follows:



1 FOUNDATION PLAN  
SCALE: 1:50

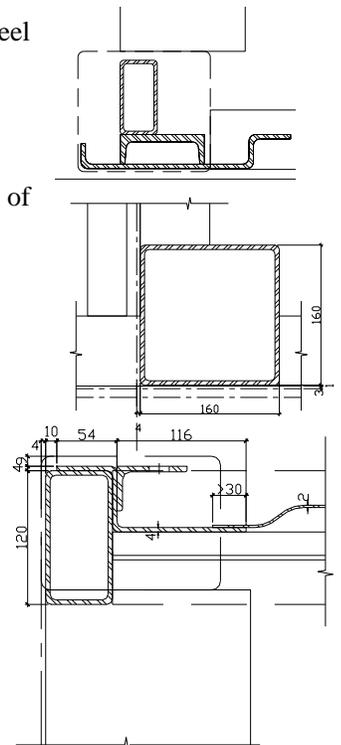
3) ① The columns which located farer to the triangle zone are modified as square steel tube of 100x50x4, which is shown as the right picture.

② The two columns which located in the middle of the container adopt the section of 160x160x4

③ The short beams of the container adopt the section of 120x120x4 , the section of which is shown as the right picture.

④ The long beams of the container adopt the section of 120x60x4 , which is shown as the right picture.

⑤ The other modified structure members are drawn in the structure general plan

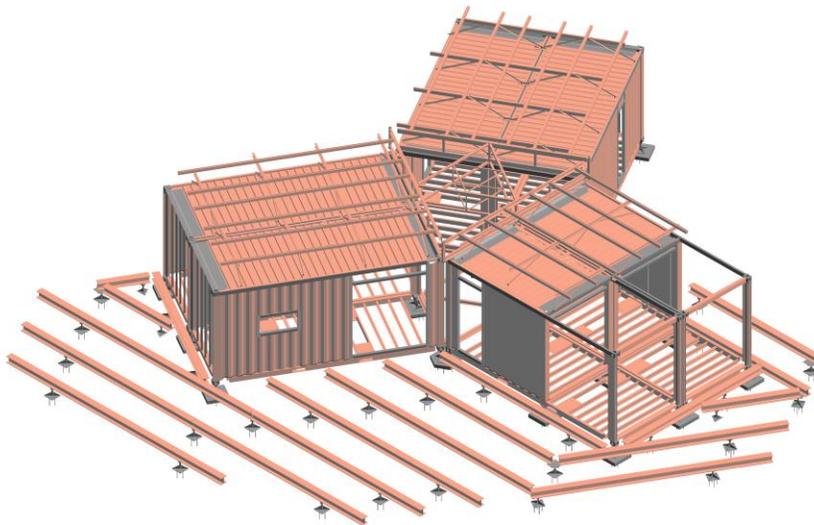


in details, such as the roof purlins, the wall beam and the individual foundation, which are not to be introduced one by one in the following.

- ⑥ The remaining structure adopts the original style of standard container, such as the roof, the wall, the floor beam and some columns which have been calculated to be safe by the engineer of standard container. Therefore, they are not given unnecessary details in the following.

### 3.2.5 Construction Calculation

As a result of the specific characteristic of the modified structure, hand computation is adopted based on the basic design specification instead of software computation.



The computation sequence is as follows:

- ① the roof zone : containing Basic Snow Load, Roof Live Load (Roof Inaccessible) and Roof Dead Load .
- ② suspended ceiling: the purlin with two types of section are arranged orthogonally ,in the middle of which is thermal insulation material.
- ③ beam: bearing the concentrated load of solar support structure and the purlins, and the uniformly distributed load of roof.
- ④ column: bearing the axial force from the beam ,the bending moment and shear force from the wall caused by the wind load.
- ⑤ individual foundation: bearing the axial force and shear force.

Note: the intensity and stability of the profiled steel sheet roof and wall as well as the inner floor are all checked by the standard of container manufacturer; the triangle zone structure and solar steel supporter are checked by the standard of solar panel manufacturer; the calculation of both will not be given unnecessary details.

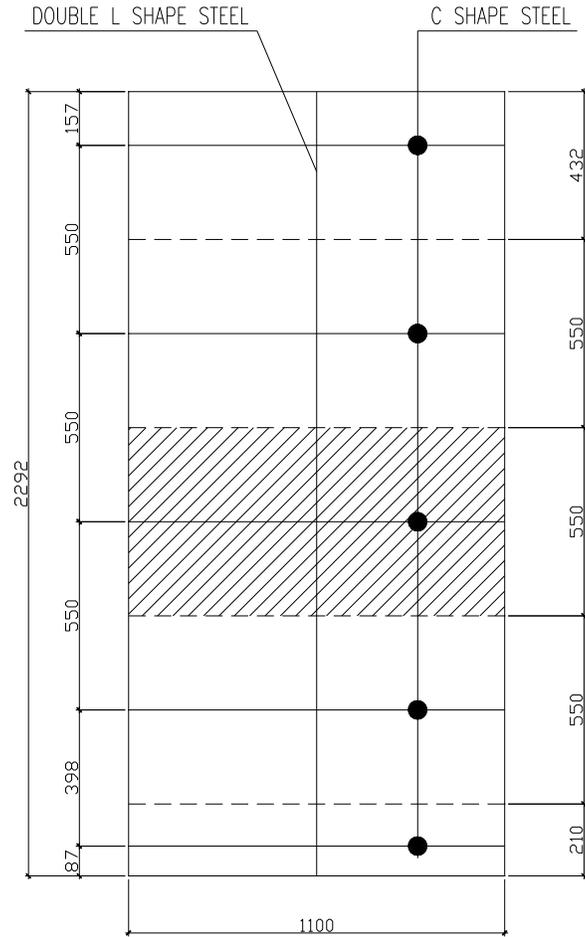
### 3.2.6 Calculation Results of Inner Force and Sectional Checking

#### 3.2.6.1 Checking of roof purlin

The suspended ceiling consists of purlins with two directions: the main purlin is fixed to the short length direction and the secondary purlin is fixed to the long length direction.

The section of main purlin is double L shape angle steel : 2L40×25×4

The section of secondary purlin is thin-walled cold-formed C shape steel:50×20×3;

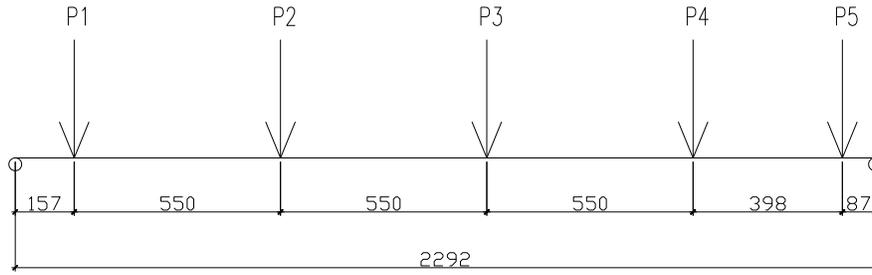


The calculation position is as above. The secondary purlin bear the load of heat insulating material of the shaded area , the weight of which is calculated in the following table:

Suspended ceiling	thickness(mm)	Density(kg/m <sup>2</sup> /mm)	Weight (N/m <sup>2</sup> )
VIP panal	20	0.15	29.40
Wood panal	12	0.45	52.92
PMMA	5	1.12	54.88
XPS panal	10	0.05	4.90
Total weight	Standard value		142.10
<b>Design dead load</b>	Design value		<b>172.65</b>

The checking of c shape steel purlin is same as the beam with two hinged joints bearing the distributed load

The checking of double L angle steel purlin is same as the beam with two hinged joints bearing the concentrated force of different position from the secondary purlins, the position plan is as follow:



Main purlin concentrated force checking	p1	p2	p3	p4	p5
Area width (mm)	432	550	550	550	210
p (N)	82.04	104.45	104.45	104.45	39.88
Bending moment (Nm)	34.45	110.02	128.14	88.81	18.78

The purlin strength checking is as follow:

Purlin checking	section	length(m)	W(mm <sup>3</sup> )	I(mm <sup>4</sup> )	Maximum bending moment(N m)	Maximum stress (N/mm <sup>2</sup> )
Main purlin	2L40X25X4	2.292	1260	23600	128.14	101.7
Secondary purlin	C50X20X3	1.1	397	5560	14.36	36.18

The maximum stress of table above is less than the  $f_y = 310N/mm^2$ , safe.

### 3.2.6.2 Calculation results of inner force of beam

6.2.1 the load condition:

Roof Live Load = 0.958kPa (Roof Inaccessible)

The concentrated force from the purlin 278N

The concentrated force from the solar supporter is as follow :

Concentrated force	Angle iron supporter L40x3	C shape steel 100x50x15x2.5	Solar panel area		Total weight	Design load
L (mm)	1355	1060	3.88	m <sup>2</sup>		
Weight unit length(N/m)	18.13	40.278	16.70	N/m <sup>2</sup>		
weight(N)	24.57	42.69	64.75		132.01	160.39

Note: the load condition is considered as the most dangerous situation to ensure the structure safe.

6.2.2 the strength checking:

item	Weight (N/m)	Area (mm <sup>2</sup> )	h (mm)	b (mm)	t (mm)	I(mm <sup>4</sup> )	W(mm <sup>3</sup> )	Maximum Bending Moment (Nm)	Shear force (N)
Long beam	103	1335	120	60	4	2407240	40120	5153.7	3403.3
Short beam	205	2669	120	120	4	4167339	69456	835.2	2740.0

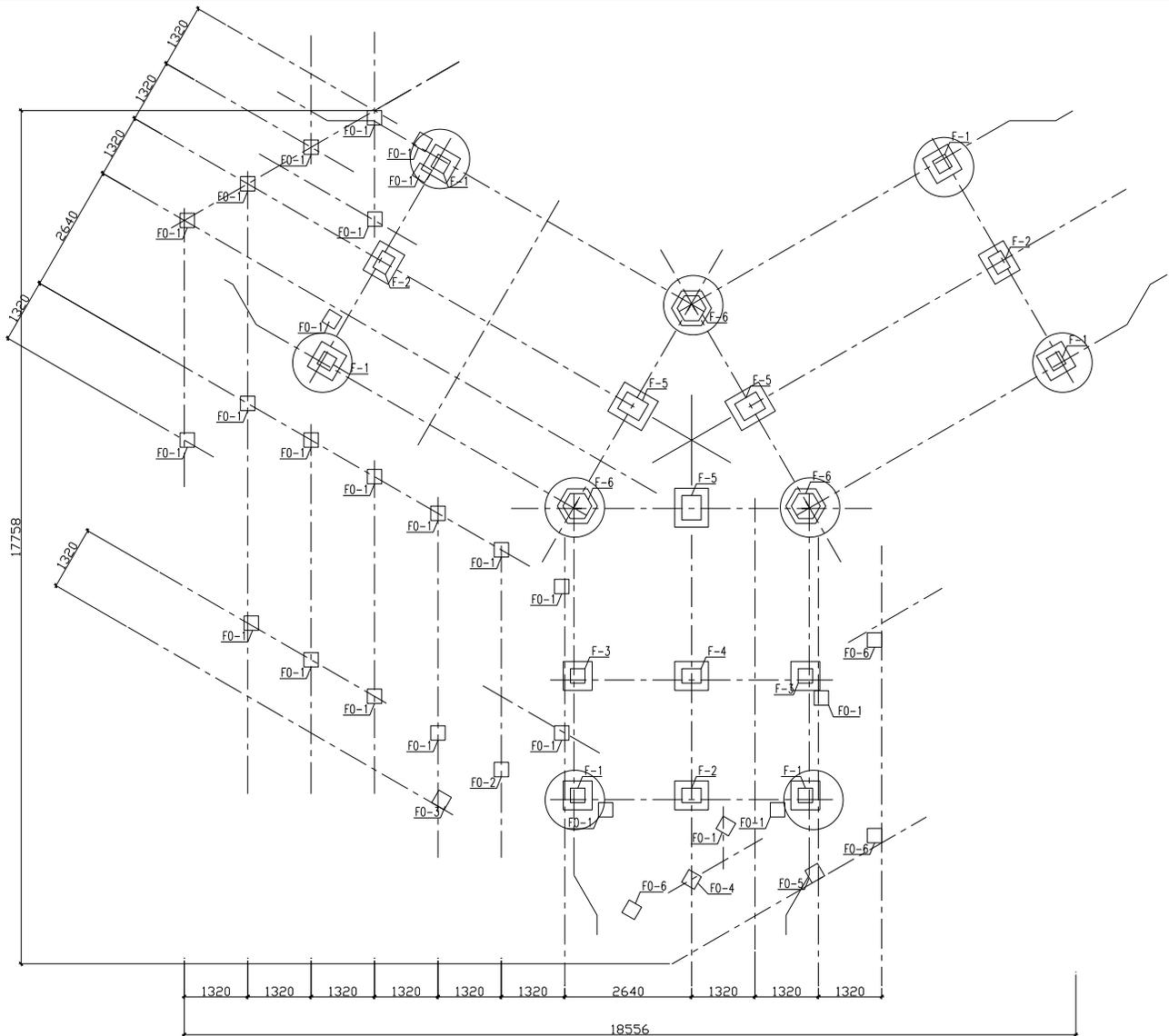
item	The maximum bending stress (N/mm <sup>2</sup> )	The maximum shear strength (N/mm <sup>2</sup> )
Long beam	128.5	4.7
Short beam	12.0	3.3

The maximum stress of table above is less than the  $f_y = 310N/mm^2$ , safe.

### 3.2.6.3 Calculation results of inner force of column

3.2.6.3.1 Location:

The original column of the standard container is not to be calculated because the checking has been done by the manufacturer. Therefore, this part focuses on the enhanced columns, the intensity and stability of which should be checked. The location of enhanced columns which are signed by circles is showed as follow:



1 FOUNDATION PLAN  
SCALE:1:50

### 3.2.6.3.2 Load condition:

The column bear the axial force from the beam, the bending moment and shear force from the wall caused by the wind load.

The axial force is 3071.6N

The distributed load on the column caused by the wind is show as below table:

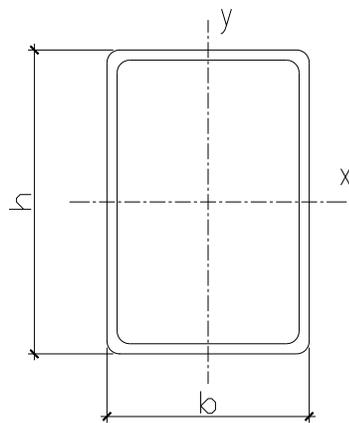
basic wind pressure (N/m <sup>2</sup> )	wind area y-y (m <sup>2</sup> )	wind area x-x (m <sup>2</sup> )
400	7.1	17.5

distributed load on the column (N/m)	487.6	1211.6
design distributed load (N/m)	395.0	981.4

3.2.6.3.3 intensity and stability checking:

The enhanced column with checking necessary is square steel tube with section of:100×50×4;

The geometric properties of cross-section is as follows:



$$I_x = 144\text{cm}^4; W_x = 28.83\text{cm}^3; i_x = 3.56\text{cm};$$

$$I_y = 47.37\text{cm}^4; W_y = 18.95\text{cm}^3; i_y = 1.85\text{cm};$$

$$A = 11.36\text{cm}^2;$$

The stress of the column is checked to be safe; the checking result is as below table:

Intensity checking	y-y	x-x
Bending moment (Nm)	414.1	1028.8
Axial force (N)	3071.6	3071.6
Maximum stress (N/mm <sup>2</sup> )	25.8	42.0

The maximum stress of table above is less than the  $f_y = 310\text{N/mm}^2$ , safe.

The stability of the enhanced column is checked to be safe; the checking result is as below table:

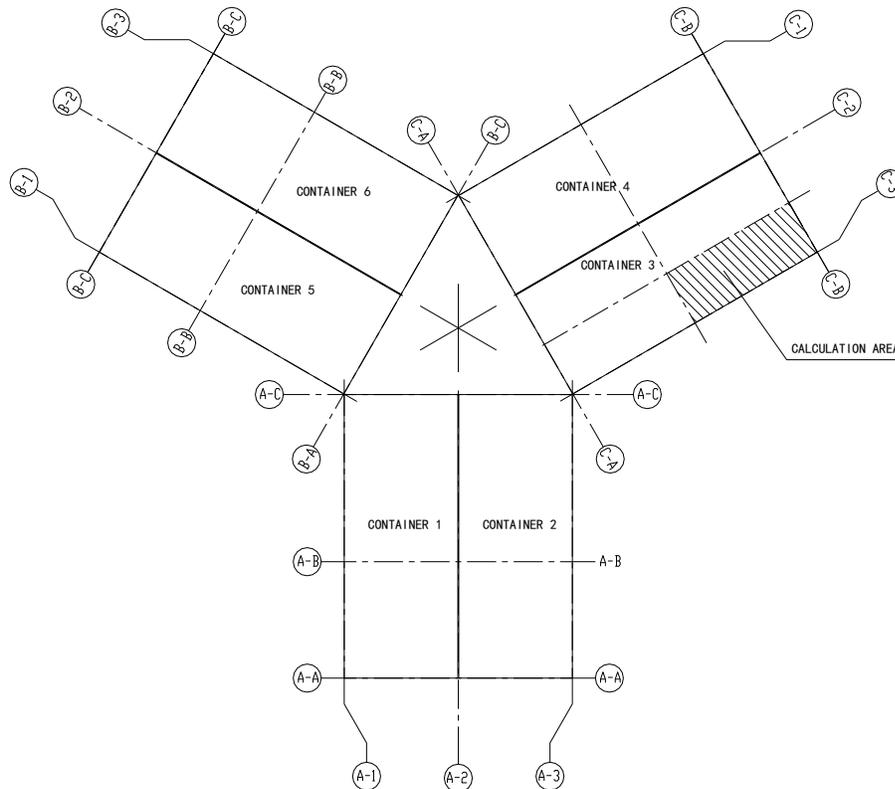
stability checking	axial compression stability factor $\varphi$	calculated slenderness ratio $\lambda'$	Slenderness ratio $\lambda$	effective length $L_0$ (m)	gyration radius $i$ (mm)	stability axial force $N_{crd}$ (kN)
x-x	0.77	66.52	57.91	2.03	35.00	238.17

y-y	0.46	114.92	100.05	2.03	20.26	143.15
-----	------	--------	--------	------	-------	--------

The stability axial force  $N_{crd}$  is more than the Axial force  $N=3.0716kN$  , so the enhanced columns meet the stability requirement.

### 3.2.6.4 Checking of soil pressrue

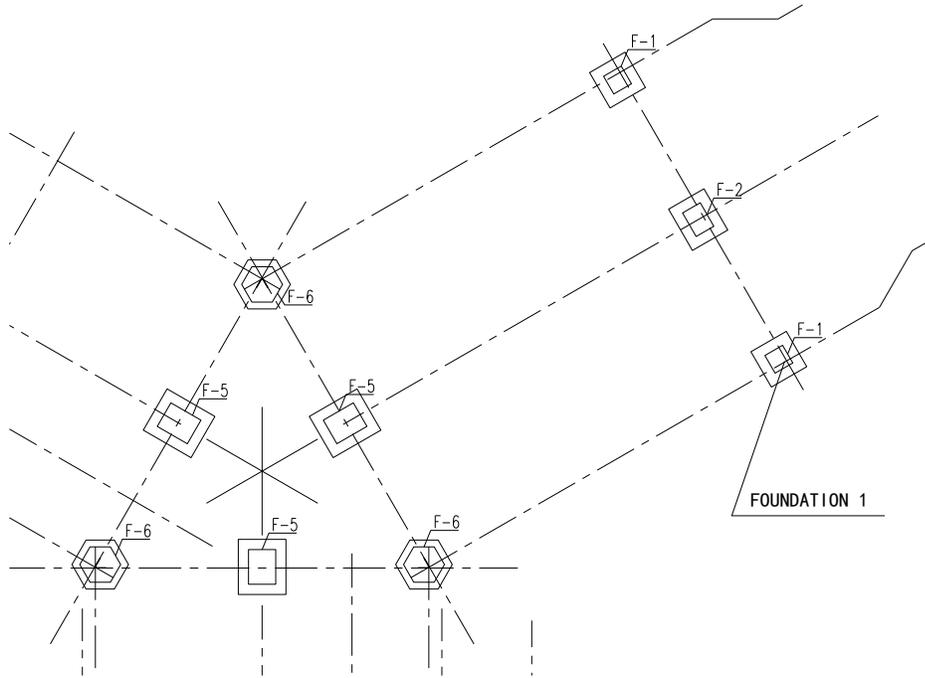
The calculation area is shown in the picture below. 1/4 of the container 3 is selected.



The corresponding load, about 1.185KN, is transferred to the foundation 1 shown in the picture below.

The connection area of the foundation 1 and soil is

$$A = 0.6 * 0.6 = 0.36m^2$$



The soil pressure is

$$f = \frac{F}{A} = \frac{11.85}{0.36} = 32.916kPa < 71.8kPa(1500psf)$$

Meet the checking requirements.

### 3.2.7 The Uplift, Sliding, Overturning Forces Calculation

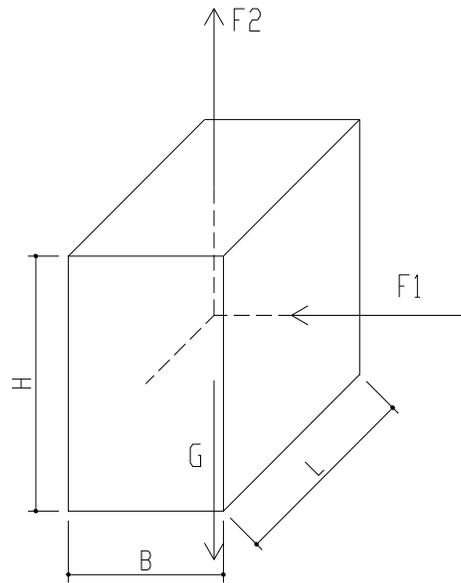
#### 3.2.7.1 The Uplift Forces Calculation

There is merely some differences between the transformed container structures and the original ones. What more, the removable wallboards in the site of openings would be installed when in hoisting and transportation. So the structure safety degree is no less than original ones. It is known that the design lifting load is 30t for the original containers, whose reliability is verified by numerous practice. The uplifting calculation of the transformed container is not necessary for only 4t.

#### 3.2.7.2 The Sliding and Overturning Forces Calculation

Wind speed for USA code	$v_{3s} =$	26.8	m/s		
Corresponding wind speed in China code	$v_{10min} =$	18.23129	m/s		
Basic Wind load	$\omega_0 =$	0.207738	$KN/m^2$		
Height variation factor of wind pressure	$\mu_z =$	1			
Shape factor for wind load	$\mu_s =$	0.8	0.5		

$\omega_k = \beta_z \mu_s \mu_z \omega_0 =$		0.16619	0.103869	3s wind speed)	
$\omega = 1.4 * 0.9 \omega_k =$		0.232666	0.145416	(10minutes wind speed)	
The container dimention for calculation model l*b*h	6.058	2.438	4		
Lateral wind load	$F_1 = \omega l h =$	5.637963	KN		
Upper wind load	$F_2 = \omega b =$	2.147712	KN		
Container weight					
Steel component	3000	kg			
Ceiling component	208.8	kg			
Floor component	256.2966	kg			
Wall component	687.936	kg			
Solar system	171.6948	kg			
Total weight per container	4324.727	kg			
G=	42.38233	KN			
<b>Sliding Calculation</b>					
Friction Coefficient	$\mu =$	0.2			
lateral force resisting capacity			Sliding load		
$\mu(G - F_2) =$	8.046924	KN	5.637963	KN	OK
<b>Overturning calculation</b>					
Resistansing moment			Overturnnging moment		
$Gb/2 =$	51.66406	$KN \bullet m$	13.89399	$KN \bullet m$	
			20.84098	$KN \bullet m$	OK



Wind load diagram

### 3.3 Specifications

#### 3.3.1 Deflection Criteria

Roof:  $L/360$

Floor:  $L/360$

#### Roof

The deflection is limited to  $L/360$  using the formula  $5wL^4/384EI$  and assuming composite action. Two spans are considered; 8ft and 12ft.

$w=11.67$  lbs/in

$L=96$  in ;  $144$  in

$E_{wood}=0.7 \times 10^6$  psi

$E_{foam}=2.0 \times 10^3$  psi (from physical testing)

#### Frames

Wood Members

Eastern white pine, #2

Green (wet)

## Connections

### Hardware:

1/4" Steel side plates

2 5/8" Shear plates

3/4" Bolts

### Edge distances:

Loaded edge: 2 3/4"

Unloaded edge: 1 3/4"

### End distances:

Loaded edge: 4"

Unloaded edge: 5"

### Spacing:

Load parallel to grain:

Parallel: 6 3/4"

Perpendicular: 3 1/2"

Load perpendicular to grain:

Parallel: 3 1/2"

Perpendicular: 4 1/4"

### Maximum Moments:

### Coefficients:

Coefficients are used in accordance with NDS 2005. Each load case was evaluated using the following duration factors:

Load Case 1 (D+S): 1.15

Load Case 2 (D+W): 1.60

Load Case 3 (D+S+W): 1.60

Load Case 4 (D+W): 1.60

Load Case 5 (D+S+W): 1.60

---

Load Case 6 (T+W): 2.00

Load Case 7 (T+W): 2.00

### **Shear Walls**

The south shear wall was designed as a shear collector for the southern face. The shear area for the south shear wall is small in comparison to the north, and governs the design. The north wall is to be constructed similar to the south.

Base shear,  $V=5$  kips

### **Floor Joists**

9 1/4" Openjoist with 2x3 flanges will be used to span the ~14' width. Floors will be designed to meet the more stringent criteria of the competition with an additional support at midspan that runs the length of the house and is installed on-site. The floors themselves will be designed for in-service loads at its permanent location, as per ASCE-07 loading criteria, to span the entire width. This will allow for the most efficient use of insulation in the floor depth while constricting height for transportation needs. It will also provide an increased flexibility for future building owners.

Open joists will be utilized for the floor system. Selection is shown in the following span table, provided by Universal Forest Products.

The use of water storage in the floor system necessitates the use of 50 psf Live Load. 16" O.C. spacing has been selected for fabrication speed, however 19.2" O.C. is acceptable.

### **Decking**

Decking: Black Locust

5/4 x 6 wide face

Decking Support: Southern Pine No. 2

2x8 Joists @ 16" O.C. Selection 1 (5 ft span)

2x10 Joists @ 16" O.C. Selection 2 (7 ft span)

2x10 Girders (5 ft span)

### **Foundations**

Maximum Allowable Soil Bearing Pressure: 1500 psf (SD2009 Building Code 6.2)

Maximum Pad Load: 5500 lbs

Maximum Soil Bearing Pressure: 1475 psf

Minimum Pad Load: 320 lbs

## Jacks

The maximum point load to the jacks is 5500 lbs.

## Pads

Allowable load on the soil of the National Mall in Washington D.C. is 1500 lb/ft<sup>2</sup>. The maximum point load to the pads is 5500 lbs. The footing area required is 3.667 ft<sup>2</sup>. The footings will be square and must have a minimum length per side of 1.915 ft. In the event of circular footings, the minimum diameter is 2.161 ft.

## Deck Posts

All deck posts to be 4x4 pressure treated lumber, connected to the girders using AC4SS Post Caps by Simpson Strong-Tie for the edges and ACE4SS Post Caps by Simpson Strong-Tie for the corners. The posts shall connect to horizontally laid 6x6 pressure treated lumber pads using A23 Angles by Simpson Strong-Tie, two per 4x4 post. Lengths of 4x4 posts to be cut on-site according to grade changes. Lengths of 6x6 pads shall be cut according to the table in Appendix F.3.

## **4. Detailed water budget**

### **Summary**

Tongji University has calculated the amount of water required during the competition by studying competition requirement and other relative instructions about water quantity. The result of the study has also determined the size of a hot water tank, which is majorly heated by solar energy. According to the result, we have estimated that a total of 1480 gallons of clean potable water will be required for the competition. All water can be contained by various containers including supply water tank, wet land (also a metal tank), two water modules (two metal tanks) and two hot water tanks. Besides, two tanks i.e. grey water tank and black water will be used to collect contaminated water of different quality. Supply water tank, grey water tank and black water tank will be located beneath the north building deck. Wet land and two water modules locate on site. And two thermal tanks are put in equipment room.

In accordance with the competition requirements and outline stated in the official Solar Decathlon Rules, the detailed plan is shown below:

### **Detailed water budget:**

FUNCTION	(GALLONS)	GAL	EVENTS	NOTES
Hot Water Draws	256	16	16	Mixed hot water and cold water
Water Vaporization	3	0.75	4	Must vaporize 5 lbs but must begin with 6 lbs
Dishwasher	20	2.5	8	Provided by manufacture's instruction
Clothes Washer	52.8	6.6	8	Provided by manufacture's instruction
Fire Protection	185	185	1	7 minute flow assumption at 40 gallons per minute, one head. Drawn from common
Thermal Storage Tanks For Domestic Hot Water	65	65	1	Initially filled
Thermal Storage Tanks For Radiant Floor	80	80	1	Initially filled
Testing	160	20	8	20 gallons per day during 8 days of assembly
Solar Thermal Collectors	10	10	1	Initial fill of solar thermal collectors
Aesthetic Purpose	600	600	1	Initially filled. Irrigation included
Safety Factor	51.4			
<b>WATER REQUIRED</b>	<b>1483.2</b>	gallons		

## 5. Summary of Reconfigurable Features

Apart from the changes of the competition prototype, the Y CONTAINER itself features several kinds of reconfigurable features. During the course of public and jury tours, team members will demonstrate multiple reconfigurable features of the Y CONTAINER. Each has been outlined below.

### Sliding Partition

The Y CONTAINER features a manually operated sliding partition in the bedroom. The sliding partition significant changes the separations of house. When all the partitions slide to the sides, and the beds are folded to the wall, the bedroom is just a big space connect the center triangle public space. When they slide as the walls, the double room is divided into to separate rooms. During personalized and jury tours, a decathlete will show this kind of change.

### Murphy Beds

The Y CONTAINER features manually operated Murphy Beds that is constructed as part of the bedroom wall. During jury tours, a decathlete will lower and raise the bed to demonstrate the flexibility of the space to the jury. During the public tours, only show this kind of alteration to the personalized tour, and otherwise just show it in the multimedia inside the room. As to the Movie Night during the contest week, both the beds are folded which spares a vacant room for enjoying the attractive movie.

### Variable Furniture

Part of the chairs and the cabinets are made of the triangular modules being in accordance with the form of the exterior deck, the roof windows and skylights. The combination of the chairs makes up of a cabinet, and in reverse the cabinet goes to the chairs. The numbers of chair are decided by the needs and the space of the house. During personalized and jury tours, a decathlete will show this kind of change.

**6. Interconnection Application Form**

Team China and Lot 113

PV Systems

Module Manufacturer	Short Description of Array	DC Rating of Array (sum of the DC ratings)
SANYO	10 pieces of PV panels form an array	2.2 kW
SANYO	10 pieces of PV panels form an array	2.2 kW
SANYO	10 pieces of PV panels form an array	2.2 kW
SANYO	10 pieces of PV panels form an array	2.2 kW

Total DC power of all arrays is 8.8 kW (in tenths)

INVERTERS

Inverter Manufacturer	Model Number	Voltage	Rating (kVA or KW)	Quantity
SMA	SUNNY BOY 8000-US	270 V	10	1

Total AC power of all inverters is 10 kVA or kW (in whole numbers)

The following information must be included in the project manual or construction documents. If located in the construction documents, list the drawing locations in this section of the project manual. (Example: B3/E-201)

1. One-Line Electrical schematic – the loads do not have to be detailed. **E-502**
2. Calculations of service/feeder net computer load and neutral load (NCE 220). **E-602**
3. Plan view of the lot showing the house, decks, ramps, tour paths, the service point and the distribution panel or load center. **G-102**

2. Calculations of service/feeder net computer load and neutral load (NCE 220) for Y-Box house

The Y House has a floor area of 880 ft<sup>2</sup>, exclusive of open porches. It has two 20-A small appliance circuits, one 20-A laundry circuit, one 5.0-kW counter-mounted cooking unit, a 3.2-kW water heater, a 2.3-kW dishwasher, a 5-kW combination clothes washer and dryer, and a 6-kW air-conditioning units. Assume counter-mounted cooking unit and dryer kW ratings equivalent to kVA ratings in accordance with NEC 220.54 and NEC 220.55.

**Calculation for Y House**

The Y House has a floor area of 880 ft<sup>2</sup>, exclusive of open porches. It has two 20-A small appliance circuits, one 20-A laundry circuit, one 5.0-kW counter-mounted cooking unit, a 3.2-kW water heater, a 2.3-kW dishwasher, a

5-kW combination clothes washer and dryer, and a 6-kW air-conditioning units. Assume counter-mounted cooking unit and dryer kW ratings equivalent to kVA ratings in accordance with NEC 220.54 and NEC 220.55.

### Calculated Load

**General Lighting Load:**  $880 \text{ ft}^2 \text{ at } 3 \text{ VA per ft}^2 = 2,640 \text{ VA}$

### Minimum Number of Branch Circuits Required

**General Lighting Load:**  $2,640 \text{ VA} \div 220 \text{ V} = 12 \text{ A}$

This requires one 15-A, 2-wire circuits.

Small-Appliance Load: Two 2-wire, 20-A circuits.

Laundry Load: One 2-wire, 20-A circuit.

Bathroom Branch Circuit: One 2-wire, 20-A circuit (no additional load calculation is required for this circuit).

### Minimum Size Feeder Required

General Lighting		2,640VA
Small Appliance		3,000VA
Laundry		1,500VA
One Cooking Unit		4,300VA
Water Heater		3,200VA
Dishwasher		2,300VA
Washer/Dryer		4,700VA
	Total general load	21,640VA
First 10kVA at 100%		10,000VA
Remainder at 40%		
(11.64kVA x 40%)		4,656VA
	Subtotal general load	14,656VA
Air Conditioning		6,000VA
	Total	20,656VA

### Calculated Load for Service

$20,656 \text{ VA} \div 220 \text{ V} = 93.9 \text{ A}$  (service rating)

### Feeder Neutral Load, per NEC 220.61

General Lighting		2,640VA
Three 20-A at 1500VA		4,500VA
	Subtotal	7,140VA
3,000VA at 100%		3,000VA
7,140VA-3,000VA=4,140VA at 35%		1,449VA
	Subtotal	4,449VA
Cooking Unit: 4,000VA at 70% for neutral load		2,100VA
Washer/Dryer: 5,000VA at 70% for neutral load		3,500VA
Dishwasher		2,300VA
	Total	12,349VA

### Calculated Load for Neutral

$$12,349 \text{ VA} \div 220 \text{ V} = 56.1 \text{ A}$$

## 7. Specifications for photovoltaic components

Photovoltaic system consists of 6 parts, which are PV array (PV panels), Module Supporter, Junction Box, surge protective device boxes, Inverter and cables for connecting.

Ten pieces of PV panels form an array. There are four arrays and two surge protective devices in our PV system. Two arrays converge to one surge protective device. The DC from two surge protective device boxes respectively flow into two inverters.

PV panels are installed only on two roofs. Each module's size is 798mm×1580mm, with capacity rating of 220Wp and module efficiency of 17.4 %. PV covered area is 56.5 m<sup>2</sup> on roofs. The total installed capacity is about 8.8 kW.

**Some important information is listed below :**

### 7.1. The Design Criteria of Photovoltaic System

CE marked according to the following ED directives and standards: The US 2008 National Electrical Code

EMC directive EN6 1000-6-1:2000 and EN6 1000-6-3/A11:2004. Low voltage directive EN50178:1997 and EN60529/A 1:2000

## 7.2. The design and specifications of the components

### 7.2.1 Photovoltaic generator(s) : SANYO HIT Power 220A Solar Panel



## HIT<sup>®</sup> Power 220A

Module Efficiency: 17.4%  
Cell Efficiency: 19.8%  
Power Output - 220Watts



**HIT<sup>®</sup> Power**  
Photovoltaic Module

#### High Efficiency

HIT<sup>®</sup> Power solar panels are leaders in sunlight conversion efficiency. Obtain maximum power within a fixed amount of space. Save money using fewer system attachments and racking materials, and reduce costs by spending less time installing per watt. HIT Power models are ideal for grid-connected solar systems, areas with performance based incentives, and renewable energy credits.

#### Power Guarantee

SANYO's power ratings for HIT Power panels guarantee customers receive 100% of the nameplate rated power (or more) at the time of purchase, enabling owners to generate more kWh per rated watt, quicker investments returns, and help realize complete customer satisfaction.

#### Temperature Performance

As temperatures rise, HIT Power solar panels produce 10% or more electricity (kWh) than conventional crystalline silicon solar panels at the same temperature.

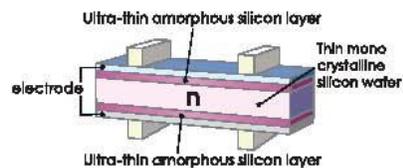
#### Valuable Features

The packing density of the panels reduces transportation, fuel, and storage costs per installed watt.

#### American Made Quality

SANYO silicon wafers located inside HIT solar panels are made in California and Oregon, and the panels are assembled in an ISO 9001 (quality), 14001 (environment), and 18001 (safety) certified factory. Unique eco-packing minimizes cardboard waste at the job site. The panels have a Limited 20-Year Power Output and 5-Year Product Workmanship Warranty.

#### SANYO HIT<sup>®</sup> Solar Cell Structure



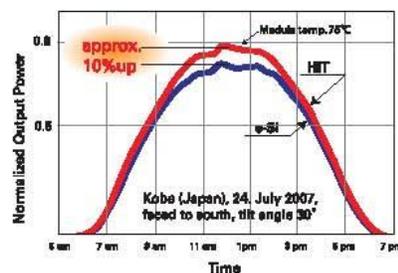
#### SANYO'S Proprietary Technology

HIT solar cells are hybrids of mono crystalline silicon surrounded by ultra-thin amorphous silicon layers, and are available solely from SANYO.

#### Unnecessary Section When Using SANYO



#### Increased Performance with SANYO



## HIT Power 220A

### Electrical Specifications

Model	HIT Power 220A or HIT-N220A01
Rated Power (P <sub>max</sub> ) <sup>1</sup>	220 W
Maximum Power Voltage (V <sub>mp</sub> )	42.7 V
Maximum Power Current (I <sub>mp</sub> )	5.17 A
Open Circuit Voltage (V <sub>oc</sub> )	52.3 V
Short Circuit Current (I <sub>sc</sub> )	5.65 A
Temperature Coefficient (P <sub>max</sub> )	-0.336%/°C
Temperature Coefficient (V <sub>oc</sub> )	-0.145 V/°C
Temperature Coefficient (I <sub>sc</sub> )	1.98 mA/°C
NOCT	114.8°F (46°C)
CEC PTC Rating	204.4 W
Cell Efficiency	19.8%
Module Efficiency	17.4%
Watts per Ft. <sup>2</sup>	16.22 W
Maximum System Voltage	600 V
Series Fuse Rating	15 A
Warranted Tolerance (-/+)	-0% / +10%

### Mechanical Specifications

Internal Bypass Diodes	3 Bypass Diodes
Module Area	13.56 Ft <sup>2</sup> (1.26m <sup>2</sup> )
Weight	35.3 Lbs. (16kg)
Dimensions LxWxH	62.2x31.4x1.8 in. (1580x798x46 mm)
Cable Length +Male/-Female	46.45/40.55 in. (1180/1030 mm)
Cable Size / Type	No. 12 AWG / PV Cable
Connector Type <sup>3</sup>	Multi-Contact <sup>®</sup> Type IV (MC4 <sup>™</sup> )
Static Wind / Snow Load	60PSF (2880Pa) / 39PSF (1867Pa)
Pallet Dimensions LxWxH	63.2x32x72.8 in. (1607x815x1850 mm)
Quantity per Pallet / Pallet Weight	34 pcs./1234.5 Lbs (560 kg)
Quantity per 53' Trailer	952 pcs.

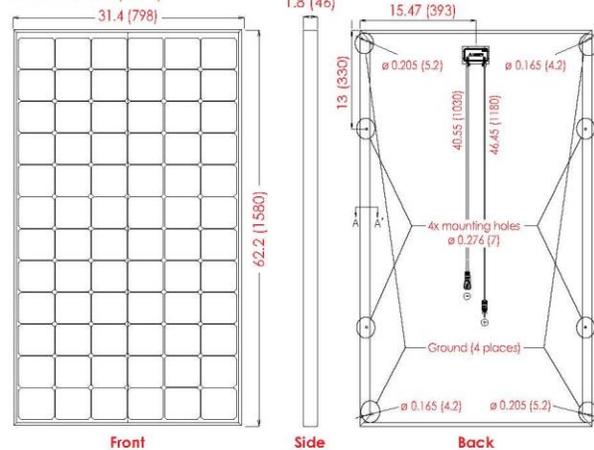
### Operating Conditions & Safety Ratings

Ambient Operating Temperature <sup>2</sup>	-4°F to 115°F (-20°C to 46°C)
Hail Safety Impact Velocity	1" hailstone (25mm) at 62 mph (23m/s)
Fire Safety Classification	Class C
Safety & Rating Certifications	UL 1703, cUL, CEC
Limited Warranty	5 Years Workmanship, 20 Years Power Output

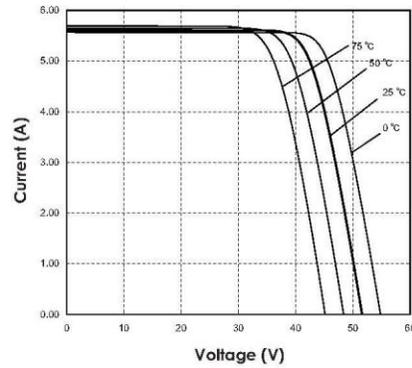
<sup>1</sup> STC: Cell temp. 25°C, AM1.5, 1000W/m<sup>2</sup> <sup>2</sup> Monthly average low and high of the installation site.  
Note: Specifications and information above may change without notice.  
All modules connected in the solar array should be of the same model number.  
<sup>3</sup> Safety locking clip (PV-SSH4) is not supplied with the module.

### Dimensions

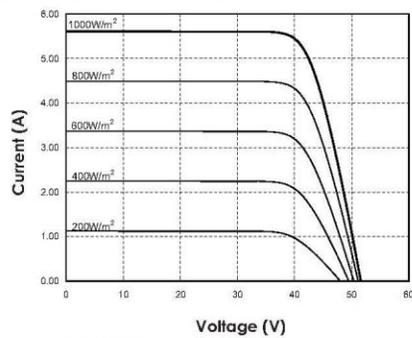
Unit: inches (mm)



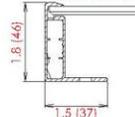
### Dependence on Temperature



### Dependence on Irradiance



### Section A-A'



HIT<sup>®</sup> is a registered trademark of SANYO Electric Co., Ltd.  
The name "HIT<sup>®</sup>" comes from "Heterojunction with intrinsic Thin-layer" which is an original technology of SANYO Electric Co., Ltd.



Read the operating instructions carefully before use of these products

# SANYO

SANYO North America  
Energy System Solutions Division

550 S. Winchester Blvd., Suite 510  
San Jose, CA 95128, U.S.A.  
www.sanyo.com/solar  
solar@sec.sanyo.com

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**7.2.2 Inverter(s) : One SUNNY BOY 8000-US inverter is installed in our system.**



<b>UL Certified</b> <ul style="list-style-type: none"><li>• For countries that require UL certification (UL 1741/IEEE 1547)</li></ul>	<b>Efficient</b> <ul style="list-style-type: none"><li>• 97% peak efficiency</li><li>• OptiCool™ active temperature management system</li></ul>	<b>Safe</b> <ul style="list-style-type: none"><li>• Galvanic isolation</li></ul>	<b>Simple</b> <ul style="list-style-type: none"><li>• Patented automatic grid voltage detection*</li><li>• Integrated DC disconnect switch</li></ul>
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## SUNNY BOY 5000-US / 6000-US / 7000-US / 8000-US

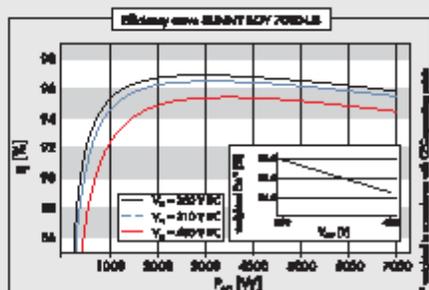
Versatile performer with UL certification

The Sunny Boy 5000 US, 6000 US, 7000 US and 8000 US inverters are UL certified and feature excellent efficiency. Graduated power classes provide flexibility in system design. Automatic grid voltage detection\* and an integrated DC disconnect switch simplify installation, ensuring safety as well as saving time. These models feature galvanic isolation and can be used with all types of modules: crystalline as well as thin film.

\* US Patent US7352549B1

Inverters with transformers

Technical data	Sunny Boy 5000-US			Sunny Boy 6000-US			Sunny Boy 7000-US			Sunny Boy 8000-US	
	208V AC	240V AC	277V AC	208V AC	240V AC	277V AC	208V AC	240V AC	277V AC	240V AC	277V AC
<b>Input (DC)</b>											
Max. recommended PV power (4 module STC)	6250 W			7500 W			8750 W			10000 W	
Max. DC power (M cos φ = 1)	5300 W			6320 W			7400 W			8600 W	
Max. DC voltage	600 V			600 V			600 V			600 V	
DC nominal voltage	310 V			310 V			310 V			345 V	
MPP voltage range	250 V - 480 V			250 V - 480 V			250 V - 480 V			300 V - 480 V	
Min. DC voltage / start voltage	250 V / 300 V			250 V / 300 V			250 V / 300 V			300 V / 365 V	
Max. input current / per string (at DC disconnect)	21 A / 20 A			25 A / 20 A			30 A / 20 A			30 A / 20 A	
Number of MPP trackers / fused strings per MPP tracker	30 A @ combined terminal			30 A @ combined terminal			30 A @ combined terminal			30 A @ combined terminal	
Output (AC)	1 / 4 (DC disconnect)										
AC nominal power	5000 W			6000 W			7000 W			7680 W / 8000 W	
Max. AC apparent power	5000 VA			6000 VA			7000 VA			8000 VA	
Nominal AC voltage / adjustable	208V / #	240V / #	277V / #	208V / #	240V / #	277V / #	208V / #	240V / #	277V / #	240V / #	277V / #
AC voltage range	100-220V	211-264V	244-305V	100-220V	211-264V	244-305V	100-220V	211-264V	244-305V	211-264V	244-305V
AC grid frequency range	60 Hz; 59.3 - 60.5 Hz			60 Hz; 59.3 - 60.5 Hz			60 Hz; 59.3 - 60.5 Hz			60 Hz; 59.3 - 60.5 Hz	
Max. output current	24 A	21 A	18 A	29 A	25 A	22 A	34 A	29 A	25 A	32 A	
Power factor (cos φ)	1										
Phase conduction / connection phases	1/2	1/2	1/1	1/2	1/2	1/1	1/2	1/2	1/1	1/2	1/1
Harmonics	< 4%										
<b>Efficiency</b>											
Max. efficiency	96.7%	96.8%	96.8%	96.9%	96.8%	97.0%	97.1%	96.9%	97.0%	96.9%	96.9%
CEC efficiency	95.5%	95.5%	95.5%	95.5%	95.5%	96.0%	95.5%	96.0%	96.0%	96.0%	96.0%
<b>Protection devices</b>											
DC reverse polarity protection	●			●			●			●	
AC short circuit protection	●			●			●			●	
Ground fault isolated / all-pole sensitive monitoring unit	●/-			●/-			●/-			●/-	
Protection class / overvoltage category	I/II			I/III			I/III			I/II	
<b>General data</b>											
Dimensions (W / H / D) in mm (in)	470 / 615 / 240 (18.5 / 24 / 9)										
DC Disconnect dimensions (W / H / D) in mm (in)	187 / 297 / 190 (7 / 12 / 7.5)										
Packing dimensions (W / H / D) in mm (in)	390 / 580 / 800 (16 / 23 / 31.5)										
DC Disconnect packing dimensions (W / H / D) in mm (in)	370 / 240 / 280 (15 / 9 / 11)										
Weight / DC Disconnect weight	64 kg (141 lb) / 3.5 kg (8 lb)										
Packing weight / DC Disconnect packing weight	67 kg (147 lb) / 4 kg (9 lb)										
Operating temperature range (full power)	-25 °C ... +45 °C (-13 °F ... +113 °F)										
Noise emission (typical)	44 dB(A)			45 dB(A)			46 dB(A)			49 dB(A)	
Instand consumption at night	0.1 W			0.1 W			0.1 W			0.1 W	
Topology	UF transformer			UF transformer			UF transformer			UF transformer	
Cooling concept	OptiCool			OptiCool			OptiCool			OptiCool	
Electronic protection rating / connection area	NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R			NEMA 3R / NEMA 3R	
<b>Features</b>											
Display: text line / graphic	●/-			●/-			●/-			●/-	
Interface: RS485 / Bluetooth	o/o			o/o			o/o			o/o	
Warranty: 10 / 15 / 20 years	●/o/o			●/o/o			●/o/o			●/o/o	
Certificates and permits (more available on request)	UL1741, UL1998, IEEE 1547, FCC Part 15 (Class A & B), CSA C22.2 No.										07.1-2001
NOTE: US inverter ship with gray lid.											
Data at nominal conditions											
● Standard feature    ○ Optional feature    - Not available											
Type designation	SB 5000US			SB 6000US			SB 7000US			SB 8000US	



Accessories

- RS-485 interface cable (RS-485) SWACHR
- Bluetooth module (Bluetooth) SWACHR
- Combi Switch (DC disconnect and PV array combiner box) CC/AC/DC/SW/CH
- Combiner box (Specify wiring for add-on connection and of any SW/CH/3R or SW/CH/4)

### 7.2.3 Batteries (not used): Batteries are not used due to the following 6 reasons:

- i .It depends on the way how PV system connects with the utility grid. Tongji Team's inverters connect directly with the utility grid. Therefore only if the utility grid works normally, the inverters can work well. If the utility grid is out of work due to some reasons, the inverters will stop working too. Then island effect takes place. It can protect the inverters and it is safer.
- ii .No small secondary battery independently connects with inverter. SUNNY BOY 8000-US inverter doesn't support such interface to small secondary battery.
- iii .Inverter itself needs current to maintain its operation. And it needs starting current from the grid.
- iv .The PV system can produce a little bit more energy than consumption. What's more, extra energy generated by PV panels can flow into the utility grid. Referring to practical project, there is no need to add rechargeable battery bank to PV system for the storage of extra electrical energy.
- v .Battery bank is normally bulky and harmful to the environment.
- vi .The 2011 SD Organization will keep the grid in villa solar working steadily. Therefore the inverters can always work normally if they are properly connected with the utility grid.

There we decided not to use rechargeable battery bank.

### 7.2.4 Cables and wiring methods

Connection between components, wiring  $4\text{mm}^2$ , output of PV panel, Maximum current 5.17A

SPD box to inverter, wiring  $4\text{mm}^2$ , Maximum current  $2 \times 5.17\text{A}$

For details please refer to TONG\_CD plan# E-602

### 7.2.5 Protection:

#### Protection measures for PVsystem:

#### 1 ) Protection against electric shock:

If all the connected nodes are insulated, there will be no electric leakage left.

Before DC side of the inverter, each switch control off the road. After the inverter, AC side can be cut off by the switch. In this way, each operation circuit can be safely protected.

#### 2 ) Protection against direct and indirect contact:

The connection wiring in the PV system is double insulated solar wire called YONGBEN, which has the TÜV certification. These Wires has a feature of resistance to ozone, ultraviolet radiation, water vapor.

---

Open circuit voltage of PV array is  $52.3 \times 10 = 523$  Voltage. The insulation voltage rating of wire selected is 1000V, which is much greater than open circuit voltage.

### 3) Fault protection:

#### ★The protection of AC side:

- In the DC diode anti- charge blocking diode would be connected.
- SPD box can protect against overvoltage and surge protection

SUNNY BOY 8000-US single-phase inverter offers protection features including over/under voltage and frequency safeguards. Its anti-islanding protection prevents the inverter from feeding power to the grid in the event of a utility outage. The photovoltaic system can automatically reconnect to the utility system whenever the voltage and frequency have recovered to within the specified ranges.

Most error or fault conditions will be identified by fault message screens on the SUNNY BOY 8000-US inverter front panel LCD. Most of these fault conditions are self-correcting and require no user action to remedy.

#### ★Protection against overload on the DC side:

In the photovoltaic system, the DC wires from the photovoltaic panels to the SPD box will be protected by the fuse in the SPD boxes. Four surge protective devices are also installed in that box. There is a series of diodes, which can guarantee the right direction of DC.

On DC side, YONGBEN cable with special insulation can prevent electrical shock as is double insulated. Maximum current of PV panel is 5.17A. YONGBEN cable can withstand four times the maximum current of PV panel. Overload is protected by fuses that comply with IEC269 and JB4011.

#### ★Protection against short-circuit currents:

The photovoltaic system has short circuit protection. If the voltage exceeds the upper limit of operating ranges, the SUNNY BOY 8000-US inverter will automatically shut down.

The next protection is the fuse in the inverters. The AC wires from the inverter to the low voltage distribution box will be protected by MCCB (It is located inside the low voltage distribution box).

MCCB has the function of protection against overload and short circuit and under voltage. It complies with standard of IEC60947-2.

Each branch has an automatic residual current device.

**★Protection against electromagnetic interference in the house:**

Electromagnetic interference takes place behind the back of inverters.

**★Selection and erection of electrical equipments**

PV panels and wiring cables belong to class II insulation product.

**★The standards of the PV modules:**

IEC 61215-2005 Crystalline silicon terrestrial photovoltaic (PV) modules –Design qualification and type

IEC61730 Photovoltaic (PV) module safety qualification.

**7.2.6 Operational conditions and external influences**

- Voltage compatibility among the PV strings、 PV array、 PV generator and inverter.

**7.2.7 Accessibility**

PV modules are installed only on two roofs. Junction boxes in mechanical room can effectively protect against lightning strike. Inverter is also installed in the mechanical room. For details please refer to construction drawings E-602.

**7.2.8 Wiring system**

**Selection and erection in relation to external influences**

**1) Cables:**

- DC cables (PV string cables, PV array cables and PV DC main cables) are all YONGBEN cables. The connection form of DC junction box with internal wiring: using YONGBEN special connector plugs.
- YONGBEN cables are composed by tinned conductor , insulation and sheath, which obtain TÜV certification and comply with international standard. Cable has the following features: anti-ozone, UV, water vapor, oil-resistance, antibiosis, antimicrobial, Chemical resistant, resistance to cutting, tearing and crack extension. Cables' ambient temperature is from -40 °C to 110 °C .Excellent flexibility can be maintained even in low temperature.

**2) Product standard:**

Structure size of conductor and insulating layer are designed referring to IEC60245-2 in 1.9/1.10/1.11 ;

References of electrical properties are IEC60245-2 in 2.1/2.2/2.4;

Physical and mechanical properties of insulating standard are IEC60881-1-1 and IEC60881-1-2;

Physical and mechanical properties of sheath standard are IEC60881-1-1 and IEC60881-1-2;

Internal protection components and wiring: each array is equipped with diode to prevent the reverse charge of PV modules.

The protection device is SPD box, which will protect the PV system. SPD box and all components shall be accordant with the related standards. The SPD box shall be maintenance free. SPD is designed to interface with the electrical assembly via conductors, which is forbidden to touch the components inside.

### **7.2.9 Isolation, switching and control**

#### **Isolation and switching:**

- Means of isolating the PV inverter from the DC side and AC side.
- Warning labels will be placed on all junction boxes

### **7.2.10 Earthing system**

The photovoltaic system includes fuse boxes, which comply with IEC269.

The voltage of DC side is not earthed. The black metal frame of Photovoltaic panels, inverters and the low voltage distribution box are earthed (TT system).

### **7.2.11 Interface with the electricity distribution network**

Electricity from PV panels is transmitted to the low-voltage electrical cabinet after being changed into alternating current. The electricity generated by PV panels will preferably meet the demand of the house's consumption. If it is overloaded, the Y-box house can draw electricity from the city's utility grid, otherwise the surplus electricity will be transmitted into the utility grid.

## **7.3. Maintenance plan**

### **7.3.1 Photovoltaic modules**

Routine maintenance is required every six months. However it is advisable to take periodic inspection of the panels for damage to glass, back-skin, frame, junction box or external electrical connections.

Check electrical connections if any connection is loose and corroded.

Please always wear rubber insulating gloves during maintaining, washing or cleaning panels.

### **7.3.2 Inverter(s) :**

To reduce the risk of electrical shock, disconnect both AC and DC circuits from the SMA SUNNY BOY 8000-US Inverter before attempting any maintenance or cleaning or working on any circuits, which are still connected to the inverters. The action of turning off power switches will not reduce this risk. Internal

capacitors will still be charged up to 30 minutes, when all power sources are shut down.

Keep the heat sink clean from dust and debris.

Do not use a pressure washer to clean the SMA SUNNY BOY 8000-US Inverter.

### **7.3.3 Cables and wiring methods :**

Periodically inspect the system to make sure that all wiring and supports are securely in place.

### **7.3.4 Protections and earthing system**

Please refer to CD plan # E-104

### **7.3.5 Supporting structure**

Please refer to CD plan # S103, S201,S202, S301,S611

## **7.4. Inverter(s) certificates**

The photovoltaic system uses one SMA SUNNY BOY 8000-US inverter. The SUNNY BOY 8000-US single-phase inverter has the safety degree of IP54. Its operation temperature is from -25°C to 45°C. Its compact and modular design makes the installation easier.

The SUNNY BOY 8000-US single-phase inverter has protection features of over/under voltage and frequency safeguards. Its anti-islanding protection prevents the inverter from transmitting electricity to the utility grid in case of a utility outage. It contains a standard two line Liquid Crystal Display with a backlit 16-character, which can provides variety of important information .It has an inverter shut off and reset toggle switch.

The SUNNY BOY 8000-US inverter can adjust disconnect settings. Voltage and frequency disconnect and islanding protection are essential safety features that ensure no person working on the grid is harmed by a distributed energy source. Default software settings are programmed into each SUNNY BOY 8000-US Inverter at the factory to ensure it does not island according to relevant safety regulations (VDE 0126, RD 1663/2000, and with section 10 of Annex XI of RD 661/2007).

In some cases it may be demanded to adjust these default settings. For example, the SUNNY BOY 8000-US Inverter may experience nuisance trips (taking the inverter offline) if the grid is weak and the voltage falls outside the allowable range specified in the regulations.

Inverters comply with CE.

#### 7.4.1 Inverters (certificate compliance with the requirements stated for grid interconnection)

For our inverter, SUNNY BOY 8000-US inverter is selected, because its maximum AC apparent Power Output is 8000W and its nominal AC Power Output is 7680W, with nominal AC voltage 240, AC voltage range 211~264Vac and nominal AC frequency 60Hz;59.3~60.5 Hz. The Max. recommended PV power (@ module STC) input is 10000W. The Max. DC power input (@ $\cos\phi=1$ ) is 8600W. The Max. DC voltage input is 600V. Its MPP voltage range is 300 to 480Vdc. Peak inverter efficiency is 96.3%. Additionally, it has 5 year parts and labor (10 year extended warranty available).

#### 7.4.2 PV array

##### Electrical Specifications

Model	HIT Power 220A or HIT-N220A01
Rated Power (Pmax) <sup>1</sup>	220 W
Maximum Power Voltage (Vpm)	42.7 V
Maximum Power Current (Ipm)	5.17 A
Open Circuit Voltage (Voc)	52.3 V
Short Circuit Current (Isc)	5.65 A
Temperature Coefficient (Pmax)	-0.336%/ °C
Temperature Coefficient (Voc)	-0.145 V/ °C
Temperature Coefficient (Isc)	1.98 mA/ °C
NOCT	114.8°F (46°C)
CEC PTC Rating	204.4 W
Cell Efficiency	19.8%
Module Efficiency	17.4%
Watts per Ft. <sup>2</sup>	16.22 W
Maximum System Voltage	600 V
Series Fuse Rating	15 A
Warranted Tolerance (-/+)	-0% / +10%

Table 7.1 Electrical Specifications of HIT Power 220A

## Operating Conditions & Safety Ratings

Ambient Operating Temperature <sup>2</sup>	-4°F to 115°F (-20°C to 46°C)
Hail Safety Impact Velocity	1" hailstone (25mm) at 52 mph (23m/s)
Fire Safety Classification	Class C
Safety & Rating Certifications	UL 1703, cUL, CEC
Limited Warranty	5 Years Workmanship, 20 Years Power Output
<sup>1</sup> STC: Cell temp. 25°C, AM1.5, 1000W/m <sup>2</sup> <sup>2</sup> Monthly average low and high of the installation site. Note: Specifications and information above may change without notice. All modules connected in the solar array should be of the same model number. <sup>3</sup> Safety locking clip (PV-SSH4) is not supplied with the module.	

Table 7.2 Operating Conditions & Safety Rating of HIT Power 220A

Type	Model	Pmax/ W	Voc/ V	Isc/ A	Vpm/ V	Ipm/ A	Voltage temperature coefficient V/°C	Current temperature coefficient mA/°C	Weight/ kg
Hybrids of mono crystalline and ultra-thin amorphous silicon	SANYO HIT POWER 220A	220	52.3	5.65	42.7	5.17	-0.145	1.98	16

Table 7.3 Components Parameters

- a. The connection of PV array:  
Serial Number: 10 , Parallel number: 4
- b. The total number of module and the HIT solar cells output rated power: 8.8kw
- c. The type of module: Hybrids of mono crystalline silicon surrounded by ultra-thin amorphous silicon layers
- d. Module serial number × Monolithic Module Output Voltage
- e. The output power of single module: 220Wp
- f. The attenuation of transfer efficiency in a decade: 90%
- g. Certification of the solar panel: UL 1703, cUL, CEC
- h. Ambient operating temperature of HIT Power 220A panel is: -20°C ~ 46°C

At cold weather condition: (-20°C)

$$V_{pm}=42.7 - (-0.145) \times (25+20) = 49.225 \text{ (V)}$$

10 PV panels are series connected and its max. Power Voltage at -20°C reaches  $10V_{pm}=492.25 \text{ (V)}$ . While Max. DC voltage of SMA SUNNY BOY 8000-US inverter is 600 (V). As a result the upper limit of inverter  $V_{peak}$  is bigger than  $10V_{pm}$  at -20°C.

Technical data	Sunny Boy 8000-US	
	240 V AC	277 V AC
<b>Input (DC)</b>		
Max. recommended PV power (@ module STC)	10000 W	
Max. DC power (@ $\cos \varphi = 1$ )	8600 W	
Max. DC voltage	600 V	
DC nominal voltage	345 V	
MPP voltage range	300 V - 480 V	
Min. DC voltage / start voltage	300 V / 365 V	
Max. input current / per string (at DC disconnect)	30 A / 20 A 36 A @ combined terminal	
Number of MPP trackers / fused strings per MPP tracker		
<b>Output (AC)</b>		
AC nominal power	7680 W	8000 W
Max. AC apparent power	8000 VA	
Nominal AC voltage / adjustable	240V / ●	277V / ●
AC voltage range	211 - 264 V	244 - 305 V
AC grid frequency; range	60 Hz; 59.3 - 60.5 Hz	
Max. output current	32 A	
Power factor ( $\cos \varphi$ )	1	
Phase conductors / connection phases	1 / 2	1 / 1

## 7.5 Design of the roof's photovoltaic system

### 7.5.1 Design of the photovoltaic panels installed on the roof

The design temperature range will be  $T_{min} = -20 \text{ }^\circ\text{C}$  (253 K) and  $T_{max} = 46 \text{ }^\circ\text{C}$  (319 K). On the roof of Team China's Solar Decathlon 2011 house SANYO HIT Power 220A solar-panels will be installed. For their specifications see the specification sheet included. The panel's voltage range within the MPP (Maximum Power Point) as well as its maximum open circuit voltage and maximum short circuit current can be

calculated using the following equations and the given design temperature range. The temperature coefficient of the voltage would be referred to as  $c_v$  and the temperature coefficient of the current would be referred to as  $c_I$ .

$$V_{mp}(T) = c_v V(T - T_{STC}) + V_{mp,STC}$$

$$V_{oc}(T) = c_v V(T - T_{STC}) + V_{oc,STC}$$

$$I_{sc}(T) = c_I (T - T_{STC}) + I_{sc,STC}$$

Where  $T_{STC} = 25\text{ }^\circ\text{C}$  (298 K) would be the temperature under Standard Test Conditions (STC). Thus for the SANYO HIT Power 220A the following results will occur.

$$V_{mp,max} = V_{mp}(T = 253\text{ K}) = 49.225\text{ V}$$

$$V_{mp,min} = V_{mp}(T = 319\text{ K}) = 39.655\text{ V}$$

$$V_{oc,max} = V_{oc}(T = 253\text{ K}) = 58.825\text{ V}$$

$$I_{sc,max} = I_{sc}(T = 319\text{ K}) = 5.692\text{ A}$$

#### 7.5.1.1 Northwest roof configuration

On the Northwest side of the roof two strings with 10 solar panels each will be installed. They will deliver a maximum dc power of  $P_{dc,max} = 4.4\text{ kW}$ . This configuration will lead to the following string voltage range, maximum open circuit voltage and maximum dc current output.

$$V_{str,mp,max} = 10V_{mp,max} = 492.25\text{ V}$$

$$V_{str,mp,min} = 10V_{mp,min} = 396.55\text{ V}$$

$$V_{str,oc,max} = 10V_{oc,max} = 588.25\text{ V}$$

$$I_{dc,max} = 2I_{sc,max} = 11.384\text{ A}$$

Max. DC voltage of SMA SUNNY BOY 8000-US inverter is 600 (V) and its max. DC power (@ $\cos\phi=1$ ) is 8600 W.

As an inverter the SMA Sunny Boy 8000-US will be used to meet this configuration. For its specifications see the specification sheet included. Since the voltage range for MPP-Tracking, the maximum input dc voltage and maximum input dc current won't be exceeded, the system should work properly under the given temperature conditions.

#### 7.5.1.2 Northeast roof configuration

On the northeast side of the roof the same configuration of 2 strings with 10 solar panels each will be used and thus the same inverter will be installed and should work properly as well.

## 7.5.2 Wiring of the roof's photovoltaic configuration

In general copper wire having a sectional area of  $ACU = 4 \text{ mm}^2$  will be used for the connection of the strings to the inverter as well as for the interconnection between the solar panels.

### 7.5.2.1 Northwest and northeast roof wiring

A total of 8 dc wires are necessary to connect the inverter of the northwest and the northeast roof to the 2 northwest and 2 northeast roof solar panel strings. The maximum length of each wire should not exceed  $l_{\max} = 20 \text{ m}$ . Since the specific resistivity of the wires would be  $\rho = 1.81 \times 10^{-8} \Omega\text{m}$ , the overall resistance of one wire could be calculated as follows.

$$R_{CU} = 0.09 \quad \Omega$$

For additional information on the installed dc wires see the specification sheet included. The following maximum current will flow through the dc wire of each string, while each string will provide a maximum dc power of  $P_{dc,\max} = 2.2 \text{ kW}$ .

$$I_{dc,\max} = \frac{P_{dc,\max}}{V_{str,mp,\max}} = 4.54 \text{ A}$$

Thus the voltage drop and power loss on one wire would be:

$$\Delta V = I_{dc,\max} R_{CU} = 0.4 \text{ V}$$

$$P_{loss} = \Delta V I_{dc,\max} = 1.86 \text{ W}$$

For the northwest and the northeast roof configuration together this would lead to a power loss of

$$P_{loss,northwest,northeast} = 8P_{loss} = 14.88 \text{ W}$$

which would be an acceptable range.

### 7.5.2.2 Design of the dc wire dimensions

In general copper wire having a sectional area of  $ACU = 4 \text{ mm}^2$  (similar to an AWG 12 wire) will be used for the connection of the strings to the inverters as well as for the interconnection between the solar panels on the roof. The maximum current for such a wire would be  $I_{\max} = 32 \text{ A}$  in air at a temperature of  $T = 30 \text{ }^\circ\text{C}$ . As the conduit might be exposed to sunlight, an ambient temperature of  $T = 60 \text{ }^\circ\text{C}$  has to be taken into account. This

reduces the maximum current to  $I = 20 \text{ A}$ . Since the current flowing in the dc wires of the roof photovoltaic system doesn't exceed this value it should meet our configuration. Thus the parallel connection will be made in a shaded place near the inverters where the ambient temperature is less than  $T = 40 \text{ }^\circ\text{C}$ . **Please note that PV string  $I_{sc}$  is only 5.65 (A).**

AC inverter output conductor calculations:

$$I_{\max} = 8000 \text{ (W)} \div 240 \text{ (V)} = 33.33 \text{ (A)};$$

We choose to use copper conduct with a cross-sectional area of  $10 \text{ mm}^2$ .

## 8. Energy Analysis Results & Discussion

### 8.1 Executive Summary

In Y container three main technologies make the energy system flexible and adaptable under different circumstances. That is HVAC assisted solar thermal and floor heating system, Phase change materials and Vacuum insulation panels in wall, natural ventilation system etc.

Firstly, the HVAC system with heat recovery and solar thermal collector system and floor heating system are designed to be integrated. A part of waste condensing heat can be used to heat the sanitary water. So it can cool the space and supply the hot sanitary water simultaneously. At the same time, solar thermal system will constantly store heat for floor heating system only when domestic hot water demand is met. If the weather is not good, the multi-function HVAC system can run automatically to be an assisted heat source. If there is no need for space cooling, the HVAC system will become an air source heat pump concentrating on supplying hot sanitary water.

Secondly, super insulation materials (vacuum insulation materials-VIP) and phase change materials (PCM) are applied in building enclosures. VIP will block heat transfer very significantly and will enlarge interior space because of its thinness compared with traditional insulation materials. With the same heat transfer coefficient VIP is 5 to 6 times thinner than normal insulation materials. On the other hand, PCM will shift the peak cooling load and moderate the inner temperature passively.

Thirdly, natural ventilation tunnel in the middle of the house can regulate the inner air distribution and supply fresh air without energy consumption. PCM and copperplates are implemented as heat storage and heat absorber materials in the ventilation tunnel. At daytime the copperplates absorb the heat from sunshine and PCM store part the heat. When hot press in the vacuum is high enough, natural ventilation will start to work accordingly. At night PCM will release heat to warm the vacuum and realize natural ventilation. In a word, without any energy consumption effective natural ventilation will be achieved.

## 8.2 Mechanical

### 8.2.1 Introduction

In this section we describe the thermal analysis of Y Container and the mechanical systems we have designed to condition the house.

We begin by defining the design markets and briefly summarizing the predicted loads, and then described the actual system design. We conclude by discussing our thermal analysis in more detail, and its implications the design process.

### 8.2.2 Supplementary Material – Detailed Component Models

From the onset of the Container House project computer simulations have been used to assess the performance of the building and its components. This has continued overtime on an iterative basis as the design is being refined. The team has used several computer-modeling tools such as EnergyPlus, Homer and DesignBuilder to assess the performance of different aspects of the design. Where possible, an integrated model of the house was used. The following sections describe the engineering team’s modeling efforts and provide justifications for the chosen design.

#### MODEL SETUP

Figure 8.1 shows the initial geometry of the Y Container, as per the preliminary design.

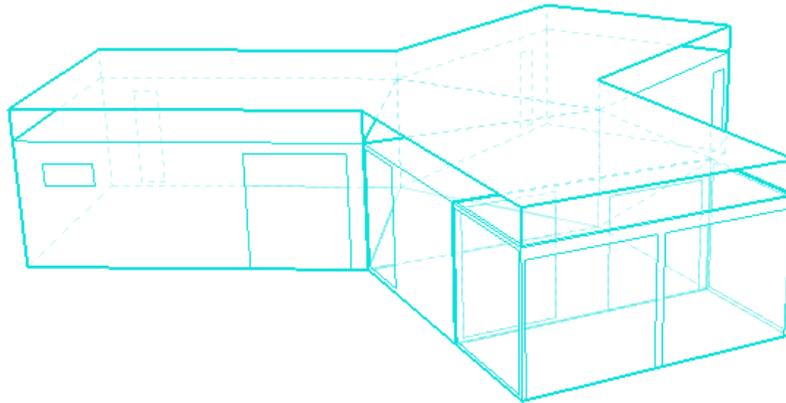


Figure 8.1. The Y Container

#### Climate:

The climate file chosen is a Washington D.C CTMY file. CTMY files contain hourly weather observations representing an artificial one-year period specifically designed for building energy calculations. CTMY hourly files represent weather conditions that result in approximately average heating and cooling loads in buildings.

#### Construction:

Table8.1. Container House Envelope Components

Construction	U-value	Composition
Walls	0.1	PVC, EPS, Plaster, Hip-board, Keel block, VIP, PCM
Windows	0.77	Heat-treated glass, SHGC=0.5
Floor	0.35	Wood floor, VIP, Keel block, Hip-board
Roof	0.28	VIP, EPS, PVC, Plaster

#### Heating / Cooling Control:

An accurate assessment of the heating/cooling energy consumption requires that the indoor space be conditioned to appropriate comfort levels during the simulation. The control scheme used in all simulations is based on a basic heating/cooling controller keeping the indoor air temperature between 20 °C and 25 °C.

**Occupancy:**

The simulations assume that two occupants are in the house at all times.

**8.2.3 Building Simulation and Loads**

The thermal loads of the building were modeled using EnergyPlus engine. Greater discussion of these simulations is offered in Section 8.2.5, but the basic parameters of the simulation for the present house design are summarized in Table 8.2.

Table 8.2. The Predicted Load

Heating Load(W)		Cooling Load(W)	
01/21 01:00:00	1213.81	07/21 01:00:00	34.47
01/21 02:00:00	1217.26	07/21 02:00:00	23.49
01/21 03:00:00	1218.89	07/21 03:00:00	15.67
01/21 04:00:00	1219.72	07/21 04:00:00	9.67
01/21 05:00:00	1220.16	07/21 05:00:00	4.88
01/21 06:00:00	1220.39	07/21 06:00:00	9.99
01/21 07:00:00	1278.68	07/21 07:00:00	32.19
01/21 08:00:00	1297.60	07/21 08:00:00	136.03
01/21 09:00:00	1376.86	07/21 09:00:00	376.30
01/21 10:00:00	1382.97	07/21 10:00:00	811.89
01/21 11:00:00	1385.86	07/21 11:00:00	1173.82
01/21 12:00:00	1350.41	07/21 12:00:00	1423.43
01/21 13:00:00	862.48	07/21 13:00:00	2237.50
01/21 14:00:00	952.16	07/21 14:00:00	2469.97
01/21 15:00:00	956.77	07/21 15:00:00	2451.26
01/21 16:00:00	1189.38	07/21 16:00:00	2249.66
01/21 17:00:00	1345.56	07/21 17:00:00	2054.80
01/21 18:00:00	1322.92	07/21 18:00:00	1775.81
01/21 19:00:00	788.78	07/21 19:00:00	1907.24
01/21 20:00:00	1199.40	07/21 20:00:00	638.53
01/21 21:00:00	1105.91	07/21 21:00:00	366.55
01/21 22:00:00	1110.09	07/21 22:00:00	191.24
01/21 23:00:00	1147.96	07/21 23:00:00	80.51
01/21 24:00:00	1206.28	07/21 24:00:00	49.45
<b>Peak</b>	<b>1385.86</b>	<b>Peak</b>	<b>2469.97</b>

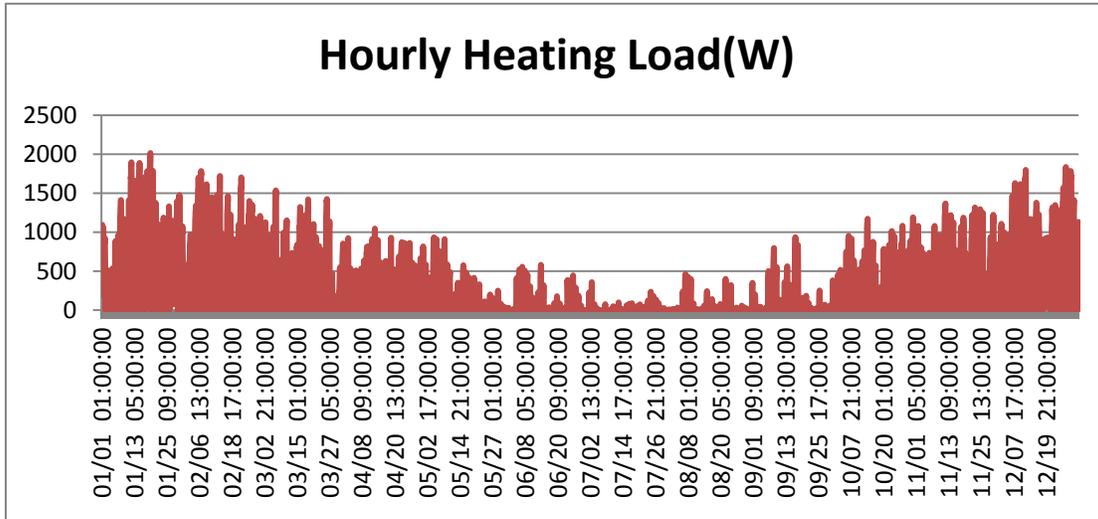


Figure 8.2 Hourly Heating Load

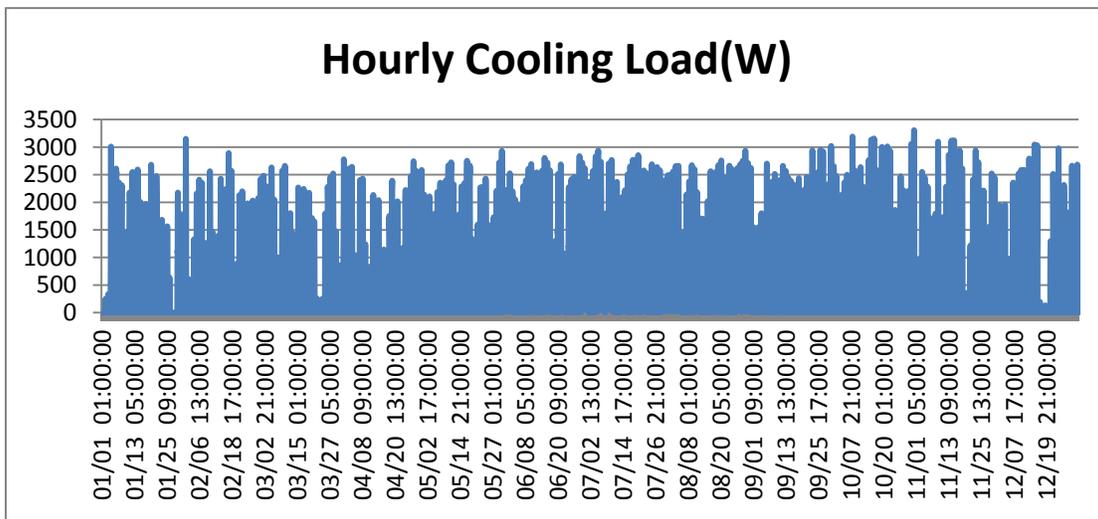


Figure 8.3 Hourly Heating Load

## 8.2.4 Mechanical System Design

### 8.2.4.1 System Motivation

Y Container is designed to use solar thermal energy to meet almost all of our night heating and hot water demands. In doing so, we have reduced our annual electrical consumption and thus the size of our expensive PV array.

Solar thermal collection is extremely effective, with instantaneous efficiencies several times greater than current PV systems. In heating, these systems are more effective - in both square footage and cost terms – than electric heat pump setups, the only other fully solar heating solution.

While the system design we will describe is highly complex and somewhat expensive, solar heating -

especially coupled with radiant systems - has been a major player of efficient HVAC design.

Considering the huge role that heating and cooling play in energy consumption across the country, meeting these demands with such an efficient alternative energy resource is an excellent way to start decreasing building electrical and gas consumption.

#### **8.2.4.2 System Overview**

The thermal systems for Y Container reflect our desire to use solar thermal energy as completely and efficiently as possible. Solar collectors energize a storage tank that heats water for both domestic use and for space heating.

Because of the exceptional efficiency of radiant systems – both in not requiring fans and in allowing more moderate water temperatures – we employ radiant heating, except when ventilation or dehumidification requires the use of a blown-air system.

Beyond these large concepts, we have done our utmost to consider every detail in designing our system. Waste heat from the chiller is used to pre-heat domestic hot water; our hydronic plumbing employs cutting edge “smart pumps” and has been designed to minimize head losses.

#### **8.2.4.3 Solar Collection and Storage**

##### 8.2.4.3.1 Description

The solar thermal array was designed using flat plate type collectors, based mostly on their aesthetic advantage over evacuated tube systems. Thermal energy will be stored in an insulated water storage tank located outside the house on a custom enclosed mechanical skid. This tank was rigorously designed to optimize thermal stratification effects that increase collector efficiency and reduce heat pump runtimes and tank thermal losses.

The following sections will discuss the design in detail.

##### 8.2.4.3.2 – Design of Collection and Storage

In Y Container we designed the south roof was sited with 8 solar collectors, which is 6.56ft length and 2.95ft width. Our solar thermal system will connect with two tanks; one supplies the domestic hot water, the other uses to the radiant heating system.

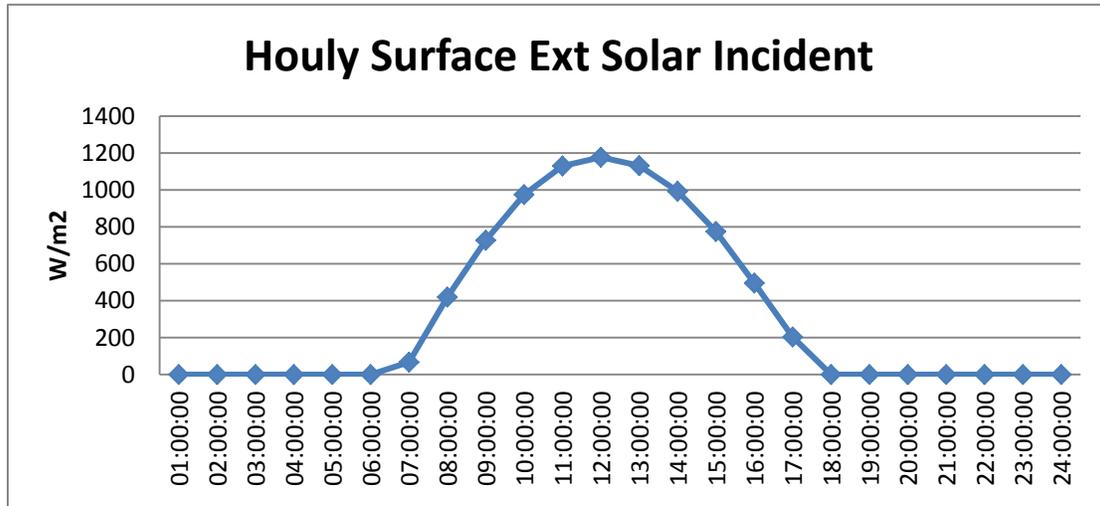


Figure 8.4 Competition Day Solar thermal Predicted

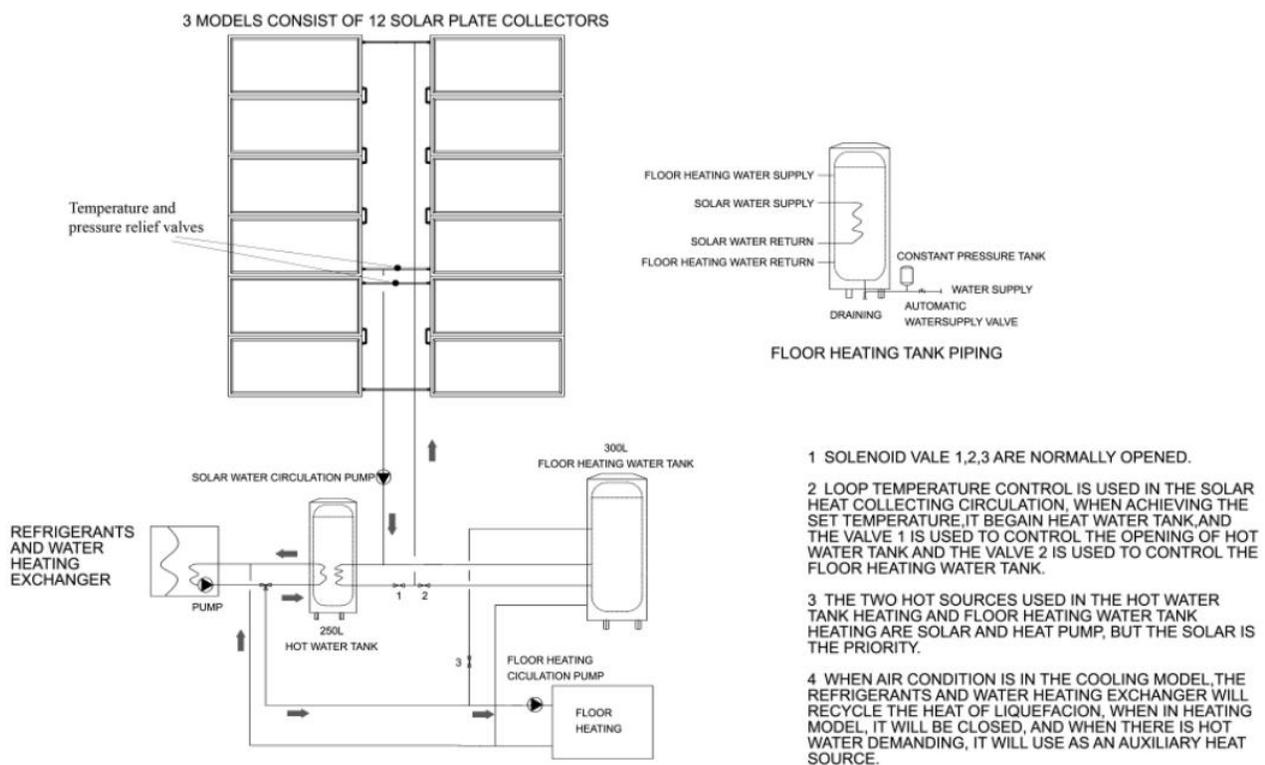


Figure 8.5 Solar water system

Notes:

1. Solar collectors firstly heat the water in domestic water tank to 55 degree. Then switch to the water for floor heating tank.
2. When temperature of water in the domestic water tank up to 50 degree, the tank will become the hot

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source of floor heating. And when the water down to 50 degree, the source will change to be heatpump.

3. In summer, the recovery of waste heat will be used to heat domestic water.
4. And in cloudy day, we can start heatpump to heat domestic water to necessary temperature manually.

#### 8.2.4.4 HVAC System

##### 8.2.4.4.1 Radiant System Description

The HVAC system is designed to be both efficient and comfortable by using radiant panels to deliver the majority of the heating load. Radiant heating is advantageous for several reasons. One, radiant systems provide good thermal comfort at more moderate air temperatures because of they affect operative temperature, which is a better metric of temperature as perceived by people. The other, they do not require high temperature differences to transfer energy, like air handler coils do. Thus radiant panels allow for more moderate water temperatures, increasing the efficiency of the generating equipment like heat pumps or chillers.

Radiant systems fall into two major categories: high-mass and low-mass. Well-designed high mass systems allow peak loads to be reduced and demand to be well-balanced throughout the day. However, they are also very slow to respond, and when conditions change quickly they can suffer in both efficiency and delivered performance. Because the house is expected to perform in different locations and climates, and because of the shipping height and weight limitations of the competition, Y Container employs a low-mass system.

The floor of Y Container will be installed radiant system, allowing for radiant heating to be done using the most efficient surface floor for heating. We have opted for a single manifold and a single mix temperature to reduce plumbing complexity, although slightly increased performance could be achieved with different floor temperatures.

##### 8.2.4.4.2 –HVAC System Design and Sizing

We use the multi-functional MX system of Dakin to design our HVAC system. The system is integrated with displacement air-conditioning, floor heating, and sanitary hot water. It combines the technology of air-source heat pump, Dc frequency conversion, and heat recovery, which is highly energy efficient and effective to provide the indoor comfort and meet the domestic hot water demand.

The air-conditioning system in Energy-container consists of outdoor unit, air handling unit, total heat recovery unit, refrigerator-water heat exchanger, duct and terminal device. This system is designed to control indoor environment, and create a comfortable living environment.

Total heat recovery unit is a device where exhausted air and outdoor air can exchange enthalpy. The exchange efficiency of this unit in Energy-container has reached 70%. This device helps to decrease the outdoor air load, and reduce the system's output.

Refrigerator-water heat exchanger can recover the condensed heat to the hot water tanks. The recovery helps to make a better use of the waste heat, thus we can make the most of energy, when this exchanger is operating, because of the lower water temperature in the tanks, the COP of the heat pump is much higher than the air-cooling heat pump.

The air-conditioning system is an all air system. Pretreated air is delivered through the duct to six terminals. The type of air distribution in Energy-container is displacement ventilation, achieved by six supply vents and three return vents. The velocity of supply air leaving these vents is under 0.5m/s, going to the bottom of the room. The three return vents are hiding in the ceiling of each room. With the help of both supply and return vents, it can make a significant temperature profile in the room that lower temperature in the bottom (floor) and higher in the top (roof). This ventilation can make sure of the best air quality and suitable temperature in the residential activity space, because the older and warmer air can go outside from the return vents with the contaminant and moisture produced from residents. Due to the need to maintain the environment in residential activity space, the air-conditioning system output can be smaller than systems with other air distribution on the premise of human comfort.

There are some innovations in our HVAC system. For the refrigeration cycle part, the HVAC heat pump, the hot water tank and the floor heating are designed to be an integrated system, where the exhausted heat from the heat pump is used to as an assistant heat source or exclusively heat water if solar radiation is not enough in winter or raining day. In this integrated system, as the refrigerant exchange heat with water through the refrigeration-water heat exchange unit, there is no direct contact of refrigerant coil with the storage water, and floor heating water, so there is no risk of the storage water contaminated by the refrigerant in terms of any leakage. For the controlling part of air condition, the indoor T/H sensors can measure the indoor environment condition and transport the signal to the central controlling unit. According to the preset program, the unit can feedback signal to all of equipment. Then equipment work to maintain or change the indoor environment.

#### 8.2.4.4.3 –Natural Ventilation Design

In order to provide adequate amount of fresh air, we make full use of natural ventilation. As we all know, natural ventilation relays on the density difference of air, which is caused by wind pressure or temperature gratitude. Natural ventilation caused by wind pressure is closely related to local weather and is hard to control. Thus, conventionally we consider more about using indoor air temperature difference, which will cause chimney effect to achieve ventilation. However, temperature gratitude must be large enough, so commonly, only buildings that are high enough and designed properly can achieve this kind of natural ventilation.

Since Y-BOX is only 4 meters high, which is not high enough to form a temperature field with large temperature difference, we came up with the idea that a heat collector can be used at the top of the house to create large temperature difference. As shown below, the triangle area is designed as a heat collector.

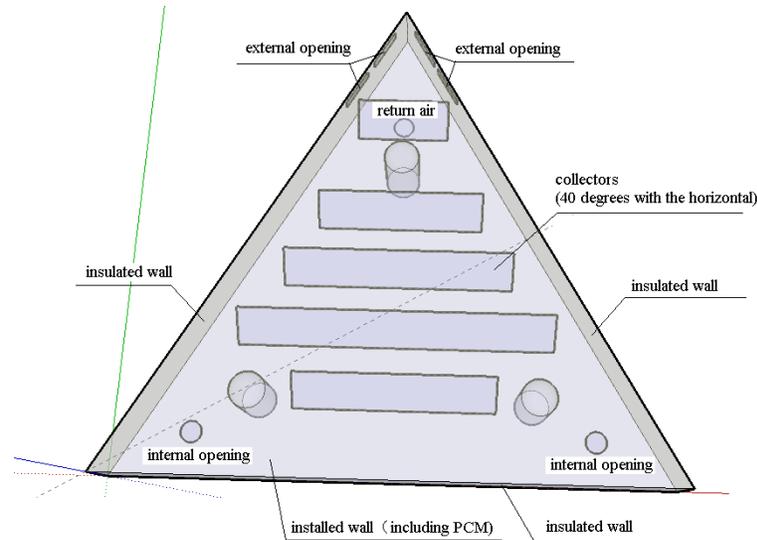


Figure 8.6 Natural Ventilation Modeling

In fact, it's a triangle container with all-glass type on its top surface and with good insulation on its other surfaces. There are several solar plate collectors in it. Collectors are installed 40 degrees with the horizontal in order to collect solar heat more effectively. The air temperature in this container increases rapidly, which contributes to induce indoor air cycle and achieve natural ventilation.

## 8.2.5 Energy Modeling and Design Narrative

### 8.2.5.1 Motivation for modeling

This section will detail more explicitly the evolution of the house's design and systems, and present the quantitative rationale to support our decisions. The most efficient systems always start with designing a house to have the smallest loads possible, and to this end we extensively modeled and engineered the house to require as little energy as possible before we began designing the systems to condition it.

Energy modeling of this detail is important in very large scale designs, and in energy efficiency development research, but is usually not employed for residences of this size. That being said, the Solar Decathlon is about pushing the design envelope, and also about gaining better insight into energy performance, and so this level of detailed analysis is practically requisite.

### 8.2.5.2 Envelope studies

#### 8.2.5.2.1 Envelope with VIP

Heat is also lost and gained through the regular surfaces of the house: walls, ceilings and floors. In almost all design conditions, more insulated houses perform better, but we sought to examine the effect in more detail for the competition month. The total energy consumption, with different insulation in the wall, roof, and floor, compared result in Figure 8.7.

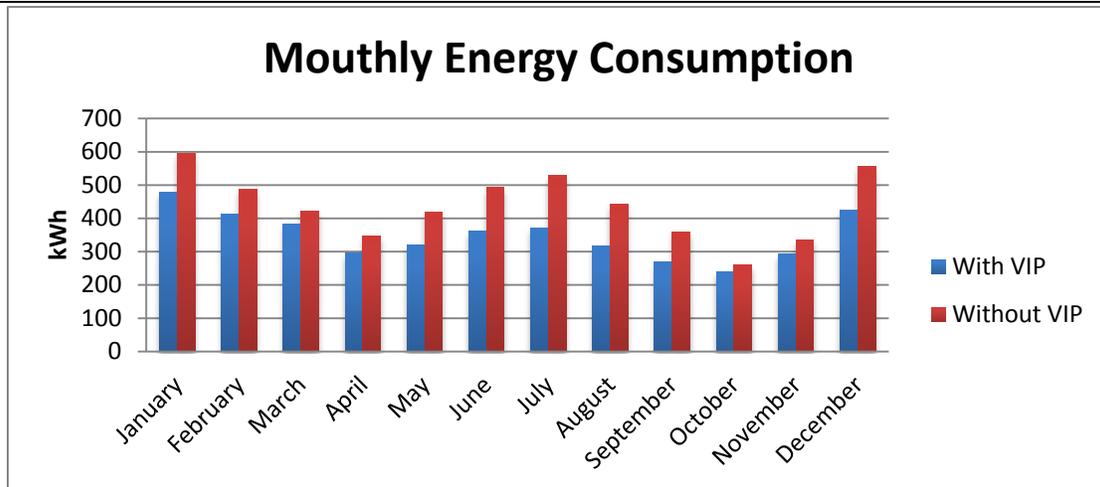


Figure 8.7 Monthly Energy Consumption about VIP

When the construction with VIP, the R-value of Wall is  $10\text{m}^2\cdot\text{k}/\text{W}$ , the R-value of Roof is  $3.52\text{m}^2\cdot\text{k}/\text{W}$ , the R-value of floor is  $2.86\text{m}^2\cdot\text{k}/\text{W}$ . And in the other case, there is no VIP but the R-values also conform to the energy-saving standard, the R-value of Wall is  $0.35\text{m}^2\cdot\text{k}/\text{W}$ , the R-value of Roof is  $0.86\text{m}^2\cdot\text{k}/\text{W}$ , the R-value of floor is  $2.04\text{m}^2\cdot\text{k}/\text{W}$ .

Meanwhile, we see a curious situation: heating is reduced by greater insulation, but cooling is more complex because the heat loss helps fight solar gains. The optimum insulation value will vary depending on the exact specifications of the house and the exact weather it is designed for, but the general trend is unchanged: greater insulation means lower load. Thus, the house will be insulated maximally given the space constraints.

#### 8.2.5.2.2 Walls with PCM

We install DuPont™ Energain® PCM Thermal Mass Panels inside the walls just behind wallpapers. PCMs can maintain a proper temperature (about  $50^\circ\text{C}$ ) in this container. This container connects with the interior Y-box. In the fine day, solar heat that the container absorbed is divided into two parts, one part is used to heat the air in the container; the other part is saved in PCMs. Just as the principle we talked, air on the upper part of the house is higher than the lower, so density difference gives rise to ventilation. Therefore indoor air is taken away by the drive force of hot air. At night, PCMs releases its heat to increase the air temperature in the container, which helps to maintain the temperature of the triangle container, and taking away indoor air.

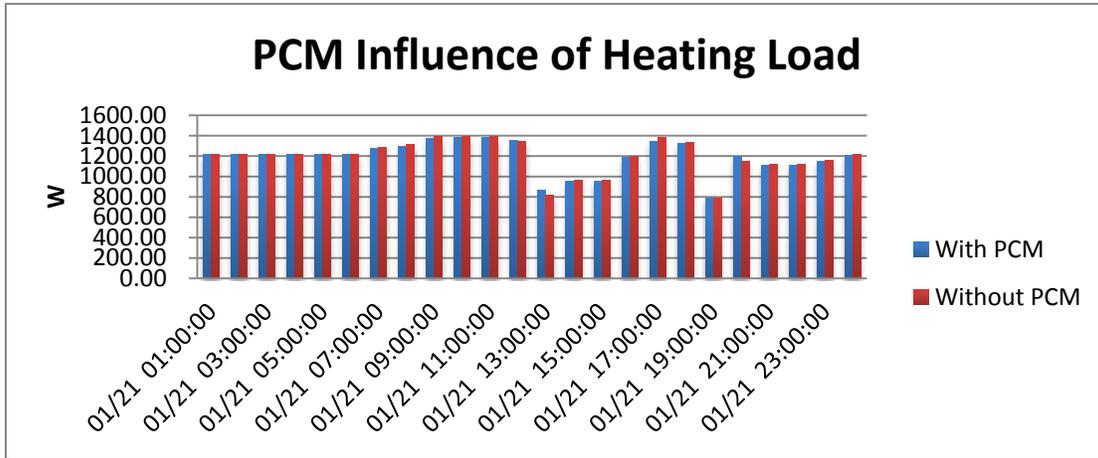


Figure 8.8 PCM Influence about Heating

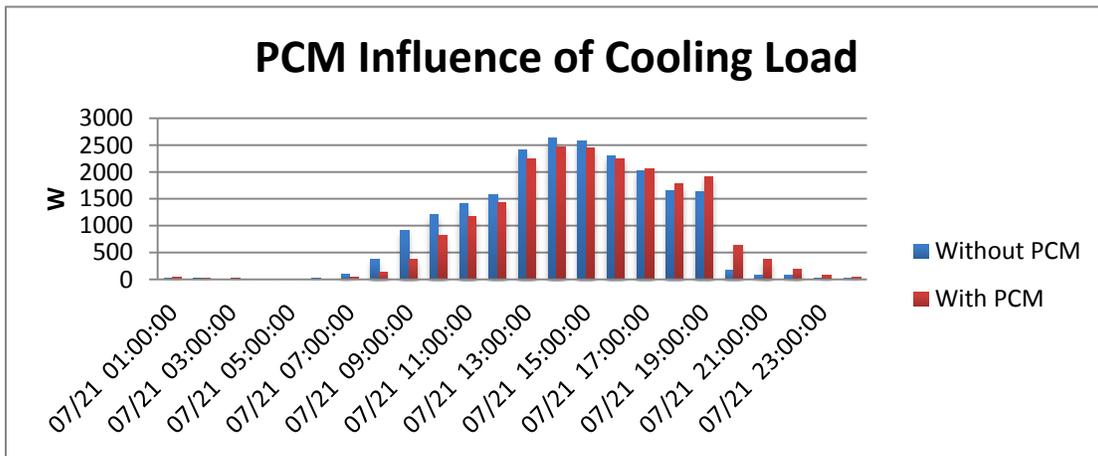


Figure 8.9 PCM Influence about Cooling

### 8.2.5.3 Window Studies

Choosing a proper glazing is vital for Y Container. It is obvious that window can be a net heat supplier during the day with appropriate U-value and solar heat gain coefficient (SHGC). The U-value is a measure of the window overall thermal transmittance, whereas the SHGC is the fraction of the solar heat that transmitted into space. Given the influence of the properties of window, Y Container employs the glazing with U-value of  $0.77\text{W/m}^2\cdot\text{K}$  and SHGC of 0.5. Table 8.3 show the different glazing constructions hourly heat gain. The ordinary double-skin glazing with Low-E and Inert Gas has the higher energy consumption during the summertime and wintertime, whereas Y Container is lower during that period. That enables us to use HVAC system less.

Table 8.3. Glazing Heat Gain

**Glazing Monthly Heat Gain (W)**

Month	Double Lowe Glazing	Y Glazing
January	1089.09	714.89
February	1297.18	851.97
March	1357.73	884.92
April	1383.58	889.51
May	1446.83	904.81
June	1538.36	953.96
July	1589.23	973.64
August	1463.21	905.84
September	1416.55	889.08
October	1433.64	923.94
November	1244.25	804.17
December	1165.24	765.43

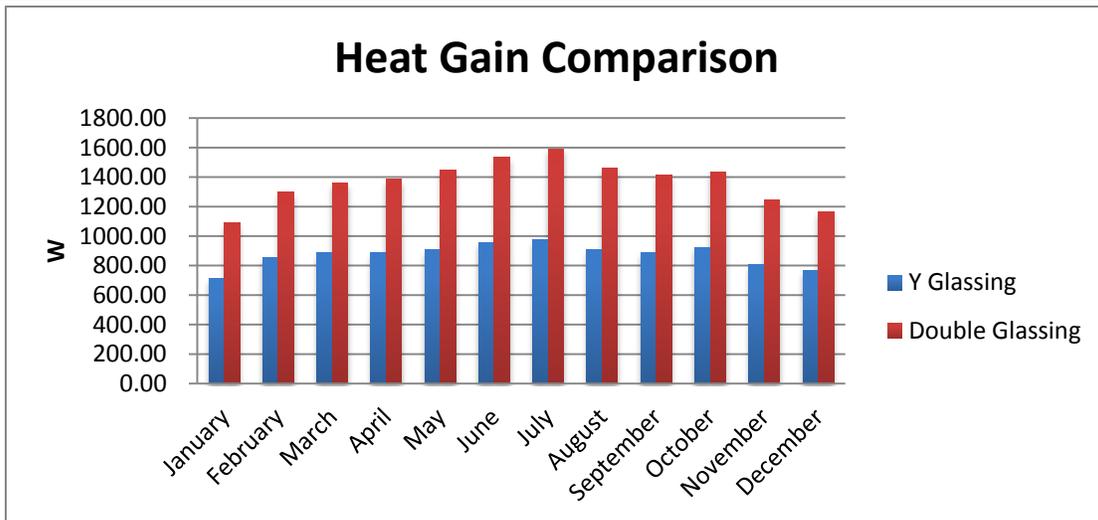


Figure 8.10 Window Comparison

#### 8.2.5.4 HVAC Studies

There are some innovations in our HVAC system. For the refrigeration cycle part, the HVAC heat pump, the hot water tank and the floor heating are designed to be an integrated system, where the exhausted heat from the heat pump is used to as an assistant heat source or exclusively heat water if solar radiation is not enough in winter or raining day.

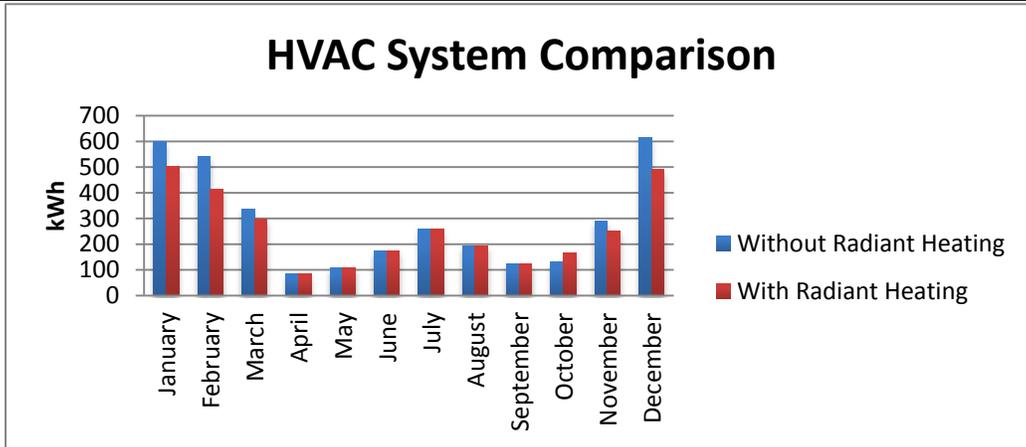


Figure 8.11 HVAC Comparison

### 8.3 Electrical Systems

#### 8.3.1 Introduction

Electrical energy efficiency is one of the most important aspects of the competition. To make Y Container as electrically-efficient as possible, we had to both maximize the power delivery of our photovoltaic system and minimize the power consumption of the house itself. As with the thermal engineering, the best designs begin with load reduction, so this was our primary concern.

We have also sought to do more than just bolt a photovoltaic system on top of our house. Following our team's mission of integration, we constrained our photovoltaic array design to appear as part of the house. In doing so, we have shown that solar power can be beautiful, and can add more than just power to a home.

In this section, we present the house appliance selection, our photovoltaic system design, an analysis of the house's anticipated loads and production, and the role homeowner habits can play in the house's energy consumption.

#### 8.3.2 Appliance Selection

Table 8.4 shows the list of appliances, plug loads and the estimated energy consumption of each component.

Table 8.4 List of Appliances and their Estimated Energy Use

Oven	
SIEMENS HB11AB520W	
Rated Power(W)	2200
Energy/year(kWh/y)	281.24
sensible energy multiplier	1
Dishwasher	
SIEMENS SN65M000EU-60cm	
Rated Power(W)	1900
Energy/year(kWh/y)	383.25
sensible energy multiplier	0.8
Refrigerator	

SIEMENS KI38SA50IE	
Rated Power(W)	120
Energy/year(kWh/y)	293
sensible energy multiplier	1
<b>Cooker</b>	
SIEMENS EH75262TI	
Rated Power(W)	3300(left),1800(right)
Energy/year(kWh/y)	730
sensible energy multiplier	1
<b>Clothes Washer</b>	
SIEMENS WD14H468TI	
Rated Power(W)	200
Energy/year(kWh/y)	130.5
sensible energy multiplier	0.8
<b>Clothes Dryer</b>	
SIEMENS WD14H468TI	
Rated Power(W)	1200
Energy/year(kWh/y)	427.2
sensible energy multiplier	0.2
<b>Ventilation hoods</b>	
VALENTI GR14	
Rated Power(W)	180
Energy/year(kWh/y)	64.1
sensible energy multiplier	1
<b>TV</b>	
Rated Power(W)	130
Energy/year(kWh/y)	138
sensible energy multiplier	1
<b>Computer</b>	
Rated Power(W)	85
Energy/year(kWh/y)	76
sensible energy multiplier	1

We estimated energy use of these appliances by the rated powers and the reasonable using time schedules.

The estimated annual energy consumption of the Y Container is shown in Figure 8.12. As stated in Table 8.4, space heating and hot water energy consumption is represented by the electrical input to the heat pumps, accounting for utilization of the useful solar thermal energy. In other words, given that all of the useful solar thermal energy is utilized. All of the estimated values represent annual electricity use.

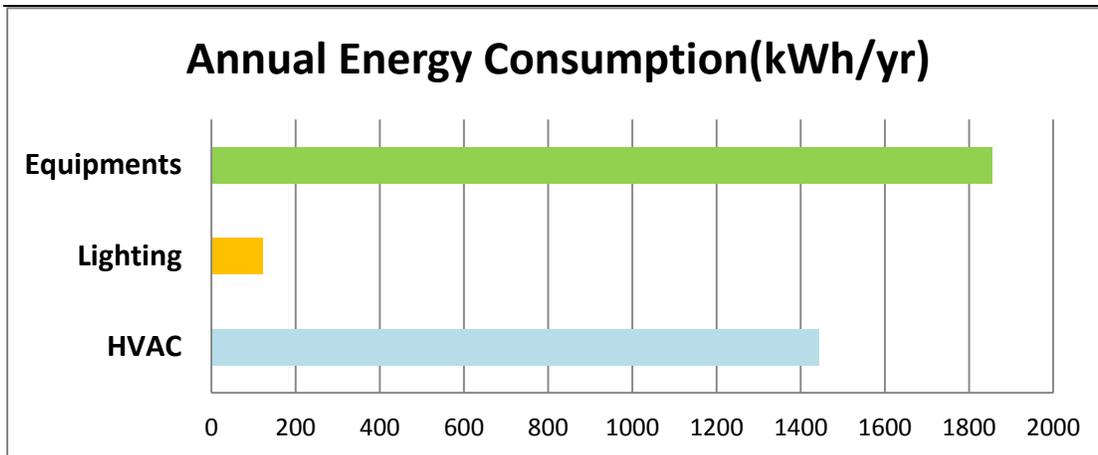


Figure 8.12 Annual Energy Consumption

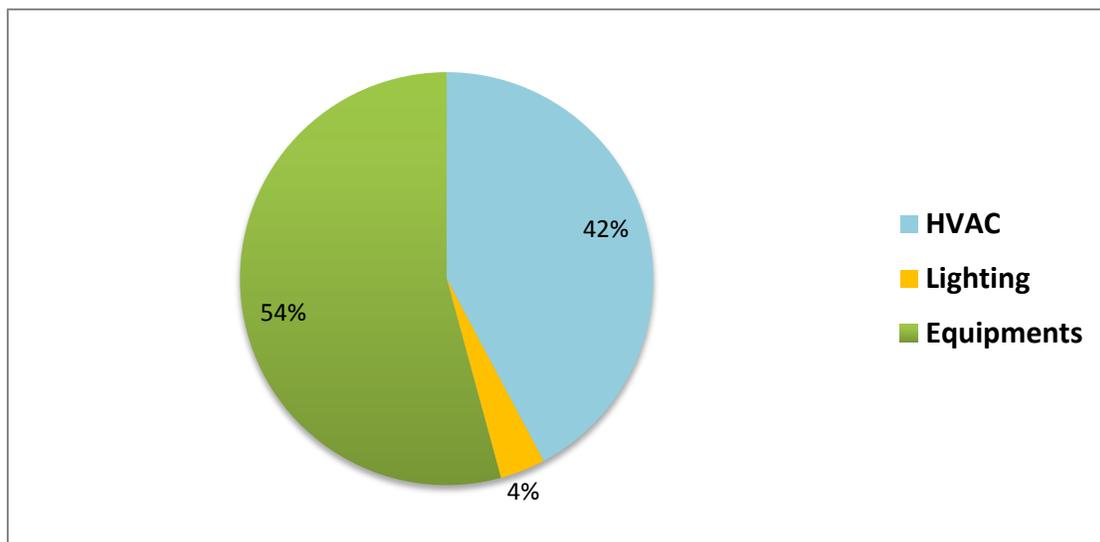


Figure 8.13 Energy Consumption by End Use

### 8.3.3 Design

#### 8.3.3.1 Goals and Challenges

Our design goal was to integrate maximum energy production with architectural aesthetics – we demanded that Y Container be a home above all, not a power plant.

Thus we set out to design the solar array to appear as an intentional part of the house rather than an afterthought. Most solar power systems are identifiably separate from the rest of the house - our design had to overcome this.

Furthermore, we wanted to maximize the power that the photovoltaic system would deliver to the house, reducing its dependence on externally-generated, carbon-heavy energy. This gives the resident the freedom to

use all of the house amenities while still having the peace of mind of energy independence.

### 8.3.3.2 PV Array Design

Panel selection was the first stage in the design process. We needed a panel that was efficient, fit densely on our roof, and were aesthetically appealing. After much deliberation, SANYO’s HIT POWER 220A solar panel was chosen for its high efficiency, small size, and its all-black appearance.

After the selection of the panel was made, we calculated that we would need approximately 42 panels to safely meet competition requirements and roof areas. To compensate for the decrease in efficiency due to our less-than-optimal panel tilt, we maximized the number of solar panels by packing them as efficiently as possible on the roof.

Based on the design of our photovoltaic array, we will generate enough power to not only meet the tasks required by the competition, but also to produce a substantial amount of net contributed power.

### 8.3.3.3 Inverters

For our inverter we chose SMA’s SUNNY BOY 8000-US inverter because its efficiency is the highest in its class. Additionally, it has an expected lifetime of at least 25 years, on par with our solar array and important for the long term value of the house.

### 8.3.3.4 Calculations

The concept of a partial tracking, or repositioning, system was evaluated. An investigation into many different arrangements of PV indicated that the single most important variable for PV energy production is the total PV area. Based on these findings, the current PV layout was chosen.

An analysis of the total PV energy production of Y container was modeled with Energy Plus’s PV model. The total yearly electrical output of the photovoltaic panels for the house is 11503kWh. An estimated 10% of the energy will be lost in the winter if the snow is allowed to accumulate on the roof array. Table1 shows the data from the simulation, and Figure1 shows the data graphically.

Table 8.5 PV Production

	West Roof AC Energy(kWh)	East Roof AC Energy(kWh)	Total Energy(kWh)
January	253.79	253.79	507.58
February	345.37	345.39	690.77
March	505.89	505.92	1011.81
April	587.46	587.47	1174.93
May	658.96	658.96	1317.91
June	676.37	676.38	1352.76
July	676.87	676.89	1353.77
August	604.04	604.05	1208.08
September	501.66	501.67	1003.33
October	411.57	411.59	823.17

November	281.73	281.75	563.47
December	247.82	247.83	495.65
<b>Total</b>	<b>5751.69</b>	<b>5751.54</b>	<b>11503.23</b>

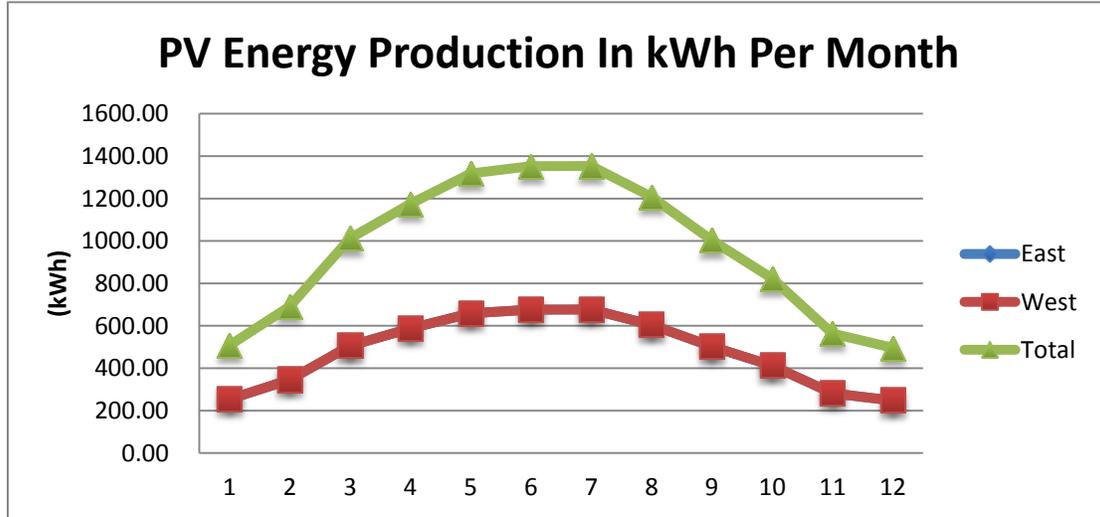


Figure 8.14 PV Energy Production

### 8.3.4 House Energy Balance

The total energy balance of the Y Container House is based on the performance analyses of the active and passive energy systems incorporated into its design. This is largely an exercise of combining the energy model predictions presented in this report.

Some results may not reflect the conversion efficiencies of certain components. For example, the energy consumption of a dishwasher does not take into account the conversion efficiency of the hot water system. The appliance energy consumption simply reflects the estimated energy use, but may not be indicative of actual energy consumption. Similarly, space cooling is determined based on an average COP of the heat pump and doesn't capture the varying performance levels as a function of the thermodynamic state of the system. Table 6 summarizes how each house component was modeled and whether or not the actual energy conversion efficiency is taken into account.

Table 8.6 Summary of Modeling Approaches for Consumption and Production Elements

Consumption	
<b>Space Heating</b>	Annual idealized demand profile was predicted by EnergyPlus. Based on these results, an averaged demand value was calculated for each month.
<b>Space Cooling</b>	Annual energy is based on an idealized demand profile predicted by EnergyPlus. An average coefficient of performance of 3.5

	was assumed for the cooling system.
<b>DHW</b>	Based on a demand profile for hot water use, the energy consumption of this system is represented by the electrical energy input to the heat pumps.
<b>Appliances and Plug Loads</b>	Energy consumption of appliances is based on product specifications, modified where necessary, for expected double occupancy use. Plug loads are based on anticipated usage schedules and average power draws.
<b>Fans and Pumps</b>	This is a rough estimate.
<b>Lighting</b>	Lighting consumption was estimated based on the wattage of per square meter and lighting schedules.
<b>PV</b>	Electricity production was modeled in Homer calculator and EnergyPlus using the selected PV modules and representative areas of roof over a one year simulation period for Washington D.C. The possible accumulation of snow was neglected. Inverter efficiencies and losses were neglected.
<b>Solar Thermal</b>	The reported value is the useful collected heat, some of which will be lost in storage when demand is insufficient to take advantage of the collected heat. The solar thermal system is designed to operate with a larger thermal storage system once the house is situated in its permanent location.

We estimated energy use of these appliances by the rated powers and the reasonable using time schedules.

Figure 8.15 shows the expected useful energy produced by the photovoltaic arrays. Ignoring any losses between the PV array and the grid, and any disruptions in production due to shading or snow cover, all of the electricity generated is considered useful.

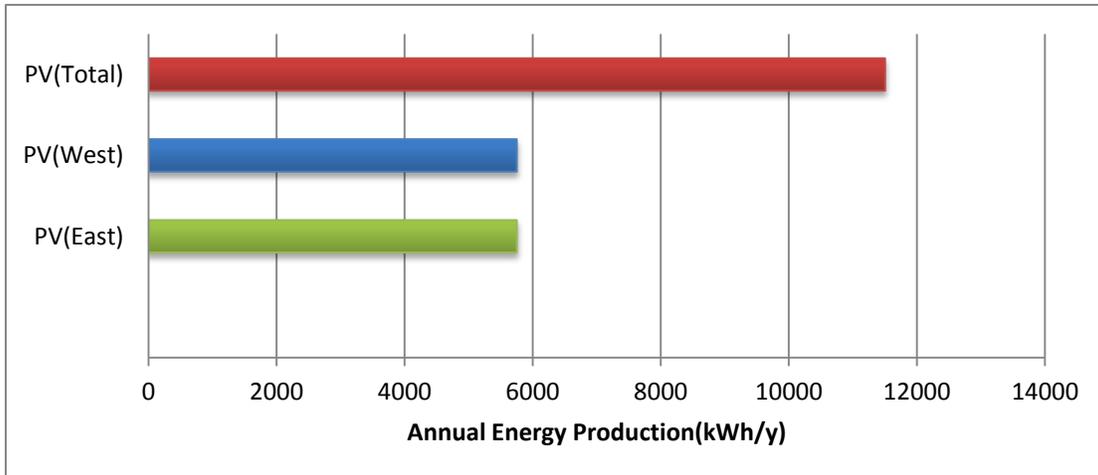


Figure 8.15 Annual PV Energy Production

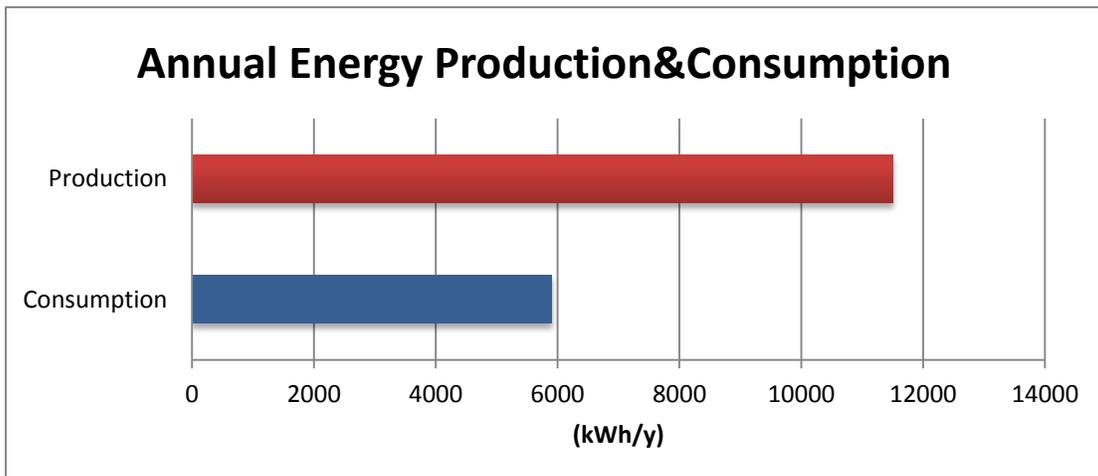


Figure 8.16 Annual Electricity Productions vs. Demand

The total annual energy consumption is 5909kWh/y.

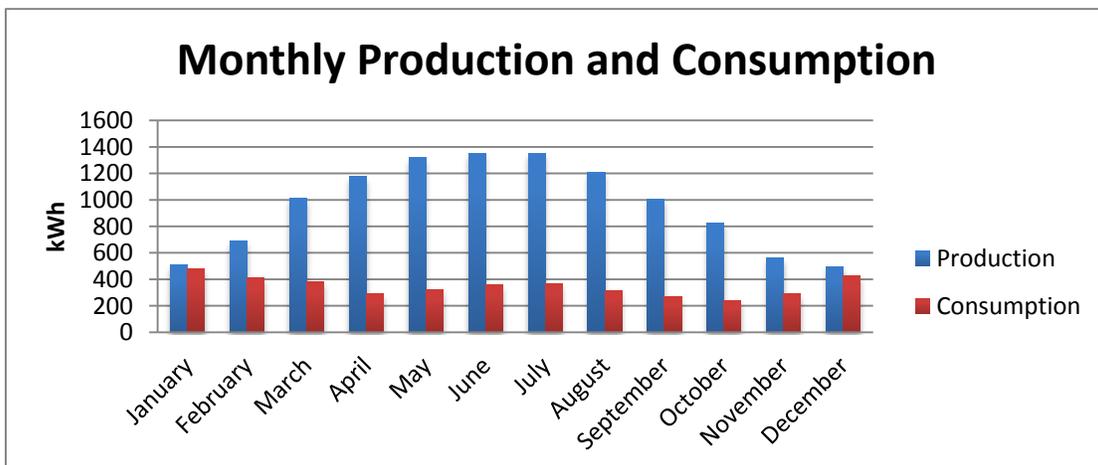


Figure 8.17 Monthly Electricity Productions vs. Demand

## 9. YAMAHA EF6300iSDE Generator

Specifications of YAMAHA EF6300iSDE Generator

<http://www.yamaha-motor.com/outdoor/products/modelspecs/622/0/specs.aspx>

MSRP*	\$4,099
Type	Brushless, Inverter
Maximum AC Output	6300 watts
Rated AC Output	5500 watts
Rated / Maximum AC Current	45.8 amps /52.5 amps @120V; 22.9 amps/26.3 amps @ 240V
Engine	OHV, Air-Cooled, Four-Stroke, Single Cylinder
Displacement	357cc
Ignition System	TCI: Transistor Controlled Ignition
Starting System	Electric start w/automatic choke (optional wireless remote)
Overall Length	30.7 in
Overall Width	24.3 in
Overall Height	27.2 in
Dry Weight	200 lb
Fuel Tank Capacity	4.5 gal
Continuous Operation at 1/4 Rated Load	13.3 hr
Noise Level	58 ~ 64 dBA
Warranty	3 Years Limited Warranty

Details please refer to YAMAHA EF6300iSDE User Manual attached at the end of this file.

## 10. Construction Specifications

Division 01 – General Requirements

**SECTION 01 10 00 SUMMARY**

**PART 1 – GENERAL**

1.1 SUMMARY of Work

A. Project: Y Container

B. Owner: Tongji University

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C. Architect: Tongji University Solar Decathlon Team

D. Website: <http://www.safekidschina.org/solarDecathlon/index.html>

## 1.2 Work Restrictions

A. Premises: During construction, Contractor will have use of area indicated, Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on Portions of Project.

1. Owner will occupy premises during the construction. Only authorized construction personnel contractors are allowed on site during construction. Perform construction only during normal working hours, unless otherwise agreed to in advance by Owner. Clean up work areas and return to usable condition at the end of each work period.
2. Limits: the site area should be at least 15m \*15m for the main house, 8 square meters for the surface walkways, patios, ramps, and another 8 square meters beyond constructed areas with permeable surfaces (such as pervious paving areas, playing fields) that require additional staging compaction in the constructed area.

B. Weather: During construction, it's better to under the good weather. If not, at least ensure the day combing two containers are not a rainy day to ensure the good interior condition.

C. Nonsmoking Building: Smoking is not permitted within the building or within 8m of entrances, operable windows, or outdoor-air intakes.

## **PART 2 – PRODUCTS (Please read interconnection application form for detail)**

## **PART 3 – EXECUTION(Not Used)**

### **END OF SECTION 011000**

## **SECTION 01 51 00 TEMPORARY UTILITIES**

### **PART 1 – GERNERAL**

#### 1.1 SUMMARY:

A. Section Includes:

1. Temporary Fuel Oil
2. Temporary Lighting
3. Temporary Water
4. Temporary Electricity

---

## 5. Sanitary Facilities

### **PART 2 – PRODUCTS**(Not Used)

### **PART 3- EXECUTION**

#### 3.1 GENERAL INSTALLATION:

Install temporary service or connect to existing service.

- A. Provide temporary fuel oil for the use of electric generator if necessary.
- B. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
- C. Provide temporary water for the landscape plants, site cleaning, yard pool and any other usage during the construction.
- D. Provide temporary electricity for any kind of facilities which will be used during the construction.
- E. Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

### **END OF SECTION 015100**

## **SECTION 01 52 00 CONSTRUCTION FACILITIES**

### **PART 1 – GENERAL**

#### 1.1 SECTION INCLUDES:

- A. Field Offices and Sheds: One Container
- B. First Aid Facilities

#### 1.2 DELIVERY, STORAGE, AND HANDLING

- A. Delivered in a separate container named SHED, which will be transported to the lot in the first day and taken away the last day of the construction period.

### **PART 2 – PRODUCTORS**

#### 2.1 MANUFACTURE

- A. YANGHZOU RUNYANG LOGISTIC EQUIPMENT CO., LTD

ADD: 99, Yangwei Road, Dev.Zone, Yangzhou, Jiangsu, P.R.China (225102)

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Tel: +86-(0)514-87576699

Fax: +86-(0)514-87573880

Email: [sales@yzry.com](mailto:sales@yzry.com)

Web: <http://www.yzryc.com/>

## 2.2 PRODUCTS:

- A. 10' single side full opening container with rear end door

## 2.3 DESCRIPTION:

- A. The field offices include all the tools, safety protections inside. It also provides a temporary resting place during the construction.
- B. First aid facilities only provide the emergency treatment for the minor wounds. For others, they maybe sent to the nearest hospital according to the Health and Safety Plan.

## **PART 3 –EXECUTION (Not Used)**

### **END OF SECTION 015200**

## **SECTION 01 54 00 CONSTRUCTION AIDS**

### **PART 1 – GERNERAL**

#### 1.1 Section Includes:

- A. Trucks
- B. Crane
- C. Forktruck
- D. Temporary Scaffolding
- E. Ladder

### **PART 2 – PRODUCTS**

- A. not yet decided
- B. not yet decided
- C. not yet decided
- D. not yet decided

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E. not yet decided

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 015400**

**SECTION 01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 – GENERAL**

1.1 Examination and Preparation

- A. Before proceeding with each component of the work, examine substrates, areas, and conditions, with installer or applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Verify compatibility with and suitability of substrates.
  - 2. Examine roughing-in for mechanical and electrical systems.
  - 3. Examine walls, floors, and roofs for suitable conditions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Take field measurements as required to fit the work properly. Where portions of the work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.
- D. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

1.2 Closeout Procedures:

- A. Prepare a list of items to be completed and corrected, the value of items on the list, and reasons why the work is not complete.
- B. Testing all the systems including intelligent control system, PV, communication facilities, cooking machines, electrical appliances.
- C. Deliver tools, spare parts, extra materials, and similar items.
- D. Complete final cleaning requirements.

**PART 2 – PRODUCTS (Not Used)**

**PART 3 –EXECUTION (Not Used)**

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**END OF SECTION 017000**

**Division 05 – Metals**

**SECTION 051200 STRUCTURAL STEEL FRAMING**

**PART 1 - GENERAL**

**1.1 SECTION REQUIREMENTS**

A. Submittals: Product Data, Shop Drawings, and Welding Procedure Specifications (WPSs).

B. Comply with applicable provisions of the following:

1. GB50017-2003 for China: Code for design of steel structures
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
5. AISC 303.

C. All work shall be in accordance with the AISC Specification.

D. Contractor shall be responsible for coordinating the selection of optional details shown on the drawings. The contractor shall also be responsible for all erection aides that include, but are not limited to erection angles, lift holes, and other aides.

**PART 2 - PRODUCTS**

**2.1 STRUCTURAL STEEL**

All structural steel design shall conform to AISC 341 Design of steel structures, and the grades of structural steel material are as follows

- A. Plates and bars: Q355NH (GB50017-2003)  $FY=320N/mm^2(46.41KSI)$
- B. All Angles Q355NH  $FY=320N/mm^2(46.41KSI)$
- C. Square or Rectangular: Q355NH  $FY=320N/mm^2(46.41KSI)$
- D. Steel Pipe Diameter Less than or equal to 12 inches: Q355NH:  $FY=320N/mm^2(46.41KSI)$
- E. Material called out on plan Q355NH  $FY=320N/mm^2(46.41KSI)$

**2.2 ACCESSORIES**

A. Anchor bolts and miscellaneous bolts: 5.6(GB50017-2003)

$FT=210N/mm^2(30.46KSI)$

$FV=190N/mm^2(27.56KSI)$

---

B. High strength bolts: 8.8(GB50017-2003)

$$FT=400N/mm^2(58.01KSI)$$

$$FV=320N/mm^2(46.41KSI)$$

### 2.3 FABRICATION

A. All structural steel components must be protect by black oxide coating unless noted otherwise. The specific demands should be conform to Eurocode 3 Design of steel structures.

B. Unless noted otherwise. All structural steel components should ensure the accuracy of dimension and locating under construction so as to ensure the installation and welding.

C. It shall be the fabricator's responsibility to choose the appropriate welding process and sequence to minish the residual weiding deformation and stress.

## PART 3 - EXECUTION

### 3.1 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to GB50017-2003 and AISC 303.

B. Base Bearing and Leveling Plates: Clean concrete - and masonry - bearing surfaces of bondreducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of base plate.

3. Snug - tighten and/or Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

Neatly finish exposed surfaces; protect grout and allow to cure.

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

D. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in GB50017-2003/

E. High - Strength Bolts: Install high - strength bolts according to GB50017-2003 .

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1. Joint Type: Snug tightened, Pretensioned, or Slip critical.

F. Weld Connections: Comply with GB50017 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

**END OF SECTION 051200**

**SECTION 05 59 00 METAL SPECIALTIES**

**PART 1 – GENERAL**

1.1 SUMMARY

A. Section includes the following:

1. Corrugated Metal Exterior Cladding
2. Fabricated Steel Cover Panels
3. Galvanized Corrugated Steel Roof
4. Thermal Tubes Structure

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
2. ASTM C 236 Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
3. ASTM E 283 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the specimen
4. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

B. American Iron and Steel Institute (AISI)

1. Specification for the Design of Cold-Formed Steel Structural Members

C. American Institute of Steel Construction (AISC)

1. Code of Standard Practice

D. American Society of Civil Engineers (ASCE)

1. ASCE-7, Minimum Design Loads for Buildings and Other Structures

1.3 SUBMITTALS

A. Product data, test reports, certifications in accordance with quality assurance and performance

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requirements specified.

1. YANGZHOU RUNYANG LOGISTIC EQUIPMENT CO., LTD

ADD: 99, Yangwei Road, Dev.Zone, Yangzhou, Jiangsu, P.R.China (225102)

Tel: +86-(0)514-87576699

Fax: +86-(0)514-87573880

Email: sales@yzry.com

Web: <http://www.yzryc.com/>

- B. Panel shop drawings consisting of design and erection drawings, finish specifications, and other data. Include, small scale layouts of panels and large-scale details of edge conditions, joints fastener and sealant placement, flashing, penetrations, and special details. Submit structural design calculations, in accordance with the AISI
- C. Custom fabricated items should indicate compliance with design loads, structural analysis data signed and sealed by the qualified professional engineer responsible for its preparation.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be unloaded and stored per the manufacturer's instructions to prevent damage due to handling and weather.

1.5 WARRANTIES

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship for a period of two years from date of shipment.
- B. Paint Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish, in accordance with the paint supplier's standards.

**PART 2 – PRODUCTS**

2.1 MANUFACTURERS

NOT DECIDED YET

2.2 PRODUCTS

NOT DECIDED YET

3.1 INSTALLATION

- 
- A. Install in accordance to manufacturer detailed assembly procedures required to achieve the structural, thermal, and weathering performance specified.
  - B. Metals filings caused by cutting and drilling shall be immediately removed from finished surfaces to prevent rusting and staining.

**END OF SECTION 05 59 00**

**Division 06 – Wood, Plastics, and Composites**

**SECTION 06 15 00 COMPOSITE DECKING**

**PART 1 – GENERAL**

1.1 SUMMARY

- A. Section includes the following:
  - 1. Exterior Composite Decking

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements
  - 1. Deck assembly shall be designed to withstand live and dead loads in accordance with local building codes and calculated loads required for the scope of the project.

1.3 SUBMITTALS

- A. Detailed drawings indicating dimensioning, configuration, and structural notes

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary decking materials shall be provided by a single manufacturer specializing in composite decking for at least five years.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 WARRANTIES

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship and against splintering, splitting, checking, rot, decay and termite damage for a period of twenty five years from date of shipment.

**PART 2 – PRODUCTS**

2.1 MANUFACTURERS

Undecided

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## 2.2 PRODUCT

Undecided

## **PART 3 – EXECUTION**

### 3.1 EXAMINATION

Undecided

### 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.
- B. Deck boards may be pre-drilled for easier fastening.

### 3.3 DECKING INSTALLATION

Undecided

### 3.5 RESTORATION

- A. Replace damaged decking and railings before substantial completion.

### 3.6 CLEANING

- A. Clean up and dispose of excess materials in accordance with all federal, state and local guidelines.

### 3.7 PROTECTION

- A. Protect installed products until completion of project.

## **END OF SECTION 06 15 00**

## **Division 07 – Thermal and Moisture Protection**

### **SECTION 07 13 00 Sheet Waterproofing**

## **PART 1 – GRNERAL**

### 1.1 SECTION REQUIREMENTS

A. Section includes:

#### 1. Weather Barrier House Wrap Membrane

### 1.2 REFERENCES

- A. ASTM International
  - 1. ASTM D 882: Test Method for Tensile Properties of Thin Plastic Sheeting
  - 2. ASTM D 1117; Standard Guide for Evaluating Non-woven Fabrics

- 
3. ASTM E 84; Test Method for Surface Burning Characteristics of Building Materials
  4. ASTM E 96; Test Method for Water Vapor Transmission of Materials
  5. ASTM E 2178; Test Method for Air Permeance of Building Materials

B AATCC – American Association of Textile Chemists & Colorists

1. Method 127 Water Resistance: Hydrostatic Pressure Test

C TAPP

1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
2. Test Method T-460; Air Resistance of Paper (Gurley Hill Method) 2.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturer’s printed product data and specifications

B. [http://www2.dupont.com/Tyvek\\_Weatherization/en\\_US/assets/downloads/K-10872\\_TW\\_Prod\\_Prop.pdf](http://www2.dupont.com/Tyvek_Weatherization/en_US/assets/downloads/K-10872_TW_Prod_Prop.pdf)

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver weather barrier materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by weather barrier manufacturer.

1.5 WARRANTY

- A. Manufacturer’s Warranty

1. Weather barrier manufacturer’s warranty for weather barrier for a period of ten years from date of Substantial Completion.
2. Approval by weather barrier manufacturer for warranty is required prior to assembly installation.
3. For warranty details, review manufacturer’s published warranty. The foregoing is merely a brief summary of the warranty and manufacturer’s obligations are limited to those set out in the warranty document.

**PART 2 – PRODUCTS**

2.1 MANUFACTURER

- A. DuPont Shanghai constituent company  
No. 11 Building, No. 339 Ke Yuan Road  
Zhangjiang Hi-tech Park  
Pu Dong New Area Shanghai

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Post code : 201203

TEL : +86-21-3862-2888

Fax : +86-21-3862-2889

Website: [http://www2.dupont.com/Tyvek\\_Construction\\_Asia\\_Pacific/zh\\_CN/](http://www2.dupont.com/Tyvek_Construction_Asia_Pacific/zh_CN/)

## 2.2 PRODUCTS

- A. DuPont TyvekThermaWrap and assembly components

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

### 3.2 INSTALLATION

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations
- B. Install weather barrier prior to installation of windows and doors.
- C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap
- D. Install weather barrier silver side facing air space.
- E. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level
- F. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
- G. Window and Door Openings: Extend weather barrier completely over openings.
- H. Overlap weather barrier: Exterior corners: minimum 12 inches. Seams: minimum 6 inches.

**END OF SECTION 07 13 00**

## **SECTION 07 21 00 Thermal Insulation**

### **PART 1 - GENERAL**

#### **SECTION INCLUDES**

- A. 07 21 23.13 Foam board Insulation

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B. 07 21 23.19 Mineral board Insulation

## 1.2 SUBMITTALS

- A. Datasheets knaufPolyfoam XPS board, **Polyfoam Linerboard**(CD: Plan# S-411-S-416)
- B. Safety datasheet knaufPolyfoam XPS board, **Polyfoam Linerboard**(CD: Plan# S-411-S-416)
- C. Knauf Brochure-Polyfoam-Solutions-Guide, **Polyfoam Linerboard**(CD: Plan# S-411-S-416)
- D. Datasheets Vacuum Insulations Panels (CD: Plan# S-411-S-416)

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

#### A.Knauf Insulation Ltd

PO Box 10  
Stafford Road  
St Helens  
Merseyside  
WA10 3NS

Phone: 01744 766600

Fax: 01744 612007

E-mail: [sales@knaufinsulation.com](mailto:sales@knaufinsulation.com)

Contact: [http://www.knaufinsulation.co.uk/contact\\_us.aspx](http://www.knaufinsulation.co.uk/contact_us.aspx)

Web: [http://www.knaufinsulation.co.uk/products/polyfoam\\_xps/polyfoam\\_wall\\_insulation/polyfoam\\_linerboard.aspx](http://www.knaufinsulation.co.uk/products/polyfoam_xps/polyfoam_wall_insulation/polyfoam_linerboard.aspx)

#### B. Fujian Super Tech Advanced Material Co., Ltd.

No. 99 Liantang Road,

North Industrial Region,

Jimei, Xiamen, Fujian, China

Contact Person: Sun Xiaokao (VIP project manager)

Mob: +86-13779964223

Tel: +86-592-6199916

Fax: +86-592-6199957

Email: [sunxiaokao@163.com](mailto:sunxiaokao@163.com)

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Website:<http://www.supertech-vip.com/En/>

## 2.2 PRODUCTS

A. knaufPolyfoam XPS board, Polyfoam 300 SE,100 kPa, 20 mm

D.SUPER TECH—VIP(Vacuum Insulation Panel)

## PART 3 - EXECUTIONS

- A. Select panels that are as square as possible.
- B. Because the envelope of the panel is made of aluminum foil, lay the panels in a double layer, overlapping by at least 5 cm.
- C. VIP must be well protected from mechanical damage.
- D. VIP must be handled with care and suitable protective measures and tools should be used.

**END OF SECTION 07 21 00**

## **SECTION 07 25 00 WEATHER BARRIERS**

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

(Specifier Note: “Weather barrier assembly” has been used throughout the document. A weather barrier is a weather-resistant membrane for vertical building envelope protection that will maintain air/moisture resistance while maintaining moisture-vapor permeability. The assembly consists of the following four components.)

- A. Weather barrier membrane (DuPont™Tyvek®DrainWrap™)
- B. Seam Tape (DuPont™Tyvek® Tape)
- C. Flashing (DuPont™FlexWrap™,DuPont™StraightFlash™ and/or DuPont™StraightFlash™ VF)
- D. Fasteners (DuPont™Tyvek® Wrap Caps)

#### 1.2 REFERENCES

- A. ASTM International
  - 1. ASTM C920; Standard Specification for Elastomeric Joint Sealants
  - 2. ASTM C1193; Standard Guide for Use of Joint Sealants
  - 3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting
  - 4. ASTM D1117; Standard Guide for Evaluating Non-woven Fabrics
  - 5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials

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6. ASTM E96; Test Method for Water Vapor Transmission of Materials
  7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls
  8. ASTM E2178; Test Method for Air Permeance of Building Materials

B. AATCC – American Association of Textile Chemists and Colorists

1. Test Method 127 Water Resistance: Hydrostatic Pressure Test

C. TAPPI

1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area)
2. Test Method T-460; Air Resistance (Gurley Hill Method)

### 1.3 SUBMITTALS

(Specifier Note: The use of a weather barrier as part of an assembly to reduce air infiltration may assist in achieving points for LEED® Certified Projects or an ENERGY STAR® label for new homes or home improvements. Contact a DuPont™ Tyvek® Specialist for assistance.)

- A. Refer to Section [01 33 00 Submittal Procedures] [insert section number and title].
- B. Product Data: Submit manufacturer current technical literature for each component.
- C. Samples: Weather Barrier membrane, minimum 8-1/2 inches by 11 inch.
- D. Quality Assurance Submittals
  1. Manufacturer Instructions: Provide manufacturer’s written installation instructions.

(Specifier Note: See the DuPont website for more information on residential warranties.)

E. Closeout Submittals

1. Refer to Section [01 78 00 Closeout Submittals] [insert section number and title].

### 1.4 QUALITY ASSURANCE

A. Qualifications

1. Installer shall have experience with installation of similar weather barrier assemblies under similar conditions.
2. Installation shall be in accordance with manufacturer’s installation guidelines and recommendations.
3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section [01 60 00 Product Requirements] [insert section number and title].

- 
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - C. Store weather barrier materials as recommended by system manufacturer.

## 1.6 SCHEDULING

(Specifier Note: The preferred order of installation for DuPont™Tyvek®DrainWrap™ is prior to the installation of windows and doors.)

- A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.

## PART 2 - PRODUCTS

(Specifier Note: Product Information is proprietary to DuPont™Tyvek®DrainWrap™. If additional products are required for competitive procurement, contact DuPont Building Innovations for assistance.)

### 2.1 MANUFACTURER

- A. DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 721, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://construction.TYVEK.com>

### 2.2 MATERIALS

- A. Basis of Design: Textured, spunbonded polyolefin, non-woven, non-perforated, weather barrier is based upon DuPont™Tyvek®DrainWrap™ and related assembly components.
- B. Performance Characteristics:
  1. Air Penetration: 0.004 cfm/ft<sup>2</sup> at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
  2. Water Vapor Transmission: 50 perms, when tested in accordance with ASTM E96, Method B.
  3. Water Penetration Resistance: 210 cm when tested in accordance with AATCC Test Method 127.
  4. Basis Weight: 2.1 oz/yd<sup>2</sup>, when tested in accordance with TAPPI Test Method T-410.
  5. Air Resistance: 300 seconds, when tested in accordance with TAPPI Test Method T-460.
  6. Tensile Strength: 30/30 lbs/in., when tested in accordance with ASTM D882, Method A.
  7. Tear Resistance: 7/9 lbs, when tested in accordance with ASTM D1117.
  8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 5, Smoke Developed: 25

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## 2.3 ACCESSORIES

A. Seam Tape: [2] [or] [3] inch wide, DuPont™Tyvek® Tape as manufactured by DuPont Building Innovations.

B. Fasteners:

(Specifier Note: Fasteners are dependent upon substrate construction. More than one type of fastener may be required on a single project. REVIEW construction conditions and DELETE fasteners that are unnecessary.)

1. (Specifier Note: Steel Frame Construction) DuPont™Tyvek® Wrap Cap Screws, as manufactured by DuPont Building Innovations: 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.

AND/OR

2. (Specifier Note: Wood Frame Construction)Tyvek® Wrap Caps, as manufactured by DuPont Building Innovations: #4 nails with large 1-inch plastic cap fasteners.

AND/OR

3. (Specifier Note: Wood Frame Construction – Residential)Tyvek® Wrap Cap staples as manufactured by DuPont Building Innovations. (Cap staples are only recommended for residential construction.)

AND/OR

4. (Specifier Note: Masonry Construction) Masonry tap-con fasteners with Tyvek® Wrap Caps as manufactured by DuPont Building Innovations: 2-inch diameter plastic cap fastener.

C. Sealants

(Specifier Note: Sealants compatible with weather barrier assembly may be specified in this section or in Division 07 sealants section. DELETE paragraphs 2 and 3 when sealants are specified in Division 07.)

1. Refer to Section [07 92 00 Joint Sealants] [insert section number and title].

OR

2. Provide sealants that comply with ASTM C920, elastomeric polymer sealant to maintain watertight conditions.

(Specifier Note: Sealant products listed below have been tested for compatibility and intermittent contact with DuPont weather barrier materials. EDIT for specific project as appropriate when sealants are specified within this section.)

3. Products:
  - a. Tremco 830
  - b. Tremco Butyl

- 
- c. Sealants recommended by the weather barrier manufacturer

D. Adhesive:

- 1. Provide adhesive recommended by weather barrier manufacturer.

(Specifier Note: Products listed below are only recommendations for inclusion when required and should be EDITED for specific project.)

- 2. Products:

- a. Liquid Nails® LN-109
- b. Polyglaze® SM 5700
- c. Denso Butyl Liquid
- d. 3M High Strength 90

(Specifier Note: SIA product meets California VOC requirements.)

- e. SIA 655
- f. Adhesives recommend by the weather barrier manufacturer.

E. Primer:

- 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

(Specifier Note: Products listed below are only recommendations for inclusion when required and should be EDITED for specific project.)

- 2. Products:

- a. 3M High Strength 90
- b. Denso Butyl Spray

(Specifier Note: SIA product meets California VOC requirements.)

- c. SIA 655
- d. Permagrip 105
- e. ITW TACC Sta' Put SPH
- f. Primers recommended by the flashing manufacturer

F. Flashing

(Specifier Note: Flashing is dependent upon construction conditions. DELETE flashing products that are unnecessary and inappropriate for specific project.)

- 
1. DuPont™ FlexWrap™, as manufactured by DuPont Building Innovations: flexible membrane flashing materials for window openings and penetrations.

AND/OR

2. DuPont™ StraightFlash™, as manufactured by DuPont Building Innovations: straight flashing membrane materials for flashing windows and doors and sealing penetrations and masonry ties, etc.

AND/OR

3. DuPont™ StraightFlash™ VF, as manufactured by DuPont Building Innovations: dual-sided, straight flashing membrane materials for brickmold and non-flanged windows and doors.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

### **3.2 INSTALLATION – WEATHER BARRIER**

(Specifier Note: It is the recommendation and the preferred application for the weather barrier to be installed prior to the installation of the windows and doors. In cases where conditions require installation of the weather barrier after the window installation or use of non-flanged windows, contact a DuPont™ Tyvek® Specialist for assistance and recommendations.)

- A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
- B. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
- C. Apply wrap with grooved surface pattern in vertical direction.
- D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with grooved surface pattern in vertical position. Maintain weather barrier plumb and level.
- E. Extend bottom roll edge over sill plate 2” to 3”. Seal weather barrier with sealant or tape. Shingle weather barrier over back edge of weep screed. Seal weather barrier with sealant or tape to weep screed. Ensure weeps are not blocked.
- F. Subsequent layers shall overlap lower layers a minimum of 6 inches horizontally in a shingling manner.
- G. Window and Door Openings: Extend weather barrier completely over openings.
- H. Weather Barrier Attachment:

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(Specifier Note: Attachment method is dependent upon substrate construction. DELETE methods that are unnecessary and inappropriate for specific project.)

1. (Specifier Note: Steel or Wood Frame Construction) Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

AND/OR

2. (Specifier Note: Masonry Construction) Attach weather barrier to masonry. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center and 24 inches maximum horizontally. Weather barrier may be temporarily attached to masonry using recommended adhesive, placed in vertical strips spaced 24 inches on center, when coordinated on the project site.

(Specifier Note: Cladding anchors, supports and fasteners will likely be specified in the Section including the cladding. COORDINATE the inclusion of the following paragraph in the appropriate specification section. With weather barrier manufacturer's approval cladding anchors can be used to fasten the weather barrier.)

- I. Apply 4 inch by 7 inch piece of DuPont™ StraightFlash™ to weather barrier membrane prior to the installation cladding anchors.

### **3.3 SEAMING**

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

(Specifier Note: Opening preparation and flashing installation is dependent upon the construction of the opening and construction of the window. DELETE execution requirements that are not appropriate for specific project. COORDINATE proper design and detailing at windows, doors and other openings or intersections for proper flashing in accordance with window manufacturer guidelines, industry standards and best flashing and waterproofing practices, For non-flanged or brick mold windows contact manufacturer.)

### **3.4 OPENING PREPARATION (for use with flanged windows)**

- A. Cut weather barrier membrane in a modified "I-cut" pattern.
  1. Cut weather barrier horizontally along the bottom of the header.
  2. Cut weather barrier vertically 2/3 of the way down from top center of window opening.
  3. Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
  4. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45-degree angle in the weather barrier membrane at window head to expose 8 inches of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

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### 3.5 FLASHING

(Specifier Note: DuPont recommends the use of the 7-inch wide DuPont™ FlexWrap™ with 2 by 4 framing and 9-inch wide DuPont™ FlexWrap™ with 2 by 6 framing.)

- A. Cut [7-inch] [9-inch] wide DuPont™ FlexWrap™ a minimum of 12 inches longer than width of sill rough opening. Apply primer to sheathing as recommended by manufacturer.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply 4-inch wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
- G. Apply 4-inch wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere using 4-inch wide DuPont™ StraightFlash™ over the 45-degree seams.
- I. Tape head flap in accordance with manufacturer recommendations
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C 1193.

### 3.6 PROTECTION

- A. Protect installed weather barrier from damage.

**END OF SECTION 07 25 00**

#### **DISCLAIMER:**

DuPont Building Innovations Guide Specifications have been written as an aid to the professionally qualified specifier and design professional. The use of this guideline specification requires the sole professional judgment and expertise of the qualified specifier and design professional to adapt the information to the specific needs for the building owner and the project, to coordinate with their construction document process, and to meet all the applicable building codes,

regulations and laws. DUPONT EXPRESSLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE OF THIS PRODUCT FOR THE PROJECT.

Please contact your local DuPont™ Tyvek® Specialist at 1-800-44-Tyvek or visit [www.Construction.Tyvek.com](http://www.Construction.Tyvek.com)

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## **SECTION 07 92 00 JOINT SEALANT**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES:

- A. Provide Sealant for exterior or interior perimeter, expansion and control joints as indicated, including substrate preparation, sealant installation and clean up of related installations.

(Specifier Note: Edit to suit each new product specified.)

#### B. Related Sections:

1. Section 04210: Unit Masonry Construction
2. Section 07270: Air Barriers
3. Section 07240: EIFS - Exterior Insulation and Finish Systems.
4. Section 08910: Metal Framed Curtain-Wall
5. Section 09220: Portland Cement Plastering and Stucco Systems.
6. Section 09960: Special Coatings

#### 2.1 REFERENCES

##### A. ASTM International

1. ASTM-C 920; Standard Specification for Elastomeric Joint Sealants
2. ASTM C1193; Standard Guide for Use of Joint Sealants

##### B. FEDERAL SPECIFICATION

1. TT-S-00230C, Type S, Class A

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C. American Architectural Manufacturers Association

1. AAMA 803.3, Sealant Compliance

3.1 SUBMITTALS

- A. Refer to Section 01330 for submittal procedures and USGBC LEED® qualification information.
- B. U.S. Green Building Counsel Leadership in Energy and Environmental Design ( USGBC LEED®): The USGBC LEED® Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance sustainable buildings.

(Specifier Note: Edit for USGBC LEED® requirements to suit the specific project. Only low-VOC sealants qualify for interior use.)

- C. Product Data: Submit sealant manufacturer’s most current technical product data indicating compliance with specified requirements and installation instructions for type of sealant specified.
- D. Quality Control Submittals:
  - 1. Pre-Installation Conference: Submit report verifying project site conditions and mock-up acceptance prior to installation, including any special requirements as applicable.
  - 2. Installation Schedule: Submit an installation schedule with sequence of sealant placement and various types of joint sealants required per area as required.
- E. Contract Closeout Submittals: Refer to Section 01780 for Closeout Submittal information.
  - 1. Warranty: Manufacturer's standard 10 year limited product warranty.

4.1 QUALITY ASSURANCE

(Specifier Note: Quality Assurance procedures can be obtained from your local DuPont™ Tyvek® Specialist. They are also accessible at [www.construction.tyvek.com](http://www.construction.tyvek.com).)

- A. Installer Qualifications: Installer to comply with quality assurance articles referenced in ASTM C-1193 for installation of residential sealants.
- B. Pre-Construction Mock-Up: Install mock-up prior to installation using acceptable residential joint sealants including surface preparation per sealant manufacturer's instructions. Obtain Architect/Engineer/Consultant or Owner’s approval of joint treatments to establish adhesion, appearance and workmanship standard.

(Specifier Note: Edit below mock-up description, size, etc. to suit each project.)

- 1. Mock-Up Size: Five (5) feet by Five (5) feet or \_\_\_\_ LF of joint sealant
- 2. Mock-Up Substrate: \_\_\_\_\_ vertical surfaces as agreed to prior to Mock-up installation.
- 3. Maintain mock-up during construction for workmanship standard.
- 4. Mock-up to be incorporated into final construction upon Architect/Engineer/Consultant/Owner’s

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written approval

### 5.1 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, handle, and protect all products in accordance with Section 01600, Product Requirements.
- B. Comply with manufacturer's ordering instructions and lead-time(s) required to avoid construction delays.
- C. Deliver residential sealant materials in manufacturer's original, unopened, undamaged containers with identification labels clearly intact.
- D. Store and protect residential sealant material containers from harmful weather conditions as recommended by sealant manufacturer. Protect from damage during construction and while stored onsite. Store joint sealant materials at temperatures recommended by sealant manufacturer.

### 6.1 PROJECT CONDITIONS

- A. Environmental Requirements: Verify substrates and ambient air temperature at project site before, during and after application to assure compliance with manufacturer's recommendations. Surfaces shall be frost-free, clean and completely dry at time of installation.
  - 1. Weather Conditions: In accordance with manufacturer's instructions, do not apply sealants in snow, rain, fog, or mist, or when such conditions are expected. Allow joint surfaces to attain dry conditions as recommended by manufacturer before sealant application. Apply only when sealant, surface and air temperatures will remain above freezing. Do not apply on substrates or surfaces that are above 160 degrees F.
  - 2. Compliance: Follow manufacturer's specific safety, health and environmental recommendations per most recent Material Safety Data Sheets, technical bulletins and instructions. Handle all solvents in compliance with applicable EPA, OSHA, and VOC requirements regarding health/safety standards.

### 7.1 WARRANTY

(Specifier Note: Specific project workmanship warranties must be provided by the installer or through a performance bond. Coordinate with Section 01700 – Contract Closeout, Warranties and Bonds.)

- A. Manufacturer's Warranty: Submit manufacturer's standard product warranty at completion.
  - 1. Warranty Areas: \_\_\_\_\_.

(Specifier Note: Use warranty areas for description of work protected and areas of work excluded as required by project conditions.)

## PART 2 - PRODUCTS

(Specifier Note: Product Information is proprietary to DuPont™ Tyvek® AtticWrap™. If additional products are required for competitive procurement, contact DuPont Building Innovations for assistance.)

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## 2.1 MANUFACTURERS

- A. Product Options: Selection of Residential joint sealant material is based upon a proprietary urethane-modified acrylic sealant technology by DuPont Building Innovations. Any request for substitution must be submitted a minimum of 10 days prior to Bid for written approval by Architect/Engineer/or Consultant. Request received after this date will not be accepted. Coordinate with Section 01630 Product Substitution Procedures.
- B. Approved Manufacturer: DuPont; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://www.construction.tyvek.com>

## 2.2 MATERIALS

- A. General: Provide residential sealant and backing materials that are compatible under conditions of service and applications based on mock-up and field-adhesion test results.
- B. Residential Grade Joint Sealant: Provide weather-barrier compatible, urethane-modified acrylic residential sealant for continuous weather sealing installation as indicated. Comply with ASTM C-920 classifications for type, grade, class, and related use exposure and joint substrate conditions as follows:
  - 1. Single-Component, non-sag, medium-modulus, U-V resistant, residential grade joint sealant:
    - DuPont™ Residential Sealant: Type S (single-component), grade, NS (Non-sag), Class 25 (+/-25% movement capability per ASTM C-719), uses, NT, M, G, A, and O.
- C. Performance Requirements: DuPont™ Residential Sealant:
  - 1. Hardness, ASTM D-661, Shore A = 13 +/-2
  - 2. Tensile Strength, ASTM D-2370 > 150 PSI
  - 3. Elongation, ASTM D-2370 – >800 percent
  - 4. Cyclic Movement, ASTM C-719; 50% (+/-25 percent movement)
  - 5. Low Temperature Flexibility, ASTM C-793; Pass 180 degree bend (1/2” inch mandrel @ -15 degrees F)
  - 6. Peel Strength, ASTM C-794 > 20 PLI
  - 7. VOC (Volatile Organic Compound) < 1.5% by weight or 16 g/l – Meets SCAQMD Rule#1168 and California Air Resources Board (CARB) VOC regulations as required for interior sealants for USGBC LEED® rated projects)

## 2.3 SEALANT ACCESSORIES:

- A. General: Provide joint backings, fillers, or primers as recommended by joint sealant manufacturer.
- B. Cylindrical Sealant Backings: Provide joint backings that meet ASTM C-1330, Type O (open-cell polyurethane) or Type B (non-absorbent bi-cellular backing materials with surface skin) sized 25% or greater

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than joint opening with proper density to control sealant depth and profile. Follow joint sealant manufacturer's recommendations with backing selections for optimum joint sealant performance.

- C. Bond-breaker tape: Polyethylene tape or other approved plastic tape as recommended by joint sealant manufacturer to prevent 3-sided joint adhesion to rigid, in-flexible joint fillers or fillet joint surfaces at back of joint where such adhesion would restrict proper sealant movement or result in sealant failure.
- D. Masking tape: Non-staining, non-absorbent and compatible with joint sealants and adjacent surfaces.
- E. Primers: Use primers only as recommended by sealant manufacturer where required for adhesion of sealant to joint substrates indicated and as determined for use from pre-construction mock-up testing.

### **PART 3 - EXECUTION**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- A. Comply with manufacturer's most recently published product data, including installation instructions, substrate field mock-up testing, and surface preparation for joint sealant installation.

#### **3.2 EXAMINATION**

- A. Site Verification of Conditions: Examine joints indicated to receive residential sealant and verify joint substrate conditions are acceptable for installation in accordance with sealant manufacturer's instructions. Avoid installation until unsatisfactory conditions have been corrected.
  - 1. General: All joint surfaces must be cleaned and totally dry, frost free, and dust free before joint sealant application begins for optimum performance. Remove all foreign matter and contaminants including dirt, dust, oil grease, mildew, loose paint, rust, scale or old caulk.
  - 2. Surface Defects and Repairs: New substrates or newly repaired joint surfaces must be allowed to cure to full-capacity per manufacturer's recommendations. Joint surfaces must be visibly clean and dry before installation of sealants or backing materials.

#### **3.3 PREPARATION**

- A. General: Clean and prepare joint surfaces immediately before installing residential sealant. Protect adjacent work areas and finished surfaces from damage during sealant installation.
- B. Clean porous surfaces by using heavy duty brushing, light abrasive, mechanical abrading or combination of these methods to produce a clean sound surface for optimum sealant bonding per joint sealant manufacturer's recommendations. Provide a dry, dust-free and cleaned substrates for optimum results.
- C. Clean non-porous surfaces by using a two-cloth, solvent wipe method as referenced in ASTM C-1193 and per sealant manufacturer's instruction. IPA (isopropyl alcohol) may be used in new construction, non-porous joint cleaning and preparation. Use xylene, toluene, or MEK (methyl ethyl ketone) should only be used for degreasing solvent or for more aggressive cleaning of non-porous surface residue.

- 
- D. Rust or scale must be removed. Prepare substrates using abrasive cleaning methods as recommended by sealant manufacturer prior to sealant installation.
  - E. Coordinate cleaning and installation to avoid contamination of wet, freshly coated or adjacent finished surfaces.

### 3.4 INSTALLATION

- A. General: Comply with residential sealant manufacturer's installation instructions for applications indicated unless more stringent project specific instructions or requirements apply. Only apply when joint sealant, surface and air temperature will remain above freezing. Avoid substrates exceeding 160 degrees F.
- B. Install joint sealant backings of type and size required. For EIFS substrates, use only joint sealant backings that are non-porous, (ASTM C-1330, Type B or C) and sized a minimum of 25% larger than joint opening. For non-EIFS joinery, install open-cell backer-rod (ASTM C-1330, Type O) as recommended by joint sealant manufacturer sized a minimum of 25% larger than joint opening.
  - 1. Avoid gaps, twisting, stretching, or puncturing joint sealant backing materials. Place backing materials into joint opening to provide the uniform sealant depth allowing optimum sealant profile.
  - 2. Install bond-breaker tape behind sealant joints where backer-rod is not feasible. Use to avoid 3-sided adhesion at backside of sealant joint.
  - 3. Use masking tape as required to protect adjacent finished surfaces prior to joint sealant installation.
- C. Apply residential sealant for continuous weatherproof protection. Vertical joints should be lapped over horizontal joints. Comply with installation recommendations in ASTM C-1193 for use of residential joint weather sealing installations. Comply with all sealant manufacturers installation instructions during installation of residential sealant.
- D. Install residential sealants in proper sequence with installation of backings.
  - 1. Using proper joint sealant dispensing equipment. Place sealants by pushing bead into joint opening to fully wet-out joint substrates. Fill sealant joint opening to full and proper hourglass configuration.
  - 2. Install providing uniform cross-sectional shapes and depths in relation to joint width for optimum sealant movement capability per joint sealant manufacturer's instructions.
- E. Immediately after placing fresh sealant and before skinning or curing begins, tool sealants using metal spatulas or tools designed for this purpose in accordance with manufacturer's recommendations. Provide a smooth uniform sealant finish, eliminating air pockets and ensuring good contact for optimum sealant adhesion within each side of the joint opening.
  - 1. Provide concave joint configuration as indicated per figure 5-A in ASTM C-1193 unless otherwise indicated for the project. Dry tooling is recommended. Avoid using soap and solvents for wet-tooling.
  - 2. Remove excess sealant from surfaces adjacent to joint openings using metal spatula, promptly cleaning any sealant residue from adjacent finished surfaces. Remove masking after joint sealant is installed.

- 
- F. Allow residential joint sealant to cure for a minimum of 7-14 days before adhesion testing is preformed as recommended by joint sealant manufacturer. Do not apply solvent-based sealers specified in Section 07190 until full sealant cure period is attained.
  - G. Match approved sealant mock-up for uniform finish, and overall aesthetics. Remove, refinish, or re-install work not in compliance with the Contract Documents.

### 3.5 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Installer to keep log of sealant installation, recording self preformed field-adhesion test as needed for the project. Coordinate with Section 01450 – Field Quality Control.

5. Field-Tests: Field test joint sealants in accordance with Method A, Field-Applied Sealant joint Hand Pull Tab, in Appendix X-1 in ASTM C-1193.

6. Evaluation: For joint sealants that fail to adhere to the substrate, clean, re-install, and then re-test until optimum results are obtained.

### 3.6 CLEANING AND PROTECTION

- A. Clean excess sealant or sealant residue adjacent to sealant joint installations as the Work progresses. Avoid damage to adjacent surfaces from harmful removal techniques. Protect finished surfaces beyond those that have been masked. Remove and replace damaged joint sealants during construction.
- B. Remove temporary coverings and masking protection from adjacent work areas upon completion. Remove construction debris from the project site on a planned and regular basis.

**END OF SECTION 07 92 00**

## **Division 08 – Openings**

### **SECTION 08 01 90 ROOF VENTILATION**

#### **PART 1 – GENERAL**

##### 1.1 SECTION INCLUDES

- A. Phase change materials (PCMs)
- B. Collectors
- C. Openings

#### **PART 2 - PRODUCTS**

##### 2.1 MANUFACTURER

- A. Guangzhou ZhengfangJienengKeji Co., Ltd.  
No.2272,Huangpu East Road, Guangzhou, China.

Tex: +86-020-8442-5794

Fax: +86-020-8442-5794

Email: [zfecgz@163.com](mailto:zfecgz@163.com)

Web: <http://product.ch.gongchang.com/d2728694.html>

B. Vic-man Co., Ltd.

No.999, Zhouxiang South Road, Ningbo, China

Tel: +86-574-6331-7755

Fax: +86-574-6331-6688

E-mail: [sales@vic-man.cn](mailto:sales@vic-man.cn)

Web: <http://www.vic-man.cn/products/>

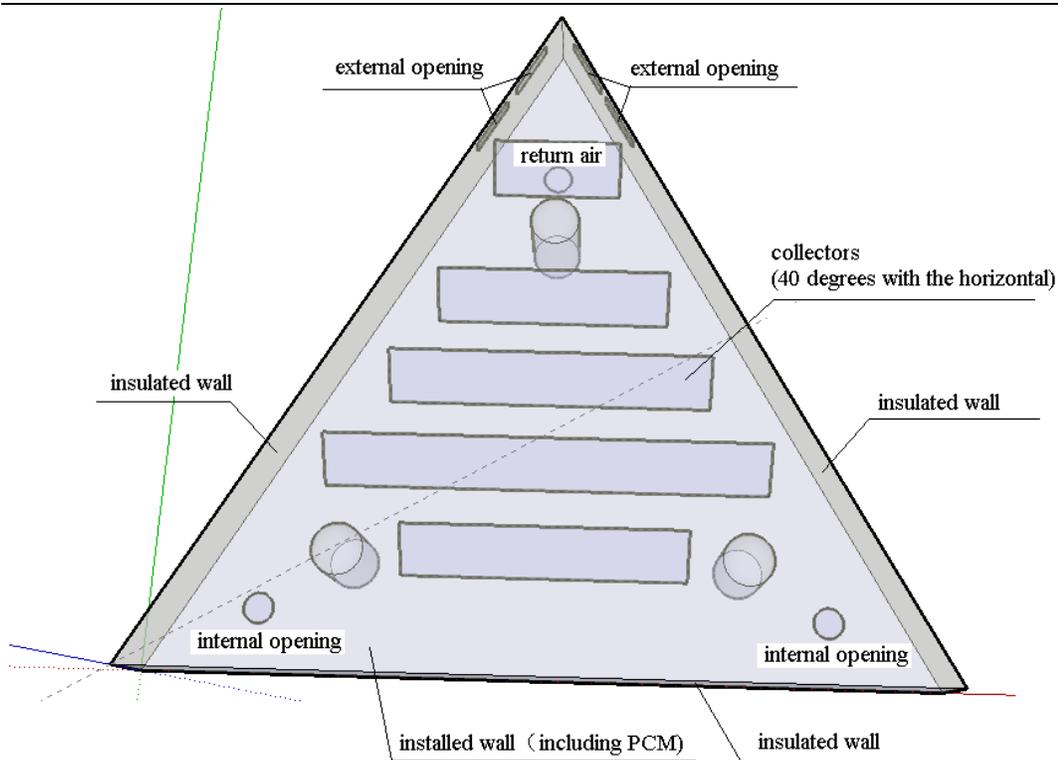
C. No determined yet

### **PART 3 – EXECUTION**

In order to provide adequate amount of fresh air, we make full use of natural ventilation.

As we all know, natural ventilation relies on the density difference of air, which is caused by wind pressure or temperature gradient. Natural ventilation caused by wind pressure is closely related to local weather and is hard to control. Thus, conventionally we consider more about using indoor air temperature difference, which will cause chimney effect to achieve ventilation. However, temperature gradient must be large enough, so commonly, only buildings that are high enough and designed properly can achieve this kind of natural ventilation.

Since Y-BOX is only 4 meters high, which is not high enough to form a temperature field with large temperature difference, we came up with the idea that a heat collector can be used at the top of the house to create large temperature difference. As shown below, the triangle area is designed as a heat collector.

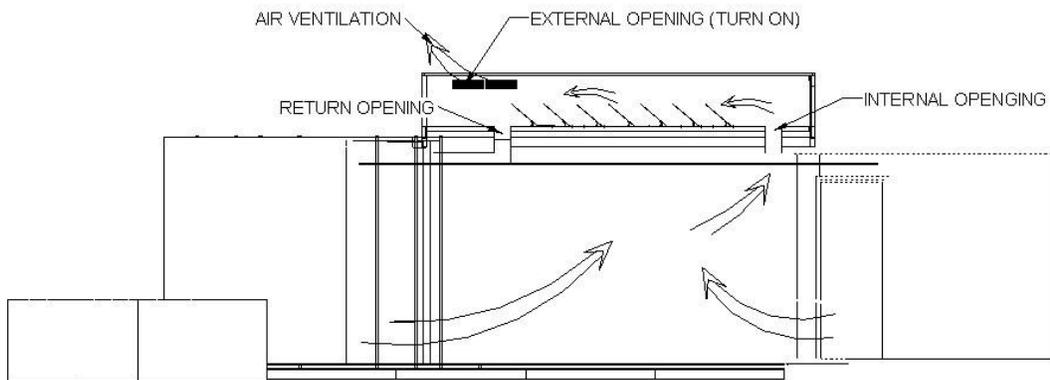


In fact, it's a triangle container with all-glass type on its top surface and with good insulation on its other surfaces. There are several solar plate collectors in it. Collectors are installed 40 degrees with the horizontal in order to collect solar heat more effectively. The air temperature in this container increases rapidly, which contributes to induce indoor air cycle and achieve natural ventilation.

We consider that the indoor air temperature is  $22^{\circ}\text{C}$  and the temperature difference of  $30^{\circ}\text{C}$  is large enough to create natural ventilation. Therefore, we take full use of lots of PCMs, which are installed in the back of collectors and on the bottom of the container. PCMs can maintain a proper temperature (about  $50^{\circ}\text{C}$ ) in this container.

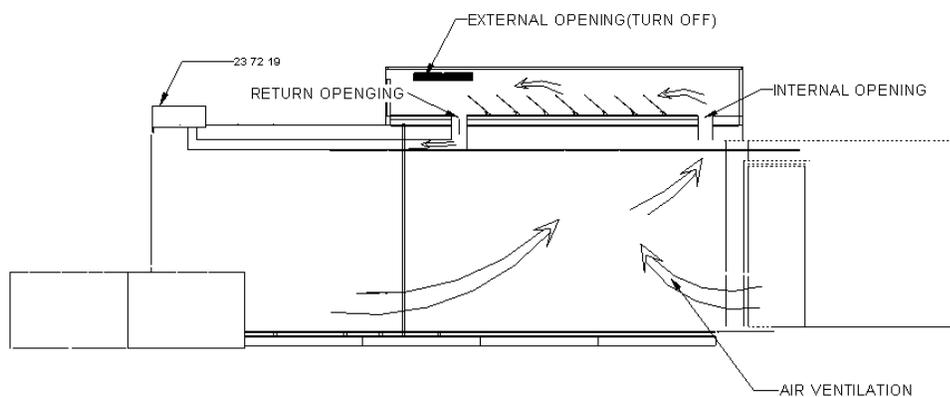
This container connects with the interior Y-box. In the fine day, solar heat that the container absorbed is divided into two parts, one part is used to heat the air in the container, the other part is saved in PCMs. Just as the principle we talked, air on the upper part of the house is higher than the lower, so density difference gives rise to ventilation. Therefore indoor air is taken away by the drive force of hot air. At night, PCMs releases its heat to increase the air temperature in the container, which helps to maintain the temperature of the triangle container, and taking away indoor air.

In autumn or spring, we should make full use of natural ventilation, which not only saving energy, but also providing us with natural environment of comfort. The indoor air is discharged through the container on roof and replaced by fresh air through door or window.



RUNING TACTICS IN AUTUMN OR SPRING

In winter, we can close the external opening to collect heat in this container to heat Y-BOX, which contributes to reduce heating load.



RUNING TACTICS IN WINTER

However, in summer, because of the good performance of insulation materials, the heat in this container would not increase the indoor load.

**END OF SECTION 08 01 90**

## **SECTION 08 10 00 DOORS AND FRAMES**

### **PART 1 – GENERAL**

#### **1.1 SUMMARY**

Section includes the following:

- A. Two Wood-framed Glass doors;
- B. safety film on the glass

#### **1.2 SUBMITTALS**

Product Datasheets

- A. Detailed drawings indicating dimensioning, configuration, type of glazing material

---

B. Product data including link to manufacturer's literature independently tested data listing performance criteria and Silber's Manual with installation instructions.

Silber website <http://www.silberfenster.com/>  
<http://www.silberchina.com/about.asp>

C. Product Data including link to manufacturer's literature independently tested data listing performance criteria and LLumars' (a branch of Solutia product) Manual with installation instructions.

LLumars website <http://www.solutia.com/>  
<http://www.llumar.com/en/automotive.aspx>  
<http://www.ezwin.com.cn/index.asp>

### 1.3 DELIVERY, STORAGE AND HANDLING

A. 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.

### 1.4 WARRANTY

A. Provide manufacturer's standard warranty against defects in materials and workmanship.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

**SILBER Fensterbau GmbH** Mistelbacher  
Str. 19 A-4613 Mistelbach /Buchkirchen bei Wels Austria  
Tel.: +43 (0) 7243/ 57170, Fax: +43 (0) 7243/ 57170-3  
E-Mail: [office@silberfenster.com](mailto:office@silberfenster.com)  
Web: [www.silberfenster.com](http://www.silberfenster.com)

LLumars website <http://www.solutia.com/>  
<http://www.llumar.com/en/automotive.aspx>  
<http://www.ezwin.com.cn/index.asp>  
Tel.: (86) 021-54155822 64607728, Fax: (86) 021-64607738  
E-Mail: [webmaster@ezwin.com.cn](mailto:webmaster@ezwin.com.cn)  
Web: <http://www.solutia.com/>  
<http://www.llumar.com/en/automotive.aspx>  
<http://www.ezwin.com.cn/index.asp>

### 2.2 PRODUCTS

- A. Entrance Door 3-glass insulation glass
- B. Terrace Doors, 3-glass insulation glass
- C. The doors' frame is fichte

**KURZBERICHT**  
**B07.270.025.480**



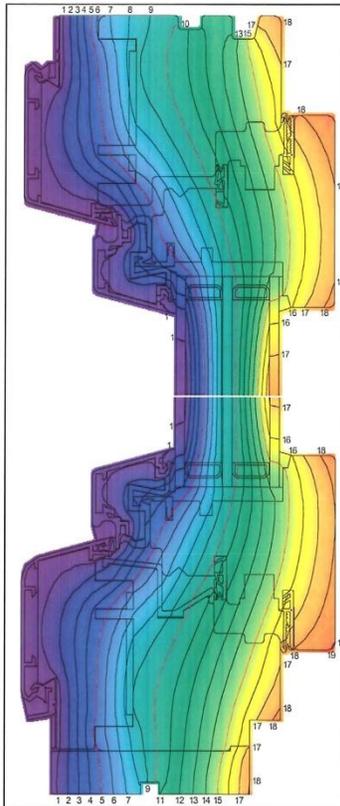
Hersteller

**Franz Silber Fensterbau GmbH**

Produktbezeichnung

**SUPERLUX - PASSIV**

**Profil**



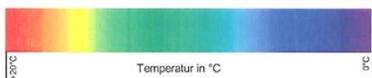
**Beschreibung**

Rahmen		Holz-Alu	
	Seite /oben	unten	
Profiltiefe	78	78	mm
Rahmenbreite	125	143	mm
<b>U<sub>f</sub></b>	<b>0,92</b>	<b>0,85</b>	W/m <sup>2</sup> K
Quelle	B07.270.023.482/LFB/12.06.2007		

Verglasung		4/16/4/16/4 mm	
Gasfüllung	Argon	90%	
Beschichtung - ε/Ebene		0,03/2+5	
<b>U<sub>g</sub></b>		<b>0,6</b>	W/m <sup>2</sup> K
Quelle	It. Berechnung LFB		

Randverbund		Swiss Spacer V	
	Seite /oben	unten	
<b>ψ</b>	<b>0,033</b>	<b>0,034</b>	W/mK
Quelle	B07.270.023.482/LFB/12.06.2007		

Fenster		einflügelig DK	
Stockaußenmaß	Breite	1230	mm
	Höhe	1480	mm
<b>U<sub>w</sub></b>		<b>0,77</b>	W/m <sup>2</sup> K
Quelle	B07.270.024.480/LFB/12.06.2007		



Anmerkungen 12.06.2007



D.The photo on the top show the passiv standard of SILBER and our doors will arrive it at least.

$U_f=0.85w/m^2k$ ;  $U_g=0.60w/m^2k$ ;  $U_w=0.77w/m^2k$



E. Solutia glass film is introduced by the official in E-mail to protect the glass. LLumars is the only branch product of Solutia in China until now. The photo on the top could prove it.

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION**

- A. The door will be installed by the professional worker from the agent.
- B. The glass film will be installed by the professional worker from the agent.
- C. If necessary, adjust hardware for proper operation.

**END OF SECTION 081000**

### **SECTION 08 50 00WINDOWS**

#### **PART 1 – GENERAL**

##### **1.1 SUMMARY**

Section includes the following:

- 
- A. Operating Hardware
  - B. Wood Windows
  - C. safety film on the glass

## 1.2 SUBMITTALS

### Product Datasheets

- A. Detailed drawings indicating dimensioning, configuration, type of glazing material
- B. Product data including link to manufacturer's literature independently tested data listing performance criteria and Silber's Manual with installation instructions.

Silber website <http://www.silberfenster.com/>

<http://www.silberchina.com/about.asp>

- C. Product Data including link to manufacturer's literature independently tested data listing performance criteria and LLumars' (a branch of Solutia product) Manual with installation instructions.

LLumars website <http://www.solutia.com/>

<http://www.llumar.com/en/automotive.aspx>

<http://www.ezwin.com.cn/index.asp>

## 1.3 DELIVERY, STORAGE AND HANDLING

- A. 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.

## 1.4 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

SILBER Fensterbau GmbH Mistelbacher

Str. 19 A-4613 Mistelbach /Buchkirchen bei Wels Austria

Tel.: +43 (0) 7243/ 57170, Fax: +43 (0) 7243/ 57170-3

E-Mail: [office@silberfenster.com](mailto:office@silberfenster.com)

Web: [www.silberfenster.com](http://www.silberfenster.com)

LLumars website <http://www.solutia.com/>

<http://www.llumar.com/en/automotive.aspx>

<http://www.ezwin.com.cn/index.asp>

Tel.: (86) 021-54155822 64607728, Fax: (86) 021-64607738

E-Mail: [webmaster@ezwin.com.cn](mailto:webmaster@ezwin.com.cn)

Web: <http://www.solutia.com/>

<http://www.llumar.com/en/automotive.aspx>

<http://www.ezwin.com.cn/index.asp>

### 2.2 PRODUCTS

- A. Windows, 3-glass insulation glass
- B. The windows' frame is fichte

C. The hardware is the "Tricoat" product of Maco.

KURZBERICHT  
B07.270.025.480



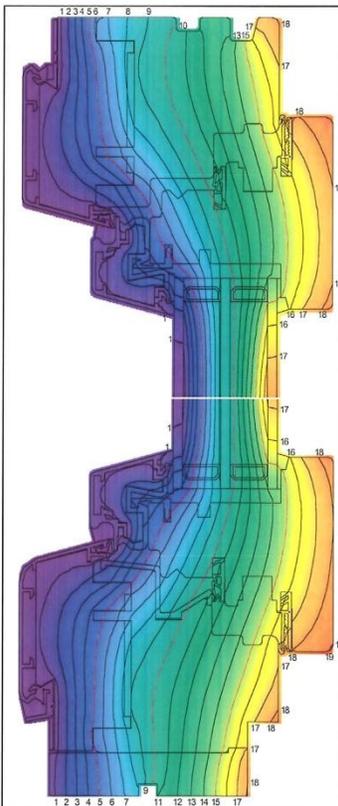
Hersteller

Franz Silber Fensterbau GmbH

Produktbezeichnung

**SUPERLUX - PASSIV**

Profil



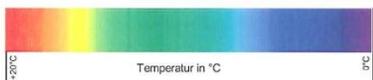
Beschreibung

Rahmen	Holz-Alu	
	Seite /oben	unten
Profiltiefe	78	78
Rahmenbreite	125	143
<b>U<sub>f</sub></b>	<b>0,92</b>	<b>0,85</b>
Quelle	B07.270.023.482/LFB/12.06.2007	

Verglasung	4/16/4/16/4	mm
Gasfüllung	Argon	90%
Beschichtung - e/Ebene	0,03/2+5	
<b>U<sub>g</sub></b>	<b>0,6</b>	
Quelle	IL Berechnung LFB	

Randverbund	Swiss Spacer V	
	Seite /oben	unten
<b>ψ</b>	<b>0,033</b>	<b>0,034</b>
Quelle	B07.270.023.482/LFB/12.06.2007	

Fenster	einflügelig DK	
Stockaußenmaß	Breite	1230 mm
	Höhe	1480 mm
<b>U<sub>w</sub></b>	<b>0,77</b>	
Quelle	B07.270.024.480/LFB/12.06.2007	



Anmerkungen 12.06.2007



D. The photo on the top show the passiv standard of SILBER and our doors will arrive it at least.

$$U_f=0.85\text{w/m}^2\text{k}; U_g=0.60\text{w/m}^2\text{k}; U_w=0.77\text{w/m}^2\text{k}$$



E. Solutia glass film is introduced by the official in E-mail to protect the glass. LLumars is the only branch product of Solutia in China until now. The photo on the top could prove it.

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION**

- A. The windows will be installed by the professional worker from the agent.
- B. The glass film will be installed by the professional worker from the agent.
- C. If necessary, adjust hardware for proper operation.

**END OF SECTION 08 50 00**

### **SECTION 08 60 00 ROOF WINDOWS AND SKYLIGHTS**

#### **PART 1 – GENERAL**

##### **1.1 SUMMARY**

- A. Section includes the following:

---

1. Roof windows complete with hardware, clear anodized finish

## 1.2 SUBMITTALS

- A. Detailed drawings indicating dimensioning, configuration, typical head jamb, side jambs, type of glazing material
- B. Product Data including link to manufacturer's literature independently tested data listing performance criteria and Energate's Manual with installation instructions.

## 1.3 DELIVERY, STORAGE AND HANDLING

- A. 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.

## 1.4 WARRANTY

- A. Provide manufacturer's standard warranty against defects in materials and workmanship.

## **PART 2 – PRODUCTS**

### 2.1 MANUFACTURERS

NOT DECIDED YET

### 2.2 PRODUCTS

NOT DECIDED YET

## **PART 3 – EXECUTION**

### 3.1 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 device and to securely and rigidly fit frame in place, absolute level, straight, and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
- C. If necessary, adjust hardware for proper operation.

**END OF SECTION 086000**

## **SECTION 08 91 00 LOUVERS**

### **PART 1 – GENERAL**

## 1.1 SUMMARY

Section includes the following:

- A. Louvers module
- B. Wood cell

## 1.2 SUBMITTALS

Product Datasheets

Louvers and open form on the facade

## 1.3 DELIVERY, STORAGE AND HANDLING

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.

## 1.4 WARRANTY

Provide manufacturer's standard warranty against defects in materials and workmanship.

## **PART 2 – PRODUCTS**

### 2.1 MANUFACTURERS

Tel: 86-21-65012228

Fax: 86-21-57793270

E-Mail: [sun-shading@qingying.net](mailto:sun-shading@qingying.net)

Web: <http://www.qingying.net>

### 2.2 PRODUCTS

The shade façade comes from the folding screen of China. Every folding screen module is made of metal frame .And regular 15mm\*15mm\*3000mm wood bars are fixed on the frame. What's more, the façade looks like a whole body.The sliding track will be fixed on the connective hardware which is fixed in the rear of the top beam.

## **PART 3 – EXECUTION**

### 3.1 INSTALLATION

- A. Install frame in accordance with manufacturer's recommendations and installation instructions.
- B. Installer to provide appropriate anchorage device and to securely and rigidly fit frame in place, absolute level, straight, and square. Install frame in proper elevation and location, and in proper alignment with other work.
- C. If necessary, adjust hardware for proper operation.

**END OF SECTION 08 91 00**

## **SECTION 09 20 00Phase Change Materials (PCMs)**

### **PART 1 – GRNERAL**

#### 1.1 SECTIION INCLUDES

- A. Thermal mass panel
- B. Tape

#### 1.2 SUBMITTALS

- A. Product Data: Submit Manufacturer's printed product data and specifications

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B.

[http://energain.co.uk/Energain/en\\_GB/assets/downloads/documentation/download/energain\\_datasheet\\_EN.pdf](http://energain.co.uk/Energain/en_GB/assets/downloads/documentation/download/energain_datasheet_EN.pdf)

## **PART 2 – PRODUCTS**

### **2.1 MANUFACTURER**

A. DuPont Shanghai constituent company

No. 11 Building, No. 339 Ke Yuan Road

Zhangjiang Hi-tech Park

Pu Dong New Area Shanghai

Post code: 201203

TEL: +86-21-3862-2888

Fax: +86-21-3862-2889

Web: [http://energain.co.uk/Energain/en\\_GB/index.html](http://energain.co.uk/Energain/en_GB/index.html)

### **2.2 PRODUCTS**

A. DuPont™Energain® Energy-Saving Thermal Mass Systems

### **2.3 DISCREPTION**

PCMs, Phase Change Materials, such as water, paraffin, salt hydrates, etc. are able to absorb, store and release large amounts of heat or cold at comparatively small temperature change by changing their physical state, as for example from solid to liquid, solid to solid or through evaporation of the storage material. The heat stored is called latent heat. Therefore materials are also referred to as “LATENT HEAT STORAGE MATERIAL”.

PCMs with a solid-liquid phase change are most commonly used, also in construction and building applications.

### **2.4 PERFORMANCE/DESIGN CRITERIA**

#### **A. Real-life experiment**

As part of the product development, DuPont has conducted a real-life experiment with the EDF (Electricite de France) Group France to primarily prove the functionality of the PCM panel when installed in the walls and roof structure of a real building and to secondarily gather data over summer, mid-season and winter season.

#### **B. Fire protection**

In case of a fire, temperature can reach up to 700°C in the first fifteen minutes and then can rise up to 1100°C. Product behavior such as ignition, surface spread, smoking and dripping are critical when fighting the fire.

DuPont has carried out a series of fire performance testing at independent notified bodies including BRE Certification Ltd., United Kingdom and MEP Leipzig GmbH, Germany.

Surface and edge exposure, 30s flame application time each: Class E, when in accordance with BS EN ISO 11925-2

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Installed behind plasterboard or stand alone: Class 1, when in accordance with BS 476 part 7

Fire resistance: Class E, when in accordance with BS EN ISO 13501-1:2003

C. Product recognitions

Web:[http://energain.co.uk/Energain/en\\_GB/products/product\\_regognitions.html](http://energain.co.uk/Energain/en_GB/products/product_regognitions.html)

## **PART 3 – EXECUTION**

### **3.1 INSTALLERS**

A. Measuring the panels

The panels should first be measured and marked to fit a specific area.

B. Cutting the panels

Where panels need to accommodate piping, angled brick/stone work and framing etc., they can be cut to any shape and size quite easily, with a sharp instrument, such as a Stanley knife. Gloves should be worn to avoid cuts, as the aluminum sheet coverings are thin and will have sharp edges when cut.

C. Taping the edges

Before installing the panels on a wall, each cut edge or abrasion to the aluminium facing of the panel should be ‘closed’ with the aluminum tape, so that none of the interior compound of copolymer and paraffin wax is exposed.

Applying the aluminum tape to any cut edge, using two people:

The first person holds the panel vertical with the interior exposed at the top of the panel.

The second person unrolls the tape out to the full length of the panel, leaving an additional 2 or 3 cm at either end.

Apply the tape initially on one side of the panel: smooth out the tape to remove any air bubbles. Then fold the tape over along the top edge of the panel. Finally, fold the tape over on to the other side of the panel, once again removing any air bubbles.

Fold back the extra tape at either end of the panel and glue in to place. Care must be taken to remove any air bubbles and to flatten out any folds which may persist. The edging of the panel is now completely covered.

D: Fixing the panels in place

DuPont™ Energain® thermal mass panels can be fixed to walls and frames (timber, aluminium or steel) in much the same way as plasterboard. They can be screwed, stapled or nailed in place with ease. The panels must be fitted before the plasterboard is installed. On interior wall or ceiling applications, there is no need to tape the joins of two panels.

DuPont™ Energain® panels must not be installed behind heating radiators. Leave a minimum distance of 40 cm between panels and any heating device.

Where there is no DuPont™ Energain® (behind the radiator), the space should be equalized by a 5 mm wooden,

---

composite or similar panel or a 5 mm lath in order to have the plasterboard at the same level.

E: Fixing the plasterboard in place

Once the DuPont™ Energain® panels have been affixed, dry line plasterboards can then be fitted over them.

F: Using as a vapor control layer

DuPont™ Energain® is 100% vapor tight, and can be used as a vapor control layer. In this case, the installation follows the above steps, but additionally the joins of two panels must be taped in order to ensure complete vapor tightness.

### 3.2 EXAMINATION

A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

**END OF SECTION 09 20 00**

## **SECTION 10 22 20 PARTITIONS**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

A. Sliding Partitions Accessories

#### 1.2 SUBMITTALS

A. Product Data.

### **PART 2 - PRODUCTS**

A. Sliding partition walls:

1. Basis - of - Design Product:
2. Description:
3. Mounting: 2
4. Size: 2239\*2240\*87
5. Material and Finish: Wood
6. Manufacturer's Specifications: MERCUPOND

B. Sliding rails:

1. Basis - of - Design Product:
2. Type:

- 
3. Mounting: 1
  4. Finish: Barrel
  5. Operation:
  6. Manufacturer's Specifications: MERCUPOND

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Refer to Manufacturer's Data and Installations sheets.

### **END OF SECTION 10 22 00**

#### **Division 10 – Specialties**

#### **SECTION 10 11 46 Wall Paper for Visual display fabrics**

##### **PART 1 – GENERAL**

###### **1.1 SUMMARY**

- A. Section includes the following:

1. Exterior fireproofing cloth

###### **1.2 SYSTEM DESCRIPTION**

- A. Performance Requirements

1. Interior finishes. Show white color and protect the wall.

###### **1.3 SUBMITTALS**

- A. Detailed drawings indicating dimensioning, configuration, and structural notes

###### **1.4 QUALITY ASSURANCE**

- A.. Manufacturer Qualifications: All primary decking materials shall be provided by a single manufacturer specializing in fireproofing cloth for at least five years.

###### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.

###### **1.6 WARRANTIES**

- A. Material Warranty: The manufacturer shall warrant that the materials and accessories furnished in accordance with these specifications shall remain free from defects in material and factory workmanship and against splintering, splitting, checking, rot, decay and termite damage for a period of twenty five years from date of shipment.

##### **PART 2 – PRODUCTS**

###### **2.1 MANUFACTURERS**

Mengzhimei Shanghai Furniture company

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No. 1 Building, No. 1388 yishan Road  
Changing Area Shanghai  
TEL : +86-21-6432-7808  
Fax : +86-21-6432-7809  
Website: [color-space.cn](http://color-space.cn)

2.2 PRODUCT  
Undecided

**PART 3 – EXECUTION**

3.1 EXAMINATION  
Undecided

3.2 PREPARATION

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

3.3 DECKING INSTALLATION

A. Glue past to the template surface.

3.5 RESTORATION

A. Replace damaged part .

3.6 CLEANING

A. Clean up and dispose of excess materials in accordance with all federal, state and local guidelines.

3.7 PROTECTION

A. Protect installed products until completion of project.

**END OF SECTION 10 11 46**

**SECTION 10 22 26 OPERABLE PARTITIONS**

Part 1 - GENERAL

1.1 SECTION INCLUDES

A. Sliding Partitions Accessories: Steel Tracks, Sliding Partitions , Swing Hangers.

1.2 SUBMITTALS

A. Product Data and Material Samples.

Part 2 - PRODUCTS

A. Sliding partition walls:

1. Basis - of - Design Product:
2. Description: Melamine Finishing,
3. Mounting: 2
4. Size: 2359\*1765\*69
5. Material and Finish: Melamine Finishing, Sound Insulation Board
6. Manufacturer's Specifications: MERCUPOND

B. Sliding Tracks:

1. Basis - of - Design Product:

2. Type: Steel
3. Mounting: 1
5. Operation:
6. Manufacturer's Specifications: MERCUPOND

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Pre-processing By the Manufacturer and On-site Installation By Our Team.

END OF SECTION 10 22 00

## **SECTION 10 28 00 TOILET, BATH, AND LAUNDRY ACCESSORIES**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

- A. 10 28 16.13 Residential Bath Accessories

#### 1.2 SUBMITTALS

- A. Product Data.

### **PART 2 - PRODUCTS**

#### A. Towel bars

1. Basis - of - Design Product:
2. Description:
3. Mounting:
4. Length:
5. Material and Finish:
6. Manufacturer's Specifications:

#### B. Toilet paper dispensers

1. Basis - of - Design Product:
2. Type:
3. Mounting:
4. Finish:
5. Operation:
6. Capacity:

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7. Manufacturer's Specifications:

C. Mirror Unit

1. Basis - of - Design Product:
2. Dimensions:

**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

**END OF SECTION 10 28 00**

**Division 11 – Equipment**

**SECTION 11 26 00 UNIT KITCHENS**

**Part 1 - GENERAL**

1.1 SECTION INCLUDES

- A. Unit Kitchen Accessories: 2 High Cubes, 3 Wall Cupboard, 3 Low Cupboard

1.2 SUBMITTALS

- A. Product Data.

**Part 2 - PRODUCTS**

- A. OULIN: DREAM-A
- B. Color: MRM606
- C. Website: <http://www.oulin.com>

**PART 3 - EXECUTION**

3.1 INSTALLATION

- A. Pre-processing By the Manufacturer and On-site Installation By Our Team.

**END OF SECTION 11 26 00**

**SECTION 11 31 00 RESIDENTIAL KITCHEN APPLIANCES**

**Part 1 - GENERAL**

1.1 SUMMARY

- A. Section includes the following:
  1. Induction Cooker

- 
2. Freezer Refrigerator
  3. Dishwasher
  4. Cloth Washer & Dryer
  5. Fume Extraction Hood
  6. Cloth Washer & Dryer

## 1.2 REFERENCES

- A. Environmental Protection Agency (EPA)

## 1.3 SUBMITTALS

- A. Product data :

1. Owner's Manual
2. Warranty Guides
3. Installation Instructions
4. Energy Guide

## 1.4 QUALITY ASSURANCE

- A. Comply with applicable local codes and regulations.
- B. Provide appliances with the EPA Energy Star label where specified.
- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at Site

1. Inspect appliances upon delivery. Report any damaged or missing components.

- B. Packing, Shipping, Handling and Unloading

1. Store appliance in manufacturer's packaging until ready for installation.

- C. Storage and Protection

1. Store packed appliances in a fully enclosed structure that will provide protection from exposure to wind, rain, moisture, and ultraviolet light. The storage surface must be level and sound.

## **PART 2 – PRODUCTS**

### 2.1 MANUFACTURERS

- A. Induction Cooker

SIEMENS: EH75262TI

Website: <http://www.siemens.com>

- B. Freezer & Refrigerator

SIEMENS: KI38SA50IE

Website: <http://www.siemens.com>

- C. Dishwasher

SIEMENS: SN65M030EA

Website: <http://www.siemens.com>

- D. Fume Extraction Hood

SIEMENS: LC956BC30W

Website: <http://www.siemens.com>

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E. Cloth Washer & Dryer

SIEMENS: WD12H460TI

Website: <http://www.siemens.com>

2.2 PRODUCTS

A. Induction Cooker

SIEMENS: EH75262TI 55\*760\*450 (H\*L\*W)

Built-in Cooktop with two burner elements, 3600W

Options: standard options

Installation and operation instruction: [Siemens Induction Hob EH75262TI.pdf](#)

B. Freezer & Refrigerator

SIEMENS: KI38SA50IE 1772\*541\*545 (H\*L\*W)

Built-in 2 door refrigerator, bottom freezer

Manufacturer's Specifications: <http://www.siemens-home.com.hk/KI38SA50IE.html>

Installation and operation instruction: [Siemens Induction Refrigerator KI38SA50IE.pdf](#)

C. Dishwasher

SIEMENS: SN65M030EA595\*595\*500 (H\*L\*W)

60cm fully integrated dishwasher

Manufacturer's Specifications: <http://www.siemens-home.com/th/en/SN65M030EA.html>

Installation and operation instruction: [Siemens Induction Dishwasher SN65M030EA.pdf](#)

D. Fume Extraction Hood

SIEMENS: LC956BC30W 860\*600\*560

Mechanical control without display, Maximum amount of suction: 640m<sup>3</sup>/h;

Rated power: 280W, Rated current: 10A, Rated voltage: 220V

Installation and operation instruction: [Siemens Induction Fume Extraction Hood LC956BC30W.pdf](#)

E. Cloth Washer & Dryer

SIEMENS: WD12H460TI 860\*600\*600

Installation and operation instruction: [Siemens Induction Clothes Washer and Dryer WD12H468TI.pdf](#)

**PART 3 – EXECUTION**

A. Refer to manufacturer's data and installations sheets in the operations manual.

**END OF SECTION 11 31 00**

**Division 12 – Furnishing**

**SECTION 12 60 00 Multiple Seating**

Part 1 - GENERAL

1.1 SECTION INCLUDES

A. Multiple Seating Accessories

1.2 SUBMITTALS

A. Unit Composing Guide

Part 2 - PRODUCTS

- A. Multiple Functions: Seats/Table/Bed/Shelf...
- B. Color: White
- C. Material and Finish: Melamine Finishing, Wood Board
- C. Manufacturer: Special Made

END OF SECTION 10 22 00

**Division 22 – Plumbing**

**SECTION 22 10 00 PLUMBING PIPING AND PUMPS**

**PART 1 - GENERAL**

1.1 SECTION INCLUDES

- A. 22 11 16 Domestic Water Piping
- B. 22 11 23 Domestic Water Pumps
- C. 22 12 00 Facility Potable-Water Storage Tank

1.2 SUBMITTALS

- A. Weblink to Product Information:

<http://www.asak.com.cn/Simplified/RequireView.asp?ID=39&SortID=1>

- B. Weblink to Product Information:

<http://www.wilo-usa.com/cps/rde/xchg/us-en/layout.xsl/2124.htm>

- C. No determined yet

**PART 2 - PRODUCTS**

2.1 MANUFACTURER

- A. Beijing Aerospace Kaiser International Investment Management Co., Ltd.

Podium Building, East Office Building,

Aerospace Ministry, No.8, Fucheng Road,

Beijing, China.

Tel: 400-883-0909

Email: <mailto:asak@asak.com.cn>

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B. WILO China Ltd.

No.23 Yuhua Road Airport Industrial ZoneB, Shunyi Beijing, China

Postcode: 101300

5F, Tower A, Airport Technology Building, No.28 Tianzhu Road,

Tianzhu Airport Industrial Zone A ShunyiDistrict,Beijing,China

Postcode: 101312

Tel: 010-58041888

Fax : 010-58041666

E-mail: <mailto:wilo.info@wilo.com.cn>

C. No determined yet

### PART 3 – EXECUTION

Water tanks are under production. There are actually eight tanks.

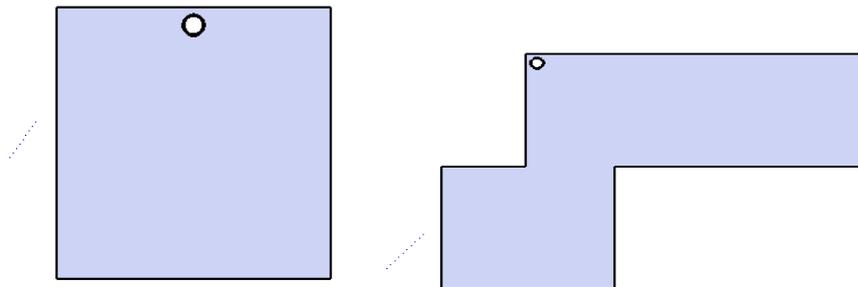
Three major tanks are supply water tank, grey water tank and black water tank. The volume of supply water tank is 595 gallon. Grey water tank is composed of two rectangular boxes; they are connected by a short tube. Its total volume is 390 gallon. Black water tank can contain water of 130 gallon. Other tanks include thermal storage water tank for daily hot water service (HWT-1, 65 gallons), thermal storage water tank for hot water radiant floor heating system (HWT-2, 80 gallons), wet land and two water modules which contain water 660 gallons, 132 gallons, 175 gallons separately.

Supply water tank is used to provide domestic water, which includes domestic hot water for daily use and cold water for domestic equipment such as dishwasher, washing machine and so on. Water needed for sprinkler system also comes from this tank. On water delivery day, water will be charged into this tank from its top opening until HWT-1 and itself are full filled (sprinkler system is also full filled to keep an appropriate pressure).

Gray water tank is used to collect water from shower, washing machine and basin in bathroom, while black water tank is used to collect water, which may contain too much oil, from dish washer and basin in kitchen. While black tank is initially empty, an appropriate amount of water needs to be charged on water delivery day into gray water tank. Because grey water tank is also used as a container in site water cycle system. The site water cycle system is both a purification system and rain-water collection system. Four tanks including grey water tank, wet land and two water modules are connected by tubes to form this cycle. On water delivery day, nearly 600 gallons of water will be initially charged into the cycle system from grey water tank or wet land (open to surrounding environment). The four tanks don't need to be fully filled. During competition, contaminated (grey) water, diluted by rain if it rains, goes around the cycle system. Wet land functions with botany, rock and sand forming a gradual purification system. The purified water can be used to irrigate as well as aesthetic water going through two water modules beside the Y-BOX.

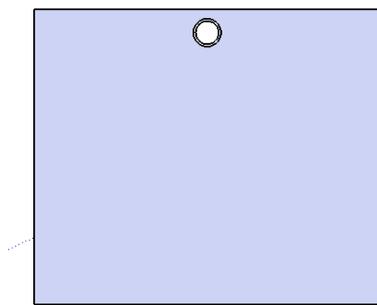
In addition, HWT-2 and solar collectors (10 gallons) also need to be filled on water delivery day.

Supply water tank, grey water tank and black water tank all have openings with diameter of 10 cm (maybe larger) on their top surfaces to charge and discharge water. The position of openings is shown below:



Supply water tank

Grey water tank



Black water tank

The calculated requirement of water usage is 1480 gallon as shown in water budget. However supply water tank is 595 gallon. The reason of the mismatch between the two figures lies in that the water in supply water tank is only used as domestic water. Other volume is initially filled in other containers which are used as parts of different systems. For example, the water needed in radiant floor heating system is initially charged and contained by HWT-2.

In all, on water delivery day, in the first circle of delivery, we will have water charge into various systems from openings of supply water tank (until both HWT-1 and itself is full filled), grey water tank (some of water will flow to wet land and two water modules) and HWT-2. Water needed in solar collector system will also be charged initially from supply water tank artificially. After tests of various system, such as radiant floor heating system, sprinkler system and domestic water service system, we may need extra water to offset water spilt in testing in the second circle of delivery.

After competition, water in black water tank will be removed from its opening by truck according to the rules. Water in site water cycle, solar collector can gradually moved artificially (use buckets) firstly into gray water tank and pump out of gray water tank. Water in other containers such as HWT-1 and HWT-2 can also be discharged

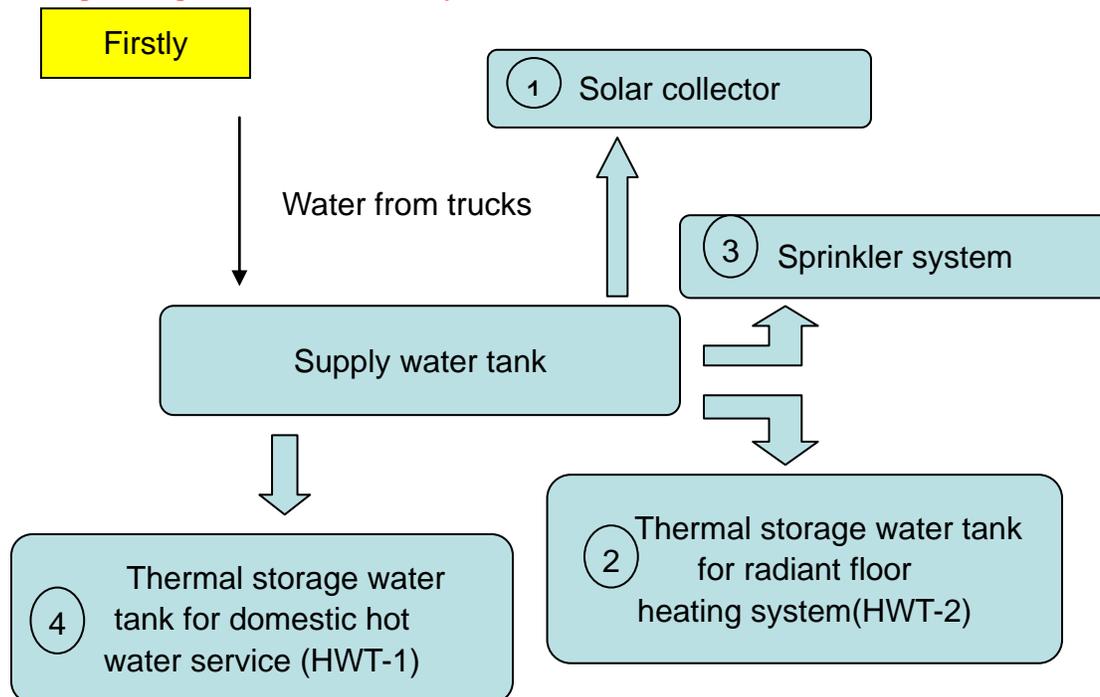
into grey water tank artificially and then pumped out.

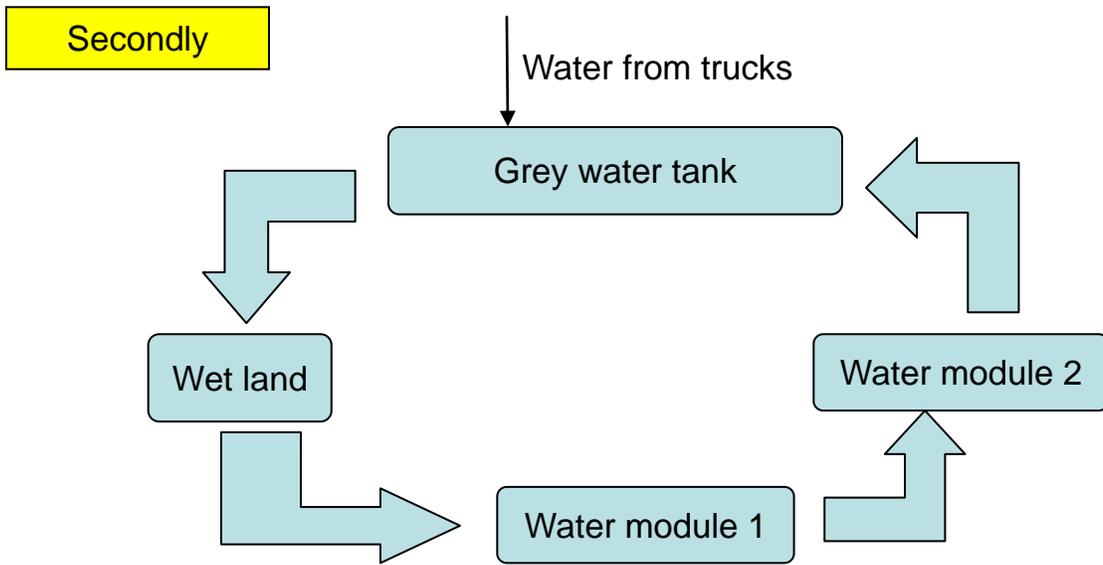
According to 4-6b, water cannot be spilt onto site. Thus our team will use several buckets to collect spilt water or water can't pump out of tank completely and move it to permitted drainage location.

In plan, our team won't provide other potable water by ourselves. But if calculated water is not enough, we are willing to purchase extra water from the company provided by the organizers.

According to rules that water tanks are not allowed to directly be put on site, our team has elevated water tanks 10 cm above by using brackets designed by relative construction designers.

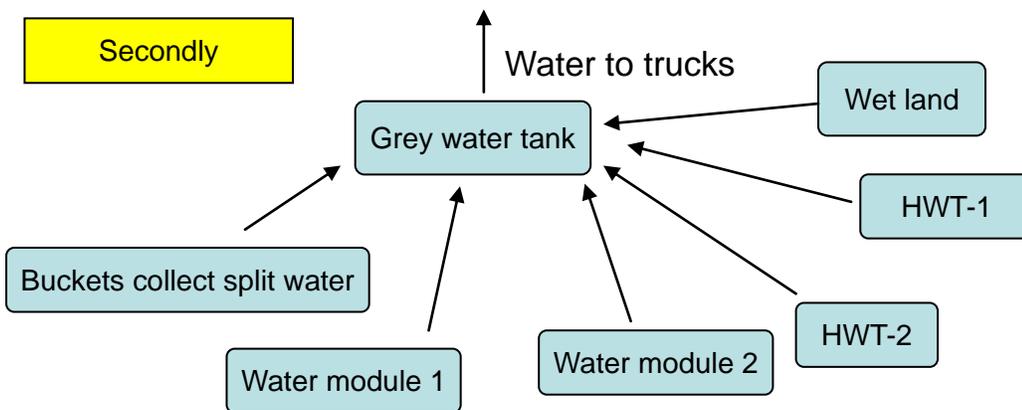
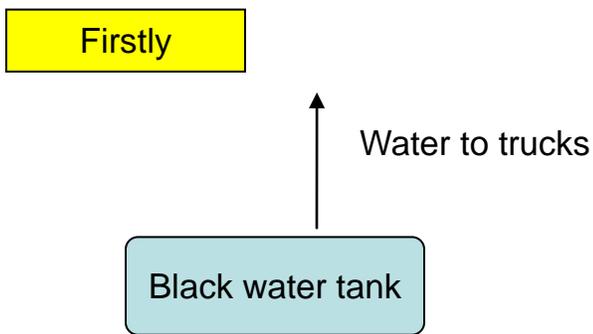
I. Complete sequence of water delivery:





Site water cycle system

2. Complete sequence of water removal:



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**END OF SECTION 221000**

**Division 23 – Heating, Ventilation, and Air-conditioning (HVAC)**

**SECTION 23 21 13 HYDRONIC PIPING**

**PART 1 - GENERAL**

**1.1 SECTION REQUIREMENTS**

- A. Summary: Heating and cooling water piping and condensate drain piping.

**PART 2 - PRODUCTS**

**2.1 PIPES, TUBES, AND FITTINGS**

- A. Hard Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) with ASME B16.22 wrought-copper solder fittings and ASTM B 32, 95-5 tin antimony solder.
- B. Soft Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A) with ASME B16.22 wrought-copper solder fittings.
- C. CPVC Pipe: ASTM F 441/F 441M, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.
- D. PVC Pipe: ASTM D 1785, Schedule 40, plain ends with ASTM F 438, socket-type solvent welding fittings.
- E. Steel Pipe: ASTM A 53, Schedule 40 Schedule 30, plain ends with cast-iron threaded fittings, Class 125 Class 300.
- F. Unions: ASME B16.39, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- G. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure, 250 deg F (121 deg C) maximum operating temperature.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, ends.

**2.2 SPECIAL-DUTY VALVES**

- A. Calibrated Plug Valves: 125-psig (860-kPa) water working pressure, 250 deg F (121 deg C) maximum operating temperature; bronze body with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. SAMPLE TEAM LOGO PM SAMPLE HOUSE WWW.SAMPLESOLARDECATHLONTEAM.EDU [Status] Published

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[Publish Date] U.S. D.O.E. Solar Decathlon 2011 Page - 2 HYDRONIC PIPING 23 21 13 - 2

- B. Pressure-Reducing Valves: Diaphragm-operated, cast-iron or brass-body valve, with low-inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem.
- C. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; to suit system pressure and heat capacity; according to ASME Boiler and Pressure Vessel Code: Section IV.

## 2.3 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure, 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.
- B. Diaphragm-Type Compression Tanks: Welded carbon steel, 125-psig (860-kPa) working pressure, 375 deg F (190 deg C) maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a flexible diaphragm securely sealed into tank. Provide taps for pressure gage and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Tank, with taps and supports, shall be constructed, tested, and labeled according to ASME Pressure Vessel Code: Section VIII.
- C. Chemical Feeder: 5-gal. (19-L), bypass-type, welded steel; 125-psig (860-kPa) working pressure; complete with fill funnel and inlet, outlet, and drain valves. Furnish chemicals specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, developed based on analysis of makeup water.
- D. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Comply with requirements in Division 23 Section "Common Work Results for HVAC" for wall penetration systems.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

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- D. Install piping free of sags and bends and install fittings for changes in direction and branch connections.
  - E. Use the fewest number of joints belowground and within floor slabs. SAMPLE TEAM LOGO PM SAMPLE HOUSE WWW.SAMPLESOLARDECATHLONTEAM.EDU [Status] Published [Publish Date] U.S. D.O.E. Solar Decathlon 2011 Page - 3 HYDRONIC PIPING 23 21 13 - 3
  - F. Install piping at a uniform slope of 0.2 percent upward in the direction of flow.
  - G. Make reductions in pipe sizes using eccentric reducer fitting installed with level side up.
  - H. Install branch connections to mains using tee fittings in main with takeoff out the bottom of the main, except for up-feed risers, which shall have swing joint and takeoff out the top of the main line.
  - I. Install unions in pipes adjacent to each valve, at final connections with each piece of equipment, and elsewhere as indicated.
  - J. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.
  - K. Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before soldering or brazing.

### 3.2 VALUE INSTALLATIONS

- A. Shutoff Duty: Use gate or ball valves.
- B. Throttling Duty: Use globe or ball valves.
- C. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- D. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- E. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.
- F. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple and cap.
- G. Install check valves on each pump discharge and elsewhere as required to control flow direction.
- H. Install safety relief valves on hot-water generators and elsewhere as required by authorities having jurisdiction. Pipe discharge to floor drain without valves.
- I. Install manual air vents at high points in the system, at heat-transfer coils, and elsewhere as

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required for system air venting.

- J. Run piping from boiler air vent connection or air separator to compression tank with 1/4 inch per foot (1:50) upward slope towards tank. Connect boiler outlet piping. SAMPLE TEAM LOGO PM SAMPLE HOUSE WWW.SAMPLESOLARDECATHLONTEAM.EDU [Status] Published [Publish Date] U.S. D.O.E. Solar Decathlon 2011 Page - 4 HYDRONIC PIPING 23 21 13 - 4

### 3.3 SPECIALTIES INSTALLATIONS

- A. Install chemical feeders in each hydronic system in upright position with top of funnel not more than 48 inches (1200 mm) above floor. Install feeder across pump or in bypass line, off main using ball valves on each side of feeder, and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.
- B. Install diaphragm-type compression tanks on floor. Vent and purge air from hydronic system; charge tank with proper air charge to suit system design requirements.
- C. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated.

### 3.4 TESTING, ADJUSTING, AND BALANCING

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens.
- B. Hydrostatically test completed piping at a pressure one and one-half times operating pressure. Isolate equipment before testing piping. Repair leaks and retest piping until there are no leaks.
- C. Balance water flow as required by Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### 3.5 PIPING SCHEDULE

- A. Hot and Chilled Water, NPS 2 (DN 50) and Smaller:
  - 1. Aboveground: Drawn-temper copper tubing with soldered joints, or steel pipe with threaded joints.
  - 2. Aboveground: Steel pipe with threaded joints.
  - 3. Aboveground: CPVC pipe and fittings with solvent welded joints.
  - 4. Belowground or within Slabs: Annealed-temper copper tubing with soldered joints.
- B. Condensate Drain Lines: Drawn-temper copper tubing with soldered joints or PVC pipe with solvent-welded joints.

**END OF SECTION 232113**

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## **SECTION 23 30 00 HVAC AIR DISTRIBUTION**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

- A. 23 31 00 HVAC Ducts and Casings
- B. 23 32 00 Air Plenums and Chases
- C. 23 33 00 Air Duct Accessories
- D. 23 35 00 Special Exhaust System
- E. 23 37 00 Air Outlets and Inlets

#### 1.2 SUBMITTALS

A-E. Product Data: Datasheets

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURER

A/C. DURKEESOX(SHANGHAI) AIR DISPERSION SYSTEM CO. LTD

Phone: 86-21-52411316

Fax: 86-21-52411316-12

E-mail: [durkee@durkeesox.com](mailto:durkee@durkeesox.com)

Web: <http://www.durkeesox.com>

D/E. DAIKIN

Phone: 86-21-64660472

Fax: 86-21-64660478

Web: <http://www.daikin.co.jp/index.html>

#### 2.2 PRODUCTS

A. Air Distribution pipe  $\varnothing$ 200 mm

Air Distribution pipe  $\varnothing$ 100 mm

Air Distribution pipe 200x200 mm

Air Distribution pipe 200x120 mm

B. Custom made, no datasheet

C. Custom made, no datasheet

D. Heat exchanger VAM150GMVE

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E. custom made, no datasheet

**PART 3 – EXECUTION** (not used)

**END OF SECTION 23 30 00**

**Division 25 Integrated Automation**

**SECTION 25 14 19 Integrated Automation Terminal Control Units**

**Part 1 GENERAL**

1.1 SECTION REQUIREMENTS

25 30 00 Integrated Automation Instrumentation and Terminal Devices

25 35 16 Integrated Automation Sensors and Transmitters

1.2 REFERENCE STANDARDS

A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)

B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations

C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

1.3 SUBMITTALS

-

1.4 RELATED DRAWINGS

A. TELECOMMUNICATIONS AND BUILDING AUTOMATIZATION SYSTEM

B. Sheet Index and Symbols

C. WIRING PLAN

D. SCHEMATIC DIAGRAM

E. E-501 SCHEDULE

F. E-605 THREE-LINES DIAGRAM(DB)

**Part 2 PRODUCTS**

2.1 MANUFACTURER

A. Schneider Electric Industries SAS

Head Office

89, bd Franklin Roosevelt

92506 Rueil-Malmaison Cedex

France

[www.schneider-electric.com](http://www.schneider-electric.com)

[www.telemecanique.com](http://www.telemecanique.com)

## 2.2 PRODUCTS

A. TWD LCDA 24DRF Twido programmable controller

B. PLC module - TM2 AMI 8HT Analogue Input Module

C. PLC module - TM2 ARI 8LRJ Analogue Input Module

D. TM2 DRA 8RT Discrete Output Module

E. MIC2000-CO2-3002BVZ CO2/Temperature/Humidity sensor

F. OMRON MKS2P-24 VDC w/PF083A-E

G. DR-100-24 Railmount DC Switch PowerSupply

H. PLC module - MODBUS <-> KNX

I. TWD NAC 485T PLC Communication Module

J. ZD Photosensor

K. PT1000 temperature sensor

## **PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

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## **SECTION 25 30 00 Integrated Automation Instrumentation and Terminal Devices**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

A. The system is used for monitoring the electric appliance working temperatures, including the temperatures for:

- Refrigerator
- Freezer
- Dishwasher
- Oven
- clothes washer
- clothes drier

B. The system includes four types of devices: PLC with its modules, sensors, cables and interfaces.

#### 1.2 REFERENCE STANDARDS

A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)

B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations

C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

#### 1.3 SUBMITTALS

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#### 1.4 RELATED DRAWINGS

A. TELECOMMUNICATIONS AND BUILDING AUTOMATIZATION SYSTEM

B. Sheet Index and Symbols

C. WIRING PLAN

D. SCHEMATIC DIAGRAM

E. E-501 SCHEDULE

## F. E-605 THREE-LINES DIAGRAM(DB)

### Part 2 PRODUCTS

#### 2.1 MANUFACTURER

A. Schneider Electric Industries SAS

Head Office

89, bd Franklin Roosevelt

92506 Rueil-Malmaison Cedex

France

[www.schneider-electric.com](http://www.schneider-electric.com)

[www.telemecanique.com](http://www.telemecanique.com)

#### 2.2 PRODUCTS

A. TWD LCDA 24DRF Twido programmable controller

- 24 I/O 14 c 24 V inputs
- 10 relay outputs
- 3000 instructions
- 0.305 kg

B. PLC module - TM2 AMI 8HT Analogue Input Module

- Used for thermocouple for type J,K,T

C. PLC module - TM2 ARI 8LRJ Analogue Input Module

- Analog input:
  - 0-10 V/0-20 mA
  - PT 100/PT 1000,

- NI 100/NI 1000

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

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## SECTION 25 35 16 Integrated Automation Sensors and Transmitters

### Part 1 GENERAL

#### 1.1 SECTION REQUIREMENTS

A. The system is used for monitoring and control the ambiance in order to create a comfort indoor environment. The control objects are listed as follows:

- HVAC
- Ventilation
- PCM
- Hot water

B. The monitoring objects are listed as follows:

- Ambiance temperature
- Ambiance humidity
- Ambiance CO<sub>2</sub> intensity

C. The system includes four types of devices: PLC with its modules, sensors, cables and interfaces.

#### 1.2 REFERENCE STANDARDS

A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)

B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations

C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

A. TELECOMMUNICATIONS AND BUILDING AUTOMATIZATION SYSTEM

B. Sheet Index and Symbols

- C. WIRING PLAN
- D. SCHEMATIC DIAGRAM
- E. SCHEDULE
- F. THREE-LINES DIAGRAM

## Part 2 PRODUCTS

### 2.1 MANUFACTURER

A. Schneider Electric Industries SAS

Head Office

89, bd Franklin Roosevelt

92506 Rueil-Malmaison Cedex

France

[www.schneider-electric.com](http://www.schneider-electric.com)

[www.telemecanique.com](http://www.telemecanique.com)

### 2.2 PRODUCTS

A. TWD LCDA 24DRF - Twido programmable controller

- 24 I/O 14 c 24 V inputs
- 10 relay outputs
- 3000 instructions
- 0.305 kg

B. PLC module - TM2 AMI 8HT Analogue Input Module

- Analog input: 0-10 V/4-20 mA

C. PLC module - TM2 ARI 8LRJ Analogue Input Module

- Analog input: Pt 100 / Pt 1000

D. TM2 DRA 8RT Discrete Output Module

E. MIC2000-CO2-3002BVZ CO2/Temperature/Humidity sensor

F. OMRON MKS2P-24 VDC w/PF083A-E

G. DR-100-24 Railmount DC Switch PowerSupply

H. PLC module - MODBUS <-> KNX

I. TWD NAC 485T PLC Communication Module

J. ZD Photosensor

K. PT1000 temperature sensor

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

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**SECTION 25 37 00 Integrated Automation Instrumentation and Terminal Devices for Communication Systems**

**Part 1 GENERAL**

1.1 SECTION REQUIREMENT

1.2 REFERENCE STANDARDS

- A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)
- B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations
- C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

1.3 SUBMITTALS

-

1.4 RELATED DRAWINGS

- A. TELECOMMUNICATIONS AND BUILDING AUTOMATIZATION SYSTEM
- B. Sheet Index and Symbols
- C. WIRING PLAN
- D. SCHEMATIC DIAGRAM
- E. SCHEDULE
- F. THREE-LINES DIAGRAM

**PART 2 PRODUCTS (Not decided yet)**

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

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## Division 26 Electrical

### SECTION 26 05 00 Common Work Results for Electrical

#### Part 1 GENERAL

##### 1.1 SECTION REQUIREMENTS

###### A. Scope of the design

Lighting, sockets, HVAC and other power supply.

###### B. Content of the design:

- Power Supply: Lighting, HVAC and sockets are all belonging to Type III load, the power supply is cited from the roof of the building where PV system locates.
- Load calculation: all calculation results are shown in the drawings.
- Distribution wires:
  - The outlet circuits of the distribution cabinet are using radial system through conduit (PC) outside the ceiling or the wall to the sockets or the lamps;
  - The wires of general lighting, socket circuit are cross-linked polyethylene halogen free low smoke flame retardant wires (WDZD-BV-450V/750V);

###### C. Power distribution equipment installation

- The capacity of general light switches and sockets is 10A, and the length from the end of the wall plate to the floor is 1.3m, all the mounting height and location of the socket can be found in Interior Elevations;
- The wires that are not indicated with numbers should be considered as three, and the wiring boxes should be added in the places as long pipe or many turns;

###### D. Protection

The protective grounding of the building is the type of TT, all metal casing of the electrical installations and the conductive parts outside the devices should be directly grounded.

E. The demand not given in the manual and drawings should be prevailed by the codes and national standard.

## 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. DGJ08-93-2002 (J10166-2002) Code for fireproofing design of wires and cables used in civil buildings
- C. GB50052-95 Code for design of electric power supply system
- D. GB50054-95 Code for design of low voltage electrical installations
- E. GB50016-2006 (2006 edition) Code of Design on Building Fire Protection and Prevention
- F. GB 50057-94 Design code for protection of structures against lightning
- G. GB50034-2004 Standard for lighting design of buildings

## 1.3 SUBMITTALS

Please refer to the following submittals within the section.

## 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-604 GRID INTERCONNECTION
- C. E-101 ELECTRICAL DISTRIBUTION PLAN
- D. E-102 LIGHTING PLAN
- E. E-104 GROUNDING PLAN
- F. E-501 SCHEDULE (DB)
- G. E-601 ONE-LINE DIAGRAM
- H. E-605 THREE-LINES DIAGRAM (DB)

## Part 2 PRODUCTS

## 2.1 MANUFACTURER

A. Baosheng Ltd.

No.1 Middle Baosheng Road,

Baoying County, Jiangsu Province, China

Tel.: +86-514-88238888 Fax: +86-514-88248888

Website: [www.baoshenggroup.com](http://www.baoshenggroup.com)

## 2.2 PRODUCTS

- A. Halogen free low smoke flame retardant wires (4mm / 2.5mm)
- B. Main equivalent potential terminal box (MEB)
- C. L50x50x5 Hot dip galvanized angle steel
- D. -40x4 Hot dip galvanized flat steel
- E. 100x100x5 Hot dip galvanized steel plate
- F. 25x4 Hot dip galvanized flat steel
- G. Grounding test point

## **PART 3 EXECUTION (Not decided yet)**

## **END OF SECTION**

## **SECTION 26 20 00 Low-Voltage Electrical Distribution**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

- A. Various types of circuit breakers are included in the section;
- B. The breaker types are selected by calculating the power loads, complying with JGJ16-2008.

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB50054-95 Code for design of low voltage electrical installations

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-604 GRID INTERCONNECTION
- C. E-101 ELECTRICAL DISTRIBUTION PLAN
- D. E-501 SCHEDULE (DB)
- E. E-601 ONE-LINE DIAGRAM
- F. E-605 THREE-LINES DIAGRAM (DB)

### **Part 2 PRODUCTS**

#### 2.1 MANUFACTURER

Schneider Electric

35 rue Joseph Monier

92500 Rueil-Malmaison

France

<http://www.schneider-electric.com>

## 2.2 PRODUCTS

### A. DPNa Vigi C16A Residual current circuit breaker

- Rated current: 16 A ( 30 °C)
- Rated voltage: 230 V
- Breaking capacity: 4.5 kA (IEC 61009 / GB 16917)
- Residual action current: 30 mA, AC
- Ambiance
  - Working temperature: -25°C - +55°C
  - iso 4211-2: wet heat: type 2 (T:55°C, H:95%)
- Wiring: Under 16 mm<sup>2</sup>
- Width: 36 mm (4 modulus)

### B. DPNa Vigi C20A Residual current circuit breaker

- Rated current: 20 A ( 30 °C)
- Rated voltage: 230 V
- Breaking capacity: 4.5 kA (IEC 61009 / GB 16917)
- Residual action current: 30 mA, AC
- Ambiance
  - Working temperature: -25°C - +55°C
  - iso 4211-2: wet heat: type 2 (T:55°C, H:95%)
- Wiring: Under 16 mm<sup>2</sup>
- Width: 36 mm (4 modulus)

### C. DPNa C16A 1P circuit breaker

- Rated current: 16 A ( 30 °C)

- Rated voltage: 230 V
- Type C curve: 5-10 In
- Ambiance
  - Working temperature: -25°C - +55°C
  - iso 4211-2: wet heat: type 2 (T:55°C, H:95%)
- Wiring: Under 16 mm<sup>2</sup>

D. C65N C63A 2P circuit breaker

- Rated current: 63 A
- Maximum working voltage: 440V AC
- Breaking capacity: (IEC 60898)
- Type C curve: 5-10 In
- Ambiance
  - Working temperature: -30°C - +70°C
  - iso 4211-2: wet heat: type 2 (T:55°C, H:95%)
- Wiring: Under 35 mm<sup>2</sup>

E. C65N C25A 2P circuit breaker

F. C65N C25A 1P circuit breaker

- Rated current: 63 A
- Maximum working voltage: 440V AC
- Breaking capacity: (IEC 60898)
- Type C curve: 5-10 In
- Ambiance
  - Working temperature: -30°C - +70°C
  - iso 4211-2: wet heat: type 2 (T:55°C, H:95%)

- Wiring: Under 35 mm<sup>2</sup>

G. DPNa Vigi C25A Residual current circuit breaker

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

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## SECTION 26 24 00 Switchboard and Equipment

### Part 1 GENERAL

#### 1.1 SECTION REQUIREMENTS

#### 1.2 REFERENCE STANDARDS

- A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)
- B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations
- C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

#### 1.3 SUBMITTALS

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#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-101 ELECTRICAL DISTRIBUTION PLAN
- C. E-103 LIGHTING PLAN
- D. E-501 SCHEDULE (DB)
- E. E-601 ONE-LINE DIAGRAM
- F. E-605 THREE-LINES DIAGRAM (DB)

### Part 2 PRODUCTS

#### 2.1 MANUFACTURER

Merten GmbH & Co. KG, Lösungen für intelligente Gebäude,

Service Center, Fritz-Kotz-Straße 8, Industriegebiet

Bomig-West, D-51674 Wiehl

Telefon: +49 2261 702-204

Telefax: +49 2261 702-136

E-Mail: servicecenter@merten.de

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Internet: [www.merten.de](http://www.merten.de)

## 2.2 PRODUCTS

Merten MTN632619 KNX ARGUS 180 UP

- Nominal voltage: DC 24 V (+6 V / -4 V)
- KNX connection: Bus connecting terminal
- Angle of detection: 180°
- Number of levels: 1
- Number of zones: 14
- Recommended mounting height: 1.1 m
- Range: up to approx. 8 m; infinite setting (rotary switch or ETS)
- Detection brightness: Infinite setting from approx. 10 lux to approx.1000 lux (rotary switch) or from 10 lux to 2000 lux (ETS)
- Overshoot time: Adjustable in 6 steps from approx. 1 s to approx. 8 min (rotary switch) or adjustable from 1 s to 255 hours (ETS)
- Display elements: 1 red programming LED
- Operating elements: 1 programming button, rotary switch for detection brightness, range, and overshoot time
- Ambient temperature
  - Operation: -5 °C to +45 °C
  - Storage: -25 °C to +55 °C
  - Transport: -25 °C to +70 °C
- EC guidelines: Low-Voltage guideline 73/23/EEC,
- EMC guideline 89/336/EEC
- Initialization: Due to the limitation of the telegram rate, a telegram cannot be generated until 20 seconds after initialization at the earliest.
- Type of protection: IP 20

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

## **SECTION 26 27 11 Electrical Metering**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

The system is used for monitoring the electric power generated by PV system, sent back to grid and consumed by various circuits.

#### 1.2 REFERENCE STANDARDS

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#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-604 GRID INTERCONNECTION
- C. E-201 ELECTRICAL ELEVATIONS
- D. E-501 SCHEDULE (DB)
- E. E-601 ONE-LINE DIAGRAM
- F. E-605 THREE-LINES DIAGRAM (DB)

### **Part 2 PRODUCTS**

#### 2.1 MANUFACTURER

A. Schneider Electric

35 rue Joseph Monier

92500 Rueil-Malmaison

France

<http://www.schneider-electric.com>

## B. CHINT

NO.1,CHINT Road,

CHINT Industrial Zone,

North Baixiang, Yueqing, Zhejiang Province, China.

Post Code: 325603

TEL: +86-577-62777777

FAX: + 86-577-62775769

Web Page: <http://www.chint.net>

E-mail: global-sales@chint.com salesdirector@chint.com

## 2.2 PRODUCTS

### A. PM9C - Electric meter

- The PM9C (Cat no. 15198) is an electrical quantity measuring unit for LV 1P+N, 3P, 3P+N networks. Metering functions:
  - Instantaneous values: U, V, I, IN, F, PF, total P (W,var, VA) and P per phase (W, var)
  - DEMAND and maximum Demand P values (W or var or VA), kWh( total & partial) kWh (total) kilowatt-hour meters, time counters
  - 1 Modbus-RS 485 communication port
  - Auxiliary power supply: 220-240 V

### B. BH-0.66 20I 50/5 - Current transformer

- Secondary current Isn: 5A
- Max. voltage rating Ue:660 V
- Frequency: 50/60 Hz
- Safety factor (fs):10
- Degree of protection: IP20
- Operating temperature: -5°C to +40°C, humidity <80%

- Altitude:  $\leq 1000\text{m}$
- Standards: IEC/EN 60044-1
- Installation type: mounting on plates or bars

#### C. MC09 Multi-circuit monitoring unit

- Monitoring type: 3-phase AC (a, b, c + N)
- accuracy of measurement:
  - Current: 0.5%
  - Voltage: 0.5%
- Voltage input: 0 - 480 V AC (L-L)
- Metering: 50 – 480 V AC (L-L)
- 9-path output characteristics:
- CT: 5 A – 10000 A / 5 A
- Input: 0 – 5 A
- Metering: 0.1 – 10 A
- Allowed overload ability: continuous current 10 A
- Control voltage: 100 – 240 V AC ( $\pm 10\%$ )
- Weight: 0.670 kg
- IP protection (IEC60529) : IP20
- Dimension: 190 x 94.5 x 71 mm
- Installation: Standard DIN
- Ambiance factors:
  - Work temperature: 0 – 60 °C
  - Storage temperature: -25 °C - +70 °C
  - Humidity: 5 – 95 %RH(40°C)
  - Installation type : 277/480 V
  - EMC: Antistatic III (IEC61000-4-2)

- rad resistance III (IEC61000-4-3)
- electric fast change pulse resistance III (IEC61000-4-4)
- surge suppression III (IEC61000-4-5)
- Communication
  - RS485
  - Modbus RTU
  - MCHMI

D.TMD XCA ISO - Cable Isolator

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

## **SECTION 26 27 16 Electrical Cabinets and Enclosures**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

- A. One electrical cabinet is used for electrical power distribution and lighting;
- B. One electrical enclosure is used for control and monitoring system.

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB50054-95 Code for design of low voltage electrical installations

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-201 ELECTRICAL ELEVATIONS
- C. E-501 SCHEDULE (DB)
- D. E-601 ONE-LINE DIAGRAM
- E. E-605 THREE-LINES DIAGRAM (DB)

### **Part 2 PRODUCTS**

#### 2.1 MANUFACTURER

Schneider Electric

35 rue Joseph Monier

92500 Rueil-Malmaison

France

<http://www.schneider-electric.com>

## 2.2 PRODUCTS

### A. NSYSF12640 Electrical Cabinet

- Front door and rear panel, with or without IP55 galvanized mounting plate
- Basic composition
  - Structure : top and bottom frame ,vertical uprights
  - Front door : plain door with reinforcement frame
  - The double doors are overlapping, with system for fixing the left door.
  - Rear panel screwed on with captive screws
  - Removable roof.
  - Standard locking system with handle and 5-mm double-bar insert.
  - 4 support brackets for the mounting plate.
  - Sliding rail for the mounting plate.
  - Supply with or without galvanized mounting plate depending on the reference.
- Dimensions (mm): 1400 x 600 x 400 (HxWxD)
- Cable-gland plate : NSYE64, NSYEC641

### B. AISI 316L stainless-steel wall-mounting enclosures

- Technical characteristics
- Dimensions(mm) : 600 x 600 x 250 (HxWxD)
- With plain door, NSYS3X6625H
- Protection rating(grade): IP 66, according to IEC 60529
- Resistance to external mechanical impacts: IK 10
- Thickness: 1.5 mm
- Single-piece body (cross-shaped structure). Gutter-shaped front profile.
- 4 rear studs for fixing the material.
- 2 cut-out vertical profiles on the door (from a height of 600 mm), with drill holes with a diameter of 4.25 mm and a pitch of 25 mm for installing accessories.

- Door strengthening frame (from a height of 1000 mm), cross-section of 20 mm x 15 mm, with drill holes with a diameter of 5 mm and a pitch of 25 mm.
- Standard lock with 3-mm double-bar lock (chrome-plated zamak).
- 2 locking points for heights of more than 500 mm or three points for two-door enclosures.
- Stainless-steel hinges screwed to the body of the enclosure. They make it easier to remove and invert the door. Opening angle: 120°.
- Polyurethane gasket.
- M6 x 16 screws on the door and on the body, allowing equal-potential connection between the earth connections (on request).
- 4 holes for fixing to the wall directly or with the help of mounting lugs (on request), blocked by sealing plugs.
- Certifications: IEC 62208 / UL 508A / CAN/CSA 22.

### **PART 3 EXECUTION (Not decided yet)**

### **END OF SECTION**

## **SECTION 26 27 26 Wiring Devices**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

- A. The wires are used for electrical distribution wiring within the house;
- B. All cables and wires for solar system are not included in this part.
- C. Various types of wall plates are included in this section.

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB50054-95 Code for design of low voltage electrical installations
- C. DGJ08-93-2002 (J10166-2002) Code for fireproofing design of wires and cables used in civil buildings

#### 1.3 SUBMITTALS

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#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-604 GRID INTERCONNECTION
- C. E-101 ELECTRICAL DISTRIBUTION PLAN
- D. E-102 LIGHTING PLAN
- E. E-104 GROUNDING PLAN
- F. E-201 ELECTRICAL ELEVATIONS
- G. E-501 SCHEDULE (DB)
- H. E-601 ONE-LINE DIAGRAM
- I. E-605 THREE-LINES DIAGRAM (DB)

## Part 2 PRODUCTS

### 2.1 MANUFACTURER

A. Merten GmbH & Co. KG, Lösungen für intelligente Gebäude,  
Service Center, Fritz-Kotz-Straße 8, Industriegebiet  
Bomig-West, D-51674 Wiehl  
Telefon: +49 2261 702-204  
Telefax: +49 2261 702-136  
E-Mail: [servicecenter@merten.de](mailto:servicecenter@merten.de)  
Internet: [www.merten.de](http://www.merten.de)

B. Schneider Electric  
35 rue Joseph Monier  
92500 Rueil-Malmaison  
France  
<http://www.schneider-electric.com>

C. Baosheng Ltd.  
No.1 Middle Baosheng Road,  
Baoying County, Jiangsu Province, China  
Tel.: +86-514-88238888 Fax: +86-514-88248888  
Website: [www.baoshenggroup.com](http://www.baoshenggroup.com)

### 2.2 PRODUCTS

- A. Chinese standard double socket-outlet insert, 2-pole/3-pole
- B. Chinese standard splashed-proof socket
- C. Chinese standard protected outdoor socket

D. Chinese standard protected socket with switch

E. Halogen free low smoke flame retardant wires (4mm / 2.5mm)

Comply with:

GB/T 17650.2 (the same as IEC60754-2)

GB/T17651.2 (the same as IEC61034-2)

GB/T18380.3 (the same as IEC60332-3)

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

## SECTION 26 30 00 Facility Electrical Power Generating and Storing Equipment

### Part 1 GENERAL

#### 1.1 SECTION REQUIREMENTS

#### 1.2 REFERENCE STANDARDS

- A. IEC61131 (GB/T 15969.1, 15969.1, 15969.3, 15969.4)
- B. GB17466-1998 General requirements for enclosures for accessories for household and similar fixed electrical installations
- C. GB/T 19582-2008 Code of industrial automation network based on Modbus protocol

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

-

### Part 2 PRODUCTS

#### 2.1 MANUFACTURER

#### 2.2 PRODUCTS

### Part 3 PRODUCTS

## END OF SECTION

## **SECTION 26 50 00 Lighting**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

- A. The system is used for smart lighting control.
- B. The system includes three types devices: actuators, sensors, bus and terminal devices.

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB/Z 20965 Control network HBES technology specification-Home and building control system
- C. CENELEC EN 50090, CEN EN 13321-1 and ISO/IEC 14543-3

#### 1.3 SUBMITTALS

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#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-102 LIGHTING PLAN
- C. E-201 ELECTRICAL ELEVATIONS
- D. E-501 SCHEDULE (DB)
- E. E-601 ONE-LINE DIAGRAM
- F. E-605 THREE-LINES DIAGRAM (DB)

### **Part 2 PRODUCTS**

#### 2.1 MANUFACTURER

- A. Merten GmbH & Co. KG, Lösungen für intelligente Gebäude,  
Service Center, Fritz-Kotz-Straße 8, Industriegebiet  
Bomig-West, D-51674 Wiehl  
Telefon: +49 2261 702-204  
Telefax: +49 2261 702-136

E-Mail: [servicecenter@merten.de](mailto:servicecenter@merten.de)

Internet: [www.merten.de](http://www.merten.de)

## 2.2 PRODUCTS

### A. UNITRONIC BUS EIB 2 x 2 x 0.8 Nr art. 2170240

- Mutual capacitance: approx. 65 nF/km @at 1 kHz
- Peak working voltage: Max. 300 V (not for power applications)
- Impedance: at 31.25 kHz: 100 +/- 20 Ohm
- Conductor resistance: Max. 24 Ohm/km
- Minimum bending radius: 15 x OD
- Range of temperature: -25°C to +90°C

### B. Merten MTN649208 – Switch actuator

- Supply from KNX: DC 24 V, max. 17.5 mA
- Nominal voltage: AC 230 V
- For each channel output
- Nominal current: 10 A, ohmic load  $\cos \varphi = 1$
- 10 A, inductive load  $\cos \Phi = 0.6$
- Capacitive load: 10 A, max. 105  $\mu$ F
- Incandescent lamps: AC 230 V, max. 2000 W
- Halogen lamps: AC 230 V, max. 1700 W
- Low voltage halogen
- lamps with wounded
- transformers: AC 230 V, 250 VA
- Fluorescent lamps: AC 230 V, max. 1800 W, uncompensated
- AC 230 V, max. 1000 W parallel compensated
- Motor load: AC 230 V, max. 1000 W

- Switching frequency: max. 15x per minute at nominal load
- Fuse: per channel one 10 A automatic cutout
- connected upstream;
- only one live conductor may be used per connecting terminal
- Ambient temperature
- Operation: -5 to +45 °C
- Storage: -25 to +55 °C
- Transport: -25 to +70 °C
- Environment: can be used at up to 2000 m above sea level (MSL)
- Max. humidity: 93%, no moisture condensation
- Operating elements: 1 programming button
- 1 manual operation key
- 1 channel key per channel
- Display elements: 1 red LED: Programming control
- 1 green LED: ready for operation, "RUN"
- 1 red LED: Manual operation status
- 1 yellow status LEDs per channel
- KNX connection: two 1 mm pins for bus connecting terminal
- Load connection: per 2 channels one plug-in 4-gang screw terminal for max. 2.5 mm<sup>2</sup>
- Device width: 4 modules = approx. 72 mm

#### C. Merten MTN649315 - Universal dimming actuator

- Power supply from the bus: DC 24 V/ca. 5 mA
- Insulation voltage: AC 4 kV bus/mains voltage
- Nominal voltage: AC 220 - 230 V, 50/60 Hz

- Fuse the universal dimming actuator using a 10 A circuit-breaker connected in series.
- Minimum nominal power:
  - Ohmic loads >30 W
  - Inductive loads >50 VA
  - Capacitive loads >50 VA
- Ambient temperature:
  - Operation -5°C to +45°C
  - Storage -25°C to +55°C
  - Transport -25°C to +70°C
- Max. humidity: 93 % relative humidity, no moisture condensation
- Environment: the device is designed for use at an installation height of up to 2000 m above sea level (MSL)
- Type of protection: IP 20
- Connections:
  - Inputs, outputs: Screw terminals
  - single-core: 1.5 mm<sup>2</sup> to 2.5 mm<sup>2</sup>
  - finely stranded (with ferrule) 1.5 mm<sup>2</sup> to 2.5 mm<sup>2</sup>
  - KNX: bus connecting terminal
  - Maximum cable length between extension input and extension unit: Mechanical extension units 100 m
  - electrical extension units (e.g. art. no. 573999) 20 m (max. 10 with a max.
  - total cable length of 20 m)
- Nominal voltage of extension units: AC 220 - 230 V, 50/60 Hz (identical phase to mains connection)
- Protective functions: Electronic load detection
- Short-circuit, overload and idling detection
- Excess temperature detection (dimming actuator temperature)

- Guidelines:
  - 73/23/EEC low-voltage guideline
  - 85/336/EEC EMC guideline

#### D. Merten MTN632619 KNX ARGUS 180 UP

- Nominal voltage: DC 24 V (+6 V / -4 V)
- KNX connection: Bus connecting terminal
- Angle of detection: 180°
- Number of levels: 1
- Number of zones: 14
- Recommended mounting height: 1.1 m
- Range: up to approx. 8 m; infinite setting (rotary switch or ETS)
- Detection brightness: Infinite setting from approx. 10 lux to approx. 1000 lux (rotary switch) or from 10 lux to 2000 lux (ETS)
- Overshoot time: Adjustable in 6 steps from approx. 1 s to approx. 8 min (rotary switch) or adjustable from 1 s to 255 hours (ETS)
- Display elements: 1 red programming LED
- Operating elements: 1 programming button, rotary switch for detection brightness, range, and overshoot time
- Ambient temperature
  - Operation: -5 °C to +45 °C
  - Storage: -25 °C to +55 °C
  - Transport: -25 °C to +70 °C
- EC guidelines: Low-Voltage guideline 73/23/EEC,
- EMC guideline 89/336/EEC
- Initialization: Due to the limitation of the telegram rate, a telegram cannot be generated until 20 seconds after initialization at the earliest.

- Type of protection: IP 20

#### E. Merten MTN663593 Brightness sensor

- Supply voltage: DC 24 V (DC 15- 30 V)
- Connecting terminals: Screw terminals, Max. 2,5 mm<sup>2</sup>
- Incoming cable: cable recommended through PG7 screw fitting: 3 x 0.25 mm<sup>2</sup>
- Cable length: max. 100 m (observe installation notes)
- Output : 0 to 10 V DC (min. 1kΩ load, short-circuit proof)
- Ambient temperature : -30 to +70 °C
- Type of protection : IP 65
- Mounting position : Any, Recommendation: PG screw fitting, lower
- Fixing method : screw fixing
- Weight : approx. 200g
- Measuring range : 0 to 60 kLx, linear
- Power consumption : approx. 5 mA

#### F. Merten MTN 681829 USB interface REG-K

- Power supply: via PC USB interface
- Connection Bus: Bus connecting terminal
- USB interface: USB socket, type B
- Transmission rate: 9600 baud
- Transmission protocol: compatible with USB 1.1/2.0
- USB cable length: max. 5 m
- Ambient temperature: -5 °C to +45 °C
- Storage temperature: -25°C to +70°C
- Type of protection: IP 20

- Protection class: II
- Mounting width: 36 mm (2 modules)

#### G. Merten MTN 670804 Push-button interface, 4-gang plus

- Generates an internal signal voltage for connecting four conventional push-buttons or floating contacts, and for connecting four low-current LEDs.
- The cores are 30 cm long and can be extended to max. 7.5 m. For installation in a conventional 60 mm switch box.
- KNX software functions: Switching, dimming or controlling blinds via 1 or 2 inputs, position values for blind control (8-bit), pulse edges with 1-, 2-, 4-, or 8-bit telegrams, differentiation between short and long activation, initialization telegram, cyclical transmission, pulse edges with 2-byte telegrams, 8-bit linear regulator, scenes, counter, disable function, break contact/make contact, debounce time. Outputs for connecting control lamps (low-current LEDs) for the status display.
- For each input/output object type: Contact voltage: < 3 V (SELV)
- Contact current: < 0.5 mA
- Output current: max. 2 mA
- Max. cable length: 30 cm unshielded, can be extended up to max. 7.5 m with twisted unshielded cable.
- Dimensions: approx. 40x30.5x12.5 mm (LxWxH)

#### H. Merten MTN628319 Push-button, 4-gang plus

- Push-button with eight operating buttons, operating display, eight blue status displays which can be triggered separately, and a labelling field. The blue operating display can also be used as an orientation sign. The lower labelling field can be parameterised as an additional operating key. The push-buttons are freely parameterisable as push-button pairs (dual-surface)

or as single push-buttons. The device is connected to the bus line with a bus connecting terminal.

- KNX software functions: Switching, toggling, dimming (single/dual-surface), blind (single/dual-surface), pulse edges trigger 1-, 2-, 4- or 8-bit telegrams (distinction between short and long operation), pulse edges with 2-byte telegrams (distinction between short and long operation), 8-bit linear regulator, scene retrieval, scene saving, disable functions.
- Accessories: Labelling sheets for pushbutton plus art. no. MTN617819.
- Contents: With protective hood for plaster.
- With bus connecting terminal.

#### I. Merten MTN683901 REG emergency power supply

- To buffer the bus voltage. If a complete mains failure occurs, an external lead gel battery with a voltage of DC 12 V (SELV) can be connected to the REG power supply for buffering. The lead gel battery is recharged or maintained in its charged state by integrated charging electronics. A binary input can be connected in order to register the operational statuses (mains voltage, error warning, battery operation). For installation on DIN rails EN 60715. A data rail is not necessary.
- Mains voltage: AC 110 - 230 V, 50~60 Hz
- Output to power supply:
  - Output voltage: DC 30 V  $\pm$ 2 V
  - Output current: without battery with mains supply max. 300 mA, with battery without mains supply max. 640 mA
- Short-circuit current: < 1.5 A
- Charging current: max. 1 A
- Connections: plug-in screw terminal for main connector, operating state (4-pin, 3 floating contacts)
- and emergency power supply. Plug-in terminal for battery connection (two 1 mm pins)
- Device width: 4 modules = approx. 72 mm

- Accessories: Lead gel battery, art. no. MTN668990.
- Lead gel battery, art. no. MTN668991.
- Binary input REG-K/4x10 art. no. MTN644492.
- Binary input REG-K/8x10 art. no. MTN644592.
- Contents: With connecting terminal and cable cover

J. Merten MTN683890 KNX power supply unit REG-K/640 mA with emergency power input

- For generating the bus voltage for a line with up to 64 bus devices. The emergency power supply REG can be connected in order to buffer the bus voltage.
- With integrated choke to decouple the power supply from the bus and a push-button to disconnect the power and reset the bus devices connected to the line.
- For installation on DIN rails EN 60715. The bus is connected using a bus connecting terminal; a data rail is not necessary.
- Mains voltage: AC 110 - 230 V, 50~60 Hz
- Output voltage: DC 30 V  $\pm$ 2 V
- Output current: max. 640 mA, short-circuit-proof
- Device width: 4 modules = approx. 72 mm
- Accessories: REG-K emergency power supply, art. no. MTN683901.
- Contents: With bus connecting terminal and cable cover.

K. Merten MTN677129 Time switch

- Quartz-controlled four-channel year time switch. The device can be programmed manually on the device itself or on the PC using the software. With bus coupler. For installation on DIN rails EN 50022.

- 
- The bus is connected using a bus connecting terminal; a data rail is not necessary. After programming on the PC, all switching times are exported to a memory chip available as an accessory, and transmitted from this into one or more time switches.
    - 324 non-volatile switching times for selectable daily, weekly and date commands, impulse commands
    - 1x switching operation for holiday/public holidays
    - 10 weekly programs for holidays and public holidays per channel
    - Free formation of channel and weekday blocks
    - Manual switching is possible via preselection and permanent switches
    - Random program can be activated
    - Operation with mains connection possible
    - High reserve power
    - Quarz-controlled
    - Automatic changeover between summer and winter time
  - KNX software functions: Switching. Dimming. Send time and date. Scene. Priority.
  - Operating voltage: Bus, DC 24 V
  - Accuracy:  $\leq \pm 1$  s/day
  - Reserve power: 1.5 years at full operability. Data backup in disconnected state approx. 40 years (EEPROM)
  - Type of protection: IP 20
  - Device width: 6 modules = approx. 105 mm
  - Accessories: Obelisk software, art. no. MTN615034.
  - Memory chip for year time switches, art. no. MTN668092

#### L. Merten MTN682191 Analog input module

- Supply voltage: 24 VAC  $\pm 10$  %, 24 VDC +25 % / -10 %
- Current consumption: 250 mA max.

- EIB voltage: 24 VDC (+6 V / -4 V)
- EIB power consumption: 150 mW typ.
- Ambient temperature: -5 °C to +45 °C
- temperature: -25 °C to +70 °C
- Humidity: Ambient/storage/transport: 93 % RH max., no condensation
- Protective system: IP 20 as per DIN EN 60529
- Installation width: 4 pitch / 70 mm
- Weight: approx. 150 g

**PART 3 EXECUTION (Not decided yet)**

**END OF SECTION**

## **SECTION 26 51 00 Interior Lighting Fixtures, Lamps and Ballasts**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB/Z 20965 Control network HBES technology specification-Home and building control system
- C. CENELEC EN 50090, CEN EN 13321-1 and ISO/IEC 14543-3

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-102 LIGHTING PLAN
- C. E-601 ONE-LINE DIAGRAM

**Part 2 PRODUCTS** (Not decided yet)

**Part 3 EXECUTION** (Not decided yet)

**END OF SECTION**

## **SECTION 26 56 00 Exterior Lighting**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. GB/Z 20965 Control network HBES technology specification-Home and building control system
- C. CENELEC EN 50090, CEN EN 13321-1 and ISO/IEC 14543-3

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

-

### **Part 2 PRODUCTS (Not decided yet)**

### **Part 3 EXECUTION (Not decided yet)**

### **END OF SECTION**

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**Division 27 – Communication**

**SECTION 27 13 43 COMMUNICATION SERVICES CABLING**

**Part 1 GENERAL**

1.1 SECTION REQUIREMENTS

Two types of communication devices are included in the project: VGA interface/cable and C5 twisted pair/RJ45.

1.2 REFERENCE STANDARDS

A. JGJ 16-2008 Code for electrical design of civil buildings

1.3 SUBMITTALS

-

5.16.1.4 RELATED DRAWINGS

- A. WIRING PLAN
- B. SCHEMATIC DIAGRAM

**Part 2 PRODUCTS**

2.1 MANUFACTURER

Siemens Ltd., China, Industry Sector, Industry Automation & Drive Technologies (SLC I IA&DT)

P.O.BOX 8543

No. 7, WangJing Zhonghuan Nan Road

Chaoyang District, Beijing City

Tel: 010-64768888

Fax: 010-64721459

<http://www.ad.siemens.com.cn/en/>

2.2 PRODUCTS

- A. VGA standard interface and cable
- B. Double RJ45 standard socket

C. Emergency Switch

**Part 3 EXECUTION (Not decided yet)**

**END OF SECTION 271343**

**SECTION 27 20 00 Data Communication Hardware**

**Part 1 GENERAL**

**1.1 SECTION REQUIREMENTS**

The human-machine interface should be a touch-screen computer, can be used for the related control and monitoring functions.

**1.2 REFERENCE STANDARDS**

**1.3 SUBMITTALS**

**1.4 RELATED DRAWINGS**

- BAS-003 WIRING PLAN
- BAS-101 SCHEMATIC DIAGRAM
- BAS-202 THREE-LINES DIAGRAM (CB)

**Part 2 PRODUCTS**

**2.1 MANUFACTURER**

**-2.2 PRODUCTS**

- A. Human machine interface (HMI)
- B. UTP CAT5e Cables for Modbus

**Part 3 EXECUTION (Not decided yet)**

**END OF SECTION 27 20 00**

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**Division 28 Electronic Safety and Security**

**SECTION 28 05 26 Grounding and Bonding for Electronic Safety and Security**

**Part 1 GENERAL**

1.1 SECTION REQUIREMENTS

- A. Grounding device: integrated grounding;
- B. Grounding connection requirement: All the wires for grounding purpose should be welded. The length for flat steel connection is 2B, the length for round steel is 6D, and welding process should comply with related standards and codes;
- C. Except for those teemed in the concrete, all the other welded places should be processed as corrosion-proof type;
- D. Grounding resistor: Grounding resistors for common grounded devices should be smaller than 1ohm. if it is larger than 1ohm, the artificial grounding device should be set.
- F. Equipment room and restroom should be connected with pre-embedded or grounding terminal devices, please refer to REFERENCE STANDARDS B. 02D501-2.

1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. 02D501-2 equivalent potential connection flush mounted

1.3 SUBMITTALS

-

1.4 RELATED DRAWINGS

- A. E-001 ELECTRICAL SHEET INDEX AND NOTES
- B. E-104 GROUNDING PLAN
- C. E-601 ONE-LINE DIAGRAM

**Part 2 PRODUCTS**

## 2.1 MANUFACTURER

Not decided yet

## 2.2 PRODUCTS

### A. Main equivalent potential terminal box (MEB)

- Flush mounted 0.3m above the ground

### B. L50x50x5 Hot dip galvanized angle steel

- Length: 2.5m
- Depth of embedded: 0.8m (top)

### C. -40x4 Hot dip galvanized flat steel

- Mounted in the concrete as round grounding device
- Stretched 1m as the connector of grounding device
- All metal pipes should be welded to the equivalent potential strip, please refer to the REFERENCE STANDARDS B. 02D501-2 equivalent potential connection flush mounted.

### D. 100x100x5 Hot dip galvanized steel plate

- Flushed mounted grounding test point H=0.50m

### E. 25x4 Hot dip galvanized flat steel

- To the MEB

### F. Grounding test point

- As shown in EL-702 GROUNDING PLAN, two flush mounted resistors should be set, 0.50m below the outdoor ground, facilitating tests of grounding resistors.

## Part 3 EXECUTION (Not decided yet)

## END OF SECTION

## **SECTION 28 31 00 Fire Detection and Alarm**

### **Part 1 GENERAL**

#### 1.1 SECTION REQUIREMENTS

#### 1.2 REFERENCE STANDARDS

- A. JGJ 16-2008 Code for electrical design of civil buildings
- B. 02D501-2 equivalent potential connection flush mounted

#### 1.3 SUBMITTALS

-

#### 1.4 RELATED DRAWINGS

- A. F-001 FIRE PROTECTION SHEET INDEX AND NOTES
- B. F-101 FIRE DETECTION AND ALARM

### **Part 2 PRODUCTS (Not decided yet)**

### **Part 3 EXECUTION (Not decided yet)**

### **END OF SECTION**

## **Division 42 – Process Heating, Cooling, and Drying Equipment**

### **SECTION 42 31 16 DESSICANT EQUIPMENT**

#### **PART 1 - GENERAL**

##### 1.1 SECTION INCLUDES

- A. Dehumidifier

##### 1.2 SUBMITTALS

- A. Weblink to Product Information:

<http://www.cn-sen.com/product-31-.html>

#### **PART 2 - PRODUCTS**

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## 2.1 MANUFACTURER

A. WGI Inc U.S.A

Phone: 86-021-64262401/64262402

Fax: 86-021-64262403

E-mail: [info@cn-sen.com](mailto:info@cn-sen.com)

Web: <http://www.cn-sen.com/>

## 2.2 PRODUCTS

A. Dehumidifier SEN CH962RB

## PART 3 – EXECUTION

We are now planning to use a dehumidifier in kitchen to control the relative humidity level.

**END OF SECTION 423116**

## Division 48 – Electrical Power Generation

### **SECTION 48 14 00 Solar Energy Electrical Power Generation Equipment**

#### **PART 1 - GENERAL**

##### 1.1 SECTION INCLUDES

A. 481413 Photovoltaic Panels

##### 1.2 SUBMITTALS

A. Datasheets SANYO HIT Power 220A solar panel

## PART2- PRODUCTS

### 2.1 MANUFACTURER

A. SANYO Electric Co., Ltd.

Room 2012, Ruijin Building, No. 205 Maoming Nan Road,

Shanghai 200020, China

Phone: +86 (010) 65881501/2/3

Fax: +86 (010) 65881505

E-mail: [chen021089@cn.sanyo.com](mailto:chen021089@cn.sanyo.com)

Web: <http://cn.sanyo.com/index.html>

### 2.2 PRODUCTS

A. SANYO HIT Power 220A solar panel

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## **PART 3 EXECUTIONS**

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Comply with : IEC 61215.2
- G. Solar modules should be covered with an opaque material during installation to avoid shocking or burning.
- H. Do not touch live terminals with bare hands. Use insulated tools for electrical connections.
- I. Do not step on the module.
- J. The module frames are made of anodized aluminum, and therefore corrosion can occur if the module is subject to a salt water environment with contact to a rack of another type of metal.
- K. Efficiency Testing: Verify equipment is properly installed, connected, and adjusted. Verify that equipment is operating as specified.

### **END OF SECTION 48 14 00**

## **SECTION 48 19 00 Electrical Power Control Equipment**

### **PART 1 - GENERAL**

#### 1.1 SECTION INCLUDES

- A. 4819 16 Electrical Power Generation Inverters

#### 1.2 SUBMITTALS

- A. Datasheets SMA Sunny Boy 8000-US inverter

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURER

- A. SMA Solar Technology AG

Sonnenallee 1  
34266 Niestetal, Germany  
Tel. +49 561 9522-0  
Fax +49 561 9522-100  
Email: [info@SMA.de](mailto:info@SMA.de)

Website: [www.SMA.de](http://www.SMA.de)

#### 2.2 PRODUCTS

- A. Sunny Boy 8000-US inverter
  - 1. Maximum AC Power Output:8000W

- 
2. Nominal AC Power Output: 7680W
  3. Nominal AC Voltage/Range:211~264V/244~305V
  4. AC grid frequency / range: 60 Hz / 59.3~60.5 Hz
  5. PV voltage range, MPPT : 300 V – 480 V
  6. Max. efficiency: 96.3 %
  7. CEC efficiency: 96.0 %
  8. Manufacturer's Information:

<http://www.sma.de/en/products/solar-inverters/sunny-boy/sunny-boy-5000-us-6000-us-7000-us-8000-us.html>

9. Operating temperature range:-25 to 45°C
10. Dimensions (W x H x D in mm): 187 / 297 / 190 mm
11. Weight : 66 kg

### **PART 3 EXECUTIONS**

- 3.1 The SMA Series Inverters are UL certified and meet all NEC code requirements in U.S.
- 3.2 Do not install the inverter during periods of precipitation or high humidity (>95%).
- 3.3 Must provide sufficient air circulation to dissipate the heat generated by the inverter.
- 3.4 To prevent electrical shock or other injury, check for existing electrical or plumbing installations in the walls before drilling mounting holes for the inverter.
- 3.5 Ensure that there are studs in the wall at the places where you intend to drill the mounting holes.
- 3.6 Before connecting the inverter to the electrical utility grid, contact the local utility company. This connection must be made only by qualified personnel.
- 3.7 Verify that the DC current of your installation does not exceed the maximum values specified in the type rating.

**END OF SECTION 48 19 00**

**Attachments:**

**1. VIP datasheet**



Nr. 444

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wollmarstr. 3, D-82318 Heumarkt, Tel. 09181/6646-0, Fax 09181/6825, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt VIP-Vakuum-Isolations-Paneel

### 1. Technische Spezifikation

Dichte: 150 - 170 kg /cbm

Sonderrohndichten für hochbelastbare Elemente:

bis 300 kg / cbm

Hüllmaterial: Metallisierte Hochbarrierefolie

Füllstoff: pyrogene Kieselsäure: lebensmitteltauglich, leicht rezyklierbar

Wärmeleitfähigkeit, ungestörter Bereich: 0,004 W/(mK) bei 22,5° mittlerer Temperatur

Innendruck bei Produktion und Auslieferung: 1 bis ca. 5 mbar

Rechenwert: Wärmeleitfähigkeit mit Alterungszuschlag: 0,008 W/(mK)

Wärmeleitfähigkeit belüftetes VIP: 0,019 W/(mK)

Temperaturbeständigkeit : Stützkörper ist nicht brennbar und erfüllt nach IMO FTPC und DIN ISO 4102 die Anforderungen der Baustoffklasse A1.  
Nach DIN EN 13501-1, Einstufung in Brandverhaltensklasse A1  
Umhüllung: bis ca. 80° Dauerbelastung

Brandklasse VIP: B2

Feuchtebeständigkeit: Benetzende Flüssigkeiten zerstören die mikroporöse Struktur des Stützkörpers, daher doppelt diffusionsdichte Einhausung in „Qasa“

Spezifische Wärmekapazität der Pulverplatte: 1,05 kJ/kg\*K (bei 400°C)

Druckbelastbarkeit variiert nach Dichte: 200 kg/m<sup>3</sup> 0,8 N/mm<sup>2</sup>

Stauchverhalten: 200 kg/m<sup>3</sup> Belastung, Atmosphärendruck + 1 bar → Stauchung 11 %



### 2. Lieferformen

Dicken: von 10 - 50 mm

Formate: von DIN A4 bis  
1250 x 3000 mm

Sonderformen: möglich

Dicke: 40 mm = 0,75 kg/m<sup>2</sup>





Nr. 444/1

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Weißmarterstr. 3, D-92318 Neumarkt, Tel. 09181/6946-0, Fax 09181/8825, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt VIP-Vakuum-Isolations-Paneel

### 3. Einsatzbereiche

Geschützte Verarbeitungsprozesse in qualitätsgesicherten Produktionen, z. B. Kühl-schrank- und Verpackungsindustrie, Transportbehälter, Maschinen- und Anlagenbau etc. Verwendung bei werkseitiger Integration in Sandwichelemente, z. B. für geschlossene Fassaden-, Brüstungs- und Füllungselemente etc.

### 4. Liefer- und Verarbeitungshinweise

VIP-Elemente im Rohzustand sind ohne weitere Schutzschichten. Alle Elemente müssen bauseits vor mechanischen und feuchtespezifischen Einwirkungen geschützt werden. Die Elemente werden werkseitig nochmals vor Versand auf den Innendruck geprüft. Die Ware ist sofort nach Zugang / Lieferung auf mögliche Beschädigungen, bzw. Belüftung zu kontrollieren. Beschädigte Elemente - erkennbar an der lose anliegenden Umhüllungsfolie - müssen sofort bei Eingang reklamiert und zurückgeschickt werden. Der Gefahrenübergang erfolgt bei werkseitiger Übergabe an das Transportunternehmen, bzw. an den Abholer. Der Verarbeiter haftet für die sachgemäße Weiterbearbeitung der VIP-Elemente. Bauphysikalische Randbedingungen müssen bauseits berücksichtigt werden.

Die Weiterverarbeitung von VIP-Elementen erfordert eine ausführliche Beratung und gegebenenfalls Schulung und Einweisung des entsprechenden Personals.

Bitte unbedingt beachten:

Mechanische Belastungen sind zu minimieren. Besonders zu vermeiden sind punktuelle Druck-, Zug- und Scherkräfte.

Beschädigung wie Anbohren, Sägen oder Verkratzen der Folie sind grundsätzlich zu vermeiden. Keinen aggressiven Gasen aussetzen.

Kontaktflächen müssen glatt und eben sein. Sie dürfen keine Kanten und Grate aufweisen.

#### 4.1 Lagerung

Hitze und Feuchtigkeit sind bei der Lagerung und Verarbeitung ungeschützter VIP`s zu vermeiden. Dies gilt insbesondere für Bereiche über 60 % relativer Luftfeuchtigkeit bzw. Temperaturen über 50° C.



Nr. 4442

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wallmarkenstr. 3, D-92218 Neumarkt, Tel. 09181/8946-0, Fax 09181/8925, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-light

### 1. Technische Spezifikation

Dichte: 150 - 170 kg /cbm

Sonderrhoichten für hochbelastbare Elemente: bis 300 kg / cbm

Hüllmaterial: Metallisierte Hochbarrierefolie

Füllstoff: pyrogene Kieselsäure: lebensmitteltauglich, leicht rezyklierbar

Wärmeleitfähigkeit, ungestörter Bereich: 0,004 W/(mK) bei 22,5° mittlerer Temperatur

Innendruck bei Produktion und Auslieferung: 1 bis ca. 5 mbar

Rechenwert: Wärmeleitfähigkeit mit Alterungszuschlag: 0,008 W/(mK)

Wärmeleitfähigkeit belüftetes VIP: 0,019 W/(mK)

Temperaturbeständigkeit : Stützkörper ist nicht brennbar und erfüllt nach IMO FTPC und DIN ISO 4102 die Anforderungen der Baustoffklasse A1.  
Nach DIN EN 13501-1, Einstufung in Brandverhaltensklasse A1  
Umhüllung: bis ca. 80° Dauerbelastung

Brandklasse VIP: B1

Feuchtebeständigkeit: Benetzende Flüssigkeiten zerstören die mikroporöse Struktur des Stützkörpers, daher doppelt diffusionsdichte Einhausung in „Qasa“

Spezifische Wärmekapazität der Pulverplatte: 1,05 kJ/kg\*K (bei 400°C)

Druckbelastbarkeit variiert nach Dichte: 200 kg/m<sup>3</sup> → 0,8 N/mm<sup>2</sup> (bezogen auf VIP)

Beidseitig geschützt mit 0,3 mm Aluminium-Deckschichten

### 2. Lieferformen

Dicken: von 11 - 51 mm

Formate: von DIN A4 bis  
1250 x 3000 mm

Sonderformen: möglich

Dicke: 41 mm = 1,0 kg/m<sup>2</sup>

(bezogen auf VIP-Dicke = mm)

Kanten mit diffusionsdichtem Kantenband geschützt (ohne Kompriband)





Nr. 444/3

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wallmarkenstr. 3, D-92318 Neumarkt, Tel. 09181/8946-0, Fax 09181/8925, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-light

### 3. Einsatzbereiche

Vorzugsweise im Innenbereich ohne mechanische, statische oder nutzungsbedingte Dauerbeanspruchung.

### 4. Liefer- und Verarbeitungshinweise

Die Qasa-light-Elemente ermöglichen eine sichere Verwendung in mäßig beanspruchten Baubereichen. Die Umhüllung schützt vor mechanischen Einwirkungen und Permeation. Der Kantenbereich ist mit flexiblen, diffusionsdichten Bändern abgedeckt, um wärmebrückenreduzierte Plattenstöße zu realisieren (ohne Kompriband). Die Elemente werden werkseitig auf Innendruck geprüft und danach für den Versand freigegeben. Die Ware ist sofort nach Zugang / Lieferung auf mögliche Beschädigungen zu kontrollieren. Beschädigte Elemente müssen sofort bei Eingang reklamiert und zurückgeschickt werden. Der Gefahrenübergang erfolgt bei werkseitiger Übergabe an das Transportunternehmen, bzw. an den Abholer. Der Verarbeiter haftet für die sachgemäße Weiterverarbeitung der Qasa-light-Elemente. Bauphysikalische Randbedingungen müssen bauseits berücksichtigt werden.

Die Weiterverarbeitung von Qasa-light-Elementen erfordert eine ausführliche Beratung und gegebenenfalls Schulung und Einweisung des entsprechenden Personals.

#### 4.1 Lagerung

Hitze und Feuchtigkeit sind bei der Lagerung und Verarbeitung ungeschützter VIP's zu vermeiden. Dies gilt insbesondere für Bereiche über 60 % relativer Luftfeuchtigkeit bzw. Temperaturen über 50° C.





Nr. 444/4

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wallmarkenstr. 3, D-92218 Neumarkt, Tel. 09181/8946-0, Fax 09181/8925, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-Sandwich

### 1. Technische Spezifikation

Stützkerndichte: 150 - 170 kg / cbm

Sonderrohdichten für hochbelastbare Elemente: bis 300 kg / cbm

Hüllmaterial: Metallisierte Hochbarrierefolie

Füllstoff: pyrogene Kieselsäure: lebensmitteltauglich, leicht rezyklierbar

Wärmeleitfähigkeit, ungestörter Bereich: 0,004 W/(mK) bei 22,5° mittlerer Temperatur

Innendruck bei Produktion und Auslieferung: 1 bis ca. 5 mbar

Rechenwert: Wärmeleitfähigkeit mit Alterungszuschlag: 0,008 W/(mK)

Wärmeleitfähigkeit belüftetes VIP: 0,019 W/(mK)

Temperaturbeständigkeit: Stützkörper ist nicht brennbar und erfüllt nach IMO FTPC und DIN ISO 4102 die Anforderungen der Baustoffklasse A1.  
Nach DIN EN 13501-1, Einstufung in Brandverhaltensklasse A1  
Umhüllung: bis ca. 80° Dauerbelastung

Brandklasse VIP: B1

Feuchtebeständigkeit: Benetzende Flüssigkeiten zerstören die mikroporöse Struktur des Stützkörpers, daher doppelt diffusionsdichte Einhausung in „Qasa“

Spezifische Wärmekapazität der Pulverplatte: 1,05 kJ/kg\*K (bei 400°C)

Druckbelastbarkeit variiert nach Dichte: 200 kg/m<sup>3</sup> → 0,8 N/mm<sup>2</sup> (bezogen auf VIP)

Gewicht: Flächengewicht / m<sup>2</sup>

### 2. Produktaufbau

VIP-Kern-Platte

2.1 beidseitig geschützt mit 4 mm VARIOTEC-PUR-Massiv-Platte (recyceltes Polyurethan mit Rohdichte 300 kg / m<sup>3</sup>),

- schlagfest,
- hochbelastbar,
- mit geringer Wärmeleitung,
- absolut wasserfest;

2.2 beidseitig verklebt mit 0,3 mm Aluminium-Deckschichten. Anordnung der Alu-Schichten, abhängig vom weiteren Verarbeitungsprozess, d. h. innen- oder außenliegend.

- **Alu innenliegend:** wenn weitere Verklebungen mit den PUR-Massiv-Schutzschichten erfolgen sollen
- **Alu außen:** wenn z. B. gegenüber Beton eine Trennschichtfunktion erforderlich wird

2.3 Kanten: allseitig mit diffusionsdichten Bändern ab- und gedeckt mit Kompriband unterlegt





Nr. 444/5

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wallmarkenstr. 3, D-92218 Neumarkt, Tel. 09181/8946-0, Fax 09181/8925, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-Sandwich

### 3. Lieferformen

Dicken: von 20 bis ca. 60 mm  
Formate: von DIN A4 bis 1250 x 6000 m  
Kanten: umlaufend mit diffusionsdichtem Kantenband geschützt und mit Quellband für fugendichte Elementstöße unterlegt  
Sonderformen: möglich  
Dicke: 50 mm = 19,5 kg/m<sup>2</sup>

### 4. Einsatzbereiche

Vorzugsweise zur Kerndämmung in Bauelementen aus Holz, Beton und sonstigen Werkstoffen für Wand-, Dach- und Fassadenbau. Als Fertigelement in technischen Bereichen, Kühl-, Klima-, Fahrzeugbau und Transportwesen usw. - Entsprechende mechanische, statische oder nutzungsbedingte Dauerbeanspruchungen nach Abstimmung möglich.

### 5. Bearbeitungsformen

Elemente lieferbar mit entsprechenden Durchführungen für Anker-, Leitungs- und Schraubverbindungen, gemäß Statik / Bauplänen. Element inkl. aller CNC-technischen Bearbeitungen.

### 6. Liefer- und Verarbeitungshinweise

Qasa-Sandwichelemente ermöglichen eine sichere Verarbeitung im Baubereich. Die diffusionsdichte Umhüllung inkl. der mechanisch hoch belastbaren PUR-Massiv-Schicht schützt vor mechanischen Einwirkungen und Permeation. Die Elemente werden werkseitig auf Innendruck geprüft und danach für den Versand freigegeben. Die Ware ist sofort nach Zugang / Lieferung auf mögliche Beschädigungen zu kontrollieren. Beschädigte Elemente müssen sofort bei Eingang reklamiert und zurückgeschickt werden. Der Gefahrenübergang erfolgt bei werkseitiger Übergabe an das Transportunternehmen, bzw. an den Abholer. Der Verarbeiter haftet für die sachgemäße Weiterverarbeitung der Qasa-Sandwichelemente. Bauphysikalische Randbedingungen müssen bauseits berücksichtigt werden.

Die Verarbeitung von Qasa-Sandwichelementen erfordert eine ausführliche Planung (Durchbrüche, Befestigungs- und Montagetechnik usw.), gegebenenfalls Schulung und Einweisung des Montagepersonals.

#### 6.1 Lagerung

Hitze und Feuchtigkeit sind bei der Lagerung und Verarbeitung ungeschützter VIP's zu vermeiden. Dies gilt insbesondere für Bereiche über 60 % relativer Luftfeuchtigkeit bzw. Temperaturen über 50° C.





Nr. 444/8

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wellenmarkstr. 3, D-82318 Neumarkt, Tel. 09181/8848-0, Fax 09181/8825, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-Bauelement

### 1. Technische Spezifikation

Dichte: 150 - 170 kg / cbm

Sonderrohndichten für hochbelastbare Elemente:

bis 300 kg / cbm

Hüllmaterial: Metallisierte Hochbarrierefolie

Füllstoff: pyrogene Kieselsäure: lebensmitteltauglich,

leicht rezyklierbar

Wärmeleitfähigkeit, ungestörter Bereich: 0,004 W/(mK) bei 22,5° mittlerer Temperatur

Innendruck bei Produktion und Auslieferung: 1 bis ca. 5 mbar

Rechenwert: Wärmeleitfähigkeit mit Alterungszuschlag: 0,008 W/(mK)

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Temperaturbeständigkeit : Stützkörper ist nicht brennbar und erfüllt nach IMO FTPC und DIN ISO 4102 die Anforderungen der Baustoffklasse A1.  
Nach DIN EN 13501-1, Einstufung in Brandverhaltensklasse A1  
Umhüllung: bis ca. 80° Dauerbelastung

Brandklasse VIP: B1

Feuchtebeständigkeit: Benetzende Flüssigkeiten zerstören die mikroporöse Struktur des Stützkörpers, daher doppelt diffusionsdichte Einhausung in „Qasa“, bzw. Qasa-light

Spezifische Wärmekapazität der Pulverplatte: 1,05 kJ/kg\*K (bei 400°C)

Druckbelastbarkeit variiert nach Dichte: 200 kg/m<sup>3</sup> → 0,8 N/mm<sup>2</sup>

Stauchverhalten: 200 kg/m<sup>3</sup> Belastung, Atmosphärendruck + 1 bar → Stauchung 11 %

Beidseitig geschützt mit 0,3 mm Aluminium-Kanten

U<sub>Panel</sub>: Abhängig von der jeweiligen technischen Elementkonzeption, Dicke, anteiligen Wärmebrücken usw.



Qasa



Nr. 4447

VARIOTEC Sandwich-Elemente GmbH & Co. KG, Wallmerstr. 3, D-42318 Heumarik, Tel. 09181/8046-0, Fax 09181/8625, E-mail: info@variotec.de, www.variotec.de

## Technisches Datenblatt Qasa-Bauelement

### 2. Lieferformen

Dicken: von 20 - 60 mm

Formate: von DIN A4 bis 3 x 10 m, entsprechend den Elementierungsplänen

Formen: alle geometrischen Sonderformen mittels CNC-Bearbeitung möglich

Bauelement-Aufbau:

Beidseitig 5 mm Flächenschutzschicht inkl. 0,3 mm Alu-Deckschichten

Kanten: Diffusionsdichter Randverbund, unterlegt mit Fugendichtungsband zur optimierten Dichtigkeit und Wärmebrückenminimierung innerhalb des Großflächenelementes

### 3. Einsatzbereiche

Zur großtechnischen bau- oder werkseitigen Verwendung, z. B. als Innenkern für Beton oder Holz-Sandwichelemente. Baustellen-geeignete Oberflächen und Ausführungen, z. B. mit Ankerdurchbrüchen, Leitungsführungen, Aufhängungen usw. Deckschichten wahlweise vorbereitet für Putz-, bzw. Beschichtungssysteme.

Alternativ Qasa-Oberflächen mit finalen Eigenschaften, z. B. mit Holzwerkstoffen, Alu, Edelstahl, Glas, HPL, etc.

### 4. Liefer- und Verarbeitungshinweise

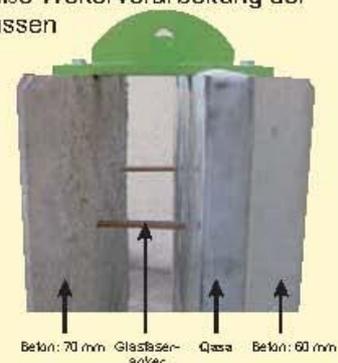
Die Qasa-Bauelemente ermöglichen eine absolut sichere Verwendung in hoch beanspruchten Baubereichen. Die Umhüllung schützt vor mechanischen Einwirkungen und Permeation. Die Elemente werden werkseitig auf Innendruck geprüft und danach für den Versand freigegeben. Die Ware ist sofort nach Zugang / Lieferung auf mögliche Beschädigungen zu kontrollieren.

Beschädigte Elemente müssen sofort bei Eingang reklamiert und zurückgeschickt werden. Der Gefahrenübergang erfolgt bei werkseitiger Übergabe an das Transportunternehmen, bzw. an den Abholer. Der Verarbeiter haftet für die sachgemäße Weiterverarbeitung der Qasa-Bauelemente. Bauphysikalische Randbedingungen müssen bauseits berücksichtigt werden.

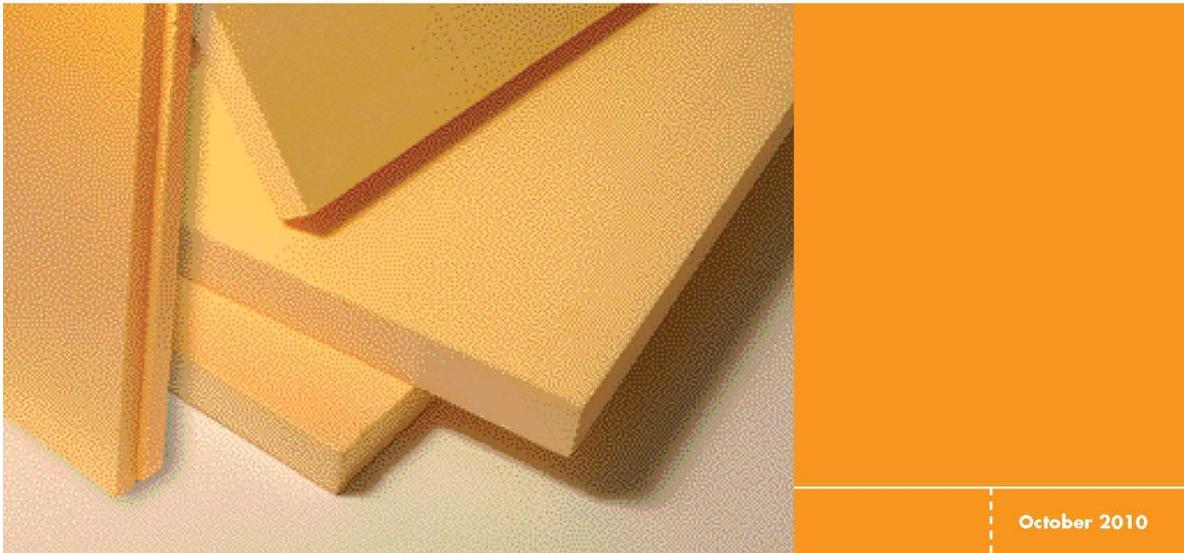
Die Weiterverarbeitung von VIP-Elementen erfordert eine ausführliche Beratung und gegebenenfalls Schulung und Einweisung des entsprechenden Personals.

#### 4.1 Lagerung

Trocken, auf ebenem Untergrund, ohne punktförmige Druck-, bzw. Biegebelastung



## 2.knaufPolyfoam XPS board datasheet



October 2010

### Polyfoam XPS

#### For almost any kind of partitioning

##### Description

Polyfoam XPS is a high performance, 100% ozone friendly, extruded polystyrene, rigid insulation board. It is lightweight, yet has excellent structural strength and compression resistance. Polyfoam XPS is available in three grades with either interlocking rebated edges or square edges.

##### Application

Polyfoam XPS is suitable for almost any floor construction including:

- Below a concrete slab
- Below a screed
- Below a chipboard sheet

##### Standards

Polyfoam XPS is manufactured in accordance with BS EN 13164:2008 and BSI Quality Assurance Standard BS EN ISO 9001:2008.

##### Certification

Polyfoam XPS is certified by BBA Certificate 04/4186.

##### Durability

The continuous service temperature limits of Polyfoam XPS are -50 to +75°C.

##### Environmental

Polyfoam XPS is free from CFCs, HCFCs and any other material with ozone depletion potential in its manufacture and content and represents no known threat to the environment. Polyfoam XPS is non bio-degradable and is 100% recyclable.

#### Performance

The thermal conductivity of Polyfoam XPS varies between 0.030 W/mK and 0.034 W/mK – see product data tables.

#### Benefits

- Excellent thermal insulation
- High compressive strength
- Highly resistant to water absorption
- Able to resist repeated freeze/thaw cycles
- Structurally stable in the long term



## Polyfoam XPS

### Compression resistance

Polyfoam XPS is highly resistant to compression and withstands both occasional and long term static loads. A factor of safety for design loads of 3 (5 for long term static loads) is applied to the compressive strength of the product.

### Vapour Resistivity

Polyfoam XPS has a water vapour resistivity of 600MNs/gm.

### Moisture absorption

Polyfoam XPS has a moisture absorption of 0.3% by volume.

### Moisture resistance

Polyfoam XPS is resistant to moisture absorption and can be laid in ground water or up against wet concrete with negligible impact on the performance of the product.

### Handling and storage

Polyfoam XPS boards are lightweight and easy to handle and are supplied in polythene packs, labelled with identifying product and manufacturing data. Ensure the boards are not stored close to open flame or other ignition source, also avoid volatile organic compounds and chemicals such as solvents. Polyfoam XPS should not be left exposed to prolonged sunlight as this will result in surface degradation, where outside storage for extended periods is required cover with opaque/light coloured sheeting.

Thickness (mm)	Thermal conductivity (W/mK)	Thermal resistance (m <sup>2</sup> K/W)	Compressive strength (kpa)	Length (mm)	Width
<b>Polyfoam 300 SE</b>					
20	0.030	0.65	300	2500	600
30	0.030	1.00	300	2500	600
40	0.030	1.35	300	2500	600
50	0.030	1.70	300	2500	600
60	0.030	2.05	300	2500	600
70	0.030	2.40	300	2500	600
<b>Polyfoam 300 LJ</b>					
50	0.030	1.70	300	2485	585
60	0.030	2.05	300	2485	585
70	0.030	2.40	300	2485	585
80	0.030	2.75	300	2485	585
100	0.032	2.90	300	2485	585
<b>Polyfoam 400 LJ</b>					
50	0.032	1.55	400	2485	585
60	0.032	1.85	400	2485	585
80	0.034	2.35	400	2485	585
<b>Polyfoam 500 LJ</b>					
50	0.034	1.45	500	2485	585

Delivery times are dependent on the ordering / cooperative agreements that are assigned, updated material and process information. Factory can maintain a basic inventory to the customer to shorten the delivery time 7-14 days. Otherwise, delivery may be 5-8 weeks.

Ref: PD150910

### Knauf Insulation Ltd

PO Box 10  
Stafford Road  
St Helens  
Merseyside  
WA10 3NS  
UK

**Tel:** 0800 14 66 22

**Fax:** +44 (0)1744 766732

**Email:** info@knaufinsulation.fi

For the contact details of your nearest Knauf Insulation Business Development Manager, please call the above number.

For more information please visit  
[www.knaufinsulation.fi](http://www.knaufinsulation.fi)

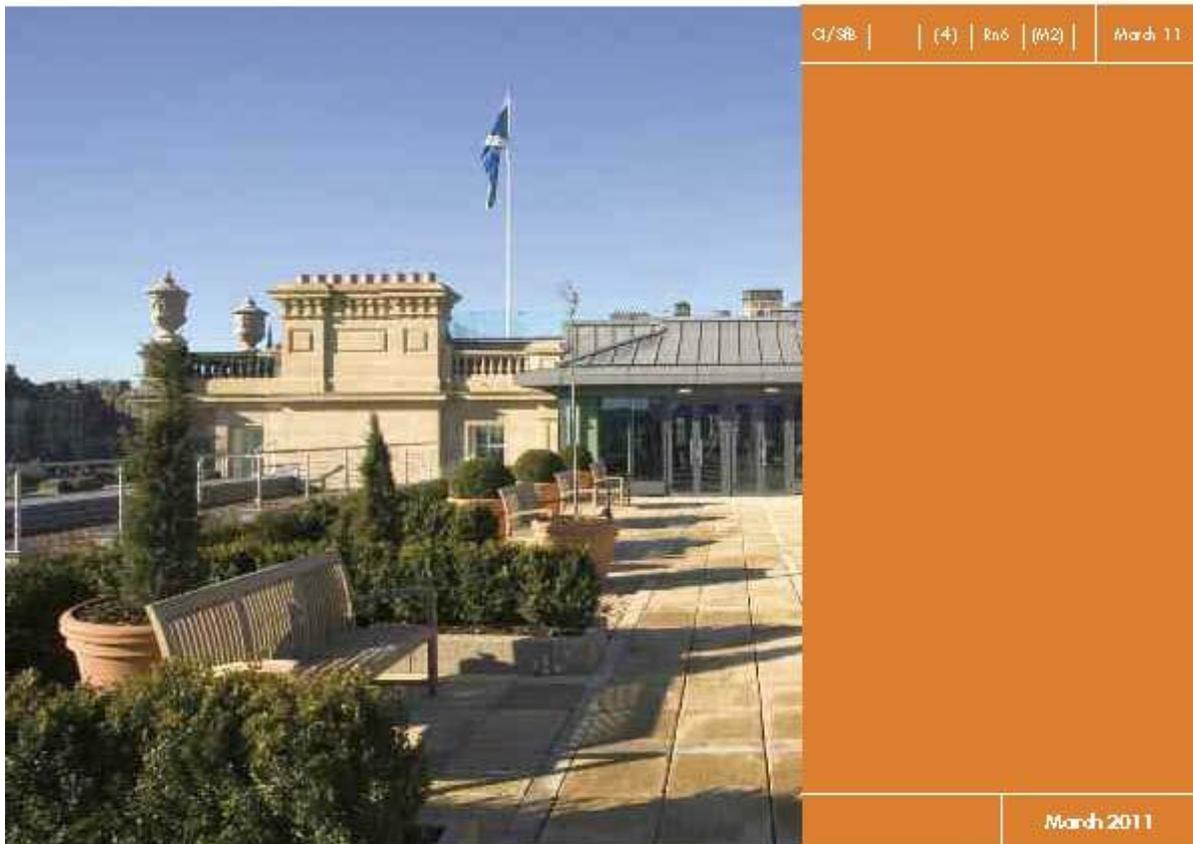
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3.knaufPolyfoam XPS board safety datasheet

<p>KNAUF INSULATION LTD. Hunter House Industrial Estate Tofts Road East, Hartlepool TS25 2BE Tel 01429 855100 Emergency Tel No 01744 766600 E Mail - <a href="mailto:Tech@knaufinsulation.com">Tech@knaufinsulation.com</a></p>				<p>KI_DP035 April 2009</p>	
<p><b>SAFETY DATA SHEET</b> <b>Nordic - Polyfoam Products</b> <b>XPS Extra, Polyfoam XPS</b></p>					
<b>1. IDENTIFICATION</b>			<b>2. HAZARD IDENTIFICATION</b>		
<p>Extruded Polystyrene Foam (XPS) for insulation</p>			<p>Non hazardous in finished form. Residual quantities of process chemicals, styrene and blowing agents are insignificant. The product is organic and therefore combustible if exposed to intense heat or a fire. Polystyrene melts at high temperature and molten droplets may cause skin burns.</p>		
<b>3. COMPOSITION</b>			<b>4. FIRST AID MEASURES</b>		
<p>Polystyrene with colouring, HFC gaseous blowing agent and 1% wt/wt Hexabromocyclododecane flame retardant added during manufacture CAS No. Blowing agent 811-97-2 and 75-37-6 CAS No. Flame Retardant 3194-55-6, EC-Number 221-695-9; Hazard symbol: N; R Phrase 50/53</p>			<p><b>EYES:</b> If dust particles enter the eye, wash with water. If any irritation symptoms persist seek medical advice <b>Skin:</b> After use, wash with soap and water. If in contact with molten material treat affected area immediately with cold water and seek medical attention. Do not attempt to remove any molten or solidified material from the skin. <b>Inhalation:</b> Dust particles from cutting are unlikely to be of inhalable dimensions unless power tools are used. If problems are experienced, remove to fresh air and drink water.</p>		
<b>5. FIRE FIGHTING MEASURES</b>			<b>6. ACCIDENTAL RELEASE MEASURES</b>		
<p><b>Extinguishing Media:</b> water, foam, carbon dioxide or dry chemical powder. <b>Products of Combustion:</b> those normally associated with combustion of organic hydrocarbons and should be considered toxic. Will include carbon monoxide, carbon dioxide and hydrogen bromide. Dense smoke will be generated and suitable breathing apparatus should be worn when fighting fires.</p>			<p>The product is in solid form and poses no hazard. See 13 for disposal considerations.</p>		
<b>7. HANDLING AND STORAGE</b>			<b>8. EXPOSURE CONTROLS - PERSONAL PROTECTION</b>		
<p>Do not store near to any sources of heat. When installing products beware of strong winds, especially when working at heights. Avoid dust generation during secondary processing. Hand cutting tools should be used when possible. If power tools are used, suitable dust extraction should be used and/or respiratory and eye protection.</p>			<p><b>Respiratory protection:</b> No MEL applicable but if dust is generated it is recommended that a disposable face mask complying with BSEN 149 type FFP1 or FFP2 is used to improve comfort. <b>Hand and skin protection:</b> No special precautions but gloves may be worn for comfort. <b>Eye protection:</b> When cutting or processing with power tools, or working with product above head height, eye protection complying with BS EN 166 is advised.</p>		
<b>9. PHYSICAL &amp; CHEMICAL PROPERTIES</b>			<b>10. STABILITY AND REACTIVITY</b>		
<p><b>Appearance</b> – rigid closed cell plastic foam usually pink in colour, but may be made in other colours <b>Melting Point</b> – above 110 °C <b>Flash point</b> – above 300 °C <b>Odour</b> – odourless <b>Solubility</b> – insoluble in water and generally chemically inert. Soluble in organic solvents.</p>			<p>Stable under normal conditions of use. Resistant to many chemicals but not to solvents. Care should be taken in the choice of adhesives to be used with Polyfoam. Avoid exposure to heat and flames, and prolonged exposure to sunlight. <b>Decomposition products</b> – fumes from molten material and smoke from fires involving the product can contain toxic gases such as carbon monoxide, carbon dioxide and hydrogen bromide.</p>		
<b>11. TOXICOLOGICAL INFORMATION</b>			<b>12. ECOLOGICAL INFORMATION</b>		
<p>Extruded polystyrene is non-toxic and not irritating to the skin or eyes.</p>			<p>It is free of HCFC blowing agents and complies with EU Regulation EC/3093/94 on substances, which deplete the ozone layer. This product contains a substance which is classified as dangerous for the environment. However recent studies on aquatic organisms have shown that articles such as XPS foams, while containing this substance, do not need to be classified for environmental hazard</p>		
<b>13. DISPOSAL CONSIDERATIONS</b>			<b>14. TRANSPORT INFORMATION</b>		
<p>Recover or recycle whenever possible. Waste material is not classified as hazardous waste and may be disposed of in normal landfill or by incineration under controlled and approved conditions.</p>			<p>Not classified as hazardous for transportation</p>		
<b>15. REGULATORY INFORMATION</b>			<b>16. OTHER INFORMATION</b>		
<p>No specific regulations apply. At all times, observe general health and safety guidance. A MEL of 10mg/m<sup>3</sup> 8 hour TWA applies to all inhalable dusts. REACH regulation (EC) No 1907/2006. This product is an Article. This product contains Hexabromocyclododecane above 0.1%(w/w) listed in the Candidate list for authorisation established in accordance with article 59.1</p>			<p>If using adhesives with this product follow the adhesive manufacturer's instructions carefully. This Safety Data Sheet has been drafted in accordance with EU Directive 91/155/EC as amended by 2001/58/EC.</p>		

Revised; April 2009; Nordic Product Range

4.knauf Brochure-Polyfoam-Solutions-Guide



## Polyfoam solutions guide

**polyfoam**  
light, yet versatile insulation



## The right insulation for the right project

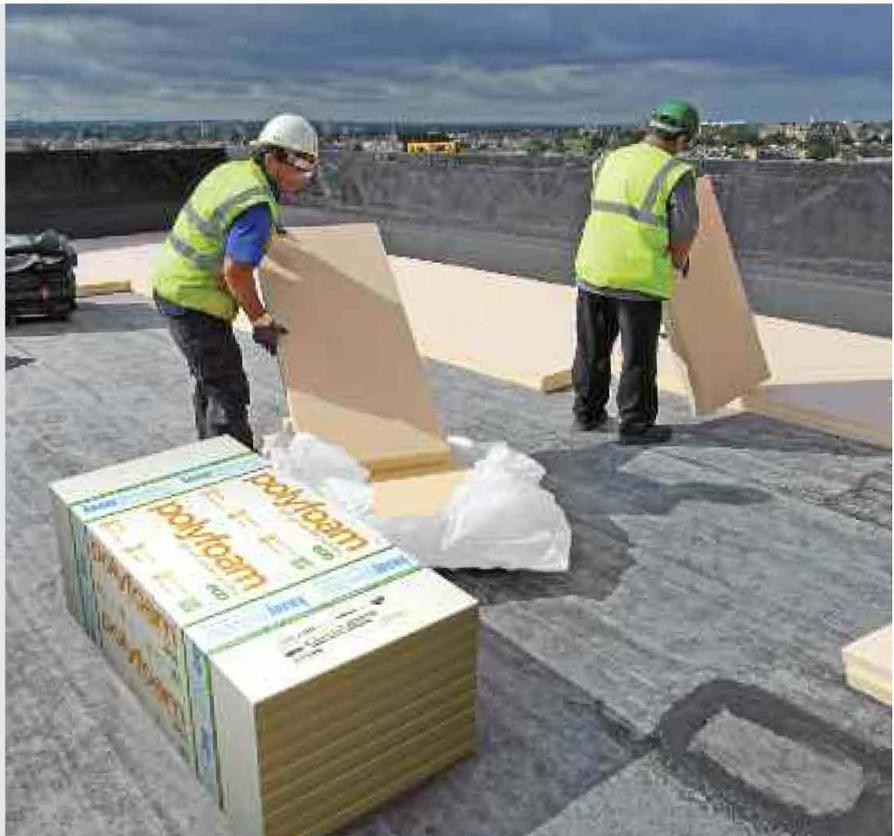
Knauf Insulation manufacture glass and rock mineral wool, extruded polystyrene (XPS) and extruded polyethylene (XPE) foam insulation products. As the only UK manufacturer of multiple types of insulation, Knauf Insulation can provide sound advice on the best solutions to match your performance requirements, for any construction detail, in any building from any sector.

## Leaders in sustainable innovation

The development of Polyfoam products with a GWP less than 5 is the latest in a programme of sustainable and environmental innovation that puts Knauf Insulation at the forefront of sustainable design for insulation in construction.

Polyfoam is a lightweight, cellular thermal insulation with excellent structural strength and very high moisture resistance.

Unlike other lightweight insulation boards, Polyfoam is both a structural and thermal insulation.



# polyfoam

*rigid, yet versatile insulation*

The Polyfoam range of extruded polystyrene insulation products are manufactured by a plastic extrusion process. The resulting boards are almost 100% closed cell, strong, highly moisture resistant and easy to cut and shape. This makes these products ideal for applications in the construction industry as they maximise versatility on site.

Polyfoam ECO and ECO PLUS products are manufactured in the UK and achieve a Global Warming Potential (GWP) of less than 5. Both products are free from CFC's, HCFC's and any other ozone depletion potential in their manufacture and content.

The Polyfoam ECO and ECO PLUS products are cost effective insulation solutions for new build and the refurbishment of buildings. The products can be used in both floor and roofing applications for non-residential and residential sectors.



**Strong**



**Water resistant**



**Versatile**



**Lightweight**

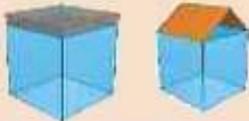
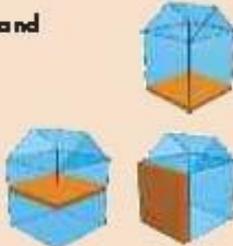


**100% Ozone friendly**



**Recyclable**

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All soffits and edge trimmings are recycled by feeding back into the process.



XPS can be segregated into mixed plastic skips on construction sites and recycled into new products.



Woody, paper, oil, metal, plastic etc. are just a few of the waste streams that are segregated on-site for recycling.



Technical Advisory Centre: 01744 766 666



# Polyfoam Application selector



polyfoam  
high performance insulation

polyfoam  
high performance insulation  
eco

polyfoam  
high performance insulation  
eco plus

## Roofs



**Polyfoam High Impact and Upright board**  
A laminate of Polyfoam high performance rigid insulation board and a tough, weather resistant facing square edged board.

- + Integral weather resistant facing
- + Excellent thermal performance
- + Structurally stable
- + Easy to install one-piece facing and insulation solution

**Polyfoam Pitched Roofboard**  
Rigid insulation board with interlocking rebated edges.

- + Thermally efficient
- + Structurally stable
- + Rigid yet lightweight
- + Easy to install – shiplap rebates do not have to be supported on rafters



**Polyfoam Raftersqueeze**  
Supplied square edged with a series of grooves along each long edge. Grooves compress during installation to provide a friction fit between rafters, enabling quick and simple installation.

- + Friction fit between rafters
- + Compressible for easy installation
- + Allows for some variation in timber centres
- + Excellent thermal performance
- + Lightweight and easy to install

**Polyfoam Roofboards**  
Lightweight, yet has excellent structural strength and long term effectiveness. Supplied with interlocking rebated edges. Polyfoam Foil Faced Roofboard is supplied for single ply membrane roofs where a separation layer is required. Available in three grades - Standard\*, Extra\* and Super.

- + Excellent thermal performance with high compressive strength
- + Highly resistant to water absorption
- + Able to resist repeated freeze/thaw cycles
- + Lightweight and easy to install
- + Tough and durable, not easily damaged

\*Available with GWP less than 5

## Floors



**Polyfoam Floorboards**  
High performance, lightweight and with excellent structural strength and compression resistance. Polyfoam Floorboard is available in three grades. Polyfoam Floorboard Super is supplied with interlocking rebated edges. Polyfoam Floorboard Standard\* and Extra\* are square edged boards.

- + Excellent thermal insulation
- + High compressive strength
- + Highly resistant to water absorption
- + Structurally stable in the long term
- + Polyfoam Floorboard is available in three grades:  
Standard – general domestic use and light commercial loading  
Extra – commercial, industrial flooring and cold storage  
Super – very high load commercial, industrial and cold storage floors



\*Available with GWP less than 5

**Polyfoam Floorfoam**  
Floorfoam is a closed cell extruded polyethylene foam available in roll form. The closed cell nature of Floorfoam makes it excellent at cushioning vibrations. It has been developed specifically to comply with Building Regulation requirements for a resilient layer in separating floors. Floorfoam is suitable for use with either traditional or liquid screed solutions and has been successfully tested with both.

- + Excellent acoustic performance
- + Good compression resistance
- + Complies with Building Regulation requirements for a resilient layer in concrete separating floors

## Walls



**Polyfoam Cavityboard**  
Supplied with interlocking rebated edges that help to create a complete insulated envelope with fewer gaps and also help to resist moisture ingress across the finished construction.

- + Excellent thermal performance
- + Highly resistant to water absorption
- + Lightweight and easy to install
- + Tough and durable, not easily damaged

**Polyfoam Linerboard**

Polyfoam linerboard is a laminate of Polyfoam rigid insulation board and plasterboard. Polyfoam Linerboard utilizes tapered edge plasterboard.

- + Facing and insulation in one-board results in fast installation
- + Standard drylining technique used for fixing and finishing boards
- + Robust nature of Polyfoam supports plasterboard, improving its impact performance
- + Excellent thermal performance
- + Ideal for upgrading listed and historic facade buildings



## Testing and standards

Polyfoam products are manufactured in accordance with EN 16001:2009 Energy Management Systems; OHSAS 18001:2007 Occupational Health and Safety Management Systems; ISO 14001:2004 Environmental Management Systems; and ISO 9001:2008 Quality Management Systems, as certified by Bureau Veritas.

Properties		Standard	CE Designation Code*
Thermal conductivity		BS EN 12667	$\lambda, 0.033 - 0.035 \text{ W/mK}$
Compressive strength		BS EN 826	CS(10\y)200, CS(10\y)300
Water absorption	Total immersion	BS EN 12087	W(1)1.5
	Diffusion	BS EN 12088	Wd(y)3
Dimensional stability	48 hours	BS EN 1604	DS(70,90)
Density		BS EN 1602	Ongoing
Dimensions	Length	BS EN 822	Floorboard: 2500mm, Roofboard: 1250
	Width	BS EN 822	Floorboard: 600mm, Roofboard: 600mm
	Thickness	BS EN 822	Floorboard: 50-100mm, Roofboard: 35-160mm
Appearance	Edge profile		Floorboard: SE, Roofboard: U and SE
Certification	BBA		This product will be added to our current BBA certificates.
			Floorboard: 04-4186 Roofboard: 07-4418

\*These are typical values. See individual product sheets for more information.

\*Results represent Polyfoam Floorboard Standard ECO, Polyfoam Floorboard Extra ECO and Polyfoam Roofboard Extra ECO.

U = Lap jointed

SE = Straight edge

### Global Warming Potential (GWP) and specification

For commercial applications, there is actually no mandatory requirement for the insulation to have a GWP of less than 5. Nor is it stipulated by current BREEAM criteria (although it was in the 2006 Responsible Sourcing document). This means that all versions of Polyfoam products are perfectly valid and specifiable solutions for most applications.

Knauf Insulation is continually developing new methods and technologies to create sustainable solutions for energy efficient buildings. In line with Knauf Insulation's own drive for evermore sustainable solutions, Polyfoam ECO and Polyfoam ECO PLUS are fully compliant with GWP less than 5 and have better thermal conductivity performance than comparable products.

The Code for Sustainable Homes  
Polyfoam ECO and Polyfoam ECO PLUS are both eligible for credits in the 'Materials' category.

Current applications for Polyfoam ECO and Polyfoam ECO PLUS  
Currently, these products are available for roof and floor applications, but other products will be available in the near future. Standard Polyfoam can be specified for the full range of applications as detailed in 'Insulation Solutions for Buildings' or on our website at [www.knaufinsulation.co.uk](http://www.knaufinsulation.co.uk)



## Roofs

Usually the most exposed surface of the building, the roof must be not only weather-tight and waterproof, but adequately insulated to ensure the specified level of heat loss is achieved. **Polyfoam is the ideal solution across a range of applications and sectors.**

### Pitched roofs (at rafter level)

Recent changes to planning policies requiring higher density residential and commercial developments have led to dramatic growth in the utilisation of the roof space as a living or recreation area. When this is coupled with the improved thermal efficiency required by the latest Building Regulations, the specification of insulation for this application is becoming a matter of increased complexity and importance.

### Flat roofs

Flat roofs can be defined as roofs with a pitch not exceeding 10° that have a continuously supported weatherproof finish. The choice of weatherproof finish includes single ply membranes, mastic asphalt and built-up roofing.

However, material choice is only one factor in the long-term performance of flat roof. Experience has shown that the quality of design and workmanship play a critical role in the durability of flat roofs.

### Green roofs

A green roof is a roof that is partially or completely covered with vegetation and soil, or growing medium, planted over a waterproofing membrane. They may also include additional layers such as a root barrier and drainage and irrigation systems.

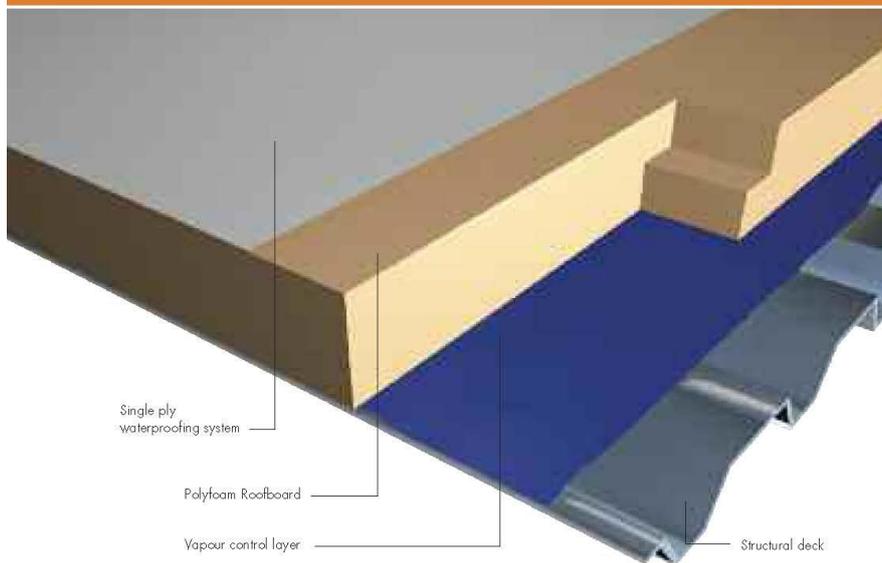
Green roofs not only provide amenity space for building users, but also evaporative cooling, as water retained in the green roof system evaporates in warm weather. The retention of water also provides the benefit of helping to control storm water run off after heavy rainfall.

### Advantages of Polyfoam

- The thermal performance is unaffected by site conditions like moisture, fluctuations in temperature and repeated freeze/thaw cycles. Making this the ideal product for inverted roofs
- Polyfoam minimises mould and fungal growth potential due to its low susceptibility to rot
- Polyfoam is robust and lightweight making it easy to handle on site and highly resistant to mechanical damage
- Polyfoam can tolerate traffic from following trades without damage
- The Polyfoam ECO and ECO PLUS range offer products with a GWP less than 5.

# Warm deck

Single ply membrane



## Typical U-values

Product	U-values (W/m <sup>2</sup> K)											
	150mm concrete 40mm screed 13mm plaster				Profiled metal deck				19mm chipboard timber joists 12.5mm plasterboard			
Thickness* (mm)	1	2	3	4	1	2	3	4	1	2	3	4
200	0.14	0.14	0.17	0.14	0.14	0.15	0.17	0.15	0.13	0.14	0.16	0.14
190	0.15	0.15	0.17	0.15	0.15	0.15	0.18	0.15	0.14	0.15	0.17	0.15
180	0.15	0.16	0.18	0.16	0.16	0.16	0.19	0.16	0.15	0.15	0.18	0.16
170	0.16	0.17	0.19	0.17	0.17	0.17	0.20	0.17	0.16	0.16	0.18	0.16
160	0.17	0.18	0.21	0.18	0.18	0.18	0.21	0.18	0.16	0.17	0.20	0.17
150	0.18	0.19	0.22	0.19	0.19	0.19	0.23	0.19	0.17	0.18	0.21	0.18
140	0.19	0.20	0.23	0.20	0.20	0.21	0.24	0.21	0.19	0.19	0.22	0.19
130	0.21	0.22	0.25	0.22	0.22	0.22	0.26	0.22	0.20	0.20	0.23	0.20
120	0.23	0.23	0.27	0.23	0.23	0.23	0.29	0.24	0.21	0.21	0.25	0.22
110	0.24	0.24	0.29	0.25	0.25	0.25	0.30	0.26	0.23	0.23	0.27	0.24

\* Some solution thicknesses are a combination of two or more boards

- \*\* 1 Polyfoam Roofboard Standard and Foil Faced  
2 Polyfoam Roofboard Extra and Foil Faced  
3 Polyfoam Roofboard Extra ECO  
4 Polyfoam Roofboard Extra ECO PLUS



## Products

Polyfoam Roofboard Standard Foil Faced; Polyfoam Roofboard Extra Foil Faced; Polyfoam Roofboard Extra ECO; Polyfoam Roofboard Extra ECO PLUS

## Advantages

- Compressive strength of Polyfoam Roofboards offer future use potential for roof
- Rebated edges provide support across spans in profiled roof decks
- Rigid support of the water proofing membrane, reduces the risk of puncture on site
- Available in products which have GWP less than 5

## Performance

### Thermal performance

Polyfoam Roofboard Extra, Polyfoam Roofboard Standard and Polyfoam Foil Faced Roofboard have a thermal conductivity of 0.029W/mK up to a thickness of 120mm and 0.030W/mK above this.

Polyfoam Roofboard Extra ECO has a thermal conductivity of 0.035W/mK.

Polyfoam Roofboard Extra ECO PLUS has a thermal conductivity of 0.030W/mK.

### Compression resistance

Highly resistant to compression and withstands both occasional and long term static loads.

### Moisture resistance

Polyfoam boards are highly resistant to moisture absorption and will perform as stated if exposed to moisture in use.

### Fire performance

When Polyfoam Roofboards are installed in a roof construction, they will not contribute to the development stages of a fire.

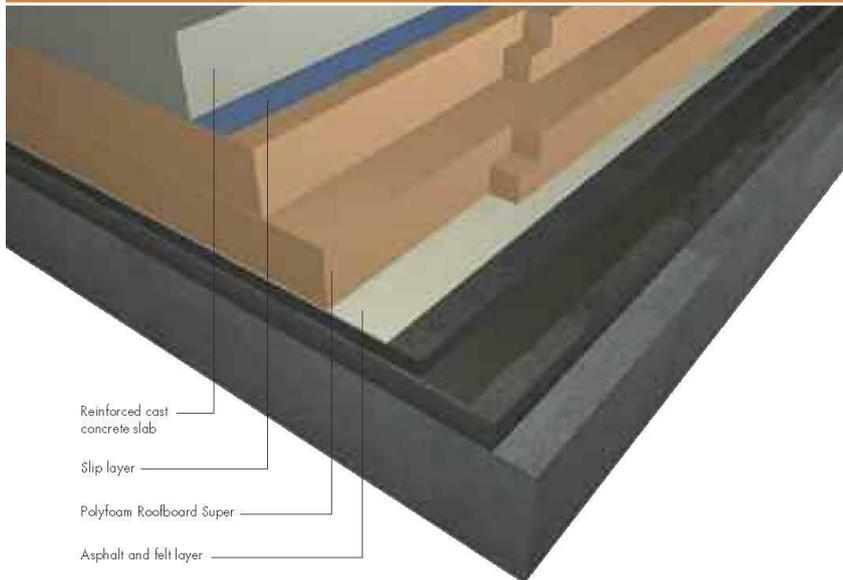


Note: All U-values calculated in line with BBA/TIMS U-value competency scheme.

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# Warm deck

Car park



Reinforced cast concrete slab  
Slip layer  
Polyfoam Roofboard Super  
Asphalt and felt layer

## Typical U-values

Thickness (mm)	U-values (W/m <sup>2</sup> K)	
	150mm concrete	40mm screed 13mm plaster
<b>Polyfoam Roofboard Super</b>		
225 (3 x 75)	0.15	
200 (2 x 100)	0.17	
175 (100 + 75)	0.19	
150 (2 x 75)	0.21	
125 (75 + 50)	0.25	
100	0.31	

Note: 100mm cast concrete slab finish assumed. The U-values have been calculated to BS EN ISO 6946: 1997. For project specific calculations contact our Technical Advisory Centre on 01744 766666

## Products

Polyfoam Roofboard Super

## Advantages

- Ultra strong Polyfoam Roofboard Super has the compressive strength to support the loads associated with a car park roof
- Protects waterproofing membrane during concrete casting, increasing its in-service life
- Thermal performance of Polyfoam Roofboard Super is unaffected by moisture
- Polyfoam Roofboard Super is lightweight so adds minimal weight to the roof

## Performance

### Thermal performance

The thermal conductivity of Polyfoam Roofboard Super is 0.030 W/mK.

### Compression resistance

Highly resistant to compression and withstands both occasional and long term static loads.

### Moisture resistance

Polyfoam boards are highly resistant to moisture absorption and will perform as stated if exposed to moisture in use.

### Fire performance

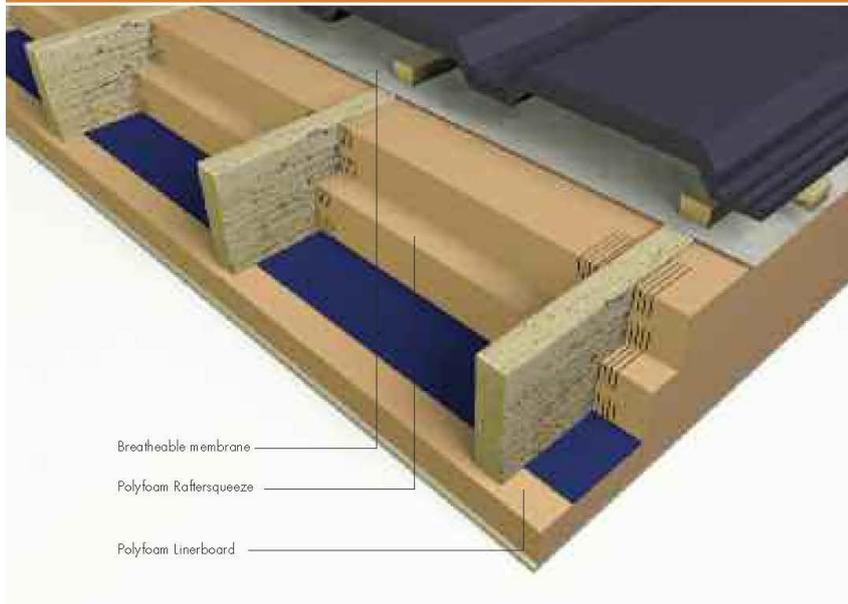
When Polyfoam Roofboards are installed in a roof construction, they will not contribute to the development stages of a fire.



Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.

# Pitched roofs – rafter level

Between and below rafters with insulated plasterboard



## Typical U-values

	Thickness (mm)	U-values (W/m <sup>2</sup> K)		
		Polyfoam Linerboard thickness (mm)		
		25.5/9.5	36/9.5	45.5/9.5
<b>Polyfoam Raftersqueeze</b>	150 (2x75)	0.19	0.17	0.17
	140 (65+75)	0.20	0.18	0.17
	125 (50+75)	0.21	0.20	0.19
	100 (2x50)	0.25	0.23	0.22

Notes: Rafter sizes assumed to be 38mm wide at 600mm centres (6.3% bridging) and the same depth as the insulation. All U-values calculated in line with BBA/TIMSA U-value competency scheme.

## Products

Polyfoam Raftersqueeze/Polyfoam Linerboard.

## Advantages

- System achieves low U-value even with shallow rafters
- Polyfoam Linerboard provides thermal and lining functions in one application
- Robust nature of Polyfoam in Polyfoam Linerboard supports the plasterboard, improving its impact resistance
- Polyfoam Raftersqueeze fits tightly to the side of rafters

## Performance

### Thermal performance

Polyfoam Raftersqueeze and the insulation in Polyfoam Linerboard has a thermal conductivity of 0.030 W/mK.

### Compression resistance

The rigidity of the Polyfoam in Polyfoam Linerboard offers an excellent support to the finished internal lining and assists in the resistance of impact, helping to prolong its service life.

### Moisture resistance

Polyfoam boards are highly resistant to moisture absorption and will perform as stated if exposed to moisture in use.

### Fire performance

Polyfoam insulation contains a flame retardant specifically designed to inhibit localised ignition. The boards will melt if brought into contact with high temperature sources. However, the use of the boards will not affect the fire rating obtained by tiled roofs when evaluated by assessment or tested to BS 476: Part 3: 2004.

Polyfoam Linerboard is faced with 9.5mm plasterboard which offers excellent fire performance.

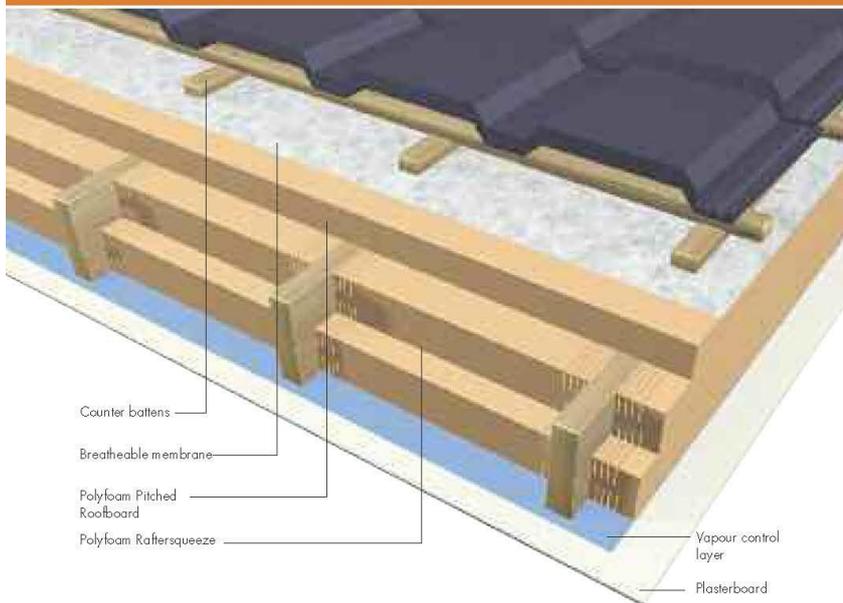


Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.

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# Pitched roofs – rafter level

Between and above rafters



## Typical U-values

Insulation between rafters	Polyfoam Rafter squeeze (mm)	U-values (W/m <sup>2</sup> K)			
		Polyfoam Pitched Roofboard thickness over rafters (mm)			
		35	50	60	75
	150 (75+75)	0.17	0.16	0.15	0.14
	125 (75+50)	0.20	0.18	0.17	0.15
	100 (50+50)	0.23	0.21	0.19	0.17
	75	0.28	0.24	0.22	0.20

Notes: Rafter sizes assumed to be 38mm wide at 600mm centres (6.3% bridging). The U-values have been calculated in accordance with BS EN ISO 6946:1997.

## Products

Polyfoam Pitched Roofboard/  
Polyfoam Rafter squeeze

## Advantages

- Polyfoam Pitched Roofboard can be used with any rafter spacing
- Vertical joints do not need to occur at rafters, making installation quick and simple
- Polyfoam is lightweight yet very strong, making it easy to handle on the roof
- Polyfoam Rafter squeeze fits tightly to the sides of rafters

## Performance

### Thermal performance

Polyfoam Pitched Roofboard has a thermal conductivity of 0.029 W/mK.  
Polyfoam Rafter squeeze has a thermal conductivity of 0.030 W/mK.

### Compression resistance

The rigidity of Polyfoam Pitched Roofboard makes the board easy to handle and less prone to site damage than less robust materials.

### Moisture resistance

Polyfoam boards are highly resistant to moisture absorption and will perform as stated if exposed to moisture in use.

### Fire performance

The boards contain a flame retardant specifically designed to inhibit localised ignition. The boards will melt if brought into contact with high temperature sources.

However, the use of the boards will not affect the fire rating obtained by tiled roofs when evaluated by assessment or tested to BS 476: Part 3: 2004. The underside of the rafters should be faced with 12.5mm plasterboard to provide fire protection.

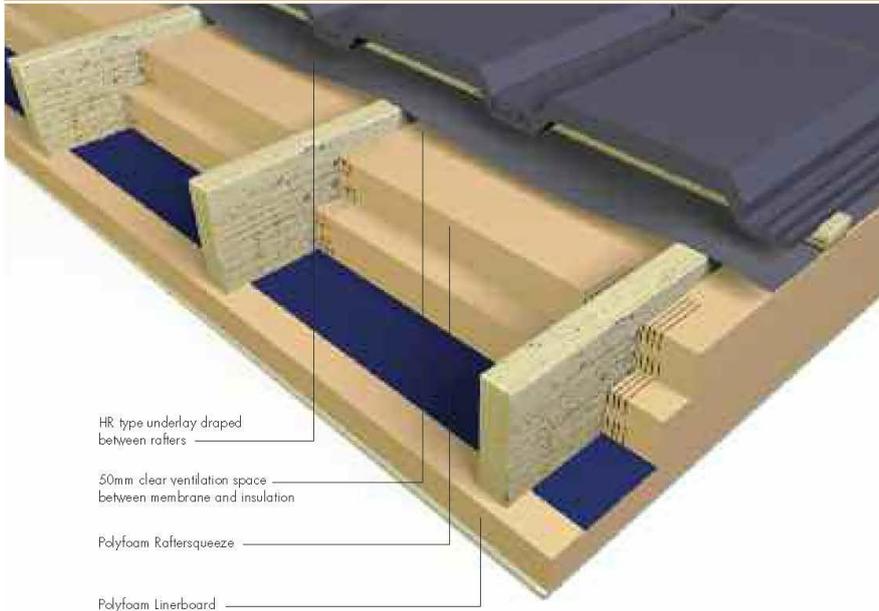
Note: Polyfoam Pitched Roofboard is not suitable to be walked on except when covered with supporting timbers.



Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.

# Pitched roofs – rafter level

Between and below rafters – existing roof



## Typical U-values of roofs with insulation between and below rafters

U-values (W/m <sup>2</sup> K)	Thickness (mm)	Polyfoam Linerboard thickness (mm)		
		25.5/9.5	36/9.5	45.5/9.5
<b>Polyfoam Raftersqueeze</b>	150 (2x75)	0.20	0.18	0.17
	140 (65+75)	0.21	0.19	0.18
	125 (50+75)	0.22	0.21	0.20
	100 (2x50)	0.26	0.24	0.22

Notes: Rafter sizes assumed to be 38mm wide at 600mm centres (6.3% bridging) and the same depth as the insulation. The U-values have been calculated in accordance with BS EN ISO 6946:1997.



Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.

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### Products

Polyfoam Raftersqueeze/ Polyfoam Linerboard

### Advantages

- Robust nature of Polyfoam in Linerboard supports the plasterboard, improving its impact resistance
- Suitable for upgrading existing roof
- Polyfoam Raftersqueeze friction fits tightly to rafters

### Performance

#### Thermal performance

Polyfoam Linerboard has a thermal conductivity of 0.030 W/mK.

Polyfoam Raftersqueeze has a thermal conductivity of 0.030 W/mK.

#### Compression resistance

The rigidity of the Polyfoam in Polyfoam Linerboard offers an excellent support to the finished internal lining and assists in the resistance of impact, helping to prolong its service life.

#### Moisture resistance

Polyfoam boards are highly resistant to moisture absorption and will perform as stated if exposed to moisture in use.

#### Fire performance

Polyfoam insulation contains a flame retardant specifically designed to inhibit localised ignition. The boards will melt if brought into contact with high temperature sources and are classed as combustible.

However, the use of the boards will not affect the fire rating obtained by tiled roofs when evaluated by assessment or tested to BS 476: Part 3: 2004.

Polyfoam Linerboard is faced with 9.5mm plasterboard which offers excellent fire performance.

# Green roofs

Warm deck green roof with single ply membrane



Labels for the diagram:  
 Growing medium and planting  
 Filter membrane  
 Drainage element/reservoir and root barrier  
 Waterproofing membrane  
 Polyfoam Roofboard Extra/ECO/ECO PLUS  
 Vapour control layer  
 Screed laid to falls  
 Concrete roof deck

## Typical U-values

	Thickness* (mm)	U-values (W/m <sup>2</sup> K)	
		150mm concrete	40mm screed 13mm plaster
<b>Polyfoam Roofboard Extra</b>			
	170	0.16	
	160	0.18	
	150	0.19	
	140	0.20	
	130	0.22	
	120	0.22	
	110	0.24	
<b>Polyfoam Roofboard Extra ECO</b>			
	160	0.20	
	150	0.22	
	140	0.23	
<b>Polyfoam Roofboard Extra ECO PLUS</b>			
	160	0.18	
	150	0.19	
	140	0.20	

Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.  
 For project specific calculations contact our Technical Advisory Centre on 01744 766666.  
 \*Some solution thickness are a combination of 2 or more boards.



Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.



## Products

Polyfoam Roofboard Extra/Polyfoam Roofboard Extra ECO/Polyfoam Roofboard Extra ECO PLUS

## Advantages

- Highly cost effective solution with compressive strength that will support a green or garden roof
- Suitable for use in any green or garden roof system
- Protects the waterproofing membrane from UV degradation
- Available in products which have GWP less than 5

## Performance

### Thermal performance

Polyfoam Roofboard Extra up to 120mm thickness has a thermal conductivity of 0.029 W/mK, and 0.030 W/mK above this.

Polyfoam Roofboard Extra ECO has a thermal conductivity of 0.035W/mK.

Polyfoam Roofboard Extra ECO PLUS has a thermal conductivity of 0.030W/mK.

### Moisture resistance

Polyfoam Roofboards are highly resistant to moisture and can be laid in standing water or up against wet concrete with negligible impact on the performance of the product.

### Compression resistance

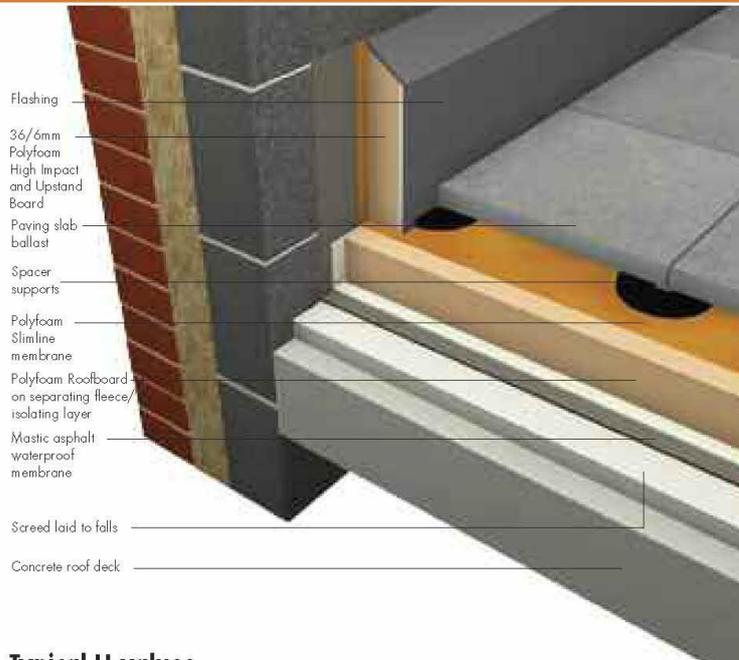
Polyfoam Roofboards are highly resistant to compression and withstands both occasional and long term static loads.

### Fire performance

When Polyfoam Roofboard Extra ECO and ECO PLUS is installed in a green roof, it will not contribute to the development stages of a fire.

# Paved roofs

## Protected membrane



### Typical U-values

	Thickness* (mm)	U-values (W/m <sup>2</sup> K)
		150mm concrete 40mm screed 13mm plaster
<b>Polyfoam Roofboard Extra</b>		
	170	0.16
	160	0.18
	150	0.19
	140	0.20
	130	0.22
	120	0.22
	110	0.24
<b>Polyfoam Roofboard Extra ECO</b>		
	160	0.20
	150	0.22
	140	0.23
<b>Polyfoam Roofboard Extra ECO PLUS</b>		
	160	0.18
	150	0.19
	140	0.20

Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.  
For project specific calculations contact our Technical Advisory Centre on 01744 766666.  
\*Some solution thickness area combination of 2 or more boards.



Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.

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### Products

Polyfoam Roofboard Extra/Polyfoam Roofboard Extra ECO/  
Polyfoam Roofboard Extra ECO PLUS

### Advantages

- System achieves superior thermal performance compared to systems with a standard filtration membrane
- Protected membrane flat roofs using the Polyfoam Slimline system are lighter as less ballast is required
- Protects waterproofing membrane from UV degradation and temperature extremes increasing the membrane's in-service life
- Thermal performance is unaffected by moisture
- Allows the creation of patios, roof terraces and balconies
- Available in products which have GWP less than 5

### Performance

#### Thermal performance

Polyfoam Roofboard Extra up to 120mm thick has a thermal conductivity of 0.029 W/mK, and 0.030 W/mK above this.

Polyfoam Roofboard Extra ECO has a thermal conductivity of 0.035W/mK.

Polyfoam Roofboard Extra ECO PLUS has a thermal conductivity of 0.030W/mK.

#### Compression resistance

Polyfoam Roofboards are highly resistant to compression and withstands both occasional and long term static loads.

The facing material of Polyfoam High Impact and Upstand Board is highly resistant to impact damage, offering an excellent robust lining.

#### Moisture resistance

Polyfoam Roofboards are highly resistant to moisture and can be laid in standing water or up against wet concrete with negligible impact on the performance of the product.

The facing material of Polyfoam High Impact Board is moisture resistant.

#### Fire performance

Polyfoam Roofboards will not contribute to the development stages of a fire. Polyfoam High Impact and Upstand Board is faced with a 6mm weather resistant facing board which offers excellent fire performance as a facing material and Polyfoam insulation which contains a flame retardant to inhibit localised ignition.

The facing board is classified as Class 1 Surface Spread of Flame to BS 476: Part 7: 1987.



## Floors, basements and walls

Recent changes to the thermal requirements of the Building Regulations have made it necessary to include insulation in increasing numbers of ground floors.

### Ground floors

Ground floors fall predominantly into two categories, ground bearing and suspended. The type chosen by the designer is largely dependent on site conditions and both ground bearing and suspended ground floors can offer excellent thermal performance by incorporating high levels of insulation.

### Exposed soffit

In domestic buildings, the Government's requirement to improve the intensity of land usage by increasing housing density has led to an increase in the number of raised ground floors being built. Building configurations can include link units above access ways or parking bays, or above integral garages.

It is important that these floors are correctly insulated to ensure that the building meets with the appropriate Building Regulation requirements and the floor does not compromise the energy efficiency of the building.

### Basements

The provision of basements in new housing dramatically improves land utilisation, energy consumption and provides homes capable of coping with changes in lifestyle. The increased depth of foundations also assists in overcoming poor ground conditions.

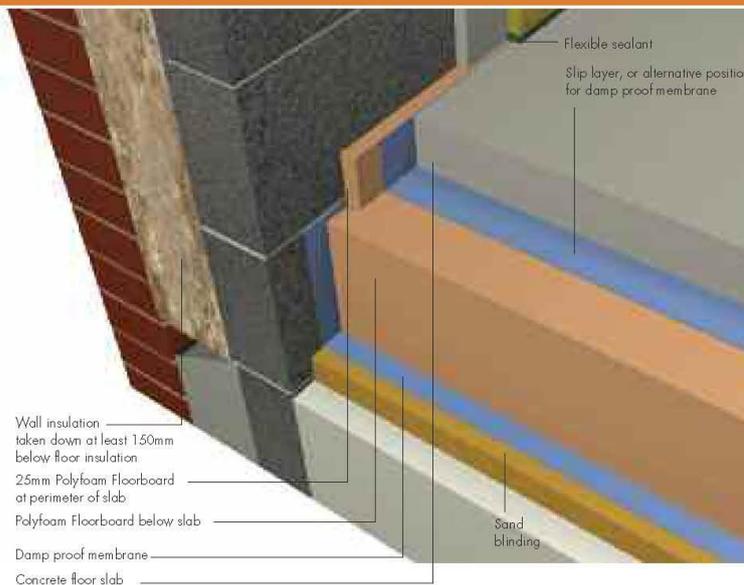
The systems detailed in this brochure offer maximum protection against possible damp problems as Polyfoam products are closed cell extruded polystyrene and are highly resistant to water in both liquid and vapour form.

### Advantages of Polyfoam

- Compression resistance, supporting screed under high point loads
- Provides high thermal performance in limited insulation zone
- Structural and thermal solution
- Robust can tolerate traffic from following trades without damage prior to floor finish being laid
- The Polyfoam ECO and ECO PLUS range offers products with a GWP less than 5.

# Ground floors

## Insulation below slab



### Typical U-values

Thickness* (mm)	U-values (W/m <sup>2</sup> K)							
	Ground bearing floor – ratio of perimeter (m) to area (m <sup>2</sup> )							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
<b>Polyfoam Floorboard Standard ECO</b>								
150	0.10	0.13	0.15	0.16	0.17	0.18	0.18	0.18
125	0.11	0.15	0.17	0.18	0.19	0.20	0.20	0.21
100	0.11	0.16	0.19	0.20	0.21	0.22	0.23	0.24
75	0.13	0.19	0.23	0.25	0.27	0.28	0.29	0.30
65	0.13	0.20	0.24	0.27	0.29	0.30	0.32	0.33
<b>Polyfoam Floorboard Extra ECO</b>								
150	0.10	0.13	0.15	0.16	0.17	0.18	0.18	0.18
125	0.11	0.15	0.17	0.18	0.19	0.20	0.20	0.21
100	0.11	0.16	0.19	0.20	0.21	0.22	0.23	0.24
75	0.13	0.19	0.23	0.25	0.27	0.28	0.29	0.30
50	0.14	0.22	0.27	0.30	0.33	0.34	0.36	0.37
<b>Polyfoam Floorboard Standard/Extra</b>								
150	0.09	0.12	0.13	0.14	0.15	0.15	0.15	0.16
125	0.10	0.13	0.15	0.16	0.17	0.17	0.18	0.18
100	0.11	0.15	0.17	0.19	0.20	0.20	0.21	0.22
75	0.12	0.17	0.20	0.22	0.24	0.25	0.26	0.26
65	0.13	0.19	0.23	0.24	0.26	0.27	0.28	0.29

Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme and assume a clay subsoil with a thermal conductivity of 1.50 W/mK. U-values for floors insulated with Polyfoam Floorboard Super can be supplied by the Knauf Insulation Technical Advisory Centre.

\* Some solution thicknesses are a combination of two or more boards



Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.

Technical Advisory Centre: 01744 766 666



### Products

Polyfoam Floorboard Standard, Polyfoam Floorboard Extra, Polyfoam Floorboard Super, Polyfoam Floorboard Standard ECO, Polyfoam Floorboard Extra ECO.

### Advantages

- Long term exposure to water has negligible impact on the thermal performance of Polyfoam
- Can be used above or below the DPM
- Available in products which have GWP less than 5

### Above damp proof membrane

- Protects DPM from damage before and during the concrete pouring process

### Below damp proof membrane

- Protects DPM from possible puncture from hardcore and extremes of temperature at perimeter
- Resists tough site conditions
- Industry leading range of compressive strengths, allows the specifier to select the most appropriate solution based on expected floor loads

### Performance

#### Thermal performance

The thermal conductivities of Polyfoam Floorboard products are as follows:-

Standard – 0.029W/mK

Extra – 0.029W/mK

Super – 0.030W/mK

Standard ECO – 0.033 - 0.035W/mK

Extra ECO – 0.033 - 0.035W/mK

#### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

#### Moisture resistance

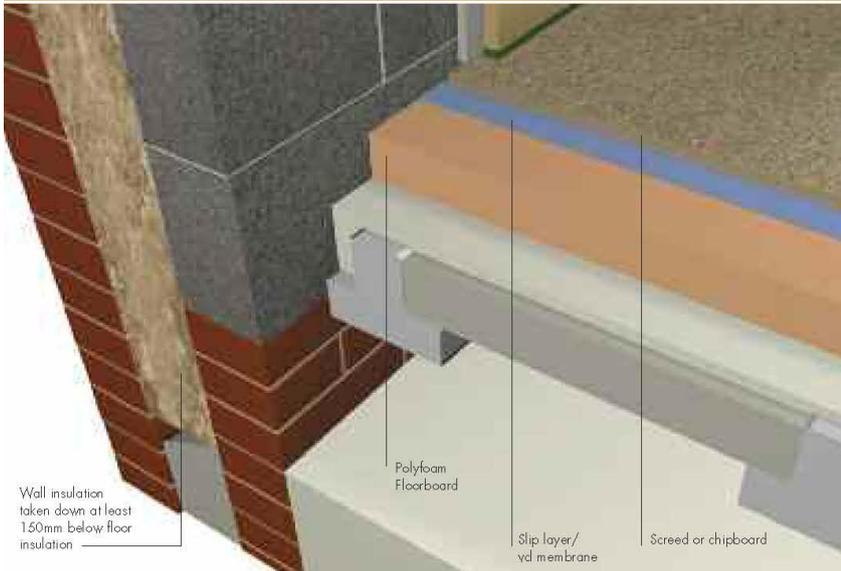
Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

#### Fire performance

When Polyfoam Floorboard is installed in a concrete floor construction, it will not contribute to the development stages of a fire.

# Ground floors

Suspended concrete floor



## Products

Polyfoam Floorboard Standard, Polyfoam Floorboard Extra, Polyfoam Floorboard Super, Polyfoam Floorboard Standard ECO, Polyfoam Floorboard Extra ECO.

## Advantages

- Compression resistant, supporting screed under high point loads
- Provides high thermal performance in limited insulation zone
- Structural and thermal solution
- Resistant to site damage
- Robust and can tolerate traffic from following trades without damage prior to floor finish being laid
- Available in products which have GWP less than 5

## Performance

### Thermal performance

The thermal conductivities of Polyfoam Floorboard products are as follows:-  
Standard – 0.029W/mK  
Extra – 0.029W/mK  
Super – 0.030W/mK  
Standard ECO – 0.033 - 0.035W/mK  
Extra ECO – 0.033 - 0.035W/mK

### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

### Moisture resistance

Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

### Fire performance

When Polyfoam Floorboards are installed in a concrete floor construction, they will not contribute to the development stages of a fire.

## Typical U-values

Thickness* (mm)	U-values (W/m <sup>2</sup> K)							
	Beam and block floor – ratio of perimeter (m) to area (m <sup>2</sup> )							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
<b>Polyfoam Floorboard Standard ECO</b>								
150	0.11	0.14	0.15	0.16	0.17	0.17	0.17	0.17
140	0.12	0.14	0.16	0.17	0.17	0.18	0.18	0.18
130	0.12	0.15	0.17	0.18	0.18	0.19	0.19	0.19
125	0.12	0.15	0.17	0.18	0.18	0.19	0.19	0.20
115	0.12	0.16	0.18	0.19	0.19	0.20	0.20	0.21
100	0.13	0.17	0.19	0.20	0.21	0.21	0.22	0.22
75	0.15	0.20	0.22	0.24	0.26	0.27	0.27	0.28
65	0.15	0.21	0.24	0.26	0.28	0.29	0.30	0.30
50	0.16	0.23	0.26	0.29	0.30	0.32	0.33	0.34
<b>Polyfoam Floorboard Extra ECO</b>								
150	0.11	0.14	0.15	0.16	0.17	0.17	0.17	0.17
125	0.12	0.15	0.17	0.18	0.18	0.19	0.19	0.20
100	0.13	0.17	0.19	0.20	0.21	0.21	0.22	0.22
75	0.15	0.20	0.22	0.25	0.26	0.27	0.27	0.28
50	0.16	0.23	0.26	0.29	0.30	0.32	0.33	0.34
<b>Polyfoam Floorboard Standard/Extra</b>								
150	0.11	0.13	0.14	0.14	0.15	0.15	0.15	0.16
125	0.12	0.14	0.16	0.16	0.17	0.17	0.18	0.18
100	0.13	0.16	0.18	0.19	0.20	0.20	0.21	0.21
75	0.14	0.19	0.21	0.23	0.24	0.25	0.25	0.26
65	0.15	0.20	0.23	0.25	0.26	0.27	0.28	0.29

Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme and assume a clay subsoil with a thermal conductivity of 1.50 W/mK. The thermal conductivity of concrete blocks – 1.22 W/mK. For project specific calculations contact our Technical Advisory Centre on 01744 766666.

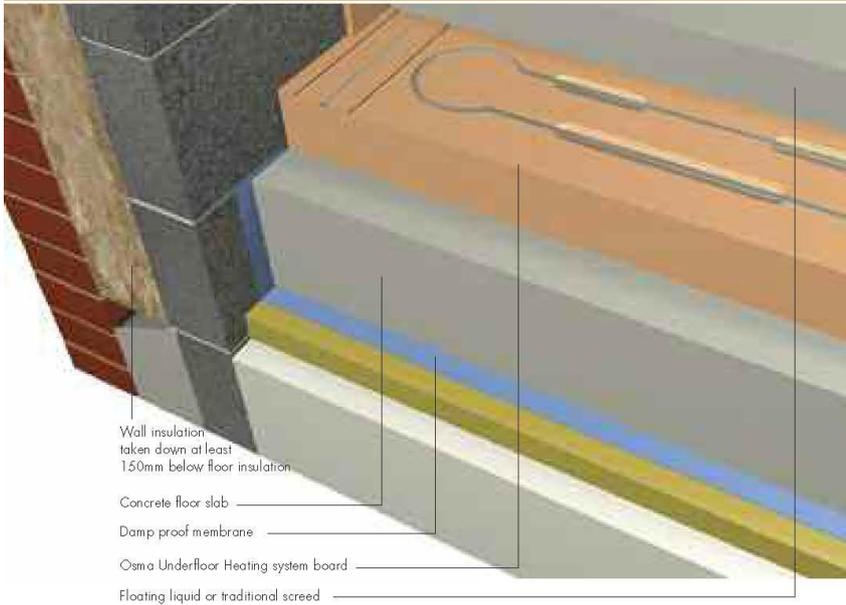
\* Some solution thicknesses are a combination of two or more boards



Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.

# Ground floors

## Underfloor heating – Osma Underfloor Heating System



### Typical U-values

Thickness (mm)	U-values (W/m <sup>2</sup> K)							
	Ratio of perimeter (m) to area (m <sup>2</sup> )							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
<b>Insulation Below Screed – Pre-channelled Polyfoam Floorboard Standard</b>								
160 (75+65*)	0.09	0.11	0.13	0.13	0.14	0.14	0.15	0.15
140 (75+65*)	0.09	0.12	0.14	0.15	0.15	0.16	0.16	0.17
125 (50+75*)	0.10	0.13	0.15	0.16	0.17	0.17	0.18	0.18
100 (50+50*)	0.11	0.15	0.17	0.19	0.20	0.20	0.21	0.22
85 (35+50*)	0.12	0.16	0.19	0.21	0.22	0.23	0.24	0.24
75	0.12	0.17	0.20	0.22	0.24	0.25	0.26	0.26
50	0.14	0.21	0.25	0.28	0.30	0.32	0.33	0.34
35	0.15	0.23	0.29	0.33	0.36	0.38	0.40	0.42
<b>Beam and Block – Pre-channelled Polyfoam Floorboard Standard</b>								
160 (75+65*)	0.10	0.12	0.13	0.14	0.14	0.14	0.15	0.15
140 (75+65*)	0.11	0.13	0.14	0.15	0.16	0.16	0.16	0.16
125 (50+75*)	0.12	0.14	0.16	0.16	0.17	0.17	0.18	0.18
100 (50+50*)	0.13	0.16	0.18	0.19	0.20	0.20	0.21	0.21
85 (35+50*)	0.14	0.18	0.20	0.21	0.22	0.23	0.23	0.24
75	0.14	0.19	0.21	0.23	0.24	0.25	0.25	0.26
50	0.16	0.23	0.26	0.29	0.30	0.32	0.33	0.33
35	0.18	0.26	0.30	0.33	0.36	0.38	0.39	0.40

Note: All U-values calculated in line with BBA/TIMSAs U-value competency scheme and assume a clay subsoil with a thermal conductivity of 1.50 W/mK. For project specific calculations contact our Technical Advisory Centre on 01744 766666.  
\* Polyfoam Floorboard Standard laid underneath channelled board.



Note: All U-values calculated in line with BBA/TIMSAs U-value competency scheme.

Technical Advisory Centre: **01744 766 666**

### Products

Pre-channelled Polyfoam Floorboard Standard

### Advantages

The decision to use an underfloor heating system will be taken on its merits as a heating strategy.

- Insulation and heating is provided by one complete system
- High quality installation is achievable and repeatable with pipes installed at the correct centres
- Heating pipes are carried within the insulation allowing a thinner layer of screed
- Prevents warm spots where flow and return pipes are concentrated

### Performance

#### Thermal performance

This system utilises Polyfoam Floorboard Standard which has a thermal conductivity of 0.029 W/mK.

#### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

#### Moisture resistance

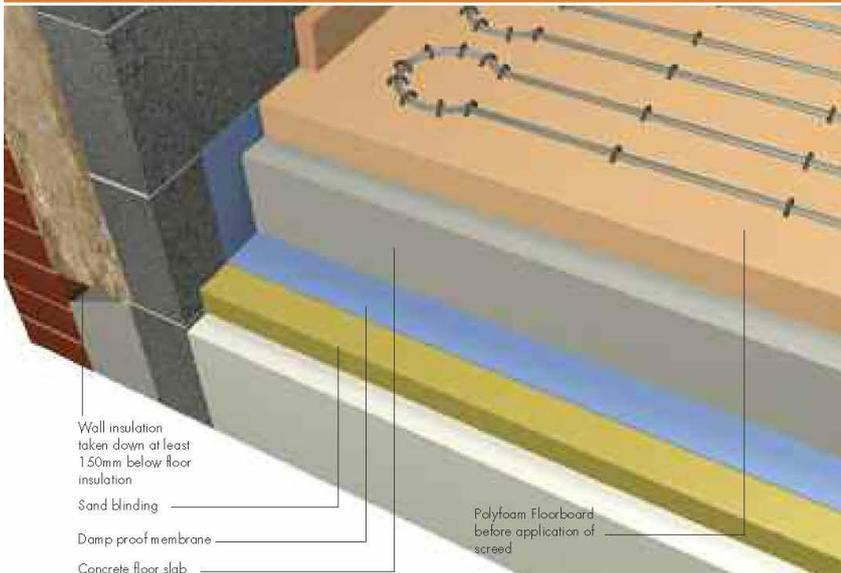
Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

#### Fire performance

When Pre-channelled Polyfoam Floorboard is installed below a screed it will not contribute to the development stages of a fire.

# Ground floors

Underfloor heating – Polyfoam Floorboard Standard



## Products

Polyfoam Floorboard Standard, Polyfoam Floorboard Extra, Polyfoam Floorboard Super, Polyfoam Floorboard Standard ECO, Polyfoam Floorboard Extra ECO.

## Advantages

- Insulation and heating is provided by one complete system
- Available in two compressive strengths, allowing underfloor heating to be used in buildings where a high load will be exerted on the floor
- Holds the clips extremely well, making installation quicker and easier
- Available in products which have GWP less than 5

## Performance

### Thermal performance

The thermal conductivities of Polyfoam Floorboards are as follows:-

Standard – 0.029W/mK

Extra – 0.029W/mK

Standard ECO – 0.033 - 0.035W/mK

Extra ECO – 0.033 - 0.035W/mK

### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

### Moisture resistance

Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

### Fire performance

When Polyfoam Floorboards are installed below a screed they will not contribute to the development stages of a fire.

## Typical U-values (ground bearing floor)

Thickness (mm)*	U-values (W/m <sup>2</sup> K)							
	0.1	0.2	Ratio of perimeter (m) to area (m <sup>2</sup> )				0.7	0.8
	0.3	0.4	0.5	0.6				
<b>Polyfoam Floorboard Standard ECO</b>								
125	0.11	0.15	0.17	0.18	0.19	0.20	0.20	0.21
100	0.11	0.16	0.19	0.20	0.21	0.22	0.23	0.24
75	0.13	0.19	0.23	0.25	0.27	0.28	0.29	0.30
65	0.13	0.20	0.24	0.27	0.29	0.30	0.32	0.33
<b>Polyfoam Floorboard Extra ECO</b>								
125	0.11	0.15	0.17	0.18	0.19	0.20	0.20	0.21
100	0.11	0.16	0.19	0.20	0.21	0.22	0.23	0.24
75	0.13	0.19	0.23	0.25	0.27	0.28	0.29	0.30
<b>Polyfoam Floorboard Standard/Extra</b>								
125	0.10	0.13	0.15	0.16	0.17	0.17	0.18	0.18
100	0.11	0.15	0.17	0.19	0.20	0.20	0.21	0.22
75	0.12	0.17	0.20	0.22	0.24	0.25	0.26	0.26
65	0.13	0.19	0.22	0.24	0.26	0.27	0.28	0.29

## Typical U-values (beam and block floor)

Thickness (mm)*	U-values (W/m <sup>2</sup> K)							
	0.1	0.2	Ratio of perimeter (m) to area (m <sup>2</sup> )				0.7	0.8
	0.3	0.4	0.5	0.6				
<b>Polyfoam Floorboard Standard ECO</b>								
125	0.12	0.15	0.17	0.18	0.18	0.19	0.19	0.20
100	0.13	0.17	0.19	0.20	0.21	0.21	0.22	0.22
75	0.15	0.20	0.22	0.24	0.26	0.27	0.27	0.29
65	0.15	0.21	0.24	0.26	0.28	0.29	0.30	0.30
<b>Polyfoam Floorboard Extra ECO</b>								
125	0.12	0.15	0.17	0.18	0.18	0.19	0.19	0.20
100	0.13	0.17	0.19	0.20	0.21	0.21	0.22	0.22
75	0.15	0.20	0.22	0.24	0.26	0.27	0.27	0.28
50	0.15	0.21	0.24	0.26	0.28	0.29	0.30	0.30
<b>Polyfoam Floorboard Standard/Extra</b>								
125	0.12	0.14	0.16	0.16	0.17	0.17	0.18	0.18
100	0.13	0.16	0.18	0.19	0.20	0.20	0.21	0.21
75	0.14	0.19	0.21	0.23	0.24	0.25	0.25	0.26
65	0.16	0.21	0.23	0.25	0.26	0.27	0.28	0.28

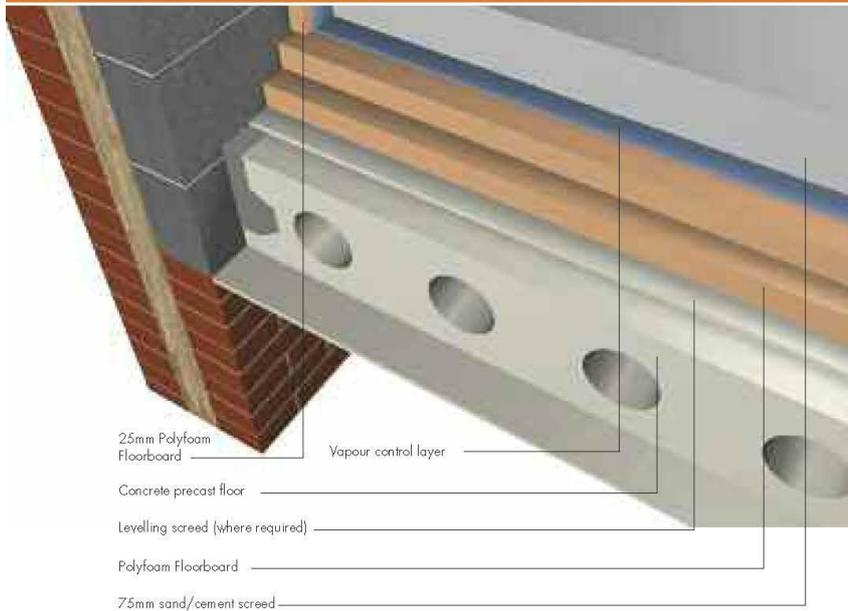
Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme and assume a clay subsoil with a thermal conductivity of 1.50 W/m.K. \* Some solution thicknesses use a combination of two or more boards.



Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.

# Exposed soffit

Insulation above concrete soffit



## Typical U-values

Thickness* (mm)	U-values (W/m <sup>2</sup> K)					
	Dense	Medium	Lightweight	Aircrete	Precast concrete plank (150mm)	Cast slabs (200mm)
<b>Polyfoam Floorboard Standard ECO – under screed (75mm)</b>						
150	0.21	0.21	0.20	0.20	0.21	0.21
125	0.24	0.24	0.23	0.22	0.24	0.24
115	0.26	0.25	0.25	0.24	0.25	0.26
<b>Polyfoam Floorboard Extra ECO – under screed (75mm)</b>						
150	0.21	0.21	0.20	0.20	0.21	0.21
125	0.24	0.24	0.23	0.22	0.24	0.24
<b>Polyfoam Floorboard Standard/Extra – under screed (75mm)</b>						
130	0.20	0.20	0.19	0.19	0.20	0.20
125	0.23	0.21	0.20	0.19	0.20	0.21
110	0.24	0.23	0.22	0.21	0.23	0.23
100	0.26	0.25	0.24	0.23	0.25	0.25
<b>Polyfoam Floorboard Standard ECO – under chipboard</b>						
150	0.21	0.20	0.20	0.19	0.20	0.21
125	0.24	0.23	0.23	0.22	0.23	0.24
115	0.26	0.25	0.25	0.24	0.25	0.26
<b>Polyfoam Floorboard Extra ECO – under chipboard</b>						
150	0.21	0.20	0.20	0.19	0.20	0.21
125	0.24	0.23	0.23	0.22	0.23	0.24
<b>Polyfoam Floorboard Standard/Extra – under chipboard</b>						
130	0.20	0.20	0.19	0.18	0.19	0.20
125	0.21	0.21	0.19	0.19	0.20	0.21
110	0.24	0.23	0.22	0.21	0.23	0.23
100	0.26	0.25	0.23	0.23	0.24	0.25

Notes: All U-values calculated in line with BBA/TIMS U-value competency scheme.

There are specific additional requirements that need to be taken into consideration when calculating the U-values for elements that are adjacent to unheated spaces. The U-value of an exposed floor (soffit) which separates a heated area from an unheated area can be calculated by including an additional amount of thermal resistance ( $R_{se}$ ) due to the sheltering effect of the unheated area. Standard default values of  $R_{se}$  can be taken from BR443 (Conventions for U-value Calculations) or SAP 2005. For situations not covered by default values, or where additional guidance is required contact our Technical Advisory Centre on 01744 766666.

\* Some solution thicknesses are a combination of two or more boards.



## Products

Polyfoam Floorboard Standard/Extra  
Polyfoam Floorboard Standard ECO/  
Polyfoam Floorboard Extra ECO

## Advantages

- Compression resistant, supporting screed under high point loads
- Provides excellent thermal performance in limited insulation zone
- Structural and thermal solution
- Robust and can tolerate traffic from following trades without damage prior to floor finish being laid.
- Can support machinery required for pumped screeding applications
- Ideal for underfloor heating solutions
- Available in products which have GWP less than 5

## Performance

### Thermal performance

Thermal conductivities of Polyfoam

Floorboards are as follows:

Standard – 0.029W/mK

Standard ECO – 0.033 - 0.035W/mK

Extra – 0.029W/mK

Extra ECO – 0.033 - 0.035W/mK

### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

### Moisture resistance

Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

### Fire performance

When Polyfoam Floorboards are installed in a floor construction they will not contribute to the development stages of a fire.

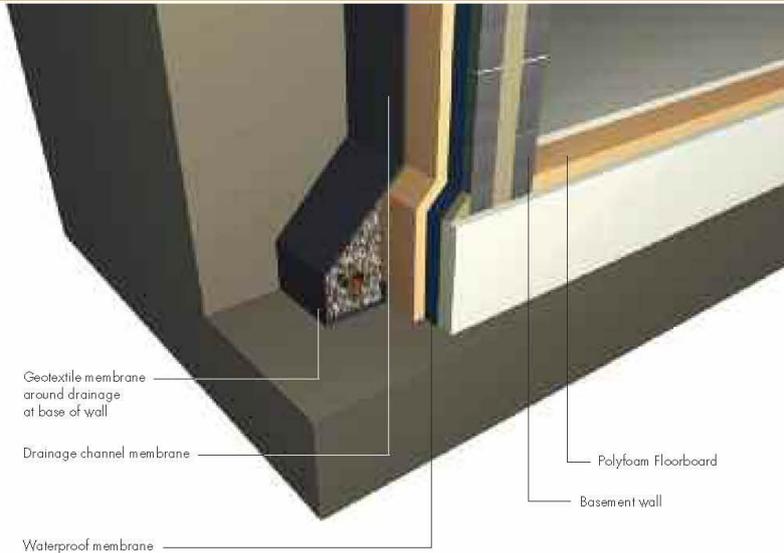


Note: All U-values calculated in line with BBA/TIMS U-value competency scheme.

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# Basements

Wall insulated externally



## Typical U-values

Thickness* (mm)	U-values (W/m <sup>2</sup> K)			
	2.00	Basement depth (m)		
		2.50	3.00	3.50
<b>Polyfoam Floorboard Standard ECO</b>				
75	0.24	0.22	n/a	n/a
65	0.26	0.24	n/a	n/a
50	0.30	0.27	n/a	n/a
<b>Polyfoam Floorboard Extra ECO</b>				
100	n/a	n/a	0.16	0.15
75	n/a	n/a	0.20	0.19
50	n/a	n/a	0.25	0.23
<b>Polyfoam Floorboard Standard</b>				
75	0.22	0.20	n/a	n/a
65	0.24	0.22	n/a	n/a
50	0.28	0.26	n/a	n/a
<b>Polyfoam Floorboard Extra</b>				
75	n/a	n/a	0.20	0.19
65	n/a	n/a	0.22	0.20
50	n/a	n/a	0.24	0.23

Notes: Rafter sizes assumed to be 38mm wide at 600mm centres (6.3% bridging) and the same depth as the insulation. All U-values calculated in line with BBA/TIMSA U-value competency scheme.

\* Solution thicknesses is a combination of two boards



Note: All U-values calculated in line with BBA/TIMSA U-value competency scheme.



## Products

Polyfoam Floorboard/Standard  
Polyfoam Floorboard Extra  
Polyfoam Floorboard Standard ECO/  
Polyfoam Floorboard Extra ECO

## Advantages

- Robust products able to withstand pressure exerted by backfill without compromising integrity or thermal performance
- Keeps the structure warm
- Long term exposure to water has negligible impact on Polyfoam's thermal performance
- Available in products which have GWP less than 5

## Performance

### Thermal performance

Thermal conductivities of Polyfoam Floorboards are as follows:  
Standard – 0.029W/mK  
Standard ECO – 0.033 - 0.035W/mK  
Extra – 0.029W/mK  
Extra ECO – 0.033 - 0.035W/mK

### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

### Moisture resistance

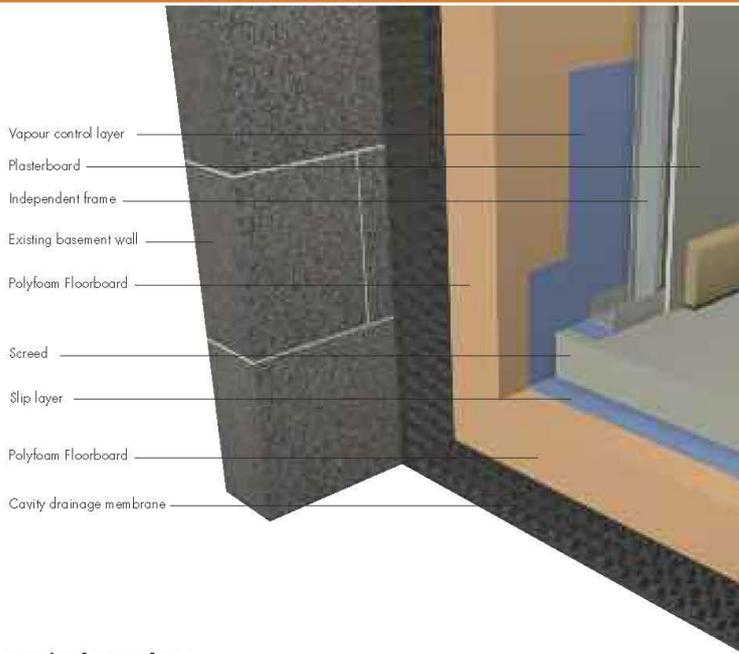
Polyfoam Floorboards can be laid exposed to ground water, with negligible impact on performance. The boards themselves do not perform the function of a damp proof membrane, but they can be laid in damp conditions or up against wet concrete without compromising their thermal performance.

### Fire performance

When Polyfoam Floorboards are installed below a screed they will not contribute to the development stages of a fire.

# Basements

Wall insulated internally



## Typical U-values

Thickness (mm)		U-values (W/m <sup>2</sup> K)			
		2.00	Basement depth (m)		
		2.50	3.00	3.50	
<b>Polyfoam Floorboard Standard ECO</b>					
75	0.24	0.22	0.20	0.19	
65	0.26	0.23	0.22	0.20	
50	0.29	0.26	0.24	0.23	
<b>Polyfoam Floorboard Extra ECO</b>					
100*	0.19	0.17	0.16	0.15	
75	0.24	0.22	0.20	0.19	
50	0.29	0.26	0.24	0.23	
<b>Polyfoam Floorboard Standard</b>					
75	0.21	0.20	0.18	0.17	
65	0.23	0.21	0.20	0.16	
50	0.27	0.25	0.23	0.22	

Notes: Rafter sizes assumed to be 38mm wide at 600mm centres (6.3% bridging) and the same depth as the insulation. All U-values calculated in line with BBA/TMSA U-value competency scheme.

\* Solution thickness is a combination of two boards



Note: All U-values calculated in line with BBA/TMSA U-value competency scheme.

Technical Advisory Centre: **01744 766 666**



## Products

Polyfoam Floorboard/Standard  
Polyfoam Floorboard Extra  
Polyfoam Floorboard Standard ECO/  
Polyfoam Floorboard Extra ECO

## Advantages

- Compression resistant, supporting screed under high point loads
- Robust and lightweight, making them easy to handle on site and they are highly resistant to mechanical damage
- Strong and moisture resistant, its compressive strength accommodates the loads associated with the fit out of the basement
- Available in products which have GWP less than 5

## Performance

### Thermal performance

The thermal conductivities of Polyfoam Floorboard products are as follows:-  
Standard – 0.029W/mK  
Standard ECO – 0.033 - 0.035W/mK  
Extra – 0.029W/mK  
Extra ECO – 0.033 - 0.035W/mK

### Compression resistance

Polyfoam Floorboards are highly resistant to compression and withstand both occasional and long term static loads.

### Moisture resistance

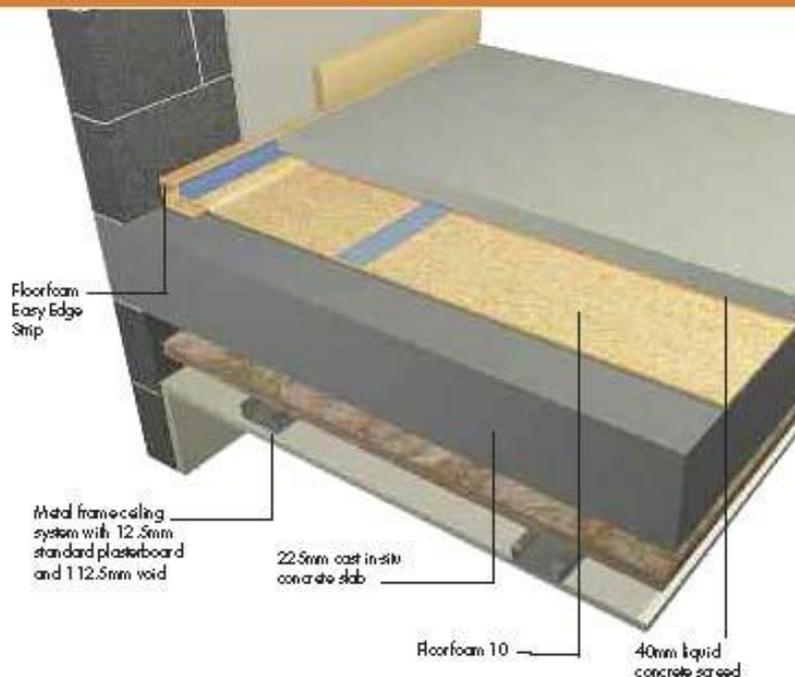
Polyfoam Floorboard has negligible water absorption and is unaffected by standing in ground water.

### Fire performance

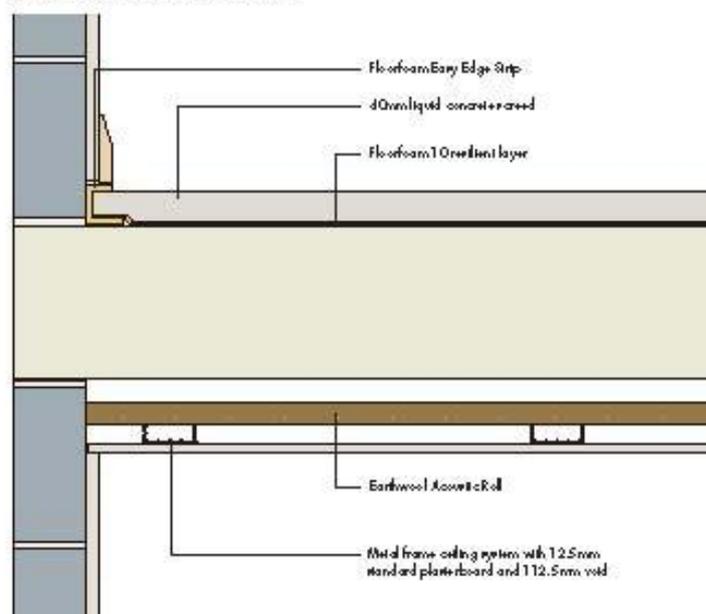
Polyfoam Floorboard is completely enclosed by other materials and will not contribute to the development stages of a fire.

## Separating floors

Concrete floor with screed and resilient layer



Typical junction with external wall



### Products

Floorfoam 10 is a 10mm thick extruded polyethylene resilient layer.

Floorfoam Easy Edge Strip is a 10mm thick strip of extruded polyethylene, pre-scored to fold around the edge of a floating floor screed.

### Advantages

- Resilient layer provides good acoustic separation to improve impact sound performance
- Independent ceiling provides acoustic isolation and void for services
- Robust system with taped joints reduces the risk of screed contact with the main structure
- Special perimeter products make it easy to correctly install the edge detail – the most common failure in the installation of this type of system

### Performance

#### Acoustic performance

Floorfoam 10 and Easy Edge Strip have been developed for cushioning vibrations. Their closed cell construction makes them excellent at absorbing impact sound. This construction requires testing to show compliance with Building Regulations.

#### Compression resistance

The closed cell nature of Floorfoam makes it resistant to compression.

#### Density

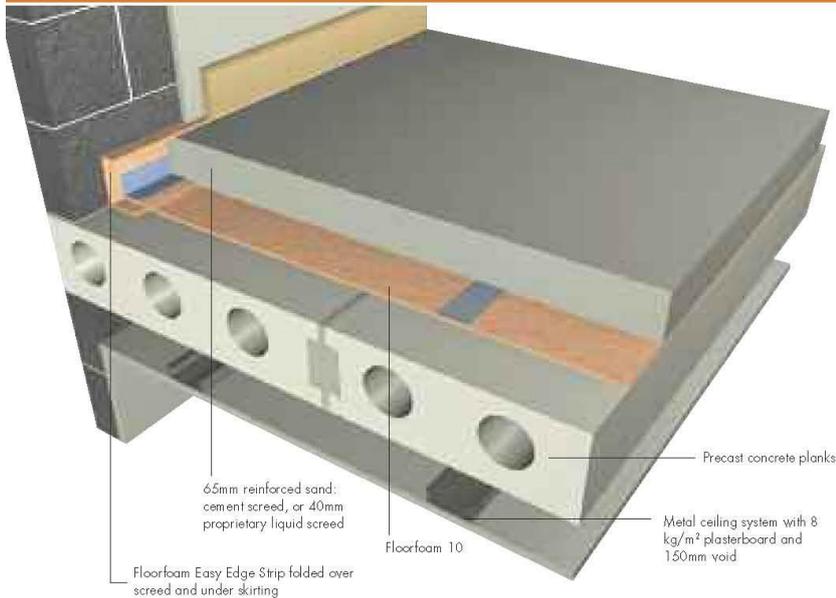
Floorfoam 10 and Floorfoam Easy Edge Strip have a minimum density of 30 kg/m<sup>3</sup>.

#### Fire performance

When Floorfoam is installed in a concrete floor construction it will not contribute to the development stages of a fire.

# Separating floors

Concrete floor with screed and resilient layer



## Results of acoustic test data – site testing

Floorfoam	Screed type	Airborne	Impact
Thickness (mm)		$R_w$ (C,C <sub>tr</sub> )	$L_{n,w}$
10	65mm sand/cement	53 dB	54 dB
10	40mm liquid screed	51 dB	55 dB

Test method: BS EN ISO 140-4: 1995/TP1.5 and BS EN ISO 140-7.

Results interpretation: BS EN ISO 717-1: 1997 and BS EN ISO 717-2.

### Products

Floorfoam 10 is a 10mm thick extruded polyethylene resilient layer.

Floorfoam Easy Edge Strip is a 10mm thick strip of extruded polyethylene, pre-scored to fold around the edge of a floating floor screed.

### Advantages

- Resilient layer provides good acoustic separation to improve impact sound performance
- Independent ceiling provides acoustic isolation and void for services
- Quick and easy installation
- Special perimeter products make it easy to correctly install the edge detail – the most common failure in the installation of this type of system

### Performance

#### Acoustic performance

Floorfoam has been developed for cushioning vibrations. Its closed cell construction makes it excellent at absorbing impact sound.

The construction shown should achieve the sound insulation performance required by Approved Document E when Floorfoam 10 is used in conjunction with Floorfoam Easy Edge Strip.

The construction shown meets the requirements of Floor type 2 with floating layer F2 together with a levelling screed to the concrete floor and a separating membrane above the Floorfoam to prevent screed entering the resilient layer.

#### Compression resistance

The closed cell nature of Floorfoam makes it resistant to compression.

#### Density

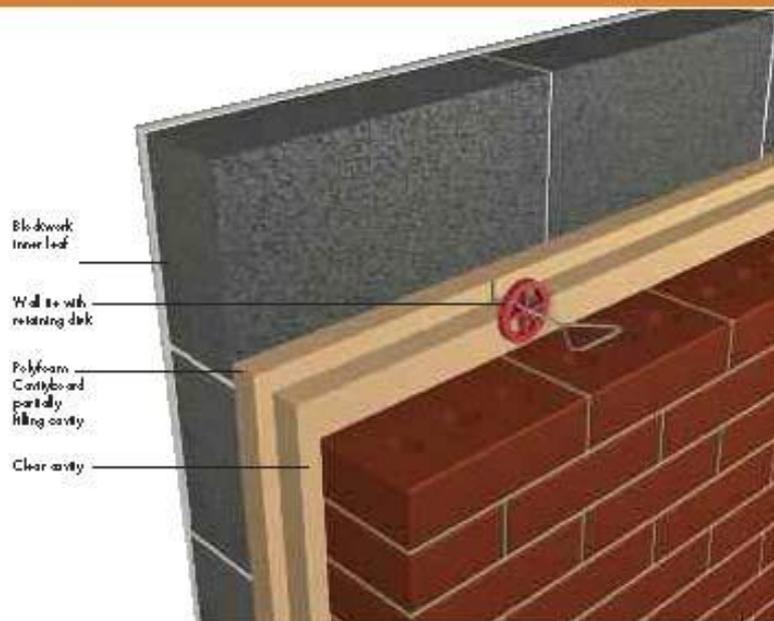
Floorfoam 10 and Floorfoam Easy Edge Strip have a minimum density of 30 kg/m<sup>3</sup>.

#### Fire performance

When Floorfoam is installed in a concrete floor construction it will not contribute to the development stages of a fire.

# Masonry cavity walls

Partial fill



## Typical U-values

U-values (W/m <sup>2</sup> K) for brick outer leaf/cavity/100mm block inner leaf, plasterboard on dabs					
Polyfoam Cavityboard thickness (mm)	Dense block (λ = 1.13)	Medium block (λ = 0.51)	Lightweight aggregate (λ = 0.24)	Standard aggregate (λ = 0.16)	Lightweight aggregate (λ = 0.11)
<b>Polyfoam Cavityboard (with internal finish of plasterboard on dabs)</b>					
75	0.30	0.29	0.28	0.26	0.25
60	0.36	0.34	0.33	0.31	0.29
50	0.40	0.39	0.38	0.35	0.32
<b>Polyfoam Cavityboard (with internal finish of 17.5/9.5mm Polyfoam Linerboard)</b>					
75	0.24	0.23	0.23	0.22	0.21
60	0.27	0.27	0.26	0.24	0.23
50	0.30	0.29	0.29	0.27	0.25
40	0.34	0.33	0.32	0.29	0.28
35	0.36	0.35	0.34	0.31	0.29
30	0.38	0.37	0.36	0.33	0.31
25	0.41	0.39	0.38	0.35	0.32
<b>Polyfoam Cavityboard (with internal finish of 36/9.5mm Polyfoam Linerboard on dabs)</b>					
75	0.22	0.22	0.21	0.20	0.19
60	0.25	0.24	0.24	0.22	0.22
50	0.27	0.27	0.26	0.24	0.23
40	0.30	0.29	0.29	0.27	0.25
35	0.32	0.31	0.30	0.28	0.26
30	0.34	0.33	0.32	0.29	0.28
25	0.36	0.35	0.34	0.31	0.29

Note: Block size assumed to be 440 x 215mm, mortar joints assumed to be 10mm, wall tie assumed to be stainless steel with a cross-sectional area of 12.5mm<sup>2</sup> for structural cavities up to 175 mm wide. The U-values have been calculated to BS EN ISO 6946:1997 and BR 448.

## Products

Polyfoam Cavityboard and Polyfoam Linerboard.

## Advantages

- Very robust product
- BBA certification for all exposure zones
- Shiplap joints between boards sheds any water in the cavity away from the inner leaf
- Retains clear cavity
- Completely unaffected by moisture

## Performance

### Thermal performance

Polyfoam Cavityboard has a thermal conductivity of 0.029W/mK, Polyfoam Linerboard has a thermal conductivity of 0.030W/mK.

### Compression resistance

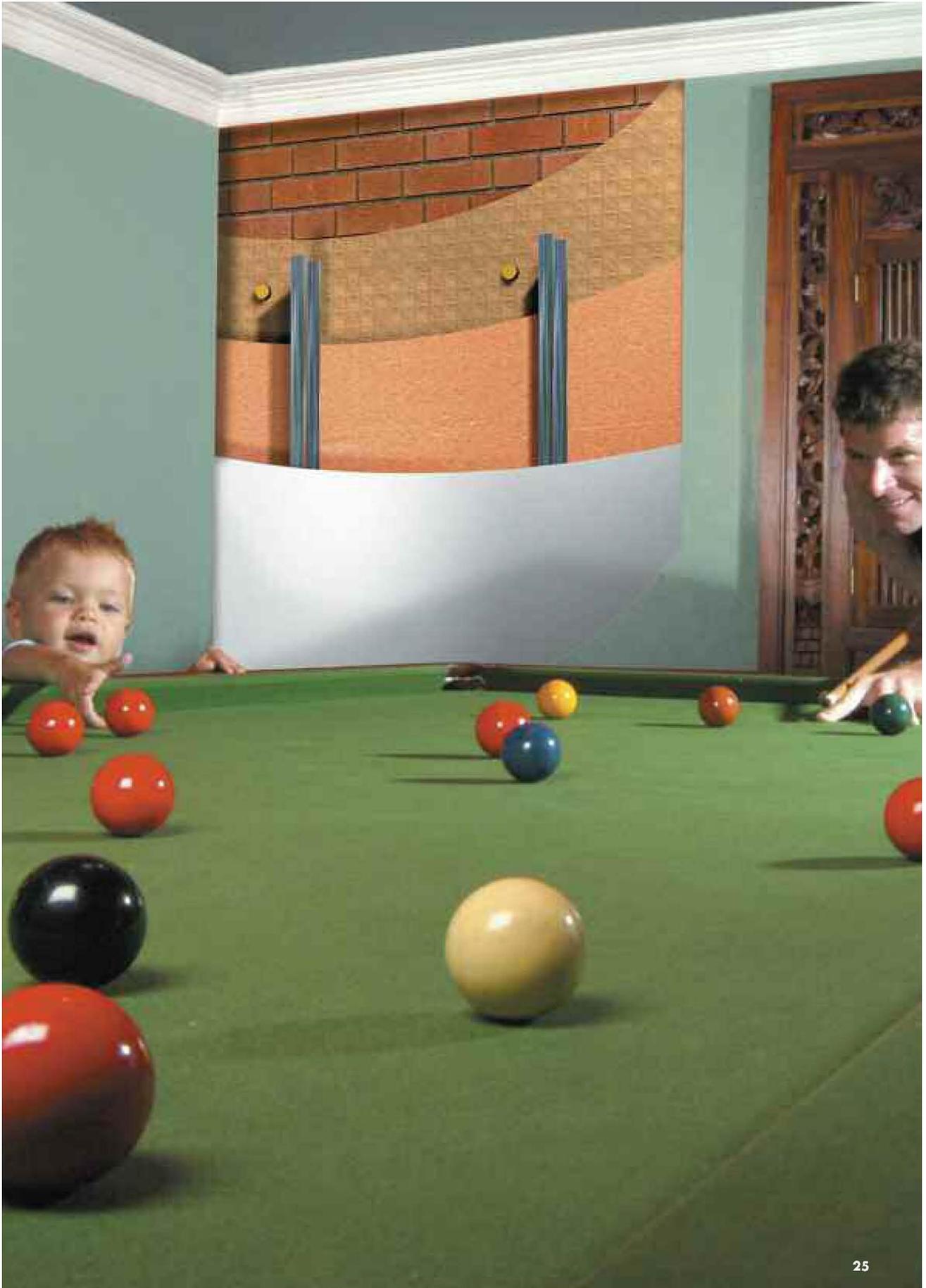
The rigidity of Polyfoam Cavityboard makes the board easy to handle and less prone to site damage than less robust materials.

### Moisture resistance

The boards are resistant to moisture absorption and can be laid in ground water or up against wet concrete with negligible impact on the performance of the product. The interlocking rebated edge sheds any water into the cavity away from the inner leaf in the unlikely event that it penetrates the face joint between two boards.

### Fire performance

Polyfoam Cavityboard contains a flame retardant to inhibit localised ignition. The use of Polyfoam Cavityboard will not prejudice the fire resistance of the wall.





## Sustainability

Knauf Insulation UK recognises that everybody has a part to play in a sustainable future.

At Knauf Insulation, we understand the wider responsibility our industry has towards the world in which we operate and take a considered approach to the issues that threaten our planet and our way of life. Sustainability must now be viewed by all businesses as the core of a sensible long-term business strategy.

Our greatest contribution to sustainable development is through our products. They provide the most cost-effective means of combating climate change by saving energy and resources in manufacture and use, while giving people the freedom to live and work in comfortable internal environments.

### **Knauf's sustainability strategy**

Knauf Insulation UK promotes continuous improvements in sustainable performance as a guiding principle in our business strategy by:

- Promoting awareness in a 'top-down approach' to sustainability, ensuring that responsible decision making predominates throughout our business
- Measuring our environmental performance and minimising our environmental impact through our continuing investment in efficiency and innovation
- Consulting with our stakeholders and engaging where appropriate
- Communicating with, and providing leadership to stakeholders to ensure that we exert positive influence through all our business dealings
- Providing sustainable solutions to our customers through our products and practices
- Strengthening our business through good relationships with customers and suppliers, and fostering community prosperity
- Sharing our knowledge appropriately with industry and acting as a role model to other companies
- Facilitating sustainability awareness in the construction industry using our products and practices as positive examples which differentiate us from our competitors.





## How Knauf Insulation can help

### **Making the right choices**

As the only UK manufacturer of multiple types of insulation products, Knauf Insulation is able to offer sound advice to ensure that the most appropriate product is used in the right way to achieve optimal energy and cost efficiency. Knauf Insulation has therefore developed a range of services to help its customers.

With the confusing array of insulation choices on the market today, our primary intention is to share our knowledge and expertise, empowering our customers to make the most appropriate product selection.

### **CPD Seminars**

As a member of the RIBA CPD Providers Network, Knauf Insulation offers CPD essential training designed to maintain, enhance and increase the knowledge and skills of the professional to the benefit of his or her capabilities.

For more information please visit: [www.knaufinsulation.co.uk](http://www.knaufinsulation.co.uk)

### **Training programme**

Successful compliance with Regulations will require specifiers and contractors to update their knowledge. Knauf Insulation recognises its responsibility to support the specifier and contractor with comprehensive training.

### **Technical Advisory Centre**

Our Technical Advisory Centre, offers ongoing, high level technical support including the provision of U-value and condensation analysis calculations, NBS specification clauses and CAD drawings. Call 01744 766666 for help and advice.

Technical Advisory Centre: 01744 766 666

### **BBA/TMSA Competency Scheme**

Knauf Insulation is a fully accredited member of the prestigious and industry leading British Board of Agrément (BBA) U-value and Condensation Calculation Competency Scheme. The scheme, which was launched on 1st April 2010, has been created by the British Board of Agrément in conjunction with the Thermal Insulation Manufacturers and Suppliers Association (TIMSA) to promote and assist accurate, objective and consistent calculation of U-values and condensation calculations within the UK construction industry.

As a result, Knauf Insulation customers can be assured that the U-value and condensation calculations supplied to them are in line with all relevant industry standards, accurate and consistent, and there is a clear and comprehensive audit trail in place.

### **Building Regulations Compliance Guides**

Available in print and online, these guides explain through the use of worked examples the routes to compliance with the Building Regulations. There are guides available on Approved Document L1A for England and Wales, Approved Document L1B in England and Wales and for the revised edition of Section 6 of the Scottish Technical Standards.

### **Project and Specification Managers**

Knauf Insulation has a team of Business Development Managers and Project and Specification Managers covering all parts of the country. Their role is to provide cost-effective solutions to specifiers for thermal insulation, acoustic insulation and fire protection.

For more information please visit: [www.knaufinsulation.co.uk](http://www.knaufinsulation.co.uk)



Ref: PB170411

March 2011

**thinkinsulation.com**



**Knauf Insulation Ltd**  
PO Box 10  
Stafford Road  
St Helens  
Merseyside  
WA10 3NS

**Customer Service (Sales)**  
Tel: 0844 800 0135  
Fax: 01744 612007  
E-mail: [sales@knaufinsulation.com](mailto:sales@knaufinsulation.com)  
[www.knaufinsulation.co.uk](http://www.knaufinsulation.co.uk)

**Technical Advisory Centre**  
Tel: 01744 766666  
Fax: 01744 766667  
E-mail: [tech@knaufinsulation.com](mailto:tech@knaufinsulation.com)

**Literature**  
Tel: 08700 668 660  
Fax: 0870 400 5797  
E-mail: [info@knaufinsulation.com](mailto:info@knaufinsulation.com)

5. Team China REScheckWebcompliance report.



Generated by REScheck-Web Software

**Compliance Certificate**

Project Title: Y-Box in Washington D.C. from Team China

Energy Code: **2009 IECC**  
 Location: **Washington, District of Columbia**  
 Construction Type: **Multifamily**  
 Building Orientation: **Bldg. faces 180 deg. from North**  
 Glazing Area Percentage: **26%**  
 Heating Degree Days: **4577**  
 Climate Zone: **4**

**Construction Site:**  
 West Potomac Park  
 Washington, District of Columbia  
 Permit Date: 09/14/11

**Owner/Agent:**  
 Tongji University  
 No. 1239 Spring Road  
 Shanghai

**Designer/Contractor:**  
 Tongji University  
 Team China

**Compliance: Passes using UA trade-off**

Compliance: **25.5% Better Than Code**      Maximum UA: **322**      Your UA: **240**

The % Better or Worse Than Code index reflects how close to compliance the house is based on code trade-off rules.

It DOES NOT provide an estimate of energy use or cost relative to a minimum-code home.

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Glazing or Door U-Factor	UA
Ceiling: Structural Insulated Panels	426		52.6		6
Skylight: Metal, Thermal Break, Double Pane SHGC: 0.76	111			0.400	44
Wall: Structural Insulated Panels Orientation: Back	318		52.6		6
Window: Wood Frame, 3 Pane w/ Low-E SHGC: 0.56 Orientation: Back	21			0.300	6
Wall: Structural Insulated Panels Orientation: Left Side	281		52.6		4
Window: Wood Frame, 3 Pane w/ Low-E SHGC: 0.56 Orientation: Left Side	81			0.300	24
Door: Glass SHGC: 0.56 Orientation: Left Side	13			0.300	4
Wall: Structural Insulated Panels Orientation: Right Side	407		52.6		7
Window: Wood Frame, 3 Pane w/ Low-E SHGC: 0.56 Orientation: Right Side	53			0.300	16
Wall: Structural Insulated Panels Orientation: Front	569		52.6		7
Window: Wood Frame, 3 Pane w/ Low-E SHGC: 0.56 Orientation: Front	245			0.300	74

Floor: Other Floor Over Uncond. Space

120

0.350

42

*Compliance Statement:* The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2009 IECC requirements in REScheck-Web and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

Y-Box from Team China

Name - Title

Jonas/(Linhui JIN)

Signature

05/20/11

Date

Project Notes:

It's energy compliance report of Y-Box from Team China

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Project Title: Y-Box in Washington D.C. from Team China Report date: 05/20/11

Data filename: Page 2



Generated by REScheck-Web Software

## Inspection Checklist

### Ceilings:

- Ceiling: Structural Insulated Panels, R-52.6 assembly R-value  
Comments: Above the ceiling is bilayer Vacuum Insulation Panels, which will can achieve most promising high performance of thermal insulation solutions

### Above-Grade Walls:

- Wall: Structural Insulated Panels, R-52.6 assembly R-value  
Comments: Bilayer Vacuum Insulation Panels are also installed in walls
- Wall: Structural Insulated Panels, R-52.6 assembly R-value  
Comments: Bilayer Vacuum Insulation Panels are also installed in walls
- Wall: Structural Insulated Panels, R-52.6 assembly R-value  
Comments: Bilayer Vacuum Insulation Panels are also installed in walls
- Wall: Structural Insulated Panels, R-52.6 assembly R-value  
Comments: Bilayer Vacuum Insulation Panels are also installed in walls

### Windows:

- Window: Wood Frame, 3 Pane w/ Low-E, U-factor: 0.300  
For windows without labeled U-factors, describe features:  
#Panes Three Frame Type Wood Thermal Break? Yes  No   
Comments: All the windows are produced by Franz Silber Fensterbau GmbH and tested by TUG (Technische Universität Graz – Labor für Bauphysik). Window type is Superlux, which acoustic efficiency is 35 dB
- Window: Wood Frame, 3 Pane w/ Low-E, U-factor: 0.300  
For windows without labeled U-factors, describe features:  
#Panes Three Frame Type Wood Thermal Break? Yes  No   
Comments: All the windows are produced by Franz Silber Fensterbau GmbH and tested by TUG (Technische Universität Graz – Labor für Bauphysik). Window type is Superlux, which acoustic efficiency is 35 dB
- Window: Wood Frame, 3 Pane w/ Low-E, U-factor: 0.300  
For windows without labeled U-factors, describe features:  
#Panes Three Frame Type Wood Thermal Break? Yes  No   
Comments: All the windows are produced by Franz Silber Fensterbau GmbH and tested by TUG (Technische Universität Graz – Labor für Bauphysik). Window type is Superlux, which acoustic efficiency is 35 dB
- Window: Wood Frame, 3 Pane w/ Low-E, U-factor: 0.300  
For windows without labeled U-factors, describe features:  
#Panes Three Frame Type Wood Thermal Break? Yes  No   
Comments: All the windows are produced by Franz Silber Fensterbau GmbH and tested by TUG (Technische Universität Graz – Labor für Bauphysik). Window type is Superlux, which acoustic efficiency is 35 dB

### Skylights:

- Skylight: Metal, Thermal Break, Double Pane, U-factor: 0.400  
#Panes Double Frame Type Steel Thermal Break? Yes  No   
Comments: It is produced by Vic-man in China and phase change materials are applied in skylights area. Three Light pipes are used to induct sunlight.

### Doors:

- Door: Glass, U-factor: 0.300  
Comments: All the doors are also produced by Franz Silber Fensterbau GmbH and tested by TUG (Technische Universität Graz – Labor für Bauphysik). Window type is Superlux, which acoustic efficiency is 35 dB

### Floors:

- Floor: Other Floor Over Uncond. Space, U-factor: 0.350  
Comments: Under the floor is bilayer Vacuum Insulation Panels, which will can achieve most promising high performance of thermal insulation solutions  
Floor insulation is installed in permanent contact with the underside of the subfloor decking.

Floor insulation is installed in permanent contact with the underside of the subfloor decking.

**Air Leakage:**

- Joints (including rim joist junctions), attic access openings, penetrations, and all other such openings in the building envelope that are sources of air leakage are sealed with caulk, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.
- Air barrier and sealing exists on common walls between dwelling units, on exterior walls behind tubs/showers, and in openings between window/door jambs and framing.
- Recessed lights in the building thermal envelope are 1) type IC rated and ASTM E283 labeled and 2) sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.
- Access doors separating conditioned from unconditioned space are weather-stripped and insulated (without insulation compression or damage) to at least the level of insulation on the surrounding surfaces. Where loose fill insulation exists, a baffle or retainer is installed to maintain insulation application.
- Wood-burning fireplaces have gasketed doors and outdoor combustion air.

**Air Sealing and Insulation:**

- Building envelope air tightness and insulation installation complies by either 1) a post rough-in blower door test result of less than 7 ACH at 33.5 psf OR 2) the following items have been satisfied:
  - Air barriers and thermal barrier: Installed on outside of air-permeable insulation and breaks or joints in the air barrier are filled or repaired.
  - Ceiling/attic: Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed.
  - Above-grade walls: Insulation is installed in substantial contact and continuous alignment with the building envelope air barrier.
  - Floors: Air barrier is installed at any exposed edge of insulation.
  - Plumbing and wiring: Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
  - Corners, headers, narrow framing cavities, and rim joists are insulated.
  - Shower/tub on exterior wall: Insulation exists between showers/tubs and exterior wall.

**Sunrooms:**

- Sunrooms that are thermally isolated from the building envelope have a maximum fenestration U-factor of 0.50 and the maximum skylight U-factor of 0.75. New windows and doors separating the sunroom from conditioned space meet the building thermal envelope requirements.

**Materials Identification and Installation:**

- Materials and equipment are installed in accordance with the manufacturer's installation instructions.
- Insulation is installed in substantial contact with the surface being insulated and in a manner that achieves the rated R-value.
- Materials and equipment are identified so that compliance can be determined.
- Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment have been provided.
- Insulation R-values and glazing U-factors are clearly marked on the building plans or specifications.

**Duct Insulation:**

- Supply ducts in attics are insulated to a minimum of R-8. All other ducts in unconditioned spaces or outside the building envelope are insulated to at least R-6.

**Duct Construction and Testing:**

- Building framing cavities are not used as supply ducts.
- All joints and seams of air ducts, air handlers, filter boxes, and building cavities used as return ducts are substantially airtight by means of tapes, mastics, liquid sealants, gasketing or other approved closure systems. Tapes, mastics, and fasteners are rated UL 181A or UL 181B and are labeled according to the duct construction. Metal duct connections with equipment and/or fittings are mechanically fastened. Crimp joints for round metal ducts have a contact lap of at least 1 1/2 inches and are fastened with a minimum of three equally spaced sheet-metal screws.
  - Exceptions:*
    - Joint and seams covered with spray polyurethane foam.
    - Where a partially inaccessible duct connection exists, mechanical fasteners can be equally spaced on the exposed portion of the joint so as to prevent a hinge effect.
    - Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. w.g. (500 Pa).
- Duct tightness test has been performed and meets one of the following test criteria:
  - Postconstruction leakage to outdoors test: Less than or equal to 8 cfm per 100 ft<sup>2</sup> of conditioned floor area.
  - Postconstruction total leakage test (including air handler enclosure): Less than or equal to 12 cfm per 100 ft<sup>2</sup> pressure differential of 0.1 inches w.g.
  - Rough-in total leakage test with air handler installed: Less than or equal to 6 cfm per 100 ft<sup>2</sup> of conditioned floor area when tested at a pressure differential of 0.1 inches w.g.

Rough-in total leakage test without air handler installed: Less than or equal to 4 cfm per 100 ft<sup>2</sup> of conditioned floor area.

**Temperature Controls:**

- Thermostats exist for each dwelling unit (non-dwelling areas must have one thermostat for each system or zone). A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each room is provided.

**Electric Systems:**

- Separate electric meters exist for each dwelling unit.

**Heating and Cooling Equipment Sizing:**

- Additional requirements for equipment sizing are included by an inspection for compliance with the International Residential Code.
- For systems serving multiple dwelling units documentation has been submitted demonstrating compliance with 2009 IECC Commercial Building Mechanical and/or Service Water Heating (Sections 503 and 504).

**Circulating Service Hot Water Systems:**

- Circulating service hot water pipes are insulated to R-2.
- Circulating service hot water systems include an automatic or accessible manual switch to turn off the circulating pump when the system is not in use.

**Heating and Cooling Piping Insulation:**

- HVAC piping conveying fluids above 105 degrees F or chilled fluids below 55 degrees F are insulated to R-3.

**Swimming Pools:**

- Heated swimming pools have an on/off heater switch.
- Pool heaters operating on natural gas or LPG have an electronic pilot light.
- Timer switches on pool heaters and pumps are present.  
*Exceptions:*
  - Where public health standards require continuous pump operation.
  - Where pumps operate within solar- and/or waste-heat-recovery systems.
- Heated swimming pools have a cover on or at the water surface. For pools heated over 90 degrees F (32 degrees C) the cover has a minimum insulation value of R-12.  
*Exceptions:*
  - Covers are not required when 60% of the heating energy is from site-recovered energy or solar energy source.

**Lighting Requirements:**

- A minimum of 50 percent of the lamps in permanently installed lighting fixtures can be categorized as one of the following:
  - Compact fluorescent
  - T-8 or smaller diameter linear fluorescent
  - 40 lumens per watt for lamp wattage <= 15
  - 50 lumens per watt for lamp wattage > 15 and <= 40
  - 60 lumens per watt for lamp wattage > 40

**Other Requirements:**

- Snow- and ice-melting systems with energy supplied from the service to a building shall include automatic controls capable of shutting off the system when a) the pavement temperature is above 50 degrees F, b) no precipitation is falling, and c) the outdoor temperature is above 40 degrees F (a manual shutoff control is also permitted to satisfy requirement 'c').

**Certificate:**

- A permanent certificate is provided on or in the electrical distribution panel listing the predominant insulation R-values; window U-factors; type and efficiency of space-conditioning and water heating equipment. The certificate does not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels.

**NOTES TO FIELD:** (Building Department Use Only)

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## 2009 IECC Energy Efficiency Certificate

Insulation Rating	R-Value
Ceiling / Roof	52.60
Wall	52.60
Floor / Foundation	52.60
Ductwork (unconditioned spaces):	

Glass & Door Rating	U-Factor	SHGC
Window	0.30	0.56
Skylight	0.40	0.76
Door	0.30	0.56

Heating & Cooling Equipment	Efficiency
Heating System: <u>Floor Heating &amp; HVAC</u>	<u>COP=3.04</u>
Cooling System: <u>Air conditioning system</u>	<u>COP=2.95</u>
Water Heater: <u>Solar Flat Plate Collectors</u>	<u>65%</u>

Name: Jonas/ (Linhui JIN)  
Comments:

Date: 05/20/11 Date: 05/19/11

## 6. Supplemental instruction of Vacuum Insulation Panel (VIP)

### 6.1 Description :

VIP is the Vacuum Insulation Panel abbreviation of English; it is one of the Insulation materials, it is by the core filling materials and vacuum protection surface layer compound and into, it effectively avoid air convection caused by heat transfer, therefore coefficient of thermal conductivity can be greatly reduced, less than 0.0025 w/m.k, and does not contain any OD materials, it has the characteristics of environmental protection and energy efficient, the world's most advanced efficient heat preservation material.

Vacuum Insulating Panel can be widely use in fridge, freezer, refrigerator, refrigerated containers, ice thermal insulation systems of chamfer of adiabatic heat preservation material.

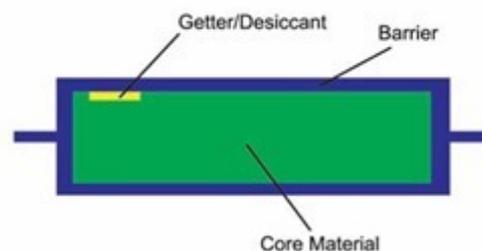
The core materials through maximize internal vacuum to isolate heat conduction, achieve the goal of energy saving; heat preservation, it is the heat preservation material upgrades, change a product, realized the heat preservation material thickness is reduced by half, energy-saving province electricity half of the effect. Currently vacuum insulating board is mainly used in refrigerator fields, have energy-saving, wall thin and effective volume big advantages. Meet the future development banned CFC insulation product revolutionary requirements. It meets the future development banned CFC insulation product revolutionary requirements.

Fujian Supertech Advanced Material Co., LTD is the largest domestic production Vacuum Insulating Panel domestic manufacturers, products occupy the numerous of share, exported to Japan, Korea, America, Europe and other countries.

### 6.2 Structure :

VIP product's structure is made up of three main parts:

1. The core of the insulation- highly refined fiber glass
2. Gas adsorption materials
3. High barrier properties of the composite films



### 6.3 Physical :

导热系数(Thermal Conductivity)	$\leq 0.0025 \text{w./m.k (20}^\circ\text{C)}$
使用温度(Working Temperature)	-50~70°C
整体密度(Overall Density)	240~314kg/m <sup>3</sup>
压缩强度(Compressive Strength)	0.14~0.25Mpa
规格尺寸(Dimension)	根据订单要求(Customer Required)

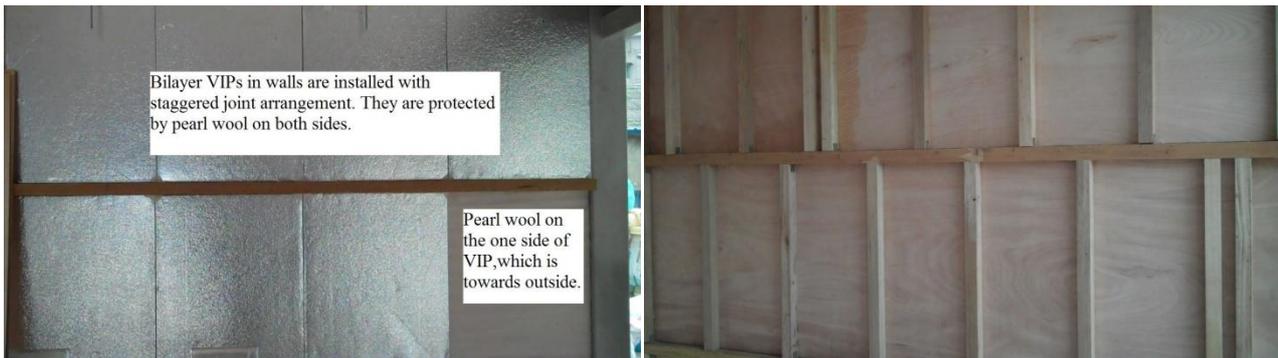
### 6.4 Principle :

Supertech Vacuum Insulating Panel takes highly refined fiber glass as the core material; the lacunose and reticular structure effectively increase the thermal resistance. Moreover, by using the vacuum pumping technique to make sure the vacuum degree inside VIP always keeps at a certain low level, which would maximally reduce the heat transferring between the gas molecules, therefore, finally meet the insulation requirements.

VIP Manufacturer's Website in English

<http://www.supertech-vip.com/En>

## 7. Envelope constructions' pictures of Y-Box



VIPs in walls with staggered joint arrangement VIP are sealed in walls



Using pear wool to protect VIPs in walls pearl wool in walls



pearl wool in ceiling knauf XPS cover glass mineral wool



cutting 50 mm glass mineral wool corss section of bilayer VIP in walls

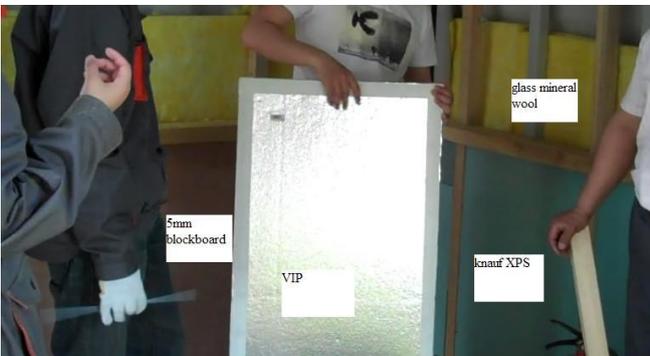


comparison between before and after VIPs are covered in walls

bilayerVIPs+bilayers pearl wool、5mm blockboard、50mm XPS and 50mm glass mineral wool are sealed in walls



50 mm glass mineral wool in walls 5mm blockboard



5mm blockboard cover 50mm knauf XPS and 50mm glass mineral wool

## 8. DuPont™ Energain® PCM Thermal Mass Panels



# DuPont™ Energain®

ENERGY-SAVING THERMAL MASS SYSTEMS

### Data Sheet - Measured Properties

#### THERMAL MASS PANEL

Descriptive Properties		Unit	Value
Thickness		mm	5.26
Width		mm	1000
Length		mm	1198
Area weight		kg/m <sup>2</sup>	4.5
Aluminium thickness (sheet)		µm	130
Aluminium thickness (edges)		µm	75
Thermal properties	Test Method		
Paraffin loading	Comparative test by DSC	%	60
Melt point (paraffin)	DSC method (1°C/min)	°C	21.7
Latent heat storage capacity	DSC method (1°C/min)	kJ/kg	> 70
Total heat storage capacity (Temperature range 14°C to 30°C)	DSC method (1°C/min)	kJ/kg	> 170
Physical properties			
Aluminium sheet delamination force	Internal DuPont test method	N/cm	> 20
Conductivity solid	BS EN 12667-2001	W/(m.K)	0.18
Conductivity liquid	BS EN 12667-2001	W/(m.K)	0.14
Flash Point (paraffin)	ASTM D56	°C	148

#### PRODUCT DESCRIPTION

The panel is a fine mixture of ethylene based polymer (40%) designed by DuPont and paraffin wax (60%) laminated on both sides with a 130 µm aluminium sheet. The edges are closed with a 75 µm aluminium tape.

#### REACTION TO FIRE

Single-flame source test	EN 11925-2	Class E
Surface spread of flame test	BS476 part 7	Class 1
BS476 part 7 & BS476 part 6 (behind plasterboard)	Building Regulations (AD B)	Class 0

#### DURABILITY

Predicted to be durable for the life-time of a building  
Chemically inert with most materials

#### ALUMINIUM TAPE

Descriptive Properties		Unit	Value
Thickness		µm	75
Width		mm	50

#### DuPont patented technology

All values correspond to average results obtained in our laboratories and outside institutes and are indicative. The right is reserved to make changes at any time without notice.

Recommendations as to methods, use of materials and construction details are based on the experience and current knowledge of DuPont and are given in good faith as a general guide to designers, contractors and manufacturers. This information is not intended to substitute for any testings you may need to conduct to determine for yourself the suitability of our products for your particular purposes. This information may be subject to revision as new knowledge and experience becomes available since we cannot anticipate all variations in actual end-use conditions. DuPont makes no warranties and assumes no liability in connection with any use of this information. Nothing in this publication is to be considered as a licence to operate under a recommendation to infringe any patent right.

DuPont de Nemours (Luxembourg) S.à r.l.  
Rue General Patton  
L-2984 Luxembourg  
Tel: 00352 3666 5885  
Fax: 00352 3666 5021  
E-mail: [energain@lux.dupont.com](mailto:energain@lux.dupont.com)  
[www.energain.dupont.com](http://www.energain.dupont.com)



## 9. English versions of specifications of Daikin air-conditioning equipments.

1.  ED71-613. pdf
2.  FHYB-F. pdf
3.  Daikin  
air-conditioning

## 10. YAMAHA EF6300iSDE User Manual

  
YAMAHA EF6300iSDE  
User Manual. pdf

## 11. Vacuum Insulation Panel Properties and Building Applications

  
Vacuum Insulation  
Panel Properties

## 12. Fire Performance of Knauf Insulation Panel



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### Polyfoam High Impact and Upstand Board

For the thermal insulation and protection of upstands in flat roofing

**Description**

Polyfoam High Impact and Upstand Board is a laminate of Polyfoam high performance, 100% ozone friendly, extruded polystyrene, rigid insulation board and a tough, weather resistant fibre reinforced cement facing board.

Polyfoam High Impact and Upstand Board is square edged.

**Application**

Polyfoam High Impact and Upstand Board is used for the thermal insulation and protection of upstands in flat roofing. It can also be used as a lining, where strength, fire performance and potential for easy cleaning are important, such as in agricultural buildings.

Where a greater thickness of insulation is required, see the Polyfoam Soffit Liner Board datasheet.

**Standards**

The extruded polystyrene content of Polyfoam High Impact and Upstand Board is manufactured in accordance with BS EN 13164: 2008 and BSI Quality Assurance Standard BS EN ISO 9001: 2008.

**Environmental**

Polyfoam High Impact and Upstand Board is free from CFCs, HCF Cs and any other material with ozone depletion potential in its manufacture and content and represents no known threat to the environment.

Polyfoam High Impact and Upstand Board is non bio-degradable.

Polyfoam High Impact and Upstand Board is 100% recyclable.

**Compression resistance**

The strength of Polyfoam offers a wider range of potential solutions to design problems.

The facing material is highly resistant to impact damage, offering an excellent robust finish.

**Moisture resistance**

Polyfoam is highly resistant to moisture absorption and can be installed in a damp area or during moist conditions with negligible impact on the performance of the product. The facing material is moisture resistant.

**Fire performance**

Polyfoam insulation contains a flame retardant which inhibits localised ignition. Polyfoam High Impact and Upstand Board is faced with a 6mm fibre reinforced cement board which offers excellent fire performance as a facing material and is classified as Class 1 Surface Spread of Flame to BS 476: Part 7: 1987.

**Handling and storage**

The boards are easy to handle and nonirritant, when cutting through the facing material it is advisable to wear a facemask to guard against dust. No special protective clothing is required.

Polyfoam High Impact and Upstand Board is supplied on pallets, labelled with identifying product and manufacturing data. They should be wrapped in a polythene shroud for temporary protection during transit and on site.

Ensure the boards are not stored close to open flame or other ignition source, also avoid volatile compounds and chemicals such as solvents.

Polyfoam products should not be left exposed to prolonged sunlight as this will result in surface degradation. Where outside storage for extended periods is required cover with opaque/light coloured sheeting.



**Performance**

**Thermal Performance**

The extruded polystyrene in Polyfoam High Impact and Upstand Board has a thermal conductivity of 0.030 W/mk.

**Fire Performance**

The cement facing board is classified as Class 1 Surface Spread of Flame to BS476: Part 7: 1987.

**Benefits**

- ◆ Integral weather resistant facing
- ◆ Capable of solving many design problems
- ◆ Excellent thermal performance
- ◆ Structurally stable
- ◆ Easy to install one-piece facing and insulation solution

**Downloads**

- ◆ Product Datasheet
- ◆ COSHH Material Safety Datasheet

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The facing board on Polyfoam High Impact and Upstand board should have edges and corners protected to prevent chipping.

Product Data

Thickness (mm)	Thermal conductivity (W/mK)	Thermal resistance (m <sup>2</sup> K/W)	Nominal Density of Insulation (kg/m <sup>3</sup> )	Minimum Compressive Strength (kPa)	Length (mm)	Width (mm)
50.0 / 6	0.030 / 0.41	1.65 / 0.014	30	200	2400	1200
45.5 / 6	0.030 / 0.41	1.50 / 0.014	30	200	2400	1200
36.0 / 6	0.030 / 0.41	1.20 / 0.014	30	200	2400	1200

*All dimensions are nominal*